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Feasibility Study for Vitrification of Sodium-Bearing Waste

*J. J. Quigley
B. D. Raivo
S. O. Bates
S. M. Berry
D. N. Nishioka
P. J. Bunnell*

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**Idaho National Engineering and Environmental Laboratory
High-Level Waste Department
Idaho Falls, Idaho 83415**

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ABSTRACT

Treatment of sodium-bearing waste (SBW) at the Idaho Nuclear Technology and Engineering Center (INTEC) within the Idaho National Engineering and Environmental Laboratory is mandated under a Settlement Agreement between the Department of Energy and the State of Idaho. One of the requirements of the Settlement Agreement is the complete calcination (i.e., treatment) of all SBW by December 31, 2012. One of the proposed options for treatment of SBW is vitrification. This study will examine the viability of SBW vitrification.

This study describes the process and facilities to treat the SBW, from beginning waste input from the INTEC Tank Farm to the final waste forms. Schedules and cost estimates for construction and operation of a Vitrification Facility are included. The study includes a facility layout with drawings, process description and flow diagrams, and preliminary equipment requirements and layouts.

EXECUTIVE SUMMARY

Treatment of sodium-bearing waste (SBW) at the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Engineering and Environmental Laboratory (INEEL) is mandated under a Settlement Agreement between the Department of Energy (DOE) and the State of Idaho. One of the requirements of the Settlement Agreement is the complete calcination (i.e., treatment) of all SBW by December 31, 2012. One of the proposed options for treatment of SBW is vitrification. This study will examine the viability of SBW vitrification.

This study describes the process and facilities to treat the SBW, from beginning waste input from the INTEC Tank Farm to the final waste forms. Schedules and cost estimates for construction and operation of a Vitrification Facility are included. The study includes a facility layout with drawings, process description and flow diagrams, and preliminary equipment requirements and layouts.

Time constraints for financing, permitting, technical development, design, construction, and startup testing extend the start of SBW processing to January 1, 2013. The anticipated completion date for SBW treatment is December 31, 2014. A 2-year operation schedule was chosen to complete processing as quickly as possible. The melter and off-gas system are large enough to treat all calcine waste by the Settlement Agreement milestone of 2035.

Facility Siting and Layout

The SBW facility is sited near the northeast corner of INTEC. Installation of a direct transfer route from the SBW storage tanks WM-180, WM-181, WM-187, and WM-188 would be optimal. The SBW process area will be a multistory structure with a footprint of approximately 380 × 169 ft. The physical structure will extend 32 ft below finished grade and approximately 70 ft above finished grade. The Administrative/Support area will be a single-story structure with a footprint of approximately 190 × 70 ft. This structure will be located at grade level and adjacent to the SBW process area.

The process area of this facility will be constructed of a concrete superstructure that extends approximately 50 ft abovegrade level. The cell walls will consist of 3-ft-thick concrete extending to support a formed, cast-in-place concrete roof with removable hatches for overhead maintenance and equipment removal/replacement. A bridge crane will be installed above to accommodate hatch cover removal and equipment removal. Process equipment cell walls will consist of 3-ft-thick, concrete walls and will extend 32 ft belowgrade level forming the foundation walls. Operating corridor perimeter walls will be constructed of reinforced concrete to 32 ft belowgrade level. All horizontal process separations, i.e., ceiling-floor and hatch structures will consist of 3-ft-thick reinforced concrete.

Stainless steel (SST) surfaces will be applied to all cells of the process areas. The lining for the floors will be 1/4-in.-thick SST; all other surfaces will be lined with 1/8-in.-thick SST.

An engineered metal building system will be used for the administrative area. The floors will consist of 6-in.-thick reinforced concrete, slab on grade. Concrete grade beams and isolated column spread footings will support the structural steel frame of the building.

Occupancy Classification

The SBW Vitrification Facility is classified as a UBC Group H, Division 7/Group B, Mixed Occupancy. The H-7 occupancy applies to buildings or portions thereof utilized for storage, or handling of materials that constitute a high health hazard. This area includes the central core of the facility contained within the shielding walls on all floors. The process equipment canyon, pump and valve corridor, the maintenance areas, canister filling and capping, welding, and decon areas are some of the major areas.

The Group B Mixed Occupancy applies to building or portions thereof used for office, laboratories, etc. that are not classified as Group H for hazardous materials. This area includes the abovegrade portion of the building that is outside of the shielding walls (office/administrative areas, mechanical, HVAC, electrical, communications rooms, etc.).

Remote Operations

The SBW Vitrification Facility will feature remote handling operations for processes and tasks that cannot be provided by a direct hands-on approach due to high radiation fields and/or high contamination areas. The basic approach will be to have the Vitrification Facility divided into a canyon and a remote service corridor (RSC) configuration for the purposes of remote maintenance activities.

The canyon approach will be used for those large vessels and equipment that typically have long intervals between maintenance actions (>5–10 years). These items will be located in a concrete-shielded enclosure structure that is accessed by shielded hatch covers when maintenance activities are required.

The remote service corridor approach will be used for pieces of equipment that require maintenance and/or replacement at periodic intervals (<5–10 years) and that can be located away from the actual vessels being served by this particular equipment. The type of equipment that typically would be located in the RSC include valves, pumps, and instrumentation that can be located away from the tank vessels located in the canyon area. In the RSC approach, jumper assemblies with the included piece of equipment (e.g., pump, valve, instrument) using a standard 3-bolt flange system interfaces with vertical wall-mounted flanges of corresponding size to complete a circuit. The jumper assemblies will be remotely removed from service by remotely operated in-cell (in the corridor) crane and wall-mounted electro-mechanical (PaR) manipulator.

Process

SBW is transferred from the Tank Farm Facility (TFF) at INTEC to a workoff storage tank located within in the Vitrification Facility. This tank provides a 12-day storage supply of raw SBW. Sugar and frit are added to the

SBW and formed into a slurry within one of four mix tanks. The mixture is then sampled and analyzed to form a qualified feedstream, adjustments are made to the mixture if necessary. The mix tank capacity provides a 2–3 day workoff storage with a 6-day sample and analysis feedback timeframe. The qualified feed is transferred to one of two feed tanks and is controlled as qualified processing feed material. This mixture is then fed into a joule-heated borosilicate glass melter. Water is evaporated from the mixture and the solids including all SBW undissolved solids (UDS) are formed into a borosilicate glass. The glass is then discharged into stainless steel canisters and sealed with welded lids. This process creates a contained glass waste which is suitable for disposal at either the Waste Isolation Pilot Plant (WIPP) or Yucca Mountain. Radiation levels of the glass canisters are estimated to be approximately 65 rem/hour.

The Vitrification Facility will be capable of treating not only about one million gal of SBW, but also newly generated liquid waste (NGLW) and the estimated 45,000 gal of sludge from the closure of the TFF. The facility has sufficient melter size and off-gas capacity to vitrify calcine with a new feed and mixing system.

Off-gas from the melter will be high in NO_x , water vapor, and CO. The off-gas will also contain halogen contaminants chlorine and fluorine as well as mercury vapor and other unknown toxic or heavy metals. The off-gas is treated by secondary thermal treatment prior to entering an off-gas cleansing system. The secondary thermal treatment consists of a three-stage combustion process. The first stage consists of high temperature $1,220^\circ\text{C}$ ($2,200^\circ\text{F}$) treatment under reducing conditions for 2 seconds residence time. The goal for the first stage is to strip off the oxygen from the NO_x and reduce to N_2 . Mercury compounds such as HgO and HgCl_2 are anticipated to be dissociated into elemental mercury vapor. The halogens (chlorine and fluorine) will pass through the first stage in the gaseous state.

In the second stage, the off-gas is partially quenched to a temperature below the auto-ignition temperature of the gas (nominally $1,400^\circ\text{F}$) in a water or steam quench section. Gas exiting stage two then enters stage three.

Stage three is controlled to complete the combustion of CO and H_2 in the off-gas while minimizing NO_x reformation. This is accomplished via injecting air to initiate auto-ignition of the gases, CO and H_2 . The temperature in the third stage tends to float and is established by the combustion potential of the gas stream. The air injected is controlled to minimize excess oxygen. The goal is to provide an N_2 -rich exit gas stream with minimal NO_x . Halogens (chlorine and fluorine) and mercury are anticipated to pass through the third stage in the gaseous state.

From stage three, the gas enters a quick quencher that reduces the temperature of the off-gas exiting the third stage from $>1,540^\circ\text{F}$ to a temperature of approximately $180\text{--}185^\circ\text{F}$. The quenching action is anticipated to minimize the recombination of Hg and O_2 in the off-gas from the multi-stage combustion denitrator, and also minimize the potential reformation of dioxins/furans from pre-cursors in the feed stream. The quench process will tend to remove large

particulates from the gas stream to the quench water and act as a first stage of off-gas cleaning.

Subsequent cleaning of the off-gas includes a gas handling system and a liquid side scrub solution system. The gas-to-liquid interface includes the quench tower and a wet scrubber, which remove particulates and water-soluble gases, including halogens. Scrubbing liquid is provided by and returns back to the scrub solution system. The gas side system includes a scrubber with knockout drum, a demister with knockout drum, a gas reheater, HEPA final filters, and granulated activated carbon polishing filters. The granulated activated carbon (GAC) beds (sulfur impregnated) are anticipated to remove elemental mercury from the off-gas. Periodically, the GAC beds will be sent to an outside contractor, such as Envirocare, for mercury recovery and disposal. This completes the disposition of the mercury cycle. Bulk nitrogen gas (N_2) with very little NO_x is anticipated to exit the carbon beds and be released through the stack. This completes the disposition of the nitrogen contained in the original SBW feed stream.

The scrubbing action of the off-gas cleanup system will remove particulate and other contaminants, which will then be entrained in the liquid. The scheme includes settling of sludge and recycling of scrubbed residue back to the inlet feed stream in the mix tank. The recycling will allow re-incorporation of the contaminants back into the glass product. Mercury particles or soluble compounds in the sludge are then recycled back to elemental mercury in the melter and multi-stage combustor for subsequent partitioning to the gas stream for removal by the activated carbon beds.

Scrub liquid is also removed from the settling tank as blowdown. The liquid passes through a prefilter to remove any entrained particulate and then enters an ion exchange column. The ion exchange system uses alkali metal alumino silicate ion exchange media to remove cesium and strontium from the blowdown. This ion exchange media is also recycled back to the mix tanks. The effluent is then stored and periodically grouted as low-level waste. Approximately 3% of the cesium is expected to volatilize in the melter and be partitioned to the off-gas and scrub system. It is anticipated that the majority of this cesium will be captured by the scrub system and recycled back to the melter for incorporation into the glass.

Waste Form Qualification

The basic Waste Form Qualification (WFQ) strategy has been utilized at the Defense Waste Processing Facility (DWPF) at Savannah River Site and the West Valley Demonstration Project. This WFQ strategy is based on the concept that a well-defined and controlled feed stream processed through a well-defined and controlled treatment process will produce a qualified waste form. This qualified waste form will not need to be sampled or tested except on a very limited basis during operation.

The relationship between process control and waste form qualification overlap. The canisters of glass are assumed to be going to the Yucca Mountain repository. The drums of grout are assumed to be contacted handled and will be

sent to WIPP if the grout waste form has contains more than 100 nCi/g TRU or some other waste site (e.g. Hanford) if less than 100 nCi/g TRU. Because the canisters of vitrified waste and the grout drums are assumed to be going to different repositories (Yucca Mountain and WIPP respectively), the waste form qualification requirements will be different. However, the basic qualification strategy will be the same for both waste forms.

The process for implementing the WFQ strategy entails the following major tasks:

- Development of a qualified waste form compositional envelope. A range or envelope of waste form compositions for both the glass and grout waste forms will be developed.
- Development testing, nonradioactive facility testing, and radioactive facility testing for process qualification. The treatment process will be qualified so that when a qualified feed is added to the treatment process and is operated within established parameters, the glass produced will be acceptable.
- Operational Control and Documentation. Once a qualified compositional envelope and process are established, facility operations will be conducted so that no waste is processed outside of these boundaries.

Cost Estimate

As currently envisioned, this facility consists of a processing building measuring approximately 380 × 169 ft at grade level, with basement levels extending 32 ft belowgrade and roof elevation at 75 ft. In addition to the main processing building, there are two truck bays attached; one measuring 80 × 40 ft and one measuring 30 × 20 ft. The office area measures 189 × 68 ft with an assumed eave height of 14 ft. The boiler building is a concrete masonry unit (CMU) building measuring 60 × 52 × 30 ft high.

The Total Project Cost is presented in Table E1. This cost includes Conceptual Design costs, Project Support costs, Permitting costs, Construction Management costs, Engineering costs, Quality Assurance costs, Project Management costs, direct and indirect construction costs, System Operation/Startup costs, Procurement Fee, G&A, escalation and contingency. The cost for an interim storage facility and for storage are not included in this study.

Table E1. Total project costs.

Estimate Element	Estimate Subtotal	Escalation	Contingency	Total
Total Estimated Cost (TEC)	\$321,252,222	\$87,927,984	\$173,048,352	\$582,228,558
Other Project Costs (OPC)	\$78,935,317	\$17,107,921	\$59,413,968	\$155,457,206
Total Project Cost (TPC)	\$400,187,539	\$105,035,905	\$232,462,320	\$737,685,764

Issues and Recommended Studies

Section 12 of the report discusses requirements, uncertainties, and issues. The following items should be addressed in subsequent studies and design efforts.

- Disposal at WIPP

It is assumed that either the SBW will be delisted for U134 (uncomplexed hydrofluoric acid, HF) or that the U134 waste code will be added to the WIPP WAC. Another assumption is that the incidental waste ruling for SBW will be that it is not HLW. Both of these assumptions impact whether the vitrified SBW can be accepted at WIPP. The delisting of SBW for U134 or the addition of U134 to the WIPP WAC must be vigorously pursued. Failure to obtain one or the other will result in the vitrified waste not being accepted at WIPP. The incidental waste ruling for SBW has been requested. However, the ruling has not yet been made. If SBW is ruled to be HLW, the glass waste will be disposed of at Yucca Mountain rather than WIPP.

- Radiological

During the conceptual design of the Vitrification Facility, additional radiological assessments must be made. Preliminary evaluations of radiation levels in the Vitrification Facility have been made to determine appropriate wall thickness and personnel protection requirements. As the design is developed, this issue should be re-evaluated to verify the radiation exposure levels to operating personnel.

- Material Balance

The material balance will need to be revised as information from additional studies becomes available. Issues of concern include sugar chemistry, mercury speciation, decontamination factor (DF) for species in the melter and off-gas systems, and off-gas chemistry.

- Grout Recipe

The grout recipe for solidification of the scrubber blowdown needs to be tailored to the composition of the blowdown.

- Multi-Stage Combustor

Actual operational data is needed for the multi-stage combustor with gas streams similar to the off-gas from the melter. Data needed includes efficiency and reliability. Operation should evaluate the use of water vs steam for the Stage 2 quench. Stage 3 combustion should be evaluated at low excess oxygen conditions.

- Operating Conditions

The temperature of the SBW and SBW mixtures must be maintained below 60°C until the SBW feed enters the melter. The high concentrations of chlorides in the SBW will cause severe stress cracking and corrosion issues above 60°C, based on historical experience at INTEC.

- Operating Life

The lifetime of the plant is assumed to be 2 years. Increases in assumed lifetime may require additional margins to be included in the design of the piping (e.g. corrosion and erosion allowances or design for remote replacement).

- Characterization of SBW

Additional characterization of SBW is needed for the conceptual design. Further characterization of the UDS in the SBW is required. There are some elements that even small amounts (>0.5 wt% in the glass) have significant melter processing impacts. Noble metals, S, P, are some elements that should be tested for.

- Ion Exchange Media for Cesium Removal

The ion exchange media chosen for removal of cesium and strontium are UOP IONSIV® IE-95 and A-51 respectively. The alkali metal, alumino-silicate ion exchange media are compatible with the melter and frit used for vitrification of SBW. Cesium and strontium (and their daughter products Ba-137m and Y-90) have the highest concentration levels of the radionuclides in the scrub blowdown. Cesium is a gamma emitter and is removed from the blowdown to reduce the radiation levels of the grout to contact-handled material. Strontium is a beta emitter, which is a strong contributor to the heat emission due to radioactive decay.

Other ion exchange media are available for removal of cesium from the scrub blowdown. UOP IONSIV® IE-911 is a crystalline silicotitanate (CST) with a high affinity for cesium, even in the presence of high concentrations of sodium and acid. The absorption of cesium on the sorbent is virtually irreversible. CST will also remove strontium from liquid waste; however, strontium can be stripped from the media.

The choice of ion exchange media should be re-evaluated based on the results of off-gas and scrubber characterization studies for SBW.

- Water Reduction in SBW

Evaporation of water from the SBW in the SBW storage tank, the mixing tanks, or the feed tanks would decrease the electrical requirements and increase the efficiency of the melter. However, evaporation would increase the stress/corrosion effects of chlorine. Also, the temperature in the tanks would need to be maintained less than 60°C to reduce the corrosion rate. Added margin

for stress-cracking concerns are accomplished by using a higher-grade material for the tanks such as Nitronic 50.

- Mercury Speciation

A better understanding of mercury speciation in the melt, the combustor, and in the scrub system is needed. Studies should be conducted to determine the amount of mercury which remains in the glass and the amount partitioning to the different systems.

- Elemental Mercury Adsorption in Off-Gas

A study should be performed on the adsorption of elemental mercury from the off-gas of the melter to determine the best adsorbent and optimal conditions.

- Slurry Characteristics

The characteristics of the feed slurry are unknown. The assumption is that the mixture can be maintained as slurry sufficient for homogeneous mixing with adequate pumping and material transfer capabilities. However, the solids and real case characteristics may present unknown difficulties both for in-tank mixing and material transfer (pumping).

- Sugar Addition

The scope of work for the feasibility study calls for the addition of sugar to the SBW and frit as part of the melter feed. The sugar is added to reduce the oxidation potential of the glass melt to control foaming of the molten glass. The nitric acid from the SBW will react with sugar to produce heat and N_2 , NO_x , CO, CO_2 , and H_2O . The interactions between sugar and nitric acid waste have been previously studied. However, experiments are needed to determine the stability of the sugar/nitric acid solution, the potential for an increased risk of flammability or explosion potential from reaction products, and the potential for use of other reductants.

- Melter Operation and Decontamination Factors

The method of control of melter and multi-stage combustor system component pressures needs to be reviewed. The design goal is to create a very homogeneous feed stream within the mix and feed tanks prior to entry into the melter. This will help to minimize potential for fluctuations. The effects of high alkali level waste (Na) feeds should be evaluated. The use of an evaporator in the SBW Work-off Tank or between the Work-off Tank and the mixing tanks should be investigated. The addition of nitric acid waste feed with a high percentage of water presents special design challenges. Successful resolution of these challenges will benefit from detailed design modeling for transient heat transfer and fluid flow, as well as thermophysical and chemical reaction modeling. The effects of inlet geometry and feed distribution on the melt should be investigated.

- Off-Gas and Scrubber Characterization

Further research must be performed to measure the off-gas and scrubber concentrations for constituents of concern. Particulate size distribution within the gas stream should be determined for the design of the scrubbing system. The effect of the pH and temperature of the scrub solution on scrubbing efficiency and scrub system materials is needed. Experiments on melter off-gas using GAC for mercury removal are needed to determine the optimal residence time and bed loading. Acid gases in the gas stream may liberate hydrogen sulfide (H_2S) gas, with subsequent damage to the beds and additional potential safety problems for dealing with this gas. Experiments should be performed to optimize gas scrubbing and HEPA filter life.

- Facility Siting Study

A siting study should be performed to determine the optimal placement of the Vitrification Facility. The study will review the impacts of this facility on site utilities and the surrounding infrastructure. The study will encompass topography, existing soil conditions, subsurface rock formations, and road and structure locations both above and below ground level.

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L. Le	Electrical Power Design
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J. L. Moncur	Drafting and Facility Layout
D. N. Nishioka	AE Facility Design, Floor Plans, Manloading
B. C. Norby	Materials Selection
H. K. Peterson	Radiation and Shielding Calculations
J. J. Quigley	Technical Team Lead, Material Balance, Process Design
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ACRONYMS

A/E	Architectural/Engineering
AHU	air handling units
ALARA	as low as reasonably achievable
Btu	british thermal unit
CCTV	cell closed-circuit television
CEM	continuous emissions monitor
cfm	cubic feet per minute
CH	contact-handled
CMA	Crane Maintenance Area
CMU	concrete masonry unit
CFR	Code of Federal Regulations
CRWMS	Civilian Radioactive Waste Management System
CsIX	cesium ion exchange
CST	crystalline silicotitanate
D&D	decontamination and decommissioning
DCS	distributed control system
DF	decontamination factor
decon	decontamination
DWPF	Defense Waste Processing Facility
DOE	Department of Energy
ECS	Emergency Communication System
EUSU	Electrical and Utility System Upgrade
G&A	General and Administrative
GAC	granulated activated carbon
H&R	(remote) handling and replacement

HAPs	hazardous air pollutants
HEPA	high-efficiency particulate air (filter)
HLW	high-level waste
HLLWE	High-Level Liquid Waste Evaporator
HVAC	heating, ventilating, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISF	Interim Storage Facility
ITDF	INTEC Technology Development Facility
iwg	inches water gage
LAN	local area network
LAW	Low Activity Waste
LDR	Land Disposal Restrictions
LCC	life-cycle cost
LLW	low-level waste
MACT	Maximum Achievable Control Technology
meq	milli equivalents
NGLW	newly generated liquid waste
NRC	Nuclear Regulatory Commission
NWCF	New Waste Calcining Facility
OMB	Office of Management and Budget
OPC	Other Project Costs
P&V	pump and valve
PaR	electro-mechanical manipulator
PE	Plutonium Equivalent

PCS	Plant Control System
QA	quality assurance
QARD	Quality Assurance Requirements and Description
RAL	Remote Analytical Laboratory
RCRA	Resource Conservation and Recovery Act
RH	remote-handled
RMTF	Remote Mockup and Test Facility
RMSS	remote maintenance service stations
RSC	Remote Service Corridor
RW	Office of Civilian Radioactive Waste Management (DOE)
SBW	sodium-bearing waste
SRS	Savannah River Site
SST	Stainless steel
TBD	to be determined
TEC	Total Estimated Cost
TFF	Tank Farm Facility
TIA/EIA	Telecommunications Industry Association/Electronics Industries Association
TOC	total organic compounds
TPC	Total Project Cost
UCS	Utility Control System
UDS	undissolved solids
UNEX	Universal Extraction Process
UMSS	utility maintenance service stations
UOP	Universal Oil Products
UPS	Uninterruptible Power Supply
VWO	Vitrified Waste Option

WAC	waste acceptance criteria
WA-SRD	Waste Acceptance System Requirements Document
WCP	Waste Form Compliance Plan
WFQ	waste form qualification
WIPP	Waste Isolation Pilot Plant
WQR	Waste Form Qualification Report
WVDP	West Valley Demonstration Project

Feasibility Study for Vitrification of Sodium-Bearing Waste

1. INTRODUCTION

Treatment of Sodium Bearing Waste (SBW) at the Idaho Nuclear Technologies Engineering Center (INTEC) within the Idaho National Engineering and Environmental Laboratory (INEEL) is mandated under a "Settlement Agreement" between the Department of Energy (DOE) and the State of Idaho (DOE 1995). One of the requirements of the Settlement Agreement is the complete calcination (i.e., treatment) of all SBW by December 31, 2012. One of the proposed options for treatment of SBW is vitrification. This study will examine the viability of the vitrification of SBW.

The first task of the feasibility study for vitrification of SBW is to determine a timeline for this capital project for design, technical development, construction, and testing/start-up. The time required for these tasks was evaluated by Cost Estimating Services (Appendix D) to extend through 2012. This study was not started early enough to meet the Settlement Agreement milestone for treatment of SBW.

Although this process cannot meet the 2012 milestone for SBW treatment, the feasibility study was continued. A 2-year operating life for the SBW Vitrification Facility was chosen instead of the originally proposed 4-year life. There were several factors related to this decision. One factor was the desire to treat the SBW in a timely manner. The difference in cost to build the Vitrification Facility for 2 or 4 years of operation was small since much of the facility is essentially the same, regardless of process flow rates. The shielding required, the canister handling system, and the support services are the same. The extra 2 years of operations costs far exceed the cost of the larger facility. Another consideration is that the 2-year Vitrification Facility has sufficient capacity to vitrify the calcine to meet the Settlement Agreement milestone for treatment of all calcine by 2035. For the Vitrification Facility to be used for treatment of calcine, as well as SBW, the design should be modified to incorporate a dry feed and mixing system in addition to the liquid feed system. Addition of a second melter would ensure continuous operation during melter changeout.

The Vitrification Facility would be available for processing other wastes when SBW treatment is completed. As part of the closure of the Tank Farm Facility (TFF), there will be an estimated 45,000 gal of sludge which can be vitrified. Additionally, newly generated liquid waste (NGLW) can be treated by vitrification.

This study describes the process and facilities to treat the SBW only, from beginning waste input from the INTEC Tank Farm to final waste forms. Schedules and cost estimates for construction and operation of the Vitrification Facility are included. The study includes a facility layout with drawings, process description and flow diagrams, and preliminary equipment requirements and layouts. Previous feasibility studies (Lopez 1999, Lopez & Kimmitt 1998) were used as starting bases for this study.

The process for treatment is that SBW (Appendix A) is removed from the TFF at INTEC to a storage tank in the Vitrification Facility. Sugar and frit are added to the SBW. This mixture is fed into the joule-heated melter. Water is evaporated and the solids are formed into a borosilicate glass. The glass is discharged into stainless steel canisters with welded lids. This creates a waste which is suitable for disposal at the Waste Isolation Pilot Plant (WIPP). However, sampling requirements for disposal at Yucca Mountain have been included in the study.

2. DESIGN BASIS AND ASSUMPTIONS

2.1 Design Basis

The follow design bases and requirements are provided in the scope of work for this feasibility study (HLW 1999).

- Provide capability to mix SBW feed with frit and other necessary additives. Provide capability to vitrify the SBW with the necessary control to ensure that the product will meet waste acceptance criteria of the proposed disposal facility including packaging and shipping requirements. Provide ancillary unit processes such as off-gas removal and treatment as required.
- Feed transfer capability from INTEC Tank Farm and receiving capability at the process facility have been addressed in the reference documents. This information will be used for this study.
- Provide final waste product handling capability. This will include handling equipment, transportation, and storage.
- Provide for final waste product interim storage if the product cannot be shipped to the final disposal facility in a reasonable amount of time and cannot be handled by surge storage capacity. Do not include design and cost of interim storage in this feasibility study.
- Determine disposal paths for low-activity waste (LAW) streams from the vitrification process (e.g., elemental mercury, activated carbon).
- Provide surge capacity or de-couple the major unit processes as required.
- Provide process system reliability through redundancy and remote removal and replacement, transportation, and maintenance capability for failure-prone equipment such as valves and pumps.
- Provide chemical makeup area and equipment to receive, store, and make-up process chemicals.
- Provide remote sampling capability to ensure process/product qualification and process operation as required. Provide sample transfer to analytical facilities. Here again, the intent is not a detailed design, but enough to include the costs of these items in the total costs.
- Maximize the use of low-maintenance process equipment in radioactive areas, and provide remotely operated decontamination capabilities for cells, cubicles, and internal and external equipment surfaces as required.
- Provide adequate support of hands-on maintenance activities, e.g., shielded cell entryways, permanent scaffolding, utility maintenance service stations.
- Provide equipment and areas for performing decontamination and repair of manipulators, cranes, etc., as required to support the remote functions of the facility.

- Provide radiation shielding and contamination control of process areas (e.g., hot process cells) to minimize personnel radiation exposure during operations and maintenance activities. Incorporate "as low as reasonably achievable" (ALARA) principles throughout the design.
- Provide heating, cooling, and ventilation as required for environmental control and contamination containment.
- Provide a central control area for process monitoring, recording, alarming, and process control. Heating, ventilating, and air conditioning (HVAC), fire protection, and contamination control systems will also be controlled and monitored in the control area.
- Use existing INTEC utility and support systems as far as practicable.
- Provide necessary electrical power and utilities as required. Provide for, or ensure there exists, support for emergency power and uninterruptible power as required as emergency power backup for essential equipment and system.

2.2 Assumptions

The assumptions listed below are the major process and design assumptions for the feasibility study. Numerous assumptions are made for selection of individual pieces of equipment and for design considerations that are explained as needed.

2.2.1 Scope of Work

The follow assumptions are provided in the scope of work for this feasibility study (HLW 1999).

1. The calciner in the New Waste Calcine Facility (NWCF) will not operate again. This process will treat all SBW.
2. There will be an incidental waste ruling that SBW is not high-level waste (HLW).
3. The U134 waste code will be added to the WIPP Waste Acceptance Criteria (WAC) or the SBW will be delisted for U134.
4. All SBW must be treated before the end of 2012. If the study finds that this is not possible, it should be clearly stated that it is not possible and a schedule of when it is possible shall be provided.
5. Operating efficiency for the process shall be on a 24 hr/day, 200 days/year basis.
6. The High-Level Liquid Waste Evaporator (HLLWE) currently located in NWCF will remain in operation. The Process Equipment Waste (PEW) Evaporator will also remain in operation. They may be used to support this process.
7. When planning schedules, assume funding will be available on a normal request schedule for line item projects.

2.2.2 Consensus Assumptions

The following assumptions were made during the weekly design meetings, by consensus of design team present and concurrence with meeting minutes by those not present.

2.2.2.1 General

1. The SBW Vitrification Facility will not need to be licensed by the Nuclear Regulatory Commission (NRC).
2. Possible use of the Vitrification Facility for treatment of calcine will be mentioned in the feasibility study. No accommodation will be made in the design for calcine treatment.
3. The INTEC Technical Development Facility (ITDF) will not be available to support the vitrification of SBW.
4. For materials of construction, Appendix M of the Architectural and Engineering (A/E) Standard will be used. The TFF and NWCF off-gas piping specifications will be used.
5. An Interim Storage Facility (ISF) will be required for the storage of filled glass canisters prior to shipment to permanent disposal, but is not part of this estimate.
6. A mock-up area is required for the Vitrification Facility.
7. Infrastructure services (electricity, raw water, sewer, etc.) are available at curb.
8. Steam heat will be used for the facility. The facility will need to supply its own steam generation.
9. Risk-Based Clean Closure of facility.
10. Off-gas will meet Maximum Achievable Control Technology (MACT) requirements for incinerators (thermal treatment).

2.2.2.2 Process

11. A continuous emissions monitor (CEM) is needed for mercury.
12. Off-gas system continues to function if power is lost. A 20-minute uninterruptible power supply (UPS) is required.
13. The water from the SBW will exit the facility as vapor in the stack. Water will not be condensed for disposal.

2.2.2.2.1 General

14. Valves around blowers on off-gas system will be butterfly valves.
15. 1,000,000 Btu/hr cooling is required for process cells.
16. Temperature sensors are needed for the carbon beds.

17. The scrub solution is not neutralized but will be maintained at a pH below 2 for removal of oxidized mercury.
18. Heaters in the off-gas system will raise the temperature 20°C above the saturation temperature of water to prevent condensation in the high-efficiency particulate air (HEPA) filters or granulated activated carbon (GAC) beds.

2.2.2.2.2 Melter

19. Lid heaters are used in the melter.
20. Only one T-tap is needed for the melter.

2.2.2.2.3 Canister Handling System

21. Transfer cart for moving canisters from facility to interim storage will be similar to that used for the Vitrified Waste Option (VWO) study (Lopez and Kimmitt 1998).
22. Interim storage is not included in the scope of the feasibility study.
23. A turntable approach will be used for canister handling.
24. The emergency/final melter tap will use a single index linear canister system.
25. A gross weight sensor is required for the canister turntable.

2.2.2.3 Sampling and Analysis

26. Sampling plan will include samples necessary to send waste to Yucca Mountain for disposal.
27. For the purposes of sample planning, samples will be sent to the Remote Analytical Laboratory (RAL) at INTEC for analysis. No analytical capability will be supplied at the treatment facility. The existing laboratory facilities will be used to support the SBW Vitrification Facility.
28. Samples will be sent to analytical laboratory by pneumatic transfer system.
29. There will be a sample storage area in the facility. Samples will be stored until the glass canister is accepted for storage.

2.2.2.4 Storage

30. Storage is required for empty canisters. Controls are required since canisters require quality assurance (QA) inspection.
31. Storage for filled glass canisters is required only during cooling. Glass-filled canisters will not be stored in the treatment facility.

2.2.2.5 Disposal

32. Zeolite from the cesium ion exchange (CsIX) process will be vitrified in the SBW Vitrification Facility.

33. The glass canister waste form will be qualified for both WIPP and the Yucca Mountain repository.
34. The low-level waste (LLW) grout drums will be sent to Hanford. 71-gal square drums such as those used at the West Valley Demonstration Project (WVDP) will be used for grout.
35. Mercury will not be retorted before amalgamation. A new law is being passed. This will be consistent with the assumptions for the Universal Extraction Process (UNEX) study.
36. GAC with mercury can be sent to a vendor for off-site treatment.

2.3 Regulatory Requirements

The design shall comply with the latest edition in effect at design start date. Appendix I is a listing of codes and standards which may be applicable.

2.4 Functional and Operational Requirements

2.4.1 Siting Requirements

Siting of the new facility and necessary support structures shall take into consideration its proximity to the waste (product) source, utility access, and site flexibility to optimize the flow of service. All existing physical attributes (roadways, structures, utilities, etc.) shall be surveyed and located for the final site layout and facility location design.

2.4.2 Facility Interface Requirements

Utilities shall include power, potable water, firewater for fire suppression systems, raw water and treated water, sanitary waste lines, steam, and plant air (Assumption 7). The electrical study for this facility indicates that a new substation is not required to support the facility. No site steam is required since the facility will have steam generation capability. The existing facilities at INTEC will be sufficient for the disposal of wastewaters such as sanitary waste and service waste. Plant instrument and breathing air will be provided by the existing INTEC utilities.

2.4.3 Functional Requirements

The primary function of this facility is to safely process SBW into a waste form that can optimize containerization and transportation to a final disposal site. The facility will also provide for the housing of ancillary and support functions staffed by the required personnel.

2.4.4 Architectural/Engineering Requirements

The physical facility shall enclose a staging area to receive and transfer process materials. The structural process enclosure shall contain the processing of the waste and protect occupants from the hazardous properties of the waste. The structure shall provide sufficient area for occupant and process circulation. The overall layout shall provide adequate mechanical space for the process as well as the administrative area. Support areas shall include circulation and access provisions including mezzanines, stairs, catwalks, platforms; maintenance corridors and rooms; utility corridors and areas; personnel hygiene facilities, commons areas, offices interstitial areas, and storage areas.

2.4.5 Waste Storage and Handling Requirements

The SBW will be transferred directly to Vitrification Facility, and will not require interim or lag storage. Storage shall be provided for process materials requiring bulk onsite storage, i.e., a 6-month supply of frit. Minimal storage of varying process times will be required to accommodate each activity such as cooling, sampling and analysis, and curing.

2.4.6 WIPP WAC

WIPP is a possible storage location for vitrified SBW if it is declared to not be HLW by a waste incidental to reprocessing ruling. The waste to be shipped to WIPP must be delisted for Resource Conservation and Recovery Act (RCRA) waste code U134, hydrofluoric acid, or the WIPP RCRA permit must have U134 added to it. Table 1 shows the pertinent acceptance criteria for WIPP remote handled (RH) waste.

Table 1. WIPP remote-handled WAC.

Criteria	Limits	SBW Glass Canisters
Container Description	DOT Type A RH Canister	
Canister Gross Weight	< 8,000 lb	
Removable Surface Contamination	< 20 dpm/100 cm ² Alpha < 200 dpm/100 cm ² Beta-Gamma(4)	Will be decontaminated to these limits.
Dunnage	Limited to inside canister	None
Filter Vents	Canisters vented	Yes
Liquids	No liquid Wastes < 6 liters total residual liquid per canister < 1 in. (2.5 cm) in the bottom of any container	No Free Liquids – Solid Glass
Pu-239 fissile gram equivalent (FGE)	< 325 g/Cask	87.3 g Pu-239 FGE/canister
Pu-239 Equivalent (PE) Activity	< 1,000 PE-Ci/ canister	9.2 PE Ci/canister
Contact Dose Rate	< 1,000 rem/hr per canister Preapproval received for > 100 rem/hr per canister < 200 mrem/hr per Cask	65 rem/hr
Thermal Power	< 300 watts/canister	5.7 watts/canister
TRU Alpha Activity	> 100 nCi/g of waste matrix and < 23 Ci/liter	6,530 nCi/g 6.53E-6 Ci/liter
Pyrophoric Materials	< 1% Radionuclides Pyrophorics No nonradionuclide pyrophorics	No nonradionuclide pyrophorics

Table 1. (Continued)

Criteria	Limits	SBW Glass Canisters
Mixed Wastes	Characterization per QAPP Limited to EPA Waste Codes listed in WAC	U-134 needs to be added to WIPP WAC or delisted from waste. LDR none Total metals based on feed analysis
Chemical Compatibility	Chemicals allowed by the RH-TRAMPAC	
Hazardous Constituents	Target analytes and TICs reported per QAPP	
Explosives, Corrosives and Compressed Gases	None Present	None
PCBs Concentration	< 50 ppm	None
Table 1.2.7 Flammable VOCs	< 500 ppm in canister headspace	No VOCs.
VOC Concentration	< Limits show in WAC	No VOCs.

2.4.7 Yucca WAC

The Yucca Mountain repository is the proposed alternate disposal location for the canisters of vitrified SBW if WIPP is unable to take the waste either due to space limitations or SBW is declared to be HLW. The waste acceptance criteria for HLW are found in the DOE's Waste Acceptance System Requirements Document (WA-SRD) (DOE 1999). For the glass waste form, the waste acceptance criteria fall under three general areas: Glass, Canister, and Finished Product. Specific requirements are summarized in Table 2 below.

Table 2. Yucca Mountain waste acceptance criteria summary.

Glass	Canister	Finished Product
Chemical Composition	Material	Free Liquid
Radionuclide Inventory	Fabrication and Closure	Gas
Product Consistency (durability)	Identification and Labeling	Explosives, Pyrophorics, Combustibles
Phase Stability		Organic Materials
Not a hazardous waste as defined in 40 CFR 261		Fill Height
		Surface Contamination
		Heat Generation
		Dose Rate
		Chemical Compatibility
		Subcriticality
		Weight, Length, Diameter, Overall Dimensions
		Drop Test
		Handling

The following is from the WA-SRD (DOE 1999) from which waste acceptance criteria for the SBW waste will be generated. Draft revision 4 to the WA-SRD has been issued for comment but not released as some the provisions are still being debated. There are few changes to the current revision 3. However, where there are proposed changes, these will be identified in the following applicable items below in footnotes.

1. Canister Specifications

- a. The standard vitrified HLW form shall be borosilicate glass sealed inside an austenitic stainless steel canister(s) with a concentric neck and lifting flange.
- b. Total length shall be 3.0 m (+0.005, -0.020 m)^a or alternatively 4.5 m (+0.005, -0.020 in)^a.
- c. Diameter shall be 61.0 cm (+1.5, -1.0 cm)^a.
- d. Weight shall not exceed 2500 kg, or alternatively 4200 kg, for the 4.5-m canister.
- e. Fill height shall be equivalent to at least:
 - (1) 80% of the volume of the empty canister for the WVDP and the Savannah River Site (SRS).
 - (2) 87% of the volume of the empty 4.5-m canister.
- f. Total heat generation rate shall not exceed 1,500 watts per 3.0-m canister at the year of shipment, or alternatively 2,540^b watts per 4.5-m canister at the year of shipment.

2. Material Compatibility - The producer shall report to the DOE Office of Civilian Radioactive Waste Management (RW), the American Society for Testing and Materials alloy specification (or other nationally recognized specification) and composition of the fill canister material, secondary canister material, canister label material, and any filler material used for welding, and the method of fabrication of the fill canister and any secondary canister.

3. Radiation Protection Criteria - The canistered HLW shall not exceed a maximum surface gamma dose rate of 105 rem per hour and a maximum neutron dose rate of 10 rem per hour at the time of shipment. The dose rate may either be measured or calculated from a radionuclide content.

4. Surface Contamination

- a. The Producer shall inspect the canistered waste form and remove visible waste glass from the exterior surface of the canister before shipment.

a. The minimum dimension may be measured prior to filling.

b. Draft WA-SRD Rev. 4 value is 1,970 watts. SBW thermal output is estimated to be less than 5.7 watts/canister.

- b. The Producer shall report to RW an estimate of the amount of canister material (particularly wall thickness) removed during decontamination of the canister surface.

The draft WA-SRD Rev. 4 adds the following provision for surface contamination:

“The level of non-fixed (removable) radioactive contamination on external HLW canister surfaces at the time of loading into transport casks shall not exceed (1) 220 dpm/100 cm² for alpha emitting radionuclides, or (2) 2,200 dpm/100 cm² for beta and gamma emitting radionuclides.”

This provision is still being debated. If it is retained, decontamination of the canister will be continued until this level is met.

5. Chemical Composition

- a. The Producer shall report to RW the chemical composition and crystalline phase projections for vitrified HLW.
- b. The Producer shall report to RW the oxide concentration of elements present in concentrations greater than 0.5% by weight (of glass) and the estimate of the error of these concentrations for vitrified HLW.

6. Radionuclide Inventory - The Producer shall report to RW the estimated total and individual canister inventory of radionuclides (in Curies) that have half-lives longer than 10 years and that are or will be present in concentrations greater than 0.05% of the total radioactive inventory. The estimates shall be indexed to the years 2010 and 3110. The Producer shall also report the estimate of the uncertainty with the radionuclide inventories.

7. Phase Stability and Integrity

- a. The Producer shall ensure the phase structure and composition of the vitrified HLW are not degraded after initial cooldown by maintaining the waste form below 400°C to ensure the glass transition temperature is not exceeded.
- b. The Producer shall provide the Time-Temperature Transformation diagrams for the vitrified HLW.

8. Product Consistency

- a. The Producer shall demonstrate control of waste form production by comparing production samples or process control information, separately or in combination to the Environmental Assessment benchmark glass using the Product Consistency Test or equivalent.
- b. For acceptance, the mean concentrations of lithium, sodium, and boron in the leachate, after normalization for the concentrations in the glass, shall be less than those of the benchmark glass.

9. Canister Impact Characteristics

- a. Requirements shall be allocated to the handling facility, barriers, transfer cell, and canister to protect the safety of the work force and the public. The HLW canisters shall be capable of withstanding a drop of 7 meters onto a flat, essentially unyielding surface without breaching or dispersing radionuclides.
- b. Drop test results shall include information on the measured canister leak rates and canister deformation after the test.

10. Canister Handling

- a. The Producer shall provide a grapple design suitable for use in loading or unloading a transportation cask with a standard 3.0-meter HLW canister or a standard 4.5-meter canister.
- b. The grapple, when attached to the hoist and engaged with the flange, shall be capable of moving the canistered waste form in the vertical direction.
- c. The grapple shall be capable of being remotely engaged with and remotely disengaged from the HLW canister flange.
- d. The grapple shall be capable of being engaged or disengaged while remaining within the projected diameter of the waste form canister (61.0 centimeters (+1.5, -1.0 cm)),
- e. The grapple shall include features that prevent inadvertent release of a suspended canistered waste form.

11. Condition at Delivery - At time of delivery, the HLW form shall stand upright without support on a flat horizontal surface and properly fit into a right-circular, cylindrical cavity (64 cm diameter and 3.01 meters length or alternatively 64 cm diameter and 4.51 meters length).

12. Reporting Requirements

- a. The Producer shall submit documentation to RW to demonstrate compliance of the HLW form with Civilian Radioactive Waste Management System (CRWMS) acceptance criteria. This documentation includes a Waste Form Compliance Plan (WCP), Waste Form Qualification Report (WQR), Production Records, and Storage and Shipping Records.
- b. EM, as the cognizant organization within DOE for HLW form production, shall produce waste form production specifications, which describe the form and content to demonstrate compliance with CRWMS acceptance criteria.
- c. The WCP shall describe the Producer plan for demonstrating compliance with CRWMS acceptance criteria, including a description of tests, analyses, and process controls to be performed by the Producer. The WCP also identifies records that will be provided as evidence of compliance.

- d. The WQR shall compile the results from waste form testing and analysis to demonstrate the ability of the Producer to comply with CRWMS acceptance criteria.
- e. The Production Records shall describe the actual canistered waste form.
- f. The Storage and Shipping Record shall describe the physical attributes of each canistered waste form and identify any unexpected events, such as thermal excursions, which have occurred during storage. Specifically, the Shipping records for HLW shall provide written documentation and certification:
 - (1) of cask conditions and contents prior to transfer to the receiving party.
 - (2) that the transportation cask subsystem has been packaged to meet DOE, Department of Transportation (DOT), and NRC requirements, and to transfer care, custody, and control of the shipment.
 - (3) of the activity in terms of the appropriate International System of Units (SI) (e.g. Becquerel, Terabecquerel, etc.) contained in each shipping package and the name of each radionuclide in each shipping package in accordance with 49 CFR Part 172.203(d)(1) and (4).
 - (4) that the standard HLW did not exceed 400°C after initial cooldown to ensure the glass transition temperature was not exceeded.
- g. Producer shall provide annual reports of waste generation and projections of quantities of vitrified HLW requiring disposal.
- h. DOE-EM shall provide information concerning canister label in accordance with the WQR, the WCP, and the Memorandum of Agreement between the Office of Civilian Radioactive Waste Management (RW) and EM.

13. Additional Requirements

The draft WA-SRD Rev 4 also included an additional provision for canister sealing. This provision states:

- a. Canisters of vitrified HLW shall be backfilled with an inert gas (e.g., helium), seal-welded, and leak tested using a Quality Assurance Requirements and Description (QARD)-compliant method (prepared under the QARD, an NRC-licensed program, or a QA program approved by RW on a case-by-case basis) that is capable of detecting a leak rate of at least 1×10^{-4} atm-cm³/s helium.
- b. Where canistered HLW is stored for an extended period of time prior to shipment to the CRWMS, canister leak rates shall be re-evaluated within 6 months of shipment to the CRWMS if there is evidence that the canister leak rate has increased since initially tested.

While this provision is still being debated and maybe removed, the current design will accommodate this provision. Weld leak checking is in the current design. To provide the “backfill with an inert gas (e.g., helium),” a leak source will be placed in the top of the canister before to weld closure. This will provide the inert backfill and a source for the leak check. If this is determined in the future not to adequately meet this requirement, the welding unit will need to be designed with an enclosure that will allow for a purge of the canister head space and then welding.

3. WASTE DESCRIPTION

3.1 HLW—Glass Canisters

3.1.1 Waste Volume

Based on the material balance (Appendix B), a feed of 395 liter/hr of SBW into the Vitrification Facility results in 127 kg/hr of glass. For the 3.8 million liters of SBW to be treated, this results in 1.2 million kg of vitrified waste. With a density of approximately 2,600 kg/m³, this is 470 m³ of glass. Each glass canister holds 0.72 m³ of glass. Therefore, about 653 canisters are required. This does not include treatment of the ion exchange zeolite from the grouting system, treatment of newly generated liquid waste, or treatment of sludge from the TFF closure.

3.1.2 Chemical Composition

These compositions are based on a 1% carryover in the off-gas for each chemical unless otherwise specified in Table 3. The other 99% of the chemical species in the feed stay in the glass melt. For some of the chemical species, 99% retention is a conservative assumption. The chemical composition of the vitrified waste is presented in Table 4.

Table 3. Carryover of chemical species.

Chemical Species	Carryover fraction
Ag ⁺¹	0.02
Cl ⁻¹	0.50
Cs ⁺¹	0.0333
F ⁻¹	0.25
H ⁺¹	1
Hg ⁺²	1
NO ₃ ⁻¹	1
Ru ⁺⁴	0.04
Se ⁺⁴	0.25
SO ₄ ⁻²	0.2
I	0.91
Tc ⁺⁷	0.5
At	0.91
Br ⁻¹	0.705
C ⁺⁴	1
Ra	1

Table 4. Chemical composition of vitrified waste.

	SBW Frit	Glass	Oxidized Species	Molecular Wt	Glass Composition		
<u>Ionic Species</u>	<u>Moles/hr</u>	<u>Moles/hr</u>	<u>Moles/hr</u>	<u>g/mole</u>	<u>kg/hr</u>	<u>wt fraction</u>	
Ag ⁺¹		0.0117	Ag ₂ O	0.00583	231.7354	0.00135	9.12E-06
Al ⁺³		258.	Al ₂ O ₃	129	101.9613	13.2	0.08908
As ⁺³		0.031	As ₂ O ₃	0.0153	197.8414	0.00303	2.04E-05
B ⁺³		11.28	B ₂ O ₃	175	69.6182	12.2	0.0822
Ba ⁺²		0.0260	BaO	0.0260	153.3294	0.00399	2.69E-05
Ca ⁺²		22.6	CaO	22.6	56.0794	1.27	0.00856
Cd ⁺²		2.20	CdO	2.20	128.4094	0.283	0.00191
Cl ⁻¹		7.08	Cl ⁻	7.08	35.453	0.251	0.00169
Cr ⁺³		2.33	Cr ₂ O ₃	1.17	151.9902	0.177	0.00120
Cs ⁺¹		0.00360	Cs ₂ O	0.00180	281.8102	0.000507	3.42E-06
F ⁻¹		31.2	F ⁻	15.6	40.08	0.625	0.00422
Fe ⁺³		10.0	Fe ₂ O ₃	63.3	159.6922	10.1	0.0682
K ⁺¹		74.4	K ₂ O	37.2	94.196	3.50	0.0237
Mg ⁺²		0.763	MgO	0.763	40.3114	0.0308	0.000208
Mn ⁺²		5.81	MnO	5.81	70.9374	0.412	0.00278
Mo ⁺⁶		0.487	MoO ₃	0.487	143.9382	0.0700	0.000473
Na ⁺¹		666	Na ₂ O	666	61.97894	41.3	0.279
Ni ⁺²		1.12	NiO	0.562	74.6994	0.0420	0.000284
Pb ⁺²		0.463	PbO	0.463	446.3988	0.207	0.00140
PO ₄ ⁻³		4.68	P ₂ O ₅	2.34	269.9397	0.631	0.00426
Ru ⁺⁴		0.183	RuO ₂	0.183	133.0688	0.0244	0.000165
Se ⁺⁴		0.00606	SeO ₂	0.00606	110.9588	0.000672	4.54E-06
Si ⁺⁴		1.67	SiO ₂	942	60.0843	56.6	0.382
SO ₄ ⁻²		15.4	SO ₃	15.4	80.0582	1.23	0.00831
Zr ⁺⁴		7.40	ZrO ₂	7.40	123.2188	0.911	0.00616
U ⁺⁴		0.881	UO ₂	0.881	270.0278	0.238	0.00161
Zn ⁺²		0.327	ZnO	0.327	162.7388	0.0533	0.00036
B ₂ O ₃	169						
Li ₂ O	75		Li ₂ O	74.4	29.8814	2.22	0.0150
SiO ₂	941						
TiO ₂	32		TiO ₂	32.0	79.8988	2.55	0.0172
Fe ₂ O ₃	58						
Total						148	1.000

3.1.3 Radiological Composition

Unless otherwise specified in Table 5, 1% of the radionuclides in the melter feed is assumed to exit the melter as part of the off-gas stream. The other 99% of the radionuclides in the feed stay in the glass melt. For many of the radionuclides, 99% retention is a conservative assumption.

Table 5. Percent radionuclide carryover in off-gas.

Radionuclide	Carryover fraction
Ba-137m	0.0333
Cs-134	0.0333
Cs-135	0.0333
Cs-137	0.0333
Tc-99	0.5
H-3	1
I-129	0.91

The radionuclide composition of the vitrified SBW waste is given in Table 6. The composition is calculated using the retention assumptions listed above.

Table 6. Radionuclide composition of vitrified waste.

Radionuclide	Ci/kg	Radionuclide	Ci/kg	Radionuclide	Ci/kg
Am-241	1.65E-03	U-234	3.70E-06	Eu-155	2.43E-04
Am-243	6.61E-07	U-235	9.53E-08	Pm-147	3.49E-04
Cm-244	5.48E-05	U-236	1.71E-07	Pr-144	2.70E-09
Np-237	5.92E-06	U-238	9.14E-08	Ni-63	1.81E-04
Pu-238	3.72E-03	Ba-137m	1.60E-01	Ru-106	4.17E-08
Pu-239	2.74E-04	Ce-144	2.70E-09	Sb-125	1.30E-04
Pu-240	7.92E-05	Co-60	2.01E-04	Sm-151	1.78E-03
Pu-241	1.72E-03	Cs-134	1.03E-04	Sr-90	1.64E-01
Pu-242	6.72E-08	Cs-135	2.82E-06	Tc-99	9.23E-05
Th-230	1.43E-09	Cs-137	1.69E-01	Y-90	1.64E-01
U-232	7.07E-09	Eu-152	1.03E-05	I-129	6.55E-06
U-233	2.36E-11	Eu-154	6.12E-04		

3.1.4 Radiation Levels

The maximum contact radiation level, calculated for the worst-case waste type, is 65 Rem/hr for the canister. The canisters will be remote handled due to the high radiation level. The maximum thermal power is calculated at 5.7 watts/canister.

3.1.5 Disposal Site

The waste disposal site for the vitrified waste has not yet been determined. However, the waste will be suitable for disposal at either WIPP or Yucca Mountain.

3.2 LLW – Grout

3.2.1 Waste Volume

The blowdown from the scrub system is 1.1 liter/hr based on the material balance. This is a total of 10,500 liter during the treatment of SBW. Using the grout formula in Section 3.2.2, this results in about 20 m³ of grout. Depending on the acceptance criteria for the selected waste disposal site, either 55-gal drums or 71-gal square drums (used at the West Valley Demonstration Project) will be used for the grout. Table 7 shows the capacity of the two drums and the number required.

Table 7. Grout containers.

Container	Nominal Volume (gal)	Grout Volume (m ³)	Number of Containers
Standard Drum	55	0.21	95
WVDP Drum	71	0.27	74

These calculations do not include wastes created by treatment of the ion exchange (IX) zeolite from the grouting system, treatment of newly generated liquid waste, or treatment of sludge from the TFF closure, or closure of the vitrification plant.

3.2.2 Chemical Composition

The grout formula used is the same used for grouting the scrubber blowdown from the 1999 vitrification feasibility study. This is documented in the report for final waste forms for INTEC radioactive waste in Banaee et al. (1999). The density of the grout is assumed to be 1,826 kg/m³. The actual grout recipe for the scrubber blowdown should be determined by analysis of the actual blowdown and laboratory experience. The recipe shown in Table 8 is tentative based on previous experience solidifying similar waste matrices.

Table 8. Grout recipe.

Ingredient	wt %
Blowdown liquid	28.7%
Cement	35.5%
Slag	35.5%
Blowdown solids	0.25%

The chemical composition of the grout is based on the chemical and radiological composition of the blowdown from the scrub system from the material balance. Two cases were considered: with and without cesium and strontium removal by ion exchange media. The chemical compositions for both cases are given in Table 9.

Table 9. Chemical composition of grout.

Species	Blowdown with Cesium			Effluent without Cesium		
	Moles/hr	gm/hr	gm/kg	moles/hr	gm/hr	gm/kg
H ₂ O	60.76	1,095	287	60.8	1,095	287
Ag ⁺¹	7.13E-06	7.7E-04	2.0E-04	7.1E-06	7.7E-04	2.0E-04
Al ⁺³	7.83E-02	2.1E+00	5.5E-01	7.8E-02	2.1E+00	5.5E-01
As ⁺³	9.27E-06	6.9E-04	1.8E-04	9.3E-06	6.9E-04	1.8E-04
B ⁺³	3.40E-03	3.7E-02	9.6E-03	3.4E-03	3.7E-02	9.6E-03
Ba ⁺²	7.88E-06	1.1E-03	2.8E-04	7.9E-06	1.1E-03	2.8E-04
Ca ⁺²	6.84E-03	2.7E-01	7.2E-02	6.8E-03	2.7E-01	7.2E-02
Cd ⁺²	6.67E-04	7.5E-02	2.0E-02	6.7E-04	7.5E-02	2.0E-02
Cl ⁻¹	1.85E-02	6.5E-01	1.7E-01	1.8E-02	6.5E-01	1.7E-01
Cr ⁺³	7.06E-04	3.7E-02	9.6E-03	7.1E-04	3.7E-02	9.6E-03
Cs ⁺¹	3.72E-06	4.9E-04	1.3E-04	3.7E-10	4.9E-08	1.3E-08
F ⁻¹	2.74E-02	5.2E-01	1.4E-01	2.7E-02	5.2E-01	1.4E-01
Fe ⁺³	3.03E-03	1.7E-01	4.4E-02	3.0E-03	1.7E-01	4.4E-02
H ⁺¹	4.58E-02	4.6E-02	1.2E-02	4.6E-02	4.6E-02	1.2E-02
Hg ⁺²	1.97E-03	3.9E-01	1.0E-01	2.0E-03	3.9E-01	1.0E-01
K ⁺¹	2.25E-02	8.8E-01	2.3E-01	2.3E-02	8.8E-01	2.3E-01
Mg ⁺²	2.31E-04	7.9E-03	2.1E-03	2.3E-04	7.9E-03	2.1E-03
Mn ⁺²	1.76E-03	9.7E-02	2.5E-02	1.8E-03	9.7E-02	2.5E-02
Mo ⁺⁶	1.47E-04	1.4E-02	3.7E-03	1.5E-04	1.4E-02	3.7E-03
Na ⁺¹	2.02E-01	4.6E+00	1.2E+00	2.0E-01	4.6E+00	1.2E+00
Ni ⁺²	3.41E-04	2.0E-02	5.2E-03	3.4E-04	2.0E-02	5.2E-03
NO ₃ ⁻¹	0.00E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb ⁺²	1.40E-04	2.9E-02	7.6E-03	1.4E-04	2.9E-02	7.6E-03
PO ₄ ⁻³	1.42E-03	1.3E-01	3.5E-02	1.4E-03	1.3E-01	3.5E-02
Ru ⁺⁴	2.29E-04	2.3E-02	6.1E-03	2.3E-04	2.3E-02	6.1E-03
Se ⁺⁴	6.07E-05	4.8E-03	1.3E-03	6.1E-05	4.8E-03	1.3E-03
Si ⁺⁴	5.05E-04	1.4E-02	3.7E-03	5.1E-04	1.4E-02	3.7E-03
SO ₄ ⁻²	0.00E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr ⁺⁴	2.24E-03	2.0E-01	5.4E-02	2.2E-03	2.0E-01	5.4E-02
U ⁺⁴	2.67E-04	6.4E-02	1.7E-02	2.7E-04	6.4E-02	1.7E-02
Zn ⁺²	9.92E-05	6.5E-03	1.7E-03	9.9E-05	6.5E-03	1.7E-03

Total	1,105	290	1,105	290
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3.2.3 Radiological Composition

The radioactivity of the grout comes from the contamination of the liquid (blowdown or ion exchange effluent) used to make the grout. Table 10 provides the radionuclides present in the grout in Ci/kg.

Table 10. Radiological composition of grout.

	Blowdown with Cesium			Effluent without Cesium		
	Curies/hr	Curies/kg	nCi/g	Curies/hr	Curies/kg	nCi/g
Am-241	6.34E-05	1.66E-05	17	6.34E-05	1.66E-05	16.6
Am-243	2.54E-08	6.65E-09	0	2.54E-08	6.65E-09	0.0
Cm-244	2.11E-06	5.52E-07	1	2.11E-06	5.52E-07	0.6
Np-237	2.28E-07	5.96E-08	0	2.28E-07	5.96E-08	0.1
Pu-238	1.43E-04	3.75E-05	37	1.43E-04	3.75E-05	37.5
Pu-239	1.05E-05	2.76E-06	3	1.05E-05	2.76E-06	2.8
Pu-240	3.04E-06	7.97E-07	1	3.04E-06	7.97E-07	0.8
Pu-241	6.62E-05	1.73E-05	17	6.62E-05	1.73E-05	17.3
Pu-242	2.58E-09	6.76E-10	0	2.58E-09	6.76E-10	0.0
Th-230	5.51E-11	1.44E-11	0	5.51E-11	1.44E-11	0.0
U-232	2.72E-10	7.12E-11	0	2.72E-10	7.12E-11	0.0
U-233	9.08E-13	2.38E-13	0	9.08E-13	2.38E-13	0.0
U-234	1.42E-07	3.73E-08	0	1.42E-07	3.73E-08	0.0
U-235	3.66E-09	9.59E-10	0	3.66E-09	9.59E-10	0.0
U-236	6.59E-09	1.73E-09	0	6.59E-09	1.73E-09	0.0
U-238	3.51E-09	9.20E-10	0	3.51E-09	9.20E-10	0.0
Ba-137m	2.09E-02	5.48E-03	5,483	2.09E-06	5.48E-07	0.5
Ce-144	1.04E-10	2.72E-11	0	1.04E-10	2.72E-11	0.0
Co-60	7.71E-06	2.02E-06	2	7.71E-06	2.02E-06	2.0
Cs-134	1.35E-05	3.53E-06	4	1.35E-09	3.53E-10	0.0
Cs-135	3.70E-07	9.70E-08	0	3.70E-11	9.70E-12	0.0
Cs-137	2.21E-02	5.80E-03	5,801	2.21E-06	5.80E-07	0.6
Eu-152	3.95E-07	1.04E-07	0	3.95E-07	1.04E-07	0.1
Eu-154	2.35E-05	6.17E-06	6	2.35E-05	6.17E-06	6.2
Eu-155	9.33E-06	2.44E-06	2	9.33E-06	2.44E-06	2.4
Pm-147	1.34E-05	3.51E-06	4	1.34E-05	3.51E-06	3.5
Pr-144	1.04E-10	2.72E-11	0	1.04E-10	2.72E-11	0.0
Ni-63	6.97E-06	1.83E-06	2	6.97E-06	1.83E-06	1.8
Ru-106	8.35E-09	2.19E-09	0	8.35E-09	2.19E-09	0.0
Sb-125	4.98E-06	1.31E-06	1	4.98E-06	1.31E-06	1.3
Sm-151	6.82E-05	1.79E-05	18	6.82E-05	1.79E-05	17.9
Sr-90	6.30E-03	1.65E-03	1,651	6.30E-06	1.65E-06	1.7
Tc-99	3.51E-04	9.20E-05	92	3.51E-04	9.20E-05	92.0
Y-90	6.30E-03	1.65E-03	1,651	6.30E-06	1.65E-06	1.7

H-3	0	0	0	0	0	0.0
I-129	2.50E-04	6.55E-05	66	2.50E-04	6.55E-05	65.5

3.2.4 Radiation Levels

Calculations were performed (Peterson 2000) for both cases considered for grout. For these calculations, the grout was assumed to be in a 55-gal drum. However, the results are relevant for the 71-gal drums as well. For the grout containers to be contact handled, the blowdown must be processed to remove cesium.

Table 11. Radiological characteristics of grout.

Grout	Heat Generation watts	Contact mR/hr	1 meter mR/hr	2 meter mR/hr	3 meter mR/hr
Treated	1.9 E-4	2.6	0.18	0.06	0.03
Untreated	3.4 E-3	460	33	10	5

3.2.5 Disposal Site

Using the rule-of-thumb 20 times the leaching requirement, Table 12 shows that the only element of concern for meeting Land Disposal Restrictions (LDR) is mercury. Therefore, although not shown as part of the process, a packed bed of GAC may be needed downstream of the CsIX unit to remove elemental and oxidized mercury before the scrubber blowdown is grouted. The grouted waste is <100 nCi/g TRU and can be disposed of at Hanford.

Table 12. Grout TCLP expectations.

Species	Blowdown Concentration	Grout Concentration	Rule-of-Thumb	Regulatory Requirements (TCLP mg/L)	
				RCRA	UTS
Ag	7.03E-04	0.20	0.01	5	0.14
As	6.34E-04	0.18	0.01	5	5
Ba	9.88E-04	0.28	0.01	100	21
Cd	6.85E-02	20	0.98	1	1.22
Cr(+3)	3.35E-02	9.6	0.48	5	0.11
Hg	3.61E-01	103	5.17	0.2	0.025
Pb	2.66E-02	7.6	0.38	5	0.75
Se	4.37E-03	3.7	0.19	1	0.16

3.3 LLW—Ion Exchange Zeolite

3.3.1 Chemical/Physical Properties

UOP IONSIV® IE-95 and A-51 are alkali metal alumino silicate ion exchange media. IE-95 is a Cesium specific zeolite; A-51 is Strontium specific. IONSIV® IE-95 has a capacity of 2.0-2.5 meq/gm in its anhydrous state. The capacity for IONSIV® A-51 is 5.0-5.5 meq/gm. Both zeolites are available in 20 × 50-mesh form. According to Universal Oil Products (UOP), the selectivity of IONSIV® IE-95, in order of increased preference is:

Li<Na<Ca<Cs

The selectivity of IONSIV® A-51 is:

Cs<Li<Rb<K<Na

Mg<Na<Ca<Sr

For IE-95, a Decontamination Factor (DF) of 10^4 for cesium is expected with 5 bed volumes per hour. The DF for strontium is 10^3 . Since A-51 is strontium specific, an overall DF of 10^4 is conservatively expected for strontium. Since IONSIV® IE-95 and A-51 are non-organic ion exchange media, they do not degrade in a high radiation field. Table 13 shows the calculated volumes of ion exchange material needed to remove all Na, Ca, and Cs ions assuming 2.0 meq/gm for IE-95 and to remove K, Na, Mg, Ca, and Sr ions assuming 5.0 meq/gm for A-51. The actual volume of ion exchange material that will be needed by the process must be determined by laboratory experimentation.

Table 13. Volume of ion exchange media IE-95 and A-51.

	Concentration (moles/liter)	Moles in IX Column (moles)	Meq	Grams	Volume m ³
UOP IONSIV IE-95					
Li	None	None	None		
Na	1.84E-01	1947	1,946,837	973,419	0.314
Ca	6.25E-03	66	66,021	33,010	0.011
Cs	3.40E-06	0	36	18	5.78E-06
UOP IONSIV A-51					
K	2.06E-02	217	217,366	43,473	0.014
Na	1.84E-01	1947	1,946,837	389,367	0.126
Mg	2.11E-04	2	2,229	446	1.44E-04
Ca	6.25E-03	66	66,021	13,204	0.004
Sr	3.24E-07	0	3	1	2.21E-07

3.3.2 Radiological Composition

Cesium and strontium (with daughter products Ba-137m and Y-90) are the radionuclides of concern in the zeolite. Of these, the controlling radionuclide is Cs-137 based on the gamma radiating nuclides. For cesium ion exchange, the non-radioactive Cs⁺² ion and the long-lived Cs-135 have the highest concentrations. Based on the capacity of IE-95, only about 67 grams of material would be needed to remove the cesium. However, additional IE-95 is required to remove the cations for which it has a lesser affinity.

Table 14. Amount of cesium and strontium in ion exchange media.

Radionuclide	Half-Life (year)	Activity Constant (1/year)	Activity (Ci/liter)	Curies in IX Column Ci	Conc. (moles/liter)	Moles in IX Column (moles)	Meq
Cs ⁺²	NA	NA	None	None	6.40E-6	0.068	68
Cs-134	2.05	0.34	1.23E-05	0.13	7.05E-11	7.4E-7	0.001
Cs-135	3,000,000	2.3E-7	3.38E-07	0.004	2.84E-6	0.030	30
Cs-137	30.23	0.023	2.02E-02	213	1.71E-6	0.018	18
Ba-137m	NA	NA	1.91E-02	202	1.62E-6	0.017	17
Sr-90	20.1	0.345	5.76E-03	61	3.24E-7	0.003	3
Y-90			5.76E-03	61	3.24E-7	0.003	3

3.3.3 Disposal Site

The ion exchange media will be vitrified in the SBW melter at the completion of the processing of SBW. Both of the alkali metal alumino silicate ion exchange media are compatible with the frit used for SBW. Additional testing is required to determine the exact vitrification formula.

3.4 LLW – Activated Carbon

A sulfur impregnated, activated carbon is used to remove elemental mercury from the off-gas. For this study, MERSORB[®] by NUCON International, Inc. was the product considered.

3.4.1 Physical and Chemical Properties

MERSORB[®] is available in extruded pellets of uniform diameter of 1.5 mm, 3 mm, or 4 mm with a bulk density of about 34 lb/ft³. The surface area of the carbon is 1,000 m² per gram. The sulfur content is 13 wt% and the adsorbent has a capacity of at least 20 wt% mercury. Typical gas contact time is 10 seconds to reduce mercury concentrations to less than 1 microgram Hg/Nm³. To meet MACT requirements, the mercury concentration in the gas leaving the stack must be reduced to 40 µg/dscm. The concentration of mercury in the off-gas to the GAC is about 200,000 µg/dscm, as shown in Table 15. Therefore, a DF of about 4,000 is required.

Table 15. Off-gas compositions.

	Off-Gas to GAC Beds 1465 sm ³ /hr		Dry Basis 754 sm ³ /hr		Flow Rate	
	sm ³ /hr	% by mole	sm ³ /hr	% by mole	gm/hr	µg/dscm
CO ₂	6,731	11.2%	6,731	21.8%	296,221	392,800,000
CO	9.9	0.017%	9.9	0.032%	278	400,000
H ₂ O(g)	29,030	48.5%			0	0
N ₂	23,144	38.7%	23,144	75.1%	648,336	859,600,000

NO	40	0.067%	40	0.13%	1,201	1,600,000
NO ₂	1.1	0.0019%	1.1	0.0037%	53	100,000
O ₂	591	0.99%	591	1.9%	18,913	25,100,000
HF	9.4	0.016%	9.4	0.030%	188	200,000
HCl	6.3	0.011%	6.3	0.021%	231	300,000
Ar	282	0.47%	282	0.91%	18,035	23,900,000
SO ₂	8.5	0.014%	8.5	0.028%	1,709	2,300,000
Hg(g)	0.8	0.0013%	0.8	0.0024%	152	200,000
	59,853	100.00%	30,823	100%		

3.4.2 Radiological Considerations

The MERSORB[®] packed bed columns are downstream of the off-gas scrub system and the HEPA filters. I-129 is present in the off-gas at a concentration of 4.58E-08 Ci/sm³. Some of the radioactive iodine will be adsorbed by the GAC. The GAC is expected to be contact-handled mixed waste.

3.4.3 Disposal Site

The GAC can be treated and disposed of by a commercial radioactive waste contractor, such as Envirocare.

3.5 Wastewater

Wastewater from the Vitrification Facility will be spent cooling water from the chillers and condensate from the steam plant. This water can be disposed of in the new perk ponds. Steam demand for the facility is 27,000 lb/hr as discussed in Section 8.6.2. During the winter months, this results in 3,240 gal per hour of steam condensate. To cool the off-gas in the knockout drum, treated water is used. To condense about 1,050 liters per hour of water from the off-gas, about 4,600 gpm are used, assuming a 60°F rise in water temperature. Some cooling may be required for the mixing tanks when sugar is added to the SBW. Reaction between the sugar and nitric acid is minimal as long as the temperature of the solution is at room temperature. Cooling jackets are provided around the mixing tanks. Peak demand for cooling the mixing tanks should not exceed 1,000 gal per hour. Therefore, the maximum flow of wastewater will be about 9,000 gal per hour (150 gpm). This is a small portion of the anticipated capacity of the new INTEC percolation ponds.

4. PROCESS DESCRIPTION

4.1 SBW Feed System

4.1.1 SBW Feed

The SBW is currently stored in tanks at the TFF at INTEC. For the material balance calculations, a composite waste stream is used. There are approximately 3.8 million liters of SBW to be treated. The composition for SBW used for the feasibility study comes from Valles et al. (1999), to be consistent with other treatment studies and is shown in Table 16. The undissolved solids (UDS) in the SBW are not filtered, but are fed into the melter with the liquid portion.

Table 16. Composition of SBW.

Species	moles/lit	Species	Ci/liter	Species	Ci/liter
Ag+1	2.95E-05	Am-241	5.26E-04	Ba-137m	4.46E-02
Al+3	6.52E-01	Am-243	2.12E-07	Ce-144	8.67E-10
As+3	7.74E-05	Cm-242	1.60E-08	Co-60	6.26E-05
B+3	2.04E-02	Cm-244	1.76E-05	Cs-134	9.96E-06
Ba+2	6.58E-05	Np-237	1.85E-06	Cs-135	9.07E-07
Ca+2	5.65E-02	Pu-238	9.71E-04	Cs-137	4.72E-02
Cd+2	5.53E-03	Pu-239	7.69E-05	Eu-152	3.30E-06
Cl-1	3.15E-02	Pu-240	2.19E-05	Eu-154	1.95E-04
Cr+3	5.77E-03	Pu-241	4.37E-04	Eu-155	7.79E-05
Cs+1	9.110E-06	Pu-242	1.64E-08	Pm-147	1.12E-04
F-1	9.810E-02	Th-230	4.60E-10	Ni-63	5.82E-05
Fe+3	2.400E-02	U-232	2.27E-09	Ru-106	1.34E-08
H+1	2.120E+00	U-233	7.58E-12	Sb-125	9.19E-06
Hg+2	1.820E-03	U-234	1.12E-06	Sm-151	5.70E-04
K+1	1.870E-01	U-235	2.90E-08	Sr-90	3.68E-02
Mn+2	1.45E-02	U-236	5.43E-08	Tc-99	1.75E-05
Mo+6	7.42E-04	U-238	2.91E-08	Y-90	3.68E-02
Na+1	1.68E+00				
Ni+2	2.39E-03				
NO3-1	6.09E+00				
Pb+2	1.15E-03				
PO4-3	7.72E-03				
Se+4	1.55E-05				
SO4-2	4.41E-02				
Zr+4	1.43E-02				
U+4	2.23E-03				
H-3	3.67E-05				
I-129	1.45E-07				
H2O	47.28				
UDS	0.63				
TOC	0.45				

The SBW will be stored in a 30,000-gal tank in the new Vitrification Facility. The SBW is not filtered. A recirculating pump is used to keep the UDS in suspension in the SBW feed tank. The material handling scheme for SBW is presented on drawing SBW01.

4.1.2 Flow Rate

Steam jets are used to remove liquid from the SBW tanks in the INTEC TFF. The steam jets are capable of removing 50 gpm (11,000 liters per hour) of the liquid waste.

4.1.3 Piping

The piping used will be 304 Stainless Steel to be compatible with the existing TFF piping. Line class AR (as defined by Appendix M of AE Standard) is used. The plan is to connect to the existing TFF piping at a valve box. Underground double encased piping will connect the TFF piping to the Vitrification Facility.

4.1.4 Pumps

A pump will be used to maintain the flow of SBW from the TFF up into the SBW storage tank in the Vitrification Facility. The pump will drive the liquid about 30 ft to the top of the storage tank.

4.1.5 Storage Tanks

The unheated storage tank is made from 316 stainless steel, as are the SBW tanks in the TFF. The tank is 30,000 gal to provide a 12-day reserve of waste for processing.

4.2 SBW/Frit/Sugar Mixing

4.2.1 Frit Feed

A commercial frit is used for making glass in the melter. Experiments by Applied Technology and Clemson University have determined that this mixture of frit is suitable for vitrification of SBW (Table 17). The input frit material handling scheme is presented on drawing SBW01.

Table 17. Frit composition.

Species	Weight Fraction
B ₂ O ₃	0.143
Li ₂ O	0.027
SiO ₂	0.686
TiO ₂	0.031
Fe ₂ O ₃	0.113

Frit is packaged in supersack soft-sided containers. The containers are transported to the site in bulk transport and offloaded to unheated covered interim storage. When needed, a supersack is transported to the facility and loaded to the supersack hopper where the bag is punctured and the frit conveyed to a bin. The bin has one of two frit system isolation gates to preclude back flow of contaminants. At no time are both isolation gates open. The first isolation gate is opened intermittently

and frit is allowed to flow into the weigh conveyor where it is conveyed to an auger feeder bin. The weigh conveyor will provide accumulated mass flow data. The weigh conveyor drops a measured batch of frit to an auger feeder hopper and the isolation gate is closed. A second isolation gate is located at the exit of the auger feeder. When this gate is opened, the auger feeder activates and pushes frit to the entrance of a one-to-two diverter. This diverter diverts the flow to either of two more one-to-two diverters. The second level of one-to-two diverters then diverts the flow to one of four mix tanks. This system provides 1 to 4 flow diversion with two isolation gates. The flow transport is mainly by gravity. The transport piping also has an isolation valve at the entrance to each mix tank.

4.2.2 Sugar Feed

Sugar in the form of sucrose, $C_{12}H_{22}O_{11}$, is added to the SBW and frit to create reducing conditions in the melt. Section 4.2.2.1 shows the reactions with sugar and HNO_3 that are expected. The addition of sugar appears to facilitate the nitrate decomposition reactions. Addition of sugar has been observed to reduce foaming and decrease melt time. The material handling scheme for sugar is presented on drawing SBW01.

4.2.2.1 Sugar Reactions. R. R. Kimmitt has compiled the following list of possible reactions for sugar, sucrose, and components of SBW. It is assumed that each reaction predominates in the given temperature range.

Below 120°C

120 – 170°C

170 – 350°C

350 – 600°C

Above 600°C

Notes:

1. About 99% of all NO_3^- can be accounted for in the reactions above. It is assumed that nitrate salts of other metals (Ni, Cr, and Cd) account for the remainder.

2. The reactions shown above are not the only ones possible. For example, nitric acid can react as follows in concentrated form:

The reactions shown above that form CO are assumed to be the aggregate of possible reactions.

3. It has been observed that the addition of activated carbon to the SBW-frit mixture results in a significant increase in melt rate. One possible reason for this is that it facilitates nitrate decomposition. Because of the very large amount of nitrate in the SBW, it is likely that nitrate salts must decompose to produce glass-forming species (K_2O , Na_2O , Al_2O_3 , etc.). Nitrate decomposition reactions then become rate limiting. Sugar causes such reactions to occur more easily, possibly at lower temperatures.

4.2.3 Mixing Tanks

The plant includes four 5,000-gal mix tanks. The tanks provide a means for batching and sampling and adjustment of batch mixture for process control. The 20,000 gal capacity (four 5,000-gal tanks) provides 2–3 day workoff storage with a 6-day sample and analysis feedback timeframe. The mixing tanks consist of a vertical cylindrical tank with a cone bottom and a dome top. Inputs to the tank include SBW liquid, frit, sugar, recycled materials including scrub solution sludge blowdown, CsIX material, and grout decon wash water. The sugar initiates an exothermic reaction with the SBW nitric acid and therefore the tanks are cooled to maintain temperature. Also, input of SBW and sugar can be controlled to maintain reactions within limits. The tanks are vented to the melter system to siphon off NO_x -laden fumes. The mixture in the tank is a slurry, therefore the tanks are continuously agitated via a motor driven top mounted paddle mixer and also agitated via pumped heel recirculation. A nominal 5-10% heel is maintained in the tank. A controlled bleed from the heel recirculation provides the input stream to the feed tanks. Plumbing is also provided to pump off the heel and empty the tank. High and low sample lines are provided for process control. The mixing tank scheme is presented on drawing SBW01.

4.2.4 Feed Tanks

The feed tanks are duplicates of the mix tanks with the following differences. Once the slurry enters the feed tanks, the slurry is destined for the melter as process certified feed material. The tanks have a mix tank feed input and a vent output at the top as well as the top mounted paddle mixer. The tanks are also agitated via a recycled heel and provide for top and bottom sampling. The feed tanks are heated to initiate evaporation of water to lessen the effects on the melter. The feed tank scheme is presented on drawing SBW01.

4.2.5 Pumps

The main feed pumps are positive displacement progressing cavity variable speed pumps capable of pumping slurry and controlling the rate of flow. The assumption is that the mix and feed tanks generate and maintain a homogeneous mixture with little variation.

4.2.6 Piping

Piping in the system will be designed for pressure, pressure drop, flow rate, and materials compatibility according to the characteristics of the fluid being transferred at the specific locations within

the system (temperature, composition, pH, abrasiveness, etc.). The use of double-walled piping will be used where necessary for lifetime and containment requirements.

The feed stream initially is a nitrate rich feed in conjunction with variable amounts of halogens (chlorides and fluorides). The nitrates in the original high concentration states are passivators for the stainless steels and benefit the stainless materials issues. The vitrification process with multistage combustion is a denitrating process and therefore the effects of the halogens (chlorides) become more relevant as the nitrate concentrations are reduced. The end result is a materials selection problem where increased margins of safety are required for material compatibility through the process. The increased chloride levels will dictate higher margin material selections (e.g. Nitronic 50) for the low-temperature piping and components. As the temperature is increased to high temperatures, stress corrosion cracking issues become a driving design factor. For the higher temperature components that see reduced nitrates and increased chlorides (halogens), additional margin for materials is desired. For these conditions, Hastelloy C22 or Inconel 625 are the preferred base materials.

4.3 Vitrification Unit

4.3.1 Melter

A joule-heated melter, similar to those used successfully at the Defense Waste Processing Facility (DWPF) at SRS and WVDP, is selected for the Vitrification Facility (see Figure 1). Joule-heated melters heat the glass by passing a current through the molten glass. The internal electrical resistance of glass causes the molten glass to generate heat like the filament of a light bulb. This is joule heating. Joule-heated melters are the most mature melter technology in use in the United States today, having been used in actual plant operations and having undergone years of testing. The operating life of joule-heated melters has been demonstrated to be up to 4 to 5 years between changeouts. The assumption is that this technology will allow the Vitrification Facility to complete the SBW processing campaign SBW without a melter change.

Other types of melter technology are currently used throughout the world. Induction melters are widely used in France. However, induction melters have not been tested or used that have the production capacity required for processing SBW in 2 years. Multiple melter units would be required, complicating the design and increasing the size of the facility. Induction melters that have been used in plants in France and England have had variable melter life before changeout is required. This would require that a melter changeout be planned for (but possibly not used) after 1 year of processing to cover that uncertainty. Induction melters offer some specific advantages in that the heat source is externally provided (via induction); this advantage also tends to limit use of induction melters due to size and scale.

Other types of melter technologies are emerging throughout the world for use in the process, mineral, metals, and waste treatment industries. These include both alternating current (AC), direct current (DC), hybrid, and specialty type units. For the purposes of this report, the joule-heated borosilicate glass type melter is considered the base case due to the known capabilities and accumulated quantity of information available within the DOE system. Alternate or emerging melter technologies may provide some advantages; however, any advantages would be considered unproven for this report.

4.3.2 Melter Operation

The melter will operate at a nominal glass temperature of 1150°C. The Vitrification Facility melter will have a melt surface area of approximately 3 m². The volume of glass within the melter will be approximately 2,500 liters. The melter will be lined with K-3 refractory with Inconel 690 electrodes. Power to the melter electrodes will be approximately 160kW @ 50 Vac.

Figure 1. West Valley waste vitrification system.

The melter will also be equipped with plenum heaters. These heaters will be used to start the melter and to boost the evaporation of the water and nitric acid in the feed. The plenum heaters will require approximately 210 kW. The vitrification melter scheme is presented on drawing SBW02.

Based on the operation of the DWPF at SRS, the inflow of air to the melter will be about 200 scm/hr.

4.3.3 Feed Inlet

The feed inlet to the melter will be a vertical piping arrangement located at the melter head. The feed stream will flow through the inlet and drop vertically to the melt surface. Special attention will be given to the geometry, materials, and operating conditions of the feed inlet to ensure reliable operations. Special precautions such as redundant inlets, inlet flushing devices, and monitoring instrumentation may be installed to ensure reliability.

4.3.4 Glass Taps

Redundant primary glass taps will be installed on the melter for primary tapping of the glass product into the glass canisters. The tappers and tapper-to-canister interfaces will incorporate lessons

learned and design improvements from similar proven designs utilized at DOE West Valley and Savannah River plants or other radioactive glass production plants around the world. The primary tappers are assumed to be side mounted siphon weir underflow/overflow taps with vacuum assist and auxiliary tapper heaters.

One bottom drain tap will be installed with its own dedicated canister for draining the melter for melter replacement or plant end-of-life decontamination and decommissioning. The bottom drain tap is assumed to be a solidified plug type with integral cooling and tap heating.

4.4 Off-Gas System

4.4.1 Multi-stage Combustor

Note: This section contains non-proprietary vendor information obtained from the John Zink Company, Tulsa Oklahoma (Rawlins 1997).

Off-gas from the melter will be high in NO_x , water vapor, and CO. The off-gas will also contain halogen contaminants chlorine and fluorine as well as mercury vapor and other unknown toxic or heavy metals. The off-gas is treated by secondary thermal treatment prior to entering the off-gas cleansing system. The secondary thermal treatment consists of a three-stage combustion process. The first stage consists of high-temperature ($1,220^\circ\text{C}$ [$2,200^\circ\text{F}$]) treatment under reducing conditions for 2 seconds residence time. The first stage utilizes a fuel-fired burner to maintain temperature and auxiliary injected fuel to maintain reducing conditions. The goal for the first stage is to strip off the oxygen from the NO_x and reduce it to N_2 . Mercury compounds such as HgO and HgCl_2 will be dissociated into elemental mercury vapor. The halogens (chlorine and fluorine) will pass through the first stage in the gaseous state. The exit temperature is a control parameter, and the gas residence time is a design parameter. The offgas leaving stage 1 is monitored for combustion products for feedback to control schemes (see Figure 2).

Figure 2. Multistage combustor process flow diagram (top) and process illustration.

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In the second stage, the off-gas is partially quenched to a temperature below the auto-ignition temperature of the gas (nominally 1,550°F) in a water (steam) injected partial quench section. The exit temperature is a control parameter for regulating the amount of cooling water (steam) injected.

Stage three is controlled to complete the combustion of CO and H₂ in the off-gas while minimizing NO_x reformation. This is accomplished via injecting air to initiate auto-ignition of the gases, CO and H₂. The temperature in the third stage tends to float and is established by the combustion of the gas. The air injected is controlled to minimize excess oxygen to 2-3% of that needed for complete combustion. The goal is to provide an N₂ exit gas stream with minimal NO_x. The residence time and/or mixing in stage three may need to be increased to ensure sufficient margin for reaction dynamics and oxidation with operations under low excess air (oxygen) conditions. Halogens (chlorine and fluorine) and mercury will pass through the third stage in the gaseous state.

The melter and multi-stage combustion process off-gas handling scheme is presented on drawing SBW02. Table 18 presents the effects of multi-stage combustion on off-gas compositions.

4.4.2 Quench

Note: This section contains information obtained from preliminary studies for the WERF incinerator MACT upgrade project (Option 4) 1998, and non-proprietary vendor information obtained from MeltTran Inc. Idaho Falls, ID (Rawlins 1997).

The quencher is termed a "full wet quencher" and consists of a corrosion-resistant, non-lined metal tube with two or more water injection nozzles. Water is injected into the gas stream under pressure at sufficient flow to ensure a complete quenching action. The quencher reduces the temperature of the off-gas coming out of the third stage of the combustor from >1540°F to a temperature of approximately 180°F – 185°F.

Table 18. Multi-stage combustor gas compositions.

Gas Component	Melter Off-Gas		Stage One		Stage Two		Stage Three	
	Mole Fraction	scm/hr	Mole Fraction	scm/hr	Mole Fraction	scm/hr	Mole Fraction	scm/hr
CO ₂	0.06855	76	0.11289	149	0.09112	149	0.09099	165
CO	0	0	0.01231	16	0.00993	16	0.00013	0
H ₂ O(g)	0.58152	645	0.53082	699	0.62132	1014	0.58330	1056
N ₂	0.25778	286	0.30754	405	0.24822	405	0.31287	566
NO	0.02524	28	0.00074	0.98	0.00060	0.98	0.00054	0.98
NO ₂	0.02524	28	0.00002	0.03	0.00002	0.03	0.00002	0.03
O ₂	0.03789	42	0	0	0	0	0.00799	14
HF	0.00023	0.25	0.00019	0.25	0.00015	0.25	0.00014	0.25
HCl	0.00015	0.17	0.00013	0.17	0.00010	0.17	0.00009	0.17
Ar	0.00329	3.64	0.00366	4.82	0.00295	4.82	0.00381	6.89
SO ₂	0.00008	0.09	0.00007	0.09	0.00006	0.09	0.00012	0.21
Hg(g)	0.00002	0.02	0.00001	0.02	0.00001	0.02	0.00001	0.02
H ₂	0	0	0.03153	42	0.02545	42	0	0
H ₂ S	0	0	0.00009	0.11	0.00007	0.11	0	0

Mercury is not oxidized at room temperatures but is slowly oxidized when heated to form HgO (Neberghall, Schmidt, and Holtzclaw 1976). To prevent the recombination of Hg and O₂ in the off-gas from the multi-stage combustion denitrator, an immediate water quench is used to quickly cool the gas to minimize Hg oxidation. The rapid cooling will also minimize the potential re-formation of dioxins/furans from pre-cursors while transitioning through the temperature range of 400 – 800°F. This action will tend to remove large particulates from the stream to the quench water and act as a first stage of offgas cleaning. A dry particulate removal system is not used since it would increase the available reaction time between elemental mercury and oxygen and for the formation of dioxin/furan. The off-gas quench scheme is presented on drawing SBW02.

4.4.3 Venturi Scrubber

The baseline off-gas scrubber utilized in the feasibility study is the venturi scrubber. The venturi scrubber removes particulates and strips soluble gases by forcing interaction of the gas stream with the scrub water through pressure drop across the venturi and injection of scrub water at an injection stream pressure. The goal is to cause as much interaction as possible between the scrub liquid and the gas stream. Figure 3 presents a graph of scrubber efficiency vs. particle diameter. The baseline scrubber uses a 10-in. water differential pressure drop across the venturi. The off-gas scrubber scheme is presented on drawing SBW02.

Figure 3. Particulate removal equipment efficiencies.

4.4.4 Mist Eliminator/Knockout Drum

The mist eliminator and knockout drum are combined as one piece of equipment. The off-gas enters the side of the vessel through a rough mist eliminator mesh, which removes liquid entrained by the venturi scrubber. The off-gas in the vessel is chilled from 80 to 71°C (176–160°F) with treated water to condense water. A second mist eliminator mesh collects the condensate. Approximately 1,040 liters/hr are condensed from the off-gas: about 810 liters/hr will be used as makeup water for the venturi scrub and 230 liters/hr will be used in the second stage of the multi-stage combustor as quench water.

The temperature of the treated water used for cooling increases from 13 to 46°C (55 to 115°F) in the knockout drum. The rate of cooling water required is 77 gpm (17,500 liter/hr).

4.4.5 Off-Gas Heater

The off-gas leaving the demister will be heated to approximately 101°C (214°F), an increase of 30°C (128°F) to prevent water from condensing in the downstream HEPA filters and GAC beds. An in-line 24 kw electrical heater will be used. The temperature of the off-gas exiting from the HEPA filters controls the heater. The outlet temperature must be maintained above the dewpoint of the gas stream.

4.4.6 HEPA Filters

The gas stream flows through a HEPA filter bank. The bank consists of four rows by two HEPA filters in series and each preceded by a prefilter. This allows one row of filters to be taken off-line for changeout. The individual HEPA filters have DOP test ports between the filters for testing the installed condition of the filters. The HEPA filters are standard 24 × 24-in. filter with a nominal capacity of 1,000 cfm. The capacity of the bank is then about 3,000 cfm. The HEPA bank incorporates a deluge water system for fire protection. The process off-gas HEPA filter and activated gas handling scheme is presented on drawing SBW03.

4.4.7 Activated Carbon/Sulfur Absorbent

After the HEPA filter bank, the GAC beds (sulfur impregnated) remove elemental mercury from the off-gas. There are three GAC beds in the system: one is used as the primary bed, a second is used as a polishing bed, while the third is in reserve or being changed out. When the primary bed is saturated it is taken out of service for GAC replacement. The polishing bed becomes the primary bed and the reserve bed becomes the polishing bed.

The current plan for mercury recovery is to send the GAC to an outside contractor (such as Envirocare) for mercury recovery and disposal. Potential methods for activated carbon handling include spent carbon bulk material transfer out of the storage tanks using dry granular material handling techniques with bulk material transfer of new activated carbon into the tanks. Alternate methods include replacing the entire spent tank with a new tank and with refill and recycle of the tank from a treatment vendor. The process off-gas HEPA filter and activated gas handling scheme is presented on drawing SBW03.

4.5 Scrubber Wastewater

There are two scrubber tanks in the scrubber system. The flow of scrub water is from cleaner to dirtier to optimize the use of the water. Relatively clean water is used for the venturi scrub. The wastewater from the venturi scrub is used as makeup water for the quench, which is the initial cleaning component.

The 2,000-gal scrub tank provides water to the venturi scrubber and makeup water for the quench tank. It receives water from the mist eliminator/knockout drum and return liquid from the venturi scrubber. Fresh makeup water can also be added.

The 2,000-gal quench tank provides chilled water to the quench tower. A recycle/blowdown stream is drawn from the quench tank into a 1,000-gal settling tank. Makeup water from the scrub tank and water from the quench tower are returned to the quench tank.

The off-gas liquid scrub cleanup and grouting scheme is presented on drawing SBW04.

4.5.1 Scrub Recycle

Approximately 35 liters per hour is drawn from the bottom of the settling tank to be added to the mixing tanks. Particulates, which have been scrubbed from the off-gas, settle to the bottom of the tank and are recycled. Mercury particles or soluble compounds in the quench are recycled to elemental mercury in the melter and multi-stage combustor. This ensures that almost all of the mercury in the system is elemental and removed by the GAC.

Since 3.3% of the cesium is expected to volatilize in the melter, the recycle returns most of the escaped cesium to the vitrified glass.

4.5.2 Scrub Blowdown

About 1.5 liter per hour of scrub water is removed from the settling tank as blowdown. This liquid is taken from the middle of the tank to minimize particulate entrainment. The liquid passes through a prefilter to remove any entrained particulate. An ion exchange system using alkali metal alumino silicate ion exchange media (Section 3.3) is used to remove cesium and strontium from the blowdown. The effluent is then stored in a 2,000-gal tank for a grouting campaign.

4.6 Grout Liquid Waste

The grout system utilizes a grout pre-mix blend procured based on sample analysis of the effluent storage tank. Then, the effluent is combined with the pre-mixed grout in a mixer and transferred to 71-gal drums. The calculated radiation levels of the effluent are of the order of 3 mrem/hr and are <100nCi/g TRU. Therefore, the effluent and grout mix operations can be a hands-on operation and the disposition assumption is as contact-handled LLW.

5. SAMPLING STRATEGY

5.1 Waste Form Qualification

The Waste Form Qualification (WFQ) strategy to be used will depend on where the waste forms will be sent. If it is ruled that SBW is not high-level waste, the glass will be disposed of at WIPP. If SBW is ruled to be high-level waste, the glass will be disposed of at the Yucca Mountain repository. The drums of grout are contacted handled and will be sent to WIPP if the grout waste form contains more than 100 nCi/g TRU, or some other waste site (e.g. Hanford) if less than 100 nCi/g TRU. However, because the final disposition of the waste is not known, the waste form qualification and sampling requirements address and meet the requirement for both options.

For either of the disposal options, the basic Waste Form Qualification (WFQ) strategy will be similar to that utilized at the Defense Waste Processing Facility (DWPF) at Savannah River Site and the West Valley Demonstration Project. This WFQ strategy is based on the concept that a well-defined and controlled feed stream processed through a well-defined and controlled treatment process will produce a qualified waste form. This qualified waste form will not need to be sampled or tested except on a very limited basis during operation.

The relationship between process control and waste form qualification overlap and are intimately related. The sampling requirements for process control are more extensive than is required for WFQ regardless of the disposal option. Sampling of the glass as it is going into the canister for process control or waste form qualifications is unrealistic. If the glass or grout is found to be out of specification (WFQ or process control specifications), there is little that can be done to recycle or bring the glass back into specification.

The process for implementing this WFQ strategy entails the following major tasks:

Development of a qualified waste form compositional envelope- A range or envelope of waste form compositions for both the glass and grout waste forms will be developed. Laboratory testing will be conducted of melter feed (waste, frit, and sugar) and grout feed that will produce an acceptable waste form if processed within acceptable melter operating parameters. The envelope will be as large as possible to account for variations in SBW composition, analytical uncertainties, and process variation while still ensuring that the waste form produced will meet WFQ requirement. If the glass is to be sent to WIPP, the limits on the compositional range may be extended to increase waste loading in the glass. This compositional work should be conducted in laboratory testing as soon as possible and be refined during full-scale and facility testing.

Development testing, nonradioactive facility testing, and radioactive facility testing for process qualification - The treatment process will be qualified so that when a qualified feed is added to the treatment process and is operated within established parameters, the glass produced will be acceptable. Establishment of these parameters will begin in laboratory tests at various scales ranging from bench to full-scale. Testing will confirm and establish which parameters must be controlled and what variation is acceptable. Once the facility is constructed, nonradioactive facility testing will be conducted. This nonradioactive testing will confirm laboratory testing, begin the documentation of the process, and start facility system operability testing. Non-radioactive testing will be followed by radioactive testing and system operability. During testing, additional sampling (including sampling of the final waste form) will be conducted that will not be needed during operations. These samples, along with process documentation, will be used to qualify the process.

Operational Control and Documentation – Once a qualified compositional envelope and process are established, facility operations will be conducted so that no waste is processed outside of these boundaries. An example of the types of operational controls that must be followed is that no melter feed is moved into the melter feed tanks or to the melter until all analytical data confirms that the melter feed is within the qualified compositional envelope. The analytical data for the feeds to the melter and grout mixer will be documented along with the process parameters used to treat. This combined data package will be the waste form qualification documentation equivalent to actual sampling and analysis of the waste form. Limited glass and grout samples will be taken during facility operation (approximately once every four-six months) to confirm that the process is performing as expected.

5.2 Regulatory Requirements

If the waste is to be sent to WIPP, the treatment systems used for the vitrification of the SBW and the secondary wastes from the vitrification process will be required to comply with regulations under the Resource Conservation and Recovery Act (RCRA) subject to the RCRA statutory exclusions applicable for WIPP. WIPP is excluded from the LDR standards by the Land Withdrawal Act. In addition, the system will have to comply with those regulation promulgated under the MACT program (Rawlins 1997) for all deposal options.

Permit testing is required under RCRA. The testing process must be structured to show that the facility design and operation will be protective of human health and the environment. Unless a different decision is made at a later date, any of these facilities would be regulated as "Miscellaneous Units" under 40 CFR 264 Subpart X. This part sets standards for activities such as inspections, testing and maintenance of equipment, and corrective actions. Specific permit testing requirements for miscellaneous units are stated in 40 CFR 270.23. Basically, any treatment unit must demonstrate the effectiveness of treatment, based on the results of laboratory or field data. Permit testing involves characterization of feed and all primary and secondary waste products, including solids, liquids, and gases. Permit testing for this facility would be similar to trial burn testing for DOE incinerators to verify compliance with the MACT standards (Rawlins 1997).

Applicable Federal and State air pollution regulations deal with releases of hazardous and toxic air pollutants from the treatment operations. The EPA requires air permit testing as described in 40 CFR 60 Subpart A (New Stationary Source Performance Standards). However, if incinerator standards are applied as suggested above, federal regulations do not require air permit testing for sources with waste feed rates below 45 tons per day (40 CFR 60 Subpart B). This facility would be below this waste feed rate.

The EPA also sets release limits for contaminants it defines as hazardous air pollutants (HAPs). The general regulations covering emissions of these species are covered in 40 CFR 61, Subpart A. Specific testing and standards that apply to incinerators are included in 40 CFR 61 Subpart C (beryllium).

The State of Idaho regulates the air emissions of a variety of materials in its HWMA regulations 16.01.05.004 (40 CFR 260) through 16.01.05.012 (40 CFR 270). The regulated materials are called toxic air pollutants, and specific allowable emissions rates are listed. Permit testing will have to demonstrate compliance with those emissions limits.

One test plan should only be required to meet the regulations. This plan would be part of the laboratory, nonradioactive, and radioactive testing to be conducted as part of the waste form qualification and system operability test. No additional sampling equipment will be required for this testing, but some additional types of samples and analyses will be required.

5.3 Sample Locations and Matrix

The locations of each sampling station are shown in the process flow diagram found in Appendix G and are identified as “Sx” points where x is the sample location number. Each sampling station is numbered. The sampling matrix shown in Table 19 lists the sampling points by number and location, the type of sample, handling requirements, sampling frequency, the type of analysis to be conducted, how the results will be used, and if the samples are routine or for start-up testing.

Table 19. Sampling matrix.

Sample ID No.	Location	Sample Type	Handling	Frequency	Analysis	Utilization			Start-up	Operation
						Process Control	WFO ^a	Regulatory Compliance		
1	Frit Storage Bins	Dry powder	CH	3/Lot	Oxides	X	Y		X	X
2	Sugar Storage Bins/Tanks	Thick fluid	CH	3/shipment	TOC	X	Y		X	X
SBW Work-OFF Storage Tank										
3	Top	Agitated Liquid/Slurry	RH	3/Batch	Radionuclides, Elemental ^b , organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y	X	X	
4	Bottom	Agitated Liquid/Slurry	RH	3/Batch	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y	X	X	X
Mixing Tank #1										
5	Top	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	
6	Bottom	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	X
Mixing Tank #2										
7	Top	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	
8	Bottom	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	X
Mixing Tank #3										
9	Top	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	
10	Bottom	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	X
Mixing Tank #4										
11	Top	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	
12	Bottom	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	X
Feed Tank #1										
13	Top	Agitated Liquid/Slurry	RH	1/Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	

Table 19. (continued).

Sample ID No.	Location	Sample Type	Handling	Frequency	Analysis	Utilization			Start-up	Operation
						Process Control	WFO ^a	Regulatory Compliance		
14	Bottom	Agitated Liquid/Slurry	RH	1/ Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	
Feed Tank #2										
15	Top	Agitated Liquid/Slurry	RH	1/ Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	
16	Bottom	Agitated Liquid/Slurry	RH	1/ Batch	Radionuclides, Frit, Sugar, elemental, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	Y		X	
17	Canister Glass	Glass	RH	Startup 1/feed tank. Operations - 1/ 6 months	Radionuclide, Elemental	X	Y		X	
18	Kerosene Storage Tank	Liquid	CH	1/ shipment	THC	X			X	X
19	Quench Tanks Bottom	Agitated Liquid/Slurry	RH	1/feed tank	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X			X	
20	Scrub Tank	Agitated Liquid/Slurry	RH	1/feed tank	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X			X	X
21	Caustic Tank	Liquid	CH	1/ Caustic tank		X			X	X
Settling Tank										
22	Top	Agitated Liquid/Slurry	RH	1/Tank fill	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	W		X	
23	Bottom	Agitated Liquid/Slurry	RH	1/Tank fill	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	W		X	X
24	CSIX Effluent Storage Tank	Liquid	CH	1/Tank	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	W	X	X	X
25	Grout Pre-Mix Storage	Dry powder	CH	3/Lot	Pre-mix components	X	W		X	X
26	Grout Cure Rate Chemical Storage	Liquid	CH	3/Lot	TBD	X	W		X	X
27	Decon Chemical Storage	Liquid	CH	3 Shipment	TBD	X			X	X
28	Mixer Wash Tank	Liquid	CH	1/ Tank	TBD	X			X	X
29	Mixer Decon Waste Water Tank	Liquid	CH	1/Tank	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²				X	

Table 19. (continued).

Sample ID No.	Location	Sample Type	Handling	Frequency	Analysis	Utilization			Start-up	Operation
						Process Control	WFO ^a	Regulatory Compliance		
30	Grout Mix	Wet Grout	CH	Startup 1/ batch of drums. Operations -1/ 6 months	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻²	X	W		X	
31	Grout Drum Smear	Smear Patch	CH	3/Drum	Alpha and Beta-Gamma surface contamination	X	W		X	X
	Dry Grout	Dry Grout	CH	1/ 6 months	Radionuclides, Elemental, organics, pH, NO ₃ ⁻¹ , PO ₄ ⁻³ , SO ₄ ⁻² , free liquid,	X			X	
	Process Stack									
32	Continuous Emissions Monitors	Off-gas, CEM	CH	Continuous	Hg			X	X	X
33	Continuous Emissions Monitor	Off-gas, CEM	CH	Continuous	In-situ Particulate Matter			X	X	X
34	Continuous Emissions Monitor	Off-gas, CEM	CH	Continuous	O ₂ , Total Hydrocarbon (THC), CO, CO ₂ , NO _x , HCl	X		X	X	X
35	Iso Kinetic Sampler	Off-gas	CH	3/batch	POHC ^c 1, 2, 3, Radionuclide, Volatile Organics, Dioxins/Furans, Hg			X	X	
Glass Canister										
36	Canister Leak Check	Canister weld	RH	1/Canister	He	X	W		X	X
37	Glass Canister Smear	Smear Patch	RH	3/canister	Alpha and Beta-Gamma surface contamination	X	X		X	X

a) Y indicates for Yucca Mtn. only, W for WIPP only, and X for both

b) Elemental includes Ag, Al, As, B, Ba, Ca, Cd, Cr, Cs, Fe, Halogens, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Se

c) POHC Principle Organic Hazardous Constituent

5.4 Sampling Hardware

The following describes the sampling hardware to be used. Where possible, the sampling hardware and description that are recommended in Adams et al. (1999) were used. This was done to reduce duplication of efforts and to provide for a more common basis for a cost estimate. Table 20 summarizes the different samples taken at each sampling station, the type of samples, and the equipment required.

Sample station 1 is for dry glass frit delivered to the Vitrification Facility. Samples of the frit are necessary to confirm that the correct frit chemistry has been delivered. The samples are manually withdrawn from within the bulk delivered frit using a D-tube sampler. The handles are first positioned 180 degrees apart to open the sample probe. The probe is then pushed into the glass frit to the depth desired, and each handle is rotated 90 degrees to close and lock a frit sample in the probe. The probe is then withdrawn from the frit and opened in a sample can.

Sample station 2 is to sample the Sugar storage tank. The sugar will be in the form of a thick molasses fluid. Samples are necessary to confirm the composition and concentration of the sugar solution. The sampling system consists of a manual valve located off the pump piping to allow for recirculation of the syrup before sampling.

Sampling stations 3–5 are for the SBW work-off tank, mixing tanks, and feed tanks. The generic liquid collection sample station consists of a shield window, a pair of master slave manipulators, a sampling table, a portable liquid sample skid with flexible hoses, a double door seal transfer system, quick disconnect fittings and piping to and from the tanks to be sampled, pneumatic and electric controls, and a decon service piping and controls. Most of these items are in use at various nuclear facilities.

Pipes run from near the bottom and top of each tank to quick disconnect fittings located on the top of the sample table. The inlet flexible hose from the sample skid is connected a quick disconnect fitting from one of the tanks. The outlet flexible hose is connected to the other tank fitting. The pump circulates agitated liquid from the tank, past the sampler, and back to the tank. The samples are taken after the sufficient circulation is established. By switching the connections, samples can be drawn from near the top and bottom of the tank. Before the connections are made with the quick disconnects for the next tank, the skid lines can be flushed with water. The flush water is piped to a drain tank.

The sample skid consists of a section of 1-in. pipe with an electrically powered centrifugal slurry pump and a liquid sampler similar to the type marketed by Bristol Equipment Company. The skid inlet pipe is connected to a quick connect fitting for the location on the tank where samples will be taken (the top or bottom). The outlet skid pipe is connected to a quick connect fitting for the other location on the tank that will act as the slurry return line. When the pump is energized, a continuous slurry stream is drawn through the piping. The Bristol-type sampler is mounted transverse to the continuous slurry stream. The sampler is a double-acting pneumatic cylinder that inserts a hollow probe into the slurry stream in a direction transverse to the slurry pipe. When the cylinder is retracted, a small amount of slurry is entrained with it, which automatically drains into a 500-ml sample container. The sampler is operated by a pneumatic valve located outside of the cell. This valve can be manually actuated, or actuated automatically by a program that takes samples at predetermined times. The skid can be easily moved for maintenance or replacement.

After the sample container has been filled, the master slave manipulator removes the sample bottle, seals it, and places it in the shielded can located in the transfer port.

Table 20. Sample stations.

Sample Station Number	Sample ID Number	System	Sample Type	Handling	Items required
1	1	Frit Storage Bins	dry powder	CH	Manual D-Tube sampler
2	2	Sugar Storage Tanks	Thick Fluid	CH	Manual Valve off pump piping
3	3-4	SBW Work-off Tank	Agitated Liquid/Slurry	RH	Pump/liquid sampler skid Sample table Flex hoses Quick disconnect ports Sampler control system (air) Pump motor control Shield window Master-slave manipulator Sample transfer system
4	5-8, 13, 14	Mixing Tanks 1 & 2, Feed Tank 1	Agitated Liquid/Slurry	RH	Pump/liquid sampler skid Sample table Flex hoses Quick disconnect ports Sampler control system (air) Pump motor control Shield window Master-slave manipulator Sample transfer system
5	9-12, 15, 16	Mixing Tanks 3 & 4, Feed Tank 2	Agitated Liquid/Slurry	RH	Pump/liquid sampler skid Sample table Flex hoses Quick disconnect ports Sampler control system (air) Pump motor control Shield window Master-slave manipulator Sample transfer system
6	17	Canister Glass	Glass	RH	Shield window Master-slave manipulator Sample transfer system Sample Can
7	18	Kerosene Storage Tank	Liquid	CH	Manual Valve off pump piping
8	19-22	Quench, Scrub, and Settling Tanks	Agitated Liquid/Slurry	RH	Pump/liquid sampler skid Sample table Flex hoses Quick disconnect ports Sampler control system (air) Pump motor control Shield window Master-slave manipulator Sample transfer system
9	24	CSIX Effluent Storage Tank	Liquid	TBD	TBD depending on RH or CH
10	25	Grout Pre-Mix Storage	Dry powder	CH	Manual D-Tube sampler

Table 20. (continued).

Sample Station Number	Sample ID Number	System	Sample Type	Handling	Items required
11	26	Grout Cure Rate Chemical Storage	Liquid	CH	Manual sampling prior to addition to the tank.
12	27	Decon Chemical Storage	Liquid	CH	Manual valve on tank
	28	Mixer Wash Tank	Liquid	CH	Manual valve on tank
	29	Mixer Decon Waste Water Tank	Liquid	CH	Manual valve on tank
13	30	Grout Mixer	Wet Grout	CH	Sample Table Grout piping/valving Water flush system
	31	Grout Drum Smear	Smear patch	CH	Manual sampling
		Dry Grout	Dry Grout	CH	Manual sampling
14	32-34	Process Stack	Gas	CH	Continuous Emissions Monitors – O2 (paramagnetism)
15	35	Process Stack	Gas	CH	Iso Kinetic Sampler
16	36	Canister Leak Check	Gas	RH	He Leak Check
	37	Glass Canister Smears	Smear Patch	RH	DWPF type smear sample system Swipe pass through system Rotating crane system

Sample station 6 will sample vitrified glass product. The samples will be taken in the canister turntable. The sample station consists of a shield window, a pair of master/slave manipulators, and a transfer system. The overhead crane will place a sample can in the top neck of a standard SRS canister and position the canister in the canister lifting mechanism. The lifting mechanism will raise the canister and sample can to the glass filling position. A glass sample will be poured into the sample can and the canister will be lowered. The overhead crane will remove the can and place it on the sample station table where the manipulators will pass the sample can out to the cell using the double-door seal transfer system. The can and sample will then be delivered to the analytical laboratory for analysis.

Sample station 7 will sample the kerosene used in the NOxidizer. The sampling system consist of a manual valve located off the pump piping to allow for recirculation of the kerosene prior to sampling.

Sample station 8 will collect samples from the Quench, Scrub, and Settling tanks. The sampling hardware is the same as used in sampling stations 3–5 listed above.

Sample station 9 will collect the CsIX effluent storage tanks. The hardware to collect this liquid sample has not been identified and depends on if the liquid is contact handled.

Sample station 10 is used to collect samples of the grout Premix as it is delivered to the facility. Samples of the pre-mixed grout are necessary to confirm that the correct mix chemistry has been delivered. The samples are manually withdrawn from within the bulk-delivered frit using a D-tube sampler identical to sample station 1.

Sampling Stations 11 and 12 will sample the liquids in the Decon chemical storage, mixer wash, and mixer decon waste water tanks. Sample will be take from manual valves located on the tanks.

Sample station 13 will sample the wet grout samples from the grout mixer. The sample station consists of glovebox access, a sampling table, a double-door seal transfer system, a pneumatically operated diaphragm sludge pump, grout piping and valving from the evaporator bottoms grout mixer, a can filling station, flush water system for the grout piping, and a grout flush drain.

The sample is taken after the grout valve is opened and the pump is energized. When the sample can is filled, the glove box is used to remove, seal, and place it in the can located in the double-door seal transfer port. The can is removed and delivered to the analytical laboratory for analysis. The piping must be flushed with water prior to the grout hardening. This is done by opening the grout valve and the water flush line. The flushed grout is drained into the existing holding tank used to flush the mixer. A check valve in the piping near the mixer prevents sample flush water from entering the mixer.

Sample stations 14 and 15 are for off-gas samples taken from the facility process stack. Sample station 14 is for the continuous emissions monitors (CEM) via a shrouded probe. The CEMs Sample station 15 if for an isokinetic sampler. The station consists of a commercial sampler and a tubing run placed in parallel with the isokinetic sampler pump. The gas sampler has a three-way valve that is manually actuated to fill the sample bomb with stack off-gas and isolate the sample. The sample bomb uses quick disconnects for installation and removal. Once the sample is taken, the bomb is manually removed and sent the analytical laboratory for analysis. The sample station will be located in the isokinetic sampler panel adjacent to the stack.

Sampling station 16 is for surface smear samples taken from the exterior of the glass canisters that are used to hold the vitrified glass product. The canisters are 2 ft in diameter and 10 ft long. The samples will be taken in the smear cell. The sample system consists of a shield window, a pair of long-reach master-slave manipulators, a canister elevating/rotating mechanism, a manipulator support stand, a pneumatic transport system with shielded radiation counter, a sample tray passthrough system, and an operator platform. The manipulators, canister elevating/rotating mechanism, manipulator support system, and pneumatic transport system with shielded radiation counter are similar in design to those used at Savannah River Site (SRS) in the DWPF smear cell. DWPF drawings W752328 through W752332 are arrangement views of the DWPF smear cell with the smear station equipment. The DWPF smear cell takes smears of SRS canisters identical to those that will be used in this facility. The canister will be placed in the elevating/rotating mechanism by the existing overhead crane located in the smear cell. Each long-reach manipulator, equipped with a smear pad, can be placed at one of three sampling locations in the manipulator support stand. The canister is elevated and rotated as necessary to smear the proper area. The smear pad is then deposited in the pneumatic transport pipe and transported to a shielded counter just outside the cell. After counting, the pad is returned to the cell, removed from the transport system and placed in a used-smear-pad shielded can. When the can is full, it is passed through port and is discarded as LLW. The passthrough port is also used to deliver fresh pads to the cell. The operator platform provides proper height for correct operation of the manual manipulators.

5.5 Changes in Sampling and Analysis for WIPP

If it is determined that the SBW glass will be sent to WIPP instead of Yucca Mountain, the sampling requirements changes are note in Table 19 but change little. Most of the sampling and analyses that are being done is also required for process control and other regulatory requirements such as MACT. However, there are a few specific sampling and analysis changes that will need to be met.

The following changes to existing sampling and analyses will be required for disposal at WIPP:

- The canister leak check will not be required, as all WIPP containers must be vented.
- The weight of the canister will need to be determined, but this could be calculated from the fill height of glass in the canister.
- The removable surface contamination requirements for both alpha (<20 dpm/100cm²) and beta-gamma (<200 dpm/100cm²) are an order of magnitude lower for WIPP than is required in the WA-SRD draft Rev.4.

The following additional samples or analyses will be required for disposal at WIPP:

- Radiation dose rates of the canister at the surface and at 2 meters will need to be measured. This could be done at the same time surface contamination swipes are taken.
- The canister headspace gas must be sampled for volatile organic compounds (VOC). As there are no VOC in the glass, waiver could be applied for to remove this requirement. If no waiver could be obtained, sampling could be conducted through the vent that must be placed in each canister. However, the draft RH-TRU WAC allows for process knowledge to minimize exposure to workers to radiation. Process knowledge may allow for a waiver of this requirement.

6. REMOTE SYSTEMS

6.1 Remote Handling and Operations

The SBW Vitrification Facility will be designed for remote handling operations for those processes and tasks that cannot be provided by a direct hands-on approach due to high radiation fields and/or high contamination areas. The basic approach will be to have the Vitrification Facility divided into a canyon and remote service corridor (RSC) configuration for the purposes of remote maintenance activities.

The canyon approach will be used for those large vessels and equipment that typically have long intervals between maintenance actions (5–10 years). These items will be located in a concrete shielded enclosure structure that is accessed by shielded hatch covers when maintenance activities are required. An overhead crane located in the maintenance area above the hatches will access the hatch covers. Due to processing requirements, the four 5,000-gal mixing tanks and the two 5,000-gal melter feed tanks will require mechanical mixers (stirrers) to be located on top of the vessels. These mechanical mixers along with at least some of the tank instrumentation may require periodic (maintenance intervals of less than 5–10 years). To accommodate this requirement, remote maintenance activities will be performed using the facility overhead crane located in the maintenance area above the shield blocks (hatch covers) to pull these units and provide access. An overhead electro-mechanical manipulator (PaR) would also be provided above the hatch covers for use in remote maintenance activities in conjunction with the overhead crane. The overhead PaR along with the overhead crane would be used to remotely disconnect (aided by strategically placed video cameras) the stirrers or instrumentation equipment for repair or replacement activities. During the time that hatch cover(s) over the canyon area have been removed for maintenance and/or repair activities, the ventilation systems serving this area would have to accommodate sufficient air flow to maintain a negative pressure versus the maintenance area above the hatches.

Before remote removal of equipment such as stirrers from the canyon area, tanks contents would likely be emptied and preliminary decon operations carried out within the vessel to remove as much of the high-level radioactive constituents as practical. When removing the equipment, such as a stirrer, bagging or sleeving would be required upon lifting the unit into the maintenance area above the canyon. Once "contained," the equipment would be moved to the decon cell area and lowered down via an access provided by a shielded hatch cover. The decon cell hatch cover would also be handled by the overhead facility crane in the maintenance area. Once in the decon cell, further decontamination efforts would be carried out on the unit to allow hands-on maintenance or repair if practicable. If existing equipment is not repairable, then disposition as rad waste will be required and new equipment will be installed remotely in the canyon area. Personnel entrance points into the canyon area would need to be provided for D&D activities and for those times that remote maintenance would not be practical. Segregation of tank vessels into separate cells within the canyon area would be provided to lessen the amount of tank content removal and decontamination activities required prior to personnel entry in order to reduce the rad fields to reasonable levels in accordance with ALARA principles.

The RSC approach will be used for those pieces of equipment requiring remote maintenance and/or remote replacement at intervals less than 10 years and that can be located away from the actual vessels being served by this particular equipment. The type of equipment that typically would be located in the RSC are valves, pumps, and some of the instrumentation that can be located away from the tank vessels located in the canyon area. The basic concept will be to use the 3-bolt flange system currently in use at INTEC for remotely maintainable piping assemblies, commonly known as "jumpers." The "jumper" interfaces with vertical, wall-mounted flanges of corresponding size to complete the piping circuit for a given section of piping function. The "jumper" contains the particular piece of equipment such as valve, pump, or instrument that requires more frequent maintenance or replacement.

In the RSC approach, jumper assemblies with the included piece of equipment (e.g., pump, valve, instrument) will be removed from service by a remotely operated, in-cell crane and a wall-mounted electro-mechanical (PaR) manipulator. These units will be teleoperated by personnel viewing directly through shielding windows and as needed by strategically placed video camera(s) in the corridor. This approach allows the failed equipment component to be readily removed from service, remotely moved to the decon cell area for decontamination, and then placed in the hands-on maintenance area for direct contact repair or replacement. Some equipment may be remotely repaired in the decon cell through the use of master-slave manipulators located in this area of the Vitrification Facility. It should be noted that with proper design and/or modification, some maintenance and repair activities might be carried out directly in the RSC with the aid of in-cell crane and PaR manipulator.

Personnel located in the "operating" corridor would control the in-cell crane and manipulator located in the RSC. This operation would be via portable control consoles that can be moved from station to station at strategically located shielded viewing windows. Operation of the in-cell crane and manipulator could be "passed" from one control console to another via appropriate control interlocks. Provisions for personnel entrance into the RSC would need to be provided for final decontamination and decommissioning (D&D) activities as well as any non-routine hands-on maintenance activities.

In the RSC approach, jumper assemblies with the included piece of equipment (e.g., pump, valve, instrument) will be remotely removed from service by teleoperated, in-cell (in-the corridor) crane and electro-mechanical (PaR) manipulator. These units will be teleoperated by personnel viewing directly through shielding windows and as needed by strategically placed video camera(s) in the corridor. This approach allows the failed equipment component to be readily removed from service, remotely moved to the decon cell area for decontamination, and then placed in the hands-on maintenance area for direct contact repair or replacement. Some equipment may be remotely repaired in the decon cell through the use of master-slave manipulators located in this area of the Vitrification Facility. It should be noted that with proper design and/or modification, some maintenance and repair activities may be carried out directly in the RSC with the aid of in-cell crane and manipulator.

6.2 Remote Maintenance Philosophy and Systems

6.2.1 Remote Maintenance Philosophy

The SBW Vitrification Facility design will provide for remote replacement of highly radioactive contaminated process equipment, which past experience has shown to be prone to failure. Equipment such as tanks and vessels that have anticipated maintenance intervals of greater than 10 years will be designed for hands-on maintenance after proper decontamination steps have been taken.

The terms "remote maintenance" and "remote replacement" are generally used interchangeably. Items requiring maintenance at the SBW Vitrification Facility will be remotely removed from service and decontaminated. Then, hands-on maintenance will be performed.

6.2.2 Remote Maintenance Systems

6.2.2.1 Component Configuration and Essential Features for Remote Maintenance.

The features of the SBW Vitrification Facility that will provide the remote handling capabilities of the facility include the following:

- RSC - A shielded and enclosed area designed and equipped to provide remote handling and replacement for those items that must be isolated from the main process cells due to their

high maintenance frequency and radiation hazard. Features required for direct maintenance will also be provided.

- Manipulator/Crane Parking and Maintenance Areas - Shielded areas designed for maintenance of major in-cell remote handling equipment. These areas will have the capability of being isolated and shielded from the RSC during maintenance operations and will permit isolation of the major remote handling equipment from the high radiation and contamination areas when the equipment is not being used.
- Remotely Operated Manipulators – Electro-Mechanical manipulators with extended reach and intermediate handling capability that can be controlled (teleoperated) from a number of locations in the operating corridor.
- Remotely Operated Cranes – Conventional cranes for lifting and transporting heavy items inside the shielded areas of the facility operated (teleoperated) from control stations adjacent to shielded viewing windows with control transferable from one station to another.
- Master-Slave Manipulators – Mechanical arms directly operated by personnel located at viewing stations when highly dexterous remote manipulation is required. NOTE: Certain models of master-slave manipulators have an electrical interface and are not strictly mechanical; therefore, force feedback is not provided on those models.
- Shielded Viewing Windows – Stations that permit direct viewing of operational areas inside the shielded cells while providing proper protection for operating personnel.
- Remotely Replaceable Lighting – Removable lighting units which provide adequate lighting in the shielded areas. Lighting units may be replaced using remote handling equipment.
- Filtered Exhaust Ventilation - A remotely changeable system designed to achieve maximum contamination control by filtering cubicle and corridor ventilation air at its exhaust point. Provisions for increased airflow during hatch removal will be provided. The preferred approach is the top-loading filter system for handling the changeout.
- Smear Cell – A dedicated shielded cell for taking smears and minor decontamination work on the canisters after decontamination efforts have been carried out in the decon cell located in the basement area of the facility. This is the final checkpoint for verifying that canister surface contamination levels meet the requirements for transport to the interim storage facility. This cell will be equipped with master-slave manipulators, shielding windows, and a small overhead bridge crane that is remotely (teleoperated) operated for handling and surveying the canisters.
- Decontamination Cell - A shielded area for decontamination, packaging, and transfer of failed equipment to other waste disposal facilities/areas. This area will be served with master-slave manipulators and a rotary turntable.
- Hands-on Maintenance (Repair) Area – A minimally shielded area for manual repair of decontaminated equipment.

The following will also be provided to permit in-cell remote handling operations and to reduce operator exposure:

- Permanently located lifting devices and scaffolding to aid in direct or remote maintenance operations
- Tool ports, in-cell tool racks, and tables
- Decontamination system for external and internal equipment surfaces as well as cell surfaces
- Quick-disconnect piping connections/remote 3-bolt flange system with captive bolts
- Controlled entry for personnel access
- Remotely controlled video-viewing systems
- Stainless steel lining for the inside of high contamination areas as appropriate to facilitate decontamination
- Remote maintenance service stations with remote connectors for utilities needed inside the shielded areas, including air, fluids (water, decontamination solutions) electric and video.

6.2.2.2 Equipment Items. High-maintenance equipment items include valves, pumps, heat exchangers, cell, vessel off-gas HEPA filters, and instrumentation. These items will be grouped into common shielded areas and the areas provided with remote equipment, (e.g., cranes, manipulators, and viewing windows). The remote areas must also be adequately illuminated with remotely replaceable lights, remote maintenance service stations (RMSS), tool-drop ports, tool storage areas, and worktables. Closed circuit video capability will also be provided if supplemental viewing is required.

Equipment that is not prone to failure such as tanks, vessels, columns, and airlifts will also be located in shielded cells, but the cells will not be equipped to permit easy remote replacement of these items. Rather, maintenance of these items will be hands-on. These areas will be equipped for maintenance access and equipment removal without interference from adjacent equipment. Permanently installed working platforms with ladders for maintenance access will be considered on a case-by-case basis. Although certain equipment items are identified as hands-on maintenance items, to reduce operator exposure remote features such as quick-disconnects, remote flanges, captive bolts, and lifting bales may be incorporated into their design if such features are determined to be cost effective. The purpose of these features is twofold: (a) to permit potential hands-on maintenance activities to proceed more rapidly, and (b) to permit remote or partially remote (i.e., overhead crane and overhead manipulator) operations to take place if the radiation fields are expected to be excessively high.

"Skyrights" will be provided to ensure equipment accessibility with overhead equipment. In addition, visibility, accessibility, and interferences must be considered during facility design. Center-of-gravity lifting bails will be provided on all remotely removable process equipment (e.g., valves). Remotely removable valves, pumps, instrumentation, and other equipment will be installed on self-aligning jumper assemblies in a remotely maintained service corridor to enhance remote removal and replacement.

Throughout the facility, remote concepts and equipment must be "proven" technology. Development items and unproven state-of-the-art items will not be included in the production facility unless the concepts/equipment can be proven by demonstration before incorporation. Remote tooling and equipment provisions must be maintained as practical, straightforward, and simple as possible. Standardization (sizes, shapes, arrangement) will also be maximized.

To provide remote handling in the SBW Vitrification Facility, certain remote capabilities are required:

- The capability for viewing and remotely transferring radioactive items and materials as required to maintain personnel radiation exposures to as-low-as-reasonably achievable levels.
- Remote process equipment will be accessible for ease of operation and maintenance.
- All in-cell mechanical and electrical equipment (windows, video equipment, manipulators, electrical enclosures, etc.) will be sealed or otherwise protected from penetration of corrosive solutions and gases.
- In-cell lights for remote cells will be designed for remote replacement.
- Provision will be made for tool storage and worktables as required.
- Closed circuit video will be provided for supplemental viewing with both fixed and movable in-cell support assemblies as necessary.
- Ladders, piping and platforms will provide minimum interference with equipment replacement and will be remotely removable where necessary.
- Remote cell cranes and manipulators will be equipped with retrieval systems. Remote cell cranes will be equipped with remote load lowering devices.
- To ensure maximum ease and efficiency of remote maintenance of jumpers, inspection ports and equipment, each operation will be defined and described in detail. Exact location of remote flanges, bolts and other disconnect devices relative to manipulator operation and viewing will be studied in front, top and side views to verify impact wrench clearances, equipment installation, removal clearances, and potential interference problems.
- Clearances for standard operation and removal of master-slave manipulators will be provided.
- Decontamination capability will include remotely controlled sprays and wash-down techniques.
- Remote connectors, bolts, flanges, wrenches, sockets, extensions, and other tooling should be standardized to the extent possible to reduce the need for wrench changes and varied operating envelopes during equipment replacement.
- Equipment will be movable, maintainable and replaceable without disturbing adjacent equipment whenever possible.
- Design of in-cell equipment supports and concrete embedments will consider possible retrofit of alternate process equipment.
- Equipment components and subsystems will be of modular design, if feasible, to facilitate removal and replacement.

- All remotely serviced equipment will be checked for dimensional fit and proper operation prior to installation.

6.2.2.3 Facility Requirements. To accommodate remote requirements, the SBW Vitrification Facility building will include the following requirements:

- Incorporation of embedments for viewing windows and master-slave manipulators (where applicable).
- Ceiling hatch access to all cells.
- Incorporation of a bridge crane and electro-mechanical manipulator in the RSC area.
- Labyrinth cell entryways with utility maintenance service stations (UMSS).^c
- A sufficient number of crane and electro-mechanical manipulator control station outlets will be adjacent to viewing windows and other operating locations to permit unrestricted remote operation.
- Sufficient clearances will be provided both ends of all master-slave manipulators to permit unrestricted movement and easy removal and replacement of the arms. Manipulator counterweight motions must also be considered.
- Dedicated shielded areas, which can be isolated from any radioactive sources, will be provided for parking/maintenance in-cell cranes and electro-mechanical manipulators, to permit decontamination and hands-on maintenance.

6.2.2.4 Operational Requirements. An RSC will be near those processing areas where radiation exposure and radiological hazards justifies the additional facility cost. Failure-prone equipment will be located within this corridor. Basic equipment and process design will minimize the total amount of maintenance that will be required. When maintenance or vessel inspection is required, the facility design will provide features that will reduce radiation exposure to personnel. The operational features of such philosophy will include both remote and direct capabilities.

Some of the operational features of this philosophy would include the following remote capabilities:

- Draining and flushing capabilities of all equipment that can contain process solutions. Remote replacement of failed equipment.
- Transporting tools, failed equipment, and/or HEPA filters to a shielded decontamination, packaging, and transfer area.
- Packaging of contaminated items in an area separate from the maintenance area and preparing for transport to a specified decontamination area.
- Maintenance of radiation and contamination control at all times.

c. A centralized grouping of selected utilities located in process cell entryways that will be available for use during cells entries

- Arrangements of equipment to facilitate remote and direct maintenance operations.
- Collection of decontamination and process solutions for recycle to salvage or waste disposal collection systems.
- Remote replacement of exhaust HEPA filters for the melter and corridor/canyon off-gas systems in the service corridor, if required.
- Adequate lighting, viewing, and utility systems to support remote handling and replacement operations.

6.2.2.5 Remote Equipment. Standard remote handling equipment will include master-slave manipulators, wall-mounted electro-mechanical manipulators, bridge-mounted electro-mechanical manipulators, bridge cranes, and jib cranes, etc. The primary usage of this equipment will be for remote maintenance and remote handling activities. All in-cell remote handling equipment will be provided with redundant features and retrieval systems to minimize the effect of failures.

Shielded viewing windows will provide unrestricted viewing of remote operations, and will provide additional viewing angles from adjacent windows. Remote operating and maintenance tasks will be located within the normal viewing angle of the windows. Remotely replaceable hot-side shields will be provided for the viewing windows where necessary.

6.3 Mockups

All critical SBW Vitrification Facility remote equipment, and major remote operations, will be mocked up in full scale and tested before design completion and procurement. Mockups will include mechanical equipment, remote handling equipment, viewing, and cell sizes and arrangements. Items being checked will include accessibility, interference, visibility, maintainability, operability, transfer routes, and lifting mechanisms and devices.

6.3.1 Maintenance Requirements

The facility will be designed to provide for repair or replacement of any process component while minimizing personnel radiation or contamination exposures, maintenance cost, and downtime. All mechanical equipment, windows, video cameras, and other equipment in potentially radioactive or contamination areas will be sealed or otherwise designed to prevent penetration by contaminated and/or decontamination solutions. Materials such as plastics and insulation that degrade in radiation or high-temperature environments will be excluded whenever possible. If used, they will be encased and shielded or otherwise protected from excessive radiation exposure and/or heat. These materials will be installed for periodic inspection and replacement.

The maintenance philosophy for radioactive process equipment in the SBW Vitrification Facility will be to replace high-maintenance items such as pumps and valves. These components will be isolated from the system (if required), uncoupled from the system, and removed to a decontamination area. The repaired or replacement component will then be reinstalled and returned to service. In selected cases, spare components will be available for service. Direct contact maintenance will be used for items that are not expected to fail more than once every 10 years and in areas where the component can be decontaminated with resultant expected radiation levels to be minimal.

Equipment will be designed to permit decontamination, inspection, replacement, and/or repair with minimum radiation exposure to personnel. Cells will have provisions for visual inspection or radiation

monitoring without exposing the inspector to radiation or contamination hazards. Access ports for transfer of small tools and equipment will be provided in areas requiring remote replacement or repair operations. RMSS will be located in selected remote maintenance cells and will be equipped with remote connectors for electrical, video, air and water utilities.

6.3.2 Remote Equipment Change/Cut-up/Disposal Scenarios

Equipment in the RSC that requires routine changeout will be able to be connected & disconnected, handled, and moved remotely. The basic philosophy for a typical jumper changeout would involve the use of an in-cell, wall-mount, electro-mechanical manipulator and in-cell bridge crane to remove the defective jumper from the RSC and transport it to the decontamination cell. These areas need to be accessible to each other and arranged to afford adequate crane coverage to perform initial decontamination activities. The crane maintenance and decontamination areas allow movement of equipment from higher contamination /rad-level environments to that of a lower level environment. After a jumper is repaired in the hands-on maintenance room and surveyed to be clean, this unit may then be transported to a clean storage area for reuse.

A jumper storage room will also be provided for clean and/or refurbished jumpers to be stored for future replacements of defective process jumpers. Jumpers would be re-introduced into the RSC by way of the air lock for the grout cell into the hands-on maintenance cell and finally on into the RSC. The crane maintenance area (CMA), decontamination cell, and hands-on maintenance area will be provided with shield doors to allow isolation between successive areas.

The philosophy will be to use a single wall-mount manipulator in the RSC. The RSC will also have a small bridge crane running the full length, including into the maintenance areas. This crane will be used to bring routine maintenance equipment into the RSC and move defective equipment into the decontamination (decon) cell area for the cleanup and possible repair. A small teleoperated bridge crane located at right angles to the RSC crane will be provided to travel from the hands-on maintenance cell to the CMA. This crane will provide the capability to move equipment and materials from the CMA to the hands-on maintenance cell and vice-versa.

The basic philosophy will be to take contaminated equipment first to the decontamination cell, and then to the hands-on maintenance cell for repair. Remote maintenance may be conducted in the decontamination cell using master-slave manipulators to perform various repair tasks on remotely maintainable equipment without having to use the hands-on maintenance cell.

If equipment cannot be refurbished, then disposal of this material will be required. After decontaminating to appropriate levels, this equipment will be placed in proper disposal containers for transfer through the hatch cover (loadout) area. Disposal of melter cell components will require a different approach to the standard service corridor concept. A bottom loading shield type container (cask) will be used to interface with the melter cell to allow the components to be withdrawn up into this container for transport to a cutup cell and minimize the spread of contamination. The cut-up cell will include equipment for dismantling of large, failed components. A plasma torch is preferred in the cut-up cell for reducing the size of metal components to that compatible with standard loadout boxes.

The Vitrification Facility melter cell poses unique remote maintenance problems due to the amount and complexity of associated equipment located within. To adequately address remote maintenance activities, the melter cell will be equipped with an overhead crane and an overhead electro-mechanical manipulator to facilitate equipment changeout of failed components. These in-cell teleoperated remote handling units will be used in conjunction with the large overhead facility crane in the maintenance area to remove and install equipment in the melter cell.

6.4 Remote Decontamination Systems

6.4.1 Decontamination Philosophy and Operations

6.4.1.1 Components Configuration and Essential Features. The basic components for the Vitrification Facility decontamination capability shall include the items described in the following paragraphs. Materials of construction shall be resistant to radiation damage and the corrosive effects of the various decontamination solutions (e.g., oxalic, citric, tartaric, and nitric acids, and caustic solutions).

- **Decontamination Cell** – An area shall be provided, within the Vitrification Facility, to decontaminate failed process equipment. This area shall be located near the CMA and shall be equipped with remote handling capability and equipment. Remote equipment will include master-slave manipulators, an overhead bridge crane, and viewing windows. The overhead bridge crane shall traverse between the hands-on maintenance area and the CMA to provide adequate coverage of these areas and interface with the RSC crane.
- **Cell Decontamination System** – Spray nozzles and piping networks shall be designed and located throughout the SBW Vitrification Facility process cells and remote handling and replacement areas to provide adequate surface wetting and will not interfere with remote or direct maintenance activities, cell lighting or vessel removal. Special attention shall be given to ensuring sprays are directed at potential collection “dead spots” or points such as cell corners. Capability shall also be provided to “spot decon” as required using master-slave or electro-mechanical manipulators to hold and control portable spray wands.
- **Equipment/Vessel Decontamination System** – The Equipment/Vessel Decontamination System shall deliver decontamination solutions to the interior surfaces of process vessels and equipment. Where effective, these solutions shall be distributed by sprays. However, such situations will also require access and provisions for nozzle removal and replacement. Agitation for decontamination solution shall also be provided (e.g., sparges) where practical.
- **Decontamination Distribution System** – A piping system shall be provided to deliver heated decontamination solutions to process cells, remote service stations and equipment. Piping shall be insulated in normally occupied areas.
- **Decontamination Solution Makeup Area** – An area shall be provided which will be equipped with multi-purpose vessels and used for makeup of decontamination solutions. This area may be part of a cold chemical makeup area that is also used for other purposes.

