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SAVANNAH RIVER LABORATORY MONTHLY REPORT

December 1985

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**E. I. du Pont de Nemours & Co.
Savannah River Laboratory
Aiken, SC 29808**

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT DE-AC09-76SR00001

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Reactor Irradiation of Nonend-Bonded Mark 31 Target Slugs

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Computer Link with Los Alamos National Laboratory

A data communications link with the Los Alamos National Laboratory allows use of Class VI computers for analysis.

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A program is under way to define the performance of L Lake and to provide cost studies of additional cooling methods that may be required to reduce the annual production penalty for L-Reactor operation.

Aging of Carbon in SRP Reactor Airborne Activity Confinement Systems

Recently completed laboratory studies have given new insight into the aging process for reactor building filter compartment carbon. Based on these studies, a number of promising concepts have been identified for increasing the capacity and longevity of the carbon beds.

Reactor Risk Assessment for Earthquakes

A preliminary assessment of risk of reactor core melting from seismic events has been completed for the Phase I PRA.

CHEMICAL PROCESSES AND ENVIRONMENTAL TECHNOLOGY

Solids Formation in a Plutonium Product Stream

A laboratory study has shown that an n-paraffin wash will remove dissolved TBP from the plutonium product stream in F-canyon and prevent solids formation that causes pluggage in FB-Line cation exchange columns. Preparations for a plant test are under way.

Revised Safety Analysis Reports for F- and H-Canyon Operations

The five-year revision of the F- and H-Canyon Safety Analysis Reports shows that the facilities can be operated without undue risk to operating personnel, to the public, or to the environment. Process related incidents contribute less than 2% of the risk that an offsite individual would receive from natural background radiation.

Organic Carbon Analysis of DWPF Samples

A method for analyzing the organic carbon content of samples from the DWPF precipitate reactor bottoms tanks has been developed.

Applications of Fourier Transform Infrared Spectrometry

Several plant and laboratory programs have benefited from the increased organic analytical capability provided by a recently acquired Fourier transform infrared spectrometer.

Water Chemistry Analyzer for SRP Reactors

The custom-built aqueous analyzer to help in the evaluation of intergranular stress corrosion cracking of SRP reactors has been designed and is being fabricated. Analyses, at the ppb level, of all Building 105-K reactor aqueous streams will be possible after installation which is scheduled for April 1986.

Study of Par Pond Biological Community

Studies confirming the existence of a balanced biological community in Par Pond, and thereby potentially avoiding the need for additional P-Reactor thermal mitigation, have been documented in a draft report to DOE.

DEFENSE WASTE AND LABORATORY OPERATIONS

Plutonium-238 Waste Incinerator Startup

A prototype Pu-238 waste incinerator was successfully started up at the TNX semiworks. During the initial run-in period, approximately 100 pounds of simulated waste mixtures were incinerated.

Experimental Canister Frit Blaster

DWPF canisters will be decontaminated by frit slurry blasting. The final phase of the development program for the experimental canister frit blaster, the parametric study, has been completed. The optimum blasting sequence, slurry concentration, canister rotation speed, and canister lifting speed have been identified.

Saltstone Disposal Area Design

A modified reference process for disposal of DWPF saltstone has been selected and the application to the State for a landfill permit is being revised.

Powder Metallurgy Core Diameter Gage

An automated tolerance gage is being developed to quickly measure a powder metallurgy reactor component for determining acceptability and/or making online process changes.

New Maintenance Shop Facility

Construction of an 11,500 ft² maintenance building has just been completed. This new facility will provide a centralized, modern, and efficient shop area and will allow for the expansion of research facilities into the vacated original maintenance shop areas.

NUCLEAR MATERIALS PLANNING

Decontamination and Decommissioning of SRP Facilities

A comprehensive decontamination and decommissioning survey was completed for radioactively contaminated facilities at the Savannah River Plant. The survey will provide a framework from which to formulate plans for specific facilities.

Environmental and Nuclear Safety Issue Study

A comprehensive compilation of environmental and nuclear safety issues which potentially could have significant impact on the viability of SRP operations identified no unaddressed issues.

This report series informs management of SRL progress in unclassified programs.

