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Report of an Investigation into Deterioration of the Plutonium Fuel Form Fabrication Facility (PuFF) at the DOE Savannah River Site

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EXECUTIVE SUMMARY

In December 1983, DOE completed plutonium 238 (Pu-238) fuel clad production for NASA's Galileo and Ulysses space missions. The Pu-238 fuel was clad at the Plutonium Fuel Form fabrication facility (PuFF) at the Savannah River Site (SRS). When production was completed, the PuFF facility was placed in standby, and the staff was reduced from more than 100 personnel to three operators. All other personnel were transferred to other production assignments. Failed equipment was left in place in the PuFF facility hot cells awaiting resumption of production.

The decision to place PuFF in the standby mode was premised on the belief that new fuel clad requirements would soon be forthcoming and production would commence again by FY 1986. It was generally expected that once new fuel clad requirements were identified, fuel clad production could be restarted quickly and at minimal cost. For this reason, and because the hot cell design made cleanup difficult without dismantling the facility, only a limited effort was undertaken to decontaminate the process cells. As a result, an indeterminate amount of highly corrosive Pu-238 oxide powder was left in the process cells.

The projected new fuel clad requirements failed to materialize and the facility was left in standby. In the ensuing years, the Office of Nuclear Energy (NE, the responsible DOE Program Office) remained convinced that new fuel clad requirements would be forthcoming. As a result, no further attempts were made to decontaminate the hot cells. As each succeeding year passed, new requirements were identified and subsequently canceled and the Pu-238 program became a successively lower priority for funding and resources. Lacking any clear direction, the facility suffered from continual management and staff turnover resulting in a lack of management stability and continuity. With the cancellation in 1987 of the Air Force's planned Dynamic Isotope Power (DIP) program, coupled with an increased emphasis in DOE on the weapons program, a mindset developed among those responsible for PuFF that it would never operate again. Several interviewees said that, by this time, those responsible in DOE and the contractor organization had literally "walked away from the facility."

As staffing and budgetary limitations became more acute, cell equipment continued to deteriorate and the maintenance program slowed almost to a halt. It is significant that after 1985, as facility conditions continued to deteriorate, neither the Program Office, DOE-SR, nor the contractor revisited their original basis for conducting only limited decontamination of the cells.

An inert gas system supplied argon to some of the hot cells and was operated primarily to retard the rate of equipment corrosion in the cells. However, the system was inoperable for extended periods between 1984 and 1989, when a decision was reached not to repair it. By the time this decision was made (in April 1989), the argon system had not been operational since May 1988, and extensive corrosion to cell equipment had already occurred. Due to the presence of corrosive Pu-238 in the process cells, cell equipment would have continued to deteriorate even if the argon system had been continually operating. Therefore, the formal decision not to repair the system in 1989 did not materially affect the condition of the equipment and sealing surfaces in the cells. Nevertheless, NS concludes that the failure to maintain operability of the system significantly accelerated the rate of corrosion of the equipment in the cells.

This investigation was initiated to ascertain whether the Savannah River management and operating (M&O) contractor and the DOE Savannah River Field Office (DOE-SR) terminated the operation of the argon inert gas system in PuFF with the knowledge that inoperability of the system would accelerate the rate of corrosion to equipment in the PuFF process cells. When the investigation established that the failure to maintain operability of the argon system was but one factor contributing to the degraded condition of the facility, the investigation was expanded to identify and evaluate the causal factors which led to the deterioration of PuFF after it was placed in standby.

An assessment of the current status of the facility revealed that NE has no documented analyses upon which a conclusion can be drawn as to: (1) the amount of Pu-238 remaining in the facility's hot cells; or (2) the functional integrity of the seals in the hot cells. The ultimate determination of the risk profile of the facility can only be made when NE performs analyses that provide a reliable determination of the Pu-238 inventory in the cells and the condition of the seals.

Because of the extensive damage which occurred to PuFF while in the standby mode and the resultant increase in cost and time to refurbish the facility, it was necessary in 1990 for DOE to transfer fuel clad production responsibilities to Los Alamos National Laboratory in order to meet projected schedules and available budgets for production of fuel clads for the CRAF and Cassini space missions. Coincident with this investigation, NE initiated an accelerated review of both the current condition of PuFF and various alternatives for decommissioning or refurbishing the facility. NE was recently advised by the contractor and DOE-SR that the cost to decontaminate and decommission the facility could be as high as $170 million.

PuFF remains under a surveillance and maintenance regime pending a final decision by NE regarding the future of the facility. It is the judgment of NS that, although the probability of a significant spread of contamination from inside the cells is currently low, it will increase with time as the equipment in the cells continues to degrade. Expeditious action to decontaminate the cells is warranted.

The PuFF experience demonstrates the high cost of management's failure to plan and budget for realistic contingencies, including, as in this case, the possibility that demand for new production might not materialize for an extended period of time. Not only did management fail to plan for realistic contingencies, but when these contingencies in fact occurred, they took no immediate action. Early on, DOE (through the Office of Nuclear Energy) failed to analyze how long the PuFF facility could remain in standby before action would have to be taken to decontaminate the facility, in order to avoid large and unnecessary costs (in dollars and in man-rem) to the Department at a later date. It also did not demand that customers of the PuFF facility pay any anticipated costs to decontaminate (not to mention decommission) the facility as part of the basic cost of obtaining its products. The PuFF experience demonstrates the validity of and necessity for strict line management responsibility for DOE facilities as espoused by Secretary Watkins.

DEPARTMENT-WIDE RECOMMENDATIONS

1. The PuFF experience demonstrates the need for a Safety Analysis Report (SAR) and derivative Technical Safety Requirements (TSRs) for all facility operating modes, including "operational standby" and "shut down pending decommissioning." The analysis necessary to support these TSRs should explicitly consider the need to maintain operability of essential equipment, aging effects, and activities necessary to decontaminate and decommission the facility. The SAR and TSR Rules and Orders, and their associated Safety Guides, should include requirements for standby and shutdown facilities.

2. PuFF is an example of a DOE Program Office relying upon a subsequent mission or user of a facility to fund the decontamination (or refurbishment) of that facility even though it was contaminated doing work for the previous user. One problem with this approach is that the facility will eventually be unable to attract future users, and the Program Office will be forced to turn to Congress for new money to pay for final decontamination and decommissioning. As in the case of PuFF, this amounts to a deferred and hidden DOE subsidy of the sponsoring agencies' actual program costs. In addition, deferred decontamination is often more expensive and more hazardous than if the facility had been decontaminated at the end of production.

   The Department should consider adopting a policy that requires a program office to establish a funding reserve for use in decontaminating facilities within a specified time after work in the facility has been terminated, particularly if work conducted in the facility was primarily done for other agencies or for other program offices. In no case should undefined mission requirements be permitted to extend the specified time to decontaminate a facility without a safety analysis supporting such a decision. This is particularly important in cases where the program is "work for others" such as Pu-238 work for NASA and DOD. Otherwise, the true cost and duration of production, including refurbishment or decontamination, cannot be accurately communicated to the users so that firm mission requirements and valid budgets can be developed in a timely manner.

PU-238 PROGRAM RECOMMENDATIONS

1. If the Department intends to continue Pu-238 production, NE should develop specific design criteria for Pu-238 facilities. The criteria should reflect the PuFF experience as well as the accumulated

operational experience with Pu-238 in other facilities both in the United States and abroad.

PUFF FACILITY RECOMMENDATIONS

1. The Office of Nuclear Energy should perform a cost-benefit analysis evaluating near-term decontamination (i.e. decontamination commenced within one year) versus delayed decontamination of the PuFF facility. This analysis will require an estimate and supporting basis for determining the remaining quantity and distribution of Pu-238 throughout the hot cells. Any physical measurements or experiments should be preceded by a safety analysis.

2. The following recommendations are applicable whether decontamination is undertaken in the near-term or is delayed; NE should:

   a. Initiate planned 24-hour operator coverage in Building 235-F;

   b. Continue the current frequency of surveillance for radiation monitoring equipment, as well as for ventilation monitoring and control devices;

   c. Maintain ventilation system operability;

   d. Analyze the consequences of and, if necessary, take remedial steps to ensure that the old stack 293 will not fail in a manner that would affect PuFF facility ventilation or structural integrity; and

   e. Identify potential accident scenarios, limiting conditions for operation, and surveillance requirements for the facility for the time periods before and after decontamination is initiated.

   f. Return alarms associated with active systems in the present ventilation configuration to an operable status.

   g. Develop procedures for evaluating and controlling combustible loads in the hot cells.

3. The following recommendations are applicable if the decontamination effort is delayed more than one year; in this case NE should:

   a. In view of the potential for degradation of the seals due to hot cell conditions and aging, take physical measurements to evaluate future seal condition;

   b. Cut and cap off all gas and water lines that penetrate the hot cell boundaries; and

   c. Remove, or lock in a de-energized state, appropriate power circuit components for the hot cells.

I. SCOPE OF THE INVESTIGATION

This investigation of the Savannah River Site's Plutonium Fuel Form fabrication facility located in Building 235-F was initiated in April 1991. The purpose of the investigation was to determine whether, as had been alleged, operation of the facility's argon inert gas system was terminated with the knowledge that continued inoperability of the argon system would cause accelerated corrosion damage to the equipment in the plutonium 238 processing cells. The investigation quickly established that the decision to discontinue operation of the argon system, by not repairing it, was merely one of the measures, and not the most important one, which led to the current deteriorated state of the facility. As a result, the scope of the investigation was broadened to more fully identify and assess those factors which contributed to the facility's current condition.

II. BACKGROUND LEADING TO THE INVESTIGATION

In December 1983, the PuFF facility completed production of Pu-238 General Purpose Heat Source (GPHS) clad fuel for the Radioisotopic Thermoelectric Generators (RTGs) used by NASA in the Ulysses and Galileo space programs. The facility was then placed in an "enhanced production readiness" (standby) mode with a staff of three operators. These operators were to implement a maintenance plan to ensure continued operability of equipment until new fuel clad requirements were identified. The goals of the enhanced production readiness mode were to ensure that: (1) production readiness would be maintained, and (2) restart of fuel clad production (projected for FY 1986) would not involve significantly increased costs. However, due to changing circumstances and priorities, no new fuel requirements were identified and the facility remained in the enhanced readiness mode until 1989 when the CRAF/Cassini Program was funded. At that time, DOE-SR and the contractor (Du Pont) projected that it would cost approximately $26 million to refurbish PuFF with completion not scheduled until 1991, due in large part to the extensive corrosion of equipment that had occurred in the east line processing cells (Cells 1 through 5). Corrosion had made decontamination of the cells more difficult because it had caused the cell master-slave manipulator arms (which would have been used in the refurbishment effort) to become frozen in place, precluding use or ready removal and replacement of the manipulator arms from the maintenance side of the cells.

The manipulators could not be easily removed because corrosion had prevented the slave arms from being moved to a horizontal position parallel to the floor so that they could be lifted from their armatures. Because of their deteriorated condition, these manipulators could no longer be used to facilitate decontamination of the process cells. It has not yet been determined how the manipulators will be removed from the cells.

In February 1990, the Program Office directed resumption of fabrication of fuel pellets in PuFF; however, when DOE-SR and the contractor submitted a revised estimate and schedule for PuFF refurbishment, projecting a cost increase to $50 million with completion deferred until 1992, fuel fabrication work for CRAF/Cassini was transferred to the Los Alamos National Laboratory. Recent SRS estimates of the cost and schedule for decontaminating and decommissioning the PuFF facility are that it could take at least six years and cost as much as $170 million.

In February 1991, Steven M. Blush, the Director of NS, inspected the PuFF facility. His visit included both a tour of Building 235-F and informal discussions with contractor and DOE personnel directly responsible for the facility. During these discussions, the Director received information that personnel responsible for maintaining the facility had made a conscious decision in approximately 1987 to terminate operation of the facility's argon inert gas system with the knowledge that inoperability of the system would lead to accelerated deterioration of the facility. These allegations prompted NS to initiate the investigation reported here.

III. PUFF FACILITY OPERATING AND DESIGN OVERVIEW

A. PuFF Operating History

In September 1971, the Atomic Energy Commission (DOE's predecessor) made a decision to transfer plutonium molybdenum cermet (PMC) fuel form preparation from the Mound facility in Miamisburg, Ohio, to Building 235-F at the Savannah River Site. According to **Individual A**, currently Tritium Program Manager, Westinghouse Savannah River Corporation (WSRC) and originally a design engineer involved in the construction of PuFF, and **Individual B**, Director, Office of Technology Support, Office of Nuclear Energy (formerly Director, Special Nuclear Projects, Office of Nuclear Energy), the decision to move plutonium operations to SRS was made because of a concern regarding the continued processing of plutonium powder at Mound in proximity to a significant population center. Both individuals said SRS was chosen because of (1) its remoteness from population centers, and (2) the availability of Building 235-F, the use of which would result in a substantial savings in construction costs for a new facility. In 1972-1973, the original scope of the PuFF facility was expanded to include fabrication of pure plutonium oxide (PPO) spheres for space power applications. In order to eliminate the need for transporting Pu-238 powder in the public domain, iridium encapsulation of the PPO spheres was also transferred to PuFF (Exhibit 1).

Construction of PuFF began in October 1973 and was completed in mid-July 1977. Cermet discs were never fabricated at PuFF; however, production of iridium-encapsulated 100-watt Pu-238 spheres for Multi-Hundred Watt RTGs commenced in 1978 and was completed in April 1980. In June 1980, production of the 62.5-watt GPHS fuel clads for NASA's Galileo and Ulysses missions began. By December 1983, all fuel clad production was completed for these missions. The last fuel clads were shipped to Mound in February 1984 for final assembly. During production, PuFF was staffed with between 100 and 130 people, including operators, engineers and shipping support personnel who processed approximately 165 kg of Pu-238. Within days after the last fuel clads were shipped to Mound, PuFF was placed in the "enhanced readiness mode" and the staff was reduced to three operators. Plant records indicate that varying levels of maintenance activity were carried out in subsequent years (primarily on the building ventilation system). However, until the initial decision was made to begin production for CRAF/Cassini at PuFF, no other significant work was planned or carried out with respect to the process cells. As previously stated, the decision to begin fuel clad production in PuFF was subsequently reversed in 1990 because of the increased cost and time necessary to refurbish PuFF. Currently, PuFF is shut down pending a final decision by the Program Office regarding the future of the facility. At the time of the NS site visit in May 1991, the facility was staffed by 12 operators and 7 supervisors (Exhibit 2).

NOTE: Various terms were used by individuals interviewed by NS and in pertinent documents to describe the status of PuFF subsequent to the completion of production in December 1983. These terms include: standby mode, production readiness mode, enhanced readiness mode, ready (active) standby and enhanced production mode. While meaning the same thing, these terms are "terms of art." For the reasons set forth in this report, they are interchangeable.

B. PuFF Design Description

The PuFF facility is located in Building 235-F at Savannah River near the geographic center of the plant site. The building was originally constructed as a Class I structure. (A Class I structure is a reinforced concrete structure capable of withstanding pressures of 1000 pounds per square foot.) Today however, Building 235-F is not considered a seismically qualified building. In addition to PuFF, Building 235-F contains three other facilities--the Actinide Billet Line, the Met Lab, and the Plutonium Experimental Facility (PEF). The building also contains storage vaults, as well as various auxiliary service areas, maintenance shops and radiation survey facilities. While the Office of Nuclear Energy is responsible for PuFF and PEF, the Office of Defense Programs is responsible for the remaining facilities in Building 235-F, including the general building systems (References 1 and 2).

PuFF was designed for production of up to 60 kg of Pu-238 per year. Pu-238 is inherently corrosive to organic, aluminum and carbon steel equipment; it is a strong alpha emitter and creates its own oxygen and heat source. The fuel clad process for producing RTG sources involves converting Pu-238 oxide powder using powder ceramic and metallurgical processes to produce compacted Pu-238 oxide fuel spheres and pellets. Compaction and encapsulation of clad fuel sources was accomplished in nine hot cells equipped with manipulators (five inerted with argon, one with helium, and three air atmosphere cells)(Reference 3). The cells are all located on the first floor of the building. As illustrated in Reference 4, the cells are divided into two parallel and facing process lines (the east line and west line) separated by an operating area. Processing of the Pu-238 oxide into fuel forms was carried out in the east line (Cells 1 through 5); iridium encapsulation in the west line (Cells 6 through 9).

NOTE: A comparison between the equipment in these two glove box lines reveals the effect of Pu-238 on the cell equipment. The equipment in the east line processing cells (containing Pu-238 powder) is significantly corroded; in the west line, where little or no Pu-238 powder was introduced, there is minimal corrosion.

The cells are separately vented and interconnected by transfer locks to maintain atmospheric purity during intercell transfers. The cells in the east side processing line are connected to the west side encapsulation line through a transfer tunnel beneath the floor. There are separate maintenance areas located in the rear of each of the processing and encapsulation lines.

The manipulator cells are leak-tight enclosures with stainless steel walls, coved corners and flush-mounted accessories. The cells have a floor height of approximately 3 feet, an inside height of 7 feet and a depth of 5 feet. The maintenance (rear) side of each cell has glove ports to provide access for in-cell repair of equipment. Shielding of the process cells was designed to limit personnel exposure to 0.5 millirem/hour in the continuously occupied operating area and to 5.0 millirem/hour in the maintenance areas located at the rear of the cells. Reference 5 is a design layout showing a cross section of a typical processing cell. The facility was designed primarily for manipulator work; however, according to the original Scope of Work dated October 8, 1973 (Exhibit 1), it was anticipated that some manual glove-port operations would occur through the rear maintenance areas. According to **Individual A**, and **Individual C**, Engineer, Separations Branch, DOE-SR, the shielding design was premised on the belief that the operators would work from the maintenance area of the cells no more than 10 percent of their time. In retrospect,

Individual C said he now believes that the recurring problems with the master-slave manipulator arms led the operators to spend more than 10 percent of their time working from the glove ports in the rear maintenance area in an attempt to maintain production goals. It was his opinion that decisions regarding the future operational viability of the facility would have to take this factor into consideration.

The second floor of the building immediately above the cells contains auxiliary equipment including, among other things, gas recirculator/purifiers for the inert gas cells, ventilation system components, and vacuum and hydraulic systems. Both floors of PuFF are compartmentalized and separated from other building areas by surrounding corridors and air locks. The facility rooms are equipped with fire detectors and halon fire suppression systems, and the walls have a two-hour fire rating.

C. Historical Basis for the Hot Cell Design

Pu-238 work is not conducted in hot cells anywhere else in the DOE Complex. The work is conducted in glove boxes. NS located two individuals who had personal knowledge of the original considerations in 1971 that led to the decision to use a hot cell design for the PuFF facility. According to these interviewees, once it was decided to move Pu-238 operations to SRS, it made sense to fit PuFF into the existing facility in Building 235-F "to save money." Further, the decision to utilize a hot cell design, as opposed to the glove box designs in use at both Mound and Los Alamos, was driven by ALARA considerations based on an assumption that they would be processing at least 30 kg of Pu-238 a year.

According to the interviewees, a glove box design was evaluated during the design phase. It was concluded that, in light of the expected production requirements for the Galileo and Ulysses missions, coupled with their past experience with operator exposure rates while working with Pu-238, a glove box would not provide enough shielding against neutron exposure and would afford limited ability to see and reach into the cells. It was felt that production needs and limits on exposures could be better accommodated through the use of a hot cell design using master-slave manipulators (**Individual A** and **Individual D**, formerly Chief, Separations Branch, DOE-SR).

IV. DISCUSSION OF EVENTS RESULTING IN THE DECISION TO PLACE PUFF IN A "PRODUCTION READINESS" (STANDBY) MODE SUBSEQUENT TO COMPLETION OF PRODUCTION REQUIREMENTS IN DECEMBER 1983

A. Differing Views On PuFF Utilization

In early 1983, DOE-SR and Du Pont projected completion of all Pu-238 fuel production requirements for the Galileo and Ulysses missions by January 1984; however, no other programs requiring continued Pu-238 production had been authorized. Based on interviews of knowledgeable DOE and Du Pont personnel, as well as a review of relevant documents, NS established that DOE-SR, the Program Office and Du Pont held a series of discussions to evaluate alternative plans for maintaining PuFF subsequent to the completion of production requirements. There were two differing views as to the manner in which PuFF should be maintained to assure that the facility could be restarted expeditiously and at minimum cost once new Pu-238 requirements were identified and funded. While the Program Office favored continued limited production of four fuel clads a month beginning in January 1984, both DOE-SR and Du Pont were opposed to continued production in the absence of identified program requirements. They recommended that the facility be placed in a standby mode.

B. DOE-SR's Basis for Recommending Placing PuFF in Standby

In May and July 1983, DOE-SR requested that the Program Office clarify NASA's Pu-238 fuel clad requirements for FY 1984 and FY 1985, so that proper planning for maintaining PuFF could proceed. DOE-SR argued that, while Pu-238 production capability should be maintained, it was not in DOE's best interest to produce fuel clads for which there were no authorized programs. DOE-SR asserted that, once contaminated, the iridium cladding would be lost to the system, and substantial costs would be incurred to recycle Pu-238 material that had no use. Further, DOE-SR reasoned that by placing PuFF in standby, rather than continuing limited production, cost savings of approximately $2.5 million could be realized without impairing their ability to restart production (Exhibits 3, 4, and 5).

Both DOE-SR and Du Pont personnel asserted that a fundamental flaw in the Program Office's rationale for initiating limited fuel clad production was their belief that production of four fuel clads a month could be accomplished with significantly less funding than that required for maintaining a full production schedule of 14 fuel clads per month. These interviewees stated that even a limited production schedule required a full production cycle and associated staffing. Therefore, the production of four fuel clads per month would not cost appreciably less than a full production schedule. On this basis, the interviewees opined that continued fuel clad production without firm requirements was not economically prudent. However, the interviewees also stated that there was great concern on the part of all those involved that PuFF not be placed in a condition that could have been construed as being completely "shut down." This concern had its genesis in the belief that if the facility were classified as shutdown, they would be required to go through the time-consuming process of preparing an Environmental Impact Statement (EIS) for the facility prior to restart of production. **Individual C** said that even the various terms used to refer to the status of the facility (e.g. ready (active) standby, enhanced production readiness, etc.) were carefully chosen in light of this concern (**Individual A**, **Individual C**, **Individual D**, **Individual E**, formerly the PuFF Production Manager, Du Pont and **Individual F**, formerly, PuFF Operations Engineer, Du Pont).

C. <u>Program Office Basis for Recommending Continued Limited Production of Fuel Clads</u>

In response to DOE-SR's recommendations, the Program Office issued "Program and Budget Planning Guidance" on September 21, 1983 (Exhibit 6) for the Office of Special Nuclear Project Activities at SRS. The Program Office stated that, despite the fact that future Pu-238 requirements were uncertain, it had concluded that DOE-SR's recommendation to place PuFF in a standby mode in early 1984 would seriously jeopardize its ability to meet what were believed to be forthcoming NASA and DOD requirements. Based on this belief, the Program Office directed that SRS activities for FY 1984 through FY 1986 include continued production and encapsulation of Pu-238 fuel clads. Specifically, the Program Office directed that commencing in January 1984, SRS should produce fuel clads at the rate of four fuel clads per month in order to meet the needs of the space and terrestrial programs through FY 1986 while maintaining the capability to resume a full production schedule for future missions.

Program Office personnel who were interviewed (including **Individual G**, formerly, Director, Office of Special Applications, Office of Nuclear Energy, **Individual H**, formerly Director of Safety, Office of Special Nuclear Programs, Office of Nuclear Energy, and **Individual B**) stated that although the Pu-238 program was facing severe budget constraints because of its low priority compared to other programs, they strongly believed that limited production of fuel clads should be continued even in the absence of firm requirements. These interviewees believed a limited production mode was the best method to assure that the facility would be kept in a condition to allow a rapid restart when new requirements were identified. Further, they felt that continued production was important in order to maintain the necessary level of experienced personnel to operate the facility. All of those interviewed said they believed at the time that new fuel clad requirements would soon be forthcoming from DOD (specifically the Air Force's Dynamic Isotope Power [DIP] program), and that it was critical to the planning process that PuFF be maintained in a condition from which it could rapidly resume production.

Individual G said he repeatedly discussed these concerns with representatives from DOE-SR, but that neither DOE-SR nor Du Pont wanted to continue even limited production without firm requirements having been identified. He said Du Pont was anxious to transfer its people to other facilities with higher priorities and that because of cyclical and uncertain funding for the Pu-238 program, Du Pont was only willing to commit minimum resources to maintaining the facility. **Individual H** added that in addition to the above reasons, he believed Du Pont wanted to avoid any appearance that PuFF was being completely shut down because that raised the "specter" of having to perform a time-consuming EIS prior to restart of the facility.

D. <u>DOE-SR Response to Program Office Planning Guidance</u>

DOE-SR responded to the program planning guidance on October 28, 1983, asserting that fuel clads already scheduled for completion by December 1983 would be sufficient to meet firm requirements. DOE-SR reiterated its contention that continued production of four fuel clads a month beginning in January 1984 was not warranted and proposed as an alternative that PuFF be placed in "ready (active) standby" enabling restart after future firm requirements were identified and funded. DOE-SR stated that continued production of four fuel clads a month rather than placing the facility in standby would: (1) result in unnecessary expenditure of $10 million; (2) result in production of unneeded and perhaps unusable fuel clads; and (3) require an additional $3 million over currently budgeted funds to permit continued production at the rate of four fuel clads a month.

NOTE: As an integral part of this proposal, DOE-SR stated that the contractor (Du Pont) had assured that production could be restarted from the standby mode within one year and that during this "ready (active) standby" mode, DOE-SR would ensure that all PuFF equipment was exercised so that production readiness would be maintained and significant cost increases would not be experienced when start-up occurred (Exhibit 7).