6.4.1.2 Decontamination Cell. The SBW Vitrification Facility Decontamination cell will provide the equipment and services required to remove contaminants from equipment retrieved from the RSC area and canyon process cells. Remote decontamination and disassembly of the equipment will be performed to reduce the radiation level on the components to levels that will permit hands-on maintenance. Small waste items shall be removed through a shielded loadout port; larger items shall be transferred to the hands-on maintenance cell for loading into a waste container, which is at ground level. This approach will facilitate final loadout via the grout cell air lock to a suitable transport vehicle. Items to consider during design include the following:

- Cleaning and decontamination techniques, materials, and equipment should be as simple as possible. Dry or damp methods are preferable to wet methods in most cases, since wet methods generate secondary waste streams that are harder to handle. Recycling and/or reuse of decontamination solutions should be practiced.

- Capability to decontaminate to hands-on level.
- Capability to remotely disassemble equipment as necessary to be able to decontaminate to a hands-on level.
- Containment of contamination and decon solutions from external areas.
- Capability to transfer equipment into and out of the cell.
- Full viewing of all decontamination operations using either windows or auxiliary viewing methods.
- Any decontamination or cleaning technique should minimize the amount of secondary waste created.
- Techniques that tend to spread contamination beyond the immediate area being cleaned should be avoided.
- The choice of techniques should accommodate a goal of no liquid discharge. All liquids should be recycled or solidified.
- The decontamination area and access points shall be sized to accommodate anticipated equipment.
- Design should allow for ease of cleanup.
- Capability to monitor equipment without cell entry by personnel.
- Provisions for cutting and packaging solid wastes for disposal.

The basis for design of the decontamination cell is to provide a shielded area where radioactive contaminants can be removed by remote operations that permit maintenance of the equipment by contact methods. The decon cell shall require shielding windows located to visually observe decon operations along with a turntable and remote handling equipment such as master-slave manipulators and an overhead crane that will permit disassembly and transport of various equipment items.

6.4.1.3 Cell and Equipment/Vessel Decontamination System. The Cell and Equipment/Vessel decontamination system shall consist of makeup and injection of heated decontamination solutions into process areas and process vessels, and a method where solutions within vessels can be recirculated. Recirculation of the decontamination solution is necessary to minimize waste generation. Recirculation capability will be provided for the 30,000-gal SBW workoff storage tank, 5,000 gal mixing tanks, and 5,000 gal feed tanks.

An area shall be designed to permit decontamination solutions to be made up in a safe and controlled manner. Equipment shall be provided to blend and heat decontamination solutions, while pumps and insulated piping shall deliver the solutions under pressure to the process areas. Curbed and stainless-steel-lined collection areas shall be provided in the makeup area to permit operators to wash down chemical spills. Emergency showers and eye wash stations shall also be located in the makeup area for personnel safety. A combination of directly and remotely controlled sprays and wipe-down techniques shall be used to decontaminate cell walls and the exterior surfaces of equipment within the RSC. The decontamination piping system shall permit spraying, flushing, and flooding the inside

surfaces of equipment in contact with radioactively contaminated process liquids and solids located in the canyon areas.

To facilitate cleanup and/or decommissioning, critically safe sumps are needed in all decontaminable areas. Either transfer jets or critically safe pumps will be installed so that decontamination solutions can be collected for sampling, recycling, and transferring to the appropriate system.

The SBW Vitrification Facility and equipment installed in the facility shall include features to reduce the duration and frequency of decontamination efforts. Experience gained from decontamination efforts in the existing INTEC facilities indicates areas for improvement that shall be incorporated into the SBW Vitrification Facility. Included are:

- “Dead” areas in vessels and piping must be eliminated to the maximum extent practical. Areas that could contribute to radiation fields (reducers, flanges, and orifices) shall not be located near the bottom of a vessel.
- Process piping or vessel construction shall not allow non-draining low points or pockets.
- Heat exchangers shall have vertical or inclined tubes.
- Vessel design shall enhance the complete removal of process and decontamination solutions and the associated undissolved solids and shall include sloped bottoms to allow free draining. Interior and exterior crevices must be excluded.
- Equipment with high failure potential shall be located in the RSC and be remotely replaceable.
- Flat plates mounted on flat surfaces on equipment located in contaminated areas (pump bases, etc.) shall be avoided. Valves shall be provided with flushing and draining capabilities, where practical.
- The RSC and canyon (cell) floor and walls shall be stainless steel lined.
- Cell floors shall be adequately sloped and a means of decontaminating sump areas included.
- Electro-polishing of component and cell liner surfaces shall be considered where cost compared to benefit is effective.
- Strippable coatings may be used in areas of frequent expected decontamination and should be considered on a case-by-case basis. Any coatings used must be compatible with waste disposal systems.

6.4.1.4 Cell and Equipment/Vessel Decontamination System Operational

Requirements. The Cell and Equipment/Vessel Decontamination System will consist of two basic operational functions: (1) to deliver heated decontamination solutions to process cells (for cell walls and external equipment and piping surfaces) and process equipment (internal surfaces) to achieve “the first cut” of gross reduction in radiation levels; (2) to continue the decontamination process without generating large volumes of radioactive waste. This will be accomplished by recycling decontamination solutions through the contaminated process equipment. This process will continue until the radiation fields are reduced to levels that will permit contact maintenance. Process areas serviced by this decontamination

system will be evaluated individually according to costs and reduction in potential radiation risks. The basic operational requirements shall be to:

- Provide tankage in a multi-purpose zone of the cold makeup area for preparing and feeding all the required decontaminating solutions to any area or equipment item in the facility requiring such service.
- Provide heating of the solutions and insulated piping for delivering heated solution to the process area or equipment item.
- Provide a remote decontamination spray system in each process cell (or separated area) which will enable thorough flushing of cell walls, ceilings, floors, and external surfaces of each piece of equipment and piping.
- Provide a system in each cell to remove solutions from the floor and process equipment; the solutions shall be transferred to the waste sampling tanks, or the waste collection tanks.
- Provide means to recirculate decontamination solutions within each piece of equipment or through portion of the process (i.e., remove from the bottom of vessel and recirculate back through the vessel inlet).
- Provide contamination control for all operational phases of the decontamination system.
- Provide for decontamination/decommissioning/closure requirements for removal of residues, contamination, and/or contaminated equipment and structures.

6.4.1.5 Personnel Decontamination. An area shall be provided on all operating levels of the facility to monitor and decontaminate personnel. This area shall contain a shower, sink and provide storage space for collecting contaminated personnel protective clothing.

7. MECHANICAL SYSTEMS

7.1 Container Fill System

7.1.1 Empty Canister Handling System

Empty containers will be transferred to the facility from storage one or two at a time by a flatbed transport truck or forklift. The canisters will be wrapped, packaged, and placed on pallets. The transport and canisters will enter the receiving truck bay and be off-loaded to the receiving area. The canisters will then be unpackaged and removed from the pallet, and again checked for QA compliance. Maintenance or receiving cleaning will be performed if necessary. A facility forklift operator will then attach a forklift-mounted special canister handling device to a canister and transfer it from the receiving area into the facility operating corridor and into the clean canister drop alcove. The forklift will be detached and the clean canister lowered through the main floor canister drop to the clean canister storage area. Once in the clean canister storage area, the storage area polar crane will be attached to the canister via a special handling tool and the canister transferred to the staging area in clean canister storage.

When a canister is required for the filling operation, it will be transferred to the canister service corridor by the clean canister storage area polar crane. This operation can occur since one of the polar crane's unique features is the rotating jib boom suspended beneath the trolley. The trolley, in turn, is located on the crane bridge, which allows excellent hook coverage within the wall boundaries and beyond through openings such as shield doors. This procedure is used to move the clean canister from the dedicated storage area out through a sliding shield door into the canister service corridor. At this point in the canister handling process, the canister service corridor overhead bridge crane engages the empty canister and transfers the unit down to the next sliding shield door area, which allows access into the canister cooling room below the melter cell. The next step is for the polar crane in the canister cooling room to reach through the sliding shield door opening and engage the empty canister for transfer into the cooling room. Once in the canister cooling room, the canister will be positioned below the melter access port location for retrieval into the melter cell by the bridge crane located in that area.

The port in the melter cell floor will be opened and the hook (with proper handling device) on the bridge crane will be lowered down into the canister cooling area to engage the empty canister and lift it into the melter cell. At this point, the melter cell bridge crane will lower the empty canister into the proper position on the melter canister turntable. Once on the turntable, the canister will be staged for turntable indexing and the melter filling operation.

7.1.2 Canister Fill System

The canister fill system consists of a remotely operated index table and a melter tapper interface shroud for the glass fill operation. For canister filling, the canister is indexed on the index table 90 degrees to the staging position. On the next index cycle, the canister is indexed another 90 degrees to the melter tapper mating position. Once located at the mating position, the tapper to canister interface shroud is remotely lowered into a mating position on the canister. A tap stream is initiated via the operation of the melter tapper and the liquid glass flows into the canister for the filling operation. When the canister is greater than 80% full as monitored by weight or thermal imaging, the canister is declared full and tapping operations ceased for subsequent canister changeout.

The melter also provides for a bottom drain tap and a dedicated drain canister. For this capability, a clean canister is transferred into the melter cell through the main floor port similar to above and loaded onto a transfer cart instead of the index table. The drain canister (cart) is then remotely relocated to position the canister below the melter drain. A tapper-to-canister interface shroud similar to the primary

fill canister system is lowered to confine the drain canister. The drain canister is provided for maintenance and end-of-life melter draining and will be used very little. Therefore, the transfer cart is dedicated to this canister.

7.1.3 Full Canister Handling System

At the determination of a full canister and cessation of tapping operations, the taper-to-canister interface shroud is retracted back to the taper and the table indexed 90 degrees for the mating of another empty canister to the tapping position. The full canister resides on the index table at the 270 degree position until the next index operation for canister changeout. The canister filling cycle is nearly 20 hours long; therefore, canister and glass cooling will be continuous from the start of tapping operations, and excessive instantaneous bulk heat will not be generated during canister filling or at the 270 degree index position of the index table. The glass will start cooling from an initial 1050 –1150°C and transition to a slower cooling rate as the overall canister temperature drops and approaches room temperature. After the second index cycle, the full canister is at the 360 degree (0 degree) initial position.

The melter cell bridge crane will then be attached to the full canister via the special handling device and the melter cell floor canister transfer port opened. The full canister will be raised, transferred horizontally to the port position and lowered through the melter floor port, back down to the canister cooling area. The melter bridge crane will then be detached, the crane hook raised and relocated to the standby position, and the melter floor port closed.

The full canister, now located in the canister (CAN) cooling area, will be engaged by the polar crane in this area and moved to position for cool down. After sufficient time has elapsed for cooling, approximately 36 hours, the canister cooling area polar crane would once again engage the full canister and transport the unit through the sliding shield door back into the canister service corridor. At this point, handling of the full canister would be transferred to the canister service corridor bridge crane for relocation underneath the weld cell access port. The bridge crane would be disconnected, the weld cell access port opened, and the weld cell bridge crane hook lowered down into the corridor to retrieve the full canister. The full canister would be raised up into the weld cell for remote welding of the canister closure lid and the access port closed. After remote welding of the closure lid has been completed and the weld has been inspected, the weld cell overhead bridge crane will once again engage the sealed, full canister and lower the unit down through a second weld cell floor access port to the canister decon cell area. Once in the canister decon cell area, the weld cell crane will disengage from the filled canister.

At this point, the sealed, full canister will undergo decontamination procedures in preparation for transfer to the canister smear cell located at the main floor elevation. After decontamination, the canister decon cell overhead crane will engage the sealed canister and move the unit to a location beneath the canister smear cell access port. The floor access port in the smear cell will be opened and the overhead bridge crane hook with engagement device in the smear cell will be lowered down into the decon cell and the filled canister retrieved up into the smear cell area. The next step is to smear the filled canister for external contamination and if determined to be at acceptable levels, prepare the canister for transport to interim storage. The overhead crane in the canister smear cell would again engage the filled canister and lower the unit down through a second floor port to the transfer tunnel area below in the basement. The canister smear cell overhead crane would be disconnected and the canister positioned by the transfer tunnel bridge crane for arrival of the transfer tunnel cart system. This cart system is the preferred method for transporting sealed, filled canisters to the interim storage complex that will be located adjacent to and supplied by others for the Vitrification Facility.

7.2 Cranes

Table 21 is a list of the cranes included in the Vitrification Facility.

Table 21. Crane list.

Item No.	Crane Description	Location
1	Overhead Facility Bridge Crane – 50 Ton with 5 Ton Auxiliary Hook - Pendant Control	Maintenance Area
2	Overhead PaR Model 6000 with Standard Control System and 50 ft Tube Extension	Maintenance Area
3	Overhead Bridge Crane – 2 Ton Teleoperated and Remote Controlled from Multiple Stations	Remote Service Corridor
4	Wall Mount PAR Model 4350 with Cimroc Control System and Multiple Remote Control Stations	Remote Service Corridor
5	Overhead Bridge Crane – 5 Ton Capacity with Pendant Control	Truck Airlock
6	Monorail Hoist – 4 ton Capacity with Pendant Control and Motorized Trolley	Main Floor – Truck Airlock
7	Overhead Polar Bridge Crane – 5 Ton Remote Controlled from Multiple Stations	Cut-up, Decon, and Hands-on Maintenance Cells
8	Overhead Bridge Crane – 5 Ton Remote Controlled from Multiple Stations	Canister Weld Cell
9	Overhead Bridge Crane – 5 Ton Remote Controlled from Multiple Stations	Canister Smear Cell
10	Overhead Bridge Crane – 5 Ton Remote Controlled from Multiple Stations	Melter Cell
11	Overhead Bridge Mount PaR Model 6350 with Cimroc Control System Remote Controlled from Multiple Stations and 45 ft Tube Extension	Melter Cell
12	Overhead Polar Bridge Crane – 2 Ton Capacity with Pendant and Single Remote Control Station	Basement – Clean Canister Storage Area
13	Overhead Polar Bridge Crane – 5 Ton Capacity Remote Controlled from Multiple Stations	Basement – Canister Cooling Cell
14	Overhead Bridge Crane – 5 Ton Capacity Remote Controlled from Multiple Stations	Basement – Canister Service Corridor
15	Overhead Bridge Crane – 5 Ton Capacity with Motorized Hook Remote Controlled from Multiple Stations	Basement – Canister Decon Cell
16	Overhead Bridge Crane – 5 Ton Capacity Remote Controlled from Multiple Stations	Basement – Canister Transfer Tunnel
17	Rail Mounted Canister Transfer Cart – 20 Ton Capacity Remote Controlled from Multiple Stations	Basement – Canister Transfer Tunnel

8. FACILITY DESCRIPTION

8.1 Civil

8.1.1 Siting

The SBW facility is sited in the northeast corner of INTEC. Installation of a direct transfer route from the SBW storage tanks WM-180, WM-181, WM-187, and WM-188 would be optimal.

Previous studies and reports describe the existing soils as consisting of gravely and sandy alluvial deposits ranging from 35 to 40 ft deep. These deposits lay over an eight-ft thick clay layer with basalt bedrock below. The groundwater is not located above the basalt elevation.

A siting study should be performed. The study will review the impacts of this facility on site utilities and the surrounding infrastructure. The study will encompass topography, existing soil conditions, subsurface rock formations, and road and structure locations both above and below ground level.

8.1.2 Physical Protection

The facility is located within the present INTEC security system and fence and will not require individual consideration for such protection.

8.1.3 Underground Utilities

Existing underground utilities shall be extended to service the SBW facility. Utilities required for the operation of the SBW include potable water, raw water, firewater, sanitary waste, power, steam, and plant air, communications including alarms, phone, voice and data. Design of potable water systems shall be in accordance with the State of Idaho Department of Health and Welfare, Idaho Regulations for Public Drinking Water Systems. Sanitary wastewater shall be routed to the INTEC sewage treatment system.

Water used in decontamination processes shall be removed by floor drains and sumps and captured in double containment while being monitored for hazardous materials, before release or disposal.

8.1.4 Site Demolition

Demolition of existing structures, abovegrade or belowgrade will be determined at final site determination and requirements.

8.1.5 Site Improvements, Pavement

Provide pavement of parking area(s) and all access and service roads to and from the proposed SBW facility. Slope all pavement away from buildings and structures at a 1% minimum slope. The design for paved roads shall conform to Idaho State Highway Standard Specifications and AASHTO HS-20 loading.

8.2 Architectural Requirements

8.2.1 General

The Architectural design shall be in accordance with the DOE-ID Architectural Engineering Standards, DOE Order 420 (replacing DOE Order 6430.1A), and the following design criteria. The facility shall have a minimum design life of 40 years.

8.2.2 Facility Layout

The SBW process area will be a multistory structure with a footprint of about 380×169 ft. The physical structure will extend 32 ft below finished grade and approximately 70 ft above finished grade.

The Administrative/Support area will be a single-story structure with a footprint of approximately 190×70 ft. This structure will be located at grade and adjacent to the SBW process area.

8.2.3 Belowgrade Features

The belowgrade area will house the canister process activities including the clean canister drop and store area, canister filling turntable and capping cell, cool down area, canister lid welding cell, and canister decontamination cell. Minimal short-term lag storage of full canisters will be provided as an interim to transfer to detached storage provided within another structure. The filled canister transfer system will be located belowgrade.

The physical structure surrounding the areas of canister processing, filling and handling will consist of three-ft thick concrete shielding walls with decontaminable surface preparation. An estimated volume of firewater and decontamination solution will be collected in a liquid collection area. The containment of liquids could be accomplished with the use of tanks located on this level.

Required personnel egress shall be provided and strategically located to accommodate the safe exit of personnel and access to critical functions.

Transfer of canisters, horizontally and vertically, will be accomplished via a crane system and hydraulic lifts where shown.

8.2.4 Abovegrade Features

The grade-level floor in will accommodate the delivery and batch storage of frit and sugar utilized in mix with SBW. The process equipment canyon will be located on this level and include the mixing and feed tanks preceding the melter and multi-stage combustor. Canister weld, smear, and decon cells will also be located at this level (above the canister filling, cooling and capping functions of the level below. The process equipment in the canyon will require minimum maintenance.

Maintenance functions of larger process equipment will be housed in a remote maintenance cell, decon cell and hands-on handling cell. Equipment cut-up and dismantling cell as well as an equipment loadout area will be located near the maintenance cell functions. Decon activities including the decon solution makeup room and decon solution distribution equipment room will be located near the loadout area.

Delivery and load/transport area will be provided in this vicinity to support the equipment maintenance/decon activities.

Maintenance of process system components, in-line, will be handled through pump and valve corridors running parallel with the process equipment canyon and along both sides of the process activities. Corridors will allow for remote viewing and maintenance of these system components, i.e., jumpers, valves, pumps, piping, seals, controls, etc.

Physical separations surrounding areas of contamination will consist of three-ft thick concrete shielding with decontaminable surface applications. These include walls around and ceiling above, floor below.

Clean areas or zones will include administrative and support spaces to house personnel involved in the SBW process activities. These spaces include offices, control/computer rooms, restrooms and change rooms, and conference room. Ancillary support areas include electrical rooms, communications and fire suppression equipment. Separate mechanical HVAC equipment areas will service the administrative and the process areas. Circulation areas accommodating personnel and equipment movement include corridors, airlocks for both personnel and vehicular access/exit, and enclosed stairways.

Above grade level, elevation 22 ft will provide overhead space in the process equipment canyon. This space will be necessary for the height configuration of the equipment as well as accommodate the ease of movement of remote equipment providing maintenance. This level will provide intermediate viewing and access to the remote maintenance activities in the pump and valve corridor.

8.3 Structural Features

8.3.1 General

The process area of this facility will be constructed of a concrete superstructure to approximately 50 ft abovegrade level. The cell walls will consist of 3-ft-thick concrete extending to support a formed, cast-in-place concrete roof with removable hatches for overhead maintenance and equipment removal/replacement. A 75-ton bridge crane will be installed above to accommodate hatch cover removal and equipment removal. Process equipment cell walls will consist of 3-ft-thick, concrete walls and will extend 32 ft belowgrade level forming the foundation walls. Operating corridor perimeter walls will be constructed of reinforced concrete to 32 ft belowgrade level. All horizontal process separations, i.e., ceiling-floor and hatch structures will consist of 3-ft-thick reinforced concrete.

Stainless steel (SST) surfaces will be applied to all cells of the process areas. The lining for the floors will be 1/4-in.-thick SST; all other surfaces will be lined with 1/8-in.-thick SST.

An engineered metal building system will be utilized for the administrative area. The floors will consist of 6-in.-thick reinforced concrete, slab on grade. Concrete grade beams and isolated column spread footings will support the structural steel frame of the building.

8.4 Occupancy Classification

8.4.1 General

The SBW Vitrification Facility is classified as a UBC Group H, Division 7/Group B, Mixed Occupancy. The H-7 occupancy applies to buildings or portions thereof utilized for storage, or handling of materials that constitute a high health hazard. This area includes the central core of the facility contained within the shielding walls on all floors. The process equipment canyon, pump and valve corridor, the maintenance areas, canister filling and capping, welding, and decon areas are some of the major areas.

The Group B Mixed Occupancy applies to building or portions thereof used for office, laboratories, etc. that are not classified as Group H for hazardous materials. This area includes the abovegrade portion of the building that is outside of the shielding walls (such as office/administrative areas, mechanical, HVAC, electrical, communications rooms). The UBC required separation between H-7 occupancy and B is one-hour construction.

An H-7 occupancy requires construction or exterior bearing walls to be 4-hour fire rated; interior bearing walls to be 2-hours fire rated; permanent partition to be 1-hour fire rated; and structural frame, floors, and ceilings to be 1-hour fire rated. Doors will need to be fire rated. A 1-hour occupancy separation wall will be required between the H-7 and B occupancy. Final selection of doors, windows, and fire walls will be made by a fire protection engineer during title design.

8.5 Structural Features

8.5.1 General

The construction type classification is UBC Type II-F.P. The allowable floor area for a B occupancy is unlimited if automatic sprinklered. The allowable floor area for an H-7 occupancy, Type II-F.P. is 39,900 ft² and twice the area, 79,800 ft², if automatic sprinklered.

8.6 Building HVAC

In addition to the off-gas system, the Vitrification Facility will have two ventilation confinement zones per DOE Order 6430.1A. This section addresses the two confinement zones, and the non-confinement area. A ventilation confinement system, in conjunction with physical barriers, maintain a continuous airflow pattern from areas of low potential contamination to areas of high potential contamination. The objectives of the confinement systems are to prevent the spread of radioactive and other hazardous materials to occupied areas; and to minimize the release of radioactive and other hazardous materials in facility effluents. The primary confinement area consists of process hot cells and hot maintenance areas, which will be exhausted through two stages of HEPA filters. The primary confinement boundary will comprise hot cell walls, welded stainless steel ductwork, and HVAC equipment designed to maintain its structural integrity during and after operational and natural-phenomena design basis accidents (DBAs). The secondary confinement boundary consists of the operating corridors and other building structures that surround the primary confinement. The secondary confinement boundary contains all ventilation system equipment such as HEPA filter units and exhaust fans. The non-confinement boundary consists of offices, control rooms and support areas outside the secondary confinement boundary. The non-confinement zones do not require once through ventilation systems and will be maintained at a slight positive pressure with respect to ambient. HEPA filters will remove contaminated particulates, but no carbon absorber beds will be provided in the primary filter trains, because semi-volatile fission products and iodine will be removed by the off-gas system.

Drawings HV-1 and HV-2 (Appendix G) depict the air flow diagram of the HVAC system for the Vitrification Facility. Up to four air-handling units (AHU) will supply 143,600 cfm of conditioned air to the secondary confinement zones. Air from the secondary confinement zones will be directed into the primary confinement zones via AHUs, each consisting of a supply blower and a single stage testable HEPA filter.

The facility will be provided with an independent chilled water system consisting of central chillers and pumps, delivering chilled water to various cooling coils. The facility will utilize steam for heating the once through air and for the office and other occupied areas. The HVAC system will be controlled by a central electronic system located within the facility.

Redundancy will ensure proper ventilation confinement during HEPA filter replacement or fan maintenance. Exhaust ductwork will be located in areas that will not be normally occupied. HEPA filter housings will have the capability to be leak tested and tested for filter efficiency in place. Single stage HEPA filtration will be provided at the hot cell intakes to prevent possible contamination from momentary back flow to the occupied areas. HEPA filters units will be designed per the American Society of Mechanical Engineers (ASME), N509, "Nuclear Power Plant Air-Cleaning Units and Components," and tested per ASME N510, "Testing of Nuclear Air Treatment Systems." Confinement boundaries will be sealed to maintain isolation when pressure differentials fall below normal conditions. Exhaust systems for the primary and secondary confinements will be round stainless steel, welded ductwork designed and installed in accordance with the Sheet Metal and Air Conditioning Contractors National Association, *Uniform Mechanical Code*, and American Conference of Governmental Industrial Hygienists standards.

Confinement zones will be supplied by once-through ventilation. Airflow from the secondary confinement zones will be HEPA filtered and directed into the primary confinement zones. The primary zone ventilation air will be HEPA filtered and discharged to the exhaust stack, with no air recirculation. Each HEPA filter unit includes a stainless steel plenum housing, a deluge system, demister, prefilter, two stages of side-bagout HEPA filters for the primary zone exhaust, single-stage side-bagout HEPA filters for secondary zone exhaust and primary supply, DOP test sections and ports, and an exhaust fan. The exhaust fans have integral adjustable flow control. It is assumed that the supply and exhaust fans for the hot cells can be powered from the INEEL site standby power grid. This allows the ventilation confinement to be maintained in the hot cells during a loss of off-Site power condition.

Automatic local stand-alone controllers will be provided with the HVAC equipment. Graphic displays mimicking the HVAC system will be available in the control room for monitoring and for remote manual override control. The HVAC system will have local operator stations. However, the control room operator will have supervisory control capability to start and stop the HVAC system and to change setpoints. Alarms and out-of-tolerance conditions will be annunciated in the control room. It is assumed that a shielded probe system can be used in the Vitrification Facility exhaust stack to monitor the discharge from the ventilation system and off-gas exhaust.

This facility will be designed with the following ventilation parameters:

- Eight air changes per hour for primary confinement
- Four air changes per hour for secondary confinement
- One cfm per square ft for administrative areas
- Two cfm per square ft for the control room
- One stage of testable HEPA filters for secondary confinement exhaust
- Two stages of testable HEPA filters for hot cell exhaust
- One stage of testable HEPA filters for hot cell inlet
- Once through ventilation for primary and secondary confinement zones
- Room pressures maintained in accordance with Table 22.

It is assumed that areas with large in-cell heat loads, which exceed normal nuclear ventilation capability, will require cooling and no additional heating.

Table 22. Room and zone requirements.

Rooms	Zone	Floor Elevation (ft)	Static Pressure (iwg)	Flow by Room (ft ³ /min)	Total by Zone (ft ³ /min)
Offices and other Rms	one	0	0.1	6,808	6,808
Crane Control Rm	two	0	0.1	1,800	6,600
Control Rm		0	0.1	2,700	
Computer Rm		0	0.1	2,100	
Elec Rm near Offices	three	0	0.1	190	563
Comm Rm		0	0.1	90	
Mech Rm		0	0.1	283	
West Outer Truck Lock	four	0	-0.25	640	79,720
East Outer Truck Lock		0	-0.25	640	
Storage		0	-0.25	2,078	
Tool/Repair Equip Stor.		0	-0.25	2,424	
Elec Rm near HVAC		0	-0.25	1,885	
Personnel Air Lock		0	-0.25	435	
Personnel Air Lock		0	-0.25	134	
Personnel Air Lock		0	-0.25	224	
Truck Air Lock		0	-0.25	269	
Exit Corridor NW		-32	-0.25	1,939	
Exit Corridor SW		-32	-0.25	653	
Exit Corridor SE		-32	-0.25	653	
Personnel Air Lock		-32	-0.25	448	
Personnel Air Lock		-32	-0.25	448	
Personnel Air Lock		-32	-0.25	448	
Clean Canister Stor		-32	-0.25	8,782	
Operating Corridor		0	-0.25	16,256	
Operating Corridor		-32	-0.25	41,363	
HVAC Room	five	0	-0.25	12,466	63,846
HVAC Room		16	-0.25	17,140	
Exit Corridor NE		-32	-0.25	1,939	
Operating Corridor		16	-0.25	17,304	
Operating Corridor		32	-0.25	14,997	
Hatch/Crane Floor	six	48	-0.75	91,661	125,485
Remote Serv Corridor		0	-0.75	25,805	
Par and Crane Maint		0	-0.75	3,405	
Crane Repair room		32	-0.75	4,614	
Melter	seven	0	-0.75	7,680	
Multi-Stage Combustion		0	-0.75	6,554	
Off-Gas Cell		0	-0.75	6,144	
Canister Weld Cell		0	-0.75	2,688	
Decon Cell		-32	-0.75	1,787	
Sub Melter Cell		-32	-0.75	5,120	
Canister Smear Cell		0	-0.75	2,688	
Csix Cell		0	-0.75	3,398	

Table 22. (continued).

Rooms	Zone	Floor Elevation (ft)	Static Pressure (iwg)	Flow by Room (ft ³ /min)	Total by Zone (ft ³ /min)
Grout Cell		0	-0.75	3,587	61,715
Cut Up Cell		0	-0.75	4,378	
Decon Cell		0	-0.75	5,198	
Hands On Maint Cell		0	-0.75	3,405	
Decon Holding Tanks		-32	-0.75	9,088	
Feed Tanks	eight	0	-0.75	5,120	30,604
Mixing Tank N		0	-0.75	3,789	
Mixing Tank S		0	-0.75	3,789	
Sample Cubicle		0	-0.75	2,816	
Can Cooling		-32	-0.75	11,404	
SBW Work Off Tank		0	-0.75	3,686	

The primary confinement areas require the largest volume of once-through air. The air exhausted from the secondary confinement zones is supplied to the primary confinement areas. As shown in the HVAC Flow Diagrams (sheets E-6 and E-7, Appendix G) additional cfm is required to meet the capacity of the primary zones. The cost to heat, cool, filter and force the once through air through the facility is mainly attributed to the volume of primary confinement zones. The primary confinement zones are the principle factor affecting HVAC system capital and operational costs.

Table 23 shows the preliminary equipment list for the HVAC feasibility study. This is not an all-inclusive list of instruments, components and equipment.

Table 23. HVAC equipment list.

Quantity	Equipment Description	Size/Power/Capacity	Comments
11	Ventilation Centrifugal Fans	60 hp	Includes standby fans
24	Ventilation Centrifugal Fans	50 hp	Includes standby fans
2	Ventilation Centrifugal Fans	75 hp	Includes standby fans
28	HEPA 4 × 4 Banks Single Stage	16 filters per bank	one filter is 24 × 24 in.
17	HEPA 4 × 4 Banks Dual Stage	16 filters per bank	one filter is 24 × 24 in.
1	Chiller: Compressors and Fans	600 hp combined	
1	Chiller: Compressors and Fans	625 hp combined	
multiple	Actuated Air Dampers	0.5 hp each	flow control to rooms
	Pre filters	217,800 cfm.	outside air filters
	Heating coils	217,800 cfm	steam heat
	Cooling coils		
17	Heat Recovery coils		for each dual HEPA bank
	Heat Recovery coils		with intake heat/cool coils

The ventilation fans and HEPA filter banks will require three rooms based upon the current HVAC floor plan size of 240×50 ft. The chillers will be located outside on concrete pads. The prefilters and the cooling and heating coils will also require an additional structure or room other than the existing HVAC rooms. The storage and tool/repair equipment storage rooms may be used on the second and third floor for the heating and cooling coils and fans for supplying the facility with the required once through air.

8.6.1 Heat Recovery Systems

It is assumed that later stages of design will provide greater detail and a more specific system description. The inclusion of a heat recovery system may have the potential to reduce operational costs. Here are two types of heat recovery systems applicable to this facility that completely separates air streams and eliminates cross-contamination. The face velocity is a primary factor in effectiveness and capital costs.

Coil energy recovery loops have an effectiveness range of 45 – 65%. The effectiveness is directly correlated to the delta T and the minimum low temperature in order to prevent freezing. Relative to other system parameters, the Vitrification Facility has a low delta T and a freezing limitation. Expected effectiveness is in the low end of the range, approximately 45%. Coil energy recovery loops require a liquid loop, typically a refrigerant and compressors. This system has more moving parts than other heat recovery systems and thus requires more maintenance.

Heat pipe heat exchangers have a higher effectiveness than coil energy recovery loops, but also have freeze protection problems. The performance of heat pipes is correlated directly to face velocities and the number of rows or heat pipes. Doubling the number of rows of heat pipes in a 60% effective heat exchanger increases the effectiveness to 75%. Effectiveness is also based upon the proper selection of fluid for the operating temperature range. According to Heat Pipe Technology Inc., typical costs range from \$0.50 to \$1.00 per cfm for a heat pipe recovery system.

Fixed plate exchangers have potential for cross contamination and are not considered here.

A coil energy recover loop is recommended primarily due to the flexibility of locating the heat exchangers in both exhaust and intake air streams. This will not require special routing of ducts in order to get close proximity that is required in a heat pipe exchanger system. Special duct routing would require additional floor space and added cost to the building structure. The heat recovery system exchangers can be located in line with the intake steam and cooling coils and just behind the HEPA filter banks prior to going to the exhaust stack. The cost would be similar to a heat pipe system at \$0.50 to \$1.00 per cfm.

8.6.2 Heating loads and steam requirements

Primary and secondary confinement zones are used to determine the heating load for the facility. The loads for the office areas are small compared to those for the confinement zones and are neglected. Typically, air is heated to 95°F (DOE-ID 1999), but due to the high rate of volume changeout, 80°F is used for more realistic results that are still conservative. The design basis for heat load is for outside an air temperature of -19°F (DOE-ID 1999). The formula used to calculate the heat load is $Q = 1.1 * (\text{cfm}) * (T_2 - T_1)$ in units of Btu/hr (ASHRAE 1997).

Secondary confinement areas, zones four and five in Table 22, require 143,566 cfm. The electrical room has a high heat load from the transformers. Therefore, 1885 cfm for this room is removed from the overall secondary requirements due to the high heat load from the transformers.

$$\text{cfm} = 143,566 - 1,885 = 141,681$$

$$\Delta T = 80^{\circ}\text{F} - (-19^{\circ}\text{F}) = 99^{\circ}\text{F}$$

$$Q = 1.1 * (141,681) * (99^{\circ}\text{F}) = 15.4 \text{ million Btu/hr}$$

Primary confinement areas, zones six, seven, and eight in Table 22, require 217,804 cfm. However, since air from the secondary confinement area is forced into the primary confinement area, 143,566 cfm is removed from the primary heating requirements. The process cells that contain the melter, multi-stage combustion, and off-gas are removed from the primary heating requirements due to the high heat load from the process equipment. Therefore, 27,995 cfm is removed.

$$\text{cfm} = 217,804 - 143,566 - 27,995 = 46,243$$

$$Q = 1.1 * (46,243) * (99^{\circ}\text{F}) = 5.0 \text{ million Btu/hr}$$

The confinement areas excluded above are considered separately below. This air is typically heated 95°F , but due to the high rate of volume changeout, 65°F is used for more realistic results that are still conservative.

$$\text{cfm} = 1,885 + 27,995 = 29,880$$

$$\Delta T = 65^{\circ}\text{F} - (-19^{\circ}\text{F}) = 84^{\circ}\text{F}$$

$$Q = 1.1 (29,880) (84^{\circ}\text{F}) = 2.8 \text{ million Btu/hr}$$

The total heat load for the facility is 23.2 million Btu/hr. For 150 psi saturated steam, 860 Btu are available per pound of steam. Therefore, the steam load for the facility is 27,000 lb steam/hr.

8.6.3 Ventilation Fans, hp

The ventilation fan sizing was based upon software and vendor data to ensure common fan motor sizes. The static pressures for each zone were conservatively approximated and all filters were assigned worst case pressure losses. The following table details the assigned pressure drops, final static pressures were based upon additional pressure drops through each zone.

Table 24. HVAC static pressure drop.

Equipment	Static Pressure Loss
Pre-filter for intake from atmosphere	1 iw g
Heating and cooling coils	1 iw g
Single HEPA filter bank	3 iw g
Dual HEPA filter bank	6 iw g
Each zone total	4 iw g
Duct to stack	1 iw g

According to the flow diagrams HV-1 and HV-2, the fan hp and cfm are shown. Each confinement zone is given a standby fan for immediate backup.

Table 25. HVAC zone horsepower requirements.

Zone	Total Static Pressure	hp Requirements
1 supply	5 iwg	15
2 supply	5 iwg	15
3 supply	5 iwg	3
4 supply	5 iwg	125
4 exhaust	6 iwg	150
5 supply	5 iwg	90
5 exhaust	6 iwg	100
6, 7 & 8 supply	3 iwg	60
6 supply	5 iwg	200
6 exhaust	9 iwg	300
7 supply	5 iwg	90
7 exhaust	9 iwg	150
8 supply	5 iwg	50
8 exhaust	9 iwg	75

Horsepower requirements are based upon centrifugal fans from GreenHeck, based upon cfm and static pressure loads.

8.6.4 Cooling, Compressor and Fan hp

For cooling the facility, primary and secondary confinement zones are used to determine the cooling load. The loads for the office areas are small compared to those for the confinement zones and are neglected. The design basis for cooling load is for outside an air temperature of 95°F (DOE-ID 1999). Typically, air is cooled to 55°F, but due to the high rate of volume changeout, 65°F is used for more realistic results that are still conservative. The formula used to calculate the heat load is $Q = 1.1 * (cfm) * (T_2 - T_1)$ in units of Btu/hr (ASHRAE 1997).

For the secondary confinement areas, zones four and five in Table 22, 143,566 cfm are required.

$$cfm = 143,566 - 1,885 = 141,681$$

$$\Delta T = 95^\circ\text{F} - (65^\circ\text{F}) = 30^\circ\text{F}$$

$$Q = 1.1 * (141,681) * (30^\circ\text{F}) = 4.7 \text{ million Btu/hr}$$

For primary confinement zones, zones six, seven, and eight in Table 22, 217,804 cfm is required. However, since air from the secondary confinement area is forced into the primary confinement area, 143,566 cfm is removed from the primary heating requirements.

$$cfm = 217,804 - 143,566 = 74,238$$

$$\Delta T = 95^\circ\text{F} - (65^\circ\text{F}) = 30^\circ\text{F}$$

$$Q = 1.1 * (74,200) * (30^{\circ}\text{F}) = 2.4 \text{ million Btu/hr}$$

The cfm exhausted from the secondary confinement zones is reused to supply the primary confinement zones. The assumed exit temperature from the secondary confinement zone is 78°F. The air will be cooled to 65°F.

$$\text{cfm} = 143,566$$

$$\Delta T = 78^{\circ}\text{F} - (65^{\circ}\text{F}) = 13^{\circ}\text{F}$$

$$Q = 1.1 * (143,566) * (13^{\circ}\text{F}) = 2.1 \text{ million Btu/hr}$$

The cooling load can be converted into tons of cooling using the conversion factor 12,000 Btu/hr = 1 ton. Based upon Product Data from Carrier, the 30GU series Flotronic™ Air-Cooled Reciprocating Liquid Chillers, 60 Hz, require the following combined hp from fans and compressors for the tonnage calculated.

Table 26. Cooling loads.

Confinement Area	Million Btu/hr	Tons	hp
Secondary	4.7	390	625
Primary	2.4	200	323
To Primary from Secondary	2.1	175	277
Total	9.2	765	1225

8.7 Electrical

8.7.1 Requirements

The electrical requirements for the SBW Vitrification Facility were analyzed and determined to be 4,747 kVA connected, with a demand projected to be 4,444 kVA. The details of the analysis are shown in Table 27 and Table 28. The major loads with the Vitrification Facility are joule-heated melter, process HEPA filters, facility HVAC, and lighting. A combination of new and existing duct banks will be used to route the 13.8 kV electrical feeders to the Vitrification Facility from existing substation 15. The Electrical and Utility System Upgrade (EUSU) project, which is currently under construction, will install a new 13.8 kV electrical distribution system throughout the complex including substation 15.

Table 27. Connected load.

Load	kVA
General Building Lighting 73,188 sq. Ft @ 1.75 VA per sq. Ft = 128,000 VA	128
Miscellaneous Loads 34,427 sq. Ft. @ 1.75 VA per sq. Ft = 60,000 VA	60
HVAC and Facility HEPA Loads	3451
Process Equipment on drawings SBW01 to SBW04: Melter and Lid Heater 5,000 Gal. Mix Tank Frit Conveyor Auger Feeder Off Gas Fan Slurry Pump Pumps, Blowers and Misc. Cranes	1113
Total Connected kVA	4,752

Table 28. Demand load.

Load	kVA
General Building Lighting 73,188 sq. Ft @ 1.75 VA per sq. Ft = 128,000 VA @ 90%	115
Miscellaneous Loads 34,428 sq. Ft. @ 1.75 VA per sq. Ft = 60,000 VA @ 80%	48
HVAC and Facility HEPA Loads @ 100%	3446
Process Equipment on drawings SBW01 to SBW04 @ 75%: Melter and Lid Heater 5,000 Gal. Mix Tank Frit Conveyor Auger Feeder Off Gas Fan Slurry Pump Pumps, Blowers and Misc. Cranes	835
Total Connected kVA	4,444

The requirements for standby power for the Vitrification Facility were analyzed and determined to be 840 kVA as shown in Table 29. The EUSU project will construct a standby power plant, install new standby generators, and tie the existing generators into the standby power system. Standby power will then be distributed through the complex by the new 13.8 kV distribution system. Upon completion of the EUSU project, an evaluation of the spare capacity will be performed. Because the excess capacity is not

Table 29. Standby power requirements.

Load	Standby Power	kVA
General Building Lighting	10% of 128 = 13	13
Miscellaneous Loads	10% of 60 = 6	6
HVAC and Facility Loads (Identified by Process Engineer)		605
Process Equipment on drawings SBW01 to SBW04: (Identified by Process Engineer)		221
Melter and Lid Heater		
5,000 Gal. Mix Tank		
Frit Conveyor		
Auger Feeder		
Off Gas Fan		
Slurry Pump		
Pumps, Blowers and Misc.		
Cranes		
Total Standby kVA		845

known, it will be assumed that the Vitrification Facility will provide a new 2,000-kVA diesel generator and associated equipment in the standby generator plant. The Utility Control System (UCS) will control the usage of standby power.

A solid state UPS with a static transfer switch will be provided. The UPS will be provided with 20-minute battery backup. Both the normal feed and bypass feed to the UPS will be on standby power. The UPS will support the following loads: voice paging/evacuation systems, environmental monitoring system, and other critical instrumentation loads.

8.7.1.1 Existing and Planned Electrical Utilities at ICPP. The INTEC ties into the 138-kV INEEL loop at Substation 2, which is located outside the area fence to the south. Substation 2 transforms the 138kV to 13.8kV and provides power to Substation 15, which is located within the INTEC complex. Power at 13.8kV will be distributed from Substation 15 to the Vitrification Facility.

Currently, standby power is provided by each facility at INTEC. Standby generators are located at various facilities and operate as an island of power during a normal power outage. The EUSU project will construct a standby power plant, install new standby generators and tie existing generators into the standby power system. Standby power will then be distributed through the complex by the new 13.8-kV distribution system. The Utility Control System (UCS) will control the usage of standby power.

8.7.2 Power Requirements

8.7.2.1 Normal Power. Normal power will be supplied to the Vitrification Facility by 13.8-kV feeders from existing Substation 15. Two new Power Sectionalizing Switches (PSS), PSS-NCE-1507AAA and PSS-NCE-1557AA, will be installed and they will be fed from two existing Power Sectionalizing Switches, PSS-NCE-1507A and PSS-NCE-1557A. A combination of new and existing duct banks will be used to route the feeders.

8.7.2.2 Standby Power. The standby loads for the Vitrification Facility consist of the following:

- UPS Normal and Bypass feeders
- Selected lighting and miscellaneous loads
- Exhaust and exhaust fans
- Bath electrode
- Other loads as determined in the Title designs.

Standby power to the Vitrification Facility will be provided over the normal power distribution system from Substation 60, the Standby power plant substation via Substation 15. The standby power system is at or near capacity. Upon completion of the EUSU project, an evaluation of the spare capacity will be performed. If necessary, a 2,000-kVA diesel generator and associated equipment will be installed in the space available in the standby generator plant. The UCS will perform shedding of the non-essential loads. The UCS will control the operation of circuit breakers and equipment to ensure that only those loads requiring standby power remain in operation.

8.7.2.3 Distribution System. Both normal and standby power will be provided by one set of redundant feeders. The EUSU project will install a redundant pair of sectionalizing switches in the north east quadrant of the complex. These switches, PSS-NCE-1507A and PSS-NCE-1557A are supplied by one set of 500KCMIL cables each. These switches are fed directly from Substation 15 and are very lightly loaded. New duct banks will be run from these switches to two new power sectionalizing switches and then a new load center. The load center will be double ended and will provide a redundant source of power to the Vitrification Facility.

8.7.2.4 Uninterruptable Power Supply (UPS). A solid-state UPS with a static transfer switch will be provided. The UPS will be provided with a 20-minute battery backup. Both the normal feed and the bypass feed to the UPS will be on standby power. The UPS will feed a 208Y/120-Volt panel. The UPS and the panel will be located in the electrical room. The UPS will support the following loads: Voice paging/evacuation systems, environmental monitoring system and other critical loads.

8.7.3 Lighting

8.7.3.1 Interior Lighting. Lighting in office areas and other low ceiling areas will be supplied by recess-mounted fluorescent fixtures. These fixtures will be operated at 277 Volts and will be locally switched. Motion detectors will be utilized in areas of low occupancy. Lighting in high bay areas will be supplied by metal halide fixtures operating at 277 Volts. The metal halide fixtures will be switched at the lighting panel.

8.7.3.2 Cell Lighting. Lighting in the cells will be designed to allow for remote operation of the equipment via an in-cell closed-circuit television (CCTV) system or by operation through cell windows. Lighting of the cells will be provided utilizing fixtures mounted in "K" plugs. The number, location, and size of the fixtures and associated "K" plugs will be coordinated with the cell design during the conceptual phase. The fixtures will be designed and fabricated to facilitate installation and removal for replacement of the light source. Metal Halide light sources are desired and will be given preference during the final design. The lighting design will take into account light loss through the translucent panels as well as the light lost in viewing operations through the cell windows.

8.7.3.3 Exterior Lighting. The exterior of the building will be illuminated with high-pressure sodium wall pack fixtures mounted over each personnel door. Loading areas will be provided with high-pressure sodium wall pack fixtures on each side of the doors. The need for area lighting in maneuvering areas will be evaluated during the conceptual and final designs.

8.7.3.4 Emergency and Exit Lighting. Emergency egress lighting will be in accordance with NFPA 101, Life Safety Code. In areas where illumination is provided by fluorescent fixtures, selected fixtures will be provided with integral battery backup. In areas where illumination is provided by metal halide fixtures, selected fixtures will be provided with a quartz lamp, which will be used, for emergency lighting. The quartz lamp will be connected to the UPS system or will be provided with an integral battery.

8.7.4 Design Description

8.7.4.1 Site Conditions. Electrical equipment will be rated for continuous operation at an elevation of 5,000 ft above sea level.

8.7.4.2 Hazardous Locations. Several areas within the facility will be used for storing or handling of hazardous materials. An evaluation will be performed during the conceptual design and the final design to determine the effects of these materials on the installation of electrical equipment. "Flammable and Combustible Liquids Codes" NFPA 30; "National Electrical Code," NFPA 70; and "Recommended Practice for Classification of Class I Hazardous Locations for Electrical Installations in Chemical Process Areas," NFPA 497A, will be used in making the determination.

8.7.4.3 Services

8.7.4.3.1 Primary Service—Two 13.8 kV feeders will be provided for the primary service to the site. The feeders will originate from Substation 2 located outside the fence. Power for the Vitrification Facility will be carried over existing feeders up to Substation 15. From Substation 15, new feeders will be routed through new and existing duct banks.

8.7.4.3.2 Standby Power—Standby power will be provided at 13.8kV over the existing primary distribution system. The existing UCS in conjunction with the Plant Control System will be installed in the Vitrification Facility. These existing systems will control selected circuit breakers to limit the standby power distribution only to those loads deemed important.

8.7.4.3.3 Utilization Voltages—Three and possibly four utilization voltages will be provided for the Vitrification Facility. Transformers and load centers located near the facility will transform the 13.8kV to 480Y/277 Volts; transformers downstream will transform the 480 Volts to 208Y/120 Volts. The third and fourth utilization will be determined during the conceptual and title designs. 4160Y/2400 Volts is desired as the third utilization however, the INTEC currently utilizes 2400Y/1386 Volts. Preferably, only one will be used. Equipment selection and operating personnel preference will determine the voltage to be utilized.

Electrical loads will be assigned voltages as follows:

- Motors 100 hp and larger - 4160V, 3 phase or 2400V, 3 phase
- Resistive loads 100 kVA and larger - 4160V, 3 phase or 2400V, 3 phase
- Motors ½ hp to less than 100 hp - 480V, 3 phase

- Resistive loads 1 kVA to less than 100 kVA - 480 V, 3 phase
- Motors less than ½ hp 120 V, single phase
- Miscellaneous loads less than 1 kVA – 120 V, single phase
- Lighting – 277 V single phase.

In certain circumstances, 480 V, 3 phase will be utilized for motors over 100 hp and loads over 100 kVA. This will be determined on an individual basis after the effects have been evaluated.

8.7.4.4 Equipment

8.7.4.4.1 Load Centers—One load center will be provided. The load center will be located outside the Vitrification Facility and will be a NEMA 3R Walk-in type similar to the load centers currently in use at the INTEC. The load center will provide 480Y/277 Volts and will be double ended. Each transformer will be sized to provide service to all loads on the load center. The load center will be provided with all equipment and wiring to ensure that it is fully compatible with the existing UCS System.

8.7.4.4.2 Transformers—Transformers 5,000 kVA and below will be cast coil, dry type transformers. Transformers over 5,000 kVA will be oil filled.

8.7.4.4.3 Lighting—Lighting levels will conform to the Illuminating Engineer's Society (IES) handbook and standard practices at the INTEC. In general, the design will provide the following illumination levels:

- Work Stations 70 foot-candles
- Work Areas 30 to 50 foot-candles depending on activity
- Non-Work Areas 10 foot-candles, 50 foot-candles where data is obtained

8.7.4.5 Grounding. Grounding at the INTEC is accomplished with bare copper conductors installed in all duct banks and ground rods installed in every manhole; this in turn is solidly connected to the casing of the deep wells. Facilities and structures throughout the INTEC are connected to this ground system. As well, the Vitrification Facility will be connected to the ground system. Grounding within the facility and at the outdoor load centers and other structures will be accomplished in accordance with the National Electrical Code and IEEE Standard 142-1991, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

8.7.4.6 Lighting Protection. Lightning protection will be provided in accordance with NFPA 78, Lightning Protection Code.

8.7.5 Utility Control System and Fiber-Optic Cable

The existing UCS fiber-optic cable loop at INTEC consists of six dedicated fibers in a 36-fiber, fiber-optic cable. Three loops of fiber-optic cable encircle the INTEC site and control and monitor the UCS, the fire alarm system, the voice paging and public address system, the criticality alarms, and local area network (LAN) systems. To connect the Vitrification Facility into these system, one of the loops

must have all 36 fibers cut/splice and the loop expanded to include the Vitrification Facility. All above systems must be tested to ensure proper functioning before reactivation.

The UCS controls the main and tie breakers of all load control centers at INTEC, while the Plant Control System (PCS) controls the main and tie breakers on the downstream motor control center and power control centers. In addition, the PCS controls starting and stopping of all loads in the facility/building. The UCS and PCS combined allow load shedding of unimportant loads from the electrical system, thus limiting and controlling the standby load requirement at INTEC.

The Vitrification Facility will be located directly over the top of an existing duct bank. The duct bank and the associated fiber-optic cable will be routed around the east side of the Vitrification Facility. The fiber-optic loop will splice in an existing manhole. New fiber-optic cable and duct bank will be routed to the Vitrification Facility from this location. Rerouting of existing fiber-optic cable or duct bank option is not required.

8.8 Instrumentation and Control

Throughout the Vitrification Facility, the design objective shall be to standardize across equipment systems. Process equipment shall be controlled by a control system that uses standardized programmable logic controllers (PLCs) and CRT-based operator workstations. Process variables shall be sensed and measured with "Smart" Transmitters that can be configured and calibrated with all parameters accessible to standard software manipulation on computer workstations. Processes that are judged to be sufficiently sensitive or critical shall be designed for redundant control and access to emergency power (UPS).

The Control System hardware will be capable of integrating with a variety of devices through such standards-based networks as DeviceNet, ControlNet and Ethernet. The system will include such features as flash-upgradable firmware and shall employ a passive data bus that utilizes "producer/consumer" network technology. Within a hardware chassis, this feature will permit multiple processors, networks, and inputs/outputs (I/O) to be mixed without restrictions, even if the system grows substantially from the original design.

The Control System hardware will be arranged in a hierarchical network comprising three levels: Level 3 (bottom level) – This level is best described as equal to "DeviceNet" and capable of discrete (digital) and analog input and output devices.

Level 2 (mid level) – This level is described as "automation and control," where rapid two-way communication takes place between local man-machine interface (MMI) consoles, intelligent power controllers such as variable frequency drives (VFDs) and modular racks of remote I/O modules.

Level 1 (top level) – This highest level is described as the "information" level. At the "information" level, process data is shared at "Ethernet" speeds with all workstations, MMI, extending into the Intranet domain and beyond to the Internet. This will make it possible for engineers and scientists at any location in the world to observe updated graphical displays of the process or historical data, such as trends or alarms, assuming they have the passwords for the various levels of access that have been configured.

The following estimates the total number of I/Os for the SBW Vitrification Facility. The data in this table indicate that the control system for this facility will need to accommodate approximately 2,000 hardware tags. It is estimated that with the additional "internal" tags to be defined during the course of the development and configuration of the system, the total number of tags will not be greater than 5,000.

Table 30. Instrumentation and controls equipment.

Total for	Number
Analog in signals	179
Analog out signals	46
Discrete inputs	796
Discrete outputs	796
Tags	1817
Motors	101

8.8.1 Control System Software for Man-Machine Interface

This software will provide a complete control window into the overall process. It will be an integrated, component-based MMI software for monitoring and controlling the process. It will include customizable ActiveX objects that embed directly into the graphic displays. (ActiveX objects consist of thousands of 3rd party developed objects representing complicated machinery or devices that are analogous to equipment in the process.) For example, the selection of an ActiveX object from a library on the Internet can be downloaded and embedded in a process graphical display. This ActiveX object can then be easily linked to the process tags that will determine the mode of animation or display desired. Such tools will save engineering time and provide vivid and descriptive representation of the Vitrification process.

The control system software will have the capability of selecting the logic tags that have been previously defined in the database of a PLC and importing all or any portion of the tags for use in the MMI display. The linking of these tags to the objects in the MMI graphical displays will be the simple process of highlighting a graphical symbol and then selecting the appropriate tag, assign the desired animation effects and click on "OK".

8.8.2 Instrumentation

As described in the "Remote Systems" section, the Vitrification Facility will be designed for remote control of those processes and tasks that cannot be accessed closely or visually. This is primarily due to high radiation fields and/or high contamination areas. These factors will result in a Vitrification Facility that is divided into a canyon service corridor configuration for the purposes of remote maintenance and control activities.

Much of the process equipment will be located in a concrete shielded enclosure that is accessed by shielded hatch covers only when a maintenance task is required. Because human access will be infrequent, and also because of the destructive effects of high radiation on sensitive electronics, it will be a requirement to keep control instrumentation and (I/O) hardware out of the concrete shielded enclosure. These devices will be located in the RSC and be connected to the sensors and devices that must be located in the shielded enclosure with self-aligning jumper assemblies that are accessible to the master-slave manipulators. This will allow changeout, removal, and replacement of devices that have failed, without human entry into the high radiation areas within the concrete shielded enclosure. Every device within the shielded, concrete enclosure shall be selected and deployed with the idea in mind, that the way it is mounted, where it is mounted, what cable is connected to it, where the cable is terminated, etc., will require service by master-slave manipulators.

State-of-the-art-technology has provided instrumentation that seldom requires calibration and provides for remote configuration utilizing digital communications that share the signal cable that is feeding the data to the distributed I/O modules. These devices can therefore be configured “on the fly” or accessed for maintenance and diagnostic checks from the MMI console.

8.8.3 Computer Hardware and Software

The control room will provide CRT- based control stations to give MMI and supervision for the vitrification processes and possibly additional facility utility functions, such as monitoring and control of the HVAC and HEPA filter systems and security monitoring.

There should be a minimum of two MMI control stations for redundancy and to allow attention to be given to multiple, simultaneous operations. It is recommended that sufficient console desktop space be allocated for as many as 4 or 5 MMI control stations to accommodate potential growth in processes and function.

The MMI control stations should be state-of-the-art technology. At the very minimum, the requirement will be CAT 5e (350 Mhz) [current standard as of March 2000] or the latest standard which has been accepted by the TIA/EIA (Telecommunications Industry Association/Electronics Industries Association) at the time of design. Design consideration shall be given to the use of fiberoptic cable in lieu of copper cable for individual workstation and control station network drops. The workstation computers will be capable of running with the Microsoft Windows NT operating system of 500 MHz Dual-Pentium processors, preferably rack mounted. The monitors shall be a minimum of 20-in., Super VGA with 800 × 600 or greater resolution. Consideration shall be given to providing touch screen and/or track ball control in combination with conventional keyboards. Each computer workstation shall have a minimum of 96 MB of RAM and 12 GB of hard disk space. In addition, each computer workstation shall have a network card, capable of bi-directional transmission of data.

8.8.4 Support Utilities

The conceptual design will determine the extent of instrumentation and controls into such utilities as the HVAC and monitoring of critical systems, such as the status of the HEPA filters. Close coordination during the conceptual and/or title design with the mechanical disciplines will be necessary to ensure that such capabilities as the following are covered:

- Alpha/numerical displays to allow observation of room temperature and humidity.
- Normal operating modes (heating, cooling, humidification, and dehumidification)
- Monitoring of individual equipment operation and the ability to activate an audible and visual alarm in the event of the such alarm conditions as high temperature, low temperature, high humidity, low humidity, restricted air filters, high pressure, and low pressure.
- Provide building utility alarm conditions to the building security system for display and operator action on designated control workstations where the security and access software resides.

8.8.5 Telecommunications

Telephone backboards will be installed in a dedicated Communications Room to allow termination of underground cable conductors to splicing terminal boards and patch panels and other telephone communication equipment.

Computer network/data system racks will also be located in the Communications Room and will be separated from the telephone equipment to minimize potential for crossing of systems. The data system will have its own termination backboards to allow use of different power supplies, surge suppression equipment, and switching equipment. The Vitrification Facility will require integration into the INEEL network or LAN system. With the rapid development of this technology, it is assumed that the requirement for the Vitrification Facility will be that all of the individual PC workstations and process control stations will be state-of-the-art technology. At the very minimum, the requirement will be CAT 5e (350 MHz) [current standard as of January 2000] or the latest standard which has been accepted by the Telecommunications Industry Association/Electronics Industries Association (TIA/EIA) at the time of design. Design consideration shall be given to the use of fiber-optic cable in lieu of copper cable for individual workstation and control station drops.

8.8.6 Security Equipment

The security systems racks will also be located in the Communications Room and will be separated from the telephone and data equipment termination racks to minimize potential for crossing of systems. The telecommunication network group will control tie points between data systems, telephone communications, and security systems. The security system will have its own termination backboards to allow use of different power supplies, supervision, surge suppression equipment, and switching equipment. Part of the security system at INTEC has a separated security duct bank system that will need to be home run from an existing duct bank and extended to some of the new duct banks being installed into the Vitrification Facility. It is assumed that all building exterior entrances will have card readers inside and outside of each door. It will be left to the conceptual study to determine the complete extent of the security system, as to whether or not any of the interior spaces, such as the hot cell gallery, or control room will require card readers or other security devices. Such devices as magnetic door switches or photoelectric sensors may be required. All security systems will be connected into the existing security system at INTEC.

8.9 Steam Facility

The Vitrification Facility requires an estimated maximum steam supply of 27,000 lb/hr. The existing steam supply is from CPP-606. Currently the boilers are undergoing replacement and are scheduled for completion by October 2000. The CPP-606 Boiler Replacement project will install four new boilers with an operating capacity of 23,000 lb/hr for each boiler. The total for the four boilers combined is approximately 92,000 lb/hr. According to the INTEC Thermal Energy Study Final Report (Balls et al. 1999), the maximum steam supplied does not allow for the additional capacity from this proposed Vitrification Facility until after FY 2015, as shown in Figure 4.

A new steam facility is planned to meet the steam demand for the Vitrification Facility. A plan view of the building and the layout of two boilers are shown in the drawings (Appendix G). Two boilers are shown: one for operational demands and the second as an immediate standby. At this stage of design a standby is included; later stages may determine whether a standby boiler is justified. The cost estimate and information from the CPP-606 Boiler Replacement project was used for the drawing and the two boiler cost estimate. The boiler building provides adequate room for installation, associated utilities and

Figure 4. Projected INTEC thermal energy demands, FY-00 through FY-40.

changeout of the boilers. The drawing does not detail the multiple utilities and systems required for the boiler, but they are incorporated into the cost estimate.

8.10 Fire Protection Systems and Equipment

At INTEC, there is an existing Emergency Communication System (ECS) which integrates the functions of Emergency Evacuation with alert tones, Fire Alarms, and the Personnel Address System. All new facilities at INTEC must be incorporated into this ECS and become an integral part of the overall system. This will require that the system components be 100% compatible and matched "like for like." It will also require that any additions to the INTEC system will be battery backed and capable of operating for a period no less than 24 hours upon loss of electrical power. The facility will require a new fire alarm panel connected into the fire alarm communications fiberoptic network for INTEC. The fire alarm system will consist of manual pull stations located next to each exit door, ceiling mounted smoke detectors in all corridors and rooms, and other places designated for special areas or equipment. Fire alarm strobe lights in high ambient noise areas will be required. Fire alarm notification will be via the ENS (Emergency Notification System). ENS speakers will be required in those areas identified during the conceptual study.

8.11 Utility Control System and Fiber-optic Cable

The existing UCS fiber-optic cable loop at INTEC consists of six dedicated fibers in a 36-fiber, fiber-optic cable. Three loops of fiber-optic cable encircle the INTEC site and control and monitor the UCS, the fire alarm system, the voice paging and public address system, the criticality alarms, and local area network (LAN) systems. To connect the Vitrification Facility into these systems, one of the loops must have all 36 fibers cut and the loop expanded to include the Vitrification Facility. All above systems must be tested to ensure proper functioning before reactivation.

The UCS controls the main and tie breakers of all load control centers at INTEC, while the Plant Control System (PCS) controls the main and tie breakers on the downstream motor control center and power control centers. In addition, the PCS controls starting and stopping of all loads in the

facility/building. The UCS and PCS combined allow load shedding of unimportant loads from the electrical system, thus limiting and controlling the standby load requirement at INTEC.

The Vitrification Facility will be located directly over the top of an existing duct bank. The duct bank and the fiber-optic cable will be routed around the east side of the Vitrification Facility. The fiber-optic loop will occur in an existing manhole. New fiber-optic cable and duct bank will be routed to the Vitrification Facility from this location. Rerouting of the existing fiber-optic cable or duct bank is not required in this option.

8.12 Vitrification Facility Staffing

Total estimated personnel needed for operating the Vitrification Facility is 109. Table 31 details the personnel needed. The following assumptions were made for estimating personnel needs.

- One shift (4-10s) for the main process, administration and support.
- Continuous process operations will require four rotating shifts for the 2-year duration of operations.
- INTEC will have infrastructure services and capabilities to accommodate some tasks not unique to this project. These include:
 - Additional drafting
 - Facility maintenance
 - Laboratory testing and analysis capabilities

Table 31. Personnel loading.

Function/Facility Requirement	Main Shift	Rotating
FACILITY – ADMINISTRATION		
Manager(s)/Supervisor(s)	2	4
Administrative Support (Including Secretarial/Clerical, Budget/Cost Control, and Schedule)	3	
Waste Tracking/Data Acquisition Tech (Including Receipt, Entry, Examination, Sampling, Repack, Storage/Shipping, etc., Manifest, and Chain of Custody)	1	4
FACILITY – TECHNICAL SUPPORT		
Engineering (Facility)	2	
Engineering (Process/Support)	2	4
Control Systems Tech – Ref: pg 4, I & C Technicians (Matrix personnel during construction, overhaul, redesign or mods)	1	
Draftsman	1	
FACILITY – DOCUMENT CONTROL		
Document control personnel	2	
FACILITY – MAINTENANCE		
PROCESS FACILITY/OPERATIONS		
Rad-con Tech (RCT/hp) Manager	1	

Table 31. (continued).

Function/Facility Requirement	Main Shift	Rotating
PROCESS CONTROL (Process Control Console, Alarm Panels, Communications)		
SBW feed and frit mixing (Includes Melter feed and Canister Fill, Glass and Gas Sampling and Analysis, Grouting System, and Off-gas Handling)	—	12
Canister Decontamination	—	16
Canister Cure/Dewatering, Transfers	—	8
Can Sealing and Inspection	—	4
Canister Tomographic Inspection	—	4
Canister Recycle	—	4
E S & Q		
Safety	1	—
RCT (Rad-Con Tech)	1	4
Quality	—	4
Industrial Hygienist	—	4
PROCESS MAINTENANCE		
Supervisors/Foreman	1	—
Electrician	—	4
Mechanic	—	4
I&C Technicians	—	4
Maintenance Planner	1	—
Preventive Maintenance/Work Order	1	—
Attendant	1	—

9. ESTIMATED COST

9.1 Planning Cost Estimate

A planning cost estimate was prepared for the Vitrification Facility, which includes an office area and two truck bays (Appendix D). An oil-fired steam generator (boiler) to produce steam for process and provide building heat was included in the estimate. The Total Project Cost (TPC) is \$738,000,000. This cost includes Conceptual Design costs, Project Support costs, Permitting costs, Construction Management costs, Engineering costs, Quality Assurance costs, Project Management costs, direct and indirect construction costs, System Operation/Startup costs, Procurement Fee, G&A, escalation and contingency.

As currently envisioned, this facility consists of a processing building measuring approximately 380×169 ft at grade level, with basement levels extending 32 ft belowgrade and roof elevation at 75 ft. In addition to the main processing building, there are two truck bays attached; one measuring 80×40 ft and one measuring 30×20 ft. The office area measures 189×68 ft with an assumed eave height of 14 ft. The boiler building is a concrete masonry unit (CMU) building measuring $60 \times 52 \times 30$ ft high.

Table 32. Total project costs.

Estimate Element	Estimate Subtotal	Escalation	Contingency	Total
Total Estimated Cost (TEC)	\$321,252,222	\$87,927,984	\$173,048,352	\$582,228,558
Other Project Costs (OPC)	\$78,935,317	\$17,107,921	\$59,413,968	\$155,457,206
Total Project Cost (TPC)	\$400,187,539	\$105,035,905	\$232,462,320	\$737,685,764

9.1.1 Basis

This estimate is based on information obtained by material take-off of preliminary facility sketches in Appendix G. Also used were several lists addressing process equipment, mechanical HVAC equipment, instrumentation, and sampling equipment in Appendix F. A one-line electrical load sketch, in Appendix G, was used to establish the electrical distribution equipment.

Much of the detail estimating was based on construction databases such as Means and the Construction Unit Price Book. Several of the special pieces of equipment were priced using preliminary vendor quotes in Appendix J.

9.1.2 Assumptions

These assumptions are conditions that are accepted or supposed true without proof of demonstration. These assumptions have a direct impact on the total estimated cost.

- Construction of this project will be competitively bid among subcontractors familiar with this type of construction and DOE projects at the INEEL.
- Design, management, quality assurance, and contractor general conditions costs are based on historical percentages and/or factors from similar site projects.
- No contaminated soil will be encountered during excavation for this project.

- All direct costs are in present-day dollars, escalated to the appropriate schedule midpoint
- No asbestos will be encountered during this project.
- Allowances for distribution piping, electrical, HVAC ductwork, structural steel, and distributed control system (DCS) are based on historical information from similar hot-cell facilities and applied parametrically by area.
- Very little information is available for Nitronic 50 alloy materials. Historically, this alloy's costs are approximately double those of stainless steel. A factor of two was used to estimate the costs of Nitronic 50 materials. Welding and machining labor is approximately 30% more than stainless steel.
- Rock will not be encountered during excavation activities. Historically, rock is located more than 35 ft below the surface at the northeast corner of INTEC.
- Although the elevation sketch indicates a 1-ft floor thickness at the hatch level, the estimate assumes three ft of concrete for shielding of personnel in the crane bay.
- Fire protection sprinkler systems throughout the process facility were assumed to be wet-pipe sprinkler systems similar to that proposed for Fuel Processing Restoration Facility (FPR).
- The design team identified areas requirement stainless steel cell lining and epoxy coating. All other exposed concrete surfaces are assumed to be sealed or painted.
- All concrete is assumed to be 400 psi. No high-density concrete is included.
- All exterior concrete walls will be covered with semi-rigid insulation and metal siding.
- Mechanical and electrical jumpers will be similar to those intended for use in FPR.
- Additional basis can be found in the estimate details in Appendix D.

9.1.3 Contingency

The risk associated with this project, and therefore the contingency needed, could be considerably greater than that addressed in the INEEL Cost Estimating Guide. The contingency to cover the risks associated with this project and the level of estimate have been addressed using the @Risk contingency program. This program statistically calculates the monies required to mitigate perceived risks by using range inputs and Monte Carlo or Latin Hypercube simulations. Appendix D contains the data used in this program.

9.2 Life-Cycle Cost Estimate

The economic and life-cycle cost (LCC) evaluation (Appendix E) assumes a 36-year period (2002-2038) since this is the estimated time to complete all of the anticipated remediation activities. The LCC evaluates the initial development, construction, operation, and post-operation costs over the life-cycle of the facility. The discounted LCC analysis assumes a constant-dollar basis, discounted at 6.30% annually per the Office of Management and Budget (OMB) Circular A-94. All costs are conservatively discounted

assuming the end-of-year convention. Annual costs for operations and maintenance are based on actual FY-98 costs and projected to a future cost based on operations and engineering judgement. These costs were increased and compounded by a 3.0% annual inflation rate. The discounted LCC for the SBW Vittrification Facility is \$606 million.

The LCC analysis is generated to match cost estimating cost structure. These costs include Permitting, Direct and Indirect Construction, G&A, Procurement Fee, Engineering, Inspection, Project Management, Construction Management, Escalation and Contingency costs. To evaluate costs, the factors of reliability, maintainability, and capacity are evaluated to determine an overall operational availability. These risks and costs are evaluated using a Monte-Carlo simulation with @Risk, a computer simulation program. The simulation defines uncertain model variables according to a probability distribution of risk. The simulation then randomly selects the value of this variable based on the distribution of occurrence. The costs generated by the program are reviewed as to their reasonableness using engineering and operations judgement.

The yearly discounted LCC is determined by adding annual tangible and intangible costs for a total annual cost, discounting each year's annual cost to the FY-00 base-year using OMB's discount rate of 6.3%. The yearly discounted LCC is summed together to get a cumulative discounted LCC.

10. PROJECT SCHEDULE

The design, construction, and operation project schedule, which is included in Appendix C, is summarized in Table 33. The entire schedule spans from start of conceptual design and project management in January 2002 until the end of D&D in December, 2038 with a hiatus from the end of processing in December 2014 until the beginning of D&D in January 2036. The construction campaign is 4 years long from July 2007 through July 2011. Startup operations' testing is expected to last 2 years from January 2011 through January 2013. The processing operation will last two years from January 2013 through December 2014.

Table 33. Project schedule.

	Days	Schedule Start	Schedule Finish
Total Project Schedule	9653	01/02/02	12/31/38
Conceptual Design	783	01/02/02	12/31/04
Project Support	2870	01/02/02	01/01/13
Permitting	2348	01/02/04	01/01/13
RCRA Permits	1044	01/02/04	01/02/08
Delist HLW	1305	01/02/08	01/01/13
Delist LLW	1305	01/02/08	01/01/13
Air Permits	782	01/04/10	01/01/13
Title Design	651	01/03/05	07/02/07
Project Management	1694	01/03/05	06/30/11
Quality Assurance	1694	01/03/05	06/30/11
Construction Management	1044	7/03/07	07/01/11
Construction	1044	7/03/07	07/01/11
SO Test/Startup	522	01/03/11	01/01/13
Start Processing	0	01/01/13	01/01/13
Process	522	01/01/13	12/31/14
D, D&D	783	1/2/36	12/31/38

11. REQUIREMENTS AND ASSESSMENTS

11.1 Disposal at WIPP

It is assumed that either the SBW will be delisted for U134 (uncomplexed hydrofluoric acid, HF) or that the U134 waste code will be added to the WIPP WAC. Another assumption is that the incidental waste ruling for SBW will be that it is not HLW. Both of these assumptions impact whether the vitrified SBW can be accepted at WIPP. The delisting of SBW for U134 or the addition of U134 to the WIPP WAC must be vigorously pursued. Failure to obtain one or the other will result in the vitrified waste not being accepted at WIPP. The incidental waste ruling for SBW has been requested. However, the ruling has not yet been made. If SBW is ruled to be HLW, the glass waste will be disposed of at Yucca Mountain, rather than WIPP.

Negotiations with WIPP are needed to alter the WIPP WAC to add U134 to the list of accepted waste codes. Disposal space for RH waste is limited at WIPP. A waste acceptance agreement is needed between WIPP and the INEEL for the vitrified waste.

11.2 Radiological

During the conceptual design of the Vitrification Facility, additional radiological assessments must be made. Preliminary evaluations of radiation levels in the Vitrification Facility have been made to determine appropriate wall thickness and personnel protection requirements. As the design is developed, this issue should be re-evaluated to verify the radiation exposure levels to operating personnel.

11.3 Material Balance

The material balance will need to be revised as information from additional studies becomes available. Issues of concern include:

- Sugar chemistry
- Mercury speciation
- Decontamination factor for species in the melter and offgas systems
- Off-gas chemistry.

11.4 Grout Recipe

The grout recipe for solidification of the scrubber blowdown needs to be tailored to the composition of the blowdown.

11.5 Multi-Stage Combustor

Actual operational data is needed for the multi-stage combustor with gas streams similar to the off-gas from the melter. This should include:

- Actual performance data for efficiency and reliability.

- Effect of a large amount of water vapor in the off-gas stream; it is assumed that water vapor will be an additional heating requirement and pass through the system.
- Steam or water quench for Stage 2, steam may be safer.
- Gas residence timing and mixing of Stage 3 to ensure complete combustion at low excess oxygen conditions.

11.6 Operating Conditions

11.6.1 Temperature of SBW

The temperature of the SBW and SBW mixtures must be maintained below 60°C until the SBW feed enters the melter. The high concentrations of chlorides in the SBW will cause severe stress cracking and corrosion issues above 60°C based on historical experience at INTEC.

12. UNCERTAINTIES & ADDITIONAL STUDIES

12.1 Open Issues

12.1.1 Operating Life

The lifetime of the plant is assumed to be 2 years. Increases in assumed lifetime may require additional margins to be included in the design of the piping (e.g. corrosion and erosion allowances or design for remote replacement).

12.1.2 Characterization of SBW

Additional characterization of SBW is needed for the conceptual design. Further characterization of the UDS in the SBW is required. There are some elements that even small amounts (>0.5 wt% in the glass) have significant melter processing impacts. SBW should be tested for elements such as noble metals, sulfur, and phosphorus.

12.1.3 Ion Exchange Media for Cesium Removal

The ion exchange media chosen for removal of cesium and strontium are UOP IONSIV® IE-95 and A-51 respectively. The alkali metal aluminosilicate ion exchange media are compatible with the melter and frit used for vitrification of SBW. Cesium and strontium (and their daughter products Ba-137m and Y-90) have the highest concentration levels of the radionuclides in the scrub blowdown. Cesium is a gamma emitter and is removed from the blowdown to reduce the radiation levels of the grout to contact handled material. Strontium is a beta emitter which is a strong contributor to the heat emission due to radioactive decay.

Other ion exchange media are available for removal of cesium from the scrub blowdown. UOP IONSIV® IE-911 is a crystalline silicotitanate (CST) with a high affinity for cesium, even in the presence of high concentrations of sodium and acid. The absorption of cesium on the sorbent is virtually irreversible. CST will also remove strontium from liquid waste; however, strontium can be stripped from the media.

The choice of ion exchange media should be re-evaluated based on the results of off-gas and scrubber characterization studies for SBW. Neutralization of the scrub blowdown should be considered to optimize the ion exchange process.

12.1.4 Water Reduction in SBW

Evaporation of water from the SBW in the SBW storage tank, the mixing tanks, or the feed tanks would decrease the electrical requirements and increase the efficiency of the melter. However, evaporation would increase the stress/corrosion effects of chlorine. Also, the temperature in the tanks would need to be maintained less than 60°C to reduce the corrosion rate. Added margin for stress-cracking concerns are accomplished by using a higher-grade material for the tanks such as Nitronic 50.

12.2 Required Studies

12.2.1 Mercury Speciation

A better understanding of mercury speciation in the melt, the combustor, and in the scrub system is needed. Studies should be conducted to determine the amount of mercury that remains in the glass. There are conflicting data for mercury retention in the glass given in Stegen (1997). Mercury compounds such as HgO and HgCl_2 are expected to decompose in the combustor to elemental Hg and O_2 and Cl_2 gas. The kinetics of reoxidation of the elemental mercury in the off-gas and the subsequent removal of the mercury compounds by the scrub system need to be investigated.

In the material balance, (Quigley 2000), mercury removal in the quench is assumed to be 99%, for the venturi scrubber, 99%, and for the mist eliminator, 99.5%. All mercury is assumed to be in the melter off-gas stream with no mercury retained in the glass. This results in 2.5% of the mercury from SBW in the scrub solution. The amount of mercury in the scrub solution may change significantly based on the mercury speciation research.

Although not shown as part of the process, a packed bed of GAC may be needed downstream of the CsIX unit to remove elemental and oxidized mercury before the scrubber blowdown is grouted. Preliminary evaluation of the mercury concentrations in the scrub indicates that the grout would not meet leachability requirements for RCRA.

12.2.2 Elemental Mercury Adsorption in Off-Gas

A study should be performed on the adsorption of elemental mercury from the off-gas of the melter to determine the best adsorbent and optimal conditions.

12.2.3 Slurry Characteristics

The characteristics of the slurry are unknown. The assumption is that the mixture can be maintained as slurry sufficient for homogeneous mixing with adequate pumping and material transfer capabilities. However, the solids and real case characteristics may present unknown difficulties both for in-tank mixing and material transfer (pumping). To accurately sample the mixture, homogeneous mixing is required.

Pump performance with the frit/sludge/SBW slurry should be evaluated. The effect of variable speed pumping and an envelope of operation conditions should be determined. Final pump selection should be based on this research.

12.2.4 Sugar Addition

The scope of work for the feasibility study, (HLW 1999), calls for the addition of sugar to the SBW and frit as part of the melter feed. The sugar is added to reduce the oxidation potential of the glass melt to control foaming of the molten glass. The nitric acid from the SBW will react with sugar to produce heat and N_2 , NO_x , CO , CO_2 , and H_2O . The interactions between sugar and nitric acid waste have been studied in Marshall (1996). However, experiments are needed to determine the following:

- The stability of the sugar/nitric acid solution. This includes the kinetics of the reactions between the sugar and nitric acid, the reaction products, and the heat released.

- The potential for an increased risk of flammability or explosion potential from reaction products.
- Other reductants should be tested as well as sugar.

The temperature within the mixing tanks will be maintained less than 60°C to reduce the corrosion rate. Cooling has been added to the mixing tanks to remove the heat from the sugar/acid reaction. The rate at which the sugar is added to the SBW can also be used to control the temperature and should be quantified. There is some indication that the reaction progresses rapidly and then slows. This may impact when samples of the tank should be taken.

12.2.5 Melter Operation and Decontamination Factors

During operation, the melter is maintained at a slight negative pressure to ensure that contaminants within the melter are drawn through the off-gas system. The carryover of particulates and volatile species needs to be evaluated for the SBW feed and melter system. The DFs are based on recommendations in Stegen (1997). However, none of the melters used for this study are liquid feed, cold cap melters. The retention of heavy metals and radionuclides in the melt needs to be researched.

The method of control of melter and multi-stage combustor system component pressures needs to be reviewed. The design goal is to create a very homogeneous feed stream within the mix and feed tanks before entry into the melter. This will help to minimize potential for fluctuations.

System pressure control is usually accomplished via a draft blower at the end of the off-gas system. However, the effect of the multi-stage combustor on this is not known. How can the negative pressure in the melter be maintained at a relatively constant level with the multi-stage combustor just after the melter? Will the large amount of evaporation of HNO_3 also cause a pressure problem?

- In some melters with high alkali level waste (Na) feeds, there tend to be significant volatility in the off gas of these components. There have been some cases where there has been enough to clog the off gas line. The potential for this to occur should be evaluated.
- The use of an evaporator in the SBW Work-off Tank or between the Work-off Tank and the mixing tanks should be investigated. The evaporation of 50%+ of the water and nitric acid would significantly increase melter feed rates, decrease the size of the melter and lid heaters, decrease the size of the off-gas system, and reduce the carry-over of waste components into the off-gas system.
- The addition of nitric acid waste feed with a high percentage of water presents special design challenges. Successful resolution of these challenges may benefit from detailed design modeling for transient heat transfer and fluid flow, as well as thermophysical and chemical reaction modeling. The effects of inlet geometry and feed distribution on the melt should be investigated.

12.2.6 Off-Gas and Scrubber Characterization

Further research must be performed to measure the off-gas and scrubber concentrations for constituents of concern. Particulate size distribution within the gas stream should be determined for the design of the scrubbing system. The effect of the pH and temperature of the scrub solution on scrubbing efficiency and scrub system materials is needed.

Experiments on melter off-gas using GAC for mercury removal are needed to determine the optimal residence time and bed loading. Acid gases in the gas stream may liberate hydrogen sulfide (H_2S) gas, with subsequent damage to the beds and additional potential safety problems for dealing with this gas.

Low-efficiency gas scrubbing will allow chlorine at sufficient levels to pass to the HEPA bank. Increased levels of chlorine will introduce corrosion issues in the HEPA bank. Standard filter banks are 300 series stainless, which is readily attacked by hydrochloric acid (HCl). High-efficiency caustic scrubbers convert chlorine to salt (NaCl). Some level of salt particulate matter may be entrained in the gas stream and reduce the operating life of the HEPA filters due to salt blinding. Experiments should be performed to optimize gas scrubbing and HEPA filter life.

12.2.7 Other Waste Streams

Although this study only considered vitrification of liquid SBW, other waste streams might be treated using the Vitrification Facility. These include TFF heel solids, NGLW, and calcine.

Although the feed system is designed to handle liquids with UDS, further work is required to determine whether the equipment suggested is suitable for TFF heel solids that have significantly more solids. The composition of all the tank heel solids has not yet been determined. Sludge in tanks WM-182 and WM-183 have been recently sampled and analyzed. Other tanks are scheduled for sampling. Waste loading and canister radiation levels can only be grossly estimated until characterization of the TFF heel solids is completed.

Treatment of the various NGLW streams depends on the characteristic of the streams. The Vitrification Facility has a contact-handled grout system that could be used for NGLW. Further evaluation is required to determine whether the grout system is large enough to handle the expected volume of NGLW and whether additional treatment systems are required.

Several issues should be addressed if the Vitrification Facility is to treat calcine. Two feed systems have been proposed for vitrification of calcine: a dry mix of calcine and frit and a slurry of calcine and frit suspended in water. The wet feed system for SBW should be evaluated for use with the calcine slurry. If a dry feed system is chosen, provision should be made in the Vitrification Facility design for addition of a dry feed system. Addition of a second, joule-heated melter, which would ensure continuous operation during a melter change out, should be considered for calcine vitrification.

12.2.8 Facility Siting Study

A siting study should be performed to determine the optimal placement of the Vitrification Facility. The study will review the impacts of this facility on site utilities and the surrounding infrastructure. The study will encompass topography, existing soil conditions, subsurface rock formations, and road and structure locations both above and below ground level.

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Appendix A
SBW Composition

Appendix A SBW Composition

Species	moles/lit	Species	Ci/liter	Species	Ci/liter
Ag+1	2.95E-05	Am-241	5.26E-04	Ba-137m	4.46E-02
Al+3	6.52E-01	Am-243	2.12E-07	Ce-144	8.67E-10
As+3	7.74E-05	Cm-242	1.60E-08	Co-60	6.26E-05
B+3	2.04E-02	Cm-244	1.76E-05	Cs-134	9.96E-06
Ba+2	6.58E-05	Np-237	1.85E-06	Cs-135	9.07E-07
Ca+2	5.65E-02	Pu-238	9.71E-04	Cs-137	4.72E-02
Cd+2	5.53E-03	Pu-239	7.69E-05	Eu-152	3.30E-06
Cl-1	3.15E-02	Pu-240	2.19E-05	Eu-154	1.95E-04
Cr+3	5.77E-03	Pu-241	4.37E-04	Eu-155	7.79E-05
Cs+1	9.110E-06	Pu-242	1.64E-08	Pm-147	1.12E-04
F-1	9.810E-02	Th-230	4.60E-10	Ni-63	5.82E-05
Fe+3	2.400E-02	U-232	2.27E-09	Ru-106	1.34E-08
H+1	2.120E+00	U-233	7.58E-12	Sb-125	9.19E-06
Hg+2	1.820E-03	U-234	1.12E-06	Sm-151	5.70E-04
K+1	1.870E-01	U-235	2.90E-08	Sr-90	3.68E-02
Mn+2	1.45E-02	U-236	5.43E-08	Tc-99	1.75E-05
Mo+6	7.42E-04	U-238	2.91E-08	Y-90	3.68E-02
Na+1	1.68E+00				
Ni+2	2.39E-03				
NO3-1	6.09E+00				
Pb+2	1.15E-03				
PO4-3	7.72E-03				
Se+4	1.55E-05				
SO4-2	4.41E-02				
Zr+4	1.43E-02				
U+4	2.23E-03				
H-3	3.67E-05				
I-129	1.45E-07				
H2O	47.28				
UDS	0.63				
TOC	0.45				

Appendix B

Flow Sheets and Material Balance

D

C

→

B

File: hrdflowshd.dwg ID: KELLCOA Layout Name: Layout1 Date: 07/28/00 - 09:30 A.M. Plot: G:\kellco\FRED

SUBCONTRACT NO.		INEEL	
REQUESTED: J. QUIGLEY		DIRECT VITRIFICATION OF SBW	
DESIGN:			
DRAWN: C. KELLY			
PROJECT NO.			
SPEC CODE			
FOR REVIEW/APPROVAL SIGNATURES		DWG-PFD-SBW-1	
SEE DAR NO.		SHEET 1 OF 1	
EFFECTIVE DATE:		SCALE: NONE	

Stream Number	1	2	3	4	5	6
Stream Name	SBW Liquid	UDS	SBW	Sugar	SBW Frit	SBW & Recycle
Flow Units	lit/hr	lit/hr	lit/hr	lit/hr	kg/hr	lit/hr
Volume or Rate	395	0.67	396	88.3	82	519
Specific Gravity	1.31	1.70	1.31	1.50	2.50	1.32
Temperature, C						
Temperature, F						
Pressure, psia						
Pressure, kPa						
Composition	moles/lit	moles/lit	moles/lit	moles/lit	kg/kg	moles/lit
Ag+1	2.95E-05	0	2.94E-05	0	0	2.29E-05
Al+3	6.52E-01	1.13E+00	6.53E-01	0	0	5.03E-01
As+3	7.74E-05	0	7.73E-05	0	0	5.95E-05
B+3	2.04E-02	4.70E+00	2.84E-02	0	0	2.18E-02
Ba+2	6.58E-05	0	6.57E-05	0	0	5.06E-05
Ca+2	5.65E-02	3.86E-01	5.71E-02	0	0	4.39E-02
Cd+2	5.53E-03	2.45E-02	5.56E-03	0	0	4.28E-03
Cl-1	3.15E-02	1.30E+00	3.37E-02	0	0	2.68E-02
Cr+3	5.77E-03	7.52E-02	5.89E-03	0	0	4.53E-03
Cs+1	9.11E-06	0	9.09E-06	0	0	7.16E-06
F-1	9.81E-02	2.38E+00	1.02E-01	0	0	7.94E-02
Fe+3	2.40E-02	7.58E-01	2.52E-02	0	0	1.94E-02
H+1	2.12E+00	0	2.12E+00	0	0	1.62E+00
Hg+2	1.82E-03	4.98E-02	1.90E-03	0	0	1.45E-03
K+1	1.87E-01	6.95E-01	1.88E-01	0	0	1.45E-01
Mg+2	0.00E+00	1.13E+00	1.93E-03	0	0	1.48E-03
Mn+2	1.45E-02	1.20E-01	1.47E-02	0	0	1.13E-02
Mo+6	7.42E-04	2.87E-01	1.23E-03	0	0	9.46E-04
Na+1	1.68E+00	3.21E+00	1.68E+00	0	0	1.30E+00
Ni+2	2.39E-03	2.67E-01	2.84E-03	0	0	2.19E-03
NO3-1	6.09E+00	0	6.08E+00	0	0	4.64E+00
Pb+2	1.15E-03	1.33E-02	1.17E-03	0	0	9.01E-04
PO4-3	7.72E-03	2.42E+00	1.18E-02	0	0	9.10E-03
Ru+4	0.00E+00	2.16E-01	3.67E-04	0	0	2.94E-04
Se+4	1.55E-05	0	1.55E-05	0	0	1.55E-05
Si+4	0.00E+00	2.47E+00	4.21E-03	0	0	3.24E-03
SO4-2	4.41E-02	2.62E+00	4.85E-02	0	0	3.70E-02
Zr+4	1.43E-02	2.59E+00	1.87E-02	0	0	1.44E-02
U+4	2.23E-03	0	2.23E-03	0	0	1.71E-03
Zn+2	0.00E+00	4.86E-01	8.27E-04	0	0	6.37E-04
	moles/lit	moles/lit	moles/lit	moles/lit	kg/kg	moles/lit
H2O	47.28	6.72	47.21	59.90	0.00	49.93
O	0	18.48	0.03	0	0	0.02
B2O3	0	0	0	0	0.143	0
Li2O	0	0	0	0	0.027	0
SiO2	0	0	0	0	0.686	0
TiO2	0	0	0	0	0.031	0
Fe2O3	0	0	0	0	0.113	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	0	0	0	0	0
CO	0	0	0	0	0	0
H2O(g)	0	0	0	0	0	0
N2	0	0	0	0	0	0
NO	0	0	0	0	0	0
NO2	0	0	0	0	0	0
O2	0	0	0	0	0	0
HF	0	0	0	0	0	0
HCl	0	0	0	0	0	0
Ar	0	0	0	0	0	0
SO2	0	0	0	0	0	0
Hg(g)	0	0	0	0	0	0
H2	0	0	0	0	0	0
H2S	0	0	0	0	0	0

Stream Number	1	2	3	4	5	6
Stream Name	SBW Liquid	UDS	SBW	Sugar	SBW Frit	SBW & Recycle
Units	lit/hr	lit/hr	lit/hr	lit/hr	kg/hr	lit/hr
Volume or Rate	395	1	396	88	82	519
	g/lit	g/lit	g/lit	g/lit	g/lit	g/lit
HEDPA	0	0	0	1000	0	170.0149832
TOC	0.698	0	0.696812071	0	0	0.531333089
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit
Am-241	5.26E-04	2.06E-03	5.29E-04	0.00E+00	0.00E+00	4.07E-04
Am-243	2.12E-07	0	2.12E-07	0	0.00E+00	1.62943E-07
Cm-244	1.76E-05	0	1.76E-05	0	0.00E+00	1.35273E-05
Np-237	1.85E-06	2.96E-05	1.90E-06	0.00E+00	0.00E+00	1.46E-06
Pu-238	9.71E-04	1.31E-01	1.19E-03	0.00E+00	0.00E+00	9.18E-04
Pu-239	7.69E-05	6.49E-03	8.78E-05	0.00E+00	0.00E+00	6.76E-05
Pu-240	2.19E-05	2.06E-03	2.54E-05	0.00E+00	0.00E+00	1.95E-05
Pu-241	4.37E-04	6.80E-02	5.52E-04	0.00E+00	0.00E+00	4.25E-04
Pu-242	1.64E-08	3.02E-06	2.15E-08	0.00E+00	0.00E+00	1.66E-08
Th-230	4.60E-10	0	4.59E-10	0	0.00E+00	3.53555E-10
U-232	2.27E-09	0	2.27E-09	0	0.00E+00	1.74472E-09
U-233	7.58E-12	0	7.57E-12	0	0.00E+00	5.82598E-12
U-234	1.12E-06	4.04E-05	1.19E-06	0.00E+00	0.00E+00	9.14E-07
U-235	2.90E-08	9.21E-07	3.05E-08	0.00E+00	0.00E+00	2.35E-08
U-236	5.43E-08	4.21E-07	5.49E-08	0.00E+00	0.00E+00	4.23E-08
U-238	2.91E-08	1.32E-07	2.93E-08	0.00E+00	0.00E+00	2.25E-08
Ba-137m	4.46E-02	3.92E+00	5.12E-02	0.00E+00	0.00E+00	4.03E-02
Ce-144	8.67E-10	0	8.66E-10	0	0.00E+00	6.66375E-10
Co-60	6.26E-05	1.07E-03	6.43E-05	0.00E+00	0.00E+00	4.95E-05
Cs-134	9.96E-06	1.35E-02	3.30E-05	0.00E+00	0.00E+00	2.60E-05
Cs-135	9.07E-07	0	9.05E-07	0	0.00E+00	7.13223E-07
Cs-137	4.72E-02	4.15E+00	5.42E-02	0.00E+00	0.00E+00	4.27E-02
Eu-152	3.30E-06	0	3.29E-06	0	0.00E+00	2.53638E-06
Eu-154	1.95E-04	9.23E-04	1.96E-04	0.00E+00	0.00E+00	1.51E-04
Eu-155	7.79E-05	0	7.78E-05	0	0.00E+00	5.98738E-05
Pm-147	1.12E-04	0	1.12E-04	0	0.00E+00	8.60831E-05
Pr-144	8.67E-10	0	8.66E-10	0	0.00E+00	6.66375E-10
Ni-63	5.82E-05	0	5.81E-05	0	0	4.47E-05
Ru-106	1.34E-08	0	1.34E-08	0	0	1.07E-08
Sb-125	9.19E-06	1.90E-02	4.16E-05	0	0	3.20E-05
Sm-151	5.70E-04	0	5.69E-04	0	0	4.38E-04
Sr-90	3.68E-02	9.28E+00	5.25E-02	0	0	4.04E-02
Tc-99	1.75E-05	7.63E-03	3.05E-05	0	0	4.46E-05
Y-90	3.68E-02	9.28E+00	5.25E-02	0	0	4.04E-02
H-3	3.67E-05	0	3.66E-05	0	0	2.79E-05
I-129	1.45E-07	1.62E-03	2.89E-06	0	0	1.66E-05

Stream Number	7	8	9	10	11	12
Stream Name	Melter Air	Glass	Melter OG	NOX Reduce Air	Fuel Reduce	NOX Reduce OG
Flow Units	sm3/hr	kg/hr	sm3/hr	sm3/hr	kg/hr	sm3/hr
Volume or Rate	364	127	1,108	118	52	1,317
Specific Gravity	1.00	2.60	1.00	1.00	0.75	1.00
Temperature, C			200			1205
Temperature, F			392			2201
Pressure, psia						
Pressure, kPa						
Composition	moles/moles	kg/kg	gm/sm3	gm/sm3	kg/kg	gm/sm3
Ag+1	0	9.91E-06	2.31E-05	0	0	1.95E-05
Al+3	0	5.50E-02	6.35E-02	0	0	5.35E-02
As+3	0	1.81E-05	2.09E-05	0	0	1.76E-05
B+3	0	9.57E-04	1.11E-03	0	0	9.31E-04
Ba+2	0	2.82E-05	3.25E-05	0	0	2.74E-05
Ca+2	0	7.14E-03	8.25E-03	0	0	6.94E-03
Cd+2	0	1.95E-03	2.26E-03	0	0	1.90E-03
Cl-1	0	1.95E-03	0.00E+00	0	0	0
Cr+3	0	9.56E-04	1.10E-03	0	0	9.29E-04
Cs+1	0	3.77E-06	1.49E-05	0	0	1.25E-05
F-1	0	4.64E-03	0.00E+00	0	0	0
Fe+3	0	4.40E-03	5.09E-03	0	0	4.28E-03
H+1	0	0	0	0	0	0
Hg+2	0	0	0	0	0	0
K+1	0	2.29E-02	2.65E-02	0	0	2.23E-02
Mg+2	0	1.46E-04	1.69E-04	0	0	1.42E-04
Mn+2	0	2.52E-03	2.91E-03	0	0	2.45E-03
Mo+6	0	3.68E-04	4.25E-04	0	0	3.58E-04
Na+1	0	1.21E-01	1.40E-01	0	0	1.17E-01
Ni+2	0	8.24E-04	9.52E-04	0	0	8.01E-04
NO3-1	0	0	0	0	0	0
Pb+2	0	7.57E-04	8.75E-04	0	0	7.36E-04
PO4-3	0	3.50E-03	4.05E-03	0	0	3.41E-03
Ru+4	0	1.46E-04	8.79E-04	0	0	7.40E-04
Se+4	0	3.77E-06	1.44E-04	0	0	1.21E-04
Si+4	0	3.69E-04	4.27E-04	0	0	3.59E-04
SO4-2	0	1.16E-02	0	0	0	0
Zr+4	0	5.32E-03	6.15E-03	0	0	5.17E-03
U+4	0	1.65E-03	1.91E-03	0	0	1.61E-03
Zn+2	0	1.69E-04	1.95E-04	0	0	1.64E-04
	moles/moles	kg/kg	gm/sm3	gm/sm3	kg/kg	gm/sm3
H2O	0	0	0	0	0	0
O	0	0.10	0	0	0	0
B2O3	0	0	0	0	0	0
Li2O	0	0	0	0	0	0
SiO2	0	0	0	0	0	0
TiO2	0	0	0	0	0	0
Fe2O3	0	0	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	0	0.06855473	0	0	0.112890786
CO	0	0	0	0	0	0.012308642
H2O(g)	0	0	0.581524786	0	0	0.530817208
N2	0.78	0	0.257783115	0.78	0	0.307538462
NO	0.25	0	0.025238071	0	0	0.000743221
NO2	0.25	0	0.025238071	0	0	2.12349E-05
O2	0.21	0	0.037890831	0.21	0	0
HF	0	0	0.000227646	0	0	0.000191538
HCl	0	0	0.000153625	0	0	0.000129258
Ar	0.01	0	0.003287766	0.01	0	0.003661033
SO2	0	0	8.47384E-05	0	0	7.12975E-05
Hg(g)	0	0	1.66201E-05	0	0	1.39839E-05
H2	0	0	0	0	0	0.0315264
H2S	0	0	0	0	0	8.69362E-05

Stream Number	7	8	9	10	11	12
Stream Name	Melter Air	Glass	Melter OG	NOX Reduce Air	Fuel Reduce	NOX Reduce OG
Units	sm ³ /hr	kg/hr	sm ³ /hr	sm ³ /hr	kg/hr	sm ³ /hr
Volume or Rate	364	127	1,108	118	52	1,317
	g/lit	g/lit	g/lit	g/lit	g/lit	g/lit
HEDPA	0	0	0	0	0	0
TOC	0	0	0	0	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/lit	Ci/kg	Ci/lit	Ci/lit	Ci/kg	Ci/sm ³
Am-241	0.00E+00	1.65E-03	1.91E-06	0.00E+00	0.00E+00	1.60E-06
Am-243	0.00E+00	6.60791E-07	7.63E-10	0	0.00E+00	6.42374E-10
Cm-244	0.00E+00	5.48581E-05	6.34E-08	0	0.00E+00	5.33292E-08
Np-237	0.00E+00	5.92E-06	6.84E-09	0.00E+00	0.00E+00	5.76E-09
Pu-238	0.00E+00	3.72E-03	4.30E-06	0.00E+00	0.00E+00	3.62E-06
Pu-239	0.00E+00	2.74E-04	3.17E-07	0.00E+00	0.00E+00	2.67E-07
Pu-240	0.00E+00	7.92E-05	9.15E-08	0.00E+00	0.00E+00	7.70E-08
Pu-241	0.00E+00	1.72E-03	1.99E-06	0.00E+00	0.00E+00	1.68E-06
Pu-242	0.00E+00	6.72E-08	7.76E-11	0.00E+00	0.00E+00	6.53E-11
Th-230	0.00E+00	1.43379E-09	1.66E-12	0	0.00E+00	1.39383E-12
U-232	0.00E+00	7.07545E-09	8.17E-12	0	0.00E+00	6.87825E-12
U-233	0.00E+00	2.36264E-11	2.73E-14	0	0.00E+00	2.29679E-14
U-234	0.00E+00	3.71E-06	4.28E-09	0.00E+00	0.00E+00	3.60E-09
U-235	0.00E+00	9.53E-08	1.10E-10	0.00E+00	0.00E+00	9.26E-11
U-236	0.00E+00	1.71E-07	1.98E-10	0.00E+00	0.00E+00	1.67E-10
U-238	0.00E+00	9.14E-08	1.06E-10	0.00E+00	0.00E+00	8.89E-11
Ba-137m	0.00E+00	1.60E-01	6.29E-04	0.00E+00	0.00E+00	5.29E-04
Ce-144	0.00E+00	2.70238E-09	3.12E-12	0	0.00E+00	2.62707E-12
Co-60	0.00E+00	2.01E-04	2.32E-07	0.00E+00	0.00E+00	1.95E-07
Cs-134	0.00E+00	1.03E-04	4.05E-07	0.00E+00	0.00E+00	3.41E-07
Cs-135	0.00E+00	2.82429E-06	1.11E-08	0	0.00E+00	9.36314E-09
Cs-137	0.00E+00	1.69E-01	6.66E-04	0.00E+00	0.00E+00	5.60E-04
Eu-152	0.00E+00	1.02859E-05	1.19E-08	0	0.00E+00	9.99922E-09
Eu-154	0.00E+00	6.13E-04	7.08E-07	0.00E+00	0.00E+00	5.96E-07
Eu-155	0.00E+00	0.000242809	2.81E-07	0	0.00E+00	2.36042E-07
Pm-147	0.00E+00	0.000349097	4.03E-07	0	0.00E+00	3.39367E-07
Pr-144	0.00E+00	2.70238E-09	3.12E-12	0	0.00E+00	2.62707E-12
Ni-63	0	1.81E-04	2.10E-07	0	0	1.76E-07
Ru-106	0	4.17E-08	2.51E-10	0	0	2.11E-10
Sb-125	0	1.30E-04	1.50E-07	0	0	1.26E-07
Sm-151	0	1.78E-03	2.05E-06	0	0	1.73E-06
Sr-90	0	1.64E-01	1.89E-04	0	0	1.59E-04
Tc-99	0	9.14E-05	1.05E-05	0	0	8.80E-06
Y-90	0	1.64E-01	1.89E-04	0	0	1.59E-04
H-3	0	0	1.31E-05	0	0	1.10E-05
I-129	0	6.11E-06	7.06E-06	0	0	5.94E-06

Stream Number	13	14	15	16	17	18
Stream Name	NOX Cooling Water	NOX Cool OG	NOX Oxidize Air	NOX Oxidize OG	Quench Water	Quench Water Out
Flow Units	lit/hr	sm3/hr	sm3/hr	sm3/hr	lit/hr	lit/hr
Volume or Rate	232	1,632	207	1,810	13,970	13,150
Specific Gravity	1.00	1.00	1.00	1.00	1.01	1.01
Temperature, C	25	760	25	903	75	81.4
Temperature, F	77	1400	77	1658	167	179
Pressure, psia						
Pressure, kPa						
Composition	moles/lit	gm/sm3	gm/sm3	gm/sm3	moles/lit	moles/lit
Ag+1	0	1.57E-05	0	1.42E-05	6.51E-06	6.94E-06
Al+3	0	4.32E-02	0	3.89E-02	7.15E-02	7.61E-02
As+3	0	1.42E-05	0	1.28E-05	8.46E-06	9.01E-06
B+3	0	7.51E-04	0	6.77E-04	3.11E-03	3.31E-03
Ba+2	0	2.21E-05	0	1.99E-05	7.19E-06	7.66E-06
Ca+2	0	5.60E-03	0	5.05E-03	6.25E-03	6.66E-03
Cd+2	0	1.53E-03	0	1.38E-03	6.09E-04	6.49E-04
Cl-1	0	0	0	0.00E+00	1.69E-02	1.66E-02
Cr+3	0	7.50E-04	0	6.76E-04	6.45E-04	6.87E-04
Cs+1	0	1.01E-05	0	9.10E-06	3.39E-06	3.61E-06
F-1	0	0	0	0	2.50E-02	2.46E-02
Fe+3	0	3.45E-03	0	3.11E-03	2.77E-03	2.95E-03
H+1	0	0	0	0	4.18E-02	4.12E-02
Hg+2	0	0	0	0	6.76E-07	5.80E-07
K+1	0	1.80E-02	0	1.62E-02	2.06E-02	2.19E-02
Mg+2	0	1.15E-04	0	1.03E-04	2.11E-04	2.25E-04
Mn+2	0	1.98E-03	0	1.78E-03	1.61E-03	1.71E-03
Mo+6	0	2.89E-04	0	2.60E-04	1.35E-04	1.43E-04
Na+1	0	9.48E-02	0	8.55E-02	1.84E-01	1.96E-01
Ni+2	0	6.46E-04	0	5.83E-04	3.11E-04	3.31E-04
NO3-1	0	0	0	0	0	0
Pb+2	0	5.94E-04	0	5.36E-04	1.28E-04	1.37E-04
PO4-3	0	2.75E-03	0	2.48E-03	1.29E-03	1.38E-03
Ru+4	0	5.97E-04	0	5.38E-04	2.09E-04	2.23E-04
Se+4	0	9.75E-05	0	8.79E-05	5.52E-05	5.88E-05
Si+4	0	2.90E-04	0	2.61E-04	4.61E-04	4.91E-04
SO4-2	0	0	0	0	0	0
Zr+4	0	4.17E-03	0	3.76E-03	2.05E-03	2.18E-03
U+4	0	1.30E-03	0	1.17E-03	2.44E-04	2.60E-04
Zn+2	0	1.32E-04	0	1.19E-04	9.06E-05	9.65E-05
	moles/lit	gm/sm3	gm/sm3	gm/sm3	moles/lit	moles/lit
H2O	55.51	0	0	0	55.51	55.51
O	0	0	0	0	0	0
B2O3	0	0	0	0	0	0
Li2O	0	0	0	0	0	0
SiO2	0	0	0	0	0	0
TiO2	0	0	0	0	0	0
Fe2O3	0	0	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	0.091115087	0	0.090989451	0	0
CO	0	0.009934407	0	0.000134379	0	0
H2O(g)	0	0.621318687	0	0.583298303	0	0
N2	0	0.248216837	0.78	0.312866642	0	0
NO	0	0.00059986	0	0.000540938	0	0
NO2	0	1.71389E-05	0	1.54554E-05	0	0
O2	0	0	0.21	0.00798997	0	0
HF	0	0.000154592	0	0.000139407	0	0
HCl	0	0.000104325	0	9.40776E-05	0	0
Ar	0	0.00295485	0.01	0.003806032	0	0
SO2	0	5.75448E-05	0	0.000115167	0	0
Hg(g)	0	1.12865E-05	0	1.01779E-05	0	0
H2	0	0.025445218	0	0	0	0
H2S	0	7.01669E-05	0	0	0	0

Stream Number	13	14	15	16	17	18
Stream Name	NOX Cooling Water	NOX Cool OG	NOX Oxidize Air	NOX Oxidize OG	Quench Water	Quench Water Out
Units	lit/hr	sm3/hr	sm3/hr	sm3/hr	lit/hr	lit/hr
Volume or Rate	232	1,632	207	1,810	13,970	13,150
	g/lit	g/lit	g/lit	g/lit	g/lit	g/lit
HEDPA	0	0	0	0	0	0
TOC	0	0	0	0	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/lit	Ci/sm3	Ci/lit	Ci/lit	Ci/lit	Ci/lit
Am-241	0.00E+00	1.29E-06	0.00E+00	1.17E-06	5.79E-05	6.17E-05
Am-243	0	5.18E-10	0	4.68E-10	2.31797E-08	2.47E-08
Cm-244	0	4.30E-08	0	3.88E-08	1.92435E-06	2.05E-06
Np-237	0.00E+00	4.65E-09	0.00E+00	4.19E-09	2.08E-07	2.21E-07
Pu-238	0.00E+00	2.92E-06	0.00E+00	2.63E-06	1.31E-04	1.39E-04
Pu-239	0.00E+00	2.15E-07	0.00E+00	1.94E-07	9.62E-06	1.02E-05
Pu-240	0.00E+00	6.21E-08	0.00E+00	5.60E-08	2.78E-06	2.96E-06
Pu-241	0.00E+00	1.35E-06	0.00E+00	1.22E-06	6.04E-05	6.44E-05
Pu-242	0.00E+00	5.27E-11	0.00E+00	4.75E-11	2.36E-09	2.51E-09
Th-230	0	1.12E-12	0	1.01E-12	5.02955E-11	5.36E-11
U-232	0	5.55E-12	0	5.01E-12	2.48198E-10	2.64E-10
U-233	0	1.85E-14	0	1.67E-14	8.28783E-13	8.83E-13
U-234	0.00E+00	2.91E-09	0.00E+00	2.62E-09	1.30E-07	1.38E-07
U-235	0.00E+00	7.48E-11	0.00E+00	6.74E-11	3.34E-09	3.56E-09
U-236	0.00E+00	1.35E-10	0.00E+00	1.21E-10	6.02E-09	6.41E-09
U-238	0.00E+00	7.17E-11	0.00E+00	6.47E-11	3.21E-09	3.41E-09
Ba-137m	0.00E+00	4.27E-04	0.00E+00	3.85E-04	1.91E-02	2.03E-02
Ce-144	0	2.12E-12	0	1.91E-12	9.47961E-11	1.01E-10
Co-60	0.00E+00	1.58E-07	0.00E+00	1.42E-07	7.04E-06	7.50E-06
Cs-134	0.00E+00	2.75E-07	0.00E+00	2.48E-07	1.23E-05	1.31E-05
Cs-135	0	7.56E-09	0	6.81E-09	3.37863E-07	3.60E-07
Cs-137	0.00E+00	4.52E-04	0.00E+00	4.08E-04	2.02E-02	2.15E-02
Eu-152	0	8.07E-09	0	7.28E-09	3.60816E-07	3.84E-07
Eu-154	0.00E+00	4.81E-07	0.00E+00	4.34E-07	2.15E-05	2.29E-05
Eu-155	0	1.91E-07	0	1.72E-07	8.51744E-06	9.07E-06
Pm-147	0	2.74E-07	0	2.47E-07	1.22459E-05	1.30E-05
Pr-144	0	2.12E-12	0	1.91E-12	9.47961E-11	1.01E-10
Ni-63	0	1.42E-07	0	1.28E-07	6.36E-06	6.78E-06
Ru-106	0	1.70E-10	0	1.54E-10	7.62E-09	8.12E-09
Sb-125	0	1.02E-07	0	9.18E-08	4.55E-06	4.85E-06
Sm-151	0	1.39E-06	0	1.26E-06	6.23E-05	6.64E-05
Sr-90	0	1.29E-04	0	1.16E-04	5.75E-03	6.13E-03
Tc-99	0	7.10E-06	0	6.41E-06	3.18E-04	3.38E-04
Y-90	0	1.29E-04	0	1.16E-04	5.75E-03	6.13E-03
H-3	0	8.89E-06	0	8.02E-06	0	0
I-129	0	4.80E-06	0	4.33E-06	2.13E-04	2.27E-04

Stream Number	19	20	21	22	23	24
Stream Name	Makeup QScrub	QScrub Blowdown	Quench OG	Venturi Water	Venturi Water Out	Makeup VScrub
Flow Units	lit/hr	lit/hr	sm3/hr	lit/hr	lit/hr	lit/hr
Volume or Rate	4.9	36.5	2,925	4,388	4,383	5.9
Specific Gravity	1.00	1.01	1.00	1.00	1.00	1.00
Temperature, C		75	81.4	75	80.2	
Temperature, F		167	179	167	176	
Pressure, psia			9.8			
Pressure, kPa			6.7			
Composition	moles/lit	moles/lit	gm/sm3	moles/lit	moles/lit	moles/lit
Ag+1	0	6.51E-06	4.39E-07	1.39E-08	1.63E-08	0
Al+3	0	7.15E-02	1.20E-03	1.52E-04	1.79E-04	0.00E+00
As+3	0	8.46E-06	3.96E-07	1.80E-08	2.12E-08	0
B+3	0	3.11E-03	2.10E-05	6.62E-06	7.78E-06	0.00E+00
Ba+2	0	7.19E-06	6.17E-07	1.53E-08	1.80E-08	0
Ca+2	0	6.25E-03	1.56E-04	1.33E-05	1.56E-05	0.00E+00
Cd+2	0	6.09E-04	4.27E-05	1.30E-06	1.53E-06	0.00E+00
Cl-1	0	1.69E-02	0	2.10E-02	2.37E-02	0.00E+00
Cr+3	0	6.45E-04	2.09E-05	1.37E-06	1.61E-06	0.00E+00
Cs+1	0	3.39E-06	2.81E-07	7.23E-09	8.49E-09	0
F-1	0	2.50E-02	0	3.11E-02	3.51E-02	0.00E+00
Fe+3	0	2.77E-03	9.64E-05	5.89E-06	6.92E-06	0.00E+00
H+1	0	4.18E-02	0.00E+00	5.21E-02	5.87E-02	0
Hg+2	0	6.76E-07	0	2.17E-06	1.73E-06	0.00E+00
K+1	0	2.06E-02	5.02E-04	4.38E-05	5.15E-05	0.00E+00
Mg+2	0	2.11E-04	3.20E-06	4.50E-07	5.28E-07	0.00E+00
Mn+2	0	1.61E-03	5.51E-05	3.43E-06	4.02E-06	0.00E+00
Mo+6	0	1.35E-04	8.06E-06	2.87E-07	3.37E-07	0.00E+00
Na+1	0	1.84E-01	2.64E-03	3.93E-04	4.61E-04	0.00E+00
Ni+2	0	3.11E-04	1.80E-05	6.63E-07	7.79E-07	0.00E+00
NO3-1	0	0	0	0	0	0
Pb+2	0	1.28E-04	1.66E-05	2.73E-07	3.21E-07	0.00E+00
PO4-3	0	1.29E-03	7.67E-05	2.76E-06	3.24E-06	0.00E+00
Ru+4	0	2.09E-04	1.67E-05	4.46E-07	5.24E-07	0.00E+00
Se+4	0	5.52E-05	2.72E-06	1.18E-07	1.38E-07	0
Si+4	0	4.61E-04	8.08E-06	9.83E-07	1.15E-06	0.00E+00
SO4-2	0	0	0	0	0	0
Zr+4	0	2.05E-03	1.16E-04	4.36E-06	5.12E-06	0.00E+00
U+4	0	2.44E-04	3.62E-05	5.20E-07	6.10E-07	0
Zn+2	0	9.06E-05	3.70E-06	1.93E-07	2.27E-07	0.00E+00
	moles/lit	moles/lit	gm/sm3	moles/lit	moles/lit	moles/lit
H2O	55.51	55.51	0	55.51	55.51	55.51
O	0	0	0	0	0	0
B2O3	0	0	0	0	0	0
Li2O	0	0	0	0	0	0
SiO2	0	0	0	0	0	0
TiO2	0	0	0	0	0	0
Fe2O3	0	0	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	0	0.056305485	0	0	0
CO	0	0	8.31554E-05	0	0	0
H2O(g)	0	0	0.741780627	0	0	0
N2	0	0	0.193606049	0	0	0
NO	0	0	0.00033474	0	0	0
NO2	0	0	9.564E-06	0	0	0
O2	0	0	0.0049443	0	0	0
HF	0	0	0.000300492	0	0	0
HCl	0	0	0.000202784	0	0	0
Ar	0	0	0.002355223	0	0	0
SO2	0	0	7.12669E-05	0	0	0
Hg(g)	0	0	6.31344E-06	0	0	0
H2	0	0	0	0	0	0
H2S	0	0	0	0	0	0

Stream Number	19	20	21	22	23	24
Stream Name	Makeup QScrub	QScrub Blowdown	Quench OG	Venturi Water	Venturi Water Out	Makeup VScrub
Units	lit/hr	lit/hr	sm3/hr	lit/hr	lit/hr	lit/hr
Volume or Rate	5	36	2,925	4,388	4,383	6
	g/lit	g/lit	g/lit	g/lit	g/lit	g/lit
HEDPA	0	0	0	0	0	0
TOC	0	0	0	0	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit
Am-241	0.00E+00	5.79E-05	3.61E-08	1.23E-07	1.45E-07	0.00E+00
Am-243	0	2.31797E-08	1.45E-11	4.93889E-11	5.80E-11	0
Cm-244	0	1.92435E-06	1.20E-09	4.10021E-09	4.82E-09	0
Np-237	0.00E+00	2.08E-07	1.30E-10	4.43E-10	5.20E-10	0.00E+00
Pu-238	0.00E+00	1.31E-04	8.15E-08	2.78E-07	3.27E-07	0.00E+00
Pu-239	0.00E+00	9.62E-06	6.00E-09	2.05E-08	2.41E-08	0.00E+00
Pu-240	0.00E+00	2.78E-06	1.73E-09	5.92E-09	6.95E-09	0.00E+00
Pu-241	0.00E+00	6.04E-05	3.77E-08	1.29E-07	1.51E-07	0.00E+00
Pu-242	0.00E+00	2.36E-09	1.47E-12	5.02E-12	5.90E-12	0.00E+00
Th-230	0	5.02955E-11	3.14E-14	1.07165E-13	1.26E-13	0
U-232	0	2.48198E-10	1.55E-13	5.28834E-13	6.21E-13	0
U-233	0	8.28783E-13	5.17E-16	1.76589E-15	2.07E-15	0
U-234	0.00E+00	1.30E-07	8.11E-11	2.77E-10	3.25E-10	0.00E+00
U-235	0.00E+00	3.34E-09	2.09E-12	7.12E-12	8.37E-12	0.00E+00
U-236	0.00E+00	6.02E-09	3.75E-12	1.28E-11	1.51E-11	0.00E+00
U-238	0.00E+00	3.21E-09	2.00E-12	6.83E-12	8.03E-12	0.00E+00
Ba-137m	0.00E+00	1.91E-02	1.19E-05	4.07E-05	4.78E-05	0.00E+00
Ce-144	0	9.47961E-11	5.92E-14	2.01982E-13	2.37E-13	0
Co-60	0.00E+00	7.04E-06	4.40E-09	1.50E-08	1.76E-08	0.00E+00
Cs-134	0.00E+00	1.23E-05	7.68E-09	2.62E-08	3.08E-08	0.00E+00
Cs-135	0	3.37863E-07	2.11E-10	7.19886E-10	8.46E-10	0
Cs-137	0.00E+00	2.02E-02	1.26E-05	4.31E-05	5.06E-05	0.00E+00
Eu-152	0	3.60816E-07	2.25E-10	7.6879E-10	9.03E-10	0
Eu-154	0.00E+00	2.15E-05	1.34E-08	4.58E-08	5.38E-08	0.00E+00
Eu-155	0	8.51744E-06	5.32E-09	1.81481E-08	2.13E-08	0
Pm-147	0	1.22459E-05	7.64E-09	2.60923E-08	3.07E-08	0
Pr-144	0	9.47961E-11	5.92E-14	2.01982E-13	2.37E-13	0
Ni-63	0	6.36E-06	3.97E-09	1.36E-08	1.59E-08	0
Ru-106	0	7.62E-09	4.76E-12	1.62E-11	1.91E-11	0
Sb-125	0	4.55E-06	2.84E-09	9.70E-09	1.14E-08	0
Sm-151	0	6.23E-05	3.89E-08	1.33E-07	1.56E-07	0
Sr-90	0	5.75E-03	3.59E-06	1.23E-05	1.44E-05	0
Tc-99	0	3.18E-04	1.98E-07	6.77E-07	7.95E-07	0
Y-90	0	5.75E-03	3.59E-06	1.23E-05	1.44E-05	0
H-3	0	0	4.96E-06	0	0.00E+00	0
I-129	0	2.13E-04	2.68E-07	8.47E-07	9.99E-07	0

Stream Number	25	26	27	28	29	30
Stream Name	VScrub Blowdown	Venturi OG	Demister Water	Demister OG	Knock-Out Water	KO to Vscrub
Flow Units	lit/hr	sm3/hr	lit/hr	sm3/hr	lit/hr	lit/hr
Volume or Rate	852	2,870	39.8	2,870	1,040	811
Specific Gravity	1.00	1.00	1.00	1.00	1.00	1.00
Temperature, C	75	80.2		80.2		
Temperature, F	167	176		176		
Pressure, psia		9.4				
Pressure, kPa		6.4				
Composition	moles/lit	gm/sm3	moles/lit	gm/sm3	moles/lit	moles/lit
Ag+1	1.38795E-08	4.95E-08	3.13879E-08	2.47E-09	0	0.00E+00
Al+3	1.52E-04	1.36E-04	3.45E-04	6.79E-06	0.00E+00	0.00E+00
As+3	1.80316E-08	4.46E-08	4.07777E-08	2.23E-09	0	0.00E+00
B+3	6.62E-06	2.36E-06	1.50E-05	1.18E-07	0.00E+00	0.00E+00
Ba+2	1.53292E-08	6.96E-08	3.46663E-08	3.48E-09	0	0.00E+00
Ca+2	1.33E-05	1.76E-05	3.01E-05	8.82E-07	0.00E+00	0.00E+00
Cd+2	1.30E-06	4.82E-06	2.94E-06	2.41E-07	0.00E+00	0.00E+00
Cl-1	2.10E-02	0.00E+00	1.59E-01	0.00E+00	0.00E+00	0.00E+00
Cr+3	1.37E-06	2.36E-06	3.11E-06	1.18E-07	0.00E+00	0.00E+00
Cs+1	7.2306E-09	3.18E-08	1.63517E-08	1.59E-09	0	0.00E+00
F-1	3.11E-02	8.47E-18	2.36E-01	4.23E-19	0.00E+00	0.00E+00
Fe+3	5.89E-06	1.09E-05	1.33E-05	5.44E-07	0.00E+00	0.00E+00
H+1	0.052149686	0.00E+00	0.395276286	0.00E+00	0	0.00E+00
Hg+2	2.17E-06	5.34E-06	9.50E-05	0.00E+00	0.00E+00	0.00E+00
K+1	4.38E-05	5.66E-05	9.91E-05	2.83E-06	0.00E+00	0.00E+00
Mg+2	4.50E-07	3.61E-07	1.02E-06	1.81E-08	0.00E+00	0.00E+00
Mn+2	3.43E-06	6.22E-06	7.75E-06	3.11E-07	0.00E+00	0.00E+00
Mo+6	2.87E-07	9.09E-07	6.49E-07	4.55E-08	0.00E+00	0.00E+00
Na+1	3.93E-04	2.98E-04	8.88E-04	1.49E-05	0.00E+00	0.00E+00
Ni+2	6.63E-07	2.03E-06	1.50E-06	1.02E-07	0.00E+00	0.00E+00
NO3-1	0	0.00E+00	0	0.00E+00	0	0.00E+00
Pb+2	2.73E-07	1.87E-06	6.18E-07	9.35E-08	0.00E+00	0.00E+00
PO4-3	2.76E-06	8.65E-06	6.24E-06	4.33E-07	0.00E+00	0.00E+00
Ru+4	4.46E-07	1.88E-06	1.01E-06	9.40E-08	0.00E+00	0.00E+00
Se+4	1.17632E-07	3.07E-07	2.6602E-07	1.53E-08	0	0.00E+00
Si+4	9.83E-07	9.12E-07	2.22E-06	4.56E-08	0.00E+00	0.00E+00
SO4-2	0	0	0	0	0	0
Zr+4	4.36E-06	1.31E-05	9.86E-06	6.57E-07	0.00E+00	0.00E+00
U+4	5.19516E-07	4.09E-06	1.17486E-06	2.04E-07	0	0.00E+00
Zn+2	1.93E-07	4.17E-07	4.37E-07	2.09E-08	0.00E+00	0.00E+00
	moles/lit	gm/sm3	moles/lit	gm/sm3	moles/lit	moles/lit
H2O	55.51	15.42	55.51	1.54	55.51	55.51
O	0	0	0	0	0	0
B2O3	0	0	0	0	0	0
Li2O	0	0	0	0	0	0
SiO2	0	0	0	0	0	0
TiO2	0	0	0	0	0	0
Fe2O3	0	0	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	0.057377441	0	0.057385145	0	0
CO	0	8.47386E-05	0	8.47499E-05	0	0
H2O(g)	0	0.737108997	0	0.737207968	0	0
N2	0	0.19729196	0	0.19731845	0	0
NO	0	0.000341113	0	0.000341159	0	0
NO2	0	9.74608E-06	0	9.74739E-06	0	0
O2	0	0.00503843	0	0.005039107	0	0
HF	0	0.000160277	0	8.01494E-05	0	0
HCl	0	0.000108162	0	5.40881E-05	0	0
Ar	0	0.002400063	0	0.002400385	0	0
SO2	0	7.26237E-05	0	7.26335E-05	0	0
Hg(g)	0	6.44951E-06	0	6.41877E-06	0	0
H2	0	0	0	0	0	0
H2S	0	0	0	0	0	0

Stream Number	25	26	27	28	29	30
Stream Name	VScrub Blowdown	Venturi OG	Demister Water	Demister OG	Knock-Out Water	KO to Vscrub
Units	lit/hr	sm ³ /hr	lit/hr	sm ³ /hr	lit/hr	lit/hr
Volume or Rate	852	2,870	40	2,870	1,040	811
	g/lit	g/lit	g/lit	g/lit	g/lit	g/lit
HEDPA	0	0	0	0	0	0
TOC	0	0	0	0	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit
Am-241	1.23E-07	4.08E-09	2.79E-07	2.04E-10	0.00E+00	0.00E+00
Am-243	4.93889E-11	1.63E-12	1.11691E-10	8.16E-14	0	0.00E+00
Cm-244	4.10021E-09	1.35E-10	9.27245E-09	6.78E-12	0	0.00E+00
Np-237	4.43E-10	1.46E-11	1.00E-09	7.32E-13	0.00E+00	0.00E+00
Pu-238	2.78E-07	9.19E-09	6.29E-07	4.60E-10	0.00E+00	0.00E+00
Pu-239	2.05E-08	6.77E-10	4.63E-08	3.39E-11	0.00E+00	0.00E+00
Pu-240	5.92E-09	1.96E-10	1.34E-08	9.78E-12	0.00E+00	0.00E+00
Pu-241	1.29E-07	4.26E-09	2.91E-07	2.13E-10	0.00E+00	0.00E+00
Pu-242	5.02E-12	1.66E-13	1.14E-11	8.30E-15	0.00E+00	0.00E+00
Th-230	1.07165E-13	3.54E-15	2.42348E-13	1.77E-16	0	0.00E+00
U-232	5.28834E-13	1.75E-14	1.19594E-12	8.74E-16	0	0.00E+00
U-233	1.76589E-15	5.84E-17	3.99348E-15	2.92E-18	0	0.00E+00
U-234	2.77E-10	9.15E-12	6.26E-10	4.58E-13	0.00E+00	0.00E+00
U-235	7.12E-12	2.35E-13	1.61E-11	1.18E-14	0.00E+00	0.00E+00
U-236	1.28E-11	4.24E-13	2.90E-11	2.12E-14	0.00E+00	0.00E+00
U-238	6.83E-12	2.26E-13	1.54E-11	1.13E-14	0.00E+00	0.00E+00
Ba-137m	4.07E-05	1.35E-06	9.21E-05	6.73E-08	0.00E+00	0.00E+00
Ce-144	2.01982E-13	6.67E-15	4.56774E-13	3.34E-16	0	0.00E+00
Co-60	1.50E-08	4.96E-10	3.39E-08	2.48E-11	0.00E+00	0.00E+00
Cs-134	2.62E-08	8.67E-10	5.93E-08	4.33E-11	0.00E+00	0.00E+00
Cs-135	7.19886E-10	2.38E-11	1.62799E-09	1.19E-12	0	0.00E+00
Cs-137	4.31E-05	1.42E-06	9.74E-05	7.12E-08	0.00E+00	0.00E+00
Eu-152	7.6879E-10	2.54E-11	1.73858E-09	1.27E-12	0	0.00E+00
Eu-154	4.58E-08	1.51E-09	1.04E-07	7.57E-11	0.00E+00	0.00E+00
Eu-155	1.81481E-08	6.00E-10	4.10411E-08	3.00E-11	0	0.00E+00
Pm-147	2.60923E-08	8.62E-10	5.90065E-08	4.31E-11	0	0.00E+00
Pr-144	2.01982E-13	6.67E-15	4.56774E-13	3.34E-16	0	0.00E+00
Ni-63	1.36E-08	4.48E-10	3.06623E-08	2.24E-11	0	0
Ru-106	1.62E-11	5.37E-13	3.67219E-11	2.68E-14	0	0
Sb-125	9.70E-09	3.21E-10	2.19E-08	1.60E-11	0	0
Sm-151	1.33E-07	4.39E-09	3.00301E-07	2.19E-10	0	0
Sr-90	1.23E-05	4.05E-07	2.77E-05	2.03E-08	0	0
Tc-99	6.77E-07	2.24E-08	1.53E-06	1.12E-09	0	0
Y-90	1.23E-05	4.05E-07	2.77E-05	2.03E-08	0	0
H-3	0	5.05E-06	0	5.06E-06	0	0
I-129	8.47E-07	4.27E-08	1.54E-06	2.13E-08	0	0

Stream Number	31	32	33	34	35	36
Stream Name	NOx Water	Knock-Out OG	Blowdown Recycle	Blowdown	Blowdown after IX	Dry Grout Mix
Flow Units	lit/hr	sm3/hr	lit/hr	lit/hr	lit/hr	kg/hr
Volume or Rate	229	1,465	35.0	1.5	1.5	3.6
Specific Gravity	1.00	1.00	1.01	1.01	1.01	
Temperature, C		71.0				
Temperature, F		160				
Pressure, psia		9.7				
Pressure, kPa		6.6				
Composition	moles/lit	gm/sm3	moles/lit	moles/lit	gm/sm3	
Ag+1	0	1.21E-14	6.51E-06	6.51E-06	6.51E-06	
Al+3	0.00E+00	3.33E-11	7.15E-02	7.15E-02	7.15E-02	
As+3	0	1.09E-14	8.46E-06	8.46E-06	8.46E-06	
B+3	0.00E+00	5.79E-13	3.11E-03	3.11E-03	3.11E-03	
Ba+2	0	1.70E-14	7.19E-06	7.19E-06	7.19E-06	
Ca+2	0.00E+00	4.32E-12	6.25E-03	6.25E-03	6.25E-03	
Cd+2	0.00E+00	1.18E-12	6.09E-04	6.09E-04	6.09E-04	
Cl-1	0.00E+00	0.00E+00	1.69E-02	1.69E-02	1.69E-02	
Cr+3	0.00E+00	5.78E-13	6.45E-04	6.45E-04	6.45E-04	
Cs+1	0	7.78E-15	3.39E-06	3.39E-06	3.39E-10	
F-1	0.00E+00	2.07E-24	2.50E-02	2.50E-02	2.50E-02	
Fe+3	0.00E+00	2.66E-12	2.77E-03	2.77E-03	2.77E-03	
H+1	0	0.00E+00	4.18E-02	4.18E-02	4.18E-02	
Hg+2	0.00E+00	0.00E+00	6.76E-07	6.76E-07	6.76E-07	
K+1	0.00E+00	1.39E-11	2.06E-02	2.06E-02	2.06E-02	
Mg+2	0.00E+00	8.85E-14	2.11E-04	2.11E-04	2.11E-04	
Mn+2	0.00E+00	1.52E-12	1.61E-03	1.61E-03	1.61E-03	
Mo+6	0.00E+00	2.23E-13	1.35E-04	1.35E-04	1.35E-04	
Na+1	0.00E+00	7.31E-11	1.84E-01	1.84E-01	1.84E-01	
Ni+2	0.00E+00	4.99E-13	3.11E-04	3.11E-04	3.11E-04	
NO3-1	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
Pb+2	0.00E+00	4.58E-13	1.28E-04	1.28E-04	1.28E-04	
PO4-3	0.00E+00	2.12E-12	1.29E-03	1.29E-03	1.29E-03	
Ru+4	0.00E+00	4.60E-13	2.09E-04	2.09E-04	2.09E-04	
Se+4	0	7.52E-14	5.52E-05	5.52E-05	5.52E-05	
Si+4	0.00E+00	2.23E-13	4.61E-04	4.61E-04	4.61E-04	
SO4-2	0	0	0	0	0	
Zr+4	0.00E+00	3.22E-12	2.05E-03	2.05E-03	2.05E-03	
U+4	0	1.00E-12	2.44E-04	2.44E-04	2.44E-04	
Zn+2	0.00E+00	1.02E-13	9.06E-05	9.06E-05	9.06E-05	
	moles/lit	gm/sm3	moles/lit	moles/lit	gm/sm3	
H2O	55.51	0.00	55.51	55.51	55.51	
O	0	0	0	0	0	
B2O3	0	0	0	0	0	
Li2O	0	0	0	0	0	
SiO2	0	0	0	0	0	
TiO2	0	0	0	0	0	
Fe2O3	0	0	0	0	0	
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	
CO2	0	0.112454692	0	0	0	
CO	0	0.00016608	0	0	0	
H2O(g)	0	0.485020082	0	0	0	
N2	0	0.386674735	0	0	0	
NO	0	0.000668551	0	0	0	
NO2	0	1.91014E-05	0	0	0	
O2	0	0.009874877	0	0	0	
HF	0	0.000157065	0	0	0	
HCl	0	0.000105994	0	0	0	
Ar	0	0.00470391	0	0	0	
SO2	0	0.000142336	0	0	0	
Hg(g)	0	1.25785E-05	0	0	0	
H2	0	0	0	0	0	
H2S	0	0	0	0	0	

Stream Number	31	32	33	34	35	36
Stream Name	NOx Water	Knock-Out OG	Blowdown Recycle	Blowdown	Blowdown after IX	Dry Grout Mix
Units	lit/hr	sm ³ /hr	lit/hr	lit/hr	lit/hr	kg/hr
Volume or Rate	229	1,465	35	1	1.5	3.6
	g/lit	g/lit	g/lit	g/lit	g/lit	kg/kg
HEDPA	0	0	0	0	0	
TOC	0	0	0	0	0	
Portland Cement	0	0	0	0	0	0.5
Slag	0	0	0	0	0	0.5
	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit
Am-241	0.00E+00	9.99E-16	5.79E-05	5.79E-05	5.79E-05	
Am-243	0	4.00E-19	2.32E-08	2.32E-08	2.32E-08	
Cm-244	0	3.32E-17	1.92E-06	1.92E-06	1.92E-06	
Np-237	0.00E+00	3.58E-18	2.08E-07	2.08E-07	2.08E-07	
Pu-238	0.00E+00	2.25E-15	1.31E-04	1.31E-04	1.31E-04	
Pu-239	0.00E+00	1.66E-16	9.62E-06	9.62E-06	9.62E-06	
Pu-240	0.00E+00	4.79E-17	2.78E-06	2.78E-06	2.78E-06	
Pu-241	0.00E+00	1.04E-15	6.04E-05	6.04E-05	6.04E-05	
Pu-242	0.00E+00	4.07E-20	2.36E-09	2.36E-09	2.36E-09	
Th-230	0	8.68E-22	5.03E-11	5.03E-11	5.03E-11	
U-232	0	4.28E-21	2.48E-10	2.48E-10	2.48E-10	
U-233	0	1.43E-23	8.29E-13	8.29E-13	8.29E-13	
U-234	0.00E+00	2.24E-18	1.30E-07	1.30E-07	1.30E-07	
U-235	0.00E+00	5.77E-20	3.34E-09	3.34E-09	3.34E-09	
U-236	0.00E+00	1.04E-19	6.02E-09	6.02E-09	6.02E-09	
U-238	0.00E+00	5.53E-20	3.21E-09	3.21E-09	3.21E-09	
Ba-137m	0.00E+00	3.30E-13	1.91E-02	1.91E-02	1.91E-06	
Ce-144	0	1.64E-21	9.48E-11	9.48E-11	9.48E-11	
Co-60	0.00E+00	1.22E-16	7.04E-06	7.04E-06	7.04E-06	
Cs-134	0.00E+00	2.12E-16	1.23E-05	1.23E-05	1.23E-09	
Cs-135	0	5.83E-18	3.38E-07	3.38E-07	3.38E-11	
Cs-137	0.00E+00	3.49E-13	2.02E-02	2.02E-02	2.02E-06	
Eu-152	0	6.22E-18	3.61E-07	3.61E-07	3.61E-07	
Eu-154	0.00E+00	3.71E-16	2.15E-05	2.15E-05	2.15E-05	
Eu-155	0	1.47E-16	8.52E-06	8.52E-06	8.52E-06	
Pm-147	0	2.11E-16	1.22E-05	1.22E-05	1.22E-05	
Pr-144	0	1.64E-21	9.48E-11	9.48E-11	9.48E-11	
Ni-63	0	1.10E-16	6.36E-06	6.36E-06	6.36E-06	
Ru-106	0	1.31E-19	7.62E-09	7.62E-09	7.62E-09	
Sb-125	0	7.85E-17	4.55E-06	4.55E-06	4.55E-06	
Sm-151	0	1.08E-15	6.23E-05	6.23E-05	6.23E-05	
Sr-90	0	9.92E-14	5.75E-03	5.75E-03	5.75E-06	
Tc-99	0	5.48E-15	3.18E-04	3.18E-04	3.18E-04	
Y-90	0	9.92E-14	5.75E-03	5.75E-03	5.75E-06	
H-3	0	9.91E-06	0	0	0	
I-129	0	4.18E-08	2.13E-04	2.13E-04	2.13E-04	

Stream Number	37	38
Stream Name	LLW Grout	Off-Gas to Stack
Flow Units	kg/hr	sm ³ /hr
Volume or Rate	5.1	2870
Specific Gravity	1.826	1.00
Temperature, C		
Temperature, F		
Pressure, psia		
Pressure, kPa		
Composition	gm/sm ³	gm/sm ³
Ag+1	2.02E-07	4.95E-08
Al+3	5.53E-04	1.36E-04
As+3	1.82E-07	4.46E-08
B+3	9.63E-06	2.36E-06
Ba+2	2.83E-07	6.96E-08
Ca+2	7.18E-05	1.76E-05
Cd+2	1.96E-05	4.82E-06
Cl-1	1.71E-04	0.00E+00
Cr+3	9.62E-06	2.36E-06
Cs+1	1.29E-11	3.18E-08
F-1	1.36E-04	8.47E-18
Fe+3	4.43E-05	1.09E-05
H+1	1.21E-05	0.00E+00
Hg+2	3.89E-08	5.34E-06
K+1	2.31E-04	5.66E-05
Mg+2	2.08E-06	3.61E-07
Mn+2	2.53E-05	6.22E-06
Mo+6	3.70E-06	9.09E-07
Na+1	1.22E-03	2.98E-04
Ni+2	5.24E-06	2.03E-06
NO3-1	0.00E+00	0.00E+00
Pb+2	7.62E-06	1.87E-06
PO4-3	3.53E-05	8.65E-06
Ru+4	6.06E-06	1.88E-06
Se+4	1.25E-06	3.07E-07
Si+4	3.72E-06	9.12E-07
SO4-2	0	0
Zr+4	5.35E-05	1.31E-05
U+4	1.66E-05	4.09E-06
Zn+2	1.70E-06	4.17E-07
	gm/sm ³	gm/sm ³
H2O	0.287	15.42398799
O	0	0
B2O3	0.001	0
Li2O	1.82E-07	0
SiO2	9.63E-06	0
TiO2	2.83E-07	0
Fe2O3	7.18E-05	0
	mole fraction	mole fraction
CO2	0.112454692	#REF!
CO	0	#REF!
H2O(g)	0	#REF!
N2	0	#REF!
NO	0	#REF!
NO2	0	#REF!
O2	0	#REF!
HF	0	#REF!
HCl	0	#REF!
Ar	0	#REF!
SO2	0	#REF!
Hg(g)	0	#REF!
H2	0	#REF!
H2S	0	#REF!