SRL also issues a classified monthly report to inform management about progress in:

- o Weapons Development Support
- o Naval Reactor Fuel
- o Production Support

NUCLEAR REACTORS AND SCIENTIFIC COMPUTATIONS

300-Area Robotics Program

The Robotics Technology Group (RTG) initiated a program to implement robotics in the 300 Area in July 1983 with the organization of a 300-Area Automation and Robotics Committee. That committee, consisting of technical and operations personnel, along with a contracted engineering consulting firm, identified, set priorities, and provided conceptual designs for several potential applications. Two systems have been implemented in 300-Area operations while some 20 additional industrial robots and automated systems are planned in projects that are scheduled for the next five years.

An industrial robot to lubricate an extrusion press was the first of the systems; it was installed in Building 321-M in January 1985. This application relieved an operator of a task which had resulted in several safety incidents in the past. Recently, operational problems with that system have necessitated an improved design and additional system components to provide greater operational flexibility. RTG is working with 300-Area technical and operations personnel to implement the improvements.

A robot system is being installed in Building 313-M to lubricate the hot-die-sizing (HDS) press operation. SRL development work demonstrated the potential for improved safety and productivity through the use of this system, which is planned for full production use in early 1986. A robotic system to replace a fixed automation turret in the HDS process workstation is presently being developed in the SRL robotics laboratory. This system will be a mechanical improvement over the existing turret and will incorporate new slug handling techniques to improve overall quality and productivity.

Conceptual design and project planning information have been provided for a slug assembly robot system for Building 313-M. This is on the FY 87 project forecast. SRL will begin development work for that project as soon as funding authorization is received. Design liaison and basic data for process automation have also been provided for three other major 300-Area projects: Building 313-M slug handling equipment, Building 321-M billet handling equipment, and the Building 313-M uranium plating line upgrade. The implementation of these systems will enhance the safety of 300-Area operations and has the potential for both quality and productivity improvements.

Reactor Irradiation of Nonend-Bonded Mark 31 Target Slugs

An end-bonding process step has traditionally been used to ensure complete bonding of aluminum cladding on the ends of annular depleted uranium target slugs. Since target slug production requirements have

increased substantially and the end-bonding step is a process bottle-neck, significant incentive exists for eliminating this step. Heat transfer, reactor slug failure probability, and reactor slug failure consequence analyses performed within SRL have indicated that end-bonding can safely be eliminated for Mark 31 inner and outer target slugs without limiting reactor operation.

Based on these findings, a Test Authorization (TA) was authored within SRL and approved in Wilmington to manufacture and irradiate Mark 31 nonend-bonded slugs. In the first full month of this test (October), a new record production of 30,870 acceptable slugs was set. The new record exceeded the previous monthly record by 33%. Although some of this increase can be attributed to improvements in equipment utility, a substantial portion of the increase is a direct consequence of the elimination of the end-bonding step.

Reactor irradiation of slugs produced without end-bonding was begun in November. Assuming successful reactor testing, anticipated results include annual savings of \$750,000 (primarily maintenance, improved yields, and reduced reactor downtime due to eutectic-caused slug failures). In addition, based on the October production figures, a substantial increase in target slug production capacity is projected to accrue from the elimination of end bonding.

Computer Link with Los Alamos National Laboratory

A data communications link has been made to the Los Alamos National Laboratory Integrated Computer Network. Hardware and software have been installed at SRL and Los Alamos to permit high speed data communications. This link provides direct access to three Class VI (Cray I) computers and two minicomputers. The link will permit SRL personnel to develop, test, and utilize computer codes which require the powerful computer facilities available at Los Alamos and to demonstrate the need for Class VI capability onsite.

L-Reactor Thermal Mitigation

Additional cooling of the hot water effluent from L-Reactor (in addition to that provided by the recently completed L Lake) will be required to allow the reactor to operate at near maximum power within present environmental constraints. The Engineering Department has been requested to provide a cost study of several methods to precool the hot effluent prior to its discharge into L Lake and possibly to enhance the performance of the lake itself. SRL studies predict an annual average production penalty of between 20 to 25% with expected lake cooling performance. It is hoped that this penalty can be reduced to the 6 to 10% range with the additional thermal mitigation program.

The performance of the lake is being audited to allow comparison between actual and predicted operation. This information is necessary to establish the final basis for the additional cooling study and to upgrade the computer model upon which the allowable reactor operating power is based. Also, it is hoped that this information can support a relaxation of environmental constraints on the operation of the lake. The audit of lake performance for one full year of reactor operation will be completed in October 1986.