E. <u>Final Program Office Decision To Place PuFF in "Ready (Active) Standby"</u>

In response to DOE-SR's arguments, the Program Office revised the Program Planning and Budget guidance on November 8, 1983. In accordance with DOE-SR's recommendations, the Program Office directed that PuFF be placed in a "ready (active) standby" status beginning in 1984. Explicit in the guidance document was the understanding that:

> the PuFF ready standby status can be assumed with no risk to the space/terrestrial Pu-238 fuels

program and that DOE-SR would ensure that all equipment in PuFF is exercised on a regular basis so that production readiness is maintained and that significant cost increases will not be incurred when start-up occurs. Also, that fueled clad production restart can be attained in PuFF within the one year lead time required to produce additional Pu-238 fuel material." The program guidance also directed DOE-SR to be prepared to restart production of fuel clads in FY 1986 to meet projected FY 1987 delivery requirements.

Revised funding estimates of $3.3 million for FY 1984, and $1.2 million for FY 1985, were provided in the revised program guidance (Exhibit 8). When interviewed, **Individual G** and **Individual B** noted that they had disagreed had with this approach and had voiced concern about the ability to properly maintain the facility and the loss of experienced operating personnel. **Individual G** opined that the funding levels provided for little more than "keeping the lights on." However, in view of the then-existing budget constraints and the lack of firm requirements, the Program Office concluded that this mode was the most viable alternative.

In a December 20, 1983, letter to DOE-SR, Du Pont stated that the funding level for FY 1985 was inadequate and required that PuFF "production readiness" activities be curtailed. While noting that there was no experience upon which to draw regarding operating costs in the "production readiness" mode, Du Pont submitted a revised request for $1.723 million for the planned level of activities (Exhibit 9). In response to Du Pont's request, on January 13, 1984, DOE-SR submitted a request to DOE Headquarters for a revised funding level of $1.9 million. DOE-SR justified the revised request on the need to maintain the argon inert gas system to prevent extensive equipment corrosion in the process cells (Exhibit 10). Budget records indicate the revised funding request was honored.

V. SRS ACTIVITIES RELATED TO PLACING PUFF IN "PRODUCTION READINESS" (STANDBY) MODE

A. General Description of SRS Initial Decontamination of PuFF in Preparation for Placing Facility in Standby

In December 1983, Du Pont completed all production requirements; by January 1984, PuFF had been placed in the standby mode. **Individual F** stated that when production ended in December 1983, the process cells were in generally good condition and all of the cell manipulators were operable. At the time, a decision was made not to replace any equipment in the cells until production was restarted in order to preserve spare parts.

According to the SRS Monthly PuFF Activity Report for December 1983 (Reference 6), all equipment used in the east line (Cells 1-5) to produce fuel clads was cleaned, inspected, and placed in storage in preparation for the production readiness mode. The report indicates that all samples, excess powder, and cell sweepings were collected and returned to the HB-Line as recyclable material. The report added that the facility was officially shut down, and only preventive maintenance and functional testing of essential equipment was contemplated for the foreseeable future. The report also stated that the west line cells (Cells 6-9) received a "thorough cleanup" (as opposed to the east line cells in which only the used equipment was cleaned) in preparation for placing the facility in standby.

B. Program Office Evaluation of PuFF Standby Status

In October 1984, the Program Office (assisted by representatives from Mound and Los Alamos) conducted a review of the status of PuFF. As a result of the review (Exhibit 11), the Program Office concluded that, while some effort would be required to clean up corrosion damage to the equipment in the east line (Cells 1-5), the facility was nevertheless ready to resume production. The review noted that there was "extensive" corrosion of manipulators and electrical connectors and insulation in Cells 1-5. At the time, SRS personnel explained that this was a normal condition for the Pu-238 contaminated cells and that sufficient spares were available to replace the damaged hardware before production resumed. However, an enclosure to the report prepared by the Los Alamos representative concluded that the corrosion was "somewhat more than anticipated," and that the main cause of the corrosion was the difficulty of keeping the hot cells clean using manipulators. The Los Alamos representative pointed out that this was in contrast to the situation at Los Alamos where glove boxes were employed and where the equipment could be cleaned more thoroughly.

The Program Office review also concluded that the decision to leave the cell equipment in a failed condition until production resumed was a correct one because replacement of failed parts would be expensive and would serve no purpose; the replacement equipment would fail before it was ever used. The enclosure to the report prepared by the Los Alamos representative stated that corrosion to the carbon steel parts of the weld fixtures in Cells 6 and 9 (the welding cells) would be minimized if the cells had an argon, helium or even nitrogen atmosphere. Noting that the facility's experienced staff had been transferred, the Los Alamos representative said it was his perception that the need to staff PuFF with experienced and properly trained operating personnel was one of the biggest hurdles to restart of the facility in a timely manner.

NOTE: According to personnel involved in the review, the conclusions were premised on resumption of production within 18 months of shutting down the facility (by early 1987) and not on the facility remaining in standby for a more extended period.

C. Discussion of Reasons For Limited Decontamination of PuFF

Interviews of numerous representatives from the Program Office, DOE-SR and the contractor (**Individual A**, **Individual B**, **Individual C**, **Individual E**, **Individual F**, **Individual G**, **Individual I**, Manager Nuclear Materials Processing Training and formerly, a PuFF Facility Manager, Du Pont, **Individual J**, Deputy Assistant Secretary for Space and Defense Power Systems, Office of Nuclear Energy, and **Individual K**, Manager, Equipment Engineering, WSRC) focused on the extent to which the PuFF facility was decontaminated prior to placing it in standby. The information derived from these interviews established that the key planning assumption when the facility was placed in standby was that new Pu-238 fuel clad requirements were imminent and that production would be restarted within 18 months. **Individual J** stated that, in view of the austere budget climate, he believed the standby mode represented the best compromise for the money, balancing the safety needs of the facility with the need to be capable of beginning production within a short time.

Based on this premise, the facility was prepared for the standby mode by wiping down with rags those areas within the cells that could be reached with the manipulators and sweeping up as much of the excess Pu-238 fines as possible. The interviewees stated that decontamination was limited because many contaminated areas within the cells could not be reached due to the limited mobility of the master-slave manipulator arms. Dismantling the facility to perform a complete decontamination was not contemplated because it would have prevented a rapid restart of the facility. However, the interviewees all readily acknowledged that, due to the corrosive nature of the Pu-238 remaining in the process cells, the longer the facility remained in standby, the more difficult it would be to restart it.

Numerous interviewees stressed that, because they were repeatedly assured that restart of production would soon be forthcoming, there was no perceived basis for unnecessarily causing additional exposure to workers by effecting a more thorough decontamination, particularly since the cells would immediately become contaminated again as soon as production commenced. One interviewee (**Individual A**) suggested that, in fact, no one really knew how to do a more complete decontamination of a Pu-238 hot cell facility short of completely dismantling the facility and burial of the contaminated cell equipment.

D. <u>Description of Maintenance Activities While in Standby Mode</u>

The transition from production to standby involved a reduction in operational staffing from more than 100 persons to three operators. The three operators were supposed to ensure that the facility was maintained in a condition that would enable resumption of production with minimal effort. The other personnel were immediately transferred to other SRS operations, unrelated to PuFF. Several interviewees suggested that the rapid reduction of personnel in the facility was at least one reason for the subsequent deterioration of the facility. **Individual I** stated that he believed that the rapid scale-down of personnel immediately after production ended was an error because it resulted in no one being left in the facility with the proper experience to maintain the cell equipment. **Individual E** asserted that while the skeleton operator crew that remained was comprised of experienced operators, they lacked experience in providing engineering support. He said this factor likely delayed their recognition of problems with the argon dryer beds in 1984 (discussed further in Section VII) that led to the intrusion of moisture into the cells and probably accelerated the rate of corrosion of cell equipment.

As part of the plan for maintaining the PuFF facility in the standby mode, Du Pont developed a monthly operating check sheet (Exhibit 12) describing the frequency and method of exercising the essential equipment in PuFF. The check sheet was reviewed and approved by the Program Office with technical review and concurrence also provided by representatives from Mound and Los Alamos.

Maintenance of the facility while in the standby mode included maintaining an argon inerted atmosphere to limit deterioration of equipment and to maintain operability of the argon system. The maintenance program also included performing routine preventative maintenance, performing daily equipment checks, replacing failed equipment and maintaining an inventory of spare equipment parts. A review of SRS monthly maintenance reports seems to indicate that facility equipment and supporting systems (primarily those related to the ventilation systems) were being maintained. However, the monthly reports stopped being recorded for a period of one year between May 1987 and May 1988. As discussed in more detail in Section VI.D, a shortage of available manpower during this period left only one custodian to maintain PuFF. In order to free more of his time for maintenance activities, he was no longer required to document the work he performed.

Despite the program to conduct maintenance and exercise equipment, it was clearly anticipated that equipment failures would occur in PuFF while in the standby mode and that the rate of equipment failure would escalate the longer the facility was not operating. For example, the operating checklist included a requirement to exercise the cell manipulators weekly. Nonetheless, both DOE-SR and Du Pont still contemplated the failure of all the cell manipulators. A copy of a 1984 overview of planned maintenance activities obtained from program files bore handwritten notes (apparently taken during a facility status briefing) indicating that all 16 cell manipulators were expected be lost within two years owing to severe corrosion (Exhibit 13).

This overview of maintenance activities also bore a handwritten note indicating that it was Du Pont's intent to leave the manipulators in place as they failed. Both **Individual C** and **Individual E** explained that there were plenty of spare manipulators on hand, but it made no sense to replace them while the facility was in standby. They believed that replacement would have required using up spares for no purpose. Further, they indicated that the manipulators were fragile and broke easily. Based on past experience, the manipulators would also be expected to experience a high failure rate while operators were being retrained prior to restart. Therefore, they believed it made more sense to use the old manipulators for training and preserve the spares for actual production work.

Individual C also said that as the standby mode grew lengthier because of the absence of new fuel clad requirements, additional equipment failed in the facility and was not replaced. As a result, the facility reached a point where there was little functional significance to many aspects of the maintenance program (particularly those not connected with the ventilation systems). For example, **Individual F** said that as early as mid-1985 the operators had stopped exercising the cell manipulators because they were all failing and could not be exercised any longer. Both **Individual C** and **Individual A**, as well as a majority of other interviewees, stated that, had there been any reason to believe that the facility would remain in standby for an extended period, they would likely have attempted to perform a more thorough decontamination of the facility, including the removal of cell equipment. However, the interviewees stressed that they were repeatedly told by the Program Office that restart was imminent. As a result, their goal was limited to attempting to maintain the facility for restart, not to performing detailed decontamination activities associated either with refurbishment or decommissioning.

VI. DISCUSSION OF FACTORS CONTRIBUTING TO DETERIORATION OF PUFF AFTER IT WAS PLACED IN STANDBY IN DECEMBER 1983

A. Manipulator Design Factors Affecting Cell Conditions

Individual A, Individual C, and **Individual L,** Program Manager, DOE-SR, all stated that a significant drawback to the existing facility design of hot cells and master-slave manipulators was that only the Model L manipulator could be utilized in the facility owing to the low ceiling clearance. The proficiency of these manipulators was extremely limited because their design lifting capacity was only eight pounds, and they had limited mobility and reach within the cells. As a result, even when the manipulators were fully functional (i.e. before they became corroded) workers were hampered in their ability to reduce or remove the Pu-238 contamination from many areas of the hot cells prior to placing the facility in the enhanced readiness mode. **Individual M**, a Program General Engineer in the Office of Nuclear Energy, recalled that the hot cell design was considered so deficient that in 1988, when there was serious consideration of building a new PuFF facility at Hanford utilizing the SRS hot cell design, DOE-SR specifically recommended that Hanford abandon any idea of using a hot cell design in favor of glove boxes.

Another factor which adversely affected the condition of the manipulators was the lack of a suitable sleeving material to protect the manipulator arms in the east line processing cells from corrosion. The original Scope of Work for PuFF (Exhibit 1) and the Safety Analysis Report (SAR) (Exhibit 4) required the manipulators in the inerted east line cells (Cells 1 through 5) to be double-booted, Model L sealed manipulators. The manipulators in the west line air atmosphere cells (Cells 6 through 9) were to be single-booted, Model G sealed manipulators. The purpose of the double-booted sleeving on the Model L manipulators was to protect the aluminum manipulators from corrosion.

During an NS investigator's tour of the PuFF facility, it was noted that the manipulators in the west line cells were still booted (and in good operating condition), while the east line manipulators (which are extensively corroded) had no booted sleeving. **Individual** E stated that the design intent of the booted sleeving was to protect the manipulators from corrosion from highly corrosive Pu-238 fines. However, he said that during the early stages of production in the late 1970s, it was found that the Pu-238 powder quickly destroyed the sleeving material, and an alternative material could not be developed that would perform the intended protective function. As a result, it was decided to discontinue the use of the booting material on the east line manipulators because of a concern that impurities would be introduced into the cells when the booting material broke down, thus potentially affecting quality of the fuel clads. **Individual E** noted that this deviation from the design did not materially affect their ability to maintain the manipulators during operations because the fragile manipulators frequently broke down and would be replaced before any corrosion could develop on them. However, once the manipulators were left in place for an extended period, such as during the enhanced readiness mode, the aluminum manipulators corroded very quickly in the Pu-238 environment.

B. Effect of Limited Decontamination While PuFF Was in Standby

As described in Sections V.C and VI.A, the hot cell design of the facility (with its reliance on master-slave manipulator arms) severely limited SRS's ability to perform a complete decontamination of PuFF prior to placing the facility in standby. As a result, when the facility ceased production in December 1983, there was an unknown, but apparently significant, amount of Pu-238 powder still remaining in the east line processing cells. Since Pu-238 is highly corrosive, both DOE-SR and Du Pont recognized that regardless of the level of maintenance performed in PuFF during standby, there would be significant corrosion of the carbon steel, aluminum and organic components in the cells (and particularly to the cell manipulators). **Individual N**, formerly Technical Manager for RTG fuel clad production at Mound, has concluded that the primary cause of the cell deterioration was the failure to properly decontaminate the cells in 1984.

At the time the facility was placed in standby, it was recognized that the longer the facility remained in this mode, the more difficult and expensive it would be to refurbish the facility prior to restarting production. As previously stated, however, all of the individuals interviewed during the NS investigation said that based on input received from the Program Office, they always believed the facility would be in standby for only a brief period and that the planned level of maintenance would be sufficient to maintain the facility.

Although these interviewees stressed that a more thorough decontamination of the cells would have been attempted if they had known that the facility would remain shut down for an extended period, no additional efforts were undertaken to preserve the cell equipment after 1984, when it became apparent that the facility would be in standby longer than anticipated. In October 1985, DOE-SR was informed by the Program Office that restart of production would be delayed for approximately one year. At that time, DOE-SR expressed its concern to Du Pont regarding the desirability of continuing to maintain PuFF in the standby mode and requested that they perform a "comprehensive study of near-term management options for the Pu-238 program" (Exhibit 14).

Du Pont responded to this request on November 19, 1985, by strongly recommending that PuFF be maintained in the "production readiness" mode. Du Pont recognized that there was significant deterioration of in-cell electrical insulation and of the manipulators, and noted that more deterioration was expected as a result of the delays in start-up. Du Pont informed DOE-SR that at least three additional months would be required to refurbish the cells prior to restart. However, Du Pont concluded that placing PuFF in "standby" as opposed to a readiness condition (which would have involved a more detailed decontamination of the facility and removal of equipment) would "seriously jeopardize" the ability to restart the facility without having to replace most of the major equipment. Du Pont then expressed concern that start-up from a "standby" mode might also require a new Environmental Impact Statement (Exhibit 15).

NOTE: The decision by Du Pont and DOE management to maintain the status quo is important. Although there was a significant level of corrosion of the equipment in the facility by this time, **Individual F** stated that he examined the facility in January 1986 and a number of the cell manipulators (approximately one-half) still had some limited mobility. Although the manipulators had to be replaced before resumption of production, it is likely that since they still had some mobility, they were not yet frozen in place from corrosion and could have been readily removed from the cells.

Individual C advised that Du Pont's recommendations to DOE-SR on this issue became moot shortly after they were received because the Program Office directed DOE-SR to begin preparing for fuel clad production for the Air Force's DIP program. (Formal program guidance to this effect was provided to DOE-SR by NE in December 1986.) When the DIP program was subsequently canceled in mid-1987, the issue was never revisited by SRS because the facility had already experienced significant deterioration and the contractor's primary focus was on restarting the K-reactor. In retrospect, **Individual C**, as well as the majority of the other interviewees, stated that the failure to re-evaluate the status of PuFF and perform a more complete decontamination in the face of repeated delays in start-up, contributed significantly to the deteriorated condition of the facility. However, the Program Office's continued belief that new requirements were forthcoming, and the need to be prepared to restart production quickly overrode considerations regarding the potential advantages of performing a more thorough decontamination of the process cells.

C. <u>Lack of New Fuel Clad Requirements Adversely Affecting Program Direction</u>

At the time of the decision in 1983-84 to place PuFF in the standby mode, the Program Office recognized that funding for NASA programs was uncertain. However, they believed there were terrestrial applications upcoming which would require fuel clad production in FY 1986. According to **Individual J,** there was never a significant period of time subsequent to 1984 when new fuel clad requirements were not on the immediate horizon. Therefore, because of the long lead time required to prepare PuFF for production, it was important to maintain the facility in a condition from which restart could begin rapidly.

Individual C added that as a practical matter, the system for developing specific, funded fuel clad requirements by NASA, DOD and the Program Office was, and remains, a significant contributor to the current condition of the PuFF facility. He explained that the production planning cycle is much longer than the budget process, and he contended that this creates significant difficulties for production planning because firm requirements are being identified and funded too close to the time when the clad fuel is actually needed. In **Individual C's** view, this problem was a major contributor to the Program Office's decision to forego performing a more thorough cleanup in favor of attempting to keep the facility in a mode from which production could be restarted quickly.

When DOD canceled the Air Force's DIP program sometime in mid-1987, the already low resource and funding priority given to the Pu-238 program diminished even further. The loss of the DIP program was considered by many to be fatal to the future of PuFF because, after repeated delays in the start-up of Pu-238 production (resulting in extensive deterioration to the facility), the DIP program was being counted on to provide the major source of funding needed to refurbish PuFF. The future of the Pu-238 Program was clouded further in July 1987 when the Office of Defense Programs (DP) informed the Office of Nuclear Energy that without firm Pu-238 requirements, or the authority to produce Pu-238 at the expense of Pu-239 production, DP would be unable to justify including maintenance of the Pu-238 isotope production facilities (e.g. HB-Line) in their budget planning. (DP traditionally budgeted Pu-238 fuel production and facilities costs.) DP indicated that without a firm commitment from customer agencies (such as NASA), the Pu-238 program was likely to fall"to the budget axe" (Exhibit 16). By early 1988, in the absence of identified requirements, SRS resource allocations and funding priorities were focused almost entirely on DP programs associated with tritium and Pu-239 production (**Individual G**, **Individual B**, **Individual C**, **Individual O,** Separations Facility Manager, WSRC, and

Individual P, formerly, Director, Special Applications, Office of Nuclear Energy).

These events contributed significantly to a mindset at SRS that PuFF would never operate again. This mindset made it more difficult, if not impossible, to persuade Du Pont to commit any resources to maintaining the facility (**Individual C** and **Individual G**). Additionally, **Individual P** and **Individual G** opined that, during this same time period, there was a high level of interest at DOE Headquarters in building a new Pu-238 production facility at Hanford. As a result, in the absence of identified and funded requirements, there was reluctance by senior management in the Program Office to fund continued activities at PuFF. Finally, according to **Individual P** and **Individual G**, a continuing series of management turnovers in DOE's Office of Special Applications resulted in a loss of program continuity and left no one to aggressively lobby for additional funding to maintain PuFF.

NOTE: Information provided during the NS investigation indicated that frequent management changes in the contractor organization also contributed to lack of stability and continuity with respect to oversight of PuFF maintenance related activities. Specifically, between 1984 and 1991, at least sixteen management changes took place in the PuFF Facility Manager and Building 235-F Manager positions. **Individual P** said the low priority assigned to maintaining PuFF was evident when he first visited the facility in 1988. **Individual P** said he could only describe the facility as a "mess" that by all appearances had been abandoned.

D. <u>Effect of Diminished Program Direction and Extended Period in Standby Mode on Level of Maintenance Activities</u>

As described in Section V.D, the maintenance program designed to exercise essential cell equipment became progressively less functional owing to the failure rate of cell equipment and the decision not to replace equipment until production resumed. Additionally, interviews of personnel responsible for facility maintenance established that the level of management oversight of maintenance continued to decrease as did the resources assigned to actually perform the work. By early 1988, all management attention and manpower at the site was almost exclusively devoted to tritium and Pu-239 production activities (**Individual P, Individual C, Individual G and Individual A)**. For example, when **Individual O**, became Facility Manager for F-Canyon in 1986, he also assumed responsibility for PuFF. He remained responsible for PuFF until 1989. **Individual O** said that during this period, because of the low priority assigned to PuFF, there was no real line supervisor with direct responsibility for the facility. **Individual O** said that because his primary responsibility was for F-Canyon, he exercised only minimal managerial oversight of PuFF.

With respect to PuFF maintenance activities, **Individual O** said that, because of manpower shortages and the low priority assigned to PuFF, only basic maintenance was being done to ensure the operability of the ventilation systems. He said that although there were three custodians (operators) assigned to PuFF, because of illnesses and manpower needs in other production areas, there were periods when only one custodian was in the facility and periods when no one was working in the facility at all. **Individual O** noted that between May of 1987 and May 1988, they were so shorthanded in PuFF that it was necessary for him to relieve the one remaining custodian of any responsibility for documenting maintenance activities in order to give him time to perform other responsibilities he had been assigned.

Individual Q, an operator assigned to PuFF in 1988, said that while there was a considerable amount of activity in Building 235-F (such as work upgrading the safeguards system and work in PEF), there was no activity related to PuFF at all. **Individual Q** said his primary function was to exercise any operable equipment and keep the argon system operating within the limited funding available. However, he said that by this time, most of the equipment (including the cell manipulators) was badly deteriorated and unusable. **Individual Q** said there was so little manpower available to maintain PuFF that he had to limit his activities exclusively to maintaining safety systems such as the ventilation and fire protection systems. It was his conclusion that by the time he was assigned to PuFF, the facility was being run "by exception." By this he meant he perceived that he should not "tell management anything about the facility unless he absolutely had to."

NOTE: This decrease in the level of maintenance activity was coincident with Du Pont's announced pullout from operation of the site, as well as with the period when the DIP Program (a projected major funding source for PuFF refurbishment) was canceled. Together, these circumstances provide substantial evidence to support the belief held by many at SRS that PuFF would never operate again, and any maintenance activities involving the preservation of cell equipment was pointless. This mindset appears to have been developed by many as early as 1986, and it was clearly the prevalent attitude in 1987 after the DIP Program was canceled.

VII. DISCUSSION OF CIRCUMSTANCES LEADING TO THE DECISION NOT TO REPAIR THE ARGON INERT GAS SYSTEM

A. Overview of Issues

In February 1991, the Director of the Office of Nuclear Safety conducted an inspection of the Savannah River Site and was struck by the deteriorated condition of the PuFF facility. The Director was told that operation of the facility's argon inert gas system had been terminated by SRS (possibly in 1987) with full knowledge that prolonged inoperability of the system would cause accelerated corrosion of process cell equipment. After an initial evaluation of this information, the Office of Nuclear Energy (NE) advised NS that although the argon system was no longer operable, its purpose was not to control equipment corrosion in the process cells. NE also informed NS that operation of the argon system had little effect on the rate of corrosion in the cells.

The threshold questions for NS to resolve in its investigation of the status of the argon inert gas system included:

(1) what was the purpose for operating the argon system while in the standby mode;

(2) when was the argon inert gas system deactivated, and what was the rationale for deactivating the system; and

(3) what effect did the argon system (and its deactivation) have on the corrosion rate in the process cells.

B. Purpose of the Argon System

The Program Office and site personnel contend that the primary purpose of the argon system during production was to enhance product quality. They have also said that the argon system was only a safety system to the extent that it served as a fire suppression system and a contamination barrier (**Individual E**, **Individual C**, **Individual D**, **Individual R**, Senior Fellow Scientist, WSRC and **Individual S**, PuFF Facility Manager, WSRC). However, the argon system was also used to maintain the amount of oxygen 16 in the Pu-238 fuel (by preventing oxygen 18 exchange for oxygen 16), thereby reducing neutron exposure to workers.

When the facility was placed in standby in December 1983, the primary reason for continuing to operate the argon system was to retard the rate of corrosion to the equipment in the process cells. Other reasons cited for operating the system were to ensure the general operability of the system and to detect leaks that may occur (**Individual D**, **Individual C**, **Individual E**, **Individual I,** et al). Individuals interviewed asserted that even with the argon system operating, they expected the cell equipment to corrode because of the presence of Pu-238 fines in the process cells. The open question was the extent to which argon would inhibit the corrosion process. Individuals involved in Pu-238 programs at Mound told NS that they agreed that even with the argon system operating, some corrosion would still occur due to the nature of Pu-238. However, they argued that if the argon inert atmosphere had been properly maintained in the cells, the rate of corrosion would have been significantly retarded (**Individual N**, and **Individual T**, formerly responsible for RTG production at Mound).

After PuFF was placed in standby, DOE-SR concluded that maintaining the argon atmosphere would have a substantial effect on slowing the rate of corrosion. Thus, in January 1984, DOE-SR requested an increase in the FY 1985 operating fund for PuFF, and in support of this request stated:

> Without additional funding $841,000 [in budget authority] and $503,000 [in budget outlays] the argon system cannot be maintained to prevent extensive equipment corrosion which would require major repairs or replacement delaying start-up and increasing costs (Exhibit 10).

