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KLX-1134

COMPLETION REPORT

PUREX AND REDOX
PHASE II EXPANSION

JOBS 1063 & 1063R

VOLUME I

CONTRACT

AT(45-1) -628

DATE

May 1, 1955

APPROVED

J. C. Tourek

J. C. Tourek
Project Manager

Classification Cancelled and Changed To

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By Authority of CG-NMP-1,
DS Review, 10-25-94.

By Jessie Moley 11-23-94.
Verified By SP-101118 12-21-94.
NOT UCM

VITRO ENGINEER
VITRO CORPORATION
120 WALL STREET

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U. S. ATOMIC ENERGY COMMISSION
Hanford, Washington

J. I. Thomas

VITRO ENGINEERING DIVISION
New York, New York

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COMPLETION REPORT - PUREX AND REDOX PHASE II

JOBS 63 & 63R

PART I. ADMINISTRATIVE

INTRODUCTION

Vitro Corporation of America entered into a contract with the United States Atomic Energy Commission on July 2, 1952 to furnish architect-engineering services in connection with the design and construction of a new chemical plant facility located in the 200 Area of the Hanford Works, Richland, Washington. This contract /1./ * provided for engineering of facilities utilizing the Purex process to separate and decontaminate uranium and plutonium contained in slugs irradiated in Hanford reactors.

Later, Vitro was requested to provide architect-engineering services for an expansion of the previously constructed Redox separation facility. This work, designated as "Redox Phase II Expansion," was authorized by Modification No. 1 to the above contract and was executed April 17, 1953 /2/.

This completion report has been prepared at the request of the AEC /3/ and is intended to provide a convenient source of information concerning the administrative history and engineering features of the Purex plant and the Redox Phase II Expansion.

* This number and others appearing in similar manner in this report refer to the bibliography included at the end of this volume.

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PROJECT REVIEW

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SCOPE OF THE PROJECT

The basic contract directed Vitro to assist in the preparation of design criteria for a Purex chemical plant facility and to prepare the engineering design with an option on the construction supervision. This facility was to be based on broad criteria contained in HAN-44346 /4/ and was identified as Project CA-513. Prime responsibility for the development of design criteria was assigned by the AEC to General Electric Company.

Modification No. 1 to the above contract redefined Vitro responsibilities as follows: "The construction project for which Architect-Engineer services are to be furnished comprises:

- a. "A chemical plant facility based on broad design criteria set forth in Document HAN-44346, dated May 12, 1952, entitled 'Description of Facilities for Contract AT(45-1)-628' (exclusive of the railroad within the exclusion area and outside the 202A Building, the Badge House and the Elevated Water Tank), and document entitled 'Purex Facility - Project CA-513 Purex Analytical Laboratory Design Criteria No. XXXIII,' dated November 12, 1952, together with changes, deletions, and additions thereto, necessary for a safe, complete and operable facility.
- b. "Effective as of February 16, 1953, the expansion of the Redox plant capacity as set forth in general terms in Document HAN-48628, Revised January 26, 1953, entitled 'Description of Proposed Facilities for Phase II Redox Expansion'."

In addition, this contract modification assigned to GE the function of construction supervision.

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PROJECT ORGANIZATION

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Figure 1 illustrates the contractual relationship between the principal agencies engaged in the Purex project - specifically, the Atomic Energy Commission, General Electric Company (operator of the Hanford Works), Vitro Engineering Division (architect-engineer), and Blaw-Knox Corporation (construction contractor). Administrative liaison was handled directly between the AEC and Vitro Corporation. Technical liaison between General Electric and Vitro was channeled through the Vitro Field office at Richland which was constantly in contact with the center of design engineering activities of the Vitro New York office. Technical liaison between Blaw-Knox and Vitro was handled by the Vitro field office through AEC and GE Title III forces.

Effective January 1, 1954, the various companies which had formerly made up the Vitro group were merged to form the Vitro Corporation of America. This merger placed the responsibility for Vitro's obligations with regard to this contract under the Vitro Engineering Division and R. A. North, General Manager of the Division.

In accordance with its standard practice, Vitro established a separate project organization in New York to handle the Purex Facility. At the outset of Vitro work in July 1952, George White was designated as Project Manager, J. C. Tourek as Chief Project Engineer, and G. R. Graham as Resident Engineer. On January 19, 1953, Mr. Tourek assumed the responsibilities of Project Manager and S. M. Stoller was designated as Chief Project Engineer. (The Vitro project organization at this point is illustrated in Fig. 2.) In addition, effective June 1, 1953, L. W. Trevena assumed the former responsibility of Mr. Graham as Resident Engineer. Process and Design Engineering were supervised during the entire course of the project by N. A. Spector and G. I. Staber, respectively.

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Fig. 1 - CONTRACTURAL RELATIONSHIP - JOB 1063

VITRO ENGINEERING DIVISION - VITRO CORPORATION of AMERICA

JANUARY 19, 1953

Fig. 2 - ORGANIZATION CHART - JOB 1063

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PROJECT CHRONOLOGY

Project highlights are given here in the order in which they occurred during the period covered by this report. Source material for this section is the record of job history as published in Vitro monthly progress reports beginning with KLX-1110, July 1952. Some duplication may be noted between this chronology and narrative sections; however, this section serves to document the record and will assist recapitulation of the project at a future date.

July 1952

On July 2, 1952 contract AT(45-1)-628 was entered into between the Atomic Energy Commission and the Vitro Corporation of America. This contract designated Vitro as architect-engineer for design of a Purex Separations Facility as described in HAN-44346.

The procedures for executing this contract were defined by an Instruction Letter dated July 30, 1952 from J. I. Thomas of the AEC to G. White, Jr. of Vitro /5/. This letter stated that "the preparation of design criteria, scope drawings (process design and preliminary plant design), and preliminary specifications" is the responsibility of the General Electric Company. Vitro was requested to supply personnel to assist GE in this work as part of their Title I contract responsibility and the first group of Vitro engineers left for Richland during July. The letter also stated that receipt of approved scope material from GE would be authorization for Vitro to proceed with detailed plant design. Further, the letter designated L. F. Perkins as AEC engineering representative.

In a letter from A. B. Greninger of GE to G. White, Jr. /6/, J. M. Frame was designated as the official GE engineering department representative, responsible for the technical direction of Vitro Title I design activities.

During July, G. White, Jr. and N. A. Spector, Job 63 Project Manager and Assistant Project Manager, respectively, visited Richland with a group of Vitro engineers to discuss specific arrangements for the Engineering Assistance Group and to discuss over-all project planning. Additional visits were made during the month by groups of Vitro engineers to take up temporary residence in Richland for the duration of the preliminary work.

It was established that Job 63 purchasing would be done by the customer but that Vitro would prepare detailed requisitions for purchase of engineered equipment. In addition, Vitro was requested to supply manpower to staff a Material Control Group, working in Richland under AEC supervision, which would maintain all necessary records regarding construction material, equipment, requisitions and purchases.

Preliminary work was started in both New York and Richland during July. A review of the engineering features of the plant was started but major design efforts had to await receipt of basic design criteria from GE.

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August 1952

Most of Job 63 effort during August was concentrated on providing Vitro assistance to GE in carrying out their Title I design responsibility. This work was done by the Vitro-Richland office. No basic scope information was received from GE by Vitro in New York. However, an extensive liaison was established between the Vitro New York and Richland offices.

Activities in the New York office consisted of scoping liaison, a structural frame analysis to confirm wall thicknesses, and a continuing review of the engineering features of the plant. Major design efforts awaited receipt of basic design criteria from GE.

On August 20, 1952 H. H. Schipper of the Hanford AEC office and F. B. McKeon of the Washington office visited the Vitro New York office to discuss possible methods of expediting the start of design and construction of the Purex Separations Facility. A letter dated August 22, 1952, outlined the scope material Vitro would require and the dates on which this material would have to be received in order to permit advance of the December 1, 1952 proposed start of design.

During August, Vitro transmitted to the AEC a preliminary schedule for design and construction of the Purex Separations Facility. This schedule included the breakdown of Vitro recommendations as to which of the individual buildings and other facilities were suitable for construction by lump sum contract.

On August 11, 1952 a letter /7/ from J.I. Thomas was received by G. White, Jr., setting forth a policy of "Austerity and Economy in Design for New Construction." On August 15th a letter /8/ was received from J.I. Thomas by Mr. White, covering "Proposed Additional Work Under Contract AT(45-1) -628", including design of the analytical laboratory as part of the 202-A Building and requesting Vitro to provide scope design assistance to GE on outside facilities.

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September 1952

At the request of the AEC, N.A. Spector of Vitro visited Wilmington, Delaware with J.M. Frame of GE and H.E. Parker of the Hanford AEC Office to discuss design and process coordination with the duPont Corporation and the regional AEC representatives. On September 27, 1952 Messrs. Frame and Parker visited the Vitro New York office to discuss methods of expediting start of detailed design, and consequently start of construction on the 202-A Building. At this meeting Vitro advised that it would be possible to advance design and construction schedules one month, as requested by the AEC. It was noted, however, that this advance would depend upon receipt of specific key portions of the scope information on dates earlier than originally planned. The revised dates for transmittal were outlined by Mr. Frame during these meetings.

During September, in addition to normal liaison, a number of Vitro engineers made visits to Richland to assist in preparation and review of scope material.

On September 22, 1952, Vitro received a request to redraw pipe and electrical connector drawings for competitive bidding.

Design effort in New York during September consisted of the following work:

Frame analysis to estimate and select a roof design for the 202-A Building and to establish preliminary thickness of Building 202-A walls and floor slabs.

Preliminary H & V design for the 291-A Facility.

Start of pipe and electrical connectors redesign.

October 1952

A group of New York personnel was still temporarily assigned to Richland to assist GE in scoping Title I of the contract. These New York engineers were working in conjunction with permanent Vitro Richland personnel who were dividing time between this task and construction inspection on Vitro Job 15. In addition, several New York engineers made visits to Richland during the month to assist in the preparation and review of scope material.

Preliminary design was initiated on the following items during October:

Structural frame analysis of the 202-A Building.

291-A Facility

277-A Facility

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GE scoping work continued during the month; Vitro received the approved Plot Plan Design Criteria and comment issues of other scope items.

November 1952

A review was made of all scope information at hand in New York and a plan established to undertake detail design of the project as a whole as opposed to spot efforts previously made. This plan was implemented during the first week of November and was confirmed by letter from the AEC /9/. This letter reviewed the scope information transmitted to Vitro and formally requested the start of detail design of the facility.

During the month, G. White, Jr., N.A. Spector, J.C. Tourek, and other Vitro personnel visited Richland to review the scope effort being carried out by GE.

During November, Vitro continued to receive revised issues of building arrangement scope drawings and revised process and engineering flow diagrams, as well as approved issues of Instrument and Rotating Equipment Design Criteria.

December 1952

A group of New York personnel was still at Richland to assist GE in the scoping of the Title I portion of the contract. This group was supplemented by permanent Vitro Richland personnel who were dividing their time between this work and construction inspection on Vitro Job 15. Part of the group returned to New York to initiate detail design work.

J. C. Tourek was appointed Project Manager under this contract, effective January 1, 1953.

Early in December, G. White, Jr. and J. C. Tourek visited Richland to review the status of the job with AEC representatives and to discuss anticipated contract renegotiation items.

Detail design work, which had been initiated in New York in November, progressed slowly during December since only a limited amount of miscellaneous approved scope information was received from Richland during the month.

Vitro was requested to prepare a study report to evaluate the feasibility of utilizing the existing 272-E Building as a mock-up facility instead of constructing a new building. Design work and necessary estimating was done.

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202-A Building

Frame analysis of the canyon portion was at an advanced stage by the end of December. Analysis of the service portion had also progressed.

Calculations were made of heat release and air ventilation required.

Studies of equipment supports, kick-plate design, and related items were started. Redesign of connectors was finished during the month; all required drawings and specifications were transmitted to GE for approval.

Studies were in progress on cell wall piping, canyon piping, pipe trench design, gallery piping, and outside facilities.

January 1953

Vitro was informed by letter /10/ that responsibility for technical management of Title II services would be transferred, effective February 1, from the GE Design Section to the GE Project Section, under the supervision of G.C. Gabler. In addition, information /11, 12/ was received that W.B. Webster had been assigned the direct Separations Project Unit responsibility for this work.

J.C. Tourek and W.P. Lamb visited Richland during January to discuss modifications to the Purex contract necessary to bring this document into conformance with the scope of Vitro responsibility.

By January 31, scoping activity was substantially complete and almost all scoping material had been transmitted to New York, as reported by letters /13, 14, 15, 16/ received from GE. Reference items not received by that date included the Vessel Design Criteria, Sampler Criteria, and Equipment & Piping Arrangement Criteria.

The first Vitro requisition was transmitted to GE.

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202-A Building

Analysis of the canyon frame was virtually complete by the end of January. All the slabs and walls were sized and the reinforcing steel requirements were also determined. In addition, excavation drawings had been started.

Heat loss calculations had been completed for the Process Area, Laboratory Area, and Service Area, based on the scope equipment arrangement and building sizes shown on the scope drawings.

Large scale (1 in. to the foot) layouts had been made for most of the complicated items of special equipment. Studies had been completed on the hot pipe trench and working drawings were also started. Piping arrangement studies on the canyon galleries and in the AQ Make-up Area were also in progress.

Studies and layouts were under way on the following: centrifuge installations, pump and agitator flanges, special vessel supports, procurement sketches for canyon vessels, vessel trunnion, lifting bale and Y-pad details, remote connector kick-plates, head layouts on special equipment to supplement piping work, pad, anchor bolts, and V-block arrangements.

Lighting plans, grounding studies, and the necessary one-line diagrams were in preparation.

Instrument schematic drawings were worked on and instrument erection detail sheets were started during the month.

291-A Building

Building 291-A layout sketches were in progress in addition to equipment layouts for the blower rooms and the laboratory ventilation equipment.

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February 1953

A joint meeting of representatives of the AEC, GE and Vitro was held in the Vitro New York office early February. At this meeting, scope material prepared in Richland by GE was reviewed prior to the actual transfer of responsibility for technical management of Title II services from the GE Design Section to the GE Project Section. Material requisitions, scheduling and other planning matters were also discussed.

On February 3, representatives of the AEC, Blaw-Knox, and Vitro met in the Vitro New York office for a general discussion of material requisitioning and procurement, construction methods, engineering construction scheduling, and designation of the facilities which would be constructed under lump sum contracts. The first formal issues of a Composite Engineering and Construction Schedule and a Design Drawing Schedule were transmitted to the AEC by Vitro during February.

Copies of an engineering and economic evaluation of the 277-A Jig-up Building vs the 272-E Mock-up Building were transmitted to GE early in February /17/. The conclusions drawn by Vitro in this study were amplified and confirmed by GE /18/. These conclusions recommended that the existing 272-E Building be converted.

By February 28 the following items of "approved" scope information had been received in New York:

- General Outer Area Service Drawing (Outside 202-A Area)
- Waste Disposal Design Criteria
- Waste Disposal Drawings
- Safety Criteria
- Vessel Criteria

Vitro also awaited sampler design requirements from GE, a decision on the utility header requirements, and information on nuclear safety considerations for cell "L" equipment-supporting framework.

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202-A Building

Scope drawings have been completely revised to reflect current design requirements. The Service Area design had been changed to provide for steel framing with corrugated siding instead of the all-concrete construction previously specified.

Canyon foundation and wall elevations drawings were under way by the end of the month. In addition, design had been started on Service Area footings, taking into consideration overhead construction of steel framing instead of the heavier, all-concrete construction formerly considered.

Service system and laboratory ventilation flow diagrams were redrawn to reflect final scope agreements and selection of major H&V equipment was made during the month. Large-scale preliminary equipment room layouts were also in progress.

Work continued on the cell piping layout drawings which detailed the hot equipment and piping arrangement. Approximately half of the required drawings had reached an advanced stage.

Layout sketches and stress calculation work for individual jumpers were started during February, and the standardization study for jumpers was essentially completed. Work also continued on the development of standard appurtenances.

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Buried wall connector piping study work continued on both the hot pipe trench and service sides.

The equipment arrangement drawing for the Pipe and Operating Gallery and the drawings for certain levels of the AQ Make-up Section were started.

Fourteen chemical equipment drawings had been started. The procurement drawings for standard canyon vessels and supporting drawings for flanges, lifting bails, etc. were also under way during the month.

Work progressed on the three sub-station arrangement drawings, and on lighting and grounding grid drawings.

Work continued on instrument schematic drawings.

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291-A Building

The 291-A filter drawings had been completed, with provisions for connecting to the by-pass duct and also to a possible future filter.

March 1953

J. C. Tourek visited Richland during early March to discuss with AEC representatives the application of Vitro Richland personnel. During these meetings, the AEC announced its decision not to exercise its option for Title III services under contract AT(45-1)-628. In answer to the letter confirming this decision /19/, Vitro informed the AEC /20/ that instructions received from them /19/ were being implemented.

Representatives of the Vitro New York office visited Richland during the week of March 9 to discuss construction methods and for a detailed review of engineering and construction schedules with AEC and Blaw-Knox representatives.

By March 31, 48 GE PX letters /21/ had been received by Vitro. Incorporation of the modifications and changes to the detailed design of the Purex Facility outlined in these letters caused major delays in certain phases of the work. Vitro evaluated these changes and work was started to incorporate them into design.

As of March 31, "approved" Waste Disposal Design Criteria scope information had not yet been received in New York. In addition, GE information on safety considerations for cell "L" equipment-supporting framework and detailed shielding requirements for buried piping had not been received. However, the first transmittal of GE-prepared instrument control panel layout drawings was made in March.

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202-A Building

Canyon foundation drawings showing mat reinforcement were substantially completed and surface arrangement plans at mat level, showing anchor bolts, equipment support pads, etc., were following the foundation drawings. Wall elevations and sections were also being prepared. Temporary construction openings had been spotted throughout the building and necessary details of reinforcement and joint treatment were indicated.

Service Area design proceeded and drawings were started during the month. The 291-A by-pass air duct from the canyon air tunnel to the fan plenum intake had been designed and drawings of the duct were substantially completed by the end of March.

The canyon frame stresses that will exist at various stages of construction were investigated during the month. Working drawings of the canyon frame will show where additional reinforcements or relocation of reinforcements, together with details of special joint conditions, are required.

A check of line sizes was made, and fixed piping was checked for a 150% capacity factor in accordance with GE instructions. Flow diagrams were revised on the basis of modifications requested by GE.

All of the cell piping layout drawings were completed by the end of the month with the exception of those required for the "J" cell. Work was continued on the piping arrangement and support drawings required for the hot pipe trench.

Most of the drawings detailing the buried wall connector piping reached the checking stage by the end of the month.

Although some piping was at an advanced stage by the end of March, major revisions were required in compliance with PX letters which defined process changes. These revisions set back completion of piping design.

Design drawings covering the standard 7- and 10-foot vessels and TK-G1 were completed during the month, while six chemical equipment drawings were in the comment stage and six others in preparation.

A Vitro representative visited Richland during March to review crane information with GE, after which a joint meeting was held with the crane vendor. Following the joint meeting, Vitro assumed responsibility for the remote cranes. A later meeting was held with the crane control vendor to develop detail design information.

Work continued on the development of miscellaneous equipment items required in the canyon, including dowels, studs, trunnions, trunnion guides, vessel and dunnage support plates, kickplates, pumps, jets, pulse generators, etc.

Four drawings on substation arrangement and elevation had been completed and lighting drawings had been brought to an advanced stage.

Work on the instrument specification sheets continued and approximately 20% were in draft form by the end of the month. In addition, 250 application sheets had been brought to a 90% completion stage.

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272-E Building

Structural steel modifications for the 272-E Mock-up Building conversion had been completed and working drawings had been started. The remainder of the structural re-work, together with design of miscellaneous platforms and supporting pads, continued during the month.

Redistribution of ventilating air in 272-E had been studied, and working drawings for ductwork modifications started during March. Design of a sprinkler system for conversion of this building was also undertaken.

Detail design of 272-E checking facilities had been started, with initial emphasis on adjustable equipment supports and trunnion jigs, and on Semi-Mock-up wall pattern and kick-plate positioning. About half the drawings were well under way.

April 1953

At the request of J.I. Thomas, Hanford AEC office, a written report of the delays caused by scope changes contained in General Electric PX series letter's received by Vitro through April 6, was made /22/. J.C. Tourek visited Richland during late April for further discussions of the design schedule.

Project representatives of the AEC, Blaw-Knox and Vitro met in New York during late April for detailed design discussions to give Blaw-Knox information to proceed with design scheduling and construction planning.

During the month, the AEC requested a construction cost estimate for that portion of the work on Project CA-513 to be designed by Vitro /23/. Instructions on format and the cost allocation basis for this estimate were received by Vitro at the conclusions of conferences with the AEC and GE at Richland.

Construction work was initiated during April. Cleaving and grubbing of the temporary construction area was substantially completed.

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202-A Building

Canyon foundation drawings, surface arrangement plans, and wall elevations had been generally revised to remove "holds" and incorporate details necessary for specific construction techniques. It was decided railroad tunnel construction would be all-concrete, as opposed to steel and transite, in accord with findings of an economic evaluation of the two types of construction. Concrete and steel framing plans for the Service Area had been started and working drawings on footings were made as design progressed. The Vicinity Plot Plan was redrawn as Revision 1, removing "holds" and incorporating information on tie-in with yard distribution facilities.

SECRET

All cell hot piping layout drawings had been revised to incorporate changes requested by Hanford and changes indicated by detailed study of the equipment in the cell jumper piping. This affected progress of hot pipe tunnel, jumper and buried piping design.

Trap pit drawings were in progress and preliminary design of the two utility outlet headers had been started. Study drawings of the Diversion Box and encased waste lines were also prepared.

Equipment arrangement drawings for the Aqueous Make-up Area were at an advanced stage and cold piping arrangement drawings for this area had been started.