A preliminary report of the Engineering Department cost estimates for additional cooling devices will be issued in July 1986. Final recommendations will be based on the cost estimate study and the lake performance analysis, and are expected to be issued in March 1987.

Aging of Carbon in SRP Reactor Airborne Activity Confinement Systems

All air leaving the SRP reactor buildings passes through a purification system known as the airborne activity confinement system (AACS). This system protects against any kind of reactor incident that might release radioactivity from the reactor fuel to the environment. One of the most important radioactive elements, because of its volatility and its role in human metabolism, is iodine which is removed by passing air through a bed of specially prepared activated carbon. Organic compounds containing iodine are also removed by fresh carbon, but as the carbon ages in use it becomes less efficient for organic iodine removal. SRL studies have shown the chemical basis for this decreased carbon efficiency to be the physical loss and chemical reaction of the potassium iodide surface coating. In fresh carbon, this compound reacts with organic iodine by a process of isotopic exchange. In use in the AACS, the potassium iodide is gradually converted to other iodine compounds that do not exchange; and, in addition, a portion of this iodide disappears completely from the carbon bed.

In the AACS, the carbon is exposed to small amounts of ozone, oxides of nitrogen and sulfur, and organic vapors in the air circulated through it causing oxidation and acidification. The iodide ion on the carbon surfaces reacts over periods of months to form either oxidized species such as iodate or organically bound iodine. Activation analysis of the carbon shows some overall loss of iodine from the used carbon. This loss is not simply the result of the oxidation of iodide to elemental iodine, for that compound binds too strongly to the carbon to be lost. Either the iodine is being blown away as a KI dust, or it is being converted to volatile organic molecules that are not retained.

This new knowledge of the reactions on the carbon is being applied to develop possible improvements in the AACS. A recent study by Oak Ridge National Laboratory suggests that organic iodides may be important in certain accident situations. In these cases it is desirable for

the AACS to have a greater capacity for retaining organic iodides than now exists.

There are several ways of providing this capacity:

- o Impregnating the carbon surface with higher concentrations of potassium iodide and triethylenediamine;
- o Using another impregnant, such as the amine salts suggested by a recent British study;
- o Providing a second bed of fresh carbon which can be used in an emergency.

The latter is included in a proposed project for upgrading the confinement system; the first two approaches will receive further study.

Reactor Risk Assessment for Earthquakes

A preliminary probabilistic assessment has been completed to evaluate the risk of reactor core melting from seismic events. The analysis indicated a risk of core melting of greater than once per 10,000 reactor-years from seismic events, while the strength of crucial reactor components was shown to be comparable to that of nuclear power reactors. The magnitude of the risk is largely due to the use of an earthquake hazard relation that predicts a much more frequent return of large earthquakes than has been previously used.

The earthquake hazard relation used was that being proposed by the NRC for use at the Vogtle power plant. Earthquake hazard relations have been developed specifically for SRP facilities, but none of them predicted return periods for earthquakes producing greater than 0.3 g peak ground accelerations. For this analysis, earthquake hazard relations were used that included return periods of earthquakes producing peak ground acceleration greater than 1 g.

The analysis indicated that seismic strength of crucial reactor components compared well with that of nuclear power reactors. Typically for nuclear power plants, the 50% probability of having core melting occurs at two to five times the design basis earthquake. For SRP reactors, the 50% probability of having core melting occurred at greater than three times the design basis earthquake. Half of the contribution to the risk of core melting was calculated to occur above a peak ground acceleration of 0.42 g. The probability was calculated to be 98% that no core melting would occur at the design basis earthquake of 0.2 g.

A historic seismicity analysis was also completed to assist in evaluating the appropriateness of use for SRP of the proposed NRC seismic hazard relation for the Vogtle power plant. This seismicity analysis calculated the ground motion experienced at the site for earthquakes that have actually occurred in the 200-year available seismic history and resulted in a much longer return period of earthquakes. The risk of reactor core melting from earthquakes using the historic seismicity was calculated to be 5×10^{-6} per reactor-year, 3% of the risk calculated when using the proposed NRC earthquake hazard relation.

CHEMICAL PROCESSES AND ENVIRONMENTAL TECHNOLOGY

Solids Formation in a Plutonium Product Stream

Periodic pluggage of cation exchange columns in the SRP plutonium metal finishing line (FB-Line) has been attributed to the formation of plutonium-bearing solids in the aqueous plutonium product stream. During interim storage of the plutonium solutions, the slightly soluble tributyl phosphate (TBP) used in the F-Canyon solvent extraction process is degraded to dibutyl phosphate which then forms insoluble compounds with plutonium.