Based on subsequent funding levels, it appears that this request was granted. **Individual C** said he wrote the request for increased funding based on a request from Du Pont. However, **Individual C** could not recall his technical basis for specifically requesting the additional funding to maintain the argon system in order to prevent equipment corrosion.

Based on interviews of DOE-SR and Du Pont personnel, as well as a review of documentation, NS concludes that DOE-SR's primary reason for continuing to operate the argon system in standby was the belief that it would reduce the rate of corrosion to equipment in the process cells.

C. Rationale for Deciding Not to Repair the Argon System

The decision not to repair the argon system was made in April 1989. The system had not operated since May of 1988, when it ceased to function because of problems with the argon blowers. Prior to that, the argon system had only operated intermittently: between January 1987 and May 1988 because of recurring problems with the argon blowers; and between January 1984 and January 1987 due to construction activities and other equipment problems. Exhibit 17 provides an operating history of the argon system after the facility was placed in standby.

Individual F made the decision not to repair the argon system after he became Technical Manager for Buildings 235-F and

247-F. **Individual** F and **Individual S** both said the decision was based on the deteriorated condition of the cells; both said the continued feeding of argon into the cells was not going to "buy them anything." **Individual** F said that by 1989, nothing in the cells was operable and the argon system had not operated in some time. Both individuals concluded that there was no point in restarting the argon system until such time as the facility was going to be refurbished for restart.

D. <u>What Effect the Argon System (and its Subsequent Inoperability) Had on the Rate of Corrosion in the Process Cells</u>

By the time the decision was made to cease repairing the argon system in April 1989, the equipment in the process cells (i.e., the manipulators, electrical insulation, cables and connectors, etc.) had already experienced extensive corrosion damage and would have had to be replaced before restart. Therefore, the decision had no practical adverse impact on the condition of the facility. That impact had already occurred owing to prolonged and repeated failure to keep the argon system operable over a period of years. Although it is acknowledged that argon retards the development of corrosion on process equipment, specific data do not exist to quantify the effect it has on the rate of corrosion. Nevertheless, information obtained during this investigation does suggest that if the argon system had been properly maintained while the facility was in standby, it would have had some degree of effectiveness in slowing the rate of corrosion in the process cells and might have prevented the manipulator arms from becoming frozen in place from corrosion.

Individual F stated that the facility (including the cell manipulators) was in good operating condition when production was completed and the facility was placed in standby in December 1983. He said although there was some corrosion forming on the manipulators during production, it was not until the spring of 1984 that appreciable levels of corrosion were first noticed on the manipulators. He also noted that this was occurring despite the fact that the argon system was operating. When they were unable to determine the reason for the increased corrosion, individuals having greater familiarity with PuFF were asked to evaluate the problem.

The personnel reviewing the corrosion problem concluded that the argon dryer beds had "caked-up" and had been rendered inoperable. This resulted in excessive moisture in the cells, accelerating the corrosion process. The dryer beds failed in April 1984, and were not repaired until approximately October 1984. **Individual** F said that by this time significant corrosion had formed in the cells. The Program Office review performed in October 1984 also noted that there was "extensive corrosion of manipulators and electrical insulation on the powder side (Cells 1-5) of PuFF."

NOTE: **Individual** E attributed the delay in identifying and repairing problems with the argon dryer beds to the fact that the skeleton crew responsible for maintaining the facility were operations oriented and had insufficient experience in engineering to permit them to identify and resolve the problem.

In April 1991, Savannah River Laboratories (SRL) completed an evaluation of the effect of cell atmospheric conditions on corrosion rates in Pu-238 contaminated cells. SRL concluded that a dry inert atmosphere was effective in minimizing the rate of corrosion in Pu-238 cells. SRL noted in its evaluation that the significant corrosion problems occurring in PuFF during 1984 coincided with the failure of the argon dryer beds and concluded that the resulting increased moisture levels in the cells during this period were likely responsible for the accelerated corrosion of equipment in the process cells. According to the SRL evaluation, subsequent problems with the argon system between 1984 and 1989 further contributed to the corrosion problem in the cells (Exhibit 18).

The interviews and documentary evidence establish that by 1989, when SRS made a "conscious" decision to cease repairing the argon inert gas system, the corrosion damage to the process cells was already extensive. Therefore, the decision not to repair the argon system was not a material factor in the deterioration of the equipment in the process cells. Deterioration of the process cell equipment was already extensive because of poor maintenance and inadequate engineering support to the facility. It is clear that even if the argon gas system had been adequately maintained, some level of corrosion and equipment deterioration would have occurred in the cells due to the extended length of the shutdown and the corrosive nature of Pu-238. Whether the cause of the corrosion was moisture build-up, absence of argon, or a combination of the two, the failure to ensure continued operability of the argon system did result in acceleration of the rate of corrosion to the equipment in the process cells and heightened the deterioration of the facility.

VIII. CURRENT ASSESSMENT OF THE PUFF FACILITY

A. Scope of the Assessment

In July 1991, the NS Performance Assessment Division performed an assessment of the current status of the facility. Because a decontamination and decommissioning (D&D) plan and schedule had not yet been developed, the risks inherent in any future D&D of the facility could not be evaluated during the assessment.

B. Current Status of the PuFF Hot Cells

There are nine hot cells in PuFF. The east line cells contain badly corroded and inoperable manipulators. Most of these cells have aluminum oxide flaking from the manipulators and oil collecting on the cell floors. The source of the oil is most likely from the oil-filled seal pots. The seal pots are connected to the maintenance exhaust line and function to automatically relieve any potential pressurization or evacuation of the cells. Radiation fields within the east line are high. For example, based on a single measurement in the Cell 1 maintenance area glove ports, the Facility Health Physics Manager estimates the radiation field in the cell at approximately 1.5 rad per hour. The west side encapsulation cells are in much better material condition.

All electrical loads, except for those circuits supplying lighting to the cells, have been de-energized. The argon and chilled water systems have been isolated via valve closures. The cells are being maintained at a vacuum (-1.8 inches water gauge to atmosphere) by suction from the maintenance exhaust header. The exhaust header flow path is radiation monitored and filtered by both the HEPA filter bank and the sand filter and exhausts via stack 292. Stack 292 is the main exhaust flow path for all facilities in Building 235-F. Twenty-four hour coverage with two operators per shift is currently scheduled to begin in Building 235-F in November 1991.

C. Overview of Facility Sealing Surfaces and Ventilation Systems

Two primary concerns in evaluating the possibility of a containment breach in the PuFF hot cells are the integrity of the sealing surfaces in the cells and the operability of the ventilation systems. There are numerous penetrations--for viewing windows, manipulators, glove ports, electrical services and chemical services (water, vacuum, gases, etc.)--through the PuFF primary contamination barrier (the welded stainless steel liners) and the surrounding shielding wall. Various kinds of seals are used in these penetrations to prevent the diffusion or migration of radioactive particles from inside the cells to the operating and maintenance galleries. A ventilation system establishes multiple zones of graded negative pressure (negative with respect to the outside atmosphere) such that if leakage develops in the system of seals, the flow of air is from the less negative operating or maintenance galleries into the most negative hot cells in order to maintain contamination control. Contamination control is enhanced in the PuFF hot cells by the addition of an annular space between the primary stainless steel liner and the shielding wall through which air flows and is discharged to the filtered ventilation system.

The ventilation system in Building 235-F is comprised of seven supply air systems, S1 through S7, and five exhaust air systems, E1 through E5 (Exhibit 19). Exhaust air from the PuFF hot cells (and air from the maintenance areas) flows through the E1 exhaust system. The air from the regulated areas and the air passed through the HEPA filters of the E1 system exhausts through the E5 exhaust system. Exhaust systems E2, E3, and E4 serve the unregulated areas of the building.

To achieve contamination control, the pressure in the process enclosures is maintained at -1.8 to -2.0 inches water gauge. A minimum pressure differential of 1.25 inches water gauge is maintained between the hot cells and the operating and maintenance rooms. This pressure differential is created by suction from the E1 exhaust fan and is monitored by pressure differential gauges. These gauges are calibrated biannually as Level 1 instruments. A drop in pressure below 1.25 inches water gauge activates an annunciator alarm in the control room (Reference 7).

The regulated areas containing the hot cells are supplied conditioned air from the S1 system. As noted above, air is removed by the E1 and E5 exhaust systems. These areas are connected directly to the supply and exhaust system. The east line hot cells are indirectly connected to the exhaust system through the hot cell annuli and directly to the maintenance exhaust header. The Argon Supply and Recirculation system is no longer operable, and the maintenance bypass valves are in the open position. Hot Cells 7 and 8 are connected to the supply air system with HEPA filtered air intakes located in the second floor service rooms. Cells 6 and 9 are directly connected to the E1 exhaust system through the maintenance exhaust header. Open air locks between Cells 6 and 7 and between 8 and 9 provide a path to the E1 exhaust (Reference 8 and 9).

The exhaust air from the PuFF hot cells, operating, maintenance and service areas passes through a two-tiered HEPA filter bank and sand filter and then is exhausted to the atmosphere from the exhaust stack. The PuFF facility exhaust systems are interconnected at the HEPA filter inlet manifold for the building.

D. Evaluation of Hazards and Discussion of Concerns

The principal hazards from PuFF in its current state can be described as a function of four components: (1) the quantity of Pu-238 oxide left in the cells; (2) the degree of Pu-238 fixation to cell internals; (3) the quality or effectiveness of the barriers to release (e.g. degradation of sealing surfaces and filtration effectiveness); and (4) the driving force available to expel Pu-238. Each of these components is examined below, and the effect of various abnormal events on each component is discussed. It should be noted that some abnormal events such as a seismic event could affect more than one of these components simultaneously. For example, a seismic event could degrade seals as well as lessen the degree of fixation.

1. <u>The Quantity of Pu-238 Remaining in the Hot Cells</u>

No basis currently exists to determine a bounding value for the quantity of Pu-238 contained in the hot cells. Without this knowledge, the magnitude of the risks cannot be estimated.

The PuFF facility's Pu-238 inventory records indicate a zero balance. Consequently, they cannot be relied upon to ascertain the quantity of Pu-238 present in the cells. Furthermore, only limited inferences can be drawn from the radiation measurements obtained in PuFF and from data obtained as a result of the cleanup of PEF. (PEF is an experimental facility in Building 235-F that was developed to conduct experiments on different techniques for processing Pu-238.) Cleanup of this facility was undertaken as part of a plan to ready PEF for restart of production.

Data collected by counting the changed HEPA filters in the normal ventilation pathway from the cells using gamma spectrometry indicates that, during the past few years, the amount of Pu-238 accumulated on the changed filters has been below detectable limits. The lower limit of detectability for the counting configuration employed in the gamma spectrometry method is approximately 0.6 grams of Pu-238. Therefore, the amount of Pu-238 collected on the filters can range between 0 and 0.6 grams Pu-238 without being counted. Gamma measurements indicate minimal amounts of Pu-238 deposited in ventilation ducts at PuFF. Based on these readings, potential localized hot spots are being scheduled for more sensitive measurements. The argon recirculation system HEPA filters that were changed out in the first quarter of 1991 contained less than detectable quantities of Pu-238. These filters were placed in service during the last few months of production in 1983. Therefore, the precise inventory of Pu-238 in the cells cannot be ascertained based on regular measurements of material accumulated on filters. Similarly, as previously discussed, the facility Health Physics Manager's estimate of a 1.5 rad per hour radiation field in Cell 1 is not convertible to a mass quantity of Pu-238 without very large uncertainty bands and cannot be relied upon for an estimate of the amount of Pu-238 in the cells.

The cleanup effort initiated in 1990 in PEF has been completed. This effort yielded a total of 8.5 grams of Pu-238. The first step in the PEF cleanup yielded 1.6 grams of Pu-238. This first step was commensurate with the level of cleanup performed in PuFF in late 1990 which yielded 3.9 grams of Pu-238. However, the 3.9 grams recovered from PuFF during the 1990 decontamination effort cannot be directly correlated to the 1.6 grams recovered from PEF because: (1) the surface area of PuFF is approximately two to three times larger than that of PEF; (2) PuFF contains several areas in the cells that the 1990 decontamination effort could not reach; and (3) the presses (hot and cold) could contain measurable quantities of Pu-238. Consequently, it appears likely that more Pu-238 could be present in the PuFF hot cells than a straight extrapolation from PEF experience would indicate.

The lack of measurable quantities of Pu-238 in the normal filtering pathways is a necessary, but not sufficient basis for concluding that the quantity of Pu-238 in the cells is not significant. There are other plausible explanations for the lack of Pu-238 in the filtered pathways. For example, the Pu-238 in the cells may be firmly affixed and would not be released, except possibly during an abnormal event. Another consideration is that there has been insufficient driving force available to expel the Pu-238.

Information concerning the integrity of the sealing surfaces can be determined by performing volumetric air flow measurements from each of the cells to the maintenance exhaust header. The existing sensing ports in the main exhaust lines may be used to perform these measurements. If these measurement results indicate substantial air flow, it would indicate that seal integrity is being compromised. In this case, the fact that less than detectable Pu-238 quantities have been deposited on the HEPA filters would indicate either that there is not a significant quantity of Pu-238, or the Pu-238 is firmly affixed in the cells. However, no assumptions concerning Pu-238 quantities in the cell can be made from the lack of detectable Pu-238 deposited on the HEPA filters if the air flow measurements indicate only minimal flow from the cells.

2. <u>The Degree of Fixation of Pu-238 in the Cells</u>

The amount of Pu-238 released during an abnormal event will be a function of the amount of airborne Pu-238. This in turn is a function of the degree of fixation of

the Pu-238 to cell internals. The degree of Pu-238 fixation is unknown.

From a review of the type of functions performed in the east line cells, most of the Pu-238 dispersed is fine powder and should be loosely adhered to surfaces. Other than the Pu-238 contained in the oil spills on the cell floors, NS did not identify any other fixation mechanism that would bind the Pu-238 in place in the cells. This concern is relevant only if a significant quantity of Pu-238 is determined to be in the cells.

3. <u>The Driving Force Available to Expel Pu-238</u>

There is a potential for flow reversal due to tornado-induced changes in ambient pressures.

The operation of the PuFF ventilation system can be affected by several driving forces which could result in overpressurization of the cells or a drop in the pressure of the operating, maintenance or service areas that could result in a reversal of air flow. The driving forces include: (1) loss of power to the E1 and E5 exhaust fans with continued operation of the S2 and S7 supply fans; (2) blockage of the tunnel discharge; or (3) a tornado-induced drop in ambient atmospheric pressure resulting in a drop in building pressure such that operating, service, and maintenance areas suffer a sudden drop in pressure which in turn results in a reversal of the pressure differential between these areas and the process cells.

The first driving force condition is currently safeguarded by the interlocking of the supply fans and the exhaust fans. Whenever the operation of the exhaust fans is lost or impeded, the supply fan operation is stopped. If power is lost to the exhaust fans, or if the pressure in the roof tunnel begins to rise, supply fans are shut down and control dampers D3 and D3A are closed. Technical standards for the facility require that these dampers be tested biannually.

The second driving force condition is currently safeguarded by a set of pressure switches that are calibrated every six months as Level 1 instruments.

The ventilation system safeguards will have no control over a tornado condition. The pressure differential monitor will sound an alarm. The system will continue to operate thereby maintaining some resistance to the flow reversal. If flow reversal occurs, it will occur first at the exhaust diffusers of the regulated areas from the tunnel, then at the Cell 6 and 8 air intakes (relatively clean), and finally at leaks in the cell penetrations.

4. The Driving Force Available to Expel Pu-238

Until 24-hour operator coverage is implemented (currently scheduled for November 1991) and out-of-service but activated control room alarms are repaired, upset of the ventilation system could go undetected and lead to a static condition in the cells.

The operation of the ventilation system can be affected by numerous forces which can result in a loss of forced air flow through the system (i.e. a static condition). A static condition of the ventilation system lasting 1.75 hours occurred on February 16, 1988, due to an error in the setting of the fan hand-standby-off control. The system interlocks responded properly upon a rise in pressure in the cells. The supply fans were deactivated and the dampers closed to prevent an air flow reversal. Although the system responded properly to prevent a flow reversal, the air went static as a result.

This condition, although annunciated by the alarm panel in the control room, was not detected for one hour because of inadequate operator staffing in the facility. While there was no detected release of radiation, the potential for a serious contamination event existed. No corrective actions have been implemented to prevent recurrence of this condition. However, according to the PuFF Facility Manager, round-the-clock operator coverage should detect and rectify ventilation system upsets before serious contamination releases occur. Twenty-four hour coverage is currently scheduled to begin in November 1991.

Additionally, the control alarm and status panel has several activated warning lights which have been tagged out due equipment failure. This condition could result in an unrecognized actual alarm even if the control room is properly staffed. All alarms associated with active systems in the present ventilation configuration should be returned to, and maintained in an operable status.

5. The Driving Force Available to Expel Pu-238

The probability of a fire affecting operation of the ventilation system could be further reduced by additional measures such as "locking-out" electrical circuits and instituting a formal process to control the combustible loading.

If an electrical fire were to occur in either the process areas or the regulated area, the HEPA filters would become clogged within a short time. If the smoke emanating from the fire were heavy, resin-laden smoke, the filters would clog within minutes. If the smoke were light, clogging would occur over a period of several hours. This clogging would result in an inability of the exhaust fans to maintain a vacuum in the process cells. The cell pressure would rise, the alarm would sound, and the condition would persist until the fire was extinguished, the filters replaced, and the system placed back on-line.

The chance of an electrical fire in the cells is remote because the circuit breakers for the power circuits have been switched off. The breakers, however, have not been locked out. The probability of a fire in the cells could be reduced further if the power were permanently disconnected. A fire in the service room should be detectable by the area smoke detectors. Since there are no fire suppression mechanisms in the service room, the probability of the filters becoming clogged from particulate loading would be dependent upon the adequacy of the response to the fire alarm. Currently, transient combustible loading is being informally evaluated during management, safety and housekeeping tours of the facility. However, there are no procedures establishing either the frequency or criteria for evaluating the transient load. The NS team observed that the present fixed combustible load in the facility is light. During any future decontamination effort, however, it is likely that transient combustible loads will increase. Procedures for evaluating and controlling this combustible load should be developed.

6. The Effectiveness of Barriers to Release

The sealing surfaces are apparently providing an effective barrier to release at the present time; however, no documented analysis has been performed to establish the functional integrity of the seals, or how long this integrity will be maintained given the amount of Pu-238 in the hot cells.

If the seals become degraded by normal wear, chemical attack or radiolysis, the contamination control provided by the multiple barrier system could be compromised and result in radioactive particles contaminating the surrounding buffer zones. The probability of loss of contamination control is low as long as the ventilation system operates properly. The probability increases as the differential pressure between the interior and exterior of the cell approaches zero. The probability of the loss of contamination control approaches near certainty if the differential pressure becomes positive, concurrent with a significant failure of the seals.

In PuFF, the only significant "chemical" attack on the sealing materials is from ozone generated by air ionized by radiation in the hot cells. The amount of ozone damage would be a function of the amount and distribution of Pu-238 within the hot cell and any air flow through the cell that would remove ozone. Radiolytic damage would be by alpha particle attack on any exposed surface of the neoprene sealing material and by beta-gamma or neutron attack on the interior of the sealing material. Degradation would be a time function of the amount of Pu-238 that could come into direct or near contact with the sealing material.

The sealing systems used in PuFF are described in Reference 10. Direct visual examination of the sealing systems now in service is not possible without disrupting the seals. However, the engineering drawings of each system were examined by NS to evaluate the quality of the designs. A spare manipulator seal tube (the through-the-wall section) was available and was also examined. For the most part, the sealing systems are well designed. Each system provides multiple independent sealing contacts so that more than one seal would have to fail to provide a path for contamination to reach the outside. Those seals directly exposed to Pu-238 or ozone are contained by stainless steel in a compressed configuration that permits direct surface attack on only the exposed edge of the gasket. The stainless steel around the gasket provides significant shielding of the body of the gasket against penetrating radiation. The single exception to the use of redundant seals is the potted epoxy seal around the insulated electrical wire in the end of the electrical through-tube connectors. However, grooves are milled into the inside surface of the tube to "lock in" the epoxy, and epoxy is very resistant to ozone or alpha attack.

The absence of detectable amounts of Pu-238 in samples from the room exhaust header indicates that the seals in the primary containment have not allowed significant contamination to spread into the surrounding gas-purged annulus. As previously described, on February 16, 1988, the ventilation systems went static for 1.75 hours as a result of exhaust fan failure. However, no spread of contamination was subsequently detected in the gas exhausted from the annulus (the most likely escape route) or in any of the surrounding galleries.

7. <u>The Effectiveness of Barriers to Release</u>

The probability of a release could be further reduced by additional measures such as physically isolating penetrations of the hot cell boundaries.

Barriers consisting only of valves can be more easily defeated by either procedural errors or hardware faults (e.g. leaks) than barriers consisting of more positive isolation devices (e.g. blanked flanges). Likewise, physical disconnection of power supplies is a more positive action than tagging out breakers. The present plan for isolation of the argon and other gas systems, as well as the chilled water system, calls for valve closures only. Based on the nature of this plan, scenarios involving inadvertent breach of barrier can be postulated.

8. <u>The Effectiveness of Barriers to Release</u>

External events (seismic or tornado) could result in simultaneous defeat of multiple barriers due to failure of the 293 stack.

A seismic event could produce a higher airborne fraction within the cells while at the same time degrading the capability of the seals to contain the airborne material. Other seismically-induced faults are possible including ventilation failures which would allow degraded seals to be challenged. For example, the failure of the 293 stack (which is no longer operational) could impact the roof of the second floor above the ventilation equipment area producing failures of ventilation filters or fans.

NS concluded in this assessment that, with the exception of failure of the 293 stack, seismic events less than .2g ground acceleration Design Basis Event (DBE) would not be severe enough to cause unrecoverable (within a few hours) ventilation faults. Seismic events of .2g or greater are considered to have radiological consequences. The probability of a DBE has been estimated by the contractor to be less than 2×10^{-4} per year which, when coupled with the anticipated consequences of such an event, would appear to be an acceptable risk.

The 293 stack could also fail from other causes such as tornadoes. Various corrective actions for either Building 235-F or the 293 stack are being considered; however, no final determination as to the appropriate action to be taken has been made. NS recommends that analyses be performed to ensure that damage would not occur if the stack were to impact above the ventilation area above the second floor.

E. <u>Assessment Summary and Recommendations</u>

Any conclusions concerning the hazard profile for PuFF will ultimately have to be based on the outcome of the determination of the Pu-238 inventory in the cells and the quality of the sealing surfaces. If these determinations indicate that the Pu-238 inventory is minimal, and the sealing surfaces are and will continue to be functionally sound, implementation of the recommendations set forth elsewhere in this report will give adequate assurance that the facility can be maintained in a safe condition pending a final decision by the Program Office on the facility's future. The longer the PuFF facility is maintained in its current state, the likelier it is that equipment will further degrade, personnel familiar with the facility will be lost, and the probability of a contamination event will increase. Therefore, a decision on the future of the facility should be made as soon as prudently possible.

IX. CONCLUSION

A combination of factors led to the deterioration of equipment in the hot cells in the PuFF facility. The Program Office contends that funding for Pu-238 programs has been cyclical and uncertain, and the length of the Pu-238 production regime has been longer than the budget process. As a result, firm production requirements were identified and funded too close to the time when the fuel clads were actually needed, and this factor drove the decision to perform only limited decontamination of the process cells in 1984 so that production could be rapidly restarted when needed. Be that as it may, it is clear that the Program Office failed to charge Pu-238 users (NASA and DOD) the true cost for production and decontamination of the PuFF facility as part of the price of undertaking the work. Charging the true cost could have provided the funds necessary for properly maintaining or refurbishing the facility while in standby.

Another factor that contributed to deterioration of PuFF was the DOE-SR and Du Pont concern that restarting PuFF from a shutdown condition might require a new Environmental Impact Statement (EIS). A requirement to perform another EIS would have caused significant delays in the resumption of production.

Because limited decontamination was undertaken, the quantity of highly corrosive Pu-238 remaining in the process cells made preservation of cell equipment difficult under the best of circumstances. The equipment could not be sustained with the minimal maintenance applied to the facility over an extended period. But even if a more complete decontamination of the facility had been contemplated in 1983, the hot cell and master-slave manipulator design of the facility would have made it difficult to decontaminate the facility without dismantling it. Dismantling was inconsistent with the Program Office's belief that new requirements were on the horizon and with its desire to be able to rapidly restart the facility when the requirements arose.

The repeated failure of funded requirements to materialize, contrary to expectations, kept PuFF in a standby mode well beyond what was anticipated or what was prudent under the conditions in which the facility was being maintained. Between 1984 and 1989, in the persistent belief that new requirements were soon forthcoming, no further decontamination of the cells was even contemplated. As the standby mode continued, the Pu-238 program became a progressively lower priority in terms of the resources and funding allocated to it. This precipitated a series of management and staff turnovers in both the Program Office and at the facility, resulting in a lack of program continuity and commitment. In reality, the facility was not being maintained in standby.

With the cancellation of the DIP Program in mid-1987, and the increased emphasis on the weapons program at SRS, a mindset developed that the facility would never operate again. This further contributed to deterioration of the facility. As manifested by the problems with the argon system, the maintenance program designed to preserve the essential equipment became less effective and no effort was being exerted to do anything beyond maintaining the most essential safety systems. NS concludes that the argon system was, in fact, an essential safety system, and that the contractor's failure to maintain it reflects the extent to which management had "walked away" from the facility. Our conclusions with respect to the argon system are based in part on the likelihood that decontamination of the facility will result in higher exposures to workers than would otherwise have been the case if the argon system had been properly maintained. By the time the decision was made not to repair the argon system in April 1989, the facility had already experienced extensive deterioration. This decision had practically no adverse impact on the condition of the facility, but only because the facility had been without argon for extended periods during the previous six (6) years.