Stream Number	37	38
Stream Name	LLW Grout	Off-Gas to Stack
Units	kg/hr	sm3/hr
Volume or Rate	5.1	2,870
	kg/kg	g/sm3
HEDPA	0	0
TOC	0	0
Portland Cement	0.355	0
Slag	0.355	0
	Ci/lit	Ci/lit
Am-241	1.66E-05	4.08E-09
Am-243	6.65E-09	1.63E-12
Cm-244	5.52E-07	1.35E-10
Np-237	5.96E-08	1.46E-11
Pu-238	3.74E-05	9.19E-09
Pu-239	2.76E-06	6.77E-10
Pu-240	7.97E-07	1.96E-10
Pu-241	1.73E-05	4.26E-09
Pu-242	6.76E-10	1.66E-13
Th-230	1.44E-11	3.54E-15
U-232	7.12E-11	1.75E-14
U-233	2.38E-13	5.84E-17
U-234	3.73E-08	9.15E-12
U-235	9.59E-10	2.35E-13
U-236	1.73E-09	4.24E-13
U-238	9.20E-10	2.26E-13
Ba-137m	5.48E-07	1.35E-06
Ce-144	2.72E-11	6.67E-15
Co-60	2.02E-06	4.96E-10
Cs-134	3.53E-10	8.67E-10
Cs-135	9.69E-12	2.38E-11
Cs-137	5.80E-07	1.42E-06
Eu-152	1.03E-07	2.54E-11
Eu-154	6.16E-06	1.51E-09
Eu-155	2.44E-06	6.00E-10
Pm-147	3.51E-06	8.62E-10
Pr-144	2.72E-11	6.67E-15
Ni-63	1.83E-06	4.48E-10
Ru-106	2.19E-09	5.37E-13
Sb-125	1.31E-06	3.21E-10
Sm-151	1.79E-05	4.39E-09
Sr-90	1.65E-06	4.05E-07
Tc-99	9.11E-05	2.24E-08
Y-90	1.65E-06	4.05E-07
H-3	0	5.05E-06
I-129	6.11E-05	4.27E-08

Appendix C
Schedule

VITRIFICATION OF SBW

Task #	Task Name	Duration	Schedule Start	Schedule Finish	% Complete	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y
1	TOTAL PROJECT SCHEDULE	9653d	01/02/02	12/31/38	0%								
2	VITRIFICATION FACILITY	9653d	01/02/02	12/31/38	0%								
3	CONCEPTUAL DESIGN	783d	01/02/02	12/31/04	0%								
4	PROJECT SUPPORT	2870d	01/02/02	01/01/13	0%								
5	PERMITTING	2348d	01/02/04	01/01/13	0%								
15	RCRA PERMITS	1044d	01/02/04	01/02/08	0%								
14	DELIST HLW	1305d	01/02/08	01/01/13	0%								
13	DELIST LLW	1305d	01/02/08	01/01/13	0%								
12	AIR PERMITS	782d	01/04/10	01/01/13	0%								
6	TITLE DESIGN	651d	01/03/05	07/02/07	0%								
7	PROJECT MANAGEMENT	1694d	01/03/05	06/30/11	0%								
8	QUALITY ASSURANCE	1694d	01/03/05	06/30/11	0%								
9	CONSTRUCTION MANAGEMENT	1044d	07/03/07	07/01/11	0%								
10	CONSTRUCTION	1044d	07/03/07	07/01/11	0%								
11	S O TEST/STARTUP	522d	01/03/11	01/01/13	0%								
16	START PROCESSING	0d	01/01/13	01/01/13	0%								
17	PROCESS	522d	01/01/13	12/31/14	0%								
18	D,D&D	783d	01/02/36	12/31/38	0%								

Default

Complete

Complete Milestone

Remaining

Remaining Milestone

Free Float

Total Float (+)

Total Float (-)

Delay

Non-Resource

Critical

Remaining

Remaining Milestone

Parent

Remaining

Remaining Milestone

[illegible]

Appendix D
Total Project Costs

INTEROFFICE MEMORANDUM

Date: May 24, 2000

To: J. J. Quigley MS 3625 6-3416

From: R. D. Adams *RDA* MS 3655 6-2963

Subject: VITRIFICATION FOR SODIUM BEARING WASTE (SBW)

Estimating Services has prepared a Planning Estimate for the subject project. This estimate was based on information received March 10, 2000, through May 23, 2000.

The Total Project Cost (TPC) is \$738,000,000. This cost includes Conceptual Design costs, Project Support costs, Permitting costs, Construction Management costs, Engineering costs, Quality Assurance costs, Project Management costs, direct and indirect construction costs, System Operation/Startup costs, Procurement Fee, G&A, escalation and contingency. The estimated costs have been escalated to the midpoints represented in the attached schedule. For more detailed information, please refer to the Cost Estimate Support Data Recapitulation form.

Attached for your review are the TPC Summary Report, the Cost Estimate Support Data Recapitulation form, Project Summary Report, Construction Detail Item Report, Contractor Distribution Report, and Project Schedule.

Due to minimal detail and scoping definition, this estimate is considered a "Planning" estimate and is not intended to be used to establish a cost baseline.

If you have any questions regarding this estimate, please contact me at 526-2963, or E-mail at radams@inel.gov.

RDA

Attachments

cc: Estimate File 2555 *[Signature]*
R. J. Turk, MS 3878
R. D. Adams File (RDA-09-00)

TPC Summary Report 2

Project Name: **VITRIFICATION OF SBW**
 Project Location: **INEEL/INTEC**
 Project Number: **2555**

ESTIMATE ELEMENT

	<u>Estimate Subtotal</u>	<u>Escalation</u>	<u>Contingency</u>	<u>TOTAL</u>
Total Estimated Cost (TEC)	\$321,252,222	27.37% \$87,927,984	42.29% \$173,048,352	\$582,228,558
Other Project Cost (OPC)	\$78,935,317	21.67% \$17,107,921	61.86% \$59,413,968	\$155,457,206
Total Project Cost (TPC)	\$400,187,539	26.25% \$105,035,905	46.01% \$232,462,320	\$737,685,764
Rounded TPC	(Rounded to the nearest \$ 1000000) \$738,000,000			

Type of Estimate: <u>Planning</u> Estimator: <u>R. D. Adams</u> Checked By: Approved By:	Remarks
---	---------

COST ESTIMATE SUPPORT DATA RECAPITULATION

Project Title: VITRIFICATION FACILITY FOR SBW
Estimator: R. D. Adams
Date: May 23, 2000
Estimate Type: Planning
File: 2555
Approved By:

I. **SCOPE OF WORK:** *Brief description of the proposed project.*

This project would construct a facility that would receive liquid Sodium Bearing Waste (SBW), process it through vitrification, treat the off-gas, and grout secondary waste streams. An office area is included at one end of the proposed facility. An oil-fired steam generator (boiler) would also be required to produce steam for process and building heating needs. As currently envisioned, this facility would consist of a processing building measuring approximately 380' by 169' at grade level, with basement levels extending 32' below grade and roof elevation at 75'. In addition to the main processing building, there are two truck bays attached; one measuring 80' by 40' and one measuring 30' by 20'. The office area would measure 189' by 68' with an assumed eave height of 14'. The boiler building would be a concrete masonry unit (CMU) building measuring 60' by 52' by 30' high.

II. **BASIS OF THE ESTIMATE:** *Drawings, Design Report, Engineers Notes and/or other documentation upon which the estimate is originated.*

This estimate is based on information obtained by material take-off of preliminary facility sketches supplied with the feasibility study estimate request. Also included with the request were several lists addressing process equipment, mechanical HVAC equipment, instrumentation, and sampling equipment. A one-line electrical load sketch was used to establish the electrical distribution equipment.

Much of the detail estimating was based on construction databases such as Means and the Construction Unit Price Book. Several of the special pieces of equipment were priced using preliminary vendor quotes.

III. **ASSUMPTIONS:** *Conditions statements accepted or supposed true without proof of demonstration. An assumption has a direct impact on total estimated cost.*

- A. Construction of this project will be competitively bid among subcontractors familiar with this type of construction and DOE projects at the INEEL.
- B. Design, management, quality assurance, and contractor general conditions costs are based on historical percentages and/or factors from similar site projects.

COST ESTIMATE SUPPORT DATA RECAPITULATION

- Continued -

Project Title: VITRIFICATION FACILITY FOR SBW
File: 2555

Page 2

- C. No contaminated soil will be encountered during excavation for this project.
- D. All direct costs are in present-day dollars, escalated to the appropriate schedule mid point.
- E. No asbestos will be encountered during this project.
- F. Allowances for distribution piping, electrical, HVAC ductwork, structural steel, and DCS are based on historical information from similar hot-cell facilities and applied parametrically by area.
- G. Very little information is available for Nitronic 50 alloy materials. Historically this alloy's costs are approximately double those of stainless steel. A factor of two was used to estimate the costs of Nitronic 50 materials. Welding and machining labor is approximately thirty percent more than stainless steel.
- H. Rock will not be encountered during excavation activities. Historically, rock is located more than 35' below the surface at the northeast corner of INTEC.
- I. Although the elevation sketch indicates a one-foot floor thickness at the hatch level, the estimate assumes three feet of concrete for shielding of personnel in the crane bay.
- J. Fire protection sprinkler systems throughout the process facility were assumed to be wet-pipe sprinkler systems similar to that proposed for FPR.
- K. The design team identified areas requiring stainless steel cell lining and epoxy coating. All other exposed concrete surfaces are assumed to be sealed or painted.
- L. All concrete is assumed to be 4000 psi. No high-density concrete is included.
- M. All exterior concrete walls will be covered with semi-rigid insulation and metal siding.
- N. Mechanical and electrical jumpers will be similar to those intended for use in FPR.
- O. Additional basis can be found in the estimate details via attached memos.

IV. **CONTINGENCY GUIDELINE IMPLEMENTATION:** *The percentage used for contingency as determined by the contingency allowance guidelines can be altered to reflect the type of construction and conditions that may impact the total estimated cost.*

Concerns when determining the amount of contingency needed to successfully complete this project:

- A. Project definition is at a planning level. The maturity of design is not sufficient to accurately determine the project cost.
- B. This is a very complex project. At least sixteen major process steps can be identified. This compounds the risk that all processes will work as planned to produce a desired outcome.
- C. The level of innovation currently employed in this project, while not necessarily first-of-a-kind applications, could not be viewed as "tried-and-true" when considering chemistries and materials-of-construction. Extensive process development activities are planned to verify the processes, but monies may be spent pursuing a design that process development later determines is not viable.

COST ESTIMATE SUPPORT DATA RECAPITULATION

- Continued -

Project Title: VITRIFICATION FACILITY FOR SBW
File: 2555

Page 3

- D. Much of the material identified for the various processes is of an exotic alloy nature. Allowances have been made to estimate the price of the items made of exotic alloys, but equipment and pipe manufacturers may not provide competitive prices for their products containing these alloys. Several of the vendors contacted for pricing were unfamiliar with the alloy and not confident of their ability to manufacture with it.

The risk associated with this project, and therefore the contingency needed, could be considerably more than addressed in the INEEL Cost Estimating Guide. Contingency to cover the risks associated with this project and level of estimate have been addressed using our @Risk contingency tool. This program statistically calculates monies required to mitigate perceived risks by using range inputs and Monte Carlo or Latin Hypercube simulations. See the backup attached.

V. OTHER COMMENTS/CONCERNS SPECIFIC TO THE ESTIMATE

- A. Subcontractor labor costs reflect INEEL Site Jurisdictional Agreement craft labor rates.
- B. Subcontractor overheads and profits are those customarily seen for work at the INEEL and projects approaching this size.
- C. Procurement fee of 4.1 percent of subcontract dollars and BBWI G&A rate of 37.5 percent of the procurement fee are the current published rates for FY 2000 and beyond.
- D. Due to minimal detail and scoping definition, this estimate is considered a "Planning" estimate and is not intended to be used to establish a cost baseline.

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: 2555

Project Summary Report

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>PROJECT DEVELOPMENT</u>	<u>Estimate Subtotal</u>	<u>Escalation</u>	<u>Contingency</u>	<u>Contingency %</u>	<u>TOTAL</u>
OPC1000		\$44,680,759	\$5,064,392	\$17,560,038	35.30%	\$67,305,189
OPC1100	--CONCEPTUAL DESIGN	\$8,040,910	\$718,053	\$3,091,914	35.30%	\$11,850,877
OPC1200	--PROJECT EXECUTION PLAN	\$205,886	\$18,386	\$79,168	35.30%	\$303,439
OPC1300	--WORK PACKAGE DEVELOPMENT	\$457,524	\$40,857	\$175,928	35.30%	\$674,309
OPC1400	--TASK BASELINE AGREEMENT	\$671,035	\$59,923	\$258,028	35.30%	\$988,987
OPC1500	--PRELIMINARY SAFETY ANALYSIS REPORT (PSAR)	\$1,305,404	\$116,573	\$501,958	35.30%	\$1,923,934
OPC1600	--TECHNICAL DEVELOPMENT	\$34,000,000	\$4,110,600	\$13,453,042	35.30%	\$51,563,642
OPC2000	PROJECT EXECUTION	\$11,488,334	\$2,734,420	\$7,523,701	52.90%	\$21,746,456
OPC2100	--PROJECT SUPPORT	\$6,030,682	\$1,333,987	\$2,627,714	35.68%	\$9,992,383
OPC2200	--PERMITTING	\$5,457,652	\$1,400,434	\$4,895,987	71.39%	\$11,754,073
1000	CONSTRUCTION MANAGEMENT	\$21,455,408	\$6,288,580	\$12,310,008	44.37%	\$40,053,996
1100	--CONSTRUCTION SUPERVISION & ENGINEERING	\$18,092,047	\$5,302,779	\$10,380,284	44.37%	\$33,775,110
1110	--CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE	\$333,210	\$97,664	\$191,179	44.37%	\$622,053
1200	--CM PROJECT CONTROLS **	\$1,439,953	\$422,050	\$826,171	44.37%	\$2,688,174
1300	--CM ES&H **	\$937,875	\$274,891	\$538,104	44.37%	\$1,750,870
1400	--CM TRAINING **	\$352,323	\$103,266	\$202,145	44.37%	\$657,734
1500	--CONSTRUCTION OTHER DIRECT COSTS	\$300,000	\$87,930	\$172,125	44.37%	\$560,055
2000	TITLE I DESIGN	\$12,313,874	\$1,888,948	\$5,070,407	35.70%	\$19,273,230
2200	--A-E ADMINISTRATIVE ACTIVITIES	\$1,255,011	\$192,519	\$516,768	35.70%	\$1,964,298
2300	--ENGINEERING SERVICES	\$301,534	\$46,255	\$124,161	35.70%	\$471,950

INEEL

05/24/2000 11:00:57

Success Estimating and Cost Management System

Page No. 1

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: 2555

Project Summary Report

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>Estimate Subtotal</u>	<u>Escalation</u>	<u>Contingency</u>	<u>Contingency %</u>	<u>TOTAL</u>
2400	\$6,030,682	\$925,107	\$2,483,217	35.70%	\$9,439,006
2500	\$4,020,455	\$616,738	\$1,655,478	35.70%	\$6,292,670
2600	\$411,665	\$63,149	\$169,509	35.70%	\$644,323
2700	\$173,913	\$26,678	\$71,611	35.70%	\$272,202
2800	\$120,614	\$18,502	\$49,664	35.70%	\$188,780
3000	\$28,986,598	\$5,414,697	\$14,992,084	43.58%	\$49,393,379
3200	\$2,908,725	\$543,350	\$1,504,414	43.58%	\$4,956,488
3300	\$703,580	\$131,429	\$363,897	43.58%	\$1,198,905
3400	\$14,071,592	\$2,628,573	\$7,277,932	43.58%	\$23,978,097
3500	\$9,850,114	\$1,840,001	\$5,094,552	43.58%	\$16,784,668
3600	\$823,330	\$153,798	\$425,833	43.58%	\$1,402,961
3700	\$347,826	\$64,974	\$179,898	43.58%	\$592,698
3800	\$281,432	\$52,571	\$145,559	43.58%	\$479,562
4000	\$9,850,114	\$2,527,539	\$4,105,668	33.17%	\$16,483,321
4100	\$9,850,114	\$2,527,539	\$4,105,668	33.17%	\$16,483,321
5000	\$29,314,789	\$7,522,175	\$15,707,281	42.64%	\$52,544,245
5100	\$19,490,001	\$5,001,134	\$10,443,020	42.64%	\$34,934,156
5110	\$77,672	\$19,931	\$41,618	42.64%	\$139,221
5200	\$3,819,432	\$980,066	\$2,046,506	42.64%	\$6,846,004
5300	\$3,316,875	\$851,110	\$1,777,229	42.64%	\$5,945,214

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Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

Project Summary Report

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>Estimate Subtotal</u>	<u>Escalation</u>	<u>Contingency</u>	<u>Contingency %</u>	<u>TOTAL</u>
5400	\$2,610,808	\$669,933	\$1,398,908	42.64%	\$4,679,650
	--SAFETY ANALYSIS				
6000	\$3,651,370	\$1,070,216	\$1,402,311	29.70%	\$6,123,897
	CONSTRUCTION AE SUPPORT				
6100	\$1,571,812	\$460,698	\$603,656	29.70%	\$2,636,166
	--DISPOSITION OF FIELD PROBLEMS				
6200	\$1,047,875	\$307,132	\$402,437	29.70%	\$1,757,444
	--VENDOR DATA REVIEW				
6300	\$1,016,713	\$297,999	\$390,469	29.70%	\$1,705,181
	--AS-BUILDING				
6400	\$14,970	\$4,388	\$5,749	29.70%	\$25,106
	--A-E OVERSIGHT OF CONSTRUCTION				
9000	\$201,022,741	\$58,919,765	\$112,521,757	43.29%	\$372,464,263
	CONSTRUCTION				
9100	\$199,675,859	\$58,524,994	\$112,059,368	43.40%	\$370,260,220
	--CONSTRUCTION SUBCONTRACTS				
9101	\$12,105,638	\$3,548,162	\$8,304,341	53.05%	\$23,958,142
	---GENERAL CONDITIONS				
9101.1	\$8,293,592	\$2,430,852	\$1,964,718	18.32%	\$12,689,162
	---CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE				
9102	\$794,155	\$232,767	\$511,921	49.85%	\$1,538,843
	---SITEWORK				
9102.1	\$696,910	\$204,264	\$449,236	49.85%	\$1,350,411
	-----EARTHWORK				
9102.2	\$97,245	\$28,502	\$62,685	49.85%	\$188,432
	-----YARD PIPING				
9103	\$17,594,294	\$5,156,887	\$23,943,343	105.24%	\$46,694,524
	---CONCRETE				
9104	\$58,957	\$17,280	\$0	0.00%	\$76,237
	---MASONRY				
9105	\$20,296,016	\$5,948,762	\$8,358,962	31.85%	\$34,603,740
	---METALS				
9105.1	\$775,373	\$227,262	\$319,339	31.85%	\$1,321,975
	-----STRUCTURAL STEEL				
9105.2	\$12,756,984	\$3,739,072	\$5,253,994	31.85%	\$21,750,050
	-----SST LINERS				
9105.3	\$427,338	\$125,253	\$176,000	31.85%	\$728,590
	-----CRANE/CART RAILS				
9105.4	\$3,856,760	\$1,130,416	\$1,588,416	31.85%	\$6,575,592
	-----REBAR				
9105.5	\$2,479,561	\$726,759	\$1,021,213	31.85%	\$4,227,533
	-----EMBEDDED METALS				

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Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: 2555

Project Summary Report

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	-----THERMAL & MOISTURE PROTECTION	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
9107		\$1,514,163	\$443,801	\$722,097	36.88%	\$2,680,061
9107.1	-----BOILER BUILDING	\$82,988	\$24,318	\$39,567	36.88%	\$146,853
9107.2	-----OFFICE ADDITION	\$44,696	\$13,100	\$21,315	36.88%	\$79,112
9107.3	-----PROCESS BUILDING	\$1,386,499	\$406,383	\$661,215	36.88%	\$2,454,097
9108	----DOORS & WINDOWS	\$235,318	\$68,972	\$83,710	27.51%	\$388,000
9109	----FINISHES	\$3,187,097	\$934,138	\$2,225,055	53.99%	\$6,346,291
9109.1	-----INTERIOR PARTITIONS	\$40,490	\$11,868	\$28,268	53.99%	\$80,626
9109.1.1	-----Plns/mel,5/8"fr drwl f,none b,3-5/8" @24" OC fmg,nothng opp f,0 Insul	\$16,800	\$4,924	\$11,729	53.99%	\$33,453
9109.1.2	-----Plns/mel,5/8"fr drwl f,none base,3-5/8" @24" OC fmg,same opp f,0 Insul	\$16,546	\$4,850	\$11,551	53.99%	\$32,947
9109.1.3	-----Plns/mel,5/8"fr drwl f,5/8"fr drwl b,3-5/8" @24" 5/8"fr opp f,0 Insul	\$7,145	\$2,094	\$4,988	53.99%	\$14,227
9109.2	-----Tile, quarry tile, mud set, minimum	\$18,089	\$5,302	\$12,629	53.99%	\$36,019
9109.3	-----Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 24 oz	\$27,842	\$8,160	\$19,438	53.99%	\$55,440
9109.4	-----CEILINGS	\$35,523	\$10,412	\$24,800	53.99%	\$70,735
9109.4.1	-----ACous clgs,3/4" fbgl bd,24" x 24" tile,tee grid,suspended support	\$28,765	\$8,431	\$20,082	53.99%	\$57,277
9109.4.2	-----DRYWALL SUSPENDEED CEILINGS	\$6,758	\$1,981	\$4,718	53.99%	\$13,457
9109.4	-----COATINGS	\$2,808,841	\$823,271	\$1,960,977	53.99%	\$5,593,089
9109.5	-----PAINT STRUCTURAL STEEL	\$39,980	\$11,718	\$27,912	53.99%	\$79,611
9109.6	-----PAINT & LABEL PIPING	\$216,333	\$63,407	\$151,032	53.99%	\$430,771
9110	---SPECIALTIES	\$58,577	\$17,169	\$0	0.00%	\$75,745
9110.1	-----ACCESS FLOORING	\$44,897	\$13,159	\$0	0.00%	\$58,056
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Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

Project Summary Report

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>Estimate Subtotal</u>	<u>Escalation</u>	<u>Contingency</u>	<u>Contingency %</u>	<u>TOTAL</u>
9110.2	\$13,680	\$4,009	\$0	0.00%	\$17,689
-----BATHROOM ACCESSORIES & LOCKERS					
9111	\$33,998,823	\$9,965,055	\$25,266,041	57.47%	\$69,229,919
-----EQUIPMENT					
9111.1	\$801,992	\$235,064	\$595,996	57.47%	\$1,633,052
-----SBW WORKOFF					
9111.2	\$80,168	\$23,497	\$59,577	57.47%	\$163,242
-----FRIT					
9111.3	\$210,008	\$61,553	\$156,066	57.47%	\$427,628
-----SUGAR					
9111.4	\$1,821,915	\$534,003	\$1,353,947	57.47%	\$3,709,865
-----MIX TANKS					
9111.5	\$840,354	\$246,308	\$624,504	57.47%	\$1,711,165
-----FEED TANKS					
9111.6	\$14,288,057	\$4,187,829	\$10,618,092	57.47%	\$29,093,978
-----MELTER					
9111.7	\$114,339	\$33,513	\$84,971	57.47%	\$232,823
-----KEROSENE					
9111.8	\$380,125	\$111,415	\$282,488	57.47%	\$774,027
-----CANISTER FILLING					
9111.9	\$2,116,868	\$620,454	\$1,573,139	57.47%	\$4,310,461
-----MULT-STAGE SECONDARY COMBUSTER					
9111.10	\$212,951	\$62,416	\$158,253	57.47%	\$433,620
-----OFF-GAS SCRUB GAS SYSTEM					
9111.10.1	\$57,147	\$16,750	\$42,468	57.47%	\$116,365
-----EMERGENCY COOLING WATER					
9111.10.2	\$107,149	\$31,405	\$79,627	57.47%	\$218,181
-----DEMISTER COOLING					
9111.10.3	\$48,655	\$14,261	\$36,158	57.47%	\$99,074
-----REHEATER					
9111.11	\$270,620	\$79,319	\$201,110	57.47%	\$551,049
-----CHARCOAL FILTER					
9111.12	\$556,276	\$163,045	\$413,394	57.47%	\$1,132,715
-----OFF-GAS SCRUB LIQUID					
9111.12.1	\$219,532	\$64,345	\$163,144	57.47%	\$447,021
-----QUENCH					
9111.12.2	\$161,751	\$47,409	\$120,205	57.47%	\$329,366
-----SETTLING TANK					
9111.12.3	\$119,625	\$35,062	\$88,899	57.47%	\$243,586
-----SCRUB TANK					
9111.12.4	\$55,368	\$16,228	\$41,146	57.47%	\$112,743
-----CAUSTIC SOLUTION					
9111.13	\$261,086	\$76,524	\$194,025	57.47%	\$531,636
-----SCRUB WATER CLEANUP SYSTEM					

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Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Project Summary Report

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
9111.14	\$471,116	\$138,084	\$350,107	57.47%	\$959,308
9111.14.1	\$257,310	\$75,418	\$191,219	57.47%	\$523,947
9111.14.2	\$213,806	\$62,666	\$158,889	57.47%	\$435,361
9111.15	\$3,751,288	\$1,099,503	\$2,787,749	57.47%	\$7,638,540
9111.16	\$6,464,443	\$1,894,728	\$4,804,015	57.47%	\$13,163,186
9111.17	\$1,357,216	\$397,800	\$1,008,608	57.47%	\$2,763,624
9112	\$73,668	\$21,592	\$0	0.00%	\$55,260
9113	\$49,761,384	\$14,565,062	\$13,191,021	20.50%	\$77,537,467
9113.1	\$2,179,703	\$638,871	\$577,808	20.50%	\$3,396,382
9113.2	\$280,092	\$82,095	\$74,248	20.50%	\$436,436
9113.3	\$42,497,736	\$12,456,086	\$11,265,534	20.50%	\$66,219,356
9113.4	\$4,803,852	\$1,408,009	\$1,273,432	20.50%	\$7,485,293
9114	\$4,733,998	\$1,387,535	\$3,248,698	53.07%	\$9,370,231
9115	\$36,954,047	\$10,831,231	\$19,490,014	40.79%	\$67,275,293
9115.1	\$25,421,971	\$7,451,180	\$11,729,140	35.68%	\$44,602,290
9115.1.1	\$25,198,332	\$7,385,631	\$11,625,958	35.68%	\$44,209,921
9115.1.2	\$66,706	\$19,552	\$30,777	35.68%	\$117,035
9115.1.3	\$156,932	\$45,997	\$72,405	35.68%	\$275,335
9115.2	\$10,077,862	\$2,953,821	\$6,912,005	53.04%	\$19,943,688
9115.2.1	\$5,246,329	\$1,537,699	\$3,598,248	53.04%	\$10,382,276
9115.2.2	\$301,400	\$88,340	\$206,719	53.04%	\$596,459
9115.2.3	\$32,048	\$9,393	\$21,980	53.04%	\$63,422

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Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

Project Summary Report

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
9115.2.4 -----SUGAR	\$67,312	\$19,729	\$46,167	53.04%	\$133,209
9115.2.5 -----MIX TANKS	\$1,044,462	\$306,132	\$716,355	53.04%	\$2,066,948
9115.2.6 -----FEED TANKS	\$392,727	\$115,108	\$269,356	53.04%	\$777,191
9115.2.7 -----OFF-GAS SCRUB GAS SYSTEM	\$933,585	\$273,634	\$640,309	53.04%	\$1,847,528
9115.2.7.1 -----EMERGENCY COOLING WATER	\$82,606	\$24,212	\$56,656	53.04%	\$163,475
9115.2.7.2 -----DEMISTER COOLING	\$116,724	\$34,212	\$80,057	53.04%	\$230,993
9115.2.7.3 -----REHEATER	\$734,254	\$215,210	\$503,596	53.04%	\$1,453,060
9115.2.8 -----CHARCOAL FILTER	\$171,902	\$50,385	\$117,901	53.04%	\$340,188
9115.2.9 -----OFF-GAS SCRUB LIQUID	\$902,320	\$264,470	\$618,865	53.04%	\$1,785,655
9115.2.9.1 -----QUENCH	\$318,938	\$93,481	\$218,747	53.04%	\$631,167
9115.2.9.2 -----SETTLING TANK	\$239,754	\$70,272	\$164,437	53.04%	\$474,463
9115.2.9.3 -----SCRUB TANK	\$289,352	\$84,809	\$198,455	53.04%	\$572,617
9115.2.9.4 -----CAUSTIC SOLUTION	\$54,276	\$15,908	\$37,226	53.04%	\$107,409
9115.2.10 -----SCRUB WATER CLEANUP SYSTEM	\$532,826	\$156,171	\$365,444	53.04%	\$1,054,441
9115.2.11 -----SECONDARY WASTE GROUT	\$188,502	\$49,388	\$115,569	53.04%	\$333,459
9115.2.11.1 -----GROUT	\$146,392	\$42,908	\$100,405	53.04%	\$289,704
9115.2.11.2 -----MIXER DECON WASTE WATERT	\$22,110	\$6,480	\$15,164	53.04%	\$43,755
9115.2.12 -----PIPING - BOILER BUILDING	\$284,449	\$83,372	\$195,092	53.04%	\$562,913
9115.3 -----PLUMBING	\$29,913	\$8,768	\$0	0.00%	\$38,681
9115.3.1 -----Electric water heater, com, 100< F rise, 50 gallon tank, 9 KW 37 GPH	\$3,619	\$1,061	\$0	0.00%	\$4,680
9115.3.2 -----Electric water heater, commercial, 100< F rise, 80 gal, 12 KW 49 GPH	\$4,628	\$1,356	\$0	0.00%	\$5,985

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Success Estimating and Cost Management System

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Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

Project Summary Report

Client:

J. J. Quigley

Prepared By:

R. D. Adams

Estimate Type: Planning

LEVEL	Estimate Subtotal	Escalation	Contingency	Contingency %	TOTAL
9115.3.3	\$5,056	\$1,482	\$0	0.00%	\$6,538
9115.3.4	\$1,886	\$553	\$0	0.00%	\$2,438
9115.5	\$5,383	\$1,578	\$0	0.00%	\$6,961
9115.6	\$2,300	\$674	\$0	0.00%	\$2,974
9115.7	\$2,249	\$659	\$0	0.00%	\$2,909
9115.3.8	\$4,792	\$1,405	\$0	0.00%	\$6,197
9115.4	\$1,424,302	\$417,463	\$848,869	46.09%	\$2,690,634
9116	\$10,016,131	\$2,935,728	\$4,749,447	36.67%	\$17,701,306
9116.1	\$7,876,283	\$2,308,539	\$3,734,774	36.67%	\$13,919,595
9116.1.1	\$1,509,277	\$442,369	\$715,669	36.67%	\$2,667,314
9116.1.2	\$754,262	\$221,074	\$357,656	36.67%	\$1,332,993
9116.1.3	\$2,231,046	\$653,920	\$1,057,917	36.67%	\$3,942,882
9116.1.4	\$387,598	\$113,605	\$183,791	36.67%	\$684,993
9116.1.4.1	\$306,798	\$89,922	\$145,477	36.67%	\$542,197
9116.1.4.2	\$80,800	\$23,682	\$38,314	36.67%	\$142,796
9116.1.5	\$1,787,578	\$523,939	\$847,633	36.67%	\$3,159,151
9116.1.5.1	\$497,577	\$145,840	\$235,941	36.67%	\$879,358
9116.1.5.2	\$1,290,001	\$378,099	\$611,692	36.67%	\$2,279,793
9116.1.6	\$639,961	\$187,573	\$303,457	36.67%	\$1,130,990
9116.1.7	\$94,701	\$27,757	\$44,905	36.67%	\$167,362
9116.1.8	\$286,971	\$84,111	\$136,076	36.67%	\$507,159

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Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

Project Summary Report

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>Estimate Subtotal</u>	<u>Escalation</u>	<u>Contingency</u>	<u>Contingency %</u>	<u>TOTAL</u>
9116.1.9	\$85,542	\$25,072	\$40,562	36.67%	\$151,176
9116.1.10	\$99,348	\$29,119	\$47,109	36.67%	\$175,575
9116.2	\$1,918,125	\$562,203	\$909,536	36.67%	\$3,389,864
9116.3	\$221,723	\$64,987	\$105,137	36.67%	\$391,847
9300	\$150,000	\$43,965	\$0	0.00%	\$193,965
9400	\$200,000	\$58,620	\$0	0.00%	\$258,620
9500	\$996,883	\$292,186	\$462,389	35.87%	\$1,751,458
OPC3000	\$22,766,224	\$9,309,109	\$34,330,228	107.03%	\$66,405,561
OPC3100	\$385,298	\$157,548	\$581,008	107.03%	\$1,123,853
OPC3200	\$14,217,454	\$5,813,517	\$21,439,148	107.03%	\$41,470,119
OPC3300	\$440,340	\$180,055	\$664,009	107.03%	\$1,284,404
OPC3400	\$293,560	\$120,037	\$442,673	107.03%	\$856,269
OPC3500	\$222,793	\$91,100	\$335,960	107.03%	\$649,853
OPC3600	\$3,961,895	\$1,620,019	\$5,974,322	107.03%	\$11,556,236
OPC3700	\$880,680	\$360,110	\$1,328,018	107.03%	\$2,568,808
OPC3800	\$264,204	\$108,033	\$398,405	107.03%	\$770,642
OPC3900	\$2,100,000	\$858,690	\$3,166,686	107.03%	\$6,125,376
GAPIF	\$14,657,328	\$4,296,063	\$6,938,836	36.61%	\$25,892,227

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Project Name:
VITRIFICATION OF SBW
Project Location: **INEEL/INTEC**
Estimate Number: **2555**

Project Summary Report

Client: **J. J. Quigley**
Prepared By: **R. D. Adams**
Estimate Type: **Planning**

<u>LEVEL</u>	<u>Estimate Subtotal</u>	<u>Escalation</u>	<u>Contingency</u>	<u>Contingency %</u>	<u>TOTAL</u>
Total Project Level TPC	\$400,187,539	\$105,035,905	\$232,462,320	46.01%	\$737,685,764

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CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
U.C. per \$ 201,022,741.00										
CONCEPTUAL DESIGN @ 4% OF CONSTRUCTION										
Subtotal					\$8,040,910	\$0	\$0	\$0	\$0	\$8,040,910
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$718,053	\$0	\$0	\$0	\$0	\$718,053
Escalation					\$3,091,914	\$0	\$0	\$0	\$0	\$3,091,914
Contingency										
---Total OPC1100 CONCEPTUAL DESIGN										
		0			\$11,850,877	\$0	\$0	\$0	\$0	\$11,850,877
--- OPC1200 PROJECT EXECUTION PLAN										
		6200								
U.C. per LOT		1.00	2700	E30	96660	0	0	0	0	96660
PEP			2,700	\$35.80	\$96,660	\$0	\$0	\$0	\$0	\$96,660
Subtotal					\$96,660	\$0	\$0	\$0	\$0	\$96,660
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$109,226	\$0	\$0	\$0	\$0	\$109,226
Subtotal Estimate					\$18,386	\$0	\$0	\$0	\$0	\$205,886
Escalation					\$79,168	\$0	\$0	\$0	\$0	\$18,386
Contingency						\$0	\$0	\$0	\$0	\$79,168
---Total OPC1200 PROJECT EXECUTION PLAN										
		2,700			\$303,439	\$0	\$0	\$0	\$0	\$303,439
--- OPC1300 WORK PACKAGE DEVELOPMENT										
		6200								
U.C. per LOT		1.00	6000	E30	214800	0	0	0	0	214800
WP DEVELOPMENT			6,000	\$35.80	\$214,800	\$0	\$0	\$0	\$0	\$214,800
Subtotal					\$214,800	\$0	\$0	\$0	\$0	\$214,800
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$242,724	\$0	\$0	\$0	\$0	\$242,724
Subtotal Estimate					\$40,857	\$0	\$0	\$0	\$0	\$457,524
Escalation					\$175,928	\$0	\$0	\$0	\$0	\$40,857
Contingency						\$0	\$0	\$0	\$0	\$175,928
---Total OPC1300 WORK PACKAGE DEVELOPMENT										
		6,000			\$674,309	\$0	\$0	\$0	\$0	\$674,309
--- OPC1400 TASK BASELINE AGREEMENT										
		6200								
U.C. per LOT		1.00	8600	E30	315040	0	0	0	0	315040
TASK BASELINE AGREEMENT			8,800	\$35.80	\$315,040	\$0	\$0	\$0	\$0	\$315,040

CONSTRUCTION DETAIL ITEM REPORT

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

Client: *J. J. Quilley*

Prepared By: **R. D. Adams**

Estimate Type: *Planning*

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
OPC1400 TASK BASELINE AGREEMENT										
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads					\$315,040	\$0	\$0	\$0	\$0	\$315,040
					\$0	\$0	\$0	\$0	\$0	\$0
					\$355,995	\$0	\$0	\$0	\$0	\$355,995
Subtotal Estimate										
Escalation										
Contingency										
OPC1500 PRELIMINARY SAFETY ANALYSIS REPORT (PSAR)										
7000										
PSAR & SAFETY SUPPORT, 3 YEARS										
Memo: Based on experience on NWCF, FAST & FPR per E. E. Hochhalter.										
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads					\$690,690	\$0	\$0	\$0	\$0	\$690,690
					\$0	\$0	\$0	\$0	\$0	\$0
					\$614,714	\$0	\$0	\$0	\$0	\$614,714
Subtotal Estimate										
Escalation										
Contingency										
OPC1600 TECHNICAL DEVELOPMENT										
Memo: R&D required to determine the process feasibility and assist the design effort.										
U.C. per LOT										
TD EFFORT TO SOLVE CRITICAL UNKNOWN										
Memo: 'Best guess' provided by A. L. Olson for the "BBWI RECOMMENDATION FOR THE PROCESSING OF SODIUM BEARING WASTE" evaluation exercise.										
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
					\$0	\$0	\$0	\$0	\$0	\$0
					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate										
Escalation										
Contingency										
OPC2100 PROJECT SUPPORT										
Memo: Design review, work order development and controls, radiological control, project controls, records management, software development, and supplies during design and construction.										
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
					\$0	\$0	\$0	\$0	\$0	\$0
					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate										
Escalation										
Contingency										
PROJECT SUPPORT @ 3% OF CONSTRUCTION COSTS										
U.C. per \$										
201,022,741.00										
0.03										
\$6,030,682										
0										
0										
0.03										
\$6,030,682										

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs.	Crew/Rate	Labor	Const	Equip	Matl	S/C	Other	TOTAL
OPC2100 PROJECT SUPPORT											
<i>Memo: Design review, work order development and controls, radiological control, project controls, records management, software development, and supplies during design and construction.</i>											
Subtotal					\$6,030,682	\$0	\$0	\$0	\$0	\$0	\$6,030,682
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$1,333,987	\$0	\$0	\$0	\$0	\$0	\$1,333,987
Escalation					\$2,627,714	\$0	\$0	\$0	\$0	\$0	\$2,627,714
Contingency					\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total OPC2100 PROJECT SUPPORT			0		\$9,992,383	\$0	\$0	\$0	\$0	\$0	\$9,992,383
OPC2200 PERMITTING											
<i>Memo: Allow 10% of labor \$ for other expenses such as travel, printing, misc. materials, etc.</i>											
National Pollution Discharge Elimination System Permit Modification											
	3310	U.C. per LOT	4,000	E08	124,280	0	0	0	0	0	124,280
			1.00		\$124,280	\$0	\$0	\$0	\$0	\$0	\$124,280
Clean Air Act New Source Performance Standards (NSPS) Permit											
	3310	U.C. per LOT	3,500	E08	108,745	0	0	0	10,900	0	119,645
			1.00		\$108,745	\$0	\$0	\$0	\$10,900	\$0	\$119,645
Clean Air Act Prevention of Significant Deterioration (PSD) Permit											
	3310	U.C. per LOT	3,500	E08	108,745	0	0	0	10,900	0	119,645
			1.00		\$108,745	\$0	\$0	\$0	\$10,900	\$0	\$119,645
Idaho Hazardous Waste Management Act (Resource Conservation and Recovery Act)											
	3310	U.C. per LOT	14,000	E08	434,980	0	0	0	43,500	0	478,480
			1.00		\$434,980	\$0	\$0	\$0	\$43,500	\$0	\$478,480
CAA's National Emission Standards for Hazardous Air Pollutants (NESHAP's)											
	3310	U.C. per LOT	10,500	E08	328,235	0	0	0	32,600	0	358,835
			1.00		\$328,235	\$0	\$0	\$0	\$32,600	\$0	\$358,835
Permit to Construct (PTC)											
	3310	U.C. per LOT	4,500	E08	139,815	0	0	0	14,000	0	153,815
			1.00		\$139,815	\$0	\$0	\$0	\$14,000	\$0	\$153,815
DELIST HLW											
	3310	U.C. per LOT	9,000	E08	279,630	0	0	0	28,000	0	307,630
			1.00		\$279,630	\$0	\$0	\$0	\$28,000	\$0	\$307,630
DELIST LLW											
	3310	U.C. per LOT	9,000	E08	279,630	0	0	0	28,000	0	307,630
			1.00		\$279,630	\$0	\$0	\$0	\$28,000	\$0	\$307,630
EPA COMPREHENSIVE TEST PLAN DEVELOPMENT											
	3310	U.C. per LOT	4,500	E08	139,815	0	0	0	14,000	0	153,815
			1.00		\$139,815	\$0	\$0	\$0	\$14,000	\$0	\$153,815
EPA COMPREHENSIVE TEST PLAN APPROVAL											
	3310	U.C. per LOT	2,250	E08	69,907.5	0	0	0	7,000	0	76,907.5
			1.00		\$69,908	\$0	\$0	\$0	\$7,000	\$0	\$76,908
EPA COMPREHENSIVE TEST REPORT											
	3310	U.C. per LOT	1,800	E08	55,926	0	0	0	5,600	0	61,526
			1.00		\$55,926	\$0	\$0	\$0	\$5,600	\$0	\$61,526

Project Name: **VITRIFICATION OF SBW**
Project Location: **INEEL/INTEC**
Estimate Number: **2555**

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor		QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- OPC2200 PERMITTING											
Memo: Allow 10% of labor \$ for other expenses such as travel, printing, misc. materials, etc.											
EPA COMPREHENSIVE TEST SAMPLE VALIDATION	3310	U.C. per EA	150.00	0	E08	\$0	0	0	45	0	45
RCRA TRIAL BURN/DRE TEST DEVELOPMENT	3310	U.C. per LOT	1.00	2250	E08	69907.5	0	0	\$6,750	0	\$6,750
RCRA TRIAL BURN/DRE TEST APPROVAL	3310	U.C. per LOT	1.00	1125	E08	69,908	0	0	7000	0	76907.5
RCRA TRIAL BURN/DRE TEST REPORT	3310	U.C. per LOT	1.00	1,125	E08	34953.75	0	0	\$7,000	0	\$76,908
RCRA TRIAL BURN/DRE TEST SAMPLE VALIDATION	3310	U.C. per EA	1.00	900	E08	\$34,954	0	0	3500	0	38453.75
WASTE FEED ANALYSIS PLAN DEVELOPMENT	3310	U.C. per LOT	1.00	300	E08	27963	0	0	\$3,500	0	\$38,454
WASTE FEED ANALYSIS QA PLAN	3310	U.C. per LOT	1.00	150	E08	\$27,963	0	0	2800	0	30763
WASTE FEED ANALYSIS REPORT	3310	U.C. per LOT	1.00	620	E08	4660.5	0	0	\$2,800	0	\$30,763
WASTE FEED ANALYSIS SAMPLES	3310	U.C. per EA	20.00	0	E08	\$4,661	0	0	45	0	45
WASTE FEED ANALYSIS SAMPLE VALIDATION	3310	U.C. per EA	120.00	0	E08	19263.4	0	0	\$6,750	0	\$6,750
PUBLIC MEETINGS	3310	U.C. per LOT	1.00	300	E08	\$9,321	0	0	900	0	10221
REPRODUCTION AND TECH EDITOR COSTS	3310	U.C. per LOT	1.00	300	E08	4660.5	0	0	\$900	0	\$10,221
Subtotal						\$4,661	0	0	500	0	5160.5
Sales Tax						\$19,263	0	0	\$500	0	\$5,161
INEEL ORG Labor/Subcontractor Overheads						\$0	0	0	1900	0	21163.4
Subtotal Estimate						\$0	0	0	\$1,900	0	\$21,163
Escalation						\$0	0	0	15000	0	15000
Contingency						\$0	0	0	\$300,000	0	\$300,000
Total OPC2200 PERMITTING						\$2,243,099	\$0	\$0	45	0	45
1100 CONSTRUCTION SUPERVISION & ENGINEERING						\$0	\$0	\$0	\$5,400	\$0	\$5,400
@ 9% INSTF IN CC						\$9,321	0	0	9300	0	18621
						\$9,321	0	0	\$9,300	0	\$18,621
						\$0	0	0	0	320000	320000
						\$0	0	0	\$0	\$320,000	\$320,000
						\$2,243,099	\$0	\$0	\$539,300	\$320,000	\$3,102,399
						\$0	\$0	\$0	\$0	\$0	\$0
						\$2,355,254	\$0	\$0	\$0	\$0	\$2,355,254
						\$1,179,937	\$0	\$0	\$138,384	\$82,112	\$5,457,652
						\$4,125,121	\$0	\$0	\$483,799	\$287,068	\$1,400,434
						\$9,903,410	\$0	\$0	\$1,161,483	\$689,180	\$4,895,987
						\$0	\$0	\$0	\$0	\$0	\$11,754,073
						\$0.09	n	0	n	n	0.09
						.047	.	\$0	.	.	\$1,741.1

Project Name:

VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
--- 1100 CONSTRUCTION SUPERVISION & ENGINEERING										
Subtotal					\$18,092,047	\$0	\$0	\$0	\$0	\$18,092,047
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate										
Escalation					\$5,302,779	\$0	\$0	\$0	\$0	\$5,302,779
Contingency					\$10,380,284	\$0	\$0	\$0	\$0	\$10,380,284
--- Total 1100 CONSTRUCTION SUPERVISION & ENGINEERING										
			0		\$33,775,110	\$0	\$0	\$0	\$0	\$33,775,110
--- 1110 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE										
U.C. per Lot										
6340			60	E30	2148	0	0	0	0	2148
Assembly Planning Team		1.00	60		\$2,148	\$0	\$0	\$0	\$0	\$2,148
U.C. per LOT										
6340			10	E30	358	0	0	0	0	358
INITIATE HAZARDS ANALYSIS		1.00	10		\$358	\$0	\$0	\$0	\$0	\$358
U.C. per LOT										
6340			25	E30	895	0	0	0	0	895
PREPARE SUPPORTING HAZARDS PROJECT DOCUMENTATION		1.00	25		\$895	\$0	\$0	\$0	\$0	\$895
U.C. per LOT										
6340			40	E30	1432	0	0	0	0	1432
DEVELOP WORK ORDER		1.00	40		\$1,432	\$0	\$0	\$0	\$0	\$1,432
U.C. per LOT										
6340			30	E30	1074	0	0	0	0	1074
APPROVE WORK ORDER		1.00	30		\$1,074	\$0	\$0	\$0	\$0	\$1,074
U.C. per Lot										
6340			180	E30	6444	0	0	0	0	6444
Develop Initial JSA & Input To Work Plans		1.00	180		\$6,444	\$0	\$0	\$0	\$0	\$6,444
U.C. per Wks										
6340			4	E30	143.2	0	0	0	0	143.2
SCHEDULE WORK ON POD		208.00	832		\$29,786	\$0	\$0	\$0	\$0	\$29,786
U.C. per EA										
6340			20	E30	716	0	0	0	0	716
OUTAGES		10.00	200		\$7,160	\$0	\$0	\$0	\$0	\$7,160
U.C. per LOT										
6340			20	E30	716	0	0	0	0	716
SUBSURFACE INVESTIGATION		1.00	20		\$716	\$0	\$0	\$0	\$0	\$716
U.C. per Wks										
6340			8	E30	286.4	0	0	0	0	286.4
Project Continuous Surveillance (2 Hours / Day)		208.00	1,664		\$59,571	\$0	\$0	\$0	\$0	\$59,571
U.C. per LOT										
6340			10	E30	358	0	0	0	0	358
POST JOB REVIEW		1.00	10		\$358	\$0	\$0	\$0	\$0	\$358

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 1110 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE										
00401400	6340	U.C. per Hours	1	CN-CMINT	15.14	0	0	0	0	15.14
Pool Account (CC + CE Direct Hours)		3,071.00	3,071	\$15.14	\$46,495	\$0	\$0	\$0	\$0	\$46,495
Subtotal					\$156,437	\$0	\$0	\$0	\$0	\$156,437
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$176,774	\$0	\$0	\$0	\$0	\$176,774
Subtotal Estimate					\$97,664	\$0	\$0	\$0	\$0	\$97,664
Escalation					\$191,179	\$0	\$0	\$0	\$0	\$191,179
Contingency					\$622,053	\$0	\$0	\$0	\$0	\$622,053
--Total 1110 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE										
-- 1200 CM PROJECT CONTROLS **										
Memo: Apply only when the project is large enough to support dedicated personnel instead of the pool account.										
	2200	U.C. per FTE	7000	F-10	190470	0	0	0	0	190470
PCE AND SCHEDULERS		4.00	28,000	\$27.21	\$761,880	\$0	\$0	\$0	\$0	\$761,880
Subtotal					\$761,880	\$0	\$0	\$0	\$0	\$761,880
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$678,073	\$0	\$0	\$0	\$0	\$678,073
Subtotal Estimate					\$422,050	\$0	\$0	\$0	\$0	\$422,050
Escalation					\$826,171	\$0	\$0	\$0	\$0	\$826,171
Contingency					\$2,688,174	\$0	\$0	\$0	\$0	\$2,688,174
--Total 1200 CM PROJECT CONTROLS **										
-- 1300 CM ES&H **										
Memo: Apply only when the project is large enough to support dedicated personnel instead of the pool account.										
	7510	U.C. per FTE	7000	T00	165410	0	0	0	0	165410
DEDICATED ES&H SUPPORT		3.00	21,000	\$23.63	\$496,230	\$0	\$0	\$0	\$0	\$496,230
Subtotal					\$496,230	\$0	\$0	\$0	\$0	\$496,230
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$441,645	\$0	\$0	\$0	\$0	\$441,645
Subtotal Estimate					\$274,891	\$0	\$0	\$0	\$0	\$274,891
Escalation					\$538,104	\$0	\$0	\$0	\$0	\$538,104
Contingency					\$1,750,870	\$0	\$0	\$0	\$0	\$1,750,870
--Total 1300 CM ES&H **										
-- 1400 CM TRAINING **										
Memo: Apply only when the project is large enough to support dedicated personnel instead of the pool account.										
	6000	U.C. per FTE	7000	T00	165410	0	0	0	0	165410
TRAINER		1.00	7,000	\$23.63	\$165,410	\$0	\$0	\$0	\$0	\$165,410

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
-- 1400 CM TRAINING --											
<i>Memo: Apply only when the project is large enough to support dedicated personnel instead of the pool account.</i>											
Subtotal					\$165,410		\$0	\$0	\$0	\$0	\$165,410
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$166,913		\$0	\$0	\$0	\$0	\$186,913
Subtotal Estimate					\$103,266		\$0	\$0	\$0	\$0	\$352,323
Escalation					\$202,145		\$0	\$0	\$0	\$0	\$103,266
Contingency							\$0	\$0	\$0	\$0	\$202,145
--Total 1400 CM TRAINING --			7,000		\$657,734		\$0	\$0	\$0	\$0	\$657,734
-- 1500 CONSTRUCTION OTHER DIRECT COSTS											
<i>Memo: Construction photographs, office equipment and supplies, transportation, etc. (for project lifeonly)</i>											
SEE NOTE			1.00	0	0	\$0	0	0	300000	0	300000
							\$0	\$0	\$300,000	\$0	\$300,000
Subtotal					\$0		\$0	\$0	\$300,000	\$0	\$300,000
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0		\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$0		\$0	\$0	\$300,000	\$0	\$300,000
Escalation					\$0		\$0	\$0	\$0	\$0	\$0
Contingency					\$0		\$0	\$0	\$0	\$0	\$0
--Total 1500 CONSTRUCTION OTHER DIRECT COSTS			0		\$0		\$0	\$0	\$560,055	\$0	\$560,055
-- 2200 A-E ADMINISTRATIVE ACTIVITIES											
<i>Memo: Currently 11.5% of 2300, 2400, 2500, 2600 and 2800 below.</i>											
DESIGN SUPERVISION & SUPPORT			0	10,913,139.00	0.115	\$1,255,011	0	0	0	0	0.115
							\$0	\$0	\$0	\$0	\$1,255,011
Subtotal					\$1,255,011		\$0	\$0	\$0	\$0	\$1,255,011
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0		\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$1,255,011		\$0	\$0	\$0	\$0	\$1,255,011
Escalation					\$192,519		\$0	\$0	\$0	\$0	\$192,519
Contingency					\$516,768		\$0	\$0	\$0	\$0	\$516,768
--Total 2200 A-E ADMINISTRATIVE ACTIVITIES			0		\$1,964,298		\$0	\$0	\$0	\$0	\$1,964,298
-- 2300 ENGINEERING SERVICES											
<i>Memo: Field investigations, energy conservation report, tradeoff studies, etc.</i>											
FIELD INVESTIGATIONS, TRADE-OFF STUDIES, ETC.			0	201,022,741.00	0.002	\$301,534	0	0	0	0	0.002
							\$0	\$0	\$0	\$0	\$301,534

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Gulgley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
2300 ENGINEERING SERVICES											
<i>Memo: Field Investigations, energy conservation report, tradeoff studies, etc.</i>											
Subtotal					\$301,534			\$0	\$0	\$0	\$301,534
INEEL ORG Labor/Subcontractor Overheads					\$0			\$0	\$0	\$0	\$0
Subtotal Estimate					\$46,255			\$0	\$0	\$0	\$46,255
Escalation					\$124,161			\$0	\$0	\$0	\$124,161
Contingency					\$471,950			\$0	\$0	\$0	\$471,950
2400 DESIGN ACTIVITIES											
<i>Memo: Technical activities including calculations, (EDFs), internal peer reviews, specifications, etc.</i>											
<i>U.C. per \$ 201,022,741.00</i>											
DESIGN ACTIVITIES			0		0.03			0	0	0	0.03
					\$6,030,682			\$0	\$0	\$0	\$6,030,682
Subtotal					\$6,030,682			\$0	\$0	\$0	\$6,030,682
Sales Tax					\$0			\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0			\$0	\$0	\$0	\$0
Subtotal Estimate					\$925,107			\$0	\$0	\$0	\$925,107
Escalation					\$2,483,217			\$0	\$0	\$0	\$2,483,217
Contingency					\$9,439,006			\$0	\$0	\$0	\$9,439,006
2500 DRAFTING SERVICES											
<i>Memo: Formal design review with customer and other organizations.</i>											
<i>U.C. per \$ 201,022,741.00</i>											
DRAFTING			0		0.02			0	0	0	0.02
					\$4,020,455			\$0	\$0	\$0	\$4,020,455
Subtotal					\$4,020,455			\$0	\$0	\$0	\$4,020,455
Sales Tax					\$0			\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0			\$0	\$0	\$0	\$0
Subtotal Estimate					\$616,738			\$0	\$0	\$0	\$616,738
Escalation					\$1,655,478			\$0	\$0	\$0	\$1,655,478
Contingency					\$6,292,670			\$0	\$0	\$0	\$6,292,670
2600 DESIGN VERIFICATION											
<i>Memo: Formal design review with customer and other organizations.</i>											
<i>U.C. per \$ 201,022,741.00</i>											
INTER-DEPARTMENT REVIEW			1	E00	35.14			0	0	0	35.14
					\$193,270			\$0	\$0	\$0	\$193,270
Subtotal					\$193,270			\$0	\$0	\$0	\$193,270
Sales Tax					\$0			\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0			\$0	\$0	\$0	\$0
Subtotal Estimate					\$0			\$0	\$0	\$0	\$0
Escalation					\$0			\$0	\$0	\$0	\$0
Contingency					\$0			\$0	\$0	\$0	\$0
2700 DEPARTMENT REVIEW											
<i>Memo: Allow 25 reviewers for 1.5 months.</i>											
<i>U.C. per \$ 201,022,741.00</i>											
DEPARTMENT REVIEW			1	E00	35.14			0	0	0	35.14
					\$193,270			\$0	\$0	\$0	\$193,270
Subtotal					\$193,270			\$0	\$0	\$0	\$193,270
Sales Tax					\$0			\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0			\$0	\$0	\$0	\$0
Subtotal Estimate					\$0			\$0	\$0	\$0	\$0
Escalation					\$0			\$0	\$0	\$0	\$0
Contingency					\$0			\$0	\$0	\$0	\$0

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEG

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
2600 DESIGN VERIFICATION											
<i>Memo: Formal design review with customer and other organizations.</i>											
Subtotal					\$193,270			\$0	\$0	\$0	\$193,270
Sales Tax					\$0			\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$218,395			\$0	\$0	\$0	\$218,395
Subtotal Estimate											
Escalation					\$83,149			\$0	\$0	\$0	\$83,149
Contingency					\$169,509			\$0	\$0	\$0	\$169,509
---Total 2600 DESIGN VERIFICATION			5,500		\$644,323			\$0	\$0	\$0	\$644,323
2700 COST ESTIMATE											
<i>Memo: Estimating services during design.</i>											
TITLE I DESIGN ESTIMATES, 5 ESTIMATORS FOR 3 MONTHS											
		U.C. per HRS	1	F22	31.44			0	0	0	31.44
			2,400		\$75,456			\$0	\$0	\$0	\$75,456
SUPERVISION & SUPPORT @ 14%											
		U.C. per HRS	0.14	Z04	6.901			0	0	0	6.901
			336		\$16,561			\$0	\$0	\$0	\$16,561
Subtotal					\$92,017			\$0	\$0	\$0	\$92,017
Sales Tax					\$0			\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$81,896			\$0	\$0	\$0	\$81,896
Subtotal Estimate											
Escalation					\$26,678			\$0	\$0	\$0	\$26,678
Contingency					\$71,611			\$0	\$0	\$0	\$71,611
---Total 2700 COST ESTIMATE			2,736		\$272,202			\$0	\$0	\$0	\$272,202
2800 DESIGN ERRORS AND OMISSIONS											
<i>Memo: Engineering activities during construction in support of design errors and omissions.</i>											
DESIGN ERRORS & OMISSIONS											
		U.C. per \$	0		0.001			0	0	0	0.001
					\$120,614			\$0	\$0	\$0	\$120,614
Subtotal					\$120,614			\$0	\$0	\$0	\$120,614
Sales Tax					\$0			\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0			\$0	\$0	\$0	\$0
Subtotal Estimate											
Escalation					\$18,502			\$0	\$0	\$0	\$18,502
Contingency					\$49,664			\$0	\$0	\$0	\$49,664
---Total 2800 DESIGN ERRORS AND OMISSIONS			0		\$186,780			\$0	\$0	\$0	\$186,780
3200 A-E ADMINISTRATIVE ACTIVITIES											
<i>Memo: Currently 11.5% of 2300, 2400, 2500, 2600 and 2800 below.</i>											
DESIGN SUPERVISION & SUPPORT											
		U.C. per \$	0		0.115			0	0	0	0.115
					\$2,908,725			\$0	\$0	\$0	\$2,908,725

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
3200 A-E ADMINISTRATIVE ACTIVITIES										
Memo: Currently 11.5% of 2300, 2400, 2500, 2600 and 2800 below.										
Subtotal					\$2,908,725	\$0	\$0	\$0	\$0	\$2,908,725
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$543,350	\$0	\$0	\$0	\$0	\$543,350
Escalation					\$1,504,414	\$0	\$0	\$0	\$0	\$1,504,414
Contingency					\$4,956,488	\$0	\$0	\$0	\$0	\$4,956,488
3200 A-E ADMINISTRATIVE ACTIVITIES										
0										
3300 ENGINEERING SERVICES										
Memo: Field Investigations, energy conservation report, tradeoff studies, etc.										
U.C. per \$										
201,022,741.00					0.003	0	0	0	0	0.003
FIELD INVESTIGATIONS, TRADE-OFF STUDIES, ETC.					\$703,580	\$0	\$0	\$0	\$0	\$703,580
Subtotal					\$703,580	\$0	\$0	\$0	\$0	\$703,580
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$131,429	\$0	\$0	\$0	\$0	\$131,429
Escalation					\$363,897	\$0	\$0	\$0	\$0	\$363,897
Contingency					\$1,198,905	\$0	\$0	\$0	\$0	\$1,198,905
3400 DESIGN ACTIVITIES										
Memo: Technical activities including calculations, (EDFs), Internal peer reviews, specifications, etc.										
U.C. per \$										
201,022,741.00					0.07	0	0	0	0	0.07
DESIGN ACTIVITIES					\$14,071,592	\$0	\$0	\$0	\$0	\$14,071,592
Subtotal					\$14,071,592	\$0	\$0	\$0	\$0	\$14,071,592
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$2,628,573	\$0	\$0	\$0	\$0	\$2,628,573
Escalation					\$7,277,932	\$0	\$0	\$0	\$0	\$7,277,932
Contingency					\$23,978,097	\$0	\$0	\$0	\$0	\$23,978,097
3500 DRAFTING SERVICES										
U.C. per \$										
201,022,741.00					0.049	0	0	0	0	0.049
DRAFTING					\$9,850,114	\$0	\$0	\$0	\$0	\$9,850,114

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
3500 DRAFTING SERVICES											
Subtotal					\$9,850,114			\$0		\$0	\$9,850,114
Sales Tax					\$0			\$0		\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0			\$0		\$0	\$0
Subtotal Estimate					\$1,840,001			\$0		\$0	\$1,840,001
Escalation					\$5,094,552			\$0		\$0	\$5,094,552
Contingency											
Total 3500 DRAFTING SERVICES			0		\$16,784,668			\$0		\$0	\$16,784,668
3600 DESIGN VERIFICATION											
<i>Memo: Formal design review with customer and other organizations.</i>											
INTER-DEPARTMENT REVIEW											
<i>Memo: Allow 25 reviewers for 1.5 months x two reviews.</i>											
			1	E00	35.14			0		0	35.14
			11,000		\$386,540			\$0		\$0	\$386,540
Subtotal					\$386,540			\$0		\$0	\$386,540
Sales Tax					\$0			\$0		\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$436,790			\$0		\$0	\$436,790
Subtotal Estimate					\$153,798			\$0		\$0	\$153,798
Escalation					\$425,833			\$0		\$0	\$425,833
Contingency											
Total 3600 DESIGN VERIFICATION			11,000		\$1,402,961			\$0		\$0	\$1,402,961
3700 COST ESTIMATE											
<i>Memo: Estimating services during design.</i>											
TITLE I DESIGN ESTIMATES, 5 ESTIMATORS FOR 6 MONTHS											
			1	F22	31.44			0		0	31.44
			4,800		\$150,912			\$0		\$0	\$150,912
Subtotal					\$150,912			\$0		\$0	\$150,912
Sales Tax					\$0			\$0		\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0			\$0		\$0	\$0
Subtotal Estimate					\$6,901			\$0		\$0	\$6,901
Escalation					\$33,123			\$0		\$0	\$33,123
Contingency											
Total 3700 COST ESTIMATE			5,472		\$592,698			\$0		\$0	\$592,698
3800 DESIGN ERRORS AND OMISSIONS											
<i>Memo: Engineering activities during construction in support of design errors and omissions.</i>											
DESIGN ERRORS & OMISSIONS											
			0		0.001			0		0	0.001
			201,022,741.00		\$281,432			\$0		\$0	\$281,432

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>Org/Subcontractor</u>	<u>QTY</u>	<u>Hrs</u>	<u>Crew/Rate</u>	<u>Labor</u>	<u>Const</u>	<u>Eqp</u>	<u>Matl</u>	<u>S/C</u>	<u>Other</u>	<u>TOTAL</u>
--- 3800 DESIGN ERRORS AND OMISSIONS											
<i>Memo: Engineering activities during construction in support of design errors and omissions.</i>											
Subtotal					\$281,432	\$0	\$0	\$0	\$0	\$0	\$281,432
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$52,571	\$0	\$0	\$0	\$0	\$0	\$52,571
Escalation					\$145,559	\$0	\$0	\$0	\$0	\$0	\$145,559
Contingency											
---Total 3800 DESIGN ERRORS AND OMISSIONS			0		\$479,562	\$0	\$0	\$0	\$0	\$0	\$479,562
--- 4100 QUALITY ASSURANCE											
<i>Memo: All Quality Engineering actions and inspections-related actions that are required to plan and perform surveillance-related activities during the execution and start-up phases of a project.</i>											
QA SUPPORT DURING DESIGN											
<i>Memo: Based @ 2% of construction cost.</i>											
		U.C. per \$	201,022,741.00		0.02	0	0	0	0	0	0.02
					\$4,020,455	\$0	\$0	\$0	\$0	\$0	\$4,020,455
QUALITY PLAN OVERSIGHT DURING CONSTRUCTION											
<i>Memo: Based @ 2.9% of construction costs.</i>											
		U.C. per \$	201,022,741.00		0.029	0	0	0	0	0	0.029
					\$5,829,659	\$0	\$0	\$0	\$0	\$0	\$5,829,659
Subtotal					\$9,850,114	\$0	\$0	\$0	\$0	\$0	\$9,850,114
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$2,527,539	\$0	\$0	\$0	\$0	\$0	\$2,527,539
Escalation					\$4,105,668	\$0	\$0	\$0	\$0	\$0	\$4,105,668
Contingency											
---Total 4100 QUALITY ASSURANCE			0		\$16,483,321	\$0	\$0	\$0	\$0	\$0	\$16,483,321
--- 5100 PM ADMINISTRATION											
<i>Memo: Based @ 5.5% of construction costs.</i>											
PM											
		U.C. per \$	201,022,741.00		0.055	0	0	0	0	0	0.055
					\$11,056,251	\$0	\$0	\$0	\$0	\$0	\$11,056,251
FIELD ENGINEERING SUPPORT											
<i>Memo: Based @ 3.3% of construction cost.</i>											
		U.C. per \$	201,022,741.00		0.033	0	0	0	0	0	0.033
					\$6,633,750	\$0	\$0	\$0	\$0	\$0	\$6,633,750

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 5100 PM ADMINISTRATION										
ES&H/RAD SUPPORT		U.C. per LOT	1.00	0	1800000	0	0	0	0	1800000
Memo: Based on 1.75 FTE per year x 7 years.					\$1,800,000	\$0	\$0	\$0	\$0	\$1,800,000
Subtotal					\$19,490,001	\$0	\$0	\$0	\$0	\$19,490,001
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$5,001,134	\$0	\$0	\$0	\$0	\$5,001,134
Escalation					\$10,443,020	\$0	\$0	\$0	\$0	\$10,443,020
Contingency					\$0	\$0	\$0	\$0	\$0	\$0
-- Total 5100 PM ADMINISTRATION										
			0		\$34,934,156	\$0	\$0	\$0	\$0	\$34,934,156
-- 5110 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE										
6200										
U.C. per Lot										
Assemble Planning Team		1.00	10	E30	358	0	0	0	0	358
			10		\$358	\$0	\$0	\$0	\$0	\$358
6200										
U.C. per LOT										
ORIGINATE WCF		1.00	4	E30	143.2	0	0	0	0	143.2
			4		\$143	\$0	\$0	\$0	\$0	\$143
6200										
U.C. per WK										
UPDATE WCF		208.00	4	E30	143.2	0	0	0	0	143.2
			832		\$29,786	\$0	\$0	\$0	\$0	\$29,786
6200										
U.C. per LOT										
INITIATE HAZARDS ANALYSIS PROCESS		1.00	40	E30	1432	0	0	0	0	1432
			40		\$1,432	\$0	\$0	\$0	\$0	\$1,432
6200										
U.C. per LOT										
PREPARE SUPPORTING HAZARDS PROJECT DOCUMENTATION		1.00	30	E30	1074	0	0	0	0	1074
			30		\$1,074	\$0	\$0	\$0	\$0	\$1,074
6200										
U.C. per LOT										
POST JOB REVIEW		1.00	10	E30	358	0	0	0	0	358
			10		\$358	\$0	\$0	\$0	\$0	\$358
6200										
U.C. per \$										
Project Management - Management Support - 10% Of P.M.		33,150.00	0		0.1	0	0	0	0	0.1
Total					\$3,315	\$0	\$0	\$0	\$0	\$3,315
Subtotal					\$38,466	\$0	\$0	\$0	\$0	\$38,466
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$41,208	\$0	\$0	\$0	\$0	\$41,208
Subtotal Estimate					\$19,931	\$0	\$0	\$0	\$0	\$19,931
Escalation					\$41,618	\$0	\$0	\$0	\$0	\$41,618
Contingency					\$0	\$0	\$0	\$0	\$0	\$0
-- Total 5110 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE										
			926		\$139,221	\$0	\$0	\$0	\$0	\$139,221

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Client: J. J. Guligley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 5200 PROJECT CONTROLS										
<i>Memo: Cost and schedule control activities for the project (dedicated personnel only; non-dedicated personnel charge to Operating Costs)</i>										
U.C. per \$										
PCE & SCHEDULERS		201,022,741.00	0		0.019	\$0	0	0	0	0.019
Memo: Based @ 1.9% of construction costs.					\$3,819,432	\$0	\$0	\$0	\$0	\$3,819,432
Subtotal					\$3,819,432	\$0	\$0	\$0	\$0	\$3,819,432
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$880,086	\$0	\$0	\$0	\$0	\$3,819,432
Escalation					\$2,046,506	\$0	\$0	\$0	\$0	\$980,066
Contingency					\$6,846,004	\$0	\$0	\$0	\$0	\$2,046,506
-- Total 5200 PROJECT CONTROLS										
-- 5300 RECORDS MANAGEMENT										
<i>Memo: Dedicated personnel involved with document control and records management.</i>										
U.C. per \$										
DOCUMENT CONTROL/RECORDS MANAGEMENT		201,022,741.00	0		0.017	\$0	0	0	0	0.017
Memo: Based @ 1.65% of construction costs.					\$3,316,875	\$0	\$0	\$0	\$0	\$3,316,875
Subtotal					\$3,316,875	\$0	\$0	\$0	\$0	\$3,316,875
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate					\$851,110	\$0	\$0	\$0	\$0	\$3,316,875
Escalation					\$1,777,229	\$0	\$0	\$0	\$0	\$851,110
Contingency					\$5,945,214	\$0	\$0	\$0	\$0	\$1,777,229
-- Total 5300 RECORDS MANAGEMENT										
-- 5400 SAFETY ANALYSIS										
<i>Memo: FSAR preparation and review.</i>										
U.C. per FTE										
FINAL SAFETY ANALYSIS SUPPORT & REPORT		4.00	10500	E19	345345	0	0	0	0	345345
Memo: Based on experience on NWCF, FAST & FPR per E. E. Hochhalter.			42,000	\$32.89	\$1,381,380	\$0	\$0	\$0	\$0	\$1,381,380
Subtotal					\$1,381,380	\$0	\$0	\$0	\$0	\$1,381,380
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$1,229,428	\$0	\$0	\$0	\$0	\$1,229,428
Subtotal Estimate					\$669,933	\$0	\$0	\$0	\$0	\$2,610,808
Escalation					\$1,398,908	\$0	\$0	\$0	\$0	\$669,933
Contingency					\$4,679,650	\$0	\$0	\$0	\$0	\$1,398,908
-- Total 5400 SAFETY ANALYSIS										
-- 6100 DISPOSITION OF FIELD PROBLEMS										
<i>Memo: CID SUPPORT, 4 YEARS</i>										
U.C. per FTE										
CID SUPPORT, 4 YEARS		3.00	7000	E00	245980	0	0	0	0	245980
			21,000	\$35.14	\$737,940	\$0	\$0	\$0	\$0	\$737,940

Project Name:

VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 6100 DISPOSITION OF FIELD PROBLEMS										
Subtotal										
Sales Tax					\$737,940	\$0	\$0	\$0	\$0	\$737,940
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
					\$833,872	\$0	\$0	\$0	\$0	\$833,872
Subtotal Estimate										
Escalation					\$460,698	\$0	\$0	\$0	\$0	\$1,571,812
Contingency					\$603,656	\$0	\$0	\$0	\$0	\$460,698
					\$2,636,166	\$0	\$0	\$0	\$0	\$603,656
-- 6200 VENDOR DATA REVIEW										
Subtotal										
Sales Tax					\$491,960	\$0	\$0	\$0	\$0	\$1,571,812
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$460,698
					\$555,915	\$0	\$0	\$0	\$0	\$603,656
Subtotal Estimate										
Escalation					\$307,132	\$0	\$0	\$0	\$0	\$1,047,875
Contingency					\$402,437	\$0	\$0	\$0	\$0	\$307,132
					\$1,757,444	\$0	\$0	\$0	\$0	\$402,437
-- 6300 AS-BUILDING										
Subtotal										
Sales Tax					\$477,330	\$0	\$0	\$0	\$0	\$477,330
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
					\$539,383	\$0	\$0	\$0	\$0	\$539,383
Subtotal Estimate										
Escalation					\$297,999	\$0	\$0	\$0	\$0	\$1,016,713
Contingency					\$390,469	\$0	\$0	\$0	\$0	\$297,999
					\$1,705,181	\$0	\$0	\$0	\$0	\$390,469
-- 6400 A-E OVERSIGHT OF CONSTRUCTION										
Subtotal										
Sales Tax					\$477,330	\$0	\$0	\$0	\$0	\$477,330
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
					\$539,383	\$0	\$0	\$0	\$0	\$539,383
Subtotal Estimate										
Escalation					\$297,999	\$0	\$0	\$0	\$0	\$1,016,713
Contingency					\$390,469	\$0	\$0	\$0	\$0	\$297,999
					\$1,705,181	\$0	\$0	\$0	\$0	\$390,469
-- 6700										
Subtotal										
Sales Tax					\$477,330	\$0	\$0	\$0	\$0	\$477,330
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
					\$539,383	\$0	\$0	\$0	\$0	\$539,383
Subtotal Estimate										
Escalation					\$297,999	\$0	\$0	\$0	\$0	\$1,016,713
Contingency					\$390,469	\$0	\$0	\$0	\$0	\$297,999
					\$1,705,181	\$0	\$0	\$0	\$0	\$390,469
-- 7028										
Subtotal										
Sales Tax					\$477,330	\$0	\$0	\$0	\$0	\$477,330
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0
					\$539,383	\$0	\$0	\$0	\$0	\$539,383
Subtotal Estimate										
Escalation					\$297,999	\$0	\$0	\$0	\$0	\$1,016,713
Contingency					\$390,469	\$0	\$0	\$0	\$0	\$297,999
					\$1,705,181	\$0	\$0	\$0	\$0	\$390,469

U.C. per FTE

U.C. per LOT

U.C. per FTE

U.C. per LOT

U.C. per FTE

U.C. per LOT

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U.C. per FTE

U.C. per LOT

U.C. per FTE

U.C. per LOT

U.C. per FTE

U.C. per LOT

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Guilgley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
6400 A-E OVERSIGHT OF CONSTRUCTION										
<i>Memo: Surveillance/field visits to verify design as requested by Project Manager.</i>										
Subtotal					\$7,028	\$0	\$0	\$0	\$0	\$7,028
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$7,942	\$0	\$0	\$0	\$0	\$7,942
Subtotal Estimate					\$4,388	\$0	\$0	\$0	\$0	\$4,388
Escalation					\$5,749	\$0	\$0	\$0	\$0	\$5,749
Contingency					\$25,106	\$0	\$0	\$0	\$0	\$25,106
9101 GENERAL CONDITIONS										
<i>Memo: Mobilization/demobilization costs @ .6% of direct construction \$.</i>										
GENERAL CONTRACTOR SUPERVISION										
	GEN	7,000.00	1	CN-CARF	35.94	0	0	0	0	35.94
			7,000	\$35.94	\$251,580	\$0	\$0	\$0	\$0	\$251,580
	GEN	45.00	160	CN-SKWK	5523.2	0	0	0	0	5523.2
			7,200	\$34.52	\$248,544	\$0	\$0	\$0	\$0	\$248,544
	GEN	1.00	0		0	0	0	501520	0	501520
					\$0	\$0	\$0	\$501,520	\$0	\$501,520
	DIRT	1,600.00	1	CN-ENGR	32.56	0	0	0	0	32.56
			1,600	\$32.56	\$52,096	\$0	\$0	\$0	\$0	\$52,096
	DIRT	6.00	80	CN-ENGR	2604.8	0	0	0	0	2604.8
			480	\$32.56	\$15,629	\$0	\$0	\$0	\$0	\$15,629
	DIRT	1.00	0		0	0	0	3120	0	3120
					\$0	\$0	\$0	\$3,120	\$0	\$3,120
	DRYW	160.00	1	CN-CARF	35.94	0	0	0	0	35.94
			160	\$35.94	\$5,750	\$0	\$0	\$0	\$0	\$5,750
	DRYW	4.00	40	CN-CARP	1385.6	0	0	0	0	1385.6
			160	\$34.64	\$5,542	\$0	\$0	\$0	\$0	\$5,542
	DRYW	1.00	0		0	0	0	160	0	160
					\$0	\$0	\$0	\$160	\$0	\$160
	ELEC	4,730.00	1	CN-ELCF	36.72	0	0	0	0	36.72
			4,730	\$36.72	\$173,686	\$0	\$0	\$0	\$0	\$173,686
	ELEC	8.00	120	CN-ELEC	4094.4	0	0	0	0	4094.4
			960	\$34.12	\$32,755	\$0	\$0	\$0	\$0	\$32,755
	ELEV	1.00	0		0	0	0	36920	0	36920
					\$0	\$0	\$0	\$36,920	\$0	\$36,920
	ELEV	80.00	1	CN-SKWK	34.52	0	0	0	0	34.52
			80	\$34.52	\$2,762	\$0	\$0	\$0	\$0	\$2,762

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
Memo: 9101 GENERAL CONDITIONS										
Mobilization/demobilization costs @ .6% of direct construction \$.										
Training, 40 hrs. per year for 1 yrs.	ELEV	U.C. per Men	3.00	40 CN-SKWK	1380.8 \$4,142	0 \$0	0 \$0	0 \$0	0 \$0	1380.8 \$4,142
Mobilization & Demobilization, ELEVATOR	ELEV	U.C. per Lot	1.00	0	0 \$0	0 \$0	0 \$0	350 \$350	0 \$0	350 \$350
FIRE PROTECTION Contractor Supervision	FP	U.C. per HRS	3,500.00	1 CN-SPRI	36.92 \$129,220	0 \$0	0 \$0	0 \$0	0 \$0	36.92 \$129,220
Training, 40 hrs. per year for 2 yrs.	FP	U.C. per Men	5.00	80 CN-SPRI	2953.6 \$14,768	0 \$0	0 \$0	0 \$0	0 \$0	2953.6 \$14,768
Mobilization & Demobilization, FIRE PROTECTION	FP	U.C. per Lot	1.00	0	0 \$0	0 \$0	0 \$0	6100 \$6,100	0 \$0	6100 \$6,100
HVAC Contractor Supervision	HVAC	U.C. per HRS	5,250.00	1 CN-SHEE	35.48 \$186,270	0 \$0	0 \$0	0 \$0	0 \$0	35.48 \$186,270
Training, 40 hrs. per year for 3 yrs.	HVAC	U.C. per Men	34.00	120 CN-SHEE	4257.6 \$144,758	0 \$0	0 \$0	0 \$0	0 \$0	4257.6 \$144,758
Mobilization & Demobilization, HVAC	HVAC	U.C. per Lot	1.00	0	0 \$0	0 \$0	0 \$0	107550 \$107,550	0 \$0	107550 \$107,550
INSTRUMENTATION Contractor Supervision	INSTR	U.C. per HRS	1,000.00	1 CN-ELCF	36.72 \$36,720	0 \$0	0 \$0	0 \$0	0 \$0	36.72 \$36,720
Training, 40 hrs. per year for 1 yrs.	INSTR	U.C. per Men	2.00	40 CN-ELEC	1364.8 \$2,730	0 \$0	0 \$0	0 \$0	0 \$0	1364.8 \$2,730
Mobilization & Demobilization, INSTRUMENTATION	INSTR	U.C. per Lot	1.00	0	0 \$0	0 \$0	0 \$0	22080 \$22,080	0 \$0	22080 \$22,080
INSULATION Contractor Supervision	INSUL	U.C. per HRS	1,040.00	1 CN-ASBE	36.92 \$38,397	0 \$0	0 \$0	0 \$0	0 \$0	36.92 \$38,397
Training, 40 hrs. per year for 1 yrs.	INSUL	U.C. per Men	4.00	40 CN-ASBE	1476.8 \$5,907	0 \$0	0 \$0	0 \$0	0 \$0	1476.8 \$5,907
Mobilization & Demobilization, INSULATION	INSUL	U.C. per Lot	1.00	0	0 \$0	0 \$0	0 \$0	1840 \$1,840	0 \$0	1840 \$1,840
PAINTING Contractor Supervision	PAINT	U.C. per HRS	3,500.00	1 CN-PAIN	30.39 \$106,365	0 \$0	0 \$0	0 \$0	0 \$0	30.39 \$106,365
Training, 40 hrs. per year for 2 yrs.	PAINT	U.C. per Men	12.00	80 CN-PAIN	2431.2 \$29,174	0 \$0	0 \$0	0 \$0	0 \$0	2431.2 \$29,174
Mobilization & Demobilization, PAINTING	PAINT	U.C. per Lot	1.00	0	0 \$0	0 \$0	0 \$0	13360 \$13,360	0 \$0	13360 \$13,360

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Gulley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9101 GENERAL CONDITIONS										
<i>Memo: Mobilization/demobilization costs @ .6% of direct construction \$.</i>										
PIPE	PIPE	5,250.00	1	CN-PIPF \$41.17	41.17	0	0	0	0	41.17
PIPING Contractor Supervision			5,250		\$216,143	\$0	\$0	\$0	\$0	\$216,143
PIPE	PIPE	11.00	120	CN-PIPE	4509.6	0	0	0	0	4509.6
Training, 40 hrs. per year for 3 yrs.			1,320	\$37.58	\$49,606	\$0	\$0	\$0	\$0	\$49,606
PIPE	PIPE	1.00	0		0	0	0	50260	0	50260
Mobilization & Demobilization, PIPING					\$0	\$0	\$0	\$50,260	\$0	\$50,260
STEEL	STEEL	5,250.00	1	CN-IRWF \$43.13	43.13	0	0	0	0	43.13
STRUCTURAL STEEL Contractor Supervision			5,250		\$226,433	\$0	\$0	\$0	\$0	\$226,433
STEEL	STEEL	49.00	120	CN-IRON	4819.2	0	0	0	0	4819.2
Training, 40 hrs. per year for 3 yrs.			5,880	\$40.16	\$236,141	\$0	\$0	\$0	\$0	\$236,141
STEEL	STEEL	1.00	0		0	0	0	86990	0	86990
Mobilization & Demobilization, STRUCTURAL					\$0	\$0	\$0	\$86,990	\$0	\$86,990
TANK	TANK	1,750.00	1	CN-BOILMK \$38.00	38	0	0	0	0	38
TANK Contractor Supervision			1,750		\$66,500	\$0	\$0	\$0	\$0	\$66,500
TANK	TANK	2.00	40	CN-BOILMK	1520	0	0	0	0	1520
Training, 40 hrs. per year for 1 yrs.			80	\$38.00	\$3,040	\$0	\$0	\$0	\$0	\$3,040
TANK	TANK	1.00	0		0	0	0	15440	0	15440
Mobilization & Demobilization, TANK					\$0	\$0	\$0	\$15,440	\$0	\$15,440
GEN	GEN	892,039.00	0		0	2.5	0	0	0	2.5
CONSTRUCTION EQUIPMENT ALLOWANCE					\$0	\$2,230,098	\$0	\$0	\$0	\$2,230,098
<i>Memo: @ \$2.50 /LABOR HOUR.</i>										
GEN	GEN	31,990,351.00	0		0	0	0.04	0	0	0.04
SMALL TOOLS & CONSUMABLES					\$0	\$0	\$1,279,614	\$0	\$0	\$1,279,614
<i>Memo: @ 4% of construction labor \$.</i>										
GEN	GEN	892,039.00	0.08	CN-LABR \$30.09	2,407	0	0	0	0	2,407
GENERAL CLEANUP			71,363		\$2,147,316	\$0	\$0	\$0	\$0	\$2,147,316
<i>Memo: @ 8% of construction labor hours.</i>										
Subtotal					\$4,431,973	\$2,230,098	\$1,279,614	\$845,690	\$0	\$8,787,375
Sales Tax					\$0	\$0	\$63,981	\$0	\$0	\$63,981
INEEL ORG Labor/Subcontractor Overheads					\$1,664,632	\$792,621	\$477,540	\$319,488	\$0	\$3,254,282
Subtotal Estimate					\$1,786,915	\$885,959	\$533,775	\$341,514	\$0	\$12,105,638
Escalation					\$4,182,208	\$2,073,553	\$1,249,280	\$799,300	\$0	\$3,548,162
Contingency									\$0	\$8,304,341
9101 GENERAL CONDITIONS										
			133,353		\$12,065,728	\$5,982,231	\$3,604,190	\$2,305,993	\$0	\$23,956,142

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9101.1 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE										
	U.C. per Wk	208.00	20	CN-CARF	718.8	0	0	0	0	718.8
Added Supervisor - GEN			4,160	\$35.94	\$149,510	\$0	\$0	\$0	\$0	\$149,510
	U.C. per HRS	313,903.00	0.15	CN-CARP	5,196	0	0	0	0	5,196
Labor Impact - 15% - GEN			47,085	\$34.64	\$1,631,040	\$0	\$0	\$0	\$0	\$1,631,040
	U.C. per Hr	10.00	1	CN-CARF	35.94	0	0	0	0	35.94
Post Job Review - GEN			10	\$35.94	\$359	\$0	\$0	\$0	\$0	\$359
	U.C. per Wk	40.00	20	CN-ENGR	651.2	0	0	0	0	651.2
Added Supervisor - EARTHWORK			800	\$32.58	\$26,048	\$0	\$0	\$0	\$0	\$26,048
	U.C. per HRS	9,453.00	0.15	CN-ENGR	4,884	0	0	0	0	4,884
Labor Impact - 15% - EARTHWORK			1,418	\$32.58	\$46,168	\$0	\$0	\$0	\$0	\$46,168
	U.C. per Hr	10.00	1	CN-ENGR	32.56	0	0	0	0	32.56
Post Job Review - EARTHWORK			10	\$32.58	\$326	\$0	\$0	\$0	\$0	\$326
	U.C. per Wk	4.00	20	CN-CARF	718.8	0	0	0	0	718.8
Added Supervisor - DRYWALL			80	\$35.94	\$2,875	\$0	\$0	\$0	\$0	\$2,875
	U.C. per HRS	527.00	0.15	CN-CARP	5,196	0	0	0	0	5,196
Labor Impact - 15% - DRYWALL			78	\$34.64	\$2,738	\$0	\$0	\$0	\$0	\$2,738
	U.C. per Hr	10.00	1	CN-CARF	35.94	0	0	0	0	35.94
Post Job Review - DRYWALL			10	\$35.94	\$359	\$0	\$0	\$0	\$0	\$359
	U.C. per Wk	158.00	20	CN-ELCF	734.4	0	0	0	0	734.4
Added Supervisor - ELEC			3,120	\$36.72	\$114,566	\$0	\$0	\$0	\$0	\$114,566
	U.C. per HRS	52,644.00	0.15	CN-ELEC	5,118	0	0	0	0	5,118
Labor Impact - 15% - ELEC			7,897	\$34.12	\$269,432	\$0	\$0	\$0	\$0	\$269,432
	U.C. per Hr	10.00	1	CN-ELCF	36.72	0	0	0	0	36.72
Post Job Review - ELEC			10	\$36.72	\$367	\$0	\$0	\$0	\$0	\$367
	U.C. per Wk	2.00	20	CN-SKWK	690.4	0	0	0	0	690.4
Added Supervisor - ELEVATOR			40	\$34.52	\$1,381	\$0	\$0	\$0	\$0	\$1,381
	U.C. per HRS	242.00	0.15	CN-SKWK	5,178	0	0	0	0	5,178
Labor Impact - 15% - ELEVATOR			36	\$34.52	\$1,253	\$0	\$0	\$0	\$0	\$1,253
	U.C. per Hr	10.00	1	CN-SKWK	34.52	0	0	0	0	34.52
Post Job Review - ELEVATOR			10	\$34.52	\$345	\$0	\$0	\$0	\$0	\$345
	U.C. per Wk	104.00	20	CN-SPRI	738.4	0	0	0	0	738.4
Added Supervisor - FP			2,080	\$36.92	\$76,794	\$0	\$0	\$0	\$0	\$76,794
	U.C. per HRS	18,535.00	0.15	CN-SPRI	5,538	0	0	0	0	5,538
Labor Impact - 15% - FP			2,480	\$36.92	\$91,571	\$0	\$0	\$0	\$0	\$91,571
	U.C. per Hr	10.00	1	CN-SPRI	36.92	0	0	0	0	36.92
Post Job Review - FP			10	\$36.92	\$369	\$0	\$0	\$0	\$0	\$369

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
9101.1 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE											
	U.C. per Wk										
Added Supervision - HVAC	156.00	20	3,120	CN-SHEE \$35.48	709.6 \$110,698	0	0	0	0	0	709.6 \$110,698
	U.C. per HRS										
Labor Impact - 15% - HVAC	178,708.00	0.15	26,808	CN-SHEE \$35.48	5,322 \$951,084	0	0	0	0	0	5,322 \$951,084
	U.C. per Hr										
Post Job Review - HVAC	10.00	1	10	CN-SHEE \$35.48	35.48 \$355	0	0	0	0	0	35.48 \$355
	U.C. per Wk										
Added Supervision - INSTRUMENTATION	25.00	20	500	CN-ELCF \$36.72	734.4 \$18,360	0	0	0	0	0	734.4 \$18,360
	U.C. per HRS										
Labor Impact - 15% - INSTRUMENTATION	2,014.00	0.15	302	CN-ELEC \$34.12	5,118 \$10,308	0	0	0	0	0	5,118 \$10,308
	U.C. per Hr										
Post Job Review - INSTRUMENTATION	10.00	1	10	CN-ELCF \$36.72	36.72 \$367	0	0	0	0	0	36.72 \$367
	U.C. per Wk										
Added Supervision - INSULATION	26.00	20	520	CN-ASBE \$36.92	738.4 \$19,198	0	0	0	0	0	738.4 \$19,198
	U.C. per HRS										
Labor Impact - 15% - INSULATION	4,080.00	0.15	612	CN-ASBE \$36.92	5,538 \$22,595	0	0	0	0	0	5,538 \$22,595
	U.C. per Hr										
Post Job Review - INSULATION	10.00	1	10	CN-ASBE \$36.92	36.92 \$369	0	0	0	0	0	36.92 \$369
	U.C. per Wk										
Added Supervision - PAINTING	104.00	20	2,080	CN-PAINT \$30.39	607.8 \$83,211	0	0	0	0	0	607.8 \$83,211
	U.C. per HRS										
Labor Impact - 15% - PAINTING	42,435.00	0.15	6,365	CN-PAINT \$30.39	4,558 \$193,440	0	0	0	0	0	4,558 \$193,440
	U.C. per Hr										
Post Job Review - PAINTING	10.00	1	10	CN-PAINT \$30.39	30.39 \$304	0	0	0	0	0	30.39 \$304
	U.C. per Wk										
Added Supervision - PIPING	158.00	20	3,120	CN-PIPF \$41.17	823.4 \$128,450	0	0	0	0	0	823.4 \$128,450
	U.C. per HRS										
Labor Impact - 15% - PIPING	53,668.00	0.15	8,050	CN-PIPE \$37.58	5,637 \$302,527	0	0	0	0	0	5,637 \$302,527
	U.C. per Hr										
Post Job Review - PIPING	10.00	1	10	CN-PIPF \$41.17	41.17 \$412	0	0	0	0	0	41.17 \$412
	U.C. per Wk										
Added Supervision - STRUCTURAL STEEL	158.00	20	3,120	CN-IRWF \$43.13	862.6 \$134,566	0	0	0	0	0	862.6 \$134,566
	U.C. per HRS										
Labor Impact - 15% - STRUCTURAL STEEL	254,842.00	0.15	38,226	CN-IRON \$40.16	6,024 \$1,535,168	0	0	0	0	0	6,024 \$1,535,168
	U.C. per Hr										
Post Job Review - STRUCTURAL STEEL	10.00	1	10	CN-IRWF \$43.13	43.13 \$431	0	0	0	0	0	43.13 \$431

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
9101.1 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE											
	TANK	U.C. per Wk	20	CN-BOILMK	760		0	0	0	0	760
Added Supervision - TANK		52.00	1,040	\$38.00	\$39,520		\$0	\$0	\$0	\$0	\$39,520
	TANK	U.C. per HRS	0.15	CN-BOILMK	5.7		0	0	0	0	5.7
Labor Impact - 15% - TANK		2,194.00	329	\$38.00	\$12,508		\$0	\$0	\$0	\$0	\$12,508
	TANK	U.C. per Hr	1	CN-BOILMK	38		0	0	0	0	38
Post Job Review - TANK		10.00	10	\$38.00	\$380		\$0	\$0	\$0	\$0	\$380
<hr/>											
Subtotal					\$5,959,751		\$0	\$0	\$0	\$0	\$5,959,751
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$2,333,841		\$0	\$0	\$0	\$0	\$2,333,841
<hr/>											
Subtotal Estimate					\$2,430,852		\$0	\$0	\$0	\$0	\$2,430,852
Escalation					\$1,964,718		\$0	\$0	\$0	\$0	\$1,964,718
Contingency							\$0	\$0	\$0	\$0	
<hr/>											
--Total 9101.1 CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE			163,597		\$12,689,162		\$0	\$0	\$0	\$0	\$12,689,162
<hr/>											
-- 9102.1 EARTHWORK											
DIRT		U.C. per CY	0.05	CN-EQHV	1.628		1.25	0	0	0	2.878
BUILDING EXCAVATION		95,820.00	4,781	\$32.56	\$155,669		\$119,525	\$0	\$0	\$0	\$275,194
DIRT		U.C. per CY	0.08	CN-EQHV	2.605		1.6	0	0	0	4.205
BUILDING BACKFILL		50,370.00	4,030	\$32.56	\$131,204		\$80,592	\$0	\$0	\$0	\$211,796
DIRT		U.C. per CY	0.1	CN-EQHV	3.256		1.9	0	0	0	5.156
BOILER BUILDING EXCAVATION		600.00	60	\$32.56	\$1,954		\$1,140	\$0	\$0	\$0	\$3,094
DIRT		U.C. per CY	0.15	CN-EQHV	4.884		2.5	0	0	0	7.384
BOILER BUILDING BACKFILL		555.00	83	\$32.56	\$2,711		\$1,388	\$0	\$0	\$0	\$4,098
DIRT		U.C. per CY	0.2	CN-EQHV	6.512		3.75	0	0	0	10.262
PIPE TRENCH EXCAVATION		970.00	194	\$32.56	\$6,317		\$3,638	\$0	\$0	\$0	\$9,954
DIRT		U.C. per CY	0.3	CN-EQHV	9.768		5	0	0	0	14.768
PIPE TRENCH BACKFILL		970.00	291	\$32.56	\$9,475		\$4,850	\$0	\$0	\$0	\$14,325

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9102.1 EARTHWORK										
	Elevators, drilling for piston, casing Included, 18" diameter	U.C. per FT	20.00	0.7 CLADB48 14 \$31.34	21,939 \$439	4,544 \$91	23.7 \$474	0 \$0	0 \$0	50.183 \$1,004
Subtotal					\$307,768	\$211,223	\$474	\$0	\$0	\$519,465
Sales Tax	INEEL ORG Labor/Subcontractor Overheads				\$0	\$0	\$24	\$0	\$0	\$24
Subtotal Estimate					\$105,113	\$72,139	\$170	\$0	\$0	\$177,422
Escalation										
Contingency										
--Total 9102.1 EARTHWORK										
			9,453		\$121,015	\$83,054	\$196	\$0	\$0	\$686,910
					\$266,147	\$182,658	\$430	\$0	\$0	\$204,264
					\$800,043	\$549,074	\$1,294	\$0	\$0	\$449,236
-- 9102.2 YARD PIPING										
	PIPE									
	SBW FEED, 3" DOUBLE CONTAINED, 304L	U.C. per LF	350.00	1.7 CN-PIPE 595 \$37.58	63,886 \$22,360	0 \$0	50 \$17,500	0 \$0	0 \$0	113,886 \$39,860
	PIPE									
	SBW VALVE BOX ENTRY	U.C. per LOT	1.00	160 CN-PIPE 160 \$37.58	6012.8 \$6,013	0 \$0	0 \$0	0 \$0	0 \$0	6012.8 \$6,013
	PIPE									
	KEROSENE SUPPLY, 1 1/2" DOUBLE CONTAINED, 304L	U.C. per LF	350.00	0.9 CN-PIPE 315 \$37.58	33,822 \$11,838	0 \$0	25 \$8,750	0 \$0	0 \$0	58,822 \$20,588
Subtotal					\$40,211	\$0	\$26,250	\$0	\$0	\$66,461
Sales Tax	INEEL ORG Labor/Subcontractor Overheads				\$0	\$0	\$1,313	\$0	\$0	\$1,313
Subtotal Estimate					\$17,486	\$0	\$11,986	\$0	\$0	\$29,472
Escalation										
Contingency										
--Total 9102.2 YARD PIPING										
			1,070		\$16,911	\$0	\$11,592	\$0	\$0	\$97,245
					\$37,192	\$0	\$25,493	\$0	\$0	\$28,502
					\$111,799	\$0	\$76,633	\$0	\$0	\$62,685
-- 9103 CONCRETE										
	GEN									
	POUR, FINISH & CURE FOUNDATIONS & SLAB-ON-GRADE	U.C. per CY	5,200.00	1 CN-SKWK 5,200 \$34.52	34,52 \$179,504	0 \$0	75 \$390,000	0 \$0	0 \$0	109,52 \$569,504
	GEN									
	POUR, FINISH & CURE WALLS	U.C. per CY	23,760.00	2 CN-SKWK 47,520 \$34.52	69,04 \$1,640,390	0 \$0	75 \$1,782,000	0 \$0	0 \$0	144,04 \$3,422,390
	GEN									
	POUR, FINISH & CURE ELEVATED SLABS	U.C. per CY	9,440.00	1.5 CN-SKWK 14,160 \$34.52	51,78 \$488,803	0 \$0	75 \$708,000	0 \$0	0 \$0	126,78 \$1,196,803
	GEN									
	FORM FOUNDATIONS & SOG	U.C. per SF	25,310.00	0.2 CN-CARP 5,062 \$34.64	6,928 \$175,348	0 \$0	0.75 \$18,983	0 \$0	0 \$0	7,678 \$194,330
	GEN									
	FORM WALLS	U.C. per SF	595,725.00	0.25 CN-CARP 148,931 \$34.64	8,66 \$5,158,979	0 \$0	0.75 \$446,794	0 \$0	0 \$0	9,41 \$5,605,772

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Success Estimating and Cost Management System

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Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9103 CONCRETE										
FORM ELEVATED SLABS	GEN	U.C. per SF	183,210.00	0.3	CN-CARP	10,392	0.75	0	0	11,142
				48,983	\$34.64	\$1,686,078	\$122,408	\$0	\$0	\$1,818,486
Subtotal						\$9,339,102	\$3,468,184	\$0	\$0	\$12,807,286
Sales Tax						\$0	\$173,409	\$0	\$0	\$173,409
INEEL ORG Labor/Subcontractor Overheads						\$3,319,304	\$1,294,295	\$0	\$0	\$4,613,599
Subtotal Estimate						\$3,710,179	\$1,446,709	\$0	\$0	\$17,594,294
Escalation						\$17,226,298	\$6,717,045	\$0	\$0	\$23,943,343
Contingency										
---Total 9103 CONCRETE			269,836			\$33,594,883	\$13,099,641	\$0	\$0	\$46,694,524
9104 MASONRY										
BOILER BUILDING BLOCK WALLS	GEN	U.C. per SF	6,720.00	0.12	CN-BRIC	3,743	2.6	0	0	6,343
				806	\$31.19	\$25,152	\$17,472	\$0	\$0	\$42,624
Subtotal						\$25,152	\$17,472	\$0	\$0	\$42,624
Sales Tax						\$0	\$874	\$0	\$0	\$874
INEEL ORG Labor/Subcontractor Overheads						\$8,939	\$6,520	\$0	\$0	\$15,460
Subtotal Estimate						\$9,992	\$7,288	\$0	\$0	\$58,957
Escalation						\$0	\$0	\$0	\$0	\$17,280
Contingency										\$0
---Total 9104 MASONRY			806			\$44,083	\$32,154	\$0	\$0	\$76,237
9105.1 STRUCTURAL STEEL										
BOILER STACK SUPPORTS	STEEL	U.C. per EA	2.00	40	CN-IRON	1606.4	275	0	0	1881.4
				80	\$40.16	\$3,213	\$550	\$0	\$0	\$3,763
BOILER BUILDING PLATFORMS	STEEL	U.C. per LBS	11,000.00	0.018	CN-IRON	0.723	1.62	0	0	2,343
				198	\$40.16	\$7,952	\$17,820	\$0	\$0	\$25,772
BOILER BUILDING ROOF FRAMING	STEEL	U.C. per LBS	21,840.00	0.012	CN-IRON	0.482	0.4	0	0	0.882
				262	\$40.16	\$10,525	\$8,736	\$0	\$0	\$19,261
STEEL		U.C. per EA	345.00	0.744	SIWSE4	30,073	129.87	0	0	161,812
Stair, sill, grating trd & pipe r, 4" wide, saf nosing,				257	\$40.41	\$10,375	\$44,805	\$0	\$0	\$55,825
sil strg										
Memo:										
STEEL		U.C. per SF	864.00	0.2	SIWSE4	8,082	35.71	0	0	44,294
Stair, landing, steel pan, conventional				173	\$40.41	\$6,983	\$30,853	\$0	\$0	\$38,270
Memo:										

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client:

J. J. Quigley

Prepared By:

R. D. Adams

Estimate Type: Planning

LEVEL	Qty	Hrs	Crew/Rate	Labor	Const	Matl	S/C	Other	TOTAL
9105.1 STRUCTURAL STEEL									
PROCESS BUILDING ROOF FRAMING	U.C. per LBS	0.012	CN-IRON	0.482	0	0.4	0	0	0.882
Memo: Based on 7# steel/sf of roof.	450,000.00	5,400	\$40.16	\$216,864	\$0	\$180,000	\$0	\$0	\$396,864
Subtotal				\$255,912	\$1,079	\$282,765	\$0	\$0	\$530,755
Sales Tax				\$0	\$0	\$14,138	\$0	\$0	\$14,138
INEEL ORG Labor/Subcontractor Overheads				\$102,329	\$431	\$118,720	\$0	\$0	\$221,480
Subtotal Estimate				\$105,000	\$443	\$121,819	\$0	\$0	\$227,262
Escalation				\$147,542	\$622	\$171,175	\$0	\$0	\$319,339
Contingency				\$610,783	\$2,575	\$708,616	\$0	\$0	\$1,321,975
9105.2 SST LINERS									
Memo: Liner prices include embedded frames, 1/8" to 3/16" liner plate, plug & seal welds, and nondestructive testing.									
STAINLESS STEEL LINER, FLOOR	U.C. per SF	1.9	CN-IRON	76,304	0	21	0	0	97,304
	21,720.00	41,268	\$40.16	\$1,657,323	\$0	\$456,120	\$0	\$0	\$2,113,443
STAINLESS STEEL LINER, WALLS	U.C. per SF	2.1	CN-IRON	84,336	0	21	0	0	105,336
	65,580.00	137,718	\$40.16	\$5,530,755	\$0	\$1,377,180	\$0	\$0	\$6,907,935
Subtotal				\$7,188,078	\$0	\$1,833,300	\$0	\$0	\$9,021,378
Sales Tax				\$0	\$0	\$91,665	\$0	\$0	\$91,665
INEEL ORG Labor/Subcontractor Overheads				\$2,874,225	\$0	\$769,717	\$0	\$0	\$3,643,941
Subtotal Estimate				\$2,949,261	\$0	\$789,811	\$0	\$0	\$3,739,072
Escalation				\$4,144,183	\$0	\$1,109,811	\$0	\$0	\$5,253,994
Contingency				\$17,155,746	\$0	\$4,594,304	\$0	\$0	\$21,750,050
9105.3 CRANE/CART RAILS									
CRANE/CART RAILS & BEAMS	U.C. per LF	2	CN-IRON	80.32	0	60	0	0	140.32
	2,130.00	4,260	\$40.16	\$171,082	\$0	\$127,800	\$0	\$0	\$298,882
Subtotal				\$171,082	\$0	\$127,800	\$0	\$0	\$298,882
Sales Tax				\$0	\$0	\$6,390	\$0	\$0	\$6,390
INEEL ORG Labor/Subcontractor Overheads				\$68,409	\$0	\$53,657	\$0	\$0	\$122,066
Subtotal Estimate				\$70,195	\$0	\$55,058	\$0	\$0	\$125,253
Escalation				\$98,635	\$0	\$77,365	\$0	\$0	\$176,000
Contingency				\$408,320	\$0	\$320,271	\$0	\$0	\$728,590
9105.4 REBAR									
BOILER BLDG., OFFICE BLDG., & PROCESS BUILDING	U.C. per LBS	0.01	CN-RODM	0.341	0	0.26	0	0	0.601
	4,487,140.00	44,871	\$34.10	\$1,530,115	\$0	\$1,166,656	\$0	\$0	\$2,696,771

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Success Estimating and Cost Management System

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CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
9105.4 REBAR											
Subtotal					\$1,530,115		\$0	\$1,166,656		\$0	\$2,696,771
Sales Tax					\$0		\$0	\$58,333		\$0	\$58,333
INEEL ORG Labor/Subcontractor Overheads					\$611,832		\$0	\$489,824		\$0	\$1,101,656
Subtotal Estimate					\$627,804		\$0	\$502,612		\$0	\$3,856,760
Escalation					\$882,166		\$0	\$708,250		\$0	\$1,130,416
Contingency							\$0			\$0	\$1,588,416
--Total 9105.4 REBAR			44,871		\$3,651,917		\$0	\$2,923,675		\$0	\$6,575,592
9105.5 EMBEDDED METALS											
Memo: Assume mostly est embedded material. Includes penetrations, sleeves, in-wall supports for setting windows and manipulators, and supports to position penetrations and sleeves.											
STEEL											
U.C. per LBS											
PROCESS BLDG. EMBEDS		407,100.00	20,355	\$34.52	\$702,655		\$0	\$1,017,750		\$0	\$1,720,405
Subtotal					\$702,655		\$0	\$1,017,750		\$0	\$1,720,405
Sales Tax					\$0		\$0	\$50,888		\$0	\$50,888
INEEL ORG Labor/Subcontractor Overheads					\$280,963		\$0	\$427,305		\$0	\$708,269
Subtotal Estimate					\$288,298		\$0	\$438,461		\$0	\$2,479,561
Escalation					\$405,105		\$0	\$616,108		\$0	\$726,759
Contingency							\$0			\$0	\$1,021,213
--Total 9105.5 EMBEDDED METALS			20,355		\$1,677,022		\$0	\$2,550,511		\$0	\$4,227,533
9107.1 BOILER BUILDING											
INSUL											
EXTERIOR WALL INSULATION W/ Z-GIRTS		6,720.00	0		\$0		\$0	\$0		\$0	\$12,768
U.C. per SF											1.9
ROOF INSULATION		3,120.00	0		\$0		\$0	\$0		\$0	\$3,120
U.C. per SF											1
EXTERIOR WALL METAL SIDING		6,720.00	0.023	CN-SHEE	\$5,484		\$0	\$20,160		\$0	\$25,644
U.C. per SF			155								3.816
STANDING SEAM METAL ROOF		3,120.00	0.016	CN-SHEE	\$1,771		\$0	\$15,600		\$0	\$17,371
U.C. per SF			50								5.568
Subtotal					\$7,255		\$0	\$35,760		\$0	\$58,903
Sales Tax					\$0		\$0	\$1,788		\$0	\$1,788
INEEL ORG Labor/Subcontractor Overheads					\$2,579		\$0	\$13,345		\$0	\$22,277
Subtotal Estimate					\$2,882		\$0	\$14,917		\$0	\$82,968
Escalation					\$4,690		\$0	\$24,271		\$0	\$24,318
Contingency							\$0			\$0	\$39,567
--Total 9107.1 BOILER BUILDING			204		\$17,405		\$0	\$90,081		\$0	\$146,853

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9107.2 OFFICE ADDITION										
	INSUL									
Wall Insul, 3.5" thk, R11, 15" W, fbgls, kraft faced, batt/bikt		U.C. per SF 4,550.00	0.005 23	ACARCARP1 \$34.64	0.173 \$768	0 \$0	0.19 \$865	0 \$0	0 \$0	0.363 \$1,653
Memo: batt/bikt										
INSUL										
Ceiling Insul, 3.5" thk, R11, 15" W, fbgls, unfaced, batt/bikt		U.C. per SF 12,800.00	0.006 76	ACARCARP1 \$34.64	0.204 \$2,616	0 \$0	0.17 \$2,176	0 \$0	0 \$0	0.374 \$4,792
Memo: batt/bikt										
INSUL										
Ceiling Insul, 6" thk, R19, 15" W, fbgls, unfaced, batt/bikt		U.C. per SF 12,800.00	0.007 90	ACARCARP1 \$34.64	0.242 \$3,104	0 \$0	0.29 \$3,712	0 \$0	0 \$0	0.532 \$6,816
Memo:										
INSUL										
ADD FOR INSUL BASKETS TO SUPPORT CEILING INSULATION		U.C. per SF 12,800.00	0.008 102	ACARCARP1 \$34.64	0.277 \$3,547	0 \$0	1.1 \$14,080	0 \$0	0 \$0	1.377 \$17,627
Subtotal					\$10,055	\$0	\$20,833	\$0	\$0	\$30,887
Sales Tax					\$0	\$0	\$1,042	\$0	\$0	\$1,042
INEEL ORG Labor/Subcontractor Overheads					\$4,021	\$0	\$8,747	\$0	\$0	\$12,767
Subtotal Estimate										\$44,696
Escalation					\$4,126	\$0	\$8,975	\$0	\$0	\$13,100
Contingency					\$6,713	\$0	\$14,603	\$0	\$0	\$21,315
-- Total 9107.2 OFFICE ADDITION										
			290		\$24,914	\$0	\$54,199	\$0	\$0	\$79,112
-- 9107.3 PROCESS BUILDING										
EXTERIOR WALL INSULATION W/ Z-GIRTS		U.C. per SF 98,340.00	0		0 \$0	0 \$0	0 \$0	1.9 \$186,846	0 \$0	1.9 \$186,846
INSUL										
ROOF INSULATION		U.C. per SF 64,220.00	0		0 \$0	0 \$0	0 \$0	1 \$64,220	0 \$0	1 \$64,220
GEN										
EXTERIOR WALL METAL SIDING		U.C. per SF 98,340.00	0.023 2,262	CN-SHEE \$35.48	0.816 \$80,249	0 \$0	3 \$295,020	0 \$0	0 \$0	3.816 \$375,269
GEN										
STANDING SEAM METAL ROOF		U.C. per SF 64,220.00	0.016 1,028	CN-SHEE \$35.48	0.568 \$36,456	0 \$0	5 \$321,100	0 \$0	0 \$0	5.568 \$357,556
Subtotal					\$116,706	\$0	\$616,120	\$251,066	\$0	\$983,892
Sales Tax					\$0	\$0	\$30,806	\$0	\$0	\$30,806
INEEL ORG Labor/Subcontractor Overheads					\$41,480	\$0	\$229,930	\$100,391	\$0	\$371,801
Subtotal Estimate										\$1,386,499
Escalation					\$46,364	\$0	\$257,007	\$103,012	\$0	\$406,383
Contingency					\$75,438	\$0	\$418,169	\$167,608	\$0	\$661,215
-- Total 9107.3 PROCESS BUILDING										
			3,289		\$279,987	\$0	\$1,552,032	\$622,078	\$0	\$2,454,097

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9108 DOORS & WINDOWS										
PERSONNEL DOOR, 3' X 7', HM	GEN	U.C. per EA	35.00	8 CN-CARP	277.12	0	700	0	0	977.12
					\$9,699	\$0	\$24,500	\$0	\$0	\$34,199
PERSONNEL DOOR, 6' X 7', HM	GEN	U.C. per EA	8.00	12 CN-CARP	415.68	0	1000	0	0	1415.68
					\$3,325	\$0	\$8,000	\$0	\$0	\$11,325
PERSONNEL DOOR, 3' X 7', SST, AIRLOCK DOORS	GEN	U.C. per EA	28.00	10 CN-IRON	401.6	0	2500	0	0	2901.6
					\$11,245	\$0	\$70,000	\$0	\$0	\$81,245
PERSONNEL DOOR, 6' X 7', SST, AIRLOCK DOORS	GEN	U.C. per EA	2.00	16 CN-IRON	642.56	0	4500	0	0	5142.56
					\$1,285	\$0	\$9,000	\$0	\$0	\$10,285
ROLL-UP DOOR, 12' X 14'	GEN	U.C. per EA	6.00	24 CN-IRON	963.84	0	4000	0	0	4963.84
					\$5,783	\$0	\$24,000	\$0	\$0	\$29,783
Subtotal					\$31,338	\$0	\$135,500	\$0	\$0	\$166,838
Sales Tax					\$0	\$0	\$6,775	\$0	\$0	\$6,775
INEEL ORG Labor/Subcontractor Overheads					\$11,138	\$0	\$50,567	\$0	\$0	\$61,705
Subtotal Estimate					\$12,450	\$0	\$66,522	\$0	\$0	\$235,318
Escalation					\$15,110	\$0	\$68,600	\$0	\$0	\$68,972
Contingency					\$70,035	\$0	\$317,965	\$0	\$0	\$83,710
9109 DOORS & WINDOWS										
9109.1.1 Plns/met, 5/8" fr drwl f, none b, 3-5/8" @ 24" OC fmg, nothing opp f, 0 Insul	GEN	U.C. per SF	7,540.00	0.016 CARP	0.437	0	0.16	0	0	0.597
					\$3,293	\$0	\$1,206	\$0	\$0	\$4,500
Metal studs, non-load brg, galv, 25Ga, 3-5/8" W, 24" o.c.				121	\$27.30	\$0				
DRYW		U.C. per SF	7,540.00	0.008 CARP2	0.277	0	0.21	0	0	0.487
					\$2,089	\$0	\$1,583	\$0	\$0	\$3,673
Drywall, gyp plasbd, nailed/scredd to std, 5/8" thk, on w/ fire res, no fin				60	\$34.64	\$0				
DRYW		U.C. per SF	7,540.00	0.008 CARP2	0.277	0	0.09	0	0	0.367
					\$2,089	\$0	\$678	\$0	\$0	\$2,768
Drywall, taping and finishing joints, add				60	\$34.64	\$0				
DRYW		U.C. per SF	7,540.00	0.004 ALATLATH1	0.139	0	0.04	0	0	0.179
					\$1,045	\$0	\$302	\$0	\$0	\$1,346
TEXTURE WALLS BEFORE PAINTING				30	\$34.64	\$0				
Subtotal					\$8,517	\$0	\$3,770	\$0	\$0	\$12,287
Sales Tax					\$0	\$0	\$189	\$0	\$0	\$189
INEEL ORG Labor/Subcontractor Overheads					\$2,955	\$0	\$1,370	\$0	\$0	\$4,324
Subtotal Estimate					\$3,362	\$0	\$1,562	\$0	\$0	\$16,800
Escalation					\$8,009	\$0	\$3,720	\$0	\$0	\$4,924
Contingency					\$22,843	\$0	\$10,609	\$0	\$0	\$11,729
9109.1.1 Plns/met, 5/8" fr drwl f, none b, 3-5/8" @ 24" OC fmg, nothing opp f, 0 Insul				271	\$22,843	\$0	\$10,609	\$0	\$0	\$33,453

VITRIFICATION OF SBW
Project Location: **INEEL/INTEC**
Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9109.1.2 Ptns/met, 5/8" fr drwl f, none base, 3-5/8" @ 24" OC fmg, same opp f, 0 Insul										
	GEN	U.C. per SF	0.016	CARP	0.437	0	0.16		0	0.597
	Metal studs, non-load brg, galv, 25Ga, 3-5/8" W, 24" o.c.	4,550.00	73	\$27.30	\$1,987	\$0	\$728	\$0	\$0	\$2,715
9109.1.3 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	GEN	U.C. per SF	0.008	CARP2	0.277	0	0.21		0	0.487
	Drywall, gyp plasb'd, nailed/scrd to std, 5/8" thk, on w/ fire res, no fin	9,100.00	73	\$34.64	\$2,522	\$0	\$1,911	\$0	\$0	\$4,433
9109.1.4 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	GEN	U.C. per SF	0.008	CARP2	0.277	0	0.09		0	0.367
	Drywall, taping and finishing joints, add	9,100.00	73	\$34.64	\$2,522	\$0	\$819	\$0	\$0	\$3,341
9109.1.5 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	GEN	U.C. per SF	0.004	ALATLATH1	0.139	0	0.04		0	0.179
	TEXTURE CEILING BEFORE PAINTING	9,100.00	36	\$34.64	\$1,261	\$0	\$364	\$0	\$0	\$1,625
9109.1.6 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	Subtotal				\$8,292	\$0	\$3,822	\$0	\$0	\$12,114
	Sales Tax				\$0	\$0	\$191	\$0	\$0	\$191
	INEEL ORG Labor/Subcontractor Overheads				\$2,860	\$0	\$1,381	\$0	\$0	\$4,241
9109.1.7 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	Subtotal Estimate				\$3,268	\$0	\$1,581	\$0	\$0	\$4,849
	Escalation				\$7,785	\$0	\$3,766	\$0	\$0	\$11,551
	Contingency				\$22,205	\$0	\$10,741	\$0	\$0	\$32,947
9109.1.8 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	GEN	U.C. per SF	0.016	CARP	0.437	0	0.16		0	0.597
	Metal studs, non-load brg, galv, 25Ga, 3-5/8" W, 24" o.c.	1,660.00	27	\$27.30	\$725	\$0	\$266	\$0	\$0	\$991
9109.1.9 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	GEN	U.C. per SF	0.008	CARP2	0.277	0	0.21		0	0.487
	Drywall, gyp plasb'd, nailed/scrd to std, 5/8" thk, on w/ fire res, no fin	4,980.00	40	\$34.64	\$1,380	\$0	\$1,046	\$0	\$0	\$2,426
9109.1.10 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	GEN	U.C. per SF	0.008	CARP2	0.277	0	0.09		0	0.367
	Drywall, taping and finishing joints, add	3,320.00	27	\$34.64	\$920	\$0	\$299	\$0	\$0	\$1,219
9109.1.11 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	GEN	U.C. per SF	0.004	ALATLATH1	0.139	0	0.04		0	0.179
	TEXTURE CEILING BEFORE PAINTING	3,320.00	13	\$34.64	\$460	\$0	\$133	\$0	\$0	\$593
9109.1.12 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	Subtotal				\$3,485	\$0	\$1,743	\$0	\$0	\$5,228
	Sales Tax				\$0	\$0	\$87	\$0	\$0	\$87
	INEEL ORG Labor/Subcontractor Overheads				\$1,200	\$0	\$629	\$0	\$0	\$1,829
9109.1.13 Ptns/met, 5/8" fr drwl f, 5/8" fr drwl b, 3-5/8" @ 24" 5/8" fr opp f, 0 Insul										
	Subtotal Estimate				\$1,373	\$0	\$721	\$0	\$0	\$2,094
	Escalation				\$3,271	\$0	\$1,717	\$0	\$0	\$4,988
	Contingency				\$9,330	\$0	\$4,897	\$0	\$0	\$14,227

05/24/2000

Success Estimating and Cost Management System

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CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Guilgley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
--	9109.2 Tile, quarry tile, mud set, minimum GEN	2,330.00	0.091 212	D7 \$32.37	2,945 \$8,862		0 \$0	2.65 \$6,175	0 \$0	0 \$0	5.595 \$13,037
	Quarry tile, flt, mud set, 1,000 SF lot, red, 6"x6"x1/2", 3/4" P.C. bed										
	Subtotal				\$6,862	\$0	\$0	\$6,175	\$0	\$0	\$13,037
	Sales Tax				\$0	\$0	\$0	\$309	\$0	\$0	\$309
	INEEL ORG Labor/Subcontractor Overheads				\$2,439	\$0	\$0	\$2,304	\$0	\$0	\$4,743
	Subtotal Estimate				\$2,726	\$0	\$0	\$2,576	\$0	\$0	\$18,089
	Escalation				\$6,494	\$0	\$0	\$6,135	\$0	\$0	\$5,302
	Contingency										\$12,629
--	Total 9109.2 Tile, quarry tile, mud set, minimum	212			\$18,521	\$0	\$0	\$17,498	\$0	\$0	\$36,019
--	9109.3 Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 24 oz GEN	710.40	0.1 71	TILF \$26.65	2,665 \$1,893	0 \$0		25 \$17,760	0 \$0	0 \$0	27,665 \$19,653
	Carpet tile, tufted, 18" x 18" or 24" x 24", 24 oz nylon										
	Subtotal				\$1,893	\$0	\$0	\$17,760	\$0	\$0	\$19,653
	Sales Tax				\$0	\$0	\$0	\$888	\$0	\$0	\$888
	INEEL ORG Labor/Subcontractor Overheads				\$673	\$0	\$0	\$6,628	\$0	\$0	\$7,301
	Subtotal Estimate				\$752	\$0	\$0	\$7,408	\$0	\$0	\$27,842
	Escalation				\$1,792	\$0	\$0	\$17,646	\$0	\$0	\$8,160
	Contingency										\$19,438
--	Total 9109.3 Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 24 oz	71			\$5,110	\$0	\$0	\$50,330	\$0	\$0	\$55,440
--	9109.4.1 Acous class 3/4" (bgl bd 24" x 24" tile, tee grid, suspended support GEN	9,700.00	0.012 116	CARP \$27.30	0.328 \$3,178	0 \$0		0.39 \$3,783	0 \$0	0 \$0	0.718 \$6,961
	Suspension systems for boards & tile, class A, 15/16" T bar, 2' x 2' g										
	Subtotal				\$3,178	\$0	\$0	\$3,783	\$0	\$0	\$6,961
	Sales Tax				\$0	\$0	\$0	\$0	\$0	\$0	\$0
	INEEL ORG Labor/Subcontractor Overheads				\$0	\$0	\$0	\$0	\$0	\$0	\$0
	Subtotal Estimate				\$3,178	\$0	\$0	\$3,783	\$0	\$0	\$6,961
	Escalation				\$0	\$0	\$0	\$0	\$0	\$0	\$0
	Contingency										\$0
--	Total 9109.4.1 Acous class 3/4" (bgl bd 24" x 24" tile, tee grid, suspended support or 24" x 24", 24 oz	116			\$3,178	\$0	\$0	\$3,783	\$0	\$0	\$6,961
--	9109.4.2 Acous class 3/4" (bgl bd 24" x 24" tile, tee grid, suspended support GEN	97.00	0.019 2	CARP \$27.30	0.519 \$50	0 \$0		0.87 \$84	0 \$0	0 \$0	1.389 \$135
	Suspension system for ceiling metal pan snap on 1'x 1'										

CONSTRUCTION DETAIL ITEM REPORT

Project Name: **VITRIFICATION OF SBW**
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

Client: **J. J. Quligley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9109.4.1 ACous clgs, 3/4" fbgl bd, 24" x 24" tile, tee grid, suspended support										
	GEN	U.C. per SF	9,700.00	CARP	0.355	0	1.03	0	0	1.385
				\$27.30	\$3,443	\$0	\$9,991	\$0	\$0	\$13,434
Susp acct clg bds, no spnsn sys, fbglis, flim fcd, 2'x2' or 2'x4', 3/4" T										
Subtotal					\$6,671	\$0	\$13,858	\$0	\$0	\$20,529
Sales Tax					\$0	\$0	\$693	\$0	\$0	\$693
INEEL ORG Labor/Subcontractor Overheads					\$2,371	\$0	\$5,172	\$0	\$0	\$7,543
Subtotal Estimate										\$28,765
Escalation					\$2,650	\$0	\$5,781	\$0	\$0	\$8,431
Contingency					\$6,312	\$0	\$13,770	\$0	\$0	\$20,082
Total 9109.4.1 ACous clgs, 3/4" fbgl bd, 24" x 24" tile, tee grid, suspended support										
			244		\$18,004	\$0	\$39,274	\$0	\$0	\$57,277
9109.4.2 DRYWALL SUSPENDED CEILINGS										
	DRYW	U.C. per SF	1,360.00	ALATLATH1	1.912	0	0.55	0	0	2.462
				\$34.64	\$2,600	\$0	\$748	\$0	\$0	\$3,348
Furring, clg spnsn system, 1.5" main @ 48" OC, w/ 3/4" chan @ 12"										
Memo: 12"										
1/2" FR DRYWALL, TAPED & FINISHED										
	DRYW	U.C. per SF	1,360.00	ALATLATH1	0.868	0	0.16	0	0	1.026
				\$34.64	\$1,178	\$0	\$218	\$0	\$0	\$1,395
TEXTURE CEILING BEFORE PAINTING										
	DRYW	U.C. per SF	1,360.00	ALATLATH1	0.139	0	0.04	0	0	0.179
				\$34.64	\$188	\$0	\$54	\$0	\$0	\$243
Subtotal					\$3,967	\$0	\$1,020	\$0	\$0	\$4,987
Sales Tax					\$0	\$0	\$51	\$0	\$0	\$51
INEEL ORG Labor/Subcontractor Overheads					\$1,355	\$0	\$366	\$0	\$0	\$1,721
Subtotal Estimate										\$6,758
Escalation					\$1,560	\$0	\$421	\$0	\$0	\$1,981
Contingency					\$3,715	\$0	\$1,003	\$0	\$0	\$4,718
Total 9109.4.2 DRYWALL SUSPENDED CEILINGS										
			115		\$10,596	\$0	\$2,861	\$0	\$0	\$13,457
9109.4 COATINGS										
	PAINT	U.C. per SF	366,110.00	CN-PAINT	3.039	0	2.05	0	0	5.089
				\$30.39	\$1,112,608	\$0	\$750,526	\$0	\$0	\$1,863,134
HIGH-BUILD EPOXY COATING ON FLOORS, WALLS & CEILINGS										

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9109.4 COATINGS										
	PAINT	U.C. per SF	0.004	CN-PAIN	0.122	0	0.12	0	0	0.242
	SEAL ALL NON-COATED, NON-LINED CONCRETE SURFACES	564,970.00	2,260	\$30.39	\$69,678	\$0	\$67,796	\$0	\$0	\$136,474
Subtotal					\$1,181,286	\$0	\$818,322	\$0	\$0	\$1,999,608
Sales Tax					\$0	\$0	\$40,916	\$0	\$0	\$40,916
INEEL ORG Labor/Subcontractor Overheads					\$444,788	\$0	\$323,528	\$0	\$0	\$768,316
Subtotal Estimate					\$476,602	\$0	\$346,669	\$0	\$0	\$823,271
Escalation					\$1,135,235	\$0	\$825,742	\$0	\$0	\$1,960,977
Contingency										
--Total 9109.4 COATINGS										
			38,871		\$3,237,912	\$0	\$2,355,177	\$0	\$0	\$5,593,089
-- 9109.5 PAINT STRUCTURAL STEEL										
	PAINT	U.C. per TON	1.8	CN-PAIN	54.702	0	20	0	0	74.702
	PAINT STRUCTURAL STEEL	348.00	626	\$30.39	\$19,036	\$0	\$6,960	\$0	\$0	\$25,996
Subtotal					0	0	0	2700	0	2700
Sales Tax					\$0	\$0	\$0	\$2,700	\$0	\$2,700
INEEL ORG Labor/Subcontractor Overheads										
Subtotal Estimate					\$7,680	\$0	\$2,948	\$1,089	\$0	\$39,980
Escalation					\$18,294	\$0	\$7,023	\$2,595	\$0	\$11,718
Contingency										\$27,912
--Total 9109.5 PAINT STRUCTURAL STEEL										
			626		\$52,179	\$0	\$20,031	\$7,401	\$0	\$79,611
-- 9109.6 PAINT & LABEL PIPING										
	PAINT	U.C. per LOT	0		0	0	0	6200	0	6200
	LABEL BOILER BUILDING PIPES	1.00	0		\$0	\$0	\$0	\$6,200	\$0	\$6,200
Memo: Based on estimated #2547-A. Assumed 1/2 the quantities.										
	PAINT	U.C. per EA	0.25	CN-PAIN	7.598	0	5	0	0	12.598
	LABEL PROCESS BUILDING PIPES	11,750.00	2,938	\$30.39	\$89,271	\$0	\$59,750	\$0	\$0	\$149,021
Subtotal					\$89,271	\$0	\$59,750	\$6,200	\$0	\$154,221
Sales Tax					\$0	\$0	\$2,938	\$0	\$0	\$2,938
INEEL ORG Labor/Subcontractor Overheads					\$33,613	\$0	\$23,227	\$2,334	\$0	\$59,175
Subtotal Estimate					\$36,017	\$0	\$24,888	\$2,501	\$0	\$216,333
Escalation					\$85,791	\$0	\$59,283	\$5,958	\$0	\$63,407
Contingency										\$151,032
--Total 9109.6 PAINT & LABEL PIPING										
			2,938		\$244,691	\$0	\$169,086	\$16,994	\$0	\$430,771

Memo: Based on estimated #2547-A. Assumed 1/2 the quantities.

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
9110.1 ACCESS FLOORING											
	GEN										
Ped acs flr, cmplr rm appl, mel, part bd or st pnl, for HP lam covng, add		3,300.00	0		\$0	0	\$0	2.59 \$8,547	0 \$0	0 \$0	2.59 \$8,547
9110.2 ACCESS FLOORING											
	GEN										
Pedestal access floors, prt bd or steel panels, no covering, <6000 SF		3,300.00	0.04 132	CARP2 \$34.64	1,386 \$4,572	0	\$0	5.65 \$18,645	0 \$0	0 \$0	7,036 \$23,217
Subtotal											
Sales Tax					\$4,572	\$0	\$0	\$27,192	\$0	\$0	\$31,764
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$1,360	\$0	\$0	\$1,360
Subtotal Estimate					\$1,625	\$0	\$0	\$10,148	\$0	\$0	\$11,773
Escalation											
Contingency											
9110.1 ACCESS FLOORING											
			132		\$8,014	\$0	\$0	\$50,042	\$0	\$0	\$58,056
9110.2 BATHROOM ACCESSORIES & LOCKERS											
	GEN										
Lockers, steel, 12' x 18' x 72", baked enamel, single tier box		20.00	1 20	MSHMSHEE1 \$35.48	35.48 \$710	0	\$0	132.33 \$2,647	0 \$0	0 \$0	167.81 \$3,356
9110.3 BATHROOM ACCESSORIES & LOCKERS											
	GEN										
Lockers, locker bench, hardwood w/iron legs		20.00	0.1 2	MSHMSHEE1 \$35.48	3.548 \$71	0	\$0	14.49 \$290	0 \$0	0 \$0	18.038 \$361
9110.4 BATHROOM ACCESSORIES & LOCKERS											
	GEN										
Bathroom accessories, grab bar, sst, straight, 24" long		2.00	0.348 1	ACARCARP1 \$34.64	12.048 \$24	0	\$0	31.1 \$62	0 \$0	0 \$0	43.148 \$86
9110.5 BATHROOM ACCESSORIES & LOCKERS											
	GEN										
Bathroom access, mirror w/5" sst shell, 3/4" sst sq fr, 18" x 24"		5.00	0.4 2	ACARCARP1 \$34.64	13.856 \$89	0	\$0	87.97 \$440	0 \$0	0 \$0	101.826 \$509
9110.6 BATHROOM ACCESSORIES & LOCKERS											
	GEN										
Bathroom accessories, surf mntd, napkin disp, w/receptor, free		1.00	1 1	ACARCARP1 \$34.64	34.64 \$35	0	\$0	584.54 \$585	0 \$0	0 \$0	619.18 \$619
9110.7 BATHROOM ACCESSORIES & LOCKERS											
	GEN										
Bathroom accessories, liquid soap disp, chrome, surf mounted		5.00	0.4 2	ACARCARP1 \$34.64	13.856 \$69	0	\$0	39.43 \$197	0 \$0	0 \$0	53.286 \$266
9110.8 BATHROOM ACCESSORIES & LOCKERS											
	GEN										
Bathroom accessories, toilet paper holder, double, roll type		4.00	0.333 1	ACARCARP1 \$34.64	11.546 \$46	0	\$0	15.2 \$61	0 \$0	0 \$0	26.746 \$107

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9110.2 BATHROOM ACCESSORIES & LOCKERS										
Bathroom accessories, towel dispenser & receptacle	GEN	U.C. per EA	2.00	1 ACARCARP1	34.64	0	261.25	0	0	295.89
				2	\$34.64	\$0	\$523	\$0	\$0	\$592
Memo:										
Bathroom accessories, towel bar, sst, 24" long	GEN	U.C. per EA	4.00	0.364 ACARCARP1	12.595	0	30.59	0	0	43.185
				1	\$34.64	\$0	\$122	\$0	\$0	\$173
Memo:										
Bathroom accessories, hat and coat strip, SS, 6 hook, 60" long	GEN	U.C. per EA	4.00	0.4 CARP	10.92	0	69	0	0	79.92
				2	\$27.30	\$0	\$276	\$0	\$0	\$320
Bathroom accessories, toilet seat cov disp, SS, surface mtd	GEN	U.C. per EA	4.00	0.533 CARP	14.551	0	25	0	0	39.551
				2	\$27.30	\$0	\$100	\$0	\$0	\$158
Partitions, toilet, cubs, flr & ckg ahr, plastic lam on particle bd	GEN	U.C. per EA	4.00	3.2 CARP2	110.848	0	470	0	0	580.848
				13	\$34.64	\$0	\$1,880	\$0	\$0	\$2,323
Pin, toilet, cubs, flr & ckg ahr, for handicap units, Incl 52" grab bars, add	GEN	U.C. per EA	2.00	0	0	0	250	0	0	250
					\$0	\$0	\$500	\$0	\$0	\$500
Partitions toilet, urinal screen, wall hung, plastic lam on prt bd	GEN	U.C. per EA	2.00	1.6 CARP2	55.424	0	108	0	0	163.424
				3	\$34.64	\$0	\$216	\$0	\$0	\$327
Subtotal Estimate										
Sales Tax					\$1,800	\$0	\$7,898	\$0	\$0	\$9,698
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$395	\$0	\$0	\$395
					\$640	\$0	\$2,947	\$0	\$0	\$3,587
Subtotal Estimate										
Escalation					\$715	\$0	\$3,294	\$0	\$0	\$4,009
Contingency					\$0	\$0	\$0	\$0	\$0	\$0
--Total 9110.2 BATHROOM ACCESSORIES & LOCKERS										
			52		\$3,155	\$0	\$14,535	\$0	\$0	\$17,689
9111.1 SBW WORKOFF TANK										
SBW WORKOFF TANK, 30,000 GAL, NITRONIC 50		U.C. per EA	1.00	150 CN-BOILMK	5700	0	410000	0	0	415700
				150	\$38.00	\$0	\$410,000	\$0	\$0	\$415,700
Memo: Material cost includes field erection labor. Based on a preliminary phone quote from Harris Thermal Transfer Products in 1997. Dollars were escalated by 8%.										
WORKOFF TANK STEAM JACKET		U.C. per EA	1.00	0 CN-BOILMK	0	0	100000	0	0	100000
					\$0	\$0	\$100,000	\$0	\$0	\$100,000
Memo: Installation included with tank. Based on \$/lb fabbed cost for 304L sst. Multiplied cost by 2 for nitronic 50.										