Recent laboratory tests have confirmed a previous study which showed that a diluent wash operation will remove soluble TBP from the plutonium product solution. This diluent washing of plutonium solutions using an n-paraffin hydrocarbon already available in F Area would eliminate formation of dibutyl phosphate which complexes with plutonium to produce the unwanted solids. Samples of plutonium solutions have been washed with n-paraffin to remove soluble TBP. After standing at room temperature for six weeks, formation of solids has not occurred. Without washing, solids were observed after six days. The laboratory study is continuing to establish operating parameters for a diluent wash operation.

A number of process and procedural modifications have already been implemented to minimize the impact of solids formation. They include the recycle of plutonium product solutions through solvent extraction after extended storage, elimination of storage tank agitation, and installation of dummy resin bed prefilters before each of the actual cation exchange resin columns. Also under consideration are shortening interim storage times and cooling the plutonium solutions during storage to slow the rate of dibutyl phosphate formation.

Although these modifications provide temporary relief from cation column pluggage, they do not solve the basic problem of TBP degradation in the plutonium solutions. A proposal to wash the plutonium product solution with n-paraffin in F-Canyon has been made, and preparations for a plant test are under way.

Revised Safety Analysis Reports for F- and H-Canyon Operations

The Savannah River Plant operates two reprocessing facilities for the recovery of products from irradiated fuel and target assemblies: F-Canyon to recover ^{239}Pu from reactor targets, and H-Canyon to recover ^{235}U from reactor fuel. The Safety Analysis Report issued in 1980 for these facilities has been revised to reflect updated equipment, administrative controls, incident data, and risk assessment methodology.

The F-Canyon analysis shows that the maximum offsite risk to an individual as a result of a process related incident is 0.28 millirem per year compared to a natural background risk of 93 millirems per year. About 80% of the risk is associated with the release of airborne radioactivity while 20% comes from waterborne releases. Over 90% of the risk results from only three incidents: processing of short-cooled targets with a subsequent large release of iodine, transfer error with radioactive materials being released outside the canyon confines, and leaks of process materials to the canyon sumps. Dissolving and high activity waste evaporation operations account for 85% of the operational risk.

The H-Canyon analysis shows that the maximum offsite risk to an individual as a result of a process related incident is 0.88 millirem per year. About 99% of the risk is associated with the release of airborne radioactivity while 1% comes from waterborne releases. Over 85% of the risk results from three incidents: transfer error with radioactive materials being released outside the canyon confines, leaks of process materials to the canyon sumps, and fire involving ion exchange materials. Ion exchange and dissolving operations account for over 90% of the operational risk.

It was concluded from the analyses that both F and H Canyons can be operated without undue risk to operating personnel, to the public, or to the environment.

Organic Carbon Analysis of DWPF Samples

Development of a method for organic carbon analysis in defense waste process samples is in progress. Carbon analyses will be performed at two sampling points: the precipitate reactor bottoms tank (PRBT) and the slurry mix evaporator (SME). The carbon level in the PRBT indicates the completeness of the precipitate hydrolysis reaction. A high carbon content in the glass melter feed could contribute to damage of the melter. The carbon level in the SME will be monitored to prevent this possibility.

The PRBT samples are aqueous slurries, and the SME samples are aqueous sludges containing glass frit. Because of the high activity of these samples (~10 Ci/L) they will be diluted by a factor of ~1000 before the carbon analyses are performed. A carbon analyzer suitable for these diluted samples has been procured and is being tested with simulated process samples from TNX. The carbon analyzer features a remote chemical bay which will facilitate its containment in a radioactive hood in the DWPF analytical facility.

A method for analyzing the PRBT samples has been developed. Replicate analyses on simulated PRBT samples yielded a carbon content of 8.3 g/L, with a precision and accuracy of ~4%. This is in agreement with carbon levels of 8 to 10 g/L measured in similar samples. Preliminary work with simulated SME samples is in progress. The analyzer will be contained for analysis of radioactive samples by February 1986.

Applications of Fourier Transform Infrared Spectrometry

A Fourier transform infrared (FTIR) spectrometer has been obtained to augment the existing organic analytic capabilities of the laboratory and to develop process monitoring applications. The instrument offers many enhanced capabilities over a conventional dispersive spectrometer, including greater mechanical stability, higher throughput, faster data collection, and computerized operation.