The PuFF experience demonstrates the high cost of management's failure to plan and budget for realistic contingencies, including, as in this case, the possibility that demand for new production might not materialize for an extended period of time. Not only did management fail to plan for realistic contingencies, but when these contingencies in fact occurred, they took no immediate action. Early on, DOE (through the Office of Nuclear Energy) failed to analyze how long the PuFF facility could remain in standby before action would have to be taken to decontaminate the facility, in order to avoid large and unnecessary costs (in dollars and in man-rem) to the Department at a later date. It also did not demand that customers of the PuFF facility pay the cost to decontaminate (not to mention decommission) the facility as part of the basic cost of obtaining its products. The PuFF experience demonstrates the validity of and necessity for strict line management responsibility for DOE facilities as espoused by Secretary Watkins.

APPENDIX A

CONDUCT OF THE INVESTIGATION

The Office of Nuclear Safety (NS) began this investigation on April 4, 1991. During the initial phase of the investigation, NS received a briefing from the Office of Nuclear Energy regarding the status of the facility, conducted preliminary background interviews, and began identifying, collecting, and analyzing relevant documents. As the investigation progressed, it became apparent that there were a multitude of factors and circumstances which ultimately led to the deteriorated condition of the PuFF facility. Therefore, the scope of the investigation was broadened in order to more fully identify and evaluate those factors. In conjunction with the investigation, the NS Performance Assessment Division conducted a technical assessment of the current status of the facility.

By July 16, 1991, when the NS field investigation ended, hundreds of documents had been collected and numerous individuals had been interviewed. The individuals interviewed during the investigation included present and former employees of the Office of Nuclear Energy, DOE-Savannah River, and the two M&O contractors. The salient details of those interviews are set forth in the body of the report.

The NS investigation and technical assessment were conducted by:

R. K. Christopher	Deputy Director, NS Enforcement Division
W. Weaver	Nuclear Engineer, NS Performance Assessment Division
G. Toomey	EA Engineering, Inc., Consultant to NS
E. Wheelwright	Pacific Northwest Laboratory, Consultant to NS

APPENDIX B

LIST OF INTERVIEWEES

Name	Affiliation
G. Albert	Westinghouse Savannah River Corporation
W. Amos	EG&G, Mound
G. Bennett	National Aeronautics and Space Administration; formerly, Department of Energy, Office of Nuclear Energy
D. Bickford	Westinghouse Savannah River Corporation
J. Brown	Westinghouse Savannah River Corporation
J. Buckner	Westinghouse Savannah River Corporation
R. Carpenter	Fairchild Space
B. Cook	Department of Energy, Office of Nuclear Energy
W. Davis	Westinghouse Savannah River Corporation
J. Dickinson	Westinghouse Savannah River Corporation
M. Eck	Fairchild Space
S. Goldston	Westinghouse Savannah River Corporation; formerly, Department of Energy, Savannah River
R. Goetzman	Westinghouse Savannah River Corporation
J. Griffo	Formerly of Department of Energy, Office of Nuclear Energy
E. Johnson	Formerly, Monsanto, Inc., Mound
J. Klansek	Department of Energy, Office of Nuclear Energy
S. Lanes	Department of Energy, Office of Nuclear Energy
J. Lombardo	Formerly of Department of Energy, Office of Nuclear Energy
E. Mastel	Department of Energy, Office of Nuclear Energy
J. McDougal	EG&G, Mound
J. McKibben	Westinghouse Savannah River Corporation
A. Mehner	Department of Energy, Office of Nuclear Energy
G. Nichols	Department of Energy, Savannah River
M. O'Rear	Department of Energy, Savannah River
D. Pyatt	Department of Energy, Office of Nuclear Safety
W. Richardson	Department of Energy, Savannah River
G. Rinehart	Los Alamos National Laboratory
B. Rock	Department of Energy, Office of Nuclear Energy
J. Scarborough	Westinghouse Savannah River Corporation
A. Shock	Fairchild Space
D. Spiker	Westinghouse Savannah River Corporation
J. Turi	Department of Energy, Office of Nuclear Energy
R. Williams	Department of Energy, Office of Nuclear Energy
R. Yourchak	Westinghouse Savannah River Corporation

Note: Many of the interviewees listed above were first employed by either DOE or E.I. Du Pont and later by the Westinghouse Savannah River Company. Individuals are listed here according to their current affiliation.

EXHIBITS

1. Relevant Sections of PuFF Scope of Work, October 1973
2. Multiwatt GPHS History
3. Memo: Goldberg to Cochran, May 5, 1983
4. Letter: Halstead to Goldberg, July 28, 1983
5. Letter: Goldberg to Chipman, August 23, 1983
6. Memo: Bernard Rock to Denise, September 21, 1983
7. Letter: Goldberg to Chipman, October 28, 1983
8. Draft Memo: Bernard Rock to Denise, November 8, 1983
9. Letter: Garvin to Clemens, December 20, 1983
10. Letter: Goldberg to Bernard Rock, January 13, 1984
11. Report on Review of PuFF Status, December 19, 1984
12. PuFF Monthly Operation Checksheet
13. Overview of PuFF Maintenance Plan
14. Letter: Sires to Granaghan, October 10, 1985
15. Letter: Maher to Sires, November 19, 1985
16. Letter: Wade to Vaughn, Undated
17. Argon System Operating History
18. Savannah River Laboratories PuFF Evaluation
19. Memo: Randy Yourchak to Files, July 3, 1991

REFERENCES

1. F-Area Map and Building Design Layout
2. Relevant Sections of PuFF Safety Analysis Report
3. Sequential Steps in Fuel Clad Production Process
4. Layout of First Level of PuFF
5. Cross Section of Typical Cell
6. Monthly Activity Reports, November 1-30, 1983, and December 1-31, 1983
7. Building 235-F HR Flow Display
8. Building 235-F Regulated Ventilation Exhaust Flow Diagram
9. PuFF Cell Argon Gas Ventilation System
10. PuFF Air Atmosphere Ventilation Systems

EXHIBIT 1

J. T. Buckner

CC: K. W. French - J. K. Lower
J. E. Conaway - W. J. Mottel
P. R. Moore - A. S. Messick
J. L. Womack
R. J. Bass
E. B. Sheldon - R. I. Martens
R. F. Rogers
J. T. Buckner
H. A. McClearen
J. S. Murdock
C. H. Ice - L. H. Meyer
H. J. Groh - J. A. Porter
S. Mirshak - R. T. Huntoon
P. K. Smith
M. L. Hyder

October 8, 1973

A. J. SCHWERTFEGER, MANAGER
PROCESS SECTION
MANUFACTURING DIVISION - AED
WILMINGTON

ATTENTION: J. F. PROCTOR - A. A. KISHBAUGH (8)

SAVANNAH RIVER PLANT
BUILDING 235-F
^{238}Pu FUEL FORMS FABRICATION FACILITY
REVISED SCOPE OF WORK FOR ENCAPSULATION
OF PPO FUEL FORM

Attached is the revised scope of work for subject facility (second issued dated September 13, 1971) to expand capability to include encapsulation of the pure plutonium oxide (PPO) fuel form in an iridium shell.

K. W. FRENCH, PLANT MANAGER

A. S. Messick

A. S. Messick
200 Area Design Liaison Coordinator

ASM:rvd
Attach.

SCOPE OF WORK

REVISION II

Pu-238 FUEL FORM FABRICATION FACILITY

BUILDING 235-F

A. S. Messick

J. T. Buckner

M. L. Latimer

R. J. Bass

R. A. Brownback

W. D. Jones

September 1973

(Revised: October 8, 1973)

TABLE OF CONTENTS

FIGURES & TABLES

I. INTRODUCTION

The Savannah River Plant was advised on September 14, 1971, of the AEC's decision to transfer plutonium molybdenum cermet (PMC) fuel form preparation to SRP. Since that time, the scope of the ^{238}Pu fuel form (PuFF) facility has grown to include fabrication of pure plutonium oxide (PPO) spheres (August 10, 1972) and, most recently, the iridium encapsulation of the PPO spheres (August 24, 1973). This facility will be located in Manufacturing Building 235-F and will be capable of producing either fuel form with a rated capacity of 30 kilograms ^{238}Pu per year (10 shifts/week) and a sprint capacity of 60 kilograms ^{238}Pu per year (21 shifts/week).

The following scope of work is an updating of the previous scope (September 13, 1972) to be used by the Engineering Department for preparing a Construction Cost Estimate (CCE). This scope of work includes additional facilities for encapsulation of the PPO spheres in iridium.

II. SUMMARY

The facility described in this scope of work will be capable of producing plutonium molybdenum cermet discs and pure plutonium oxide spheres for heat sources in radioisotopic thermoelectric generators. The PMC discs will be about two inches in diameter and 0.2 inches thick, and the PPO spheres about 1.5 inches in diameter. In addition to the production of discs and spheres, the facility provides for iridium encapsulation of the PPO spheres and a cell for dismantling of encapsulated heat source assemblies (equipment not included).

Shielded process cells and wing cabinets will be built on the first floor of Building 235-F, with auxiliary facilities, such as vacuum pumps, inert gas purifiers, hydraulic pumps, motor generator, etc., located on the second floor. In general, the processing operation will be performed with manipulators through the front of the shielded process cells. Shielded wing cabinets, joined to the back of the process cells, will house the major pieces of processing equipment and contain entry - exit ports for material transfer. Although the facilities are designed for manipulator work, some hand assists through the back of the cells are anticipated. The hand assist is deemed acceptable and practical for operations that are not time-consuming and would otherwise require complex equipment - which would be space-consuming and difficult to service and maintain.

Shielding of process cells has been designed to limit personnel exposure to 0.5 mrem/hr in continuously occupied areas. In areas not continuously occupied, a somewhat higher exposure level (5 mrem/hr) will be permitted.

Design includes fire detection and Halon suppression systems consistent with normal engineering practice for similar installations.

No plutonium recovery or manipulator repair is planned for the facility. All plutonium recovery operations will be performed in the HB-Line. Manipulator repair will be done in Building 779-A.

IV. EQUIPMENT DESCRIPTION

CONTAINMENT BOXES

Wing Cabinets

All shielded wing cabinets are to be gas-tight for use with inert atmospheres. The maximum leakage rate should not exceed 0.02 cubic feet per hour per 100 cubic foot volume at a differential pressure of 2" W.C. The boxes will be constructed of stainless steel, Type 304L.

Wing cabinets shall be equipped with a transfer lock with bag port and provision for changing the lock atmosphere as a means for introducing and removing equipment and material. Wing cabinet windows and interior lighting should be designed to provide good visibility and illumination.

Manipulator Cells

All cells are to be designed for use with inert atmospheres. The maximum leakage rate should not exceed 0.02 cubic feet ~~foot~~ per hour per 100 cubic foot volume at a differential pressure of 2" W.C. As required, cells should be provided with a crane or hoist for moving large equipment. Boxes should be stainless steel, Type 304L.

Cells should have a floor height of about 3 feet, inside height of 7 feet, and inside depth of 5 feet. Lengths of the first eight cells are as shown on Drawing W-448422; Cell 9 shall be approximately 9 feet long. The maintenance side of each cell shall have glove ports located between the wing cabinets for maintenance of in-cell equipment. Windows are to be installed on both the operating side and maintenance side. Lights should be selected and located to provide good illumination. All cells will be connected by evacuable transfer locks.

SHIELDING

Wing Cabinets

The sides, end, top and bottom of wing cabinets will be provided with shielding of 4" of water and 1/2" of lead on the outside. Window shielding will be equivalent to 4" of water with 1" lead glass (6.2 g/cc) on the outside.

Manipulator Cells (Figure IV-1)

Shielding for the front of the manipulator cells will consist of 21" of limonite concrete. Window shielding will be the equivalent of 18" of water with 1" lead glass (6.2 g/cc) on the outside.

The back of the cells will have 14.5" of limonite concrete. Areas between wing cabinets will have hinged shields covering glove ports and viewing windows. Glove ports will have water-filled plugs when not in use. Window shielding will be equivalent to 4" of water with 1" of lead glass (6.2 g/cc) on the outside. The hinged carbon steel shield is filled with 6" of water and can be opened for access to the glove ports and the working space below and above the cells. This will provide 10" of water plus 1/2" lead shielding for normal operation and 4" water plus 1" lead glass shielding when working through the glove ports.

Front and rear shielding shall extend from the floor to the top of the cell. The top of the cells will be shielded with 4" of limonite concrete, and the front shield wall from the top of the cell to the ceiling will be at least 5" of limonite concrete.

Shielding is required for Plutonium-238 storage areas. For in-cell storage areas of up to 1500 grams of 80% $^{238}Pu\ ^{16}O_2$, shielding equivalent to 4" of water is required around the perimeter of the storage sleeve array. Each storage sleeve shall be plugged with the equivalent of 4" of water. Shielding requirements for the storage area in Cell 2, where up to 6000 grams may be stored, are 1/2" lead and 6" water.

MANIPULATORS

Double-booted, Model L, sealed manipulators will be used for all inert cells. The vendor's leakage rate is less than 5 cubic inches per day at a differential pressure of 3" W.C. Single-booted, Model G, sealed manipulators will be used for all air atmosphere cells.

All manipulators will be mounted at a centerline height of about 8 feet from the floor. No repair facility need be provided; manipulators will be bagged and transferred to Building 779-A for repair.

OPERATING STATIONS (FIGURE IV-2)

1. Entry Removal Hood

The standard SRP shipping - storage cask (DOT 5320) for Pu-238 use will be used to transport feed material (PuO_2) from HB-Line to the Fuel Form Fabrication Facility. A shielded hood should be provided for receipt and final decontamination of the outer container (Drawing D-138580) (DPSPU 67-30-9). Since the container is designed for reuse, final decontamination from levels of 50,000 d/m/square foot must be performed prior to removal from the hood. A 10" - 12" bag port located in the floor of the cabinet is required for removal and disposal of contaminated wipes. All surfaces of the hood should be smooth for ease of decontamination. The back of the hood should be provided with a shielded door through which the containers are passed into the adjacent glove box.

The hood exhaust should provide an air flow of 200 feet/minute through the hand openings. (It is common practice in SRP facilities to use a hood as the process room exhaust.)

EXHIBIT 2

Multi-Hundred Watt / GPHS History

10 / 73	PuFF Construction Started
7 / 77	Pu-238 Oxide Introduced into PuFF Cells
10 / 78	Multi-Hundred Watt Production Began
4 / 80	Galileo / Ulysses GPHS Production Began
11 / 83	Final GPHS Pellet Fabricated
2 / 84	Final Shipment of GPHS Fueled Clads to Mound Facility
3 / 84	Building 235-F at Minimum Staffing (1 supv and 2 operators)
1986	Some "Interest" in SDI - No Staffing or S / U Preparations
2/87	Dedicated Building Sandfilter Operational
7 / 87	PEF Renovation Began for Direct Fab Development (Minimum Staffing)
4 / 89	Some Staffing Added for <u>Building</u> Improvements
2 / 90	Decision to Fab CRAF / Cassini GPHS Pellets in PuFF
11 / 90	Decision to Use LANL for CRAF / Cassini GPHS Fabrication (No Mission for PuFF)
2 / 91	Building 235-F at Minimum Staffing Level

EXHIBIT 3

~~03251~~

03291

MAY 5 1983

R. W. Cochran, Director
Office of Nuclear Materials
  Production, HQ (DP-13)

PLUTONIUM-238 PROGRAM RE-EVALUATION (REF. MEMO, HEUSSER-ONMP TO HALSTED-SR ET.AL., JANUARY 28, 1983)

The referenced memorandum transmitted a listing of agreements and commitments from the January 27, 1983 meeting at Germantown regarding Savannah River's plutonium-238 program re-evaluation. This memorandum provides SR's response to Items 3, 4, and 5 (Attachment I).

Three cases based on the updated forecast provided by ONMP (Attachment II) were evaluated by SR and Du Pont to determine the optimum operation of PuFF and HB line and the potential for processing Pu-239 through the replacement HB line. The three cases evaluated were (1) base case (2) no Saturn mission, and (3) a one-year delay in each mission. The Du Pont evaluation of these cases including costs is attached for your review.

For Case 1, we would plan on a campaign operation for PuFF and the neptunium-237 billet line utilizing the same persons for each operation. This would allow a reduction of approximately twelve persons in 235-F and would have the advantage of maintaining both a stable workforce and the Pu-238 facilities' capabilities. Also, the demand for Pu-238 is sufficiently low that Pu-239 oxide could be produced for six months a year on a one shift basis to yield up to an additional 265 kgs to the system beginning in FY 1985. Four shift operation could yield 540 kgs.

In Cases 2 and 3, we would extend the current campaign in PuFF for two months beyond the planned completion date of December 1983 and produce an additional 28 fuel clads. This would meet the PuFF requirements for FY 1984 and FY 1985. The facility would be placed on standby beginning in March 1984 and reactivated when firm program requirements are forthcoming. If the facility remains down through FY 1985, approximately one year would be required to provide the feed material and restart PuFF. LANL requirements for 83.5% Pu-238 would be met from existing inventory.

During the PuFF standby operation, the replacement HB line would be available almost entirely for Pu-239 oxide production. If available, up to 530 kgs of fast Pu-239 oxide per year could be produced on a one shift basis in the replacement HB line beginning in FY 1985. Four shift production could yield 1080 kgs. These throughputs of Pu-239 oxide assume fast material; slow material would yield about one-half these totals.

While SR supports maintaining the Pu-238 capability for DOE and providing fuel clads as needed for authorized programs, we do not feel it is in DOE's best interest to produce fuel clads for which there are no authorized programs. Once contaminated, the iridium cladding is lost to the system and substantial costs are incurred for Pu-238 recycle of material that has no use and must be returned to SR. We therefore propose that the FY 1984 and FY 1985 NASA programs be resolved as soon as possible so that proper planning at SR may proceed. We would hope for a response by June 15, 1983.

Further, in order to provide a CAB cost estimate for the modifications necessary to the replacement HB line for Pu-239 oxide production, we will require $200K and six months for the required engineering studies. High spot capital cost estimates are approximately $2 million for conversion to handle 6% Pu-240 feed, $5-$15 million for 12% Pu-240 feed and $30-$50 million for LIS (20% Pu-240) feed.

SR endorses the utilization of the replacement HB line for additional Pu-239 oxide production. The additional capacity could provide increased flexibility and support for DOE's programs in the near future. Also, Pu-239 scrap declared to the OSMC is increasing. We expect declarations totaling fully 60% of the FY 1982 inventory to be sent to OSMC for evaluation in FY 1983. SR feels it is in the best interest of DOE to process this material as quickly as possible rather than store it at several DOE sites until processing services can be made available. We will discuss this with you further at the May 10-11, 1983 Budget Review at SR.

Any questions your staff may have should be directed to M. G. O'Rear, FTS 239-[illegible], of my staff.

E. S. Goldberg
Assistant Manager
for Operations

OWS:MGO'R:[illegible]

2 Attachments

cc w/attachments:
G. L. Chipman, DOE-HQ (NE-50)
J. E. Bickel, DOE-AL

EXHIBIT 4

112... 10-2 9/8

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29801

JUL 2 8 1983

E. S. Goldberg
Assistant Manager for Operations

PUFF OPERATIONS FY 1984 AND BEYOND (REF: MEMO, GOLDBERG/COCHRAN DATED MAY 5, 1983, PLUTONIUM -238 PROGRAM RE-EVALUATION)

The referenced memorandum requested ONMP guidance by June 15, 1983 concerning the need to supply PuFF with Pu-238 in FY 1984 and FY 1985. As yet, SR has received no guidance.

Currently, there are still no identified programs which would require GPHS fuel clads in FY 1984 and FY 1985. Further correspondence between NASA and DOE has confirmed this (attached).

Savannah River has documented our position that it is not in the best interest of DOE to produce fuel clads for which there are no authorized programs. Once contaminated, the iridium cladding is lost to the system and substantial costs are increased for recycle of Pu-238 that has no defined use. Therefore, we would plan to place PuFF in standby in FY 1984 and restart when we are notified there are authorized programs. We request your assistance in reopening this issue with R. W. Cochran, ONMP-HQ. Du Pont has indicated they need to know what the PuFF program will be so that proper staffing planning can be done. We expect Du Pont to reopen this issue with us very soon.

Please call if we may provide additional information.

C. G. Halsted

C. G. Halsted, Director
Process and Weapons Division

OWS:MGO'R:sah

4 Attachments:
Ltr., dated 4/22/83, Kerrebrock/Brewer
Ltr., dated 5/19/83, Brewer/Kerrebrock
Ltr., dated 5/5/83, Goldberg/Cochran
Ltr., dated 4/14/83, Peters/Goldberg

EXHIBIT 5

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29801

AUG 2 3 1983

G. L. Chipman, Jr., Deputy Assistant Secretary
for Breeder Reactor Programs, HQ (NE-50)

PUFF OPERATIONS FOR FY 1984 AND BEYOND (REF: MEMO GOLDBERG/COCHRAN, CC: CHIPMAN, DATED MAY 5, 1983, PLUTONIUM-238 PROGRAM RE-EVALUATION)

The referenced memorandum requested the FY 1984 and FY 1985 NASA programs be resolved as soon as possible so that proper planning at Savannah River (SR) for PuFF operations may proceed. Subsequent to the above request, we were provided the correspondence between NASA and DOE which states that the Solar System Exploration Committee has not recommended any missions over the next five years that would require radioisotopic heat sources (attached). However NASA did state there were discussions underway to be resolved by January 1984 about a possible follow-on to the Galileo mission that could be launched in the next five years and would require radioisotopic heat sources.

Based on the above information, we would plan to implement the option described in the referenced memorandum which would extend the current 14 fueled clads per month campaign for two months beyond the planned completion date of December 1983. The facility would then be placed in standby in March 1984 and reactivated when firm program requirements are forthcoming. The 28 additional fueled clads produced in January and February could be used for research and testing programs. If a follow-on to Galileo was approved in January 1984, and fueled clads were required immediately, operations could be continued in PuFF with little or no delay. Otherwise, once the facility has been in standby for more than a few months, restart would take up to one year after funding has been authorized.

Current Nuclear Energy (NE) guidance is to produce 14 fueled clads per month through December 1983 and then continue in a maintenance mode producing four fueled clads per month through FY 1985. NE has stated this will preserve the capability to produce heat sources and that it is expected that all of the fueled clads will eventually be used.

2985
G. Chipman

While SR supports maintaining the Pu-238 capability for DOE and providing fueled clads as needed for authorized programs, we do not feel it is in DOE's best interest to produce fueled clads for which there are no authorized programs. At SR, once fueled clads are produced, the iridium cladding is lost to the system because it is contaminated. Also, substantial costs are incurred for storage and recycle of Pu-238 that has no use and must be returned to SR.

Therefore, it is economically undesirable for DOE to produce fueled clads when there are no firm programs. The cost savings realized from placing PuFF in standby ($2,425K) can be transferred to conduct development activities at other sites or to fund preproduction of iridium and converter hardware. This would maintain the heat source capability of DOE and possibly provide improvements. Table I details the cost savings to NE for SR planned operation versus the current NE guidance.

We would appreciate your response to SR's planned operation of PuFF for FY 1984 and FY 1985 by September 15, 1983. Any questions your staff may have should be directed to M. G. O'Rear, FTS 239-3777, of my staff.

E. S. Goldberg
Assistant Manager
for Operations

OWS:MGO'R:sah

2 Attachments:
Ltr., Kerrebrock/Brewer dated 4/22/83
Table I

cc w/attachments:
R. W. Cochran, HQ (DP-13)

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

ATTACHMENT 1

Attn of

RTS-6

APR 22 1983

Dr. Shelby T. Brewer
Assistant Secretary for
Nuclear Energy
Department of Energy
Washington, DC 20585

Dear Dr. Brewer:

Thank you for your letter of 25 February 1983, advising us of the availability of three multihundred watt(e) converters and three plutonium-238 heat sources. Based on our current approved plans, NASA has no mission requiring the above items.

With regard to the future, our best thinking in this area is based on the recommendations of the Solar System Exploration Committee. Some of the missions they foresee to be flown before the year 2000 do have requirements for Radioisotope Thermoelectric Generators, hence a need for radioisotope heat sources. There are no missions recommended, however, that would require them in the next five years.

Notwithstanding the above, there are discussions underway about a possible follow-on to the Galileo mission. Missions under consideration would be launched during your five year period under consideration. These missions can be characterized in two classes:

1. Probe only missions to Titan;

2. Saturn orbiter missions with or without Titan Probe.

If either of these mission types were to be selected and approved either the MHWs in the case of probe only missions or two Galileo type GPHS RTGs for orbiter related missions would be required. In light of this fact, we suggest that you delay any consideration of recyling MHW fuels until January 1984.

To M. 5/6/83

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25th Anniversary
1958-1983

Should our forecasts change we will advise you immediately as we depend on the Department of Energy's capabilities in the production of nuclear fuels.

Sincerely,

Jack L Kerrebrock

Jack L. Kerrebrock
Associate Administrator for
Aeronautics and Space Technology

TABLE I
(\$ THOUSANDS)

	SR PLANNED OPERATION	NE GUIDANCE[1/]	COST SAVINGS
FY 1984	\$4,920	\$7,345	\$2,425

1. Current funds identified by NE in President's Budget is \$7,120K.

EXHIBIT 6

U.S. DEPARTMENT OF ENERGY

memorandum

DATE September 21, 1983

REPLY TO ATTN OF NE-55

SUBJECT Program and Budget Planning Guidance for the Office of Special Nuclear Projects' Activities at Savannah River for FY 1984 through FY 1986

TO R. P. Denise, Acting Manager
Savannah River Operations Office

Reference: Memorandum, E. S. Goldberg to G. L. Chipman, Jr., "PuFF Operations for FY 1984 and Beyond," dated August 23, 1983

1. Plutonium Fuel Form Facility (PuFF) Operations for FY 1984 and Beyond (Ref. Memo Goldberg/Chipman, dated August 23, 1983)

The referenced memorandum states that Savannah River Operations Office plans to extend the current 14 fueled clads per month campaign through February 1984 then place the facility on standby. Choice of this option appears to have been made principally on the uncertain status of National Aeronautics and Space Administration (NASA) programs after the Galileo and the International Solar Polar Mission (ISPM). While the NASA space missions do introduce some uncertainty, at this time, there are forthcoming specialized terrestrial applications which are equally important for consideration in planning fueled clad production through FY 1986. The Department of Defense (DOD) interest in Plutonium-238 fueled units has increased in the past year to the extent that part or all of the following requirements are expected to be forthcoming in the next several months.