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9111.1 SBW WORKOFF TANK										
SBW WORKOFF PUMPS										
Memo: Centrifugal, 100 gpm, nitronic 50. Based on phone quote received by FDNW in 1997. Escalated by 8%.										
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads										
Subtotal Estimate										
Escalation										
Contingency										
-- Total 9111.1 SBW WORKOFF										
-- 9111.2 FRIT GEN										
FRIT HOPPER/SUPERSACK OPENER, CARBON STEEL										
FRIT CONVEYOR		1.00	40	CN-MILL	1316.8	0	15000	0	0	16316.8
			40		\$1,317	\$0	\$15,000	\$0	\$0	\$16,317
FRIT WEIGH CONVEYOR BIN, CARBON STEEL		1.00	30	CN-MILL	987.6	0	10000	0	0	10987.6
			30		\$988	\$0	\$10,000	\$0	\$0	\$10,988
FRIT WEIGH CONVEYOR		1.00	40	CN-MILL	1316.8	0	10000	0	0	11316.8
			40		\$1,317	\$0	\$10,000	\$0	\$0	\$11,317
FRIT AUGER FEEDER HOPPER AUGER FEEDER		1.00	20	CN-MILL	658.4	0	6000	0	0	6658.4
			20		\$658	\$0	\$6,000	\$0	\$0	\$6,658
		1.00	40	CN-MILL	1316.8	0	10000	0	0	11316.8
			40		\$1,317	\$0	\$10,000	\$0	\$0	\$11,317
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads										
Subtotal Estimate										
Escalation										
Contingency										
-- Total 9111.2 FRIT										
-- 9111.3 SUGAR PIPE										
SUGAR TRUCK TRANSPORT UNLOADING STATION										
		1.00	20	CN-PIPE	751.6	0	3000	0	0	3751.6
			20		\$752	\$0	\$3,000	\$0	\$0	\$3,752
SUGAR STORAGE TANK, 7500 GAL, 304 SS		1.00	100	CN-BOILMK	3800	0	79000	0	0	82800
			100		\$3,800	\$0	\$79,000	\$0	\$0	\$82,800
SUGAR STORAGE TANK STEAM JACKET, 304 SS		1.00	0		0	0	40000	0	0	40000
					\$0	\$0	\$40,000	\$0	\$0	\$40,000
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads										
Subtotal Estimate										
Escalation										
Contingency										
-- Total 9111.3 SUGAR										
-- 9111.4 FRIT										
SUGAR TRUCK TRANSPORT UNLOADING STATION										
		1.00	20	CN-PIPE	751.6	0	3000	0	0	3751.6
			20		\$752	\$0	\$3,000	\$0	\$0	\$3,752
SUGAR STORAGE TANK, 7500 GAL, 304 SS		1.00	100	CN-BOILMK	3800	0	79000	0	0	82800
			100		\$3,800	\$0	\$79,000	\$0	\$0	\$82,800
SUGAR STORAGE TANK STEAM JACKET, 304 SS		1.00	0		0	0	40000	0	0	40000
					\$0	\$0	\$40,000	\$0	\$0	\$40,000
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads										
Subtotal Estimate										
Escalation										
Contingency										
-- Total 9111.4 FRIT										
-- 9111.5 SUGAR										
SUGAR TRUCK TRANSPORT UNLOADING STATION										
		1.00	20	CN-PIPE	751.6	0	3000	0	0	3751.6
			20		\$752	\$0	\$3,000	\$0	\$0	\$3,752
SUGAR STORAGE TANK, 7500 GAL, 304 SS		1.00	100	CN-BOILMK	3800	0	79000	0	0	82800
			100		\$3,800	\$0	\$79,000	\$0	\$0	\$82,800
SUGAR STORAGE TANK STEAM JACKET, 304 SS		1.00	0		0	0	40000	0	0	40000
					\$0	\$0	\$40,000	\$0	\$0	\$40,000
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads										
Subtotal Estimate										
Escalation										
Contingency										
-- Total 9111.5 SUGAR										
-- 9111.6 FRIT										
SUGAR TRUCK TRANSPORT UNLOADING STATION										
		1.00	20	CN-PIPE	751.6	0	3000	0	0	3751.6
			20		\$752	\$0	\$3,000	\$0	\$0	\$3,752
SUGAR STORAGE TANK, 7500 GAL, 304 SS		1.00	100	CN-BOILMK	3800	0	79000	0	0	82800
			100		\$3,800	\$0	\$79,000	\$0	\$0	\$82,800
SUGAR STORAGE TANK STEAM JACKET, 304 SS		1.00	0		0	0	40000	0	0	40000
					\$0	\$0	\$40,000	\$0	\$0	\$40,000
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads										
Subtotal Estimate										
Escalation										
Contingency										
-- Total 9111.6 FRIT										
-- 9111.7 SUGAR										
SUGAR TRUCK TRANSPORT UNLOADING STATION										
		1.00	20	CN-PIPE	751.6	0	3000	0	0	3751.6
			20		\$752	\$0	\$3,000	\$0	\$0	\$3,752
SUGAR STORAGE TANK, 7500 GAL, 304 SS		1.00	100	CN-BOILMK	3800	0	79000	0	0	82800
			100		\$3,800	\$0	\$79,000	\$0	\$0	\$82,800
SUGAR STORAGE TANK STEAM JACKET, 304 SS		1.00	0		0	0	40000	0	0	40000
					\$0	\$0	\$40,000	\$0	\$0	\$40,000
Subtotal										
Sales Tax										
INEEL ORG Labor/Subcontractor Overheads										
Subtotal Estimate										
Escalation										
Contingency										
-- Total 9111.7 SUGAR										

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9111.3 SUGAR										
	PIPE	U.C. per EA	2.00	CN-MILL	658.4	0	6400	0	0	7058.4
	SUGAR STORAGE TANK PUMPS, CENTRIFUGAL, 304 SS, 10 HP			40	\$32.92	\$0	\$12,800	\$0	\$0	\$14,117
Subtotal					\$5,868	\$0	\$134,800	\$0	\$0	\$140,668
Sales Tax					\$0	\$0	\$6,740	\$0	\$0	\$6,740
INEEL ORG Labor/Subcontractor Overheads					\$2,508	\$0	\$60,092	\$0	\$0	\$62,600
Subtotal Estimate					\$2,455	\$0	\$59,098	\$0	\$0	\$210,008
Escalation					\$6,225	\$0	\$149,842	\$0	\$0	\$61,553
Contingency										\$156,066
9111.3 SUGAR										
			160		\$17,056	\$0	\$410,572	\$0	\$0	\$427,628
9111.4 MIX TANKS										
	TANK	U.C. per EA	100	CN-BOILMK	3800	0	80000	0	0	83800
	MIX TANK, 5000 GAL, NITRONIC 50		4.00	\$38.00	\$15,200	\$0	\$320,000	\$0	\$0	\$335,200
Memo: Based on historical costs, escalated and adjusted for nitronic.										
	TANK	U.C. per EA	0		0	0	30000	0	0	30000
	MIX TANK STEAM/COOLING JACKET		4.00		\$0	\$0	\$120,000	\$0	\$0	\$120,000
Memo: Installation included with tank. Based on \$/lb fabbed cost for 304L sst. Multiplied cost by 2 for nitronic 50.										
	PIPE	U.C. per EA	40	CN-PIPE	1503.2	0	22000	0	0	23503.2
	MIX TANK CHILLERS, 125 kw, 420,000 BTU/hr		160	\$37.58	\$6,013	\$0	\$88,000	\$0	\$0	\$94,013
Memo: Based on quote from Climate Technologies Corp.										
	TANK	U.C. per EA	40	CN-MILL	1316.8	0	111000	0	0	112316.8
	MIX TANK AGITATOR, 15 HP, NITRONIC 50		160	\$32.92	\$5,267	\$0	\$444,000	\$0	\$0	\$449,267
Memo: Based on Richardson's, adjusted for material.										
	PIPE	U.C. per EA	20	CN-MILL	658.4	0	26800	0	0	27458.4
	MIX TANK PUMPS, PROGRESSIVE CAVITY-SLURRY, NIT. 50, 10 HP		160	\$32.92	\$5,267	\$0	\$214,400	\$0	\$0	\$219,667
Memo: Based on a phone quote on Moyno pumps.										
Subtotal					\$31,747	\$0	\$1,186,400	\$0	\$0	\$1,218,147
Sales Tax					\$0	\$0	\$59,320	\$0	\$0	\$59,320
INEEL ORG Labor/Subcontractor Overheads					\$13,567	\$0	\$530,882	\$0	\$0	\$544,448
Subtotal Estimate					\$13,282	\$0	\$520,722	\$0	\$0	\$1,821,915
Escalation					\$33,675	\$0	\$1,320,272	\$0	\$0	\$534,003
Contingency										\$1,353,947
9111.4 MIX TANKS										
			880		\$92,270	\$0	\$3,617,595	\$0	\$0	\$3,709,865
9111.5 FEED TANKS										
	TANK	U.C. per EA	100	CN-BOILMK	3800	0	80000	0	0	83800
	FEED TANK, 5000 GAL, NIT. 50		2.00	\$38.00	\$7,600	\$0	\$160,000	\$0	\$0	\$167,600
Memo: Based on historical costs, escalated and adjusted for nitronic.										

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
-- 9111.5 FEED TANKS											
	TANK										
	FEED TANK STEAM JACKET, 304	2.00	0		\$0			30000	0	0	30000
	Memo: Installation included with tank. Based on \$/lb tabbed cost for 304L est. Multiplied cost by 2 for nitronic 50.							\$60,000	\$0	\$0	\$60,000
FEED TANK AGITATOR											
	TANK										
	U.C. per EA	2.00	40	CN-MILL	1316.8			111000	0	0	112316.8
	Memo: Based on Richardson's, adjusted for material.				\$2,634			\$222,000	\$0	\$0	\$224,634
FEED TANK PUMPS, PROGRESSIVE CAVITY-SLURRY, NIT. 50, 10 HP											
	PIPE										
	U.C. per EA	4.00	20	CN-MILL	658.4			26800	0	0	27458.4
	Memo: Based on a phone quote on Moyno pumps.				\$2,634			\$107,200	\$0	\$0	\$109,834
Subtotal											
	Sales Tax				\$12,887			\$549,200	\$0	\$0	\$562,087
	INEEL ORG Labor/Subcontractor Overheads				\$0			\$27,460	\$0	\$0	\$27,460
					\$5,476			\$245,350	\$0	\$0	\$250,826
Subtotal Estimate											
	Escalation				\$5,376			\$240,931	\$0	\$0	\$246,308
	Contingency				\$13,632			\$610,873	\$0	\$0	\$624,504
--Total 9111.5 FEED TANKS											
			360		\$37,351			\$1,673,814	\$0	\$0	\$1,711,165
-- 9111.6 MELTER											
	GEN										
	U.C. per EA	1.00	1200	CN-SKWK	41424			10000000	0	0	10041424
	Memo: Price based in information obtained by the design engineers. Includes all refractory-lined off-gas duct, taps, canister docking station, camera, and freeze valve assembly.				\$41,424			\$10,000,000	\$0	\$0	\$10,041,424
Subtotal											
	Sales Tax				\$41,424			\$10,000,000	\$0	\$0	\$10,041,424
	INEEL ORG Labor/Subcontractor Overheads				\$0			\$500,000	\$0	\$0	\$500,000
					\$14,723			\$3,731,910	\$0	\$0	\$3,746,633
Subtotal Estimate											
	Escalation				\$16,457			\$4,171,373	\$0	\$0	\$4,187,829
	Contingency				\$41,725			\$10,576,367	\$0	\$0	\$10,618,092
--Total 9111.6 MELTER											
			1,200		\$114,329			\$28,979,649	\$0	\$0	\$29,093,978
-- 9111.7 KEROSENE											
	TANK										
	U.C. per EA	1.00	180	CN-BOILMK	6840			70000	0	0	76840
	Memo: Based on information received for the NWCF MACT Study.				\$6,840			\$70,000	\$0	\$0	\$76,840

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
-- 9111.7 KEROSENE											
Subtotal					\$6,840		\$0	\$70,000	\$0	\$0	\$76,840
Sales Tax					\$0		\$0	\$3,500	\$0	\$0	\$3,500
INEEL ORG Labor/Subcontractor Overheads					\$2,895		\$0	\$31,105	\$0	\$0	\$33,999
Subtotal Estimate					\$2,853		\$0	\$30,660	\$0	\$0	\$114,339
Escalation:					\$7,234		\$0	\$77,736	\$0	\$0	\$33,513
Contingency							\$0		\$0	\$0	\$84,971
-- Total 9111.7 KEROSENE			180		\$19,822		\$0	\$213,000	\$0	\$0	\$232,823
-- 9111.8 CANISTER FILLING											
GEN			80	CN-MILL	2633.6		0	60000	0	0	62633.6
CANISTER TURNTABLE			160	\$32.92	\$5,267		\$0	\$120,000	\$0	\$0	\$125,267
Memo: Based on historical information from previous INEEL projects. Includes motor and index controls.											
GEN			4	CN-MILL	131.68		0	2000	0	0	2131.68
CANISTER TURNTABLE LOAD CELLS			16	\$32.92	\$527		\$0	\$8,000	\$0	\$0	\$8,527
Memo: Based on Richardsons.											
GEN			0		0		0	15000	0	0	15000
MELTER DRAIN CANISTER			1.00		\$0		\$0	\$15,000	\$0	\$0	\$15,000
GEN			200	CN-SKWK	6904		0	112000	0	0	118904
CANISTER WELD STATION			200	\$34.52	\$6,904		\$0	\$112,000	\$0	\$0	\$118,904
Subtotal					\$12,698		\$0	\$255,000	\$0	\$0	\$267,698
Sales Tax					\$0		\$0	\$12,750	\$0	\$0	\$12,750
INEEL ORG Labor/Subcontractor Overheads					\$4,513		\$0	\$95,164	\$0	\$0	\$99,677
Subtotal Estimate					\$5,045		\$0	\$106,370	\$0	\$0	\$380,125
Escalation					\$12,790		\$0	\$269,697	\$0	\$0	\$111,415
Contingency							\$0		\$0	\$0	\$282,488
-- Total 9111.8 CANISTER FILLING			376		\$35,046		\$0	\$738,981	\$0	\$0	\$774,027
-- 9111.9 MULTI-STAGE SECONDARY COMBUSTER											
GEN			1500	CN-SKWK	51780		0	1200000	250000	0	1501780
MULTI-STAGE SECONDARY COMBUSTER			1.00	\$34.52	\$51,780		\$0	\$1,200,000	\$250,000	\$0	\$1,501,780
Memo: Based on a preliminary quote from the John Zink Co. Includes all three stages, quench and refractory lined duct.											
Subtotal					\$51,780		\$0	\$1,200,000	\$250,000	\$0	\$1,501,780
Sales Tax					\$0		\$0	\$60,000	\$0	\$0	\$60,000
INEEL ORG Labor/Subcontractor Overheads					\$18,404		\$0	\$447,829	\$88,855	\$0	\$555,088
Subtotal Estimate					\$20,571		\$0	\$500,565	\$99,318	\$0	\$2,116,868
Escalation					\$52,157		\$0	\$1,269,164	\$251,818	\$0	\$620,454
Contingency							\$0			\$0	\$1,573,139
-- Total 9111.9 MULTI-STAGE SECONDARY COMBUSTER			1,500		\$142,911		\$0	\$3,477,558	\$689,992	\$0	\$4,310,461

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
--- 9111.10.1 EMERGENCY COOLING WATER TANK										
EMERGENCY COOLING TANK		U.C. per EA	1.00	CN-BOILMK	3800	0	22000	0	0	25800
Memo: 1000 gal, 304L.				\$38.00	\$3,800	\$0	\$22,000	\$0	\$0	\$25,800
EMERGENCY COOLING PUMPS										
GEN		U.C. per EA	2.00	CN-MILL	658.4	0	6000	0	0	6658.4
Memo: 3 hp, 20 gpm, 50 psi, 304L.				\$32.92	\$1,317	\$0	\$12,000	\$0	\$0	\$13,317
Subtotal										
Sales Tax					\$5,117	\$0	\$34,000	\$0	\$0	\$39,117
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$1,700	\$0	\$0	\$1,700
Escalation					\$2,076	\$0	\$14,254	\$0	\$0	\$16,330
Contingency					\$0	\$0	\$0	\$0	\$0	\$0
--- Total 9111.10.1 EMERGENCY COOLING WATER										
			140		\$14,647	\$0	\$101,719	\$0	\$0	\$116,365
--- 9111.10.2 DEMISTER COOLING										
GEN		U.C. per EA	1.00	CN-SKWK	3452	0	17000	0	0	20452
DEMISTER				\$34.52	\$3,452	\$0	\$17,000	\$0	\$0	\$20,452
Memo: Based on a preliminary quote from Koch-Otto York. Demister with knockout drum, 2022 scmh (1,499 acfm) Inlet gas @ 180-185oF, -10.5 to -15.0" w.g. downstream pressure 1.0-3.0" w.g. dP, -11.5 to -18" w.g. upstream; 26 l/hr (0.12 gpm) condensed liquid back to scrub tank.										
DEMISTER COOLER										
GEN		U.C. per EA	1.00	CN-SKWK	0	0	55000	0	0	55000
Memo: Cooler jacket based on a preliminary cost from Climate Technologies Corp., 1.35 million btuh, 304L.					\$0	\$0	\$55,000	\$0	\$0	\$55,000
Subtotal										
Sales Tax					\$3,452	\$0	\$72,000	\$0	\$0	\$75,452
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$3,600	\$0	\$0	\$3,600
Escalation					\$1,227	\$0	\$26,870	\$0	\$0	\$28,097
Contingency					\$0	\$0	\$0	\$0	\$0	\$0
--- Total 9111.10.2 DEMISTER COOLING										
			100		\$9,527	\$0	\$208,653	\$0	\$0	\$218,181
--- 9111.10.3 REHEATER PIPE										
REHEATER		U.C. per EA	60	CN-PIPE	2254.8	0	14000	0	0	16254.8
Memo: Caloritech Inc. estimate, 2-480V, 7 kW heaters in Inconel 625. 2022 scmh (1,499 acfm) Inlet gas @ 180oF, 210oF outlet temp., -11.5 to -18" w.g. pressure, 24 inch dia duct inlet and outlet, 8 ft/sec vel. 4.0' long.					\$4,510	\$0	\$28,000	\$0	\$0	\$32,510

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Equip	Matl	S/C	Other	TOTAL
-- 9111.10.3 REHEATER											
Subtotal					\$4,510		\$0	\$28,000	\$0	\$0	\$32,510
Sales Tax					\$0		\$0	\$1,400	\$0	\$0	\$1,400
INEEL ORG Labor/Subcontractor Overheads					\$1,981		\$0	\$12,785	\$0	\$0	\$14,766
Subtotal Estimate					\$1,897		\$0	\$12,364	\$0	\$0	\$14,261
Escalation					\$4,809		\$0	\$31,349	\$0	\$0	\$36,158
Contingency							\$0				
-- Total 9111.10.3 REHEATER			120		\$13,176		\$0	\$85,899	\$0	\$0	\$99,074
-- 9111.11 CHARCOAL FILTER GEN											
CHARCOAL FILTER UNITS		U.C. per EA	100	CN-SKWK	3452		0	55000	0	0	58452
Memo: Selective Adsorption Associates Inc. estimate, MERSORB (R) @ 4250 lb/batch @ \$4/lb X 5 batches = \$85,000, 2- housing in coated carbon shell @ \$5-7K each = \$10-15K, housings adjusted by +80% for 316L. Bulk sulfur impregnated charcoal filter units for gas polishing and elemental Hg capture. 2025 scmh (1580 acfm) @ 2050F and -23' to -30" w.g. (-3.0 to -9.0" w.g. dP) 6.0' dia x 10' high, 0.9 ft/sec vel. 10 sec residence time. MERSORB (R) 1400 kg of mercury requires four batches of carbon, for redundancy five batches.											
SPENT CHARCOAL STORAGE BIN, 304L		U.C. per EA	40	CN-SKWK	1380.8		0	27000	0	0	28380.8
GEN			40		\$1,381		\$0	\$27,000	\$0	\$0	\$28,381
SPENT CHARCOAL STORAGE BIN DRUM TRANSFER SYSTEM		U.C. per EA	160	CN-SKWK	5523.2		0	40000	0	0	45523.2
GEN			160		\$5,523		\$0	\$40,000	\$0	\$0	\$45,523
Subtotal					\$13,808		\$0	\$177,000	\$0	\$0	\$190,808
Sales Tax					\$0		\$0	\$8,850	\$0	\$0	\$8,850
INEEL ORG Labor/Subcontractor Overheads					\$4,908		\$0	\$66,055	\$0	\$0	\$70,962
Subtotal Estimate					\$5,486		\$0	\$73,833	\$0	\$0	\$79,319
Escalation					\$13,908		\$0	\$187,202	\$0	\$0	\$201,110
Contingency							\$0				
-- Total 9111.11 CHARCOAL FILTER			400		\$38,110		\$0	\$512,940	\$0	\$0	\$551,049
-- 9111.12.1 QUENCH TANK											
QUENCH TANK, 2000 GAL, NIT. 50		U.C. per EA	100	CN-BOILMK	3800		0	60000	0	0	63800
GEN			100		\$3,800		\$0	\$60,000	\$0	\$0	\$63,800
QUENCH PUMPS		U.C. per EA	20	CN-MILL	658.4		0	8000	0	0	8658.4
GEN			80		\$2,634		\$0	\$32,000	\$0	\$0	\$34,634
Memo: Based on a phone quote received from FDNW for the WTS on similar pumps made of Hastelloy. Centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle, 10 gpm @ 55 psi per quench pump											
QUENCH LINE HEAT EXCHANGER		U.C. per EA	40	CN-SKWK	1380.8		0	17500	0	0	18880.8
GEN			80		\$2,762		\$0	\$35,000	\$0	\$0	\$37,762
Memo: Climate Technologies Corporation estimate, 2 quench chillers @ 185,000 btuh.											

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
-- 9111.12.1 QUENCH											
	GEN	U.C. per EA	1.00	40 CN-SKWK	1380.8			14000		0	15380.8
				\$34.52	\$1,381			\$14,000		\$0	\$15,381
Subtotal					\$10,576						
Sales Tax					\$0						
INEEL ORG Labor/Subcontractor Overheads					\$4,018						
Subtotal Estimate											\$151,576
Escalation											\$7,050
Contingency											\$60,906
-- Total 9111.12.1 QUENCH											
			300		\$4,277			\$60,068		\$0	\$219,532
					\$10,844			\$152,300		\$0	\$64,345
					\$29,714			\$417,307		\$0	\$163,144
-- 9111.12.2 SETTLING TANK											
	TANK										
	SETTLING TANK, 1000 GAL, NIT. 50	U.C. per EA	1.00	100 CN-BOILMK	3800			28000		0	31800
				\$38.00	\$3,800			\$28,000		\$0	\$31,800
SETTLING TANK BLOWDOWN RECYCLE PUMP	GEN	U.C. per EA	2.00	20 CN-MILL	658.4			39600		0	40258.4
Memo: Solids/slurry pump, progressive cavity positive displacement variable speed, 20 gpm, nit. 50, 3 hp.				\$32.92	\$1,317			\$79,200		\$0	\$80,517
Subtotal					\$5,117			\$107,200		\$0	\$112,317
Sales Tax					\$0			\$5,360		\$0	\$5,360
INEEL ORG Labor/Subcontractor Overheads					\$2,076			\$41,999		\$0	\$44,075
Subtotal Estimate											\$161,751
Escalation											\$47,409
Contingency											\$120,205
-- Total 9111.12.2 SETTLING TANK											
			140		\$2,108			\$45,301		\$0	\$161,751
					\$5,345			\$114,859		\$0	\$47,409
					\$14,647			\$314,719		\$0	\$120,205
-- 9111.12.3 SCRUB TANK											
	TANK										
	SCRUB TANK, 2000 GAL, NIT. 50	U.C. per EA	1.00	100 CN-BOILMK	3800			60000		0	63800
				\$38.00	\$3,800			\$60,000		\$0	\$63,800
SCRUB PUMP	GEN	U.C. per EA	2.00	20 CN-MILL	658.4			8000		0	8658.4
Memo: Based on a phone quote received from FDNW for the WTS on similar pumps made of Hastelloy. Centrifugal, (2530 l/hr / 2) 11.5 gpm total scrub water to scrubber, 15 gpm @ 55 psi per scrub pump.				\$32.92	\$1,317			\$16,000		\$0	\$17,317
Subtotal					\$5,117			\$76,000		\$0	\$81,117
Sales Tax					\$0			\$3,800		\$0	\$3,800
INEEL ORG Labor/Subcontractor Overheads					\$2,076			\$32,632		\$0	\$34,708
Subtotal Estimate											\$119,625
Escalation											\$35,062
Contingency											\$88,899
-- Total 9111.12.3 SCRUB TANK											
			140		\$2,108			\$32,954		\$0	\$119,625
					\$5,345			\$83,553		\$0	\$35,062
					\$14,647			\$228,939		\$0	\$243,586

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
<u>9111.12.4 CAUSTIC SOLUTION</u>										
	TANK									
CAUSTIC SOLUTION MIX TANK, 500 GAL, 304L		U.C. per EA	1.00	100 CN-BOILMK \$38.00	3800 \$3,800	0 \$0	17000 \$17,000	0 \$0	0 \$0	20800 \$20,800
CAUSTIC METERING PUMP, 2 GPM, 304L	GEN	U.C. per EA	2.00	20 CN-MILL \$32.92	658.4 \$1,317	0 \$0	8000 \$16,000	0 \$0	0 \$0	8658.4 \$17,317
<u>Subtotal</u>										
Sales Tax					\$5,117	\$0	\$33,000	\$0	\$0	\$38,117
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$1,650	\$0	\$0	\$1,650
					\$2,076	\$0	\$13,525	\$0	\$0	\$15,601
<u>Subtotal Estimate</u>										
Escalation					\$2,108	\$0	\$14,120	\$0	\$0	\$16,228
Contingency					\$5,345	\$0	\$35,801	\$0	\$0	\$41,146
<u>Total 9111.12.4 CAUSTIC SOLUTION</u>										
			140		\$14,647	\$0	\$88,096	\$0	\$0	\$112,743
<u>9111.13 SCRUB WATER CLEANUP SYSTEM</u>										
	GEN									
CsIX RESIN STORAGE BIN		U.C. per EA	1.00	40 CN-SKWK \$34.52	1380.8 \$1,381	0 \$0	5000 \$5,000	0 \$0	0 \$0	6380.8 \$6,381
CsIX RESIN PREP TANK	GEN	U.C. per EA	1.00	60 CN-SKWK \$34.52	2071.2 \$2,071	0 \$0	15000 \$15,000	0 \$0	0 \$0	17071.2 \$17,071
CsIX RESIN PREP TANK SLURRY PUMP	PIPE	U.C. per EA	1.00	10 CN-PIPE \$37.58	375.8 \$376	0 \$0	5000 \$5,000	0 \$0	0 \$0	5375.8 \$5,376
CsIX PREFILTER	PIPE	U.C. per EA	1.00	10 CN-PIPE \$37.58	375.8 \$376	0 \$0	10000 \$10,000	0 \$0	0 \$0	10375.8 \$10,376
CsIX COLUMNS	GEN	U.C. per EA	3.00	80 CN-SKWK \$34.52	2761.6 \$8,285	0 \$0	15000 \$45,000	0 \$0	0 \$0	17761.6 \$53,285
CsIX INLET PUMP	GEN	U.C. per EA	1.00	10 CN-MILL \$32.92	329.2 \$329	0 \$0	1000 \$1,000	0 \$0	0 \$0	1329.2 \$1,329
CsIX BLOWDOWN PUMP	GEN	U.C. per EA	1.00	20 CN-MILL \$32.92	658.4 \$658	0 \$0	14460 \$14,460	0 \$0	0 \$0	15118.4 \$15,118
Memo: Based on a phone quote on Moyno pumps.										
CsIX EFFLUENT RESINS FINES FILTER	PIPE	U.C. per EA	2.00	4 CN-PIPE \$37.58	150.32 \$301	0 \$0	4000 \$8,000	0 \$0	0 \$0	4150.32 \$8,301
CsIX EFFLUENT STORAGE TANK EXPANSION TANK, 50 GAL, 316L	TANK	U.C. per EA	1.00	20 CN-BOILMK \$38.00	760 \$760	0 \$0	5000 \$5,000	0 \$0	0 \$0	5760 \$5,760
CsIX EFFLUENT STORAGE TANK, 2000 GAL, 316L	TANK	U.C. per EA	1.00	100 CN-BOILMK \$38.00	3800 \$3,800	0 \$0	48000 \$48,000	0 \$0	0 \$0	51800 \$51,800

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
9111.13 SCRUB WATER CLEANUP SYSTEM											
GEN	CsIX EFFLUENT STORAGE TANK PUMP, 6 GPM, 316L	U.C. per EA	2.00	20 CN-MILL	658.4	0	0	2000	0	0	2658.4
			40	\$32.92	\$1,317	\$0	\$0	\$4,000	\$0	\$0	\$5,317
Subtotal					\$19,853	\$0	\$0	\$180,460	\$0	\$0	\$180,113
Sales Tax					\$0	\$0	\$0	\$8,023	\$0	\$0	\$8,023
INEEL ORG Labor/Subcontractor Overheads					\$7,378	\$0	\$0	\$65,572	\$0	\$0	\$72,950
Subtotal Estimate					\$7,923	\$0	\$0	\$68,602	\$0	\$0	\$76,524
Escalation					\$20,088	\$0	\$0	\$173,937	\$0	\$0	\$194,025
Contingency											
9111.13 SCRUB WATER CLEANUP SYSTEM											
558					\$55,042	\$0	\$0	\$476,593	\$0	\$0	\$531,636
9111.14.1 GROUT											
GEN	TRUCK UNLOADING STATION	U.C. per EA	1.00	30 CN-SKWK	1035.6	0	0	11000	0	0	12035.6
	Memo: Based on CsIX study.			\$34.52	\$1,036	\$0	\$0	\$11,000	\$0	\$0	\$12,036
GEN	GROUT PRE-MIX SAMPLE STATION	U.C. per EA	1.00	10 CN-SKWK	345.2	0	0	6000	0	0	6345.2
	Memo: Based on CsIX study.			\$34.52	\$345	\$0	\$0	\$6,000	\$0	\$0	\$6,345
GEN	GROUT PRE-MIX BIN, 7500 GAL, 304L	U.C. per EA	1.00	60 CN-SKWK	2071.2	0	0	38000	0	0	40071.2
	Memo: Based on CsIX study.			\$34.52	\$2,071	\$0	\$0	\$38,000	\$0	\$0	\$40,071
PIPE	GROUT OUTLET EDUCATOR	U.C. per EA	1.00	2 CN-PIPE	75.16	0	0	5000	0	0	5075.16
	Memo: Based on CsIX study.			\$37.58	\$75	\$0	\$0	\$5,000	\$0	\$0	\$5,075
GEN	GROUT OUTLET EDUCATOR AIR SUPPLY	U.C. per EA	1.00	20 CN-MILL	658.4	0	0	50000	0	0	50658.4
	Memo: 100 horsepower oil flooded rotary screw with -40oF dryer, normal power, 100 psi, 304L.			\$32.92	\$658	\$0	\$0	\$50,000	\$0	\$0	\$50,658
GEN	GROUT PRE-MIX WEIGH BIN	U.C. per EA	1.00	15 CN-SKWK	517.8	0	0	2000	0	0	2517.8
	Memo: Based on CsIX study.			\$34.52	\$518	\$0	\$0	\$2,000	\$0	\$0	\$2,518
GEN	GROUT PRE-MIX WEIGH BIN CONVEYOR	U.C. per EA	1.00	10 CN-SKWK	345.2	0	0	4000	0	0	4345.2
	Memo: Based on CsIX study.			\$34.52	\$345	\$0	\$0	\$4,000	\$0	\$0	\$4,345
GEN	GROUT MIXER, 3 HP, 304L	U.C. per EA	1.00	60 CN-MILL	1975.2	0	0	20000	0	0	21975.2
	Memo: Based on CsIX study.			\$32.92	\$1,975	\$0	\$0	\$20,000	\$0	\$0	\$21,975
GEN	GROUT CURE RATE CHEM. STOR. TANK, 50 GAL, 304L	U.C. per EA	1.00	20 CN-SKWK	690.4	0	0	5000	0	0	5690.4
				\$34.52	\$690	\$0	\$0	\$5,000	\$0	\$0	\$5,690
GEN	GROUT CURE RATE CHEM. STOR. PUMP, 2 GPM, 304L	U.C. per EA	1.00	20 CN-MILL	658.4	0	0	2000	0	0	2658.4
				\$32.92	\$658	\$0	\$0	\$2,000	\$0	\$0	\$2,658

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Guilgley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Equip	Matl	S/C	Other	TOTAL
-- 9111.14.1 GROUT											
	TANK										
GROUT MIXER WASH TANK, 1000 GAL, 304L		U.C. per EA	100	CN-BOILMK	3800		0	22000	0	0	25800
			100		\$3,800		\$0	\$22,000	\$0	\$0	\$25,800
GROUT MIXER WASH TANK PUMP, 304L	GEN	U.C. per EA	20	CN-MILL	658.4		0	2000	0	0	2658.4
			20		\$32.92		\$0	\$2,000	\$0	\$0	\$2,658
Subtotal											
Sales Tax					\$12,831		\$0	\$167,000	\$0	\$0	\$179,831
INEEL ORG Labor/Subcontractor Overheads					\$0		\$0	\$8,350	\$0	\$0	\$8,350
					\$4,824		\$0	\$64,305	\$0	\$0	\$69,129
Subtotal Estimate											
Escalation					\$5,175		\$0	\$70,243	\$0	\$0	\$75,418
Contingency					\$13,120		\$0	\$178,099	\$0	\$0	\$191,219
--Total 9111.14.1 GROUT											
			367		\$35,950		\$0	\$487,957	\$0	\$0	\$523,947
-- 9111.14.2 MIXER DECON WASTE WATER											
	GEN										
GROUT DECON CHEM. STOR. TANK PUMP, 304L		U.C. per EA	20	CN-MILL	658.4		0	2000	0	0	2658.4
			20		\$32.92		\$0	\$2,000	\$0	\$0	\$2,658
GROUT DI WATER STOR. TANK PUMP, 304L	GEN	U.C. per EA	20	CN-MILL	658.4		0	2000	0	0	2658.4
			20		\$32.92		\$0	\$2,000	\$0	\$0	\$2,658
SPENT DECON PUMP, 304L	GEN	U.C. per EA	20	CN-MILL	658.4		0	2000	0	0	2658.4
			20		\$32.92		\$0	\$2,000	\$0	\$0	\$2,658
SPENT DECON FILTER, 304L	GEN	U.C. per EA	20	CN-SKWIK	690.4		0	8000	0	0	8690.4
			20		\$34.52		\$0	\$8,000	\$0	\$0	\$8,690
MIXER DECON WASTE WATER TANK, 1000 GAL, 304L	TANK	U.C. per EA	100	CN-BOILMK	3800		0	22000	0	0	25800
			100		\$3,800		\$0	\$22,000	\$0	\$0	\$25,800
MIXER DECON WASTE WATER TANK PUMP, 1 HP, 304L	GEN	U.C. per EA	20	CN-MILL	658.4		0	2000	0	0	2658.4
			20		\$32.92		\$0	\$2,000	\$0	\$0	\$2,658
EMPTY DRUM TRANSFER SYSTEM	GEN	U.C. per LOT	80	CN-SKWIK	2761.6		0	20000	0	0	22761.6
Memo: Based on CsIX study.			80		\$2,762		\$0	\$20,000	\$0	\$0	\$22,762
MIXED GROUT DRUM FILL STATION	GEN	U.C. per EA	200	CN-SKWIK	6904		0	50000	0	0	56904
			200		\$6,904		\$0	\$50,000	\$0	\$0	\$56,904
MIXED GROUT DRUM WEIGH STATION	GEN	U.C. per EA	10	CN-SKWIK	345.2		0	2000	0	0	2345.2
			10		\$34.52		\$0	\$2,000	\$0	\$0	\$2,345

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
<u>9111.14.2 MIXER DECON WASTE WATER</u>										
FILLED DRUM TRANSFER SYSTEM	GEN	1.00	80	CN-SKWK \$34.52	2781.6 \$2,762	0 \$0	20000 \$20,000	0 \$0	0 \$0	22761.6 \$22,762
Subtotal					\$19,896	\$0	\$130,000	\$0	\$0	\$149,896
Sales Tax					\$0	\$0	\$6,500	\$0	\$0	\$6,500
INEEL ORG Labor/Subcontractor Overheads					\$7,329	\$0	\$50,080	\$0	\$0	\$57,409
Subtotal Estimate										
Escalation					\$7,980	\$0	\$54,687	\$0	\$0	\$213,806
Contingency					\$20,232	\$0	\$138,656	\$0	\$0	\$62,666
--- Total	9111.14.2 MIXER DECON WASTE WATER		570		\$55,438	\$0	\$379,923	\$0	\$0	\$158,889
<u>9111.15 SAMPLING</u>										
MANUAL D-TUBE SAMPLER	PIPE	8.00	0	CN-PIPE	0 \$0	0 \$0	1210 \$9,680	0 \$0	0 \$0	1210 \$9,680
MANUAL TANK TAP	PIPE	12.00	0		0 \$0	0 \$0	200 \$2,400	0 \$0	0 \$0	200 \$2,400
PUMP/LIQUID SAMPLER SKID	PIPE	5.00	0		0 \$0	0 \$0	12000 \$60,000	0 \$0	0 \$0	12000 \$60,000
SAMPLE TABLE	GEN	5.00	0		0 \$0	0 \$0	2000 \$10,000	0 \$0	0 \$0	2000 \$10,000
FLEX HOSES	PIPE	10.00	0		0 \$0	0 \$0	1000 \$10,000	0 \$0	0 \$0	1000 \$10,000
QUICK DISCONNECT PORTS	PIPE	32.00	0		0 \$0	0 \$0	1500 \$48,000	0 \$0	0 \$0	1500 \$48,000
SAMPLE TRANSFER SYSTEM	PIPE	1.00	0		0 \$0	0 \$0	125000 \$125,000	0 \$0	0 \$0	125000 \$125,000
Memo: Assume sample transfer system, similar to the existing, is run on existing supports where possible. Includes sending station, valving, and controls in vit facility.										
SAMPLE CANS	GEN	50.00	0		0 \$0	0 \$0	200 \$10,000	0 \$0	0 \$0	200 \$10,000
GLOVEBOX WITH BAGOUT PORT	HVAC	3.00	0		0 \$0	0 \$0	20000 \$60,000	0 \$0	0 \$0	20000 \$60,000
GROUT SAMPLING SYSTEM	PIPE	1.00	0		0 \$0	0 \$0	30000 \$30,000	0 \$0	0 \$0	30000 \$30,000
ROTATION TABLE	GEN	1.00	0		0 \$0	0 \$0	20000 \$20,000	0 \$0	0 \$0	20000 \$20,000
CEM- 002 PARAMAGNETISM	INSTR	2.00	0		0 \$0	0 \$0	10000 \$20,000	0 \$0	0 \$0	10000 \$20,000

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9111.15 SAMPLING										
CEM - CO2 NONDISPERSIVE INFARED	INSTR	U.C. per EA	2.00	0	\$0	0	10000	0	0	10000
							\$20,000	\$0	\$0	\$20,000
CEM - CO NONDISPERSIVE INFARED	INSTR	U.C. per EA	2.00	0	\$0	0	12000	0	0	12000
							\$24,000	\$0	\$0	\$24,000
CEM - TOTAL HYDROCARBON	INSTR	U.C. per EA	2.00	0	\$0	0	24000	0	0	24000
							\$48,000	\$0	\$0	\$48,000
CEM - INSTU PARTICLE MATTER	INSTR	U.C. per EA	2.00	0	\$0	0	50000	0	0	50000
							\$100,000	\$0	\$0	\$100,000
CEM - NOx	INSTR	U.C. per EA	2.00	0	\$0	0	20000	0	0	20000
							\$40,000	\$0	\$0	\$40,000
CEM - Hg	INSTR	U.C. per EA	2.00	0	\$0	0	25000	0	0	25000
							\$50,000	\$0	\$0	\$50,000
CEM - HCL	INSTR	U.C. per EA	2.00	0	\$0	0	25000	0	0	25000
							\$50,000	\$0	\$0	\$50,000
ISO KINETIC STACK SAMPLER	INSTR	U.C. per EA	1.00	0	\$0	0	20000	0	0	20000
							\$20,000	\$0	\$0	\$20,000
CANISTER LEAK CHECK	INSTR	U.C. per EA	1.00	100	CN-MILL	3292	1030000	0	0	1033292
						\$3,292	\$1,030,000	\$0	\$0	\$1,033,292
DWPF TYPE SMEAR SAMPLE SYSTEM	INSTR	U.C. per EA	1.00	0	\$0	0	600000	0	0	600000
							\$600,000	\$0	\$0	\$600,000
SWIPE PASS THROUGH	GEN	U.C. per EA	1.00	0	\$0	0	20000	0	0	20000
							\$20,000	\$0	\$0	\$20,000
CANISTER FILL MONITOR - INFRARED LEVEL DETECTION SYS.	INSTR	U.C. per EA	2.00	0	\$0	0	86000	0	0	86000
							\$172,000	\$0	\$0	\$172,000
Memo: Based on West Valley cost for similar system.										
Subtotal					\$3,292	\$0	\$2,579,080	\$0	\$0	\$2,582,372
Sales Tax					\$0	\$0	\$128,954	\$0	\$0	\$128,954
INEEL ORG Labor/Subcontractor Overheads					\$1,240	\$0	\$1,038,723	\$0	\$0	\$1,039,962
Subtotal Estimate						\$0	\$1,098,174	\$0	\$0	\$3,751,288
Escalation					\$1,328	\$0	\$2,784,382	\$0	\$0	\$1,099,503
Contingency					\$3,368	\$0	\$0	\$0	\$0	\$2,787,749
--Total 9111.15 SAMPLING										
			100		\$9,227	\$0	\$7,629,313	\$0	\$0	\$7,638,540
-- 9111.16 IN-CELL HANDLING										
PaR, MODEL 4350 WALL MOUNTED	GEN	U.C. per EA	1.00	200	CN-MILL	6584	1419000	0	0	1425584
						\$32.92	\$1,419,000	\$0	\$0	\$1,425,584
Memo: With CIMROC 400 control system, 35' Y travel, 320' X travel, 11 control stations. Based on current phone quote from PaR.										

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9111.16 IN-CELL HANDLING										
	GEN	U.C. per EA	300	CN-MILL	9876	0	1310000	0	0	1319876
PaR, MODEL 6350 BRIDGE MOUNTED		1.00	300	\$32.92	\$9,876	\$0	\$1,310,000	\$0	\$0	\$1,319,876
Memo: With CIMROC 400 control system, 30' Y travel, 40' X travel, 40' Z travel, 8 control stations. Based on current phone quote from PaR.										
PaR, MODEL 6000 BRIDGE MOUNTED										
	GEN	U.C. per EA	400	CN-MILL	13168	0	1785000	0	0	1798168
1.00		1.00	400	\$32.92	\$13,168	\$0	\$1,785,000	\$0	\$0	\$1,798,168
Memo: With standard control system, 80' X travel, 320' Y travel, 50' Z travel. Based on current phone quote from PaR.										
Subtotal					\$29,628	\$0	\$4,514,000	\$0	\$0	\$4,543,628
Sales Tax					\$0	\$0	\$225,700	\$0	\$0	\$225,700
INEEL ORG Labor/Subcontractor Overheads					\$10,530	\$0	\$1,694,584	\$0	\$0	\$1,695,115
Subtotal Estimate					\$11,770	\$0	\$1,892,958	\$0	\$0	\$6,464,443
Escalation					\$29,843	\$0	\$4,774,172	\$0	\$0	\$1,894,728
Contingency										\$4,804,015
-- Total 9111.16 IN-CELL HANDLING										
			900		\$61,772	\$0	\$13,081,414	\$0	\$0	\$13,163,186
-- 9111.17 BOILER EQUIPMENT										
	GEN	U.C. per EA	60	CN-BOILMK	2280	0	200000	0	0	202280
BOILERS		2.00	120	\$38.00	\$4,560	\$0	\$400,000	\$0	\$0	\$404,560
FEED WATER HEATER										
	GEN	U.C. per EA	40	CN-BOILMK	1520	0	20000	0	0	21520
1.00		2.00	80	\$38.00	\$3,040	\$0	\$40,000	\$0	\$0	\$43,040
CHEMICAL FEED SYSTEM										
	PIPE	U.C. per LOT	500	CN-PIPE	18790	0	100000	0	0	118790
1.00		1.00	500	\$37.58	\$18,790	\$0	\$100,000	\$0	\$0	\$118,790
WATER TREATMENT SYSTEM										
	PIPE	U.C. per LOT	1800	CN-PIPE	67644	0	250000	0	0	317644
1.00		1.00	1,800	\$37.58	\$67,644	\$0	\$250,000	\$0	\$0	\$317,644
OIL STORAGE TANK, ~750 BBL										
	TANK	U.C. per BBL	750.00		0	0	0	65	0	65
1.00		1.00	750		\$0	\$0	\$0	\$48,750	\$0	\$48,750
Subtotal					\$94,034	\$0	\$790,000	\$48,750	\$0	\$932,784
Sales Tax					\$0	\$0	\$39,500	\$0	\$0	\$39,500
INEEL ORG Labor/Subcontractor Overheads					\$40,288	\$0	\$324,014	\$20,631	\$0	\$384,932
Subtotal Estimate					\$39,370	\$0	\$338,095	\$20,335	\$0	\$1,357,216
Escalation					\$99,820	\$0	\$857,228	\$51,560	\$0	\$397,800
Contingency										\$1,008,608
-- Total 9111.17 BOILER EQUIPMENT										
			2,500		\$273,512	\$0	\$2,348,836	\$141,276	\$0	\$2,763,624
-- 9112 FURNISHINGS - OFFICE AREA										
	GEN	U.C. per EA	5	ACARCARP2	173.2	0	1642	0	0	1815.2
1.00		24.00	120	\$34.64	\$4,157	\$0	\$39,408	\$0	\$0	\$43,565
Memo: Furniture systems, workstation, office, 5 ft										

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Equip	Matl	S/C	Other	TOTAL
<u>9112 FURNISHINGS - OFFICE AREA</u>											
CONFERENCE ROOM FURNITURE	GEN	U.C. per LOT	1.00	12	ACARCARP2	415.68	0	8000	0	0	8415.68
				12	\$34.64	\$416	\$0	\$8,000	\$0	\$0	\$8,416
Subtotal						\$4,572	\$0	\$47,408	\$0	\$0	\$51,980
Sales Tax						\$0	\$0	\$0	\$0	\$0	\$2,370
INEEL ORG Labor/Subcontractor Overheads						\$1,625	\$0	\$17,692	\$0	\$0	\$19,317
Subtotal Estimate						\$1,817	\$0	\$19,776	\$0	\$0	\$23,668
Escalation						\$0	\$0	\$0	\$0	\$0	\$21,592
Contingency						\$0	\$0	\$0	\$0	\$0	\$0
<u>9113 SHIELD DOORS</u>											
Memo: Door costs are based on In-house historical costs from previous projects. Used an average of \$400/sf and 1 manhour/sf. Assumed all doors are the same thickness.											
REMOTE SERVICES CORRIDOR TO PAR & CRANE MAINTENANCE AREA	GEN	U.C. per EA	1.00	672	CN-IRON	26987.52	0	270000	0	0	296987.52
Memo: Sliding door - 14'W x 48'H.				672	\$40.16	\$26,988	\$0	\$270,000	\$0	\$0	\$296,988
CRANE MAINT. AREA TO CUT-UP CELL	GEN	U.C. per EA	1.00	480	CN-IRON	19276.8	0	192000	0	0	211276.8
Memo: Sliding door - 10'W x 48'H.				480	\$40.16	\$19,277	\$0	\$192,000	\$0	\$0	\$211,277
CUT-UP CELL TO DECON CELL	GEN	U.C. per EA	1.00	480	CN-IRON	19276.8	0	192000	0	0	211276.8
Memo: Sliding door - 10'W x 48'H.				480	\$40.16	\$19,277	\$0	\$192,000	\$0	\$0	\$211,277
DECON CELL TO HANDS-ON MAINT. CELL	GEN	U.C. per EA	1.00	480	CN-IRON	19276.8	0	192000	0	0	211276.8
Memo: Sliding door - 10'W x 48'H.				480	\$40.16	\$19,277	\$0	\$192,000	\$0	\$0	\$211,277
CLEAN CANISTER STORAGE TO CANISTER SERVICE CORRIDOR	GEN	U.C. per EA	1.00	240	CN-IRON	9638.4	0	96000	0	0	105638.4
Memo: Sliding door - 8'W x 30'H				240	\$40.16	\$9,638	\$0	\$96,000	\$0	\$0	\$105,638
CAN COOLING TO CANISTER SERVICE CORRIDOR	GEN	U.C. per EA	1.00	240	CN-IRON	9638.4	0	96000	0	0	105638.4
Memo: Sliding door - 8'W x 30'H				240	\$40.16	\$9,638	\$0	\$96,000	\$0	\$0	\$105,638
CANISTER SERVICE CORRIDOR TO CRANE MAINT. AREA	GEN	U.C. per EA	1.00	420	CN-IRON	18867.2	0	168000	0	0	184867.2
Memo: Vertical door - 14'W x 30'H				420	\$40.16	\$16,867	\$0	\$168,000	\$0	\$0	\$184,867

--Total 9112 FURNISHINGS - OFFICE AREA

-- 9113.1 SHIELD DOORS

Memo: Door costs are based on In-house historical costs from previous projects. Used an average of \$400/sf and 1 manhour/sf. Assumed all doors are the same thickness.

GEN U.C. per EA

672 CN-IRON

26987.52

0

270000

0

296987.52

0

\$296,988

1.00

672

\$40.16

\$26,988

\$0

\$270,000

\$0

\$296,988

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Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
9113.1 SHIELD DOORS											
<i>Memo: Door costs are based on In-house historical costs from previous projects. Used an average of \$400/sf and 1 manhour/sf. Assumed all doors are the same thickness.</i>											
	GEN	U.C. per ea	480	CN-IRON	19276.8	0	0	192000	0	0	211276.8
	PaR & CRANE MAINT. ROOM ADJACENT TO MELTER	1.00	480	\$40.16	\$19,277	\$0	\$0	\$192,000	\$0	\$0	\$211,277
<i>Memo: Sliding door - 30'W x 16'H.</i>											
Subtotal					\$140,239	\$0	\$0	\$1,398,000	\$0	\$0	\$1,538,239
Sales Tax					\$0	\$0	\$0	\$69,900	\$0	\$0	\$69,900
INEEL ORG Labor/Subcontractor Overheads					\$49,844	\$0	\$0	\$521,721	\$0	\$0	\$571,565
Subtotal Estimate											\$2,179,703
Escalation					\$55,713	\$0	\$0	\$583,158	\$0	\$0	\$638,871
Contingency					\$50,388	\$0	\$0	\$527,420	\$0	\$0	\$577,808
9113.1 SHIELD DOORS											
9113.2 PRE-ENGINEERED METAL BUILDINGS											
<i>GEN</i>											
OFFICE ADDITION, 14' EAVE, 3-SIDED		U.C. per SF	0.08	E4	3.213	0.206	0	8.6	0	0	12,019
		12,800.00	1,024	\$40.16	\$41,124	\$2,634	\$0	\$110,080	\$0	\$0	\$153,838
<i>GEN</i>											
SMALL TRUCK BAY, 14' EAVE, 3-SIDED		U.C. per SF	0.08	E4	3.213	0.206	0	8.6	0	0	12,019
		600.00	48	\$40.16	\$1,928	\$123	\$0	\$5,160	\$0	\$0	\$7,211
<i>GEN</i>											
LARGE TRUCK BAY, 14' EAVE, 3-SIDED		U.C. per SF	0.08	E4	3.213	0.206	0	8.6	0	0	12,019
		3,200.00	256	\$40.16	\$10,281	\$658	\$0	\$27,520	\$0	\$0	\$38,459
Subtotal					\$53,332	\$3,416	\$0	\$142,760	\$0	\$0	\$199,508
Sales Tax					\$0	\$0	\$0	\$7,138	\$0	\$0	\$7,138
INEEL ORG Labor/Subcontractor Overheads					\$18,955	\$1,214	\$0	\$53,277	\$0	\$0	\$73,446
Subtotal Estimate											\$280,092
Escalation					\$21,188	\$1,357	\$0	\$59,551	\$0	\$0	\$82,095
Contingency					\$19,162	\$1,227	\$0	\$53,859	\$0	\$0	\$74,248
9113.2 PRE-ENGINEERED METAL BUILDINGS											
9113.3 SHIELD WINDOWS											
<i>GEN</i>											
SHIELD WINDOWS, 3' EQUIVALENT CONCRETE SHIELD		U.C. per EA	100	CN-MILL	3282	0	0	200000	0	0	203292
		147.00	14,700	\$32.92	\$483,924	\$0	\$0	\$29,400,000	\$0	\$0	\$29,883,924
Subtotal					\$483,924	\$0	\$0	\$29,400,000	\$0	\$0	\$29,883,924
Sales Tax					\$0	\$0	\$0	\$1,470,000	\$0	\$0	\$1,470,000
INEEL ORG Labor/Subcontractor Overheads					\$171,996	\$0	\$0	\$10,971,815	\$0	\$0	\$11,143,812
Subtotal Estimate											\$42,497,736
Escalation					\$192,250	\$0	\$0	\$12,263,836	\$0	\$0	\$12,456,086
Contingency					\$173,875	\$0	\$0	\$11,091,659	\$0	\$0	\$11,265,534
9113.3 SHIELD WINDOWS											
			14,700		\$1,022,045	\$0	\$0	\$65,197,310	\$0	\$0	\$66,219,356

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9113.4 MANIPULATORS										
MANIPULATOR, M/S	GEN	U.C. per EA	80	CN-MILL	2633.6	0	65000	0	0	67633.6
Memo: Based on Central Research Laboratory (CRL), Model FX- Heavy Duty. Price reflects preliminary phone quote from CRL.					\$131,680	\$0	\$3,250,000	\$0	\$0	\$3,381,680
					\$0	\$0	\$162,500	\$0	\$0	\$162,500
					\$46,802	\$0	\$1,212,871	\$0	\$0	\$1,259,672
Subtotal										
Sales Tax					\$52,313	\$0	\$1,355,696	\$0	\$0	\$4,803,952
INEEL ORG Labor/Subcontractor Overheads					\$47,313	\$0	\$1,226,119	\$0	\$0	\$1,408,009
Subtotal Estimate					\$278,108	\$0	\$7,207,186	\$0	\$0	\$1,273,432
Escalation										
Contingency										
9114 CONVEYING SYSTEMS										
9114 CONVEYING SYSTEMS										
OVERHEAD BRIDGE CRANE, 2T, REMOTE, 11 STATIONS	GEN	U.C. per EA	300	CN-MILL	9876	2000	250000	0	0	261876
Memo: Based on earlier phone quotes on similar cranes.					\$9,876	\$2,000	\$250,000	\$0	\$0	\$261,876
OVERHEAD BRIDGE CRANE, 5T, REMOTE, 2-6 STATIONS										
Memo: Based on earlier phone quotes on similar cranes.					\$9876	2000	\$800,000	0	0	211876
					\$39,504	\$8,000	\$800,000	\$0	\$0	\$847,504
OVERHEAD BRIDGE CRANE, 5T, REMOTE, 7 STATIONS										
Memo: Based on earlier phone quotes on similar cranes.					\$9876	2000	\$250,000	0	0	261876
					\$9,876	\$2,000	\$250,000	\$0	\$0	\$261,876
OVERHEAD BRIDGE CRANE, 5T, REMOTE, 2 STATIONS, MOTORIZED HOOK										
Memo: Based on earlier phone quotes on similar cranes.					\$9876	2000	\$250,000	0	0	261876
					\$9,876	\$2,000	\$250,000	\$0	\$0	\$261,876
OVERHEAD POLAR BRIDGE CRANE, 5T, REMOTE, 8 STATIONS										
Memo: Based on earlier phone quotes on similar cranes without the polar feature. Added \$100,000 to base crane to cover the added capabilities of a polar crane.					13168	2000	350000	0	0	365168
					\$13,168	\$2,000	\$350,000	\$0	\$0	\$365,168
OVERHEAD POLAR BRIDGE CRANE, 2T, REMOTE, 1 STATION										
Memo: Based on earlier phone quotes on similar cranes without the polar feature. Added \$100,000 to base crane to cover the added capabilities of a polar crane.					13168	2000	275000	0	0	290168
					\$13,168	\$2,000	\$275,000	\$0	\$0	\$290,168
OVERHEAD POLAR BRIDGE CRANE, 5T, REMOTE, 4 STATION										
Memo: Based on earlier phone quotes on similar cranes without the polar feature. Added \$100,000 to base crane to cover the added capabilities of a polar crane.					13168	2000	300000	0	0	315168
					\$13,168	\$2,000	\$300,000	\$0	\$0	\$315,168
OVERHEAD BRIDGE CRANE, 50T, PENDENT CONTROLLED										
Memo: Based on phone quote for similar crane on the Idaho Spaceport effort.					9876	3000	300000	0	0	312876
					\$9,876	\$3,000	\$300,000	\$0	\$0	\$312,876
REMOTE CANISTER TRANSFER CART W/ 4 CONTROL STATIONS										
Memo: Based on costs received from ANL-W on similar transfer cart in HFEF.					13168	0	250000	0	0	263168
					\$13,168	\$0	\$250,000	\$0	\$0	\$263,168

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9114 CONVEYING SYSTEMS										
OVERHEAD BRIDGE CRANE IN TRUCK BAY, 5T	GEN	U.C. per EA	1.00	160 CN-MILL	5287.2	2000	67000	0	0	74287.2
Memo: Based on Richardsons with a +30% site factor added.										
MONORAIL HOIST W/ UNDERSLUNG EXTENSION @ TRUCK BAY	GEN	U.C. per EA	1.00	70 CN-MILL	2304.4	0	20000	0	0	22304.4
Memo: Based on Richardsons with a +30% site factor added.										
Elevators, hydraulic freight, 6000 lb cap, 2 stop, 50 FPM	ELEV	U.C. per EA	1.00	242.424 SSELELEV2	9168.059	0	46410	0	0	55576.059
Memo:										
Subtotal										
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$53,372	\$8,888	\$1,181,993	\$0	\$0	\$1,244,250
Subtotal Estimate										
Escalation					\$59,144	\$9,932	\$1,318,459	\$0	\$0	\$4,733,998
Contingency					\$138,478	\$23,254	\$3,086,966	\$0	\$0	\$1,387,535
-- Total 9114 CONVEYING SYSTEMS										
					4,472	\$67,071	\$8,903,748	\$0	\$0	\$9,370,231
-- 9115.1.1 HVAC - PROCESS BUILDING										
FAN, 60 HP	HVAC	U.C. per EA	11.00	27.2 CN-SHEE	965.056	0	34030	0	0	34995.056
					299	\$0	\$374,330	\$0	\$0	\$384,946
FAN, 50 HP	HVAC	U.C. per EA	24.00	22.7 CN-SHEE	805.396	0	28360	0	0	29165.396
					545	\$0	\$680,640	\$0	\$0	\$699,970
FAN, 75 HP	HVAC	U.C. per EA	2.00	34 CN-SHEE	1208.32	0	42540	0	0	43746.32
					68	\$0	\$85,080	\$0	\$0	\$87,493
HEPA FILTER BANKS, 4 X 4 SINGLE PASS THRU	HVAC	U.C. per EA	28.00	48 CN-SHEE	1703.04	0	112000	0	0	113703.04
					1,344	\$0	\$3,136,000	\$0	\$0	\$3,183,685
HEPA FILTER BANKS, 4 X 4 DOUBLE PASS THRU	HVAC	U.C. per EA	17.00	80 CN-SHEE	2838.4	0	192000	0	0	194838.4
					1,360	\$0	\$3,264,000	\$0	\$0	\$3,312,253
PREFILTERS	HVAC	U.C. per CFM	217,800.00	0.001 CN-SHEE	0.035	0	3	0	0	3.035
					218	\$0	\$653,400	\$0	\$0	\$661,128
CHILLER COMPRESSOR & FANS	HVAC	U.C. per TON	775.00	0.6 CN-SHEE	21,288	0	425	0	0	446,288
					465	\$0	\$329,375	\$0	\$0	\$345,873
STEAM COILS	HVAC	U.C. per SF	364.00	0.7 CN-SHEE	24,836	0	65	0	0	89,836
					255	\$0	\$23,660	\$0	\$0	\$32,700
COOLING COILS	HVAC	U.C. per SF	364.00	0.7 CN-SHEE	24,836	0	65	0	0	89,836
					255	\$0	\$23,660	\$0	\$0	\$32,700

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9115.1.1 HVAC - PROCESS BUILDING										
HEAT RECOVERY COILS	HVAC	U.C. per SF	728.00	0.7 CN-SHEE 510 \$35.48	24,836 \$18,081	0 \$0	65 \$47,320	0 \$0	0 \$0	89,836 \$65,401
GALV. DUCT	HVAC	U.C. per LBS	623,000.00	0.08 CN-SHEE 49,840 \$35.48	2,838 \$1,768,323	0 \$0	0.75 \$467,250	0 \$0	0 \$0	3,588 \$2,235,573
Memo: Includes dampers & supports.										
SST DUCT	HVAC	U.C. per LBS	610,000.00	0.2 CN-SHEE 122,000 \$35.48	7,096 \$4,328,560	0 \$0	2 \$1,220,000	0 \$0	0 \$0	9,096 \$5,548,560
Memo: Includes dampers & supports.										
EXHAUST STACK	HVAC	U.C. per EA	1.00	0	0 \$0	0 \$0	0 \$0	350000 \$350,000	0 \$0	350000 \$350,000
Memo: Assume 10' dia. x 120' high, carbon steel.										
ISOKINETIC STACK SAMPLER	HVAC	U.C. per LOT	1.00	0	0 \$0	0 \$0	0 \$0	250000 \$250,000	0 \$0	250000 \$250,000
Subtotal										
Sales Tax					\$6,285,568	\$0	\$10,304,715	\$600,000	\$0	\$17,190,281
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$515,236	\$0	\$0	\$515,236
					\$2,659,995	\$0	\$4,578,906	\$253,915	\$0	\$7,492,815
Subtotal Estimate										
Escalation					\$2,621,944	\$0	\$4,513,405	\$250,282	\$0	\$25,198,332
Contingency					\$4,127,286	\$0	\$7,104,695	\$383,977	\$0	\$7,385,631
---Total 9115.1.1 HVAC - PROCESS BUILDING										
			177,158		\$15,694,790	\$0	\$27,016,956	\$1,496,174	\$0	\$44,209,921
9115.1.2 HVAC - BOILER BUILDING										
HVAC	HVAC	U.C. per LOT	1.00	200 CN-SHEE 200 \$35.48	7086 \$7,096	240 \$240	36700 \$36,700	1000 \$1,000	0 \$0	45036 \$45,036
Memo: Based on AFC estimate #2547-A. This will be a two boiler system vs. a four in estimate 2547-A; all quantities are halved.										
Subtotal										
Sales Tax					\$7,096	\$240	\$36,700	\$1,000	\$0	\$45,036
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$1,835	\$0	\$0	\$1,835
					\$3,003	\$102	\$16,308	\$423	\$0	\$19,835
Subtotal Estimate										
Escalation					\$2,960	\$100	\$16,074	\$417	\$0	\$66,706
Contingency					\$4,659	\$158	\$25,303	\$657	\$0	\$19,552
---Total 9115.1.2 HVAC - BOILER BUILDING										
			200		\$17,718	\$569	\$96,220	\$2,497	\$0	\$117,035
9115.1.3 HVAC - OFFICE BUILDING										
AIR HANDLER PACKAGE	HVAC	U.C. per CFM	14,000.00	0.005 CN-SHEE 70 \$35.48	0.177 \$2,484	0 \$0	1.5 \$21,000	0 \$0	0 \$0	1.677 \$23,484

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9115.1.3 HVAC - OFFICE BUILDING										
	HVAC									
DUCTWORK, DAMPERS, GRILLS, ETC.		U.C. per SF	12,800.00	0.1 CN-SHEE	3,548	0	3		0	6,548
					\$45,414	\$0	\$38,400	\$0	\$0	\$83,814
Subtotal					\$47,898	\$0	\$59,400	\$0	\$0	\$107,298
Sales Tax					\$0	\$0	\$2,970	\$0	\$0	\$2,970
INEEL ORG Labor/Subcontractor Overheads					\$20,270	\$0	\$26,394	\$0	\$0	\$46,664
Subtotal Estimate					\$19,980	\$0	\$26,017	\$0	\$0	\$156,932
Escalation					\$31,451	\$0	\$40,854	\$0	\$0	\$45,997
Contingency										\$72,405
--Total 9115.1.3 HVAC - OFFICE BUILDING										
			1,350		\$119,599	\$0	\$155,735	\$0	\$0	\$275,334
-- 9115.2.1 GENERAL DISTRIBUTION PIPING										
	PIPE									
PIPE, 304L, SCH 40		U.C. per LF	53,745.00	0.26 CN-PIPE	9,771	0	13.1	0	0	22,871
					\$525,132	\$0	\$704,060	\$0	\$0	\$1,229,191
Memo: Based on .75 lf of pipe per sf of process area. One half of pipe to be 304l and one half to be Nit. 50. Assume a fitting every 20', a manual valve every 200', one half the welds to be in the field, and 10% of welds to be x-rayed.										
PIPE, NITRONIC 50, SCH 40		U.C. per LF	53,745.00	0.29 CN-PIPE	10,898	0	19.12	0	0	30,018
					\$585,724	\$0	\$1,027,604	\$0	\$0	\$1,613,328
SHOP X-RAYS		U.C. per EA	592.00	0	0	0	0	40	0	40
					\$0	\$0	\$0	\$23,680	\$0	\$23,680
FIELD X-RAYS		U.C. per EA	592.00	0	0	0	0	400	0	400
					\$0	\$0	\$0	\$236,800	\$0	\$236,800
TEST WELDS		U.C. per DI	11,830.00	0.3 CN-PIPE	11,274	0	0.1	0	0	11,374
					\$193,371	\$0	\$1,183	\$0	\$0	\$134,554
TESTING & SUPPORTS		U.C. per LOT	1.00	2980 CN-PIPE	111236.8	0	181820	0	0	293056.8
					\$111,237	\$0	\$181,820	\$0	\$0	\$293,057
Memo: Based on 10% of hours and material \$ for pipe, fittings & valves.										
JUMPER JIGS		U.C. per EA	6.00	0	0	0	0	5000	0	5000
					\$0	\$0	\$0	\$30,000	\$0	\$30,000
Subtotal					\$1,355,464	\$0	\$1,914,667	\$290,480	\$0	\$3,560,611
Sales Tax					\$0	\$0	\$95,733	\$0	\$0	\$95,733
INEEL ORG Labor/Subcontractor Overheads					\$589,432	\$0	\$874,236	\$126,317	\$0	\$1,589,985
Subtotal Estimate					\$570,049	\$0	\$845,487	\$122,163	\$0	\$5,246,329
Escalation					\$1,333,927	\$0	\$1,978,457	\$285,865	\$0	\$1,537,699
Contingency										\$3,598,248
--Total 9115.2.1 GENERAL DISTRIBUTION PIPING										
			36,069		\$3,848,871	\$0	\$5,708,580	\$824,825	\$0	\$10,382,276
-- 9115.2.2 SBW WORKOFF										
	PIPE									
4" SCH 40 NITRONIC 50 PIPE		U.C. per LF	20.00	0.25 CN-PIPE	9,395	0	31	0	0	40,395
					\$188	\$0	\$620	\$0	\$0	\$808

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>Org/Subcontractor</u>	<u>QTY</u>	<u>Hrs</u>	<u>Crew/Rate</u>	<u>Labor</u>	<u>Const Eqp</u>	<u>Matl</u>	<u>S/C</u>	<u>Other</u>	<u>TOTAL</u>
4" FITTINGS	9115.2.2 SBW WORKOFF PIPE	U.C. per EA 4.00	0.3 1	CN-PIPE \$37.58	11,274 \$45	0 \$0	108 \$424	0 \$0	0 \$0	117,274 \$469
4" BW	PIPE	U.C. per EA 8.00	8 64	CN-PIPE \$37.58	300,64 \$2,405	0 \$0	0 \$0	0 \$0	0 \$0	300,64 \$2,405
2" SCH 40, 304L, PIPE	PIPE	U.C. per LF 100.00	0.17 17	CN-PIPE \$37.58	6,389 \$639	0 \$0	5.7 \$570	0 \$0	0 \$0	12,089 \$1,209
2" FITTINGS	PIPE	U.C. per EA 4.00	0.25 1	CN-PIPE \$37.58	9,395 \$38	0 \$0	15 \$60	0 \$0	0 \$0	24,395 \$98
2" STEAM CONTROL VALVE	PIPE	U.C. per EA 1.00	3.2 3	CN-PIPE \$37.58	120,256 \$120	0 \$0	2000 \$2,000	0 \$0	0 \$0	2120,256 \$2,120
2" MANUAL VALVE	PIPE	U.C. per EA 3.00	1.6 5	CN-PIPE \$37.58	60,128 \$180	0 \$0	1800 \$5,400	0 \$0	0 \$0	1860,128 \$5,580
2" JUMPERS	PIPE	U.C. per EA 4.00	0 0	CN-PIPE	0 \$0	0 \$0	4000 \$16,000	0 \$0	0 \$0	4000 \$16,000
2" BW	PIPE	U.C. per EA 16.00	2.2 35	CN-PIPE \$37.58	82,676 \$1,323	0 \$0	0 \$0	0 \$0	0 \$0	82,676 \$1,323
1 1/2", SCH 40, NIT. 50, VALVE	PIPE	U.C. per EA 4.00	1.5 6	CN-PIPE \$37.58	56,37 \$225	0 \$0	2800 \$11,200	0 \$0	0 \$0	2856,37 \$11,425
1 1/2" RCV	PIPE	U.C. per EA 5.00	3 15	CN-PIPE \$37.58	112,74 \$564	0 \$0	4800 \$23,000	0 \$0	0 \$0	4712,74 \$23,564
1 1/2" STRAINER	PIPE	U.C. per EA 2.00	1.5 3	CN-PIPE \$37.58	56,37 \$113	0 \$0	5000 \$10,000	0 \$0	0 \$0	5056,37 \$10,113
1 1/2" JUMPER	PIPE	U.C. per EA 13.00	0 0	CN-PIPE	0 \$0	0 \$0	6300 \$81,900	0 \$0	0 \$0	6300 \$81,900
1 1/2" BW	PIPE	U.C. per EA 14.00	2.3 32	CN-PIPE \$37.58	86,434 \$1,210	0 \$0	0 \$0	0 \$0	0 \$0	86,434 \$1,210
1", SCH 40, NIT. 50, PIPE	PIPE	U.C. per LF 200.00	0.13 26	CN-PIPE \$37.58	4,885 \$977	0 \$0	6 \$1,200	0 \$0	0 \$0	10,885 \$2,177
1" FITTINGS	PIPE	U.C. per EA 20.00	0.25 5	CN-PIPE \$37.58	9,395 \$188	0 \$0	24 \$480	0 \$0	0 \$0	33,395 \$668
1" RCV	PIPE	U.C. per EA 2.00	2.6 5	CN-PIPE \$37.58	97,708 \$195	0 \$0	3500 \$7,000	0 \$0	0 \$0	3597,708 \$7,195
1" JUMPER	PIPE	U.C. per EA 2.00	0 0	CN-PIPE	0 \$0	0 \$0	5000 \$10,000	0 \$0	0 \$0	5000 \$10,000
1" BW	PIPE	U.C. per EA 44.00	2 88	CN-PIPE \$37.58	75,16 \$3,307	0 \$0	0 \$0	0 \$0	0 \$0	75,16 \$3,307

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
--- 9115.2.2 SBW WORKOFF										
X-RAYS	PIPE	U.C. per EA	8.00	0	0	0	0	220	0	220
					\$0	\$0	\$0	\$1,760	\$0	\$1,760
TEST WELDS	PIPE	U.C. per DI	129.00	0.3	CN-PIPE	0	0.1	0	0	11,374
				39	\$37.58	\$0	\$13	\$0	\$0	\$1,467
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	273	CN-PIPE	0	6195	0	0	16454.34
				273	\$37.58	\$0	\$6,195	\$0	\$0	\$16,454
Memo: Based on 10% of hours and material \$ for pipe, fittings & valves.										
Subtotal										
Sales Tax					\$23,431	\$0	\$176,062	\$1,760	\$0	\$201,253
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$8,803	\$0	\$0	\$8,803
					\$10,189	\$0	\$80,390	\$765	\$0	\$91,344
Subtotal Estimate										
Escalation					\$9,854	\$0	\$77,746	\$740	\$0	\$301,400
Contingency					\$23,059	\$0	\$181,928	\$1,732	\$0	\$88,340
--- Total 9115.2.2 SBW WORKOFF			624		\$66,533	\$0	\$524,929	\$4,998	\$0	\$206,719
--- 9115.2.3 FRIT										
4" SCH 40, 304L, PIPE	PIPE	U.C. per LF	160.00	0.25	CN-PIPE	0	15.4	0	0	24,795
				40	\$37.58	\$0	\$2,464	\$0	\$0	\$3,967
4" FITTINGS	PIPE	U.C. per EA	16.00	0.3	CN-PIPE	0	53	0	0	64,274
				5	\$37.58	\$0	\$848	\$0	\$0	\$1,028
4" VALVE (SLIDE)	PIPE	U.C. per EA	4.00	3.1	CN-PIPE	0	400	0	0	516,498
				12	\$37.58	\$0	\$1,600	\$0	\$0	\$2,066
4" CARBON STEEL VALVE (SLIDE)	PIPE	U.C. per EA	2.00	3.1	CN-PIPE	0	200	0	0	316,498
				6	\$37.58	\$0	\$400	\$0	\$0	\$633
4" BW	PIPE	U.C. per EA	42.00	6.2	CN-PIPE	0	0	0	0	232,996
				260	\$37.58	\$0	\$0	\$0	\$0	\$9,786
X-RAYS	PIPE	U.C. per EA	4.00	0	0	0	0	220	0	220
					\$0	\$0	\$0	\$880	\$0	\$880
TEST WELDS	PIPE	U.C. per DI	168.00	0.3	CN-PIPE	0	0.1	0	0	11,374
				50	\$37.58	\$0	\$17	\$0	\$0	\$1,911

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9115.2.3 FRIT										
TESTING & SUPPORTS	PIPE	U.C. per LOT	33	CN-PIPE	1240.14	0	531	0	0	1771.14
Memo: Based on 10% of hours and material \$ for pipe, fittings & valves.										
		1.00	33	\$37.58	\$1,240	\$0	\$531	\$0	\$0	\$1,771
Subtotal										
Sales Tax					\$15,303	\$0	\$5,860	\$880	\$0	\$22,042
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$293	\$0	\$0	\$293
					\$6,554	\$0	\$2,676	\$383	\$0	\$9,713
Subtotal Estimate										
Escalation					\$6,436	\$0	\$2,588	\$370	\$0	\$32,048
Contingency					\$15,059	\$0	\$6,055	\$866	\$0	\$21,980
--- Total 9115.2.3 FRIT										
			407		\$43,452	\$0	\$17,471	\$2,499	\$0	\$63,422
9115.2.4 SUGAR										
1 1/2" SCH 40 304L PIPE	PIPE	U.C. per LF	0.15	CN-PIPE	5,637	0	4.4	0	0	10,037
		120.00	18	\$37.58	\$678	\$0	\$528	\$0	\$0	\$1,204
1 1/2" FITTINGS	PIPE	U.C. per EA	0.25	CN-PIPE	9,395	0	13	0	0	22,395
		12.00	3	\$37.58	\$113	\$0	\$156	\$0	\$0	\$269
1 1/2" VALVE	PIPE	U.C. per EA	1.5	CN-PIPE	56,37	0	1600	0	0	1656,37
		2.00	3	\$37.58	\$113	\$0	\$3,200	\$0	\$0	\$3,313
1 1/2" BW	PIPE	U.C. per EA	1.7	CN-PIPE	63,886	0	0	0	0	63,886
		26.00	44	\$37.58	\$1,661	\$0	\$0	\$0	\$0	\$1,661
1" SCH 40 304L PIPE	PIPE	U.C. per LF	0.13	CN-PIPE	4,895	0	3	0	0	7,885
		130.00	17	\$37.58	\$635	\$0	\$390	\$0	\$0	\$1,025
1" FITTINGS	PIPE	U.C. per EA	0.25	CN-PIPE	9,395	0	12	0	0	21,395
		13.00	3	\$37.58	\$122	\$0	\$156	\$0	\$0	\$278
1" VALVE	PIPE	U.C. per EA	1.3	CN-PIPE	48,854	0	1000	0	0	1048,854
		7.00	9	\$37.58	\$342	\$0	\$7,000	\$0	\$0	\$7,342
1" RCV	PIPE	U.C. per EA	2.6	CN-PIPE	97,708	0	2800	0	0	2897,708
		7.00	18	\$37.58	\$684	\$0	\$19,600	\$0	\$0	\$20,284
1" BW	PIPE	U.C. per EA	1.5	CN-PIPE	56,37	0	0	0	0	56,37
		54.00	81	\$37.58	\$3,044	\$0	\$0	\$0	\$0	\$3,044
X-RAYS	PIPE	U.C. per EA	0		0	0	0	220	0	220
		8.00	0		\$0	\$0	\$0	\$1,760	\$0	\$1,760
TEST WELDS	PIPE	U.C. per DI	0.3	CN-PIPE	11,274	0	0.1	0	0	11,374
		93.00	28	\$37.58	\$1,048	\$0	\$9	\$0	\$0	\$1,058

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 0115.2.4 SUGAR										
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	23 CN-PIPE	864.34	0	3103	0	0	3967.34
					\$864	\$0	\$3,103	\$0	\$0	\$3,967
Memo: Based on 10% of hours and material \$ for pipe, fittings & valves.										
Subtotal					\$9,303	\$0	\$34,142	\$1,760	\$0	\$45,205
Sales Tax					\$0	\$0	\$1,707	\$0	\$0	\$1,707
INEEL ORG Labor/Subcontractor Overheads					\$4,045	\$0	\$15,589	\$765	\$0	\$20,400
Subtotal Estimate					\$3,912	\$0	\$15,077	\$740	\$0	\$19,729
Escalation					\$9,155	\$0	\$35,280	\$1,732	\$0	\$46,167
Contingency										
--Total 0115.2.4 SUGAR					\$26,416	\$0	\$101,795	\$4,998	\$0	\$133,209
-- 0115.2.5 MIX TANKS										
1 1/2" SCH 40 NIT. 50 PIPE	PIPE	U.C. per LF	200.00	0.15 CN-PIPE	5,637	0	8.8	0	0	14,437
					\$1,127	\$0	\$1,760	\$0	\$0	\$2,887
1 1/2" FITTINGS	PIPE	U.C. per EA	20.00	0.25 CN-PIPE	9,395	0	26	0	0	35,395
					\$188	\$0	\$520	\$0	\$0	\$708
1 1/2" BW	PIPE	U.C. per EA	40.00	2.3 CN-PIPE	86,434	0	0	0	0	86,434
					\$3,457	\$0	\$0	\$0	\$0	\$3,457
1", SCH 40, NIT. 50, PIPE	PIPE	U.C. per LF	1,710.00	0.13 CN-PIPE	4,885	0	6	0	0	10,885
					\$8,354	\$0	\$10,260	\$0	\$0	\$18,614
1" FITTINGS	PIPE	U.C. per EA	171.00	0.25 CN-PIPE	9,395	0	24	0	0	33,395
					\$1,607	\$0	\$4,104	\$0	\$0	\$5,711
1" VALVE	PIPE	U.C. per EA	44.00	1.3 CN-PIPE	48,854	0	1700	0	0	1748,854
					\$2,150	\$0	\$74,800	\$0	\$0	\$76,950
1" RCV	PIPE	U.C. per EA	20.00	2.6 CN-PIPE	97,708	0	3500	0	0	3597,708
					\$1,954	\$0	\$70,000	\$0	\$0	\$71,954
1" JUMPER	PIPE	U.C. per EA	72.00	0 CN-PIPE	0	0	5000	0	0	5000
					\$0	\$0	\$360,000	\$0	\$0	\$360,000
1" BW	PIPE	U.C. per EA	470.00	2 CN-PIPE	75,16	0	0	0	0	75,16
					\$35,325	\$0	\$0	\$0	\$0	\$35,325
1" SCH 40 304L PIPE	PIPE	U.C. per LF	360.00	0.13 CN-PIPE	4,885	0	3	0	0	7,885
					\$1,759	\$0	\$1,080	\$0	\$0	\$2,839
1" FITTINGS	PIPE	U.C. per EA	4.00	0.25 CN-PIPE	9,395	0	12	0	0	21,395
					\$38	\$0	\$48	\$0	\$0	\$86
1" VALVE	PIPE	U.C. per EA	12.00	1.3 CN-PIPE	48,854	0	1000	0	0	1048,854
					\$586	\$0	\$12,000	\$0	\$0	\$12,586

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Egg	Matl	S/C	Other	TOTAL
--- 9115.2.5 MIX TANKS										
1" RCV	PIPE	U.C. per EA	4.00	2.6 CN-PIPE	97,708	0	2800	0	0	2897,708
					\$391	\$0	\$11,200	\$0	\$0	\$11,591
1" JUMPER	PIPE	U.C. per EA	16.00	0 CN-PIPE	0	0	3000	0	0	3000
					\$0	\$0	\$48,000	\$0	\$0	\$48,000
1" BW	PIPE	U.C. per EA	40.00	1.5 CN-PIPE	56,37	0	0	0	0	56,37
					\$2,255	\$0	\$0	\$0	\$0	\$2,255
X-RAYS	PIPE	U.C. per EA	55.00	0	0	0	0	220	0	220
					\$0	\$0	\$0	\$12,100	\$0	\$12,100
TEST WELDS	PIPE	U.C. per DI	570.00	0.3 CN-PIPE	11,274	0	0.1	0	0	11,374
					\$6,426	\$0	\$57	\$0	\$0	\$6,483
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	191 CN-PIPE	7177.78	0	18577	0	0	25754.78
					\$7,178	\$0	\$18,577	\$0	\$0	\$25,755
Subtotal										
Sales Tax					\$72,794	\$0	\$612,406	\$12,100	\$0	\$697,300
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$30,620	\$0	\$0	\$30,620
					\$31,655	\$0	\$279,624	\$5,262	\$0	\$316,541
Subtotal Estimate										
Escalation					\$30,614	\$0	\$270,429	\$5,089	\$0	\$1,044,462
Contingency					\$71,638	\$0	\$632,809	\$11,908	\$0	\$308,132
Total 9115.2.5 MIX TANKS			1,937		\$206,701	\$0	\$1,825,889	\$34,358	\$0	\$2,066,948
--- 9115.2.6 FEED TANKS										
1" SCH 40, NIT. 50, PIPE	PIPE	U.C. per LF	600.00	0.13 CN-PIPE	4,885	0	6	0	0	10,885
					\$2,931	\$0	\$3,600	\$0	\$0	\$6,531
1" FITTINGS	PIPE	U.C. per EA	60.00	0.25 CN-PIPE	9,395	0	24	0	0	33,395
					\$564	\$0	\$1,440	\$0	\$0	\$2,004
1" VALVE	PIPE	U.C. per EA	10.00	1.3 CN-PIPE	48,854	0	1700	0	0	1748,854
					\$489	\$0	\$17,000	\$0	\$0	\$17,489
1" RCV	PIPE	U.C. per EA	10.00	2.6 CN-PIPE	97,708	0	3500	0	0	3597,708
					\$977	\$0	\$35,000	\$0	\$0	\$35,977
1" JUMPER	PIPE	U.C. per EA	24.00	0 CN-PIPE	0	0	5000	0	0	5000
					\$0	\$0	\$120,000	\$0	\$0	\$120,000
1" BW	PIPE	U.C. per EA	160.00	2 CN-PIPE	75,16	0	0	0	0	75,16
					\$12,026	\$0	\$0	\$0	\$0	\$12,026
1" SCH 40 304L PIPE	PIPE	U.C. per LF	270.00	0.13 CN-PIPE	4,885	0	3	0	0	7,885
					\$1,319	\$0	\$810	\$0	\$0	\$2,129
1" FITTINGS	PIPE	U.C. per EA	27.00	0.25 CN-PIPE	9,395	0	12	0	0	21,395
					\$254	\$0	\$324	\$0	\$0	\$578

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9115.2.6 FEED TANKS										
1" VALVE	PIPE	U.C. per EA	2.00	1.3 CN-PIPE 3 \$37.58	48,854 \$98	0 \$0	1000 \$2,000	0 \$0	0 \$0	1048,854 \$2,098
1" RCV	PIPE	U.C. per EA	6.00	2.6 CN-PIPE 16 \$37.58	97,708 \$586	0 \$0	2800 \$16,800	0 \$0	0 \$0	2897,708 \$17,386
1" JUMPER	PIPE	U.C. per EA	8.00	0 CN-PIPE	0 \$0	0 \$0	3000 \$24,000	0 \$0	0 \$0	3000 \$24,000
1" BW	PIPE	U.C. per EA	70.00	1.5 CN-PIPE 105 \$37.58	56,37 \$3,946	0 \$0	0 \$0	0 \$0	0 \$0	56,37 \$3,946
X-RAYS	PIPE	U.C. per EA	23.00	0	0 \$0	0 \$0	0 \$0	220 \$5,060	0 \$0	220 \$5,060
TEST WELDS	PIPE	U.C. per DI	230.00	0.3 CN-PIPE 69 \$37.58	11,274 \$2,593	0 \$0	0.1 \$23	0 \$0	0 \$0	11,374 \$2,616
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	62 CN-PIPE 62 \$37.58	2329.96 \$2,330	0 \$0	8082 \$8,082	0 \$0	0 \$0	10411.96 \$10,412
9115.2.7.1 EMERGENCY COOLING WATER										
Subtotal					\$28,112	\$0	\$229,079	\$5,060	\$0	\$282,251
Sales Tax					\$0	\$0	\$11,454	\$0	\$0	\$11,454
INEEL ORG Labor/Subcontractor Overheads					\$12,225	\$0	\$104,597	\$2,200	\$0	\$119,022
Subtotal Estimate					\$11,823	\$0	\$101,159	\$2,128	\$0	\$115,108
Escalation					\$27,665	\$0	\$236,711	\$4,980	\$0	\$269,356
Contingency					\$79,824	\$0	\$682,999	\$14,368	\$0	\$777,191
9115.2.6 FEED TANKS										
1" SCH 40 304L PIPE	PIPE	U.C. per LF	150.00	0.13 CN-PIPE 20 \$37.58	4,885 \$733	0 \$0	3 \$450	0 \$0	0 \$0	7,885 \$1,183
1" FITTINGS	PIPE	U.C. per EA	15.00	0.25 CN-PIPE 4 \$37.58	9,395 \$141	0 \$0	12 \$180	0 \$0	0 \$0	21,395 \$321
1" STRAINER	PIPE	U.C. per EA	2.00	1.1 CN-PIPE 2 \$37.58	41,338 \$83	0 \$0	3600 \$7,200	0 \$0	0 \$0	3841,338 \$7,283
1" VALVE	PIPE	U.C. per EA	4.00	1.3 CN-PIPE 5 \$37.58	48,854 \$195	0 \$0	1000 \$4,000	0 \$0	0 \$0	1048,854 \$4,195
1" RCV	PIPE	U.C. per EA	2.00	2.6 CN-PIPE 5 \$37.58	97,708 \$195	0 \$0	2800 \$5,600	0 \$0	0 \$0	2897,708 \$5,795
1" JUMPER	PIPE	U.C. per EA	10.00	0 CN-PIPE	0 \$0	0 \$0	3000 \$30,000	0 \$0	0 \$0	3000 \$30,000
1" BW	PIPE	U.C. per EA	48.00	1.5 CN-PIPE 69 \$37.58	56,37 \$2,593	0 \$0	0 \$0	0 \$0	0 \$0	56,37 \$2,593

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9115.2.7.1 EMERGENCY COOLING WATER										
X-RAYS	PIPE	U.C. per EA	5.00	0	0	0	0	220	0	220
					\$0	\$0	\$0	\$1,100	\$0	\$1,100
TEST WELDS	PIPE	U.C. per DI	46.00	0.3 CN-PIPE	11,274	0	0.1	0	0	11,374
					\$519	\$0	\$5	\$0	\$0	\$523
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	10 CN-PIPE	375.8	0	1743	0	0	2118.8
					\$376	\$0	\$1,743	\$0	\$0	\$2,119
Subtotal										
Sales Tax					\$4,835	\$0	\$49,178	\$1,100	\$0	\$55,112
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$2,459	\$0	\$0	\$2,459
					\$2,102	\$0	\$22,454	\$478	\$0	\$25,035
Subtotal Estimate										
Escalation					\$2,033	\$0	\$21,716	\$463	\$0	\$24,212
Contingency					\$4,758	\$0	\$50,816	\$1,083	\$0	\$56,655
9115.2.7.1 EMERGENCY COOLING WATER										
			129		\$13,728	\$0	\$146,623	\$3,123	\$0	\$163,475
9115.2.7.2 DEMISTER COOLING										
PIPE										
24" SCH 40 C22 PIPE		U.C. per LF	30.00	1.4 CN-PIPE	52,612	0	460	0	0	512,612
					\$1,578	\$0	\$13,800	\$0	\$0	\$15,378
PIPE										
24" FITTINGS		U.C. per EA	3.00	0.7 CN-PIPE	26,306	0	8400	0	0	8426,306
					\$79	\$0	\$25,200	\$0	\$0	\$25,279
PIPE										
24" BW		U.C. per EA	6.00	37 CN-PIPE	1390.46	0	0	0	0	1390.46
					\$6,343	\$0	\$0	\$0	\$0	\$8,343
PIPE										
1" SCH 40 304L PIPE		U.C. per LF	100.00	0.13 CN-PIPE	4,885	0	3	0	0	7,885
					\$489	\$0	\$300	\$0	\$0	\$789
PIPE										
1" FITTINGS		U.C. per EA	10.00	0.25 CN-PIPE	9,395	0	12	0	0	21,395
					\$94	\$0	\$120	\$0	\$0	\$214
PIPE										
1" VALVE		U.C. per EA	3.00	1.3 CN-PIPE	48,854	0	1000	0	0	1048,854
					\$147	\$0	\$3,000	\$0	\$0	\$3,147
PIPE										
1" RCV		U.C. per EA	1.00	2.6 CN-PIPE	97,708	0	2800	0	0	2897,708
					\$98	\$0	\$2,800	\$0	\$0	\$2,898
PIPE										
1" JUMPER		U.C. per EA	4.00	0	0	0	3000	0	0	3000
					\$0	\$0	\$12,000	\$0	\$0	\$12,000
PIPE										
1" BW		U.C. per EA	28.00	1.5 CN-PIPE	56,37	0	0	0	0	56,37
					\$1,578	\$0	\$0	\$0	\$0	\$1,578
PIPE										
X-RAYS		U.C. per EA	4.00	0	0	0	0	220	0	220
					\$0	\$0	\$0	\$880	\$0	\$880
PIPE										
TEST WELDS		U.C. per DI	172.00	0.3 CN-PIPE	11,274	0	0.1	0	0	11,374
					\$1,939	\$0	\$17	\$0	\$0	\$1,956

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Egg	Matl	S/C	Other	TOTAL
--- 9115.2.7.2 DEMISTER COOLING										
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	34 CN-PIPE	1277.72	0	4522	0	0	5799.72
					\$1,278	\$0	\$4,522	\$0	\$0	\$5,800
Subtotal					\$15,622	\$0	\$61,759	\$880	\$0	\$78,261
Sales Tax					\$0	\$0	\$3,088	\$0	\$0	\$3,088
INEEL ORG Labor/Subcontractor Overheads					\$6,793	\$0	\$28,199	\$383	\$0	\$35,375
Subtotal Estimate					\$6,570	\$0	\$27,272	\$370	\$0	\$116,724
Escalation					\$15,374	\$0	\$63,817	\$866	\$0	\$34,212
Contingency						\$0			\$0	\$80,057
--- Total 9115.2.7.2 DEMISTER COOLING										
			416		\$44,359	\$0	\$184,135	\$2,499	\$0	\$230,993
--- 9115.2.7.3 REHEATER										
24" SCH 40 C22 PIPE	PIPE	U.C. per LF	180.00	1.4 CN-PIPE	52,612	0	460	0	0	512,612
					\$9,470	\$0	\$82,800	\$0	\$0	\$92,270
24" FITTINGS	PIPE	U.C. per EA	3.00	0.7 CN-PIPE	26,306	0	8400	0	0	8426,306
					\$79	\$0	\$25,200	\$0	\$0	\$25,279
24" VALVE	PIPE	U.C. per EA	4.00	12 CN-PIPE	450,96	0	7000	0	0	7450,96
					\$1,804	\$0	\$28,000	\$0	\$0	\$29,804
24" RCV	PIPE	U.C. per EA	2.00	24 CN-PIPE	901,92	0	10000	0	0	10901,92
					\$1,804	\$0	\$20,000	\$0	\$0	\$21,804
24" JUMPER	PIPE	U.C. per EA	6.00	0 CN-PIPE	0	0	45000	0	0	45000
					\$0	\$0	\$270,000	\$0	\$0	\$270,000
24" BW	PIPE	U.C. per EA	18.00	37 CN-PIPE	1390,46	0	0	0	0	1390,46
					\$25,028	\$0	\$0	\$0	\$0	\$25,028
X-RAYS	PIPE	U.C. per EA	2.00	0	0	0	0	500	0	500
					\$0	\$0	\$0	\$1,000	\$0	\$1,000
TEST WELDS	PIPE	U.C. per DI	432.00	0.3 CN-PIPE	11,274	0	0.1	0	0	11,374
					\$4,870	\$0	\$43	\$0	\$0	\$4,914
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	105 CN-PIPE	3945,9	0	15600	0	0	19545,9
					\$3,946	\$0	\$15,600	\$0	\$0	\$19,546
Subtotal					\$47,001	\$0	\$441,643	\$1,000	\$0	\$489,645
Sales Tax					\$0	\$0	\$22,082	\$0	\$0	\$22,082
INEEL ORG Labor/Subcontractor Overheads					\$20,439	\$0	\$201,654	\$435	\$0	\$222,528
Subtotal Estimate					\$19,767	\$0	\$195,023	\$421	\$0	\$734,254
Escalation					\$46,255	\$0	\$456,357	\$984	\$0	\$215,210
Contingency						\$0			\$0	\$503,596
--- Total 9115.2.7.3 REHEATER										
			1,251		\$133,461	\$0	\$1,316,759	\$2,840	\$0	\$1,453,060

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>Org/Subcontractor</u>	<u>QTY</u>	<u>Hrs</u>	<u>Crew/Rate</u>	<u>Labor</u>	<u>Const Eqp</u>	<u>Matl</u>	<u>S/C</u>	<u>Other</u>	<u>TOTAL</u>
9115.2.8 CHARCOAL FILTER										
6" SCH 40 316L PIPE	PIPE	U.C. per LF	200.00	0.35 70	CN-PIPE \$37.58	13,153 \$2,631	0 \$0	0 \$0	0 \$0	40,153 \$9,031
6" FITTINGS	PIPE	U.C. per EA	20.00	0.35 7	CN-PIPE \$37.58	13,153 \$2,631	0 \$0	0 \$0	0 \$0	163,153 \$3,263
6" VALVE	PIPE	U.C. per EA	4.00	4 16	CN-PIPE \$37.58	150,32 \$601	0 \$0	0 \$0	0 \$0	3150,32 \$12,601
6" JUMPER	PIPE	U.C. per EA	4.00	0	CN-PIPE	0 \$0	0 \$0	0 \$0	0 \$0	6500 \$26,000
6" BW	PIPE	U.C. per EA	48.00	7.3 350	CN-PIPE \$37.58	274,334 \$13,168	0 \$0	0 \$0	0 \$0	274,334 \$13,168
1" SCH 40 316L PIPE	PIPE	U.C. per LF	260.00	0.13 34	CN-PIPE \$37.58	4,885 \$1,270	0 \$0	0 \$0	0 \$0	7,885 \$2,050
1" FITTINGS	PIPE	U.C. per EA	26.00	0.25 7	CN-PIPE \$37.58	9,395 \$244	0 \$0	0 \$0	0 \$0	21,395 \$556
1" VALVE	PIPE	U.C. per EA	4.00	1.3 5	CN-PIPE \$37.58	48,854 \$195	0 \$0	0 \$0	0 \$0	1048,854 \$4,195
1" ROV	PIPE	U.C. per EA	3.00	2.6 8	CN-PIPE \$37.58	97,708 \$293	0 \$0	0 \$0	0 \$0	2897,708 \$8,693
1" JUMPER	PIPE	U.C. per EA	7.00	0	CN-PIPE	0 \$0	0 \$0	0 \$0	0 \$0	3000 \$21,000
1" BW	PIPE	U.C. per EA	66.00	1.5 99	CN-PIPE \$37.58	56,37 \$3,720	0 \$0	0 \$0	0 \$0	56,37 \$3,720
X-RAYS	PIPE	U.C. per EA	12.00	0		0 \$0	0 \$0	220 \$2,640	0 \$0	220 \$2,640
TEST WELDS	PIPE	U.C. per DI	354.00	0.3 108	CN-PIPE \$37.58	11,274 \$3,991	0 \$0	0 \$0	0 \$0	11,374 \$4,026
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	60 60	CN-PIPE \$37.58	2254.8 \$2,255	0 \$0	0 \$0	0 \$0	5643.8 \$5,644
Subtotal										
Sales Tax						\$28,632	\$0	\$2,640	\$0	\$115,589
INEEL ORG Labor/Subcontractor Overheads						\$0	\$0	\$0	\$0	\$4,216
						\$12,451	\$0	\$1,148	\$0	\$52,098
Subtotal Estimate										
Escalation						\$12,041	\$0	\$1,110	\$0	\$171,902
Contingency						\$28,177	\$0	\$2,598	\$0	\$50,385
--Total 9115.2.8 CHARCOAL FILTER				762		\$81,302	\$0	\$7,496	\$0	\$340,188

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9115.2.9.1 QUENCH										
6" SCH 40 NIT. 50 PIPE	PIPE	U.C. per LF	30.00	0.35 CN-PIPE 11	13,153 \$395	0 \$0	54 \$1,620	0 \$0	0 \$0	67,153 \$2,015
6" FITTINGS	PIPE	U.C. per EA	3.00	0.35 CN-PIPE 1	13,153 \$39	0 \$0	300 \$900	0 \$0	0 \$0	313,153 \$939
6" VALVE	PIPE	U.C. per EA	1.00	4 CN-PIPE 4	150,32 \$150	0 \$0	7000 \$7,000	0 \$0	0 \$0	7150,32 \$7,150
6" JUMPER	PIPE	U.C. per EA	1.00	0 CN-PIPE 0	0 \$0	0 \$0	12000 \$12,000	0 \$0	0 \$0	12000 \$12,000
6" BW	PIPE	U.C. per EA	8.00	9.5 CN-PIPE 76	357,01 \$2,856	0 \$0	0 \$0	0 \$0	0 \$0	357,01 \$2,856
1" SCH 40, NIT. 50, PIPE	PIPE	U.C. per LF	650.00	0.13 CN-PIPE 85	4,885 \$3,176	0 \$0	6 \$3,900	0 \$0	0 \$0	10,885 \$7,076
1" FITTINGS	PIPE	U.C. per EA	65.00	0.25 CN-PIPE 16	9,395 \$611	0 \$0	24 \$1,560	0 \$0	0 \$0	33,395 \$2,171
1" VALVE	PIPE	U.C. per EA	10.00	1.3 CN-PIPE 13	48,854 \$489	0 \$0	1700 \$17,000	0 \$0	0 \$0	1748,854 \$17,489
1" RCV	PIPE	U.C. per EA	7.00	2.8 CN-PIPE 18	97,708 \$684	0 \$0	3500 \$24,500	0 \$0	0 \$0	3597,708 \$25,184
1" JUMPER	PIPE	U.C. per EA	22.00	0 CN-PIPE 0	0 \$0	0 \$0	5000 \$110,000	0 \$0	0 \$0	5000 \$110,000
1" BW	PIPE	U.C. per EA	164.00	2 CN-PIPE 328	75,16 \$12,326	0 \$0	0 \$0	0 \$0	0 \$0	75,16 \$12,326
X-RAYS	PIPE	U.C. per EA	17.00	0 0	0 \$0	0 \$0	0 \$0	220 \$3,740	0 \$0	220 \$3,740
TEST WELDS	PIPE	U.C. per DI	212.00	0.3 CN-PIPE 64	11,274 \$2,390	0 \$0	0.1 \$21	0 \$0	0 \$0	11,374 \$2,411
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	55 CN-PIPE 55	2066.9 \$2,067	0 \$0	5648 \$5,648	0 \$0	0 \$0	7714.9 \$7,715
Subtotal					\$25,182	\$0	\$184,149	\$3,740	\$0	\$213,072
Sales Tax					\$0	\$0	\$9,207	\$0	\$0	\$9,207
INEEL ORG Labor/Subcontractor Overheads					\$10,951	\$0	\$84,082	\$1,626	\$0	\$96,659
Subtotal Estimate										
Escalation					\$10,591	\$0	\$81,317	\$1,573	\$0	\$318,938
Contingency					\$24,782	\$0	\$190,284	\$3,661	\$0	\$93,481
--Total 9115.2.9.1 QUENCH			670		\$71,506	\$0	\$549,041	\$10,620	\$0	\$218,747

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9115.2.9.2 SETTLING TANK	PIPE									
2" SCH 40 NIT. 50 PIPE	U.C. per LF	120.00	0.17	CN-PIPE \$37.58	6,389 \$767	0 \$0	11.4 \$1,368	0 \$0	0 \$0	17,789 \$2,135
2" FITTINGS	U.C. per EA	12.00	0.25	CN-PIPE \$37.58	9,395 \$113	0 \$0	30 \$360	0 \$0	0 \$0	39,395 \$473
2" BW	U.C. per EA	24.00	2.9	CN-PIPE \$37.58	108,982 \$2,616	0 \$0	0 \$0	0 \$0	0 \$0	108,982 \$2,616
1" SCH 40, NIT. 50, PIPE	U.C. per LF	1,200.00	0.13	CN-PIPE \$37.58	4,885 \$5,862	0 \$0	6 \$7,200	0 \$0	0 \$0	10,885 \$13,082
1" FITTINGS	U.C. per EA	120.00	0.25	CN-PIPE \$37.58	9,395 \$1,127	0 \$0	24 \$2,880	0 \$0	0 \$0	33,395 \$4,007
1" VALVE	U.C. per EA	2.00	1.3	CN-PIPE \$37.58	48,854 \$98	0 \$0	1700 \$3,400	0 \$0	0 \$0	1748,854 \$3,498
1" RCV	U.C. per EA	9.00	2.6	CN-PIPE \$37.58	97,708 \$879	0 \$0	3500 \$31,500	0 \$0	0 \$0	3597,708 \$32,379
1" JUMPER	U.C. per EA	13.00	0	CN-PIPE	0 \$0	0 \$0	5000 \$65,000	0 \$0	0 \$0	5000 \$65,000
1" BW	U.C. per EA	262.00	2	CN-PIPE \$37.58	75,16 \$19,692	0 \$0	0 \$0	0 \$0	0 \$0	75,16 \$19,692
X-RAYS	U.C. per EA	29.00	0		0 \$0	0 \$0	0 \$0	220 \$6,380	0 \$0	220 \$6,380
TEST WELDS	U.C. per DI	310.00	0.3	CN-PIPE \$37.58	11,274 \$3,495	0 \$0	0.1 \$31	0 \$0	0 \$0	11,374 \$3,526
TESTING & SUPPORTS	U.C. per LOT	1.00	102	CN-PIPE \$37.58	3833.16 \$3,833	0 \$0	4671 \$4,671	0 \$0	0 \$0	8504.16 \$8,504
Subtotal					\$38,482	\$0	\$116,410	\$6,380	\$0	\$161,272
Sales Tax					\$0	\$0	\$5,821	\$0	\$0	\$5,821
INEEL ORG Labor/Subcontractor Overheads					\$16,734	\$0	\$53,153	\$2,774	\$0	\$72,661
Subtotal Estimate					\$16,184	\$0	\$51,405	\$2,683	\$0	\$239,754
Escalation					\$37,870	\$0	\$120,288	\$6,279	\$0	\$70,272
Contingency										\$164,437
9115.2.9.2 SETTLING TANK			1,024		\$109,270	\$0	\$347,076	\$18,116	\$0	\$474,463
9115.2.9.3 SCRUB TANK										
6" SCH 40 NIT. 50 PIPE	U.C. per LF	20.00	0.35	CN-PIPE \$37.58	13,153 \$263	0 \$0	54 \$1,080	0 \$0	0 \$0	67,153 \$1,343
6" FITTINGS	U.C. per EA	2.00	0.35	CN-PIPE \$37.58	13,153 \$26	0 \$0	300 \$600	0 \$0	0 \$0	313,153 \$626

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9115.2.9.3 SCRUB TANK										
6" RCV	PIPE	U.C. per EA	1.00	8 CN-PIPE	300.64	0	7000	0	0	7300.64
				8	\$37.58	\$0	\$7,000	\$0	\$0	\$7,301
6" JUMPER	PIPE	U.C. per EA	1.00	0 CN-PIPE	0	0	12000	0	0	12000
					\$0	\$0	\$12,000	\$0	\$0	\$12,000
6" BW	PIPE	U.C. per EA	6.00	9.5 CN-PIPE	357.01	0	0	0	0	357.01
				57	\$2,142	\$0	\$0	\$0	\$0	\$2,142
1", SCH 40, NIT. 50, PIPE	PIPE	U.C. per LF	700.00	0.13 CN-PIPE	4.885	0	6	0	0	10.885
				91	\$3,420	\$0	\$4,200	\$0	\$0	\$7,620
1" FITTINGS	PIPE	U.C. per EA	70.00	0.25 CN-PIPE	9.395	0	24	0	0	33.395
				18	\$658	\$0	\$1,680	\$0	\$0	\$2,338
1" STRAINER	PIPE	U.C. per EA	2.00	1.1 CN-PIPE	41.338	0	3600	0	0	3641.338
				2	\$83	\$0	\$7,200	\$0	\$0	\$7,283
1" VALVE	PIPE	U.C. per EA	8.00	1.3 CN-PIPE	48.854	0	1700	0	0	1748.854
				10	\$391	\$0	\$13,600	\$0	\$0	\$13,991
1" RCV	PIPE	U.C. per EA	5.00	2.6 CN-PIPE	97.708	0	3500	0	0	3597.708
				13	\$489	\$0	\$17,500	\$0	\$0	\$17,989
1" JUMPER	PIPE	U.C. per EA	17.00	0 CN-PIPE	0	0	5000	0	0	5000
					\$0	\$0	\$85,000	\$0	\$0	\$85,000
1" BW	PIPE	U.C. per EA	170.00	2 CN-PIPE	75.16	0	0	0	0	75.16
				340	\$12,777	\$0	\$0	\$0	\$0	\$12,777
X-RAYS	PIPE	U.C. per EA	18.00	0	0	0	0	220	0	220
					\$0	\$0	\$0	\$3,960	\$0	\$3,960
TEST WELDS	PIPE	U.C. per DI	206.00	0.3 CN-PIPE	11.274	0	0.1	0	0	11.374
				62	\$2,322	\$0	\$21	\$0	\$0	\$2,343
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	60 CN-PIPE	2254.8	0	14475	0	0	16729.8
				60	\$2,255	\$0	\$14,475	\$0	\$0	\$16,730
Subtotal										
					\$25,126	\$0	\$164,356	\$3,960	\$0	\$193,442
Sales Tax					\$0	\$0	\$8,218	\$0	\$0	\$8,218
INEEL ORG Labor/Subcontractor Overheads					\$10,926	\$0	\$75,045	\$1,722	\$0	\$87,693
Subtotal Estimate										
Escalation					\$10,567	\$0	\$72,577	\$1,665	\$0	\$289,352
Contingency					\$24,727	\$0	\$169,831	\$3,897	\$0	\$84,809
Total 9115.2.9.3 SCRUB TANK					669	\$71,346	\$490,026	\$11,245	\$0	\$572,617
9115.2.9.4 CAUSTIC SOLUTION										
1" SCH 40 304L PIPE	PIPE	U.C. per LF	500.00	0.13 CN-PIPE	4.885	0	3	0	0	7.885
				65	\$2,443	\$0	\$1,500	\$0	\$0	\$3,943

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Gulley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

Project Name: **VITRIFICATION OF SBW**
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9115.2.9.4 CAUSTIC SOLUTION										
1" FITTINGS	PIPE	U.C. per EA	50.00	0.25 CN-PIPE 13	9,395 \$470	0 \$0	12 \$600	0 \$0	0 \$0	21,395 \$1,070
1" VALVE	PIPE	U.C. per EA	4.00	1.3 CN-PIPE 5	48,854 \$195	0 \$0	1000 \$4,000	0 \$0	0 \$0	1048,854 \$4,195
1" RCV	PIPE	U.C. per EA	3.00	2.6 CN-PIPE 8	97,708 \$293	0 \$0	2800 \$8,400	0 \$0	0 \$0	2897,708 \$8,693
1" JUMPER	PIPE	U.C. per EA	2.00	0 CN-PIPE	0 \$0	0 \$0	3000 \$6,000	0 \$0	0 \$0	3000 \$6,000
1" BW	PIPE	U.C. per EA	114.00	1.5 CN-PIPE 171	56,37 \$6,426	0 \$0	0 \$0	0 \$0	0 \$0	56,37 \$6,426
X-RAYS	PIPE	U.C. per EA	12.00	0	0 \$0	0 \$0	0 \$0	220 \$2,640	0 \$0	220 \$2,640
TEST WELDS	PIPE	U.C. per DI	114.00	0.3 CN-PIPE 34	11,274 \$1,285	0 \$0	0.1 \$11	0 \$0	0 \$0	11,374 \$1,297
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	27 CN-PIPE 27	1014,66 \$1,015	0 \$0	1450 \$1,450	0 \$0	0 \$0	2484,66 \$2,465
Subtotal Estimate										
Sales Tax					\$12,127	\$0	\$21,961	\$2,640	\$0	\$36,728
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$1,098	\$0	\$0	\$1,098
					\$5,274	\$0	\$10,028	\$1,148	\$0	\$16,449
Subtotal Estimate										
Escalation					\$5,100	\$0	\$9,698	\$1,110	\$0	\$54,276
Contingency					\$11,934	\$0	\$22,693	\$2,598	\$0	\$15,908
					\$34,435	\$0	\$65,478	\$7,496	\$0	\$37,226
-- Total 9115.2.9.4 CAUSTIC SOLUTION										
-- 9115.2.10 SCRUB WATER CLEANUP SYSTEM										
2" SCH 40 NIT. 50 PIPE	PIPE	U.C. per LF	100.00	0.17 CN-PIPE 17	6,389 \$639	0 \$0	11.4 \$1,140	0 \$0	0 \$0	17,789 \$1,779
2" FITTINGS	PIPE	U.C. per EA	10.00	0.25 CN-PIPE 3	9,395 \$94	0 \$0	30 \$300	0 \$0	0 \$0	39,395 \$394
2" VALVE	PIPE	U.C. per EA	2.00	1.6 CN-PIPE 3	60,128 \$120	0 \$0	3100 \$6,200	0 \$0	0 \$0	3160,128 \$6,320
2" RCV	PIPE	U.C. per EA	1.00	3.2 CN-PIPE 3	120,256 \$120	0 \$0	5000 \$5,000	0 \$0	0 \$0	5120,256 \$5,120
2" JUMPER	PIPE	U.C. per EA	3.00	0 CN-PIPE	0 \$0	0 \$0	7200 \$21,600	0 \$0	0 \$0	7200 \$21,600
2" BW	PIPE	U.C. per EA	26.00	2.9 CN-PIPE 75	108,982 \$2,834	0 \$0	0 \$0	0 \$0	0 \$0	108,982 \$2,834

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Equip	Matl	S/C	Other	TOTAL
9115.2.10 SCRUB WATER CLEANUP SYSTEM											
2" SCH 40, 304L, PIPE	PIPE	U.C. per LF	1,000.00	0.17 CN-PIPE	6,389			5,700			12,089
					\$6,389			\$5,700			\$12,089
2" FITTINGS	PIPE	U.C. per EA	100.00	0.25 CN-PIPE	9,395			15,500			24,395
					\$940			\$1,500			\$2,440
2" MANUAL VALVE	PIPE	U.C. per EA	15.00	1.6 CN-PIPE	60,128			1800			1860,128
					\$902			\$27,000			\$27,902
2" RCV	PIPE	U.C. per EA	20.00	3.2 CN-PIPE	120,256			3500			3620,256
					\$2,405			\$70,000			\$72,405
2" JUMPERS	PIPE	U.C. per EA	38.00	0 CN-PIPE	0			4000			4000
					\$0			\$152,000			\$152,000
2" BW	PIPE	U.C. per EA	270.00	2.2 CN-PIPE	82,676			0			82,676
					\$22,323			\$0			\$22,323
X-RAYS	PIPE	U.C. per EA	30.00	0	0			0			220
					\$0			\$0			\$6,600
TEST WELDS	PIPE	U.C. per DI	588.00	0.3 CN-PIPE	11,274			0.1			11,374
					\$6,629			\$59			\$6,688
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	108 CN-PIPE	4058.64			11684			15742.64
					\$4,059			\$11,684			\$15,743
Subtotal					\$47,452			\$302,183			\$356,235
Sales Tax					\$0			\$15,109			\$15,109
INEEL ORG Labor/Subcontractor Overheads					\$20,635			\$137,976			\$161,481
Subtotal Estimate											
Escalation											
Contingency											
--- Total 9115.2.10 SCRUB WATER CLEANUP SYSTEM			1,263		\$19,956			\$133,439			\$532,826
					\$46,698			\$312,250			\$156,171
					\$134,742			\$900,958			\$365,444
9115.2.11.1 GROUT											
2" SCH 40, 304L, PIPE	PIPE	U.C. per LF	100.00	0.17 CN-PIPE	6,389			5,700			12,089
					\$639			\$570			\$1,209
2" FITTINGS	PIPE	U.C. per EA	10.00	0.25 CN-PIPE	9,395			15,500			24,395
					\$94			\$150			\$244
2" MANUAL VALVE	PIPE	U.C. per EA	3.00	1.6 CN-PIPE	60,128			1800			1860,128
					\$180			\$5,400			\$5,580
2" JUMPERS	PIPE	U.C. per EA	4.00	0 CN-PIPE	0			4000			4000
					\$0			\$16,000			\$16,000
2" BW	PIPE	U.C. per EA	26.00	2.2 CN-PIPE	82,676			0			82,676
					\$2,150			\$0			\$2,150

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Success Estimating and Cost Management System

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Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9115.2.11.1 GROUT										
1" SCH 40 304L PIPE	PIPE	U.C. per LF	640.00	0.13 CN-PIPE 83	4,885 \$3,127	0 \$0	3 \$1,920	0 \$0	0 \$0	7,885 \$5,047
1" FITTINGS	PIPE	U.C. per EA	64.00	0.25 CN-PIPE 16	9,395 \$601	0 \$0	12 \$768	0 \$0	0 \$0	21,395 \$1,369
1" VALVE	PIPE	U.C. per EA	9.00	1.3 CN-PIPE 12	48,854 \$440	0 \$0	1000 \$9,000	0 \$0	0 \$0	1048,854 \$9,440
1" JUMPER	PIPE	U.C. per EA	13.00	0 CN-PIPE 0	0 \$0	0 \$0	3000 \$39,000	0 \$0	0 \$0	3000 \$39,000
1" BW	PIPE	U.C. per EA	146.00	1.5 CN-PIPE 219	56,37 \$8,230	0 \$0	0 \$0	0 \$0	0 \$0	56,37 \$8,230
X-RAYS	PIPE	U.C. per EA	17.00	0 0	0 \$0	0 \$0	0 \$0	220 \$3,740	0 \$0	220 \$3,740
TEST WELDS	PIPE	U.C. per DI	198.00	0.3 CN-PIPE 59	11,274 \$2,232	0 \$0	0.1 \$20	0 \$0	0 \$0	11,374 \$2,252
TESTING & SUPPORTS	PIPE	U.C. per LOT	1.00	60 CN-PIPE 60	2254.8 \$2,255	0 \$0	1780 \$1,780	0 \$0	0 \$0	4034.8 \$4,035
Subtotal										
INEEL ORG Labor/Subcontractor Overheads					\$19,947	\$0	\$74,608	\$3,740	\$0	\$98,295
Sales Tax					\$0	\$0	\$3,730	\$0	\$0	\$3,730
Contingency					\$8,674	\$0	\$34,066	\$1,626	\$0	\$44,367
Subtotal Estimate										
Escalation					\$8,389	\$0	\$32,946	\$1,573	\$0	\$42,908
Total					\$55,641	\$0	\$77,093	\$3,651	\$0	\$100,405
9115.2.11.2 GROUT										
9115.2.11.2 MIXER DECON WASTE WATER										
1" SCH 40 304L PIPE	PIPE	U.C. per LF	80.00	0.13 CN-PIPE 10	4,885 \$391	0 \$0	3 \$240	0 \$0	0 \$0	7,885 \$631
1" FITTINGS	PIPE	U.C. per EA	8.00	0.25 CN-PIPE 2	9,395 \$75	0 \$0	12 \$96	0 \$0	0 \$0	21,395 \$171
1" VALVE	PIPE	U.C. per EA	2.00	1.3 CN-PIPE 3	48,854 \$98	0 \$0	1000 \$2,000	0 \$0	0 \$0	1048,854 \$2,098
1" JUMPER	PIPE	U.C. per EA	3.00	0 CN-PIPE 0	0 \$0	0 \$0	3000 \$9,000	0 \$0	0 \$0	3000 \$9,000
1" BW	PIPE	U.C. per EA	20.00	1.5 CN-PIPE 30	56,37 \$1,127	0 \$0	0 \$0	0 \$0	0 \$0	56,37 \$1,127
X-RAYS	PIPE	U.C. per EA	2.00	0 0	0 \$0	0 \$0	0 \$0	220 \$440	0 \$0	220 \$440

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
TEST WELDS										
	9115.2.11.2 MIXER DECON WASTE WATER PIPE	U.C. per DI	0.3	CN-PIPE	11,274	0	0.1	0	0	11,374
		20.00	6	\$37.58	\$225	\$0	\$2	\$0	\$0	\$227
TESTING & SUPPORTS										
	PIPE	U.C. per LOT	24	CN-PIPE	801.92	0	234	0	0	1135.92
		1.00	24	\$37.58	\$902	\$0	\$234	\$0	\$0	\$1,136
Subtotal										
	Sales Tax				\$2,819	\$0	\$11,572	\$440	\$0	\$14,831
	INEEL ORG Labor/Subcontractor Overheads				\$0	\$0	\$579	\$0	\$0	\$579
					\$1,226	\$0	\$5,284	\$191	\$0	\$6,701
Subtotal Estimate										
	Escalation				\$1,185	\$0	\$5,110	\$185	\$0	\$22,110
	Contingency				\$2,774	\$0	\$11,958	\$433	\$0	\$6,480
Total 9115.2.11.2 MIXER DECON WASTE WATER										
			75		\$8,003	\$0	\$34,502	\$1,249	\$0	\$43,755
STEAM & SUPPORT PIPING										
	PIPE	U.C. per LOT	2325	CN-PIPE	87373.5	1820	89150	0	0	178343.5
		1.00	2,325	\$37.58	\$87,374	\$1,820	\$89,150	\$0	\$0	\$178,344
PIPE INSULATION										
	INSUL	U.C. per LOT	175	CN-ASBE	6461	0	8920	0	0	15381
		1.00	175	\$36.92	\$6,461	\$0	\$8,920	\$0	\$0	\$15,381
Subtotal										
	Sales Tax				\$93,835	\$1,820	\$98,070	\$0	\$0	\$193,725
	INEEL ORG Labor/Subcontractor Overheads				\$0	\$0	\$4,904	\$0	\$0	\$4,904
					\$40,578	\$791	\$44,451	\$0	\$0	\$85,821
Subtotal Estimate										
	Escalation				\$39,396	\$785	\$43,210	\$0	\$0	\$284,449
	Contingency				\$92,188	\$1,791	\$101,113	\$0	\$0	\$83,372
Total 9115.2.12 PIPING - BOILER BUILDING										
			2,500		\$265,998	\$5,168	\$291,747	\$0	\$0	\$195,092
9115.3.1 Electric water heater, com. 100< F rise, 50 gallon tank, 9 KW, 37 GPH										
	PIPE	U.C. per LF	0.105	PLUM	3,423	0	1.8	0	0	5,223
	Pipe cu solder jls, type L tubing, cplgs & hgrs 10' o.c., 3/4" dia	34.00	4	\$32.60	\$116	\$0	\$61	\$0	\$0	\$178
PIPE										
	Pipe, cu fig, wrought, sldr jl, cu x cu, 90< elb, 3/4"	5.00	2	\$32.60	13,725	0	0.82	0	0	14,545
					\$69	\$0	\$4	\$0	\$0	\$73
PIPE										
	Pipe, cu fig, wrought, sldr jl, cu x cu, T, 3/4"	2.00	1	\$32.60	21,744	0	1.52	0	0	23,264
					\$43	\$0	\$3	\$0	\$0	\$47
PIPE										
	Union, copper, wrought, copper x copper, 3/4"	2.00	1	\$32.60	14,475	0	4.7	0	0	19,175
					\$29	\$0	\$9	\$0	\$0	\$38
PIPE										
	Adapter, copper, wrought, copper x male IPS, 3/4"	1.00	0	\$32.60	15,355	0	1.36	0	0	16,715
					\$15	\$0	\$1	\$0	\$0	\$17

05/24/2000

Success Estimating and Cost Management System

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Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9115.3.1 Electric water heater, com, 100< F rise, 50 gallon tank, 9 KW 37 GPH										
	PIPE	U.C. per EA								
Valves, bronze, gate, N.R.S., soldered, 125 PSI, 3/4" size		2.00	0.4	PLUM \$32.60	13.04 \$26	0 \$0	15.1 \$30	0 \$0	0 \$0	28.14 \$56
PIPE										
Valves, bronze, relief, pressure & temp, self-close, ASME, 3/4" size,		1.00	0.286	PLUM \$32.60	9.324 \$9	0 \$0	61.5 \$62	0 \$0	0 \$0	70.824 \$71
PIPE										
Water hts, com, 100< rise, elec, 50 gal., 9 KW, 37 GPH, 208V		1.00	4.444	PLUM \$32.60	144.874 \$145	0 \$0	1800 \$1,800	0 \$0	0 \$0	1944.874 \$1,945
Subtotal										
Sales Tax					\$453	\$0	\$1,971	\$0	\$0	\$2,424
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$99	\$0	\$0	\$99
Subtotal Estimate					\$197	\$0	\$900	\$0	\$0	\$1,097
Escalation										
Contingency					\$191	\$0	\$870	\$0	\$0	\$3,619
-- Total 9115.3.1 Electric water heater, com, 100< F rise, 50 gallon tank, 9 KW 37 GPH										
			14		\$841	\$0	\$3,839	\$0	\$0	\$4,680
-- 9115.3.2 Electric water heater, commercial, 100< F rise, 80 gal, 12 KW 49 GPH										
PIPE		U.C. per LF								
Pipe cu solder jls, type L tubing, cplgs & hgrs 10' o.c., 3/4" dia		4.00	0.105	PLUM \$32.60	3.423 \$14	0 \$0	1.8 \$7	0 \$0	0 \$0	5.223 \$21
PIPE										
Pipe cu solder jls, type L tubing, cplgs & hgrs 10' o.c., 1-1/4" dia		30.00	0.138	PLUM \$32.60	4.499 \$135	0 \$0	3.11 \$93	0 \$0	0 \$0	7.609 \$228
PIPE										
Pipe, cu fig, wrought, sldr jls, cu x cu, 90< elb, 3/4"		1.00	0.421	PLUM \$32.60	13.725 \$14	0 \$0	0.82 \$1	0 \$0	0 \$0	14.545 \$15
PIPE										
Pipe, cu fig, wrt, sldr jls, cu x cu, 90< elb, 1-1/4"		4.00	0.533	PLUM \$32.60	17.376 \$70	0 \$0	3.02 \$12	0 \$0	0 \$0	20.396 \$82
PIPE										
Pipe, cu fig, wrt, sldr jls, cu x cu, T, 1-1/4"		2.00	0.889	PLUM \$32.60	28.982 \$58	0 \$0	7 \$14	0 \$0	0 \$0	35.982 \$72
PIPE										
Pipe, cu fig, wrt, sldr jls, cu x cu, uns, 1-1/4"		2.00	0.571	PLUM \$32.60	18.615 \$37	0 \$0	14.45 \$29	0 \$0	0 \$0	33.065 \$66
PIPE										
Adapter, copper, wrought, copper x male IPS, 3/4"		1.00	0.471	PLUM \$32.60	15.355 \$15	0 \$0	1.36 \$1	0 \$0	0 \$0	16.715 \$17
PIPE										
Valves, bronze, gate, N.R.S., soldered, 125 psi, 1-1/4" size		2.00	0.533	PLUM \$32.60	17.376 \$35	0 \$0	47 \$94	0 \$0	0 \$0	64.376 \$129

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
--- 9115.3.2 Electric water heater, commercial, 100< F rise, 80 gal, 12 KW 49 GPH										
	PIPE	U.C. per EA	1.00	PLUM	9.324	0	61.5	0	0	70.824
	Valves, bronze, relief, pressure & temp, self-close, ASME, 3/4" size,		0	\$32.60	\$9	\$0	\$62	\$0	\$0	\$71
PIPE										
	Water htrs, com, 100< rise, elec, 80 gal., 12 kW, 49 GPH, 208V	U.C. per EA	5.333	PLUM	173.856	0	2225	0	0	2398.856
			5	\$32.60	\$174	\$0	\$2,225	\$0	\$0	\$2,399
Subtotal										
	Sales Tax				\$560	\$0	\$2,538	\$0	\$0	\$3,099
	INEEL ORG Labor/Subcontractor Overheads				\$0	\$0	\$127	\$0	\$0	\$127
					\$244	\$0	\$1,159	\$0	\$0	\$1,403
Subtotal Estimate										
	Escalation				\$236	\$0	\$1,121	\$0	\$0	\$1,356
	Contingency				\$0	\$0	\$0	\$0	\$0	\$0
--- Total 9115.3.2 Electric water heater, commercial, 100< F rise, 80 gal, 12 KW 49 GPH										
			17		\$1,040	\$0	\$4,945	\$0	\$0	\$5,985
--- 9115.3.3 Laboratory w/trim wall hung, vitreous china, 18" x 15"										
	PIPE	U.C. per EA	10.00	PLUM	11.866	0	4.73	0	0	16.596
	Faucets/fittings, water supply stops, polished chrome pl, angle, 1/2"		4	\$32.60	\$119	\$0	\$47	\$0	\$0	\$166
PIPE										
	Supports/carr, lav, encl arm, w/ mld, in std or mas, flt sib fix	U.C. per EA	1.333	PLUM	43.456	0	96.5	0	0	139.956
			7	\$32.60	\$217	\$0	\$483	\$0	\$0	\$700
PIPE										
	Traps, chromed brs, tubular, P trap, W/ co, 20 Ga., 1-1/4" pipe size	U.C. per EA	0.444	PLUM	14.474	0	16.5	0	0	30.974
			2	\$32.60	\$72	\$0	\$83	\$0	\$0	\$155
PIPE										
	Pipe cu solder jls, type L tubing, cplgs & hgrs 10' O.C., 1-1/4" dia.	U.C. per LF	0.099	PLUM	3.227	0	1.26	0	0	4.487
			5	\$32.60	\$161	\$0	\$63	\$0	\$0	\$224
PIPE										
	Pipe- cu, sldr jls, type DWV tubing, cplgs & hgrs 10' o.c., 1-1/4" dia	U.C. per LF	0.133	PLUM	4.336	0	2.56	0	0	6.896
			3	\$32.60	\$87	\$0	\$51	\$0	\$0	\$138
PIPE										
	Pipe, cu fig, wrought, sldr jt, cu x cu, 90< elb, 1/2"	U.C. per EA	0.4	PLUM	13.04	0	0.38	0	0	13.42
			4	\$32.60	\$130	\$0	\$4	\$0	\$0	\$134
PIPE										
	Pipe, cu fig, wrought, sldr jt, cu x cu, T, 1/2"	U.C. per EA	0.615	PLUM	20.049	0	0.62	0	0	20.669
			6	\$32.60	\$200	\$0	\$6	\$0	\$0	\$207
PIPE										
	Pipe, cu, wrt, DWV, sldr jls, cu x cu, T, san, 1-1/4"	U.C. per EA	0.889	PLUM	28.981	0	6.75	0	0	35.731
			4	\$32.60	\$145	\$0	\$34	\$0	\$0	\$179

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
9115.3.3 Lavatory w/trim, wall hung, vitreous china, 18" x 15"											
PIPE											
Pipe st. sched 40, thrded, W/cplgs&hgtrs, 10' o. c., galv, 1-1/4" dia	U.C. per LF	20.00	0.18 4	Q1 \$40.07	7.213 \$144		0 \$0	2.2 \$44	0 \$0	0 \$0	9.413 \$188
9115.3.3 Lavatory w/trim, wall hung, vit china, 18"x15", single bowl w/backsplash											
PIPE											
Lavatory, w/trim, wall hung, vit china, 18"x15", single bowl w/backsplash	U.C. per EA	5.00	2.288 11	Q1 \$40.07	91.6 \$458		0 \$0	178 \$890	0 \$0	0 \$0	269.6 \$1,348
Subtotal											
INEEL ORG Labor/Subcontractor Overheads											
Subtotal Estimate											
Escalation											
Contingency											
Total 9115.3.3 Lavatory w/trim, wall hung, vitreous china, 18" x 15"											
50											
9115.3.4 Svese sink w/trim, PE on CL cnr fl. wall hung w/trim guard, 24" x 20"											
PIPE											
Faucets/littings, water supply stops, polished chrome pl, angle, 1/2"	U.C. per EA	2.00	0.384 1	PLUM \$32.60	11.867 \$24		0 \$0	4.73 \$9	0 \$0	0 \$0	16.597 \$33
9115.3.4 Supports/carriers, sink, wall mounted, exposed arms, single hvy fixt											
PIPE											
Supports/carriers, sink, wall mounted, exposed arms, single hvy fixt	U.C. per EA	1.00	1.6 2	PLUM \$32.60	52.16 \$52		0 \$0	126 \$126	0 \$0	0 \$0	178.16 \$178
9115.3.4 Traps, copper, P trap, standard pattern, 3" pipe size											
PIPE											
Traps, copper, P trap, standard pattern, 3" pipe size	U.C. per EA	1.00	0.727 1	PLUM \$32.60	23.7 \$24		0 \$0	92.5 \$93	0 \$0	0 \$0	116.2 \$116
9115.3.4 Pipe cu solder jls, type L tubing, cplgs & hgtrs 10' O.C., 1/2" dia.											
PIPE											
Pipe cu solder jls, type L tubing, cplgs & hgtrs 10' O.C., 1/2" dia.	U.C. per LF	10.00	0.099 1	PLUM \$32.60	3.227 \$32		0 \$0	1.26 \$13	0 \$0	0 \$0	4.487 \$45
9115.3.4 Pipe cu solder jls, type DWV tubing, cplgs & hgtrs 10' o.c., 2" dia											
PIPE											
Pipe cu solder jls, type DWV tubing, cplgs & hgtrs 10' o.c., 2" dia	U.C. per LF	4.00	0.192 1	PLUM \$32.60	5.933 \$24		0 \$0	4.18 \$17	0 \$0	0 \$0	10.113 \$40
9115.3.4 Pipe cu solder jls, type DWV tubing, cplgs & hgtrs 10' o.c., 3" dia											
PIPE											
Pipe cu solder jls, type DWV tubing, cplgs & hgtrs 10' o.c., 3" dia	U.C. per LF	6.00	0.276 2	Q1 \$40.07	11.059 \$66		0 \$0	7 \$42	0 \$0	0 \$0	18.059 \$108
9115.3.4 Pipe, cu fig, wrought, sldr jlt, cu x cu, 90- elb, 1/2"											
PIPE											
Pipe, cu fig, wrought, sldr jlt, cu x cu, 90- elb, 1/2"	U.C. per EA	2.00	0.4 1	PLUM \$32.60	13.04 \$26		0 \$0	0.38 \$1	0 \$0	0 \$0	13.42 \$27
9115.3.4 Pipe, cu fig, wrought, sldr jlt, cu x cu, T, 1/2"											
PIPE											
Pipe, cu fig, wrought, sldr jlt, cu x cu, T, 1/2"	U.C. per EA	2.00	0.615 1	PLUM \$32.60	20.049 \$40		0 \$0	0.62 \$1	0 \$0	0 \$0	20.669 \$41
9115.3.4 Pipe 3"cu,wrgt,DWV,sldr jls,cu x cu,ean T											
PIPE											
Pipe 3"cu,wrgt,DWV,sldr jls,cu x cu,ean T	U.C. per EA	1.00	2.288 2	Q1 \$40.07	91.6 \$92		0 \$0	36 \$36	0 \$0	0 \$0	127.6 \$128

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9115.3.4 Syce sink w/trim, PE on CI, cnr fl, wall hung w/rim guard, 24" x 20"										
	PIPE	U.C. per EA	4	Q1	160.28	0	400	0	0	560.28
	Sinks, w/faucets & drain, service, wall, polithn on		4	\$40.07	\$160	\$0	\$400	\$0	\$0	\$560
	CI roll rim, 24"x20"	1.00								
Subtotal										
					\$540	\$0	\$737	\$0	\$0	\$1,277
INEEL ORG Labor/Subcontractor Overheads										
					\$0	\$0	\$37	\$0	\$0	\$37
					\$235	\$0	\$337	\$0	\$0	\$571
Subtotal Estimate										
					\$227	\$0	\$326	\$0	\$0	\$553
					\$0	\$0	\$0	\$0	\$0	\$0
					\$1,002	\$0	\$1,436	\$0	\$0	\$2,438
-- 9115.5 Shower stall, fiberglass 1 piece, three walls, 36" square										
	PIPE	U.C. per EA	0.333	PLUM	10.856	0	2.45	0	0	13.306
	Faucets/fittings, stop and waste valves, brz, strway, sldr end, 1/2"	8.00	3	\$32.60	\$87	\$0	\$20	\$0	\$0	\$106
	PIPE	U.C. per EA	0.471	PLUM	15.355	0	25	0	0	40.355
	Traps, copper, P trap, standard pattern, 1-1/2" pipe size	4.00	2	\$32.60	\$61	\$0	\$100	\$0	\$0	\$161
	PIPE	U.C. per LF	0.099	PLUM	3.227	0	1.26	0	0	4.487
	Pipe cu solder jls, type L tubing, cplgs & hgrs 10' O.C., 1/2" dia.	64.00	6	\$32.60	\$207	\$0	\$81	\$0	\$0	\$287
	PIPE	U.C. per LF	0.148	PLUM	4.825	0	3.2	0	0	8.025
	Pipe cu sldr jls, type DWV tubing, cplgs & hgrs 10' O.C., 1-1/2" dia	24.00	4	\$32.60	\$116	\$0	\$77	\$0	\$0	\$193
	PIPE	U.C. per EA	0.4	PLUM	13.04	0	0.38	0	0	13.42
	Pipe, cu fig, wrought, sldr jt, cu x cu, 90< elb, 1/2"	12.00	5	\$32.60	\$156	\$0	\$5	\$0	\$0	\$161
	PIPE	U.C. per EA	0.615	PLUM	20.049	0	0.62	0	0	20.669
	Pipe, cu fig, wrought, sldr jt, cu x cu, T, 1/2"	8.00	5	\$32.60	\$160	\$0	\$5	\$0	\$0	\$165
	PIPE	U.C. per EA	1	PLUM	32.6	0	8.6	0	0	41.2
	Pipe, cu, wrt, DWV, sldr jls, cu x cu, T, san, 1-1/2"	4.00	4	\$32.60	\$130	\$0	\$34	\$0	\$0	\$165