This instrument has provided qualitative and/or quantitative information on widely differing problems at SRL and SRP. Qualitative information is typically obtained by "fingerprinting," in which the spectrum of an unknown is matched with a reference spectrum. As one example, a radiolytically degraded gasket from the C-Reactor process room was identified as a polyurethane by "fingerprinting."

Often, the "fingerprinting" capability is used with other powerful capabilities of the FTIR to obtain information that a conventional spectrometer could not provide. In a study of the thermal decomposition of perfluorinated alkanes and ethers, decomposition products were identified by spectral subtraction. In this subtraction mode, the FTIR computer stripped away the infrared absorption peaks of the starting materials so that the degradation products could be identified. In another experiment, the high throughput feature of the instrument was used along with an external reflectance attachment to examine the spectra of organic layers on metal surfaces. Identifying corrosion-inducing decomposition products of tetraphenylborate provided motivation for this study.

Recent studies of the degradation products of tributyl phosphate (TBP) in plant solvent serve as an example of the quantitative uses of FTIR spectrometry and its potential application as a process monitor. The concentration of dibutyl phosphate (DBP), a TBP degradation product of major concern due to its undesirable complexation of metal ions, has been measured over a range from 0.1 to 5% in the absence of uranium. At uranium concentrations above 1 gram/liter, DBP is strongly complexed by uranium, and sophisticated deconvolution routines are needed to determine DBP concentrations. Statistical data reduction techniques (chemometrics) developed at the University of Washington are being considered for this deconvolution.

Water Chemistry Analyzer for SRP Reactors

The Reactor Materials Program is an experimental and analytical program to evaluate the current condition and expected life of the reactor tanks, moderator piping, and thermal shields of SRP reactors. The goals of the program are to provide the technical bases to predict and extend reactor service life and to improve reactor safety. Emphasis is on control of moderator chemistry to mitigate stress corrosion cracking, qualification of repair methods for piping and tanks, assessment of safety margins for potential cracks in the reactor tanks and pipes, and surveillance of irradiation effects on reactor tank walls.

One of the problems in the SRP reactor system is the intergranular stress corrosion cracking (IGSCC) of type 304 stainless steel. IGSCC requires 1) a susceptible material, 2) tensile stresses, and 3) an aggressive environment. The first two conditions are present in SRP reactors due to welding 304 stainless steel. The environment is the only IGSCC requirement that can be evaluated and partially controlled at a relatively low cost. Based on boiling water reactor data, IGSCC is caused by high-temperature oxygenated water (generally $>150^{\circ}\text{C}$) and is accelerated by the presence of impurities such as chloride, sulfate, or carbon dioxide in the ppb range.

To evaluate present aqueous quality in SRP reactors, requests for proposals were sent to three vendors for a custom-designed analyzer. This analyzer was to determine impurities at the ppb level in all the reactor aqueous streams. The proposals were independently evaluated by three people and the General Electric Company (GE) proposal was accepted.

The aqueous analyzer was purchased at \$250,000. Presently 75% of the equipment is on hand at GE, and delivery to SRP is scheduled for March 1986. The analyzer is composed of three basic modules. First and most complex is the high performance liquid chromatography section that can analyze for anions, monovalent cations, and organic acids at about 1 ppb. The second module will be a CO_2 analyzer that will determine both dissolved CO_2 and organic CO_2 to a 100 ppb lower limit. A third module will analyze for H_2O_2 , again at a 100 ppb lower limit. Peroxide is important because it can be an oxygen precursor. The entire system is computer controlled and is to run for at least 72 hours unattended.

The analyzer is scheduled to be installed by GE in Building 105-K during April 1986. A fifty-day shutdown beginning in January 1986 will be used by Du Pont Construction to install the necessary piping at a cost of about \$200,000. Training of personnel is expected to take place in April 1986, with analyses starting immediately thereafter.

Study of Par Pond Biological Community

A draft document presenting demonstrations under Sections 316(a) and (b) of the Federal Water Pollution Control Act of 1972 regarding ecological effects of reactor operations in the P-Reactor cooling system has been delivered to DOE-SR. The report documents the existence of a balanced biological community (BBC) in Par Pond. Demonstration of a BBC should permit negotiation of a new NPDES compliance point for P Reactor with SCDHEC and avoid any additional mitigation of P Reactor thermal effluent.