Equipment arrangement drawings for the Pipe and Operating Gallery were also completed. Approximately six piping arrangement drawings for the east end of the gallery had been started. Over-all layout work for the various process and utility headers in the Operating Gallery continued during the month.

Equipment arrangement drawings for the sampler locations in the Sample Gallery were issued for preliminary reference at the end of the month. Ten piping arrangement drawings for the process and utility headers located in the Sample Gallery were also started.

A layout drawings showing the arrangement of the equipment making up the product concentrator package was transmitted to GE for review before proceeding with further work.

By the end of the month work had been started on essentially all hot vessels required. Design work was complete and requisitions issued for over half of the cold vessels required. Design was also started on the majority of remaining vessels.

A change of philosophy in regard to the use of trunnion guides and the request to relocate them resulted in a large amount of revision work, which was started during April.

Design of hot pumps was completed and purchase requisitions were issued during the month. In addition, design of the hot agitators and the majority of the jets required were completed, and requisitions for the jets were issued.

DECLASSIFIED

SECRET

Sampler design was brought to the comment stage and preliminary prints were transmitted to Richland for review by GE during April. Design of the wall kickplate installation was completed and requisitions were prepared for the kickplates and transmitted to Richland.

Lighting design for the Service Area and the Pipe and Operating Gallery went on and design for the Storage Gallery was completed during April. However, lighting design for the Sample Gallery was delayed, pending firm information on sampler design, which was not received until the end of the month. Canyon and cab gallery lighting design was also halted pending receipt of firm information on the crane.

Sample Gallery and Pipe and Operating Gallery power design proceeded during the month.

Extensive studies were made to determine design requirements for the various communications and alarm systems. Work then proceeded on detailed design drawings.

During the month, scope information on the graphic and auxiliary panels was received and design work started.

May 1953

DECLASSIFIED

During May, a letter /24/ was transmitted to the AEC outlining Vitro's understanding of their field engineering responsibilities and the assistance to be given the AEC during the construction of this facility.

A group of GE representatives, headed by H. H. Hubble, visited the Vitro New York office during the month to discuss critical design items for Project CA-513. The items covered a review of Class I vessel designs, the increase of specific line sizes to allow for future plant capacity increase, a detailed review of equipment affected by critical mass considerations, and other design matters.

H. H. Schipper of the Richland AEC office and F. B. McKeon of the Washington AEC office joined the GE group on May 21 and 22 for additional conferences with Vitro representatives. Detailed discussions on requisitions and procurement scheduling were held.

SECRET

During May, Vitro report, KLX-1121, "Preliminary Cost Estimate - Project CA-513 - Purex Facility" a cost estimate of the Vitro design portion of the job, was transmitted to the Richland AEC office. The estimate had been prepared at the request of the AEC.

DECLASSIFIED

202-A Building

Minor revisions, incorporating customer comments and miscellaneous design refinements in room layouts, had been made to the Service Area drawings. Interior finish schedule had also been reworked and checked against detailed scope requirements.

Canyon foundation drawings had been brought up to date and cell equipment changes had been incorporated during May. Emphasis was then shifted to wall elevation drawings and lower-level gallery drawings.

Service Area floor plans and framing drawings progressed on schedule during the month.

Sample Gallery duct work drawings had been revised to avoid piping interferences and storage gallery ventilation was modified to provide necessary cooling for the electrical equipment area.

By the end of May, Service Area duct drawings and plumbing drawings were on schedule, and laboratory hood design was progressing on the basis of recent customer comments.

The cell scope drawings which detail the equipment and piping arrangement in the canyon process section were revised during May to reflect the latest changes requested by GE. Work also continued on jumper calculations and drafting.

Essentially all of the buried piping drawings were at an advanced stage, and the cell fog and washdown drawings were revised to conform to latest design changes during the month. Work on the cell fog and washdown drawings was expedited through the use of selective overtime.

Preliminary work continued on the piping arrangement drawings required for the Pipe and Operating Gallery and study work was completed for the piping associated with Cells A, B, C, D, E, and H.

SECRET

Design of Class I vessels was stressed during May and selective overtime was used to expedite completion of vessel design. By the end of the month requisitions were issued for all of the standard vessels and for a major portion of the special Class I equipment. In addition, design work was essentially complete for all cold vessels.

By the end of the month, design work had been completed for the bulk of the cold pumps and agitators and requisitions were issued for these items.

Vitro representatives visited the centrifuge vendor to observe field-testing of the liquid-liquid centrifuge. After reviewing test results, GE requested Vitro to proceed immediately with the preparation of the necessary specifications, layouts and data sheets for procurement of both the solid-liquid and liquid-liquid centrifuges.

Changes in the Product Removal Area requested by GE necessitated complete re-design of this area. This work was started during the month.

Design of the Pipe and Operating Gallery was completed and design for the service area was brought to 40% completion during May. Design for the canyon, the Cab Gallery and the Sample Gallery was also continued.

Design for all Process Areas was continued and power and control studies for the Aqueous Make-up Area, the Service Areas and the auxiliary buildings were undertaken during the month. Communication and alarm design was also brought to about 20% completion.

Arrangement drawings of the head end graphic panel were completed and drawings for the other panels remained on schedule.

Excavation for the building was started during the month.

272-E Building

DECLASSIFIED

Building conversion drawings had been completed and during May were changed to reflect minor revision comments.

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June 1953

During the later part of June, Vitro received two copies of the Blaw-Knox construction schedule. The accompanying letter /25/ requested Vitro's design schedule be revised to suit the Blaw-Knox schedule, which showed September 1, 1954 as a new construction completion date. Vitro advised against revising the design schedule /26/.

202-A Building

The upper gallery slab drawings were practically complete and were just awaiting information on surface arrangement details by the end of June. Service Area framing drawings and column and footing schedules also neared completion.

H & V process flow diagrams had been brought up to date, with air quantities added. Also, laboratory hood design details had been reconciled with customer requirements and working drawings had been initiated.

Service Area ductwork drawings had been completed, and plumbing drawings had been revised to reflect customer comments. Data sheets for H&V equipment were also essentially complete by the end of the month.

Work continued on jumper calculations and drafting. In addition, the sample jumper drawings which are to serve as a basis for the jumper requisition were nearly completed.

By the end of June, drawings for buried supports and piping were about 50% complete. Preliminary work had also been started for the Pipe and Operating Galleries.

Drawings for all standard Class I vessels were completed and column design was approximately 60% complete, with drawings for some of the units completed, by the end of June.

Work on the concentrators was essentially complete and work on the "L" cell package was about 50% complete. Work on Class II vessels was also completed during the month.

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Redesign of the Product Removal Area, as requested by GE, was substantially completed. Pulse generator drawings were also near completion and it was expected that a requisition for these items would be ready early in July.

All drawings necessary for the mat pour were released and continuous emphasis was placed on those drawings necessary for early wall pours.

R. C. Mann of GE visited the Vitro New York office during the week of June 22 to discuss details of instrument design. Copies of the head end graphic panel drawings and schematics were given to Mr. Mann for transmittal to the Panellit Company as advance information which would aid Panellit in initial work. Listings of rotameters and temperature elements were mailed to Panellit to expedite procurement of long-delivery items.

Bulk building excavation was completed.

The construction contractor continued to pour concrete strips to support the mat reinforcing steel. Installation of concrete forms for mat pours has been started. The estimated date for the first mat pour was changed from June 29 to July 8.

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July 1953

During July a major portion of the design effort was expended on revising detailed drawings due to design modifications. During the month, the total number of drawings so revised was 278. These drawings were largely in areas of early construction, and consequently had to be given priority over new work. This revision work had noticeably affected the design schedule. For the first time during the course of the job, design work fell behind schedule (59.8% against a scheduled 60.0%). To maintain the design schedule as well as to expedite production of urgent construction information, an increased amount of overtime was worked during July.

Meetings of representatives of the AEC, Blaw-Knox, and Vitro were held in the Vitro New York office during early July to discuss the Blaw-Knox construction schedule. Mr. McKeefe of Blaw-Knox presented, in detail, Blaw-Knox requirements for design information necessary to meet the advanced completion date set by the AEC for Project CA-513. These dates were re-

viewed and targets were established /27/ for release by the Vitro New York office of specific design information.

A major scope change to design of the five large concentrators for Building 202-A was initiated during the month. H.H. Hubble of GE brought a scope package of the new design to the Vitro New York office for design discussions with Vitro. This work required extensive changes to five cells including changes to cell and buried piping, gallery piping and instrumentation and a complete new vessel design. To expedite procurement of the equipment, Vitro was requested to prepare a vessel design package during August for release to equipment vendors so that bids could be made. Work on this package was started during July. It was anticipated that revision work on other affected design items would be started during August.

DECLASSIFIED

202-A Building

Canyon drawings were virtually completed during the month.

Service Area drawings progressed with minor changes being made as required by final design considerations. Structural steel drawings had also been brought to a point of completion suitable for negotiations with prospective sub-contractors.

Canyon ductwork drawings progressed and minor revisions were made to Service Area ductwork drawings. All of the above had also been brought to a point of completion suitable for negotiations with prospective sub-contractors.

Development of supply and exhaust air control drawings had progressed during July along with the development of heating and ventilating control specifications for subsequent issue as a complete package.

Hot Pipe Trench - Approximately half of the piping arrangement drawings and accompanying support sheets were completed. Work also continued on the remaining arrangement and support sheets. All of the buried Unistrut drawings required for the trench piping were approved.

Buried Piping - All buried piping drawings required for the lower portion of Building 202-A were completed by the end of the month.

SECRET

Jumpers - All of the drawings required for the jumper requisitions were completed. Jumper work for the centrifuges in both the feed preparation and solvent recovery cells was delayed because of lack of firm dimensional information for these units. Drainage drawings for the Sample, Cab, and Operating Galleries were essentially complete by the end of the month. Working drawings for the Pipe and Operating Gallery were 30% complete, over-all, with certain key drawings at an 85% stage. Pulse column design was completed and a requisition was issued in July. In addition, the work on the "L" cell package was essentially complete by the end of the month.

Approximately 45 additional mechanical equipment drawings were added to the drawings schedule. These additional drawings reflected either added necessary detail work or increased scope of work in the following categories: samplers, jumper checking jigs, Product Removal Room, column handling fixtures, pulse generator supplies, and laboratory waste storage. Addition of these drawings affected the completion figure for mechanical equipment design.

Electrical drawings for the initial pours were expedited and released to comply with the construction schedule, while Canyon and gallery lighting was also completed. By the end of July Service Area lighting design was 85% complete; canyon and gallery conduit and grounding drawings were 65% complete; Service Area power design was 10% complete and Communication and alarm drawings were 50% complete.

By the end of the month, the graphic panel requisition had been issued and all buried air tubing and conduit design work for Building 202-A had been completed.

The first mat was poured on July 8 and subsequent pours were made during the remainder of the month.

203-A & 211-A Buildings

Equipment arrangement drawings were issued and the resulting comments were incorporated in the preliminary detail design studies during July. Vessel requisitions and data sheets were also prepared and transmitted to the customer for procurement. In addition, piping design was initiated and piping and mechanical equipment requisitions were prepared and issued.

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272-E Building

Foundations for the "A" frames were completed in early July, while removal of all the existing cell mock-up structure and associated utilities continued.

291-A Building

Equipment arrangement and heating and ventilating design details for the Fan Platform, Plenum, and Control House progressed to a point where working drawings could follow.

Outside Facilities

On July 8, 1953, HW-28320, Waste Disposal Design Criteria, dated June 12, 1953, was received. This document required an additional investigation of shielding and drainage, which was started during the month.

August 1953

The difference (3.9%) between actual and scheduled completion of detailed design during the month was attributed to the delayed impact of scope and design changes. These changes and their affects on detailed design progress had been discussed in correspondence /28/ thru /32/. Increased efforts were continued on expanding drawing revisions so that early construction needs could be filled. To assist in accomplishing this, an increased amount of overtime was worked during the month. Representatives of Blaw-Knox and the AEC visited the Vitro New York office to review the Vitro design drawing schedule and its relation to the Blaw-Knox construction schedule requirements.

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A procurement package covering the concentrator redesign was delivered during mid-August. A letter was transmitted to the AEC /33/ outlining the Vitro viewpoint on the technical aspects of the concentrator redesign and its effect on the design schedule.

During the month, representatives of GE and Vitro met in Richland to discuss Project CA-513 (Purex) heating and ventilation design and its relation to the contamination problem encountered in Building 202-S (Redox). A detailed study of the design information discussed at these meetings was made and the results summarized in a letter /34/ to GE.

202-A Building

Ductwork drawings were virtually complete by the end of the month. However, it was expected that some of the completed heating and ventilating work would have to be revised in order to resolve the contamination elimination problems.

Jumpers While work continued on the jumper drawings, design work relating to the five concentrator cell locations was stopped until design changes were completed. Work in the centrifuge cells was also held in abeyance pending receipt of firm vendor information. These two items comprise about 15% of the total jumper effort.

Hot Pipe Trench Work continued on the drawings required for the west half of the trench. Revision of previously issued drawings was also started. Practically all buried piping had to be changed because of continuing process changes and minor design modifications requested by GE.

Aqueous Make-up Work had been virtually stopped in this area due to the need for manpower on buried piping. Near the end of August, however, a shift in manpower allocation was made and it was expected that better progress would be made in September. The drawings were at 20% overall completion.

The redesign of the procurement package for the large concentrators was completed as scheduled, on August 19 and the drawings, with requisitions were approved for bid purposes by GE on August 20.

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The graphic panel requisition package required a major amount of rework due to the concentrator redesign and other scope changes. It was intended to furnish the requisition information to the vendor in meetings at his plant early in September, with formal confirmation to follow.

Pouring of the foundation mat was completed the first week of August. The Blaw-Knox wall pouring sequence has been revised to give their engineering group more lead time over actual construction, and to adjust to delivery of forming equipment.

272-E Building

Removal of existing cell mock-up structure was completed and forming of new mock-up foundations was started.

September 1953

Actual completion of detailed design (73.1%) continued to fall behind the scheduled completion (80.0%) due to the delayed result of the numerous scope and detailed design changes and revisions. This inevitable impact had been pointed out in correspondence to the AEC since March. An increased amount of overtime was again worked during September and the total hours worked exceeded the 3% stipulation limit for overtime /35/. It had been hoped that the excessive volume of revision work necessary to complete the drawings had passed its peak and that increasing efforts could be made to expand on new design work so that the project could get back on schedule.

It became evident during September that the construction contractor had been holding back work he was able to do, awaiting information beyond that in hand. To discuss this, a meeting of representatives of the AEC, Blaw-Knox and Vitro was held in New York on September 23. In late September, at the request of the AEC, an extensive program was instituted for supplemental pinpointing of construction information to the construction contractor in sufficient detail so that he could know specifically where work could proceed without waiting for revised information yet to come. In the meeting mentioned above, it was established that there were approximately 200 monoliths which were clear to pour from the standpoint of design information and word was immediately sent to Blaw-Knox in the field.

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In two meetings in Richland revisions to the heating and ventilating system to control future contamination in Building 202-A were discussed and Vitro proposals were reviewed. Based on scope information decided upon at these meetings, Vitro initiated design on an entirely rescoped process ventilation system.

202-A Building

Cell vent ports and canyon supply ducts were resized and drawings revised to meet the conditions of the increased exhaust ventilation system. Revision to the process air flow diagram was begun to incorporate customer comments and reflect new requirements.

Sample Gallery The drawings required for the shielded piping run in the Sample Gallery were completed. The drawings detailing the piping run in the Sample Gallery proper were brought to the comment stage.

Cell Arrangement Final revision of the cell arrangement drawings was under way at the end of the month, however, this work was held back until completion of the buried piping. These revisions reflected the latest process design changes and design development shown by detail jumper layout studies.

Aqueous Make-up The over-all detail drawing completion for this area was 40% complete and continuing emphasis was placed on the drawings.

Pipe and Operating Gallery The piping arrangement drawings for this area were at an over-all 52% completion.

As a result of a meeting at Chicago with representatives of GE, Blaw-Knox, Panellit Company and Vitro, questions concerning recent scope changes were completely clarified. Revised schematics were scheduled to be issued in October for a revision to the requisition.

Interconnection diagrams were brought to 95% completion with "holds" for vendor information noted on all drawings. Erection sheets were at 82% completion with minor revisions in progress on a few drawings. Tubing routing drawings were started during the month as soon as piping drawings became available.

DECLASSIFIED

272-E Building

The large jumper checking jig drawings were completed and a Vitro representative visited Richland to review them with GE engineers. Necessary changes were made in the Vitro field office and this item was then processed for procurement.

291-A Facility

The exhaust stack was resized for new ventilation requirements and as a basis for revision to the specification. Work was also initiated on revising the exhaust fan data sheets to meet the new operating conditions and performance requirements. Preliminary redesign of the sand filter was made in order to establish a new layout for revision of the Vicinity Plot Plan.

October 1953

As of October 3, all construction drawings, including latest revisions and specific detail lists pinpointing this information, had been released by the Vitro New York office.

Revisions to completed drawings continued to divert a considerable portion of the design effort from completing new design. A total of 338 revisions was issued during the month. During October, however, a concentrated effort was made to get the design work back toward schedule and to establish a positive lead over construction. In order to achieve these ends, personnel employed during the month exceeded the budgeted allotments. Extensive amounts of overtime were also applied to the project during the month.

During early October, J. C. Tourek, in discussions with AEC and Blaw-Knox representatives, summarized the status of the Vitro design with respect to construction requirements. Mr. Tourek stated that by the end of the month, all the design work necessary to allow construction of the entire canyon portion of Building 202-A would be completed. This commitment was subsequently met.

DECLASSIFIED

202-A Building

The architectural work for this facility was completed. However, occasional revision work required by design development, was still to be done.

Structural work for this facility was 98% complete by the end of the month. However, a concerted effort was made to bring the Service Area drawings up to date with latest design requirements to expedite the release of information to the structural steel subcontractor.

All the piping arrangement drawings has been completed, but they all require revision in accordance with the GE request for a larger collection header. Work continued on the support drawings required for the hot pipe trench piping.

Revision work on the buried piping drawings was completed. Revision work also continued on the drawings for the trap pits outside of Building 202-A.

The over-all detail drawing completion for the Aqueous Make-up Area was 54%, with about a third of the drawings Vitro approved.

Detail drawings for the Pipe and Operating Gallery were brought to an over-all completion of 71%, with about half of the drawings complete.

All drawings were complete at the end of the month with the exception of 18 vessel arrangement drawings, which were in checking, and six newly added vessel insulation drawings.

During the month, final revisions to the column drawings were completed.

Except for those sampler drawings affected by the pH meter installation, all of the sampler drawings required for the job were completed and transmitted to GE for approval.

A joint meeting was held between the centrifuge vendor, GE and Vitro to review the design of the two types of machines required. By the end of the meeting all major design questions were satisfactorily resolved. Detailed vendor drawings were well under way by the end of the month for the "solids" centrifuge. Vendor layouts for the "liquids" machine were started.

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All power, lighting, and communication drawings for the canyon and gallery areas were completed and revisions were made as required.

Service Area communication drawings were brought to completion, with Service Area conduit and grounding drawings at an over-all 45% completion.

Erection sheets were brought to an over-all completion of 90%. Inter-connection diagrams were completed. Tubing routing drawings were brought to 30% completion.

272-E Building

The design of this facility was virtually complete by the end of October.

203-A Building

Structural design is complete.

November 1953

In a continued effort to get design work on this project back on schedule, the number of personnel employed during November again exceeded the budgeted allotment for the month and extensive overtime was employed. /36, 37/. The average number of personnel assigned to the project during November was 368 as opposed to budgeted average of 251.

A positive lead over the construction contractor was established. To maintain this lead, a large part of the November design effort was concentrated on the incorporation of design changes and revisions to completed drawings. The load of work needed to make these revisions had proved to be a longer-lasting impediment to the design than originally anticipated.

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On the basis of the above, J. C. Tourek informed the AEC /38/ of an anticipated over-run in design dollar expenditures for Project CA-513. Vitro evaluated the design status of the project in respect to revised budgetary requirements.

202-A Building

Structural work for this facility was virtually complete by the end of the month.

The heating and ventilating control systems design package was completed and a requisition for it was prepared during the month, and another package covering the majority of the lab hoods was released for procurement.

Manpower which had been diverted to piping related to imminent concrete pours was brought back to jumper design work, thereby accelerating jumper drawing production.

During the month the remaining chemical equipment drawings were completed.

Revisions to the sampler drawings requested by GE were completed in Richland. Design work on the samplers was complete except for the drawings affected by the pH meter installation.

Detail layouts were completed for the equipment items which would require special handling during installation and removal from the Building 202-A canyon.

A review of canyon equipment yokes was made to coordinate their design with changes developed in the course of the Vitro equipment handling study.

Approximately 20 new electrical drawings were added to the drafting schedule in order to present more complete construction information.

Revisions to the instrument schematics were emphasized during November to make possible issuance of an alteration to the panelboard requisition during December. Changes to the schematics affected erection sheets, interconnection diagrams, etc., and revisions were started on these related drawings.

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203-A & 211-A Buildings

Detail piping design drawings for both areas were brought to an over-all completion of 46%, with emphasis on buried piping required for Building 203-A construction. Structural design for the 211-A facility was started and brought to 39% over-all completion.

291-A Building

Over-all design was being held up pending a decision by GE as to what type of exhaust air filter would be designed for future installation. Layout sketches have been made for the fan platform to allow structural work to proceed.

Outside Facilities

Piping arrangement drawings for the piping and diversion box were completed in November.

Outside Utilities

Detail design drawings were in progress for the outside utilities distribution systems, both piping and electrical. These drawings were based on continuing layout studies.