RTG	RTG Units	FC Units	Delivery Years
Additional 5-Watt	6	12	1985-1986
One-Watt RTG	20	20	1986-1987
Upgraded Mod 3	4	192	1986-1987

In addition to the requirements cited above, the Office of Special Nuclear Projects (OSNP) is proceeding with a Congressionally approved development program starting in FY 1984 for a modular version of a special applications RTG. Fueled clads will be required for initial qualification testing in FY 1985. The outcome of this development program will be directly applicable to the one-watt RTG program.

In addition to these requirements, the Department is embarking upon a Congressionally approved program to develop a new, lighter, more efficient generator (the Modular Radioisotope Thermoelectric Generator or MOD-RTG). A contract is planned to be negotiated in the very near future to design and develop the MOD-RTG. The engineering development program is planned to be completed in FY 1986 and the Department plans to test a qualification MOD-RTG in FY 1988. Sufficient fueled clads will be needed in 1986-1987 from Savannah River (SR) to enable Mound to build 12 General Purpose Heat Source (GPHS) modules plus two spares. The objective of the MOD-RTG program is to be ready for flight in 1989/1990.

In parallel with the MOD-RTG development, the OSNP is initiating an iridium improvement program at the Oak Ridge National Laboratory (ORNL). It is anticipated that at least eight fueled clads will have to be assembled from the new material in late FY 1984 or early FY 1985 to qualify the material for flight. OSNP also plans a safety improvement program with the GPHS modules. This program will start in FY 1985 when the Los Alamos National Laboratory (LANL) completes its current flight safety testing. The details of the program will be defined in FY 1985 but it is expected that at least 30 fueled clads will be needed to select and qualify the improved GPHS design features.

Based on the above additional considerations, it is our conclusion that to place the PuFF facility on standby in March 1984 would seriously jeopardize our ability to meet forthcoming NASA and DOD requirements even though all of them may not materialize. The following guidance provides the absolute minimum production needed to preserve the ability to meet our most conservative estimate of requirements.

2. <u>General Guidance</u>

Based on the position stated above, activities at SR for FY 1984 and extending through FY 1986 should be directed toward continued production and encapsulation of the GPHS fuel at PuFF. The Savannah River Plant (SRP) should plan to complete the fueled clad production commitment for the Galileo and the ISPM during the first quarter of FY 1984. Subsequently, the production of flight quality GPHS fueled clads (FC's) should be reduced to a level of four (4) fueled clads per month, starting in January 1984. This production rate should meet the needs of space and terrestrial programs through FY 1986 while maintaining a capability to resume the current production rate for future missions. Defined DOE/SR production procedures and specifications should be maintained (revised as necessary to include approved changes) to assure Government acceptance and delivery of FC's to the Mound Plant (MP) as Government furnished equipment (GFE). This is in accordance with the Interface Working Agreement for Encapsulated Plutonium-238 Fuel Form Production dated August 1980, as amended. DOE/SR should continue to sign for the final product so it is accepted as GFE at MP, DOE/AL, and DOE/DAO. In this regard, DOE/SR should make sure that it is certifying product to the latest criteria approved by DOE/OSNP. Technical support for fuel form production and encapsulation activities should continue to be provided by the Savannah River Laboratory (SRL) in FY 1984 through FY 1986. Coordination of both plant and laboratory activities should be continued with other Government laboratories and system contractors as necessary to support RTG system design and heat source certification.

SRP should continue to interface with the OSNP lead heat source laboratory, MP, to meet overall heat source requirements, and to provide fuel production details as needed and SRP schedular input into the overall Mound integrated production schedule. The following guidance on program, schedule, and budget is provided to assist in planning SR program activities through FY 1986.

3. Production for Galileo/ISPM

SR should continue to fabricate flight quality GPHS fuel pellets (nominal 62.5 watts) and encapsulated FC's at a rate to complete fuel clad production for the Galileo and ISPM programs during the first quarter of FY 1984. Final shipment of these units to MP should be completed by January 1984. SRP should continue to maintain backup options in case of hardware breakdowns and/or material shortages. The thermal loadings of the fuel should be sufficient to meet the GE total heat source requirement to support the Galileo spacecraft and ISPM launches, both to take place in the May/June 1986 period.

4. Analytical Services

Analytical services should be readily accessible to measure and control impurity levels in the $^{238}PuO_2$ GPHS fuel, PuFF gases, and welding gases to within the specification limits. Support groups should be available, as necessary, to ensure system maintenance is provided as required to sustain required production levels in the PuFF facility. Critical spare components for production equipment should be retained as ready replacements on needed occasions.

5. GPHS Fueled Clads for Future Space/Terrestrial Programs

SR should continue production of GPHS flight quality fueled clads at a rate of four (4) per month in accordance with the system accepted GPHS fueled clad specifications and conditions necessary for delivery to MP as a GFE product. Fueled clads having a weld Non-Destructive Evaluation (NDE) value of greater than eight (8) should continue to be dispositioned by a Material Review Board (MRB) to permit consideration for terrestrial programs, and special applications. In particular, SRP should plan to conduct fuel form production and encapsulation activities at a pace required to ensure the continued operational readiness status of the PuFF facility, including a minimum core of trained operators to sustain scheduled production activities, and permit resumption of the full normal production level of fourteen (14) fueled clads per month within a 1-year period following notification from OSNP.

6. Development Activities (within funding restraints)

6.1 General

SRL should continue to provide, as required, direct and near-term support for fuel form production in the PuFF facility, including evaluation of processes and hardware, some characterization of PuFF GPHS materials, and assistance in resolving any production problems.

6.2 Helium Aging Studies

Helium aging studies, fuel fabrication and testing activities should be coordinated with other Government laboratories (e.g., MP, LANL, ORNL) as necessary to preclude duplication of efforts.

6.3 Fuel Process Improvements

SRL should direct efforts toward completing the direct fabrication feed process flowsheet and related improvements for GPHS fuel form production. These efforts should include establishing manufacturing process limits and initiating fuel qualification testing at LANL.

6.4 Safety Analyses

SRL should continue to provide safety analyses pertaining to the PuFF fuel production operation.

6.5 Assistance and Consultation

SRL should continue to provide assistance and consultation to DOE/OSNP in engineering and technical areas related to heat source materials, design, and converter interfaces.

7. Scrap Recovery

SR should continue to receive and disassemble scrap items containing Pu-238 in various forms as will be occasionally defined through standard scrap declaration forms. Plans should include removal of fuel from returned units, appropriate storage, or preparation for immediate reprocessing. Such activities should be technically documented to an appropriate level of archival detail. Disassembly and fuel reprocessing should not interfere with priority mission-related activities.

8. Storage of Contaminated Noble Metals

SR should continue storage of contaminated platinum and iridium metals pending availability of decontamination services via ORNL.

DuPont should continue to discharge its fuel form and encapsulation production functions consistent with this program letter and MP Integrated Master Schedule. DuPont should integrate its production work with Mound and continue to be responsive to Mound's role as the lead heat source laboratory. For planning purposes, the following funding estimates, which are subject to Congressional appropriations and OMB apportionment, are provided as guidance in supporting the program requirements.

Funding (In Thousands)

	FY 1984 BA	FY 1984 BO	FY 1985 BA	FY 1985 BO
AE 20-10-05				
Operating--SRP	6,620	6,620	4,000	4,000
SRL	500	500	500	500
35 AE 20-10				
Capital Equipment	500	500	500	500

In support of the budget cycle, the above planning estimates have been established prior to receiving detailed estimates. The SR budget plan should be presented in B/A and B/O cost estimates. Identification of operating and capital equipment estimated expenditures should be made through FY 1986. Task proposals should be submitted by December 1, 1983, using the Work Package Proposal and Authorization System (WPAS), including a breakout of procurement, person-years (subdivided by numbers of operators, technicians, engineers, health physicists, QA support, managers, or equivalent breakout), equipment (ranked by priority), and other major tasks. It is emphasized that SR must provide a detailed justification for its budget requests.

Original signed by
Bernard J. Rock
B. J. Rock, Director
Office of Special Nuclear Projects
Office of Nuclear Energy

cc:
L. Whitlaw, Budget Div., SRO
R. W. Cochran, DP-13

Dist:
Subject
OSNP rdr
NE-73 (4)
Griffo rdr
Bennett
Lombardo
Rock
Hurlebaus
Goch
NE-55:J. Griffo:jal:353-3997:08/24/83 (WP #83-658)
Retyped: NE-55:JGriffo:cw:X3997:09/30/83 (WP)
Rewritten:NE-55:JGriffo:hy:X3997:09/07/83 (WP)
Rewritten:NE-55:JGriffo:hy:353-3997:09/12/83 (WP)

*Previous Coordination Valid

CONCURRENCES

RTG SYMBOL	INITIALS/SIG.	DATE
NE-55	Griffo	9/1 /83
NE-55	Bennett	9/10/83
NE-55	Lombardo	9/16/83
NE-55	Rock	9/16/83
*NE-50	Goch	9/ /83
*NE-50	Hurlebaus	9/ /83
NE-50	Dahlquist	9/22/83
		9/21/83

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EXHIBIT 7

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29801

OCT 28 1983

Gordon L. Chipman, Jr.
Deputy Assistant Secretary
for Breeder Reactor Programs, HQ (NE-50)

OPERATION OF PLUTONIUM-238 FUEL FORM FACILITY (PuFF)

We have determined that GPHS fueled clads (FC) scheduled to be completed through December 1983 will provide sufficient hardware to meet firm Office of Special Nuclear Projects (OSNP) requirements. Current budget guidance from OSNP requests Savannah River to operate PuFF to produce four FC/month from January 1984 through FY 1985. We believe that continued operation in this mode is not warranted and, therefore, propose as an alternative that PuFF be placed in ready (active) standby enabling restart after future firm requirements are established. Budgetary and manpower constraints make it essential that we have concurrence on this matter as soon as possible.

The attached paper presents our recommendation on this issue. To summarize, continuing PuFF production at the four FC/month rate from March 1984 (as shown in the latest GPHS integrated master schedule) through FY 1986 rather than placing it in standby as of January 1, 1984 will:

1. result in an unnecessary expenditure of $10 million,

2. result in production of unneeded and perhaps unuseable FC which will have to be stored and later recovered as scrap; and

3. will require an additional $3 million over currently budgeted funds to permit continued four/month operation beyond February 1985.

I have been assured by Du Pont management that production restart can be attained in PuFF within the one-year lead time required to produce additional plutonium-238 fuel material. It should be noted that this material production lead time will be required in either the ready standby or the four/month case. During ready (active) standby, Savannah River will ensure that all equipment in PuFF is exercised on a regular basis so that production readiness is maintained and that significant cost increases will not be incurred when startup occurs. Spare equipment can be made available to Los Alamos to enable production of any developmental fueled clads required during this period of standby operation at Savannah River.

We, therefore, request that program guidance be provided to operate in the specified standby manner. It should be understood that we are fully committed to continued support of the space isotope power program and will operate as required within the funding provided.

E. S. Goldberg

E. S. Goldberg
Assistant Manager
for Operations

OWS:GMN:sah

Attachment

cc w/attach:
F. C. Gilbert, ONM, HQ (DP-10)
R. W. Cochran, ONM, HQ (DP-13)

ATTACHMENT

SR POSITION: CURRENT PLUS NEAR TERM PRODUCTION OF FUELED CLADS MEETS REQUIREMENTS

Total Fueled Clads Received at Mound Through September 30, 1983		452
Current Requirements		
Q-1	80	
F-1	76	
F-2	76	
Five-Watt	8	
A/S Leakers	12	
Leakers to SRP	6	
Leakers to LANL	4	
Leaking and Swollen	1	
Swollen	1	
SVT	54	
LANL Testing	2	
Development	3	
Five-Watt Test	2	325
Total Available for Flight Application		127
REU Units		6
		133
Future Shipments (Through December 1983)		48
Present and Future FCs Available for Flight and REU.		181
Remaining Requirements		
F-3	76	
F-4	76	152
Contingency		29* (23 flight plus 6 REU)

*12 will be needed for future five-watt RTGs

SR POSITION: PuFF CAN BE PLACED IN STANDBY AND RESTARTED TO MEET FY 86-87 AND LATER COMMITMENTS AT NO RISK TO THE PROGRAM AND AT LOWER COST THAN OPERATING AT 4/MONTH

Costs (Thousands):

	Standby	4/Month	Current Budget
FY 1984	$3,300	$ 7,348	$ 7,120
FY 1985	1,220	7,313	4,500
Total	$4,520	$14,661	$11,620

Analysis

Current plans for standby mode provide for maintenance of H&V and other critical equipment. We expect to require three new furnaces for startup for a total of three weeks lead required. Required lead time for production of additional Pu-238 is one year in both cases; this lead is more than ample to resume production in PuFF.

Conclusion

Considering the foregoing, it is cost-effective and prudent to put PuFF in ready standby in February 1984 and maintain it in that status until future firm programmatic requirements evolve.

EXHIBIT 8

UNCLASSIFIED

X

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NOV - 8 1983

XX

USDOE, B. J. ROCK, DIRECTOR
OFFICE OF SPECIAL NUCLEAR PROJECTS
OFFICE OF NUCLEAR ENERGY
GERMANTOWN, MARYLAND

Original Signed By
Bernard J. Rock

USDOE, R. P. DENISE, ACTING MANAGER
SAVANNAH RIVER OPERATIONS OFFICE

INFO: USDOE, C. G. HALSTED, SR
USDOE, ANN CHAPMAN, BUDGET DIV, SRO

UNCLASSIFIED/N O N W D

SUBJECT: SUPPLEMENT NO. 1, PROGRAM AND BUDGET PLANNING GUIDANCE FOR THE OFFICE OF SPECIAL NUCLEAR PROJECTS ACTIVITIES AT SAVANNAH RIVER FOR FY 1984 THROUGH FY 1986

REFERENCES: (1) LETTER, E. S. GOLDBERG TO G. L. CHIPMAN, JR., "OPERATION OF PLUTONIUM-238 FUEL FORM FACILITY (PuFF)", DATED OCTOBER 28, 1983.

(2) "PROGRAM AND BUDGET PLANNING GUIDANCE FOR THE OFFICE OF SPECIAL NUCLEAR PROJECTS ACTIVITIES AT SAVANNAH RIVER FOR FY 1984 THROUGH FY 1986", DATED SEPTEMBER 21, 1983.

THE PROGRAM AND BUDGET PLANNING GUIDANCE FOR THE OFFICE OF SPECIAL NUCLEAR PROJECTS SPACE FUELS PROGRAM AT THE SAVANNAH RIVER PLANT (SRP), REFERENCE 2, IS REVISED IN ACCORDANCE WITH THE RECOMMENDATION OF THE SAVANNAH RIVER OPERATIONS OFFICE (SRO), REFERENCE 1. SPECIFICALLY FOLLOWING COMPLETION OF PRODUCTION OF FUELED CLADS REQUIRED FOR GALILEO AND THE INTERNATIONAL SOLAR POLAR MISSION (ITEM NO. 5, REFERENCE 2), SRP WILL PLACE THE PuFF PRODUCTION LINE IN A READY (ACTIVE) STANDBY STATUS FROM FEBRUARY 1983 THROUGH FY 1985. DURING

GLBennett
NE-55
353-5367

CONCURRENCES
RTG SYMBOL
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(7-79) UNCLASSIFIED

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FY 1984 AND FY 1985 PRODUCTION AND READY STANDBY SUPPORT ACTIVITIES OF THE SAVANNAH RIVER LABORATORY (ITEM NO. 6, REFERENCE 2) SHOULD BE READILY PROVIDED AS SOLICITED THROUGH SRP WRITTEN WORK ORDER REQUESTS. IT IS UNDERSTOOD THAT THE PuFF FACILITY READY STANDBY STATUS CAN BE ASSUMED WITH NO RISK TO THE SPACE/TERRESTRIAL PLUTONIUM-238 FUELS PROGRAM; SRP WILL ENSURE THAT ALL EQUIPMENT IN PuFF IS EXERCISED ON A REGULAR BASIS, SO THAT PRODUCTION READINESS IS MAINTAINED AND THAT SIGNIFICANT COST INCREASES WILL NOT BE INCURRED WHEN STARTUP OCCURS; ALSO, THAT FUELED CLAD PRODUCTION RESTART CAN BE ATTAINED IN PuFF WITHIN THE ONE-YEAR LEAD TIME REQUIRED TO PRODUCE ADDITIONAL PLUTONIUM-238 FUEL MATERIAL. SPARE EQUIPMENT SHOULD BE MADE AVAILABLE AS REQUESTED TO LOS ALAMOS TO ENABLE PRODUCTION OF ANY DEVELOPMENTAL FUELED CLADS REQUIRED DURING THE PERIOD OF STANDBY OPERATION AT SAVANNAH RIVER.

IN ACCORDANCE WITH THE SRO RECOMMENDATION (REFERENCE 1) SUFFICIENT FUELED CLADS ARE PLANNED TO BE AVAILABLE AS OF DECEMBER 31, 1983, TO PROVIDE 12 SUCH UNITS REQUIRED FOR THE FIVE WATT RTG PROGRAM IN FY 1985 AND FY 1986. HOWEVER, SRP SHOULD PLAN TO RESTART THE PuFF FUELED CLAD PRODUCTION LINE IN FY 1986 TO MEET THE FOLLOWING PREDICTED FUELED CLAD PRODUCTION AND RTG DELIVERY REQUIREMENTS BEGINNING IN FY 1987.

	RTG's (NO. OF UNITS)	RTG DELIVERY (FY)	FC's (NO. OF UNITS)	FC DELIVERY FY
ONE-WATT RTG	8	1988	4	1987
			4	1988
	12	1989	8	1988
			4	1989
UPGRADED	2	1988	96	1987
MOD-3	2	1989	96	1988

THE FOLLOWING REVISED FUNDING ESTIMATES, SUBJECT TO CONGRESSIONAL APPROPRIATIONS AND OMB APPORTIONMENT, IS PROVIDED FOR FY 1985 AS GUIDANCE IN SUPPORTING THE PROGRAM REQUIREMENTS. THE FISCAL YEAR 1984 ESTIMATED FUNDS WILL BE IMPLEMENTED IN THE DECEMBER 1983 FINANCIAL PLAN.

CONCURRENCES

RTG SYMBOL
INITIALS/SIG.
DATE

RTG SYMBOL
INITIALS/SIG.
DATE

RTG SYMBOL
INITIALS/SIG.
DATE

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DATE

REVISED FUNDING (IN THOUSANDS)

	FY 1984		FY 1985		FY 1986	
	BA	BO	BA	BO	BA	BO
AE-20-10-05 OPERATING - SRP	3,300	3,300	1,220	1,220	TBD	TBD
35 AE 20-10 CAPITAL EQUIPMENT	500	500	TBD	TBD	TBD	TBD

THE ABOVE IDENTIFIED CHANGES SHOULD BE REFLECTED IN THE SRP ACTIVITIES PLANNED FOR FY 1984 THROUGH FY 1986, AND BE INCLUDED IN THE SRP WORK PACKAGE PROPOSAL AND AUTHORIZATION SYSTEM (WPAS) TASK PROPOSALS TO BE SUBMITTED TO OSNP BY JANUARY 16, 1984, IN ACCORDANCE WITH REFERENCE 2. IT IS EMPHASIZED THAT SR MUST PROVIDE A JUSTIFICATION FOR ITS BUDGET REQUESTS. END:NE-55

DIST
SUBJ
OSNP
NE-73(4)
Griffo
Bennett
Lombardo
Murdock
Rock
Goch
Wahlquist
036
cc:
F. C. Gilbert, DP-10
R. W. Cochran, DP-13

NE-55:Griffo:mcr:353-5367:11/7/83

CONCURRENCES

RTG SYMBOL	INITIALS/SIG.	DATE
NE-55	Griffo	11/7/83
NE-55	Bennett	11/7/83
NE-55	Lombardo	11/7/83
NE-55	Murdock	11/7/83
NE-55	Rock	11/7/83
NE-50	Goch	11/07/83
NE-50	Wahlquist	11/8/83

11/7/83

1091
1102

EXHIBIT 9

DU PONT

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED
ATOMIC ENERGY DIVISION
SAVANNAH RIVER PLANT
AIKEN, SOUTH CAROLINA 29801

'23.10-5

December 20, 1983

Mr. D. B. Clemens, Director (2)
Office of Budget and Program Support
Savannah River Operations Office
U. S. Department of Energy
P. O. Box A
Aiken, SC 29801

Dear Mr. Clemens:

ADVANCED NUCLEAR SYSTEMS PROGRAM (AE) FY 1986 BUDGET REQUEST AND LONG RANGE PROJECTION (FY 1987 - FY 1990)

Ref: Letter, D. B. Clemens to R. G. Garvin, 11-16-83

As requested, the FY 1986 Advanced Nuclear Program Operating and Capital Budget Request and Long Range Projection estimates are attached. These estimates were prepared using the specified Department of Energy's assumptions and format.

Your current funding guidance and our forecast program funding requirements to meet schedule production goals are summarized below:

CURRENT FUNDING GUIDANCE
(Dollars in Thousands)

	FY 84	FY 85
OPERATING (B/O)		
SRP	3,300	1,220
SRL	0	0
TOTAL	3,300	1,220
CAPITAL (B/A)	500	TBD

PROGRAM FUNDING REQUIREMENTS
(Dollars in Thousands)

DECREMENT OPERATING (B/O)	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90
SRP	3,300	1,723	1,854	1,854	1,854	1,854	1,854
SRL	0	0	0	0	0	0	0
VAC. ACC.	0	275	95	0	0	0	0
TOTAL	3,300	1,998	1,949	1,854	1,854	1,854	1,854
CAPTIAL (B/A)	500	1,200	1,000	1,000	1,000	1,000	1,000
PROGRAM REQUIREMENT OPERATING (B/O)							
SRP	3,300	1,723	8,531	9,811	9,811	9,811	9,811
SRL	0	0	0	0	0	0	0
VAC. ACC.	0	275	95	0	0	0	0
TOTAL	3,300	1,998	8,626	9,811	9,811	9,811	9,811
CAPITAL (B/A)	500	1,200	1,000	1,000	1,000	1,000	1000
ENHANCED OPERATING (B/O)							
SRP	3,300	4,200	9,811	9,811	9,811	9,811	9,811
SRL	0	0	0	0	0	0	0
VAC. ACC.	0	275	95	0	0	0	0
TOTAL	3,300	4,475	9,906	9,811	9,811	9,811	9,811
CAPITAL (B/A)	500	1,200	1,000	1,000	1,000	1,000	1,000

For comparison, total operating cost in FY 83 was $7,933,477 including $2,470,000 from NASA, and capital funding totaled $500,000. The decrease in requested funds for FY 84 and FY 85 results from halting production after December 1983 and, beginning January 1984, only providing for production readiness capability throughout FY 84 and FY 85 except that restaffing occurs in June 1985 for the enhanced program requirement.

If restricted to the DOE guidance funding level of $1,220,000 in FY 85, the PuFF production readiness activities will probably have to be curtailed. Although no actual cost experience is available under the production readiness mode of operation, we believe the revised estimate of $1,723,000 is valid for the planned level of activities.

Program funding of $275,000 in FY 85 and $95,000 in FY 86 is included to provide for earned vacation accrual as required by the Financial Accounting Standards Board (FASB). Currently, BA/BO is requested on the basis of vacation taken rather than vacation earned.

Programmatic detail and justifications are provided in the attached schedule.

Any questions your staff may have should be directed to J. J. Shuler, extension 2963 or F. B. Cavanaugh, extension 2108.

Yours very truly,

R. G. Garvin

R. G. Garvin, Superintendent
Budget Coordination Department

JJS:dl
Att

EXHIBIT 10

36

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29801

[illegible]

B. J. Rock, Director
Special Nuclear Projects (NE-55), GTN

FY 1986 BUDGET FOR ADVANCED NUCLEAR SYSTEMS ACTIVITIES AT SR (YOUR MEMO AND TWX DATED 9/21 AND 11/8/83, RESPECTIVELY AND MY MEMO TO G. L. CHIPMAN DATED 10/28/83)

Attached are three (3) copies of Savannah River's FY 1986 budget estimates for ANS-Space and Terrestrial Applications (WPAS Forms and Schedules 21a and 45). Our estimates are based on guidance correspondence referenced above and are summarized below:

	FY 1984		FY 1985				FY 1986			
			$(MILLIONS)							
			Prog.Req.		Enhanced		Prog.Req.		Enhanced	
	BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
AE-20-10-05-0 Operating	3.3	3.3	2.1	1.7	5.2	4.2	10.7	8.9	11.7	10.2
35-AE-20-10 Capital Equip.	.5	.5	1.2	1.2	1.2	1.2	1.0	1.5	1.0	1.5
Total Program	3.8	3.8	3.3	2.9	6.4	5.4	11.7	10.4	12.7	11.7

The above estimates represent funding needed to keep the PuFF facility in a production readiness mode through September 30, 1985. No funding is provided for SRL. Their assistance will be requested on an as needed basis.