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Equip	Matl	S/C	Other	TOTAL
--- 9115.5 Shower, stall, fiberglass 1 piece, three walls, 36" square										
	PIPE	U.C. per EA	4.00	6.687 Q1	267.147	0	340	0	0	607.147
	Shower, stall, w/door & trim, fbgls, one PC, w/ 3 wall, 36" x 36" sq			\$40.07	\$1,089	\$0	\$1,360	\$0	\$0	\$2,429
Subtotal										
	Sales Tax				\$1,986	\$0	\$1,681	\$0	\$0	\$3,667
	INEEL ORG Labor/Subcontractor Overheads				\$0	\$0	\$84	\$0	\$0	\$84
					\$864	\$0	\$768	\$0	\$0	\$1,631
Subtotal Estimate										
	Escalation				\$835	\$0	\$742	\$0	\$0	\$5,383
	Contingency				\$0	\$0	\$0	\$0	\$0	\$1,578
--- Total 9115.5 Shower, stall, fiberglass 1 piece, three walls, 36" square										
			55		\$3,686	\$0	\$3,275	\$0	\$0	\$6,961
--- 9115.6 Urinal, vitreous china, wall hung										
	PIPE	U.C. per LF	8.00	0.25 Q1	10.018	0	6.8	0	0	16.818
	Pipe, CI, soil, on hangers 5' o.c., NO hub, cplgs 10' o.c., 3" dia			\$40.07	\$80	\$0	\$54	\$0	\$0	\$135
PIPE										
	Pipe, CI fig, no hub, cplg, & lab req'd at Jts not Incl'd, san T, 3"		2.00	0	0	0	7.8	0	0	7.8
					\$0	\$0	\$16	\$0	\$0	\$16
PIPE										
	Pipe, CI fig, NO hub, cplg, & lab req'd at Jts not Incl'd, cplg, std, 3"		4.00	0.421 Q1	16.87	0	4.32	0	0	21.19
				\$40.07	\$67	\$0	\$17	\$0	\$0	\$85
PIPE										
	Pipe cu solder Jts, type L tubing, cplgs & hgrs 10' o.c., 3/4" dia		10.00	0.105 PLUM	3.423	0	1.8	0	0	5.223
				\$32.60	\$34	\$0	\$18	\$0	\$0	\$52
PIPE										
	Pipe cu solder Jts, type DWV tubing, cplgs & hgrs 10' o.c., 2" dia		6.00	0.182 PLUM	5.933	0	4.18	0	0	10.113
				\$32.60	\$36	\$0	\$25	\$0	\$0	\$61
PIPE										
	Pipe, cu fig, wrought, sldr Jt, cu x cu, 90° elb, 3/4"		2.00	0.421 PLUM	13.725	0	0.82	0	0	14.545
				\$32.60	\$27	\$0	\$2	\$0	\$0	\$29
PIPE										
	Pipe, cu fig, wrought, sldr Jt, cu x cu, T, 3/4"		2.00	0.667 PLUM	21.744	0	1.52	0	0	23.264
				\$32.60	\$43	\$0	\$3	\$0	\$0	\$47
PIPE										
	Pipe, cu fig, wrt, DWV, sldr Jts, cu x cu, 90° elb, 2"		2.00	0.8 PLUM	26.08	0	6.85	0	0	32.93
				\$32.60	\$52	\$0	\$14	\$0	\$0	\$66
PIPE										
	Pipe st, sched 40, thrdded, W/cplgs & hgrs, 10' o.c., galv, 1-1/2" dia		10.00	0.2 Q1	8.014	0	2.79	0	0	10.804
				\$40.07	\$80	\$0	\$28	\$0	\$0	\$108

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2655**

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Equip	Matl	S/C	Other	TOTAL
<hr/>										
9115.6 Urinal, vitreous china, wall hung	PIPE	U.C. per EA	2.00	5.333 Q1	213.694 \$427	0 \$0	271 \$542	0 \$0	0 \$0	484.694 \$969
Urinals, wall hung, vitreous china, hanger & self-closing valve, siphon										
<hr/>										
Subtotal					\$848	\$0	\$719	\$0	\$0	\$1,567
Sales Tax					\$0	\$0	\$36	\$0	\$0	\$36
INEEL ORG Labor/Subcontractor Overheads					\$369	\$0	\$328	\$0	\$0	\$697
<hr/>										
Subtotal Estimate					\$357	\$0	\$317	\$0	\$0	\$2,300
Escalation					\$0	\$0	\$0	\$0	\$0	\$674
Contingency					\$0	\$0	\$0	\$0	\$0	\$0
<hr/>										
9115.6 Urinal, vitreous china, wall hung			22		\$1,574	\$0	\$1,400	\$0	\$0	\$2,974
<hr/>										
9115.7 Water cooler, electric, wall hung, wheelchair type, 7.5 GPH	PIPE	U.C. per EA	1.00	0.333 PLUM	10.856 \$11	0 \$0	4.26 \$4	0 \$0	0 \$0	15.116 \$15
Faucets/fittings, stop and waste valves, brz, sinway, sldr end, 3/8"										
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PIPE		U.C. per EA	1.00	0.444 PLUM	14.474 \$14	0 \$0	25 \$25	0 \$0	0 \$0	39.474 \$39
Traps, copper, P trap, standard pattern, 1-1/4" pipe size										
<hr/>										
PIPE		U.C. per LF	5.00	0.095 PLUM	3.097 \$15	0 \$0	1.08 \$5	0 \$0	0 \$0	4.177 \$21
Pipe cu solder jts, type L tubing, cplgs & hgrs 10' o.c., 3/8" dia										
<hr/>										
PIPE		U.C. per LF	4.00	0.133 PLUM	4.336 \$17	0 \$0	2.56 \$10	0 \$0	0 \$0	6.896 \$28
Pipe- cu, sldr jts, type DWV tubing, cplgs & hgrs 10' o.c., 1-1/4" dia										
<hr/>										
PIPE		U.C. per EA	1.00	0.364 PLUM	11.866 \$12	0 \$0	1.03 \$1	0 \$0	0 \$0	12.896 \$13
Pipe, cu ftg, wrought, sldr jt, cu x cu, 90< elb, 3/8"										
<hr/>										
PIPE		U.C. per EA	1.00	0.571 PLUM	18.615 \$19	0 \$0	0.62 \$1	0 \$0	0 \$0	19.235 \$19
Pipe, cu ftg, wrt unless otherwise noted, sldr jts, cu x cu, T, 3/8"										
<hr/>										
PIPE		U.C. per EA	1.00	0.889 PLUM	28.981 \$29	0 \$0	6.75 \$7	0 \$0	0 \$0	35.731 \$36
Pipe, cu, wrt, DWV, sldr jts, cu x cu, T, san, 1-1/4"										

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client:

J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
<u>9115.7 Water cooler, electric, wall hung, wheelchair type, 7.5 GPH</u>										
	PIPE	U.C. per EA	4	Q1	160.28	0	1175	0	0	1335.28
	Water cooler, wall mounted, wheelchair type, 8 GPH	1.00	4	\$40.07	\$160	\$0	\$1,175	\$0	\$0	\$1,335
Subtotal					\$278	\$0	\$1,228	\$0	\$0	\$1,506
Sales Tax					\$0	\$0	\$61	\$0	\$0	\$61
INEEL ORG Labor/Subcontractor Overheads					\$121	\$0	\$561	\$0	\$0	\$682
Subtotal Estimate										
Escalation					\$117	\$0	\$542	\$0	\$0	\$2,249
Contingency					\$0	\$0	\$0	\$0	\$0	\$659
<u>9115.7 Water cooler, electric, wall hung, wheelchair type, 7.5 GPH</u>										
			8		\$516	\$0	\$2,393	\$0	\$0	\$2,909
<u>9115.3.8 Water closet, vitreous china, bowl only with flush valve, floor mount</u>										
	PIPE	U.C. per LF	0.276	Q1	11,059	0	8,85	0	0	19,909
	Pipe, CI, soli, on hangers 5' o.c., NO hub, cplgs 10' o.c., 4" dia	16.00	4	\$40.07	\$177	\$0	\$142	\$0	\$0	\$319
<u>PIPE</u>										
	Pipe, CI fig, lead & oakum jls, clo bend, 4" dia, 1"x4" ring, 6"x16"	4.00	1.231	Q1	49,326	0	42.5	0	0	91,826
			5	\$40.07	\$197	\$0	\$170	\$0	\$0	\$367
<u>PIPE</u>										
	Pipe-CI, no hub, cplg & lab req'd at lt not incld, comb Y&1/8 bend, 4" pipe	4.00	0		0	0	19,75	0	0	19,75
					\$0	\$0	\$79	\$0	\$0	\$79
<u>PIPE</u>										
	Pipe, CI fig, no hub, cplg & lab req'd at jls not incld, cplg, std, 4" p	12.00	0.485	Q1	19,434	0	5.15	0	0	24,584
			6	\$40.07	\$233	\$0	\$62	\$0	\$0	\$295
<u>PIPE</u>										
	Pipe cu solder joints, type L tubing, cplgs & hgrs 10' o.c., 1" dia	20.00	0.118	PLUM	3,847	0	2.48	0	0	6,307
			2	\$32.60	\$77	\$0	\$49	\$0	\$0	\$126
<u>PIPE</u>										
	Pipe, cu fig, wrought, s/dr lt, cu x cu, 90< elb, 1"	8.00	0.5	PLUM	16.3	0	1.84	0	0	18.14
			4	\$32.60	\$130	\$0	\$15	\$0	\$0	\$145
<u>PIPE</u>										
	Pipe, cu fig, wrought, s/dr lt, cu x cu, T, 1"	4.00	0.8	PLUM	28.08	0	4.4	0	0	30.48
			3	\$32.60	\$104	\$0	\$18	\$0	\$0	\$122
<u>PIPE</u>										
	Pipe st, sched 40, thrdd, W/cplgs & hgrs, 10' o.c., galv, 2" dia	18.00	0.25	Q1	10,018	0	3.36	0	0	13,378
			4	\$40.07	\$160	\$0	\$54	\$0	\$0	\$214

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
-- 9115.3.8 Water closet, vitreous china, bowl only with flush valve, floor mount										
	PIPE	U.C. per Ea	2.759	Q1	110,553	0	288	0	0	396,553
	Water clo, bowl only, w/flush valve, seat, floor mounted	4.00	11	\$40.07	\$442	\$0	\$1,144	\$0	\$0	\$1,586
Subtotal										
					\$1,522	\$0	\$1,732	\$0	\$0	\$3,253
Sales Tax										
					\$0	\$0	\$87	\$0	\$87	\$1,452
INEEL ORG Labor/Subcontractor Overheads										
					\$662	\$0	\$791	\$0	\$0	\$4,792
Subtotal Estimate										
					\$640	\$0	\$765	\$0	\$0	\$1,405
Escalation										
					\$0	\$0	\$0	\$0	\$0	\$0
Contingency										
					\$2,823	\$0	\$3,374	\$0	\$0	\$6,197
--Total 9115.3.8 Water closet, vitreous china, bowl only with flush valve, floor mount										
			40							
-- 9115.4 FIRE PROTECTION										
	FP	U.C. per SF	0		0	0	0	3.5	0	3.5
FIRE SPRINKLER SYSTEM - BOILER BUILDING										
		3,120.00			\$0	\$0	\$0	\$10,920	\$0	\$10,920
FIRE SPRINKLER SYSTEM - OFFICE BUILDING										
	FP	U.C. per SF	0		0	0	0	3.5	0	3.5
		12,800.00			\$0	\$0	\$0	\$44,800	\$0	\$44,800
FIRE SPRINKLER SYSTEM - PROCESS BUILDING										
	FP	U.C. per SF	0		0	0	0	4.5	0	4.5
		213,720.00			\$0	\$0	\$0	\$961,740	\$0	\$961,740
Subtotal										
					\$0	\$0	\$0	\$1,017,460	\$0	\$1,017,460
Sales Tax										
					\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads										
					\$0	\$0	\$0	\$406,842	\$0	\$406,842
Subtotal Estimate										
					\$0	\$0	\$0	\$417,463	\$0	\$1,424,302
Escalation										
					\$0	\$0	\$0	\$848,869	\$0	\$417,463
Contingency										
					\$0	\$0	\$0	\$2,690,634	\$0	\$848,869
--Total 9115.4 FIRE PROTECTION										
			0							
-- 9116.1.1 SWITCHGEAR										
	ELEC	U.C. per Ea	40	CN-ELEC	1364.8	5000	175000	0	0	181364.8
		1.00	40	\$34.12	\$1,365	\$5,000	\$175,000	\$0	\$0	\$181,365
5000 KVA 13.8-480/277 Transformers w/ primary protection										
			120	CN-ELEC	4094.4	5000	125000	0	0	134094.4
		1.00	120	\$34.12	\$4,094	\$5,000	\$125,000	\$0	\$0	\$134,094
6000 amp double ended switchgear, nema 1										
	ELEC	U.C. per Ls	160	CN-ELEC	5459.2	0	50000	0	0	55459.2
		1.00	160	\$34.12	\$5,459	\$0	\$50,000	\$0	\$0	\$55,459
6000 amp armor clad busduct										
	ELEC	U.C. per Ea	120	CN-ELEC	4094.4	1500	54000	0	0	59594.4
		1.00	120	\$34.12	\$4,094	\$1,500	\$54,000	\$0	\$0	\$59,594
2000 amp double ended MCC, 12 section										
	ELEC	U.C. per Ea	24	CN-ELEC	818.88	0	6000	0	0	6818.88
		4.00	96	\$34.12	\$3,276	\$0	\$24,000	\$0	\$0	\$27,276
480-208/120 transformers, assume 112.5 kVA										

VITRIFICATION OF SBW
Project Location: **INEEL/INTEC**
Estimate Number: **2555**

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

CONSTRUCTION DETAIL ITEM REPORT

<u>LEVEL</u>	<u>Org/Subcontractor</u>	<u>QTY</u>	<u>Hrs</u>	<u>Crew/Rate</u>	<u>Labor</u>	<u>Const Eqp</u>	<u>Matl</u>	<u>S/C</u>	<u>Other</u>	<u>TOTAL</u>
--	<u>9116.1.1 SWITCHGEAR</u>									
	High voltage switches	U.C. per Ea	2.00	24 CN-ELEC \$34.12	818.88 \$1,638	1500 \$3,000	12000 \$24,000	0 \$0	0 \$0	14318.88 \$28,638
	Misc. lighting and power panels	U.C. per Ea	30.00	16 CN-ELEC \$34.12	545.92 \$16,378	0 \$0	3000 \$90,000	0 \$0	0 \$0	3545.92 \$106,378
	Misc. safety switches, assume 50	U.C. per Ls	1.00	75 CN-ELEC \$34.12	2559 \$2,559	0 \$0	15000 \$15,000	0 \$0	0 \$0	17559 \$17,559
	Equipment pads for transformers and HV switches	U.C. per Ls	1.00	0 \$0	0 \$0	0 \$0	0 \$0	20000 \$20,000	0 \$0	20000 \$20,000
	Allowance for temporary power/lighting over life of project	U.C. per Ls	1.00	10000 CN-ELEC \$34.12	341200 \$341,200	0 \$0	75000 \$75,000	0 \$0	0 \$0	416200 \$416,200
	Subtotal				\$380,063	\$14,500	\$632,000	\$20,000	\$0	\$1,046,563
	Sales Tax				\$0	\$0	\$31,600	\$0	\$0	\$31,600
	INEEL ORG Labor/Subcontractor Overheads				\$151,972	\$5,798	\$265,347	\$7,997	\$0	\$431,114
	Escalation									
	Contingency									
--	<u>Total 9116.1.1 SWITCHGEAR</u>									
	2500 kW standby diesel generator, complete with 5000 gal. tank and all piping	U.C. per Ea	1.00	240 CN-ELCF \$36.72	8812.8 \$8,813	5000 \$5,000	500000 \$500,000	0 \$0	0 \$0	513812.8 \$513,813
	Subtotal									
	Sales Tax									
	INEEL ORG Labor/Subcontractor Overheads				\$8,813	\$5,000	\$500,000	\$0	\$0	\$513,813
	Escalation				\$3,524	\$1,999	\$209,927	\$0	\$0	\$215,450
	Contingency									
--	<u>Total 9116.1.2 STANDBY POWER</u>									
	Cell Lighting, remote ballast, includes conduit and wiring	U.C. per Ea	300.00	24 CN-ELEC \$34.12	818.88 \$245,664	0 \$0	2400 \$720,000	0 \$0	0 \$0	3218.88 \$965,664
	High Bay Lighting	U.C. per Sf	158,560.00	0	0 \$0	0 \$0	0 \$0	3.25 \$515,320	0 \$0	3.25 \$515,320

CONSTRUCTION DETAIL ITEM REPORT

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

Client: J. J. Guligley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
9116.1.3 LIGHTING										
	ELEC	U.C. per Sf	27,520.00	0	0	0	0	2.5	0	2.5
								\$68,800	\$0	\$68,800
All other lighting, office, opr. corridor, equip. rooms, etc.										
	ELEC	U.C. per Ls	1.00	80	2729.6	0	5000	0	0	7729.6
					\$2,730	\$0	\$5,000	\$0	\$0	\$7,730
Allowance for area and wall lighting, assume 20 lights										
Subtotal					\$248,394	\$0	\$725,000	\$584,120	\$0	\$1,557,514
Sales Tax					\$0	\$0	\$36,250	\$0	\$0	\$36,250
INEEL ORG Labor/Subcontractor Overheads					\$99,323	\$0	\$304,393	\$233,566	\$0	\$637,282
Subtotal Estimate					\$101,916	\$0	\$312,340	\$239,684	\$0	\$2,231,046
Escalation					\$164,880	\$0	\$505,307	\$387,730	\$0	\$653,920
Contingency						\$0			\$0	\$1,057,917
9116.1.3 LIGHTING										
---Total			7,280		\$614,512	\$0	\$1,883,290	\$1,445,080	\$0	\$3,942,882
9116.1.4.1 MAIN FEEDERS										
	ELEC	U.C. per Lf	6,000.00	0.08	2.73	0	5.5	0	0	8.23
					\$16,378	\$0	\$33,000	\$0	\$0	\$49,378
750 mcm 15 KV feeders, assume 1000 ft. from Sub. 15										
	ELEC	U.C. per Lf	2,000.00	0.024	0.819	0	0.9	0	0	1.719
					\$1,638	\$0	\$1,800	\$0	\$0	\$3,438
4/0 ground										
	ELEC	U.C. per Ea	12.00	4	136.48	0	50	0	0	186.48
					\$1,638	\$0	\$600	\$0	\$0	\$2,238
750 mcm terminations										
	ELEC	U.C. per Ls	1.00	0	0	0	0	100000	0	100000
					\$0	\$0	\$0	\$100,000	\$0	\$100,000
Allowance for manholes/handholes & ductbank from EUSU loop										
	ELEC	U.C. per Ls	1.00	750	25590	0	35000	0	0	60590
					\$25,590	\$0	\$35,000	\$0	\$0	\$60,590
Sub Feeders to branch panels										
Subtotal					\$45,243	\$0	\$70,400	\$100,000	\$0	\$215,643
Sales Tax					\$0	\$0	\$3,520	\$0	\$0	\$3,520
INEEL ORG Labor/Subcontractor Overheads					\$18,091	\$0	\$29,558	\$39,986	\$0	\$87,635
Subtotal Estimate					\$18,563	\$0	\$30,329	\$41,030	\$0	\$306,798
Escalation					\$30,032	\$0	\$49,067	\$66,379	\$0	\$89,922
Contingency						\$0			\$0	\$145,477
9116.1.4.1 MAIN FEEDERS										
---Total			1,326		\$111,929	\$0	\$182,874	\$247,394	\$0	\$542,197
9116.1.4.2 BRANCH CIRCUITS										
	ELEC	U.C. per Ls	1.00	1000	36720	0	20000	0	0	56720
					\$36,720	\$0	\$20,000	\$0	\$0	\$56,720
Allowance for branch circuits, misc outlets and other power requirements										

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Equip	Matl	S/C	Other	TOTAL
9116.1.4.2 BRANCH CIRCUITS											
Subtotal											
Sales Tax											
INEEL ORG Labor/Subcontractor Overheads					\$36,720	\$0	\$0	\$20,000	\$0	\$0	\$56,720
					\$0	\$0	\$0	\$1,000	\$0	\$0	\$1,000
					\$14,683	\$0	\$0	\$8,397	\$0	\$0	\$23,080
Subtotal Estimate											
Escalation					\$15,066	\$0	\$0	\$9,616	\$0	\$0	\$24,682
Contingency					\$24,374	\$0	\$0	\$13,939	\$0	\$0	\$38,314
Total 9116.1.4.2 BRANCH CIRCUITS			1,000		\$90,843	\$0	\$0	\$51,953	\$0	\$0	\$142,796
9116.1.5.1 EQUIPMENT CONNECTIONS AND POWER FEEDS											
ELEC											
50 HP fan, assume 100 amps, 200' run	U.C. per Ea	11.00	36	CN-ELEC	1228.32	0	0	600	0	0	1828.32
			396	\$34.12	\$13,512	\$0	\$0	\$6,600	\$0	\$0	\$20,112
ELEC											
60 HP fan, assume 100 amps, 200' run	U.C. per Ea	24.00	36	CN-ELEC	1228.32	0	0	700	0	0	1928.32
			864	\$34.12	\$29,480	\$0	\$0	\$16,800	\$0	\$0	\$46,280
ELEC											
75 HP fan, assume 120 amps, 200' run	U.C. per Ea	2.00	36	CN-ELEC	1228.32	0	0	900	0	0	2128.32
			72	\$34.12	\$2,457	\$0	\$0	\$1,800	\$0	\$0	\$4,257
ELEC											
600 HP chiller/ fan, assume 900 amps, 200' run	U.C. per Ea	4.00	180	CN-ELEC	6141.6	0	0	4630	0	0	10771.6
			720	\$34.12	\$24,566	\$0	\$0	\$18,520	\$0	\$0	\$43,086
ELEC											
625 HP chiller/ fan, assume 900 amps, 200' run	U.C. per Ea	1.00	180	CN-ELEC	6141.6	0	0	4630	0	0	10771.6
			180	\$34.12	\$6,142	\$0	\$0	\$4,630	\$0	\$0	\$10,772
ELEC											
2 ton overhead crane, connect power and control	U.C. per Ea	2.00	24	CN-ELEC	818.88	0	0	3000	0	0	3818.88
			48	\$34.12	\$1,638	\$0	\$0	\$6,000	\$0	\$0	\$7,638
ELEC											
5 ton overhead crane, connect power and controls	U.C. per Ea	9.00	24	CN-ELEC	818.88	0	0	3000	0	0	3818.88
			216	\$34.12	\$7,370	\$0	\$0	\$27,000	\$0	\$0	\$34,370
ELEC											
50 ton overhead crane, connect power and controls	U.C. per Ea	1.00	48	CN-ELEC	1637.76	0	0	15000	0	0	16637.76
			48	\$34.12	\$1,638	\$0	\$0	\$15,000	\$0	\$0	\$16,638
ELEC											
20 ton transfer cart, connect power and controls	U.C. per Ea	1.00	24	CN-ELEC	818.88	0	0	5000	0	0	5818.88
			24	\$34.12	\$819	\$0	\$0	\$5,000	\$0	\$0	\$5,819
ELEC											
Mono rail hoist, connect power and controls	U.C. per Ea	1.00	12	CN-ELEC	409.44	0	0	3000	0	0	3409.44
			12	\$34.12	\$409	\$0	\$0	\$3,000	\$0	\$0	\$3,409
ELEC											
Overhead bridge mounted PAR manipulator, connect power and controls	U.C. per Ea	3.00	24	CN-ELEC	818.88	0	0	3000	0	0	3818.88
			72	\$34.12	\$2,457	\$0	\$0	\$9,000	\$0	\$0	\$11,457

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
9116.1.5.1 EQUIPMENT CONNECTIONS AND POWER FEEDS											
U.C. per Ea											
M/S manipulators, connect power and controls		50.00	24	CN-ELEC	818.88		0	2000	0	0	2818.88
			1,200	\$34.12	\$40,944		\$0	\$100,000	\$0	\$0	\$140,944
Subtotal					\$131,430		\$0	\$213,350	\$0	\$0	\$344,780
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$10,668
INEEL ORG Labor/Subcontractor Overheads					\$52,554		\$0	\$89,576	\$0	\$0	\$142,129
Subtotal Estimate					\$53,928		\$0	\$91,914	\$0	\$0	\$145,840
Escalation					\$87,241		\$0	\$148,700	\$0	\$0	\$235,941
Contingency											
9116.1.5.1 EQUIPMENT CONNECTIONS AND POWER FEEDS											
3,852											
9116.1.5.2 POWER AND CONTROLS											
U.C. per Ea											
Gulton style plugs in cell walls, control & power		382.00	3	CN-ELEC	102.36		0	2200	0	0	2302.36
			1,146	\$34.12	\$39,102		\$0	\$840,400	\$0	\$0	\$879,502
Subtotal					\$39,102		\$0	\$840,400	\$0	\$0	\$879,502
Sales Tax					\$0		\$0	\$42,020	\$0	\$0	\$42,020
INEEL ORG Labor/Subcontractor Overheads					\$15,635		\$0	\$352,844	\$0	\$0	\$368,480
Subtotal Estimate					\$16,043		\$0	\$362,056	\$0	\$0	\$1,290,001
Escalation					\$25,955		\$0	\$585,737	\$0	\$0	\$378,099
Contingency											\$611,692
9116.1.5.2 POWER AND CONTROLS											
1,146											
9116.1.6 INSTRUMENT CONNECTIONS											
U.C. per Ea											
Instruments, connect only		600.00	1.25	CN-ELEC	42.65		0	35	0	0	77.65
			750	\$34.12	\$25,590		\$0	\$21,000	\$0	\$0	\$46,590
3/4" GRC with average of 6 #14 conductors		68,000.00	0.128	CN-ELEC	4.367		0	1.75	0	0	6.117
			8,448	\$34.12	\$288,246		\$0	\$115,500	\$0	\$0	\$403,746
Subtotal					\$313,836		\$0	\$136,500	\$0	\$0	\$450,336
Sales Tax					\$0		\$0	\$6,825	\$0	\$0	\$6,825
INEEL ORG Labor/Subcontractor Overheads					\$125,490		\$0	\$57,310	\$0	\$0	\$182,800
Subtotal Estimate					\$128,766		\$0	\$58,806	\$0	\$0	\$639,961
Escalation					\$208,320		\$0	\$95,137	\$0	\$0	\$187,573
Contingency											\$303,457
9116.1.6 INSTRUMENT CONNECTIONS											
9,198											
9116.1.7 GROUNDING											
U.C. per Sf											
Building ground		41,000.00	0		\$0		0	0	0.75	0	0.75
					\$0		\$0	\$0	\$30,750	\$0	\$30,750

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Equip	Matl	S/C	Other	TOTAL
9116.1.7 GROUNDING		U.C. per Sf	0	CN-ELEC	0	0	0	0	0.9	0	0.9
Lightning protection		41,000.00			\$0	\$0	\$0	\$0	\$36,900	\$0	\$36,900
Subtotal											
Sales Tax											
INEEL ORG Labor/Subcontractor Overheads											
Subtotal Estimate											
Escalation											
Contingency											
Total 9116.1.7 GROUNDING											
9116.1.8 LIFE SAFETY SYSTEMS											
Fire Detection and Alarm		U.C. per SF	0		0	0	0	0	3.5	0	3.5
Voice Page and Evac		41,000.00			0	0	0	0	1.5	0	1.5
Subtotal											
Sales Tax											
INEEL ORG Labor/Subcontractor Overheads											
Subtotal Estimate											
Escalation											
Contingency											
Total 9116.1.8 LIFE SAFETY SYSTEMS											
9116.1.9 SECURITY SYSTEMS											
Install and wire card readers, complete system at each access to cell area		U.C. per Ea	10.00	CN-ELEC	1364.8	0	0	3000	0	0	4364.8
Security system main control panel and associated equipment		U.C. per Ls	1.00	CN-ELEC	5459.2	0	0	10000	0	0	15459.2
Subtotal											
Sales Tax											
INEEL ORG Labor/Subcontractor Overheads											
Subtotal Estimate											
Escalation											
Contingency											
Total 9116.1.9 SECURITY SYSTEMS											

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
-- 9116.1.10 TESTING ELEC											
	Allowance for testing of systems and equipment	U.C. per Ls	1.00	2080 CN-ELEC \$34.12	70969.6 \$70,970		0 \$0	0 \$0	0 \$0	0 \$0	70969.6 \$70,970
Subtotal					\$70,970		\$0	\$0	\$0	\$0	\$70,970
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$28,378		\$0	\$0	\$0	\$0	\$28,378
Subtotal Estimate					\$29,119		\$0	\$0	\$0	\$0	\$29,119
Escalation					\$47,109		\$0	\$0	\$0	\$0	\$47,109
Contingency					\$175,575		\$0	\$0	\$0	\$0	\$175,575
-- Total 9116.1.10 TESTING											
			2,080								
-- 9116.2 INSTRUMENTATION INSTR											
DCS SYSTEM		U.C. per EA	1.00	100 CN-ELEC \$34.12	3412 \$3,412		0 \$0	1000000 \$1,000,000	0 \$0	0 \$0	1003412 \$1,003,412
DP TRANSMITTER		U.C. per EA	52.00	8 CN-ELEC \$34.12	272.96 \$14,194		0 \$0	2500 \$130,000	0 \$0	0 \$0	2772.96 \$144,194
FLOW TRANSMITTERS		U.C. per EA	1.00	7 CN-ELEC \$34.12	238.84 \$239		0 \$0	1500 \$1,500	0 \$0	0 \$0	1738.84 \$1,739
LEVEL TRANSMITTERS		U.C. per EA	27.00	7 CN-ELEC \$34.12	238.84 \$6,449		0 \$0	1700 \$45,900	0 \$0	0 \$0	1938.84 \$52,349
TEMPERATURE TRANSMITTERS		U.C. per EA	48.00	7 CN-ELEC \$34.12	238.84 \$10,987		0 \$0	750 \$34,500	0 \$0	0 \$0	988.84 \$45,487
SOV		U.C. per EA	215.00	4 CN-ELEC \$34.12	136.48 \$29,343		0 \$0	200 \$43,000	0 \$0	0 \$0	336.48 \$72,343
PH TRANSMITTER		U.C. per EA	2.00	10 CN-ELEC \$34.12	341.2 \$682		0 \$0	5000 \$10,000	0 \$0	0 \$0	5341.2 \$10,682
Subtotal					\$65,306		\$0	\$1,264,900	\$0	\$0	\$1,330,206
Sales Tax					\$0		\$0	\$63,245	\$0	\$0	\$63,245
INEEL ORG Labor/Subcontractor Overheads					\$24,589		\$0	\$500,085	\$0	\$0	\$524,675
Subtotal Estimate					\$26,348		\$0	\$535,854	\$0	\$0	\$1,918,125
Escalation					\$42,626		\$0	\$866,910	\$0	\$0	\$562,203
Contingency					\$158,870		\$0	\$3,230,994	\$0	\$0	\$909,536
-- Total 9116.2 INSTRUMENTATION											
			1,914								
-- 9116.3 CCTV SYSTEM ELEC											
CCTV SYSTEM - CAMERAS		U.C. per EA	20.00	4 CN-ELEC \$34.12	136.48 \$2,730		0 \$0	2000 \$40,000	0 \$0	0 \$0	2136.48 \$42,730
MONITOR/CONTROL STATIONS		U.C. per EA	20.00	8 CN-ELEC \$34.12	272.96 \$5,459		0 \$0	3000 \$60,000	0 \$0	0 \$0	3272.96 \$65,459

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
-- 9116.3 CCTV SYSTEM											
	ELEC	U.C. per EA	20	CN-ELEC	682.4	0	0	10000	0	0	10682.4
			40	\$34.12	\$1,365	\$0	\$0	\$20,000	\$0	\$0	\$21,365
CONTROL ROOM MONITOR/RECORDING CONSOLE											
	ELEC	U.C. per EA	15	CN-ELEC	511.8	0	0	600	0	0	1111.8
			300	\$34.12	\$10,236	\$0	\$0	\$12,000	\$0	\$0	\$22,236
CONNECTION CONDUIT & CABLE											
Subtotal					\$19,790	\$0	\$0	\$132,000	\$0	\$0	\$151,790
Sales Tax					\$0	\$0	\$0	\$6,600	\$0	\$0	\$6,600
INEEL ORG Labor/Subcontractor Overheads					\$7,913	\$0	\$0	\$55,421	\$0	\$0	\$63,334
Subtotal Estimate											\$221,723
Escalation					\$8,120	\$0	\$0	\$56,867	\$0	\$0	\$64,987
Contingency					\$13,136	\$0	\$0	\$92,001	\$0	\$0	\$105,137
--Total 9116.3 CCTV SYSTEM											
			580		\$48,958	\$0	\$0	\$342,889	\$0	\$0	\$391,847
-- 9300 CONSTRUCTION SUPPORT											
<i>Memo: Surveys, outages, temporary facilities, telecommunications, radio and alarm, radiological control support (if dedicated), security systems, weld lab, etc. provided by the company.</i>											
CONSTRUCTION SUPPORT											
		U.C. per LOT	1.00	0	\$0	0	\$0	0	150000	0	150000
Subtotal					\$0	\$0	\$0	\$0	\$150,000	\$0	\$150,000
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate											\$150,000
Escalation					\$0	\$0	\$0	\$0	\$43,965	\$0	\$43,965
Contingency					\$0	\$0	\$0	\$0	\$0	\$0	\$0
--Total 9300 CONSTRUCTION SUPPORT											
			0		\$0	\$0	\$0	\$0	\$193,965	\$0	\$193,965
-- 9400 CONSTRUCTION QUALITY CONTROL											
<i>Memo: First line inspection activities performed during construction. Includes Material Lab, compaction, and other tests normally performed by the company.</i>											
FIRST LINE INSPECTION & LAB TESTS											
		U.C. per LOT	1.00	0	200000	0	0	0	0	0	200000
					\$200,000	\$0	\$0	\$0	\$0	\$0	\$200,000
Subtotal					\$200,000	\$0	\$0	\$0	\$0	\$0	\$200,000
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate											\$200,000
Escalation					\$58,620	\$0	\$0	\$0	\$0	\$0	\$58,620
Contingency					\$0	\$0	\$0	\$0	\$0	\$0	\$0
--Total 9400 CONSTRUCTION QUALITY CONTROL											
			0		\$258,620	\$0	\$0	\$0	\$0	\$0	\$258,620

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

Project Name: VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
-- 9500 CONSTRUCTION DOCUMENTATION											
Memo: Red-lined drawings by CH.											
6340											
OE ASSIGNED TO RED LINES, 4 YEARS											
Subtotal											
Sales Tax											
INEEL ORG Labor/Subcontractor Overheads											
Subtotal Estimate											
Escalation											
Contingency											
-- Total 8500 CONSTRUCTION DOCUMENTATION											
			14,000		\$1,751,458	\$0	\$0	\$0	\$0	\$0	\$1,751,458
-- OPC3100 TESTING AND TURNOVER PLANNING											
3300											
TESTING & TURNOVER PLAN											
Subtotal											
Sales Tax											
INEEL ORG Labor/Subcontractor Overheads											
Subtotal Estimate											
Escalation											
Contingency											
-- Total OPC3100 TESTING AND TURNOVER PLANNING											
			5,250		\$1,123,853	\$0	\$0	\$0	\$0	\$0	\$1,123,853
-- OPC3200 S.O. TESTING											
3310											
SO TEST @ 1.5% OF TEC											
U.C. per \$		357,988,285.00	0		0.015	\$0	\$0	\$0	\$0	\$0	0.015
					\$5,369,524	\$0	\$0	\$0	\$0	\$0	\$5,369,524
U.C. per LOT		1.00	0		0	\$0	\$0	\$0	\$0	\$0	135,000
					\$0	\$0	\$0	\$0	\$0	\$0	\$135,000
U.C. per LOT		1.00	3,150	F06	98311.5	\$0	\$0	\$0	\$0	\$0	98311.5
					\$98,312	\$0	\$0	\$0	\$0	\$0	\$98,312
U.C. per LOT		1.00	0		0	\$0	\$0	\$0	\$0	\$0	75,000
					\$0	\$0	\$0	\$0	\$0	\$0	\$75,000
U.C. per TESTS		15.00	0		0	\$0	\$0	\$0	\$0	\$0	800
					\$0	\$0	\$0	\$0	\$0	\$0	\$12,000
U.C. per TESTS		6.00	0		0	\$0	\$0	\$0	\$0	\$0	800
					\$0	\$0	\$0	\$0	\$0	\$0	\$4,800
U.C. per TESTS		3.00	0		0	\$0	\$0	\$0	\$0	\$0	3000
					\$0	\$0	\$0	\$0	\$0	\$0	\$9,000

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Guilgley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const Eqp	Matl	S/C	Other	TOTAL
OPC3200 S. O. TESTING	3310									
TOTAL CHLORINE		U.C. per TESTS	6.00	0	\$0	0	0	0	2000	2000
					\$0	\$0	\$0	\$0	\$12,000	\$12,000
TOTAL ORGANIC HALOGENS	3310	U.C. per TESTS	6.00	0	0	0	0	0	3000	3000
					\$0	\$0	\$0	\$0	\$18,000	\$18,000
VISCOSITY	3310	U.C. per TESTS	6.00	0	0	0	0	0	800	800
					\$0	\$0	\$0	\$0	\$4,800	\$4,800
ICP METALS	3310	U.C. per TESTS	18.00	0	0	0	0	0	9000	9000
					\$0	\$0	\$0	\$0	\$162,000	\$162,000
MERCURY	3310	U.C. per TESTS	18.00	0	0	0	0	0	3000	3000
					\$0	\$0	\$0	\$0	\$54,000	\$54,000
TSS	3310	U.C. per TESTS	12.00	0	0	0	0	0	1000	1000
					\$0	\$0	\$0	\$0	\$12,000	\$12,000
TDS	3310	U.C. per TESTS	12.00	0	0	0	0	0	1000	1000
					\$0	\$0	\$0	\$0	\$12,000	\$12,000
TOC	3310	U.C. per TESTS	12.00	0	0	0	0	0	2000	2000
					\$0	\$0	\$0	\$0	\$24,000	\$24,000
pH	3310	U.C. per TESTS	12.00	0	0	0	0	0	1000	1000
					\$0	\$0	\$0	\$0	\$12,000	\$12,000
HALOGENS	3310	U.C. per TESTS	12.00	0	0	0	0	0	2000	2000
					\$0	\$0	\$0	\$0	\$24,000	\$24,000
PCB	3310	U.C. per TESTS	18.00	0	0	0	0	0	5000	5000
					\$0	\$0	\$0	\$0	\$90,000	\$90,000
TCPLP	3310	U.C. per TESTS	18.00	0	0	0	0	0	30000	30000
					\$0	\$0	\$0	\$0	\$540,000	\$540,000
DIOXINS AND FURANS	3310	U.C. per TESTS	12.00	0	0	0	0	0	5000	5000
					\$0	\$0	\$0	\$0	\$60,000	\$60,000
PARTICULATES (IN GASES)	3310	U.C. per TESTS	24.00	0	0	0	0	0	1000	1000
					\$0	\$0	\$0	\$0	\$24,000	\$24,000
HCL AND CL2	3310	U.C. per TESTS	36.00	0	0	0	0	0	3000	3000
					\$0	\$0	\$0	\$0	\$108,000	\$108,000
VOLATILE ORGANICS	3310	U.C. per TESTS	12.00	0	0	0	0	0	10000	10000
					\$0	\$0	\$0	\$0	\$120,000	\$120,000
SEMI-VOLATILE ORGANICS	3310	U.C. per TESTS	12.00	0	0	0	0	0	10000	10000
					\$0	\$0	\$0	\$0	\$120,000	\$120,000
ICP METALS	3310	U.C. per TESTS	36.00	0	0	0	0	0	9000	9000
					\$0	\$0	\$0	\$0	\$324,000	\$324,000

Project Name:
VITRIFICATION OF SBW
 Project Location: **INEEL/INTEC**
 Estimate Number: **2555**

CONSTRUCTION DETAIL ITEM REPORT

Client: **J. J. Quigley**
 Prepared By: **R. D. Adams**
 Estimate Type: **Planning**

<u>LEVEL</u>	<u>Org/Subcontractor</u>	<u>QTY</u>	<u>Hrs</u>	<u>Crew/Rate</u>	<u>Labor</u>	<u>Const</u>	<u>Eqp</u>	<u>Matl</u>	<u>S/C</u>	<u>Other</u>	<u>TOTAL</u>
-- OPC3200 S. O. TESTING											
MERCURY	3310	U.C. per TESTS	36.00	0	0	0	0	0	0	3000	3000
					\$0	\$0	\$0	\$0	\$0	\$108,000	\$108,000
PCB	3310	U.C. per TESTS	9.00	0	0	0	0	0	0	5000	5000
					\$0	\$0	\$0	\$0	\$0	\$45,000	\$45,000
CONTINUOUS CO & O2 MONITORING	3310	U.C. per TESTS	3.00	0	0	0	0	0	0	10000	10000
					\$0	\$0	\$0	\$0	\$0	\$30,000	\$30,000
EPA COMPREHENSIVE TEST REPORT	3310	U.C. per LOT	1.00	1800	F06	56178	0	0	0	0	56178
				1,800	\$31.21	\$56,178	\$0	\$0	\$0	\$0	\$56,178
RCRA TRIAL BURN/DRE TEST REPORT	3310	U.C. per LOT	1.00	900	F06	28089	0	0	0	0	28089
				900	\$31.21	\$28,089	\$0	\$0	\$0	\$0	\$28,089
BURN TEST SAMPLE VALIDATION	3310	U.C. per EA	351.00	0	0	0	0	0	0	45	45
					\$0	\$0	\$0	\$0	\$0	\$15,795	\$15,795
WASTE FEED ANALYSIS SAMPLES	3310	U.C. per EA	20.00	0	0	0	0	0	0	15000	15000
					\$0	\$0	\$0	\$0	\$0	\$300,000	\$300,000
WASTE FEED ANALYSIS SAMPLE VALIDATION	3310	U.C. per EA	120.00	0	0	0	0	0	0	45	45
					\$0	\$0	\$0	\$0	\$0	\$5,400	\$5,400
NEPA SUPPORT	3310	U.C. per LOT	1.00	500	F06	15605	0	0	0	0	15605
				500	\$31.21	\$15,605	\$0	\$0	\$0	\$0	\$15,605
PUBLIC MEETINGS	3000	U.C. per LOT	1.00	300	E08	9321	0	0	0	0	9321
				300	\$31.07	\$9,321	\$0	\$0	\$0	\$0	\$9,321
REPRODUCTION AND TECH EDITOR COSTS	3310	U.C. per LOT	1.00	0	0	0	0	0	0	320000	320000
					\$0	\$0	\$0	\$0	\$0	\$320,000	\$320,000
Subtotal											
Sales Tax					\$5,577,029	\$0	\$0	\$75,000	\$0	\$2,705,795	\$8,357,824
INEEL ORG Labor/Subcontractor Overheads					\$5,855,880	\$0	\$0	\$3,750	\$0	\$0	\$3,750
								\$0	\$0	\$0	\$5,855,880
Subtotal Estimate											
Escalation					\$4,674,916	\$0	\$0	\$32,201	\$0	\$1,106,400	\$14,217,454
Contingency					\$17,240,206	\$0	\$0	\$118,751	\$0	\$4,080,192	\$5,813,517
											\$21,439,148
--Total OPC3200 S. O. TESTING											
				6,650	\$33,348,031	\$0	\$0	\$229,702	\$0	\$7,892,386	\$41,470,119
-- OPC3300 ORR SUPPORT											
ORR SUPPORT	3300	U.C. per LOT	1.00	6000	E30	214800	0	0	0	0	214800
				6,000	\$35.80	\$214,800	\$0	\$0	\$0	\$0	\$214,800

Project Name:

VITRIFICATION OF SBW

Project Location: INEEL/INTEC

Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley

Prepared By: R. D. Adams

Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
OPC3300 ORR SUPPORT											
Subtotal					\$214,800			\$0		\$0	\$214,800
Sales Tax					\$0			\$0		\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$225,540			\$0		\$0	\$225,540
Subtotal Estimate					\$180,055			\$0		\$0	\$180,055
Escalation					\$664,009			\$0		\$0	\$664,009
Contingency					\$1,284,404			\$0		\$0	\$1,284,404
OPC3400 FACILITY ACCEPTANCE REVIEW											
Subtotal					7160			0		0	7160
Sales Tax					\$143,200			\$0		\$0	\$143,200
INEEL ORG Labor/Subcontractor Overheads					\$150,360			\$0		\$0	\$150,360
Subtotal Estimate					\$120,037			\$0		\$0	\$120,037
Escalation					\$442,673			\$0		\$0	\$442,673
Contingency					\$856,269			\$0		\$0	\$856,269
OPC3500 RADIOLOGICAL CONTROL SUPPORT											
Subtotal					117880			0		0	117880
Sales Tax					\$117,880			\$0		\$0	\$117,880
INEEL ORG Labor/Subcontractor Overheads					\$104,913			\$0		\$0	\$104,913
Subtotal Estimate					\$91,100			\$0		\$0	\$91,100
Escalation					\$335,960			\$0		\$0	\$335,960
Contingency					\$649,853			\$0		\$0	\$649,853
OPC3600 OPERATOR TRAINING											
Subtotal					38465			0		0	38465
Sales Tax					\$1,923,250			\$0		\$0	\$1,923,250
INEEL ORG Labor/Subcontractor Overheads								\$0		\$0	
Subtotal Estimate								\$0		\$0	
Escalation								\$0		\$0	
Contingency								\$0		\$0	

Client: *J. J. Quigley*
Prepared By: *R. D. Adams*
Estimate Type: *Planning*

Project Name: **VITRIFICATION OF SBW**
Project Location: **INEEL/INTEC**
Estimate Number: **2555**

Client: *J. J. Quigley*
Prepared By: *R. D. Adams*
Estimate Type: *Planning*

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
--- OPC3600 OPERATOR TRAINING											
Subtotal					\$1,923,250		\$0	\$0	\$0	\$0	\$1,923,250
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$2,038,645		\$0	\$0	\$0	\$0	\$2,038,645
Subtotal Estimate											
Escalation					\$1,620,019		\$0	\$0	\$0	\$0	\$1,620,019
Contingency					\$5,974,322		\$0	\$0	\$0	\$0	\$5,974,322
---Total OPC3600 OPERATOR TRAINING											
			87,500		\$11,556,236		\$0	\$0	\$0	\$0	\$11,556,236
--- OPC3700 OPERATING PROCEDURES											
3300											
OPERATING PROCEDURES											
		U.C. per FTE	6.00	E30	71600		0	0	0	0	71600
					\$429,600		\$0	\$0	\$0	\$0	\$429,600
Subtotal					\$429,600		\$0	\$0	\$0	\$0	\$429,600
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$451,080		\$0	\$0	\$0	\$0	\$451,080
Subtotal Estimate											
Escalation					\$360,110		\$0	\$0	\$0	\$0	\$360,110
Contingency					\$1,328,018		\$0	\$0	\$0	\$0	\$1,328,018
---Total OPC3700 OPERATING PROCEDURES											
			12,000		\$2,568,808		\$0	\$0	\$0	\$0	\$2,568,808
--- OPC3800 START-UP COORDINATION											
3310											
START-UP COORDINATION											
		U.C. per FTE	4.00	E30	32220		0	0	0	0	32220
					\$128,880		\$0	\$0	\$0	\$0	\$128,880
Subtotal					\$128,880		\$0	\$0	\$0	\$0	\$128,880
Sales Tax					\$0		\$0	\$0	\$0	\$0	\$0
INEEL ORG Labor/Subcontractor Overheads					\$135,324		\$0	\$0	\$0	\$0	\$135,324
Subtotal Estimate											
Escalation					\$108,033		\$0	\$0	\$0	\$0	\$108,033
Contingency					\$398,405		\$0	\$0	\$0	\$0	\$398,405
---Total OPC3800 START-UP COORDINATION											
			3,600		\$770,642		\$0	\$0	\$0	\$0	\$770,642
--- OPC3900 SPARES											
Memo: In support of start-up and testing only.											
		U.C. per LOT	1.00		0		0	2000000	0	0	2000000
					\$0		\$0	\$2,000,000	\$0	\$0	\$2,000,000
CONSTRUCTION/S O TEST SPARES											
Memo: Based on 6% of equipment cost.											

Project Name:
VITRIFICATION OF SBW
Project Location: INEEL/INTEC
Estimate Number: 2555

CONSTRUCTION DETAIL ITEM REPORT

Client: J. J. Quigley
Prepared By: R. D. Adams
Estimate Type: Planning

LEVEL	Org/Subcontractor	QTY	Hrs	Crew/Rate	Labor	Const	Eqp	Matl	S/C	Other	TOTAL
Memo: In support of start-up and testing only.											
Subtotal											
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$2,000,000	\$0	\$0	\$2,000,000
					\$0	\$0	\$0	\$100,000	\$0	\$0	\$100,000
					\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate											
Escalation					\$0	\$0	\$0	\$858,690	\$0	\$0	\$858,690
Contingency					\$0	\$0	\$0	\$3,166,686	\$0	\$0	\$3,166,686
---Total OPC3900 SPARES											
			0		\$0	\$0	\$0	\$6,125,376	\$0	\$0	\$6,125,376
--- GAPIF Non-Orig G&A and PIF											
Memo: This is a model that works with the macro named "INEELRollup_Rev0.BAS".											
PF					0	0	0	0	0	1	1
Procurement Fee 4.10%					\$0	\$0	\$0	\$9,834,658	\$0	\$9,834,658	\$9,834,658
G&A					0	0	0	0	0	1	1
G&A Fee 37.50%					\$0	\$0	\$0	\$4,822,670	\$0	\$4,822,670	\$4,822,670
Subtotal											
Sales Tax					\$0	\$0	\$0	\$0	\$0	\$14,657,328	\$14,657,328
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$0	\$0	\$0	\$0	\$0
					\$0	\$0	\$0	\$0	\$0	\$0	\$0
					\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal Estimate											
Escalation					\$0	\$0	\$0	\$0	\$0	\$4,296,063	\$4,296,063
Contingency					\$0	\$0	\$0	\$0	\$0	\$6,938,836	\$6,938,836
---Total GAPIF Non-Orig G&A and PIF											
			0		\$0	\$0	\$0	\$0	\$0	\$25,892,227	\$25,892,227
Subtotal Project Level TPC											
Sales Tax					\$169,118,294	\$2,492,375	\$93,022,561	\$39,349,984	\$17,683,123	\$321,666,337	\$321,666,337
INEEL ORG Labor/Subcontractor Overheads					\$0	\$0	\$4,651,128	\$0	\$0	\$4,651,128	\$4,651,128
					\$35,454,993	\$883,982	\$35,790,184	\$1,740,915	\$0	\$73,870,074	\$73,870,074
Subtotal Estimate											
Escalation					\$53,021,902	\$989,610	\$39,370,560	\$6,169,258	\$5,484,574	\$105,035,905	\$105,035,905
Contingency					\$1,111,111	\$2,296,207	\$71,030,607	\$17,629,956	\$11,306,096	\$232,462,320	\$232,462,320
Total Project Level TPC											
			1,629,139		\$387,794,643	\$6,662,174	\$243,865,040	\$64,890,113	\$34,473,793	\$737,685,764	\$737,685,764

Report Settings Contractor Distribution Report
Reported From: Project Level TPC

NOTES:

- 1.) All features of SUCCESS are functional with this report.
- 2.) If Level Markups are used they should always be at the lowest level of the PWS Branch
- 3.) Detail line items should only be placed at the lowest level of a PWS Branch
- 4.) If a Level is collapsed then the detail will not be grouped nor reported. Completely expand the PWS to produce an accurate report
- 5.) If a level is distributed the amount will be added to the prime contractor amount
- 6.) Markup records must be percents and applied to all cost components
- 7.) The Other 1,2,3 cost components are combined in the "Others" column.
- 8.) Reports are accurate to two decimal places (Productivity up to three decimal places).
- 9.) Multiple Prime Contractors may be used. The "Prime Contractor" totals will include all prime contractors' work, and the Prime Contractor Markups will be the aggregate markup of all prime contractors.
- 10.) Up to 10 contractor markups per contractor may be used, and must be percentages (not amounts).

Project Name
Type of Estimate
Joe Estimator
Manager of Estimating

CONTRACTOR DISTRIBUTION REPORT

Reported From: Project Level TPC

CONTRACTOR	MARK-UP PERCENT HOURS	LABOR	MATERIAL	EQUIPMENT	OTHERS	SUBTOTAL	% MARKUP	% DIRECT COST	% TOTAL COST
<u>PRIME CONTRACTOR</u>									
DIRECT COST		\$108,383,799	\$2,100,000	\$0	\$34,150,000	\$144,633,799			
TOTAL FOR PRIME CONTRACTOR	0	\$108,383,799	\$2,100,000	\$0	\$34,150,000	\$144,633,799			
<u>Planning & Controls - 2200</u>									
DIRECT COST		\$761,880	\$0	\$0	\$0	\$761,880			
Organizational Multiplier	89.00%	\$678,073	\$0	\$0	\$0	\$678,073	89.00%		
TOTAL FOR Planning & Controls - 2200	28,000	\$1,439,953	\$0	\$0	\$0	\$1,439,953	89.00%	0.23%	0.10%
<u>Estimating Services - 2240</u>									
DIRECT COST		\$276,052	\$0	\$0	\$0	\$276,052			
Organizational Multiplier	89.00%	\$245,687	\$0	\$0	\$0	\$245,687	89.00%		
TOTAL FOR Estimating Services - 2240	8,208	\$521,739	\$0	\$0	\$0	\$521,739	89.00%	0.08%	0.04%
<u>Environmental Management (EM) Program</u>									
DIRECT COST		\$9,321	\$0	\$0	\$0	\$9,321			
Organizational Multiplier	105.00%	\$9,787	\$0	\$0	\$0	\$9,787	105.00%		
TOTAL FOR Environmental Management (EM)	300	\$19,108	\$0	\$0	\$0	\$19,108	105.00%	0.00%	0.00%
<u>High Level Waste - 3300</u>									
DIRECT COST		\$975,550	\$0	\$0	\$0	\$975,550			
Organizational Multiplier	105.00%	\$1,024,328	\$0	\$0	\$0	\$1,024,328	105.00%		
TOTAL FOR High Level Waste - 3300	27,250	\$1,999,878	\$0	\$0	\$0	\$1,999,878	105.00%	0.30%	0.13%
<u>HLW Program Support - 3310</u>									
DIRECT COST		\$7,939,686	\$78,750	\$0	\$3,565,095	\$11,583,531			
Organizational Multiplier	105.00%	\$8,336,671	\$82,688	\$0	\$3,743,350	\$12,162,708	105.00%		
TOTAL FOR HLW Program Support - 3310	82,145	\$16,276,357	\$78,750	\$0	\$3,565,095	\$19,920,202	71.97%	3.55%	1.57%

INEEL

05/24/2000

Success Estimating and Cost Management System

Page

2

Project Name
Type of Estimate
Joe Estimator
Manager of Estimating

CONTRACTOR DISTRIBUTION REPORT

Reported From: Project Level TPC

CONTRACTOR	MARK-UP PERCENT HOURS	LABOR	MATERIAL	EQUIPMENT	OTHERS	SUBTOTAL	MARKUP	% DIRECT COST	% TOTAL COST
<u>INTEC Operations - 5210</u>									
DIRECT COST									
Organizational Multiplier	106.00%	\$1,923,250 \$2,038,645	\$0 \$0	\$0 \$0	\$0 \$0	\$1,923,250 \$2,038,645	106.00%		
TOTAL FOR INTEC Operations - 5210	87,500	\$3,961,895	\$0	\$0	\$0	\$3,961,895	106.00%	0.59%	0.26%
<u>Site Services & Infrastructure - 6000</u>									
DIRECT COST									
Organizational Multiplier	113.00%	\$165,410 \$186,913	\$0 \$0	\$0 \$0	\$0 \$0	\$165,410 \$186,913	113.00%		
TOTAL FOR Site Services & Infrastructure	7,000	\$352,323	\$0	\$0	\$0	\$352,323	113.00%	0.05%	0.02%
<u>Project Management - 6200</u>									
DIRECT COST									
Organizational Multiplier	113.00%	\$662,966 \$749,151	\$0 \$0	\$0 \$0	\$0 \$0	\$662,966 \$749,151	113.00%		
TOTAL FOR Project Management - 6200	18,426	\$1,412,117	\$0	\$0	\$0	\$1,412,117	113.00%	0.20%	0.09%
<u>Construction Management (CM/Force Acc</u>									
DIRECT COST									
Organizational Multiplier	113.00%	\$624,457 \$705,636	\$0 \$0	\$0 \$0	\$300,000 \$339,000	\$624,457 \$1,044,636	113.00%		
TOTAL FOR Construction Management (CM/Force Acc	20,142	\$1,330,093	\$0	\$0	\$300,000	\$1,630,093	76.33%	0.28%	0.13%
<u>Engineering - 6700</u>									
DIRECT COST									
Organizational Multiplier	113.00%	\$2,294,068 \$2,592,297	\$0 \$0	\$0 \$0	\$0 \$0	\$2,294,068 \$2,592,297	113.00%		
TOTAL FOR Engineering - 6700	72,700	\$4,886,365	\$0	\$0	\$0	\$4,886,365	113.00%	0.70%	0.31%
<u>ESH&QA - 7000</u>									
DIRECT COST									
Organizational Multiplier	89.00%	\$2,072,070 \$1,844,142	\$0 \$0	\$0 \$0	\$0 \$0	\$2,072,070 \$1,844,142	89.00%		
TOTAL FOR ESH&QA - 7000	63,000	\$3,916,212	\$0	\$0	\$0	\$3,916,212	89.00%	0.63%	0.28%

INEEL

05/24/2000

Success Estimating and Cost Management System

Project Name
Type of Estimate
Joe Estimator
Manager of Estimating

CONTRACTOR DISTRIBUTION REPORT

Reported From: Project Level TPC

CONTRACTOR	MARK-UP PERCENT	LABOR HOURS	LABOR	MATERIAL	EQUIPMENT	OTHERS	SUBTOTAL	% MARKUP	% DIRECT COST	% TOTAL COST
<u>QA & Conduct Of Operations Oversight</u>										
DIRECT COST			\$496,230	\$0	\$0	\$0	\$496,230			
Organizational Multiplier	89.00%		\$441,645	\$0	\$0	\$0	\$441,645	89.00%		
TOTAL FOR QA & Conduct Of Operations Ove		21,000	\$937,875	\$0	\$0	\$0	\$937,875	89.00%	0.15%	0.07%
<u>Radiological Engineering - 7610</u>										
DIRECT COST			\$117,880	\$0	\$0	\$0	\$117,880			
Organizational Multiplier	89.00%		\$104,913	\$0	\$0	\$0	\$104,913	89.00%		
TOTAL FOR Radiological Engineering - 761		3,500	\$222,793	\$0	\$0	\$0	\$222,793	89.00%	0.04%	0.02%
<u>EARTHWORK CONTRACTOR - DIRT</u>										
DIRECT COST			\$448,035	\$498	\$211,223	\$3,120	\$662,875			
BOND	1.00%		\$4,480	\$5	\$2,112	\$31	\$6,629	1.00%		
SUBTIER HANDLING	5.00%		\$22,626	\$25	\$10,667	\$158	\$33,475	5.05%		
PROFIT	10.00%		\$47,514	\$53	\$22,400	\$331	\$70,298	10.61%		
OVERHEAD	15.00%		\$78,398	\$87	\$36,960	\$546	\$115,992	17.50%		
TOTAL FOR EARTHWORK CONTRACTOR - DIRT		13,761	\$601,053	\$668	\$283,362	\$4,186	\$889,269	34.15%	0.20%	0.09%
<u>DRYWALL CONTRACTOR - DRYW</u>										
DIRECT COST			\$35,521	\$8,563	\$0	\$160	\$44,243			
BOND	1.00%		\$355	\$86	\$0	\$2	\$442	1.00%		
SUBTIER HANDLING	5.00%		\$1,794	\$432	\$0	\$8	\$2,234	5.05%		
PROFIT	10.00%		\$3,767	\$908	\$0	\$17	\$4,692	10.61%		
OVERHEAD	15.00%		\$6,216	\$1,498	\$0	\$28	\$7,742	17.50%		
TOTAL FOR DRYWALL CONTRACTOR - DRYW		1,016	\$47,652	\$11,487	\$0	\$215	\$59,354	34.15%	0.01%	0.01%
<u>ELECTRICAL CONTRACTOR - ELEC</u>										
DIRECT COST			\$1,904,273	\$3,475,133	\$19,500	\$1,013,690	\$6,412,595			
BOND	1.00%		\$19,043	\$34,751	\$195	\$10,137	\$64,126	1.00%		
SUBTIER HANDLING	5.00%		\$96,166	\$175,494	\$985	\$51,191	\$323,836	5.05%		
PROFIT	10.00%		\$201,948	\$368,538	\$2,068	\$107,502	\$680,056	10.61%		

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Success Estimating and Cost Management System

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CONTRACTOR DISTRIBUTION REPORT

Reported From: Project Level TPC

Project Name
Type of Estimate
Joe Estimator
Manager of Estimating

CONTRACTOR	MARK-UP PERCENT HOURS	LABOR	MATERIAL	EQUIPMENT	OTHERS	SUBTOTAL	MARKUP %	DIRECT COST	% TOTAL COST
<u>ELECTRICAL CONTRACTOR - ELEC</u>									
DIRECT COST		\$1,904,273	\$3,475,133	\$19,500	\$1,013,690	\$6,412,595			
OVERHEAD	20.00%	\$444,286	\$810,783	\$4,550	\$236,504	\$1,496,123	23.33%		
TOTAL FOR ELECTRICAL CONTRACTOR - ELEC	55,118	\$2,665,715	\$4,664,699	\$27,297	\$1,419,024	\$8,976,735	39.99%	1.97%	0.87%
<u>ELEVATOR CONTRACTOR - ELEV</u>									
DIRECT COST		\$19,049	\$48,731	\$0	\$350	\$68,130			
BOND	1.00%	\$190	\$487	\$0	\$4	\$681	1.00%		
SUBTIER HANDLING	5.00%	\$962	\$2,461	\$0	\$18	\$3,441	5.05%		
PROFIT	10.00%	\$2,020	\$5,168	\$0	\$37	\$7,225	10.61%		
OVERHEAD	22.00%	\$4,889	\$12,506	\$0	\$90	\$17,485	25.66%		
TOTAL FOR ELEVATOR CONTRACTOR - ELEV	529	\$27,111	\$69,353	\$0	\$498	\$96,961	42.32%	0.02%	0.01%
<u>FIRE PROTECTION CONTRACTOR - FP</u>									
DIRECT COST		\$312,722	\$0	\$0	\$1,023,560	\$1,336,282			
BOND	1.00%	\$3,127	\$0	\$0	\$10,236	\$13,363	1.00%		
SUBTIER HANDLING	5.00%	\$15,792	\$0	\$0	\$51,690	\$67,482	5.05%		
PROFIT	10.00%	\$33,164	\$0	\$0	\$108,549	\$141,713	10.61%		
OVERHEAD	20.00%	\$72,961	\$0	\$0	\$238,807	\$311,768	23.33%		
TOTAL FOR FIRE PROTECTION CONTRACTOR - F	8,470	\$437,767	\$0	\$0	\$1,432,841	\$1,870,607	39.99%	0.41%	0.18%
<u>GENERAL CONTRACTOR - GEN</u>									
DIRECT COST		\$15,145,829	\$63,297,739	\$2,258,513	\$751,520	\$81,453,600			
BOND	1.00%	\$151,458	\$632,977	\$22,585	\$7,515	\$814,536	1.00%		
PROFIT	10.00%	\$1,529,729	\$6,393,072	\$228,110	\$75,904	\$8,226,814	10.10%		
OVERHEAD	22.00%	\$3,701,943	\$15,471,233	\$552,026	\$183,687	\$19,908,889	24.44%		
TOTAL FOR GENERAL CONTRACTOR - GEN	446,952	\$20,528,959	\$85,795,021	\$3,061,234	\$1,018,625	\$110,403,839	35.54%	24.96%	11.04%
<u>HVAC CONTRACTOR - HVAC</u>									
DIRECT COST		\$7,733,725	\$10,983,856	\$240	\$708,550	\$19,426,370			
BOND	1.00%	\$77,337	\$109,839	\$2	\$7,086	\$194,264	1.00%		
SUBTIER HANDLING	5.00%	\$390,553	\$554,685	\$12	\$35,782	\$981,032	5.05%		
PROFIT	10.00%	\$820,161	\$1,164,838	\$25	\$75,142	\$2,060,167	10.61%		

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Success Estimating and Cost Management System

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Project Name
Type of Estimate
Joe Estimator
Manager of Estimating

CONTRACTOR DISTRIBUTION REPORT

Reported From: Project Level TPC

CONTRACTOR	MARK-UP PERCENT	LABOR HOURS	LABOR	MATERIAL	EQUIPMENT	OTHERS	SUBTOTAL	MARKUP %	DIRECT COST	% TOTAL COST
<u>HVAC CONTRACTOR - HVAC</u>										
DIRECT COST			\$7,733,725	\$10,983,856	\$240	\$708,550	\$19,426,370			
OVERHEAD	22.00%		\$1,984,791	\$2,818,908	\$62	\$181,843	\$4,985,603	25.66%		
TOTAL FOR HVAC CONTRACTOR - HVAC		217,974	\$11,006,567	\$15,632,125	\$342	\$1,008,402	\$27,647,435	42.32%	5.95%	2.63%
<u>INSTRUMENTATION CONTRACTOR - INSTR</u>										
DIRECT COST			\$137,082	\$3,610,845	\$0	\$22,080	\$3,770,007			
BOND	1.00%		\$1,371	\$36,108	\$0	\$221	\$37,700	1.00%		
SUBTIER HANDLING	5.00%		\$6,923	\$182,348	\$0	\$1,115	\$190,385	5.05%		
PROFIT	10.00%		\$14,538	\$382,930	\$0	\$2,342	\$399,809	10.61%		
OVERHEAD	18.00%		\$28,784	\$758,202	\$0	\$4,636	\$791,622	21.00%		
TOTAL FOR INSTRUMENTATION CONTRACTOR - I		3,906	\$188,698	\$4,970,433	\$0	\$30,394	\$5,189,524	37.65%	1.16%	0.51%
<u>INSULATION CONTRACTOR - INSUL</u>										
DIRECT COST			\$102,983	\$31,240	\$0	\$268,794	\$403,017			
BOND	1.00%		\$1,030	\$312	\$0	\$2,688	\$4,030	1.00%		
SUBTIER HANDLING	5.00%		\$5,201	\$1,578	\$0	\$13,574	\$20,352	5.05%		
PROFIT	10.00%		\$10,921	\$3,313	\$0	\$28,506	\$42,740	10.61%		
OVERHEAD	20.00%		\$24,027	\$7,289	\$0	\$62,712	\$94,028	23.33%		
TOTAL FOR INSULATION CONTRACTOR - INSUL		2,807	\$144,161	\$43,732	\$0	\$376,274	\$564,167	39.99%	0.12%	0.05%
<u>Non-Org PF, G&A, and PIF - NOGAPIF</u>										
DIRECT COST			\$0	\$0	\$0	\$14,657,328	\$14,657,328			
			\$0	\$0	\$0	\$0	\$0	0.00%		
TOTAL FOR Non-Org PF, G&A, and PIF - NOG		0	\$0	\$0	\$0	\$14,657,328	\$14,657,328		4.49%	1.99%
<u>PAINTING CONTRACTOR - PAINT</u>										
DIRECT COST			\$1,682,087	\$928,233	\$0	\$22,260	\$2,632,581			
BOND	1.00%		\$16,821	\$9,282	\$0	\$223	\$26,326	1.00%		
SUBTIER HANDLING	5.00%		\$84,945	\$46,876	\$0	\$1,124	\$132,945	5.05%		
PROFIT	10.00%		\$178,385	\$98,439	\$0	\$2,361	\$279,185	10.61%		

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Success Estimating and Cost Management System

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Project Name
Type of Estimate
Joe Estimator
Manager of Estimating

CONTRACTOR DISTRIBUTION REPORT

Reported From: Project Level TPC

CONTRACTOR	MARK-UP PERCENT HOURS	LABOR	MATERIAL	EQUIPMENT	OTHERS	SUBTOTAL	MARKUP	% DIRECT COST	% TOTAL COST
<u>PAINTING CONTRACTOR - PAINT</u>									
DIRECT COST		\$1,682,087	\$928,233	\$0	\$22,260	\$2,632,581			
OVERHEAD	18.00%	\$353,203	\$194,910	\$0	\$4,674	\$552,787	21.00%		
TOTAL FOR PAINTING CONTRACTOR - PAINT	55,350	\$2,315,442	\$1,277,740	\$0	\$30,642	\$3,623,824	37.65%	0.81%	0.36%
<u>PIPING CONTRACTOR - PIPE</u>									
DIRECT COST		\$2,712,328	\$6,014,968	\$1,820	\$395,420	\$9,124,536			
BOND	1.00%	\$27,123	\$60,150	\$18	\$3,954	\$91,245	1.00%		
SUBTIER HANDLING	5.00%	\$136,973	\$303,756	\$92	\$19,969	\$460,789	5.05%		
PROFIT	10.00%	\$287,642	\$637,887	\$193	\$41,934	\$967,657	10.61%		
OVERHEAD	23.00%	\$727,735	\$1,613,855	\$488	\$106,094	\$2,448,172	26.83%		
TOTAL FOR PIPING CONTRACTOR - PIPE	71,418	\$3,891,801	\$8,630,616	\$2,611	\$567,371	\$13,092,400	43.49%	2.80%	1.24%
<u>STRUCTURAL STEEL CONTRACTOR - STEEL</u>									
DIRECT COST		\$11,980,579	\$4,649,685	\$1,079	\$86,990	\$16,718,332			
BOND	1.00%	\$119,806	\$46,497	\$11	\$870	\$167,183	1.00%		
SUBTIER HANDLING	5.00%	\$605,019	\$234,809	\$54	\$4,393	\$844,276	5.05%		
PROFIT	10.00%	\$1,270,540	\$493,099	\$114	\$9,225	\$1,772,979	10.61%		
OVERHEAD	20.00%	\$2,795,189	\$1,084,818	\$252	\$20,296	\$3,900,554	23.33%		
TOTAL FOR STRUCTURAL STEEL CONTRACTOR -	307,328	\$16,771,133	\$6,508,907	\$1,510	\$121,774	\$23,403,325	39.99%	5.12%	2.27%
<u>TANK MANUFACTURER/INSTALLER - TANK</u>									
DIRECT COST		\$201,463	\$2,445,450	\$0	\$64,190	\$2,711,103			
BOND	1.00%	\$2,015	\$24,455	\$0	\$642	\$27,111	1.00%		
SUBTIER HANDLING	5.00%	\$10,174	\$123,495	\$0	\$3,242	\$136,911	5.05%		
PROFIT	10.00%	\$21,365	\$259,340	\$0	\$6,807	\$287,513	10.61%		
OVERHEAD	22.00%	\$51,704	\$627,603	\$0	\$16,474	\$695,780	25.66%		
TOTAL FOR TANK MANUFACTURER/INSTALLER -	5,339	\$286,721	\$3,480,342	\$0	\$91,355	\$3,858,418	42.32%	0.83%	0.37%

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Success Estimating and Cost Management System

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Project Name
Type of Estimate
Joe Estimator
Manager of Estimating

CONTRACTOR DISTRIBUTION REPORT

Reported From: Project Level TPC

CONTRACTOR	MARK-UP PERCENT HOURS	LABOR	MATERIAL	EQUIPMENT	OTHERS	SUBTOTAL	% MARKUP	% DIRECT COST	% TOTAL COST
TOTAL DIRECT COST	1,629,139	\$169,118,294	\$97,673,689	\$2,492,375	\$57,033,107	\$326,317,465		100.00%	
TOTAL SUBCONTRACTOR MARKUPS		\$35,454,993	\$35,790,184	\$883,982	\$1,740,915	\$73,870,074			10.01%
TOTAL COST TO PRIME		\$204,573,287	\$133,463,873	\$3,376,357	\$58,774,022	\$400,187,539			
ESCALATION	27.62%	\$53,021,902	\$39,370,560	\$989,610	\$11,653,832	\$110,520,479			14.98%
PROJECT COST BEFORE LEVEL MARK		\$257,595,189	\$186,485,775	\$15,030,189	\$75,912,429	\$510,708,018			
CONTINGENCY	45.52%	\$130,199,454	\$71,030,607	\$2,296,207	\$28,936,052	\$232,462,320			31.51%
TOTAL PROJECT COST W/LEVEL MARKUPS		\$387,794,643	\$257,516,382	\$17,326,397	\$104,848,481	\$743,170,339			

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Success Estimating and Cost Management System

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Description	minRiskLevel	maxRiskLevel	levelComment
- PROJECT DEVELOPMENT	20	90	TD may be high, lowering overall cost.
- PROJECT SUPPORT	5	100	
- PERMITTING	10	200	
- CONSTRUCTION MANAGEMENT	5	125	Team was concerned about changing requirements and attitudes at ID and EPA.
- TITLE I DESIGN	5	100	
- TITLE II DESIGN	10	120	
- QUALITY ASSURANCE	10	90	Dennis Harrell was concerned that more stringent requirements could be imposed.
- PROJECT MANAGEMENT	5	120	
- CONSTRUCTION AE SUPPORT	10	80	
- GENERAL CONDITIONS	5	150	
- CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE	5	50	
- SITEWORK	5	140	Might hit rock.
- CONCRETE	5	300	Might have to use HD concrete for some cell applications.
- MASONRY	10	70	
- METALS	20	80	Less est liner possible.
- THERMAL & MOISTURE PROTECTION	10	100	
- DOORS & WINDOWS	10	75	Cell entry doors may need to be shielding-type not just sst.
- FINISHES	10	150	If there is less sst liner, then there will be more epoxy and maybe more expensive epoxy.
- SPECIALTIES	10	50	
- EQUIPMENT	10	160	Nitronic 50 scares most vendors.
- FURNISHINGS - OFFICE AREA	10	50	
- SPECIAL CONSTRUCTION	15	50	Most costs based on phone quotes. Pretty standard models used.
- CONVEYING SYSTEMS	5	150	If in-cell cranes are nuclear rated, costs will go way up.
- HVAC	5	100	
- PIPING	5	150	Estimate based on allowances only.
- PLUMBING	10	50	
- FIRE PROTECTION	5	130	Cells could require special fire suppression equip., est. based on wet pipe.
- ELECTRICAL	10	100	Might need new substation, more power, etc.
- CONSTRUCTION SUPPORT	10	75	
- CONSTRUCTION QUALITY CONTROL	10	80	
- CONSTRUCTION DOCUMENTATION	5	100	
- PROJECT ACCEPTANCE/CLOSEOUT	15	300	On the (-) side, might be able to send waste to WIPP, lowering overall product requirements. ☐ On the (+) side, if something serious goes wrong during startup, major money and time delays to fix.
- Non-Org G&A and PIF	10	100	

Summary Statistics

Simulation Results for Book1.XLS

Iterations= 2000
 Simulations= 1
 # Input Variables= 33
 # Output Variables= 1
 Sampling Type= Latin Hypercube
 Runtime= 00:00:06
 Run on 5/24/00, 9:17:10 AM

Summary Statistics

Cell	Name	Minimum	Mean	Maximum
F2	Contingency	7.20E+07	1.95E+08	3.33E+08
B3	(Input) - PROJECT DEVELOPMENT / Level Total Cost with RISK	4.02E+07	6.14E+07	9.40E+07
B4	(Input) - PROJECT SUPPORT / Level Total Cost with RISK	7020430	9696817	1.46E+07
B5	(Input) - PERMITTING / Level Total Cost with RISK	6240108	1.12E+07	2.04E+07
B6	(Input) - CONSTRUCTION MANAGEMENT / Level Total Cost with RISK	2.65E+07	3.88E+07	6.16E+07
B7	(Input) - TITLE I DESIGN / Level Total Cost with RISK	1.38E+07	1.87E+07	2.83E+07
B8	(Input) - TITLE II DESIGN / Level Total Cost with RISK	3.11E+07	4.70E+07	7.52E+07
B9	(Input) - QUALITY ASSURANCE / Level Total Cost with RISK	1.12E+07	1.57E+07	2.34E+07
B10	(Input) - PROJECT MANAGEMENT / Level Total Cost with RISK	3.52E+07	5.10E+07	8.05E+07
B11	(Input) - CONSTRUCTION AE SUPPORT / Level Total Cost with RISK	4279428	5823281	8436201
B12	(Input) - GENERAL CONDITIONS / Level Total Cost with RISK	1.49E+07	2.32E+07	3.89E+07
B13	(Input) - CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE / Level Total Cost with RISK	1.02E+07	1.23E+07	1.60E+07
B14	(Input) - SITEWORK / Level Total Cost with RISK	980973.6	1489036	2434055
B15	(Input) - CONCRETE / Level Total Cost with RISK	2.18E+07	4.51E+07	9.02E+07
B16	(Input) - MASONRY / Level Total Cost with RISK	68867.08	91484.59	128497.9
B17	(Input) - METALS / Level Total Cost with RISK	2.12E+07	3.15E+07	4.68E+07
B18	(Input) - THERMAL & MOISTURE PROTECTION / Level Total Cost with RISK	1774378	2545357	3883202
B19	(Input) - DOORS & WINDOWS / Level Total Cost with RISK	275410.1	370217.3	527737.3
B20	(Input) - FINISHES / Level Total Cost with RISK	3735742	6044458	1.02E+07
B21	(Input) - SPECIALTIES / Level Total Cost with RISK	68405.69	85845.05	113103.1
B22	(Input) - EQUIPMENT / Level Total Cost with RISK	3.98E+07	6.59E+07	1.13E+08
B23	(Input) - FURNISHINGS - OFFICE AREA / Level Total Cost with RISK	85947.2	107961.3	141992.3
B24	(Input) - SPECIAL CONSTRUCTION / Level Total Cost with RISK	5.50E+07	7.19E+07	9.59E+07
B25	(Input) - CONVEYING SYSTEMS / Level Total Cost with RISK	5848067	9080301	1.51E+07
B26	(Input) - HVAC / Level Total Cost with RISK	3.14E+07	4.33E+07	6.53E+07
B27	(Input) - PIPING / Level Total Cost with RISK	1.24E+07	1.93E+07	3.22E+07
B28	(Input) - PLUMBING / Level Total Cost with RISK	35014.91	43838.26	57900.07
B29	(Input) - FIRE PROTECTION / Level Total Cost with RISK	1758767	2609202	4221107
B30	(Input) - ELECTRICAL / Level Total Cost with RISK	1.17E+07	1.68E+07	2.56E+07
B31	(Input) - CONSTRUCTION SUPPORT / Level Total Cost with RISK	175281.5	235989.9	336080.3
B32	(Input) - CONSTRUCTION QUALITY CONTROL / Level Total Cost with RISK	234152.2	318965.5	462576.2
B33	(Input) - CONSTRUCTION DOCUMENTATION / Level Total Cost with RISK	1228027	1697276	2552301
B34	(Input) - PROJECT ACCEPTANCE/CLOSEOUT / Level Total Cost with RISK	2.76E+07	6.25E+07	1.26E+08
B35	(Input) - Non-Org G&A and PIF / Level Total Cost with RISK	1.71E+07	2.48E+07	3.75E+07

Detail Statistics

@RISK Simulation of Book1.XLS

Run on 5/24/00, 9:17:10 AM

Name

Contingency

Description

Output

Cell

F2

Minimum =

7.20E+07

Maximum =

3.33E+08

Mean =

1.95E+08

Std Deviation =

4.31E+07

Variance =

1.86E+15

Skewness =

0.1584699

Kurtosis =

2.641755

Errors Calculated =

0

Mode =

1.98E+08

5% Perc =

\$127,303,000

10% Perc =

\$138,529,000

15% Perc =

\$148,217,700

20% Perc =

\$156,968,900

25% Perc =

\$164,840,400

30% Perc =

\$170,542,700

35% Perc =

\$177,042,200

40% Perc =

\$182,465,800

45% Perc =

\$187,908,900

50% Perc =

\$193,791,700

55% Perc =

\$199,607,700

60% Perc =

\$205,220,800

65% Perc =

\$212,207,300

70% Perc =

\$218,116,400

75% Perc =

\$225,127,500

80% Perc =

\$232,465,600

85% Perc =

\$241,891,100

90% Perc =

\$253,917,200

95% Perc =

\$268,128,900

Filter Minimum =

Filter Maximum =

Type (1 or 2) =

Values Filtered =

0

Scenario #1 =

>75%

Scenario #2 =

<25%

Scenario #3 =

>90%

Tornado Graphs

Regression Sensitivity for Contingency/F2

Sensitivity

Simulation Sensitivities for Contingency In Cell F2
(From @RISK Simulation of Book1.XLS- Run on 5/24/00, 9:17:10 AM, Simulations= 1, Iterations= 2000)

Rank	Cell	Name	Sensitivity (RSqr=0.9999 976)	Rank Correlation Coefficient	WEIGHT	AMOUNT	LEVEL MARKUP %
#1	B34	PROJECT ACCEPTANCE/CLOSEOUT	0.53991	0.54866	0.14768	\$34,330,117	107.03%
#2	B22	EQUIPMENT	0.39737	0.40513	0.10869	\$25,266,412	57.47%
#3	B15	CONCRETE	0.37655	0.34106	0.10299	\$23,942,764	105.24%
#4	B3	PROJECT DEVELOPMENT	0.27615	0.26498	0.07553	\$17,558,655	35.30%
#5	B10	PROJECT MANAGEMENT	0.24705	0.22335	0.06757	\$15,708,535	42.64%
#6	B8	TITLE II DESIGN	0.23580	0.26644	0.06450	\$14,993,097	43.58%
#7	B24	SPECIAL CONSTRUCTION	0.20746	0.16874	0.05675	\$13,191,403	20.50%
#8	B6	CONSTRUCTION MANAGEMENT	0.19358	0.16896	0.05295	\$12,308,795	44.37%
#9	B26	HVAC	0.18449	0.19884	0.05046	\$11,730,420	35.68%
#10	B17	METALS	0.13148	0.12808	0.03596	\$8,360,227	31.85%
#11	B12	GENERAL CONDITIONS	0.13061	0.11964	0.03573	\$8,304,896	53.05%
#12	B35	Non-Org G&A and PIF	0.10914	0.07647	0.02985	\$6,939,772	36.61%
#13	B27	PIPING	0.10871	0.11050	0.02973	\$6,912,069	53.04%
#14	B7	TITLE I DESIGN	0.07974	0.08445	0.02181	\$5,070,299	35.70%
#15	B5	PERMITTING	0.07700	0.10490	0.02106	\$4,895,705	71.39%
#16	B30	ELECTRICAL	0.07469	0.08297	0.02043	\$4,749,220	36.67%
#17	B9	QUALITY ASSURANCE	0.08457	0.05617	0.01766	\$4,105,484	33.17%
#18	B25	CONVEYING SYSTEMS	0.05109	0.05584	0.01397	\$3,248,609	53.07%
#19	B4	PROJECT SUPPORT	0.04133	0.02559	0.01131	\$2,628,078	35.68%
#20	B20	FINISHES	0.03499	0.05310	0.00957	\$2,224,916	53.99%
#21	B13	CONDUCT OF OPERATIONS/CONDUCT OF MAINTENANCE	0.03090	0.01809	0.00845	\$1,964,479	18.32%
#22	B11	CONSTRUCTION AE SUPPORT	0.02206	0.01725	0.00603	\$1,402,509	29.70%
#23	B29	FIRE PROTECTION	0.01335	0.00205	0.00365	\$848,902	46.09%
#24	B18	THERMAL & MOISTURE PROTECTION	0.01136	0.01521	0.00311	\$722,069	36.88%
#25	B14	SITEWORK	0.00805	-0.01067	0.00220	\$511,937	49.85%
#26	B33	CONSTRUCTION DOCUMENTATION	0.00727	0.01577	0.00199	\$462,335	35.87%
#27	B19	DOORS & WINDOWS	0.00132	0.00386	0.00036	\$83,713	27.51%
#28	B16	MASONRY	0.00000	-0.01427	0.00000	\$0	0.00%
#29	B21	SPECIALTIES	0.00000	-0.00836	0.00000	\$0	0.00%
#30	B23	FURNISHINGS - OFFICE AREA	0.00000	0.03203	0.00000	\$0	0.00%
#31	B28	PLUMBING	0.00000	-0.00729	0.00000	\$0	0.00%
#32	B31	CONSTRUCTION SUPPORT	0.00000	0.00318	0.00000	\$0	0.00%
#33	B32	CONSTRUCTION QUALITY CONTROL	0.00000	-0.01026	0.00000	\$0	0.00%
			3.65602	1.00000	\$232,465,418		

Output Graphs

Appendix E
Life-Cycle Cost Estimate

Date: July 7, 2000

To: J. J Quigley MS 3625 6-3416

From: R. J. Turk MS 3878 6-3611

Subject: LIFE-CYCLE ANALYSIS FOR VITRIFICATION FOR SODIUM BEARING WASTE (SBW)-RJT-20-00

As requested an Economic and Life-Cycle Cost (LCC) has been conducted to evaluate the VITRIFICATION FOR SODIUM BEARING WASTE (SBW). This facility will accept liquid Sodium Bearing Waste (SBW), process it through vitrification, and treat the off-gas and grout secondary waste streams.

This economic analysis is based on information provided by material take off of preliminary facility sketches supplied with the feasibility study. R. D. Adams provided cost estimates.

Methodology:

The Economic Evaluation assumed a 36-year period, (2002-2038) since this is the estimated time required to complete all of the anticipated remediation activities. The LCC identifies evaluated the initial development, construction, operation and post-operating costs over the life-cycle. A discounted LCC analysis assumes a constant-dollar basis, discounted at 6.30% annually per the Office of Management and Budget (OMB) Circular A-94. All costs are conservatively discounted assuming the end-of-year convention.

Assumptions:

The scope of work and requirements of all related activities are vague at this time. The LCC analysis was generated to match cost estimating cost structure. These costs include Permitting, Direct and Indirect Construction, G&A, Procurement Fee, Engineering, Inspection, Project Management, Construction Management, Escalation and Contingency costs.

The design period is assumed to be accomplished in three years with construction completed in four years. The operational period for this facility was assumed to be two years, facility and processing costs were developed from historical experience associated with operations at the INEEL, followed by three years of post-operations activities. The Post operations costs were generated utilizing a DD&D program utilizing historical data and software program developed at the INEEL. Prior to demolition, the facility is put into surveillance and monitored for nineteen years then the building site is closed RCRA standards.

To evaluate *costs*, the factors of reliability, maintainability, and capacity were evaluated to determine an overall operational availability. These risks and costs were evaluated using EXCEL and @RISK (by Palisade Corporation). @Risk allows for the evaluation of many possible outcomes using Monte-Carlo simulation. With Monte Carlo simulation, uncertain model variables are defined according to a probability distribution of risk. The simulation then randomly selects the value of this variable based on the distribution of occurrence. Lastly, these *costs* were reviewed as to their reasonableness using engineering and operations judgement.

In the final step of the discounted life-cycle cost (LCC) is determined by adding annual tangible and *intangible* costs for a total annual cost, discounting each year's annual cost to the FY-00 base-year using OMB's (Office of Management and Budget) discount rate of 6.3% (as described in OMB Circular A-94, revised January 1999). The evaluation is complete when the discounted LCC is summed together to get a cumulative discounted LCC.

Annual costs for operations and maintenance for both options were based on actual FY-98 costs and projected to a future cost based on operations and engineering judgement. These costs were increased and compounded by a 3.0% annual inflation rate.

The analysis utilized the disposal and transportation cost as stated in the EIS review for 1999. It was assumed the waste would be transferred to Hanford for final disposition.

Results:

The VITRIFICATION FOR SODIUM BEARING WASTE (SBW) - has a Discounted LCC of \$ 606 MILLION.

Attachments:

cc: R. J. Turk File

Verification of SBW Life-Cycle Cost (LCC) Analysis						2002 2	2003 3	2004 4	2005 5	2006 6	2007 7	2008 8	2009 9
(ALL COST X1000)						1.053	1.082	1.112	1.144	1.176	1.209	1.242	1.277
Other Project Cost (OPC)	min	mean	max	expected value	Total Cost								
OPC													
Conceptual Design, Project Mgt, & Permitting	\$36,341	\$56,169	\$75,997	\$56,169	\$56,169	\$18,723	\$18,723	\$18,723					
Testing and Start-up	\$14,730	\$22,766	\$30,803	\$22,766	\$22,766								
Total OPC (unescalated)		\$78,935			\$78,935	18,723	18,723	18,723	0	0	0	0	0
plus escalation of		\$17,030			\$15,030	3,565	3,565	3,565	0	0	0	0	0
plus contingency of		\$59,414			\$58,913	13,974	13,974	13,974	0	0	0	0	0
Total OPC including escalation, mgt reserve, & contingency					\$152,879	36,262	36,262	36,262	0	0	0	0	0
TEC													
Title Design, Inspection	\$33,094	\$51,151	\$69,207	\$51,151	\$51,151				\$17,050	\$17,050			
Project mgt	\$21,329	\$32,966	\$44,603	\$32,966	\$32,966				\$4,709	\$4,709	\$4,709	\$4,709	
Construction Mgt	\$23,365	\$36,113	\$48,861	\$36,113	\$36,113					0	\$7,223	\$7,223	\$7,223
Construction, Equip, G&A & Procurement	\$130,062	\$201,023	\$271,984	\$201,023	\$201,023						\$40,205	\$40,205	\$40,205
Total TEC (unescalated)		\$321,252			\$321,252	0	0	0	21,760	21,760	69,187	52,137	52,137
plus escalation of		\$87,928			\$87,928	0	0	0	5,956	5,956	18,937	14,270	14,270
plus contingency of		\$173,048			\$173,048	0	0	0	11,721	11,721	37,269	28,084	28,084
Total TEC including escalation, mgt reserve, contingency					\$582,228	0	0	0	39,437	39,437	125,392	94,491	94,491
Total Project Cost (TPC)													
TPC unescalated		\$400,188			\$400,188	18,723	18,723	18,723	21,760	21,760	69,187	52,137	52,137
plus escalation of		\$105,036			\$102,958	3,565	3,565	3,565	5,956	5,956	18,937	14,270	14,270
plus contingency of		\$232,462			\$231,961	13,974	13,974	13,974	11,721	11,721	37,269	28,084	28,084
Total TPC including esc, mgt res, contingency		\$733,686			\$735,107	36,262	36,262	36,262	39,437	39,437	125,392	94,491	94,491
discount factor @ OMB discount rate of	6.30%					1.130	1.201	1.277	1.357	1.443	1.534	1.630	1.733
Discounted Annual Cost					\$462,708	\$32,091	\$30,189	\$28,400	\$29,056	\$27,334	\$81,759	\$57,959	\$54,524
Operations	2080 hr-ship/yr.	min	mean	max	expected value								
Tangible Costs	\$3827.52				\$279,626								
Manpower		998	\$1,248	\$1,560	\$1,269	\$3,601							
Supervision		3,145	\$3,931	\$4,914	\$3,997	\$11,344							
Labor (Production)		22,630	\$28,288	\$35,360	\$28,759	\$81,632							
(Maintenance)		3,894	\$4,326	\$6,273	\$4,579	\$13,713							
Maintenance of Equipment		11,746	\$13,051	\$18,923	\$13,812	\$41,365							
Canisters		4,960	\$6,200	\$7,750	\$6,303	\$8,946							
CAHS		4	\$5	\$7	\$6	\$8							
Consumables		62	\$78	\$97	\$79	\$113							
Utilities(Power&Water)		1,042	\$1,303	\$1,628	\$1,324	\$1,880							
STEAM		324	\$405	\$506	\$412	\$584							
Disposal (m3)	440	61,600	\$77,000	\$96,250	\$78,283	\$111,101							
Analytical		2,960	\$3,700	\$4,625	\$3,762	\$5,339							
Operations subtotal					\$279,626								
plus Operations Contingency @	2.0%	12.0%	30.0%	15%	\$5,593	0	0	0	0	0	0	0	0
Total Operations (w/contingency)					\$285,218	0	0	0	0	0	0	0	0
discount factor @ OMB discount rate of	6.30%					1.130	1.201	1.277	1.357	1.443	1.534	1.630	1.733
Discounted Annual Cost					\$125,029	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Post Operations		min	mean	max	expected value								
Decommission		6,777	\$8,471	\$10,589	\$8,613	\$8,613							
Decontamination/surveillance		12,539	\$15,674	\$19,593	\$15,936	\$14,418							
Demolition		16,760	\$20,950	\$26,187	\$21,299	\$21,299							
Post-Operations Subtotal		\$36,076	\$45,095	\$56,369	\$45,847	\$44,329	0	0	0	0	0	0	0
plus Escalation						\$57,755	0	0	0	0	0	0	0
plus Post-Operations Contingency @	5%	13%	40%	19%	\$5,104	0	0	0	0	0	0	0	0
Total Post-Operations (w/ escalation & contingency)					\$107,188	0	0	0	0	0	0	0	0
discount factor @ OMB discount rate of	6.30%					1.130	1.201	1.277	1.357	1.443	1.534	1.630	1.733
Discounted Annual Cost					\$18,151	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total Cost					\$724,143	18,723	18,723	18,723	21,760	21,760	69,187	52,137	52,137
Cumulative Total LCC					\$22,925,482	18,723	37,446	56,169	77,929	99,688	168,875	221,012	273,148
Total Cost (w/mgt reserve, & contingency)					\$1,127,513	36,262	36,262	36,262	39,437	39,437	125,392	94,491	94,491
Cumulative Total LCC					\$1,127,513	36,262	72,524	108,786	148,222	187,659	313,051	407,542	502,033
discount factor @ OMB discount rate of	6.30%					1.130	1.201	1.277	1.357	1.443	1.534	1.630	1.733
Discounted Annual Cost					\$605,867	\$32,091	\$30,189	\$28,400	\$29,056	\$27,334	\$81,759	\$57,959	\$54,524
Cumulative Discounted LCC						\$32,091	\$62,280	\$90,680	\$119,736	\$147,070	\$228,829	\$286,788	\$341,313

Verification of SBW Life-Cycle Cost (LCC) Analysis						2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
(All Costs \$1000)						10	11	12	13	14	15	16	17	18	19
Other Project Cost (OPC)					Total Cost										
	min	mean	max	expected value											
OPC															
Conceptual Design, Project Mgt. & Permitting	\$38,941	\$56,169	\$75,997	\$56,169	\$56,169										
Testing and Start-up	\$14,730	\$22,766	\$30,803	\$22,766	\$22,766	0	\$11,383	\$11,383							
Total OPC (unescalated)		\$76,935			\$76,935	0	11,383	11,383	0	0	0	0	0	0	0
plus escalation of		\$17,108			\$15,030	0	2,167	2,167	0	0	0	0	0	0	0
plus contingency of		\$59,414			\$58,913	0	8,496	8,496	0	0	0	0	0	0	0
Total OPC including escalation, mgt reserve, & contingency					\$152,879	0	22,046	22,046	0	0	0	0	0	0	0
TEC															
Title Design, Inspection	\$33,094	\$51,151	\$69,207	\$51,151	\$51,151										
Project mgt.	\$21,329	\$32,966	\$44,603	\$32,966	\$32,966	\$4,709	\$4,709		0	0					
Construction Mgt.	\$23,365	\$36,113	\$48,861	\$36,113	\$36,113	\$7,223	\$7,223								
Construction, Equip, C&A & Procurement	\$130,062	\$201,023	\$271,984	\$201,023	\$201,023	\$40,205	\$40,205								
Total TEC (unescalated)		\$321,252			\$321,252	52,137	52,137	0	0	0	0	0	0	0	0
plus escalation of		\$87,928			\$87,928	14,270	14,270	0	0	0	0	0	0	0	0
plus contingency of		\$173,048			\$173,048	28,084	28,084	0	0	0	0	0	0	0	0
Total TEC including escalation, mgt reserve, & contingency					\$582,228	94,491	94,491	0	0	0	0	0	0	0	0
Total Project Cost (TPC)															
TPC unescalated		\$400,188			\$400,188	52,137	63,520	11,383	0	0	0	0	0	0	0
plus escalation of		\$105,036			\$102,958	14,270	16,437	2,167	0	0	0	0	0	0	0
plus contingency of		\$232,462			\$231,941	28,084	36,580	8,496	0	0	0	0	0	0	0
Total TPC including esc, mgt res, contingency		\$737,686			\$735,107	94,491	116,537	22,046	0	0	0	0	0	0	0
discount factor @ OMB discount rate of	6.30%					1.842	1.958	2.082	2.213	2.352	2.500	2.658	2.825	3.003	3.193
Discounted Annual Cost					\$462,708	\$51,293	\$59,511	\$10,591	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Operations	2080 hr-ent/yr.	min	mean	max	expected value										
Tangible Costs	33427.52				\$279,626				138,001	141,625			0	0	0
Managerial	998	\$1,248	\$1,560	\$1,269	\$3,601				\$1,777	\$1,824					
Supervision	3,145	\$3,631	\$4,914	\$3,897	\$11,344				\$5,599	\$5,746					
Labor (Production)	22,630	\$28,288	\$35,360	\$28,759	\$81,632				\$40,287	\$41,345					
(Maintenance)	3,894	\$4,326	\$6,273	\$4,579	\$13,713				\$6,768	\$6,945					
Maintenance of Equipment	11,746	\$13,051	\$18,823	\$13,812	\$41,365				\$20,414	\$20,651					
Cables	4,960	\$6,200	\$7,750	\$6,303	\$8,946				\$4,415	\$4,531					
C&A's	4	\$5	\$7	\$6	\$8				\$4	\$4					
Consumables	62	\$78	\$97	\$79	\$119				\$56	\$57					
Utilities (Power & Water)	1,042	\$1,303	\$1,828	\$1,324	\$1,880				\$328	\$332					
STEAM	324	\$405	\$506	\$412	\$584				\$288	\$296					
Disposal (m3)	440	\$1,600	\$77,000	\$66,250	\$78,283				\$54,831	\$56,271					
Analytical	2,960	\$3,700	\$4,625	\$3,762	\$5,339				\$2,635	\$2,704					
Operations subtotal					\$279,626				138,001	141,625	0	0	0	0	0
plus Operations Contingency @	2.0%	12.0%	30.0%	15%	\$5,593	0	0	0	2,760	2,833	0	0	0	0	0
Total Operations (w/contingency)					\$285,218	0	0	0	140,781	144,458	0	0	0	0	0
discount factor @ OMB discount rate of	6.30%					1.842	1.958	2.082	2.213	2.352	2.500	2.658	2.825	3.003	3.193
Discounted Annual Cost					\$125,029	\$0	\$0	\$0	\$63,613	\$61,415	\$0	\$0	\$0	\$0	\$0
Post Operations		min	mean	max	expected value										
Decommission	6,777	\$8,471	\$10,589	\$8,613	\$8,613						8,613				
Decontamination/surveillance	12,539	\$15,674	\$19,593	\$15,936	\$14,418							759	759	759	
Dismantle	16,760	\$20,950	\$26,187	\$21,299	\$21,299										
Post-Operations Subtotal	\$36,076	\$45,095	\$56,369	\$45,847	\$44,329	0	0	0	0	0	8,613	759	759	759	
plus Escalation					\$57,755	0	0	0	0	0	4,733	450	484	519	
plus Post-Operations Contingency @	5%	13%	40%	19%	\$5,104	0	0	0	0	0	667	80	62	64	
Total Post-Operations (w/ escalation & contingency)					\$107,188	0	0	0	0	0	14,013	1,269	1,305	1,341	
discount factor @ OMB discount rate of	6.30%					1.842	1.958	2.082	2.213	2.352	2.500	2.658	2.825	3.003	3.193
Discounted Annual Cost					\$78,151	\$0	\$0	\$0	\$0	\$0	\$0	\$5,272	\$448	\$434	\$420
Total Cost					\$724,143	52,137	63,520	11,383	138,001	141,625	0	8,613	759	759	759
Cumulative Total LCC					\$22,025,482	325,285	388,804	400,188	538,188	679,813	679,813	688,426	689,185	689,944	690,703
Total Cost (w/mgt reserve, & contingency)					\$7,127,513	94,491	116,537	22,046	140,781	144,458	0	14,013	1,269	1,305	1,341
Cumulative Total LCC					\$7,127,513	596,523	713,060	735,107	875,867	1,020,325	1,020,325	1,034,338	1,035,607	1,036,912	1,038,253
discount factor @ OMB discount rate of	6.30%					1.842	1.958	2.082	2.213	2.352	2.500	2.658	2.825	3.003	3.193
Discounted Annual Cost					\$605,587	\$51,293	\$59,511	\$10,591	\$63,613	\$61,415	\$0	\$5,272	\$448	\$434	\$420
Cumulative Discounted LCC						392,606	452,117	462,708	526,321	587,736	587,736	593,008	593,458	593,892	594,312

Verification of \$B/W Life-Cycle Cost (LCC) Analysis						2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
						20	21	22	23	24	25	26	27	28	29
(ALL COST X1000)						1.730	1.779	1.829	1.880	1.933	1.987	2.042	2.100	2.158	2.219
Other Project Cost (OPC)	min	mean	max	expected value	Total Cost										
OPC															
Conceptual Design, Project Mgt, & Permitting	\$39,341	\$50,169	\$75,997	\$56,169	\$56,169										
Testing and Start-up	\$14,730	\$22,766	\$30,803	\$22,766	\$22,766										
Total OPC (unescalated)		\$78,935			\$78,935	0	0	0	0	0	0	0	0	0	0
plus escalation of		\$17,108			\$15,030	0	0	0	0	0	0	0	0	0	0
plus contingency of		\$59,414			\$58,919	0	0	0	0	0	0	0	0	0	0
Total OPC including escalation, mgt reserve, & contingency					\$152,879	0	0	0	0	0	0	0	0	0	0
TEC															
Title Design, Inspection	\$33,094	\$51,151	\$69,207	\$51,151	\$51,151										
Project Mgt	\$21,329	\$32,968	\$44,603	\$32,966	\$32,966										
Construction Mgt	\$23,365	\$36,113	\$48,861	\$36,113	\$36,113										
Construction, Equip, O&M & Procurement	\$130,062	\$201,023	\$271,984	\$201,023	\$201,023										
Total TEC (unescalated)		\$321,252			\$321,252	0	0	0	0	0	0	0	0	0	0
plus escalation of		\$87,928			\$87,928	0	0	0	0	0	0	0	0	0	0
plus contingency of		\$173,048			\$173,048	0	0	0	0	0	0	0	0	0	0
Total TEC including escalation, mgt reserve, contingency					\$582,228	0	0	0	0	0	0	0	0	0	0
Total Project Cost (TPC)															
TPC unescalated		\$400,188			\$400,188	0	0	0	0	0	0	0	0	0	0
plus escalation of		\$105,036			\$102,958	0	0	0	0	0	0	0	0	0	0
plus contingency of		\$232,462			\$231,961	0	0	0	0	0	0	0	0	0	0
Total TPC including esc, mgt res, contingency					\$735,107	0	0	0	0	0	0	0	0	0	0
discount factor @ OMB discount rate of Discounted Annual Cost	6.30%				\$462,708	3.394	3.607	3.835	4.076	4.333	4.606	4.896	5.205	5.533	5.881
						\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Operations	2080 hr-ann/yr.	min	mean	max	expected value										
Tangible Costs	\$3627.82				\$279,626	0	0	0	0	0	0	0	0	0	0
Maintenance	998	\$1,248	\$1,560	\$1,269	\$3,601										
Supervision	3,145	\$3,831	\$4,814	\$3,987	\$11,344										
Labor (Production)	22,630	\$28,288	\$35,260	\$28,759	\$81,632										
(Maintenance)	3,884	\$4,826	\$6,273	\$4,579	\$13,713										
Maintenance of Equipment	11,746	\$13,051	\$18,823	\$13,812	\$41,365										
Coalsters	4,660	\$6,200	\$7,750	\$6,303	\$8,946										
CAHS	4	\$5	\$7	\$6	\$3										
Consumables	62	\$78	\$97	\$79	\$113										
Utilities (Power & Water)	1,042	\$1,303	\$1,628	\$1,324	\$1,880										
STEAM	224	\$405	\$506	\$412	\$584										
Disposal (m3)	440	\$1,600	\$77,000	\$96,250	\$78,283										
Analysis	2,860	\$3,700	\$4,625	\$3,762	\$5,339										
Operations subtotal					\$279,626	0	0	0	0	0	0	0	0	0	0
plus Operations Contingency @	2.0%	12.0%	30.0%	15%	\$5,593	0	0	0	0	0	0	0	0	0	0
Total Operations (w/contingency)					\$285,219	0	0	0	0	0	0	0	0	0	0
discount factor @ OMB discount rate of Discounted Annual Cost	6.30%				\$125,029	3.394	3.607	3.835	4.076	4.333	4.606	4.896	5.205	5.533	5.881
						\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Post Operations		min	mean	max	expected value										
Decommission	6,777	\$8,471	\$10,589	\$8,613	\$8,613										
Decommission/maintenance	12,539	\$15,674	\$19,593	\$15,836	\$14,418	759	759	759	759	759	759	759	759	759	759
Demolition	16,760	\$20,950	\$28,187	\$21,299	\$21,299										
Post-Operations Subtotal	\$36,076	\$45,095	\$56,369	\$45,847	\$44,329	759	759	759	759	759	759	759	759	759	759
plus Escalation					\$57,755	554	591	629	668	708	749	791	834	879	925
plus Post-Operations Contingency @	5%	13%	40%	19%	\$5,104	66	67	69	71	73	75	77	80	82	84
Total Post-Operations (w/ escalation & contingency)					\$107,188	1,378	1,417	1,457	1,498	1,540	1,583	1,627	1,673	1,720	1,768
discount factor @ OMB discount rate of Discounted Annual Cost	6.30%				\$18,151	3.394	3.607	3.835	4.076	4.333	4.606	4.896	5.205	5.533	5.881
						\$406	\$393	\$380	\$367	\$355	\$344	\$332	\$321	\$311	\$301
Total Cost					\$724,143	759	759	759	759	759	759	759	759	759	759
Cumulative Total LCC					\$22,825,482	691,461	692,220	692,979	693,738	694,497	695,256	696,014	696,773	697,532	698,291
Total Cost (w/mgt reserve, & contingency)					\$1,127,519	1,379	1,417	1,457	1,498	1,540	1,583	1,627	1,673	1,720	1,768
Cumulative Total LCC					\$1,127,519	1,039,632	1,041,049	1,042,506	1,044,004	1,045,544	1,047,127	1,048,754	1,050,427	1,052,147	1,053,915
discount factor @ OMB discount rate of Discounted Annual Cost	6.30%					3.394	3.607	3.835	4.076	4.333	4.606	4.896	5.205	5.533	5.881
						\$406	\$393	\$380	\$367	\$355	\$344	\$332	\$321	\$311	\$301
Cumulative Discounted LCC					\$605,887	594,719	595,111	595,491	595,859	596,214	596,558	596,890	597,212	597,522	597,823

Verification of SBW Life-Cycle Cost (LCC) Analysis						2020	2021	2022	2023	2024	2025	2026	2027	2028
(All Cost \$1000)						30	31	32	33	34	35	36	37	38
						2.281	2.245	2.410	2.478	2.547	2.619	2.692	2.767	2.845
Other Project Cost (OPC)	min	mean	max	expected value	Total Cost									
OPC														
Conceptual Design, Project Mgt. & Permitting	\$36,341	\$56,169	\$75,997	\$56,169	\$56,169									
Trail and Start-up	\$14,730	\$22,766	\$30,803	\$22,766	\$22,766									
Total OPC (unescalated)					\$78,935	0	0	0	0	0	0	0	0	0
plus escalation of					\$15,030	0	0	0	0	0	0	0	0	0
plus contingency of					\$58,913	0	0	0	0	0	0	0	0	0
Total OPC including escalation, mgt reserve, & contingency					\$152,879	0	0	0	0	0	0	0	0	0
TEC														
Title Design, Inspection	\$33,084	\$51,151	\$69,207	\$51,151	\$51,151									
Project mgt	\$21,329	\$32,966	\$44,603	\$32,966	\$32,966									
Construction Mgt	\$23,365	\$36,113	\$48,861	\$36,113	\$36,113									
Construction, Equip, C&A & Procurement	\$130,062	\$201,023	\$271,854	\$201,023	\$201,023									
Total TEC (unescalated)		\$321,252			\$321,252	0	0	0	0	0	0	0	0	0
plus escalation of		\$87,928			\$87,928	0	0	0	0	0	0	0	0	0
plus contingency of		\$173,048			\$173,048	0	0	0	0	0	0	0	0	0
Total TEC including escalation, mgt reserve, contingency					\$582,228	0	0	0	0	0	0	0	0	0
Total Project Cost (TPC)														
TPC unescalated		\$400,188			\$400,188	0	0	0	0	0	0	0	0	0
plus escalation of		\$105,036			\$105,036	0	0	0	0	0	0	0	0	0
plus contingency of		\$232,462			\$232,462	0	0	0	0	0	0	0	0	0
Total TPC including esc, mgt res, contingency		\$737,686			\$737,686	0	0	0	0	0	0	0	0	0
discount factor @ OMB discount rate of	6.30%					6.252	6.646	7.064	7.509	7.982	8.485	9.020	9.588	10.192
Discounted Annual Cost					\$462,708	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Operations	2080 hr-yr	min	mean	max	expected value									
2080 hr-yr														
Tangible Costs	\$3,627.52				\$279,626	0	0	0	0	0	0	0	0	0
Managerial	998	\$1,248	\$1,560	\$1,269	\$3,601									
Supervision	3,145	\$3,931	\$4,914	\$3,997	\$11,344									
Labor (Production)	22,630	\$28,288	\$35,360	\$28,759	\$81,632									
(Maintenance)	3,894	\$4,326	\$6,273	\$4,579	\$13,713									
Maintenance of Equipment	11,748	\$13,051	\$18,923	\$13,812	\$41,365									
Canisters	4,960	\$6,200	\$7,750	\$6,393	\$8,946									
CANS	4	\$5	\$7	\$6	\$8									
Consumables	62	\$78	\$97	\$79	\$113									
Utilities(Power&Water)	1,042	\$1,303	\$1,628	\$1,324	\$1,680									
STEAM	324	\$405	\$506	\$412	\$584									
Disposal (m3)	440	\$1,600	\$77,000	\$96,250	\$78,283									
Analysis	2,960	\$3,700	\$4,625	\$3,762	\$5,339									
Operations subtotal					\$279,626	0	0	0	0	0	0	0	0	0
plus Operations Contingency @	2.0%	12.0%	30.0%	15%	\$5,593	0	0	0	0	0	0	0	0	0
Total Operations (w/contingency)					\$285,218	0	0	0	0	0	0	0	0	0
discount factor @ OMB discount rate of	6.30%					6.252	6.646	7.064	7.509	7.982	8.485	9.020	9.588	10.192
Discounted Annual Cost					\$125,029	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Post Operations		min	mean	max	expected value									
Decommission	6,777	\$8,471	\$10,589	\$8,613	\$8,613									
Decontamination/surveillance	12,539	\$16,674	\$19,593	\$15,936	\$14,418	759	759	759	759	759	759	0	0	
Demolition	16,780	\$20,060	\$26,187	\$21,299	\$21,299							7,100	7,100	7,100
Post-Operations Subtotal	\$36,076	\$45,095	\$56,369	\$45,847	\$44,329	759	759	759	759	759	759	7,100	7,100	7,100
plus Escalation					\$57,755	972	1,020	1,070	1,121	1,174	1,226	12,012	12,547	13,097
plus Post-Operations Contingency @	5%	13%	40%	19%	\$5,104	87	89	91	94	97	99	958	982	1,010
Total Post-Operations (w/ escalation & contingency)					\$107,188	\$1,817	\$1,868	\$1,921	\$1,974	\$2,030	\$2,086	\$20,067	\$20,629	\$21,206
discount factor @ OMB discount rate of	6.30%					6.252	6.646	7.064	7.509	7.982	8.485	9.020	9.588	10.192
Discounted Annual Cost					\$18,151	\$291	\$281	\$272	\$263	\$254	\$246	\$2,225	\$2,152	\$2,081
Total Cost					\$724,143	\$759	\$759	\$759	\$759	\$759	\$759	\$7,100	\$7,100	\$7,100
Cumulative Total LCC					\$22,925,482	\$699,050	\$699,809	\$700,567	\$701,326	\$702,085	\$702,844	\$709,844	\$717,043	\$724,143
Total Cost (w/mgt reserve, & contingency)					\$1,127,513	\$1,817	\$1,868	\$1,921	\$1,974	\$2,030	\$2,086	\$20,067	\$20,629	\$21,206
Cumulative Total LCC					\$1,127,513	\$1,055,732	\$1,057,600	\$1,059,521	\$1,061,495	\$1,063,525	\$1,065,611	\$1,085,678	\$1,106,207	\$1,127,513
discount factor @ OMB discount rate of	6.30%					6.252	6.646	7.064	7.509	7.982	8.485	9.020	9.588	10.192
Discounted Annual Cost					\$605,887	\$598,114	\$598,395	\$598,667	\$598,930	\$599,184	\$599,430	\$601,655	\$603,806	\$605,887
Cumulative Discounted LCC														

INEL Non Contaminated and RAD Contaminated Surplus Facilities Cost Model ==> D&D Cost

PROJECT Vit for SBW FACILITY CLOSURE BUILDING AREA INTEC

Prepared by DJ Kenoyer, SA LaBuy, Revision 0, 19-Jan-96; Modifications made to Rev 0 by S. Johnston, Apr/May - 1997; Revised by S. Coward on 8/22/98

*REV 4, DATED 12/01/98

ID Number	Facility Description	Closure Type	Floor Space		Bldg Lvls	Below (B) Ground	Facility Rating					CHRTZ
			Sqaure Feet				ACM	HAZ	RAD	SYS	Bldg	
FACILITY DESCRIPTION												
	- Above Ground Non-Contaminated Area	RB	165,108		3	A	NA	NA	NA	L	C	L
	- Below Ground Non-Contaminated Area	RB	20,631		1	B	NA	NA	NA	A	C	L
	- Above Ground Contaminated Area	RB	27,520		1	A	NA	H	H	H	C	H
	- Below Ground Contaminated Area	RB	16,381		1	B	NA	H	H	H	C	H
	TOTALS		229,640									

PREP'D BY RJTRDA DATE 6/29/00

No. of Tanks	Total Tank Gallons	Deact		D&D		Tank ROM Cost (\$)	DEACTIV ROM Cost (\$)	S&M PROGRAM		CHRTZ ROM Cost (\$)	D&D ROM Cost (\$)	Subtotal ROM Cost (\$) (without S&M)	TOTAL ROM Cost (\$)
		Start	Fin	Start	Fin			Total Years	Annual Cost (\$)				
NA	NA	2015	2016	2036	2039		485,418	21	121,354	809,029	4,045,146	5,339,593	8,737,515
NA	NA	2015	2016	2036	2039		100,202	21	25,051	167,004	835,019	1,102,225	3,826,021
11	4600	2015	2016	2036	2039		1,227,117	21	283,181	2,831,808	9,439,360	13,498,285	18,028,992
26	114000	2015	2016	2036	2039		861,906	21	198,901	1,989,014	6,630,046	9,480,966	13,421,717
						1,081,091	2,674,643		628,487	5,796,855	20,949,571	30,502,159	45,095,337

Appendix F
Equipment List

Table 1. Process bill of materials for direct vitrification of SBW									
Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Depth (ft.)
4									
5		Feed System							
6			INTEC SBW storage tanks	N/A	existing SBW storage	300,000 gal			
7									
8			Main facility SBW isolation valve	2	manual operated shutoff valves in series at facility entrance				
9			SBW workoff tank inlet piping	1	main inlet pipe for SBW from tank farm				
10			SBW workoff tank vent line	1	tank vent line	4 inch			
11			SBW workoff tank	1	In facility storage tank for workoff	30,000 gal			1
12			SBW workoff tank heater	1	tank external heater coiled tube or jacket-steam heat exchange				
13			SBW workoff tank heater steam piping	1	steam piping to tank				
14			SBW workoff tank heater steam control valve	1	steam remote control valve and control components				
15			SBW workoff tank heater steam control valve manual valves	3	steam remote control valve isolation valves 2 upstream and 1 downstream				
16			SBW workoff tank pumps	2	centrifugal, 100 gpm				
17			SBW workoff tank valves	4	manual valves				
18			SBW workoff tank valves	5	remote operated valves				
19			SBW workoff tank strainers	2	mainly for system startup operations tests and use when needed				
20									
21			SBW workoff tank sample lines	2	Tank high and tank low	1 inch			
22			SBW workoff tank sample line valves	2	remote operated valves	1 inch			
23									
24			Frit hopper	1	frit supersack handler, bag opener and hopper				
25			Frit conveyor	1	closed conveyor to weigh conveyor bin				
26			Frit weigh conveyor bin	1					
27			Frit isolation valve	1	isolation valve between weigh conveyor and weigh conveyor bin				
28			Frit weigh conveyor	1					
29			Frit auger feeder hopper and auger feeder	1	auger feeder for metering frit to mix tanks				
30			Isolation valve	1	isolation valve between auger feeder and first diverter				
31			Frit diverter	3	1 input to 2 output diverters to feed 4 tanks				
32			Diverter piping	2	gravity feed piping between diverters				
33			Diverter piping	4	gravity feed piping between diverter and mix tank				
34			Diverter piping valve	4	Frit diverter to mix tank remote operated shutoff valve				
35									
36									
37			Sugar truck transport unloading station	1	liquid sugar tank truck pumped transfer-5000 gallon transport				
38			Sugar tank inlet isolation valve	2	manual operated shutoff valves in series at facility entrance				
39			Sugar storage tank inlet piping	1	inlet pipe for sugar tank				
40			Sugar storage tank vent line	1	tank vent line				
41			Sugar storage tank	1	facility storage tank for workoff	7,500 gal			7
42			Sugar storage tank heater	1	tank external heater coiled tube or jacket-steam heat exchange				
43			Sugar storage tank heater steam piping	1	steam piping to tank				
44			Sugar storage tank heater steam control valve	1	steam remote control valve and control components				

		Electrical						
Height (ft.)	Materials of Construction	Watt	HP	Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
	304 SS					High nitrates passivate 304 SS, chlorides, fluorides, mercury		
	304 SS					High nitrates passivate 304 SS		
	304 SS					High nitrates passivate 304 SS		
	nitronic 50							
44.0	nitronic 50					2 year workoil, 200 days/yr, 2-3 day capacity, High nitrates passivate 304 SS, evaporation reduces nitrate passivation benefits and increases chlorine issues		
	nitronic 50					steam heat exchange at tank to evaporate some of the water in the SBW		
	304 SS					304 SS for decon		
	304 SS							
	nitronic 50		3			Normal power		
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
	carbon steel					Frit is approximately 100 micron, calcine is approximately 200-500 micron		
	carbon steel		10			Normal power		
	carbon steel							
	carbon steel		1			Standby power		
	carbon steel		3			Normal power		
	carbon steel		25			Normal power		
	carbon steel		1			Standby power		
			1			Normal power		
	304 SS							
	304 SS							
	304 SS							
	304 SS							
	304 SS							
27.0	304 SS					Sugar to water ratio = 1:0.5 by volume - thick syrup		
	304 SS							
	304 SS							
	304 SS							

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Depth (ft.)
45			Sugar storage tank heater steam control valve manual valves	3	steam remote control valve isolation valves 2 upstream and 1 downstream				
46			Sugar storage tank pumps	2	Centrifugal				
47			Sugar storage tank valves	4	manual valves				
48			Sugar storage tank valves	5	remote operated valves				
49			Sugar tank piping water flush line	1					
50			Sugar tank piping water flush line valve	1	remote operated valves				
51			Sugar storage tank sample lines	1	tank low				
52			Sugar storage tank sample line valves	1	remote operated valves				
53									
54			Mix Tank #1						
55			Mix tank inlet piping	1	7 top inlet pipes from SBW workoff, sugar storage, frit storage, scrub blowdown recycle, mix tank recycle, CsIX end-of-life blowdown, grout mix tank decon waste recycle				
56			Mix tank inlet piping valves	7	inlet piping shutoff valves				
57			Mix tank vent line	1	tank vent line				
58			Mix tank	1	cooled mix tank to keep the SBW, sugar and frit in suspension and maintain temperature from exothermic reaction of sugar and nitric acid	5,000 gal			
59			Mix tank heat exchange loop	1	closed loop tank external coiled tubes or tank jacket chilled water to heat exchanger				
60			Mix tank chiller	1	closed loop refrigeration chiller to tank heat exchanger with circulating pump				
61			Mix tank cooler chiller piping	1	chiller piping to tank				
62			Mix tank cooler chilled water control valve	1	remote control valve and control components				
63			Mix tank cooler chilled water control valve manual valves	3	remote control valve isolation valves 2 upstream and 1 downstream				
64			Mix tank agitator	1	paddle				
65			Mix tank agitator motor	1	3-phase gear reduced	15 hp			
66			Mix tank pumps	2	progressive cavity-slurry pump				
67			Mix tank valves	4	manual valves				
68			Mix tank valves	3	remote operated valves				
69			Mix tank sample lines	2	tank high and tank low				
70			Mix tank sample line valves	2	remote operated valves				
71									
72			Mix Tank #2	1	Same as mix tank #1				
73			Mix Tank #3	1	Same as mix tank #1				
74			Mix Tank #4	1	Same as mix tank #1				
75									
76			Feed Tank # 1						
77			Feed tank inlet piping	1	1 inlet pipe from mix tanks				
78			Feed tank inlet piping valves	1	inlet piping shutoff valve				
79			Feed tank vent line	1	tank vent line				
80			Feed tank	1	heated tank to keep the SBW, sugar and frit in suspension and evaporate water from the slurry	5,000 gal			
81			Feed tank heater	1	tank external coiled tube or jacket heat exchange - steam				

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
	304 SS							
	304 SS		10			Normal power		
	304 SS							
	304 SS							
	304 SS							
	304 SS							
	304 SS							
	304 SS							
	nitronic 50							
	nitronic 50							
	nitronic 50							
25.0	nitronic 50					2 year workoff, 200 days/yr, 2-3 day capacity yields 4 x 5000 gallon mix tanks. High nitrates passivate 304 SS, evaporation reduces passivation benefits and increases chlorine issues		
	304 SS		2			Circulating motor - standby power		
		125	2			125 kw chiller, 420,000 BTU/hr thermal per tank, assume one tank operation at a time	\$22K each	Climate Technologies Corporation estimate, chiller @ 420,000 btuh @ \$21,250 each
	304 SS							
	304 SS							
	304 SS							
	nitronic 50							
			15			15 hp gear reduced, normal power		
						Standby power. The combined flow to the melter is 491 liter/hr (2.2 gpm) at s.g about 1.32. The pumps need to pump into 0 backpressure in the downstream equipment (feed and melter) but need to overcome head and friction losses. Assuming the pipes may extend 40-50 feet high or so plus friction losses gives a pressure head of say 80-90 feet or so. Say 100 feet pressure head or 45 psi. Tentatively rate pumps at 0.1-10 gpm at 50 psi, 1.32 s.g. slurry, nitronic 50 material (or high \$ hastelloy to compare).		
	nitronic 50		10					
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
25.0	nitronic 50					High nitrates passivate 304 SS, evaporation reduces passivation benefits and increases chlorine issues		
	304 SS							

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Dia (ft.)
82			Feed tank steam piping	1	steam piping to tank				
83			Feed tank steam control valve	1	remote control valve and control components				
84			Feed tank steam control valve manual valves	3	remote control valve isolation valves 2 upstream and 1 downstream				
85			Feed tank agitator	1	vertical top down paddle / impeller?				
86			Feed tank agitator motor	1	3-phase gear reduced	15 hp			
87			Feed tank pumps	2	positive displacement variable speed				
88			Feed tank valves	4	manual valves				
89			Feed tank valves	3	remote operated valves				
90			Feed tank sample lines	2	tank high and tank low				
91			Feed tank sample line valves	2	remote operated valves				
92			Feed tank piping water flush line	1	water flush to clean lines				
93									
94			Feed Tank #2	1	Same as feed tank #1				
95									
96		Melter							
97			Melter slurry input line	1	input line from feed tanks				
98			Vent line from feed, mix and SBW tanks	1					
99			Melter power supply	1					
100			Melter - HLW BSG glass	1	Stainless steel shell, refractory lined 1050-1100°C glass temp, 250-300°C plenum, approx 2 meter (6 ft) diameter melt surface	0.6 mt/m2-day		15.0	15.0
101			Melter taps	2	Teapot taps			3.0	3.0
102			Melter tapper / canister docking station	2	top down telescoping				
103			Melter camera	1	remote viewing remote replaceable				
104			Canister		typical HLW canister				2.0
105			Canister turntable	2	4 position turntable				
106			Canister turntable motor	1	5 hp gear reduced				
107			Canister turntable index controls	6	limit switch				
108			Canister turntable load cells	4					
109			Melter drain freeze valve	1					
110			Melter drain freeze valve cooling coils	1					
111			Melter drain freeze valve chiller	1					
112			Melter drain freeze valve cooling control	1					
113			Melter drain freeze valve heaters	3	SiC resistance heaters embedded				
114			Melter drain canister docking station	1					
115			Melter drain canister	1	end of life and safety drain				
116			Melter drain canister trolley	1	railroad tracks and dolly				
117									

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
	304 SS							
	304 SS							
	304 SS							
	nitronic 50							
			15			15 hp gear reduced - normal power		
						Standby power. The combined flow to the melter is 491 liter/hr (2.2 gpm) at s.g about 1.32. The pumps need to pump into 0 backpressure in the downstream equipment (feed and melter) but need to overcome head and friction losses. Assuming the pipes may extend 40-50 feet high or so plus friction losses gives a pressure head of say 80-90 feet or so. Say 100 feet pressure head or 45 psi. Tentatively rate pumps at 0.1-10 gpm at 50 psi, 1.32 s.g. slurry, nitronic 50 material (or high \$ hastelloy to compare).		
	nitronic 50		10					
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
	304 SS							
	304 SS							
	304 SS		15			Designed for solids-suspension		
	304 SS		2			Will not operate continuously		
	nitronic 50							
	nitronic 50							
		450-500 kW, 3 phase 460/7200 V input		<0.1		160 kW melter power to electrodes at 25-100 Volts (50 volts nominal) normal power; 210 kW, 460V 3 phase resistance heating to SiC lid heaters, normal power		
		joule electrodes 160 kW @ 50 volt, lid globars 209 kW				SS 304 shell, monofrax K-3 refractory, 1050-1100oC glass cold cap, 250-300oC headspace, SiC headspace heaters, 4 opposed inconel 690 electrodes, 2 high 2 low, teapot taps, bottom freeze valve drain, 12 TC embedded, 1 thermowell melt TC, one headspace TC, video camera, melter pressure -0.5'w.g. to -5.0'w.g.		
10.0	304 SS shell w/ refractory			100 rem				
4.0	304 SS shell w/ refractory			100 rem		Teapot tap vacuum assist with SiC embedded heaters		
				100 rem				
10.0	304L			78 rem		HLW canister, 8000 lb. weight limit, 2.0' dia x 10.0' high, 90-95% full, 0.7 m3 glass/canister, 68 rem, 3-50% Cs to glass		
	304 SS							
			5			normal power		
				78 rem				
				78 rem				
				78 rem				
				78 rem				
			5			5 hp trolley motor, normal power		

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Diameter (ft.)
118			Melter offgas duct	1					
119			Multi-stage secondary combustor						
120			Kerosene tank	1		5000 gal			
121			Stage 1 multichamber combustion	1	304L shell refractory lined, 2200oF reducing chamber 2 seconds residence, fuel/air burner with excess fuel	882 scmh			
122			Stage 1 to Stage 2 90 degree elbow	1	304L with refractory lined				
123			Stage 2 multichamber combustion	1	partial quench (water) chamber	991 scmh		14.0	

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
2.0	Haynes 188 or 304 L shell lined with refractory			50-100 rem				
							\$1,500,000	Estimate from vendor for typical industrial non-rad installation of similar size is \$1,000,000 for equipment + \$300,000 installation
	Cs			<0.1		One tanker truck is approximately 5000 gallon		
15.0	304L shell with refractory, assume high alumina refractory		1+1	25-100 rem		2200oF operation, reducing (sub stoichiometric) with excess fuel (kerosene), residence time of 2 seconds. Use burner running at stoichiometric and additional nozzle injecting additional fuel. Goal is to strip off oxygen from the nitrates (NOx). 882scmh (669 acfm) from melter, 3.0' ID x 5.5' OD x 15' high vertical, system pressure 0.5" w.g. to -5.0" w.g. High temperatures in presence of chlorides, fluorides and mercury present stress corrosion cracking issues. Assume 1 hp on burner fuel injection and 1 hp on kerosene injection pump, normal power. From John Zink Co. NOXidizer (TM) not insulated and emits 1-2 million btuh with skin temp 175-260oC	Multi-stage Combustor (all 3 stages) 400K-600K Carbon Steel, 600-900K Stainless	John Zink Co. NOXidizer (TM) budgetary quote
	304L shell with refractory, assume high alumina refractory			25-100 rem		304L elbow shell with refractory lining 2.0' ID x 4.4' OD long radius elbow with flanges each end, pressure -0.5"w.g. to -5.0" w.g., pressure -0.5" w.g. to -5.0" w.g.		
	304L shell with refractory assume high alumina			25-100 rem		Partial quench using water (or steam) to 1400oF operation, residence time of 1 second. 991 scmh inlet from stage 1, 179 l/hr water injection, 1235 scmh (2594 acfm) out at 1400oF. Should have CO, N2 very low NOx, Chlorine (96% of input -form?), fluorine (form?), particulates and condensable, some Cs (approx 50% of input), and volatile heavy metals (Hg); 2.0' ID x 4.4' OD x 14' long horizontal. May be able to shorten residence time and total length. Pressure -0.5" w.g. to -5.0" w.g. High temperatures in presence of chlorides, fluorides and mercury present stress corrosion cracking issues.		