December 1953

A revised budget dated December 16, 1953 was submitted by Vitro to the AEC by letter of December 17 /38/. The budget was incorporated into the working plans for prosecuting the remainder of the Vitro design re-

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sponsibility on this project. The letter /38/ included an itemized breakdown reconciling the revised budget with the original budget.

Design work on the 291-A facility was held up pending a decision by the AEC on the installation of the ventilation air filter. In addition to heating and ventilating design work, piping and other design work was affected.

During the month, additional requests for new design changes were received, including basic changes in the trap pit design and in the yard drainage facilities. Work on incorporating these changes, which critically affect the construction contractor's operations, was expedited.

202-A Building

All structural drawings have been completed except for one drawing held up due to lack of vendor print information.

Work proceeded on heating and ventilating changes discussed in the joint GE - Vitro meetings held in Richland in late November and early December.

All of the piping arrangement drawings for both the shielded pipe chase section and the unshielded gallery area were complete by the end of the month.

Considerable rework on the drawings for the 276-A Solvent Recovery Area was necessitated by the design modifications to the liquid-liquid centrifuges, which are located in this area. Piping arrangement drawings were brought to an advanced stage.

Drafting work was completed during December on the pipe support drawings.

Revision work was completed on the piping arrangement drawings for the acid storage vault. These drawings had been previously issued for buried piping only.

By the end of the month, 405 of a total of 580 jumper drawings were completed and most of the remainder had been started.

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SECRET

All remaining sampler drawings were completed during the month.

Drawings for customer-requested yoke storage racks, pump and agitator storage racks, and equipment removal capsules were also completed during the month.

All Service Area conduit and grounding drawings were completed. Inter-connection diagrams were 60% complete over-all. In addition, all communication riser diagrams and schematics were completed during December.

Vendor's prints for the head end graphic panel were received at the end of the month and comments were recorded for the vendor's action. Revisions to the instrument schematic drawings were completed for transmittal to the vendor.

An over-all cross check of schematics vs. requisitions vs. application sheets was started.

203-A & 211-A Buildings

Detailed piping design for the 203-A facility was completed. Piping design for the 211-A facility was 45% complete, over-all, with about one-third of the drawings completed. Structural design drawings for these facilities was also completed. Substantial progress was made on the instrument, electrical, and heating and ventilating drawings for both facilities.

January 1954

By letter /39/ of January 7th, the AEC formally accepted Vitro's revised estimate of the cost of Project CA-513. This revised budget had been discussed earlier in the month during a visit to Richland by J.C. Tourek.

On January 20th, Messrs. J.I. Thomas and L.F. Perkins of the Richland AEC office visited the Vitro New York office. A general review and discussion on the status of work under Contract AT(45-1)-628 was held.

DECLASSIFIED

Late in the month, the awaited scope package for the new 291-A exhaust ventilation filter was received. The necessary design work was started at the end of the month.

Virtually all construction work was halted during the first three weeks of January as a result of a two-week carpenter strike and one week of extremely bad weather.

202-A Building

All piping drawings were completed for the 276-A Solvent Recovery Area, and all except 19 jumper drawings were completed by the end of January. Piping design for the Aqueous Make-Up Area and for the Pipe and Operating Gallery was also completed.

Customer-requested redesign of three pulse columns was completed in January, and design of alterations to two surplus Hanford tanks was made so that these tanks could be used in the stack washdown and neutralization system. Vendor drawing work on chemical equipment was approximately 90% complete by the end of the month.

Only six electrical drawings remained to be completed for Building 202-A. Of these, three could not be completed owing to lack of information from the vendors supplying controls for the centrifuge equipment.

Only three instrumentation drawings remain to be completed. Final revisions to schematics and erection sheets had been accumulated for a cross-check of drawings, data sheets, and comments. Drafting was to start in February.

February 1954

Early in the month, meetings were held in Richland between representatives of the AEC, the Vitro New York office and the Vitro Richland office. The general status of remaining design work for the Vitro New York office was discussed.

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A review meeting on construction progress was called by the AEC in mid-February. This meeting was attended by representatives of the Washington AEC office, the Hanford AEC office, GE, Blaw-Knox and Vitro. J. C. Tourek presented the history of design work relative to its affect on construction, concluding that adequate lead time had been maintained. Comparison curves presented at this time illustrated that design-construction phasing on this project compared favorably with previous Vitro engineering work at Hanford.

Design work on the 291-A exhaust ventilation filter package was completed during February and delivered to Richland.

202-A Building

An extensive instrument design effort remained in preparing the instrument acceptance auxiliary data sheets and completing approximately 4000 instrument application sheets.

During the month, major efforts were continued on forming and pouring the canyon walls. The construction of the canyon roof was also started during the month.

Work was continued on setting bearing plates and installing kickplates in the "H" wall.

March 1954

Discussions were held during March to decide upon the handling of a number of additional work items requested by GE for incorporation into the Purex plant. Vitro was assigned responsibility for completed designs on several of these projects; on others, design authorization had not yet been given by the AEC, and Vitro was asked merely to carry out the immediate changes in the permanent construction necessary to allow installation of the new systems at a later date. It was expected that this work would be completed in April.

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Other Title I, II, and IV work on this project was essentially complete at the end of March. The only items remaining were the preparation of two electrical interconnection drawings which awaited vendor information, and revisions of certain drawings to delete the few remaining vendor "holds." Receipt of vendor information for these items was being expedited through the purchaser.

April 1954

All work on the additional items requested in General Electric letters PX-472, -478, -480, -482, -483, -485, -486, -487, and -489 was completed on schedule during the month. Full completion of other Title I, II and IV work was awaiting certain tardy vendor information.

On April 15, a revised budget was submitted by Vitro to the Commission /40/. Included in this budget were provisions for the additional design work Vitro had previously been requested to perform. Revised estimated costs for Title III work were also included, based upon firm information as to the services Vitro was to perform. It was anticipated that this budget would cover all remaining Vitro work on this contract.

May 1954

The two centrifuge interconnection diagrams were transmitted for approval during May, thus completing issuance of all drawings. In addition, numerous "clean-up" revisions were made to scope drawings and other non-critical information.

By the end of May, essentially all Vitro design work was complete.

By letter of May 3, 1954 /41/, the Commission accepted the revised cost estimate submitted by Vitro during April. This letter also approved the resident engineer force proposed by Vitro to render construction assistance (Title III work).

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SUMMARY OF PUREX PROJECT

The Purex Project is described in some detail from a process standpoint in Part II and from an engineering standpoint in Part III. An exhibit of representative drawings is included in Volume II.

Design Performance

Scope and Detail Drawings

The number of scope and detail drawings prepared by Vitro has been summarized, by categories, in Table 1.

A total of 2549 drawings was prepared. As of November 12, 1954, revisions to these drawings totaled approximately 3947, including those prepared in the Vitro Richland Field Office as well as in New York.

Specifications

A total of 59 specifications was prepared by Vitro in connection with this Project. (See Table 2.)

Requisitions

A total of 562 requisitions were issued by Vitro for this Project. (See Table 3.) A small number of these were bulk requisitions initiated by GE in advance of the start of Vitro detailed design, to expedite placement of orders for long delivery, critical items. These requisitions were later taken over by Vitro.

Manpower

Figure 3 records the number of Vitro personnel assigned to the Project. This chart also compares the scheduled to the actual manpower requirements. (The numbers are presented in terms of equivalent full-time

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TABLE 1

STATUS OF SCOPE AND DETAIL DRAWINGS—PUREX FACILITY*

May 31, 1954

Class	Reqd.	Number of Drawings		Appv'd for		Construction	
		Started	Completed	Sched.	Act.	Sched.	Act.
		Sched.	Act.	Sched.	Act.	Sched.	Act.
202A Bldg. (Incl. 276A)							
Struct.	143	143	143	143	143	143	140
Arch.	49	49	49	49	49	49	49
H&V	156	156	156	156	156	156	155
Mech.	497	497	497	497	497	496	497
Piping	1095	1095	1095	1095	1095	1085	1078
Elec.	187	187	187	187	187	187	185
Inst.	210	210	210	210	210	210	156
Sub-Total	2337	2337	2337	2337	2337	2326	2260
203 - UNH Storage	37	37	37	37	37	36	36
211A - Chem Storage	34	34	34	34	34	33	33
241A - Div. Box & Catch Tank	18	18	18	18	18	18	18
272E - Mock-up	52	52	52	52	52	52	52
291A - Stack Filter & Cont. House	31	31	31	31	31	31	31
271A - Chem. Whse.	2	2	2	2	2	2	2
Outside Utilities & Facilities (Inc. Rds., Walks, Fences, Process Waste Lines Detail)	38	38	38	38	38	38	33
TOTAL	2549	2549	2549	2549	2549	2536	2465

*Excludes drawings for Redox Expansion, Project C-535

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TABLE 2
STATUS OF SPECIFICATIONS—PUREX FACILITY*

April 30, 1954

<u>Class</u>	<u>Estimated Number Reqd.</u>	<u>Vitro Sched.</u>	<u>Complete Act.</u>	<u>Customer Sched.</u>	<u>Appv'd Act.</u>
Structural	8	8	8	8	8
Architectural	15	15	15	15	15
Heating & Ventilating	5	5	5	5	5
Mechanical	9	9	9	9	9
Piping	15	15	15	15	15
Electrical	2	2	2	2	2
Instrumentation	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>
TOTAL	59	59	59	59	59

*Excludes specifications for Redox Expansion, Project C-535.

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TABLE 3

STATUS OF REQUISITIONS—PUREX FACILITY*

April 30, 1954

<u>Class</u>	<u>Estimated Number Required</u>	<u>Vitro Complete Sched.</u>	<u>Act.</u>
Structural	21	21	21
Architectural	9	9	9
Heating & Ventilating	66	66	66
Chemical Equipment	58	58	58
Mechanical Equipment	38	38	38
Special Devices	<u>62</u>	<u>62</u>	<u>62</u>
Mechanical	158	158	158
Piping	73	73	73
Electrical	75	75	75
Instrumentation	<u>160</u>	<u>160</u>	<u>160</u>
TOTAL	562	562	562

*Excludes requisitions for Redox Expansion, Project C-535.

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FIG. 3

MANPOWER REQUIREMENTS
PUREX FACILITY-JOB 1063 (EXCL. 1063.06)
DESIGN ONLY-EXCLUDES SUPERVISION OF CONSTRUCTION

NOTE

DESIGN ONLY INCLUDES TITLE I, II, & IV WORK;
SUPERVISION OF CONSTRUCTION, TITLE III, IS EXCLUDED

SCHEDULE APPROVED FOR AEC

BY DATE

VITRO CORPORATION OF AMERICA
KLX-H36
JUNE 7, 1954

personnel.) In all, a total of 912,741 manhours was expended by June 30, 1954. It is expected that the final total, when all activities have been completed, will approximate 917,688 manhours.

Financial

Figure 4 records Vitro expenditures over the course of the Purex Project, comparing actual expenditures with estimated requirements. The total expenditure to May 31, 1954 was \$ 3,914,196. It is estimated that the final total expenditure, when all activities have been completed, will approximate \$ 4,017,372 in accordance with the last Project Budget prepared April 16, 1954.

Project Over-all

Figure 5 records detailed design progress in terms of schedule vs actual % completion. As shown, the project was % complete on March 1, 1954 as compared to the design schedule.

ACKNOWLEDGMENT

Design of the Purex Facility, which represents the fourth completed phase of Vitro's work for the HAPO, was completed in accordance with the established schedule and included provisions for future operation of the plant at expanded capacity. The Vitro Corporation wishes to acknowledge cooperation and assistance received from the AEC and GE Co. in the handling of both the administrative and technical problems inherent in this major engineering undertaking.

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FIG. 4

ESTIMATED AND ACTUAL VITRO EXPENDITURES (EXCLUDING COMMITMENTS AND FEES)
PUREX FACILITY-JOB 1063 (EXCL. 1063.06)

DESIGN ONLY--EXCLUDES SUPERVISION OF CONSTRUCTION

TOTAL ESTIMATED
COST \$3,956,872

SCHEDULE APPROVED BY AEG

BY _____ DATE _____

NOTE

DESIGN ONLY INCLUDES TITLE I, II & III WORK.
SUPERVISION OF CONSTRUCTION, TITLE III, IS EXCLUDED.

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KLX-1136
JUNE 7, 1964

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FIG. 5

JOB PROGRESS CHART
PUREX FACILITY-JOB 1063 (EXCL.1063.06)
DETAIL DESIGN ONLY

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II PROCESS DESCRIPTION*

INTRODUCTION

The Purex process is designed to separate the uranium, plutonium and fission products contained in irradiated uranium slugs produced in the Hanford pile reactors. A three-cycle solvent extraction system is utilized for this separation. In the extraction system, the relative solubilities of the various components in aqueous and organic phases are carefully controlled so as to effect the desired separations.

The plant is designed to maintain an average production of 200 short tons of uranium per month (30 days) or 102 kilograms of plutonium per month, whichever is limiting under the prevailing conditions of pile operations. A combined time and operating efficiency of 80% is assumed for the purpose of setting the instantaneous design rate of $8\frac{1}{3}$ short tons of uranium per day or 4.25 kilograms of plutonium per day. In addition, major process equipment items and related buried lines are designed for a peak load of 25-100% over the instantaneous design rate, to minimize changes in event of future revisions in process or required plant capacity.

A product recovery of at least 98% of both uranium and plutonium is expected. The permissible fission products in the uranium and plutonium products (tentative specifications) are 1×10^{-27} beta curies and 5×10^{-8} gamma curies per gram of uranium and 8×10^{-5} beta plus gamma curies per gram of plutonium. Consequently, over-all gamma decontaminations of about 4.5×10^6 for uranium and about 1×10^7 for plutonium will be required to meet the tentative specifications.

* This section is based on information furnished by Document HW-26177 from G. R. Graham to J. C. Tourek, December 26, 1952. The information contained in this document was revised where necessary to reflect any changes subsequent to the date of issuance.

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PROCESS SUMMARY

The heart of the Purex process is a TBP (tributyl phosphate) solvent extraction system. In order to assure the required separation and decontamination, a three-cycle system has been chosen. Uranium and plutonium are separated from fission products in the first cycle (pre-cycle); uranium and plutonium are separated from each other and further decontaminated in the second cycle, called the "partition" cycle; and each of the two product streams (uranium and plutonium) is still further decontaminated in the third (decontamination) cycle.

Decontamination (separation of fission products from uranium and/or plutonium) is effected in all cycles by the preferential absorption of uranium and plutonium in the organic phase in counter current extractors, the preferential absorption being encouraged by a "salting" agent (nitric acid) in the aqueous phase and controlled organic to aqueous flow ratios. Separation of uranium from plutonium in the partition cycle is effected by first reducing the plutonium to the aqueous-favoring trivalent state (by addition of ferrous ion), again adjusting composition and flow rates to encourage the desired preferential absorption of uranium in the organic phase.

The solvent extraction system is preceded by slug casing removal, dissolution, feed clarification and feed adjustment steps. After extraction, the uranium and plutonium streams are concentrated to provide a suitable feed for UNH conversion and product finishing plant, respectively. The aqueous waste, containing the fission products, is concentrated, neutralized and piped to underground storage. Nitric acid is recovered during concentration steps for re-use in the process. The organic solvent is purified by chemical scrubs and returned to the process. (See Fig. 6.)

DETAILED PROCESS DESCRIPTION

Each of the steps in the process is discussed in more detail in this section, which should be studied in conjunction with the Purex Process Flow Diagrams.

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Fig. 6 - BLOCK DIAGRAM - PUREX PROCESS STEPS

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METAL SOLUTION FEED PREPARATION

The material to be processed in the Purex plant is irradiated uranium slugs from the Hanford reactors. These slugs are cooled for 90 days before processing in the Purex plant and contain uranium, plutonium and fission products.

Four steps are required in the preparation of feed solution from the irradiated slugs for the first extraction column (HA column). These steps are batch operations, which include:

- (1) Removal of slug jackets.
- (2) Dissolution of slugs.
- (3) Clarification of metal solution prepared in Step 2.
- (4) Adjustment of the composition and valence of the clarified solution before routing to the HA column.

The first two steps are performed in one of three dissolver units. Three units are required, taking into account adverse weather conditions, to maintain production. A dissolver unit consists of dissolver, dissolver tower, silver reactor, off-gas filter, a metal solution tank, and gallery side chemical addition and drowning tanks. The third step is performed in two centrifuges which are operated in parallel. The fourth step is performed in a separate make-up tank operated, batchwise, in series with a common centrifuge catch tank:

These steps are discussed in detail below.

Removal of Slug Jackets

Before charging starts, the water heel remaining from the previous dissolution is jetted to the rinse tank, which serves all three dissolvers. The dissolver is then charged with about 2,100 eight inch slugs which are equivalent to approximately $8\frac{1}{3}$ tons irradiated uranium. The slugs are charged in 8 hours using 15 loaded slug buckets and are charged directly onto the $8\frac{2}{3}$ ton metal heel remaining from the previous batch.

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The aluminum jacket and bonding layer between the jacket and slug proper are removed according to present Hanford practice, using a 10% NaOH - 20% NaNO₃ solution. Jacket removal is assisted by a steam sparge upward through the pile of slugs. After the dissolving is complete, the jacket waste is jetted to the neutralizer tank via a waste hold-up tank. The undissolved slugs are then washed twice with water. The first wash is jetted to the waste hold-up tank and the second wash is jetted to the waste concentration section. Based on previous dissolving experience, losses of uranium and plutonium during jacket removal do not exceed 0.04% of that present in the slugs. Ten hours' time is allocated for the jacket removal step, including charging of chemicals, washing and jetting.

Dissolution of Slugs

60% HNO₃ is used to dissolve the metal. The metal is dissolved in two increments or cuts, but the operational procedure for the two cuts is identical. Consequently, one-half of the total acid required per dissolver batch is added for each cut. After the acid is charged, cooling water is started through the tubes of the dissolver tower and the contents of the dissolver are heated to initiate the dissolution reaction. As in all canyon equipment, a negative pressure is required in the dissolver at all times. The start of the reaction is determined by a sudden increase in the differential pressure across the dissolver tower. After the dissolution starts, heating is temporarily discontinued and the heat generated by the exothermic metal dissolving reaction maintains the reaction and brings the solution to the boiling point.

At the start of the dissolution, the predominate chemical reaction is believed to be:

Maximum amounts of nitrogen oxides are generated by this reaction. During the dissolution, other reactions than the one shown above occur and the overall amount of HNO₃ required is much less than 8 moles per mole of uranium. Such reactions produce NO as well as NO₂. The amount of HNO₃ that must be charged depends on the quantity of nitrogen oxides which is recovered in the dissolver tower. These oxides are converted to nitric acid in the tower and

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are refluxed to the dissolver to react with more uranium. As the reaction continues, it is necessary to heat the contents of the vessel to maintain a favorable rate of reaction.

Air is required to oxidize NO to NO₂. The nitrogen oxides formed by the dissolving reactions, along with HNO₃ and water vapors, are mixed with process air which is drawn into the vapor space of the dissolver. The NO₂ is then recoverable as HNO₃, as shown below.

The mixture is brought to the top of the vertical tube dissolver tower, the main purpose of which is to reflux HNO₃ solution, to recover nitrogen oxides as HNO₃ solution and to return the acid solution to the dissolver. The vapors enter the top of the dissolver tower to permit co-current flow of nitrogen oxides and condensate, but the flow of cooling water in the tubes is counter-current to the flow of the gas mixture. Cold process water is sprayed into the top of the dissolver tower during the initial three hours of each cut. This water is required for proper dilution of the metal solution, is used to cool the hot gases and vapors, and provides an additional source of water for the absorption of NO₂. This mixture of water, gases and vapors from the dissolver solution, air and entrained liquid is cooled as it passes down the tower. As water vapors are condensed, they absorb NO₂ gas forming HNO₃ according to the equation:

A portion of the NO formed above is oxidized to NO₂ and a part of this NO₂ is then absorbed.

Experimental data have shown that the over-all chemical reaction as written around the dissolver and dissolver tower can be approximated as:

This means that 1 mole of nitrogen oxides is discharged to the stack per mole of dissolved U. All other nitrogen oxides formed in the dissolution reaction and absorption reaction are refluxed to the dissolver as a HNO₃ solution.

The dissolution continues until the specific gravity of the boiling metal solution reaches 1.82. At this time, substantially all HNO₃ added to the dissolver has been consumed. The solution is then

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diluted with water from the rinse tank and cooled to about 45°C before jetting to the metal solution tank. Three metal solution tanks are provided, each connected to its normally operated dissolver. The first cut of each batch is held in the metal solution tank until it is combined and blended with the second cut of the same batch. Blending the two cuts is necessary to assure a uniform Pu concentration in the dissolved batch. The entire batch is then jetted to the centrifuge feed tank.

As soon as the second cut is jetted from the dissolver, the 8-2/3 ton metal heel remaining in the dissolver is covered with water from the rinse tank and remains immersed until the next dissolution commences. Fresh make-up water is added from a gallery tank as required.

Small amounts of radioactive iodine are contained in the gas leaving the dissolver. Consequently, the gas and vapor mixture leaving the dissolver tower is deentrained, heated and contacted with silver before routing to the gas filter and stack. Entrained liquid is removed in a packed deentrainment section of the silver reactor, and refluxed to the dissolver, before the gas enters the heating section. The gas is heated in a tubular heat exchanger with 185 psig steam, maintaining an exit gas temperature of 160-220°C, and is then passed through the silver reactor which removes radioactive iodine. The gas mixture leaving the silver reactor is then filtered and is discharged to the atmosphere via the stack.

Eleven hours is allocated for each cut. Nine hours of this time is required for the actual dissolution and the other two hours is spent in adding chemicals, cooling and jetting. Total dissolver cycle time is 48 hours, which includes charging, jacket removal, metal dissolution, and 8 hours' down time.

One drowning tank is available for each of the three dissolvers. These tanks contain water which can be quickly added to a dissolver to quench an uncontrolled dissolving reaction.