FY 1985 operating funding ($1,220,000 BA and BO) as identified in your November 8, 1983 TWX is not adequate to maintain the PuFF facility in a ready (active) standby status during FY 1985. Without additional funding ($841,000 BA and $503,000 BO) the argon system cannot be maintained to prevent extensive equipment corrosion which would require major repairs or replacement delaying start up and increasing costs. Additional FY 1985 funding detailed above is hereby requested.

Any questions your staff may have should be directed to G. M. Nichols (FTS 239-3777) for Technical or A. L. Chapman (FTS 239-2263) for Budget.

E. S. Goldberg
Assistant Manager
for Operations

OBB:ALC:dsl

Attachments (3)

cc w/attachment:
A. E. Guyer, Ofc. of Budget (MA-30)

SR-DOE FORM-5120.1 11/81

SAVANNAH RIVER
OPERATIONS OFFICE

U.S. DEPARTMENT OF ENERGY
FIELD WORK PACKAGE PROPOSAL/AGREEMENT

1. WORK PACKAGE NO. Summary	2. REV NO.	3. CONTRACTOR NO. SR00001	4. DATE PREPARED 12/14/83
5. WORK PACKAGE TITLE Advanced Nuclear Systems-Fuels			6. BUDGET AND REPORTING CODE AE-20-10-05-0
7. CONTRACT NUMBER	8. PHASE	9. PROJECT NUMBER	10. CONTRACT TERM
11. WORK PACKAGE TERM OPEN	12. Does this work package include any management service efforts? ____ YES ____ NO		13. Is this work package included in the institutional Plan? ____ YES ____ NO

14. NAME: (Last, First, MI) (FTS NUMBER)
HEADQUARTERS PROGRAM MANAGER:
Bennett, G. L.

15. OPERATIONS OFFICE/HQ WORK PKG. MANAGER:
Goldston, W. T.

16. CONTRACTOR WORK PACKAGE MANAGER:
Kiger, E. C.

17. HEADQUARTERS ORGANIZATION:
NE

DOE ORGANIZATION CODE NE

18. OPERATIONS OFFICE:
SR

CODE SR

19. CONTRACTOR NAME:
Du Pont

CODE (See instructions) SRB

20. WORK LOCATION (if different from contractor main office)
Savannah River
Aiken, SC 29808

21. WORK PACKAGE DESCRIPTION (Approach, relation to work package, in 200 words or less)

This activity includes the production of iridium clad ^{238}Pu heat sources for space and special applications. Following final delivery in December 1983 of fueled clads to satisfy the requirements of Galileo and Solar Polar missions, PuFF Facility will be placed in a production readiness mode in January 1984 in accordance with Program and Budget Planning Guidance received November 16, 1983.

FY 84 funding of $3,300,000 is required to complete scheduled deliveries of FC's, convert the facilities to a production readiness status (January 1984) and maintain the facilities in a production readiness mode for the remainder of FY 84. Funding includes staffing levels of 86 person-years for the first three months and nine person-years for the last nine months.

22. CONTRACTOR WORK PACKAGE MANAGER:

(Signature) (Date)

23. DOE WORK PACKAGE MANAGER:

(Signature) (Date)

24. ASSISTANT SECRETARY OR DESIGNEE

(Signature) (Date)

25. DESIGNATED HEADQUARTERS OFFICIAL

(Signature) (Date)

20. DETAIL ATTACHMENTS: (See instructions)

___ a. Facility requirements	___ d. Background	___ g. Future accomplishments	___ j. Explanation of milestones
___ b. Publications	___ e. Approach	___ h. Relationships to other projects	___ k. ZBB detail
___ c. Purpose	___ f. Technical progress	___ i. Environmental assessment	___ l. Other (Specify)

21. WORK PACKAGE DESCRIPTION (Continued)

FY 85 funding of $1,723,000 is required to maintain the PuFF Facility in a production readiness mode. While in the production readiness mode, the facility will be maintained in such a condition to enable resumption of processing with a minimum amount of effort and preparation. This will involve maintaining an inert atmosphere in the processing cells to prevent deterioration of the equipment, periodically exercising key process equipment to maintain and verify operability, performing routine preventative maintenance as necessary, replacing failed equipment and maintaining the current inventory of spare equipment. Staffing level of nine person-years is needed for all months. Enhanced program funding requirement for FY 85 is $4,200,000. This includes staffing levels of nine person-years for eight months and 86 person-years for four months due to restaffing in June 1985 for training and facility run-in.

Projected capital equipment funding will be required to provide for maintenance and repairs of equipment and facilities necessary to maintain production readiness.

Capital funding of $500,000 in FY 84 will be used to replace the lead glass annealed windows in the process lines.

Capital funding of $1,200,000 in FY 85 will be used to purchase the following items:

1) New metallagraphic facility ($1,000,000)
2) Miscellaneous projects, each $75,000 or less ($200,000).

Major tasks to be accomplished in FY 84 will be to complete delivery of fueled clads as scheduled, prepare and maintain the facility in a production readiness mode and replace the glass windows in the process lines.

Disassembly of encapsulated heat sources and radioisotopic thermoelectric generators will be discontinued during the period the facility remains in the production readiness mode.

SRL support activities will be provided to the activity during production and production readiness mode as solicited through written Requests for Technical Assistance (RTA). Present level of funding does not provide for developmental work to be performed by SRL other than normal process support requested through RTA's.

Funding to provide for the accounting for vacation costs as earned rather than as taken, as required by the Financial Accounting Standards Board, is included in FY 86. Vacations are earned in the year proceeding the year in which they are taken. Currently, vacation costs are funded in the year taken. Conversion to funding in the year earned will require additional funding of $370,000 in the transition year (FY 1986).

EXHIBIT 11

(5-83)

United States Government | Department of Energy

memorandum

~~#~~ 1120.10.9

DATE: DEC 19 1984

REPLY TO
ATTN OF: NE-55

SUBJECT: Review of PuFF Status, Safety, and Emergency Preparedness

TO: B. J. Rock, Director
Office of Special Nuclear Projects

Introduction

On October 30-31, 1984, J. S. Griffo, N. Klug and I conducted a review of the status, safety and emergency preparedness of the Plutonium Fuel Form (PuFF) Facility located in Building 235-F at the Savannah River Plant (SRP). On October 30, 1984, we were assisted by J. McDougal of Mound and G. H. Rinehart of Los Alamos. Currently, PuFF is in a state of production readiness, having completed the encapsulated fuel production requirements for the Galileo, Ulysses and Five-Watt programs. In general, we found PuFF to be ready to resume production although some effort will be required to clean up the corrosion damage on the powder side (cells 1-5).

The following sections cover the principal topics. The list of attendees is given in Attachment 1. The handouts are in Attachments 2-8. A detailed review was not made since PuFF is not currently operating.

Overview of Production Readiness Mode

Will Davis of SRP gave the overview presentation (see Attachment 2). PuFF has been in production readiness since January 1, 1984, when it completed the production requirements for the OSNP programs. Currently, the PuFF staffing level is one supervisor (Clyde Hill) and two operators. No administrative support is being provided. The production readiness activities include routine facility patrols, tests of safety-related systems, exercising key process equipment, facility maintenance, and assistance on capital projects. Davis expanded on each of these items. The key point is that the SRP activities are aimed at preserving PuFF, recognizing that some equipment failure is anticipated.

The group toured Building 235-F noting that in general there appeared to be sufficient spare parts to enable an early continuation of production. Housekeeping appeared to be very good. Several items were noted:

- Extensive corrosion of manipulators and electrical insulation on the powder side (Cells 1-5) of PuFF. SRP personnel explained this was normal for Pu-238 contaminated cells and that sufficient spares were available to replace the damaged hardware when production resumed.

- Master ends of spare manipulators were not bagged to protect against dust and other environmental effects (SRP agreed to correct this immediately).

- An eye wash appeared corroded (SRP agreed to correct this immediately).

G. Nichols of SR noted that the lead time to continue production may have to be extended from 3 months to 6 months particularly if production readiness extends beyond 2 years. He reported that Q-clearances are currently taking up to 8 months to obtain. For an April 1987 production he said SRP would need to staff up in October 1986.

SRP reported that it has all of its production procedures and data packages in the vault in Building 235-F. Forty shipping casks are stored on site. We requested that at least one of these be kept certified and ready for use.

Following the tour, Steve Bagley of SRP gave an overview of the facility status. Bagley covered maintenance work since January 1, 1984, the present status of equipment, the projected 1987 status of equipment, and the startup time (see Attachment 3). Most of the maintenance work appeared to be routine. By 1987, the following equipment is expected to be inoperable.

o Furnaces (3) - replacement parts are available
o Incell hoists (3)
o Manipulators (16) - 22 manipulators are in storage
o Intercell transfer device - spares are in storage
o Transfer devices (2) - bearings will have to be replaced

The presses, ball mill, welders, NDE equipment, vacuum outgassing furnace, and argon/helium purification/recirculation equipment are projected to be operable. The two key items affecting the startup time were reported to be replacement of furnaces and training of personnel.

Emergency Conditions

Steve Bagley of SRP described such emergency conditions as loss of ventilation and loss of cooling water as well as unusual occurrence procedures and the emergency conditions manuals (see Attachment 4). If the process exhauster shuts down, the building personnel have 15 minutes to solve the problem or they must evacuate the building. Plastic suits and procedures were reported to be available outside PuFF. Bagley reported that PuFF has an independent supply of cooling water, although PuFF uses the same emergency cooling as F area.

We gave a quick review of the manual "Emergency Conditions Building 235-F" which covered building ventilation, cell ventilation, cooling water systems, and the following unusual occurrence procedures (DPSOLs).

235-F-PuFF-3400	Loss of Instrument Air
235-F-PuFF-3401	Loss of Normal Power Supply
235-F-PuFF-3402	Emergency Shutdown Procedure
235-F-Puff-3410	Action to be Taken for Loss of Breathing Air
235-F-Puff-3413	Loss of Domestic Water

These procedures appear to cover in general terms what to do when the described events occur.

PuFF Safety Plan

John T. Buckner of SRP described the PuFF safety plan (see Attachment 5). The Du Pont document "Control of Processes in the Atomic Energy Division" (DPW-73-160, December 1962, revised March 1973) was stated to be still in effect although a draft replacement is out for review. SRP obtains independent technical overview of production processes by having SRL prepare the safety analysis reports (SARs) and, in the case of PuFF, having the Separations Technology people provide independent technical oversight. The PuFF SAR was revised in June 1983 but will not be signed off by SR until PuFF is ready to resume production.

Buckner reported that SRL will prepare the operational safety requirements (OSRs) and technical standards for PuFF. (The technical standards were in existence when PuFF was producing fueled clads; the OSRs are a newer DOE requirement and SRL will have a draft OSR to SR by December 1, 1984.) The various documents were described in some detail. Buckner also reviewed the SRP QA manual which was issued in April 1984 and is to be fully implemented by December 1985.

With respect to the SR commitment to upgraded training, SRP personnel reported that a dedicated training building is being built. Lesson plans for PuFF are scheduled to be ready in January 1985. Memphis State University is involved in the training preparation.

In response to a question about the currency of knowledge about plutonium facility designs and standards, SRP personnel said they participate in an inter-laboratory group (including Rocky Flats, Los Alamos, Westinghouse Hanford and LLNL) dealing with this topic. Also, J. K. Brown and J. T. Buckner serve on the ASTM Committee for nuclear facilities.

The SRP safety organization reports to the plant manager. While there are area safety engineers, there is not a specific PuFF safety engineer. SRP relies on SRL and SRP Separations Technology for that technical oversight. Health physicists are assigned to PuFF (only one during production readiness).

Subsequently, the following QA Assessment Reports were reviewed:

QAAR-200-F-119	Waste Handling	September 27, 1982
QAAR-200-F-118	Shipping Hardware	August 23, 1982
QAAR-200-F-61	Building 235-F Ventilation System	July 25, 1982
QAAR-200-F-120	PuFF Facility	August 12, 1982

It appears that SRP has an active safety review process.

Emergency Preparedness Plan

J. K. Brown of SRP described the three types of emergency responses (alert, protective response, and complete shutdown - see Attachment 6.) There is no specific plan for PuFF, rather SR/SRP/SRL use a site-wide plan.

NOTE: All of the reviewers observed the increased attention and effort devoted to security at SRP.

SRP Emergency Operations

John Merrick gave an overview of Savannah River emergency planning (see Attachment 7) and later took the reviewers on a tour of the SR Emergency Operations Center. Merrick is the overall coordinator for emergency planning at SR. He receives support from du Pont and outside contractors. Merrick reported that the reactors dominate the calculated site risk (not PuFF).

SR has obtained experience by participating in the St. Lucie exercise and in helping the states develop plans. On November 15, 1984, SR will participate in an exercise involving C-Reactor. Merrick reported that SR has agreements with Fort Gordon for helicopter airlifts and with the Dwight David Eisenhower Hospital as well as agreements or interfaces with nearby states.

Merrick reported that SR had completed all of the scheduled items listed in the June 22, 1982 memorandum from R. L. Morgan to H. E. Roser, Subject: Submission for Approval of SR Implementation Plan for DOE Orders 5500.2, 3, and 4.

Merrick described the emergency response organization. Each area and facility has a coordinator. (Clyde Hill is the Facility Coordinator for PuFF). The key to the emergency response organization is the emergency operations center (EOC) which is staffed 24 hours a day with a minimum of 3 people (2 du Pont, 1 Wackenhut). The duty officer for emergencies would be the senior DOE person present.

With respect to emergencies involving PuFF, SRP said the only releases postulated would be from failures of filters or exhausters and these were not considered credible. The only monitors for such an incident are on the F-area stacks not in PuFF.

The EOC has a real-time computer capability to track and predict the effects of a release. Merrick demonstrated this to us for PuFF. Merrick reported that H-Canyon also has a control room with WIND (Weather Information System) plotter.

SR has performed a general appraisal of JB line on emergency preparedness but <u>not</u> on PuFF.

I discussed separately with Merrick the SR EOC support for the Galileo and Ulysses launches in 1986. Merrick said he had been contacted by J. Nolan Bailey of AL and was willing to provide support.

<u>SR Safety Activities</u>

Roger Rollins of SR reviewed the PuFF facility safety from a DOE/SR viewpoint (see Attachment 8). In particular he described the SR implementation of the DOE orders on the safety of nuclear facilities and the safety analysis documentation. He showed the PuFF SAR which he said SR would not be approved until PuFF resumes operation (see Attachment 8).

The revised SAR is in two documents

- System description
- Addendum to 200 F Area SAR

(The production readiness review mode is not addressed because SR considers it to be less risky than the production mode.)

Rollins noted that separate SARs are issued for the PuFF vaults. Currently these SARs are on the SR backlog list for review with the review scheduled to begin in November 1984. Rollins also described related PuFF safety documentation and the SR Environmental, Safety and Health (ES&H) appraisal program. SR has conducted several ES&H appraisals involving PuFF. SR Order 5480.1A, Chapter XI (approved February 17, 1984) invokes ALARA on SR contractors. SR is also involved in the DOE UOR System and the NRC inspection notice system.

Two documents have been developed by du Pont to control radiation exposure

DPSPU 83-11-18 - Reducing Radiation Exposure to As Low as Reasonably Achievable (ALARA) at the Savannah River Plant.

DPSOP-40 - Savannah River Plant Radiation and Contamination Control

Rollins reported that DOE safety orders are implemented through the SR Contracting Officer. Rollins said SRP is implementing the DOE UOR system and that effluent/environmental monitoring of PuFF is carried out.

Subsequently, Norm Klug and I reviewed a recent SR safety appraisal covering PuFF:

"Functional Appraisal of the 221-F Canyon, 221-F B-Line, F-Area Outside Facilities, 772-F, and 235-F Radiation Safety Program, May 2 - October 5, 1983" conducted by W. D. Dillon of the SR Occupational Safety Branch.

PuFF appeared to have come out very well in the review. (PuFF was described as having the best ventilation system then operating on site). While there were some high individual exposures early in the program (2130 mRem in 1981), PuFF had had no reported incidents or special hazards investigations from 1981 to May 1983.

PuFF appeared to have met its 1981 and 1982 goals on cumulative person-rems.

The other item noted in the SR appraisal was a lack of a consistent approach to nuclear criticality in PuFF. The occupants of Building 235-F are apparently not required to wear CNDs (criticality neutron dosimeters). The reliance is on administrative controls to prevent criticality.

Conclusion

The following conclusions can be drawn from the review:

1. PuFF is in a state of production readiness (although 3-6 months minimum would be required to resume production).

2. Emergency procedures are in place for the most likely PuFF emergencies (loss of ventilation or loss of cooling water).

3. SRP has a safety system in place but is still working to meet the full intent of the DOE orders (e.g., OSRs). SRP relies on SRL and SRP Separations Technology for independent technical oversight on PuFF, not on an independent safety organization.

4. SR/SRP have a site-wide emergency plan but nothing specific to PuFF. SR is exercising this plan regularly. No specific appraisals of the PuFF emergency preparedness have been made.

Attachments 9-11 contain the trip reports of N. P. Klug, G. H. Rinehart and J. R. McDougal respectively.

Gary L. Bennett, Director
Safety and Nuclear Operations
Office of Special Nuclear Projects
Office of Nuclear Energy

Attachments
1. List of Attendees (in 3 parts)
2. Pu-238 Space Fuels Program Review
3. Facility Status
4. Emergency Conditions
5. PuFF Safety Plan
6. Emergency Preparedness Plan
7. SRP Emergency Operations
8. SR Safety Presentation
9. Trip Report - N. P. Klug
10. Trip Report - G. H. Rinehart
11. Trip Report - J. R. McDougal

cc:
N. Goldenberg, NE-74
M. P. Norin, NE-74
N. Klug, NE-74
J. J. Lombardo, NE-55
G. H. Ogburn, Jr., NE-55
K. G. Sommer, NE-55
W. T. Goldston, SR
W. Reese, SR
J. Merrick, SR

DOE F 1325.8
(4-84)

ATTACHMENT 9

United States Government

Department of Energy

memorandum

(1) GOLDENBERG
(2) GRIFFO CY
(3) BENNETT

DATE: NOV 2 1984

REPLY TO ATTN OF: NE-74

SUBJECT: Trip Report - Savannah River, October 30-31, Safety Review of PuFF

TO: Neal Goldenberg

On October 30-31, I accompanied Gary Bennett and Joe Griffo of NE-OSNP on a visit to the Savannah River Plant (SRP). On the first day, we were joined by Jim McDougal of Mound and Gary Reinhardt of LASL.

The purpose of our visit was to review the plutonium-238 space fuels program at SRP, with particular emphasis on the safety aspects. The major facility where the program is carried out is the PuFF, which has been designated as a non-reactor nuclear facility under Part V of DOE 5480.1.

This facility has been shut down since January 1984, and is being kept in a production readiness mode. Present plans project restart of the facility in April 1987; six months before this SRP would have to start getting ready.

Our visit consisted of a thorough walkthrough of the facility; discussions with SRP and DOE-SR staff; and a visit to the Emergency Operations Center (EOC). Both prior to and during the visit, we also reviewed pertinent documents, including some of the SRP internal QA/safety assessments of themselves and DOE appraisals of SRP. A copy of the agenda is attached.

My major observations are as follows:

1. The housekeeping was excellent. We did find that some hot cell manipulators in storage needed covering, but by and large everything else looked good.

2. Due to time and environmental conditions, there is already considerable deterioration in the hot cell equipment and other parts of PuFF. SRP is trying to keep up the facility in reasonably good shape, but it will still require a substantial effort to get it back into a production mode.

   There will also be a need to rebuild an operating staff, since most of the PuFF group has gone elsewhere. This may be the biggest problem.

3. Based on the technical discussions as well as review of both SRP and DOE/SR safety appraisal reports, there appears to be a high level of attention to safety at SRP in general, and Puff in specific. Like other DOE contractors, there are some delays in "documentation". For example, there has been a substantial delay in issuing <u>in final form</u> DPW 82-104, "Administrative and Procedures Control Systems for Savannah River Plant Non-reactor Process Facilities".

4. SRP and DOE/SR have placed major attention on upgrading the SRP emergency plans and their operation centers. DOE/SR played a major

role in the St. Lucie exercise, and on November 15, a large emergency exercise will be conducted at the SRP. Their releases of tritium have given them considerable practice in handling off-site situations.

5. An updated organizational chart of Savannah River Operations Office is attached. Mel Sires, formerly Asst. Manager for ES&H, is now Assistant Manager for Operations. G. A. Smithwood is Acting Assistant Manager for ES&H, but continues to be Division Director for Process and Weapons. Bruce Twining, who has been in the San Francisco Office, will be Deputy Director to Bob Morgan.

6. Under the newly revised DOE Orders, it is my view that restartup of the PuFF will require Headquarters (both NE and PE) review of the Safety Analysis Report and approval (by NE) and concurrence (by PE) of the SRP and DOE/SR plans to put this plant back into production mode. The visit was very helpful to me in getting an initial review of this activity.

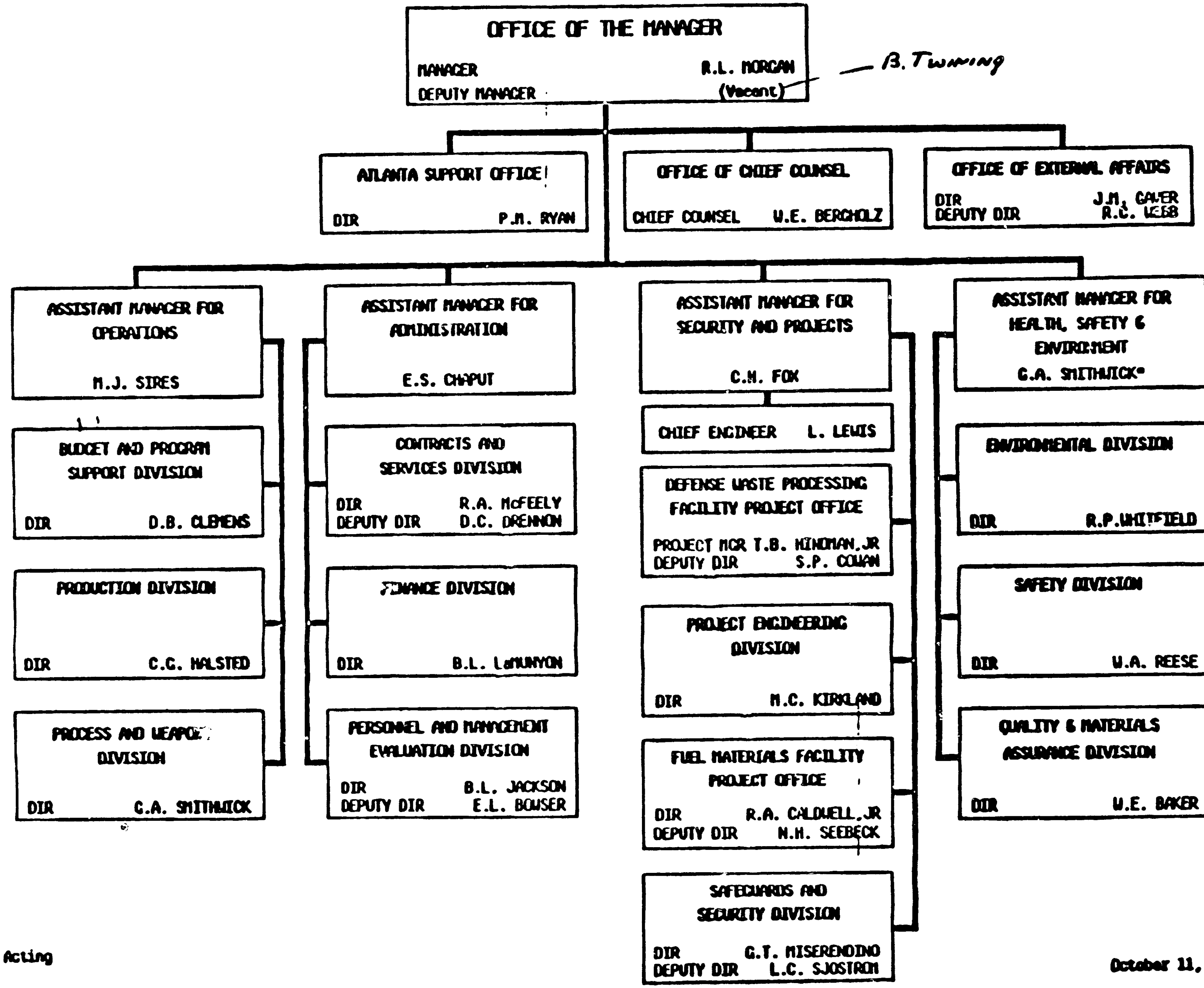
Norman Klug

Norman P. Klug, Manager
Operational Safety
Division of Safety, Quality Assurance,
and Safeguards

ATTACHMENT

cc: M. Norin
G. Bennett, NE-55

SAVANNAH RIVER OPERATIONS OFFICE



* Acting

October 11, 1984

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Date: November 5, 1984
Reference: MST-11-RDH-84-125

Mr. Gary L. Bennett
US Department of Energy
B107/GTN
Office of Special Nuclear Projects/NE-55
Germantown, Maryland 20767

Dear Gary:

SUBJECT: REVIEW OF SRP PuFF FACILITY STANDBY STATUS

I wish to thank you for the opportunity to provide input on the review of the PuFF Facility Status. This was my first visit to the PuFF Facility and I found the tour and presentation to be most informative. The following are my perceptions of the present facility status and the effort required to bring the facility on-line in FY87.

A. Present Condition of Facility

1. Hot Cells

The cells that were used for powder preparation (numbers 1-5) had somewhat more corrosion than I had anticipated. There is significant corrosion of electrical connectors, electrical cables, and the slave manipulators. The main cause of the corrosion is due to $^{238}PuO_2$ and the difficulty of keeping the hot cells clean using manipulators. At Los Alamos, gloveboxes are used to process $^{238}PuO_2$ and the operators are able to keep the gloveboxes relatively clean by wiping down the equipment and walls with ethanol dampened cheesecloths. I saw no significant corrosion of the hot cell stainless steel walls. I have no real concern about the corrosion of equipment, since the electrical connectors and cables can be replaced at little cost. Replacement of manipulators will be much more expensive. The corrosion observed did not alarm me from a safety standpoint.