No significant adverse effects were attributed to the thermal effluent discharged to Par Pond or the pumping of cooling water from Par Pond to P Reactor. It was concluded that Par Pond, the principal reservoir in the cooling system for P Reactor, contains a balanced indigenous biological community that meets all criteria commonly used in defining such communities. In other words, Par Pond is not dominated by thermally tolerant species and contains a diverse, self-sustaining community that compares favorably with cooling lakes and reservoirs throughout the southeast.

DEFENSE WASTE AND LABORATORY OPERATIONS

Plutonium-238 Waste Incinerator Startup

A prototype Pu-238 waste incinerator process to demonstrate continuous, remotely operable, electric incineration equipment and techniques has been built and successfully started up at TNX. Similar equipment will eventually process combustible waste contaminated with Pu-238 that is currently stored retrievably in the burial ground. This waste is generated during normal Pu-238 processing line operation and during decommissioning activities. The incineration process will generate ash that is amenable to either recovery of the Pu-238 or incorporation into DWPF borosilicate glass.

The incineration process consists of a continuous feed preparation system, a two-stage, electrically fired incinerator, and a filtration off-gas system. No manual handling or sorting of the waste is needed in the feed preparation system, which shreds and feeds polyethylene drums of simulated waste materials (paper, polyethylene, PVC, etc.) to the primary incineration chamber. The primary chamber uses a slowly moving woven wire-mesh belt to convey the material through the furnace. This mode of operation, along with electric rather than fuel heating, minimizes carryover of radioactive particulate with the flue gas. The flue gases are burned to completion in a secondary chamber, cooled with dilution air, filtered in precoated sintered metal filters and high efficiency particulate air filters, and released to the atmosphere.

During the startup run of the process, the incinerator was idled at temperature for 60 hours and fed material for six hours. Mechanical operation of the incineration system was excellent. Some plugging in the feed preparation system was observed; design modifications to streamline the plug points are in progress. The process will be operated for a year to verify the mechanical integrity of the equipment and to determine the life of several candidate materials of construction for the woven wire belt in the primary chamber. Dysprosium and cerium are being used as stand-ins to simulate the performance of Pu-238 in the system. After the operational tests are complete, remote maintenance equipment and procedures will be mocked up and demonstrated.

Experimental Canister Frit Blaster

DWPF canisters will be decontaminated by frit slurry blasting. This process has been developed with an experimental canister frit blaster (ECFB) that has been installed at TNX. The ECFB is capable of frit slurry blasting full size canisters, and is similar in design to the units planned for the DWPF.

The final phase of the development program for the ECFB, the parametric study, has been completed. The optimum blasting sequence, slurry concentration, canister rotation speed, and canister lifting speed have been identified. Blasting with the optimum parameters will result in a significant reduction in the amount of both frit and water that will be required to decontaminate a canister, reducing the process requirements for the DWPF slurry mix evaporator. Frit consumption has been reduced from 750 lb/canister to 180 lb/canister, and water consumption reduced from 360 gal/canister to 260 gal/canister.

The ECFB development program not only reduced material consumption but also identified numerous design improvements for the DWPF canister decontamination chamber (CDC). For instance, two separate modifications to the ribbon jet were required before it would function acceptably, and the blast jets had to be redesigned to prevent leakage.

The first CDC to be built will be installed at the equipment test facility for operability testing. The CDC will use much of the same auxiliary equipment, i.e., pumps, drives, programmable controller, as the ECFB to reduce costs. The operability test will confirm the design improvements made on the CDC, and will test the components not provided on the ECFB, i.e., chamber rinse jets, guide rinse nozzles, air spargers, and exhaust cyclone separator.

Saltstone Disposal Area Design

As part of the DWPF, decontaminated salt solution will be mixed with a cement - fly ash blend and saltstone, the resulting product, will be disposed onsite in an engineered disposal area.

Mathematical modeling (both analytic and numerical) has shown that the previous reference disposal area design would release contaminants in excess of applicable groundwater standards. Model predictions are that nitrate releases from the previous design will peak at 460 ppm; releases will exceed the 44 ppm nitrate groundwater standard for at least 200 years.