An alternate procedure for slug dissolution is the substitution of HNO₃ solution of reduced strength for the 60% solution, and the reduction or elimination of the cold process water spray at the top of the dissolver tower. This would decrease the peak reaction rate. The alternate procedure is identical to that previously described in

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all other respects. No additional lines or equipment are required. The equipment may be operated using any strength acid between 43% and 60%.

Clarification of Metal Solution

The metal solution in the centrifuge feed tank is jetted, at a two GPM rate, to each of the two centrifuges, which are operated in parallel. The centrifuges provide a force of about 1800 times gravity to remove small quantities of solid matter. A solution hold-up time of about 20 minutes is required. A centrifuge bowl size of 65 gallons (the maximum size commercially available) is desired, in order to provide for future process changes which may result in substantial quantities of solids in the centrifuge feed stream. Clear solution from both centrifuges is discharged to a common catch tank.

After centrifuging, the centrifuge cake is washed with a dilute HNO_3 solution to reduce product losses in the cake to 0.01% or less of the uranium and plutonium present in the slugs. A stream diverter is provided so that centrifuge skimmings and wash solution may be sent forward to the catch tank or returned to the centrifuge feed tank.

The clarified metal solution is batched from the catch tank to the HAF make-up tank. The make-up tank is sized to normally handle one-half of a day's production (one-half of a dissolver batch).

The washed centrifuge cake is slurried in water and jetted to the slurry tank. Several batches are accumulated in the slurry tank and periodically are jetted to underground waste storage via the waste neutralizer. By alternate routings, the slurry may be sent to waste via the coating waste tank or returned to the centrifuge feed tank for reworking. Stub lines for diversion to a possible future outside facility are provided at the metal solution tanks, slurry tank and centrifuge feed tank.

Adjustment of Composition of Clarified Metal Solution

The valence of the majority of the plutonium entering the tank is as Pu (IV); however, small amounts may occur as Pu (III) or Pu (VI). For minimum loss of plutonium in the HAW, it is essential that the plutonium be adjusted to the plus IV valence state. (However, a small percentage of Pu-VI is not detrimental.) To assure the IV

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valence state, the metal solution in the HAF make-up tank is reacted with NaNO_2 solution for one hour at approximately 120°F .

Following the nitrite treatment, the HNO_3 and water content are adjusted and the HAF solution is jetted to the HAF feed tank. From the HAF feed tank, the solution is continuously pumped to the HA column of the first extraction battery.

An alternate method of plant operation may be used to reduce product losses. In this alternate scheme, the bottoms from the No. 2 acid concentrator in the waste treatment section (2WW solution) are:

- (1) Received continuously in the acid recycle tank.
- (2) Periodically batched to the waste rework tank.
- (3) Held in this rework tank and refluxed to destroy the butyl phosphates.
- (4) Periodically batched to the centrifuge feed tank.

The 2WW solution is blended with metal solution, centrifuged, and the solution reacted with NaNO_2 as before. The ratio of acid and water content to uranium are adjusted in the HAF make-up tank to the same as used in the previously described procedure, and the alternate HAF solution is jetted to the HAF feed tank.

EXTRACTION

The extraction process consists of three cycles. The first, or pre-cycle, separates fission products from uranium and plutonium. The second, or partition cycle, separates fission products from U and Pu and then separates the U from Pu. The third, or decontamination cycle, is for Pu and U stream decontamination and treatment. Details are discussed below.

Pre-Cycle

The function of the pre-cycle is to separate the fission products, including ruthenium, zirconium, niobium and others, from the

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U and Pu. The cycle consists of two pulse columns, HA and HC.

The HA column is a pulse column receiving aqueous from the HAF feed tank and separating the fission products into the aqueous waste with U and Pu transferring into the organic stream. The aqueous waste passes to the acid recovery system and the organic solution passes on to the next (HC) column. The separation is effected by adjusting the valence of U to +VI and Pu to +IV and salting them out with nitric acid. Acidity and flow rates are adjusted for maximum recovery of U and Pu, consistent with desired decontamination. Ruthenium decontamination is favored by the higher acid concentration at the expense of zirconium and niobium. The decontamination factor through the column is 700, bringing the gamma curies from 1.7×10^6 to 2.4×10^3 .*

The HC pulse column receives the organic stream from HA, containing U and Pu, and transfers the U and Pu back into the aqueous phase for concentration and introduction into the 1A column. The transfer from organic to aqueous is made possible by the low nitric acid concentration and high aqueous-organic ratio in the column. An incidental gain is the decontamination through the column.

If adequate ruthenium decontamination can be obtained without the pre-cycle, the use of silica gel treatment for niobium-zirconium decontamination will allow the pre-cycle to be discarded or replaced. Lines have been provided to allow the HA column feed to pass directly to the HCP concentrator or the 1A column.

A vertical tube evaporator is used for stripping residual organic and for concentrating HCP for feed to the 1A column. The specification of crib waste restricts the beta activity to 4 microcuries per liter, 0.5 micrograms plutonium or 1.0 gram uranium per liter. This means that the vapors from the HCP, 1CU and 2EU concentrators can contain no more than 1 pound of entrained concentrate for every 30,000 pounds of vapor. A deentrainment section, followed by a surface condenser is provided. Condensate from the HCP concentrator will be disposed of by cribbing.

*Gamma curies are on the basis of 8-1/3 tons (the "instantaneous" daily rate).

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Partition Cycle

The cycle consists of three pulse columns: 1A, 1B, and 1C. The function of the partition cycle is to effect further decontamination and also separate the U and Pu, returning the U to the aqueous stream in the 1C column for concentration and introduction into the 2D column. The Pu is removed in the aqueous stream from the 1B column and sent to the 2A column via the 2AF tank.

In 1A the U and Pu are further decontaminated in a treatment the same as in HA with the aqueous waste passing to acid recovery and the products transferring to the organic for feed to the 1B column. The decontamination factor through 1A is approximately 150, bringing the gamma curies from 1.7×10^3 to 11.

In 1B the U is separated from Pu. The uranium is retained in the organic for entry into 1C and the Pu is transferred into the aqueous for treatment and feed to the 2A column. The separation is made possible by reduction, with ferrous sulfamate, of Pu to a +III valence which favors the aqueous phase. The ferrous ion reduces the Pu, and the sulfamate ion retains the Pu in the +III state by neutralizing the oxidizing effect of the oxides of nitrogen. At the same time, the uranium is retained in the organic phase using nitric acid for salting effect. Acidity and flow ratios are adjusted to guarantee minimum Pu carry-over into the U (organic) stream.

The function of the 1C column is to return the U to the aqueous stream to be concentrated, treated and fed to 2D. The transfer is made by merely reducing the nitric acid concentration to prevent salting out the U into the organic. The 1CU concentrator is similar to that used for HCP in the pre-cycle. Sodium nitrite is added to the 1CU concentrator to improve ruthenium decontamination in the uranium decontamination cycle.

Decontamination Cycle

Plutonium

Plutonium decontamination is effected by extraction in the 2A and 2B pulse columns.

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The function of the 2A column is to further decontaminate the plutonium by extracting it into the organic phase with the fission products passing to acid recovery in the aqueous waste. Five gamma curies pass into 2A with 0.17 emerging in the product stream (a decontamination factor (D.F.) of 30 through the column). The Pu feed stream is adjusted to a +IV valence in the 2AF tank and salted into the organic phase using nitric acid. The 2A column is designed with a high acid extraction section for ruthenium decontamination and for Pu concentration. The scrub section is operated at low nitrate concentration for zirconium-niobium decontamination. The Pu (organic) stream is then fed to the 2B column.

The function of the 2B column is to return the Pu to the aqueous phase so that it may be concentrated and removed as plutonium nitrate product. The transfer from organic to aqueous is made possible by reducing the nitric acid concentration. The organic waste stream passes to the organic recovery system. The aqueous (Pu) stream is stripped of organic and concentrated to 50-75 grams/liter for transfer from the Purex plant. Due to the high Pu concentration, it is necessary to re-evaporate the distillate in order to minimize product losses.

Bottoms from the No. 2 concentrator are reintroduced as additional feed to the No. 1 concentrator.

Uranium

Uranium decontamination is effected in the 2D and 2E pulse columns in a fashion similar to that used in the pre-cycle.

The 2D column decontaminates uranium by separating the fission products into the aqueous for recovery of acid and the uranium into the organic phase for feed to the 2E column. The gamma curies entering are 4.0 and the uranium stream leaving contains 0.60. The transfer of U is made by salting with nitric acid with U in the +IV state. The small amount of Pu in the feed stream is reduced with ferrous sulfamate to +III and extracted into the aqueous waste stream.

The 2E column returns the uranium to the aqueous stream for organic stripping and concentration. This stripper-concentrator is similar to the HCP concentrator. After concentration, the uranium nitrate solution is sent to temporary storage (203-A) for transfer to the UO_3 recovery facility.

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Space has been provided adjacent to the 203-A building for the possible installation of an ion-exchange facility. This is a silica gel bed for removal of zirconium and niobium from the 2EU stream. It is the unit that might contribute to the elimination of the pre-cycle, as before mentioned.

Summary Data

A 98.75% recovery of plutonium is indicated, with 0.08 gamma curies per day remaining in the product stream. Approximately 0.2% of the charged metal is lost in the waste stream of each column in which it is processed.

A 98.75% uranium recovery is shown, with 0.38 gamma curies per day remaining. Approximately 0.2% of the charged metal is lost in the waste stream of each column in which it is processed.

All figures are on the basis of 8-1/3 tons of uranium processed per day.

The organic waste streams are sent to the organic treatment section for recovery for reuse.

The aqueous wastes are sent to waste treatment for recovery of nitric acid.

Rework is provided for off-standard U and Pu as follows: Alternate routings are provided for returning the U streams, containing fission products or cross-contamination from the 2EU sampler directly to the 1AF tank, 2DF tank, or the HAF make-up tank, or to the centrifuge feed tank via the utility tank. Pu rework streams are routed from the vacuum tank to the HAF make-up tank. Rework of waste streams is provided through the waste section.

WASTE TREATMENT

The aqueous wastes from HA, 1A, 2A, 2D, 1T, 2T, and No. 2 Pu concentrator are processed in this section to produce concentrated fission product waste for storage, recovered HNO_3 for reuse, and low activity condensate for subsequent disposal to cribs. Details are discussed below.

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Waste Concentration

The aqueous wastes from the HA, 1T and 2T columns and the No. 2 acid concentrator bottoms are accumulated in the acid recycle tank, which feeds the No. 1 acid concentrator. The bottoms from the No. 1 acid concentrator, which contain the waste salts, fission products and uranium and plutonium losses are disposed of to underground storage via the waste receiver, waste sampler and waste neutralizer tanks. Wastes that are found to be off specification in the waste sampler, due to high U or Pu, are returned to the centrifuge feed tank via the waste rework tank.

The overheads from the No. 1 acid concentrator are condensed and accumulated in the acid accumulator tank along with the aqueous wastes from 1A, 2A, and 2D columns, No. 2 Pu concentrator, laboratory, vent condenser, vacuum jet condenser, and No. 2 jacket rinse from dissolvers. By alternate routing, the aqueous wastes from 1T and 2T centrifuges, off specification condensate, and condensate from the waste rework condenser may also be routed to the acid accumulator. The acid accumulator tank provides the continuous feed to the No. 2 acid concentrator.

The bottoms of the No. 2 acid concentrator are normally sent to the acid recycle tank. The overhead from the No. 2 acid concentrator feeds (as a vapor) the acid fractionator.

The acid fractionator delivers recovered nitric acid from the bottom (ca. 60%). The recovered acid is routed to storage via HNO₃ receiver tank and HNO₃ sample tank. The radioactivity of recovered HNO₃ is estimated at 2.1 gamma curies per day.

The low activity condensate from the fractionator is sent to disposal by cribbing.

Waste Rework

An acid waste rework tank, which is provided in the waste system, may receive off-specification streams from the acid recycle tank, the waste sampler tank, and the waste neutralizer tank. After hydrolysis in the rework tank, the rework material may be routed to the centrifuge feed tank or the dissolvers for recycle through the extraction battery.

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The rework tank is utilized to destroy by hydrolysis any residual TBP, DBP, or MBP that may be present in the off specification streams prior to returning these streams to the extraction battery. The destruction is effected by boiling in 8M HNO₃ for an extended period of time (ca. 15 hours). The rework tank is designed to permit this boiling either as a batch concentrator or at total reflux. When operated as a batch concentrator, the condensate can be routed to acid accumulator tank.

A general utility tank is provided for treating and separating waste solutions containing solvent. This tank may receive from the acid accumulator, acid recycle tank, cell drain collection tank, and from interface jets on HA, 1A, 1B, 2D, 1O and 2O towers. A secondary use is for possible temporary storage of rework streams; a jet line from the 2EU sample tank is included. A decanter operates in conjunction with the utility tank. The aqueous phase from the decanter is routed to the waste neutralizer or to the acid recycle tank; the organic phase is returned to the utility tank. Organic from the utility tank may be routed to the organic crib, the 1B pump tank or the 1OF tank. Aqueous may be sent to the waste neutralizer or, for rework, to the centrifuge feed tank.

Sump Drain Collection

A cell drain collection tank receives waste jetted from cell sumps and also receives drainage from the sampler drain, condenser vent, vessel vent, and jet vent headers. Lines are provided to jet this waste direct to crib, to the acid accumulator, or to the utility tank.

Alternate Waste Treatment System

An alternate method of operating the acid concentrators has been provided which permits routing the No. 2 acid concentrator bottoms to the centrifuge feed tank to be used in lieu of a portion of the acid make-up required in the HAF make-up tank or dissolvers.

This recycle system may prove to be desirable because the U and Pu in the No. 2 acid concentrator bottoms are thus returned to the extraction battery. Inasmuch as the activity level of the No. 2

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bottoms is low (from 2nd and 3rd cycle wastes) and the remainder of the stream is primarily HNO_3 , the effect of substituting No. 2 bottoms in the HAF for a portion of the normal acid should be negligible. The advantage is a slight lowering of U and Pu losses. In order to operate by this alternate system, an alternate routing of HAW direct to the No. 1 acid concentrator is provided. The acid recycle tank then will only accumulate No. 2 acid concentrator bottoms which are batch transferred to the rework tank for hydrolysis and subsequently routed to the centrifuge feed tank or dissolvers.

SOLVENT TREATMENT

Solvent treatment is necessary to maintain solvent extraction efficiency when it is recycled through the plant. The treatment system separates fission products, TBP decomposition products, uranium and plutonium from the organic solvent. Two separate systems are provided. The first system (1-O cycle) located in the 202-A building, treats the organic from the HC, 1C, and 2B columns. The second system (2-O cycle) located in the 276-A building, normally treats the organic from the 2-E column, with an alternate routing to pick up the solvent from 2-B if experience shows the activity level to be sufficiently low.

1-O Cycle - Normal Operation

The 1-O solvent treatment equipment includes a receiver-feed tank (1OF), an extraction contactor (1-O), two centrifuges, two storage-treatment tanks, a decanter, a wash collection tank, and operating gallery make-up and centrifuge spray head tanks.

Organic is received continuously in the 1OF tank, which normally rides on the line providing surge capacity. The 1OF tank is so constructed and lines are provided so that it can also be used as a tank-type pre-contactor with reduced surge. Organic is continuously pumped to the 1-O contactor, which is shown as a pulse column, where it is contacted with 2-1/2% Na_2CO_3 solution. The sodium carbonate is recirculated to the top of the column by pumping through an external line. It is charged, batchwise, to the pulse column system and, when depleted, is jetted to the neutralizer. The organic passes continuously upward through the 1-O contactor, then flows by gravity to a pair of centrifuges in parallel.

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The centrifuges break the emulsion that forms during alkaline contacting, returning the small amount of "hot" aqueous material to the 1OW tank, and allowing the organic to flow on to a pair of storage tanks (1-TO). The solids that accumulate in the centrifuge are periodically slurried out (with chemicals pumped from a centrifuge spray tank located in the operating gallery) and sent to the wash collection tank. During centrifuge cleanout, the stream is temporarily by-passed around the centrifuge being cleaned or the rate doubled in the operating centrifuge.

Each of the two storage tanks will hold 15,000 gallons, the volume of the entire organic system. One storage tank is normally "on-the-line" and the other kept filled with clean solvent, ready to go on the line for replacing solvent in the entire system. Each tank is equipped with three pumps. Two of these, the discharge pumps, are cross-connected for automatic startup of the installed spare upon failure of the operating unit. This assures a continuous feed, through a pressurized header, to the HC, 1C and 2B columns. Provision is made to add a batch aqueous wash solution to either of these tanks and agitate at the aqueous-organic interface. The third pump in each tank is for recirculating the mixture through a decanter, returning the organic to the tank and routing the aqueous phase to the wash collection tank.

Normally, organic make-up required in the No. 1 system is added from the No. 2 system. However, fresh TBP and diluent can be added to either of the storage tanks or to the 1OF tank. A gallery head tank is supplied for sampling prior to delivery to the system, if so desired.

1-O Cycle - Alternate

Piping through concrete is to be supplied for an alternate system, which substitutes a tank type co-current contactor for the 1-O pulse column.

The tank type contactor is a modified 5000 gallon (standard) tank. The tank is divided, by a centrally located vertical tube, into two sections, the outer annulus of which is packed. Organic is fed through a spray ring at the top of the packed section along with recirculated aqueous scrub. The inner tube is solid to about 18 inches above the tank bottom, but is perforated below. The down-flowing mixture enters the bottom of the central tube and settles into two layers; the lower (aqueous) layer is recirculated by pump and the upper (organic) layer pumped to the centrifuge.

A number of alternate routings is supplied. Organic may be jetted from the 1OF tank to the utility tank for recovery of U and Pu. The 1OF tank and 1-O contactor may receive Na_2CO_3 solution directly from a head tank in the aqueous make-up area or from their corresponding units in the 2-O cycle. Normally the 1OF tank is used as a surge tank. However, as noted above, piping is installed to allow its use as a combination surge tank (with lower surge capacity) and pre-contactor. Accordingly, jet out lines to neutralizer are provided for both 1OF and 1O contactor. Stub lines from the cell to outside are supplied so that organic can be pumped from 1OF or from a storage tank to and from any future outside facility that may be installed. Alternate jumpers permit sending aqueous from the centrifuge to the wash collection tank, instead of to the 1-O tank contactor. A jumper change at the two storage tanks will allow routing of organic to the organic crib. Jets in the decanter and at the pulse column interface can be used to transfer material to the centrifuge. The wash collection tank has jets to the neutralizer, to the acid re-cycle tank, and to the storage tanks. By a jumper change, the collection tank can be jetted to the diversion box, thence to crib or underground storage.

2-O Cycle - Normal Operation

The 2-O cycle process is identical to that of the 1-O cycle with the following exceptions:

- (a) Equipment is located in the 276-A building, a "semi-remote" area, where lines, valves and equipment do not carry the strict limitations of completely remote operation.
- (b) Normally all fresh organic make-up and scrub streams will be fed to the 2-O cycle, thence to the 1-O cycle.
- (c) The treated organic from the 2-O system is pumped to a head tank (in a penthouse over the aqueous make-up area) for feed to the 2D (and 2A) columns and make-up to the 1-O system.

2-O Cycle - Alternate

An alternate tank-type contactor and required piping is to be supplied for the 2-O cycle. This alternate is the same as that described for the 1-O cycle alternate.

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MISCELLANEOUS PROCESS AUXILIARIES

Chemical storage and aqueous make-up facilities are not described in detail in this document, since they do not require special consideration with regard to radioactivity.

Other auxiliary systems include condenser and vessel vent cleanup, laboratory waste disposal, and tanks in the decontamination cell and Hot Shop for pump and agitator maintenance.

Process Vent System

Vents from the various canyon vessels lead to a single pipe trench header. Vents from concentration and acid fractionation condensers lead to another. The required suction for each of the vent headers is attained by steam jets discharging into a common vent condenser. The vent condenser removes excess moisture from the vent gases to avoid subsequent condensation in the silver reactor or building ventilation system filter. The condensate is routed to the acid accumulator. The dry gases are further treated for iodine removal by heating and passing through a tower packed with silver impregnated ceramic Berl Saddles (identical to the units used for dissolver off-gas). The vent gases are discharged to the building air tunnel, and are carried through the ventilation system filter where particulate matter is removed along with particulate matter that may be contained in building ventilation exhaust.

Laboratory Waste Treatment

Aqueous waste from the laboratory is collected in one of two waste receivers, each sized for about 12 hours storage. The waste is sampled and neutralized (if necessary). If fission product content is too high for cribbing, the waste may be sent to the coating waste tank for disposal.

Remote Maintenance Tanks

For use in pump and agitator decontamination and run-in, a decontamination tank is provided in the decontamination cell and a shielded

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run-in tank in the Hot Shop. The detailed functions and operation of these tanks are described in other documents describing the remote maintenance facilities. Solutions to either of these tanks are supplied from a 500 gallon head tank located in the operating gallery. Waste from the Hot Shop tank is jetted to the decontamination tank. Waste from the D. C. tank is jetted either to crib or to 241 underground storage via the outside diversion box. The D. C. tank is equipped with a heating coil and with a spray for cleaning equipment. It also acts as a receiver for waste from SWP change room decontamination sinks and from Hot Shop sumps.

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III ENGINEERING DESCRIPTION

SCOPE OF THE ENGINEERING DESIGN

The Purex Facility is similar in basic design to previously constructed Hanford Separations plants. However, it contains a number of different features. These new features, along with a brief general description of the over-all facility, are discussed below:

The Purex Facility was designed to supplement the existing Hanford operations for the chemical separation of uranium and plutonium from each other and from fission product elements produced in the irradiation of uranium slugs in the Hanford reactors. Completion of the Purex plant will provide sufficient capacity to handle the increased production expected from new reactors being constructed concurrently with Purex, and will permit the shutdown of the now-obsolete Bismuth Phosphate separations plants.