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Dia. (ft.)
124			Stage 3 multichamber combustion	1	304L shell refractory lined, 1540oF oxidizing chamber with minimal excess air (oxygen), fuel/air burner (for heatup only) with excess air (oxygen) injection	1235	scmh	10.0	5.0
125			Stage 3 to quench 90 degree elbow	1	304L with refractory lined	1235	scmh		4.4
126									
127			Off-Gas Scrub Gas System						
128			Quench	1	full wet water quench from 1500-1800oF to 180-185oF	1235	scmh		2.0
129									
130			Emergency cooling tank	1	Water storage tank for emergency cooling water	1000	gal		3.5
131			Emergency cooling tank pumps	2	centrifugal, 20 gpm @ 50 psi	20	gpm		
132			Emergency cooling tank valves	4	manual valves	1	inch		
133			Emergency cooling tank valves	2	remote operated valves	1	inch		
134			Emergency cooling tank strainers	2	mainly for system startup operations tests and use when needed				
135			Emergency cooling water lines	1		0.75	inch		
136									
137			Venturi scrubber	1	venturi with knockout drum	2108	scmh		1.0

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
	304L shell with refractory assume high alumina		1 + 10	25-100 rem		1540oF operation, oxidizing with excess air (oxygen), residence time of about 1 second (non-controlling). Use burner for heatup only running at stoichiometric and additional air (oxygen) injecting nozzle. Goal is to oxidize the CO from stage 1 and 2 to CO2, with minimal excess air to minimize NOx regeneration. Using minimum excess air may require longer residence time to control for complete combustion. 1235 scmh in from stage 2 + 72 scmh air in = 1296 scmh (2931 acfm); 2.5' ID x 5.0' OD x 10' lg with about 1 second residence time. System pressure -0.5" w.g. to -5.0" w.g. Should have CO2, N2 very low NOx, Chlorine (96% of input -form?), fluorine (form?), particulates and condensable, some Cs (approx 50% of input), elemental Hg (form?), and other and volatile heavy metals. High temperatures in presence of chlorides, fluorides and mercury present stress corrosion cracking issues. Assume 1 hp on burner fuel injection and 10 hp on air injection blower, normal power.		
	304L shell with refractory, assume high alumina refractory			25-100 rem		304L elbow shell with refractory lining 2.0' ID x 4.4' OD long radius elbow with flanges each end, pressure -0.5" w.g. to -5.0" w.g. High temperatures in presence of chlorides, fluorides and mercury present stress corrosion cracking issues.		
15.0	hastelloy C22 or inconel 625			25-100 rem		Full wet water quench from 1500-1800oF to 180-185oF; two main nozzles, upper and lower approximate 5-10 gpm each, two emergency cooling nozzles from emergency cooling pumps/tank 5 gpm each. High temperatures in presence of chlorides, fluorides and mercury present stress corrosion cracking issues.	\$120-240K in Hastelloy C22 or Inconel 625	John Zink Co. quote, includes pumps, instrumentation and pH controls
14.0	304L			<0.1		Emergency cooling water tank mounted high in the facility		
			3	<0.1		3 hp, 20 gpm 50 psi water pumps, Standby power		
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
10.0	hastelloy C22 or inconel 625					Venturi with knockout drum, 2108 scmh (1,524 acfm) inlet gas @ 180-185oF, -0.5 to -5.0" w.g. downstream pressure 10" w.g. dP, 5.5 to -15" w.g. upstream; 2568 l/hr (11.6 gpm) scrub solution flow @ 45-55 psi. High temperatures in presence of chlorides, fluorides and mercury present stress corrosion cracking issues.	\$180-300K in Hastelloy C22 or Inconel 625	John Zink Co. quote, includes pumps, instrumentation and pH controls, stainless not recommended for HF

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Dia (ft.)
138			Demister	1		2022 scmh			
139			Demister cooler	1	tank external cooler coiled tube or jacket chilled water heat exchange				
140			Demister cooler chiller piping	1	chiller piping to tank				
141			Demister cooler chilled water control valve	1	remote control valve and control components				
142			Demister cooler chilled water control valve manual valves	3	remote control valve isolation valves 2 upstream and 1 downstream				
143									
144			Reheater #1	1	in-line reheater, 2022 scmh (1499 acfm) gas 180oF to 210oF reheat	2022 scmh			2
145			Reheater #2	1	in-line reheater, 2022 scmh (1499 acfm) gas 180oF to 210oF reheat	2022 scmh			2
146			Reheater manual valves	4					
147			Reheater remote control dampers	2					
148			Reheater electrical controls						
149									
150			HEPA filter housing and HEPA filters	1	HEPA filter bank 4 row x 2 HEPA filters 24"x24" x 12" with 24" x 24" x 6" prefilters and DOP test units				
151									
152			Charcoal filter units	2	bulk sulfur impregnated charcoal filter units for gas polishing and Hg capture	2025 scmh			6
153			Charcoal bed gas ducting		gas side ducting from HEPA bank to charcoal beds and from charcoal bed to fans, with bypass line	2025 scmh			1
154			Charcoal bed manual valves	4					
155			Charcoal bed remote control dampers	3	2 control dampers for beds and 1 bypass damper				
156			Charcoal bed charcoal fill piping	2	charcoal fill line	6 inch			0
157			Charcoal bed charcoal fill piping isolation valve	2	isolation valve	6 inch			0

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
10.0	hastelloy C22 or Inconel 625			<10 mr/hr		Demister with knockout drum, 2022 scmh (1,499 acfm) inlet gas @ 180-185oF, -10.5 to -15.0 " w.g. downstream pressure 1.0-3.0" w.g. dP, -11.5 to -18" w.g. upstream; 26 l/hr (0.12 gpm) condensed liquid back to scrub tank. High temperatures in presence of chlorides, fluorides and mercury present stress corrosion cracking issues.	\$17K in Inconel 625, (Style 326 Inconell 625 \$3,500, housing in Inconel 625 \$13,000)	Koch - Otto York estimate
	304L			<1 mr/hr			\$55K	Climate Technologies Corporation estimate, knockout drum chiller @ 1.35 million btuh @ \$54,150
	304L			<0.1 mr/hr				
	304L			<0.1 mr/hr				
	304L			<0.1 mr/hr				
4.0	hastelloy C22 or Inconel 625	75?		<10 mr/hr		2022 scmh (1,499 acfm) inlet gas @ 180oF, 210oF outlet temp., -11.5 to -18" w.g. pressure, 24 inch dia duct inlet and outlet, 8 ft/sec vel. 4.0' long. High temperatures in presence of chlorides, fluorides and mercury present stress corrosion cracking issues. Standby power.	\$14,000 each in Inconel 625	Caloritech Inc. estimate, 2-480V, 7 kW heaters in Inconel 625
4.0	hastelloy C22 or Inconel 625	75?		<10 mr/hr		redundant to reheater #1	\$14,000 each in Inconel 625	
				<10 mr/hr		for maintenance and changeout		
				<10 mr/hr		for automatic control of reheater		
						460 Volt input		
	316L			<1.0		2025 scmh (1581 acfm) inlet at 210oF and -18.0" w.g. housing outlet 205oF-210F at -18.0 to -21.0 " w.g. Outlet 12.0 dia 33 ft/sec (2000 fpm) outlet velocity; HEPA filter bank 4 row x 2 HEPA filters 24"x 24" x 12" with 24" x 24" x 6" prefilters and DOP test units. High temperatures in presence of chlorides even at ppm level and mercury present stress corrosion cracking issues.		
10.0	316L			<0.1		Bulk sulfur impregnated charcoal filter units for gas polishing and elemental Hg capture. 2025 scmh (1580 acfm) @ 205oF and -23" to -30" w.g. (-3.0 to -9.0" w.g. dP) 6.0' dia x 10' high, 0.9 ft/sec vel. 10 sec residence time. MERSORB (R) 1400 kg of mercury requires four batches of carbon, for redundancy five batches. Condensation in carbon beds will quickly clog the pores and make it ineffective, acid gases will liberate impregnated sulfur as H2S gas, organics > 2-5 ppm will rapidly clog the bed	\$100,000	Selective Adsorption Associates Inc. estimate, MERSORB (R) @ 4250 lb/batch @ \$4/lb X 5 batches = \$85,000, 2-housing in coated carbon stell @ \$5-7K each = \$10-15K
	316L			<0.1		2000 fpm (33 ft/sec) nominal velocity		
				<0.1				
	316L			<0.1				
	316L			<0.1				

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Diameter (ft.)
158			Charcoal storage bin						
159			Charcoal bed charcoal empty piping	2	charcoal fill line	6 inch			0
160			Charcoal bed charcoal empty piping isolation valve	2	isolation valve	6 inch			0
161			Spent charcoal storage bin	1					
162			Spent charcoal storage bin drum transfer system	1	drum transfer from spent charcoal bin to 55 gallon drums				
163									
164			Exhaust fans	3	3100 scmh (2550 acfm) @ 205oF and -40 inch w.g.; variable speed drives with variable speed frequency controller	3100 scmh			
165			Exhaust fan isolation valve	6	manual isolation valves	12 inch			12
166			Exhaust duct	1	2000-2700 fpm (33-45 f/sec), 14 inch diameter	2025 scmh			1
167									
168			CEM	1	Continuous emissions monitor	2025 scmh			
169			CEM shrouded probe in exhaust duct						
170			CEM instrument air compressor						
171			Iso-kinetic sample probe and sample system to CEM						
172			Offgas ducting to stack	1					
173			Offgas stack	1					
174									
175		Offgas Scrub Liquid Subsystem							
176			Quench tank	1	Holding tank for quench water mainly for system startup operations tests and use when needed	2000 gal			5
177			Quench pump strainers	2					
178			Quench #1 pump	1	centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle	10 gpm			
179			Quench #1 pump backup	1	redundant #1 quench pump	10 gpm			
180			Quench #2 pump	1	centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle	10 gpm			
181			Quench #2 pump backup	1	redundant #2 quench pump	10 gpm			
182			Quench tank piping manual valves	8	manual valves				
183			Quench tank piping valves	5	remote operated valves				
184			Quench line heat exchanger	2	in-line heat exchanger				
185			Quench line heat exchanger piping						
186			Quench line heat exchanger piping valves	2	manual isolation valves				
187			Quench line heat exchanger chiller	1	chiller with circulating pump				
188			Quench tank vent line	1	vent to quencher				
189			Quench tank sample lines	1	Tank low	1 inch			
190			Quench tank sample line valves	1	remote operated valves	1 inch			
191									
192			Quench tank to settling tank piping	1	drain pipe	6 inch			6
193			Quench tank to settling tank piping valve	1	remote operated valve				
194									
195			Settling tank	1	Holding tank for particulates and sludge from quench and scrub tanks	1000 gal			4
196			Settling tank blowdown recycle pump	1	solids/slurry pump, progressive cavity positive displacement variable speed, 20 gpm	20 gpm			

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
	304L			<0.1				
	316L			<0.1				
	316L			<0.1				
	304L			<0.1				
				<0.1				
						3100 scmh (2550 acfm) @ 205oF and -40 inch w.g.; variable speed drives with variable speed frequency controller, 2000 fpm exhaust nominal 33 f/s - 45 ft/s, 14 inch exhaust duct, standby power		
	CS		25	<0.1				
	304L			<0.1		2025 scmh (1580 acfm) @ 205oF, 2000-2700 fpm (33-45 f/sec), 14 inch diameter		
		5		<0.1		THC, O2, CO2, CO, HCL, Nox, 120 Volt UPS power		
	316L			<0.1				
			10	<0.1		air -40oF dewpoint oil-free, filtered, standby power		
	316L	5		<0.1		120 Volt UPS power		
	Lined carbon steel			<0.1		Size dependent on facility air volume + process air volume		
	Lined carbon steel			<0.1		Size dependent on facility air volume + process air volume		
15.0	nitronic 50							
	nitronic 50							
	nitronic 50		3			centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle, 10 gpm @ 55 psi per quench pump. Standby power		
	nitronic 50		3			centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle, 10 gpm @ 55 psi per quench pump. Standby power		
	nitronic 50		3			centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle, 10 gpm @ 55 psi per quench pump. Standby power		
	nitronic 50		3			centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle, 10 gpm @ 55 psi per quench pump. Standby power		
	nitronic 50							
	nitronic 50							
							\$35K	Climate Technologies Corporation estimate, 2 quench chillers @ 185,000 btuh @ \$17,250each
	304L							
	nitronic 50							
	nitronic 50							
	nitronic 50							
12.0	nitronic 50							
	nitronic 50		3			centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle, 10 gpm @ 55 psi per quench pump, normal power		

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Dia (ft.)
197			Settling tank pump backup	1	same as settling tank blowdown recycle pump		gpm		
198			Settling tank piping manual valves	2	manual valves				
199			Settling tank piping valves	4	remote operated valves				
200			Settling tank vent line	1	vent to quencher				
201			Settling tank sample lines	2	Tank high and tank low		1 inch		
202			Settling tank sample line valves	2	remote operated valves		1 inch		
203			Settling tank blowdown recycle piping	1	recycle back to mix tanks				
204			Settling tank piping to prefilter	1					
205			Settling tank piping to prefilter valve	3	remote operated valves				
206									
207			Scrub tank	1	Holding tank for scrub water mainly for system startup operations tests and use when needed	2000 gal			5
208			Scrub pump strainers	2					
209			Scrub #1 pump	1	centrifugal, (2530 l/hr / 2) 11.5 gpm total scrub water to scrubber	12 gpm			
210			Scrub #1 pump backup	1	redundant #1 quench pump	10 gpm			
211			Scrub tank piping manual valves	6	manual valves				
212			Scrub tank piping valves	3	remote operated valves				
213			Scrub tank vent line	1	vent to quencher				
214			Scrub tank sample lines	1	Tank low		1 inch		
215			Scrub tank sample line valves	1	remote operated valves		1 inch		
216									
217			Scrub tank to settling tank piping	1	drain pipe		6 inch		6
218			Scrub tank to settling tank piping valve	1	remote operated valve				
219									
220			Fresh water makeup piping to scrub tank	1			1 inch		
221			Fresh water makeup piping valves	2	manual isolation valves		1 inch		
222			Fresh water makeup piping valves	1	remote operated valve		1 inch		
223									
224			Caustic solution mix tank	1	manual input of caustic to tank, DI facility manual input to tank	500 gal			
225			Caustic injection pump	1	caustic metering pump	2 gpm			
226			Caustic injection pump backup	1	same				
227			Caustic tank piping manual valves	4	manual valves		1		
228			Caustic tank piping valves	2	remote operated valves		1		
229			Caustic tank sample lines	1	Tank low		1 inch		
230			Caustic tank sample line valves	1	remote operated valves		1 inch		
231									
232			Scrub water cleanup system						
233			CsIX resin storage bin		truck unloading station				
234			CsIX resin prep tank						
235			CsIX resin prep tank DI water inlet piping						
236			CsIX resin prep tank slurry pump	1					
237			CsIX resin prep tank pump piping valves	2	manual isolation				
238			CsIX resin prep tank outlet piping to CsIX columns						
239									
240			CsIX prefilter	1					
241			Prefilter valves manual	2	isolation		2 inch		
242			Prefilter valves remote	1	Control		2 inch		
243			CsIX columns	3	plumbed for any two in series, one offline				
244			CsIX columns inlet piping	1	inlet piping from CsIX storage		2 inch		
245			CsIX columns bulk inlet piping valve	3	pneumatic transfer		2 inch		
246			CsIX columns piping				2 inch		
247			CsIX columns effluent piping	2 l/hr			2 inch		
248			CsIX columns effluent piping valve	1	remote		2 inch		
249			CsIX columns piping valves	12	remote		2 inch		
250			CsIX columns outlet blowdown piping				2 inch		
251			CsIX columns outlet blowdown piping valves	7	3 on columns and 4 on tank inlets - remote		2 inch		

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
	nitronic 50		3			centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle, 10 gpm @ 55 psi per quench pump, normal power		
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
15.0	nitronic 50							
	nitronic 50							
	nitronic 50		3			centrifugal, (2530 l/hr / 2) 111.5 gpm total scrub water to scrubber, 15 gpm @ 55 psi per scrub pump, standby power		
	nitronic 50		3			centrifugal, (2314 l/hr / 2) 10.4 gpm total quench 6 gpm/nozzle, 10 gpm @ 55 psi per quench pump, standby power		
	nitronic 50							
	nitronic 50							
	nitronic 50							
	nitronic 50							
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
	304L		1	<0.1		Normal power		
	304L		1	<0.1		Normal power		
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
	304L			<0.1				
	304L		3	<0.1		Normal power		
	304L			<0.1				
	304L			<0.1				
	Nitronic 50							
	Nitronic 50							
	Nitronic 50							
	316L							
	316L							
	316L							
	316L			3 mr/hr		low rad after CSIX columns		
	316L							
	316L							
	316L							

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Dia (ft.)
252			CsIX columns inlet pump	1	between prefilter and columns 2 l/hr (0.01 gpm)				
253			CsIX column end of life blowdown pump	1	pump for end of life blowdown, progressive cavity positive displacement 5-10 gpm		1		
254									
255			CsIX effluent resins fines filters	2					
256			CsIX effluent resins fines filters piping valves	5	manual isolation valves				
257			CsIX effluent storage tank expansion tank	1	closed bladder tank	50 gal			
258			CsIX effluent storage tank	1	Storage tank for effluent	2000 gal			
259			CsIX effluent storage tank pump	2		5 gpm			
260			CsIX effluent storage tank pump valves	5	manual isolation				
261			CsIX effluent storage tank outlet piping			1 inch			
262									
263			Secondary waste grout subsystem						
264			Truck unloading station						
265			Grout pre-mix sample station	1					
266			Grout pre-mix bin	1		7500 gal			
267			Grout outlet piping			2 inch			
268			Grout outlet piping valve			2 inch			
269			Grout outlet eductor			2 inch			
270			Grout outlet piping eductor air supply		100 psi plant air				
271			Grout outlet piping eductor air supply valve	1					
272			Grout Pre-mix weigh bin	1		50 gallon			
273			Grout Pre-mix weigh conveyor	1					
274			Grout Pre-mix weigh conveyor isolation valve	1					
275			Grout mixer	1					
276			Grout cure rate chemical storage tank	1		50 gal			
277			Grout cure rate chemical storage tank piping			1 inch			
278			Grout cure rate chemical storage tank pump	1		2 gpm			
279			Grout cure rate chemical storage tank pump isolation valves	2	manual isolation	1 inch			
280									
281			Grout mixer wash tank	1		1000 GAL			
282			Grout mixer wash tank piping						
283			Grout mixer wash tank pump	1					
284			Grout mixer wash tank pump isolation valves	2					
285			Grout mixer wash tank sample line	1		1 inch			
286			Grout mixer wash tank sample line valve	1		1 inch			
287			Grout mixer wash tank decon chemical storage tank piping						
288			Grout mixer wash tank decon chemical storage tank pump	1					
289			Grout mixer wash tank chemical storage tank pump isolation valves	2					
290			Grout mixer wash tank DI water storage tank piping						
291			Grout mixer wash tank DI water storage tank pump	1					
292			Grout mixer wash tank DI water storage tank pump isolation valves	2					
293									
294			Spent decon pump						
295			spent decon filter						
296			Mixer decon waste water tank	1		1000 gal			
297			Mixer decon waste water tank pump	1	recycle to main mix tanks				
298			Mixer decon waste water tank pump valves	2	manual isolation valves				
299									
300			Mixed grout sample system						
301			Empty drum transfer system		manual transfer				

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
	316L		1			Normal power		
	316L		3			Normal power		
	316L			3 mr/hr				
	316L			3 mr/hr				
	316L			3 mr/hr				
	316L			3 mr/hr				
	316L		1	3 mr/hr		Normal power		
	316L			3 mr/hr				
	316L			3 mr/hr				
	304 L			<0.1				
	304 L			<0.1				
	304 L			<0.1		cement truck transport 1000 ft3 (7500 gallon)		
	304 L			<0.1				
	304 L			<0.1				
	304 L		100	<0.1		100 horsepower oil flooded rotary screw with -40oF dryer, normal power		
	304 L			<0.1				
	304 L			<0.1				
	304 L		1	<0.1		normal power		
	304 L			<0.1				
	304 L			3 mr/hr		normal power, 3 hp gear reduced		
	304 L			<0.1				
	304 L			<0.1				
	304 L		1	<0.1		Normal power		
	304 L			<0.1				
	304 L			<10 mr/hr				
	304 L			<10 mr/hr				
	304 L		1	<10 mr/hr		Normal power		
	304 L			<10 mr/hr				
	304 L			<10 mr/hr				
	304 L			<10 mr/hr				
	304 L		1	<10 mr/hr		Normal power		
	304 L			<10 mr/hr				
	304 L			<10 mr/hr				
	304 L		1	<10 mr/hr		Normal power		
	304 L			<10 mr/hr				
	304 L			<10 mr/hr				
	304 L		1	<10 mr/hr		Normal power		
	304 L			<10 mr/hr				
	304 L			<10 mr/hr				

Line	Equipment Number	Subsystem	Component Item	Number Required	Description	Size or Capacity	Units	Length (ft.)	Width or Di (ft.)
302			Mixed grout drum fill station						
303			Mixed grout drum weigh scale			2000 lb			
304			Filled drum transfer system		manual transfer				
305			Drum swipe sample						

Height (ft.)	Materials of Construction	Electrical		Radiation Field	Flow Diagram	Notes or Reference	Estimated Cost	Estimated Cost Basis
		Watt	HP					
	304 L							
	304 L							

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
LT	1	Level Transmitter at Frit bin	E-2	1							
LT	2	Level Transmitter at SWB Work Off Storage Tank	E-2	1							
TT	3	Temp Transmitter at SWB Work Off Storage Tank	E-2	1							
LT	4	Level Transmitter at Mixing Tank No.1	E-2	1							
TT	5	Temp Transmitter at Mixing Tank No.1	E-2	1							
LT	6	Level Transmitter at Mixing Tank No.2	E-2	1							
TT	7	Temp Transmitter at Mixing Tank No.2	E-2	1							
LT	8	Level Transmitter at Mixing Tank No.3	E-2	1							
TT	9	Temp Transmitter at Mixing Tank No.3	E-2	1							
LT	10	Level Transmitter at Mixing Tank No.4	E-2	1							
TT	11	Temp Transmitter at Mixing Tank No.4	E-2	1							
LT	12	Level Transmitter at SBW/Frit Feed Tank No.1	E-2	1							
TT	13	Temp Transmitter at SBW/Frit Feed Tank No.1	E-2	1							
LT	14	Level Transmitter at SBW/Frit Feed Tank No.2	E-2	1							
TT	15	Temp Transmitter at SBW/Frit Feed Tank No.2	E-2	1							
LT	16	Level Transmitter at Sugar Storage Tank	E-2	1							
TT	17	Temp Transmitter at Sugar Storage Tank	E-2	1							
CV	18	Steam Control Valve at Sugar Storage Tank	E-2		1						
M	19	Material Handling Conveyor for Frit	E-2			1	1	1	10		
M	20	Frit Weight Conveyor	E-2			1	1	1	3		
M	21	Frit Auger Feeder	E-2			1	1	1	25		
M	22	SBW Feed Pump No.1	E-2			1	1	1	3		
M	23	SBW Feed Pump No.2	E-2			1	1	1	3		
M	24	Feed Pump No.1 from Mixing Tank No.1	E-2			1	1	1	10		
M	25	Feed Pump No.2 from Mixing Tank No.2	E-2			1	1	1	10		
M	26	Feed Pump No.1 from Mixing Tank No.2	E-2			1	1	1	10		
M	27	Feed Pump No.2 from Mixing Tank No.2	E-2			1	1	1	10		

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
M 28		Feed Pump No.1 from Mixing Tank No.3	E-2			1	1	1	10		
M 29		Feed Pump No.2 from Mixing Tank No.3	E-2			1	1	1	10		
M 30		Feed Pump No.1 from Mixing Tank No.4	E-2			1	1	1	10		
M 31		Feed Pump No.2 from Mixing Tank No.4	E-2			1	1	1	10		
M 32		Feed Pump No.1 from Sugar Storage Tank	E-2			1	1	1	10		
M 33		Feed Pump No.2 from Sugar Storage Tank	E-2			1	1	1	10		
M 34		Feed Pump No.1 from SBW/Frit Feed Tank No.1	E-2			1	1	1	10		Standby Power
M 35		Feed Pump No.2 from SBW/Frit Feed Tank No.1	E-2			1	1	1	10		Standby Power
M 36		Feed Pump No.1 from SBW/Frit Feed Tank No.2	E-2			1	1	1	10		Standby Power
M 37		Feed Pump No.2 from SBW/Frit Feed Tank No.2	E-2			1	1	1	10		Standby Power
WT 38		Weight Controller for Frit Weight Conveyor	E-2	1							
IV 39		Isolation Valve at discharge of Frit Feed bin	E-2			2	2				
IV 40		Isolation Valve at discharge of Frit Auger feed	E-2			2	2				
IV 41		Isolation Valve at feed input to Mixing Tank No.1	E-2			2	2				
IV 42		Isolation Valve at feed input to Mixing Tank No.2	E-2			2	2				
IV 43		Isolation Valve at feed input to Mixing Tank No.3	E-2			2	2				
IV 44		Isolation Valve at feed input to Mixing Tank No.4	E-2			2	2				
M 45		Agitator for Mixing Tank No.1	E-2			1	1	1	5		
M 46		Agitator for Mixing Tank No.2	E-2			1	1	1	5		
M 47		Agitator for Mixing Tank No.3	E-2			1	1	1	5		
M 48		Agitator for Mixing Tank No.4	E-2			1	1	1	5		
M 49		Agitator for SBW/FRIT feed tank No.1	E-2			1	1	1	5		
M 50		Agitator for SBW/FRIT feed tank No.2	E-2			1	1	1	5		

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwrg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV 51		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 52		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 53		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 54		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 55		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 56		Remotely operated Valve at discharge of SWB Work Off Storage Tank-sample S3	E-2			2	2				
SOV 57		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 58		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 59		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 60		Remotely operated Valve at discharge of SWB Work Off Storage Tank	E-2			2	2				
SOV 61		Remotely operated Valve at discharge of SWB Work Off Storage Tank-sample S4	E-2			2	2				
SOV 62		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 63		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 64		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 65		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 66		Remotely operated Valve feeding Scrub Blowdown Recycle to Mixing Tank No.1	E-2			2	2				
SOV 67		Remotely operated Valve associated with 5000 gal Mixing Tank No.1-sample S5	E-2			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV 68		Remotely operated Valve associated with 5000 gal Mixing Tank No.1- sample S6	E-2			2	2				
SOV 69		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 70		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 71		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 72		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 73		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 74		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 75		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 76		Remotely operated Valve associated with 5000 gal Mixing Tank No.1	E-2			2	2				
SOV 77		Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV 78		Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV 79		Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV 80		Remotely operated Valve feeding Scrub Blowdown Recycle to Mixing Tank No.2	E-2			2	2				
81		UNUSED NUMBER									
SOV 82		Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV 83		Remotely operated Valve associated with 5000 gal Mixing Tank No.2- Sample S7	E-2			2	2				
SOV 84		Remotely operated Valve associated with 5000 gal Mixing Tank No.2-Sample S8	E-2			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	85	Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV	86	Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV	87	Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV	88	Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV	89	Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV	90	Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV	91	Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV	92	Remotely operated Valve associated with 5000 gal Mixing Tank No.2	E-2			2	2				
SOV	93	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	94	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	95	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	96	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
	97	UNUSED NUMBER									
SOV	98	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	99	Remotely operated Valve associated with 5000 gal Mixing Tank No.3- Sample S9	E-2			2	2				
SOV	100	Remotely operated Valve associated with 5000 gal Mixing Tank No.3- Sample S10	E-2			2	2				
SOV	101	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	102	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	103	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	104	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	105	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	106	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	107	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	108	Remotely operated Valve associated with 5000 gal Mixing Tank No.3	E-2			2	2				
SOV	109	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV	110	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV	111	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV	112	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
	113	UNUSED NUMBER									
SOV	114	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV	115	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV	116	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV	117	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV	118	Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV 119		Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV 120		Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV 121		Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV 122		Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV 123		Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV 124		Remotely operated Valve associated with 5000 gal Mixing Tank No.4	E-2			2	2				
SOV 125		Remotely operated Valve feeding Scrub Blowdown Recycle to Mixing Tank No.3	E-2			2	2				
SOV 126		Remotely operated Valve feeding Scrub Blowdown Recycle to Mixing Tank No.4	E-2			2	2				
SOV 127		Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV 128		Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV 129		Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV 130		Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV 131		Remotely operated Valve associated with Sugar Storage Tank- Sample S2	E-2			2	2				
SOV 132		Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV 133		Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV 134		Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV 135		Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	136	Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV	137	Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV	138	Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV	139	Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV	140	Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV	141	Remotely operated Valve associated with Sugar Storage Tank	E-2			2	2				
SOV	142	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT	E-2			2	2				
SOV	143	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT-Sample S13	E-2			2	2				
SOV	144	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT	E-2			2	2				
SOV	145	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT	E-2			2	2				
SOV	146	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT	E-2			2	2				
SOV	147	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT-Sample S14	E-2			2	2				
SOV	148	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT	E-2			2	2				
SOV	149	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT	E-2			2	2				
SOV	150	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT	E-2			2	2				
SOV	151	Remotely operated Valve associated with 5000 gallon feed tank No.1 for SBW/FRIT	E-2			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	152	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT	E-2			2	2				
SOV	153	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT-Sample S15	E-2			2	2				
SOV	154	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT-Sample S16	E-2			2	2				
SOV	155	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT	E-2			2	2				
SOV	156	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT	E-2			2	2				
SOV	157	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT	E-2			2	2				
SOV	158	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT	E-2			2	2				
SOV	159	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT	E-2			2	2				
SOV	160	Remotely operated Valve associated with 5000 gallon feed tank No.2 for SBW/FRIT - Flush Water	E-2			2	2				
SPD	161	Control Signal to control speed of FRIT auger feeder	E-2		1						
TT	162	Temp xmtr - t/c #1, Stage 1 Multi-State Combustor	E-2	1							
TT	163	Temp xmtr - t/c #2, Multi-State Combustor	E-2	1							
AT	164	O2 Analyzer/xmtr, Multi-State Combustor	E-2	1							Oxygen Analyzer
DP	165	Press xmtr, Stage 1 Multi-State Combustor	E-2	1							
TT	166	t/c Temp xmtr, Melter-Deep thermowell No.1	E-2	1							
TT	167	t/c Temp xmtr, Melter Bottom No. 1	E-2	1							
TT	168	t/c temp xmtr, Melter Tap No. 1	E-2	1							
TT	169	t/c Temp xmtr, Melter Tap No.2	E-2	1							

VIT of SBW Sequential Tag List for all Devices

<u>PFX</u>	<u>Num</u>	<u>DESCRIPTION</u>	<u>dwg</u>	<u>An</u> <u>in</u>	<u>An</u> <u>out</u>	<u>Disc</u> <u>in</u>	<u>Disc</u> <u>out</u>	<u>Mtr</u>	<u>Mtr</u> <u>Hp</u>	<u>Other</u> <u>Loads</u> <u>(kw)</u>	<u>Comments</u>
TT	170	t/c Temp xmtr, Melter-Deep thermowell No.2	E-2	1							
TT	171	t/c Temp xmtr, Melter Bottom No.2	E-2	1							
TT	172	t/c Temp xmtr, Melter Cold cap No.1	E-2	1							
TT	173	t/c Temp xmtr, Melter Cold cap No.2	E-2	1							
VC	174	Video Camera at Melter	E-2	1							
WT	175	Load Cell Controller at Turntable	E-3	1							The purpose of the load cell and weight controller will be for a gross weight check on the canister being filled. The entire turntable will have to be supported by a structure that is loaded on at least three load cells.
M	176	Transport Cart for Drain Canister	E-3								Canister would sit on a cart situated on a linear track. A motor controlled by a reversible, soft start/stop controller. The cart would be positioned under the spout by fixed restraint and limit switch to deactivate the VFD.
VFD	177	soft/start/stop/rev Controller	E-3			1	1	1	5		
OEM	178	Stage 1 OEM Controller for Multi-State Combustor Furnace {See Note 1 at end of report}				2	2	1			
		Multi-State Combustor Furnace, Stage 1 Air Valve or Damper - furnished with OEM furnace package	E-3	2	2	2	2				Assume - OEM furnished controller for Multi-State Combustor Furnish
CV	179	Multi-State Combustor Furnace, Stage 1 fuel valve, furnished with OEM furnace package	E-3	1							Modulating Control valve- assumed furnished with OEM designed and supplied Multi-State Combustor Furnace
CV	180										Modulating Control valve- assumed furnished with OEM designed and supplied Multi-State Combustor Furnace
			E-3	1							Question - What is going on here with the Kerosene? Is the flow of Kerosene being controlled into the furnace? What is it's relationship with the regular fuel into the furnace?
	181	UNUSED NUMBER	E-3	1							

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
CV	182	Multi-State Combustor Furnace, Stage 3 fuel valve - furnished with OEM furnace package	E-3	1							
CV	183	Multi-State Combustor Furnace, Stage 3 air valve or damper - furnished with OEM furnace package	E-3	1							
CV	184	RE-OX air valve or damper for Noxidizing furnace, Stage 3	E-3	1							
OEM	185	Stage 3 OEM Controller for Multi-State Combustor Furnace	E-3	2	2	2	2				
AT	186	O2 Analyzer/xmtr for Stage 3 Noxidizing furnace	E-3	1							Oxygen Analyzer
DP	187	Press xmtr after Stage 3 Quench	E-3	1							
DP	188	Press xmtr after stage 2 Quench	E-3	1							
TT	189	t/c Temp xmtr, sensing air on discharge from quencher	E-3	1							
LT	190	Level xmtr at Quench Tank	E-3	1							
TT	191	t/c temp xmtr at quench tank	E-3	1							
DP	192	press xmtr at quench tank	E-3	1							
LT	193	Level xmtr at 1000 gal settling tank	E-3	1							
TT	194	t/c Temp xmtr at 1000 gal settling tank	E-3	1							
DP	195	Press xmtr at input air stream to demister	E-3	1							
DP	196	Press xmtr - input air stream to venturi scrubber	E-3	1							
LT	197	Level xmtr, 2000 gal scrub tank	E-3	1							
TT	198	t/c Temp xmtr at 2000 gal scrub tank	E-3	1							
LT	199	Level xmtr at caustic solution tank	E-3	1							
PH	200	ph xmtr at caustic solution tank	E-3	1							
TT	201	t/c Temp xmtr at caustic solution tank	E-3	1							
TT	202	t/c Temp xmtr at disch of stage 3 Multi-State Combustor	E-3	1							
LT	203	Level xmtr at prefilter Nitronic 50 #1	E-3	1							
TT	204	t/c Temp xmtr at prefilter nutronic 50 #1	E-3	1							
LT	205	Level xmtr at prefilter nutronic 50 #2	E-3	1							

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
TT	206	t/c Temp xmtr at prefilter nitronic 50 #2	E-3	1							
TT	207	t/c temp xmtr at quench stream #1	E-3	1							
TT	208	t/c temp xmtr quench stream #2	E-3	1							
S	209	Primary glass sample system - S17 {See Note 2 at end of report}	E-3								This sample system is yet to be defined
SOV	210	Remote operated Solenoid Valve on Discharge from 2000 gal quench tank to 1000 gal settling tank	E-3			2	2				
SOV	211	Remote operated Sampling Valve (S19) on discharge from 2000 gal quench tank	E-3			2	2				
SOV	212	Remote operated valve for overflow from 2000 gal quench tank to header for prefilter tanks #1 & #2	E-3			2	2				
SOV	213	Remote operated valve - infeed to prefilter Nitronic 50, Tank #1	E-3			2	2				
SOV	214	Remote operated valve - infeed to prefilter Nitronic 50, Tank #2	E-3			2	2				
SOV	215	Remote operated valve, disch from prefilter nitronic 50, tank #1	E-3			2	2				
SOV	216	Remote operated valve, f disch from prefilter nitronic 50, tank #2	E-3			2	2				
SOV	217	Remote sampling valve at 1000 gal settling tank (S22)	E-3			2	2				
SOV	218	Remote sampling valve at discharge of 1000 gal settling tank (S23)	E-3			2	2				
SOV	219	Remote discharge valve at 1000 gal settling tank	E-3			2	2				
SOV	220	Remote pump bypass valve on discharge from 1000 gal settling tank	E-3			2	2				
M	221	Scrub Blowdown Pump #1	E-3			1	1	1	10		
M	222	Scrub Blowdown Pump #2	E-3			1	1	1	10		
SOV	223	Scrub blowdown pump #2, downstream isolation valve	E-3			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	224	Scrub blowdown pump #2, upstream isolation valve	E-3			2	2				
SOV	225	Scrub blowdown pump #1, downstream isolation valve	E-3			2	2				
SOV	226	Scrub blowdown pump #1, upstream isolation valve	E-3			2	2				
SOV	227	Quench liquid - upstream valve assembly	E-3			2	2				
SOV	228	Quench liquid - upstream valve assembly	E-3			2	2				
SOV	229	Quench liquid - upstream valve assembly	E-3			2	2				
SOV	230	Quench liquid - upstream valve assembly	E-3			2	2				
SOV	231	Quench liquid - upstream valve assembly	E-3			2	2				
SOV	232	Isolation valve - input to main pump - quench #1	E-3			2	2				
SOV	233	Isolation valve - discharge from main quench pump #1	E-3			2	2				
SOV	234	Isolation valve - input to backup quench pump #1	E-3			2	2				
SOV	235	Isolation valve - discharge from backup quench pump #1	E-3			2	2				
SOV	236	Isolation valve - input to main quench pump #2	E-3			2	2				
SOV	237	Isolation valve - discharge from main quench pump #2	E-3			2	2				
SOV	238	Isolation valve - input to backup quench pump #2	E-3			2	2				
SOV	239	Isolation valve - discharge from backup quench pump #2	E-3			2	2				
M	240	Main pump - Quench #1	E-3			1	1	1	3		Standby Power
M	241	Backup Pump - Quench #1	E-3			1	1	1	3		Standby Power
M	242	Main pump - Quench #2	E-3			1	1	1	3		Standby Power
M	243	Backup Pump - Quench #2	E-3			1	1	1	3		Standby Power
M	244	Discharge pump from prefilter Nitronic 50 tank	E-3			1	1	1	1		
PH	245	ph xmtr at 2000 gal scrub tank	E-3	1							

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV 246		Remote sampling valve at discharge of 2000 gal scrub tank (S20)	E-3			2	2				
SOV 247		Discharge valve at 2000 gal scrub tank	E-3			2	2				
SOV 248		Remote control valve for water feed to caustic solution tank	E-3			2	2				
SOV 249		Sample valve at caustic solution tank (S21)	E-3			2	2				
SOV 250		Remote discharge isolation valve for caustic metering pump #1	E-3			2	2				
SOV 251		Input isolation valve for caustic metering pump #1	E-3			2	2				
SOV 252		Discharge isolation valve for caustic metering pump #2	E-3			2	2				
SOV 253		Input isolation valve for caustic metering pump #2	E-3			2	2				
M 254		Caustic metering pump #1	E-3			1	1	1	1		
M 255		Caustic metering pump #2	E-3			1	1	1	1		
M 256		Venturi scrub pump #1	E-3			1	1	1	1		Standby Power
M 257		Venturi scrub pump #2	E-3			1	1	1	1		Standby Power
SOV 258		Input isolation valve for venturi scrub pump #1	E-3			2	2				
SOV 259		Discharge isolation valve for venturi scrub pump #1	E-3			2	2				
SOV 260		Input isolation valve for venturi scrub pump #2	E-3			2	2				
SOV 261		Discharge isolation valve for venturi scrub pump #2	E-3			2	2				
SOV 262		Venturi scrub liquid from 2000 gal scrub tank (valve cluster -1)	E-3			2	2				
SOV 263		Venturi scrub liquid from 2000 gal scrub tank (valve cluster -2)	E-3			2	2				
SOV 264		Venturi scrub liquid from 2000 gal scrub tank (valve cluster -3)	E-3			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	265	Venturi scrub liquid from 2000 gal scrub tank (valve cluster -4)	E-3			2	2				
SOV	266	Venturi scrub liquid from 2000 gal scrub tank (valve cluster -5)	E-3			2	2				
SOV	267	Remote control valve for fresh water makeup to 2000 gal scrub tank	E-3			2	2				
M	268	Main pump for emergency cooling water to quencher	E-3			1	1	1	3		Standby Power
M	269	Backup pump for emergency cooling water to quencher	E-3			1	1	1	3		Standby Power
SOV	270	Isolation valve at discharge of main pump for emergency cooling water to quencher	E-3			2	2				
SOV	271	Isolation valve at infeed to main pump for emergency cooling water to quencher	E-3			2	2				
SOV	272	Isolation valve at discharge of backup pump for emergency cooling water to quencher	E-3			2	2				
SOV	273	Isolation valve at infeed to backup pump for emergency cooling water to quencher	E-3			2	2				
TT	274	t/c temp xmtr for air discharge from demister	E-3	1							
LT	275	Level xmtr for emergency cooling water tank	E-3	1							
TT	276	t/c temper xmtr for emergency cooling water tank	E-3	1							
SOV	277	Partial water quench - remote valve (Input to stage 2)	E-3			2	2				
SOV	278	Remote valve for suction tap assis/vent at melter	E-3			2	2				
M	279	Makeup air fan no.1 for process air to HEPA filters 1-11	E-6			1	1	1	60		
M	280	Makeup air fan no.2 for process air to HEPA filters 1 - 11	E-6			1	1	1	60		

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr Hp	Other Loads (kw)	Comments
M	281	Makeup air fan no.3 for process air to HEPA filters 1-11	E-6			1	1	1	60	
BFV	282	Input isolation valve for fan no.1 - process air to HEPA filters 1-11	E-6			2	2			Butterfly valve
BFV	283	Output isolation valve for fan no.1 - process air to HEPA filters 1-11	E-6			2	2			Butterfly valve
BFV	284	Input isolation valve for fan no.2 - process air to HEPA filters 1-11	E-6			2	2			Butterfly valve
BFV	285	Output isolation valve for fan no.2 - process air to HEPA filters 1-11	E-6			2	2			Butterfly valve
BFV	286	Input isolation valve for fan no.3 - process air to HEPA filters 1-11	E-6			2	2			Butterfly valve
BFV	287	Output isolation valve for fan no.3 - process air to HEPA filters 1-11	E-6			2	2			Butterfly valve
RAD	288	Radiation monitor for stack stream {See Note 4 at end of report}	E-7							
	289	UNUSED NUMBER								
ISO	290	ISO Kinetic sampling Instrument {This is an expensive type of instrumentation}	E-7							
TT	291	t/c temperature xmtr for makeup air for offices and other rooms	E-7	1						
TT	292	t/c temperature xmtr for makeup air for crane control room, control room, and computer room	E-7	1						
TT	293	t/c temperature xmtr for makeup air for elec room near offices, comm room, and mechanical room	E-7	1						
BFV	294	Isolation valve on input to makeup air fan for offices and other rooms	E-7			2	2			Butterfly Valve
BFV	295	Isolation valve on output of makeup air fan for offices and other rooms	E-7			2	2			Butterfly Valve
BFV	296	Isolation valve on input to makeup air fan for crane control room, control room, and computer room	E-7			2	2			Butterfly Valve

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An. in	An. out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
BFV 297		Isolation valve on output of makeup air fan for crane control room, control room, computer room	E-7			2	2				Butterfly Valve
BFV 298		Isolation valve on input of makeup air fan for elec room, near offices, comm room, & mechanical room	E-7			2	2				Butterfly Valve
BFV 299		Isolation valve on output of makeup air fan for elec room, near offices, comm room, & mechanical room	E-7			2	2				Butterfly Valve
	300	UNUSED NUMBER									
	301	UNUSED NUMBER									
	302	UNUSED NUMBER									
CV 303		Steam control valve for heating of makeup air for elec room near offices, comm room, and mechanical room	E-7		1						
M 304		HEPA filters 29-37 - downstream fan no.1	E-6			1	1	1	1	60	
M 305		HEPA filters 29-37 - downstream fan no.2	E-6			1	1	1	1	60	
M 306		HEPA filters 29-37 - downstream fan no.3	E-6			1	1	1	1	60	
BFV 307		Input isolation valve to downstream fan no.1 - HEPA filters 29-37	E-4			2	2				Butterfly Valve
BFV 308		Output isolation valve to downstream fan no.1 - HEPA filters 29-37	E-4			2	2				Butterfly Valve
BFV 309		Input isolation valve to downstream fan no.2 - HEPA filters 29-37	E-7			2	2				Butterfly Valve
BFV 310		Output isolation valve to downstream fan no.2 - HEPA filters 29-37	E-7			2	2				Butterfly Valve
BFV 311		Input isolation valve to downstream fan no.3 - HEPA filters 29-37	E-7			2	2				Butterfly Valve
BFV 312		Output isolation valve to downstream fan no.3 - HEPA filters 29-37	E-7			2	2				Butterfly Valve
M 313		Makeup air fan for offices and other rooms	E-7			1	1	1	1	15	
M 314		Makeup air fan for crane control room, control room, and computer room	E-7			1	1	1	1	15	

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
M	315	Makeup air fan for elec room near offices, comm room, and mechanical room	E-7			1	1	1	3		
HTR	316	Steam heater coil for makeup air for offices and other rooms	E-7								No I/O or electrical energy requirement
HTR	317	Steam heater coil for makeup air for crane control room, control room, and computer room	E-7								No I/O or electrical energy requirement
HTR	318	Steam Heater for makeup air for elec room near offices, comm room, and mechanical room	E-7								No I/O or electrical energy requirement
CHL	319	Chiller for makeup air for offices and other rooms	E-7			1	1	1	88		No I/O or electrical energy requirement 88 hp is the portion of 181 hp calculated for the chiller for the HVAC system (non-HEPA filtered air)
CHL	320	Chiller coil for makeup air for crane control room, control room, and computer room	E-7			1	1	1	85		85 hp is the portion of 181 hp calculated for the chiller for the HVAC system (non-HEPA filtered air)
SOV	321	Remote operated valve to control refill of carbon fill to carbon w/sulfur bed No.1	E-4			2	2				
BFV	322	Remote controlled butterfly valve to control air flow from top of Carbon bed No.1 to input header of HEPA ID fans	E-4			2	2				Butterfly Valve
SOV	323	Remote Sample valve out of Cabon bed No.1	E-4			2	2				
BFV	324	Remote discharge damper out of Carbon Bed No.1 to HG retort packaging	E-4			2	2				Butterfly Valve
BFV	325	Remote damper to control air flow from HEPA filters to input of activated carbon w/sulfur bed No.1	E-4			2	2				Butterfly Valve
BFV	326	Remote bypass damper to permit bypass of air stream from HEPA filters directly to input of HEPA ID fan header	E-4			2	2				Butterfly Valve
SOV	327	Remote operated valve to control refill of activated carbon fill to carbon w/sulfur bed No.2	E-4			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
BFV 328		Remote controlled damper to control air flow from top of Carbon bed No.2 to input header of HEPA ID fans	E-4			2	2				Butterfly Valve
BFV 329		Remote damper to control air flow from HEPA filters to input of activated carbon w/sulfur bed No.2	E-4			2	2				Butterfly Valve
SOV 330		Remote Sample valve out of Carbon bed No.2	E-4			2	2				
SOV 331		Remote discharge valve out of Carbon Bed No.2 to HG retort packaging	E-4			2	2				
M 332		CSIX resin prep tank discharge pump	E-5			1	1	1	10		
M 333		CSIX 316L discharge pump	E-5			1	1	1	10		
M 334		CSIX effluent Pump No. 1 discharging from CSIX effluent storage tank (2000 gal)	E-5			1	1	1	10		
M 335		CSIX effluent Pump No.2 discharging from CSIX effluent storage tank (2000 gal)	E-5			1	1	1	10		
M 336		Metering pump discharging from the Grout Cure Rate Chemical Storage 316L tank	E-5			1	1	1	10		
M 337		Mixer Wash Pump, discharging from 316L Mixer wash tank (1000 gal)	E-5			1	1	1	10		
M 338		Mixer Decon Pump, discharging from Grout Mixer, forcing decon fluid through spent decon filter	E-5			1	1	1	10		
M 339		Decon Chemical Storage tank discharge pump, pumping to Mixer wash tank	E-5			1	1	1	10		
M 340		DI Water tank discharge pump, pumping to Mixer wash tank	E-5			1	1	1	10		
M 341		Mixer Decon Waste Water Tank discharge pump, pumping to main mixing tanks 1, 2, 3, and 4	E-5			1	1	1	10		
SOV 342		Remote operated valve to control flow from CSIX resin prep tank to CSIX storage tank No.1	E-5			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	343	Remote operated valve to control flow from CSIX resin prep tank to CSIX storage tank No.2	E-5			2	2				
SOV	344	Remote operated valve to control flow from CSIX resin prep tank to CSIX storage tank No.3	E-5			2	2				
SOV	345	Remote operated valve to control flow from "Prefilter" header to CSIX Storage tank No.1	E-5			2	2				
SOV	346	Remote operated valve to control recycle flow from "CSIX Recycle" header back into CSIX Storage tank No.1	E-5			2	2				
SOV	347	Remote operated valve to control flow from "Prefilter" header to CSIX Storage tank No.2	E-5			2	2				
SOV	348	Remote operated valve to control recycle flow from "CSIX Recycle" header back into CSIX Storage tank No.2	E-5			2	2				
SOV	349	Remote operated valve to control flow from "Prefilter" header to CSIX Storage tank No.3	E-5			2	2				
SOV	350	Remote operated valve to control recycle flow from "CSIX Recycle" header back into CSIX Storage tank No.3	E-5			2	2				
SOV	351	Remote operated valve to control discharge of recycle from CSIX storage tank No.1 to recycle header	E-5			2	2				
SOV	352	Remote operated valve to control discharge of CSIX fluid from CSIX storage tank No.1	E-5			2	2				
SOV	353	Remote operated valve to control flow of resin fluid from CSIX storage tank No.1 to Resin Fines Filter header	E-5			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	354	Remote operated valve to control discharge of recycle from CSIX storage tank No.2 to recycle header	E-5			2	2				
SOV	355	Remote operated valve to control discharge of CSIX fluid from CSIX storage tank No.2	E-5			2	2				
SOV	356	Remote operated valve to control flow of resin fluid from CSIX storage tank No.2 to Resin Fines Filter header	E-5			2	2				
SOV	357	Remote operated valve to control discharge of recycle from CSIX storage tank No.3 to recycle header	E-5			2	2				
SOV	358	Remote operated valve to control discharge of CSIX fluid from CSIX storage tank No.3	E-5			2	2				
SOV	359	Remote operated valve to control flow of resin fluid from CSIX storage tank No.3 to Resin Fines Filter header	E-5			2	2				
SOV	360	Remote operated valve to control flow into "Resin Fines Filter No.1"	E-5			2	2				
SOV	361	Remote operated valve to control flow into "Resin Fines Filter No.2"	E-5			2	2				
SOV	362	Remote operated valve to control flow out of "Resin Fines Filter No.1"	E-5			2	2				
SOV	363	Remote operated valve to control flow out of "Resin Fines Filter No.2"	E-5			2	2				
SOV	364	Remote operated bypass valve around "Resin Fines Filters 1, & 2"	E-5			2	2				
SOV	365	Remote operated effluent sample valve	E-5			2	2				
SOV	366	Remote operated isolation valve permitting recycle of CSIX effluent back to effluent recycle header	E-5			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	367	Remote operated infeed valve to CSIX effluent storage tank (2000 gal) permitting recycle of effluent back to the storage tank	E-5			2	2				
SOV	368	Remote operated infeed valve to CSIX effluent Pump No.1	E-5			2	2				
SOV	369	Remote operated discharge valve to CSIX effluent Pump No.1	E-5			2	2				
SOV	370	Remote operated infeed valve to CSIX effluent Pump No.2	E-5			2	2				
SOV	371	Remote operated discharge valve to CSIX effluent Pump No.2	E-5			2	2				
SOV	372	Remote operated isolation valve permitting input of effluent into the Grout Mixer	E-5			2	2				
LT	373	Level xmtr at CSIX Resin Bin	E-5	1							
LT	374	Level xmtr at CSIX resin Prep tank	E-5	1							
TT	375	t/c temp xmtr at CSIX Resin Bin	E-5	1							
TT	376	t/c temp xmtr at CSIX Resin Prep Tank	E-5	1							
LT	377	Level xmtr at CSIX storage Tank No.1	E-5	1							
TT	378	t/c temp xmtr at CSIX storage tank No.1	E-5	1							
LT	379	Level xmtr at CSIX storage tank No.2	E-5	1							
TT	380	t/c temp xmtr at CSIX storage tank No.2	E-5	1							
LT	381	Level xmtr at CSIX storage tank No.3	E-5	1							
TT	382	t/c temp xmtr at CSIX storage tank No.3	E-5	1							
LT	383	Level xmtr at Grout Pre-Mix Bin	E-5	1							
WT	384	Load Cell - Weight Transmitter at Grout Pre-mix weigh bin	E-5	1							
LT	385	Level xmtr at Grout cure rate chemical storage tank	E-5	1							
LT	386	Level xmtr at decon chemical storage tank	E-5	1							
LT	387	Level xmtr at DI water tank	E-5	1							
LT	388	Level xmtr at Mixer wash tank (1000 gal)	E-5	1							
LT	389	Level xmtr at Mixer Decon Waste Water Tank (1000 gal)	E-5	1							

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
WT	390	Load Cell - Weight Transmitter at Cs drum weight scale	E-5	1							
M	391	Eductor for pre-mix grout to grout pre-mix weigh bin	E-5			1	1	1	10		
M	392	Grout Mixer	E-5			1	1	1	10		
SOV	393	Remote operated valve or rotary valve on discharge from grout pre-mix bin	E-5			2	2				
SOV	394	Remote operated infeed valve or rotary valve to control pre-mix grout material to grout pre-mix weigh bin	E-5			2	2				
M	395	weight conveyor motor for flow measurement of pre-mix grout to grout mixer	E-5			1	1	1	1		
FT	396	Flow xmtr, measuring pre-mix grout flow to grout mixer	E-5	1							
SOV	397	Remote isolation valve on discharge of pre-mix grout from weigh conveyor	E-5			2	2				
SOV	398	Remote operated discharge valve, controlling grout cure chemical to input of metering pump	E-5			2	2				
SOV	399	Remote operated isolation valve on discharge of chemical metering pump to the grout mixer	E-5			2	2				
SOV	400	remote operated sampling valve on discharge of chemical storage tank	E-5			2	2				
SOV	401	Remote operated discharge valve from decon chemical storage tank to infeed of Decon Chemical Pump	E-5			2	2				
SOV	402	Remote operated isolation valve on discharge of Decon chemical pump, pumping to mixer wash tank	E-5			2	2				
SOV	403	Remote operated discharge valve from DI water tank to infeed of DI water pump	E-5			2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
SOV	404	remote operated isolation valve on discharge from DI water feed pump to mixer wash tank	E-5			2	2				
SOV	405	Remote sampling valve on discharge of Mixer wash tank	E-5			2	2				
SOV	406	Remote operated discharge valve from Mixer wash tank to input of Mixer wash pump	E-5			2	2				
SOV	407	Remote operated valve to control recycle of decon fluid back to mixer wash tank	E-5			2	2				
SOV	408	Remote operated valve to control infeed of fluid to 1000 gal mixer decon waste water tank	E-5			2	2				
SOV	409	Remote operated sampling valve on discharge from 1000 gal mixer decon waste water tank	E-5			2	2				
SOV	410	Remote operated discharge valve to control input to wash pump that pumps to main mixing tanks 1, 2, 3, and 4	E-5			2	2				
SOV	411	Remote operated valve to control input to mixer decon pump	E-5			2	2				
SOV	412	Remote operated sampling valve on discharge from grout mixer	E-5			2	2				
SOV	413	Remote operated valve of some type, controlling flow of mixed grout and waste into waste drum	E-5			2	2				
LT	414	Level xmtr on CSIX effluent storage tank (2000 gal)	E-5	1							

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
											Four electrodes, arranged 90 degrees apart. Two are high in the melter and two are low. Heat is transferred to the melt via the conduction of current between electrodes. The control scheme would possibly be an averaging scheme of some or all of the t/c. This averaged signal would be the measured variable into a PLC PID block. The controlled variable would be input into an SCR controller that would impose a variable voltage on opposite electrodes at the same elevation in the melter. The controlled effect would be to maintain a setpoint temperature.
ELEC	415	Melter Electrodes for joule heating (Voltage - approx 50 VAC or DC)	E-3							160	
ELEC	416	Melter Lid glow bars	E-3							180	
ELEC	417	Melter Tea Pot Tap (overflow) - glow bar heaters	E-3							35	
SCR	418	Melter SCR control for joule heating electrodes	E-3		1	2	2				Solid state, SCR controller, capable of 160 kw demand power at 50 Vac. This unit would impose voltage at the "ELEC415" electrodes, a total of 4, arranged 90 degrees apart. (2 high and 2 low)
SCR	419	Melter Lid heater SCR controller for glow bar elements	E-3		1	2	2				Solid state, SCR controller, capable of 180 kw demand power at 480 Vac.
SCR	420	Melter tea-pot tap SCR controller for glow bar elements	E-3		1	2	2				Solid state, SCR controller, capable of 35 kw demand power at 480 Vac.
DIV	421	Primary dry material diverter	E-2			2	2				
DIV	422	Dry material diverter to Mixing tank #3 or #4	E-2			2	2				
DIV	423	Dry material diverter to Mixing tank #1 or #2	E-2			2	2				Only one chiller for all four tanks is needed since there would be no need to be mixing them all at the same time.
CHL	424	Chiller for 5000 gal mixing Tank No.1	E-2			1	1			125	

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
CHL 425		Chiller for 5000 gal mixing Tank No.1	E-2			1	1				Only one chiller for all four tanks is needed since there would be no need to be mixing them all at the same time.
CHL 426		Chiller for 5000 gal mixing Tank No.1	E-2			1	1				Only one chiller for all four tanks is needed since there would be no need to be mixing them all at the same time.
CHL 427		Chiller for 5000 gal mixing Tank No.1	E-2			1	1				Only one chiller for all four tanks is needed since there would be no need to be mixing them all at the same time.
CHL 428		Chiller for No.2 Quench line	E-3			1	1				Need Energy requirement
VFD 429		VFD for HEPA filters 29-37, downstream fan no.1	E-7	1	1	2	2				Variable Frequency Drive required for all HEPA fans. Assuming that the HEPA fans are approximately 100 hp each - this power requirement is included at the motor tag number for each HEPA fan.
VFD 430		VFD for HEPA filters 29-37, downstream fan no.2	E-7	1	1	2	2				Variable Frequency Drive required for all HEPA fans. Assuming that the HEPA fans are approximately 100 hp each - this power requirement is included at the motor tag number for each HEPA fan.
VFD 431		VFD for HEPA filters 29-37, downstream fan no.3	E-7	1	1	2	2				Variable Frequency Drive required for all HEPA fans. Assuming that the HEPA fans are approximately 100 hp each - this power requirement is included at the motor tag number for each HEPA fan.
CHL 432		Chiller for makeup air for elec room near offices, comm room, and mechanical room	E-7			1	1	1	7		7 hp is the portion of 181 hp calculated for the chiller for the HVAC system (non-HEPA filtered air)
CV 433		Steam control valve for heating of makeup air for offices and other rooms	E-7		1						
CV 434		Steam control valve for heating of makeup air for crane control room, control room, computer room	E-7		1						
TT 435		t/c temp xmtr, lower portion of tea-pot tap	E-3	1							

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
TT	436	t/c temp xmtr, upper portion of melter	E-3	1							
CHL	437	Chiller for No.1 Quench line	E-3			1	1				Need energy requirement
CHL	438	Chiller for Demister	E-3			1	1				Need energy requirement
AT	439	Oxygen Monitor	E-4	1							Signal from CEM Analyzer
AT	440	Carbon Dioxide Monitor	E-4	1							Signal from CEM Analyzer
AT	441	Carbon Monoxide Monitor	E-4	1							Signal from CEM Analyzer
AT	442	THC Monitor	E-4	1							Signal from CEM Analyzer
AT	443	Hg Monitor	E-4	1							Signal from CEM Analyzer
TT	444	t/c temp xmtr in Activated Carbon w/sulfur bed No.1	E-4	1							
TT	445	t/c temp xmtr in Activated Carbon w/sulfur bed No.2	E-4	1							
M	446	Canister Turntable	E-3					1	5		Motor with VFD
VFD	447	VFD control for Canister Turntable	E-3		1	2	2				VFD for Canister Turntable
M	448	Makeup air fan no.4 for process air to HEPA filters 1-11	E-6			1	1	1	50		
M	449	Makeup air fan no.5 for process air to HEPA filters 1-11	E-6			1	1	1	50		
M	450	Makeup air fan no.6 for process air to HEPA filters 1-11	E-6			1	1	1	50		
BFV	451	Isolation input valve for fan no.4 - process air to HEPA filters 1-11	E-6			2	2				Butterfly Valve
BFV	452	Isolation output valve for fan no.4 - process air to HEPA filters 1-11	E-7			2	2				Butterfly Valve
BFV	453	Isolation input valve for fan no.5 - process air to HEPA filters 1-11	E-7			2	2				Butterfly Valve
BFV	454	Isolation output valve for fan no.5 - process air to HEPA filters 1-11	E-7			2	2				Butterfly Valve
BFV	455	Isolation input valve for fan no.6 - process air to HEPA filters 1-11	E-7			2	2				Butterfly Valve
BFV	456	Isolation output valve for fan no.6 - process air to HEPA filters 1-11	E-7			2	2				Butterfly Valve
	457	UNUSED NUMBER									
	458	UNUSED NUMBER									

VIT of SBW Sequential Tag List for all Devices

<u>PFX</u>	<u>Num</u>	<u>DESCRIPTION</u>	<u>dwg</u>	<u>An in</u>	<u>An out</u>	<u>Disc in</u>	<u>Disc out</u>	<u>Mtr</u>	<u>Mtr Hp</u>	<u>Other Loads (kw)</u>	<u>Comments</u>
	459	UNUSED NUMBER									
HTR	460	Steam heater bank for makeup air to HEPA filters 1-11	E-6								No I/O or electrical energy
HTR	461	Steam heater bank for makeup air to HEPA filters 1-11	E-6								No I/O or electrical energy
CHL	462	Chiller No. 1 for makeup air to HEPA filters 1-11	E-6			1	1	1	312		Approx 312 hp - probable multiple motors for condensers and compressor
CHL	463	Chiller No. 2 for makeup air to HEPA filters 1-11	E-6			1	1	1	313		Approx 313 hp - probable multiple motors for condensers and compressor
M	464	Downstream fan no. 1 from HEPA filters 1-6	E-6			1	1	1	50		
M	465	Downstream fan no. 2 from HEPA filters 1-6	E-6			1	1	1	50		
M	466	Downstream fan no. 3 from HEPA filters 1-6	E-6			1	1	1	50		
M	467	Downstream fan no. 4 from HEPA filters 1-6	E-6			1	1	1	50		
M	468	Downstream fan no. 1 from HEPA filters 7-11	E-6			1	1	1	50		
M	469	Downstream fan no. 1 from HEPA filters 7-11	E-6			1	1	1	50		
M	470	Downstream fan no. 1 from HEPA filters 7-11	E-6			1	1	1	50		
VFD	471	VFD for downstream fan no. 1 from HEPA filters 1-6	E-6	1	1	2	2				Energy requirement estimated with motor
VFD	472	VFD for downstream fan no. 2 from HEPA filters 1-6	E-6	1	1	2	2				Energy requirement estimated with motor
VFD	473	VFD for downstream fan no. 3 from HEPA filters 1-6	E-6	1	1	2	2				Energy requirement estimated with motor
VFD	474	VFD for downstream fan no. 4 from HEPA filters 1-6	E-6	1	1	2	2				Energy requirement estimated with motor
VFD	475	VFD for downstream fan no. 1 from HEPA filters 7-11	E-6	1	1	2	2				Energy requirement estimated with motor

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
VFD	476	VFD for downstream fan no.2 from HEPA filters 7-11	E-6	1	1	2	2				Energy requirement estimated with motor
VFD	477	VFD for downstream fan no.3 from HEPA filters 7-11	E-6	1	1	2	2				Energy requirement estimated with motor
BFV	478	Input isolation valve for fan no.1 - downstream from HEPA filters 1-6	E-6			2	2				
BFV	479	Output isolation valve for fan no.1 - downstream from HEPA filters 1-6	E-6			2	2				
BFV	480	Input isolation valve for fan no.2 - downstream from HEPA filters 1-6	E-6			2	2				
BFV	481	Output isolation valve for fan no.2 - downstream from HEPA filters 1-6	E-6			2	2				
BFV	482	Input isolation valve for fan no.3 - downstream from HEPA filters 1-6	E-6			2	2				
BFV	483	Output isolation valve for fan no.3 - downstream from HEPA filters 1-6	E-6			2	2				
BFV	484	Input isolation valve for fan no.4 - downstream from HEPA filters 1-6	E-6			2	2				
BFV	485	Output isolation valve for fan no.4 - downstream from HEPA filters 1-6	E-6			2	2				
BFV	486	Input isolation valve for fan no.1 - downstream from HEPA filters 7-11	E-6			2	2				
BFV	487	Output isolation valve for fan no.1 - downstream from HEPA filters 7-11	E-6			2	2				
BFV	488	Input isolation valve for fan no.2 - downstream from HEPA filters 7-11	E-6			2	2				
BFV	489	Output isolation valve for fan no.2 - downstream from HEPA filters 7-11	E-6			2	2				
BFV	490	Input isolation valve for fan no.3 - downstream from HEPA filters 7-11	E-6			2	2				
BFV	491	Output isolation valve for fan no.3 - downstream from HEPA filters 7-11	E-6			2	2				
HTR	492	Steam Heater Bank - downstream of facility air HEPA filters	E-6								No I/O or electrical energy

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
HTR	493	Steam Heater bank - makeup air from the outside	E-6								No I/O or electrical energy
CHL	494	Chiller - downstream of facility air HEPA filters	E-6			1	1	1	300		approx 300 hp - not concurrent with electric heater bank for downstream air - after HEPA filters
CHL	495	Chiller - Makeup air for process air	E-6			1	1	1	300		approx 300 hp - not concurrent with electric heater bank for makeup process air
M	496	Process - Makeup air fan no.1	E-6			1	1	1	60		
M	497	Process - Makeup air fan no.2	E-6			1	1	1	60		
M	498	Process - Pre HEPA filter filters 12-20, fan no.1	E-6			1	1	1	50		
M	499	Process - Pre HEPA filter filters 12-20, fan no.2	E-6			1	1	1	50		
M	500	Process - Pre HEPA filter filters 12-20, fan no.3	E-6			1	1	1	50		
M	501	Process - Pre HEPA filter filters 12-20, fan no.4	E-6			1	1	1	50		
M	502	Process - Pre HEPA filter filters 12-20, fan no.5	E-6			1	1	1	50		
M	503	Process - Pre HEPA filters 21-25, fan no.1	E-6			1	1	1	50		
M	504	Process - Pre HEPA filters 21-25, fan no.2	E-6			1	1	1	50		
M	505	Process - Pre HEPA filters 21-25, fan no.3	E-6			1	1	1	50		
M	506	Process - Pre HEPA filters 26-28, fan no.1	E-6			1	1	1	50		
M	507	Process - Pre HEPA filters 26-28, fan no.2	E-6			1	1	1	50		
VFD	508	VFD for Process - Pre HEPA filters 12-20, fan no.1	E-6	1	1	2	2				
VFD	509	VFD for Process - Pre HEPA filters 12-20, fan no.2	E-6	1	1	2	2				
VFD	510	VFD for Process - Pre HEPA filters 12-20, fan no.3	E-6	1	1	2	2				
VFD	511	VFD for Process - Pre HEPA filters 12-20, fan no.4	E-6	1	1	2	2				

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
VFD	512	VFD for Process - Pre HEPA filters 12-20, fan no.5	E-6	1	1	2	2				
VFD	513	VFD for Process - Pre HEPA filters 21-25, fan no.1	E-6	1	1	2	2				
VFD	514	VFD for Process - Pre HEPA filters 21-25, fan no.2	E-6	1	1	2	2				
VFD	515	VFD for Process - Pre HEPA filters 21-25, fan no.3	E-6	1	1	2	2				
VFD	516	VFD for Process - Pre HEPA filters 26-28, fan no.1	E-6	1	1	2	2				
VFD	517	VFD for Process - Pre HEPA filters 26-28, fan no.2	E-6	1	1	2	2				
BFV	518	Output Isolation Valve for Process Makeup air fan no.1	E-6			2	2				
BFV	519	Input Isolation Valve for Process Makeup air fan no.1	E-6			2	2				
BFV	520	Output Isolation Valve for Process Makeup air fan no.2	E-6			2	2				
BFV	521	Input Isolation Valve for Process Makeup air fan no.1	E-6			2	2				
BFV	522	Output Isolation Valve for Process Pre HEPA filters 12-20, Fan no.1	E-6			2	2				
BFV	523	Input Isolation Valve for Process Pre HEPA filters 12-20, Fan no.1	E-6			2	2				
BFV	524	Output Isolation Valve for Process Pre HEPA filters 12-20, Fan no.2	E-6			2	2				
BFV	525	Input Isolation Valve for Process Pre HEPA filters 12-20, Fan no.2	E-6			2	2				
BFV	526	Output Isolation Valve for Process Pre HEPA filters 12-20, Fan no.3	E-6			2	2				
BFV	527	Input Isolation Valve for Process Pre HEPA filters 12-20, Fan no.3	E-6			2	2				
BFV	528	Output Isolation Valve for Process Pre HEPA filters 12-20, Fan no.4	E-6			2	2				

VIT of SBW Sequential Tag List for all Devices

<u>PFX</u>	<u>Num</u>	<u>DESCRIPTION</u>	<u>dwg</u>	<u>An in</u>	<u>An out</u>	<u>Disc in</u>	<u>Disc out</u>	<u>Mtr</u>	<u>Mtr Hp</u>	<u>Other Loads (kw)</u>	<u>Comments</u>
BFV	529	Input Isolation Valve for Process Pre HEPA filters 12-20, Fan no.4	E-6			2	2				
BFV	530	Output Isolation Valve for Process Pre HEPA filters 12-20, Fan no.5	E-6			2	2				
BFV	531	Input Isolation Valve for Process Pre HEPA filters 12-20, Fan no.5	E-6			2	2				
BFV	532	Output Isolation Valve for Process Pre HEPA filters 21-25, Fan no.1	E-6			2	2				
BFV	533	Input Isolation Valve for Process Pre HEPA filters 21-25, Fan no.1	E-6			2	2				
BFV	534	Output Isolation Valve for Process Pre HEPA filters 21-25, Fan no.2	E-6			2	2				
BFV	535	Input Isolation Valve for Process Pre HEPA filter bank No.1, Fan no.2	E-6			2	2				
BFV	536	Output Isolation Valve for Process Pre HEPA filters 21-25, Fan no.3	E-6			2	2				
BFV	537	Input Isolation Valve for Process Pre HEPA filters 21-25, Fan no.3	E-6			2	2				
BFV	538	Output Isolation Valve for Process Pre HEPA filters 26-28, Fan no.1	E-6			2	2				
BFV	539	Input Isolation Valve for Process Pre HEPA filters 26-28, Fan no.1	E-6			2	2				
BFV	540	Output Isolation Valve for Process Pre HEPA filters 26-28, Fan no.2	E-6			2	2				
BFV	541	Input Isolation Valve for Process Pre HEPA filters 26-28, Fan no.2	E-6			2	2				
M	542	Process downstream HEPA bank no.1, fan no.4	E-6			1	1	1	60		
M	543	Process downstream HEPA bank no.1, fan no.5	E-6			1	1	1	60		
M	544	Process downstream HEPA bank no.1, fan no.6	E-6			1	1	1	60		
M	545	Process downstream HEPA bank no.2, fan no.1	E-6			1	1	1	60		

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
M	546	Process downstream HEPA bank no.2, fan no.2	E-6			1	1	1	60		
M	547	Process downstream HEPA bank no.2, fan no.3	E-6			1	1	1	60		
M	548	Process downstream HEPA bank no.2, fan no.4	E-6			1	1	1	60		
VFD	549	VFD for HEPA filters 29-37, downstream fan no.4	E-6	1	1	2	2				Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.
VFD	550	VFD for HEPA filters 29-37, downstream fan no.5	E-6	1	1	2	2				Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.
VFD	551	VFD for HEPA filters 29-37, downstream fan no.6	E-6	1	1	2	2				Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.
VFD	552	VFD for HEPA filters 38-42, downstream fan no.1	E-6	1	1	2	2				Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.
VFD	553	VFD for HEPA filters 38-42, downstream fan no.2	E-6	1	1	2	2				Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.
VFD	554	VFD for HEPA filters 38-42, downstream fan no.3	E-6	1	1	2	2				Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.
VFD	555	VFD for HEPA filters 38-42, downstream fan no.4	E-6	1	1	2	2				Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
BFV	556	Output Isolation valve for fan no.4, downstream HEPA filters 29-31	E-6			2	2				Butterfly valve
BFV	557	Input Isolation valve for fan no.4, downstream HEPA filters 29-31	E-6			2	2				Butterfly valve
BFV	558	Output Isolation valve for fan no.5, downstream HEPA filters 29-31	E-6			2	2				Butterfly valve
BFV	559	Input Isolation valve for fan no.5, downstream HEPA filters 29-31	E-6			2	2				Butterfly valve
BFV	560	Output Isolation valve for fan no.6, downstream HEPA filters 29-31	E-6			2	2				Butterfly valve
BFV	561	Input Isolation valve for fan no.6, downstream HEPA filters 29-31	E-6			2	2				Butterfly valve
BFV	562	Output Isolation valve for fan no.1, downstream HEPA filters 38-42	E-6			2	2				Butterfly valve
BFV	563	Input Isolation valve for fan no.1, downstream HEPA filters 38-42	E-6			2	2				Butterfly valve
BFV	564	Output Isolation valve for fan no.2, downstream HEPA filters 38-42	E-6			2	2				Butterfly valve
BFV	565	Input Isolation valve for fan no.2, downstream HEPA filters 38-42	E-6			2	2				Butterfly valve
BFV	566	Output Isolation valve for fan no.3, downstream HEPA filters 38-42	E-6			2	2				Butterfly valve
BFV	567	Input Isolation valve for fan no.3, downstream HEPA filters 38-42	E-6			2	2				Butterfly valve
BFV	568	Output Isolation valve for fan no.4, downstream HEPA filters 38-42	E-6			2	2				Butterfly valve
BFV	569	Input isolation valve - Process - downstream HEPA bank no.2, fan no.4	E-6			2	2				Butterfly valve
M	570	Process air - downstream fan no.1 for HEPA filters 43-45	E-6			1	1	1	75		
M	571	Process air - downstream fan no.2 for HEPA filters 43-45	E-6			1	1	1	75		

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr Hp	Other Loads (kw)	Comments
VFD	572	VFD for process - downstream fan no.1 for HEPA filters 43-45	E-6	1	1	2	2			Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.
VFD	573	VFD for process - downstream fan no.2 for HEPA filters 43-45	E-6	1	1	2	2			Variable Frequency Drive required for all HEPA fans. The power requirement is included at the motor tag number for each HEPA fan.
BFV	574	Output Isolation valve for Process air fan no.1 - downstream HEPA filters 43-45	E-6			2	2			
BFV	575	Input Isolation valve for Process air fan no.1 downstream HEPA filters 43-45	E-6			2	2			
BFV	576	Output Isolation valve for Process air fan no.2 - downstream HEPA filters 43-45	E-6			2	2			
BFV	577	Input Isolation valve for Process air fan no.2 downstream HEPA filters 43-45	E-6			2	2			
TT	578	t/c temp xmtr - makeup air for process air to HEPA filters 1-11	E-6	1						
TT	579	t/c temp xmtr - makeup air for process air to HEPA filters 1-11	E-6	1						
CV	580	Steam Control Valve for makeup air for process air to HEPA filters 1-11	E-6		1					
CV	581	Steam Control Valve for makeup air for process air to HEPA filters 1-11	E-6		1					
CV	582	Steam Control Valve for secondary air from facility HEPA groups 1 & 2	E-6		1					
CV	583	Steam Control Valve for Makeup air	E-6		1					
TT	584	t/c temp xmtr for secondary air from facility HEPA groups 1 & 2	E-6	1						
TT	585	t/c temp xmtr for makeup air	E-6	1						
DP	586	HEPA filter, dp press xmtr - grid no.1	E-6	1						
DP	587	HEPA filter, dp press xmtr - grid no.2	E-6	1						
DP	588	HEPA filter, dp press xmtr - grid no.3	E-6	1						
DP	589	HEPA filter, dp press xmtr - grid no.4	E-6	1						

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
DP	590	HEPA filter, dp press xmtr - grid no.5	E-6	1							
DP	591	HEPA filter, dp press xmtr - grid no.6	E-6	1							
DP	592	HEPA filter, dp press xmtr - grid no.7	E-6	1							
DP	593	HEPA filter, dp press xmtr - grid no.8	E-6	1							
DP	594	HEPA filter, dp press xmtr - grid no.9	E-6	1							
DP	595	HEPA filter, dp press xmtr - grid no.10	E-6	1							
DP	596	HEPA filter, dp press xmtr - grid no.11	E-6	1							
DP	597	HEPA filter, dp press xmtr - grid no.12	E-6	1							
DP	598	HEPA filter, dp press xmtr - grid no.13	E-6	1							
DP	599	HEPA filter, dp press xmtr - grid no.14	E-6	1							
DP	600	HEPA filter, dp press xmtr - grid no.15	E-6	1							
DP	601	HEPA filter, dp press xmtr - grid no.16	E-6	1							
DP	602	HEPA filter, dp press xmtr - grid no.17	E-6	1							
DP	603	HEPA filter, dp press xmtr - grid no.18	E-6	1							
DP	604	HEPA filter, dp press xmtr - grid no.19	E-6	1							
DP	605	HEPA filter, dp press xmtr - grid no.20	E-6	1							
DP	606	HEPA filter, dp press xmtr - grid no.21	E-6	1							
DP	607	HEPA filter, dp press xmtr - grid no.22	E-6	1							
DP	608	HEPA filter, dp press xmtr - grid no.23	E-6	1							
DP	609	HEPA filter, dp press xmtr - grid no.24	E-6	1							
DP	610	HEPA filter, dp press xmtr - grid no.25	E-6	1							
DP	611	HEPA filter, dp press xmtr - grid no.26	E-6	1							
DP	612	HEPA filter, dp press xmtr - grid no.27	E-6	1							
DP	613	HEPA filter, dp press xmtr - grid no.28	E-6	1							
DP	614	HEPA filter, dp press xmtr - grid no.29	E-6	1							
DP	615	HEPA filter, dp press xmtr - grid no.30	E-6	1							
DP	616	HEPA filter, dp press xmtr - grid no.31	E-6	1							
DP	617	HEPA filter, dp press xmtr - grid no.32	E-6	1							
DP	618	HEPA filter, dp press xmtr - grid no.33	E-6	1							
DP	619	HEPA filter, dp press xmtr - grid no.34	E-6	1							
DP	620	HEPA filter, dp press xmtr - grid no.35	E-6	1							
DP	621	HEPA filter, dp press xmtr - grid no.36	E-6	1							
DP	622	HEPA filter, dp press xmtr - grid no.37	E-6	1							
DP	623	HEPA filter, dp press xmtr - grid no.38	E-6	1							

VIT of SBW Sequential Tag List for all Devices

PFX	Num	DESCRIPTION	dwg	An in	An out	Disc in	Disc out	Mtr	Mtr Hp	Other Loads (kw)	Comments
DP	624	HEPA filter, dp press xmttr - grid no.39	E-6	1							
DP	625	HEPA filter, dp press xmttr - grid no.40	E-6	1							
DP	626	HEPA filter, dp press xmttr - grid no.41	E-6	1							
DP	627	HEPA filter, dp press xmttr - grid no.42	E-6	1							
DP	628	HEPA filter, dp press xmttr - grid no.43	E-6	1							
DP	629	HEPA filter, dp press xmttr - grid no.44	E-6	1							
DP	630	HEPA filter, dp press xmttr - grid no.45	E-6	1							
	631										
	632	Total Number of Analog In signals	179								
	633	Total Number of Analog out signals	46								
	634	Total Number of Discrete Inputs	796								
	635	Total Number of Discrete Outputs	796								
	636	Total Number of Tags	1817								
	637	Total Number of Motors	101								
	638	Total Motor horsepower	3880								
	639	Total Process loads other than motors (KW)	500								
		It is assumed that the Multi-State Combustor Furnaces (two stages) will include all of the control devices - sensing and activation required to control the furnaces. It is also assumed that at least some, perhaps all, of the signals will require monitoring by the overall DCS (Distributed control system). It is for this reason, that some DCS analog and discrete (inputs and outputs) are included in the total DCS I/O count.									
zz	Note 1										
zz	Note 2	It is assumed that this system will be an OEM designed system.									

VIT of SBW Sequential Tag List for all Devices

<u>PFX</u>	<u>Num</u>	<u>DESCRIPTION</u>	<u>dwg</u>	<u>An in</u>	<u>An out</u>	<u>Disc in</u>	<u>Disc out</u>	<u>Mtr</u>	<u>Mtr Hp</u>	<u>Other Loads (kw)</u>	<u>Comments</u>
zz	Note 3	{Assumption: These butterfly valves are pneumatically powered and electrically controlled with extreme travel sensors}									
zz	Note 4	This radiation monitor is an extremely critical device. There have been RAD monitors installed at INTEC and they are very expensive. There is continuing research as to the monitoring technique, such as iso-kinetic, to determine which technology is the most reliable.									
zz	Note 5	This is a critical instrument package. It is assumed to be very expensive. It will require some digging to come up with an accurate estimated cost.									

Appendix G

Sketches

D

C

B

A

VITRIFICATION
FACILITY

INTEC AREA MAP

SCALE: 1"=250.0'

User: MKG

Date: 01/27/98 - 10:18 A.M.

File: 3532-9.dwg

Path: P:\CSP-HLW

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

SITE MAP
SCALE: NONE

DRAWING INDEX

PAGE NO.	DWG NO.	A-E DWG NO.	REV	DRAWING TITLE
1		T-1		SITE MAP, AREA MAP AND DRAWING INDEX
2		A-1		SBW-VIT MAIN FLOOR PLAN
3		A-2		SBW-VIT BASEMENT FLOOR PLAN
4		A-3		HATCH LEVEL PLAN
5		A-4		BUILDING ELEVATION -- WEST
6		A-5		SECTION
7		A-6		STEAM FLOOR PLAN
8		P-1		PIPING PROCESS DIAGRAM
9		P-2		PIPING PROCESS DIAGRAM
10		P-3		PIPING PROCESS DIAGRAM
11		P-4		PIPING PROCESS DIAGRAM
12		P-5		CANISTER FLOW DIAGRAM
13		HV-1		HVAC FLOW DIAGRAM
14		HV-2		HVAC FLOW DIAGRAM
15		E-1		ONE LINE DIAGRAM
16		E-2		POWER AND INSTRUMENT DIAGRAM
17		E-3		POWER AND INSTRUMENT DIAGRAM
18		E-4		POWER AND INSTRUMENT DIAGRAM
19		E-5		POWER AND INSTRUMENT DIAGRAM
20		E-6		POWER AND INSTRUMENT DIAGRAM
21		E-7		POWER AND INSTRUMENT DIAGRAM

FOR DRAWING INDEX SEE DRAWING NO.		SUB CONTRACT NO.			
 SCALE: 1" = 250.0'		REQUESTER: DESIGNER: DRAWN: B. RHODES PROJECT NO.: SPEC CODE:			
DESIGN PHASE: STUDY		FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.		SITE MAP, AREA MAP AND DRAWING INDEX SIZE: D CAGE CODE: 01MF3 INDEX CODE: 200 0100 02 530 DWG- SCALE: 1"=250.0'	
QUALITY LEVEL: 3		EFFECTIVE DATE:		SHEET T-1

D

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B

A

FLOOR PLAN
 VITON = 0'-0"

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENGINEERING & TECHNOLOGY, LLC</small>	
REQUESTER: DESIGN: D NISHIOKA DRAWN: J MONCUR PROJECT NO. SPEC CODE		FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO. EFFECTIVE DATE:			
DESIGN PHASE: STUDY QUALITY LEVEL:		SCALE: 1/16" = 1'-0"		SBW-VIT MAIN FLOOR PLAN INDEX CODE NUMBER AREA TYPE Q DESG DWG- 090	
		SCALE: 1/16" = 1'-0"		SHEET A-1

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B

File: 369004.dwg ID: M03
 Layout Name: Layout1
 Date: 05/26/00 - 08:01 A.M.
 Plot: F:\highlevelwaste

A

SBW-VIT BASEMENT FLO
 FINISH FLOOR EL = -32'-0"

8

7

6

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R PLAN

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENGINEERING & MANAGEMENT, LLC</small>	
<p>SCALE: 1/16" = 1'-0"</p>		REQUESTER:		INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY SBW-VIT BASEMENT FLOOR PLAN	
		DESIGN: D NISHIOKA			
		DRAWN: J MONCUR			
		PROJECT NO.			
SPEC CODE		FOR REVIEW/APPROVAL SIGNATURES		SIZE: D	CAGE CODE: 1090
SEE DAR NO.		EFFECTIVE DATE:		DWG- 1090	
DESIGN PHASE: STUDY		QUALITY LEVEL:		SCALE: 1/16" = 1'-0"	
SHEET A-2					

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D

C

B

HATCH

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HATCH LEVEL PLAN
EL. +48'-0"

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENERGY & ENVIRONMENTAL SERVICES, LLC</small> INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY				
		REQUESTER: DESIGN: D NISHIOKA DRAWN: J MONCUR PROJECT NO. SPEC CODE						HATCH LEVEL PLAN
DESIGN PHASE: STUDY		FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.		SIZE: D	CAGE CODE	INDEX CODE NUMBER AREA TYPE CL ORG	DWG-	REV
QUALITY LEVEL:		EFFECTIVE DATE:		SCALE: 1/16"=1'-0"		SHEET A-3		

D

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MECHANICAL/ELECTRICAL BUILDING

ADMINISTRATION BUILDING

B

WEST ELE

ATION

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENERGY & ENVIRONMENTAL SERVICES, LLC</small>					
		REQUESTER:		INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY BUILDING ELEVATION -- WEST					
		DESIGNER: D. NISHIOKA							
		DRAWN: J. MONCUR							
		PROJECT NO.							
SPEC CODE		FOR REVIEW/APPROVAL SIGNATURES		SIZE	CAGE CODE	INDEX CODE NUMBER		DWG-	REV
DESIGN PHASE: STUDY		SEE DAR NO.		D		AREA	TYPE		
QUALITY LEVEL:		EFFECTIVE DATE:		SCALE: 3/32"=1'-0"				SHEET A-4	

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C

B

A

GRADE

HVAC ROOM

HVAC ROOM

HVAC ROOM

OPERATING
CORRIDOR

OPERATING
CORRIDOR

OPERATING
CORRIDOR

CRANE

REMOTE
SERVICE
CORRIDOR

OVERHEAD
FACILITY
BRIDGE
CRANE

8

7

6

5

SECTION A
A-1

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENGINEERING & ENVIRONMENTAL CONSULTING</small> <small>REGENTEL SWAYTIDANO, LLC</small>	
 SCALE: 1/8" = 1'-0"		REQUESTER: DESIGN: D. NISHIOKA DRAWN: J. MONCUR PROJECT NO. SPEC CODE			
DESIGN PHASE: STUDY		FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.		SECTION INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY	
QUALITY LEVEL:		EFFECTIVE DATE:		SIZE: D PAGE CODE INDEX CODE: MAJOR AREA: TYPE: CL: ORG: 090 DWG- SHEET A-5

20'-0"

D

NEW VITRIFICATION
FACILITY

C

B

60'-0"

STEAM

STEAM FLOOR PLAN

Layout Name: Layout1
Date: 06/25/00 - 10:31 AM

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File: 3699001.dwg ID: MXJ
Path: P:\highlevelwaste

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENGINEERING & MANAGEMENT, LLC SECURITY/SAFETY/INTEGRITY/QUALITY/ENVIRONMENT/ETHICS</small>					
		REQUESTER		INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY STEAM FLOOR PLAN					
		DESIGN: S. ALSTAD							
		DRAWN: J. MONCLER							
		PROJECT NO.							
SPEC CODE		FOR REVIEW/APPROVAL SIGNATURES		SIZE	CAGE CODE	INDEX BOOK NUMBER	DWG-	REV	
DESIGN PHASE: STUDY		SEE DAR NO.		D		AREA	TYPE	Q. I. ORG.	1090
QUALITY LEVEL:		EFFECTIVE DATE:		SCALE 1/16" = 1'-0"		SHEET		A-6	

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FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		<div>INEEL</div> <div>INTEGRATED NUCLEAR ENGINEERING & ENVIRONMENTAL SERVICES</div> <div>BECHTEL-SWATD-INDO, LLC</div>																	
NO SCALE		REQUESTER:		<div>INTEC</div> <div>VITRIFICATION OF SODIUM BEARING WASTE FACILITY</div> <div>PIPING PROCESS DIAGRAM</div>																	
		DESIGN: RAMO																			
		DRAWN: J. L. SEELEY																			
		PROJECT NO.																			
		SPEC CODE																			
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DESIGN PHASE: STUDY		SEE DAR NO.		D				AREA		TYPE		Q		Q		241090					
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FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENGINEERING & LABORATORY SERVICES</small> <small>800 N. CENTRAL AVE. SUITE 1000, CHICAGO, IL 60610</small>			
NO SCALE		REQUESTER:		INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY PIPING PROCESS DIAGRAM			
		DESIGN: RAND					
		DRAWN: J. L. SEELEY					
		PROJECT NO.					
		SPEC CODE		SIZE	CAGE CODE	INDEX CODE	MARKET
DESIGN PHASE: STUDY		FOR REVIEW/APPROVAL SIGNATURES		D		200	24/090
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FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENGINEERING & TECHNOLOGY, INC.</small> INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY PIPING PROCESS DIAGRAM	
NO SCALE		REQUESTER: DESIGN: RANDO DRAWING: J. L. SEELEY PROJECT NO. SPEC CODE			
DESIGN PHASE: STUDY		FOR REVIEW/APPROVAL SIGNATURES		SIZE: D	DWG- 200 24 090
QUALITY LEVEL:		EFFECTIVE DATE:		SCALE: NONE	SHEET P-4

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File: SRW-05.dwg ID: M2J
 Layout Name: Layout1 Date: 04/23/00 - 11:11 AM
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A

CANISTER FI
 TYPICAL BUIL

FLOW DIAGRAM
LOADING SECTION

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		LOCKHEED MARTIN	
NO SCALE		REQUESTER:		INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY CANISTER FLOW DIAGRAM	
		DESIGN: RAND			
		DRAWING: J. L. SEELEY			
		PROJECT NO.			
SPEC CODE		FOR REVIEW/APPROVAL SIGNATURES		SIZE: D 01MF3 AREA: 200 Q. L. ORG: 24 090 DWG- SCALE: NONE	
DESIGN PHASE: STUDY		SEE DAR NO.		REV	
QUALITY LEVEL:		EFFECTIVE DATE:		SHEET P-5	

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B

HVAC FLOW DIAGRAM

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

→ 6808 CFM

→ 6600 CFM

→ 563 CFM

FOR DRAWING INDEX SEE DRAWING NO.	SUBCONTRACT NO.	INEEL <small>INTEGRATED NUCLEAR ENERGY & ENVIRONMENTAL SERVICES, LLC</small>					
NO SCALE	REQUESTER:	INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY HVAC FLOW DIAGRAM					
	DESIGN:						
	DRAWN:						
	PROJECT NO.						
	SPEC CODE	SIZE D	CAGE CODE	INDEX CODE NUMBER AREA TYPE Q DWG 090	DWG-	REV	
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QUALITY LEVEL:	EFFECTIVE DATE:						

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A

ONE LINE DIAGRAM

EXISTING
INEEL
RA

000KVA

LEGEND

SCR SILICON CONTROL RECTIFIER
NC NORMALLY CLOSE
NO NORMALLY OPEN

NOTES

1. ALL MOTOR LOADS ARE LESS THAN 100 HP.

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENERGY & ENVIRONMENTAL LABORATORY</small>						
NO SCALE	REQUESTER	INTEC VITRIFICATION OF SODIUM BEARING WASTE FACILITY ONE LINE DIAGRAM								
	DESIGN									
	DRAWN									
	PROJECT NO.									
	SPEC CODE	SIZE	CAGE CODE	INDEX CODE NUMBER		DWG-	REV			
DESIGN PHASE:	FOR REVIEW/APPROVAL SIGNATURES		D		AREA	TYPE	G	LOGS	090	
QUALITY LEVEL:	EFFECTIVE DATE:		SCALE: NONE		SHEET		E-1			

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THESE ARE EXISTING MOTORS THAT DO NOT REQUIRE STARTERS OR CONTROLS

File: TAC01.dwg
 Layout Name: D Size
 Date: 04/25/00 - 12:32 P.M.
 Id: MKJ
 Path: P:\HighPressure

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL	
NO SCALE		REQUESTER:		INTEC	
		DESIGN: BUNNELL		VITRIFICATION OF SODIUM	
		DRAWING:		BEARING WASTE FACILITY	
		PROJECT NO.		POWER AND INSTRUMENT DIAGRAM	
DESIGN PHASE: STUDY		FOR REVIEW/APPROVAL SIGNATURES		SIZE: D	
QUALITY LEVEL:		SEE DAR NO.		CAGE CODE: 200	
		EFFECTIVE DATE:		INDEX CODE: 241090	
				DWG- 241090	
				REV	
				SHEET E-3	

D

ATM
143600 CFM

PREFILTER

M279
M280
M281

HTR460
CHL462

HEPA-1
HEPA-2
HEPA-3
HEPA-4
HEPA-5
HEPA-6

M464
M465
M466
M467

HTR492
CHL494

M448
M449
M450

HTR461
CHL463

HEPA-7
HEPA-8
HEPA-9
HEPA-10
HEPA-11

M468
M469
M470

PREFILTER

74200 CFM
ATM

M496
M497

HTR493
CHL495

C

M498
M499
M500
M501
M502

HEPA-12
HEPA-13
HEPA-14
HEPA-15
HEPA-16
HEPA-17
HEPA-18
HEPA-19
HEPA-20

HEPA-29
HEPA-30
HEPA-31
HEPA-32
HEPA-33
HEPA-34
HEPA-35
HEPA-36
HEPA-37

M304
M305
M306
M542
M543
M544

M503
M504
M505

HEPA-21
HEPA-22
HEPA-23
HEPA-24
HEPA-25

HEPA-38
HEPA-39
HEPA-40
HEPA-41
HEPA-42

M545
M546
M547
M548

M506
M507

HEPA-26
HEPA-27
HEPA-28

HEPA-43
HEPA-44
HEPA-45

M570
M571

B

REFER TO DWG - TAG05 FOR MORE DETAIL

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		<div>INEEL</div> <div>TECHTEL&WY10A00.LLC</div>											
NO SCALE		REQUESTER:		<div>INTEC</div> <div>VITRIFICATION OF SODIUM</div> <div>BEARING WASTE FACILITY</div> <div>POWER AND INSTRUMENT DIAGRAM</div>											
		DESIGN: BUNNELL													
		DRAWING:													
		PROJECT NO.													
SPEC CODE				SIZE		CAGE CODE		INDEX CODE NUMBER		DWG-		REV			
DESIGN PHASE: STUDY		FOR REVIEW/APPROVAL SIGNATURES		D				AREA		TYPE		Q		ORIG	
QUALITY LEVEL:		EFFECTIVE DATE:		SCALE: NONE				200				24		090	
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Layout Name: Layout1
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 File: TUC05.dwg

DIAGRAM

FOR DRAWING INDEX SEE DRAWING NO.		SUBCONTRACT NO.		INEEL <small>INTEGRATED NUCLEAR ENERGY EVALUATION LABORATORY</small>	
NO SCALE		REQUESTER: DESIGN: BURNELL DRAWING: PROJECT NO. SPEC. CODE: FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO. EFFECTIVE DATE:			
DESIGN PHASE: STUDY		SIZE: D CASE CODE: 200 AREA: 24 TYPE: 090 DWG-		PROJECT NO. 24-090 SHEET E-6	
QUALITY LEVEL:		EFFECTIVE DATE:		SCALE: NONE	

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C

B

HVAC FLOW DIAGRAM

Appendix H
Engineering Design Files

1. Project File No. 015735 2. Project/Task Vitrification of SBW

3. Subtask Material Balance & WIPP WAC

4. Title: Material Balance for Vitrification of SBW

5. Summary: .

This study examines the viability of vitrification as a method for treating SBW for disposal. This includes a material balance of the process and evaluation of the final waste form for disposal at the Waste Isolation Pilot Plant (WIPP).

A material balance was performed using the program created by D. Taylor and C. Barnes. The vitrified SBW meets the Waste Acceptance Criteria for WIPP for remote handled waste.

Vitrification of SBW is a viable option. It is recommended that a feasibility study be performed to determine the cost and schedule for this option.

6. Distribution (complete package):

D. J. Harrell
A. L. Olson
C. M. Barnes
R. R. Kimmitt-

Distribution (summary package only): D. Crandall, V. Balls, M. Pratt

7. Review (R) and Approval (A) Signatures: (Minimum reviews and approvals are listed. Additional reviews/approvals may be added as necessary.)

	R/A	Printed Name	Signature	Date
J. J. Quigley	R			5-22-00
C. M. Barnes	R			5-24-00
A. L. Olson	A			10 Aug 2000

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ATTACHMENTS

Attachment 1	Material Balance Model
Attachment 2	Glass Chemistry
Attachment 3	WIPP WAC
Attachment 4	Sugar Reactions
Attachment 5	Grout from Blowdown
Attachment 6	Radiological Calculations for Specified SBW Waste Packages

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1 INTRODUCTION

The Department of Energy (DOE) currently stores and manages calcined High Level Waste (HLW) and liquid Sodium Bearing Waste (SBW) that is left over from reprocessing spent nuclear fuel at the Idaho Nuclear Technologies and Engineering Center (INTEC), at the Idaho National Engineering and Environmental Laboratory (INEEL). In October of 1995 the DOE entered into a Settlement Agreement with the state of Idaho that requires the DOE to treat and convert the wastes into acceptable final waste forms for disposal. The Agreement contains several commitments for the treatment and disposal of the HLW and SBW. Under the Settlement Agreement, DOE agreed to meet the following milestones:

- Complete calcination of all remaining non-sodium bearing liquid HLW by June 1998. This milestone is completed.
- Commence negotiations with the State of Idaho concerning the plan and schedule for treatment of calcined waste by December 1999
- Complete calcination (i.e. treatment) of all SBW by December 31, 2012.
- Complete treatment of all calcined wastes by December 31, 2035 so that all HLW is "road ready" to be moved out of Idaho for disposal by the year 2035.

Based on the commitments, DOE must determine how to treat the HLW and associated waste streams at INTEC to facilitate ultimate disposal.

1.1 Scope of Task

This study will examine the viability of the vitrification of SBW. This will include updated material balances of the process and the evaluation of the final waste form for compatibility with the Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC).

If the concept is possible, a feasibility study will be performed which will include process and facilities to treat the SBW, from beginning waste input from the INTEC Tank Farm to final waste forms. This will include schedule and cost estimates for construction and operation of the vitrification facility. This is not included in this report.

1.2 Purpose

The primary objective of this study is to determine the viability of direct vitrification of SBW. Calcine treatment with this facility is not included at this time. This EDF will include material balance and flowsheet for vitrification of SBW. The waste forms from the process will be evaluated for disposal. The Engineering Design File (EDF) will include documentation of the assumptions for the process design, material balance and flowsheet.

1.3 Conclusion

Vitrification is a viable treatment for SBW. The glass waste in the stainless steel canisters will meet the WIPP WAC, revision 4, for remote handled waste. All secondary waste can be disposed. Undissolved solids (UDS) can be treated by vitrification.

2 DESIGN BASIS AND ASSUMPTIONS

2.1 Assumptions

- 2.1.1 The calciner in the New Waste Calcine Facility (NWCF) will not operate again. All SBW will be treated by vitrification.
- 2.1.2 An incidental waste ruling will rule that SBW is not HLW.
- 2.1.3 The U134 waste code will be added to the WIPP WAC or the SBW will be delisted for U134.
- 2.1.4 Mercury compounds such as HgCl_2 and HgO are reduced to elemental mercury in the Noxidizer®.

2.2 Functional and Operational Requirements

- 2.2.1 Operating efficiency for the process shall be on a 24 hr per day, 200 days per year basis.
- 2.2.2 All SBW will be processed in two years.
- 2.2.3 The vitrified waste produced from SBW must meet the requirements of the WIPP WAC.

3 WASTE DESCRIPTION

The primary waste produced by vitrification of SBW is glass. The glass is poured into metal canisters for disposal at either WIPP or Yucca. Other wastes produced by the process include a grouted waste from a side-stream of the scrubber system. HEPA filters from the off-gas system will be changed out periodically and disposed. The GAC absorbs mercury from the off-gas. This will be sent to an off-site vendor for mercury recovery and disposal.

3.1 HWL - Glass Waste in Canisters

3.1.1 Chemical Composition

The chemical and radiological compositions of the vitrified waste are presented in Attachment 1, the material balance for the vitrification process.

3.1.2 Radiation Levels

The maximum contact radiation level, calculated for the worst case waste type, is 68 Rem/hr for the canister. The canisters will be remote handled due to the high radiation level. The maximum thermal power is calculated to be 5.7 watts/canister.

3.1.3 Disposal Site

The canisters containing the vitrified waste are suitable for disposal at either WIPP or Yucca Mountain.

3.2 Ion Exchange Zeolite

3.2.1 Chemical Composition Cesium/Strontium Zeolite

UOP IONSIV® IE-95 is a cesium specific, alkali metal alumino-silicate, $(\text{Na}_2\text{O}, \text{MgO}, \text{CaO}) \cdot \text{Al}_2\text{O}_3 \cdot 4-6\text{SiO}_2 \cdot \text{H}_2\text{O}$, ion exchange media. IONSIV® IE-95 has a capacity of 2.0-2.5 meq/gm in its anhydrous state. According to Dennis Fennelly (Reference 12), the selectivity of IONSIV® IE-95, in order of increase preference is:

UOP IONSIV® A-51 is a strontium specific, alkali metal alumino-silicate, $\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 4.5\text{H}_2\text{O}$, ion exchange media. The capacity for IONSIV® A-51 is 5.0-5.5 meq/gm. The selectivity of IONSIV® A-51 (Reference 12) is:

Both UOP IONSIV® IE-95 and A-51 zeolites are available in 20x50-mesh form. For IE-95, a decontamination factor (DF) of 10,000 for cesium is expected with a residence time of 12 minutes based on experience at WVDP. The DF for strontium is expected to be about 1000. Since IONSIV® IE-95 and A-51 are non-organic ion exchange media, they do not degrade in a high radiation field.

3.2.2 Radiological Composition

During operations, the IE-95 zeolite is expected to remove about 210 curies of cesium from the feed to the grouting system. About 50 curies of strontium will be removed by A-51. Other radionuclides will not be removed in quantity.

3.2.3 Radiation Levels

The radiation level of the ion exchange columns has not yet been calculated since no transportation is required.

3.2.4 Disposal

The zeolites can be added to the melter feed. No other disposal is required.

3.3 LLW – Grout

3.3.1 Chemical Composition

The chemical composition of the grout is based on the chemical and radiological composition of the blowdown from the scrub system. Two cases were considered; with and without cesium and strontium removal by ion exchange media. The chemical compositions for both cases are given in Attachment 4.

The grout formula used is the same used in for grouting the scrubber blowdown from the 1999 vitrification feasibility study. This is documented in the report for final waste forms for INTEC radioactive waste in Reference 8. The density of the grout is assumed to be 1826 kg/m³.

Table 1 Grout Recipe

Ingredient	wt %
water	28.7%
cement	35.5%
slag	35.5%
solids	0.25%

3.3.2 Radiological Composition

The radioactivity of the grout comes from the contamination of the liquid (blowdown or ion exchange effluent) used to make the grout. Attachment 4 provides the radionuclides present in the grout in Ci/kg.

3.3.3 Radiation Levels

Table 2 Radiological Characteristics of Grout

Grout	Heat Generation watts	Contact mR/hr	1 meter mR/hr	2 meter mR/hr	3 meter mR/hr
Treated	1.9E-4	2.6	0.18	0.06	0.03
Untreated	3.4 E-3	460	33	10	5

3.3.4 Disposal Site

The grouted waste is not <100 nCi/g TRU and can be disposed of at Hanford.

3.4 LLW – Activated Carbon

3.4.1 Chemical Composition

A sulfur impregnated granulated activated carbon (GAC) known as MERSORB® is used for mercury removal. MERSORB® is 13% sulfur by weight; the remainder is activated carbon. Pellets are available in 1.5 mm, 3 mm or 4mm diameter. The mercury capacity is >20% by weight. Therefore, about 7000 kg of MERSORB® are required to absorb the mercury in the off-gas.

3.4.2 Radiological Composition

The MERSORB® absorbers are downstream of the second set of HEPA filters. The off-gas is considered non-radioactive at this point. Therefore, the spent MERSORB® is not considered radioactive and can be processed by mercury recycling companies.

4 PROCESS DESCRIPTION

The SBW is stored in tanks WM-180, WM-181, WM-184, and WM-186 at INTEC. For the material balance calculations, a composite waste stream is used. There are approximately 3.8 million liters of SBW to be treated.

The SBW will be stored in a tank in the new vitrification facility. The SBW is not filtered. A recirculating pump is used to keep undissolved solids (UDS) in suspension in the SBW feed tank. The SBW will be mixed with glass frit and a sucrose solution. The resulting mixture will be fed at essentially steady state into the melter.

The melter is joule-heated, with a cold cap, capable of producing 136 kg (300 lb) of glass per hour with wet feed. The melter has a design temperature range of 1100–1400°C; but is expected to operate between 1100–1150°C. The melter is capable of handling wet, slurried, or dry waste feed. The cold cap on the melter is maintained by the incoming of feed.

Off-gas from the melter consists mainly of water, carbon monoxide and carbon dioxide, nitrogen and nitrous oxides (N_2 , NO, and NO_2) and air. The off-gas goes to a two-stage Noxidizer®. The first stage is the reduction phase. Fuel is combusted with a deficit of oxygen which causes the reduction NO and NO_2 to elemental nitrogen, N_2 and CO_2 to CO. The second stage is an oxidation phase. Fuel is burnt with an excess of oxygen at a lower temperature than the reduction phase. Carbon monoxide is oxidized to CO_2 but the temperature of the chamber is insufficient to oxide N_2 gas. Mercury compounds will be reduced to elemental mercury in the Noxidizer®.

The gas from the Noxidizer® is immediately cooled in a quench vessel. This sudden cooling will minimize reoxidation of elemental mercury. This will also provide liquid/gaseous contact for transfer of soluble things like cesium and nitrous oxide to the liquid phase. Entrained solids and condensed mercury will be knocked out of the gas.

This is followed by a venturi scrubber which provides additional liquid/gas contact between the scrubbing water and the off-gas. A demister vessel is used to remove entrained water from the off-gas. This also causes liquid/gas contact at the demister mesh. The gas leaving the demister is saturated with water.

A knock-out drum is used to cool the off-gas and condense some of the water vapor in the gas. The off-gas is heated to prevent condensation in the HEPA filters and the granulated activated carbon (GAC) beds. Two HEPA filters in series remove radioactive and other particulates. The HEPA FILTERS are at least 99.97% efficient on 0.3 micron particles or greater.

Granulated activated carbon filters are used to remove mercury from the off-gas before discharge to the atmosphere.

4.1 Melter Feed

4.1.1 SBW Feed

The composition for SBW used for the material balance comes from Reference 6. To meet the goal of completion of processing in two years, the SBW Feed rate will be 395 liter/hr. The SBW has an average density of 1.31 and average pH of -0.3. The SBW is not filtered. Undissolved solids (UDS) in the SBW are fed into the melter with the liquid SBW. The composition of SBW and UDS used is shown in Attachment 1, Table 3.

4.1.2 Frit Feed

A commercial frit is used for making glass in the melter. Experiments by Applied Technology and Clemson University have determined that this mixture of frit is suitable for vitrification of SBW. This frit makes a borosilicate glass.

Table 3 Frit Composition

Species	Weight Fraction
B ₂ O ₃	0.143
Li ₂ O	0.027
SiO ₂	0.686
TiO ₂	0.031
Fe ₂ O ₃	0.113

4.1.3 Sugar Feed

Sugar in the form of sucrose (C₁₂H₂₂O₁₁) is added to the SBW and frit to create reducing conditions in the melt. Attachment 3 shows the reactions with sugar and HNO₃ that are expected. The addition of sugar appears to facilitate the nitrate decomposition reactions. Addition of sugar has been observed to reduce foaming and decrease melt time.

Table 4 shows the amount of sugar consumed in each of the projected reactions. For each liter of SBW liquid (including UDS), 0.65167 moles of sugar is required.

Table 4 Sugar Reactions in Melter

Reactant in SBW	Begin Mole/liter	HNO ₃	120°C	Al(NO ₃) ₃	170°C	Sugar	350°C	Na(NO ₃)	K(NO ₃)	600°C	Fe ₂ O ₃	> 600°C
		Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter
Al+3	0.653		0.653	-0.653	0		0			0		0
H+1	2.116	-2.116	0.000		0		0			0		0
K+1	0.188		0.188		0.188		0.188		-0.188	0		0
Na+1	1.683		1.683		1.683		1.683	-1.683		0		0
NO3-1	6.080	-2.116	3.963	-1.958	2.005		2.005	-1.683	-0.188	0.134		0.134
Fe+3	0.025		0.025		0.025		0.025			0.025	-0.004	0.017
Sugar	0.65167	-0.176	0.475	-0.163	0.312	-0.312	0			0		0

Reaction Products	Begin Mole/liter	HNO ₃	120°C	Al(NO ₃) ₃	170°C	Sugar	350°C	Na(NO ₃)	K(NO ₃)	600°C	Fe ₂ O ₃	> 600°C
		Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter	Mole/liter
H ₂ O		2.998	2.998	1.795	4.793	3.433	8.227			8.227		8.227
N ₂								0.421	0.047	0.468		0.468
NO		1.058	1.058	0.979	2.037		2.037	0.841	0.094	2.973		2.973
NO ₂		1.058	1.058	0.979	2.037		2.037			2.037		2.037
CO		2.116	2.116	1.958	4.075		4.075	3.365	0.376	7.816	0.004	7.820
C			0		0	3.745	3.745	-3.365	-0.376	0.004	-0.004	0.000
Na ₂ O								0.841		0.841		0.841
K ₂ O									0.094	0.094		
FeO											0.008	0.008

4.2 Vitrification Unit

4.2.1 Melter

The melter is similar to the joule-heated melter in the Transportable Vitrification Unit (TVU). The melter will operate at a temperature of about 1100°C. The melter will produce 124 kg/hr (273 lb/hr) of vitrified waste. The melter has lid heaters to facilitate start up heating of the melter. These heaters can also be used during operation to help evaporate water from the waste.

Normal operating conditions for the melter will include a continuous feed of SBW, frit, and sugar to the melter. This will maintain a "cold cap" on top of the melted glass. The cold cap helps trap volatile materials such as cesium in the melt. The operation modeled in the material balance does not use the lid heaters. The off-gas from the melter is modeled as 200°C.

The user specified melter air is the amount of air leaking into the melter due to the negative pressure of the system. This air cools fittings and connections on the melter and provides a driving force for carrying water vapor out of the melter. At Savannah River, the melter has an influx of air of approximately 154 sm³/hr. For this material balance, an influx of 200 sm³/hr (88 scfm) is used but additional air is added due to the reducing atmosphere created in the melter by the sugar.

5 WIPP WAC

Revision 7 of the Waste Acceptance Criteria (WAC) for the Waste Isolation Pilot Plant, Reference 2, does not address requirements for remote handled waste. Therefore, the requirements of Revision 5, Reference 1 are used for comparison of the glass waste. The requirements for remote-handled TRU (RH-TRU) must be met. Attachment 2 compares the WIPP WAC requirements to the vitrified SBW.

5.1 Canister

Canisters shall be noncombustible and meet, as a minimum, the structural requirements and design conditions for Type A packaging as contained in 49 CFR 173.412. All RH-TRU canisters shall be certified in accordance with DOT Specification 7A, Type A, and shall meet the Type A packaging specifications from the time of RH-TRU waste certification to disposal in the WIPP.

5.1.1 Dimensions

RH-TRU canisters shall be no larger than a nominal 26 inches (0.66 m) in diameter with a maximum length of 10 feet, 1 inch (3.1 m), including the pintle, per Rockwell International Drawing RI-H-2-91273. The weight of the RH-TRU canister must be no more than 8,000 lbs when loaded.

5.1.2 Surface Contamination

Removable surface contamination on RH-TRU canisters shall not be greater than 20 dpm per 100 cm² for alpha-emitting radionuclides and 200 dpm per 100 cm² for beta-gamma-emitting radionuclides.

6 REFERENCES

6.1 Regulations and Requirements

1. Waste Acceptance Criteria for the Waste Isolation Pilot Plant, DOE/WIPP-069, Rev. 5, Chg. 2, dated December 1996.
2. Waste Acceptance Criteria for the Waste Isolation Pilot Plant, DOE/WIPP-069, Rev. 7, November 8, 1999.

6.2 Reference Books

3. General Chemistry, 5th Edition, Nebergall, W. H, Schmidt, F. C., and Holtzclaw, H. F., Jr., D. C Heath and Company, 1976.

6.3 Reports

4. "Feasibility Study Report for NWCF MACT Compliance Facility", J. K. Rawlins, INEEL/EXT-97-00992, November 1997.
5. "Summary of NWCF Calciner Emissions Inventory Data", R. D. Boardman, et. al., INEEL/EXT-99-1190, November 1999.
6. "Sodium-Bearing Waste to WIPP Waste (SBW³) Optimization Study," N. O. Valles, et. al., INEEL/EXT-00-00975, November 1999.
7. "CsIX/TRU Grout Feasibility Study," S. J. Losinski, C. M. Barnes, B. K. Grover, INEEL/EXT-99-00034, November 1998.
8. "Final Waste Form Requirements and Path to Disposal-Volume II: Evaluation of Potential Disposal Sites for INTEC Radioactive Mixed Wastes," by J. Banaee, R. Kimmitt and A. Poloski.
9. "Vitrified Waste Option Study Report", INEEL/EXT-97-01389, D. A. Lopez and R. R. Kimmitt, February 1998.
10. "EDFs Related to HLW EIS Projects for Vitrifying SBW and Calcine (P88) and Calcine Blending and Vitrification (P60)", April 1998.
11. "High-Level Waste Vitrification Facility Feasibility Study", D. A. Lopez, INEEL/EXT-99-00792, August 1999.
12. D. Fennelly, UOP Molecular Sieves, faxed letter to J. Quigley, UOP IONSIV[®] Ion Exchangers, October 26, 1995.

Attachment 1
Material Balance Model

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1 INTRODUCTION

Vitrification of sodium bearing waste (SBW) at the Idaho Nuclear Technology Engineering Center (INTEC) of the Idaho National Engineering and Environmental Laboratory (INEEL) is being developed. SBW is a radioactive liquid waste with high concentrations of sodium in the waste. The waste is also a hazardous waste under RCRA. A model has been developed to generate the material balance for this process. The model uses Excel macro programs and user supplied input to create the material balance. The output is in the form of an Excel spreadsheet.

Presented in this report are the input used by the model to generate the material balance for vitrification of SBW and the basis for the input values. Also presented is the material balance and process flow diagrams (PFD) for the process.

2 MODEL SPREADSHEET

Streams

The model file defines the components and the material streams used by the model. The "Streams" worksheet defines how material balance streams connect components (unit operations or groups of unit operations). The input is shown in Table 1.

Table 1 File: MODEL, Worksheet: Streams

"From" Component	"From" Component Stream Type	Stream Type	Stream ID	"To" Component	"To" Component Stream Type
Input	OUT_combined	liquid	SBW Liquid	SBW Feed	IN_aqueous
Input		liquid	UDS	SBW Feed	IN_aqueous
SBW Feed		liquid	SBW	Melter Feed	IN_aqueous
Input		liquid	Sugar	Melter Feed	IN_aqueous
Input		solid	SBW Frit	Melter	IN_frit
Melter Feed	OUT_combined	liquid	SBW & Sugar	Melter	IN_feed
Input	OUT_glass	gas	Melter Air	Melter	IN_air
Melter		solid	Glass		Output
Melter	OUT_gas	gas	Melter OG	NOX Reduce	IN_offgas
Input	OUT_offgas	gas	NOX Reduce Air	NOX Reduce	IN_air
Input		gas	Fuel Reduce	NOX Reduce	IN_fuel
NOX Reduce		gas	NOX Reduce OG	NOX Cool	IN_offgas
NOX Cool	INTER_offgas	gas	NOX Cooling		Output
Input	OUT_offgas	liquid	NOX Cooling Water	NOX Cool	IN_water
NOX Cool		gas	NOX Cool OG	NOX Oxidize	IN_offgas
Input	OUT_offgas	gas	NOX Oxidize Air	NOX Oxidize	IN_air
NOX Oxidize		gas	NOX Oxidize OG	Quench	IN_offgas
Scrub Tank	OUT_aqueous	liquid	Quench Water	Quench	IN_quench
Quench	OUT_quench	liquid	Quench Water Out	Scrub Tank	IN_aqueous
Quench	OUT_offgas	gas	Quench OG	Venturi	IN_offgas
Scrub Tank	OUT_aqueous	liquid	Venturi Water	Venturi	IN_quench
Venturi	OUT_quench	liquid	Venturi Water Out	Scrub Tank	IN_aqueous
Venturi	OUT_offgas	gas	Venturi OG	Demister	IN_offgas
Demister	OUT_liquid	liquid	Demister Water	Scrub Tank	IN_aqueous
Demister	OUT_offgas	gas	Demister OG	Knock-Out Drum	IN_offgas
Knock-Out Drum	OUT_liquid	liquid	Knock-Out Water	Scrub Tank	IN_aqueous
Knock-Out Drum	OUT_offgas	gas	Knock-Out OG		Output
Input	INTER_aqueous	liquid	Makeup Scrub	Scrub Tank	IN_makeup
Scrub Tank		liquid	Scrub Comp		Output
Scrub Tank		liquid	Scrub Blowdown	Split Blowdown	IN_stream
Split Blowdown	OUT_stream	liquid	Blowdown Recycle	SBW Feed	IN_aqueous
Split Blowdown	OUT_stream	liquid	Blowdown		Output

Components

Input on the "Components" worksheet names each component identifies which calculation module the model is to use for that component, and provides input parameters needed in the calculations for that component. Table 2 contains the input for components. The column on the right contains information that is not needed by the model. It is included to help identify the input parameter or to ensure proper units for the parameter value.

Table 2 File: MODEL, Worksheet: Components

NAME	TYPE	PARAMETERS	INDEX (0 for non-arrays)	VALUE	(units assumed in code or description)
Melter	Melter	Waste type	0	SBW	
		Glass waste loading	SBW	0.35	
		Glass waste loading	Al calcine	0.07	
		Glass waste loading	Zr calcine	0.09	
		Glass waste loading	Na calcine	0.16	
		Excess air to melter	0	0	
		Fractional conv HNO ₃ -N ₂	0	0.05	
		N ₂ /NO ₂ ratio in offgas	0	1	
		Melter offgas temp-C	0	200	
		User specified air	0	200	(sm ³ /hr)
NOX Reduce	LAW_DeNOx	Fuel converted to CO ₂ /H ₂ O	0	0.3855	fraction
		Fuel converted to CO/H ₂ O	0	0.1823	fraction
		Fuel converted to CO ₂ /H ₂	0	0.4322	fraction
		NO conversion	0	0.965	fraction
		NO ₂ conversion	0	0.999	fraction
		Reduction temperature	0	1205	degrees C
		Energy release by NO reduction	0	21.6	kcal/mol
		Energy release by NO ₂ reduction	0	8.041	kcal/mol
		Fuel type	0	Kerosene	"Kerosene" or "Natural gas"
NOX Cool	LAW_Cool	Quench water enthalpy change	0	942.4	kcal/kg
		Cooling chamber temperature	0	760	degrees C
		Solids heat capacity	0	0.233	cal/gm-C=kcal/kg-C
NOX Oxidize	LAW_ReOx	CO oxidation fraction	0	0.985	
		H ₂ oxidation fraction	0	1	
		H ₂ S oxidation fraction	0	1	
		Fractional excess air	0	0.5	
Quench	LAW_Quench	Quench tower temperature	0	81.9	°C
		Solids heat capacity	0	0.233	cal/g-°C
		Quench tower pressure	0	9.8	psia
		Device type	0	Quench tower	
		Outlet liquid density	0	1	g/cc

NAME	TYPE	PARAMETERS	INDEX (0 for non-arrays)	VALUE	(units assumed in code or description)
Venturi	LAW_Quench	Solids heat capacity	0	0.233	cal/g-°C
		Quench tower pressure	0	9.4	psia
		Liquid entrainment fraction	0	0.0010	
		Device type	0	Venturi scrubber	("Quench tower" or "Venturi scrubber")
		Liquid/Gas ratio	0	1.5	lit/sm3
		Outlet liquid density	0	1	g/cc
Scrub Tank	LAW_Scrub_Tank	Makeup divided by total flow	0	0.0022	
		HNO3 molarity in makeup	0	0	Molar
		Scrub outlet temperature	0	75.4	degrees C
Demister	LAW_KO	Device type	0	Demister	("Demister" or "Knock out drum")
		Liquid separation fraction	0	0.9	
		Outlet liquid density	0	1	
Knock-Out Drum	LAW_KO	Device type	0	Knock out drum	("Demister" or "Knock out drum")
		Knock out drum pressure	0	9.7	psia
		Outlet liquid density	0	1	gm/cm3
		Knock out drum temperature	0	76.9	degrees C
Split Blowdown	Split_liquid	Flow fraction	0	0.97	
		Stream to receive fraction	0	Blowdown Recycle	
SBW Feed	Jct_liquid				
Melter Feed	Jct_liquid				

3 BASIS FOR INPUT PARAMETERS

Melter

Type: Melter

The melter is similar to the joule-heated melter in the Transportable Vitrification Unit (TVU). The melter will operate at a temperature of about 1100°C. The melter has lid heaters to facilitate start up heating of the melter. These heaters can also be used during operation to help evaporate water from the waste. Normal operating conditions for the melter will include a continuous feed of SBW, frit, and sugar to the melter. This will maintain a "cold cap" on top of the melted glass. The cold cap helps trap volatile materials such as cesium in the melt. The operation modeled in the material balance does not use the lid heaters. The off-gas from the melter is modeled as 200°C, based on actual operation the Savannah River melter which ranges from 200 to 350°C.

The user specified melter air is the amount of air leaking into the melter due to the negative pressure of the system. This air cools fittings and connections on the melter and provides a driving force for carrying water vapor out of the melter. At Savannah River, the melter has an influx of air of approximately 154 sm³/hr. For this material balance, an influx of 200 sm³/hr (118 scfm) is used.

The waste loading is 35% on a dry basis taken from experimental results using a SBW simulant. Fractional conversion of HNO₃ to N₂ is assumed to be 0.05. The ratio of conversion to NO and NO₂ is expected to be 1:1.

Sugar is expected to be oxidized to CO and H₂O in the melt. All organics in the feed, including the CO from the sugar, are assumed to be oxidized to CO₂ and H₂O in the melter air. The input parameter "Excess air to melter" sets the air rate to exceed the stoichiometric requirements for oxidation. Insufficient oxygen is available from the "User specified air" parameter. Additional air is added to oxidize the CO from sugar reduction to CO₂.

NOX Reduce

Type: LAW_DeNOx

The NOX Reduce module is the first of three modules needed to model a Noxidizer™, which reduces nitrous oxides (NO_x) to nitrogen gas (N₂). John Zink Company manufactures the "Noxidizer™". Information on the operation of the Noxidizer™ is in Attachment 3 to Appendix E of Reference 3. The first stage is a high-temperature >1200°C (>2200°F) combustion chamber that operates in a reducing atmosphere by limiting the amount of available oxygen. An operating temperature of 1205°C (2200°F) is used in the model.

For the material balance, kerosene is used as the combustion agent. Natural gas could also be used but kerosene was chosen because it is already used at INTEC for the NWCF. The conversion fractions used for CO and H₂O, CO₂ and H₂, CO₂ and H₂O, NO, and NO₂ are based on the information from John Zink. The heats of reaction for the reduction of NO and NO₂ are calculated from tables of standard heats of formation.

NOX Cool

Type: LAW_Cool

The second stage is a partial quench of the gas to 760°C (1400°F) based on operation information in Attachment 3 to Appendix E of Reference 3. This reduces the temperature so N₂ and O₂ don't recombine. Cooling water is sprayed into the gas. The quench water enthalpy change is taken from ASME Steam Tables, 3rd Edition, for 80°F quench water converted to 1400°F (760°C) steam. The heat capacity for entrained solids is assumed to be 0.233 cal/g-°C which is the heat capacity of borosilicate glass taken from Chemical Engineers' Handbook, 5th Edition.

NOX Oxidize

Type: LAW_ReOx

The third-stage of the Noxidizer is another combustion chamber. The temperature of the combustion chamber is maintained between 980 - 1090°C (1800 - 2000°F) to limit the formation of thermal NOx. Excess air is added to create an oxidizing atmosphere to combust the remaining fuel. Enough air is injected to give an excess oxygen level of 1.5% to 2% by volume on a dry basis in the final flue gases. Residence time is about 1 second.

The input for fraction of excess air is based on percent excess oxygen required for combustion rather than excess oxygen in the final flue gases. Therefore, the fractional excess air is found by trial to be 50% which results in an excess oxygen level of 1.6% by volume on a dry basis in the flue gases.

Quench

Type: LAW_Quench

The component type "LAW_Quench" is used for both quench towers and venturi scrubbers. For this component, the input parameter "Device type" is set to "Quench Tower."

The temperature of the quench tower is set to keep the ratio of liquid to gas similar to that in the quench tower operated with the calciner at NWCF. Information about the operating conditions of the NWCF quench tower are taken from Table A1 of Reference 4. The ratio used is approximately 7.5 liters quench water per 1 sm³.

The heat capacity for entrained solids is assumed to be 0.233 cal/g-°C as discussed for NOX Cool. The quench tower pressure (9.8 psia) is based on a Noxidizer pressure of 10 psia. A density of 1.00 g/cm³ is assumed for the quench liquid effluent.

Venturi

Type: LAW_Quench

The input parameter "Device type" is set to "Venturi scrubber" for this component. The liquid to gas ratio is based on the operating conditions of the NWCF venturi scrubber shown in Table A1 of Reference 4. A ratio of 1.5 liters/sm³ is used. The heat capacity for entrained solids is assumed to be 0.233 cal/g-°C. The pressure drop in the venturi is assumed to be 0.4 psi. The density of the liquid is assumed to be 1.00. The fraction of liquid entering the venturi scrubber which is entrained in the gas stream is 0.001. This assumes that there is a liquid collection drum after the venturi scrubber.

Scrub Tank

Type: LAW_Scrub_Tank

Cesium and other compounds accumulate in the scrub solution. A portion of the scrub solution is drawn off as a blowdown stream. The input variable "Makeup divided by total flow" is the ratio of the blowdown stream to the total flows into the scrub tank. A fraction of 0.0022 is used. Water is used to for make-up scrub solution with a HNO₃ molarity of 0. The scrub outlet temperature after cooling is assumed to be 75.4°C

Demister

Type: LAW_KO

The same component type is used for both the Demister and Knock-Out Drum. For this component, the input parameter "Device type" is "Demister." The input "Liquid separation fraction" is 0.90 since most entrained liquid is removed after the venturi scrubber. The liquid is assumed to have a density of 1.00.

Knock-Out Drum

Type: LAW_KO

This component includes a per-HEPA heater, a prefilter, two stages of HEPA filters, a cooler, and a knock-out drum. The "Device type" is "Knock out drum." The pressure is 9.7 psia based on a fan upstream of the HEPA filters boosting the pressure to 12 psia and a 2.3 psi pressure drop across the filters and cooler. The temperature of the cooler is 76.9°C.

Split Blowdown

Type: Split_liquid

The component Split Blowdown divides the stream "Scrub Blowdown" into two streams, "Blowdown Recycle" and "Blowdown". The flow fraction to the stream "Blowdown Recycle" is 0.97.

SBW Feed

Type: Jct_Liquid

The SBW Feed component mixes the stream "SBW Liquid" with the stream "UDS" to create the liquid waste stream, "SBW" to the melter. No input parameters are required.

Melter Feed

Type: Jct_Liquid

The Melter Feed component mixes the stream "Blowdown Recycle" with the streams "SBW" and "Sugar" to create the liquid waste stream, "SBW & Recycle" to the melter. No input parameters are required.

4 COMPOSITIONS SPREADSHEET

In_Streams

The "In_Streams" worksheet is the only place that lists chemical and radionuclide species that are used in the model. The list is divided into five sections: "chemicals," which includes all ions, "nuclides," "compounds," gases," and "others" which includes UDS, organics, fuels, ion exchange resins and grout additives. Also included is the charge for ionic species, molecular weights for ionic and gaseous species, and half-lives for radionuclides. This data is provided in Table 3.

The compositions of the sodium bearing waste liquid phase and undissolved solids phase are taken from "Sodium-Bearing Waste to WIPP Waste (SBW³) Optimization Study," N. O. Valles, et. al., INEEL/EXT-00-00975, November 1999. This is consistent with the other SBW treatment feasibility studies being performed.

Offgas Sepn Factors

The "Offgas Sepn Factors" worksheet contains separation factors of the melter offgas components. The separation factors are given as the fraction of the melter feed that is carried into the offgas. The values shown in Table 4 are taken from Reference 6

NOx Conv

The worksheet "NOx Conv" is not used for this model.

Volatility Facs

The "Volatility Facs" worksheet shows volatility factors for the off-gas treatment equipment. Factors are taken from Reference 5 with the exception of mercury. Mercury is expected to be in elemental form when it exits the NoxidizerTM, not HgO or HgCl₂. The factors used are that 99% of the mercury passes through the quench and venturi scrubber and that 99.5% passes through the demister.

Table 3 File: COMPOSITIONS, Worksheet: In_Streams

Species Types	Species	Valences	MWs	Name---->	SBW Liquid	UDS	Sugar	Melter Air	SBW Frit	NOX Air	Makeup Scrub	NOX Cooling Water
				Type-->	liquid	liquid	liquid	gas	solid	gas	liquid	liquid
				Amount or Rate-->	395	0.674	88.3					
				Units-->	lit/hr	lit/hr	lit/hr	sm ³ /hr	kg/hr	sm ³ /hr	lit/hr	lit/hr
				stream factor (hr/yr)	4800	4800	4800	4800	4800	4800	4800	4800
				Specific Gravity-->	1.31	1.7	1.5		2.5		1	1
				Composition Units-->	moles/lit	moles/lit	moles/lit	moles/lit	kg/kg	moles/lit	moles/lit	moles/lit
TOP	TOP	TOP	TOP	HALF LIFE	TOP	TOP	TOP	TOP	TOP	TOP	TOP	TOP
chemicals	Ag+1	1	107.868		2.95E-05							
	Al+3	3	26.9815		6.52E-01	1.13E+00						
	As+3	3	74.92		7.74E-05							
	B+3	3	10.81		2.04E-02	4.70E+00						
	Ba+2	2	137.34		6.58E-05							
	Ca+2	2	40.08		5.65E-02	3.86E-01						
	Cd+2	2	112.4		5.53E-03	2.45E-02						
	Ce+4	4	85.47									
	Cl-1	-1	35.453		3.15E-02	1.30E+00						
	CO3-2	-2	59.993									
	Cr+3	3	51.996		5.77E-03	7.52E-02						
	Cs+1	1	132.9		9.110E-06							
	F-1	-1	18.998		9.810E-02	2.379E+00						
	Fe+3	3	55.847		2.400E-02	7.576E-01						
	H+1	1	1.008		2.120E+00							
	Hg+2	2	200.59		1.820E-03	4.981E-02						
	K+1	1	39.102		1.870E-01	6.953E-01						
	Mg+2	2	24.312			1.1321965						
	Mn+2	2	54.938		1.45E-02	1.20E-01						
	Mo+6	6	95.94		7.42E-04	2.87E-01						
	Na+1	1	22.99		1.68E+00	3.21E+00						
	Nb+5	5	92.906									
	Nd+3	3	101.07									
	NH4+1	1	18.039									

Species Types	Species	Valences	MWts	Name---->	SBW Liquid	UDS	Sugar	Melter Air	SBW Frit	NOX Air	Makeup Scrub	NOX Cooling Water
	Ni+2	2	58.69		2.39E-03	2.67E-01						
	NO3-1	-1	62.01		6.09E+00							
	OH-1	-1	17.01									
	Pb+2	2	207.19		1.15E-03	1.33E-02						
	Pd+3	3	102.9									
	PO4-3	-3	94.972		7.72E-03	2.42E+00						
	Pr+3	3	138.9									
	Ru+4	4	127.6									
	Se+4	4	78.96		1.55E-05	0.2157207						
	Si+4	4	28.086			2.4743487						
	Sn+4	4	118.69									
	Sr+2	2	87.62									
	SO4-2	-2	96.06		4.41E-02	2.62E+00						
	Zr+4	4	91.22		1.43E-02	2.59E+00						
	Am+4	4	241									
	I	0	129									
	Np+4	4	237									
	Pu+4	4	239									
	Tc+7	7	99									
	U+4	4	238		2.23E-03							
	Ac+3	3	227									
	At	0	210									
	Be+2	2	9.01									
	Bi+3	3	209									
	Br-1	-1	79.9									
	C+4	4	12									
	Cf+3	3	251									
	Cm+3	3	247									
	Cu+2		63.55									
	Dy+3	3	162.5									
	Er+3	3	167.26									
	Eu+3	3	152									
	Fr+1	1	223									
	Ga+3	3	69.7									
	Gd+3	3	157.25									

Species Types	Species	Valences	MW's	Name---->	SBW Liquid	UDS	Sugar	Melter Air	SBW Frit	NOX Air	Makeup Scrub	NOX Cooling Water
	Ge+2	2	72.6									
	Ho+3	3	164.9									
	In+3	3	114.8									
	La+3	3	88.9									
	Li+1	1	6.94									
	Pa+4	4	231									
	Pm+3	3	145									
	Po+2	2	209									
	Ra	0	226									
	Rb+3	1	140.1									
	Rh+3	3	106.4									
	Sb+4	4	121.75									
	Sm+3	3	150.35									
	Tb+3	3	158.9									
	Te+4	4	140.9									
	Th+4	4	232									
	Ti+4		47.9									
	Tl+3	3	204.4									
	Tm+3	3	168.9									
	Y+3	3	144.2									
	Yb+3	3	173									
	Zn+2	2	65.37									
nuclides	Am-241		241	432.7		5.26E-04						4.86E-01
	Am-243		243	7380		2.12E-07						0.002056
	Cm-242		242	0.446027397								0.00E+00
	Cm-244		244	18.11		1.76E-05						0.00E+00
	Np-237		237	2.14E+06		1.85E-06						2.956E-05
	Pu-238		238	87.74		9.71E-04						0.1308333
	Pu-239		239	2.41E+04		7.69E-05						0.0064907
	Pu-240		240	6537		2.19E-05						0.002056
	Pu-241		241	14.7		4.37E-04						0.0679653
	Pu-242		242	3.76E+05		1.64E-08						3.024E-06
	Th-230		230	7.70E+04		4.60E-10						0.00E+00
	Th-231		231	0.002890411								0.00E+00
	U-232		232	72		2.27E-09						0.00E+00

Species Types	Species	Valences	MWts	Name-->	SBW Liquid	UDS	Sugar	Melter Air	SBW Frit	NOX Air	Makeup Scrub	NOX Cooling Water
	U-233		233	1.59E+05	7.58E-12	0.00E+00						
	U-234		234	2.44E+05	1.12E-06	4.04E-05						
	U-235		235	7.04E+08	2.90E-08	9.209E-07						
	U-236		236	2.34E+07	5.43E-08	4.214E-07						
	U-237		237	0.018493151		0.00E+00						
	U-238		238	4.47E+09	2.91E-08	1.319E-07						
	Ba-137m		137	4.8554E-06	4.46E-02	3.9249983						
	Ce-144		144	0.779178082	8.67E-10	0.00E+00						
	Co-60		60	5.27	6.26E-05	0.0010705						
	Cs-134		134	2.062	9.96E-06	0.0135421						
	Cs-135		135	2.30E+06	9.07E-07	0.00E+00						
	Cs-137		137	30.17	4.72E-02	4.1458856						
	Eu-152		152	13.4	3.30E-06	0.00E+00						
	Eu-154		154	8.2	1.95E-04	0.0009226						
	Eu-155		155	4.76	7.79E-05	0.00E+00						
	Pm-147		147	2.6234	1.12E-04	0.00E+00						
	Pr-144		144	3.28767E-05	8.67E-10	0.00E+00						
	Ni-63		63	100	5.82E-05	0.00E+00						
	Ru-106		106	1.008219178	1.34E-08	0.00E+00						
	Sb-125		125	2.73	9.19E-06	0.0190303						
	Sm-151		151	93	5.70E-04	0.00E+00						
	Sr-90		90	29	3.68E-02	9.2772686						
	Tc-99		99	2.13E+05	1.75E-05	0.0076291						
	Y-90		90	0.007305936	3.68E-02	9.2772686						
	H-3		3	12.33	3.67E-05	0						
	I-129		129	1.59E+07	1.45E-07	0.0016159						
compounds	H2O	0	18.0154		47.28	6.7152714	59.90				55.56	55.56
	O	0	15.9994			18.478769						
	H2O2	0	34.0148									
	CaS	0	72.144									
	HgS	0	232.65									
	CaCO3	0	100.078									
	NaNO3		85									
	KNO3		101.11									
	NaCl		58.443									

Species Types	Species	Valences	MWts	Name---->	SBW Liquid	UDS	Sugar	Melter Air	SBW Frit	NOX Air	Makeup Scrub	NOX Cooling Water
	KCl		74.553									
	CaCl2		110.986									
	NaF		41.988									
	KF		58.098									
	CaF2		78.076									
	HgO		216.589									
	Na3PO4		163.942									
	Na3VO4		183.942									
	K3PO4		212.272									
	Ca3(PO4)2		310.184									
	Na2SO4		142.04									
	K2SO4		174.26									
	CaSO4		136.14									
	KAlO2		98.0803									
	NaAlO2		81.9703									
	Na2O		61.9794									
	K2O		94.1994									
	Al2O3		101.961									
	B2O3	0	69.62						0.143			
	Li2O	0	29.8						0.027			
	SiO2	0	60.1						0.686			
	TiO2	0	79.9						0.031			
	Fe2O3	0	159.6						0.113			
gases	CO2	0	43.9988									
	CO	0	28.0104									
	H2O(g)	0	18.0154									
	N2	0	28.014					0.79		0.79		
	NO	0	30.0064									
	NO2	0	46.0058									
	O2	0	31.9988									
	HF	0	20.006					0.21		0.21		
	HCl	0	36.461									
	HNO3	0	63.018									
	Ar	0	39.95									
	SO2	0	64.0612									

Species Types	Species	Valences	MWs	Name---->	SBW Liquid	UDS	Sugar	Melter Air	SBW Frit	NOX Air	Makeup Scrub	NOX Cooling Water
	Hg(g)	0	200.59									
	CH4		16.043									
	C2H4		28.054									
	H2		2.016									
	NH3		17.03									
	H2S		34.08									
others	UDS	0										
	Truex solvent	0										
	SREX solvent											
(Sugar)	HEDPA						1000					
	TOC	0				0.698						
	Sorbent											
	Tc resin											
	Natural gas											
	Kerosene											
	Portland cement											
	BFS											
	Flyash											
	Plasticizer											

Table 4 File: COMPOSITIONS, Worksheet: Offgas Sepn Factors

Species	Fraction	Species	Fraction	Species	Fraction	Species	Fraction
Ag+1	0.02	Ru+4	0.04	In+3	0.01	Th-230	0.01
Al+3	0.01	Se+4	0.25	La+3	0.01	Th-231	0.01
As+3	0.01	Si+4	0.01	Li+1	0.01	U-232	0.01
B+3	0.01	Sn+4	0.01	Pa+4	0.01	U-233	0.01
Ba+2	0.01	Sr+2	0.01	Pm+3	0.01	U-234	0.01
Ca+2	0.01	SO4-2	0.2	Po+2	0.01	U-235	0.01
Cd+2	0.01	Zr+4	0.01	Ra	1	U-236	0.01
Ce+4	0.01	Am+4	0.01	Rb+3	0.01	U-237	0.01
Cl-1	0.50	I	0.91	Rh+3	0.01	U-238	0.01
Cr+3	0.01	Np+4	0.01	Sb+4	0.01	Ba-137m	0.0333
Cs+1	0.0333	Pu+4	0.01	Sm+3	0.01	Ce-144	0.01
F-1	0.25	Tc+7	0.5	Tb+3	0.01	Co-60	0.01
Fe+3	0.01	U+4	0.01	Te+4	0.01	Cs-134	0.0333
H+1	1	Ac+3	0.01	Th+4	0.01	Cs-135	0.0333
Hg+2	1	At	0.91	Tl+3	0.01	Cs-137	0.0333
K+1	0.01	Be+2	0.01	Tm+3	0.01	Eu-152	0.01
Mg+2	0.01	Bi+3	0.01	Y+3	0.01	Eu-154	0.01
Mn+2	0.01	Br-1	0.705	Yb+3	0.01	Eu-155	0.01
Mo+6	0.01	C+4	1	Zn+2	0.01	Pm-147	0.01
Na+1	0.01	Cf+3	0.01	Am-241	0.01	Pr-144	0.01
Nb+5	0.01	Cm+3	0.01	Am-243	0.01	Ni-63	0.01
Nd+3	0.01	Dy+3	0.01	Cm-242	0.01	Ru-106	0.04
NH4+1	0.01	Er+3	0.01	Cm-244	0.01	Sb-125	0.01
Ni+2	0.01	Eu+3	0.01	Np-237	0.01	Sm-151	0.01
NO3-1	1	Fr+1	0.01	Pu-238	0.01	Sr-90	0.01
Pb+2	0.01	Ga+3	0.01	Pu-239	0.01	Tc-99	0.5
Pd+3	0.01	Gd+3	0.01	Pu-240	0.01	Y-90	0.01
PO4-3	0.01	Ge+2	0.01	Pu-241	0.01	H-3	1
Pr+3	0.01	Ho+3	0.01	Pu-242	0.01	I-129	0.91

Table 5 File: COMPOSITIONS, Worksheet: Volatility Facs

species	Quench tower	Venturi scrubber	Demister	Prefilter	HEPA Stage 1	HEPA Stage 2	LAW KO drum
solids	0.05	0.05	0.05	0.05	0.005	0.01	1
HCl	0.1	0.1	0.5	1	1	1	1
HF	0.1	0.1	0.5	1	1	1	1
Hg	0.99	0.99	0.995	1	1	1	1
I-129	0.1	0.1	0.5	1	1	1	1
H-3	1	1	1	1	1	1	1

5 GENERAL SPREADSHEET

Gas Cp

Worksheet "Gas Cp" contains specific heat equations for gases taken from Table 2-194 of Reference 23. The equation form and constants for the equations are shown in Table 6.

Table 6 File: GENERAL, Worksheet: Gas Cp

Specific heat equations (T in K), cal/K-gmol					
Gases	A	B	C	D	Equation
Ar	4.97				$C_p = A$
CO ₂	10.34	2.74E-03	-1.96E+05		$C_p = A + B \cdot T + C/T^2$
HCl	6.7	8.40E-04			$C_p = A + B \cdot T$
HF	6.6	8.40E-04			$C_p = A + B \cdot T$
Hg(g)	4.97				$C_p = A$
H ₂ O(g)	8.22	1.50E-04		1.34E-06	$C_p = A + B \cdot T + D \cdot T^2$
N ₂	6.5	1.00E-03			$C_p = A + B \cdot T$
NO	8.05	2.33E-04	-1.56E+05		$C_p = A + B \cdot T + C/T^2$
NO ₂	12.185	3.62E-04	-3.44E+05		$C_p = A + B \cdot T + C/T^2$
O ₂	8.27	2.58E-04	-1.88E+05		$C_p = A + B \cdot T + C/T^2$
SO ₂	7.7	5.30E-03		-8.30E-07	$C_p = A + B \cdot T + D \cdot T^2$

Fuel Calcs

The "Fuel Calcs" worksheet performs fuel calculations for the denitrator and NoxidizerTM. The only input values on the worksheet are the sulfur content and molecular weight of the kerosene. The molecular weight is based on assuming an average formula for kerosene of C₁₂H₂₆. The sulfur content of kerosene is 0.0029 grams sulfur per gram of kerosene per Reference 5.

Properties

Worksheet "Properties" contains thermal properties of water, composition and heating values for natural gas and kerosene, composition of air, and the composition of organic species in terms of carbon, hydrogen, oxygen and nitrogen. Information for natural gas, air, NGLW, TRUEX solvent and SREX solvent are included because the program expects this information. The data is not used for calculations in this model.

However, to model the addition of sugar to the melter feed, HEDPA properties have been replaced with sugar properties. The number of moles of each element is calculated per gram of sugar as shown in Table 7. Since the hydrogen and oxygen are in stoichiometric ratio for water, the moles per gram are not included in the "Properties" worksheet. The water in the sugar is included in the water of dissolution for making the sugar solution.