The other hotcells (number 6-10) that were used for hot pressing, vacuum outgassing, encapsulation, helium leak checking, decontamination, and welding into shipment containers were in good condition. My only concern about these cells is that the welding cells (#6 & 9) do not have an inert atmosphere. Some corrosion of carbon steel parts of the weld fixtures was occurring. Corrosion would be minimized if the cells had an argon, helium, or even nitrogen atmosphere.

2. Processing Equipment

(a) Inside Cells - Most of the equipment inside cells #1-5 is not operable due to corroded electrical connectors, electrical cables, furnace core windings, and hoses. The ball mill was still operational, but I would not expect it to last much longer due to corrosion of the electrical cable or the electrical motor itself. The furnace shells are made of stainless steel and they appeared to be in good shape.

The equipment in cells #6-10 appear to be in good condition, and I would expect little deterioration except perhaps in the electrical wiring.

(b) Outside Cells - All equipment appeared to be in very good condition.

3. Safety Related Equipment

The ventilation equipment was working normally during the tour and I sensed that the operators were diligent in keeping this very important system maintained. All radiation monitoring equipment that I observed was operational. In addition, a health physics technician is present at the facility eight hours a day. I did see one hot cell window (cell #5, I believe) that was cracked and should be replaced.

B. Maintenance of Facility

Clyde Hill is doing an excellent job of maintaining the facility with limited personnel. I believe that he has chosen the correct equipment to exercise and maintain. His efforts will have a most significant effort on reducing the startup costs of the facility.

C. Spare Equipment Inventory

The facility has a good supply of spare parts for key processing equipment. Space parts are available for the processing furnaces and slave manipulators. A complete welding fixture is also available.

D. Startup of PuFF Facility in FY87

If the personnel in the PuFF facility continue the maintenance program, there should be no major obstacles (equipment problems) to starting up production. Several months of work will be necessary to clean up the cells and bring the processing equipment on line. The largest obstacle to initiating production will be the staffing and training of qualified personnel.

Sincerely,

Gary H. Rinehart

Gary H. Rinehart

GHR:bs (K510)

Distribution:
J. S. Griffo, OSNP/NE-55, Washington, DC
S. S. Hecker, Los Alamos/MST-DO, MS G756
J. L. Green, Los Alamos/MST-11, MS E505
S. E. Bronisz, Los Alamos/MST-5, MS G730
R. W. Zocher, Los Alamos/MST-5, MS G730
G. H. Rinehart, Los Alamos/MST-11, MS E505
CRM-4 (2), MS A150
File

MOUND

Inter-Office Correspondence

From : J. R. McDougal

Date : November 6, 1984

Subject : Trip Report #299, Attend PUFF Facility Standby Review at SRP, 10/30/84

Reference :

cc : W. R. Amos
B. R. Kokenge
W. B. Witmer
File

TO : J. P. Highland

I attended a PUFF facility standby review meeting at the Savannah River Plant on 10/30/84. The following formal presentations were given by SRP personnel:

1) Pu-238 Space Fuels Program Review
2) Facility Status
3) PUFF Safety Plan
4) Emergency Preparedness Plan
5) Emergency Conditions

Copies of the handouts covering each of the presentations are available from the undersigned.

There was also a tour of the PUFF facility to observe the equipment firsthand. I felt that the equipment in the boxlines was in as good a condition as could be expected. Much of the equipment in the powder handling boxlines was badly corroded, i.e., slave end of manipulators. This condition, however, is what one would expect to see in the time period that the equipment has been in the line. I believe that SRP's approach of leaving the equipment in a failed condition until the time of production startup is a correct one. Replacing the failed parts would be expensive and would serve no purpose, as the replacement parts would also be failed before they were ever used. The welding and decontamination boxes were all in very good condition, with only mild oxidation visible on the Gilman slides on the welding fixture.

The equipment that had been chosen to be run or operated during the standby period, appeared to be correct and was of the type that Mound would have chosen. The frequency of operation of the equipment was also acceptable.

The spare parts on hand, the storage method and the general condition of the facility appeared to be excellent. The only storage method of spare parts that I might question would be the storage of spare manipulators. Practically everything was stored inside the building in a heated, humidity-controlled environment except the manipulators, which were stored in a metal building attached to the main PUFF buildings. I feel that perhaps this condition could be reevaluated. Many of the manipulator parts are aluminum and stainless steels that will not suffer from rust, but other parts may oxidize.

The trip was worthwhile, as it compared SRP's standby philosophy with that at Mound in the "F" line area. It also fulfills part of our responsibility as the Heat Source Lead Laboratory to provide technical evaluations of this type condition.

In summary, I feel that SRP is doing an excellent job of maintaining the PUFF facility in the standby condition.

J. R. McDougal

J. R. McDougal

JRM:cf

EXHIBIT 12

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29801

Gary Bennett, Director
Safety and Nuclear Operations
Office of Special Nuclear Projects, HQ (NE-55)

PUFF DPSOLS

The attached are forwarded as requested by Joe Griffo. They describe the frequency and method of exercising the equipment in PuFF during the reduced requirement period.

W. T. Goldston, Chief
Separations Branch
Process and Weapons Division

OWS:GMN:aq

Attachment

5) Record the following filter differentials .

Equipment Identification	Normal range Inches WC	COMMENTS
PuFF Exhaust Pressure Differential, Filters 5 throught 10	1.0 to 2.2	
Alloy and Compact Line Exhaust Pressure Differential, Filters 1 through 4	1.0 to 2.2	
PEF Exhaust Pressure Differential, Filters 11 and 12	1.0 to 2.2	
[redacted]	0.04 to 0.06	
Argon Supply Filter Differential	1.2 to 2.0	
Argon Return Filter Differential	4.0 to 6.0	

Completed by________________

DO NOT REMOVE From SRP
Without Approval
SEPARATIONS DEPARTMENT
DPSOP Ref 26B-
Pu FUEL FORM FACILITY (PuFF)

DPSOL 235-F-PRM-11
Revision 0
Approval Date ________
Category UET

OPERATING AND SWITCHING EQUIPMENT
WEEKLY CHECK SHEET

---

*Denotes revision to this DPSOL

APPROVALS:

W T Davis 1/26/84
Sep Date

[signature] 1/26/84
Sep Tech Date

FREQUENCY:

Operating and Shut-down equipment must be switched or exercised once each week. These tasks should be performed on Thursday or sooner.

INFORMATION:

Shut-down equipment should be exercised as follows: Pumps- Run for 15 minutes each; Hot and Cold Presses - Run all rams through at least one cycle; Motor Generator - Run 15 minutes; Other equipment - Run for 15 minutes.
Operating Equipment should be switched or placed in service sooner if needed.
All Equipment shall be operated by 235-F-PuFF DPSOLs.

SAFETY:

Comply with all Building Safety Rules.

RADIATION AND CONTAMINATION CONTROL:

1) Comply with DPSOL 200-FH-9 (DPSOP 40-1), Regulated Areas and Radiation Zones, Building 235-F.

PROCEDURE:

Date________________

Equipment	Exercised Upper Ram		Exercised Lower Ram		Exercised Clamp Ram		Remarks
	Yes	No	Yes	No	Yes	No	
Hot Press							
Cold Press							
Np. Press							

Date________________

Equipment	Shut-down Equipment to be exercised weekly	
	Minutes exercised	Remarks
Hot Press Aux. Cooling Water Pump EP 30-3-8.60		

Equipment	Shut-down Equipment to be exercised weekly		
	Minutes exercised		Remarks
Hot Press Aux. Cooling Water Pump EP 30-3-9.60			
Hot Press Hydraulic Pump			
Hot Press MG Set			
Furnace Cooling Pump EP 5-1-1.3A			
Furnace Cooling Pump EP 5-1-1.3B			
Oxygen Analyzer Pump - Helium			
Oxygen Analyzer Pump - Argon			
East Line Manipulators		Each	
West Line Manipulators		Each	
Cell 9 Vacuum Pump			
Cell 6 Vacuum Pump			
Cell 6 Welder			
Cell 9 Welder			
Cell 6 Helium Recirculating Blower			
Cell 9 Helium Recirculating Blower			
Wand Vacuum Pump			
Evacuable Lock Pump			

Date_____________

Equipment	Operating Equipment to be switched weekly		
	From	To	Remarks
[redacted]			
Argon Blowers #1 and #2			
Hot Press Cooling Water Pumps EP 30-3-5.60 and EP 30-3-6.60			
Vacuum Outgas Cooling Water Pumps A and B			
Instrument Air Compressors #1 and #2			
Breathing Air Compressors #1 and #2			
Process Chillers #1 and #2			
[redacted]			

Date_____________

	Range	Systems With Low Voltage	Remarks
Batteries For Fire Detection Systems 1 through 13 (Test Each Battery)	Each Battery Must Read Greater Than 22 Volts		

DO NOT REMOVE From SRP
Without Approval
SEPARATIONS DEPARTMENT
DPSOP Ref 268-
Pu FUEL FORM FACILITY (PuFF)

DPSOL 235-F-FRM-10
Revision 0
Approval Date ________
Category UET

OPERATING EQUIPMENT DAILY CHECK SHEET

---

*Denotes revision to this DPSOL

APPROVALS:

W T Davis 1/26/84
Sep Date

J Bulkner 1/26/84
Sep Tech Date

FREQUENCY:
Record the readings of operating equipment twice each day; once in the morning and afternoon, five days a week.

INFORMATION:
Notify Supervisor immediately of any readings out of the normal range or of any unusual conditions that arise. All equipment will be operated in accordance with 235-F-PuFF DPSOLs.

SAFETY:
Comply with all Building Safety Rules

RADIATION AND CONTAMINATION CONTROL:
1) Comply with DPSOL 200-FH-9 (DPSOP 40-1), Regulated Areas and Radiation Zones, Building 235-F.

Date________________

Equipment	Range	AM On	AM Temp	AM Off	PM On	PM Temp	PM Off	Remarks
EP472.23 A/C	72 °F±8 °							
EP475.41 Exhauster	----							
EP472.11 A/C	72 °F±8 °							
EP475.30 Exhauster	---							
EP579-50-2 A/C	72 °F±8 °							
EP475.24 Exhauster	---							
EP579-50-1 A/C	72 °F±8 °							

Date__________

Equipment	Range	AM On	AM Temp	AM Off	PM On	PM Temp	PM Off	Remarks
EP472.21 A/C	Heating Coils Only							
EP12-1-1.60 A/C	72 °F ±8°							
EP12-1-2.60 A/C	72 °F ±8°							
EP 20906 A/C PEF	---							

Equipment	On	Off	Chill Water Out Temp	Oil Press.	Surge Tank Level OK	Condenser Water Inlet Pressure	Time
EP235F-2F-20901 Refrig. Unit							AM
							PM
EP12-1-4B Refrig. Unit							AM
							PM
EP12-1-5A Refrig. Unit							AM
							PM
Process Chiller							AM
							PM
Process Chiller							AM
							PM

Equipment	Hand	Auto	Cooling Water Supply Adequate? Yes	Cooling Water Supply Adequate? No	Oil Level-OK Yes	Oil Level-OK No	Does the Compressor Carry the Load Alone? Yes	Does the Compressor Carry the Load Alone? No	Time
Instrument Air Comp.									AM
									PM

DO NOT REMOVE From SRP
Without Approval
SEPARATIONS DEPARTMENT
DPSOP Ref 268-2
PUFUEL FORM FACILITY (PuFF)

DPSOL 235-F-FRM-12
Revision 0
Approval Date ________
Category UET

MONTHLY OPERATING CHECKSHEET

---

*Denotes revision to this DPSOL

APPROVALS:

W.T. Davis 1/26/84
Sep Date

1/26/84
Sep Tech Date

FREQUENCY:
The tasks listed below are to be completed the first week of each month .

INFORMATION:
Some equipment in the 235-F facility should be operated monthly . Water samples and filter differential readings should be taken monthly .

SAFETY:
Comply with all Building Safety rules .

RADIATION AND CONTAMINATION CONTROL:
1) Comply with DPSOL 200-FH-9 (DPSOP 40-1), Regulated Areas and Radiation Zones, Building 235-F.

PROCEDURE:

1) Operate the window water recirculation system per DPSOL 235-F-PuFF-3369 .

____
DATE

2) Operate the air handling unit in the Calorimeter Room for thirty minutes each month .

____
DATE

3) Operate the Emergency Diesel Generator at least once each month .

____
DATE

4) Sample the Recirculation Water per DPSOL 235-F-PuFF-3369 .

____
DATE

Date___________

Equipment	Hand	Auto	Cooling Water Supply Adequate?		Oil Level-OK		Does the Compressor Carry the Load Alone?		Time
			Yes	No	Yes	No	Yes	No	
Instrument Air Comp.									AM
									PM
Breathing Air Comp.									AM
									PM
Breathing Air Comp.									AM
									PM

Equipment	In Secure		Heating Switched				Time
	AM	PM	AM	PM	Yes	No	
Dryer Inst. Air							AM
							PM
Dryer Inst. Air							AM
							PM

Equipment	On	Off	Expected Reading	Range	Reading		Remarks
					AM	PM	
[redacted]			Plenum Vac -6.2	-5.0 -7.0			
			Plenum Vac -6.2	-5.0 -7.0			
D-4 Flow Gage			.05	.04 -.06			
D-1 Static			.34	.32-.36			
D-2 Static			.34	.34-.38			
Argon Blower			600	CFM 550 - 610			
Argon Blower			600	CFM 550 = 610			

Date____________

Equipment	On	Off	Expected Reading	Range	Reading AM	Reading PM	Remarks
Hot Press Cooling Water Pump EP 30-3-5.60							
Hot Press Cooling Water Pump EP 30-3-6.60							
Hot Press Surge Tank EP 30-3-4.2			9.0	8.0 - 10.0			
Surge Tank EP 30-3-7.2			9.0	8.0 - 10.0			
Surge Tank EP 5-1-1.1			9.0	8.0 - 10.0			
VOG Cooling Pump A			-	-			
VOG Cooling Pump B Pump B			-	-			
VOG Surge Tank							

PuFF Control Room	Name	AM		PM		Remarks
		Yes	No	Yes	No	
Red Alarms on Panel Boards?						
Fire Systems 1-13 Alarm or Trouble?						
Cell 1 - 5 On Recirculate						
Hot Press Vacuum Pumps Operating?						
Vacuum Outgas Pumps Operating?						

	Range	AM	PM	Chart Dated	Remarks
Exhaust Fan Plenum Vacuum	5.0 - 7.0				
Dew Point Of Inst. Air	-30° to -10°				
Roof Tunnel Vac.	Read Gage Direct -1.0 to -2.8				
Argon Tank Level	40" to 178"				
Waste Tank Level	5" to 75"				

EXHIBIT 13

PRESENT PuFF STATUS

- o FACILITY PLACED IN PRODUCTION READINESS 1/1/84

- o PRESENT STAFFING LEVEL:

  1 - SUPERVISOR — Chuck Hill

  2 - OPERATORS

  0 - ADMINISTRATIVE SUPERVISION

PRODUCTION READINESS ACTIVITIES

o ROUTINE FACILITY PATROL

o TESTS OF SAFETY RELATED SYSTEMS

o EXERCISING KEY PROCESS EQUIPMENT

o FACILITY MAINTENANCE

o ASSIST ON CAPITAL PROJECTS — Clyde Hill helps here furnaces are not expensive – no major parts

ROUTINE FACILITY PATROL

o **DAILY EQUIPMENT CHECKS**

- HOT PRESS VACUUM PUMPS – maintained under vacuum all the time maintains seals
- VACUUM OUTGAS FURNACE VACUUM PUMPS – run continuously
- VENTILATION EQUIPMENT — 24 hrs/day
- REFRIGERATION EQUIPMENT – 24 hrs/day (cools vac pumps)
- INSTRUMENT AIR COMPRESSORS
- BREATHING AIR COMPRESSORS
- DIESEL GENERATOR — has to be on line check battery charge & fuel levels
- CONTAMINATION CONTROL EQUIPMENT – HP fans & exhausters

Are storing Pu-239 in a vault

ROUTINE FACILITY PATROL

All of this is production type equipment

o WEEKLY OPERATING CHECKS

- HOT PRESS HYDRAULICS – move up & down
- HOT PRESS MG SET – just start MG & run thru cycle; mfg said start w/ move
- COLD PRESS HYDRAULICS – make sure ~~the~~ seals okay & rams won't freeze
- CELL 6 WELDER – run table ass'y & chuck ass'y up & down & torch in & out but don't fire it
- CELL 6 HELIUM UNIT
- CELL 9 WELDER – just run chuck in & out
- CELL 9 HELIUM UNIT
- MANIPULATORS – 9 on west side, on east side; exercise manipulators up & down
- BALL MILL – run 15-30 minutes
- NDE EQUIPMENT – has been drained (Calgon); rotate chuck & exercise stepping motor
- AUXILIARY VACUUM PUMPS

no checking of electronics

kept in air (not with inspect of running He test)

just make sure blowers work

in intervals ...

ROUTINE FACILITY PATROL

o MONTHLY EQUIPMENT CHECKS

- WINDOW WATER SYSTEM — change out filters (have algae or rust inhibitors) Same frequency as when operating, lab analyzes for levels of inhibitors

- EMERGENCY DIESEL GENERATOR — once a month do a load test (put load on & mill power) Same type tests as when operating

- VENTILATION CONTROL DAMPERS — check settings to make sure air differentials are what is desired

TESTS OF SAFETY RELATED SYSTEMS

same frequency as operating

- EMERGENCY POWER SYSTEM — tested once a month
- FIRE SUPPRESSION SYSTEM — 2 tests — semiannual - weigh halon bottles & test ...
  annual - weigh all ... functionally test ... circuits
- VENTILATION EXHAUST DAMPERS
- CELL SEAL POTS — Cell 6 & 9 of pellet processing cell prevents blowout from overpressure & implosion from vacuum.

Max ΔP = 4" - most set at this level

EXERCISING KEY PROCESS EQUIPMENT

- o EQUIPMENT WAS SELECTED BY OPERATING GROUP – no priority factor for all.
- o FREQUENCY ESTABLISHED BASED ON production EXPERIENCE
- o PURPOSE - PRESERVATION, NOT OPERATION – avoid major replacements
- o SOME EQUIPMENT FAILURE ANTICIPATED

ANTICIPATED EQUIPMENT FAILURES

- o MANIPULATORS — will lose all 16 ner ? yrs or more (extensive oxidation) will lose manipulators in train of start up
- o HOISTS — 3 hoists (lost 1 every 3 months) - large endeavor not experiencing
- o FURNACE HOSES — neoprene hoses will crack & fail - same for electrical cords
- o FURNACE LIGHTS all cell lights will have to be replaced
- o ELECTRICAL CORDS
- o TRANSFER DEVICE BEARINGS rollers ~~[illegible]~~ bearings on cold press XE[illegible] lost a bearing every 4 months
- o INTERCELL TRANSFER DEVICE Kevlar belt + oxygen motor & helium motor

lost kevlar tape ~ 6 months

& particles will do this

<u>FACILITY MAINTENANCE</u>

o MAINTAIN ESSENTIAL EQUIPMENT

o MAINTAIN KEY PROCESS EQUIPMENT

o PERFORM SELECTIVE PREVENTATIVE MAINTENANCE

o NO PROVISION FOR REPAIR OF NONESSENTIAL EQUIPMENT

(e.g. manipulators left in place

EXHIBIT 14

1120.10-2

32

OCT 10 1985

Mr. J. T. Granaghan
Plant Manager
Savannah River Plant
E. I. du Pont de Nemours and Company
Aiken, SC 29808

Dear Mr. Granaghan:

RESTART OF THE PLUTONIUM FUEL FORM FACILITY (PuFF)

We have been advised by the Department of Energy-Headquarters that we shoul[illegible] plan restart of production in PuFF to support delivery of fueled clads at th[illegible] rate of 14 per month beginning in April 1989. This represents a delay of on[illegible] year in our previous plans for production restart.

The projected delay in restart of PuFF may have implications other than thos[illegible] associated with budgeting for restart of the facility. From previous conversations with your staff and from our own observation, we are concerned abou[illegible] the desirability of maintaining PuFF in the current production readines[illegible] mode. The delay in planned deliveries also impacts the activities o[illegible] HB-Line, the frames and ultimately the reactors.

In order to answer these concerns, you are requested to provide a comprehensive study of near-term management options for the Plutonium-238 program. I[illegible] performing this study, you are requested to address as a minimum the area[illegible] indicated on the enclosed outline which also lists the assumptions to b[illegible] used.

Please provide us with the results of this study by November 15, 198[illegible] Should your staff have any comments or questions concerning this effort, the[illegible] may refer them to Gordon Nichols, extension 5-[illegible].

Sincerely,

Original Signed by M. J. Sires

M. J. Sires
Assistant Manager
for Operations

CWS:GMN:lcj

Enclosure

cc w/enclosure:
J. E. Conaway, AED, Du Pont-Wilm.

bcs: Production (Concur)
FMSPS (Concur)
MSO
SR Reading File

CONCURRENCES
RTG SYMBOL
INITIALS/SIG.
DATE
RTG SYMBOL
INITIALS/SIG.
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DOE F 1325.10
(7-79)

OFFICIAL FILE COPY

EXHIBIT 15

DUPONT

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED

ATOMIC ENERGY DIVISION

SAVANNAH RIVER PLANT
AIKEN, SOUTH CAROLINA 29808-0001
(TWX 810 771 2670 TEL 803 725-6211 WU AUGUSTA GA)

November 19, 1985

Mr. M. J. Sires (2)
Assistant Manager for Operations
Savannah River Operations Office
U. S. Department of Energy
P. O. Box A
Aiken, SC 29802

Dear Mr. Sires:

RESTART OF PLUTONIUM FUEL FORM (PuFF) FACILITY

Ref: Letter, M. J. Sires to J. T. Granaghan, 10-10-85

In the referenced letter you requested a review of the impact of the delay in starting of PuFF, and a study of the near term options for the plutonium-238 program. As a result of this study, we strongly recommend that PuFF be maintained in the production readiness mode. Because of continuing deterioration of in-cell electrical insulation and aluminum manipulator parts, an additional three months will be required to replace this equipment and thoroughly clean the cells. We recommend that PuFF be started up in the fourth quarter of FY 1988 in order to begin delivery of 14 fueled clads per month in April 1989.

Delaying PuFF startup until 1989 has no adverse effect on H-Frames, H B-Line, or reactor schedules. The delay will actually increase plutonium-239 production in FY 87 by permitting plutonium-239 to be processed in the neptunium facility in H B-Line.

Additional details are attached. If you have any questions or would like more information please contact Mr. J. T. Buckner of my staff.

Yours very truly,

R. Maher
Manager of Operations

JTB/vrb
Att

CC: J. E. Conaway, AED-Wilm
J. T. Granaghan, SRP, 703-A

Additional details are attached. If you have any questions or would like more information please contact Mr. J. T. Buckner of my staff.

Yours very truly,

R. Maher

R. Maher
Manager of Operations

JTB/vrb
Att

CC: J. E. Conaway, AED-Wilm
J. T. Granaghan, SRP, 703-A
BCC: J. T. Lowe, SRL, 773-A
J. A. Kelley, 703-A
J. F. Ortaldo, 703-A
L. M. Papouchado, 703-A
J. K. Brown, 703-H
J. G. McKibben, 703-H
J. T. Buckner, 703-F

Attachment

PuFF

Current Status

PuFF has been maintained in the production readiness mode since January 1984. All safety systems, including emergency power, fire suppression, and ventilation systems are operable. All major equipment, presses, vacuum systems, welders, etc. are exercised on a regular basis and repaired as necessary to maintain the equipment in an operable state. An adequate supply of spare parts is kept, including enough manipulators to permit a complete changeout prior to startup. The inert atmosphere in the east cell line is maintained to 1) ensure operability of the system, 2) detect leaks that may occur, and 3) reduce corrosion due to high moisture content. In addition, general building readiness is maintained.

Equipment Deterioration

In spite of these maintenance measures, significant deterioration of in-cell electrical insulation and aluminum manipulator parts has occurred and more is expected to occur as a result of the two year delay in startup. Prior to startup of PuFF, all in-cell electrical wiring and manipulators in cells 1-4 must be replaced and the cells thoroughly cleaned. The extended outage will, no doubt, affect the integrity of many other systems which are not routinely used. It is estimated that three additional months will be required to bring the PuFF facility back to full operating status.

Equipment Replacement

With the exception of the in-cell electrical insulation and manipulator deterioration, maintaining PuFF in the production readiness mode has kept the facility in excellent condition. The only major piece of equipment that needs to be replaced is a calorimeter. This calorimeter, which is defective and cannot be repaired, must be replaced.

There has not been, and is not expected to be, any significant obsolescence of equipment in the PuFF facility. Most of the major equipment items are of special design and are adequate for PuFF restart. However, the clean iridium welder used by the Equipment Engineering Department for training, process support, and special welding programs is an older model without computer control. This welder is getting old and difficult to maintain and should be replaced with one identical to the PuFF welder.

Before startup of PuFF, a new waste handling facility and a standby air compressor need to be added to the facility. The waste handling facility is needed to handle the new B-25 waste containers now in use at SRP. These large containers must be loaded out of doors and are, therefore, subject to weather conditions. A shed to cover the B-25 containers during loading and a room to store radioactive waste prior to discard is needed.

A standby air compressor is needed to ensure that Building-235 essential functions are maintained. All PuFF compressors (breathing air, instrument air, etc.) are cooled by process water. In the event of a process water outage, it is difficult to maintain proper building ventilation. An air cooled, oil free compressor and protective building are needed.