The saltstone disposal area has been redesigned to reduce release of nitrate and other contaminants to acceptable levels. The new design incorporates increasing the size of the monolith to contain saltstone production from one year to reduce the surface area to volume ratio and thus the diffusional flux. In addition, monoliths are placed in a concrete vault situated partially above grade. Final decommissioning of the disposal area may involve capping with clay to divert most of the infiltrating rainwater.

The newly designed disposal area will not release any contaminants to the environment for several hundred years. Maximum contaminant concentrations in groundwater will not occur for about 1000 years after decommissioning. Maximum concentrations of all contaminants are predicted to be below current groundwater standards; for example, the maximum nitrate concentration is predicted to be 2.6 ppm.

Revision of the saltstone disposal area permit application is in progress. Plans are to discuss the disposal area application with the South Carolina Department of Health and Environmental Control in early January and to submit the revised permit application in late January or early February.

Powder Metallurgy Core Diameter Gage

A facility is being designed to produce powder metallurgy billet cores which will be used in the production of reactor fuel tubes. The outside diameter of the core is dependent on a number of process variables which must be kept under control. Because the outside and average diameters of each core vary slightly, the maximum radius of each core must be determined to verify that the core will fit into the machined billet components. A system incorporating an IBM PC micro-computer, a printer, and an ultrasonic distance measuring device is being developed to make noncontact measurements on the billet cores. The data collected will be used to determine the maximum, minimum, and average outer radii of each core.

Preliminary tests were conducted using the ultrasonic device and an IBM computer. Test results indicate a measurement accuracy of ± 0.002 inch at a distance of 1/2 inch from the surface of the core. Also, 1,700 data points are used to determine the maximum, minimum, and average radii in under 2 minutes. This is well within the billet core production rate of 1 every 12 minutes and will assist in detecting trends in production.

New Maintenance Shop Facility

The Maintenance Services Group of LSD provides machine shop support for research programs conducted in SRL and at TNX, as well as day-to-day maintenance of existing facilities and equipment. Until now, shop facilities have been scattered throughout the technical area in space more suitably designed for research activities. In addition, this has caused the need for duplicate work areas, power tools and equipment, and precluded the utilization of larger-scale materials handling equipment.

With recent completion of the new maintenance shop facility in Building 749-A, the Maintenance Services Group now has a centralized machine shop designed specifically for this essential support activity. The 11,500 ft² facility contains tool grinding, engraving, and tool crib rooms in addition to a main high bay machine shop with its overhead, two-ton bridge crane for material handling. Office, change, and lunchroom facilities are also provided.

NUCLEAR MATERIALS PLANNING

Decontamination and Decommissioning of SRP Facilities

A comprehensive decontamination and decommissioning (D&D) survey was completed for radioactively contaminated facilities at the Savannah River Plant. Of the approximately 3,000 site facilities, 513 are radioactively contaminated and will require D&D after shut-down. Only 75 of the 513 facilities are projected to be decommissioned prior to FY 2000; D&D of all facilities is projected to be completed by FY 2045. The total estimated cost (in constant FY 85 dollars) is approximately \$800 million. Total solid waste volumes are projected to be 5,000,000 and 17,000 ft³, for low level waste and transuranium-element-bearing waste, respectively.

Three hundred eighty of the 513 facilities were assumed to be decommissioned by entombment which is essentially closure of the facility as a concrete monolith. Highly contaminated facilities near the center of the site were treated in this way. Since the radioactivity would remain, the entombed facilities would require surveillance until the radioactivity decayed to an innocuous level. One hundred thirty-three lightly contaminated facilities near the site boundaries were assumed to be decontaminated and decommissioned by dismantlement, which would restore the site of the facility for another use.

The survey will provide a framework from which to formulate plans for specific facilities.

Environmental and Nuclear Safety Issue Study

A comprehensive compilation of environmental and nuclear safety issues which potentially could have significant impact on the viability of SRP operations identified no unaddressed issues. Forty-one issues were identified and evaluated against criteria consisting of release characteristics, health hazards to the offsite population, costs, and political consequences. Based on the evaluation, the issues were ranked according to significance on plant operation. Health hazards as possibly perceived by the public and political consequences from public opposition were both given high weighting in the evaluation. For the 20 issues with the greatest significance, a matrix was constructed showing hazards, risks, mitigation measures, and programs for dealing with the issues.

A separate ranking of the issues was also made using only risk to the offsite population as the ranking criterion. Significant differences in ranking among the issues resulted from the two methods because risk reduction measures for some issues are likely to be discounted by opposition segments of the public.

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