Values used for the "Properties" worksheet are shown in Table 1

Table 7 Sugar Properties

$C_{12}H_{22}O_{11}$	Number of atoms	Molecular weight	grams/mole	wt%	M/gram
C	12	12.01115	144.1338	42%	0.0350569
H	22	1.0079	22.1738	6%	0.0642709
O	11	15.9994	175.9934	51%	0.0321355
Total			342.301	100%	

Table 8 File: GENERAL, Worksheet: Properties

Specie	property ID	value	units
H2O(l)	H2O(l) latent heat, kcal/kg	544.81	kcal/kg
	H2O(l) heat capacity	1	kcal/kg-C
	H2O(l) latent heat, kcal/mol	9.814970074	kcal/mol
	H2O MW	18.0154	
Natural gas	Natural gas CH4 fraction	0.904	mole fraction
	Natural gas C2H6 fraction	0.053	mole fraction
	Natural gas C3H8 fraction	0.017	mole fraction
	Natural gas C4H10 fraction	0.0066	mole fraction
	Natural gas CO2 fraction	0.0055	mole fraction
	Natural gas N2 fraction	0.0139	mole fraction
	Natural gas heating value to CO2/H2O	203.91	kcal/mole natural gas
	Natural gas heating value to CO/H2O	175.185	kcal/mole natural gas
Kerosene	Natural gas heating value to CO2/H2	84.384	kcal/mole natural gas
	Kerosene sulfur content	0.0029	wt%
	Kerosene density	0.75	kg/lit
	Kerosene heating value to CO2/H2O	1795.02	kcal/mole kerosene
	Kerosene heating value to CO/H2O	1478.03	kcal/mole kerosene
	Kerosene heating value to CO2/H2	1043.65	kcal/mole kerosene
	Kerosene heating value to CH4/C2H4	0	kcal/mole kerosene
Air	Kerosene density	0.75	kg/lit
	Mole fraction N2 in air	0.78	mole fraction
	Mole fraction O2 in air	0.21	mole fraction
NGLW	Mole fraction Ar in air	0.01	mole fraction
	M/gm C in NGLW	0.039934	
	M/gm H in NGLW	0.069251	
	M/gm O in NGLW	0.038721	
HEDPA	M/gm N in NGLW	0.002962	
	M/gm C in HEDPA	0.035056865	SUGAR
	M/gm H in HEDPA	0	
	M/gm O in HEDPA	0	
Truex solvent	M/gm N in HEDPA	0	
	M/gm C in Truex solvent	0.0713	
	M/gm H in Truex solvent	0.1426	
	M/gm O in Truex solvent	0	
SREX solvent	M/gm N in Truex solvent	0	
	M/gm C in SREX solvent	0.0713	
	M/gm H in SREX solvent	0.1426	
	M/gm O in SREX solvent	0	
	M/gm N in SREX solvent	0	

Grout Formulation

Although the worksheet "Grout Formulation" is included in the file "GENERAL" the model does not use the information.

6 DISTRIBUTION COEFFICIENTS SPREADSHEET

The distribution coefficients are not used for this model. The file is included because the program expects to find it.

7 REFERENCES

Reference Books

1. General Chemistry, 5th Edition, Nebergall, W. H, Schmidt, F. C., and Holtzclaw, H. F., Jr., D. C Heath and Company, 1976.
2. Chemical Engineers' Handbook, 7th Edition, Perry.

Reports

3. "Feasibility Study Report for NWCF MACT Compliance Facility", J. K. Rawlins, INEEL/EXT-97-00992, November 1997.
4. "Summary of NWCF Calciner Emissions Inventory Data", R. D. Boardman, et. al., INEEL/EXT-99-1190, November 1999.
5. CMB-06-99, *TRANSMITTAL OF INTEC SODIUM-BEARING WASTE AND CALCINE FULL SEPARATIONS MATERIAL BALANCE MODEL INPUT AND BASIS*, dated September 14, 1999.
6. DSI97-GES-024, MELTER OFFGAS TECHNOLOGY INFORMATION, dated June 30, 1997.

D

C

B

A

SUBCONTRACT NO.		INEEL <small>Engineering & Construction Services TECHNICAL SERVICES, LLC</small>	
REQUESTER: J. OUGLEY		DIRECT VITRIFICATION OF SBW	
DESIGN:			
DRAWN: C. KELLY			
PROJECT NO.			
SPEC CODE			
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.		SIZE: D	INDEX CODE NUMBER: DWG-PFD-SBW-1
EFFECTIVE DATE:		SCALE: NONE	SHEET 1 OF 1

Stream Number	1	2		3	4	5
Stream Name	SBW Liquid	UDS	SBW	SBW & Recycle	Sugar	SBW Frit
Flow Units	lit/hr	lit/hr	lit/hr	lit/hr	lit/hr	kg/hr
Volume or Rate	395	0.67	396	435	88.3	82.4
Specific Gravity	1.31	1.70	1.31	1.28	1.50	2.50
Temperature, C						
Temperature, F						
Pressure, psia						
Pressure, kPa						
Composition	moles/lit	moles/lit	moles/lit	moles/lit	moles/lit	kg/kg
Ag+1	2.95E-05	0	2.94E-05	2.73E-05	0	0
Al+3	6.52E-01	1.13E+00	6.53E-01	6.00E-01	0	0
As+3	7.74E-05	0	7.73E-05	7.10E-05	0	0
B+3	2.04E-02	4.70E+00	2.84E-02	2.61E-02	0	0
Ba+2	6.58E-05	0	6.57E-05	6.03E-05	0	0
Ca+2	5.65E-02	3.86E-01	5.71E-02	5.24E-02	0	0
Cd+2	5.53E-03	2.45E-02	5.56E-03	5.11E-03	0	0
Cl-1	3.15E-02	1.30E+00	3.37E-02	3.25E-02	0	0
Cr+3	5.77E-03	7.52E-02	5.89E-03	5.41E-03	0	0
Cs+1	9.11E-06	0	9.09E-06	8.55E-06	0	0
F-1	9.81E-02	2.38E+00	1.02E-01	9.56E-02	0	0
Fe+3	2.40E-02	7.58E-01	2.52E-02	2.32E-02	0	0
H+1	2.12E+00	0	2.12E+00	1.93E+00	0	0
Hg+2	1.82E-03	4.98E-02	1.90E-03	1.73E-03	0	0
K+1	1.87E-01	6.95E-01	1.88E-01	1.73E-01	0	0
Mg+2	0.00E+00	1.13E+00	1.93E-03	1.77E-03	0	0
Mn+2	1.45E-02	1.20E-01	1.47E-02	1.35E-02	0	0
Mo+6	7.42E-04	2.87E-01	1.23E-03	1.13E-03	0	0
Na+1	1.68E+00	3.21E+00	1.68E+00	1.55E+00	0	0
Ni+2	2.39E-03	2.67E-01	2.84E-03	2.61E-03	0	0
NO3-1	6.09E+00	0	6.08E+00	5.53E+00	0	0
Pb+2	1.15E-03	1.33E-02	1.17E-03	1.08E-03	0	0
PO4-3	7.72E-03	2.42E+00	1.18E-02	1.09E-02	0	0
Ru+4	0.00E+00	2.16E-01	3.67E-04	3.47E-04	0	0
Se+4	1.55E-05	0	1.55E-05	1.86E-05	0	0
Si+4	0.00E+00	2.47E+00	4.21E-03	3.87E-03	0	0
SO4-2	4.41E-02	2.62E+00	4.85E-02	4.41E-02	0	0
Zr+4	1.43E-02	2.59E+00	1.87E-02	1.72E-02	0	0
U+4	2.23E-03	0	2.23E-03	2.05E-03	0	0
Zn+2	0.00E+00	4.86E-01	8.27E-04	7.60E-04	0	0
	moles/lit	moles/lit	moles/lit	moles/lit	moles/lit	kg/kg
H2O	47.28	6.72	47.21	47.96	59.9	0
O	0	18.48	0.0314	0.029	0	0
B2O3	0	0	0	0	0	0.143
Li2O	0	0	0	0	0	0.027
SiO2	0	0	0	0	0	0.686
TiO2	0	0	0	0	0	0.031
Fe2O3	0	0	0	0	0	0.113
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	0	0	0	0	0
CO	0	0	0	0	0	0
H2O(g)	0	0	0	0	0	0
N2	0	0	0	0	0	0
NO	0	0	0	0	0	0
NO2	0	0	0	0	0	0
O2	0	0	0	0	0	0
HF	0	0	0	0	0	0
HCl	0	0	0	0	0	0
Ar	0	0	0	0	0	0
SO2	0	0	0	0	0	0
Hg(g)	0	0	0	0	0	0
H2	0	0	0	0	0	0
H2S	0	0	0	0	0	0

Stream Number	1	2		3	4	5
Stream Name	SBW Liquid	UDS	SBW		Sugar	SBW Frit
Units	lit/hr	lit/hr	lit/hr		lit/hr	kg/hr
Volume or Rate	395	1	396		88	82
	g/lit	g/lit	g/lit	g/lit	g/lit	kg/kg
HEDPA	0	0	0	0	1000	0
TOC	0.698	0	0.697	0.634	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/kg
Am-241	5.26E-04	2.06E-03	5.29E-04	4.86E-04	0	0
Am-243	2.12E-07	0	2.12E-07	1.94E-07	0	0
Cm-244	1.76E-05	0	1.76E-05	1.61E-05	0	0
Np-237	1.85E-06	2.96E-05	1.90E-06	1.74E-06	0	0
Pu-238	9.71E-04	1.31E-01	1.19E-03	1.10E-03	0	0
Pu-239	7.69E-05	6.49E-03	8.78E-05	8.07E-05	0	0
Pu-240	2.19E-05	2.06E-03	2.54E-05	2.33E-05	0	0
Pu-241	4.37E-04	6.80E-02	5.52E-04	5.07E-04	0	0
Pu-242	1.64E-08	3.02E-06	2.15E-08	1.98E-08	0	0
Th-230	4.60E-10	0	4.59E-10	4.22E-10	0	0
U-232	2.27E-09	0	2.27E-09	2.08E-09	0	0
U-233	7.58E-12	0	7.57E-12	6.95E-12	0	0
U-234	1.12E-06	4.04E-05	1.19E-06	1.09E-06	0	0
U-235	2.90E-08	9.21E-07	3.05E-08	2.80E-08	0	0
U-236	5.43E-08	4.21E-07	5.49E-08	5.05E-08	0	0
U-238	2.91E-08	1.32E-07	2.93E-08	2.69E-08	0	0
Ba-137m	4.46E-02	3.92E+00	5.12E-02	4.81E-02	0	0
Ce-144	8.67E-10	0	8.66E-10	7.95E-10	0	0
Co-60	6.26E-05	1.07E-03	6.43E-05	5.91E-05	0	0
Cs-134	9.96E-06	1.35E-02	3.30E-05	3.10E-05	0	0
Cs-135	9.07E-07	0	9.05E-07	8.51E-07	0	0
Cs-137	4.72E-02	4.15E+00	5.42E-02	5.09E-02	0	0
Eu-152	3.30E-06	0	3.29E-06	3.03E-06	0	0
Eu-154	1.95E-04	9.23E-04	1.96E-04	1.80E-04	0	0
Eu-155	7.79E-05	0	7.78E-05	7.14E-05	0	0
Pm-147	1.12E-04	0	1.12E-04	1.03E-04	0	0
Pr-144	8.67E-10	0	8.66E-10	7.95E-10	0	0
Ni-63	5.82E-05	0	5.81E-05	5.34E-05	0	0
Ru-106	1.34E-08	0	1.34E-08	1.27E-08	0	0
Sb-125	9.19E-06	1.90E-02	4.16E-05	3.82E-05	0	0
Sm-151	5.70E-04	0	5.69E-04	5.23E-04	0	0
Sr-90	3.68E-02	9.28E+00	5.25E-02	4.83E-02	0	0
Tc-99	1.75E-05	7.63E-03	3.05E-05	5.35E-05	0	0
Y-90	3.68E-02	9.28E+00	5.25E-02	4.83E-02	0	0
H-3	3.67E-05	0	3.66E-05	3.33E-05	0	0
I-129	1.45E-07	1.62E-03	2.89E-06	1.57E-05	0	0

Stream Number		6	7	8	9	10
Stream Name	SBW & Sugar	Melter Feed	Melter Air	Glass	Melter OG	NOX Reduce Air
Flow Units	lit/hr	kg/hr	sm3/hr	kg/hr	sm3/hr	sm3/hr
Volume or Rate	524	773	364	127	1,114	122
Specific Gravity	1.32		1.00	2.60	1.00	1.00
Temperature, C					200	
Temperature, F					392	
Pressure, psia						
Pressure, kPa						
Composition	moles/lit	kg/kg	moles/moles	kg/kg	gm/sm3	gm/sm3
Ag+1	2.27E-05	1.66E-03	0	9.92E-06	2.30E-05	0
Al+3	4.99E-01	9.11E+00	0	5.50E-02	6.32E-02	0
As+3	5.90E-05	2.99E-03	0	1.81E-05	2.08E-05	0
B+3	2.17E-02	1.59E-01	0	9.58E-04	1.10E-03	0
Ba+2	5.02E-05	4.66E-03	0	2.82E-05	3.24E-05	0
Ca+2	4.36E-02	1.18E+00	0	7.15E-03	8.21E-03	0
Cd+2	4.25E-03	3.23E-01	0	1.95E-03	2.24E-03	0
Cl-1	2.70E-02	6.49E-01	0	1.98E-03	0.00E+00	0
Cr+3	4.50E-03	1.58E-01	0	9.57E-04	1.10E-03	0
Cs+1	7.11E-06	6.39E-04	0	3.77E-06	1.48E-05	0
F-1	7.95E-02	1.02E+00	0	4.68E-03	0.00E+00	0
Fe+3	1.93E-02	7.29E-01	0	4.41E-03	5.06E-03	0
H+1	1.60E+00	1.09E+00	0	0.00E+00	0.00E+00	0
Hg+2	1.44E-03	1.95E-01	0	0.00E+00	0.00E+00	0
K+1	1.43E-01	3.80E+00	0	2.30E-02	2.64E-02	0
Mg+2	1.47E-03	3.42E-02	0	1.46E-04	1.68E-04	0
Mn+2	1.12E-02	4.17E-01	0	2.52E-03	2.89E-03	0
Mo+6	9.39E-04	6.10E-02	0	3.68E-04	4.23E-04	0
Na+1	1.29E+00	2.00E+01	0	1.21E-01	1.39E-01	0
Ni+2	2.17E-03	8.62E-02	0	5.21E-04	5.98E-04	0
NO3-1	4.60E+00	1.93E+02	0	0.00E+00	0.00E+00	0
Pb+2	8.94E-04	1.25E-01	0	7.58E-04	8.70E-04	0
PO4-3	9.03E-03	5.80E-01	0	3.51E-03	4.03E-03	0
Ru+4	2.89E-04	1.98E-02	0	1.46E-04	6.93E-04	0
Se+4	1.54E-05	8.24E-04	0	3.77E-06	1.43E-04	0
Si+4	3.22E-03	6.12E-02	0	3.70E-04	4.24E-04	0
SO4-2	3.67E-02	2.38E+00	0	1.16E-02	0.00E+00	0
Zr+4	1.43E-02	8.81E-01	0	5.32E-03	6.12E-03	0
U+4	1.70E-03	2.74E-01	0	1.66E-03	1.90E-03	0
Zn+2	6.32E-04	2.80E-02	0	1.69E-04	1.94E-04	0
	moles/lit	kg/kg	moles/moles	kg/kg	gm/sm3	gm/sm3
H2O	49.97	6.09E+02	0	0	0	0
O	0.0238	2.58E-01	0	0.102	0	0
B2O3	0	1.52E-02	0	0	0	0
Li2O	0	2.88E-03	0	0	0	0
SiO2	0	7.30E-02	0	0	0	0
TiO2	0	3.30E-03	0	0	0	0
Fe2O3	0	1.20E-02	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	0	0	0	6.82E-02	0
CO	0	0	0	0	0	0
H2O(g)	0	0	0	0	5.84E-01	0
N2	0	0	0.78	0	2.56E-01	0.78
NO	0	0	0	0	2.51E-02	0
NO2	0	0	0	0	2.51E-02	0
O2	0	0	0.21	0	3.77E-02	0.21
HF	0	0	0	0	2.28E-04	0
HCl	0	0	0	0	1.55E-04	0
Ar	0	0	0.01	0	3.27E-03	0.01
SO2	0	0	0	0	8.43E-05	0
Hg(g)	0	0	0	0	1.65E-05	0
H2	0	0	0	0	0	0
H2S	0	0	0	0	0	0

Stream Number		6	7	8	9	10
Stream Name	SBW & Sugar	Melter Feed	Melter Air	Glass	Melter OG	NOX Reduce Air
Units	lit/hr	kg/hr	sm ³ /hr	kg/hr	sm ³ /hr	sm ³ /hr
Volume or Rate	524	773	364	127	1,114	122
	g/lit	kg/kg	g/sm ³	kg/kg	g/sm ³	g/lit
HEDPA	169	0.11	0	0	0	0
TOC	0.527	0.00036	0	0	0	0
Portland Cement	0	0.00	0	0	0	0
Slag	0	0.00	0	0	0	0
	Ci/lit	Ci/kg	Ci/sm ³	Ci/kg	Ci/sm ³	Ci/sm ³
Am-241	4.04E-04	2.73E-04	0	1.65E-03	1.90E-06	0
Am-243	1.62E-07	1.09E-07	0	6.61E-07	7.60E-10	0
Cm-244	1.34E-05	9.08E-06	0	5.49E-05	6.31E-08	0
Np-237	1.45E-06	9.81E-07	0	5.93E-06	6.81E-09	0
Pu-238	9.10E-04	6.16E-04	0	3.72E-03	4.28E-06	0
Pu-239	6.71E-05	4.54E-05	0	2.74E-04	3.15E-07	0
Pu-240	1.94E-05	1.31E-05	0	7.92E-05	9.10E-08	0
Pu-241	4.22E-04	2.85E-04	0	1.72E-03	1.98E-06	0
Pu-242	1.64E-08	1.11E-08	0	6.72E-08	7.72E-11	0
Th-230	3.51E-10	2.37E-10	0	1.43E-09	1.65E-12	0
U-232	1.73E-09	1.17E-09	0	7.08E-09	8.13E-12	0
U-233	5.78E-12	3.91E-12	0	2.36E-11	2.72E-14	0
U-234	9.06E-07	6.14E-07	0	3.71E-06	4.26E-09	0
U-235	2.33E-08	1.58E-08	0	9.54E-08	1.10E-10	0
U-236	4.19E-08	2.84E-08	0	1.72E-07	1.97E-10	0
U-238	2.24E-08	1.51E-08	0	9.15E-08	1.05E-10	0
Ba-137m	4.00E-02	2.71E-02	0	1.60E-01	6.26E-04	0
Ce-144	6.61E-10	4.48E-10	0	2.70E-09	3.11E-12	0
Co-60	4.91E-05	3.33E-05	0	2.01E-04	2.31E-07	0
Cs-134	2.58E-05	1.75E-05	0	1.03E-04	4.03E-07	0
Cs-135	7.08E-07	4.79E-07	0	2.83E-06	1.11E-08	0
Cs-137	4.23E-02	2.87E-02	0	1.69E-01	6.62E-04	0
Eu-152	2.52E-06	1.70E-06	0	1.03E-05	1.18E-08	0
Eu-154	1.50E-04	1.01E-04	0	6.13E-04	7.04E-07	0
Eu-155	5.94E-05	4.02E-05	0	2.43E-04	2.79E-07	0
Pm-147	8.54E-05	5.78E-05	0	3.49E-04	4.01E-07	0
Pr-144	6.61E-10	4.48E-10	0	2.70E-09	3.11E-12	0
Ni-63	4.44E-05	3.00E-05	0	1.82E-04	2.09E-07	0
Ru-106	1.05E-08	7.12E-09	0	4.18E-08	1.98E-10	0
Sb-125	3.17E-05	2.15E-05	0	1.30E-04	1.49E-07	0
Sm-151	4.35E-04	2.94E-04	0	1.78E-03	2.04E-06	0
Sr-90	4.01E-02	2.72E-02	0	1.64E-01	1.89E-04	0
Tc-99	4.45E-05	3.01E-05	0	9.19E-05	1.05E-05	0
Y-90	4.01E-02	2.72E-02	0	1.64E-01	1.89E-04	0
H-3	2.77E-05	1.88E-05	0	0	1.30E-05	0
I-129	1.31E-05	8.86E-06	0	4.87E-06	5.60E-06	0

Stream Number	11	12		14	15	16
Stream Name	Fuel Reduce	NOX Reduce OG	NOX Cooling	NOX Cooling Water	NOX Cool OG	NOX Oxidize Air
Flow Units	kg/hr	sm3/hr	sm3/hr	lit/hr	sm3/hr	sm3/hr
Volume or Rate	52	1,328	1,328	232	1,643	208
Specific Gravity	0.75	1.00	1.00	1.00	1.00	1.00
Temperature, C		1205		25	760	25
Temperature, F		2201		77	1400	77
Pressure, psia						
Pressure, kPa						
Composition	kg/kg	gm/sm3	gm/sm3	moles/lit	gm/sm3	gm/sm3
Ag+1	0	1.93E-05	1.93E-05	0	1.56E-05	0
Al+3	0	5.30E-02	5.30E-02	0	4.29E-02	0
As+3	0	1.74E-05	1.74E-05	0	1.41E-05	0
B+3	0	9.23E-04	9.23E-04	0	7.46E-04	0
Ba+2	0	2.72E-05	2.72E-05	0	2.20E-05	0
Ca+2	0	6.88E-03	6.88E-03	0	5.57E-03	0
Cd+2	0	1.88E-03	1.88E-03	0	1.52E-03	0
Cl-1	0	0.00E+00	0.00E+00	0	0.00E+00	0
Cr+3	0	9.22E-04	9.22E-04	0	7.45E-04	0
Cs+1	0	1.24E-05	1.24E-05	0	1.00E-05	0
F-1	0	0.00E+00	0.00E+00	0	0.00E+00	0
Fe+3	0	4.24E-03	4.24E-03	0	3.43E-03	0
H+1	0	0.00E+00	0.00E+00	0	0.00E+00	0
Hg+2	0	0.00E+00	0.00E+00	0	0.00E+00	0
K+1	0	2.21E-02	2.21E-02	0	1.79E-02	0
Mg+2	0	1.41E-04	1.41E-04	0	1.14E-04	0
Mn+2	0	2.43E-03	2.43E-03	0	1.96E-03	0
Mo+6	0	3.55E-04	3.55E-04	0	2.87E-04	0
Na+1	0	1.16E-01	1.16E-01	0	9.41E-02	0
Ni+2	0	5.02E-04	5.02E-04	0	4.06E-04	0
NO3-1	0	0.00E+00	0.00E+00	0	0.00E+00	0
Pb+2	0	7.30E-04	7.30E-04	0	5.90E-04	0
PO4-3	0	3.38E-03	3.38E-03	0	2.73E-03	0
Ru+4	0	5.81E-04	5.81E-04	0	4.70E-04	0
Se+4	0	1.20E-04	1.20E-04	0	9.70E-05	0
Si+4	0	3.56E-04	3.56E-04	0	2.88E-04	0
SO4-2	0	0.00E+00	0.00E+00	0	0.00E+00	0
Zr+4	0	5.13E-03	5.13E-03	0	4.15E-03	0
U+4	0	1.60E-03	1.60E-03	0	1.29E-03	0
Zn+2	0	1.63E-04	1.63E-04	0	1.32E-04	0
	kg/kg	gm/sm3	gm/sm3	moles/lit	gm/sm3	gm/sm3
H2O	0	0	174.6	55.51	0	0
O	0	0	0	0	0	0
B2O3	0	0	0	0	0	0
Li2O	0	0	0	0	0	0
SiO2	0	0	0	0	0	0
TiO2	0	0	0	0	0	0
Fe2O3	0	0	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	1.12E-01	1.12E-01	0	9.09E-02	0
CO	0	1.23E-02	1.23E-02	0	9.95E-03	0
H2O(g)	0	5.31E-01	5.31E-01	0	6.21E-01	0
N2	0	3.08E-01	3.08E-01	0	2.49E-01	0.78
NO	0	7.37E-04	7.37E-04	0	5.96E-04	0
NO2	0	2.11E-05	2.11E-05	0	1.70E-05	0
O2	0	0	0	0	0	0.21
HF	0	1.92E-04	1.92E-04	0	1.55E-04	0
HCl	0	1.30E-04	1.30E-04	0	1.05E-04	0
Ar	0	3.66E-03	3.66E-03	0	2.96E-03	0.01
SO2	0	7.07E-05	7.07E-05	0	5.72E-05	0
Hg(g)	0	1.39E-05	1.39E-05	0	1.12E-05	0
H2	0	3.15E-02	3.15E-02	0	2.55E-02	0
H2S	0	8.70E-05	8.70E-05	0	7.03E-05	0

Stream Number	11	12	0	14	15	16
Stream Name	Fuel Reduce	NOX Reduce OG	NOX Cooling	NOX Cooling Water	NOX Cool OG	NOX Oxidize Air
Units	kg/hr	sm3/hr	sm3/hr	lit/hr	sm3/hr	sm3/hr
Volume or Rate	52	1,328	1,328	232	1,643	208
	g/lit	g/sm3	g/sm3	g/lit	g/sm3	g/sm3
HEDPA	0	0	0	0	0	0
TOC	0	0	0	0	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/kg	Ci/sm ³	Ci/sm ³	Ci/lit	Ci/sm ³	Ci/sm ³
Am-241	0	1.59E-06	1.59E-06	0	1.29E-06	0
Am-243	0	6.37E-10	6.37E-10	0	5.15E-10	0
Cm-244	0	5.29E-08	5.29E-08	0	4.28E-08	0
Np-237	0	5.71E-09	5.71E-09	0	4.62E-09	0
Pu-238	0	3.59E-06	3.59E-06	0	2.90E-06	0
Pu-239	0	2.64E-07	2.64E-07	0	2.14E-07	0
Pu-240	0	7.64E-08	7.64E-08	0	6.17E-08	0
Pu-241	0	1.66E-06	1.66E-06	0	1.34E-06	0
Pu-242	0	6.48E-11	6.48E-11	0	5.24E-11	0
Th-230	0	1.38E-12	1.38E-12	0	1.12E-12	0
U-232	0	6.82E-12	6.82E-12	0	5.51E-12	0
U-233	0	2.28E-14	2.28E-14	0	1.84E-14	0
U-234	0	3.57E-09	3.57E-09	0	2.89E-09	0
U-235	0	9.19E-11	9.19E-11	0	7.43E-11	0
U-236	0	1.65E-10	1.65E-10	0	1.34E-10	0
U-238	0	8.81E-11	8.81E-11	0	7.12E-11	0
Ba-137m	0	5.25E-04	5.25E-04	0	4.25E-04	0
Ce-144	0	2.61E-12	2.61E-12	0	2.11E-12	0
Co-60	0	1.94E-07	1.94E-07	0	1.57E-07	0
Cs-134	0	3.38E-07	3.38E-07	0	2.74E-07	0
Cs-135	0	9.29E-09	9.29E-09	0	7.51E-09	0
Cs-137	0	5.56E-04	5.56E-04	0	4.49E-04	0
Eu-152	0	9.92E-09	9.92E-09	0	8.02E-09	0
Eu-154	0	5.91E-07	5.91E-07	0	4.78E-07	0
Eu-155	0	2.34E-07	2.34E-07	0	1.89E-07	0
Pm-147	0	3.37E-07	3.37E-07	0	2.72E-07	0
Pr-144	0	2.61E-12	2.61E-12	0	2.11E-12	0
Ni-63	0	1.75E-07	1.75E-07	0	1.41E-07	0
Ru-106	0	1.66E-10	1.66E-10	0	1.34E-10	0
Sb-125	0	1.25E-07	1.25E-07	0	1.01E-07	0
Sm-151	0	1.71E-06	1.71E-06	0	1.38E-06	0
Sr-90	0	1.58E-04	1.58E-04	0	1.28E-04	0
Tc-99	0	8.77E-06	8.77E-06	0	7.09E-06	0
Y-90	0	1.58E-04	1.58E-04	0	1.28E-04	0
H-3	0	1.09E-05	1.09E-05	0	8.83E-06	0
I-129	0	4.70E-06	4.70E-06	0	3.80E-06	0

Stream Number	17	18	19	20	21	22
Stream Name	NOX Oxidize OG	Quench Water	Quench Water Out	Quench OG	Venturi Water	Venturi Water Out
Flow Units	sm3/hr	lit/hr	lit/hr	sm3/hr	lit/hr	lit/hr
Volume or Rate	1,822	13,920	13,092	2,948	4,422	4,458
Specific Gravity	1.00	1.01	1.01	1.00	1.01	1.01
Temperature, C	904	75	81.4	81.4	75.0	80.2
Temperature, F	1659	167	179	179	167	176
Pressure, psia				9.8		
Pressure, kPa				67.6		
Composition	gm/sm3	moles/lit	moles/lit	gm/sm3	moles/lit	moles/lit
Ag+1	1.41E-05	5.84E-06	6.23E-06	4.35E-07	5.84E-06	5.79E-06
Al+3	3.86E-02	6.41E-02	6.84E-02	1.19E-03	6.41E-02	6.36E-02
As+3	1.27E-05	7.59E-06	8.09E-06	3.93E-07	7.59E-06	7.52E-06
B+3	6.73E-04	2.79E-03	2.97E-03	2.08E-05	2.79E-03	2.76E-03
Ba+2	1.98E-05	6.45E-06	6.88E-06	6.12E-07	6.45E-06	6.40E-06
Ca+2	5.02E-03	5.60E-03	5.98E-03	1.55E-04	5.60E-03	5.56E-03
Cd+2	1.37E-03	5.46E-04	5.83E-04	4.24E-05	5.46E-04	5.42E-04
Cl-1	0.00E+00	2.11E-02	2.07E-02	0.00E+00	2.11E-02	2.49E-02
Cr+3	6.72E-04	5.78E-04	6.17E-04	2.08E-05	5.78E-04	5.73E-04
Cs+1	9.04E-06	3.04E-06	3.25E-06	2.79E-07	3.04E-06	3.02E-06
F-1	0.00E+00	3.10E-02	3.04E-02	0.00E+00	3.10E-02	3.66E-02
Fe+3	3.09E-03	2.48E-03	2.64E-03	9.56E-05	2.48E-03	2.46E-03
H+1	0.00E+00	5.21E-02	5.11E-02	0.00E+00	5.21E-02	6.15E-02
Hg+2	0.00E+00	1.04E-06	5.86E-07	0.00E+00	1.04E-06	1.71E-06
K+1	1.61E-02	1.85E-02	1.97E-02	4.98E-04	1.85E-02	1.83E-02
Mg+2	1.03E-04	1.89E-04	2.02E-04	3.18E-06	1.89E-04	1.88E-04
Mn+2	1.77E-03	1.44E-03	1.54E-03	5.47E-05	1.44E-03	1.43E-03
Mo+6	2.59E-04	1.21E-04	1.29E-04	8.00E-06	1.21E-04	1.20E-04
Na+1	8.49E-02	1.65E-01	1.76E-01	2.62E-03	1.65E-01	1.64E-01
Ni+2	3.66E-04	2.79E-04	2.97E-04	1.13E-05	2.79E-04	2.77E-04
NO3-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb+2	5.32E-04	1.15E-04	1.23E-04	1.65E-05	1.15E-04	1.14E-04
PO4-3	2.46E-03	1.16E-03	1.24E-03	7.61E-05	1.16E-03	1.15E-03
Ru+4	4.24E-04	1.49E-04	1.58E-04	1.31E-05	1.49E-04	1.47E-04
Se+4	8.75E-05	4.96E-05	5.29E-05	2.70E-06	4.96E-05	4.92E-05
Si+4	2.60E-04	4.14E-04	4.41E-04	8.02E-06	4.14E-04	4.10E-04
SO4-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr+4	3.74E-03	1.84E-03	1.96E-03	1.16E-04	1.84E-03	1.82E-03
U+4	1.16E-03	2.19E-04	2.33E-04	3.59E-05	2.19E-04	2.17E-04
Zn+2	1.19E-04	8.13E-05	8.66E-05	3.67E-06	8.13E-05	8.06E-05
	gm/sm3	moles/lit	moles/lit	gm/sm3	moles/lit	moles/lit
H2O	0	55.51	55.51	0	55.51	55.51
O	0	0	0	0	0	0
B2O3	0	0	0	0	0	0
Li2O	0	0	0	0	0	0
SiO2	0	0	0	0	0	0
TiO2	0	0	0	0	0	0
Fe2O3	0	0	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	9.08E-02	0	0	5.61E-02	0	0
CO	1.35E-04	0	0	8.32E-05	0	0
H2O(g)	5.83E-01	0	0	7.42E-01	0	0
N2	3.13E-01	0	0	1.94E-01	0	0
NO	5.37E-04	0	0	3.32E-04	0	0
NO2	1.53E-05	0	0	9.49E-06	0	0
O2	8.00E-03	0	0	4.95E-03	0	0
HF	1.40E-04	0	0	3.67E-04	0	0
HCl	9.50E-05	0	0	2.50E-04	0	0
Ar	3.81E-03	0	0	2.36E-03	0	0
SO2	1.15E-04	0	0	7.10E-05	0	0
Hg(g)	1.01E-05	0	0	6.31E-06	0	0
H2	0	0	0	0	0	0
H2S	0	0	0	0	0	0

Stream Number	17	18	19	20	21	22
Stream Name	NOX Oxidize OG	Quench Water	Quench Water Out	Quench OG	Venturi Water	Venturi Water Out
Units	sm3/hr	lit/hr	lit/hr	sm3/hr	lit/hr	lit/hr
Volume or Rate	1,822	13,920	13,092	2,948	4,422	4,458
	g/sm3	g/lit	g/lit	g/sm3	g/lit	g/lit
HEDPA	0	0	0	0	0	0
TOC	0	0	0	0	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/sm ³	Ci/lit	Ci/lit	Ci/sm ³	Ci/lit	Ci/lit
Am-241	1.16E-06	5.19E-05	5.54E-05	3.59E-08	5.19E-05	5.15E-05
Am-243	4.64E-10	2.08E-08	2.22E-08	1.44E-11	2.08E-08	2.06E-08
Cm-244	3.86E-08	1.73E-06	1.84E-06	1.19E-09	1.73E-06	1.71E-06
Np-237	4.16E-09	1.86E-07	1.99E-07	1.29E-10	1.86E-07	1.85E-07
Pu-238	2.62E-06	1.17E-04	1.25E-04	8.08E-08	1.17E-04	1.16E-04
Pu-239	1.93E-07	8.63E-06	9.20E-06	5.96E-09	8.63E-06	8.55E-06
Pu-240	5.56E-08	2.49E-06	2.66E-06	1.72E-09	2.49E-06	2.47E-06
Pu-241	1.21E-06	5.42E-05	5.78E-05	3.74E-08	5.42E-05	5.37E-05
Pu-242	4.72E-11	2.11E-09	2.25E-09	1.46E-12	2.11E-09	2.10E-09
Th-230	1.01E-12	4.51E-11	4.81E-11	3.11E-14	4.51E-11	4.47E-11
U-232	4.97E-12	2.23E-10	2.37E-10	1.54E-13	2.23E-10	2.21E-10
U-233	1.66E-14	7.43E-13	7.92E-13	5.13E-16	7.43E-13	7.37E-13
U-234	2.60E-09	1.17E-07	1.24E-07	8.05E-11	1.17E-07	1.16E-07
U-235	6.70E-11	3.00E-09	3.20E-09	2.07E-12	3.00E-09	2.97E-09
U-236	1.21E-10	5.39E-09	5.75E-09	3.73E-12	5.39E-09	5.35E-09
U-238	6.42E-11	2.88E-09	3.07E-09	1.99E-12	2.88E-09	2.85E-09
Ba-137m	3.83E-04	1.71E-02	1.83E-02	1.18E-05	1.71E-02	1.70E-02
Ce-144	1.90E-12	8.50E-11	9.06E-11	5.87E-14	8.50E-11	8.43E-11
Co-60	1.41E-07	6.32E-06	6.74E-06	4.36E-09	6.32E-06	6.26E-06
Cs-134	2.47E-07	1.10E-05	1.18E-05	7.62E-09	1.10E-05	1.09E-05
Cs-135	6.77E-09	3.03E-07	3.23E-07	2.09E-10	3.03E-07	3.00E-07
Cs-137	4.05E-04	1.81E-02	1.93E-02	1.25E-05	1.81E-02	1.80E-02
Eu-152	7.23E-09	3.24E-07	3.45E-07	2.23E-10	3.24E-07	3.21E-07
Eu-154	4.31E-07	1.93E-05	2.06E-05	1.33E-08	1.93E-05	1.91E-05
Eu-155	1.71E-07	7.64E-06	8.14E-06	5.27E-09	7.64E-06	7.57E-06
Pm-147	2.45E-07	1.10E-05	1.17E-05	7.58E-09	1.10E-05	1.09E-05
Pr-144	1.90E-12	8.50E-11	9.06E-11	5.87E-14	8.50E-11	8.43E-11
Ni-63	1.27E-07	5.71E-06	6.08E-06	3.94E-09	5.71E-06	5.66E-06
Ru-106	1.21E-10	5.41E-09	5.77E-09	3.74E-12	5.41E-09	5.37E-09
Sb-125	9.12E-08	4.08E-06	4.35E-06	2.82E-09	4.08E-06	4.05E-06
Sm-151	1.25E-06	5.59E-05	5.96E-05	3.86E-08	5.59E-05	5.54E-05
Sr-90	1.15E-04	5.16E-03	5.50E-03	3.56E-06	5.16E-03	5.12E-03
Tc-99	6.39E-06	2.86E-04	3.05E-04	1.98E-07	2.86E-04	2.84E-04
Y-90	1.15E-04	5.16E-03	5.50E-03	3.56E-06	5.16E-03	5.12E-03
H-3	7.96E-06	0	0	4.92E-06	0	0
I-129	3.42E-06	1.45E-04	1.55E-04	2.12E-07	1.45E-04	1.44E-04

Stream Number	23	24	25	26	27	28
Stream Name	Venturi OG	Demister Water	Demister OG	Knock-Out Water	Knock-Out OG	Makeup Scrub
Flow Units	sm3/hr	lit/hr	sm3/hr	lit/hr	sm3/hr	lit/hr
Volume or Rate	2,893	4.0	2,892	808	1,796	21
Specific Gravity	1.00	1.01	1.00	1.00	1.00	1.00
Temperature, C	80.2		80.2		75.0	
Temperature, F	176		176		167	
Pressure, psia	9.4				9.7	
Pressure, kPa	64.8				66.9	
Composition	gm/sm3	moles/lit	gm/sm3	moles/lit	gm/sm3	moles/lit
Ag+1	9.86E-07	6.25E-06	4.93E-08	0	1.99E-13	0
Al+3	2.71E-03	6.87E-02	1.35E-04	0	5.45E-10	0
As+3	8.90E-07	8.13E-06	4.45E-08	0	1.79E-13	0
B+3	4.71E-05	2.98E-03	2.36E-06	0	9.49E-12	0
Ba+2	1.39E-06	6.91E-06	6.93E-08	0	2.79E-13	0
Ca+2	3.51E-04	6.00E-03	1.76E-05	0	7.08E-11	0
Cd+2	9.61E-05	5.85E-04	4.80E-06	0	1.93E-11	0
Cl-1	0.00E+00	1.55E+00	0.00E+00	0	0.00E+00	0
Cr+3	4.71E-05	6.19E-04	2.35E-06	0	9.47E-12	0
Cs+1	6.33E-07	3.26E-06	3.16E-08	0	1.27E-13	0
F-1	1.12E-17	2.28E+00	5.60E-19	0	2.26E-24	0
Fe+3	2.17E-04	2.66E-03	1.08E-05	0	4.36E-11	0
H+1	0.00E+00	3.83E+00	0.00E+00	0	0.00E+00	0
Hg+2	5.30E-07	9.42E-04	0.00E+00	0	0.00E+00	0
K+1	1.13E-03	1.98E-02	5.65E-05	0	2.27E-10	0
Mg+2	7.20E-06	2.03E-04	3.60E-07	0	1.45E-12	0
Mn+2	1.24E-04	1.54E-03	6.20E-06	0	2.50E-11	0
Mo+6	1.81E-05	1.29E-04	9.06E-07	0	3.65E-12	0
Na+1	5.94E-03	1.77E-01	2.97E-04	0	1.20E-09	0
Ni+2	2.56E-05	2.99E-04	1.28E-06	0	5.16E-12	0
NO3-1	0.00E+00	0.00E+00	0.00E+00	0	0.00E+00	0
Pb+2	3.73E-05	1.23E-04	1.86E-06	0	7.51E-12	0
PO4-3	1.72E-04	1.24E-03	8.63E-06	0	3.47E-11	0
Ru+4	2.97E-05	1.59E-04	1.48E-06	0	5.97E-12	0
Se+4	6.13E-06	5.31E-05	3.06E-07	0	1.23E-12	0
Si+4	1.82E-05	4.43E-04	9.09E-07	0	3.66E-12	0
SO4-2	0.00E+00	0.00E+00	0.00E+00	0	0.00E+00	0
Zr+4	2.62E-04	1.96E-03	1.31E-05	0	5.27E-11	0
U+4	8.14E-05	2.34E-04	4.07E-06	0	1.64E-11	0
Zn+2	8.31E-06	8.70E-05	4.16E-07	0	1.67E-12	0
	gm/sm3	moles/lit	gm/sm3	moles/lit	gm/sm3	moles/lit
H2O	1.54	55.51	0.15	55.51	0	55.51
O	0	0	0	0	0	0
B2O3	0	0	0	0	0	0
Li2O	0	0	0	0	0	0
SiO2	0	0	0	0	0	0
TiO2	0	0	0	0	0	0
Fe2O3	0	0	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	5.72E-02	0	5.72E-02	0	9.21E-02	0
CO	8.48E-05	0	8.48E-05	0	1.37E-04	0
H2O(g)	7.37E-01	0	7.37E-01	0	5.77E-01	0
N2	1.97E-01	0	1.97E-01	0	3.18E-01	0
NO	3.38E-04	0	3.39E-04	0	5.45E-04	0
NO2	9.67E-06	0	9.67E-06	0	1.56E-05	0
O2	5.04E-03	0	5.04E-03	0	8.12E-03	0
HF	1.55E-04	0	7.74E-05	0	1.25E-04	0
HCl	1.05E-04	0	5.27E-05	0	8.48E-05	0
Ar	2.40E-03	0	2.40E-03	0	3.87E-03	0
SO2	7.24E-05	0	7.24E-05	0	1.17E-04	0
Hg(g)	6.40E-06	0	6.37E-06	0	1.03E-05	0
H2	0	0	0	0	0	0
H2S	0	0	0	0	0	0

Stream Number	23	24	25	26	27	28
Stream Name	Venturi OG	Demister Water	Demister OG	Knock-Out Water	Knock-Out OG	Makeup Scrub
Units	sm ³ /hr	lit/hr	sm ³ /hr	lit/hr	sm ³ /hr	lit/hr
Volume or Rate	2,893	4	2,892	808	1,796	21
	g/sm ³	g/lit	g/sm ³	g/lit	g/sm ³	g/lit
HEDPA	0	0	0	0	0	0
TOC	0	0	0	0	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/sm ³	Ci/lit	Ci/sm ³	Ci/lit	Ci/sm ³	Ci/lit
Am-241	8.12E-08	5.56E-05	4.06E-09	0	1.64E-14	0
Am-243	3.25E-11	2.23E-08	1.63E-12	0	6.55E-18	0
Cm-244	2.70E-09	1.85E-06	1.35E-10	0	5.44E-16	0
Np-237	2.92E-10	2.00E-07	1.46E-11	0	5.87E-17	0
Pu-238	1.83E-07	1.25E-04	9.16E-09	0	3.69E-14	0
Pu-239	1.35E-08	9.23E-06	6.75E-10	0	2.72E-15	0
Pu-240	3.90E-09	2.67E-06	1.95E-10	0	7.85E-16	0
Pu-241	8.48E-08	5.80E-05	4.24E-09	0	1.71E-14	0
Pu-242	3.31E-12	2.26E-09	1.65E-13	0	6.66E-19	0
Th-230	7.06E-14	4.83E-11	3.53E-15	0	1.42E-20	0
U-232	3.48E-13	2.38E-10	1.74E-14	0	7.01E-20	0
U-233	1.16E-15	7.96E-13	5.82E-17	0	2.34E-22	0
U-234	1.82E-10	1.25E-07	9.12E-12	0	3.67E-17	0
U-235	4.69E-12	3.21E-09	2.35E-13	0	9.44E-19	0
U-236	8.44E-12	5.78E-09	4.22E-13	0	1.70E-18	0
U-238	4.50E-12	3.08E-09	2.25E-13	0	9.06E-19	0
Ba-137m	2.68E-05	1.83E-02	1.34E-06	0	5.40E-12	0
Ce-144	1.33E-13	9.10E-11	6.65E-15	0	2.68E-20	0
Co-60	9.88E-09	6.76E-06	4.94E-10	0	1.99E-15	0
Cs-134	1.73E-08	1.18E-05	8.64E-10	0	3.48E-15	0
Cs-135	4.74E-10	3.24E-07	2.37E-11	0	9.55E-17	0
Cs-137	2.84E-05	1.94E-02	1.42E-06	0	5.71E-12	0
Eu-152	5.06E-10	3.46E-07	2.53E-11	0	1.02E-16	0
Eu-154	3.02E-08	2.06E-05	1.51E-09	0	6.07E-15	0
Eu-155	1.20E-08	8.18E-06	5.98E-10	0	2.41E-15	0
Pm-147	1.72E-08	1.18E-05	8.59E-10	0	3.46E-15	0
Pr-144	1.33E-13	9.10E-11	6.65E-15	0	2.68E-20	0
Ni-63	8.93E-09	6.11E-06	4.47E-10	0	1.80E-15	0
Ru-106	8.47E-12	5.80E-09	4.24E-13	0	1.71E-18	0
Sb-125	6.39E-09	4.37E-06	3.19E-10	0	1.29E-15	0
Sm-151	8.74E-08	5.98E-05	4.37E-09	0	1.76E-14	0
Sr-90	8.07E-06	5.52E-03	4.04E-07	0	1.63E-12	0
Tc-99	4.48E-07	3.06E-04	2.24E-08	0	9.01E-14	0
Y-90	8.07E-06	5.52E-03	4.04E-07	0	1.63E-12	0
H-3	5.02E-06	0	5.02E-06	0	8.08E-06	0
I-129	2.44E-07	8.79E-05	1.22E-07	0	1.97E-07	0

Stream Number		29	30	31	32	33
Stream Name	Scrub Comp	Scrub Water	Scrub Blowdown	Blowdown Recycle	Blowdown	Blowdown after IX
Flow Units	lit/hr	lit/hr	lit/hr	lit/hr	lit/hr	lit/hr
Volume or Rate	18,383	18,342	40	39	1.2	1.2
Specific Gravity	1.01	1.01	1.01	1.01	1.01	1.01
Temperature, C		75.00	75			
Temperature, F		167.00	167			
Pressure, psia						
Pressure, kPa						
Composition	moles/lit	moles/lit	moles/lit	moles/lit	moles/lit	moles/lit
Ag+1	5.84E-06	5.84E-06	5.84E-06	5.84E-06	5.84E-06	5.84E-06
Al+3	6.41E-02	6.41E-02	6.41E-02	6.41E-02	6.41E-02	6.41E-02
As+3	7.59E-06	7.59E-06	7.59E-06	7.59E-06	7.59E-06	7.59E-06
B+3	2.79E-03	2.79E-03	2.79E-03	2.79E-03	2.79E-03	2.79E-03
Ba+2	6.45E-06	6.45E-06	6.45E-06	6.45E-06	6.45E-06	6.45E-06
Ca+2	5.60E-03	5.60E-03	5.60E-03	5.60E-03	5.60E-03	5.60E-03
Cd+2	5.46E-04	5.46E-04	5.46E-04	5.46E-04	5.46E-04	5.46E-04
Cl-1	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02
Cr+3	5.78E-04	5.78E-04	5.78E-04	5.78E-04	5.78E-04	5.78E-04
Cs+1	3.04E-06	3.04E-06	3.04E-06	3.04E-06	3.04E-06	3.04E-10
F-1	3.10E-02	3.10E-02	3.10E-02	3.10E-02	3.10E-02	3.10E-02
Fe+3	2.48E-03	2.48E-03	2.48E-03	2.48E-03	2.48E-03	2.48E-03
H+1	5.21E-02	5.21E-02	5.21E-02	5.21E-02	5.21E-02	5.21E-02
Hg+2	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06
K+1	1.85E-02	1.85E-02	1.85E-02	1.85E-02	1.85E-02	1.85E-02
Mg+2	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04
Mn+2	1.44E-03	1.44E-03	1.44E-03	1.44E-03	1.44E-03	1.44E-03
Mo+6	1.21E-04	1.21E-04	1.21E-04	1.21E-04	1.21E-04	1.21E-04
Na+1	1.65E-01	1.65E-01	1.65E-01	1.65E-01	1.65E-01	1.65E-01
Ni+2	2.79E-04	2.79E-04	2.79E-04	2.79E-04	2.79E-04	2.79E-04
NO3-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb+2	1.15E-04	1.15E-04	1.15E-04	1.15E-04	1.15E-04	1.15E-04
PO4-3	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03
Ru+4	1.49E-04	1.49E-04	1.49E-04	1.49E-04	1.49E-04	1.49E-04
Se+4	4.96E-05	4.96E-05	4.96E-05	4.96E-05	4.96E-05	4.96E-05
Si+4	4.14E-04	4.14E-04	4.14E-04	4.14E-04	4.14E-04	4.14E-04
SO4-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr+4	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03
U+4	2.19E-04	2.19E-04	2.19E-04	2.19E-04	2.19E-04	2.19E-04
Zn+2	8.13E-05	8.13E-05	8.13E-05	8.13E-05	8.13E-05	8.13E-05
	moles/lit	moles/lit	moles/lit	moles/lit	moles/lit	moles/lit
H2O	55.51	55.51	55.51	55.51	55.51	55.51
O	0	0	0	0	0	0
B2O3	0	0	0	0	0	0
Li2O	0	0	0	0	0	0
SiO2	0	0	0	0	0	0
TiO2	0	0	0	0	0	0
Fe2O3	0	0	0	0	0	0
	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction	mole fraction
CO2	0	0	0	0	0	0
CO	0	0	0	0	0	0
H2O(g)	0	0	0	0	0	0
N2	0	0	0	0	0	0
NO	0	0	0	0	0	0
NO2	0	0	0	0	0	0
O2	0	0	0	0	0	0
HF	0	0	0	0	0	0
HCl	0	0	0	0	0	0
Ar	0	0	0	0	0	0
SO2	0	0	0	0	0	0
Hg(g)	0	0	0	0	0	0
H2	0	0	0	0	0	0
H2S	0	0	0	0	0	0

Stream Number		29	30	31	32	33
Stream Name	Scrub Comp	Scrub Water	Scrub Blowdown	Blowdown Recycle	Blowdown	Blowdown after IX
Units	lit/hr	lit/hr	lit/hr	lit/hr	lit/hr	lit/hr
Volume or Rate	18,383	18,342	40	39	1.2	1.2
	g/lit	g/lit	g/lit	g/lit	g/lit	g/lit
HEDPA	0	0	0	0	0	0
TOC	0	0	0	0	0	0
Portland Cement	0	0	0	0	0	0
Slag	0	0	0	0	0	0
	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit	Ci/lit
Am-241	5.19E-05	5.19E-05	5.19E-05	5.19E-05	5.19E-05	1.10E-09
Am-243	2.08E-08	2.08E-08	2.08E-08	2.08E-08	2.08E-08	3.03E-11
Cm-244	1.73E-06	1.73E-06	1.73E-06	1.73E-06	1.73E-06	1.81E-06
Np-237	1.86E-07	1.86E-07	1.86E-07	1.86E-07	1.86E-07	3.24E-07
Pu-238	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.93E-05
Pu-239	8.63E-06	8.63E-06	8.63E-06	8.63E-06	8.63E-06	7.64E-06
Pu-240	2.49E-06	2.49E-06	2.49E-06	2.49E-06	2.49E-06	1.10E-05
Pu-241	5.42E-05	5.42E-05	5.42E-05	5.42E-05	5.42E-05	8.50E-11
Pu-242	2.11E-09	2.11E-09	2.11E-09	2.11E-09	2.11E-09	5.71E-06
Th-230	4.51E-11	4.51E-11	4.51E-11	4.51E-11	4.51E-11	5.41E-09
U-232	2.23E-10	2.23E-10	2.23E-10	2.23E-10	2.23E-10	4.08E-06
U-233	7.43E-13	7.43E-13	7.43E-13	7.43E-13	7.43E-13	0.00E+00
U-234	1.17E-07	1.17E-07	1.17E-07	1.17E-07	1.17E-07	0.00E+00
U-235	3.00E-09	3.00E-09	3.00E-09	3.00E-09	3.00E-09	0.00E+00
U-236	5.39E-09	5.39E-09	5.39E-09	5.39E-09	5.39E-09	0.00E+00
U-238	2.88E-09	2.88E-09	2.88E-09	2.88E-09	2.88E-09	0.00E+00
Ba-137m	1.71E-02	1.71E-02	1.71E-02	1.71E-02	1.71E-02	0.00E+00
Ce-144	8.50E-11	8.50E-11	8.50E-11	8.50E-11	8.50E-11	0.00E+00
Co-60	6.32E-06	6.32E-06	6.32E-06	6.32E-06	6.32E-06	0.00E+00
Cs-134	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	0.00E+00
Cs-135	3.03E-07	3.03E-07	3.03E-07	3.03E-07	3.03E-07	0.00E+00
Cs-137	1.81E-02	1.81E-02	1.81E-02	1.81E-02	1.81E-02	0.00E+00
Eu-152	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	0.00E+00
Eu-154	1.93E-05	1.93E-05	1.93E-05	1.93E-05	1.93E-05	0.00E+00
Eu-155	7.64E-06	7.64E-06	7.64E-06	7.64E-06	7.64E-06	0.00E+00
Pm-147	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	0.00E+00
Pr-144	8.50E-11	8.50E-11	8.50E-11	8.50E-11	8.50E-11	0.00E+00
Ni-63	5.71E-06	5.71E-06	5.71E-06	5.71E-06	5.71E-06	0
Ru-106	5.41E-09	5.41E-09	5.41E-09	5.41E-09	5.41E-09	0
Sb-125	4.08E-06	4.08E-06	4.08E-06	4.08E-06	4.08E-06	0
Sm-151	5.59E-05	5.59E-05	5.59E-05	5.59E-05	5.59E-05	0
Sr-90	5.16E-03	5.16E-03	5.16E-03	5.16E-03	5.16E-03	0
Tc-99	2.86E-04	2.86E-04	2.86E-04	2.86E-04	2.86E-04	0
Y-90	5.16E-03	5.16E-03	5.16E-03	5.16E-03	5.16E-03	0
H-3	0	0	0	0	0	0
I-129	1.45E-04	1.45E-04	1.45E-04	1.45E-04	1.45E-04	0

Vitrification of SBW

5/24/00

Stream Number	34	35	36
Stream Name	Dry Grout Mix	LLW Grout	Off-Gas to Stack
Flow Units	kg/hr	kg/hr	sm3/hr
Volume or Rate	3.0	4.2	1795.8
Specific Gravity		1.826	1.00
Temperature, C			
Temperature, F			
Pressure, psia			
Pressure, kPa			
Composition		kg/kg	gm/sm3
Ag+1		1.81E-07	1.99E-13
Al+3		4.96E-04	5.45E-10
As+3		1.63E-07	1.79E-13
B+3		8.64E-06	9.49E-12
Ba+2		2.54E-07	2.79E-13
Ca+2		6.44E-05	7.08E-11
Cd+2		1.76E-05	1.93E-11
Cl-1		2.15E-04	0.00E+00
Cr+3		8.63E-06	9.47E-12
Cs+1		1.16E-11	1.27E-13
F-1		1.69E-04	2.26E-24
Fe+3		3.97E-05	4.36E-11
H+1		1.51E-05	0.00E+00
Hg+2		5.98E-08	0.00E+00
K+1		2.07E-04	2.27E-10
Mg+2		1.86E-06	1.45E-12
Mn+2		2.27E-05	2.50E-11
Mo+6		3.32E-06	3.65E-12
Na+1		1.09E-03	1.20E-09
Ni+2		4.70E-06	5.16E-12
NO3-1		0.00E+00	0.00E+00
Pb+2		6.83E-06	7.51E-12
PO4-3		3.16E-05	3.47E-11
Ru+4		4.31E-06	5.97E-12
Se+4		1.12E-06	1.23E-12
Si+4		3.33E-06	3.66E-12
SO4-2		0.00E+00	0.00E+00
Zr+4		4.80E-05	5.27E-11
U+4		1.49E-05	1.64E-11
Zn+2		1.52E-06	1.67E-12
		kg/kg	gm/sm3
H2O		0.287	0
O		0.000	0
B2O3		0.000	0
Li2O		1.63E-07	0
SiO2		8.64E-06	0
TiO2		2.54E-07	0
Fe2O3		6.44E-05	0
		mole fraction	mole fraction
CO2		0	9.21E-02
CO		0	1.37E-04
H2O(g)		0	0.00E+00
N2		0	3.18E-01
NO		0	5.45E-04
NO2		0	1.56E-05
O2		0	8.12E-03
HF		0	1.25E-04
HCl		0	8.48E-05
Ar		0	3.87E-03
SO2		0	1.17E-04
Hg(g)		0	2.36E-09
H2		0	0.00E+00
H2S		0	0.00E+00

Stream Number	34	35	36
Stream Name	Dry Grout Mix	LLW Grout	Off-Gas to Stack
Units	kg/hr	kg/hr	sm3/hr
Volume or Rate	3.0	4.2	1,796
	kg/kg	kg/kg	g/sm3
HEDPA		0	0
TOC		0	0
Portland Cement	0.5	0.355	0
Slag	0.5	0.355	0
	Ci/lit	Ci/kg	Ci/sm3
Am-241		1.49E-05	1.64E-14
Am-243		5.96E-09	6.55E-18
Cm-244		4.95E-07	5.44E-16
Np-237		5.35E-08	5.87E-17
Pu-238		3.36E-05	3.69E-14
Pu-239		2.47E-06	2.72E-15
Pu-240		7.15E-07	7.85E-16
Pu-241		1.56E-05	1.71E-14
Pu-242		6.06E-10	6.66E-19
Th-230		1.29E-11	1.42E-20
U-232		6.39E-11	7.01E-20
U-233		2.13E-13	2.34E-22
U-234		3.34E-08	3.67E-17
U-235		8.60E-10	9.44E-19
U-236		1.55E-09	1.70E-18
U-238		8.25E-10	9.06E-19
Ba-137m		4.92E-07	5.40E-12
Ce-144		2.44E-11	2.68E-20
Co-60		1.81E-06	1.99E-15
Cs-134		3.17E-10	3.48E-15
Cs-135		8.69E-12	9.55E-17
Cs-137		5.20E-07	5.71E-12
Eu-152		9.28E-08	1.02E-16
Eu-154		5.53E-06	6.07E-15
Eu-155		2.19E-06	2.41E-15
Pm-147		3.15E-06	3.46E-15
Pr-144		2.44E-11	2.68E-20
Ni-63		1.64E-06	1.80E-15
Ru-106		1.55E-09	1.71E-18
Sb-125		1.17E-06	1.29E-15
Sm-151		1.60E-05	1.76E-14
Sr-90		1.48E-06	1.63E-12
Tc-99		8.21E-05	9.01E-14
Y-90		1.48E-06	1.63E-12
H-3		0	8.08E-06
I-129		4.17E-05	1.97E-07

Attachment 2 Glass Chemistry

Ionic Species	SBW Frit	Glass	Oxidized Species		Molecular Weights		%
	Moles/hr	Moles/hr		Moles/hr	g/mole	kg/hr	
Ag+1		0.012	Ag ₂ O	0.006	231.735	0.001	0.001%
Al+3		258.441	Al ₂ O ₃	129.221	101.961	13.176	10.357%
As+3		0.031	As ₂ O ₃	0.015	197.841	0.003	0.002%
B+3		11.229	B ₂ O ₃	174.779	69.618	12.168	9.565%
Ba+2		0.026	BaO	0.026	153.329	0.004	0.003%
Ca+2		22.589	CaO	6.988	56.079	0.392	0.308%
Cd+2		2.202	CdO	2.202	128.409	0.283	0.222%
Cl-1		7.081	NaCl	7.081	58.443	0.414	0.325%
Cr+3		2.331	Cr ₂ O ₃	1.166	151.990	0.177	0.139%
Cs+1		0.004	Cs ₂ O	0.002	281.810	0.001	0.000%
F-1		31.203	CaF ₂	15.602	78.077	1.218	0.958%
Fe+3		9.996	Fe ₂ O ₃	63.274	159.692	10.104	7.943%
K+1		74.380	K ₂ O	37.190	94.196	3.503	2.754%
Mg+2		0.763	MgO	0.763	40.311	0.031	0.024%
Mn+2		5.812	MnO	5.812	70.937	0.412	0.324%
Mo+6		0.487	MoO ₃	0.487	143.938	0.070	0.055%
Na+1		666.128	Na ₂ O	321.844	61.979	19.948	15.680%
Ni+2		1.124	NiO	0.562	74.699	0.042	0.033%
Pb+2		0.4634	PbO	0.463	446.399	0.207	0.163%
PO4-3		4.6784	P ₂ O ₅	2.339	269.940	0.631	0.496%
Ru+4		0.1833	RuO ₂	0.183	133.069	0.024	0.019%
Se+4		0.0061	SeO ₂	0.006	110.959	0.001	0.001%
Si+4		1.6671	SiO ₂	941.954	60.084	56.597	44.489%
SO4-2		15.3600	NaSO ₄	15.360	119.047	1.829	1.437%
Zr+4		7.3960	ZrO ₂	7.396	123.219	0.911	0.716%
U+4		0.8812	UO ₂	0.881	270.028	0.238	0.187%
Zn+2		0.3275	ZnO	0.327	162.739	0.053	0.042%
B2O3	169						
Li2O	74		Li ₂ O	74.4	29.881	2.22	1.748%
SiO2	940						
TiO2	32		TiO ₂	32.0	79.899	2.55	2.007%
Fe2O3	58						
Total						127.2	100.000%

Attachment 3 WIPP WAC

CRITERIA	LIMITS	
Container Description	<ul style="list-style-type: none"> • DOT Type A RH Canister 	
Canister Gross Weight	<ul style="list-style-type: none"> • < 8000 lbs 	
Removable Surface Contamination	<ul style="list-style-type: none"> • < 20 dpm/100 cm² Alpha • < 200 dpm/100 cm² Beta-Gamma⁽⁴⁾ 	Will be decontaminated to these limits.
Dunnage	<ul style="list-style-type: none"> • Limited to inside canister 	None
Filter Vents	<ul style="list-style-type: none"> • Canisters vented 	Yes
Liquids	<ul style="list-style-type: none"> • No liquid Wastes • < 6 liters total residual liquid per canister • < 1 in. (2.5 cm) in the bottom of any container 	No Free Liquids – Solid Glass
Pu-239 FGE	<ul style="list-style-type: none"> • < 325 g/Cask 	87.3 g Pu-239 FGE/canister
Pu-239 Equivalent Activity	<ul style="list-style-type: none"> • < 1000 PE-Ci/ canister 	9.2 PE Ci/canister
Contact Dose Rate	<ul style="list-style-type: none"> • < 1000 rem/hr per canister • Preapproval received for > 100 rem/hr per canister • < 200 mrem/hr per Cask 	68 rem/hr
Thermal Power	<ul style="list-style-type: none"> • < 300 watts/canister 	5.7 watts/canister
TRU Alpha Activity	<ul style="list-style-type: none"> • > 100 nCi/g of waste matrix and < 23 Ci/liter 	6530 nCi/g 6.53E-6 Ci/liter
Pyrophoric Materials	<ul style="list-style-type: none"> • < 1% Radionuclides Pyrophorics • No non-radionuclide pyrophorics 	No non-radionuclide pyrophorics
Mixed Wastes	<ul style="list-style-type: none"> • Characterization per QAPP • Limited to EPA Waste Codes listed in WAC 	U-123 needs to be added to WIPP WAC or delisted from waste.
Chemical Compatibility	<ul style="list-style-type: none"> • Chemicals allowed by the RH-TRAMPAC 	
Hazardous Constituents	<ul style="list-style-type: none"> • Target analytes and TICs reported per QAPP 	
Explosives, Corrosives and Compressed Gases	<ul style="list-style-type: none"> • None Present 	None
PCBs Concentration	<ul style="list-style-type: none"> • < 50 ppm 	None
Table 1.2.7 Flammable VOCs	<ul style="list-style-type: none"> • < 500 ppm in canister headspace 	No VOCs.
VOC Concentration	<ul style="list-style-type: none"> • < Limits show in WAC 	No VOCs.

NOTES:

- (1) Applies to RH-TRU 72-B Cask payload control only
- (2) Applies to mixed wastes only
- (3) May be 1000 dpm/100 cm for certain isotopes

Attachment 4

Sugar Reactions

R. R. Kimmitt has compiled the following list of possible reactions for sugar, sucrose, and components of SBW. It is assumed that each reaction predominates in the given temperature range.

Below 120°C

120°C – 170°C

170°C – 350°C

350°C – 600°C

Above 600°C

Notes:

1. About 99% of all NO_3^- can be accounted for in the reactions above. It is assumed that nitrate salts of other metals (Ni, Cr, and Cd) account for the remainder.
2. The reactions shown above are not the only ones possible. For example, nitric acid can react as follows in concentrated form:

The reactions shown above that form CO are assumed to be the aggregate of possible reactions.

3. It has been observed that the addition of activated carbon to the SBW-frit mixture results in a significant increase in melt rate. One possible reason for this is the facilitation of nitrate decomposition. Because of the very large amount of nitrate in the SBW, it is likely that nitrate salts must decompose to produce glass-forming species (K_2O , Na_2O , Al_2O_3 , etc.). Nitrate decomposition reactions then become rate limiting. Sugar causes such reactions to occur more easily, possibly at lower temperatures.

Attachment 5

Grout from Blowdown

flow density	Blowdown with Cesium			Effluent without Cesium		
	1.11			1.11		
	1.01			1.0072		
	Moles/hr	gm/hr	gm/kg	moles/hr	gm/hr	gm/kg
H2O	67.42	1,215	287	67.4	1,215	287
Ag+1	7.10E-06	7.7E-04	1.8E-04	7.1E-06	7.7E-04	1.8E-04
Al+3	7.79E-02	2.1E+00	5.0E-01	7.8E-02	2.1E+00	5.0E-01
As+3	9.22E-06	6.9E-04	1.6E-04	9.2E-06	6.9E-04	1.6E-04
B+3	3.38E-03	3.7E-02	8.6E-03	3.4E-03	3.7E-02	8.6E-03
Ba+2	7.84E-06	1.1E-03	2.5E-04	7.8E-06	1.1E-03	2.5E-04
Ca+2	6.81E-03	2.7E-01	6.4E-02	6.8E-03	2.7E-01	6.4E-02
Cd+2	6.64E-04	7.5E-02	1.8E-02	6.6E-04	7.5E-02	1.8E-02
Cl-1	2.56E-02	9.1E-01	2.1E-01	2.6E-02	9.1E-01	2.1E-01
Cr+3	7.02E-04	3.7E-02	8.6E-03	7.0E-04	3.7E-02	8.6E-03
Cs+1	3.70E-06	4.9E-04	1.2E-04	3.7E-10	4.9E-08	1.2E-08
F-1	3.77E-02	7.2E-01	1.7E-01	3.8E-02	7.2E-01	1.7E-01
Fe+3	3.01E-03	1.7E-01	4.0E-02	3.0E-03	1.7E-01	4.0E-02
H+1	6.33E-02	6.4E-02	1.5E-02	6.3E-02	6.4E-02	1.5E-02
Hg+2	1.26E-06	2.5E-04	6.0E-05	1.3E-06	2.5E-04	6.0E-05
K+1	2.24E-02	8.8E-01	2.1E-01	2.2E-02	8.8E-01	2.1E-01
Mg+2	2.30E-04	7.9E-03	1.9E-03	2.3E-04	7.9E-03	1.9E-03
Mn+2	1.75E-03	9.6E-02	2.3E-02	1.8E-03	9.6E-02	2.3E-02
Mo+6	1.47E-04	1.4E-02	3.3E-03	1.5E-04	1.4E-02	3.3E-03
Na+1	2.01E-01	4.6E+00	1.1E+00	2.0E-01	4.6E+00	1.1E+00
Ni+2	3.39E-04	2.0E-02	4.7E-03	3.4E-04	2.0E-02	4.7E-03
NO3-1	0.00E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb+2	1.40E-04	2.9E-02	6.8E-03	1.4E-04	2.9E-02	6.8E-03
PO4-3	1.41E-03	1.3E-01	3.2E-02	1.4E-03	1.3E-01	3.2E-02
Ru+4	1.80E-04	1.8E-02	4.3E-03	1.8E-04	1.8E-02	4.3E-03
Se+4	6.02E-05	4.8E-03	1.1E-03	6.0E-05	4.8E-03	1.1E-03
Si+4	5.02E-04	1.4E-02	3.3E-03	5.0E-04	1.4E-02	3.3E-03
SO4-2	0.00E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr+4	2.23E-03	2.0E-01	4.8E-02	2.2E-03	2.0E-01	4.8E-02
U+4	2.66E-04	6.3E-02	1.5E-02	2.7E-04	6.3E-02	1.5E-02
Zn+2	9.87E-05	6.5E-03	1.5E-03	9.9E-05	6.5E-03	1.5E-03
Total		1,225	289		1,225	289

	Curies/hr	Curies/kg	nCi/g	Curies/hr	Curies/kg	nCi/g
Am-241	6.31E-05	1.49E-05	15	6.31E-05	1.49E-05	14.9
Am-243	2.52E-08	5.96E-09	0	2.52E-08	5.96E-09	0.0
Cm-244	2.10E-06	4.95E-07	0	2.10E-06	4.95E-07	0.5
Np-237	2.26E-07	5.35E-08	0	2.26E-07	5.35E-08	0.1
Pu-238	1.42E-04	3.36E-05	34	1.42E-04	3.36E-05	33.6
Pu-239	1.05E-05	2.47E-06	2	1.05E-05	2.47E-06	2.5
Pu-240	3.03E-06	7.15E-07	1	3.03E-06	7.15E-07	0.7
Pu-241	6.58E-05	1.56E-05	16	6.58E-05	1.56E-05	15.6
Pu-242	2.57E-09	6.06E-10	0	2.57E-09	6.06E-10	0.0
Th-230	5.48E-11	1.29E-11	0	5.48E-11	1.29E-11	0.0
U-232	2.70E-10	6.39E-11	0	2.70E-10	6.39E-11	0.0
U-233	9.03E-13	2.13E-13	0	9.03E-13	2.13E-13	0.0
U-234	1.42E-07	3.34E-08	0	1.42E-07	3.34E-08	0.0
U-235	3.64E-09	8.60E-10	0	3.64E-09	8.60E-10	0.0
U-236	6.55E-09	1.55E-09	0	6.55E-09	1.55E-09	0.0
U-238	3.49E-09	8.25E-10	0	3.49E-09	8.25E-10	0.0
Ba-137m	2.08E-02	4.92E-03	4,916	2.08E-06	4.92E-07	0.5
Ce-144	1.03E-10	2.44E-11	0	1.03E-10	2.44E-11	0.0
Co-60	7.67E-06	1.81E-06	2	7.67E-06	1.81E-06	1.8
Cs-134	1.34E-05	3.17E-06	3	1.34E-09	3.17E-10	0.0
Cs-135	3.68E-07	8.69E-08	0	3.68E-11	8.69E-12	0.0
Cs-137	2.20E-02	5.20E-03	5,201	2.20E-06	5.20E-07	0.5
Eu-152	3.93E-07	9.28E-08	0	3.93E-07	9.28E-08	0.1
Eu-154	2.34E-05	5.53E-06	6	2.34E-05	5.53E-06	5.5
Eu-155	9.28E-06	2.19E-06	2	9.28E-06	2.19E-06	2.2
Pm-147	1.33E-05	3.15E-06	3	1.33E-05	3.15E-06	3.2
Pr-144	1.03E-10	2.44E-11	0	1.03E-10	2.44E-11	0.0
Ni-63	6.93E-06	1.64E-06	2	6.93E-06	1.64E-06	1.6
Ru-106	6.58E-09	1.55E-09	0	6.58E-09	1.55E-09	0.0
Sb-125	4.96E-06	1.17E-06	1	4.96E-06	1.17E-06	1.2
Sm-151	6.79E-05	1.60E-05	16	6.79E-05	1.60E-05	16.0
Sr-90	6.27E-03	1.48E-03	1,480	6.27E-06	1.48E-06	1.5
Tc-99	3.48E-04	8.21E-05	82	3.48E-04	8.21E-05	82.1
Y-90	6.27E-03	1.48E-03	1,480	6.27E-06	1.48E-06	1.5
H-3	0.00E+00	0.00E+00	0	0	0	0.0
I-129	1.77E-04	4.17E-05	42	1.77E-04	4.17E-05	41.7

Attachment 6

Radiological Calculations for Specified SBW Waste Packages

INTEROFFICE MEMORANDUM

Date: March 14, 2000

To: R. R. Kimmitt MS 3625 6-5158

From: H. K. Peterson *H. K. Peterson* MS 2107 6-8657

Subject: RADIOLOGICAL CALCULATIONS FOR SPECIFIED SBW WASTE PACKAGES – HKP-07-00

References: a) Excel spreadsheet entitled "SBW Vitrification Study-Glass Activity"
b) E-mail note from J. J. Quigley to H. K. Peterson entitled "Grout Rad Calcs", 03/06/2000
c) MicroShield, Version 5.01, Grove Engineering, Inc. Rockville, MD

Calculations have been performed to determine the radiation field and heat generation for specified packages of SBW as defined in references a and b. The calculations were made with the MicroShield code (Ref.c) with input/output listings attached for documentation purposes. The first package is a canister [26 inches (0.66 meters) in diameter by 10-feet (3.1 meters) in length] of vitrified waste from waste stream WM-189 (Ref.a). The density of this vitrified product is assumed to be 2.7 g/cc. The radiation field calculated for the outside (1 cm from the canister surface) of the side midpoint is 65 R/hr (SBWGL189.MS5). The max heat generation for this package is 5.7 watts.

The second package, a 55-gallon drum, is calculated for two options: a) one with an untreated waste, and b) one with a "treated" waste where cesium (Cs) and strontium (Sr) have been removed. Radionuclide concentrations for these wastes were assumed to be 28.7% of the weight of the drum, i.e., 109 kg. Therefore, the concentrations for the drums are 109 times the "Curies/kg" values of the spreadsheet. The density of the grout is assumed to be 1.826 g/cc. The radiation field at the midpoint of the side of a drum of "untreated" waste is calculated to be 480 mR/hr (JJQUTR.MS5) and the maximum calculated heat generation for this package is 3.4E-3 watts. The radiation field calculated for a drum of "treated" waste is 2.6 mR/hr (JJQTR.MS5) and the maximum heat generation for this package is 1.9E-4 watts. For the 55-gal drums, the percentages of the surface dose rates for various distances from the surface are as follows: 7.09% at 1 meter; 2.22% at 2 meters; and 1.06% at 3 meters.

If there are any comments or questions concerning the above analysis, please call me at the above-listed number.

hkp

Attachments as stated

cc: P. D. Ritter, BBWI, MS 2107 *PDR*
G. J. Stormberg, BBWI, MS 2107 *for KJS*

J. J. Quigley, BBWI, MS 3625
HKP Letter File

Reference A

SBW Vitrification Study - Glass Activity								
Isotope	Glass Activity Levels from SBW Tanks							
	WM-180		WM-187		WM-188		WM-189	
	Ci/kg	Total Ci	Ci/kg	Total Ci	Ci/kg	Total Ci	Ci/kg	Total Ci
Am-241	1.73E-03	3.46E+00	1.34E-03	2.68E+00	1.25E-03	2.50E+00	2.54E-03	5.07E+00
Am-243	7.82E-07	1.56E-03	6.04E-07	1.21E-03	5.65E-07	1.13E-03	7.49E-07	1.50E-03
Cm-242	5.03E-12	1.00E-08	3.87E-12	7.73E-09	6.78E-12	1.35E-08	2.45E-07	4.89E-04
Cm-244	5.59E-05	1.12E-01	4.32E-05	8.62E-02	4.07E-05	8.14E-02	9.13E-05	1.82E-01
Np-237	1.36E-06	2.72E-03	3.27E-06	6.54E-03	1.84E-06	3.68E-03	2.04E-05	4.08E-02
Pu-238	1.02E-03	2.03E+00	1.78E-03	3.56E+00	3.46E-03	6.92E+00	6.62E-03	1.32E+01
Pu-239	1.77E-04	3.55E-01	2.34E-04	4.67E-01	2.70E-04	5.39E-01	3.08E-04	6.15E-01
Pu-240	5.31E-05	1.06E-01	6.07E-05	1.21E-01	9.52E-05	1.90E-01	6.20E-05	1.24E-01
Pu-241	6.53E-04	1.31E+00	8.63E-04	1.72E+00	1.36E-03	2.72E+00	2.94E-03	5.87E+00
Pu-242	3.99E-08	7.97E-05	3.27E-08	6.54E-05	5.50E-08	1.10E-04	8.45E-08	1.69E-04
TRU Subtotal		7.37E+00		6.65E+00		1.30E+01		2.51E+01
TRU Activity nCi/gram		2.73E+03		3.20E+03		4.80E+03		9.31E+03
Th-230	3.64E-10	7.28E-07	8.81E-10	1.76E-06	4.95E-10	9.89E-07	4.95E-09	9.88E-06
Th-231	N/A		N/A		N/A		N/A	
U-232	3.83E-09	7.66E-06	9.38E-09	1.87E-05	9.02E-09	1.80E-05	6.92E-09	1.38E-05
U-233	5.56E-12	1.11E-08	1.34E-11	2.68E-08	7.54E-12	1.51E-08	8.41E-11	1.68E-07
U-234	1.76E-06	3.52E-03	5.00E-06	9.99E-03	4.28E-06	8.55E-03	3.43E-06	6.86E-03
U-235	4.84E-08	9.66E-05	1.25E-07	2.50E-04	1.14E-07	2.27E-04	8.60E-08	1.72E-04
U-236	2.31E-08	4.62E-05	2.88E-07	5.75E-04	2.33E-07	4.65E-04	1.70E-07	3.40E-04
U-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-238	2.94E-08	5.88E-05	2.44E-07	4.87E-04	8.03E-08	1.61E-04	4.49E-08	8.97E-05
Ba-137m	6.43E-02	1.28E+02	1.25E-01	2.50E+02	1.20E-01	2.40E+02	2.91E-01	5.82E+02
Ce-144	1.91E-09	3.82E-06	2.63E-09	5.25E-06	3.61E-09	7.21E-06	2.73E-09	5.46E-06
Co-60	1.31E-04	2.61E-01	1.21E-04	2.42E-01	3.32E-04	6.63E-01	1.74E-04	3.48E-01
Cs-134	2.75E-06	5.49E-03	2.35E-05	4.69E-02	2.77E-05	5.54E-02	8.38E-05	1.67E-01
Cs-135	1.32E-06	2.63E-03	2.50E-06	5.00E-03	2.44E-06	4.88E-03	5.95E-06	1.19E-02
Cs-137	6.80E-02	1.36E+02	1.33E-01	2.65E+02	1.27E-01	2.54E+02	3.08E-01	6.16E+02
Eu-152	1.49E-06	2.98E-03	7.83E-06	1.56E-02	1.46E-05	2.91E-02	1.93E-05	3.85E-02
Eu-154	8.79E-05	1.76E-01	4.64E-04	9.28E-01	8.62E-04	1.72E+00	1.14E-03	2.27E+00
Eu-155	7.07E-05	1.41E-01	3.01E-04	6.01E-01	3.75E-04	7.50E-01	2.48E-04	4.96E-01
Pm-147	2.48E-04	4.96E-01	4.23E-04	8.45E-01	4.10E-04	8.20E-01	3.51E-04	7.0

Reference B

INEL

Jennifer J Quigley

03/06/2000 11:10:23 AM

To: Henry K Peterson/HKP/CC01/INEEL/US@INEL
cc: Vondell J Balls/BALLVJ/CC01/INEEL/US@INEL
Fax to:
Subject: Grout Rad Calcs

Henry - I have attached the spreadsheet for the grout composition. There are two cases. In one, the liquid is passed through ion exchange to remove Cs and Sr before being grouted. The second is not treated.

The grout will be placed in 55 gallon drums. Assume that the drums are full (worst case). Please calculate the contact radiation levels, 3 meter rad levels (if possible) and the energy generated.

Could you please document the results of these calculations and the ones you performed earlier for Rod Kimmitt and myself (glass cannisters for Vitrified SBW) in a letter?

Please call me at 6-3416 with any questions.

Thanks a lot.

Jenna

Grout.xls

stream_name Grout Liquid
 conc_units moles/lit
 flow_units lit/hr
 flow 1.13
 density 1.01

gm/kg

Ag+1 1.94E-04
 Al+3 5.31E-01
 As+3 1.75E-04
 B+3 6.65E-03
 Ba+2 2.73E-04
 Ca+2 6.83E-02
 Cd+2 1.88E-02
 Cl-1 2.99E-01
 Cr+3 9.05E-03
 Cs+1 1.24E-08
 F-1 9.19E-03
 Fe+3 4.04E-02
 H+1 8.98E-03
 Hg+2 2.14E-01
 K+1 2.21E-01
 Mn+2 2.40E-02
 Mo+6 2.15E-03
 Na+1 1.17E+00
 Ni+2 4.23E-03
 NO3-1 0.00E+00
 Pb+2 7.19E-03
 PO4-3 2.21E-02
 Se+4 1.21E-03
 SO4-2 0.00E+00
 Zr+4 3.94E-02
 U+4 1.60E-02
 Total 2.707464952

Curies/kg

Am-241 1.58699E-05 ✓
 Am-243 6.39623E-09 ✓
 Cm-242 4.82735E-10 ✓
 Cm-244 5.31008E-07 ✓
 Np-237 5.58162E-08 ✓
 Pu-238 2.9296E-05 ✓
 Pu-239 2.32014E-06 ✓
 Pu-240 6.60743E-07 ✓
 Pu-241 1.31847E-05 ✓
 Pu-242 4.94803E-10 ✓
 Th-230 1.38786E-11 ✓
 U-232 6.8488E-11 ✓
 U-233 2.28696E-13 ✓
 U-234 3.37914E-08 ✓
 U-235 8.74957E-10 ✓
 U-236 1.63828E-09 ✓
 U-238 8.77974E-10 ✓
 Ba-137m 0.004585164 ✓
 Ce-144 2.61582E-11 ✓
 Co-60 1.8887E-06 ✓
 Cs-134 1.02395E-10 ✓
 Cs-135 9.32454E-12 ✓
 Cs-137 4.85246E-07 ✓
 Eu-152 9.9564E-08 ✓

Curies/kg

1.58699E-05
 6.39623E-09
 4.82735E-10
 5.31008E-07
 5.58162E-08
 2.9296E-05
 2.32014E-06
 6.60743E-07
 1.31847E-05
 4.94803E-10
 1.38786E-11
 6.8488E-11
 2.28696E-13
 3.37914E-08
 8.74957E-10
 1.63828E-09
 8.77974E-10
 0.004585164 ✓
 2.61582E-11
 1.8887E-06
 1.02395E-10
 9.32454E-12
 0.00485246 ✓
 9.9564E-08

Rod Kimmitt
 6-5158

treated

untreated

Eu-154	5.88333E-06 ✓	5.88333E-06
Eu-155	2.35031E-06 ✓	2.35031E-06
Pm-147	3.37914E-06 ✓	3.37914E-06
Ni-63	1.75595E-06 ✓	1.75595E-06
Ru-106/Rh	1.66593E-09 ✓	1.66593E-09
Sb-125	2.77271E-07 ✓	2.77271E-07
Sm-151	1.71974E-05 ✓	1.71974E-05
Sr-90	1.11029E-06 ✓	0.00111029
Tc-99	5.05833E-05 ✓	5.05833E-05
Y-90	1.11029E-06 ✓	0.00111029
I-129	2.47718E-06 ✓	2.47718E-06
H2O	15.91984623	15.91984623

Pr-144 = Ce-144

Total Weight

	wt %
cement	35.6%
water	28.8%
slag	35.6%

solids

assume density of grout

volume grout/hr

Volume of grout total

gm/hr
1405
1134
1405
3944
10.7
3954

0.00217 m3/hr
1.134 liter/hr
0.00191 m3/liter

1.13 liter/hr
200 day/yr
24 hr/day
2 yr operation

10,887 liter
12,644 liter in scrub tank
23,531 liters

44.9 m3

1826 kg/m3

$$= 1.8268/a \times 2.08 \times 10^6 cc$$

$$= 3.801 \times 10^5 g = 380 kg$$

2.5 m3/hr - cont.

432 m3/hr - cont.

28.68% - 109 kg/drum

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: SBWGL189.MS5
Run Date: March 14, 2000
Run Time: 2:36:24 PM
Duration: 00:03:47

File Ref: HKP-07-01
Date: 3/14/00
By: [Signature]
Checked: PDR 3/16/00

Case Title: SBWkimmitt
Description: R/hr at surface of WM-189 Glass log
Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions
Height ✓ 310.0 cm 10 ft 2.0 in
Radius ✓ 32.385 cm 1 ft 0.7 in

Dose Points
1 X 34.02 cm Y 155 cm Z 0 cm
1 ft 1.4 in 5 ft 1.0 in 0.0 in

Shields
Shield Name Dimension Material Density
Source 1.02e+06 cm³ Concrete 2.7
Transition 1.0 cm Air 0.0011
Air Gap Air 0.00122
✓ Wall Clad .635 cm Iron 7.86
Top Clad .7 cm Iron 7.86

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : ICRP-38

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
✓ Am-241	5.0700e+000	1.8759e+011	4.9637e+000	1.8366e+005
Am-243	1.5000e-003	5.5500e+007	1.4686e-003	5.4337e+001
Ba-137m	5.8200e+002	2.1534e+013	5.6980e+002	2.1083e+007
Ce-144	5.4600e-006	2.0202e+005	5.3456e-006	1.9779e-001
Cm-242	4.8900e-004	1.8093e+007	4.7875e-004	1.7714e+001
Cm-244	1.8200e-001	6.7340e+009	1.7819e-001	6.5929e+003
Co-60	3.4800e-001	1.2876e+010	3.4071e-001	1.2606e+004
Cs-134	1.6700e-001	6.1790e+009	1.6350e-001	6.0495e+003
Cs-135	1.1900e-002	4.4030e+008	1.1651e-002	4.3107e+002
✓ Cs-137	6.1600e+002	2.2792e+013	6.0309e+002	2.2314e+007
Eu-152	3.8500e-002	1.4245e+009	3.7693e-002	1.3946e+003
Eu-154	2.2700e+000	8.3990e+010	2.2224e+000	8.2230e+004
Eu-155	4.9600e-001	1.8352e+010	4.8560e-001	1.7967e+004
I-129	1.0500e-004	3.8850e+006	1.0280e-004	3.8036e+000
Ni-63	3.7200e-001	1.3764e+010	3.6420e-001	1.3476e+004
Np-237	4.0800e-002	1.5096e+009	3.9945e-002	1.4780e+003
Pm-147	7.0100e-001	2.5937e+010	6.8631e-001	2.5393e+004
Pr-144	5.4600e-006	2.0202e+005	5.3456e-006	1.9779e-001
Pu-238	1.3200e+001	4.8840e+011	1.2923e+001	4.7816e+005
Pu-239	6.1500e-001	2.2755e+010	6.0211e-001	2.2278e+004
Pu-240	1.2400e-001	4.5880e+009	1.2140e-001	4.4918e+003

DOS File: SBWGL189.MS5
Run Date: March 14, 2000
Run Time: 2:36:24 PM
Duration: 00:03:47

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>uCi/cm³</u>	<u>Bq/cm³</u>
Pu-241	5.8700e+000	2.1719e+011	5.7470e+000	2.1264e+005
Pu-242	1.6900e-004	6.2530e+006	1.6546e-004	6.1219e+000
Rh-106	8.3200e-005	3.0784e+006	8.1456e-005	3.0139e+000
Ru-106	8.3200e-005	3.0784e+006	8.1456e-005	3.0139e+000
Sb-125	6.0000e-002	2.2200e+009	5.8742e-002	2.1735e+003
Sm-151	3.5800e+000	1.3246e+011	3.5050e+000	1.2968e+005
Sr-90	3.3900e+002	1.2543e+013	3.3189e+002	1.2280e+007
Tc-99	9.5200e-002	3.5224e+009	9.3205e-002	3.4486e+003
Th-230	9.8800e-006	3.6556e+005	9.6729e-006	3.5790e-001
U-232	1.3800e-005	5.1060e+005	1.3511e-005	4.9990e-001
U-233	1.6800e-007	6.2160e+003	1.6448e-007	6.0857e-003
U-234	6.8600e-003	2.5382e+008	6.7162e-003	2.4850e+002
U-235	1.7200e-004	6.3640e+006	1.6839e-004	6.2306e+000
U-236	3.4000e-004	1.2580e+007	3.3287e-004	1.2316e+001
U-238	8.9700e-005	3.3189e+006	8.7820e-005	3.2493e+000
Y-90	3.3900e+002	1.2543e+013	3.3189e+002	1.2280e+007

Buildup

The material reference is : Source

Integration Parameters

Radial	30
Circumferential	30
Y Direction (axial)	32

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Results</u>			
		<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	4.695e+10	1.230e-136	1.728e-22	1.055e-137	1.482e-23
0.02	6.221e+10	3.556e-60	3.602e-22	1.232e-61	1.248e-23
0.03	1.310e+12	1.930e-16	3.916e-16	1.913e-18	3.881e-18
0.04	3.330e+11	5.358e-06	1.753e-05	2.370e-08	7.753e-08
0.05	5.853e+09	1.334e-03	6.373e-03	3.553e-06	1.698e-05
0.06	6.728e+10	1.359e+00	8.263e+00	2.699e-03	1.641e-02
0.08	5.979e+09	6.316e+00	4.498e+01	9.995e-03	7.118e-02
0.1	3.841e+10	2.189e+02	1.572e+03	3.349e-01	2.405e+00
0.15	1.460e+08	4.544e+00	2.876e+01	7.483e-03	4.735e-02
0.2	6.061e+09	3.933e+02	2.210e+03	6.941e-01	3.900e+00
0.3	5.836e+08	8.519e+01	4.008e+02	1.616e-01	7.603e-01
0.4	1.468e+09	3.604e+02	1.488e+03	7.022e-01	2.898e+00
0.5	7.072e+08	2.570e+02	9.575e+02	5.045e-01	1.879e+00
0.6	1.935e+13	9.665e+06	3.303e+07	1.886e+04	6.448e+04
0.8	3.769e+10	3.110e+04	9.346e+04	5.916e+01	1.778e+02
1.0	3.977e+10	4.848e+04	1.326e+05	8.937e+01	2.444e+02
1.5	4.628e+10	1.145e+05	2.673e+05	1.927e+02	4.497e+02
2.0	1.705e+06	6.888e+00	1.464e+01	1.065e-02	2.264e-02
3.0	9.808e+02	7.690e-03	1.453e-02	1.043e-05	1.972e-05

DOS File: SBWGL189.MS5
Run Date: March 14, 2000
Run Time: 2:36:24 PM
Duration: 00:03:47

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
TOTALS:	2.135e+13	9.860e+06	3.353e+07	1.921e+04	6.536e+04

MicroShield v5.01 (5.01-00121)
 Lockheed Martin Idaho Technologies Company
 Case File Heat Generation
 Case File: SBWGL189.MS5
 Case Title: SBWkimmitt

<u>Isotope</u>	<u>Activity</u> <u>Curies</u>	<u>Activity</u> <u>Bequerels</u>	<u>Heat Generation</u> <u>Watts/Curie</u>	<u>Heat Generation</u> <u>Watts</u>
Am-241	5.0700e+000	1.8759e+011	3.2755e-002	1.6607e-001
Am-243	1.5000e-003	5.5500e+007	3.1599e-002	4.7399e-005
Ba-137m	5.8200e+002	2.1534e+013	3.5403e-003	2.0604e+000
Ce-144	5.4600e-006	2.0202e+005	6.0991e-004	3.3301e-009
Cm-242	4.8900e-004	1.8093e+007	3.6195e-002	1.7699e-005
Cm-244	1.8200e-001	6.7340e+009	3.4375e-002	6.2563e-003
Co-60	3.4800e-001	1.2876e+010	1.5417e-002	5.3650e-003
Cs-134	1.6700e-001	6.1790e+009	1.0149e-002	1.6949e-003
Cs-135	1.1900e-002	4.4030e+008	3.9913e-004	4.7496e-006
Cs-137	6.1600e+002	2.2792e+013	1.1086e-003	6.8287e-001
Eu-152	3.8500e-002	1.4245e+009	7.3864e-003	2.8438e-004
Eu-154	2.2700e+000	8.3990e+010	8.7221e-003	1.9799e-002
Eu-155	4.9600e-001	1.8352e+010	6.4902e-004	3.2192e-004
I-129	1.0500e-004	3.8850e+006	4.7222e-004	4.9583e-008
Ni-63	3.7200e-001	1.3764e+010	1.0154e-004	3.7774e-005
Np-237	4.0800e-002	1.5096e+009	2.8548e-002	1.1648e-003
Pm-147	7.0100e-001	2.5937e+010	3.6732e-004	2.5749e-004
Pr-144	5.4600e-006	2.0202e+005	7.3470e-003	4.0115e-008
Pu-238	1.3200e+001	4.8840e+011	3.2552e-002	4.2969e-001
Pu-239	6.1500e-001	2.2755e+010	3.0531e-002	1.8777e-002
Pu-240	1.2400e-001	4.5880e+009	3.0591e-002	3.7933e-003
Pu-241	5.8700e+000	2.1719e+011	3.1773e-005	1.8651e-004
Pu-242	1.6900e-004	6.2530e+006	2.9012e-002	4.9030e-006
Rh-106	8.3200e-005	3.0784e+006	9.5865e-003	7.9760e-007
Ru-106	8.3200e-005	3.0784e+006	5.9466e-005	4.9476e-009
Sb-125	6.0000e-002	2.2200e+009	3.0911e-003	1.8547e-004
Sm-151	3.5800e+000	1.3246e+011	1.1669e-004	4.1773e-004
Sr-90	3.3900e+002	1.2543e+013	1.1603e-003	3.9334e-001
Tc-99	9.5200e-002	3.5224e+009	6.0024e-004	5.7143e-005
Th-230	9.8800e-006	3.6556e+005	2.7709e-002	2.7377e-007
U-232	1.3800e-005	5.1060e+005	3.1460e-002	4.3415e-007
U-233	1.6800e-007	6.2160e+003	2.8571e-002	4.8000e-009
U-234	6.8600e-003	2.5382e+008	2.8232e-002	1.9367e-004
U-235	1.7200e-004	6.3640e+006	2.7030e-002	4.6492e-006
U-236	3.4000e-004	1.2580e+007	2.6729e-002	9.0880e-006
U-238	8.9700e-005	3.3189e+006	2.4838e-002	2.2280e-006
Y-90	3.3900e+002	1.2543e+013	5.5407e-003	1.8783e+000
Total			Heat Generation:	5.6696e+000

0.56 $\frac{\text{watt}}{\text{S}}$ Pu-238
 0.032 $\frac{\text{watt}}{\text{Ci}}$ Pu-238

Q = 5.67e-001 watt

Page : 1
DOS File: JJQUTR.MS5
Run Date: March 8, 2000
Run Time: 9:49:43 AM
Duration: 00:03:28

File Ref: HKP-07-00
Date: 3/14/00
By: [Signature]
Checked: PDE 3.1.1c

Case Title: JJQ

Description: R/hr for drum of grouted "untreated" waste-(Cs & Sr removed)

Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height 86.36 cm 2 ft 10.0 in
Radius 29.21 cm 11.5 in

Dose Points

	X	Y	Z
# 1	30.37 cm	43.18 cm	0 cm
	12.0 in	1 ft 5.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
√Source	2.31e+05 cm ³	Concrete	1.826
Transition	1.0 cm	Air	0.001
Air Gap		Air	0.0011
Wall Clad	.16 cm	Iron	7.86
Top Clad	.16 cm	Iron	7.86

Source Input

Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Excluded

Library : ICRP-38

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
√Am-241	1.7300e-003	6.4010e+007	7.4734e-003	2.7652e+002
Am-243	6.9720e-007	2.5796e+004	3.0118e-006	1.1144e-001
Ba-137m	5.0030e-001	1.8511e+010	2.1612e+000	7.9966e+004
Ce-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Cm-242	5.2610e-008	1.9466e+003	2.2727e-007	8.4090e-003
Cm-244	5.7880e-005	2.1416e+006	2.5004e-004	9.2513e+000
Co-60	2.0590e-004	7.6183e+006	8.8947e-004	3.2910e+001
Cs-134	1.1160e-008	4.1292e+002	4.8210e-008	1.7838e-003
Cs-135	1.0160e-009	3.7592e+001	4.3890e-009	1.6239e-004
√Cs-137	5.2890e-001	1.9569e+010	2.2848e+000	8.4538e+004
Eu-152	1.0850e-005	4.0145e+005	4.6871e-005	1.7342e+000
Eu-154	6.4120e-004	2.3724e+007	2.7699e-003	1.0249e+002
Eu-155	2.5620e-004	9.4794e+006	1.1068e-003	4.0950e+001
I-129	2.7000e-004	9.9900e+006	1.1664e-003	4.3156e+001
Ni-63	1.9140e-004	7.0818e+006	8.2683e-004	3.0593e+001
Np-237	6.0840e-006	2.2511e+005	2.6282e-005	9.7245e-001
Pm-147	3.6830e-004	1.3627e+007	1.5910e-003	5.8868e+001
Pr-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Pu-238	3.1940e-003	1.1818e+008	1.3798e-002	5.1052e+002
Pu-239	2.5290e-004	9.3573e+006	1.0925e-003	4.0423e+001
Pu-240	7.2020e-005	2.6647e+006	3.1112e-004	1.1511e+001

DOS File: JJQUTR.MS5
 Run Date: March 8, 2000
 Run Time: 9:49:43 AM
 Duration: 00:03:28

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>µCi/cm³</u>	<u>Bq/cm³</u>
Pu-241	1.4370e-003	5.3169e+007	6.2077e-003	2.2969e+002
Pu-242	5.3930e-008	1.9954e+003	2.3297e-007	8.6200e-003
Rh-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Ru-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Sb-125	3.0230e-005	1.1185e+006	1.3059e-004	4.8319e+000
Sm-151	1.8750e-003	6.9375e+007	8.0998e-003	2.9969e+002
Sr-90	1.2100e-001	4.4770e+009	5.2271e-001	1.9340e+004
Tc-99	5.5130e-003	2.0398e+008	2.3816e-002	8.8118e+002
Th-230	1.5130e-009	5.5981e+001	6.5360e-009	2.4183e-004
U-232	7.4650e-009	2.7621e+002	3.2248e-008	1.1932e-003
U-233	2.4930e-011	9.2241e-001	1.0770e-010	3.9847e-006
U-234	3.6830e-006	1.3627e+005	1.5910e-005	5.8868e-001
U-235	9.5380e-008	3.5291e+003	4.1203e-007	1.5245e-002
U-236	1.7850e-007	6.6045e+003	7.7110e-007	2.8531e-002
U-238	9.5700e-008	3.5409e+003	4.1342e-007	1.5296e-002
Y-90	1.2100e-001	4.4770e+009	5.2271e-001	1.9340e+004

Buildup

The material reference is : Source

Integration Parameters

Radial	34
Circumferential	24
Y Direction (axial)	34

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Results</u>			
		<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.330e+07	3.233e-36	1.540e-25	2.773e-37	1.321e-26
0.02	2.061e+07	4.369e-17	5.506e-17	1.513e-18	1.907e-18
0.03	1.130e+09	1.549e-04	2.593e-04	1.535e-06	2.569e-06
0.04	2.745e+08	4.780e-02	1.072e-01	2.114e-04	4.740e-04
0.05	1.905e+06	7.282e-03	2.118e-02	1.940e-05	5.641e-05
0.06	2.300e+07	4.586e-01	1.600e+00	9.109e-04	3.178e-03
0.08	3.006e+06	3.163e-01	1.290e+00	5.005e-04	2.041e-03
0.1	1.172e+07	2.781e+00	1.174e+01	4.255e-03	1.797e-02
0.15	4.344e+04	2.708e-02	1.090e-01	4.459e-05	1.795e-04
0.2	1.747e+06	1.813e+00	6.827e+00	3.200e-03	1.205e-02
0.3	1.670e+05	3.283e-01	1.096e+00	6.228e-04	2.078e-03
0.4	5.694e+05	1.734e+00	5.253e+00	3.379e-03	1.023e-02
0.5	2.262e+05	9.664e-01	2.711e+00	1.897e-03	5.322e-03
0.6	1.662e+10	9.364e+04	2.459e+05	1.828e+02	4.800e+02
0.8	9.005e+06	7.877e+01	1.873e+02	1.498e-01	3.562e-01
1.0	1.516e+07	1.870e+02	4.133e+02	3.448e-01	7.618e-01
1.5	1.700e+07	3.927e+02	7.639e+02	6.607e-01	1.285e+00
2.0	5.372e+02	1.924e-02	3.466e-02	2.975e-05	5.360e-05
3.0	1.403e+00	9.137e-05	1.489e-04	1.240e-07	2.020e-07

DOS File: JJQUTR.MS5
Run Date: March 8, 2000
Run Time: 9:49:43 AM
Duration: 00:03:28

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
TOTALS:	1.814e+10	9.431e+04	2.473e+05	1.840e+02	4.825e+02

MicroShield v5.01 (5.01-00121)
 Lockheed Martin Idaho Technologies Company
 Case File Heat Generation
 Case File: JJQUTR.MS5
 Case Title: JJQ

<u>Isotope</u>	<u>Activity</u> <u>Curies</u>	<u>Activity</u> <u>Bequerels</u>	<u>Heat Generation</u> <u>Watts/Curie</u>	<u>Heat Generation</u> <u>Watts</u>
Am-241	1.7300e-003	6.4010e+007	3.2755e-002	5.6666e-005
Am-243	6.9720e-007	2.5796e+004	3.1599e-002	2.2031e-008
Ba-137m	5.0030e-001	1.8511e+010	3.5403e-003	1.7712e-003
Ce-144	2.8510e-009	1.0549e+002	6.0991e-004	1.7389e-012
Cm-242	5.2610e-008	1.9466e+003	3.6195e-002	1.9042e-009
Cm-244	5.7880e-005	2.1416e+006	3.4375e-002	1.9897e-006
Co-60	2.0590e-004	7.6183e+006	1.5417e-002	3.1743e-006
Cs-134	1.1160e-008	4.1292e+002	1.0149e-002	1.1326e-010
Cs-135	1.0160e-009	3.7592e+001	3.9913e-004	4.0551e-013
Cs-137	5.2890e-001	1.9569e+010	1.1086e-003	5.8631e-004
Eu-152	1.0850e-005	4.0145e+005	7.3864e-003	8.0143e-008
Eu-154	6.4120e-004	2.3724e+007	8.7221e-003	5.5926e-006
Eu-155	2.5620e-004	9.4794e+006	6.4902e-004	1.6628e-007
I-129	2.7000e-004	9.9900e+006	4.7222e-004	1.2750e-007
Ni-63	1.9140e-004	7.0818e+006	1.0154e-004	1.9435e-008
Np-237	6.0840e-006	2.2511e+005	2.8548e-002	1.7369e-007
Pm-147	3.6830e-004	1.3627e+007	3.6732e-004	1.3528e-007
Pr-144	2.8510e-009	1.0549e+002	7.3470e-003	2.0946e-011
Pu-238	3.1940e-003	1.1818e+008	3.2552e-002	1.0397e-004
Pu-239	2.5290e-004	9.3573e+006	3.0531e-002	7.7214e-006
Pu-240	7.2020e-005	2.6647e+006	3.0591e-002	2.2032e-006
Pu-241	1.4370e-003	5.3169e+007	3.1773e-005	4.5658e-008
Pu-242	5.3930e-008	1.9954e+003	2.9012e-002	1.5646e-009
Rh-106	1.8160e-007	6.7192e+003	9.5865e-003	1.7409e-009
Ru-106	1.8160e-007	6.7192e+003	5.9466e-005	1.0799e-011
Sb-125	3.0230e-005	1.1185e+006	3.0911e-003	9.3445e-008
Sm-151	1.8750e-003	6.9375e+007	1.1669e-004	2.1879e-007
Sr-90	1.2100e-001	4.4770e+009	1.1603e-003	1.4040e-004
Tc-99	5.5130e-003	2.0398e+008	6.0024e-004	3.3091e-006
Th-230	1.5130e-009	5.5981e+001	2.7709e-002	4.1924e-011
U-232	7.4650e-009	2.7621e+002	3.1460e-002	2.3485e-010
U-233	2.4930e-011	9.2241e-001	2.8571e-002	7.1228e-013
U-234	3.6830e-006	1.3627e+005	2.8232e-002	1.0398e-007
U-235	9.5380e-008	3.5291e+003	2.7030e-002	2.5782e-009
U-236	1.7850e-007	6.6045e+003	2.6729e-002	4.7712e-009
U-238	9.5700e-008	3.5409e+003	2.4838e-002	2.3770e-009
Y-90	1.2100e-001	4.4770e+009	5.5407e-003	6.7042e-004
Total			Heat Generation:	3.3542e-003

Page : 1
DOS File: JJQTR.MS5
Run Date: March 8, 2000
Run Time: 9:21:30 AM
Duration: 00:03:23

File Ref: HKP-07-30
Date: 3/14/00
By: [Signature]
Checked: PDR 3/17/00

Case Title: JJQ

Description: R/hr for drum of grouted "treated" waste-(Cs & Sr removed)

Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height 86.36 cm 2 ft 10.0 in
Radius 29.21 cm 11.5 in

Dose Points

	X	Y	Z
# 1	30.37 cm	43.18 cm	0 cm
	12.0 in	1 ft 5.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.31e+05 cm ³	Concrete	1.826
Transition	1.0 cm	Air	0.0011
Air Gap		Air	0.0011
Wall Clad	.16 cm	Iron	7.86
Top Clad	.16 cm	Iron	7.86

Source Input

Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Excluded

Library : ICRP-38

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.7300e-003	6.4010e+007	7.4734e-003	2.7652e+002
Am-243	6.9720e-007	2.5796e+004	3.0118e-006	1.1144e-001
Ba-137m	5.0030e-005	1.8511e+006	2.1612e-004	7.9966e+000
Ce-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Cm-242	5.2610e-008	1.9466e+003	2.2727e-007	8.4090e-003
Cm-244	5.7880e-005	2.1416e+006	2.5004e-004	9.2513e+000
Co-60	2.0590e-004	7.6183e+006	8.8947e-004	3.2910e+001
Cs-134	1.1160e-008	4.1292e+002	4.8210e-008	1.7838e-003
Cs-135	1.0160e-009	3.7592e+001	4.3890e-009	1.6239e-004
✓Cs-137	5.2890e-005	1.9569e+006	2.2848e-004	8.4538e+000
Eu-152	1.0850e-005	4.0145e+005	4.6871e-005	1.7342e+000
Eu-154	6.4120e-004	2.3724e+007	2.7699e-003	1.0249e+002
Eu-155	2.5620e-004	9.4794e+006	1.1068e-003	4.0950e+001
I-129	2.7000e-004	9.9900e+006	1.1664e-003	4.3156e+001
Ni-63	1.9140e-004	7.0818e+006	8.2683e-004	3.0593e+001
Np-237	6.0840e-006	2.2511e+005	2.6282e-005	9.7245e-001
Pm-147	3.6830e-004	1.3627e+007	1.5910e-003	5.8868e+001
Pr-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Pu-238	3.1940e-003	1.1818e+008	1.3798e-002	5.1052e+002
Pu-239	2.5290e-004	9.3573e+006	1.0925e-003	4.0423e+001
Pu-240	7.2020e-005	2.6647e+006	3.1112e-004	1.1511e+001

DOS File: JJQTR.MS5
 Run Date: March 8, 2000
 Run Time: 9:21:30 AM
 Duration: 00:03:23

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>µCi/cm³</u>	<u>Bq/cm³</u>
Pu-241	1.4370e-003	5.3169e+007	6.2077e-003	2.2969e+002
Pu-242	5.3930e-008	1.9954e+003	2.3297e-007	8.6200e-003
Rh-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Ru-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Sb-125	3.0230e-005	1.1185e+006	1.3059e-004	4.8319e+000
Sm-151	1.8750e-003	6.9375e+007	8.0998e-003	2.9969e+002
Sr-90	1.2100e-004	4.4770e+006	5.2271e-004	1.9340e+001
Tc-99	5.5130e-003	2.0398e+008	2.3816e-002	8.8118e+002
Th-230	1.5130e-009	5.5981e+001	6.5360e-009	2.4183e-004
U-232	7.4650e-009	2.7621e+002	3.2248e-008	1.1932e-003
U-233	2.4930e-011	9.2241e-001	1.0770e-010	3.9847e-006
U-234	3.6830e-006	1.3627e+005	1.5910e-005	5.8868e-001
U-235	9.5380e-008	3.5291e+003	4.1203e-007	1.5245e-002
U-236	1.7850e-007	6.6045e+003	7.7110e-007	2.8531e-002
U-238	9.5700e-008	3.5409e+003	4.1342e-007	1.5296e-002
Y-90	1.2100e-004	4.4770e+006	5.2271e-004	1.9340e+001

Buildup

The material reference is : Source

Integration Parameters

Radial	34
Circumferential	24
Y Direction (axial)	34

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.290e+07	3.137e-36	1.494e-25	2.691e-37	1.282e-26
0.02	2.054e+07	4.353e-17	5.486e-17	1.508e-18	1.900e-18
0.03	9.322e+06	1.277e-06	2.139e-06	1.266e-08	2.119e-08
0.04	8.143e+06	1.418e-03	3.180e-03	6.273e-06	1.406e-05
0.05	1.905e+06	7.282e-03	2.118e-02	1.940e-05	5.641e-05
0.06	2.300e+07	4.586e-01	1.600e+00	9.109e-04	3.178e-03
0.08	3.006e+06	3.163e-01	1.290e+00	5.005e-04	2.041e-03
0.1	1.172e+07	2.781e+00	1.174e+01	4.255e-03	1.797e-02
0.15	4.344e+04	2.708e-02	1.090e-01	4.459e-05	1.795e-04
0.2	1.747e+06	1.813e+00	6.827e+00	3.200e-03	1.205e-02
0.3	1.670e+05	3.283e-01	1.096e+00	6.228e-04	2.078e-03
0.4	5.694e+05	1.734e+00	5.253e+00	3.379e-03	1.023e-02
0.5	2.262e+05	9.664e-01	2.711e+00	1.897e-03	5.322e-03
0.6	3.608e+06	2.033e+01	5.339e+01	3.968e-02	1.042e-01
0.8	9.005e+06	7.877e+01	1.873e+02	1.498e-01	3.562e-01
1.0	1.516e+07	1.870e+02	4.133e+02	3.448e-01	7.618e-01
1.5	1.700e+07	3.927e+02	7.639e+02	6.607e-01	1.285e+00
2.0	5.372e+02	1.924e-02	3.466e-02	2.975e-05	5.360e-05
3.0	1.403e+00	9.137e-05	1.489e-04	1.240e-07	2.020e-07

DOS File: JJQTR.MS5
Run Date: March 8, 2000
Run Time: 9:21:30 AM
Duration: 00:03:23

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
TOTALS:	1.381e+08	6.873e+02	1.449e+03	1.210e+00	2.561e+00

MicroShield v5.01 (5.01-00121)
 Lockheed Martin Idaho Technologies Company
 Case File Heat Generation
 Case File: JJQTR.MS5
 Case Title: JJQ

<u>Isotope</u>	<u>Activity</u> <u>Curies</u>	<u>Activity</u> <u>Bequerels</u>	<u>Heat Generation</u> <u>Watts/Curie</u>	<u>Heat Generation</u> <u>Watts</u>
Am-241	1.7300e-003	6.4010e+007	3.2755e-002	5.6666e-005
Am-243	6.9720e-007	2.5796e+004	3.1599e-002	2.2031e-008
Ba-137m	5.0030e-005	1.8511e+006	3.5403e-003	1.7712e-007
Ce-144	2.8510e-009	1.0549e+002	6.0991e-004	1.7389e-012
Cm-242	5.2610e-008	1.9466e+003	3.6195e-002	1.9042e-009
Cm-244	5.7880e-005	2.1416e+006	3.4375e-002	1.9897e-006
Co-60	2.0590e-004	7.6183e+006	1.5417e-002	3.1743e-006
Cs-134	1.1160e-008	4.1292e+002	1.0149e-002	1.1326e-010
Cs-135	1.0160e-009	3.7592e+001	3.9913e-004	4.0551e-013
Cs-137	5.2890e-005	1.9569e+006	1.1086e-003	5.8631e-008
Eu-152	1.0850e-005	4.0145e+005	7.3864e-003	8.0143e-008
Eu-154	6.4120e-004	2.3724e+007	8.7221e-003	5.5926e-006
Eu-155	2.5620e-004	9.4794e+006	6.4902e-004	1.6628e-007
I-129	2.7000e-004	9.9900e+006	4.7222e-004	1.2750e-007
Ni-63	1.9140e-004	7.0818e+006	1.0154e-004	1.9435e-008
Np-237	6.0840e-006	2.2511e+005	2.8548e-002	1.7369e-007
Pm-147	3.6830e-004	1.3627e+007	3.6732e-004	1.3528e-007
Pr-144	2.8510e-009	1.0549e+002	7.3470e-003	2.0946e-011
Pu-238	3.1940e-003	1.1818e+008	3.2552e-002	1.0397e-004
Pu-239	2.5290e-004	9.3573e+006	3.0531e-002	7.7214e-006
Pu-240	7.2020e-005	2.6647e+006	3.0591e-002	2.2032e-006
Pu-241	1.4370e-003	5.3169e+007	3.1773e-005	4.5658e-008
Pu-242	5.3930e-008	1.9954e+003	2.9012e-002	1.5646e-009
Rh-106	1.8160e-007	6.7192e+003	9.5865e-003	1.7409e-009
Ru-106	1.8160e-007	6.7192e+003	5.9466e-005	1.0799e-011
Sb-125	3.0230e-005	1.1185e+006	3.0911e-003	9.3445e-008
Sm-151	1.8750e-003	6.9375e+007	1.1669e-004	2.1879e-007
Sr-90	1.2100e-004	4.4770e+006	1.1603e-003	1.4040e-007
Tc-99	5.5130e-003	2.0398e+008	6.0024e-004	3.3091e-006
Th-230	1.5130e-009	5.5981e+001	2.7709e-002	4.1924e-011
U-232	7.4650e-009	2.7621e+002	3.1460e-002	2.3485e-010
U-233	2.4930e-011	9.2241e-001	2.8571e-002	7.1228e-013
U-234	3.6830e-006	1.3627e+005	2.8232e-002	1.0398e-007
U-235	9.5380e-008	3.5291e+003	2.7030e-002	2.5782e-009
U-236	1.7850e-007	6.6045e+003	2.6729e-002	4.7712e-009
U-238	9.5700e-008	3.5409e+003	2.4838e-002	2.3770e-009
Y-90	1.2100e-004	4.4770e+006	5.5407e-003	6.7042e-007

Total

Heat Generation:

1.8688e-004

Page : 1
DOS File: JJQTR1.MS5
Run Date: March 8, 2000
Run Time: 2:27:51 PM
Duration: 00:03:31

File Ref: HRP-01.00
Date: 3/14/00
By: DRH/00
Checked: FDR 3/1/00

Case Title: JJQ

Description: R/hr for drum of grouted "treated" waste-(Cs & Sr removed)

Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height 86.36 cm 2 ft 10.0 in
Radius 29.21 cm 11.5 in

Dose Points

	X	Y	Z
# 1	129.37 cm	43.18 cm	0 cm
	4 ft 2.9 in	1 ft 5.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.31e+05 cm ³	Concrete	1.826
Transition	100.0 cm	Air	0.0011
Air Gap		Air	0.00122
Wall Clad	.16 cm	Iron	7.86
Top Clad	.16 cm	Iron	7.86

Source Input

Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Excluded

Library : ICRP-38

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.7300e-003	6.4010e+007	7.4734e-003	2.7652e+002
Am-243	6.9720e-007	2.5796e+004	3.0118e-006	1.1144e-001
Ba-137m	5.0030e-005	1.8511e+006	2.1612e-004	7.9966e+000
Ce-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Cm-242	5.2610e-008	1.9466e+003	2.2727e-007	8.4090e-003
Cm-244	5.7880e-005	2.1416e+006	2.5004e-004	9.2513e+000
Co-60	2.0590e-004	7.6183e+006	8.8947e-004	3.2910e+001
Cs-134	1.1160e-008	4.1292e+002	4.8210e-008	1.7838e-003
Cs-135	1.0160e-009	3.7592e+001	4.3890e-009	1.6239e-004
✓Cs-137	5.2890e-005	1.9569e+006	2.2848e-004	8.4538e+000
Eu-152	1.0850e-005	4.0145e+005	4.6871e-005	1.7342e+000
Eu-154	6.4120e-004	2.3724e+007	2.7699e-003	1.0249e+002
Eu-155	2.5620e-004	9.4794e+006	1.1068e-003	4.0950e+001
I-129	2.7000e-004	9.9900e+006	1.1664e-003	4.3156e+001
Ni-63	1.9140e-004	7.0818e+006	8.2683e-004	3.0593e+001
Np-237	6.0840e-006	2.2511e+005	2.6282e-005	9.7245e-001
Pm-147	3.6830e-004	1.3627e+007	1.5910e-003	5.8868e+001
Pr-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Pu-238	3.1940e-003	1.1818e+008	1.3798e-002	5.1052e+002
Pu-239	2.5290e-004	9.3573e+006	1.0925e-003	4.0423e+001
Pu-240	7.2020e-005	2.6647e+006	3.1112e-004	1.1511e+001

DOS File: JJQTR1.MS5
Run Date: March 8, 2000
Run Time: 2:27:51 PM
Duration: 00:03:31

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>µCi/cm³</u>	<u>Bq/cm³</u>
Pu-241	1.4370e-003	5.3169e+007	6.2077e-003	2.2969e+002
Pu-242	5.3930e-008	1.9954e+003	2.3297e-007	8.6200e-003
Rh-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Ru-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Sb-125	3.0230e-005	1.1185e+006	1.3059e-004	4.8319e+000
Sm-151	1.8750e-003	6.9375e+007	8.0998e-003	2.9969e+002
Sr-90	1.2100e-004	4.4770e+006	5.2271e-004	1.9340e+001
Tc-99	5.5130e-003	2.0398e+008	2.3816e-002	8.8118e+002
Th-230	1.5130e-009	5.5981e+001	6.5360e-009	2.4183e-004
U-232	7.4650e-009	2.7621e+002	3.2248e-008	1.1932e-003
U-233	2.4930e-011	9.2241e-001	1.0770e-010	3.9847e-006
U-234	3.6830e-006	1.3627e+005	1.5910e-005	5.8868e-001
U-235	9.5380e-008	3.5291e+003	4.1203e-007	1.5245e-002
U-236	1.7850e-007	6.6045e+003	7.7110e-007	2.8531e-002
U-238	9.5700e-008	3.5409e+003	4.1342e-007	1.5296e-002
Y-90	1.2100e-004	4.4770e+006	5.2271e-004	1.9340e+001

Buildup

The material reference is : Transition

Integration Parameters

Radial	34
Circumferential	24
Y Direction (axial)	34

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.290e+07	1.144e-35	1.482e-26	9.809e-37	1.272e-27
0.02	2.054e+07	1.405e-17	5.190e-17	4.866e-19	1.798e-18
0.03	9.322e+06	2.061e-07	2.002e-06	2.042e-09	1.984e-08
0.04	8.143e+06	2.048e-04	3.410e-03	9.058e-07	1.508e-05
0.05	1.905e+06	9.237e-04	1.744e-02	2.461e-06	4.645e-05
0.06	2.300e+07	5.124e-02	8.919e-01	1.018e-04	1.772e-03
0.08	3.006e+06	2.972e-02	3.838e-01	4.703e-05	6.074e-04
0.1	1.172e+07	2.377e-01	2.369e+00	3.636e-04	3.625e-03
0.15	4.344e+04	2.094e-03	1.410e-02	3.449e-06	2.323e-05
0.2	1.747e+06	1.353e-01	7.145e-01	2.388e-04	1.261e-03
0.3	1.670e+05	2.378e-02	9.586e-02	4.511e-05	1.818e-04
0.4	5.694e+05	1.237e-01	4.226e-01	2.410e-04	8.234e-04
0.5	2.262e+05	6.819e-02	2.077e-01	1.338e-04	4.077e-04
0.6	3.608e+06	1.422e+00	3.969e+00	2.776e-03	7.747e-03
0.8	9.005e+06	5.438e+00	1.335e+01	1.034e-02	2.540e-02
1.0	1.516e+07	1.278e+01	2.878e+01	2.356e-02	5.306e-02
1.5	1.700e+07	2.635e+01	5.146e+01	4.433e-02	8.658e-02
2.0	5.372e+02	1.276e-03	2.284e-03	1.972e-06	3.533e-06
3.0	1.403e+00	5.973e-06	9.601e-06	8.104e-09	1.303e-08

DOS File: JJQTR1.MS5
Run Date: March 8, 2000
Run Time: 2:27:51 PM
Duration: 00:03:31

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
TOTALS:	1.381e+08	4.666e+01	1.027e+02	8.219e-02	1.815e-01

Page : 1
DOS File: JJQTR1.MS5
Run Date: March 8, 2000
Run Time: 2:11:41 PM
Duration: 00:03:33

File Ref: HKP-07-01
Date: 3/14/00
By: DT Henderson
Checked: _____

Case Title: JJQ

Description: R/hr for drum of grouted "treated" waste-(Cs & Sr removed)
Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions
Height 86.36 cm 2 ft 10.0 in
Radius 29.21 cm 11.5 in

Dose Points
1 X Y Z
229.37 cm 43.18 cm 0 cm
7 ft 6.3 in 1 ft 5.0 in 0.0 in

Shields
Shield Name Dimension Material Density
Source 2.31e+05 cm³ Concrete 1.826
Transition 200.0 cm Air 0.0011
Air Gap Air 0.00122
Wall Clad .16 cm Iron 7.86
Top Clad .16 cm Iron 7.86

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : ICRP-38

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.7300e-003	6.4010e+007	7.4734e-003	2.7652e+002
Am-243	6.9720e-007	2.5796e+004	3.0118e-006	1.1144e-001
Ba-137m	5.0030e-005	1.8511e+006	2.1612e-004	7.9966e+000
Ce-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Cm-242	5.2610e-008	1.9466e+003	2.2727e-007	8.4090e-003
Cm-244	5.7880e-005	2.1416e+006	2.5004e-004	9.2513e+000
Co-60	2.0590e-004	7.6183e+006	8.8947e-004	3.2910e+001
Cs-134	1.1160e-008	4.1292e+002	4.8210e-008	1.7838e-003
Cs-135	1.0160e-009	3.7592e+001	4.3890e-009	1.6239e-004
Cs-137	5.2890e-005	1.9569e+006	2.2848e-004	8.4538e+000
Eu-152	1.0850e-005	4.0145e+005	4.6871e-005	1.7342e+000
Eu-154	6.4120e-004	2.3724e+007	2.7699e-003	1.0249e+002
Eu-155	2.5620e-004	9.4794e+006	1.1068e-003	4.0950e+001
I-129	2.7000e-004	9.9900e+006	1.1664e-003	4.3156e+001
Ni-63	1.9140e-004	7.0818e+006	8.2683e-004	3.0593e+001
Np-237	6.0840e-006	2.2511e+005	2.6282e-005	9.7245e-001
Pm-147	3.6830e-004	1.3627e+007	1.5910e-003	5.8868e+001
Pr-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Pu-238	3.1940e-003	1.1818e+008	1.3798e-002	5.1052e+002
Pu-239	2.5290e-004	9.3573e+006	1.0925e-003	4.0423e+001
Pu-240	7.2020e-005	2.6647e+006	3.1112e-004	1.1511e+001

DOS File: JJQTR1.MS5
Run Date: March 8, 2000
Run Time: 2:11:41 PM
Duration: 00:03:33

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>uCi/cm³</u>	<u>Bq/cm³</u>
Pu-241	1.4370e-003	5.3169e+007	6.2077e-003	2.2969e+002
Pu-242	5.3930e-008	1.9954e+003	2.3297e-007	8.6200e-003
Rh-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Ru-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Sb-125	3.0230e-005	1.1185e+006	1.3059e-004	4.8319e+000
Sm-151	1.8750e-003	6.9375e+007	8.0998e-003	2.9969e+002
Sr-90	1.2100e-004	4.4770e+006	5.2271e-004	1.9340e+001
Tc-99	5.5130e-003	2.0398e+008	2.3816e-002	8.8118e+002
Th-230	1.5130e-009	5.5981e+001	6.5360e-009	2.4183e-004
U-232	7.4650e-009	2.7621e+002	3.2248e-008	1.1932e-003
U-233	2.4930e-011	9.2241e-001	1.0770e-010	3.9847e-006
U-234	3.6830e-006	1.3627e+005	1.5910e-005	5.8868e-001
U-235	9.5380e-008	3.5291e+003	4.1203e-007	1.5245e-002
U-236	1.7850e-007	6.6045e+003	7.7110e-007	2.8531e-002
U-238	9.5700e-008	3.5409e+003	4.1342e-007	1.5296e-002
Y-90	1.2100e-004	4.4770e+006	5.2271e-004	1.9340e+001

Buildup

The material reference is : Transition

Integration Parameters

Radial	34
Circumferential	24
Y Direction (axial)	34

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.290e+07	5.099e-36	4.755e-27	4.373e-37	4.079e-28
0.02	2.054e+07	5.862e-18	2.163e-17	2.031e-19	7.493e-19
0.03	9.322e+06	7.158e-08	6.905e-07	7.094e-10	6.843e-09
0.04	8.143e+06	6.575e-05	1.085e-03	2.908e-07	4.799e-06
0.05	1.905e+06	2.872e-04	5.390e-03	7.651e-07	1.436e-05
0.06	2.300e+07	1.572e-02	2.738e-01	3.123e-05	5.439e-04
0.08	3.006e+06	9.034e-03	1.177e-01	1.430e-05	1.862e-04
0.1	1.172e+07	7.203e-02	7.294e-01	1.102e-04	1.116e-03
0.15	4.344e+04	6.343e-04	4.367e-03	1.045e-06	7.191e-06
0.2	1.747e+06	4.104e-02	2.218e-01	7.244e-05	3.914e-04
0.3	1.670e+05	7.238e-03	2.981e-02	1.373e-05	5.655e-05
0.4	5.694e+05	3.774e-02	1.316e-01	7.353e-05	2.563e-04
0.5	2.262e+05	2.085e-02	6.473e-02	4.092e-05	1.271e-04
0.6	3.608e+06	4.357e-01	1.238e+00	8.504e-04	2.416e-03
0.8	9.005e+06	1.671e+00	4.171e+00	3.178e-03	7.934e-03
1.0	1.516e+07	3.937e+00	9.004e+00	7.257e-03	1.660e-02
1.5	1.700e+07	8.155e+00	1.614e+01	1.372e-02	2.716e-02
2.0	5.372e+02	3.961e-04	7.180e-04	6.126e-07	1.110e-06
3.0	1.403e+00	1.864e-06	3.025e-06	2.528e-09	4.104e-09

DOS File: JJQTR1.MS5
Run Date: March 8, 2000
Run Time: 2:11:41 PM
Duration: 00:03:33

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
TOTALS:	1.381e+08	1.440e+01	3.213e+01	2.536e-02	5.681e-02

Page : 1
 DOS File: JJQTR1.MS5
 Run Date: March 8, 2000
 Run Time: 2:17:26 PM
 Duration: 00:03:33

File Ref: HKP-07-02
 Date: 3/14/02
 By: B. H. Anderson
 Checked: PDR 3/16/02

Case Title: JJQ

Description: R/hr for drum of grouted "treated" waste-(Cs & Sr removed)
 Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height 86.36 cm 2 ft 10.0 in
 Radius 29.21 cm 11.5 in

Dose Points

	X	Y	Z
# 1	329.37 cm	43.18 cm	0 cm
	10 ft 9.7 in	1 ft 5.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.31e+05 cm ³	Concrete	1.826
Transition	300.0 cm	Air	0.0011
Air Gap		Air	0.00122
Wall Clad	.16 cm	Iron	7.86
Top Clad	.16 cm	Iron	7.86

Source Input

Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Excluded

Library : ICRP-38

Nuclide	curies	becquerels	µCi/cm ³	Bq/cm ³
Am-241	1.7300e-003	6.4010e+007	7.4734e-003	2.7652e+002
Am-243	6.9720e-007	2.5796e+004	3.0118e-006	1.1144e-001
Ba-137m	5.0030e-005	1.8511e+006	2.1612e-004	7.9966e+000
Ce-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Cm-242	5.2610e-008	1.9466e+003	2.2727e-007	8.4090e-003
Cm-244	5.7880e-005	2.1416e+006	2.5004e-004	9.2513e+000
Co-60	2.0590e-004	7.6183e+006	8.8947e-004	3.2910e+001
Cs-134	1.1160e-008	4.1292e+002	4.8210e-008	1.7838e-003
Cs-135	1.0160e-009	3.7592e+001	4.3890e-009	1.6239e-004
Cs-137	5.2890e-005	1.9569e+006	2.2848e-004	8.4538e+000
Eu-152	1.0850e-005	4.0145e+005	4.6871e-005	1.7342e+000
Eu-154	6.4120e-004	2.3724e+007	2.7699e-003	1.0249e+002
Eu-155	2.5620e-004	9.4794e+006	1.1068e-003	4.0950e+001
I-129	2.7000e-004	9.9900e+006	1.1664e-003	4.3156e+001
Ni-63	1.9140e-004	7.0818e+006	8.2683e-004	3.0593e+001
Np-237	6.0840e-006	2.2511e+005	2.6282e-005	9.7245e-001
Pm-147	3.6830e-004	1.3627e+007	1.5910e-003	5.8868e+001
Pr-144	2.8510e-009	1.0549e+002	1.2316e-008	4.5569e-004
Pu-238	3.1940e-003	1.1818e+008	1.3798e-002	5.1052e+002
Pu-239	2.5290e-004	9.3573e+006	1.0925e-003	4.0423e+001
Pu-240	7.2020e-005	2.6647e+006	3.1112e-004	1.1511e+001

DOS File: JJQTR1.MS5
Run Date: March 8, 2000
Run Time: 2:17:26 PM
Duration: 00:03:33

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>uCi/cm³</u>	<u>Bq/cm³</u>
Pu-241	1.4370e-003	5.3169e+007	6.2077e-003	2.2969e+002
Pu-242	5.3930e-008	1.9954e+003	2.3297e-007	8.6200e-003
Rh-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Ru-106	1.8160e-007	6.7192e+003	7.8450e-007	2.9026e-002
Sb-125	3.0230e-005	1.1185e+006	1.3059e-004	4.8319e+000
Sm-151	1.8750e-003	6.9375e+007	8.0998e-003	2.9969e+002
Sr-90	1.2100e-004	4.4770e+006	5.2271e-004	1.9340e+001
Tc-99	5.5130e-003	2.0398e+008	2.3816e-002	8.8118e+002
Th-230	1.5130e-009	5.5981e+001	6.5360e-009	2.4183e-004
U-232	7.4650e-009	2.7621e+002	3.2248e-008	1.1932e-003
U-233	2.4930e-011	9.2241e-001	1.0770e-010	3.9847e-006
U-234	3.6830e-006	1.3627e+005	1.5910e-005	5.8868e-001
U-235	9.5380e-008	3.5291e+003	4.1203e-007	1.5245e-002
U-236	1.7850e-007	6.6045e+003	7.7110e-007	2.8531e-002
U-238	9.5700e-008	3.5409e+003	4.1342e-007	1.5296e-002
Y-90	1.2100e-004	4.4770e+006	5.2271e-004	1.9340e+001

Buildup

The material reference is : Transition

Integration Parameters

Radial	34
Circumferential	24
Y Direction (axial)	34

Results

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>		<u>Exposure Rate</u>	
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.290e+07	2.514e-36	2.311e-27	2.156e-37	1.982e-28
0.02	2.054e+07	2.859e-18	1.055e-17	9.904e-20	3.654e-19
0.03	9.322e+06	3.388e-08	3.268e-07	3.358e-10	3.239e-09
0.04	8.143e+06	3.080e-05	5.093e-04	1.362e-07	2.253e-06
0.05	1.905e+06	1.341e-04	2.531e-03	3.574e-07	6.743e-06
0.06	2.300e+07	7.341e-03	1.290e-01	1.458e-05	2.561e-04
0.08	3.006e+06	4.218e-03	5.572e-02	6.676e-06	8.817e-05
0.1	1.172e+07	3.366e-02	3.468e-01	5.150e-05	5.306e-04
0.15	4.344e+04	2.973e-04	2.082e-03	4.895e-07	3.429e-06
0.2	1.747e+06	1.927e-02	1.059e-01	3.401e-05	1.868e-04
0.3	1.670e+05	3.408e-03	1.424e-02	6.464e-06	2.702e-05
0.4	5.694e+05	1.780e-02	6.289e-02	3.468e-05	1.225e-04
0.5	2.262e+05	9.849e-03	3.096e-02	1.933e-05	6.077e-05
0.6	3.608e+06	2.061e-01	5.923e-01	4.022e-04	1.156e-03
0.8	9.005e+06	7.919e-01	1.997e+00	1.506e-03	3.799e-03
1.0	1.516e+07	1.869e+00	4.314e+00	3.445e-03	7.952e-03
1.5	1.700e+07	3.883e+00	7.745e+00	6.532e-03	1.303e-02
2.0	5.372e+02	1.890e-04	3.449e-04	2.923e-07	5.334e-07
3.0	1.403e+00	8.915e-07	1.455e-06	1.210e-09	1.974e-09

DOS File: JJQTR1.MS5
Run Date: March 8, 2000
Run Time: 2:17:26 PM
Duration: 00:03:33

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
TOTALS:	1.381e+08	6.846e+00	1.540e+01	1.205e-02	2.722e-02

ENGINEERING DESIGN FILE

PROJECT FILE NO. 015735
EDF SERIAL NO. EDF-1505
FUNCTIONAL FILE NO. _____

PROJECT/TASK HIGH LEVEL WASTE

SUBTASK Vitrification of Sodium Bearing Waste

EDF PAGE NO. 1 OF 5

TITLE MAN-LOADING AND PHYSICAL SPACE IDENTIFICATION

SUMMARY

The following investigation identifies associated activities that may be required for the operation of this facility. Space allocation based on these activities has been estimated. Man-loading has been extrapolated from previous projects similar in nature, resource documents, and engineering judgment based on experience.

QUALITY LEVEL ☐ 1 ☐ 2 ☒ 3

KEYWORDS (e.g. area, structure no., general subject matter, etc.)

Man-loading, Space, High Level Waste

DISTRIBUTION (COMPLETE PACKAGE):

D. J. Harrell, M.S. 3211, J. J. Quigley, M.S. 3625, V. J. Balls, M.S. 3650, Project File

DISTRIBUTION (COVER SHEET ONLY):

AUTHOR D. E. Nishioka M.S. 3650	DATE <i>[Signature]</i> 6/28/00	CHECKED E. P. Wagner M.S. 3211	DATE	APPROVED/ACCEPTED S. L. Austad, P.E. M.S. 3650	DATE <i>[Signature]</i> 6/28/00
		BBWI REVIEW	DATE	BBWI REVIEW	DATE

Attachment A

MAN-LOADING for 2 YEAR CAMPAIGN

February 21, 2000

Assume: One (4)-10's shift for main process, administrative and support. Continuous process operations will require (4) rotating shifts for the 2 year duration. Total man-loading is 109 personnel.

<u>FUNCTION/FACILITY REQUIREMENT</u>	<u>MAIN SHIFT</u>	<u>ROTATING</u>
---	--------------------------	------------------------

FACILITY – ADMINISTRATION

An attached building will house approximately 30+ personnel and ancillary spaces supporting the main process and its functions. Physical requirements have been estimated based on an average of 500 square feet allowance per person.

• Manager(s)/Supervisor(s)	2	4
• Administrative Support	3	-
Secretarial/Clerical		
Budget/Cost Control		
Schedule		
• Waste Tracking/Data Acquisition Tech	1	4
(Receipt, Entry, Examination, Sampling, Repack,		
Storage/Shipping, etc., Manifest, Chain of Custody		

File/Document Storage Office Machines

FACILITY – TECHNICAL SUPPORT

• Engineering (Facility)	2	-
• Engineering (Process/Support)	2	4
• Control Systems Tech – Ref: pg 4, I & C Technicians	1	-
(Matrix personnel during const. Overhaul, redesign or mods)		
• Draftsman	1	-

Assume: INTEC will have infrastructure services and capabilities to accommodate some tasks not unique to this project. Additional drafting is assumed to be one of these.

Storage – spare parts, work bench for repair/maintenance

FUNCTION/FACILITY REQUIREMENT

MAIN SHIFT ROTATING

FACILITY -- DOCUMENT CONTROL

- Document control personnel

2

-

File/Document Storage Fire Vault, Library, Office Machines

FACILITY -- TRAINING (Physical requirements only)

- Conference Room -- utilized for training and equipment storage

FACILITY -- COMMON ANCILLARY SPACE (Physical requirements only)

- Lunch Room/Break Room
- Toilet Rooms, Showers and Lockers
- Janitor Room
- Storage
- Circulation
- Electrical
- Communications
- Mechanical

FACILITY -- MAINTENANCE

Assume: INTEC will have infrastructure services and capabilities to accommodate some tasks not unique to this project. Facility maintenance is assumed to be one of these.

- Office Space for foreman

DOE TRANSIENTS @ FACILITY OFFICE(S) - (Physical requirements only)

- Offices (1)

FUNCTION/FACILITY REQUIREMENT

MAIN SHIFT ROTATING

PROCESS FACILITY/OPERATIONS

- Rad-con Tech (RCT/HP) Manager

1

-

Assume: INTEC will have infrastructure services and capabilities to accommodate some tasks not unique to this project. Laboratory testing and analysis capabilities is assumed to be one of these.