The major component of the Purex Facility is a heavily shielded, concrete "canyon" building, designated as Building 202-A, designed for remote operation and maintenance of process equipment. This building has two major sections — a canyon section and a service section.

The canyon section of the building is a single, longitudinal, reinforced concrete structure housing the process equipment in a series of in-line cells. It includes associated facilities for remote maintenance, slug storage, and remote access; longitudinal galleries housing auxiliary operating equipment, piping, and sampling equipment; a shielded pipe trench for radioactive piping; and an air tunnel for exhaust of canyon ventilating air to an exhaust disposal stack. This arrangement is indicated on drawings H-2-52061A, H-2-52062A, H-2-52063A, and H-2-52064A.

The non-canyon or service section of the building includes centralized operational control rooms, chemical make-up facilities, recovered

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acid and condensate storage, solvent recovery and storage, and miscellaneous industrial facilities such as control laboratories, offices, switch gear rooms, blower rooms, shops, etc.

In addition to the main building, auxiliary yard facilities have been provided as follows:

1. 203-A - The Recovered Metal Solution Storage Farm for storage of the Decontaminated Metal Solution. Means are provided for transfer of this solution to a future conversion facility. This area also houses the third recovered acid system with provision for routing recovered acid back to 202-A.
2. 211-A - The Chemical Tank Farm for bulk storage of liquid chemicals.
3. 291-A - The Waste Gas Disposal System, which includes a Fiberglas filter, fan house, stack, gas sampling facilities, and stack washdown system, all for the treatment and disposal of process exhaust gases and contaminated ventilation air.
4. 241-A - The Waste Tank Farm for storage of highly contaminated wastes.
5. 216-A - The Waste Disposal Cribs for ground disposal of slightly contaminated wastes.
6. 272-E - The Mock-up Shop for checking dimensional tolerances of equipment prior to installation in the canyon.
7. 275-A - The Warehouse for storage of sodium nitrate.
8. Outside Utilities, including steam, water, fire protection, electrical power, sanitary and process sewers, roads, walks, etc.

In establishing the detailed location of the plant and the orientation of its facilities, the following major factors were considered:

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1. Slope of all waste lines to guarantee proper flow of the waste material.
2. Minimum railroad construction cost from the standpoint of length of road and variation in grade for the 202-A Building.
3. Prevailing wind direction so that the off-gases from the 291-A stack would not contaminate buildings of the general production area.
4. Economic use of interfacility lines for distribution of services and process materials within the process area.
5. Space allotment for future additional installation.

These factors governed the selection of the southeast corner of the 200-E Area of the Hanford Works as the site of the Purex Facility.

In most particulars, the building design was governed by the specifications given in the publications listed below:

1. AEC Regulation, Safety, No. 2, "Standard Safety Requirements" (Latest Edition).
2. Pacific Coast Building Officials' Conference, "Uniform Building Code" (Latest Edition).
3. Western Plumbing Officials' Association, "Uniform Building Code" (Latest Edition).
4. National Board of Fire Underwriters (Editions of applicable publications).
5. AEC General Criteria for Design - (Latest Edition).

In addition to the above publications, a number of other specifications, all listed in Appendix A, Part 2 were used to guide the design work.

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202-A BUILDING DETAILED DESIGN DESCRIPTION

BUILDING ARRANGEMENT AND DESIGN

The canyon is 1000 ft long by 54 feet wide by 94 feet high, of which 34 feet are below grade. The depth of the Purex cells, 40 feet, required restriction of the remote crane elevation to 26 feet above the deck in order to achieve suitable vision for the crane operator when performing remote manipulation on equipment near the cell floor. The 26-foot above-deck elevation would not, however, permit removal of the tallest pieces of process equipment and the longest process pipe jumpers. To overcome this, a second remote crane, operable from and controlled by the main crane cab, was positioned on separate rails above the main crane. The second remote crane had a clearance of 44 feet above the canyon deck. This arrangement set the over-all canyon building height. The arrangement of facilities within the canyon portion has been designed to accommodate the process in approximate order of radioactivity level. The "hot" end is at the east where the dissolving operations take place, and the level of radiation drops from east to west. A single-track, transverse railroad tunnel, designed to permit motor truck entry, is located at the east end of the canyon and is sized to accommodate a total of three Hanford standard cask cars. These cars will carry three casks, each containing Hanford standard-design slug buckets. The closed-end portion of the tunnel is long enough to permit a twelve-foot clearance between head car and car stop when rear car is in unloading position. Similarly, the entrance position of the tunnel is sized for twelve foot clearance between rear car and entry door when front car is in unloading position. A remotely operated car-puller is installed in the tunnel to permit shifting of cask cars without assistance from the switching locomotive after initial delivery of the three-car train to the canyon.

A water-filled storage basin is provided at the end of the canyon adjacent to and east of the Railroad Tunnel to permit interim storage of loaded slug buckets. The storage basin has a capacity of forty yoke-suspended buckets on one level, accessible to the main canyon

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remote crane. Support beams have been designed to sustain twice the normal number of loaded buckets to permit possible future expansion to a two-level system of bucket storage.

A Decontamination and Hot Equipment Storage Cell is provided at the west end for cleaning and storing of contaminated canyon equipment. The cell is large enough to accommodate the largest piece of canyon process equipment and is provided with standard, remote-type service connections. A Pool Cell is provided as a separate part of the Decontamination Cell to serve the multiple functions of an underwater repair facility, an underwater storage facility, and a water shield for semi-contact decontamination of process pipe jumpers. The Pool Cell will also serve, when drained, as storage space for canyon process equipment.

A Hot Shop adjacent to the Decontamination Cell is provided for maintenance of canyon equipment by semi-remote and contact methods. The shop is sufficiently large to accommodate the largest canyon process equipment and has an opening to the canyon deck for easy access.

In the canyon area, both the cells and hot pipe trench are provided with reinforced, removable shielding cover blocks, which also serve as working deck space when in place. These cover blocks are gasketed for ventilation controls, as described later in this section.

The galleries, located inside the north canyon wall, are of reinforced concrete slab construction with a shielding wall separating them from the process cells. The lowest or Storage Gallery is at canyon mat level, and houses the Product Removal Area, the drive equipment for the pulse generators, the telephone room, and a partitioned-off area which provides chemical storage space. Directly above is the Sample Gallery, which houses the sampler boxes, the air-sampling equipment and a contaminated pipe chase. This gallery is a controlled personnel area with a SWP (Special Work Permit) lobby provided for entrance. The next level above is the Pipe and Operating Gallery, which contains all utility headers and sub-headers for feeding utilities to the process area, chemical addition piping, air-operated manual control stations for liquid transfer jets and pipe coils, electrical motor control centers, and electrical conduit and instrument tubing routing ducts. This level is also cross-connected to the service portion directly adjacent to the canyon on the north. Uppermost is the Crane Cab Gallery, which is shielded

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by a parapet wall from the canyon, thus allowing personnel access to the remote cranes. The "cold" or west end of this gallery is used as a crane maintenance platform.

The service facilities for the 202-A Building extend virtually the full length of the building and are directly adjacent to and north of the galleries. They are of varying levels, depending on the service required. At the west end, and extending from the canyon mat level up to grade, is the 276-A Solvent Recovery Section which provides decontamination treatment and storage for recovered second-cycle solvent. This facility is housed in a reinforced concrete vault with removable cover blocks and the equipment in it is designed with the same physical dimensions as its cell counterpart in the first-cycle solvent recovery system, but is fabricated to commercial standards. On the extreme east end of the service portion of the building is the 202-A Acid Storage Facility. This facility which is housed in a vault structure similar to the Solvent Recovery Section, provides for lag storage of recovered nitric acid as well as hold-up and treatment for process condensate and laboratory waste prior to disposal. The equipment here is designed with the same philosophy as the solvent recovery vault equipment; that is, it has the same physical dimensions as its cell counterpart, but is fabricated to commercial standards.

Two control rooms have been provided for central control of the continuous and batch portions of the plant, respectively. These house graphic instrument panels which control, record, and indicate all process variables.

A multi-story aqueous chemical make-up section has been provided for the make-up and adjustment of all addition chemicals required in the process. This section of the service area is arranged for gravity flow from one level to another.

An analytical laboratory has been provided for routine laboratory analysis of process solutions. This is a two-story structure, the first floor of which houses the laboratory room and is of reinforced concrete with necessary shielding provided in the contamination rooms. The second floor is of conventional steel and transite construction and houses the ventilation equipment and utility piping.

The remainder of the service area is made up of shops, offices, sanitary facilities, switch gear and cable rooms, loading facilities, etc.

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PR Room

The PR Room is located below the sample gallery, north of and adjacent to the Pu concentration cell (L Cell). The concentrated Pu stream is fed into this product removal area where it is transferred by vacuum to the product cans. The process equipment and area are suitably designed for operation with this corrosive and toxic product. The equipment is located in a concrete labyrinth with operating valves extending through removable panels. The area is provided with controlled ventilation, water washdown and drains to cribs.

Trap and Pump Pits

The semi-remote Trap and Back Pressure Valve Pits are located along the south side of the 202-A facility. They have been located external to the canyon to provide easy access for maintenance of the steam traps and back pressure valves which control the condensate flow from critical chemical equipment such as dissolvers, silver reactors, concentrators and fractionators.

The trap discharge for the fractionator and concentrator normally flows directly to the condensate outlet header. When it is necessary to operate these units at an extremely low pressure and sufficient head is not available to achieve required flows, provisions have been incorporated to divert this condensate to the pump pits, from which it is pumped into the condensate outlet header. The traps and back pressure valves are provided with by-passes which can be operated from grade level with built-in extension handles. The pipe assemblies and pumps have been designed for remote removal.

Vacuum Cleaning System

A vacuum cleaning system is built into the Purex facility in terms of the plug-in connections strategically spotted along the north canyon wall a few feet above the cell covers. The system is for general clean-up of the canyon deck. The suction fan is located in a semi-remote pit south of the 202-A Building. A removable filter is provided upstream of the blower to preclude the entry of radioactive dust particles into the fan and fan pit. Both the filter and the pump pit are provided with suitable drainage to hold up cribs.

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STRUCTURAL DESIGN

Building foundations, exterior walls, canyon area roof, and canyon walls are constructed of poured reinforced concrete and are supported on a continuous mat footing. This mat design largely eliminates the problem of differential settlement between opposite connector-carrying walls by uniting both sides of the building. This is extremely significant because of the very exact tolerances necessary for successful operation of the remote maintenance equipment. The soil-bearing value does not exceed 4 tons/sq. ft. for virgin soil. Over disturbed or excavated areas, compacted back-fill has been specified.

The wind load has been taken as 30 lbs./sq. ft. The wind pressure for overturning has been assumed to be less than $2/3$ of the dead load resisting moment. The snow load has been taken as 30 lbs/sq. ft. of horizontal projection.

The canyon cross section is designed as a rigid frame structure, fixed both at the roof and at the footing. The canyon roof is designed as a rigid concrete arch, integrally tied to the canyon exterior walls. It is of sufficient thickness to reduce sky-shine radiation to a safe level when the protective covers over the cells are removed. The building design includes provision for earthquake protection in accordance with the latest edition of the "Uniform Building Code" of the Pacific Coast Building Officials' Conference.

The service area of the building was designed for steel frame construction using reinforced concrete floor slabs and corrugated transite for most of the exterior walls. The roof over the service portion is constructed of poured gypsum slab.

The structure was designed in accordance with the following codes:

- a. Structural steel work complies with the AISC code, latest revision, and uses a maximum unit fiber stress of 20,000 psi.
- b. Reinforced concrete work complies with the ACI code, latest revision, and uses 3,000-lb concrete for the canyon walls and mat, 4,500-lb concrete for the canyon roof, and 3,750-lb concrete for the service area and elsewhere. The allowable design tensile stress in the reinforcing steel is 20,000 psi with "n" equal to 10.

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- c. In all cases, the National Fire Code of the National Board of Fire Underwriters has been used as the standard of safety for protection against fire.

HEATING AND VENTILATING DESIGN

The heating and ventilating system was designed to provide complete separation between ventilation of the process area and the service area. Further, wherever series air flow is used, the air moves from the least radioactive to the most radioactive area.

Such a series flow is utilized in ventilating the process cells. The air is first preheated, filtered, washed, and reheated in the process blower room, after which it is routed through large ducts to the space above the cell covers, which acts as a supply plenum. The air is then drawn down between the cover blocks and the canyon deck into the cells and through the cells to the exhaust stack via the air tunnel. A slight vacuum is maintained in the cells and the air tunnel by the exhaust fans. Metering of the air flow to each cell, under normal operating conditions (cover blocks in place and railroad tunnel ventilation cover closed), is done by means of slots in the gaskets on which the cell covers are seated. Under conditions of charging in the dissolver cells, the air to those cells is metered by the outlet ports between the cells in the air tunnel. These ports control the pressure drop when the covers are off. Similarly, under conditions of remote maintenance (where a maximum of two adjacent covers might be off) the outlet ports control.

The flow of air and the pressure levels maintained in ventilating the 202-A Building are shown on the venilation flow diagrams, drawings H-2-52301K, H-2-52302K, and H-2-52303K. To facilitate maintenance, similar equipment and control systems have been used wherever practicable.

As a basis for the design of heating and ventilating systems, the following conditions were assumed for the outside air:

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Winter Conditions: An average dry-bulb temperature of -10°F and a wet-bulb temperature of -12°F .

Summer Conditions: An average dry-bulb temperature of 101°F and a wet-bulb temperature of 65°F , corresponding to a humidity of 21 grains/lb. of dry air.

The 202-A Building heating and ventilating systems are broken down into the four systems described in the following paragraphs:

System 1 - Process Area

This system includes the canyon, cab gallery, process cells, hot shop, decontamination cell, solvent head tank room, and hot pipe trench. The canyon, above the deck, receives a normal supply equivalent to not less than $1\frac{1}{2}$ air changes per hour, corresponding to $2\frac{1}{2}$ to 12 changes per hour in the cells, with provision for dumping additional air to any one cell when cover blocks are removed. The air changes in the other parts of this system vary up to a maximum 9 air changes per hour for the head tank room. This system exhausts through a Fiberglass filter to the exhaust fan plenum and through the exhaust fans to the 291-A Stack.

Two identical motor-driven supply fans have been provided in the process blower room, each one capable of supplying 50% of the required air. Four exhaust fans have been provided, three of which are motor-driven and handle $\frac{1}{3}$ each of the total exhaust air; the fourth exhaust fan is turbine driven and supplies 50% of the exhaust air quantity.

System 2 - Sample Gallery

This system includes the sample gallery (including sampler hoods), the 276-A organic vault, the acid storage vault, canyon lobby, regulated shop, corridor 1, and the PR facilities. An average of approximately eight air changes per hour is supplied to this area. The supply consists of two fans, each one capable of supplying 100% of the air. The arrangement of pre-heaters, filters and washers is similar to system 1 except that individual zone reheat has been provided instead of central reheat.

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The exhaust system consists of passing the air through CWS-type filters, through an exhaust fan, and out through a separate local stack.

The solvent and the acid vaults are each supplied with an evaporative cooling tower to reduce vault temperature.

System 3 - Service Area

This system includes the pipe and operating gallery, the storage gallery, and all of the service area facilities except the analytical lab and the two vaults included in system 2. The system is designed to maintain a temperature between 50°F and 70°F in the winter and between 73°F and 90°F in the summer.

The system is equipped with two motor-driven supply fans located in the service area blower room, and exhausts through individual gravity or mechanical exhausters.

System 4 - Analytical Laboratory Facility

Two supply fans, each one equipped to handle 100% of the load, are located on the second floor of the analytical laboratory. The system exhausts through CWS filters to a separate stack through two exhaust fans, each one equipped to handle 100% of the exhaust air quantity.

Duct Work

In general the duct work is fabricated of hot-dipped galvanized steel sheets, ASTM A-123. In some critical contaminated areas and where the duct is inaccessible, type 347 SS has been used. The ducts are adequately reinforced and are supported to meet the air pressure requirements. Accessibility has been provided at all points which may require inspection and service, and in locations where the duct may impede equipment maintenance it is fabricated in removable sections.

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Control Systems

The control systems are operated from a central graphic type panel board in the power unit control room area of the process control room. Temperature control is accomplished by means of space thermostats in those areas where reheaters are used. Preheat unit is controlled by a dewpoint thermostat to maintain the outlet air dewpoint at 52°F and to reduce thermal stratification. When the system is shut down, outside air dampers close to prevent freezing within the apparatus. Volume control dampers have been installed on the exhaust fans for pressure and capacity control. Supply fans operate manually without volume control. The control systems actuate pneumatic motors and diaphragm valves which automatically govern the operation of the heating and ventilating unit elements. Automatic emergency controls are provided which (a) throttle the supply fans to maintain safe pressure differentials between personnel areas and "hot" areas; (b) turn on the steam turbine exhaust fan when any of the electrical exhaust fans stop; and (c) shut certain dampers to prevent backflow through the system. The detailed design and the sequency of the control systems are covered in Specification HWS-5512.

PIPING

The piping systems may be divided into two general groups. The "hot" piping includes all of the piping buried in shielding walls, the removable jumper piping in the process cells, the hot pipe trench piping, the product removal facilities, the waste disposal piping and miscellaneous services such as the vacuum cleaning runs, crib lines, etc.. The "cold" piping includes all chemical feed lines, utility lines, etc., outside of the above areas.

Hot Piping

The normal routing of the hot piping is from utility or chemical addition headers in the Pipe and Operating Gallery or from the sampler boxes in the Sample Gallery through the gallery shielding wall to connector wall plates on the inside face of the cells. From these wall plates, removable jumpers are used to bring these addition and utility lines to the equipment pieces they serve. From

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the equipment the piping is routed through the cell wall into the hot pipe trench, where a grid system on rack supports provides for the subsequent routing to other parts of the canyon. Typical pipe trench arrangements are shown on drawings H-2-53121M, H-2-53122M, H-2-53123M, and H-2-53124M.

Buried Lines

All buried piping is of welded construction and the material is SS type 347 or 304L. Design temperatures were established for all of this piping and the expected thermal expansions were calculated for these temperatures. Piping through concrete has been designed to meet a 15,000 psi maximum allowable stress and no credit has been assumed in the calculations for concrete bond. Positive means of anchoring, such as a plate welded to the pipe, have been provided.

Piping in the main shielding walls between the cells and either the galleries or the hot pipe trench has been wrapped with layers of corrugated paper to allow pipe movement due to thermal expansion. The anchor point is kept close to the cell wall connector plate to allow the rest of the line freedom.

Tolerances on all buried fabricated piping are $\pm 1/16$ inch. The number of welds has been kept to a minimum by the use of pipe bends wherever possible rather than welded fittings. Welds are located away from points of maximum stress wherever possible. Where welds had to be made at maximum stress points, reinforcing sleeves have been used. All the buried piping between the canyon and the pipe and operating galleries have offset bends within the concrete to prevent radiation "shine."

Jumpers

All jumpers have been designed to make the remote connector operation screw accessible to the impact wrench. Wherever possible, layout has been such as to allow handling of the lifting bail by the main crane hooks. Where this was not possible, crane hook extensions must be used for the auxiliary hoists employed. In the jumper layout work, impact wrench size, supporting cables, and hook blocks have all been considered. The jumpers are mounted on

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structural steel frames which provide sufficient stiffening to make the entire assembly self-supporting; this bracing has been considered in the layout so as not to interfere with adjacent jumper removal. The center of gravity has been calculated for each jumper with its bracing. This permits locating the lifting bail so that the jumper can be handled without guidance, using only the crane hook. For electrical jumpers, the weight of the wiring has also been included in the calculation.

Crossing of jumpers has been avoided as far as possible. Where it was found necessary, process jumpers and those containing valves, instruments or other equipment most likely to require removal for maintenance, have been placed on top. Jumper dip legs for pressure-sensing lines, sampling, and jet-out terminate just above the bottom head. Temperature element dip legs terminate somewhat higher. All of the dip legs are reinforced to sustain remote handling shock loads wherever encountered. All of the dip legs are removable with their jumpers except for a few continuous overflow lines and the centrifuge dip legs, which are not vertical.

The equipment in jumpers is either welded or flanged. Teflon gaskets are used on flanged joints. The piping is stainless steel, schedule 40 for the 2-inch jumpers and schedule 10 for the 3-inch and 4-inch sizes. There are also pneumatic instrument and lubrication jumpers, which are fabricated with three 1/2-inch stainless steel tubes; sampler jumpers, which have two 1/2-inch and one 1/8-inch stainless steel tubes; and electrical jumpers, which are made of carbon steel conduit. Bracing is of structural steel, with Amercoat paint applied to permit acid washdown.

All jumpers are drainable except where a trap is provided for pressure seal, or where holdup is unavoidable, such as in rotameter jumpers. The design has been standardized as much as possible to facilitate replacement operations. Jumpers have been fabricated to $\pm 1/16$ inch, but are designed to absorb the required cumulative tolerances from the equipment. Jumpers have been designed for the full allowable stresses based on the material being used. Stresses due to thermal expansion and/or expansion of the equipment, plus the vertical and horizontal thrusts for nozzles were calculated for every jumper.

Hot Pipe Trench

Piping within the hot pipe trench has been designed as a permanent, inaccessible installation. A number of spare lines has been provided

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for alternate routing to provide either for process changes or for failure. Since the general mechanical design is similar to that for buried piping, all stresses were carefully checked.

The trench piping rests on "unistrut" members arranged in uniformly spaced racks down the length of the tunnel. The lowest pipe runs are reserved for continuous headers which run the full length of the building. The upper runs are used for intra and inter cell piping. Pipe loops are used throughout for expansion and the expansion bends are nested to provide maximum access during construction.