File/Document Storage Office Machines

PROCESS CONTROL (Process Control Console, Alarm Panels, Communications)

Note: In high rad areas, require a minimum of (2) people suited and (1) high rad guard.

- SBW feed and frit mixing (personnel for this
Operation will provide oversight for the (4) processes below
- Melter feed and Canister Fill
- Glass and Gas Sampling and Analysis
- Grouting System
- Offgas Handling
- Canister Decontamination
- Canister Cure/Dewatering, Transfers
- Can Sealing and Inspection
- Canister Tomographic Inspection
- Canister Recycle

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12

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-

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16

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8

-

4

-

4

-

4

ES & Q

- Safety
- RCT (Rad-Con Tech)
- Quality
- Industrial Hygienist

1

-

1

4

-

4

-

4

Equipment storage (surveillance, analyzers, etc)

FUNCTION/FACILITY REQUIREMENT

MAIN SHIFT ROTATING

PROCESS MAINTENANCE

• Supervisors/Foreman	1	-
• Electrician	-	4
• Mechanic	-	4
• I&C Technicians	-	4
• Maintenance Planner	1	-
• Preventive Maintenance/Work Order	1	-
• Attendant	1	-

PROCESS SUPPORT (Physical Requirements only)

- Anti-C Issue Rooms
- Change Rooms/Shower Rooms
- Personnel Decon Area
- Ready Room (Break Room)
- Toilet Rooms and Janitor Room
- Emergency Equipment Room
- Process Mechanical Area
- Facility Mechanical Room
- Electrical and Communications
- Stack Emissions Monitoring Room (CEM and Rad monitoring)
- Shop – Materials and Equipment Storage, Work Bench Area
- Instrument Shop – I&C, Protected Storage for Calibrated Instruments, Work Bench
- Contaminated, Hot Maintenance Area
- Tool Room – Storage of Issue Tools
- Storage - Clean Containers
- Storage - Lag/Lead
- Storage - Process Interim

Assume: INTEC will have infrastructure services and capabilities to accommodate some tasks not unique to this project. The following functions and facilities have been assumed to exist and have the capabilities of servicing this process:

- Machine Shop
- Welding Shop
- Storage Warehouse
- Mock-up Area
- Laydown Area

ENGINEERING DESIGN FILE

PROJECT FILE NO. 015735
EDF SERIAL NO. EDF-1509
FUNCTIONAL FILE NO. _____

PROJECT/TASK SBW Vitrification Facility Feasibility Study

SUBTASK HVAC and HEPA filtration preliminary design

EDF PAGE NO. 1 OF 1

TITLE Energy Requirements for SBW Vitrification HVAC System

SUMMARY

This EDF details the HVAC energy requirements for the new SBW Vitrification Facility. Energy requirements are summarized for cooling, heating, fan power and HEPA filtration. This report defines the primary and secondary confinement zones for the new SBW Vitrification Facility and the required peak seasonal heating and cooling loads. The HEPA filtration system and fan layout are also stated.

Peak heating: 23.2 million Btu/hr equivalent to 27,000 lbs/hr 150 psi saturated steam

Fan HP total: 1423 HP

Peak cooling: 1225 HP equivalent to 774 tons of cooling

See Attachment

QUALITY LEVEL ☐ 1 ☐ 2 ☒ 3

KEYWORDS (e.g. area, structure no., general subject matter, etc.)

DISTRIBUTION (COMPLETE PACKAGE):

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AUTHOR J. L. Benson <i>J. L. Benson</i>	DATE 7/6/00	CHECKED N. Z. Hertelendy <i>N. Z. Hertelendy</i>	DATE 7/6/00	APPROVED/ACCEPTED E. C. Anderson, P.E. <i>E. C. Anderson</i>	DATE 7/6/00
		BBWI REVIEW	DATE	BBWI REVIEW	DATE

HVAC

In addition to the offgas system, the VF will be required to have two ventilation confinement zones per DOE Order 6430.1A. This section addresses the two confinement zones, and the non-confinement area. A ventilation confinement system in conjunction with physical barriers, maintain a continuous airflow pattern from areas of low potential contamination to areas of high potential contamination. The objectives of the confinement systems are to prevent the spread of radioactive and other hazardous materials to occupied areas; and to minimize the release of radioactive and other hazardous materials in facility effluents. The primary confinement area consists of process hot cells and hot maintenance areas, which will be exhausted through two stages of HEPA filters. The primary confinement boundary will be comprised of hot cell walls, welded stainless steel ductwork and HVAC equipment designed to maintain its structural integrity during and after operational and natural-phenomena design basis accidents (DBAs). The secondary confinement boundary consists of the operating corridors and other building structures that surround the primary confinement. The secondary confinement boundary contains all ventilation system equipment such as HEPA filter units and exhaust fans. The non-confinement boundary consists of offices, control rooms and support areas outside the secondary confinement boundary. The non-confinement zones do not require once through ventilation systems and will be maintained at a slight positive pressure with respect to ambient. HEPA filters will remove contaminated particulates, but no carbon absorber beds will be provided in the primary filter trains, because semivolatile fission products and iodine will be removed by the offgas system.

The facility will be provided with an independent chilled water system consisting of central chillers and pumps, delivering chilled water to various cooling coils. The facility will utilize steam for heating the once through air and for the office and other occupied areas. The HVAC system will be controlled by a central electronic system located within the facility.

Redundancy will ensure proper ventilation confinement during HEPA filter replacement or fan maintenance. Exhaust ductwork will be located in areas that will not be normally occupied. HEPA filter housings will have the capability to be leak tested and tested for filter efficiency in place. Single stage HEPA filtration will be provided at the hot cell intakes to prevent possible contamination from momentary back flow to the occupied areas. HEPA filters units will be designed per the American Society of Mechanical Engineers (ASME), N509, Nuclear Power Plant Air-Cleaning Units and Components, and tested per ASME N510, Testing of Nuclear Air Treatment Systems. Confinement boundaries will be sealed to maintain isolation when pressure differentials fall below normal conditions. Exhaust systems for the primary and secondary confinements will be round stainless steel welded joint ductwork designed and installed in accordance with applicable Sheet Metal and Air Conditioning Contractors National Association, Uniform Mechanical Code, and American Conference of Governmental Industrial Hygienists standards.

Confinement zones will be supplied by once through ventilation. Airflow from the secondary confinement zones will be HEPA filtered to the primary confinement zones. The once through ventilation will be HEPA filtered and discharged to the exhaust stack, with no air recirculation. Each HEPA filter unit includes a stainless steel plenum housing, a deluge system, demister, prefilter, two stages of side-bagout HEPA filters for the primary zone exhaust, single stage side-bagout HEPA filters for secondary zone exhaust and primary supply, DOP test sections and ports, and an exhaust fan. The exhaust fans have integral adjustable flow control. It is assumed that the supply and exhaust fans for the hot cells can be powered from the INEEL site standby power grid. This allows the ventilation confinement to be maintained in the hot cells during a loss of off-Site power condition.

Automatic local stand-alone controllers will be provided with the HVAC equipment. Graphic displays mimicking the HVAC system will be available in the control room for monitoring and for remote manual override control. The HVAC system will have local operator stations. However, the control room operator will have supervisory control capability to start and stop the HVAC system and to change setpoints. Alarms and out-of-tolerance conditions will be annunciated in the control room. It is assumed that a shielded probe system can be used in the VF exhaust stack to monitor the discharge from the ventilation system and offgas exhaust.

This facility will be designed with the following ventilation parameters:

- Eight air changes per hour for primary confinement
- Four air changes per hour for secondary confinement
- One cfm per square foot for administrative areas
- Two cfm per square foot for the control room
- One stage of testable HEPA filters for secondary confinement exhaust
- Two stages of testable HEPA filters for hot cell exhaust
- One stage of testable HEPA filters for hot cell inlet
- Once through ventilation for primary and secondary confinement zones
- Room pressures maintained in accordance with Table 1.

It is assumed that areas with large in-cell heat loads, which exceed normal nuclear ventilation capability, will require cooling and no additional heating.

Table 1 Room and Zone Requirements

Rooms	Zone	Floor Elev	Static Pressure iwg	Room CFM	Total CFM / Zone
Offices and other Rms	one	0	0.1	6808	total 6808
Crane Control Rm	two	0	0.1	1800	total 6600
Control Rm		0	0.1	2700	
Computer Rm		0	0.1	2100	
Elec Rm near Offices	three	0	0.1	190	total 563
Comm Rm		0	0.1	90	
Mech Rm		0	0.1	283	
West Outer Truck Lock	f	0	-0.25	640	
East Outer Truck Lock		0	-0.25	640	
Storage		0	-0.25	2078	
Tool/Repair Equip Stor.		0	-0.25	2424	
Elec Rm near HVAC		0	-0.25	1885	

Personnel Air Lock		0	-0.25	435	
Personnel Air Lock		0	-0.25	134	
Personnel Air Lock		0	-0.25	224	
Truck Air Lock		0	-0.25	269	
Exit Corridor NW		-32	-0.25	1939	
Exit Corridor SW		-32	-0.25	653	
Exit Corridor SE		-32	-0.25	653	
Personnel Air Lock		-32	-0.25	448	
Personnel Air Lock		-32	-0.25	448	
Personnel Air Lock		-32	-0.25	448	
Clean Canister Stor		-32	-0.25	8782	
Operating Corridor		0	-0.25	16256	
Operating Corridor		-32	-0.25	41363	total 79720
HVAC Room	five	0	-0.25	12466	
HVAC Room		16	-0.25	17140	
Exit Corridor NE		-32	-0.25	1939	
Operating Corridor		16	-0.25	17304	
Operating Corridor		32	-0.25	14997	total 63846
Hatch/Crane Floor	six	48	-0.75	91661	
Remote Serv Corridor		0	-0.75	25805	
Par and Crane Maint		0	-0.75	3405	
Crane Repair room		32	-0.75	4614	total 125485
Melter	seven	0	-0.75	7680	
Multi-Stage Combustion		0	-0.75	6554	
Off-Gas Cell		0	-0.75	6144	
Canister Weld Cell		0	-0.75	2688	
Decon Cell		-32	-0.75	1787	
Sub Melter Cell		-32	-0.75	5120	
Canister Smear Cell		0	-0.75	2688	
Csix Cell		0	-0.75	3398	
Grout Cell		0	-0.75	3587	
Cut Up Cell		0	-0.75	4378	
Decon Cell		0	-0.75	5198	
Hands On Maint Cell		0	-0.75	3405	
Decon Holding Tanks		-32	-0.75	9088	total 61715
Feed Tanks	eight	0	-0.75	5120	
Mixing Tank N		0	-0.75	3789	
Mixing Tank S		0	-0.75	3789	
Sample Cubicle		0	-0.75	2816	
Can Cooling		-32	-0.75	11404	
SBW Work Off Tank		0	-0.75	3686	total 30604

The primary confinement areas require the largest volume of once through air. The air exhausted from the secondary confinement zones is supplied to the primary confinement areas. As shown in the HVAC Flow Diagram additional CFM is required to meet the capacity of the primary zones. The cost to heat, cool, filter and force the once through air through the facility is mainly attributed to the volume of primary confinement zones. The primary confinement zones are the principle factor affecting HVAC system capital and operational costs.

The following table shows the preliminary equipment list for the HVAC feasibility study. This is not an all-inclusive list of instruments, components and equipment.

Quantity	Equipment Description	Size/Power/Capacity	Comments
11	Ventilation Centrifugal Fans	60 HP	Includes standby fans
24	Ventilation Centrifugal Fans	50 HP	Includes standby fans
2	Ventilation Centrifugal Fans	75 HP	Includes standby fans
28	HEPA 4x4 Banks Single Stage	16 filters per bank	one filter is 24" by 24"
17	HEPA 4x4 Banks Dual Stage	16 filters per bank	one filter is 24" by 24"
1	Chiller: Compressors and Fans	600 HP combined	
1	Chiller: Compressors and Fans	625 HP combined	
multiple	Actuated Air Dampers	0.5 HP each	flow control to rooms
	Pre filters	217800 CFM.	outside air filters
	Heating coils	217800 CFM	steam heat
	Cooling coils		
17	Heat Recovery coils		for each dual HEPA bank
	Heat Recovery coils		with intake heat/cool coils

The ventilation fans and HEPA filter banks will require three rooms based upon the current HVAC floor plan size of 240'-5" by 50'-6". The chillers shall be located outside on concrete pads. The pre-filters and the cooling and heating coils will also require an additional structure or room other than the existing HVAC rooms. The storage and tool/repair equipment storage rooms may be used on the second and third floor for the heating and cooling coils and fans for supplying the facility with the required once through air.

Heat Recovery Systems

It is assumed that later stages of design will provide greater detail and a more specific system description. The inclusion of a heat recovery system may have the potential to reduce operational costs. Here are two types of heat recovery systems applicable to this facility that completely separates air streams and eliminating cross-contamination. The face velocity is a primary factor in effectiveness and capital costs.

Coil energy recovery loops have an effectiveness range of 45% to 65%. The effectiveness is directly correlated to the delta T and the minimum low temperature in order to prevent freezing. Relative to other system parameters, the Vitrification Facility has a low delta T and a freezing limitation. Expected effectiveness is in the low end of the range, approximately 45%. Coil energy recovery loops require a liquid loop, typically a refrigerant and compressors. This system has more moving parts than other heat recovery systems and thus requires more maintenance.

Heat pipe heat exchangers have a higher effectiveness than coil energy recovery loops but also have freeze protection problems. The performance of heat pipes is correlated directly to face velocities and the number of rows or heat pipes. Doubling the number of rows of heat pipes in a 60% effective heat exchanger increases the effectiveness to 75%. Effectiveness is also based upon the proper selection of fluid for the operating temperature range. According to Heat Pipe Technology Inc. typical costs range from \$0.50 to \$1.00 per CFM for a heat pipe recovery system.

Fixed plate exchangers have potential for cross contamination and are not considered here.

A coil energy recover loop is recommended primarily due to the flexibility of locating the heat exchangers in both exhaust and intake air streams. This will not require special routing of ducts in order to get close proximity that is required in a heat pipe exchanger system. Special duct routing would require additional floor space and added cost to the building structure. The heat recovery system exchangers can be located in line with the intake steam and cooling coils and just behind the HEPA filter banks prior to going to the exhaust stack. The cost would be similar to a heat pipe system \$0.50 to \$1.00 per CFM.

Heating loads and steam requirements

As referenced from ASHRAE Fundamentals Handbook.

$$Q = 1.1 (\text{CFM}) (T_2 - T_1) \text{ in units of Btu / hr}$$

Based upon the CFM requirements for the secondary confinement zones.

$$\text{CFM} = 143,500 - 1,885.3 = 141,614.7$$

The electrical room requires 1,885.3 CFM and is removed from the overall secondary requirements due to the high heat load from the transformers.

$$T_2 = 80^\circ\text{F}$$

Typically air is heated to 95°F, but due to the high rate of volume change out 80°F is used for more realistic results that are still conservative.

$$T_1 = -19^\circ\text{F}$$

$$Q = 1.1 (141,614.7) (80 - (-19)) = 15.4 \text{ million Btu / hr}$$

Based upon the CFM requirements for the primary confinement zones.

$$\text{CFM} = 74,200 - 27,995.2 = 46,204.8$$

The various process cells that contain the melter, multi-stage combustion, off gas and etc. require 27,995.2 CFM and is removed from the overall primary requirements due to the high heat load from the process equipment.

$$T_2 = 80^\circ\text{F}$$

Typically air is heated to 95°F, but due to the high rate of volume change out 80°F is used for more realistic results that are still conservative.

$$T_1 = -19^\circ\text{F}$$

$$Q = 1.1 (46,204.8) (80 - (-19)) = 5.0 \text{ million Btu / hr}$$

Based upon the total rooms and cells not requiring 80°F heat.

$$\text{CFM} = 1,885.3 + 27,995.2 = 29,881.5$$

This volume of air is considered heated separately for calculation purposes only.

These are the combined secondary and primary CFM heated to 65°F.

$$T_2 = 65^\circ\text{F}$$

Typically air is heated to 95°F, but due to the high rate of volume change out 80°F is used for more realistic results that are still conservative.

$$T_1 = -19^\circ\text{F}$$

$$Q = 1.1 (29,881.5) (65 - (-19)) = 2.8 \text{ million Btu / hr}$$

$$\text{Total } Q = 23.2 \text{ million Btu / hr}$$

Using 150 psi saturated steam, 860 Btu / lb of steam.

$$\text{Total steam load is} = 23,200,000 \text{ Btu / hr} \times 1 \text{ lb} / 860 \text{ Btu} = \underline{27,000 \text{ lbs / hr steam}}$$

Ventilation Fans, HP

The ventilation fan sizing was based upon software and vendor data to ensure common fan motor sizes. The static pressures for each zone were conservatively approximated and all filters were assigned worst case pressure losses. The following table details the assigned pressure drops, final static pressures were based upon additional pressure drops through each zone.

Equipment	Static pressure loss
Pre-filter for intake from atmosphere	1 iwg
Heating and cooling coils	1 iwg
Single HEPA filter bank	3 iwg
Dual HEPA filter bank	6 iwg
Each zone total	4 iwg
Duct to stack	1 iwg

According to the flow diagrams HV-1 and HV-2 the fan HP and CFM are shown. Each confinement zone is given a standby fan for immediate backup.

Zone	Total static pressure	HP requirements
1 supply	5 iwg	15
2 supply	5 iwg	15
3 supply	5 iwg	3
4 supply	5 iwg	125
4 exhaust	6 iwg	150
5 supply	5 iwg	90
5 exhaust	6 iwg	100
6, 7 & 8 supply	3 iwg	60
6 supply	5 iwg	200
6 exhaust	9 iwg	300
7 supply	5 iwg	90
7 exhaust	9 iwg	150
8 supply	5 iwg	50
8 exhaust	9 iwg	75

HP requirements are based upon centrifugal fans from GreenHeck, based upon CFM and static pressure loads.

Cooling, Compressor and Fan HP

$$Q = 1.1 (\text{CFM}) (T_2 - T_1) \text{ in units of Btu / hr}$$

Based upon the CFM requirements for the secondary confinement zones.

$$\text{CFM} = 143,500$$

$$T_2 = 95^\circ\text{F}$$

$$T_1 = 65^\circ\text{F}$$

Typically air is cooled to 55°F, but due to the high rate of volume change out 65°F is used for more realistic results that are still conservative.

$$Q = 1.1 (143,500) (95 - 65) = 4.75 \text{ million Btu / hr}$$

Based upon the CFM requirements for the primary confinement zones.

$$\text{CFM} = 74,200$$

The CFM from the secondary confinement zones is supplied to the primary confinement zones. The additional air required from the atmosphere is cooled.

$$T_2 = 95^\circ\text{F}$$

$$T_1 = 65^\circ\text{F}$$

Typically air is cooled to 55°F, but due to the high rate of volume change out 65°F is used for more realistic results that are still conservative.

$$Q = 1.1 (74,200) (95 - 65) = 2.45 \text{ million Btu / hr}$$

$$\text{CFM} = 143,500$$

This is the CFM exhausted from the secondary confinement zones and is reused to supply the primary confinement zones.

$$T_2 = 78^\circ\text{F}$$

The assumed the exit temperature from the secondary confinement zones.

$$T_1 = 65^\circ\text{F}$$

Typically air is cooled to 55°F, but due to the high rate of volume change out 65°F is used for more realistic results that are still conservative.

$$Q = 1.1 (143,500) (78 - 65) = 2.1 \text{ million Btu / hr}$$

Converting the Btu / hr to tons the conversion is 12,000 Btu / hr = 1 ton

Based upon Product Data from Carrier. The 30GU series Flotronic™ Air-Cooled Reciprocating Liquid Chillers 60 Hz require the following combined HP from fans and compressors for the tonnage calculated.

4.75 million Btu / hr = 395 tons requiring a combined 625 HP

2.45 million Btu / hr = 204.2 tons requiring a combined 323 HP

2.1 million Btu / hr = 175 tons requiring a combined 277 HP
Total HP = 1,225 HP

Project File Number _____

Project/Task HLW Vitrification of Sodium
 Bearing Waste Feasibility Studies

Subtask Vitrification of Sodium Bearing Waste (SBW)

Title: Electrical Requirements for Vitrification of SBW

Summary: This EDF evaluated the electrical requirements for the Vitrification of SBW Facility. The connected loads were estimated to be 4.747 MVA, an evaluation of the usage indicated that the demand would be approximately 4.444 MVA. The majority of the demand is from the joule-heated melters. The Bath Electrode requires a source of standby power. The estimated standby requirement is 840 kVA. The standby power system at the ICPP is presently undergoing a complete redesign and the final configuration and spare capacity is not known. It would be safe to assume that a new standby generator would be needed. This generator would be installed in the existing standby generator building and would be connected to the Substation 60 which distributes standby power to the ICPP. Normal power would be supplied from Substation 15 via two existing Power Sectionalizing Switches. These switches which are located in the northeast quadrant of the INTEC will be supplied power to two new power sectionalizing switches and then would supply a 13.8kV feed to the new load center. The load center would supply a secondary voltage of 480 Volts for building and process loads. Standby power would be supplied through this load center from Substation 60 via 2400-480Y/277 VAC transformer.

Distribution (complete package):

Distribution (summary package only):

Author Luong V. Le	Dept. Facilities Design	Reviewed <i>WHR</i>	Date 14 Sep 00	Approved <i>WHR</i>	Date 14 Sep 00
		BBWI Review	Date	BBWI Approval	Date

See Management Control Procedure (MCP) 6 for instructions on use of this form.

HLW VITRIFICATION OF SODIUM BEARING WASTE

1.0 ELECTRICAL REQUIREMENTS

1.1 EXISTING AND PLANNED ELECTRICAL UTILITIES AT ICPP

The INTEC ties into the 138kV INEEL loop at Substation 2, which is located outside the area fence to the south. Substation 2 transforms the 138kV to 13.8kV and provides power to Substation 15, which is located within the INTEC complex. Power at 13.8kV will be distributed from Substation 15 to the Vitrification of SBW Facility.

Currently, standby power is provided by each facility. Standby generators are located at various facilities and operate as an island of power during a normal power outage. The EUSU project will construct a standby power plant, install new standby generators and tie existing generators into the standby power system. Standby power will then be distributed through the complex by the new 13.8kV distribution system. The Utility Control System (UCS) will control the usage of standby power.

1.2 POWER REQUIREMENTS

1.2.1 NORMAL POWER

The electrical requirements of the Vitrification of liquid Sodium Bearing Waste (SBW) Facility were analyzed and determined to be 4,752 kVA connected, with a demand projected to be 4,444 kVA. The results of the analysis are shown in Tables 1 and 2. The major loads with the Vitrification of SBW Facility are the joule-heated melter, lid heater, HVAC equipment, and lighting.

Normal power will be supplied to the Vitrification of SBW Facility by 13.8 kV feeders from existing Substation 15. Two new Power Sectionalizing Switches (PSS), PSS-NCE-1507AAA and PSS-NCE-1557AA, will be installed and they will be fed from two existing Power Sectionalizing Switches, PSS-NCE-1507A and PSS-NCE-1557A. A combination of new and existing duct banks will be used to route the feeders.

TABLE 1**VITRIFICATION OF SBW FACILITY****CONNECTED LOAD**

LOAD	kVA
General Building Lighting 73,188 sq. Ft @ 1.75 VA per sq. Ft = 128,000 VA	128
Miscellaneous Loads 34,427 sq. Ft. @ 1.75 VA per sq. Ft = 60,000 VA	60
HVAC and Facility HEPA Loads	3451
Process Equipment on drawings SBW01 to SBW04: Melter and Lid Heater 5000 Gal. Mix Tank Frit Conveyor Auger Feeder Off Gas Fan Slury Pump Pumps, Blowers and Misc Cranes	1113
Total connected kVA	4,752

TABLE 2**VITRIFICATION SBW FACILITY****DEMAND LOAD**

LOAD	kVA
General Building Lighting 73,188 sq. Ft @ 1.75 VA per sq. Ft = 128,000 VA @ 90%	115
Miscellaneous Loads 34,428 sq. Ft. @ 1.75 VA per sq. Ft = 60,000 VA @ 80%	48
HVAC and Facility HEPA Loads @ 100%	3446
Process Equipment on drawings SBW01 to SBW04 @ 75%: Melter and Lid Heater 5000 Gal. Mix Tank Frit Conveyor Auger Feeder Off Gas Fan Slury Pump Pumps, Blowers and Misc Cranes	835
Total connected kVA	4,444

1.2.2 STANDBY POWER

The requirements for standby power for the Vitrification of SBW Facility were analyzed and determined to be 845 kVA. The results of the analysis are shown in Table 3. The standby loads for the Vitrification of SBW Facility will consist of the following:

- UPS Normal and Bypass feeders
- Selected lighting and miscellaneous loads
- Exhaust and exhaust fans
- Bath electrode
- Other loads as determined in the Title designs

Standby power to the Vitrification of SBW Facility will be provided over the normal power distribution system from Substation 60, the Standby power plant substation via Substation 15. The standby power system is at or near capacity. Upon completion of the EUSU project, an evaluation of the spare capacity will be performed. If necessary, a 2000 kVA diesel generator and associated equipment will be installed in the space available in the standby generator plant. The UCS will perform shedding of the non-essential loads. The UCS will control the operation of circuit breakers and equipment to assure that only those loads requiring standby power remain in operation.

1.2.3 DISTRIBUTION SYSTEM

Both normal and standby power will be provided by one set of redundant feeders. The EUSU project will install a redundant pair of sectionalizing switches in the north east quadrant of the complex. These switches, PSS-NCE-1507A and PSS-NCE-1557A are supplied by one set of 500KCMIL cables each. These switches are fed directly from Substation 15 and are very lightly loaded. New duct banks will be run from these switches to two new power sectionalizing switches and then a new load center. The load center will be double ended and will provide a redundant source of power to the Vitrification of SBW Facility.

1.2.4 UNINTERRUPTABLE POWER SUPPLY (UPS)

A solid state UPS with a static transfer switch will be provided. The UPS will be provided with a 20-minute battery backup. Both the normal feed and the bypass feed to the UPS will be on standby power. The UPS will feed a 208Y/120 Volt panel. The UPS and the panel will be located in the electrical room. The UPS will support the following loads: Voice paging/evacuation systems, environmental monitoring system and other critical loads.

TABLE 3**VITRIFICATION OF SBW FACILITY****STANDBY POWER REQUIREMENTS**

LOAD	STANDBY POWER	kVA
General Building Lighting	10% of 128 = 13	13
Miscellaneous Loads	10% of 60 = 6	6
HVAC and Facility Loads (Identified by Process Engineer)		605
Process Equipment on drawings SBW01 to SBW04: (Identified by Process Engineer) Melter and Lid Heater 5000 Gal. Mix Tank Frit Conveyor Auger Feeder Off Gas Fan Slury Pump Pumps, Blowers and Misc Cranes		221
Total Standby kVA		845

1.3 LIGHTING

1.3.1 INTERIOR LIGHTING

Lighting in office areas and other low ceiling areas will be supplied by recess mounted fluorescent fixtures. These fixtures will be operated at 277 Volts and will be locally switched. Motion detectors will be utilized in areas of low occupancy. Lighting in high bay areas will be supplied by metal halide fixtures operating at 277 Volts. The metal halide fixtures will be switched at the lighting panel.

1.3.2 CELL LIGHTING

Lighting in the cells will be designed to allow for remote operation of the equipment via an in cell closed-circuit television (CCTV) system or by operation through cell windows. Lighting of the cells will be provided utilizing fixtures mounted in "K" plugs. The number, location, and size of the fixtures and associated "K" plugs will be coordinated with the cell design during the conceptual phase. The fixtures will be designed and fabricated to facilitate installation and removal for replacement of the light source. Metal Halide light sources are desired and will be given preference during the final design. The lighting design will take into account light loss through the translucent panels as well as the light lost in viewing operations through the cell windows.

1.3.3 EXTERIOR LIGHTING

The exterior of the building will be illuminated with high pressure sodium wall pack fixtures mounted over each personnel door. Loading areas will be provided with high pressure sodium wall pack fixtures on each side of the doors. The need for area lighting in maneuvering areas will be evaluated during the conceptual and final designs.

1.3.4 EMERGENCY AND EXIT LIGHTING

Emergency egress lighting will be in accordance with NFPA 101, Life Safety Code. In areas where illumination is provided by fluorescent fixtures, selected fixtures will be provided with integral battery back up. In areas where illumination is provided by metal halide fixtures, selected fixtures will be provided with a quartz lamp, which will be used, for emergency lighting. The quartz lamp will be connected to the UPS system or will be provided with an integral battery.

1.4 DESIGN DESCRIPTION

1.4.1 SITE CONDITIONS

Electrical equipment will be rated for continuous operation at an elevation of 5,000 feet above sea level.

1.4.2 HAZARDOUS LOCATIONS

Several areas within the facility will be used for storing or handling of hazardous materials. An evaluation will be performed during the conceptual design and the final design to determine the effects of these materials on the installation of electrical equipment. Flammable and Combustible Liquids Codes NFPA 30: National Electrical Code, NFPA 70; and Recommended Practice for Classification of Class I Hazardous Locations for Electrical Installations in Chemical Process Areas, NFPA 497A will be used in making the determination.

1.4.3 SERVICES

1.4.3.1 PRIMARY SERVICE

Two 13.8 kV feeders will be provided for the primary service to the site. The feeders will originate from Substation 2 located outside the fence. Power for Vitrification of SBW Facility will be carried over existing feeders up to Substation 15. From Substation 15, new feeders will be routed through new and existing duct banks.

1.4.3.2 STANDBY POWER

Standby power will be provided at 13.8kV over the existing primary distribution system. The existing UCS in conjunction with the Plant Control System will be installed in the Vitrification of SBW Facility. These existing systems will control selected circuit breakers to limit the standby power distribution only to those loads deemed important.

1.4.3.3 UTILIZATION VOLTAGES

Three and possibly four utilization voltages will be provided for the Vitrification of SBW Facility. Transformers and load centers located near the facility will transform the 13.8kV to 480Y/277 Volts; transformers down stream will transform the 480 Volts to 208Y/120 Volts. The third and fourth utilization will be determined during the conceptual and title designs. 4160Y/2400 Volts is desired as the third utilization however, the INTEC currently utilizes 2400Y/1386 Volts. Preferably, only one will be used. Equipment selection and operating personnel preference will determine the voltage to be utilized.

Electrical loads will be assigned voltages as follows:

- Motors 100 HP and larger - 4160V, 3 phase or 2400V, 3 phase
- Resistive loads 100 kVA and larger - 4160V, 3 phase or 2400V, 3 phase
- Motors ½ HP to less than 100 HP - 480V, 3 phase
- Resistive loads 1 kVA to less than 100 kVA - 480V, 3 phase
- Motors less than ½ HP 120V, single phase
- Miscellaneous loads less than 1 kVA - 120V, single phase
- Lighting - 277V single phase.

In certain circumstances, 480V, 3 phase will be utilized for motors over 100 HP and loads over 100 kVA. This will be determined on an individual basis after the effects have been evaluated.

1.4.4 EQUIPMENT

1.4.4.1 LOAD CENTERS

One load center will be provided. The load center will be located outside the Vitrification of SBW Facility and will be a NEMA 3R Walk-in type similar to the load centers currently in use at the INTEC. The load center will provide 480Y/277 Volts and will be double ended. Each transformer will be sized to provide service to all loads on the load center. The load center will be provided with all equipment and wiring to insure that it is fully compatible with the existing UCS System.

1.4.4.2 TRANSFORMERS

Transformers 5,000 kVA and below will be cast coil, dry type transformers. Transformers over 5,000 kVA will be oil filled.

1.4.5 LIGHTING

Lighting levels will conform to the Illuminating Engineer's Society (IES) handbook and standard practices at the INTEC. In general, the design will provide the following illumination levels:

- Work Stations 70 foot candles
- Work Areas 30 to 50 foot candles depending on activity
- Non-Work Areas 10 foot candles, 50 foot candles where data is obtained

1.4.6 GROUNDING

Grounding at the INTEC is accomplished with bare copper conductors installed in all duct banks and ground rods installed in every manhole this in turn is solidly connected to the casing of the deep wells. Facilities and structures throughout the

INTEC are connected to this ground system. As well, the Vitrification of SBW Facility will be connected to the ground system. Grounding within the facility and at the outdoor load centers and other structures will be accomplished in accordance with the National Electrical Code and IEEE Standard 142-1991, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

1.4.7 LIGHTNING PROTECTION

Lightning protection will be provided in accordance with NFPA 78, Lightning Protection Code.

Appendix I
Codes and Standards

Appendix I

Codes and Standards

1. Code of Federal Regulations
2. Department of Energy
 - DOE-ID Architectural Engineering Standards (AES)
 - DOE-ID Orders
 - DOE STD
 - DOE Procedures
 - DOE Manuals
 - DOE EM STD
 - DOE HDBK Handbook
3. Congressional Acts
4. American Disabilities Act
 - Executive Order 11988, "Floodplain Management Guidelines."
 - USC Title 16 "Conservation" Chapter 1A section 469, USC Title 16 Chapter 35
 - Endangered Species Act"
 - Idaho Administrative Procedures Act (IDAPA)
5. Applicable Codes and Standards

Division 1 General Requirements

Subdivision 0100 – General Design Requirements

- DOE O 420.1, Facility Safety
- DOE O 430.1, Life Cycle Asset Management
- 29 CFR 1910, Occupational Safety and Health Standards
- 29 CFR 1910, Subpart A, General
- 29 CFR 1910, Subpart B, Adoption and Extension of Established Federal Standards
- 29 CFR 1926, Occupational Safety and Health Standards for the Construction Industry (for construction activities, such as shoring)
- ANSI A117.1, Specifications for Making Buildings and Facilities Accessible to, and Useable by, Physically Handicapped People,
- 40 CFR 265.1101, required PE certification of building compliance to design standards
- 40 CFR 265 Subpart I, waste container/generator compliance
- 40 CFR 265 Subpart J, waste tank/generator compliance
- 40 CFR 265 Subpart W, drip pad/generator compliance
- 40 CFR 265 Subpart DD, generator compliance w/containment building requirements
- 40 CFR 266 "Standards for Materials Being Recycled/Reused"
- ASCE Standard 795, Minimum Design Loads for Buildings and Other Structures
- ICBO, Uniform Building Code
- NFPA 101, Life Safety Code
- ASTM and ASHTO Standards when specifying materials

Subdivision 0110 – Architectural

- AES 01001, Codes and Standards
- NFPA 101, Life Safety Code
- NFPA Codes applicable to special occupancies or materials |
- DOE M 440.11, DOE Explosive Safety Manual |
- ICBO, Uniform Building Code (UBC)
- ICBO, Uniform Fire Code (UFC)
- NFPA 80A Protection from Exposure Fires
- NFPA 101A, Alternative Approaches to Life Safety
- NFPA 220 Standard Types of building Construction
- FM Engineering Association Approval Guide
- FM Loss Prevention Data Sheet, FM1-14, Construction Systems
- FM Loss Prevention Data Sheet, FM1-20, Protection Against Exterior Fire Exposure
- FM Loss Prevention Data Sheet, FM1-31, Metal Roof Systems
- FM Loss Prevention Data Sheet, FM1-57, Rigid Plastic Building Materials |
- UL Fire Resistance Directory |
- 29 CFR 1910, Occupational Safety and Health Standards.

Subdivision 0111 – Structural Design

- AES 01001, Codes and Standards
- DOE Order 420.1, Facility Safety
- DOESTD1020, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities
- DOE STD1021, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components
- ASCE 4 Seismic Analysis of Safety Related Nuclear Structures
- ASCE 7, Minimum Design Loads for Buildings and Other Structures
- Factory Mutual Data Sheet 154
- USNRC Regulatory Guide 1.60
- DOE ID 12118, Climatology of the INEL, 2nd Ed., December 1, 1989
- FM Loss Prevention Data Sheet, FM1-7, Wind Forces on Buildings and Other Structures
- FM Loss Prevention Data Sheet, FM1-9, Roof Anchorage
- FM Loss Prevention Data Sheet, FM1-54, Roof Loads for New Construction

Subdivision 0112 – Energy Conservation

- AES 01001, Codes and Standards
- 10 CFR 435, Energy Conservation Voluntary Performance Standards for New Buildings, Mandatory for Federal Buildings
- DOE O 430.2 In House Energy Management
- ASHRAE Standard 100 shall apply to existing construction.
- NBS Handbook 135, Life Cycle Cost Manual for Federal Energy Management Programs
- ASHRAE publication, Passive Solar Heating Analysis, J. Douglas Balcomb, et al., 1984
- NAVFAC DM4.9, Naval Facilities Engineering Command Design Manual
- ID12118, Climatology of the INEL, Second Edition, Dec. 1, 1989
- REA 83050, A 33 Year Statistical Study of the Air Temperature at the INEL
- DOE AD 0006/1, DOE Facilities Solar Design Handbook
- CR 82.030, Standardized EMCS Energy Saving Calculations

Subdivision 0140 – Quality Assurance

- AES 01001, Codes and Standards.
- 10 CFR 830.120, Quality Assurance Requirements (applicable to nuclear facilities) |
- DOE-ID Order 5700.6C, Quality Assurance
- ANSI/ASME NQA-1, American National Standard quality Assurance program Requirements for Nuclear Power Plants

Subdivision 0180 – Security

- AES 01001, Codes and Standards
- DOE 1360.B, Unclassified Computer Security Program
- DOE 5636.C, Protection and Control of Safeguards and Security Interests
- DOE 5639.6A, Classified Automated Information System Security Program
- DOE G 5632.1C1, The Guide for Implementation of Classified Matter Protection and Control
- DOE M 5632.1C1, Manual for Protection and Control of Safeguards and Security Interests
- DOE O 5632.1C, requirements for physical protection of security interest
- NFPA 780, Lightning Protection Code
- ANSI/NFPA 70, 75, False floor cable runs
- UL, approved emergency exit hardware
- 10 CFR 1046, Physical Protection of Security Interests

Subdivision 0185 – Fire Protection

- AES 01001, Codes and Standards
- National Fire Protection Association (NFPA) Codes and Standards.
- DOE O 420.1, Facility Safety
- DOE O 440.1, Worker Protection Management for DOE Federal and Contractor Employees
- Other DOE Orders and statutory requirements, not listed above, that contain requirements of a more limited extent relating to the DOE Fire Protection Program.
- DOE HDBK 1062, DOE Fire Protection Handbook
- FM Loss Prevention Data Sheet, FM 2-8, Earthquake Protection
- FM Loss Prevention Data Sheet, FM 2-8N, Installation of Sprinkler Systems
- FM Loss Prevention Data Sheet, FM 3-26, Fire Protection Water Demand for Nonstorage Properties
- FM Loss Prevention Data Sheet, FM 8-0, General Storage Safeguards
- FM Loss Prevention Data Sheet, FM 8-1, Commodity Classification
- FM Loss Prevention Data Sheet, FM 8-9, Storage of Class 1, 2, 3, and 4 Plastic Commodities
- NFPA 13, Standard for the Installation of Sprinkler Systems
- DOE STD 1088, Fire Protection for Relocatable Structures (See Appendix K)
- DOE STD 1061, Fire Protection Design Criteria (in draft)
- Factory Mutual Loss Prevention Data Sheets.
- American Petroleum Institute Guidelines.
- Product Directories of Underwriters Laboratories, together with the periodic supplements (UL).
- Factory Mutual Research Corporation Approval Guide (FM)
- ICBO UFC, Uniform Fire Code
- 29 CFR 1910, Subpart E, Means of Egress
- 29 CFR 1910, Subpart L, Fire Protection

Subdivision 0190 – Environmental, Safety, and Health

- AES 01001, Codes and Standards

- DOE Order 420.1 "Facility Safety", section 4.4 "Natural Phenomena Hazard Mitigation"
- DOE M 411.11 Manual of Safety Management Functions, Responsibilities, and Authorities.
- DOE M 435.1 Radioactive Waste Management (Staging for longer than 90 days)
- DOE P 450.4, Safety Management System Policy, and
- DOE P 450.5, Line Environment, Safety and Health Oversight sections
- DOE Order 460.1A "Packing and Transportation Safety".
- DOE Order 460.2 "Departmental Materials Transportation and Packing Management".
- DOE Order 5400.1 "General Environmental Protection Program"
- DOE Order 5400.5 "Radiation Protection of the Public and the Environment". ALARA
- DOE Order 5480.23 "Nuclear Safety Analysis Reports" (Hazard Category)
- DOE Order 5480.4 "Environmental Protection, Safety, and Health Protection
- DOE ID Order 5481.1B Safety Analysis and Review System
- DOE EM STD 5502 "Hazard Baseline Documentation"
- DOE STD 1027 "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23,
- DOE/EV/1830T5, A Guide to Reducing Radiation Exposures to ALARA
- 10 CFR 71, Packaging and Transportation of Radioactive Material
- 10 CFR 73, Physical Protection of Plants and Materials
- 10 CFR 1021, (DOE O 5440.1D, 40 CFR 1500-1508, SEN 15-90), NEPA implementing procedures
- 10 CFR 1022, Compliance with Floodplain-Wetlands Environmental Review Requirements
- 10 CFR 830, Nuclear Safety Management
- 10 CFR 835, Occupational Radiation Protection, ALARA
- 29 CFR 1910, Occupational Safety and Health Standards
- 29 CFR 1910, Subpart C, General Safety and Health Provisions
- 29 CFR 1910, Subpart D, Walking, Working Surfaces
- 29 CFR 1910, Subpart I, Personal Protective Equipment
- 29 CFR 1910, Subpart J, General Environmental Controls
- 29 CFR 1910, Subpart K, Medical and First Aid
- 29 CFR 1910, Subpart H, Hazardous Materials, (Compressed gas)
- 29 CFR 1926, Safety and Health Regulations for Construction
- 40 CFR 260 et.seq., Hazardous Waste Management system: General (Resource Conservation and Recovery Act (RCRA)).
- 40 CFR 261, Identification and Listing of Hazardous Waste
- 40 CFR 262, Standards Applicable to Generators of Hazardous Waste (sample and sample residue management)
- 40 CFR 264, Subpart N, Appendix V, examples of incompatible wastes
- 40 CFR 264 Subpart N Paragraph 312, "Special requirements for Ignitable or Reactive Waste"
- 40 CFR 264 Subpart AA "Air Emission Standards for Process Vents"
- 40 CFR 264 Subpart BB "Air Emission Standards for Equipment Leaks"
- 40 CFR 268, Land Disposal Restrictions, Subparts C and D.
- 40 CFR 268.4 "Treatment Standards for Hazardous Waste"
- 40 CFR 268.48, Universal Treatment Standards (UTS)
- 40 CFR 268.49 "Alternative LDR Treatment Standards for Contaminated Soils"
- 40 CFR 268.50, Land Disposal Restrictions (Decontamination water)
- 40 CFR 300 et.seq., National Oil and Hazardous Substances Pollution Contingency Plan (Operations-MSDS and chemical inventory)
- 40 CFR 761 Subpart D paragraph 761.79 "Decontamination Standards and Procedures"
- 49 CFR 173, Subpart I, Shippers- General Requirements for Shipments and Packages Radioactive Materials (surfaces of transport packages)
- ANSI/ANS 8.1 (R1988), American National Standard Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors (Criticality analysis/safety)

- ANSI/ANS 8.3, American National Standard Criticality Accident Alarm System (Criticality analysis/safety)
- ANSI/ANS 8.17 (R1989), American National Standard Criticality Safety Criteria for Handling, Storage, and Transportation of LWR Fuel Outside Reactors (Criticality analysis/safety)

Division 2 Site and Civil Engineering

Subdivision 0200 – Civil Design

- AES 01001, Codes and Standards
- ICBO – UBC, 1997, Soil profile types, seismic calculations
- CERCLA, Comprehensive Environmental Response, Compensation, and Liability Act
- RCRA, Resource Conservation and Recovery Act
- TSCA, Toxic Substance Conservation Act
- AASHTO Standards.
- NESC, National Electrical Safety Code
- State of Idaho Transportation Department, Division of Highways, Standard Specifications for Highway Construction
- Union Pacific Railroad, Technical Specifications for Industrial Tracks
- DOE Order 420.1, Facility Safety
- DOE STD1020, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities
- DOE STD1021, Natural Phenomena Hazards Performance Categorization
- Guidelines for Structures, Systems, and Components
- 40 CFR 270.14, EPA Administered Permit Programs: The Hazardous Waste Permit Program Contents of Part B: General Requirements
- 40 CFR 761.65, Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce and Prohibitions Storage for Disposal
- Executive Order 11988, "Floodplain Management Guidelines."
- USC Title 16 "Conservation" Chapter 1A section 469, USC Title 16 Chapter 35 "Endangered Species Act".
- 36 CFR Part 65 "National Historic Landmarks Program"

Subdivision 0260 – Underground Piping

- AES 01001, Codes and Standards
- AES 015401, Codes and Standards

Subdivision 0266 – Water Distribution System

- AES 01001, Codes and Standards
- NFPA and FM references applicable to combined firewater and potable water systems.
- Idaho Regulations For Public Drinking Water Systems, State of Idaho
- Department of Health and Welfare (IDAPA 16.01.08.550)
- Well Construction Standards, Rules and Regulations, State of Idaho
- Department of Water Resources
- National Sanitation Foundation Listings
- American Water Works Association (AWWA) Standards
- FM Loss Prevention Data Sheet, FM3-10, Installation/Maintenance of Private Service Mains and their Appurtenances
- NFPA 13, Standard for the Installation of Sprinkler Systems

Subdivision 0269 – Oil Distribution Systems

- AES 01001, Codes and Standards
- 40 CFR 264.190, Hazardous Waste Treatment, Storage and Disposal Facilities
- 40 CFR 280, Underground Storage Tanks
- NFPA 30, Flammable and Combustible Liquids Code
- NFPA 31, Oil Burning Equipment

Subdivision 0270 – Sewerage and Sewage Treatment Systems

- AES 01001, Codes and Standards
- Idaho Water Quality Standards and Waste Water Treatment Requirements (Idaho Code, Title 1, Chapter 2)
- Recommended Standards for Wastewater Facilities, Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers

Division 3 - Concrete

Subdivision 0300 - Concrete

- ACI 318, Building Code Requirements for Reinforced Concrete
- ACI 349, Code Requirements for Nuclear Safety Related Concrete Structures
- ACI 350, Environmental Engineering Concrete Structures
- ACI Manual of Concrete Practice as applicable to the specific project |
- AASHTO, Standard Specifications for Highway Bridges

Division 4 – Masonry

- AES 01001, Codes and Standards
- AASHTO, Standard Specifications for Highway Bridges |
- ICBO, Uniform Building Code
- AISC, Specification for Structural Steel Buildings, Allowable Stress Design, Plastic Design
- AISC, Load and Resistance Factor Design Specification for Structural Steel Buildings
- ANSI/AISC N690, Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities |
- AISI, Specification for the Design of Cold Formed Steel Structural Members
- ASME Section III, Division 1, Article NF
- MBMA, Metal Building Systems Manual
- SDI, Design Manual for Composite Decks, Form Decks and Roof Decks
- SDI, Diaphragm Design Manual
- SJI, Standard Specification for Open Web Steel Joists.

Division 5 - Metals Subdivision 0512 – Structural Steel

- AES 01001, Codes and Standards
- AASHTO, Standard Specifications for Highway Bridges
- AISC, Specification for Structural Steel Buildings, Allowable Stress Design, Plastic Design
- AISC, Load and Resistance Factor Design Specification for Structural Steel Buildings
- ANSI/AISC N690, Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities
- ANSI/ACI 349, Code Requirements for Nuclear Safety Related Concrete Structures
- ANSI/ASCE 7, Minimum Design Loads for Buildings and Other Structures
- AISI, Specification for the Design of Cold Formed Steel Structural Members
- ASME Section III, Division 1, Article NF
- MBMA, Metal Building Systems Manual
- SDI, Design Manual for Composite Decks, Form Decks and Roof Decks
- SDI, Diaphragm Design Manual
- AWS D1.1, Structural Welding Code Steel
- INEL Welding Manual
- SJI Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders

Subdivision 0532 - Welding

- AES 01001, Codes and Standards
- AWS, American Welding Society Welding Codes |
- INEL Welding Manual |
- ANSI/ASME B&PV Code, Standards, applicable sections including certification, examination (welding and brazing qualifications)
- ANSI/API 620, Rules for Design and Construction of Large Welded, Low Pressure Storage Tanks
- ANSI/API 650, Welded Steel Tanks for Oil Storage (for tanks)
- 29 CFR 1910, Subpart Q, Welding, Cutting and Brazing

Division 6 - Wood and Plastics

- ICBO, Uniform Building Code

Division 7 - Thermal and Moisture Protection

Subdivision 0720 – Insulation, Sealants, and Joints

- AES 01001, Codes and Standards
- 10 CFR 435, Energy Conservation
- NAASR 10100, Conventional Buildings for Reactor Containment
- ICBO, Uniform Building Code
- FM, Factory Mutual
- UL, Underwriters Laboratories

Subdivision 0750 – Roofing Systems

- AES 01001, Codes and Standards
- ASCE 7, Minimum Design Loads for Buildings and Other Structures
- FM 128, Wind Loads to Roof Systems and Roof Deck Securement
- FM 128S, Wind Uplift Pressures on Roofs
- FM Approval Guide (or other equivalent national standard)
- AFM 9136 BuiltUp Roof Management Program with enclosed BUR Repair/Replacement Guide Specifications
- ARMA Residential Asphalt Roofing Manual
- ARMA Guide to Preparing BuiltUp Roofing (BUR) Specifications, Recommended
- Performance Criteria for Roofing Membranes using Polymer Modified Bituminous Products
- MBMA various publications.
- NRCA Roofing and Waterproofing Manual, Handbook of Accepted Roofing Knowledge
- NRCA Steep Roofing Manual
- SMACNA Architectural Sheet Metal Manual
- SPRI A Professionals Guide to Specifications, Parts IIV Wind Design Guide for Ballasted Single Ply Roofing Systems, Wind Design Guide for Mechanically Attached Single Ply Roofing Systems, Wind Design Guide for Fully Adhered Single Ply Roofing Systems
- 29 CFR 1926, Fall Protection

Division 8 - Doors and Windows

- AES 01001, Codes and Standards
- ANSI A156 series, Door and Window Hardware |
- NFPA 80, Fire Doors and Windows |
- NFPA 101, Life Safety Code |
- ISDSI 102, Installation Standard for Insulated Steel Door Systems |
- SDI 100, Standard Steel Doors and Frames |
- SDI 108, Selection and Usage Guide for Standard Steel Doors |
- ASTM E 283, Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
- NFPA 80, Fire Doors and Windows
- NFPA 101, Life Safety Code
- SDI100, Steel Door Institute
- ICBO, Uniform Building Code

Division 9 – Finishes

- ANSI N 512, Protective Coatings (Paints) for the Nuclear Industry
- SSPCPA, Steel Structures Painting Council, Paint Application Guide No. 4
- UBC Standard 4718, Metal Suspension Systems for Acoustical Tile and for LayIn Panel Ceilings

Division 10 – Specialties

- NFPA 232, Protection of Records
- ICBO, Uniform Building Code

Division 11 – Equipment

- ICBO, Uniform Building Code
- 40 CFR Part 264 Subpart DD "Containment Buildings"
- 40 CFR 264, Subpart J "Tank Systems"
- 40 CFR 264 Subpart S paragraph 264.553 "Temporary Units"
- 40 CFR 264, Subpart X "Miscellaneous Units"
- 40 CFR 460, Parts 464 and 465, Subpart DD, "Containment Buildings"
- 40 CFR 761 Subpart D paragraph 761.79 "Decontamination Standards and Procedures"
- 40 CFR 761 Subpart D "Storage and Disposal" and paragraph 761.65 "Storage for Disposal"

Division 12 – Furnishings

- ICBO, Uniform Building Code

Division 13 - Special Construction

Subdivision 1385 – Fire alarm Systems

- AES 01001, Codes and Standards
- AES 01854.1 and 4.2.
- AES1390, Fire Protection Systems
- AES 1600, Electrical Design
- ANSI S3.5, Methods of Calculation of the Speech Intelligibility Index
- Code of Federal Regulations, parts 1900, 1910
- NFPA101, Life Safety Code
- NFPA72, National Fire Alarm Code
- DOE Order 420.1 "Facility Safety" ("Fire Protection")
- ICBO, Uniform Building Code

Subdivision 1390 – Fire Protections Systems

- AES 01001, Codes and Standards
- AES 01851.1, Applicable Codes and Standards
- ANSI/NFPA 10, American National standard for Portable Fire Extinguishers
- ANSI/NFPA 13, American National Standard for Installation of Sprinkler Systems
- ANSI/NFPA 14, American National Standard for Installation of Standpipe and Hose Systems
- ANSI/NFPA 72, American National Standard National Fire Alarm Code, Smoke Detectors
- NFPA 101, Life Safety Code
- ICBO UFC, Uniform Fire Code
- Cross Connection Control Manual, Accepted Procedure and Practice Pacific Northwest Section of AWWA
- IDAPA, MIL-F-51068C, Filter: Particulate High Efficiency, Fire Resistant
- IDAPA, MIL-F-51079A, Filter Medium: Fire Resistant High Efficiency
- FM Loss Prevention Data Sheet, FM 2-8, Earthquake Protection
- FM Loss Prevention Data Sheet, FM 2-8N, Installation of Sprinkler Systems
- FM Loss Prevention Data Sheet, FM3-26, Fire Protection Water Demand for Nonstorage Properties
- FM Loss Prevention Data Sheet, FM 8-0, General Storage Safeguards
- FM Loss Prevention Data Sheet, FM 8-1, Commodity Classification
- FM Loss Prevention Data Sheet, FM 8-9, Storage of Class 1, 2, 3, and 4 Plastic Commodities
- Factory Mutual Approval Guide

Subdivision 1392 – Fire Water Storage and Distribution

- AES 01001, Codes and Standards
- AES 02661, Applicable Codes and Standards
- FM Loss Prevention Data Sheet, FM3-10, Installation/Maintenance of Private Service Mains and their Appurtenances
- NFPA 13, Installation of Sprinkler Systems

Division 14 - Conveying Systems

Subdivision 1460 – Cranes and Hoists

- AES 01001, Codes and Standards
- ASME B30.2, Overhead and Gantry Cranes
- ANSI B30.11, Monorails and Underhung Cranes
- ANSI B30.16, Overhead Hoists (Underhung)
- ANSI/ASME NOG-1, American National Standard Rules for Construction of Cranes, Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)
- CMAA 70, Crane Manufacturers Association of America, Inc., Specification for Electric Overhead Traveling Cranes
- CMAA 74, Crane Manufacturers Association of America, Inc., Specification for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes
- DOE STD 1090 Hoisting and Rigging
- 29 CFR 1910, Subpart N, Materials Handling and Storage (Cranes and Rigging Equip)

Division 15 – Mechanical (General)

- DOE-ID Architectural Engineering Standards
- ANSI N 510, Testing of Nuclear Air Treatment Systems
- IAPMO, Uniform Plumbing Code
- NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals
- UL 555, Safety Fire Dampers
- UL 555S, Safety Leakage Rated Dampers for Use in Smoke Control Systems
- ACGIH, American Conference of Government Industrial Hygienist (Chapter 3 & 10)
- 40 CFR Part 264 Subpart AA "Air Emission Standards for Process Vents"
- 10 CFR 435, Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings

Subdivision 1500 – Mechanical Design

- AES 01001, Codes and Standards
- AES 0512, Structural Steel
- ASME Boiler and Pressure Vessel Codes
- IAPMO/ICBO, Uniform Mechanical Code
- ISA Standards
- TEMA Standards
- 29 CFR 1910.147, Locking devices

Subdivision 1540 – Piping – General Requirements

- AES 01001, Codes and Standards |
- ASME/ANSI B31.1, Power Piping. |
- ASME/ANSI B31.3, Chemical Plant and Petroleum Refinery Piping. |
- ASME/ANSI B31.9, Building Service Piping. |
- IAPMO, Uniform Plumbing Code |
- NFPA 54/ANSI A223.1, National Fuel Gas Code. |
- NFPA 58, Standard for the Storage and Handling of Liquefied Petroleum Gases.
- NEC 31010 and 3842, for common space runs
- ANSI A131, Color coding of all exposed piping
- AES16604, Cathodic protection requirements where required by project

Subdivision 1541 – Plumbing System

- AES 01001, Codes and Standards
- IAPMO, Uniform Plumbing Code
- ICBO, Uniform Building Code Chapter 29

Subdivision 1542 – Plant Utility Piping

- AES 01001, Codes and Standards
- AES 15401.1, Applicable Codes and Standards
- ICBO/UPC, Uniform Plumbing Code, Piping
- IDAPA 16.08.550, Public Drinking Water System, Piping Design

Subdivision 1543 – Chemical Process Piping

- AES 01001, Codes and Standards |
- ASME/ANSI B31.3, Chemical Plant and Petroleum Refinery Piping
- 40 CFR 264.193 Containment and Detection of Releases

Subdivision 1550 – Heating and Ventilation

- AES 01001, Codes and Standards
- AES 0112, Energy Conservation
- ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning, Energy Handbooks and Standards
- NFPA Standards applicable to ovens, furnaces and boilers
- NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
- NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems
- ASME Boiler and Pressure Vessel Codes
- ACGIH, Industrial Ventilation Manual of Recommended Practice
- 10 CFR 435, Energy Conservation Performance Standards for New Buildings
- 29 CFR 1910, Subpart G, Occupational Health and Environmental Control (HVAC, noise)
- 29 CFR 1910, Subpart M, Compressed Gas and Compressed air Equipment
- 29 CFR 1910, Subpart Z, HVAC
- FM Loss Prevention Data Sheet, FM 6-4, Oil and Gas Fired Single Burner Boilers

Subdivision 1551 – Special Requirements for Nuclear and Sensitive Duty HVAC

- AES 01001, Codes and Standards
- AES 1550, Heating and Ventilation
- AES 1595, Controls
- DOE G 420.1X, Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria
- ERDA 7621, Nuclear Air Cleaning Handbook
- ANSI/ASME N509, American National Standard for Nuclear Power Plant air Cleaning Units and Components
- ANSI/ASME N510, American national Standard for Testing of Nuclear Air Cleaning Systems

Subdivision 1554 – Filtration System

- AES 01001, Codes and Standards
- AES 15501.1, Applicable Codes and Standards |
- AES 15511.1, Applicable Codes and Standards |
- UL 900, Test Performance of Air Filter Units
- NEF 345T, Nuclear Standard Specification for HEPA Filters Used by DOE Contractors
- 40 CFR 50, National Primary and Secondary Ambient air Quality Standards
- 40 CFR 51, Requirements for Preparation, Adoption, and Submittal of Implementation Plans
- 40 CFR 52, Approval and Promulgation of Implementation Plans
- 40 CFR 53, ambient air Monitoring Reference and Equivalent Methods (Storage Area, HEPA)
- 40 CFR 58, Ambient air quality Surveillance (Storage Area, HEPA)
- IDAPA 16.01.01000-01999, Clean Air Act, HVAC/HEPA filtration

Subdivision 1560 – Engineered Components

- AES 01001, Codes and Standards
- ASME Boiler and Pressure Vessel Code
- ACGIH Manual, Threshold Limit Values for Chemical Substances and Physical Agents
- ANSI/NB23, National Board Inspection Code

Subdivision 1589 – Stack Design Criteria

- AES 01001, Codes and Standards
- 40 CFR 61, National Emission Standards for Hazardous Air Pollutants
- 40 CFR 61 Subpart A, “General Requirements”
- 40 CFR 61 Subpart H “National Emission Standards for Emissions Other Than Radon From DOE Facilities” requirements:
- 40 CFR 61 Subpart M “National Emission Standard for Asbestos”

Division 16 – Electrical

- NFPA 70, National Electric Code
- NFPA 101, Life Safety Code

Subdivision 1600 – Electrical Design

- AES 01001, Codes and Standards
- AES 1121, Codes and Standards
- AES 1801, Codes and Standards (as applicable to security systems)
- ANSI/NFPA 70 National Electric Code (NEC)
- ANSI/C2, National Electrical Safety Code (NESC)
- NEMA Standards
- UL Standards and Product Directories
- FM Approval Guide, and FM Loss Prevention Data Sheets
- ISA Electrical Guide for Control Centers, Recommended Practice RP60
- AES 1111, Codes and Standards
- ANSI/IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
- ANSI/IEEE 493, Recommended Practice for Design of Reliable Industrial and Commercial Power Systems
- ANSI/N13.1, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities
- ANSI/N42.17 B, Performance specification for Health Physic Instrumentation Occupational Airborne Radioactivity Monitoring Instrumentation
- DOE O 420.1, Facility Safety
- ICEA Standards
- Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria
- NFPA 780, Lightning Protection Code
- NFPA/NEC, Hazard Classification
- 29 CFR 1910.47, Locking Devices
- ANSI/C57.110, UL verification

Subdivision 1630 – Exterior Electrical Utility Service

- AES 01001, Codes and Standards

- AES 16001.1, Applicable Codes and Standards
- ANSI/IEEE C37 series, Circuit Breakers, Switchgear, Relays, Substations and Fuses
- ANSI/IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
- ANSI/IEEE 399, Recommended Practice for Power Systems Analysis
- ANSI/IEEE 493, Recommended Practice for Design of Reliable Industrial and Commercial Power Systems
- REA Bulletin 501 Standard T805B
- REA Bulletin 503 Standard D804
- REA Bulletin 506 Standard D806
- Factory Mutual Loss Prevention Data Sheet 5.4.
- NFPA 70, Demand and Diversity Factors
- NEC Article 710, NESC, Pole line rating
- Federal Specification TTW00571 J
- IEEE 48, Class I Standards, Use of Termination Kits

Subdivision 1639 – Grounding

- AES 01001, Codes and Standards
- AES 16001.1, Applicable Codes and Standards |
- ANSI/IEEE 80, Safety in AC Substation Grounding |
- ANSI/IEEE 142, Grounding of Industrial and Commercial Power Systems Section 250, Building Grounding Electrode System
- NESC, Fence Grounding

Subdivision 1640 – Service and Distributions Equipment

- AES 01001, Codes and Standards
- AES 16001.1, Applicable Codes and Standards |
- AES 0112, Energy Conservation

Subdivision 1641 – Wiring Methods and Materials

- AES 01001, Codes and Standards
- AES 16001.1, Applicable Codes and Standards |
- ANSI/IEEE 383, Type Test of Class 1E Electrical Cables, Field Splices, and Connections for Nuclear Power Generating Stations |
- ANSI/IEEE 576, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in the Petroleum and Chemical Industry

Subdivision 1642 – Raceways

- AES 01001, Codes and Standards
- AES 1600, Electrical Design

Subdivision 1645 – Receptacles and Outlets

- AES 01001, Codes and Standards
- AES 16001.1, Applicable Codes and Standards |

Subdivision 1646 – Electrical Component Marking

- AES 01001, Codes and Standards

Subdivision 1655 Lighting

- AES 01001, Codes and Standards.
- AES 16001.1, Applicable Codes and Standards |
- IES Lighting Handbook |

Subdivision 1660 – Special Systems

- AES 16001, Codes and Standards
- DOE O 420.1, Facility Safety
- DOE G 420.1X, Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria
- ANSI/IEEE 484, Recommended Practice for Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations
- NFPA 101, Life Safety Code
- NFPA 110, Emergency and Standby Power Systems
- NFPA 780, Standard for the Installation of Lightning Protection Systems
- 40 CFR 280, Cathodic Protection for Underground Storage Tanks

Subdivision 1665 – Instrumentation

- AES 01001, Codes and Standards
- AES 16001.1, Applicable Codes and Standards |
- ANSI/HFS 100 1988 Human Factors Engineering of Video Display Terminal Workstation.
- ANSI Y32.2/IEEE 31575 & 315A86, Electrical and Electronics Graphic Symbols and Reference Designations
- ASME, Fluid Meters Handbook
- ISA, Standards and Practices for Instrumentation
- ANSI/IEEE Standard 576, IEEE Recommended Practice for Installation, Termination, and Testing of Insulated Power Cables
- ANSI/ANS 58.91981, ANSI/IEEE 3791977, and USNRC Reg. Guide 1.53, Single Failure Analysis Standards

Subdivision 1670 – Communications

- AES 01001, Codes and Standards
- AES 1600, Electrical Design

Appendix J

Vendor Data

Selective Adsorption Associates, Inc.

534 Gables Court Langhorne, PA 19047 USA

YOUR ONE-STOP ADSORBENT SHOP

Home

Technical Support

Custom

Application Request

PRODUCT DATA

MERSORB®

MERCURY ADSORBENT

**MERCURY VAPOR REMOVAL FROM:
AIR, HYDROGEN, & OTHER GASES**

BENEFITS

- Longer Service Life
- High Hg Removal Efficiency
- Less Blower Horsepower Required
- Clean Operation
- Proven Performance
- Dependable Technical Support

PERFORMANCE FEATURES

- Pellets Minimize Flow Channelling, thus Maximizing Adsorbent Performance
- 50 % Lower Pressure Drop than 4x10 granular
- Hard, Low Dust Pellets
- Many Commercial Installations, Worldwide
- Backed by Extensive Lab & Field Test Data

PRODUCT FEATURES

- **FORM:** Extruded Pellets of Uniform Diameter, Available in Pellet Diameters of 1.5 mm, 3 mm, or 4 mm.
- **IMPREGNATION:** Elemental Sulfur Dispersed on High Surface Area Activated Carbon.
- **SURFACE AREA of CARBON SUBSTRATE:** 1,000 sq. meters per gram (by N₂ BET test method)
- **HARDNESS:** 97 % Hardness, Minimum (ASTM D 3802)
- **PACKED BULK DENSITY:** 34 Lbs per Cu. Ft. (550 Kg/Cu. Meter)(ASTM D 2854)
- **SULFUR CONTENT:** 13 Wt. %, Typical
- **MERCURY CAPACITY:** ≥ 20 Wt. % Hg Adsorption Capacity is Typical in Dynamic, Gas-Treatment Applications
- **MOISTURE CONTENT:** 3 Wt. %, Maximum (ASTM D 2867)
- **pH:** 6-8 (ASTM D 3838)
- **RECYCLING:** Spent, Hg-loaded Adsorbent Can Be Processed by Mercury Recycling Companies.

APPLICATIONS

MERSORB® mercury adsorbent has proven performance in many commercial applications requiring removal of mercury vapor to extremely low concentrations in air, hydrogen, and other gases. Typically, a gas contact time of 10 seconds is used in designing process systems with MERSORB® adsorbent. MERSORB® mercury adsorbent installations have demonstrated performance for reducing mercury concentrations to < 1 microgram Hg/Nm³ in both dry and water saturated gases, with appropriate gas contact times. Extensive technical data, adsorption design and field technical services are available.

CAUTION: Wet activated carbon removes oxygen from air. Thus, an asphyxiation hazard exists inside enclosed spaces containing activated carbon. Use appropriate safety precautions when entering vessels or other enclosed spaces containing activated carbon.

MERSORB® is a registered trademark of NUCON International, Inc. (NUCON®) for impregnated activated carbons used to remove mercury from gases and liquids. Information presented herein is believed to be accurate and reliable but does not provide any guarantee or warranty by NUCON International, Inc. or by Selective Adsorption Associates, Inc. Nothing herein shall be construed as an invitation to use processes covered by patents without proper arrangements with individuals or companies owning those patents.

Selective Adsorption Associates, Inc. 534 Gables Court Langhorne, PA 19047 USA
Telephone: (215) 702-0323 FAX: (215) 702-0577 Email: saai@selectiveadsorption.com

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<http://www.selectiveadsorption.com>

**MOLSIV®
ADSORBENTS**

a product of UOP

PRODUCT INFORMATION

IONSIV® A-50 ION EXCHANGER SERIES

Description

UOP IONSIV® A-50 Ion Exchanger Series are an alkali metal aluminosilicate of the Type A crystal supplied in the Na⁺ (sodium) form.

Chemical Formula

Shipping Information

IONSIV® A-50 Ion Exchanger Series are available in powder and 20x50 mesh form. Samples may be obtained on request.

Regeneration

Typically, regeneration may be accomplished by the use of NaCl solution as the regenerant fluid.

Typical Properties

	A-50	A-51
Particle Size	Powder (1 to 10 μm)	Mesh (20x50)
Pore Openings	4.2 Å into α -cage 2.2 Å into β -cage	4.2 Å into α -cage 2.2 Å into β -cage
Bulk Density		
As shipped	26 lbs/cu.ft. 420 kg/cu.m.	42 lbs/cu.ft. 670 kg/cu.m.
Hydrated, packed		50 lbs/cu.ft. 800 kg/cu.ft.
BS&D Density (hydrated)		42 lbs/cu.ft. 670 kg/cu.m.
H ₂ O Content	18-22 wt%	
as shipped		1-105 wt%
hydrated		16-20 wt%
Ion Exchange capacity	6.0-7.0 meq/gm (anhydrous)	5.0-5.5 meq/gm (anhydrous)

Typical Application Areas

UOP IONSIV® A-50 Ion Exchanger Series products are generally highly effective cation exchangers for the removal of small ions from dilute solutions.

Additional Information

Bulletins discussing additional application of UOP Molecular Sieves are available. Call or write your nearest UOP Molecular Sieve Sales Office.

SALES OFFICES

UOP
Molecular Sieve Adsorbents
25 E. Algonquin Road
Des Plaines, IL 60017-3017
(747) 391-2000

EASTERN REGION
Molecular Sieve Adsorbents
307 Fellowship Road
Suite 207
Mt. Laurel, NJ 08054
(609) 727-9400

MIDWESTERN REGION
Molecular Sieve Adsorbents
10 South Riverside Plaza
Suite 2230
Chicago, IL 60606-3812
(312) 454-2230

Molecular Sieve Adsorbents
25111 Country Club Blvd.
Suite 265
N. Olmsted, OH 44070
(216) 734-0016

SOUTHWESTERN REGION
Molecular Sieve Adsorbents
13105 Northwest Freeway
Suite 600
Houston, TX 77040
(713) 744-2140

PACIFIC REGION
Molecular Sieve Adsorbents
12399 Lewis Street, Suite 201
Garden Grove, CA 92640
(714) 750-1551

CANADA
UOP Canada, Inc.
Suite 1160, 444-5th Ave., S.W.
Calgary, Alberta T2P 2T4, Canada
(403) 777-3750

UOP Canada, Inc.
120 Eglington Ave. East
Suite 304
Toronto, Ontario, M4F 1E2, Canada
(416) 411-4752

EUROPE
UOP M.S. S.p.A.
Viale Millelunici
Palazzo E1
20090 Azzate MI
Italy
39-257540211

UOP
Molecular Sieve Adsorbents
P.O. Box 9241, FL 25
Dubai International Trade Centre
Dubai, United Arab Emirates
(971-4) 312-441

FAR EAST
UOP K.K.
Singapore Representative Office
Molecular Sieve Adsorbents
101 Thompson Road
11-05 United Square
Singapore 1130
(65) 253-1652

UNITED SHOWA K.K.
Molecular Sieve Adsorbents
Showa Building
27-17 Hamamatsu-cho, 1 Chome
Minato-ku, Tokyo 105, Japan
(81) 3-3432-7553

IONSIV®

PRODUCT INFORMATION

**MOLSIV®
ADSORBENTS**
a product of UOP

IONSIV® IE-910 ION EXCHANGER SERIES

Description

UOP IONSIV® IE-910 Ion Exchanger Series Products are crystalline silicotitanates supplied in the sodium (Na⁺) form.

Chemical Formula

Na₂O, SiO₂, TiO₂ + Trade Secret Oxides

Shipping Information

IONSIV® IE-910 Ion Exchanger Series Products are available in powder and 30 x 60 mesh form.

Regeneration

Due to the extremely high Cs selectivity, Cs cannot be reasonably eluted from IONSIV® IE-910 Ion Exchangers. Sr can be eluted by the use of a suitable salt solution.

Typical Application Areas

UOP IONSIV® IE-910 & IE-911 Ion Exchanger Products are effective for the following applications:

- Removal of Cs & Sr from highly alkaline radwastes and processing solutions.
- Removal of Cs from acidic radioactive waste solutions.
- Removal of Cs & Sr from groundwater that is radioactively contaminated.
- Removal of Cs, Sr & radionuclides from fuel storage & cooling ponds.

$$(1) \quad K_d = \frac{(C_0 - C_1)}{C_1} \times \frac{V}{M \times F}$$

where: C₀ is the initial counts of the ion of interest in the feed solution before contact. C₁ is the counts after contact; V is the solution volume in ml, M is the CST mass in grams, F is the mass of dry exchanger divided by the mass of wet exchanger.

For further information:

please contact Eastern Region sales office, 307 Fellowship Road, Suite 207, Mt. Laurel, NJ at (609) 727-9400.

This information is not to be taken as a warranty or representation for which we assume legal responsibility nor as permission or recommendation to practice any patented invention without a license. It is offered solely for your consideration, investigation and verification.

Typical Properties

	IE-910	IE-911
Particle Size	Powder (< 1µm)	Mesh (30x60)
Pore Openings	approx. 4 Å	approx. 4 Å
Bulk Density, As shipped		60 lbs/cu.ft. 960 kg/cu.m.
Piece Density		2.44 g/ml
Typical Cs K _d ⁽¹⁾		

Additional Information

Bulletins discussing additional application of UOP Molecular Sieves are available.

Crystalline Silicotitanates Exhibit
High Cs Distribution Coefficients
(Data Courtesy Sandia National Laboratories)

PRODUCT INFORMATION

**MOLSIV®
ADSORBENTS**

a product of UOP

IONSIV® IE-95 ION EXCHANGER

Description

UOP IONSIV® IE-95 Ion Exchanger is an alkali metal alumino silicate supplied in the mixed ionic (Na⁺, Mg⁺⁺, Ca⁺⁺) form.

Chemical Formula

(Na₂O, MgO, CaO) · Al₂O₃ · 4-6 SiO₂ · H₂O

Shipping Information

IONSIV® IE-95 Ion Exchanger is available in 20 x 50 mesh form. Samples may be obtained on request.

Regeneration

Typically, regeneration may be accomplished by the use of NaCl solution as the regenerant fluid.

Typical Properties

Particle Size	Mesh (20 x 50)
Pore Openings	3.7x4.2 Å and 2.6 Å
Bulk Density	
As shipped	40 lbs/cu.ft. 640 kg/cu.m.
Hydrated, packed	46 lbs/cu.ft. 740 kg/cu.m.
BS&D Density (hydrated)	38 lbs/cu.m. 610 kg/cu.m.
H ₂ O Content	
As shipped	1-10 wt. %
Hydrated	12-17 wt. %
Ion Exchange Capacity	2.0-2.5 meq/gm (anhydrous)

Typical Application Areas

UOP IONSIV® IE-95 Ion Exchanger Products have been found to be effective for recovery and storage of radio-nuclides and for cation exchange from mild acid solutions.

Additional Information

Bulletins discussing additional application of UOP Molecular Sieves are available. Call or write your nearest UOP Molecular Sieve Sales Office.

SALES OFFICES

UOP
Molecular Sieve Adsorbents
25 E. Algonquin Road
Des Plaines, IL 60017-5017
(708) 391-2000

EASTERN REGION
Molecular Sieve Adsorbents
307 Fellowship Road
Suite 202
Mt. Laurel, NJ 08054

MIDWESTERN REGION
Molecular Sieve Adsorbents
10 South Riverside Plaza
Suite 2200
Chicago, IL 60606-3882
(312) 454-2230

Molecular Sieve Adsorbents
25111 Country Club Blvd.
Suite 265
N. Olmsted, OH 44070
(216) 734-0085

SOUTHWESTERN REGION
Molecular Sieve Adsorbents
13105 Northwest Freeway
Suite 600
Houston, TX 77040
(713) 744-2840

PACIFIC REGION
Molecular Sieve Adsorbents
12399 Lewis Street, Suite 201
Garden Grove, CA 92640
(714) 750-1551

CANADA
UOP Canada, Inc.
Suite 1860, 444-5th Ave., S.W.
Calgary, Alberta T2P 2T8, Canada
(403) 294-1757

UOP Canada, Inc.
120 Eglinton Ave. East
Suite 304
Toronto, Ontario, M4P 1E2, Canada
(416) 458-4752

EUROPE
UOP M.S. S.p.A.
Viale Milnesofori
Palazzo El
20090 Asago MI
Italy
39-2-57540218

UOP
Molecular Sieve Adsorbents
P.O. Box 9248, Fl. 25
Dubai International Trade Centre
Dubai, United Arab Emirates

FAR EAST
UOP K.K.
Singapore Representative Office
Molecular Sieve Adsorbents
101 Thompson Road
11-05 United Square
Singapore 11130
(65) 253-1652

UNION SHOWA K.K.
Molecular Sieve Adsorbents
Sanwa Building
27-17 Hamamatsu-cho, 1 Chome
Minato-ku, Tokyo 105, Japan
(81) 3-3432-7553

Post-it® Fax Note

7671

Date	1/14	# of pages	3
To	Jennifer Quigley	From	UOP
Co./Dept.	Bechtel	Co.	
Phone #		Phone #	856-727-9400
Fax #	208-526-4057	Fax #

Product Data

30GU Flotronic™ Air-Cooled Reciprocating Liquid Chillers 50/60 Hz

Nominal Capacity: 25 to 280 Tons
88 to 985 kW

Quality Assurance

Certificate No FM 21837

Approvals:
ISO 9002
EN 29002
BS5750 PART 2
ANSI/ASQC Q92

Performance Assurance

Rated in accordance with
ARI Standard 590-92
(60 Hz only)

New catalog in process at time of printing. Contact your
Carrier Representative for most recent information.

State of the Art Chillers with Advanced
Microprocessor-Based Electronic
Controls for Years of Reliability

- wide size range for every application need
- flexibility through multiple compressors and refrigerant circuits
- efficient, reliable 06E semi-hermetic compressors
- factory charged with R-134a — tested under load
- quality construction, and sturdy, protective shipping package
- Flotronic controls

Features/Benefits

Quality design and construction

Model 30GU Flotronic chillers are the result of extensive engineering development and testing. Every component has been tested to provide many years of superior performance in every climate. Units are UL (Underwriters' Laboratories) listed. Major components are qualified to 500-hour salt spray test according to the American Society for Testing and Materials (ASTM) B-117 Standard to assure longevity and reliability.

All export chillers are packaged with woodboard coil protection and hardwood top cap. A polyolefin bag with a rust inhibitor is shrink-wrapped around the units for increased protection against hazards of land and sea transportation, and ensures product delivery in original factory condition.

Advanced technology and serviceability

The powerful 30GU Flotronic chillers incorporate the latest in integrated microprocessor control and refrigeration cycle optimization devices. The electronic expansion valve (EXV) and the microprocessor controller let the chiller operate at low pressure differentials, and accurately control refrigerant superheat during start-up and load changes. The result is efficient energy usage and accurate leaving-fluid

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Model number nomenclature

30GU — 230 A — C 6 — — —		
Air-Cooled Liquid Chillers		Options
30GU — Flotronic™ Controls		— — NOTE: For Brine and numerous other options, contact your Carrier representative.
Compressor Start		Packaging
— — Across-The-Line Start		Not Used
P — Part-Wind Start		
Unit Sizes*		V-Ph-Hz
040 070 110 190 255 330		1 — 575-3-60
045 080 130 210 270 360		2 — 380-3-60†
050 090 150 230 290 390		3 — 346-3-50†
060 100 170 245 315 420		5 — 208/230-6-60
Module Designation (230-420 Units)*		6 — 460-3-60
A		9 — 380/415-3-50†
B		
Sound Option		Condenser Material
— — None		— — Copper Tube, Aluminum Fins
L — Low Noise Condenser Fans		C — Copper Tube, Copper Fins
		H — Copper Tube, Heresite Coated Aluminum Fins (post coated)**
		J — Copper Tube, Heresite Copper Fins (post coated)**
		K — Copper Tube, Pre-Coated Aluminum Fins**

LEGEND
EXV — Electronic Expansion Valve

*Refer to Unit Sizes and Modular Combinations table below.
†Export only — not for U.S. domestic sale.
**Contact your local Carrier representative for more details.

UNIT SIZES AND MODULAR COMBINATIONS

UNIT MODEL 30GU	TOTAL UNIT		SECTION A UNIT 30GU	SECTION B UNIT 30GU
	Nominal Tons	KW		
040	25	88	—	—
045	28	98	—	—
050	34	120	—	—
060	40	141	—	—
070	48	169	—	—
080	55	193	—	—
090	60	211	—	—
100	70	246	—	—
110	75	264	—	—
130*	85	299	—	—
150*	100	352	—	—
170*	110	387	—	—
190*	120	422	—	—
210*	140	492	—	—
230*	155	545	150	080
245*	160	563	150	090
255*	170	598	150	100
270*	180	633	170	100
290*	195	686	190	110
315*	215	756	210	110
330*	220	774	170	170
360*	240/230†	844/809	190	190/170†
390*	260	914	210	190
420*	280	985	210	210

*Requires special order. Contact factory.

†60 Hz units/50 Hz units.

Performance data — English and SI

60 Hz — STANDARD RATINGS* — REFRIGERANT 134a

30GU UNIT SIZE	OUTPUT (CAPACITY)			INPUT POWER (kW)		EFFICIENCY	
	kW	Tons	Btuh	Compressor	Fan	EER	COP
40	84.0	23.9	286,800	23.5	6.2	9.6	2.83
45	94.2	26.8	321,600	27.4	6.2	9.6	2.80
50	117.8	33.5	402,000	33.6	6.2	10.1	2.96
60	150.4	42.8	513,600	43.9	9.3	9.7	2.83
70	173.6	49.4	592,800	51.9	9.3	9.7	2.84
80	196.1	55.8	669,600	57.5	9.4	10.0	2.93
90	203.9	58.0	696,000	58.5	9.4	10.3	3.00
100	233.7	66.5	798,000	65.0	12.7	10.3	3.01
110	252.7	71.9	862,800	74.4	12.7	9.9	2.90
130	290.0	82.5	990,000	85.2	15.5	9.8	2.88
150	333.9	95.0	1,140,000	99.0	15.5	10.0	2.92
170	379.3	107.9	1,294,800	108.9	15.5	10.4	3.05
190	414.8	118.0	1,416,000	118.8	18.5	10.3	3.02
210	479.4	136.4	1,636,800	141.4	18.6	10.2	3.00
230	530.1	150.8	1,809,600	156.5	24.9	10.0	2.92
245	537.8	153.0	1,836,000	157.5	24.9	10.1	2.95
255	567.7	161.5	1,938,000	164.0	28.2	10.1	2.95
270	613.4	174.5	2,094,000	173.9	28.1	10.4	3.04
290	667.5	189.9	2,278,800	193.2	31.2	10.2	2.97
315	732.5	208.4	2,500,800	215.8	31.3	10.1	2.96
330	758.5	215.8	2,589,600	217.7	30.9	10.4	3.05
360	829.5	236.0	2,832,000	237.6	31.1	10.3	3.09
390	894.2	254.4	3,052,800	260.2	37.1	10.3	3.01
420	958.9	272.8	3,273,600	282.8	37.1	10.2	3.00

LEGEND

ARI — Air Conditioning and Refrigeration Institute
COP — Coefficient of Performance
EER — Energy Efficiency Ratio

*Per ARI Standard 590-92.

NOTE: 95 F (35 C) condenser entering air temperature;
54 F (12.2 C) entering/44 F (6.7 C) leaving cooler water;
.00025 ft² • hr • °F/Btu (.000044 m² • °C/W) cooler fouling allowance.

$$\text{EER} = \frac{\text{Capacity (Btuh)}}{\text{Unit Input Power (W)}}$$

$$\text{COP} = \frac{\text{Capacity (kW)}}{\text{Unit Input Power (kW)}}$$

Dimensions (cont)

MOUNTING WEIGHTS (Approximate); 30GU130-210, 230A-315A, 330A/B-420A/B (50 Hz)

30GU UNIT SIZE	CONDENSER COIL	LB							
		A	B	C	D	E	F	G	H
130	C-AL	928	1569	1160	834	1438	1375	1764	1444
	C-C	1056	1696	1287	961	1628	1566	1954	1635
150,230A-255A	C-AL	948	1591	1160	834	1438	1375	1829	1502
	C-C	1075	1719	1287	961	1628	1566	2020	1692
170,270A,330A/B,360B	C-AL	963	1744	1348	873	1527	1673	1849	1466
	C-C	1090	1871	1475	1000	1718	1864	2040	1657
190,290A,360A,390B	C-AL	1365	1953	1807	1127	1430	1839	1765	1621
	C-C	1555	2143	1997	1316	1620	2029	1955	1811
210,315A,390A,420A/B	C-AL	1383	2151	1876	1128	1430	1860	2102	1615
	C-C	1573	2341	2066	1318	1620	2050	2292	1805

50 Hz

30GU UNIT SIZE	CONDENSER COIL	KG							
		A	B	C	D	E	F	G	H
130	C-AL	422	714	527	379	654	625	802	656
	C-C	480	770	585	436	740	711	888	743
150,230A-255A	C-AL	430	723	527	379	653	625	831	682
	C-C	486	781	585	437	740	711	918	769
170,270A,330A/B,360B	C-AL	437	792	612	397	694	760	840	666
	C-C	495	850	670	454	780	847	927	753
190,290A,360A,390B	C-AL	620	887	821	512	650	835	802	736
	C-C	707	974	907	598	736	922	977	823
210,315A,390A,420A/B	C-AL	628	977	852	512	650	845	955	734
	C-C	715	1064	940	599	736	931	1042	820

LEGEND

C-AL — Copper Tubing — Aluminum Fins
C-C — Copper Tubing — Copper Fins

*And associated modules.

NOTE: Dimensions in () are in millimeters.

RIGGING CENTER OF GRAVITY

30GU UNIT SIZE	130		150,230A-255A		170,270A,330A/B,360B		190,290A,360A,390B		210,315A,390A,420A/B	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
X Dimension	112.5	2858	112.1	2849	112.8	2865	136.0	3454	135.6	3444
Y Dimension	49.9	1267	50.5	1283	50.5	1283	50.5	1283	50.6	1285

Selective Adsorption Associates, Inc.
 534 Gables Court Langhorne, PA 19047 USA
 YOUR ONE-STOP ADSORBENT SHOP

Home Technical Support Custom Application Request

PRODUCT DATA

MERSORB® LW

MERCURY REMOVAL FROM:

LIQUID WATER

PRODUCT INFORMATION

MERSORB® LW mercury adsorbent is a pelleted, steam activated, coal-based activated carbon which has been sulfur impregnated to remove mercury from water. The base carbons, chosen for their high surface area and open pore structure, provide optimum mercury adsorption capacity and adsorption kinetics for removal of Hg & Hg ions from liquid water. This product is available in:

- 1.5 mm pellet diameter
- 3.0 mm pellet diameter

APPLICATIONS

MERSORB® LW mercury adsorbent is a commercially proven adsorbent for applications where Hg must be reduced to extremely low levels in water. Effluent water containing < 0.1ppBw Hg has been achieved from feed water containing several ppmw of Hg. See "Design & Performance Characteristics of MERSORB® Mercury Adsorbents in Liquids and Gases" for data useful in designing adsorption systems for specific applications.

TYPICAL PHYSICAL PROPERTIES

Surface Area, base carbon, N ₂ BET	1,000 m ² /gram
CCl ₄ activity (ASTM D 3467)	60 weight %
Hardness (ASTM D 3802)	97 %
Apparent Density (ASTM D 2854)	34 lbs/ft ³ (550 kg/m ³)
Moisture Content (ASTM D 2867)	3 weight %, max., as packed

TYPICAL CHEMICAL PROPERTIES

Sulfur Content	13 weight %
pH (ASTM D 3838)	6-8
Hg Capacity, max.	75 weight %

CAUTION: Wet activated carbon removes oxygen from air. Thus, an asphyxiation hazard exists inside enclosed spaces containing activated carbon. Use appropriate safety precautions when entering vessels or other enclosed spaces containing activated carbon.

MERSORB® is a registered trademark of NUCON International, Inc. (NUCON®) for impregnated activated carbons used to remove mercury from gases and liquids. Information presented herein is believed to be accurate and reliable but does not provide any guarantee or warranty by NUCON International or by Selective Adsorption Associates, Inc. Nothing herein shall be construed as an invitation to use processes covered by patents without proper arrangements with individuals or companies owning those patents.

Selective Adsorption Associates, Inc. 534 Gables Court Langhorne, PA 19047 USA
Telephone: (215) 702-0323 FAX: (215) 702-0577 Email: saai@selectiveadsorption.com

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Selective Adsorption Associates, Inc.

534 Gables Court Langhorne, PA 19047 USA

YOUR ONE-STOP ADSORBENT SHOP

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PRODUCT DATA

MERSORB®

MERCURY ADSORBENT

**MERCURY VAPOR REMOVAL FROM:
AIR, HYDROGEN, & OTHER GASES**

BENEFITS

- Longer Service Life
- High Hg Removal Efficiency
- Less Blower Horsepower Required
- Clean Operation
- Proven Performance
- Dependable Technical Support

PERFORMANCE FEATURES

- Pellets Minimize Flow Channelling, thus Maximizing Adsorbent Performance
- 50 % Lower Pressure Drop than 4x10 granular
- Hard, Low Dust Pellets
- Many Commercial Installations, Worldwide
- Backed by Extensive Lab & Field Test Data

PRODUCT FEATURES

- **FORM:** Extruded Pellets of Uniform Diameter, Available in Pellet Diameters of 1.5 mm, 3 mm, or 4 mm.
- **IMPREGNATION:** Elemental Sulfur Dispersed on High Surface Area Activated Carbon.
- **SURFACE AREA of CARBON SUBSTRATE:** 1,000 sq. meters per gram (by N₂ BET test method)
- **HARDNESS:** 97 % Hardness, Minimum (ASTM D 3802)
- **PACKED BULK DENSITY:** 34 Lbs per Cu. Ft. (550 Kg/Cu. Meter)(ASTM D 2854)
- **SULFUR CONTENT:** 13 Wt. %, Typical
- **MERCURY CAPACITY:** ≥ 20 Wt. % Hg Adsorption Capacity is Typical in Dynamic, Gas-Treatment Applications
- **MOISTURE CONTENT:** 3 Wt. %, Maximum (ASTM D 2867)
- **pH:** 6-8 (ASTM D 3838)
- **RECYCLING:** Spent, Hg-loaded Adsorbent Can Be Processed by Mercury Recycling Companies.

APPLICATIONS

MERSORB® mercury adsorbent has proven performance in many commercial applications requiring removal of mercury vapor to extremely low concentrations in air, hydrogen, and other gases. Typically, a gas contact time of 10 seconds is used in designing process systems with MERSORB® adsorbent. MERSORB® mercury adsorbent installations have demonstrated performance for reducing mercury concentrations to < 1 microgram Hg/Nm³ in both dry and water saturated gases, with appropriate gas contact times. Extensive technical data, adsorption design and field technical services are available.

CAUTION: Wet activated carbon removes oxygen from air. Thus, an asphyxiation hazard exists inside enclosed spaces containing activated carbon. Use appropriate safety precautions when entering vessels or other enclosed spaces containing activated carbon.

MERSORB® is a registered trademark of NUCON International, Inc. (NUCON®) for impregnated activated carbons used to remove mercury from gases and liquids. Information presented herein is believed to be accurate and reliable but does not provide any guarantee or warranty by NUCON International, Inc. or by Selective Adsorption Associates, Inc. Nothing herein shall be construed as an invitation to use processes covered by patents without proper arrangements with individuals or companies owning those patents.

Selective Adsorption Associates, Inc. 534 Gables Court Langhorne, PA 19047 USA
Telephone: (215) 702-0323 FAX: (215) 702-0577 Email: saai@selectiveadsorption.com

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<http://www.selectiveadsorption.com>

PORTAGE

Portage Environmental, Inc.
P.O. Box 3726
Idaho Falls, ID 83403
Phone: (208) 528-6608
Fax: (208) 523-8860
E-mail: portage@srv.net

www.portageenv.com

Jennifer J. Quigley
Project Manager
Bechtel BWXT Idaho, LLC
P.O. Box 1625
Idaho Falls, ID 83415

June 26, 2000

Dear Jenna;

Please find attached calculations and mercury vapor pressure vs. temperature plot that shows the physical state of mercury in the wet-scrub system associated with vitrification of sodium bearing waste. As can be seen from the calculations, the quench system operated at the design temperatures will result in nearly all of the mercury being captured on the sulfur-impregnated granular activated carbon (GAC) columns. If it is required to condense the mercury out of the off-gas stream in the wet-scrub system and into the settling tank, the exit temperature of the off-gas would have to be lower than 13°C (55°F).

If the water spray temperature remains at 83°C, the mercury will be captured within the GAC columns and polishing unit. These columns can be transported to Envirocare of Utah for mercury amalgamation at the completion of the project. Alternatively, if the mercury is taken out in the wet scrub system by reducing the quench temperature, the mercury can be collected in the settling tank or passed through a wet GAC column. However, mercury removed in the scrubber could potentially become high-level waste requiring disposal at a certified facility.

If you have any questions regarding this, or any other matter, please do not hesitate to call me at 528-6608.

Sincerely,

Trevor Jackson, Ph.D.
Senior Engineer
Portage Environmental, Inc.
P.O. Box 3726
Idaho Falls, ID 83403

cc: Kevin Poor

Native American Owned

8 (a) Certified SDB

Flow:		1855 sm ³ /hr		System Pressure =		465 mmHg		9 psia	
Calculations:		given	= g/sm ³ * sm ³ /hr = g/sm ³ * 1855	= (g/hr)/(total g/hr) = (g/hr)/142,331.016	= sum of atomic MW	= (g/hr)/(g/mol) = (mol/hr)/(total mol/hr)	= (mol/hr)/(total mol/hr)	= mol fraction * system pressure	
		g/sm ³	g/hr	g%	MW (g/mol)	mol/hr	mol fraction	partial P (mmHg)	
TI02		0	0	0.0000%	79.9	0	0.0000E+00	0.00E+00	
CO2		6,873	12,825,018	9.0107%	44	291,478	4.45138E-02	2.07E+01	
CO		10	18,660	0.0131%	28	666	1.01775E-04	4.73E-02	
H2O (g)		44,385	82,785,090	58.1838%	18	4,599,172	7.02372E-01	3.27E+02	
N2		24,033	44,845,578	31.5079%	28	1,601,628	2.44596E-01	1.14E+02	
NO		40	74,640	0.0524%	30	2,488	3.79900E-04	1.77E-01	
NO2		1	1,885	0.0013%	46	41	6.19500E-06	2.88E-03	
O2		614	1,145,724	0.8050%	32	35,804	5.48787E-03	2.54E+00	
HF		22	41,052	0.0285%	20	2,053	3.13487E-04	1.46E-01	
HCl		15	27,990	0.0197%	38.45	768	1.17272E-04	5.45E-02	
Ar		293	546,738	0.3841%	39.95	13,686	2.09002E-03	9.72E-01	
SO2		9	16,784	0.0118%	64	262	4.00739E-05	1.86E-02	
Hg (g)		1	1,866	0.0013%	200.6	9	1.42059E-06	6.61E-04	
H2		0	0	0.0000%	2	0	0.00000E+00	0.00E+00	
Total		76,276	142,331,016	1		6,548,054	1	465	

QUENCHER INLET

IF the off-gas was considered an ideal gas: $PV=nRT$

$V = nRT/P$
 $n = 6,548,054 \text{ mol/hr}$
 $R = 8.314 \text{ m}^3 \text{ Pa / mol K}$
 $T = 1,111 \text{ K}$
 $P = 61,995 \text{ Pa}$
 $V = 975,751 \text{ m}^3 / \text{hr}$

$T (C) = 838$
 $T (K) = 1,111 \text{ K}$
 $P (\text{mmHg}) = 465 \text{ mmHg}$
 $P (\text{Pa}) = 61,995 \text{ Pa}$

QUENCHER OUTLET

IF the off-gas was considered an ideal gas: $PV=nRT$

$V = nRT/P$
 $n = 6,548,054 \text{ mol/hr}$
 $R = 8.314 \text{ m}^3 \text{ Pa / mol K}$
 $T = 356 \text{ K}$
 $P = 61,995 \text{ Pa}$
 $V = 312,751 \text{ m}^3 / \text{hr}$

$T (C) = 83$
 $T (K) = 356 \text{ K}$
 $P (\text{mmHg}) = 465 \text{ mmHg}$
 $P (\text{Pa}) = 61,995 \text{ Pa}$

NOTE: Individually boxed values are referenced throughout the spreadsheet.

The following data is from the "Vapor Pressure of Mercury" table in Weast, R.C. Ed., 1975, Handbook of Chemistry and Physics, 55th Ed., Cleveland, OH: CRC Press, p. D-161.

T (C)	Vapor Pressure (mmHg)
-38	0.00000145
-36	0.00000197
-34	0.00000266
-32	0.00000359
-30	0.00000476
-28	0.0000063
-26	0.00000828
-24	0.0000108
-22	0.000014
-20	0.0000181
-18	0.0000232
-16	0.0000296
-14	0.000038
-12	0.0000481
-10	0.0000606
-8	0.0000782
-6	0.0000954
-4	0.000119
-2	0.000149
0	0.000185
2	0.000228
4	0.000276
6	0.000335
8	0.000406
10	0.00049
12	0.000588
14	0.000706
16	0.000846
18	0.001009
20	0.001201
22	0.001426
24	0.001691
26	0.002
28	0.002359
30	0.002777
32	0.003261
34	0.003823
36	0.004471
38	0.005219
40	0.006079
42	0.007067
44	0.0082
46	0.009497
48	0.01098
50	0.01267
52	0.01459
54	0.01677
56	0.01925
58	0.02206
60	0.02524
62	0.02883
64	0.03287
66	0.0374
68	0.04251
70	0.04825
72	0.05469
74	0.06189
76	0.06993
78	0.07889
80	0.0888
82	0.1
84	0.1124
86	0.1261
88	0.1413
90	0.1582
92	0.1769
94	0.1978
96	0.2202
98	0.2453

Assumptions:

- Constant pressure, flow (steady state)
- Ideal gas ($y(a) * P = p^*(a)$; mol fraction of a times pressure = partial pressure of a)
- No condensation (Hg mol fraction remains constant)

Quencher	Hg Partial Pressure (at Quencher Inlet)
Exit Temperature (C)	(mmHg)
83	0.00065

Given the above conditions (465 mmHg, 83 C), Hg will begin to condense at about 13 C.

Feasibility Study for Vitrification of Sodium Bearing Waste Cost Estimate for Components of the Off-Gas Treatment System

Prepared by: Stephen Reese, 4/12/00

Summary

This report contains costing information for components of the off-gas treatment system. The components included are the multi-stage combustor; wet quench; venturi scrubber; mist eliminator; reheater; granulated, activated carbon bed; and chillers for the knock-out drum, quench, and mixing tanks (not part of the off-gas system).

Apparently the chillers are no longer required, due to the availability of ample once-through, treated cooling water. The price estimates for the chillers are included for comparison should that availability change.

These prices are rough estimates only, suitable only for the level of detail of this feasibility study.

Multi-stage Combustor, Wet Quench, & Venturi Scrubber

Quote received from:

Lawrence L. Crynes

John Zink Company, LLC, a division of Koch-Glitsch, Inc.

P.O. Box 21220

Tulsa, OK 74121-1220

(918) 234-1800

NOXidizer® multi-stage combustor, in carbon steel: \$400,000 - 600,000

NOXidizer® multi-stage combustor, in stainless steel: \$600,000 - 900,000

Includes instrumentation for burner management and safety, and combustion air fans.

Quench system, in Hastelloy C22 or Inconel 625: \$120,000 - \$240,000

Includes pumps, instrumentation, and pH controls.

Venturi scrubber system, in Hastelloy C22 or Inconel 625: \$180,000 - 300,000

Notes:

- John Zink Company typically does not recommend using stainless steel when HF is present in the waste stream.
- The refractory's lifespan is very operation dependent. If the proper operating conditions are followed, it should last ten years or more. With abuse, it may fail within one year.
- Installation costs are not included. That service would be sub-contracted if John Zink were asked to provide it.
- The skin temperature of the NOXidizer® is 175 - 260°C, and it emits 1-2 million Btu/h of heat into the facility. It is not insulated.

Mist Eliminator

Quote received from:

Scott Ecklund, Western Regional Sales Manager
Koch – Otto York
(316) 828-8889

Demister® Style 326 <u>mist eliminator</u> , in Inconel 625:	\$3,500
Housing for demister, in Inconel 625:	\$13,000
<u>Total:</u>	<u>\$17,000</u>

Reheaters

Quote received from:

Kevin Pender
Caloritech, Inc.
25 Hazelwood Drive
Amherst, NY 14228
(800) 974-6333

2 – 480V, 7 kW heaters, in Inconel 625 @ \$14,000 each: \$28,000

Granulated, Activated, Sulphur-Impregnated Carbon Bed

Quote received from:

Bob Sofle (sp?)
Selective Adsorption Associates, Inc.
534 Gables Court
Langhorne, PA 19047
(215) 702-0323

MERSORB® mercury adsorbent	
@ 4,250 lbs. per batch @ \$4/lb X 5 batches:	\$85,000
2 – Housings, in coated carbon steel @ \$5,000 - 7,000 each:	\$10,000 -15,000
<u>Total:</u>	<u>\$100,000</u>

Notes:

- Four batches of MERSORB® mercury adsorbent will be needed to filter out 1400 kg of carbon. Since two housing are planned, for redundancy, at least five batches of carbon will be needed to ensure a second, clean carbon bed is available at all times.
- If condensation occurs in the carbon bed, it will quickly clog the porosity of the bed, making it ineffective for mercury filtering. Design efforts will have to ensure that condensation will be avoided in this piece of the process.

- Acidic gases in the waste stream will liberate the impregnated sulphur as H₂S gas, damaging the bed and creating a harmful constituent at the end of the waste stream treatment process. As a result, should the gas stream prove to still contain such contaminants at this step in the process, additional upstream filtering may be necessary.
- It should be noted that if organics are present in amounts greater than 2-5 ppm, they will rapidly clog the bed, rendering it useless. The NOXidizer should destroy any organics in the waste stream, but due to the low concentrations that are significant in this case, this factor merits mention.

Chillers

Quote received from:

Ken Ignagni

Climate Technologies Corporation

43334 W. Seven Mile Road

Northville, MI 48167-2280

(248) 380-2020

2 Quench chillers @ 185,000 Btu/h @ \$17,250 each:	\$35,000
Knock-out drum chiller @ 1.35 million Btu/h:	\$54,150
Mixing tank chiller @ 420,000 Btu/h:	\$21,250
<u>Total:</u>	<u>\$110,400</u>

Note:

- Each chiller is a reciprocating compressor, air-cooled package chiller.
- The two quench chillers will operate in parallel, thus each will only shoulder half of the load. I incorrectly requested a quote for two chillers each capable of handling the full load, thus the \$35k price is somewhat inflated.
- The load calculated for the mixing tank chiller is based upon mixing only one batch at a time. Should the design evolve to call for more than one tank to mix at a time, a higher capacity chiller would be required.

FAX TRANSMITTAL FORM

JOHN ZINK COMPANY, LLC

A Division of Koch - Glitsch, Inc.

P.O. Box 21220

Tulsa, OK 74121-1220

DELIVER TO:	Steve Reese	DATE: 3/28/00
COMPANY:	INEEL	
FAX NUMBER:	208-526-0528 208-526-1061	
TOTAL PAGES:	3	
SENDER'S NAME:	Lawrence L. Crynes, Ph.D.	MSG. NO.: {CRYNESL@KOCHIND.COM
YOUR REFERENCE:	Glass Smelter Off-Gas Treatment	918-234-1849
OUR REFERENCE:	TG-12767 NOxidizer System	
FAX COPIES TO:		
OFFICE COPIES TO:	Loretta Sherman (918-234-2883)	

IF MISSENT, PLEASE TELEPHONE 918 234-1849. THIS MESSAGE IS BEING SENT FROM FAX (918) 234-1987

I have reviewed your application and can offer the following preliminary information for your feasibility study. The off-gas components would be destroyed in our patented, multistage NOxidizer unit. The NOxidizer minimizes NOx formation while destroying NOx contained in the incoming waste. In this system, the waste and assist fuel are fired through a low-NOx burner into the reducing chamber which is operated at substoichiometric oxygen levels. The operating temperature in this chamber is 2200 to 2600°F. The products from the reducing zone are then cooled to about 1400 to 1600°F by water injection in the quench zone. Air is then introduced and the remaining combustibles are oxidized at about 1800°F in the third, oxidation chamber. This flue gas then flows into a quench system which would use cooling water to reduce the flue temperature to about 170°F. The quench system consists of a water weir, water contactor, downcomer and quench tank. After the quench, the flue gas enters the venturi scrubber.

The NOxidizer is constructed of carbon steel. We would typically not recommend the use of stainless steel when HF is present in the waste. The actual physical layout can be varied to meet your application needs. It comes complete with a corrosion resistant mastic lining and shop installed castable refractory. The steel shell temperature is maintained at about 350°F to prevent condensation of HCl and H2SO4. Special materials such as Hastelloy, Inconel or Zirconium are used for the quench and scrubber to prevent corrosion.

JOHN ZINK COMPANY

March 28, 2000

PAGE 2

Equipment sizing is based on a relatively constant flow of the following off-gas at 572°F:

<u>Component</u>	<u>Mol/Hr</u>
CO2	0.766
H2O (gas)	12.966
N2	2.515
NO	0.587
NO2	0.587
O2	0.804
HF	0.0002
HCl	0.003
Ar	0.032
SO2	0.002
Hg (gas)	0.0004

During normal operation, the NOxidizer will require approximately 2 MMBtu/hr of an assist fuel such as natural gas. It will also utilize about 120 SCFM of combustion air, 80 SCFM of re-oxidation air and 1 gpm of quench water.

Budgetary pricing for a John Zink NOxidizer System consisting of one burner, multistage NOxidizer and instrumentation is \$350,000 to 500,000

Budgetary pricing for the Quench System (weir, contactor, downcomer and tank) is \$100,000 to 200,000

Budgetary pricing for the Venturi Scrubber System is \$150,000 to 250,000

The NOxidizer scope includes standard John Zink instrumentation for burner management and safety. Combustion air fans are included to provide enough motive force to move the combustion and re-oxidation air through the oxidizer, quench and scrubber. The quench scope includes pumps, instrumentation and pH controls for the quench system. Instrumentation includes a John Zink supplied PLC with critical safeties hardwired. The instrumentation is designed for a nonhazardous area classification. Neither scope includes detonation arrestors or DCS.

Pricing is approximate for the purposes of your feasibility study. It could vary depending on final details of your application and specifications. The current design is based on John Zink standards. Our pricing does not include interconnect piping or wiring, installation, foundations, structural supports, chemicals and the like. A vent stack has not been included since you indicate that there will be charcoal beds and filters downstream of the John Zink equipment.

JOHN ZINK COMPANY

March 28, 2000

PAGE 3

We recommend that the incoming waste streams be insulated to prevent condensation of HCl or H₂SO₄. You might also consider injecting a small amount of alkali into the quench water in order to neutralize HF and some of the other corrosive compounds. We would expect that neutralizing to a pH of 7 to 7.5 would be sufficient. This would be especially effective if you intend to operate the equipment continuously on a long-term basis.

Should you have questions, please feel free to call me at 918-234-1849.

Best Regards,

Lawrence L. Crynes, Ph.D.

Applications Engineer

"Ecklund, Scott" <EcklundS@kochind.com> on 04/11/2000 01:01:39 PM

To: "reessj@inel.gov" <reessj@inel.gov>
cc: "**Misc Unifin CPI Sales,(30)" <jfok@teleport.com>
Subject: DEMISTER(R) Quote

Steve,

You will want to go with a 24" diameter Demister. The cost for a DEMISTER(R) Style 326, 24" diameter X 6" thick with 1" thick top and bottom grids in Alloy 625 is \$3,500.00. If your inlet and outlet piping to this mist eliminator is less than 24" dia. then you will need to swedge up to the 24" dia. using a reducer. I am not sure what material you want for the housing, but a budget price for an Alloy 625 housing would be \$ 13,000.00.

I will fax the Demister data sheets (English and Metric).

If you have any questions please do not hesitate to give me a call or our representative in your area, Jim Fok at 503-361-7975.

Best Regards,

Scott Ecklund
Western Regional Sales Manager
Koch-Otto York
Ph. 316-828-8889
Fax 316-828-8018

Ecklund, Scott

From: Ecklund, Scott
Sent: Tuesday, April 11, 2000 2:02 PM
To: 'reessj@inel.gov'
Cc: *Misc Unifin CPI Sales,(30)
Subject: DEMISTER(R) Quote

TO: STEVE REESE
4 PAGES
4/11/00

Steve,

You will want to go with a 24" diameter Demister. The cost for a DEMISTER(R) Style 326, 24" diameter X 6" thick with 1" thick top and bottom grids in Alloy 625 is \$3,500.00. If your inlet and outlet piping to this mist eliminator is less than 24" dia. then you will need to swedge up to the 24" dia. using a reducer. I am not sure what material you want for the housing, but a budget price for an Alloy 625 housing would be \$ 13,000.00.

I will fax the Demister data sheets (English and Metric).

If you have any questions please do not hesitate to give me a call or our representative in your area, Jim Fok at 503-361-7975.

Best Regards,

Scott Ecklund
Western Regional Sales Manager
Koch-Otto York
Ph. 316-828-8889
Fax 316-828-8018

COMPANY: KOCH ENGINEERING Lab. BY: SCOTT ECKLUND
EQUIPMENT ID: COMPANY: Koch-Otto York
OTTO YORK REF.: LOCATION: Wichita KS

P.2

KOCH-GLITSCH INC., OTTO YORK DIV., MIST® MIST ELIMINATOR DESIGN PROGRAM
WORLD HEADQUARTERS: Parsippany, NJ USA PHONE: (973) 299-9200 FAX: (973) 299-9401
OTTO YORK NV: Merksem, Belgium PHONE: -(32) 3-647-2847 FAX: -(32) 3-647-2879

APPLICATION SELECTED: No Application Selected

PROCESS DATA:

Vapor flow rate: 1820.000 normal cubic meters/hour.
Vapor density: 0.982 kilograms/cubic meter
Vapor viscosity: .02 centipoise (assumed typical value)
Molecular weight: 29.000
Compressibility factor: 1.000
Operating pressure: 100.000 kilopascals absolute
Operating temperature: 82.000 degrees Centigrade
Liquid loading: <2.5 cu. m/hr/sq. m (assumed to be highest amount)
Liquid viscosity: <20 centipoise (assumed to be highest value)
Liquid density: 1000.000 kilograms/cubic meter.
Surface tension: >15 dyne/cm (assumed to be a minimum value)

MIST ELIMINATOR SPECIFICATIONS:

DEMISTER STYLE 326
Diameter (specified): 0.610 meters
Area (specified): 0.292 square meters
Thickness: 152.400 millimetres

PERFORMANCE DATA:

Design velocity: 2.721 meter/second
Allowable velocity range: 0.816 to 2.993 meter/second
Velocity through an existing vessel: 2.284 meter/second

The following performance data was
calculated for a velocity of: 2.284 meter/second

K (C-factor): 0.07 meters/second
F-Factor: 2.26 meters/second*(kilograms/cubic meter)^.5
Pressure drop: 1.77 mm Hg

Collection efficiency for the DEMISTER at a given particle diameter, Percent:

Particle diameter, microns:				
3	5	8	10	20
Roppenecker method:				
85.77	98.98	99.92	99.98	100.00

PRICE:
No Price

PROPRIETARY AND CONFIDENTIAL: INFORMATION CONTAINED HEREIN IS CONFIDENTIAL
AND MUST NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION FROM
THE KOCH-GLITSCH, INC.

KOCH-GLITSCH INC., OTTO YORK DIV., MIST® MIST ELIMINATOR DESIGN PROGRAM
WORLD HEADQUARTERS: Parsippany, NJ USA PHONE: (973) 299-9200 FAX: (973) 299-9401
OTTO YORK NV: Merkssem, Belgium PHONE: -(32) 3-647-2847 FAX: -(32) 3-647-2879

APPLICATION SELECTED: No Application Selected

PROCESS DATA:

Vapor flow rate: 1071.070 SCFM.
Vapor density: 0.061 pounds/cubic foot
Vapor viscosity: .02 centipoise (assumed typical value)
Molecular weight: 29.000
Compressibility factor: 1.000
Operating pressure: 14.500 psia
Operating temperature: 179.600 degrees Fahrenheit
Liquid loading: <1 gpm/sq. ft. (assumed to be highest amount)
Liquid viscosity: <20 centipoise (assumed to be highest value)
Liquid density: 62.400 pounds/cubic foot.
Surface tension: >15 dyne/cm (assumed to be a minimum value)

MIST ELIMINATOR SPECIFICATIONS:

DEMISTER STYLE 326
Diameter (specified): 2.000 feet
Area (specified): 3.142 square feet
Thickness: 6.000 inches

PERFORMANCE DATA:

Design velocity: 8.927 feet/second
Allowable velocity range: 2.678 to 9.820 feet/second
Velocity through an existing vessel: 7.494 feet/second

The following performance data was
calculated for a velocity of: 7.494 feet/second

K (C-factor): 0.24 feet/second
K-Factor: 1.86 feet/second*(pounds/cubic foot)^.5
Pressure drop: 0.95 inches of water column

Collection efficiency for the DEMISTER at a given particle diameter, Percent:

Particle diameter, microns:				
3	5	8	10	20
Toppenacker method:				
35.77	98.98	99.92	99.98	100.00

PRICE:
No Price

PROPRIETARY AND CONFIDENTIAL: INFORMATION CONTAINED HEREIN IS CONFIDENTIAL
AND MUST NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION FROM
THE KOCH-GLITSCH, INC.

COMPANY: APR 11 '00 02:04PM KOCH ENGINEERING Lab. BY: Scott Ecklund
EQUIPMENT ID: COMPANY: Koch-Otto York
OTTO YORK REF.: LOCATION: Wichita KS

F.4

DESIGN NOTES:

Because the internal geometry of any installation may affect the proper operation of a mist eliminator, you should consider reviewing the vessel design with an Otto York engineer before it is finalized.

The performance data given above is based on test work carried out under conditions which may not apply to your requirements. No warranties or guarantee are expressed or implied

PROPRIETARY AND CONFIDENTIAL: INFORMATION CONTAINED HEREIN IS CONFIDENTIAL AND MUST NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION FROM THE KOCH-GLITSCH, INC.

Feasibility Study for Vitrification of Sodium Bearing Waste
Cost Estimate for Components of the Off-Gas Treatment System
Prepared by: Stephen Reese, 4/12/00

Summary

This report contains costing information for components of the off-gas treatment system. The components included are the multi-stage combustor; wet quench; venturi scrubber; mist eliminator; reheater; granulated, activated carbon bed; and chillers for the knock-out drum, quench, and mixing tanks (not part of the off-gas system).

Apparently the chillers are no longer required, due to the availability of ample once-through, treated cooling water. The price estimates for the chillers are included for comparison should that availability change.

These prices are rough estimates only, suitable only for the level of detail of this feasibility study.

Multi-stage Combustor, Wet Quench, & Venturi Scrubber

Quote received from:

Lawrence L. Crynes
John Zink Company, LLC, a division of Koch-Glitsch, Inc.
P.O. Box 21220
Tulsa, OK 74121-1220
(918) 234-1800

NOXidizer® multi-stage combustor, in carbon steel:	\$400,000 - 600,000
NOXidizer® multi-stage combustor, in stainless steel:	\$600,000 - 900,000
Includes instrumentation for burner management and safety, and combustion air fans.	
Quench system, in Hastelloy C22 or Inconel 625:	\$120,000 - \$240,000
Includes pumps, instrumentation, and pH controls.	
Venturi scrubber system, in Hastelloy C22 or Inconel 625:	\$180,000 - 300,000

Notes:

- John Zink Company typically does not recommend using stainless steel when HF is present in the waste stream.
- The refractory's lifespan is very operation dependent. If the proper operating conditions are followed, it should last ten years or more. With abuse, it may fail within one year.
- Installation costs are not included. That service would be sub-contracted if John Zink were asked to provide it.
- The skin temperature of the NOXidizer® is 175 - 260°C, and it emits 1-2 million Btu/h of heat into the facility. It is not insulated.

Mist Eliminator

Quote received from:

Scott Ecklund, Western Regional Sales Manager
Koch – Otto York
(316) 828-8889

Demister® Style 326 <u>mist eliminator</u> , in Inconel 625:	\$3,500
Housing for demister, in Inconel 625:	\$13,000
Total:	<hr/> \$17,000

Reheaters

Quote received from:

Kevin Pender
Caloritech, Inc.
25 Hazelwood Drive
Amherst, NY 14228
(800) 974-6333

2 – 480V, 7 kW heaters, in Inconel 625 @ \$14,000 each: \$28,000

Granulated, Activated, Sulphur-Impregnated Carbon Bed

Quote received from:

Bob Sofle (sp?)
Selective Adsorption Associates, Inc.
534 Gables Court
Langhorne, PA 19047
(215) 702-0323

MERSORB® mercury adsorbent	
@ 4,250 lbs. per batch @ \$4/lb X 5 batches:	\$85,000
2 – Housings, in coated carbon steel @ \$5,000 - 7,000 each:	\$10,000 -15,000
Total:	<hr/> \$100,000

Notes:

- Four batches of MERSORB® mercury adsorbent will be needed to filter out 1400 kg of carbon. Since two housing are planned, for redundancy, at least five batches of carbon will be needed to ensure a second, clean carbon bed is available at all times.
- If condensation occurs in the carbon bed, it will quickly clog the porosity of the bed, making it ineffective for mercury filtering. Design efforts will have to ensure that condensation will be avoided in this piece of the process.

- Acidic gases in the waste stream will liberate the impregnated sulphur as H₂S gas, damaging the bed and creating a harmful constituent at the end of the waste stream treatment process. As a result, should the gas stream prove to still contain such contaminants at this step in the process, additional upstream filtering may be necessary.
- It should be noted that if organics are present in amounts greater than 2-5 ppm, they will rapidly clog the bed, rendering it useless. The-NOXidizer should destroy any organics in the waste stream, but due to the low concentrations that are significant in this case, this factor merits mention.

Chillers

Quote received from:

Ken Ignagni

Climate Technologies Corporation

43334 W. Seven Mile Road

Northville, MI 48167-2280

(248) 380-2020

2 Quench chillers @ 185,000 Btu/h @ \$17,250 each:	\$35,000
Knock-out drum chiller @ 1.35 million Btu/h:	\$54,150
Mixing tank chiller @ 420,000 Btu/h:	\$21,250
Total:	\$111,000

Note:

- Each chiller is a reciprocating compressor, air-cooled package chiller.
- The two quench chillers will operate in parallel, thus each will only shoulder half of the load. I incorrectly requested a quote for two chillers each capable of handling the full load, thus the \$35k price is somewhat inflated.
- The load calculated for the mixing tank chiller is based upon mixing only one batch at a time. Should the design evolve to call for more than one tank to mix at a time, a higher capacity chiller would be required.

Comments

HLW

↳ Document Control

Dennis ?

② Reduce RH-TRU to limit PE curies/canister to 40
down from 1000, now @ ~300

FAX

CLIMATE TECHNOLOGIES

CORP.

Commercial & Industrial HVAC, Refrigeration, Architectural & Air Pollution Control

43334 W. Seven Mile Road ■ Northville, MI 48167-2280 ■ (248) 380-2020 ■ Fax: (248) 380-2025

TO: IDAHO NATIONAL ENERGY ENVIRONMENTAL LABDATE: 4.11.00 FAX NO. 208.526.0528ATTENTION: STEVE REESEFROM: KEN LUNAGNINUMBER OF PAGES INCLUDING THIS PAGE 10RE: AIR COOLED CHILLERSCHILLERS 1+2 @ \$17,250.00 EACH 185,000 BTUCHILLER 3 @ \$54,150.00 1,350,000 BTUCHILLER 4 @ 21,250.00 420,000 BTU

THESE ARE BUDGET NUMBERS BASED ON THE OPERATING
CONDITIONS DISCUSSED. COMPLETE TECHNICAL DATA FOR
EACH MACHINE IS ON THE SUBSEQUENT PAGES OF THIS
FAX.

STEVE, IF YOU HAVE ANY QUESTIONS OR FURTHER INFORMAT-
ION, PLEASE CONTACT ME.

Ken

DUNHAM-BUSH®**PERFORMANCE SUMMARY • CH-3**

Untitled

Reciprocating Compressor Air Cooled Package Chiller

Model # ACDB112DARZBNN1YLN2NNNNNNNNNNNNNN
 Quantity 1

Notes

- Certified in accordance with the ARI Water-Chilling Packages Using the Vapor Compression Cycle Certification Program, which is based on ARI Standard-550/590-98.
- Meets ASHRAE 90.1-89 chiller minimum efficiency guidelines.

Physical Specifications

Compressors	(2)6DB3/(2)6DG3	Shipping weight (lb)	9,666
Length (in)	210.75	Operating weight (lb)	10,231
Width (in)	86.00	Refrigerant	R-22
Height (in)	86.61		

Conditions of Service

Percent of full load	100%	Fan power (kW)	16.0
Capacity (Tons)	113.9	Energy efficiency (EER)	9.5
Unit power (kW)	143.5	IPLV (EER)	12.7
Compressor power (kW)	127.5		

Evaporator

Model	EXD12122J09	Leaving fluid temp. (°F)	44.0
Fluid	Water	Fouling factor (hr-ft ² -°F/Btu)	0.00010
Fluid flow rate (gal/min)	273.6	Pressure drop (psi/ft w.g.)	9.0/20.8
Entering fluid temp. (°F)	54.0	Fluid freezing point (°F)	32.0

Condenser

Design ambient (°F)	95.0	Altitude (ft)	0
Low ambient control to (°F)	0.0		

Electrical Characteristics

Unit power supply	460V/3/60	Unit rated load amps	243
Unit max. fuse/HACR CB size	300	Unit min. circuit ampacity	258

DUNHAM-BUSH®**PERFORMANCE SUMMARY • CH-3**

Untitled

IPLV Points

% Full load	Tons	Unit kW	Comp. kW	Fan kW	EER	Ambient	Type
100%	113.9	143.5	127.5	16.0	9.5	95.0	Actual
75%	85.4	95.6	84.2	11.4	11.4	80.0	Interpolated
50%	56.9	51.8	45.1	6.7	13.4	65.0	Interpolated
25%	28.5	23.8	21.4	2.4	14.4	55.0	Derated for cycling

Actual Unloading Points

% Full load	Tons	Unit kW	Comp. kW	Fan kW	EER	Ambient	Type
100%	113.9	143.5	127.5	16.0	9.5	95.0	Actual
84%	95.7	106.1	90.1	16.0	10.8	85.5	Actual
56%	64.1	59.7	51.7	8.0	12.9	66.7	Actual
34%	38.4	31.2	28.0	3.2	14.8	55.2	Actual

Standard Equipment**Cabinet Construction**

- Units shall be constructed of heavy gauge galvanized steel and aluminum condenser tube steels. The control box and trim panels at the opposite end of the unit are finished with paint that meets the requirements for outdoor unit application of 500 hour salt spray paint tested in accordance with ASTM-B-117.

Semi Hermetic Compressors

- Positive pump lubrication system
- Crankcase heater(s)
- Suction & discharge service valves
- Cylinder unloading (1 or 2 compressor models only)
- Compressor staging

Air Cooled Condenser

- Copper tubes
- Enhanced aluminum fins
- Integral subcooler circuit(s)
- Direct drive fans with internal motor protection
- Full coil tubesheet air dividers between each fan section for superior head pressure control

Cooler

- Inner-Fin design
- ASME approved
- Heater tape with thermostat
- Fully insulated
- Drain & vent plugs

Refrigeration Specialties

- Thermal expansion valve(s)
- Liquid line solenoid valve(s)
- Removable core filter/driers(s)
- Refrigerant charge of R-22

Controls

- DB Director full function Windows based microcomputer controller on all models
- Two line 16 character alpha numeric display control functions
- Compressor loading/staging based on leaving fluid temperature
- High and low pressure protection
- Cooler fluid freeze protection
- Staggered starting of compressors
- Anti-recycle timing
- Fan cycling
- Pump down control
- Remote monitoring via RS-232 and RS-485 ports
- Accepts remote start & stop signal
- 0 to 5 VDC chilled water reset signal (standard)
- Keyboard accessed LCD readouts, continuously updated
- Cooler leaving fluid temperature
- Cooler entering fluid temperature
- Discharge and suction pressure for all circuits

Separate refrigerant circuits (1 or 2 compressor models only)**Two compressors per circuit (4 compressor models only)**

Units conform to NEC, NEMA, ANSI/ASHRAE 15 and ANSI/ASME B31.5. Units are rated and tested in accordance with ARI std. 550/590

DUNHAM-BUSH®**PERFORMANCE SUMMARY • CH-3**

Untitled

Optional Equipment/Service**Factory Mounted Options**

- Control circuit transformer (TSF) - Appropriate KVA rating to power the 115V/1/60 control circuit and compressor oil heaters.
- Hot gas bypass (HGB1) - is for circuit #1 only to minimize compressor cycling when the load is less than the unit minimum mechanical capacity.
- Low ambient control (LAC) to 0 °F (-17.8 °C) minimum ambient - units use variable speed fans in conjunction with standard fan cycling.
- Operating and safety lights (OSL) - individual lights indicating control power to the unit and faults for high discharge pressure, low evaporator pressure, low oil pressure and high motor temperature and

Factory Mounted Options (cont.)

- alarm status.
- Gauges (GAG2) - includes suction, discharge and oil pressure for all unit models. The micro computer displays discharge and suction pressure so these readings are redundant. If OPM option is ordered, it may eliminate the need for gauges.

Accessories (Shipped Loose)

- Water flow switch (WFS) - paddle type field adjustable flow switch available for remote cooler option. Usually tied into the unit safety circuit so that the package will remain off until water flow is proved. Helps prevent cooler freeze up. NEMA 3R enclosure, for use on water or glycol circuits.

DUNHAM-BUSH®**PERFORMANCE SUMMARY • CH-4**

Untitled

Reciprocating Compressor Air Cooled Package Chiller

Model # ACDRB035SARZBNN1YLN2N2NNNN1NNNNN
 Quantity 1

Notes

- Certified in accordance with the ARI Water-Chilling Packages Using the Vapor Compression Cycle Certification Program, which is based on ARI Standard 550/590-98.
- Meets ASHRAE 90.1-89 chiller minimum efficiency guidelines.

Physical Specifications

Compressors	6DJ3	Shipping weight (lb)	2,328
Length (in)	128.75	Operating weight (lb)	2,413
Width (in)	43.00	Refrigerant	R-22
Height (in)	88.61		

Conditions of Service

Percent of full load	100%	Fan power (kW)	4.8
Capacity (Tons)	35.2	Energy efficiency (EER)	9.7
Unit power (kW)	43.7	IPLV (EER)	12.2
Compressor power (kW)	38.9		

Evaporator

Model	CHS008601A	Leaving fluid temp. (°F)	44.0
Fluid	Water	Fouling factor (hr-ft²-F/Btu)	0.00010
Fluid flow rate (gal/min)	84.6	Pressure drop (psi/ft w.g.)	5.8/13.4
Entering fluid temp. (°F)	54.0	Fluid freezing point (°F)	32.0

Condenser

Design ambient (°F)	95.0	Altitude (ft)	0
Low ambient control to (°F)	0.0		

Electrical Characteristics

Unit power supply	460V/3/60	Unit rated load amps	73
Unit max. fuse/HACR CB size	150	Unit min. circuit ampacity	89

DUNHAM-BUSH®**PERFORMANCE SUMMARY • CH-4**

Untitled

IPLV Points

% Full load	Tons	Unit kW	Comp. kW	Fan kW	EER	Ambient	Type
100%	35.2	43.7	38.9	4.8	9.7	95.0	Actual
75%	26.4	30.4	27.1	3.3	11.2	80.0	Interpolated
50%	17.6	17.1	15.3	1.8	12.7	85.0	Interpolated
25%	8.8	7.7	6.8	0.9	13.7	55.0	Derated for cycling

Actual Unloading Points

% Full load	Tons	Unit kW	Comp. kW	Fan kW	EER	Ambient	Type
100%	35.2	43.7	38.9	4.8	9.7	95.0	Actual
78%	27.6	30.6	25.8	4.8	10.8	81.9	Actual
46%	16.2	15.0	13.4	1.6	13.0	62.7	Actual

Standard Equipment**Cabinet Construction**

- Units shall be constructed of heavy gauge galvanized steel and aluminum condenser tube steels. The control box and trim panels at the opposite end of the unit are finished with paint that meets the requirements for outdoor unit application of 500 hour salt spray paint tested in accordance with ASTM-B-117.

Semi Hermetic Compressors

- Positive pump lubrication system
- Crankcase heater(s)
- Suction & discharge service valves
- Cylinder unloading (1 or 2 compressor models only)
- Compressor staging

Air Cooled Condenser

- Copper tubes
- Enhanced aluminum fins
- Integral subcooler circuit(s)
- Direct drive fans with internal motor protection
- Full coil tubesheet air dividers between each fan section for superior head pressure control

Cooler

- Inner-Fin design
- ASME approved
- Heater tape with thermostat
- Fully insulated
- Drain & vent plugs

Refrigeration Specialties

- Thermal expansion valve(s)
- Liquid line solenoid valve(s)
- Removable core filter/driers(s)
- Refrigerant charge of R-22

Controls

- DB Director full function Windows based microcomputer controller on all models
- Two line 16 character alpha numeric display control functions
- Compressor loading/staging based on leaving fluid temperature
- High and low pressure protection
- Cooler fluid freeze protection
- Staggered starting of compressors
- Anti-recycle timing
- Fan cycling
- Pump down control
- Remote monitoring via RS-232 and RS-485 ports
- Accepts remote start & stop signal
- 0 to 5 VDC chilled water reset signal (standard)
- Keyboard accessed LCD readouts, continuously updated
- Cooler leaving fluid temperature
- Cooler entering fluid temperature
- Discharge and suction pressure for all circuits

Separate refrigerant circuits (1 or 2 compressor models only)**Two compressors per circuit (4 compressor models only)**

Units conform to NEC, NEMA, ANSI/ASHRAE 15 and ANSI/ASME B31.5. Units are rated and tested in accordance with ARI std. 550/590

PERFORMANCE SUMMARY • CH-4

Untitled

Optional Equipment/Service

Factory Mounted Options

- Control circuit transformer (TSF) - Appropriate KVA rating to power the 115V/1/80 control circuit and compressor oil heaters.
- Hot gas bypass (HGB1) - is for circuit #1 only to minimize compressor cycling when the load is less than the unit minimum mechanical capacity.
- Low ambient control (LAC) to 0 °F (-17.8 °C) minimum ambient - units use variable speed fans in conjunction with standard fan cycling.
- Operating and safety lights (OSL) - individual lights indicating control power to the unit and faults for high discharge pressure, low evaporator pressure, low oil pressure and high motor temperature and alarm status.

Factory Mounted Options (cont.)

- Gauges (GAG2) - includes suction, discharge and oil pressure for all unit models. The micro computer displays discharge and suction pressure so these readings are redundant. If OPM option is ordered, it may eliminate the need for gauges.
- Over and under voltage and phase protection relay (UVR2) - protects against high and low incoming voltage conditions as well as single phasing, phase reversal and phase imbalance by opening the control circuit. It is an automatic reset device, but the microcomputer can be set up for manual reset to prevent unwanted restarts.
- Suction line insulation (INS) - suggested for medium and low temperature applications.

DUNHAM-BUSH®**PERFORMANCE SUMMARY • CH-1&2**

Untitled

Reciprocating Compressor Air Cooled Package Chiller

Model # ACDRB021SARZBNN1YLN2N2NNNN1NNNNN
 Quantity 2

Notes

- Certified in accordance with the ARI Water-Chilling Packages Using the Vapor Compression Cycle Certification Program, which is based on ARI Standard-550/590-98.
- Meets ASHRAE 90.1-89 chiller minimum efficiency guidelines.

Physical Specifications

Compressors	4DH3	Shipping weight (lb)	1,712
Length (in)	92.75	Operating weight (lb)	1,762
Width (in)	43.00	Refrigerant	R-22
Height (in)	86.61		

Conditions of Service

Percent of full load	100%	Fan power (kW)	3.2
Capacity (Tons)	21.3	Energy efficiency (EER)	10.2
Unit power (kW)	25.0	IPLV (EER)	12.9
Compressor power (kW)	21.8		

Evaporator

Model	CHS007601A	Leaving fluid temp. (°F)	44.0
Fluid	Water	Fouling factor (hr-ft²°F/Btu)	0.00010
Fluid flow rate (gal/min)	51.2	Pressure drop (psi/ft w.g.)	5.8/13.4
Entering fluid temp. (°F)	54.0	Fluid freezing point (°F)	32.0

Condenser

Design ambient (°F)	95.0	Altitude (ft)	0
Low ambient control to (°F)	0.0		

Electrical Characteristics

Unit power supply	460V/3/60	Unit rated load amps	43
Unit max. fuse/HACR CB size	80	Unit min. circuit ampacity	53

DUNHAM-BUSH®**PERFORMANCE SUMMARY • CH-1&2**

Untitled

IPLV Points

% Full load	Tons	Unit kW	Comp. kW	Fan kW	EER	Ambient	Type
100%	21.3	25.0	21.8	3.2	10.2	95.0	Actual
75%	16.0	17.0	14.8	2.2	11.7	80.0	Interpolated
50%	10.7	9.5	8.2	1.3	13.4	65.0	Derated for cycling
25%	5.3	4.3	3.6	0.6	15.0	55.0	Derated for cycling

Actual Unloading Points

% Full load	Tons	Unit kW	Comp. kW	Fan kW	EER	Ambient	Type
100%	21.3	25.0	21.8	3.2	10.2	95.0	Actual
62%	13.1	12.7	11.1	1.6	12.4	72.0	Actual

Standard Equipment**Cabinet Construction**

- Units shall be constructed of heavy gauge galvanized steel and aluminum condenser tube steels. The control box and trim panels at the opposite end of the unit are finished with paint that meets the requirements for outdoor unit application of 500 hour salt spray paint tested in accordance with ASTM-B-117.

Semi Hermetic Compressors

- Positive pump lubrication system
- Crankcase heater(s)
- Suction & discharge service valves
- Cylinder unloading (1 or 2 compressor models only)
- Compressor staging

Air Cooled Condenser

- Copper tubes
- Enhanced aluminum fins
- Integral subcooler circuit(s)
- Direct drive fans with internal motor protection
- Full coil tubesheet air dividers between each fan section for superior head pressure control

Cooler

- Inner-Fin design
- ASME approved
- Heater tape with thermostat
- Fully insulated
- Drain & vent plugs

Refrigeration Specialties

- Thermal expansion valve(s)
- Liquid line solenoid valve(s)
- Removable core filter/driers(s)
- Refrigerant charge of R-22

Controls

- DB Director full function Windows based microcomputer controller on all models
- Two line 16 character alpha numeric display control functions
- Compressor loading/staging based on leaving fluid temperature
- High and low pressure protection
- Cooler fluid freeze protection
- Staggered starting of compressors
- Anti-recycle timing
- Fan cycling
- Pump down control
- Remote monitoring via RS-232 and RS-485 ports
- Accepts remote start & stop signal
- 0 to 5 VDC chilled water reset signal (standard)
- Keyboard accessed LCD readouts, continuously updated
- Cooler leaving fluid temperature
- Cooler entering fluid temperature
- Discharge and suction pressure for all circuits

Separate refrigerant circuits (1 or 2 compressor models only)

Two compressors per circuit (4 compressor models only)

Units conform to NEC, NEMA, ANSI/ASHRAE 15 and ANSI/ASME B31.5. Units are rated and tested in accordance with ARI std. 550/590

DUNHAM-BUSH®**PERFORMANCE SUMMARY • CH-1&2**

Untitled

Optional Equipment/Service**Factory Mounted Options**

- Control circuit transformer (TSF) - Appropriate KVA rating to power the 115V/1/60 control circuit and compressor oil heaters.
- Hot gas bypass (HGB1) - is for circuit #1 only to minimize compressor cycling when the load is less than the unit minimum mechanical capacity.
- Low ambient control (LAC) to 0 °F (-17.8 °C) minimum ambient - units use variable speed fans in conjunction with standard fan cycling.
- Operating and safety lights (OSL) - individual lights indicating control power to the unit and faults for high discharge pressure, low evaporator pressure, low oil pressure and high motor temperature and alarm status.

Factory Mounted Options (cont.)

- Gauges (GAG2) - includes suction, discharge and oil pressure for all unit models. The micro computer displays discharge and suction pressure so these readings are redundant. If OPM option is ordered, it may eliminate the need for gauges.
- Over and under voltage and phase protection relay (UVR2) - protects against high and low incoming voltage conditions as well as single phasing, phase reversal and phase imbalance by opening the control circuit. It is an automatic reset device, but the microcomputer can be set up for manual reset to prevent unwanted restarts.
- Suction line insulation (INS) - suggested for medium and low temperature applications.

Caloritech
INC.Ask about
our new
Explosion
Resistant
Unit Heater **XGA**NAME / COMPANY: STEVE REESEINEELFAX: (208) 526-0528 DATE: APR 10, 00 PAGE: 1 OF 1FROM: Kevin PenderREF: REQUEST FOR BUDGET QUOTESTEVE,

WE ARE PLEASED TO OFFER THE FOLLOWING:
(PLEASE NOTE THAT THIS IS BUDGETARY AND
SUBJECT TO CHANGE)

PART # EXNG07F437DMRY 480V 3 ϕ 7KW CIRCULATION
HEATER DESIGN FOR 50 PSIG @ 300°F. 9W:
1. INCONEL 625 WETTED PARTS.

BUDGET PRICE - \$14,100.00
EACH

DELIVERY - 6 WKS.

Regis

Kevin Pender

electrical heating equipment for industry
 25 Hazelwood Drive, Amherst, NY 14228
 • Tel. (716) 564-0010 • Fax (716) 564-0044
 (800) 974-6333 (800) 884-3981

Internet: www.caloritech.com