Cold Piping

Cold piping is designed in accordance with the best industrial standards. All piping is grouped in properly supported banks. A minimum vertical clearance of 6 feet, 6 inches is maintained in all passageways. Lines are generally designed to be self-draining, but where pockets are unavoidable, valved drains or traps have been specified.

Materials used for cold piping include stainless steel for the chemical addition lines, carbon steel for most utility pipe, and aluminum for demineralized water. Conventional appurtenances such as valves, traps, strainers, filters, gaskets, etc., have been used throughout.

Piping has been designed in accordance with the following codes and specifications:

1. American Standard Code for Pressure Piping - latest edition.
2. HWS-5500 - Process and Utility Piping Specification.
3. HWS-5510 - Field Welding Specification.
4. HWS-5503 - Thermal Insulation Specification.
5. HWS-5508 - Protective Coating Specification.

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MECHANICAL EQUIPMENT

Canyon Cranes

Two canyon cranes have been provided, each with a main hook capacity of 40 tons. These cranes are mounted one directly above the other. The lower or Remote Maintenance Crane is equipped with a heavily shielded cab to protect the operator against radiation. It houses all the devices required for remote manipulation. These include binocular systems for viewing the equipment, as well as provision for closed circuit color television. The Auxiliary Crane is essentially a slave to the main crane for remote operation. It is controlled from the main crane cab, although a standard industrial type cab has been provided to permit its use during construction operations.

The function of the canyon cranes is the remote maintenance of all cell equipment. In order to meet this requirement, the cranes must perform the following functions:

1. Remove and replace cell covers.
2. Remove and replace all pipe and electrical jumpers.
3. Remove and replace all cell equipment.
4. Other miscellaneous operations related to the above.

The tallest items of equipment and a small number of jumpers of extreme length, which cannot be handled by the main crane, are handled by the Auxiliary Crane, which provides the necessary additional headroom above the canyon deck to accommodate this equipment. One item, the 2A column, is of such a length that it must be handled by both cranes, operating simultaneously.

Remote Connectors

The pipe and electrical connectors for the Purex Facility are essentially identical with those developed for the Redox Plant, differing only in detail to facilitate gasket replacement and to reduce the hook kick-off dimension.

The pipe connector is of the three-jaw type and consists of a male end fabricated from bar stock and machined to the desired pipe size,

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and a female end with a similar bar stock body containing the impact parts. The male end terminates in a spherical face backed up by a shoulder upon which the hooks engage. The spherical face is stellited to prevent scoring and wear. The female block is machined to fit the male end. Sealing is accomplished by means of a teflon gasket held in place by a retainer ring.

The electrical connector is similar to the Redox connector except that the explosion-proof features are not required. This connector consists of a male section incorporating seven contact buttons and a female section containing matching, spring-loaded contacts.

The impact operation, of both the pipe and electrical remote connectors, is as follows: The tapered hexagonal head of the impact screw is engaged by the remote impact wrench; the jaws, following a cam contour, engage or disengage on the end of the male stub shoulder as the crane operator actuates the impact wrench.

Remote Samplers

Samples taken from radioactive solutions in Building 202-A are divided into three groups based upon their degree of radioactivity. Samples of each group are obtained by means of air jet recirculation system, each with a different type of sampling device as follows:

Highly radioactive solutions are sampled by means of a Gilmont pipette, hydraulically filled and discharged by an operator protected from direct radiation by a shielding barricade. A measured small volume of the primary sample is discharged into a dilution flask, which is carried in a shielded carrier to the laboratory for analysis. Specific gravity determinations are also done on the undiluted sample by the operator at the sampling station, using the falling drop method.

Moderately radioactive solutions are sampled with a bayonet type sampler which holds approximately 4 milliliters of solution. This primary sample is carried to the laboratory in a shielded carrier for analysis.

"Cold" or slightly radioactive solutions are sampled in 4-ounce bottles inserted into the jet recirculation system. These samples do not require shielding.

Facilities are also provided for installing an in-line continuous sampler analyzer at each of the stations used for sampling highly radioactive solutions.

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The sampling stations are located in the Sample Gallery and are barricaded by massive concrete shielding on all sides, including the floor. In addition, the sampling stations are provided with special ventilation through laboratory-type hoods.

Sampling of process gases is also accomplished in the Sample Gallery through laboratory hoods. One such sampling hood serves the three dissolver cell off-gas systems. A second hood serves the vessel vent and condenser vent off-gas system.

Rotating Equipment

Pumps and Agitators

The remote pumps and agitators are similar in design to units existing in the Hanford Separation Plants. The "hot" pumps are of the deep-well, turbine type and all bearings except those in the process motors are lubricated by the fluid being pumped. The motors are of the standard induction type, TEFC, vertical standard hollow shaft, 1750 rpm for 440-volt, 3-phase, 60-cycle current. Class B insulation has been provided to withstand the elevated cell temperature. The bearings are mounted in large pre-packed grease chambers with shaft seals which prevent grease from entering the motor.

The remote agitators are of the direct drive turbine or propeller type and operate at speeds directly obtainable with standard electric motors. The lowest speed compatible with service requirements was used. The motors are similar to those specified for the remote pumps.

Both the agitators and pumps are grouped, insofar as possible, by size and type. In addition, all assemblies of the pumps and agitators are standardized, as much as possible, with respect to arrangement of appurtenances. Provision for remote operation and maintenance has been provided. All pipe and electrical connections are made with remote connectors. Lifting bails have been provided for crane removal. Assembly details have been simplified to allow contact maintenance.

All materials, other than the bearings, are of 18-8 stainless steel except the motor and other external components.

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Pulse Generators

The pulse generators are designed for remote installation in process cells, in precise relation to the extraction columns both in plan and elevation. Variable speed control is supplied by electrical devices separate and removed from the drive motors. Their pistons serve to impart a pulsing flow to the contacting fluids in the column. A pulse generator assembly consists of a pulse generator and appurtenances, a process connection jumper, overflow and vent connections, and a base for dunnage, where necessary.

The pulse generators are required in three sizes based on piston displacement and related requirements for power and power transmission. Speed range for all sizes is 35 to 110 strokes per minute. The material and construction features for all sizes is the same and the assemblies are standardized within a size group, insofar as possible.

Lubrication of the moving parts and bearings is supplied by a self-priming rotary pump, direct driven by the crank shaft. The pump draws from, circulates, and returns oil to a reservoir at the bottom of the mechanism box. This pool is of adequate capacity to properly lubricate the mechanism over long periods of operation. A remotely removable waste oil tank is provided below the mechanism box, so located as to receive displaced oil from the oil pool.

The motor is a standard induction type, TEFC, Class B insulation, vertical solid shaft, 1750 rpm, for 440-volt, 3-phase, 60-cycle current. Bearings are mounted in large grease chambers provided with shaft seals to keep grease out of the motor, and provision has been made for grease addition through a remote lubrication jumper and a Farval Valve.

All parts of the cylinder assembly are of stainless steel or suitable corrosion-resistant material. All external appurtenances including the motor, dunnages, etc., are carbon steel protected by Amercoat.

Centrifuges

As dictated by process requirements, the plant utilizes "solids-liquid" and "liquid-liquid" centrifuges. These are similar machines, but the "liquid-liquid" centrifuge, used for solvent recovery, is equipped with the additional parts necessary to enable it to perform

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a liquid phase separation in addition to the normal "solids-liquid" separation.

The centrifuges are of a direct drive, suspended bowl type, and are designed for "solids-liquid" separation. They incorporate bowls capable of non-swaying operations with unbalanced loads. The machines are capable of either continuous or batch operations. The assemblies are designed for remote installation and control. The bowl and all parts in contact with process solution are of stainless steel. A shroud surrounding the external shaft and motor coupling has been provided to prevent outleakage of process vapors. Braking is accomplished electrically in the drive motor and no mechanical brake is required. A hydraulically operated skimmer has been provided, with the controls remotely operable from the gallery. A single motion plow has also been included. This, too, is remotely operable from the gallery. The centrifuges are supplied with four process dip legs, a weight factor indicator dip leg, a thermowell, a high pressure internal bowl spraying system, and speed measurement over the entire range of operation.

The motor is of the two-speed type, 600 to 1200 rpm TEFC, Class B insulation, vertical solid shaft, induction-type for 440-volt, 3-phase, 60-cycle current. However, current normally supplied to the motors will be 75 cycle, which gives the required operating speeds to develop the specified centrifugal force. The 75-cycle current is supplied by motor generator sets.

Process Vessels

The process vessels may be divided into three classes as follows:

Class I - includes all vessels in the cells and product removal room.

Class II - includes all stainless steel vessels outside of these areas.

Class III - includes all other than stainless steel vessels located outside of the above areas.

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Class I Vessels

Class I Vessels have been designed not only to satisfy process requirements, but also to meet the demands of remote handling and maintenance. They have been grouped into the fewest standard sizes compatible with process requirements and within each standard size the vessels are identical with respect to nozzle orientation. Class I tanks and columns are remotely located by means of attached trunnions which fit into permanently installed trunnion guides, and are supported either under the bottom head or by structural steel dunnages. Support pads have been provided in the cell floor to make unnecessary accurate finishing of the concrete and to provide an exact elevation point for vessel support. Vessels supported on dunnage are positioned with dowels and secured by studs and nuts operated by the impact wrench. Class I vessels are equipped with lifting lugs or bails designed for handling with the canyon cranes. In general, the bails are located on the equipment so that the vessel hangs in its normally supported position.

Vessel tolerances are more rigid than in standard commercial practice. In addition, the fabrication procedures and inspection are very strictly controlled to insure the highest quality product.

Class II and III Vessels

These vessels are designed entirely in accordance with standard commercial practice.

INSTRUMENTATION

The Purex process is controlled remotely from centralized graphic panel boards located in the service area of the 202-A Building. The instrumentation system includes purged dip tubes for measuring weight, specific gravity, and liquid level; resistance thermometers for measuring fluid temperatures; and vertical in-line rotameters and control valves for metering "hot" flows. In each case, the sensing element is connected directly to the process equipment in the remote areas and electrical leads or tubing are brought through the shielding wall to the panel boards. Maximum consideration has been given to the use of simple primary elements. The elements

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themselves are fabricated so that all parts in contact with the process fluids are stainless steel.

The panel boards are in three different rooms in the service area. The first or so-called "head end control room", is a graphic panel board located at about the center of the head end portion of the process (east end of the 202-A canyon). This board contains all of the instrumentation required for monitoring the feed preparation portion of the process. It is arranged in the pattern of the process flow, with the routing and equipment graphically indicated on the face of the panel. The second panel board, "central control room", is located about at the mid point of the continuous portion of the process. It handles the waste, organic and extraction cycles, and houses all of the instrumentation for monitoring the remainder of the process. The third panel board is used entirely for heating and ventilating controls and serves no process function. It is located in the process blower room and is of the general graphic type with respect to the individual instruments. However, since it is not a process system, there are no flow patterns or symbols.

In addition to the systems described above, there are a number of miscellaneous local panels to monitor the various "cold" process systems. These include aqueous make-up, compressor room, PR room, etc.

Radiation elements have been provided for monitoring radiation levels in both "hot" and "cold" areas. A signal from these elements is transmitted through an amplifier to the recorders and alarms on the process panel boards.

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Power

Incoming power lines to the Purex Facility are 13.8 kv, 60 cycle, 3 phase, three wire for normal power and 2.4 kv, 60 cycle, 3 phase, three wire for emergency power. These lines terminate at switching structures in the vicinity of the 202-A Building and main transformers, fed by them, supply the power system for the plant. The primary power feeders are 2.4 kv, 60 cycle, 3 phase,

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three wire, coming off the 2.4-kv switchgear inside the building with throat connections through the building wall to the transformers. There are two 2400/480-volt substations inside the building, with outdoor transformers providing 480-volt power to all motors up to 150 horsepower.

The emergency system is cross-connected to the main busses to supply emergency power to selected services.

The power distributions systems covered above are schematically indicated on electrical "one-line diagrams" (drawing numbers H-2-54350N, H-2-54351N and H-2-54352N).

Lighting

In general the design of lighting levels has been based upon the recommendation of the Illuminating Engineers Society. Lighting circuits have been supplied by 480 to 120/208-volt, 3-phase, dry-type transformers. Receptacles and small single phase loads are considered part of the lighting system.

Between 10 and 20% of the general lighting and all of the exit lighting installations have been supplied from the emergency power bus. In addition, all exterior building lighting and all interior lighting which will pass light to the exterior through openings or passageways are tied into a blackout system which is remotely controlled from the dispatcher's control desk in the 202-A Building.

Special lighting has been provided as required in the control room, on stairways, at the sample receiving area of the laboratory and at all hoods. A minimum of 10-foot candles has been maintained on the canyon deck to facilitate maintenance and to provide lighting, supplementary to the lights on the main crane, for background light for the television cameras.

Street and fence lighting have been supplied to the area on 6.6 ampere series circuits supplied from the 2.4-kv switchgear. This load is tied into the blackout circuit and provides for a minimum of 1/2 foot-candle on the exclusion fence, except at gate entrances where a 1 1/2 foot-candle level is maintained.

Communications

There are three communication systems in the Purex area as follows:

1. HW plant telephone dial system. This system consists of dial telephones, installed and connected as a part of the Hanford Works system and includes approximately 40 telephones.

2. Inner area system telephones. A local automatic telephone exchange is located in the storage gallery of the 202-A Building for Purex inner area service between buildings. This system uses standard, dial type office instruments. Each is furnished with a hand set as a part of the unit plus an auxiliary plug receptacle so that a separate portable hand set may be plugged in for service. Approximately 90 telephones have been included in this system and eight portable hand sets have been furnished.
3. Multi-Station Intercommunication Systems. An intercommunication "Teletalk" system has been installed for direct communication between principal operating control points in the 202-A Building. Twelve stations with annunciators have been supplied.

Evacuation Alarm and Fire Alarm

An evacuation alarm system for the plant, manually controlled from the dispatcher's desk, has been supplied. The signals are located throughout the building and are of the vibratory type which produce a distinctive tone of sufficient volume to overcome surrounding noise levels. The signal power is taken from the emergency lighting panels and provides coverage for all the Purex plant areas, both inside and out.

An auxiliary alarm system has been provided for detecting fires in the canyon cells. It employs electronic elements mounted in jumpers, which actuate a signal system on the dispatcher's desk. A standard plant fire alarm system with connections from the master fire alarm boxes at the 202-A Building main entrances to the outside pole line conductors has also been provided.

Building Ground System

The building ground system consists of 4/0 stranded copper cable connected to building columns, ventilating equipment, wall connector plates, etc., and bonded to the water mains. Pipe lines and ducts carrying inflammable liquids or vapors have electrical ground continuity at all flanged connections and are grounded to the building grid.

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Miscellaneous Systems

Miscellaneous systems such as provision for welding outlets, instrument supply, laboratory supply, railroad gate locks and door locks, and the dispatcher's control desk have been supplied as required.

OUTSIDE FACILITIES

203-A Recovered UNH Storage Facility and 211-A Chemical Tank Farm

The 203-A facility consists of four 100,000-gallon stainless steel tanks, a pump house, a truck loading spot, three stainless steel trailer trucks, two tanks, and the necessary equipment for transferring recovered acid from another area to the main building. Each of the four UNH tanks is enclosed in a concrete basin capable of holding the contents of one tank with provision for disposal by jet to portable containers or tank trucks. The tanks are designed in accordance with American Petroleum Institute standards, with full design consideration given to the high value of the process material. Pumps have been provided which are capable of transferring the tank contents to the truck loading spot as well as recirculating them for sampling purposes.

The pumps, controls, and instrumentation are installed in a small centrally located pump house which also houses the equipment for the recovered acid system in a separate section.

The 211-A facility consists of a tank farm and pump house. The tank farm provides for storage of nitric acid, caustic soda, TBP, hydrocarbon diluent, demineralized water; and sulfuric acid. The pump house contains transfer pumps, controls, instrumentation, the demineralizer, and associated equipment. It is of standard construction with a concrete floor and a transite exterior. All chemical pumps and motors are mounted on elevated concrete pads and are underlined with stainless steel drip pans.

The tank farm is located alongside a double track railroad spur as indicated on drawing H-2-55051H. Two tank car unloading stations with unloading pump facilities, transfer piping and utilities have been provided. In addition, one truck unloading station for transferring nitric acid to the sample tank and from the sample tank to

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the two nitric acid storage tanks has been provided. Also included is an unloading system for transfer of TBP from barrels to the TBP storage tank.

In order to permit sampling, an elevated walkway has been provided which allows passage along the top of the tanks. The tanks themselves are of welded construction in accordance with the API code for storage tanks and other applicable codes. Tank foundations have been constructed in accordance with standard industrial practice and where required, the tanks have been insulated.

Two mixed bed demineralizing units, each capable of processing 150,000 gallons of water per day without regeneration, have been installed in the central pump house, together with necessary water softener and chemical reagent tankage.

241-A Waste Tank Farm

This facility consists of several large underground storage tanks and a diversion box, with catch tank, for use in routing highly contaminated wastes to them. The diversion box utilizes standard remote connectors and jumpers and space has been provided in it for storing jumpers. Spare routings have been provided for future use.

216-A Waste Disposal Cribs

Several cribs have been provided for above-ground disposal of the slightly contaminated waste materials which do not require permanent underground storage. They include the condensate crib, the organic crib, and the laboratory waste crib. These cribs are of standard Hanford Works design and have provisions for sampling and radiation monitoring.

291-A Waste Gas Disposal System

This system provides the necessary equipment for treatment and disposal of contaminated ventilation and process gases from the 202-A Building. It includes a Fiberglass filter, an exhaust fan house, gas sampling facilities, an exhaust stack, and a stack

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washdown and drainage system. The exhaust filter is in two sections: (1) a pre-filter of coarse fiber which serves both for decontamination and water de-entrainment, and (2) an after filter, made of fine fibers, which does most of the air cleanup. Provisions have been made for adding a filter in the future, if necessary, and bypassing the existing filter.

The exhaust stack is of reinforced concrete with a stainless steel liner. It is 16 feet 7 inches in diameter at the bottom, 12 feet in diameter at the top and 210 feet high, over-all. It has provisions for gas sampling and liner wash down. The liner is of all welded construction, designed to be self-supporting. The fan house includes the fan platform on which the four exhaust fans are mounted, the fan inlet and discharge plenums, and the stack breeching.

272-E Mock-Up Shop

This shop was designed for installation in an existing building following a cost analysis which indicated that the existing building could be reconverted at a considerable saving over the cost of construction of an entirely new facility. The function of this building is to check dimensionally all canyon equipment prior to its installation in the canyon and to perform the necessary run-in tests on rotating equipment. A number of jigs and fixtures have therefore been designed to allow dimensional checking of individual plant components. These include jumper checking jigs, trunnion locating fixtures, a tank checking jig and test stands for the pumps and agitators, pulse mechanisms, centrifuges, etc.

The major structural changes to the existing building were to remove the old floor and strengthen the structure to accommodate a 40 ton crane. To do this, existing structural steel members were reinforced and outrigger foundations were added to carry the new load.

A number of relatively minor changes, such as increasing the rolling door size, adding a ventilation duct work system, etc., were also made.

271-A Warehouse

This warehouse was designed to store sodium nitrate pellets and is an all steel, prefabricated building with a concrete floor. Lighting

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and a gravity ventilation system have been provided. The building floor is located at the same elevation as the chemical unloading dock so that material transfers to the 202-A Building can be made by fork lift truck.

Outside Utilities

Raw Water

Raw water is supplied to the 202-A area for process cooling, canyon fire protection sprays, cell washdown sprays, sample box sprays, and compressor jackets. Points of entry to the 202-A Building are located at the west end and the northeast corner of the building to allow flexibility in routing and to assure operational continuity of the building distribution system. The system consists of a single 100-psig sectionalized header running the length of the Pipe Gallery and supplied from both ends to form a loop. Major process cooling water and cell fire protection demands are connected directly to the header. Other services have been supplied from a subheader network.

Sanitary Water

Sanitary water is used for the generation of demineralized water, sanitary facilities, safety showers, building ventilation air washers, and fire mains. Points of entry to the 202-A Building are in the same general locations as the raw water. Additional branches from the northern portion of the main line have been provided to supply the auxiliary facilities and fire hydrants. Similarly, a line has been supplied to the south side of the 202-A Building to supply the fire protection system and the 291-A Building. Distribution in the 202-A Building is from a looped, sectionalized header located in the Pipe Gallery, supplied from both ends, and operating at 100 psig.

Demineralized Water

The demineralized water is generated and heated in the 211-A Pump House and routed via a 90,000 gallon storage tank in 211-A to the 202-A Building for general process use.

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Steam

Steam is furnished to the 202-A area at a nominal 185 psig pressure. This high pressure steam is used directly for the emergency, turbine-driven exhaust blower at 291-A and for the steam heated silver reactors in the dissolver cells of the 202-A Building. The system is arranged so that the emergency turbine steam and the silver reactor steam have equal priority and are supplied at the expense of the balance of the 202-A area. To accomplish this, controls have been provided to maintain these mandatory steam demands at all times. Pressure-reducing stations are located within the various facility structures as required. The distribution system within the 202-A Building consists of a 100-psig, sectionalized steam header located in the Pipe Gallery and supplied from PRV's at both ends of the gallery off of the 185 psig header which services the silver reactors. In addition, a low pressure header is included to serve process and non-process low pressure requirements.

Compressed Air

The compressed air requirements of the 202-A area are supplied by two separate systems: an instrument air system and a service air system.

The compressors and auxiliary equipment for these systems have been located within the compressor room of the 202-A Building. The two systems are cross-connected in the compressor room to permit the use of service air for emergency instrument air supply in case of failure of the instrument air system. Instrument air is supplied at 80 psig and service air at 100 psig.

Service Drops

Service drops for low pressure steam, 100 psig sanitary water, and 100 psig service air have been grouped together and located along the canyon, in the remote and regulated shops, the acid and 276-A vaults, the galleries, and other areas in the building.

Sanitary Waste Disposal

A single sanitary waste disposal system has been provided to serve the entire Purex plant. The system collects sewage from the locker

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and toilet rooms on the service side of the building and conducts it west and north to a septic tank and tile field.

Cold Chemical Sewers

The cold chemical sewer system collects uncontaminated wastes from all of the non-regulated areas of the plant and conducts them northward to an open drainage ditch. This system serves a dual purpose, since it disposes of both cold chemical wastes and a large quantity of uncontaminated waste water. Examples of the various wastes that are eliminated through this system are: unregulated flow of drains, chemical tank overflows in the aqueous make-up and Pipe Gallery, 211-A drainage, showers and drinking fountains, waste water from ventilation units, and steam condensate from the ventilating system. The waste lines inside the building are of lightweight stainless steel pipe. The outside waste lines are acid-resisting tile.

Roads and Walks

Proposed roads and walks for the 202-A area are shown on plot plan H-2-55051H. Design is in conformance with Hanford Works standards.

Fences

Fence locations are shown on plot plan H-2-55051H. These fences, in all respects, conform to Hanford Works standards for chain-link security fence.

Badge House

The 2702-A exclusion gate house is a wood frame structure with asbestos shingle siding and is constructed on a concrete slab. It duplicates the design of the badge house for the 221-U area except for provisions for an evaporative cooler and other minor changes.

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PART IV. JOB 63R - REDOX PHASE II - PROJECT C-535

INTRODUCTION

The scope of Vitro work on Project C-535 included:

1. Design of increased capacity for outside chemical storage Facilities 204-S and 211-S.
2. Design of new equipment for Cells D and G of the 202-S Facility to increase capacity.
3. Design of a new plutonium-product, continuous-concentration and loadout facility known as 233-S.

The original scope of the job was defined in basic design guides for Vitro design work on Redox, Phase II.* As the design progressed, this scope material was amplified and revised by DA letters issued by the General Electric Company.

* "Basic Design Guides for Vitro Design work on Redox Phase II,"
G. C. Gabler, AEC to J. C. Tourek, Vitro Engineering Division,
February 20, 1953.

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JOB DESCRIPTION

OUTSIDE CHEMICAL STORAGE FACILITIES

204-S Facility

The 204-S Facility for storage of UNH solution was enlarged by the design of two additional storage tanks. The tanks designed were 25 ft diameter x 14 ft of stainless steel construction, and insulated and heated. The new tanks were located immediately north of the original tanks in a new concrete diked facility similar in design to the original installation. As the new tanks serve only as increased storage capacity, no new pumps were required. The piping to and from the new tanks was integrated with the existing 204-S piping system. Temperature and liquid level instrumentation was provided similar to that used in the original installation. The tanks were fabricated in accordance with specification HW-5521.

211-S Facility

Original Job 63R scoping plans called for the addition of two 300,000 gal aluminum nitrate storage tanks for the 211-S Facility in order to provide 60-day inventory requirements. This requirement was subsequently modified by an instruction, DA-9, dated August 14, 1953, calling for one 300,000 gal tank. Accordingly, one stainless steel tank 38 ft diameter x 36 ft, heated and insulated was located on the foundation from which TK-305-B was removed. Piping drawings were provided integrating the piping for the additional tank with the original 211-S Facility piping system. The liquid level and temperature instrumentation provided on the new tank was similar in design to that used in the original 211-S Facility. The tank was constructed in accordance with specification HW-5521.

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202-S FACILITY EQUIPMENT DESIGN

General

The design work completed for the 202-S Facility included the redesign of equipment and piping in cells D and G in order to satisfy the new flowsheet capacity and routing.

Cell D

The new equipment in Cell D consisted of replacing existing concentrator tower and condenser.

Condenser

The new condenser design consisted of a stainless-steel, horizontal, shell-and-tube unit incorporating all welded construction and floating-head design.

Tower

The new tower design consisted of a 5 ft diameter stainless-steel tower containing five bubble-cap trays and a packed de-entrainment section. The tower was connected at the reboiler pot by a remote flange.

Reboiler

The reboiler design was considerably modified from the previous design in order to incorporate remotely removable, heat-exchanger bundles. Previous experience with corrosion of equipment in similar service indicated that such a design change was desirable. The new reboiler design consists of a stainless-steel pot flange at the bottom of the tower. The reboiler pot contains two bayonet-type heat-exchange bundles which are installed through two remotely flanged openings in the head of the pot. The heat-exchange bundles are separately removable by remote means.

Cell G

The revised equipment in Cell G consists of an organic still, reboiler, tower and combined condenser-phase separator.

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Condenser-Phase Separator

This unit was designed to condense the azeotropic vapors in the organic still to sub-cool and separate the aqueous and organic phases. The aqueous phase is returned to the tower bottom where the organic is removed for re-use in the process. The unit consists of a horizontal, stainless-steel, shell-and-tube type with internal floating head and all welded construction. The vapor is condensed in the upper half of the shell above the longitudinal baffle and the condensate is sub-cooled and separated in the lower half of the shell. The separated phases are continuously withdrawn through fixed jack legs.

Tower and Reboiler

In the interests of maximum standardization of equipment in order to reduce sparing requirements, the tower and reboiler for Cell G are identical in design to the tower and reboiler in Cell D. Extra nozzles on the equipment are closed by blank connectors as required.

Miscellaneous

The pipe jumpers and instrumentation were revised as required to satisfy the new equipment design and flowsheet. The design of pipe jumpers and equipment is complicated by the necessity of utilizing existing buried piping and by the limited space available in the cells.

The new equipment is fabricated in accordance with specifications HW-4987 and HWS-5660 except for the reboiler bundles which are fabricated according to specification HW-5662.

233-S Facility

This facility consists of a new building and ventilation exhaust system and contains facilities for continuously concentrating and batch loading of plutonium solution of the 3-BP stream from the 202-S Building.

Process Description

The 3-BP stream is received batch-wise from the feed tank TK-1001 from 202-S via a new pipe trench. This stream contains the dilute plutonium product from the Redox extraction system. This material is continuously pumped from the feed tank to the midpoint of the packed stripping tower T-1002. In this tower the organic in the feed is stripped and condensed

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overhead in a vertical condenser and subsequently recycled to the 202-S building via the condensate sample tank TK-1006. The stripper bottoms from T-1002 (approximately 90% of the feed) flows by gravity to the plutonium concentrator T-1003 where it is concentrated. The concentrated bottoms containing 50-100 g/l of plutonium is intermittently removed by a time controlled let down valve to the product receiver TK-1004. The overhead vapors containing water, HNO_3 and entrained plutonium are condensed in a horizontal condenser and the condensate evaporator TK-1005.

This condensate is evaporated in T-1005, the overhead containing HNO_3 and water is condensed and the condensate recycled to the 202-S building via the condensate sample tank TK-1006. The concentrated bottoms containing recovered plutonium and HNO_3 are recycled to the reboiler of the plutonium concentrator T-1003.

The concentrated plutonium product is batch transferred from the product receiver TK-1004 to the sample tank TK-1008 by vacuum. In the sample tank the solution is agitated by a recirculating pump, sampled and if on-specification, is transferred batchwise by gravity to the head tank in the plutonium loadout facility. Provisions for recycling off-specification plutonium solution to either TK-1001 or the 202-S Building are provided in the sample tank TK-1008 via the recycle tank TK-1013.

The plutonium product is loaded from the head tank in the loadout facility in volume-controlled batches into PR transfer cans for manual transfer to subsequent processing steps.

233-S FACILITY DESIGN

233-S Building

233-S Building is of reinforced-concrete construction, located just north of the 202-S Building and adjacent to the column carrier outlet. The building is approximately 35 ft x 43 ft in plan. The roof elevation is approximately 10 ft except for the process area which is 32 ft and the loadout area which is 15 ft. The building is divided into a process area, loadout area, central control room, utility room and SWP change room. The building is designed without windows with one normal entrance through the SWP change room and with an emergency exit in the control room, loadout area and process area.

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Process Area

The process area occupies the southeast corner of the building and is approximately 13 ft 6 in. x 30 ft and is separated from the control room and the loadout area by 12 in. concrete shield walls. The process area houses all the process vessels containing radioactive solutions. The equipment is arranged along the common shielding wall and is enclosed by a ventilation screen of lucite and stainless steel. It is anticipated that the process area will be habitable under SWP conditions during operation. The ventilation screen is designed with removable panels to permit access to valves and equipment for maintenance.

The instrument transmitters are also located in the process area. These transmitters are located on a platform at high elevation to minimize the danger of any hot liquid backflow through the instrument lines to the cold control area. Access to the transmitter platform and to high equipment for maintenance is provided by the use of a high mobile lift platform.

Loadout Area

The loadout area is approximately 10 ft x 24 ft in plan and located in the northeast corner of the building. This area houses the loading and decontamination hood similar in design to the unit previously described for the PR room in Purex. In addition, this area also contains a recycle hood for returning material from PR cans to the process. The material to be recycled is received in PR transfer cans from another process.

The area contains a monorail system for handling PR cans within and between the various hoods and an accountability scale for weighing entering and leaving containers.

Control Room

The control room is approximately 10 ft x 30 ft in plan and is located in the central portion of the building adjacent to the process area. This room contains the subpanel board and all controls for the remote operation of the control area. This room also contains the cold chemical makeup and wash facilities, motor control center and gang valve assemblies. Piping between the control room and the process area is through the common shield wall.

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Utility Room

The utility room which houses the ventilation equipment is approximately 10 ft x 16 ft and is located adjacent to the control room in the southwest corner of the building.

SWP Change Room

The SWP change room is located in the northwest corner of the building. This room contains normal locker room facilities and health monitoring instruments. The normal entrance to this facility is through this room. The only entrance to the loadout area and process area, is from this room.

Process Equipment and Piping

The process equipment in the process area is nearly identical in design with the equipment of similar function previously described for L-Cell in the Purex process. The major design problem for this equipment was the limits imposed by solution criticality. The equipment, except TK-1001 and TK-1013, is designed to be "always safe" by reason of geometry. In the excepted tanks the solution criticality is limited by batch volume control.

The equipment arrangement and piping designs are limited by consideration of minimizing interaction between vessels with criticality control and accessability for maintenance within the severely limited area available.

The loadout equipment in the 233-S Facility is similar to that used in the PR room for the Purex plant which has been previously described. The loadout facility includes within a hood, equipment for filling PR cans to accurately determine volumes, surveying the cans for external contamination and equipment for decontamination the cans as required. These functions are carried out within a specially ventilated hood equipped with suitable monorail equipment for transferring the cans between operating locations.

Ventilation

Fresh air is supplied by fans to the building through suitable air washers and tempering coils. Air is controlled to flow from the less contaminated to the more contaminated areas. The contaminated air is exhausted from

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the process area enclosure through a Fiberglas filter by an exhaust fan and discharged to a stack.

The required temperature controls to maintain winter comfort conditions and provide evaporative cooling within the limits of the system are provided. Pressure controls and interlocks are provided to prevent the operation of the supply fan without the exhaust fan.

Instrumentation

The process facility is designed and instrumented for remote operation from the control room. All operating instruments are located on the main control panel in the control room. Air actuated remote valves, both control and block, and purge type level and pressure instrumentation are used. Flows in general, are measured by remotely located rotameters.

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PROJECT CHRONOLOGY

MONTHLY PROGRESS

February, 1953

The scope drawings were completely revised to reflect current design requirements. The service area design was changed to provide for steel framing with corrugated siding instead of the all-concrete construction previously specified.

March, 1953

During March, Vitro's efforts on Project C-535 were directed toward interpreting and supplementing scope information required for initiation of design. The following basic information was received from GE during the month:

1. Basic Design Guides for Vitro Work on Redox Phase II /1R/*.
2. Proposed Product Concentration and Removal Building (233-S), drawing SK-2-5746.

Drawing and engineering schedules were issued by Vitro during the month.

Process equipment design for equipment for Building 233-S was started, based upon unapproved (50% complete) flow diagrams. Process equipment design for the Organic Still Facility (Building 202-S) was essentially completed and design data were compiled to permit start of detailed design.

*This and other references so marked in this chronology are listed in the bibliography at the end of this section.

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April, 1953

During the month work progressed satisfactorily and no serious delays were encountered.

Approved copies of process flow diagrams were received in New York early in the month. Representatives of GE visited New York during the month to discuss instrumentation design and to review the status of scope and design progress. During this meeting, Facilities 233-S, 204-S, 211-S and 202-S were thoroughly reviewed and agreements were reached on many points of design.

May, 1953

On May 18, H. E. Hanthorn and D. B. Wilson of GE met with Vitro personnel in the Vitro New York office. A number of Project C-535 scope changes were made as a result of this meeting, the most important of which were:

1. Revision of the material balance and product specification for the 233-S Facility.
2. Elimination of the design of centrifuge feed tank facility from the scope of Vitro design responsibility.

The effect of the first mentioned change was that it made necessary considerable revision of the proposed equipment design and arrangement resulting in a scheduled delay of from two to four weeks. This allowed time to re-do design studies and calculations before the start of detailed design.

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June, 1953

GE acknowledged by letter of June 4, 1953 /2R/ that Vitro had been relieved of design responsibility for the centrifuge feed tank facility and associated jumper changes. This was in accordance with agreements reached during the May 18 visit of H. E. Hanthorn to the New York office.

Upon receipt of approved 233-S Facility scope drawings, work on detailed architectural, structural, equipment arrangement, and piping drawings was initiated.

During the month, emphasis was placed on the completion of design of mechanical equipment for the 233-S and 202-S Facilities.

July, 1953

During July, a number of DA letters were received from GE approving Vitro drawings, subject to comments. The comments reflected a number of scope changes, including:

1. New reboiler design for the 202-S Building concentrators.
2. Questionable feasibility of modifying existing condenser surface because of contamination.
3. Apparent increased design load for stripper in Building 233-S.

These requested equipment design revisions necessarily entailed expensive revisions to arrangement and jumper drawings and materially affected the design schedule. The full extent of the effect, however, could not be known until clarifying discussions were held with GE during early August.

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August, 1953

Extensive equipment scope changes necessitated a re-evaluation of the schedule and progress status of work on Project C-535. Considerable progress was discounted where completed work, now void, had to be redone.

September, 1953

More equipment scope changes were received during the month. Based on all changes, a revised drawing schedule was issued which showed a three-month delay in completion. As of August 31, over-all completion had dropped from 70.6% completion for the project as originally scoped, to 48.8% for the newly scoped project./3R/ As of September 30, these figures were, respectively, 86.1% and 64.3%.

October, 1953

Major effort during the month was centered on completion of drawings critical for construction of Building 233-S. A target date of November 11, 1953 was set for Vitro-approved drawings. Over-all completion of the project at the end of the month was 81.1%.

November, 1953

During the latter part of November, major effort was concentrated on new drawings. Revision to drawings, unless critical, was not made until all new drawings were completed. Over-all drawing progress, as of November 30, was 88.3% as compared to 74.2% on October 31.

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December, 1953

During December, major effort was concentrated on the completion of new drawings, and only 12 new piping drawings were outstanding at the end of the month. Within the limits of available manpower, revision of previously issued drawings was accomplished during the month. Over-all drawing completion, as of December 31, was 97.9%.

January, 1954

C. C. Randall of the Vitro New York office visited Richland during the month to confer with AEC and GE personnel on the status of design of Project C-535. It was agreed at these meetings that the Vitro New York office would complete the drawings in its possession, and also would complete the design revisions as requested by DA and RA letters up to DA-32, which specifically applied to them. It was decided that all further revisions to C-535 design drawings would be done in Richland.

References

- /1R/ G. C. Gabler of GE to J. C. Tourek of Vitro, "C-535 - Redox Capacity Increase Design Instructions" dated February 20, 1953.
- /2R/ H. E. Hanthorn of GE to J. C. Tourek of Vitro, "C-535, Redox Capacity Increase - Phase II - Revised Drawing Schedule" June 4, 1953.
- /3R/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "C-535, Redox Expansion Phase II - Job 63R" dated September 10, 1953.

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APPENDIX A — PART 1

DESIGN CRITERIA FOR PUREX

Description of Work	Drawing No.	Transmittal Date (1953)
I. PRIMARY FLOW SHEET HW-24763		
II. PROCESS DESIGN CRITERIA HW-25744		
III. MATERIAL BALANCE FLOW SHEET		
Mat. Bal. Flow Sheet I	SK-2-1170	1/23
Mat. Bal. Flow Sheet II	SK-2-1171	1/23
Mat. Bal. Flow Sheet III	SK-2-1172	1/23
Mat. Bal. Flow Sheet IV	SK-2-1173	1/23
IV. PROCESS DESCRIPTION HW-25488	HW-26177	1/8
V. GENERAL METHODS OF PROCESS CONTROL HW-25632		
VI. PROCESS FLOW DIAGRAM		
Metal Sol. Feed Prep. Sheet I	SK-2-1181	1/23
Metal Sol. Feed Prep. Sheet II	SK-2-1182	1/23
Partition Cycle Decontamination	SK-2-1183	1/23
Uranium Cycle Decontam. Sheet I	SK-2-1184	1/23
Uranium Cycle Decontam. Sheet II	SK-2-1185	1/23
Second Cycle "Pu" Decontam.	SK-2-1186	1/23
Waste Section	SK-2-1187	1/23
Pre-Cycle Decontamination	SK-2-1189	1/23
Engineers Flow Sketch	SK-2-1615	1/8
Aqueous Make-up Sheet I	SK-2-1191	1/23
Aqueous Make-up Sheet II	SK-2-1199	1/23
Process Vent System, Lab. Waste		
Treatment and Decontam. Tank	SK-2-1559	1/23
Chemical Tank Farm	SK-2-1552	1/23
Waste Disposal	SK-2-1598	
Sol. Treat. No. 1 Cycle, Alternate	SK-2-1594	1/23
Sol. Treat. No. 1 Cycle	SK-2-1595	1/23
Sol. Treat. No. 2 Cycle, Alternate	SK-2-1596	1/23
Sol. Treat. No. 2 Cycle	SK-2-1597	1/23

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Description of Work	Drawing No.	Transmittal Date (1953)
VII. PROCESS EQUIPMENT PRELIMINARY DESIGN - PROCESS REQUIREMENTS		
Written Criteria - HW-25778		1/23
Calculations - HW-25843		1/23
VIII. SPECIALIZED EQUIPMENT SKETCHES*		
Plutonium Receiver	SK-2-1193	1/23
Plutonium Receiver	SK-2-1578	1/23
2AF Tank	SK-2-1588	1/23
"T" Type Column - Ass'y and Detail	SK-2-1195	1/23
"C" Type Column - Ass'y and Detail	SK-2-1214	1/23
"A" Type Column - Ass'y and Detail	SK-2-1215	1/23
1BS Type Column - Ass'y and Detail	SK-2-1216	1/23
1BX Type Column - Ass'y and Detail	SK-2-1217	1/23
2A Type Column - Ass'y and Detail	SK-2-1218	1/23
2B Type Column - Ass'y and Detail	SK-2-1219	1/23
"O" Type Tank Contactor	SK-2-1196	1/23
"O" Type Pulse Column		
Fractionator - Ass'y and Detail	SK-2-1201	1/23
PU Vacuum Tank	SK-2-1628	1/23
Large Concentrator	SK-2-1203	1/23
Large Condenser	SK-2-1207	1/23
Plutonium Sol. Stripper - Ass'y and Detail	SK-2-1204	1/23
Plutonium Packaged Unit No. 1	SK-2-1205	1/29
5,000 Gallon Tank and Coil	SK-2-1208	1/23
1,725 Gallon Tank and Coil	SK-2-1209	1/23
Dissolver - Assembly and Detail	SK-2-1210	1/23
Dissolver Tower Ass'y and Detail	SK-2-1211	1/23
Plutonium Concentrator Condenser and Detail	SK-2-1212	1/23
Plutonium Concentrator - Ass'y and Detail	SK-2-1213	1/23
Large Concentrator Seal Pot	SK-2-1576	1/23
PR Can	SK-2-1577	1/23
Plutonium Concentrator Seal Pot Vent Pot	SK-2-1580	
Waste Rework Condenser	SK-2-1581	1/23
Plutonium Sampler	SK-2-1578	1/23
Decanter	SK-2-1593	1/23
15,000 Gallon Tank and Coil		
Silver Reactor	SK-2-1198	1/23
Hydraulic Schematic Sheet I	SK-2-1220	1/29
Hydraulic Schematic Sheet II	SK-2-1221	1/29
Hydraulic Schematic Sheet III	SK-2-1222	
Hydraulic Schematic Sheet IV	SK-2-1223	
Hydraulic Schematic Sheet V	SK-2-1224	
Heater	SK-2-1627	1/23
Dissolver Knockout Pot	SK-2-1626	1/23
Organic Cooler	SK-2-1585	
IX. PROCESS SUMMARY BOOK - IN- CLUDING UTILITIES SUMMARY		

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Description of Work	Drawing No.	Transmittal Date (1953)
X. PROCESS EQUIPMENT PRELIMINARY DESIGN - MECHANICAL REQUIREMENTS		
a. Vessels b. Concentrators, Fractionators and Extraction Equipment c. Agitators d. Pumps e. Centrifuges and H. Pulse Gener. f. Piping g. Samplers i. Pipe and Electrical Connectors		
XI. ARCHITECTURAL AND STRUCTURAL DESIGN CRITERIA		
XII. BUILDING ARRANGEMENT DRAWINGS		
Plan - Pipe and Cab Gallery Level	SK-2-1421	1/14
Plan - Sample and Storage Gallery Level	SK-2-1422	1/14
Longitudinal Section - Service and Canyon Area	SK-2-1423	1/14
Typical Cross Section	SK-2-1424	1/14
Arch. - Misc. Room Layouts	SK-2-1425	1/14
Misc. Cross Section Sheet I	SK-2-1426	1/14
Misc. Cross Section Sheet II	SK-2-1427	1/14
XIII. EQUIPMENT AND PIPING ARRANGEMENT DESIGN CRITERIA		
XIV. EQUIPMENT AND PIPING ARRANGEMENT DRAWINGS		
Equipment Arrangement Plan and Longitudinal Section Sheet I	SK-2-1431	1/23
Equipment Arrangement Plan and Longitudinal Section Sheet II	SK-2-1431	1/23
Equipment Arrangement Plan and Longitudinal Section Sheet III	SK-2-1431	1/23
Cross Section - Canyon	SK-2-1433	1/23
Canyon Cell Layout - Tunnel Schematic	SK-2-1434	1/23
Hot Pipe Trench Schematic	SK-2-1437	
Trench Piping Arrangement	SK-2-1438	
Trench Piping Arrangement	SK-2-1439	
XV. ENGINEERING FLOW DIAGRAMS		
Met. Sol. Feed Prep., Sheet I	SK-2-1153	1/14
Met. Sol. Feed Prep., Sheet II	SK-2-1159	
Met. Sol. Feed Prep., Sheet III	SK-2-1155	1/14
Met. Sol. Feed Prep., Sheet IV	SK-2-1156	1/14
Met. Sol. Feed Prep., Sheet V	SK-2-1157	1/14
Process Vent System	SK-2-1158	1/14
Pre-Cycle, Sheet I	SK-2-1526	1/14

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Description of Work	Drawing No.	Transmittal Date (1953)
Pre-Cycle, Sheet II	SK-2-1527	1/14
Partition Cycle, Sheet I	SK-2-1529	1/14
Partition Cycle, Sheet II	SK-2-1530	1/14
Partition Cycle, Sheet III	SK-2-1531	1/14
Uranium Decontam. Cycle, Sheet I	SK-2-1532	1/14
Uranium Decontam. Cycle, Sheet II	SK-2-1533	1/14
Uranium Decontam. Cycle, Sheet III	SK-2-1534	1/14
Plutonium Decontam. Cycle, Sheet I	SK-2-1535	1/14
Plutonium Decontam. Cycle, Sheet II	SK-2-1536	1/14
Plutonium Decontam. Cycle, Sheet III	SK-2-1537	1/14
Waste Treatment, Sheet I	SK-2-1166	1/14
Waste Treatment, Sheet II	SK-2-1167	1/14
Waste Treatment, Sheet III	SK-2-1168	1/14
Waste Treatment, Sheet IV	SK-2-1169	1/14
Waste Treatment, Sheet V	SK-2-1542	1/14
Aqueous Make-Up, Sheet I	SK-2-1544	1/23
Aqueous Make-Up, Sheet II	SK-2-1545	1/23
Aqueous Make-Up, Sheet III	SK-2-1546	1/23
Aqueous Make-Up, Sheet IV	SK-2-1547	1/23
Aqueous Make-Up, Sheet V	SK-2-1548	1/23
Aqueous Make-Up, Sheet VI	SK-2-1549	1/23
Recovered Acid Storage	SK-2-1550	1/14
Condensate Treatment	SK-2-1551	1/14
Chemical Tank Farm, Sheet I	SK-2-1610	1/29
Chemical Tank Farm, Sheet II	SK-2-1611	1/29
Headers, Sheet I, Pipe Trench	SK-2-1553	1/29
Headers, Sheet II, Pipe Trench	SK-2-1554	1/29
Headers, Sheet III, Pipe Trench	SK-2-1555	1/29
UNH Storage Facility	SK-2-1613	1/14
Sol. Treat. No. 1 Cycle, Sheet I	SK-2-1560	1/14
Sol. Treat. No. 1 Cycle, Sheet II	SK-2-1561	1/14
Sol. Treat. No. 1 Cycle, Sheet III	SK-2-1562	1/14
Sol. Treat. No. 2 Cycle, Sheet I	SK-2-1563	1/14
Sol. Treat. No. 2 Cycle, Sheet II	SK-2-1564	1/14
Sol. Treat. No. 2 Cycle, Sheet III	SK-2-1565	1/14
Lab. Waste	SK-2-1543	1/14
Treatment Tank		
Decont. Cell and Hot Shop Tank	SK-2-1617	1/14

XVI. INSTRUMENT DESIGN CRITERIA

XVII. INSTRUMENT ENGINEERING FLOW DIAGRAM

Metal Sol. Feed Prep., Sheet I	SK-2-1300	1/23
Metal Sol. Feed Prep., Sheet II	SK-2-1301	1/23
Metal Sol. Feed Prep., Sheet III	SK-2-1302	1/23
Metal Sol. Feed Prep., Sheet IV	SK-2-1303	1/23
Metal Sol. Feed Prep., Sheet V	SK-2-1304	1/23
Metal Sol. Feed Prep., Sheet VI	SK-2-1305	1/23
Metal Sol. Feed Prep., Sheet VII	SK-2-1306	1/23
Uranium Decontam., Sheet I	SK-2-1307	1/23
Uranium Decontam., Sheet II	SK-2-1308	1/23
Uranium Decontam., Sheet III	SK-2-1309	1/23
Sol. Treat., No. 1 Cycle, Sheet III	SK-2-1312	1/23

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Description of Work	Drawing No.	Transmittal Date (1953)
Sol. Treat., No. 2 Cycle, Sheet I	SK-2-1313	1/23
Sol. Treat., No. 1 Cycle, Sheet I	SK-2-1310	1/23
Sol. Treat., No. 1 Cycle, Sheet II	SK-2-1311	1/23
Waste Treatment, Sheet I	SK-2-1314	1/23
Waste Treatment, Sheet II	SK-2-1315	1/23
Waste Treatment, Sheet III	SK-2-1316	1/23
Waste Treatment, Sheet IV	SK-2-1317	1/23
Waste Treatment, Sheet V	SK-2-1339	1/23
Typical Instr. Det. and Insta., Sheet I	SK-2-1318	1/23
Typical Instr. Det. and Instal., Sheet II	SK-2-1319	1/23
Typical Instr. Det. and Instal., Sheet III	SK-2-1349	1/23
Typical Instr. Det. and Instal., Sheet IV	SK-2-1326	1/23
Panel Board Layout - Head End Control Room	SK-2-1321	
Panel Board Layout - Head End Control Room	SK-2-1320	
Panel Board Layout - H and V Control Room	SK-2-1341	
Panel Board and Control Room Details	SK-2-1323	1/23
Graphic Panel Board Isometric	SK-2-1329	
Partition Cycle, Sheet I	SK-2-1330	1/23
Partition Cycle, Sheet II	SK-2-1331	1/23
Partition Cycle, Sheet III	SK-2-1332	1/23
Pre-Cycle, Sheet I	SK-2-1333	1/23
Pre-Cycle, Sheet II	SK-2-1334	1/23
Aqueous Make-Up, Sheets I, II, III, IV	SK-2-1622, 3, 4, 5	1/23
Auxiliary Panel	SK-2-	
Plutonium Decontam., Sheet I	SK-2-1336	1/23
Plutonium Decontam., Sheet II	SK-2-1337	
Plutonium Decontam., Sheet III	SK-2-1338	
Solvent Treatment No. 2 Cycle, Sheet II	SK-2-1344	
Solvent Treatment No. 2 Cycle, Sheet III	SK-2-1345	
Decontam. Cell - Lab. Waste	SK-2-1346	
Condensate Treatment	SK-2-1347	
Recovered Acid Storage	SK-2-1348	
203-A	-1644	
211-A	-1643	

XVIII. INSTRUMENT SPECIFICATIONS APPLICATION AND STANDARDS

Instrumentation Specifications 1/23

XIX. REMOTE MAINTENANCE EQUIPMENT DESIGN CRITERIA

- a. Remote Canyon Crane
- b. Viewing Devices
- c. Decontamination Cell, Hot Shop,
and Regulated Shop
- d. Remote Equipment, Handling
- e. Miscellaneous Equipment

33 ft. Columns Handling Study	SK-2-1411	1/8
40 ft. Columns Handling Study	SK-2-1412	1/8

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Transmittal
Date (1953)

Description	Drawing No.	
Decont. and Hot Shop Equip. Arrgt.	SK-2-1441	1/8
Decont. and Hot Shop Equip. Arrgt.	SK-2-1442	
Decont. and Hot Shop Equip. Arrgt.	SK-2-1443	
Special Ten Ton Hook	SK-2-1444	
Clearance Dia. Purex Canyon Crane	SK-2-1445	
Purex Canyon Crane Cab Shielding	SK-2-1446	
Purex Canyon Crane Arrgt. (Prop.)	SK-2-1447	
Purex Canyon Crane - Limit		
Switch Arrangement	SK-2-1448	
Proposed Arrgt. Purex Remote		
Maintenance Cranes	SK-2-1449	
Ten Ton Hook and Block Assembly	SK-2-1450	
XX. HEATING AND VENTILATING DESIGN CRITERIA		
XXI. HEATING AND VENTILATION - ONE LINE DIAGRAMS		
Vent. Flow Diagram - Process	SK-2-1413	1/23
Vent. Flow Diagram - Service	SK-2-1414	1/8
Control Diagram Process	SK-2-1415	1/8
Control Diagram Service	SK-2-1416	1/8
Control Diagram 291-A	SK-2-1417	1/23
One Line Duct Diagram, Sheet I	SK-2-1418	
One Line Duct Diagram, Sheet II	SK-2-1419	
One Line Duct Diagram, Sheet III	SK-2-1420	
XXII. SITE LOCATION AND PLOT PLAN DESIGN CRITERIA		
XXIII. PLOT PLAN DRAWINGS		
200-E Area Plot Plan	SK-2-1260	
200-A Utility and Facility Plot Plan		
Sheet II	SK-2-1298	
Purex Prod. Plant - Tank Farm Area,		
Sheet I	SK-2-1298	
200-A Utility and Facility Plot Plan,		
Sheet III	SK-2-1298	
XXIV. GEN. OUTER AREA SERVICES DESIGN CRITERIA		
Export Water		1/23
Steam Generation		1/8
Water, Elec., and R. R. Systems		1/23
Filtered Water		1/23
XXV. GEN. OUTER AREA SERVICES DWGS.		
200-A Utility and Facility Plot Plan, Sheet II	SK-2-1298	
200-A Utility and Facility Plot Plan, Sheet III	SK-2-1298	

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Transmittal
Date (1953)

Description	Drawing No.	
200-E Outside Underground Water Lines Plot Plan Export Water System	SK-2- SK-2-1460	
XXVI. GEN. INNER AREA SERVICES DESIGN CRITERIA		
1. Solvent Recovery and Storage 276-A Acid, Condensate and Laboratory Waste Storage (202-A)		1/23
2. Chemical Tank Farm, 211-A and Recovered UNH Storage, 203-A		1/23
3. Electrical Power Street and Fence Lighting, Communication and Fire Alarm		1/23
4. Steam, Sanitary, Raw and Deminer- alized Water, Compressed Air Supply and Fire Lines		1/27
5. Misc. Facilities: Sanitary and Process Sewerage Systems, Roads, Walks, Badge House, Fences and Railroads		1/23
XXVII. GENERAL INNER AREA SERVICE DESIGN DRAWINGS		
Solvent Recovery and Storage 276-A Equip. Arrgt. Plan and Section Acid, Condensate and Lab. Waste Storage Vault (202-A)	SK-2-1461	1/23
Equip. Arrgt. Plan	SK-2-1462	1/23
Equip. Arrgt. Section A-A	SK-2-1463	1/23
Equip. Arrgt. Section B-B		
Solvent Recovery and Storage 276-A Pipe Routing Studies	SK-2-1464	1/23
Equipment and Piping Arrgt., Sheet I	SK-2-	
Equipment and Piping Arrgt., Sheet II	SK-2-	
Chemical Tank Farm 211-A, Plan and Layout	SK-2-	
Recovered UNH Storage 203-A - Plan Layout	SK-2-	
Electrical One Line Diagram	SK-2-1451	1/8
Electrical One Line Diagram	SK-2-1452	
Electrical One Line Diagram	SK-2-1453	
Steam, Water Compressed Air and Fire Line, Sheet I	SK-2-1298	
Misc. Facilities Sanitary and Process System, Badge House, Fences, Roads, Walks, etc., Sheet I	SK-2-1298	

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Date (1953)

Description	Drawing No.	
XXVIII. RAD. SCIENCE SERVICES DESIGN CRITERIA		
XXIX. RAD. SCIENCE SERVICES DESIGN DRAWINGS		
Air Sampling and Monitoring, Sheet I	SK-2-1342	1/23
Air Sampling and Monitoring, Sheet II	SK-2-1342	
XXX. WASTE DISPOSAL DESIGN CRITERIA		
XXXI. WASTE DISPOSAL DRAWINGS		
	SK-2-1470	
	SK-2-1471	
	SK-2-1472	
	SK-2-1473	
	SK-2-1474	
	SK-2-1475	
XXXII. WRITTEN DESCRIPTION OF MOCK-UP AND JIGGING METHODS, 277-A		
XXXIII. LABORATORY CRITERIA LABORATORY DRAWINGS		
Purex Laboratory Floor Plan- see	SK-2-1421	
Ventilation One Line Diagram	SK-2-1497	1/8
Equipment Arrangement	SK-2-1499	1/8
XXXIV. SAFETY CRITERIA		

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APPENDIX A — PART 2

HWS SPECIFICATION LIST

<u>Specification Number</u>	<u>Title</u>
HWS-5508	Application of Chemical Resistant Paint
HWS-5517	Site Preparation, Excavation and Backfill for Structures
HWS-5518	Forming, Reinforcing, Placing, Finishing & Curing of Portland Cement Concrete
HWS-5519	Material, Fabrication and Erection of Structural Steel
HWS-5523	Roads, Walks & Grading
HWS-5524	Fencing
HWS-5525	Concrete Ventilation Stack — 291-A
HWS-5536	Elevators and Dumbwaiters
HWS-5509	Building Painting
HWS-5520	General Architectural Specification Section 2 — Poured Gypsum Slabs Section 3 — Waterproofing Section 4 — Misc. Metal (Stairs, Ladders, etc.) Section 5 — Insulated Corrugated Asbestos Siding Section 6 — Roofing, Flashing, and Sheet Metal Section 7 — Calking Section 8 — Carpentry, Millwork & Glazing Section 11 — Hollow Metal Doors Section 12 — Asbestos & Metal Partitions

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Specification Number

Title

	Section 13 — Metal Toilet Compartments
	Section 14 — Acoustical Ceilings
	Section 15 — Resilient Tile Floors
	Section 16 — Finishing Hardware
HWS-5539	Building 272-E
HWS-5511	Heating, Ventilating and Air Conditioning
HWS-5512	Heating and Ventilating Controls
HWS-5513	Heating and Ventilating Balancing and Testing
HWS-5514	Plumbing
HWS-5515	Sprinkler System
HWS-5504	Process Connectors
HWS-5505	Electrical Connectors
HWS-5506 (HWS-5540)	Class I, Vessels (Critical Class I Vessels — Prepared by GE)
HWS-5507	Class II Vessels
HWS-5521	Procurement and Erection of Tanks for 203-A & 211-A Facility
HWS-5522	Canyon Agitator & Pump Assemblies
HWS-5535	Erection of Process & Mechanical Equipment
HWS-5538	Solids-Liquid & Liquid-Liquid Centrifuge Assemblies
HWS-5541	3,000 Gal Tank Semi-Trailer & Heavy Duty Truck Tractor
HWS-5500	Process and Auxiliary Piping Section 1 — General Requirements Section 2 — Piping Codes and Materials Section 3 — Valve Code

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Specification Number

Title

Section 4 — Strainer Code
Section 5 — Trap Code
Section 6 — Gasket Code

HWS-5501 Cleaning and Testing of Process & Auxiliary Piping

HWS-5502 Fabrication & Erection of Process & Auxiliary Piping in Bldg. 202-A
 Section 1 — General Requirements
 Section 2 — Off Site Fabrication Process & Electrical Jumpers
 Section 3 — Hot Piping
 Section 4 — Cold Piping

HWS-5503 Insulation of Piping and Equipment

HWS-5510 Field Welding

HWS-5516 Stainless Steel Welding Fittings

HWS-5537 Outside Above ground & Underground Process & Auxiliary Piping

HWS-5533 Electrical Construction Specifications

HWS-5534 Testing of Electrical Equipment and Installations

HWS-5526 Main Instrument Panelboards

HWS-5527 Auxiliary Instrument Panelboards

HWS-5528 Instrument Piping, Tubing and Wiring

HWS-5529 Instrument and Instrument Panelboard Erection

HWS-5530 Instrument Testing and Calibration

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APPENDIX A — PART 3

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- /1/ J. I. Thomas of the AEC to G. White, Jr. of Vitro, "Instruction Letter Under Contract AT(45-1)-628 Architect-Engineer Services" dated July 30, 1952.
- /2/ A. B. Greninger of GE to G. White, Jr. of Vitro, "Technical Direction of Contract AT(45-1)-628 Vitro Corp. of America" dated August 5, 1952.
- /3/ J. I. Thomas of the AEC to G. White, Jr. of Vitro "Austerity and Economy in Design for New Construction" dated August 11, 1952.
- /4/ J. I. Thomas of the AEC to G. White, Jr. of Vitro, "Proposed Additional Work under Contract AT(45-1)-628" dated August 15, 1952.
- /5/ J. I. Thomas of the AEC to J. C. Tourek of Vitro, "Start of Detailed Design" dated November 4, 1952.
- /6/ H. H. Schipper of the AEC to J. C. Tourek of Vitro, "Contract AT(45-1)-628, Technical Management" dated January 20, 1953.
- /7/ G. C. Gabler of GE to J. C. Tourek of Vitro, "Contract AT(45-1)-628 Technical Management" dated January 27, 1953.
- /8/ G. C. Gabler of GE to J. C. Tourek of Vitro, "Assignment" dated January 30, 1953.
- /9/ J. M. Frame of GE to J. C. Tourek of Vitro, "Project CA-513, Purex Facility, Summary of Approved Scope Material Transmitted to Date" dated January 8, 1953.
- /10/ J. M. Frame of GE to J. C. Tourek of Vitro, "Project CA-513, Purex Facility, Summary of Approved Scope Material Transmitted to Date" dated January 14, 1953.

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- /11/ J. M. Frame of GE to J. C. Tourek of Vitro, "Project CA-513, Purex Facility, Summary of Approved Scope Material Transmitted to Date" dated January 23, 1953.
- /12/ J. M. Frame of GE to J. C. Tourek of Vitro, "Project CA-513, Purex Facility, Summary of Approved Scope Material Transmitted to Date" dated January 29, 1953.
- /13/ G. R. Graham of Vitro to W. B. Webster of GE, "Project CA-513-Purex Facility — Mock-up Building" dated February 2, 1953.
- /14/ W. B. Webster of GE to J. C. Tourek, "Purex Facility, Jigging Building" dated February 27, 1953.
- /15/ J. I. Thomas of the AEC to J. C. Tourek of Vitro, "Engineering Liaison — Contract AT(45-1)-628" dated March 13, 1953.
- /16/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "Engineering Liaison — Contract AT(45-1)-628" dated March 20, 1953.
- /17/ W. B. Webster of GE to G. R. Graham of Vitro, "Serial Numbers of General Electric to Vitro Letters" dated March 24, 1953.
- /18/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "CA-513 — Purex Facility — Job 63" dated April 27, 1953.
- /19/ J. I. Thomas of the AEC to J. C. Tourek of Vitro, "Project CA-513-A Purex Facility — Preparation of Construction Cost Estimate" dated April 6, 1953.
- /20/ G. R. Graham of Vitro to J. I. Thomas of the AEC, "Project CA-513 — Vitro Field Office Responsibilities During Construction of the Purex Facility" dated May 15, 1953.
- /21/ J. I. Thomas of the AEC to J. C. Tourek of Vitro, "Construction Schedule — Project CA-513 — Purex Facility" dated June 19, 1953.
- /22/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "Contract AT(45-1)-628 Construction Schedule" dated June 30, 1953.
- /23/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "Contract AT(45-1)-628 — Construction Schedule" dated July 13, 1953.

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- /24/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "CA-513 — Purex Facility — Concentrator Re-Design" dated August 19, 1953.
- /25/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "Contract AT(45-1)-628 Construction Schedule" dated July 13, 1953.
- /26/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "Contract AT(45-1)-628 Construction Schedule" dated June 30, 1953.
- /27/ J. C. Tourek of Vitro to L. F. Perkins of the AEC, "May Report — Scheduled Work Week on Contract AT(45-1)-628" dated June 4, 1953.
- /28/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "CA-513 — Purex Facility — Job 63" dated April 27, 1953.
- /29/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "CA-513 — Purex Facility — Concentrator Re-Design" dated August 19, 1953.
- /30/ L. W. Trevena of Vitro to W. B. Webster of GE, "Purex Heating & Ventilating Design" dated August 12, 1953.
- /31/ J. C. Tourek of Vitro to L. F. Perkins of the AEC, "September Report — Scheduled Work Week and Overtime on Contracts AT(45-1)-628 and G-148" dated October 13, 1953.
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- /33/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "CA-513 — Purex Facility — Job 63 — Forty-Eight Hour Work Week" dated December 4, 1953.
- /34/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "CA-513 — Purex Facility — Job 63 — Budget" dated December 17, 1953.
- /35/ J. I. Thomas of the AEC to J. C. Tourek of Vitro, "Contract AT(45-1)-628 — Revised Estimate of Cost" dated January 7, 1954.

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- /36/ J. C. Tourek of Vitro to J. I. Thomas of the AEC, "Contract AT(45-1)628 - Budget for Titles I, II, IV, and Title III," dated April 15, 1954.
- /37/ J. E. Travis of the AEC to J. C. Tourek of Vitro, "Contract AT(45-1)628 - Revised Estimate of Cost," dated May 3, 1954.

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