A list of capital equipment items required are listed below and are included in the proposed FY 1988 capital budget.

Capital Equipment

Calorimeter	$100,000
Welding System for EED	$200,000
Waste Handling Facility	$100,000
Standby Air Compressor	$150,000
Total	$550,000

Production Readiness Mode

Maintaining PuFF in the production readiness mode has provided essential protection for most PuFF cell equipment, safety systems, and general building functions. It is strongly recommended that PuFF remain in the production readiness mode until startup. Putting PuFF in "standby" condition would seriously jeopardize the ability to restart PuFF without replacement of most of the major equipment items and a general rework of all facility functions. In addition, restarting PuFF from a standby condition may require a new Environmental Impact Statement.

PLUTONIUM-238 PRODUCTION

H-Frames

The H-Frames upgrade work needs to proceed on the current schedule in order to complete development work and ensure arrival of long delivery items. Early replacement of the frames is desirable. Frames removal requires a significant amount of canyon crane time, and there is likely to be considerable more crane time available in FY 1986 than in subsequent years because of the C Reactor outage.

Available Mark 53 targets will be processed in 1986 to meet the FY 86-FY 88 LANL commitments. Plutonium-238 scrap will be processed, if time permits, to provide sufficient plutonium-238 oxide for FY 89-FY 90 LANL commitments as a contingency against further slippage of the PuFF schedule. Frames processing needs to be curtailed no later than June 1986 to begin Frames removal and other Frames project upgrades.

H B-Line

Present H B-Line staffing appears to be adequate until the 3Q of FY 1988 when it will be necessary to staff up the plutonium-238 facility (Phase III) to permit operation of the neptunium-237 (Phase II) and plutonium-238 facilities concurrently (see Figure 1). This staffing will be required as long as the plutonium-238 facility operates. The schedule assumes operation of the neptunium facility on plutonium-239 scrap/impure oxide when it is not producing neptunium-237 oxide.

Delaying plutonium-238 production one year allows the neptunium facility to process plutonium-239 in FY 1987. Beginning in FY 1988, fifty percent of the neptunium facility capacity will be required for neptunium-237 processing. The schedule shows that neptunium-237 and plutonium-239 would be run in alternate years rather than alternating every six months. We feel that this maximizes plutonium-239 production since extensive flushing is required between campaigns.

The impact of processing plutonium-239 in the neptunium oxide facility is that it will be FY 88 or FY 90 before the "marginal" plutonium-238 scrap can be processed. The neptunium oxide facility schedule dictates the scrap recovery facility (Phase I) schedule, since no scrap plutonium-239 can be processed while neptunium-237 is being processed through the neptunium facility. During these periods, plutonium-238 scrap and EUPu will be processed in the scrap recovery facility (see Figure 2). When plutonium-239 is processed in the neptunium facility, both scrap recovery lines will process plutonium-239 scrap.

Neptunium Billet Line

The neptunium billet line in Building 235-F will operate concurrently with the neptunium facility in H B-Line on alternate years. The startup expense prior to each campaign will be less costly than running the facility at a slower rate continuously.

REACTOR SCHEDULE

There will be no adverse effect on reactor schedules. Approximately 18 months lead time (a minimum of 12 months) is required to fabricate, irradiate, cool, and process the Mark 53 targets. The Mark 53 targets are substituted for Mark 31 targets in the reactors with only a minor loss of plutonium production and little impact on the reactor schedules.

FIGURE 1

PLUTONIUM-238 PRODUCTION SCHEDULE

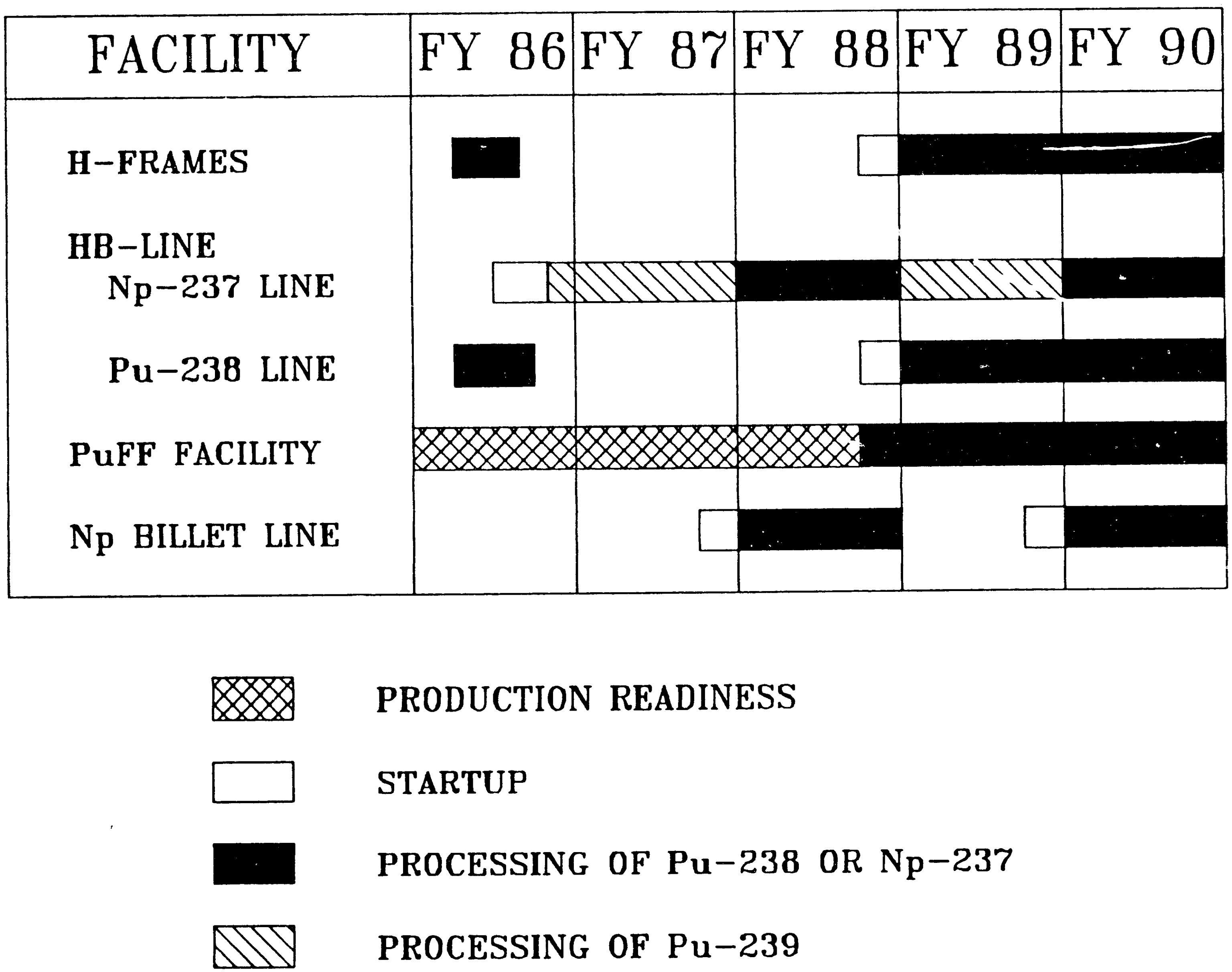

FIGURE 2

PLUTONIUM-238 SCRAP SCHEDULE

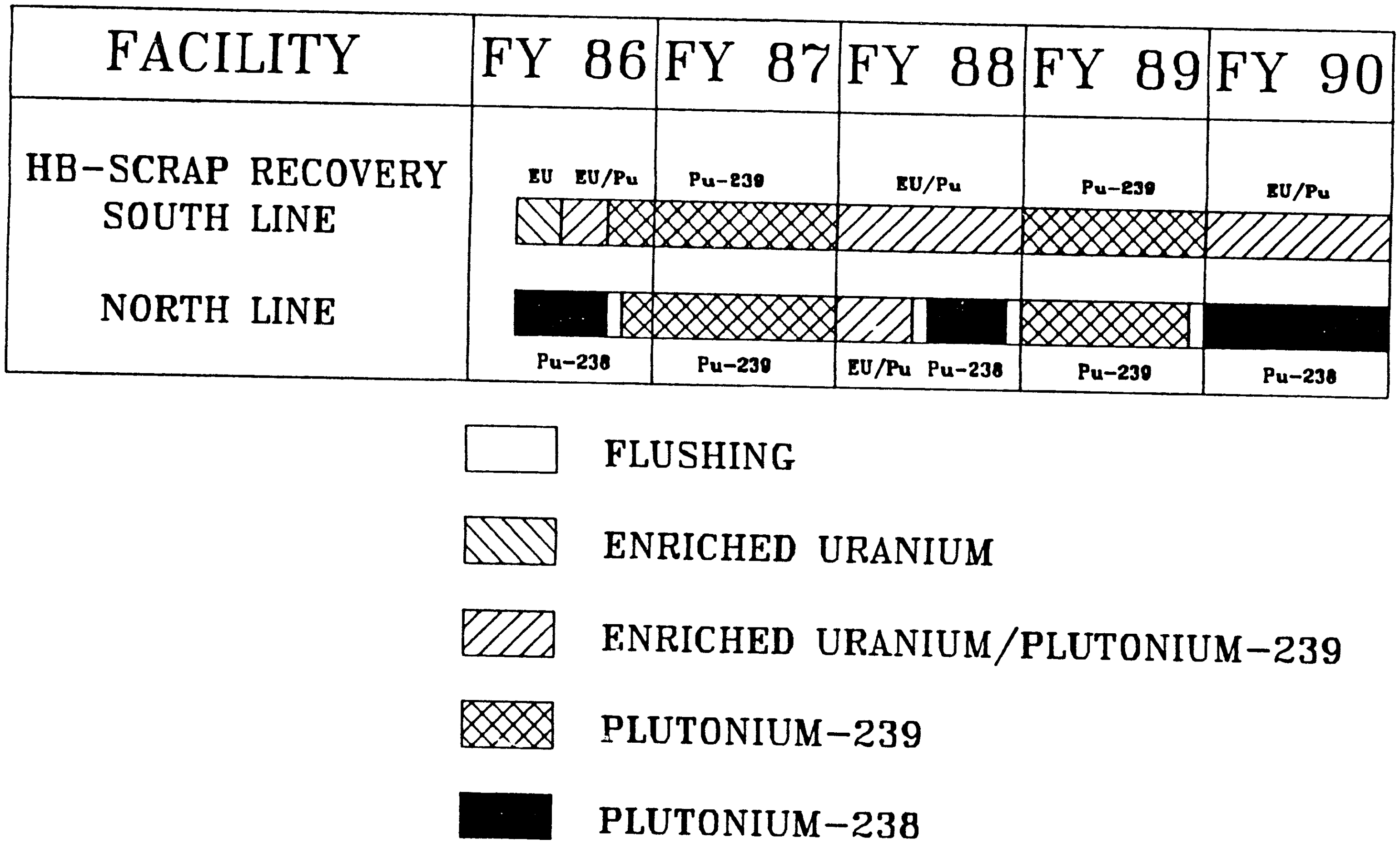

EXHIBIT 16

2139 - 3 DRAFT

James W. Vaughan, Jr.
Principal Deputy Assistant Secretary
for Nuclear Energy

PLUTONIUM-238 AVAILABILITY FOR SPACE AND TERRESTRIAL POWER SYSTEMS (MEMO VAUGHAN TO WADE DATED JUNE 24,1987)

In reply to the concerns expressed in your memo please let me assure you that I share our mutual interest in continuing the Department's commitment to production of Pu-238. As you are aware, however, the austere budget climate we now face, coupled with requirements to comply with an ever-increasing and more stringent body of regulations related to safeguards, environmental protection, and safety dictates that available funding be applied to production of materials for which there exist firm requirements. Unfortunately, our past experience has shown that Pu-238 requirements have had a tendency to undergo significant reduction by the time that they become firm. This has resulted in production facilities planning for production of significantly more Pu-238 than was actually required. Prior to FY 1987, even though we were not in receipt of confirmed requirements, we felt that we had sufficient ceiling to permit including in our budget requests funds to allow planning for production of Pu-238 and maintenance of the isotope production facilities while not compromising our primary mission or the many required cross-cut programs. Unfortunately, this is no longer the case. Without firm Pu-238 requirements coupled with the necessary authority to produce Pu-238 at the expense of Pu-239 production, we are unable to justify including maintenance of the Pu-238 isotope production facilities in our current budget planning.

I had hoped that availability of Department of Defense funding for the Defense Isotope Power System (DIPS) would permit us to continue operating the HB-Line facilities in preparation for the high production demands of that program. I now understand that the likelihood of such funding beyond FY 87 is in doubt pending the Air Force Program Office commitment to the nuclear system. I had also hoped that in lieu of DOD funding we would be able to identify within the Department or through appeal to Congress sufficient funding to permit HB-Line to participate in the recovery of some of the Pu-239 scrap available. Such activity would serve the ~~dual purpose of permitting continued activity in the HB-Line~~ as well as contributing to the resolution of some of the

Pu-239 production shortfalls Unfortunately, it appears that the probability is not high that these funds can be provided.

I am providing for your information and use the attached HB-Line fact sheet prepared by SR Staff and covering various aspects of the operation of the HB-Line. I understand that a somewhat condensed version has been provided to the DOD to answer questions they had concerning future operations in HB-Line. As you will note, I feel that, unless sufficient FY 1988 funds are identified by August 10, 1987, I will have no choice other than to place the HB-Line in cold-standby status. We have not attempted to estimate the costs or time required to restart the line once it has been placed in this status. Previous experience, however has shown us that costs and delays increase with the amount of time that a facility remains in standby status. It should also be noted that barring some unforeseen change in the budget outlook, any request for restart would have to be fully funded by the requesting agency unless the requirement were confirmed sufficiently in advance to permit the necessary additional budget ceiling to be incorporated into the normal budget process.

I regret that I can not provide a more optimistic view of the future. It does appear, however, that unless customer agencies are willing to commit to firm requirements for Pu-238, through signed interagency Memoranda of Understanding and provision of some funding in the near term, the Pu-238 program may fall to the budget axe. I will be happy to discuss this further should you wish, either directly or through continued dialogue between our staffs. In the meantime, we will continue to pursue any avenues which will protect and continue our commitment to the Pu-238 programs.

T. E. Wade
Principal Deputy Assistant Secretary
for Defense Programs

bcc: PROD XIV

FACT SHEET FOR HB-LINE, SAVANNAH RIVER PLANT (SRP)

1. Designed as Plutonium-238 (Pu-238) Facility

   - Capability to: - Recover Pu-238 Scrap

     - Produce Pu-238 Oxide

     - Produce Neptunium (Np) Oxide for Pu-238 Reactor target feed

   - Capability to dissolve Enriched Uranium (Eu), Eu/Pu-239 Scrap included in original design (Material sent to H-Canyon, Pu stored as liquid Nitrate Solution, Eu mixed with SRP fuel stream.).

2. Facility in three sections (Phases):

   Original Design:

   Phase I: Dissolve Pu-238 Oxide Scrap

   Dissolve Eu, Eu/Pu-239 Scrap

   Phase II: Produce NpO_2 from H-Canyon Material

   Phase III: Produce Pu-238 Oxide

   Modified Design (Completed 1986):

   Phase II: Added capability to produce Pu-239 Oxide

3. Operating Methodology for Phase II

   - Can produce Pu-239 Oxide or NpO_2.

   - Estimate three months required between product campaigns for piping modification and flushing. Minimum justifiable production campaign - six months.

   - Pu-239 Oxide production rates vary with feed.

   - Product sent to Los Alamos National Laboratory for conversion to metal.

4. Status:

Phase I - Operating

Phase II - Ready for Operation 1QFY88

Phase III - Operating

5. Funding:

- Operating Costs - $750,000/month for any product
- No firm funding after September 31, 1987
- Np to Pu-239 and Pu-239 to Np conversion costs charged to Pu-239

6. Planning:

- Full support for DIPS will require full use of Phase II after April 1988 (No Pu-239 production possible).
- DIPS uncertain.
- No firm funding for Pu-239.
- If Pu-239 funded, approximately four years of feed has been identified.
- Savannah River Operations Office plans to recommend placing HB-line in cold standby by October 1, 1987, if funding not identified by July 31, 1987.
- Cold standby status defined as all material removed, facility removed from Material Access Area status, security forces withdrawn, staffing reduced to 2 Man/24 hr/7 day fire watch.

EXHIBIT 17

February 13, 1991

TO: Rudy
Bill Dennis

FROM: Randy RMY

ARGON SYSTEM OPERATION (U)

The following is the information requested regarding the timing and background on some of the argon system operational problems.

- The last pellet was pressed in PuFF in 11/83. The last shipment to Mound took place in 2/84. Staffing of the building was down to the minimal level (one supervisor and two operators) by 3/84.

- By 4/84, with the argon system operational, corrosion was observed forming in the East Line Cells. A few individuals familiar with the system were contacted and an investigation was conducted over the next month a time permitted.

- By 6/84, with the corrosion still forming, it was found that the argon dryer beds (molecular sieve material) had "caked-up" and had been rendered inoperable. The result was that the moisture in the cells was not being removed and thus corrosion was being formed. Replacement material was ordered.

- By 10/84, the molecular sieve material was received and the argon dryer beds were returned to service. Over this six month period, though, a significant amount of corrosion had formed on the cells, equipment, and associated plugs & wiring.

- From 10/84 through 7/85, the argon system functioned as intended.

- For a two month period (8/85 - 9/85) the argon system was intentionally shutdown to allow construction work to take place at [redacted]. The chilled water lines running through the vault to the argon system were relocated.

- From 10/85 through 1/87, the argon system functioned as intended. The dryer beds (molecular sieve material) was inspected in 12/86. Everything was OK.

- From 1/87 through 5/88, a number of significant mechanical failures occurred in which repairs were required. During this period of time, the system ran intermittently. An estimate would probably be 50%-75% downtime.

- From 5/88 through 4/89, the blowers were down and the argon cut off from the cells.

- In 4/89, as part of the PuFF renovation tasks, a concious decision was made to leave the system down until restart activities dictated placing the system back in operation. A significant amount of corrosion had taken place and restarting the argon system would not positively impact initial renovation tasks.

CC: Dan
Dave
Jon

EXHIBIT 18

SRL-ATS-91-181

WESTINGHOUSE SAVANNAH RIVER COMPANY
SAVANNAH RIVER LABORATORY

INTER-OFFICE MEMORANDUM

April 15, 1991

To: C. R. Goetzman, 707-F

From: J. W. Congdon, 235-11F JWC

cc: J. G. McKibbin, 707-F
R. L. Yourchak, 235-F
A. L. Blancett, 773-A
J. E. Black, 773-A
ATS File c/o J. B. Reese, 773-A

Subject: Effect of Atmosphere on Corrosion Rates in $^{238}PuO_2$ Contaminated Gloveboxes and Cells

The Plutonium Fuel Form (PuFF) Facility has been shutdown since early 1984. During the intervening period significant equipment degradation occurred, primarily in the East Line. The Savannah River Laboratory was requested to assess the role of the failure to continuously maintain an inert atmosphere in the PuFF cells on the degradation which occurred during shutdown.

Detailed studies of the interactive effects of the oxygen level, moisture content, and $^{238}PuO_2$ contamination levels on corrosion rates of various metals are not available. General observations can be made about the corrosion of materials in $^{238}PuO_2$ facilities under a variety of conditions. $^{238}PuO_2$ glovebox facilities, including the Alpha Materials Facility (AMF) in Bldg. 773-A and the old Metallography Laboratory in Bldg. 235-F, were operated with a once-through air atmosphere. The gloveboxes and all of the major equipment in these facilities were constructed from stainless steel to avoid corrosion problems. Most metals, other than stainless steel, corroded very rapidly when used in these facilities. It is known that $^{238}PuO_2$ accelerates corrosion due to alpha sputtering of the protective films on most metals. Due to the low energy of alpha particles, $^{238}PuO_2$ must be on the surface of the metal to have a significant effect. This is most likely to be prevalent in cells or gloveboxes used for processing fine powder which is easily dispersed. When the Plutonium Experimental Facility (PEF) was operated with an inert atmosphere from 1978 to 1982 very little corrosion was observed despite significant accumulation of fines from powder processing. Similar observations were made during the operation of the PuFF Facility. The inert systems for the PEF were shutdown from 1982 to 1988 and air was purged through the boxes. During this period, significant corrosion was observed on metals other than stainless steel in the PEF gloveboxes.

These observations indicate that a dry, inert atmosphere is effective in minimizing corrosion in $^{238}PuO_2$ gloveboxes and cells. Moisture and/or oxygen are obviously required to initiate corrosion since it is an oxidation process. The role of $^{238}PuO_2$ in the corrosion process is to accelerate the corrosion rate by alpha sputtering of the protective oxide films on the surface of metals.

The corrosion problems which were observed in the PuFF cells shortly after shutdown in 1984 coincided with the failure of the argon dryer beds. Although the beds were repaired by October, 1984, a significant amount of corrosion had formed in the cells. It is likely that the increased moisture levels during this period were responsible for the accelerated corrosion rates. Subsequent problems with the argon system resulted in periods in which the dry, inert atmosphere was not maintained. Several mechanical failures in the inert system occurred throughout 1987 and by the end of the year the system had failed. The argon system has not been restarted.

The moist air in the cells contributed to the corrosion problems which occurred in the PuFF Facility after shutdown. This was most obvious in the corrosion of the aluminum on the manipulators in the East line. In any case, these manipulators would have been replaced with manipulators with an increased lifting capacity. The corrosion on the seal tubes and slave connections would have complicated the replacement of the manipulator slave ends. Because of the corrosion, it would have been necessary to remove the slave portion of the manipulator through to the operating side using a procedure which had been demonstrated during the previous production campaign. It is likely that the corrosion of minor items such as nuts and bolts or electrical contacts would have hindered the renovation. A thorough clean-up of the corrosion products would have been required to minimize the risk of introducing these impurities during processing. Most of the major equipment in the PuFF Facility was constructed from stainless steel which did not experience any corrosion problems. Based on the experience acquired during the PEF renovations, the major problems expected in the PuFF hot press and furnaces would have been a result of the degradation of organic materials rather than metallic materials. O-rings, gaskets, plastics, rubber water hoses, and other organic materials must be routinely replaced when exposed to $^{238}PuO_2$, regardless of the atmosphere. It is also likely that the in-cell cabling would have required replacement, regardless of the atmosphere, due to failures of the electrical insulation.

In summary, the most significant corrosion damage resulting from the loss of the inert atmosphere in the PuFF Facility was the damage to the manipulators and seal tubes in the East Line. Extensive repairs or replacement of the hot press chamber and vacuum system would have been necessary regardless of the atmosphere. Likewise, most of the in-cell wiring, bench-top equipment, handling tools, balances, measurement devices, thermocouples, valves, and seals on the furnaces would have required replacement after this extended shutdown.

EXHIBIT 19

OSR 3-4A-W (Rev 1-89)

WESTINGHOUSE SAVANNAH RIVER COMPANY

INTER-OFFICE MEMORANDUM

NMP-SFF-910317

July 3, 1991

TO: FILE

FROM: R.L.YOURCHAK, 235-F
2-4232

PLUTONIUM FUEL FORM (PuFF) CELL CONTAINMENT BARRIERS (U)

The following enclosure equipment pieces maintain the contamination barriers (containment) for the PuFF Facility Eastline Cells 1-5.

MODEL-L MASTER-SLAVE MANIPULATOR

The Model-L manipulator is a sealed unit. A double seal system is provided with a space between the sets of static and dynamic seals which is accessible at the master side.

The seal tube is a concentric tube assembly capable of transmitting all manipulator motions. The seal tube consists of six rotating stainless shafts to transmit the manipulator motions and one shaft to actuate the slave engagement mechanism. Mounted on each end of the seal-tube assembly is a plate which contains a set of seals for each shaft. The space between each set of seals is oil filled and communicates with other seals in the seal plate.

The seventh sealed manipulator motion is the rotation of the seal tube within its assembly. It consists of a set of seals located at each end of the seal tube with the space between sets of seals oil filled and a set of expandable elastomer seals to seal the annular space between the wall tube and the seal tube.

Leakage across either interface is essentially zero as long as the oil level in the reservoirs is maintained. Oil usage does not mean that leakage across the interface is occuring. As long as the oil level in the reservoirs can be maintained and no air gets into the system, the integrity of the seals will be maintained.

So, basically, the seal system consists of a set of seals at the master interface with the space between individual seals oil filled and fed by an oil reservoir on the master side and a set of seals located at the slave interface with the space between individual seals oil filled and fed by an oil reservoir at the master end.

- The static seals are lubricated with dry molykote type Z prior to installation in the enclosure wall to prevent the seals from seizing to the wall tube. The static seals are made of an elastomer.
- Welch Duo-Seal pump oil is used for the slave and master oil-reservoirs. Gaskets and o-rings are made of polyethylene.
- Approximately nineteen (19) inches of lead shielding is provided in each seal tube.

BULK SHIELD WINDOW ASSEMBLY (Control Room Side)

The window assembly on the Control Room side of the Eastline Cells 1-5 consists of an inner containment window, an eighteen (18) inch thick water filled shielding window, a second sealed window, followed by a final piece of lead glass protected by two thin layers of plate glass.

- Inner Containment Window (Direct Contact to Cells)

  The inner containment window is a 3/4" thick piece of lime white tempered plate glass. Three individual seals (one each on each face, one at the base) ensure containment. The seals on each face are 3/8 " neoprene while the seal at the base is 1/8" polyvinylchloride.

- Water Filled Shielding Window

  An eighteen (18) inch thick water filled tank is installed on each of the cells to provide shielding during processing. The water is de-ionized, filtered, and maintained at a pH of 5-7.

- The Second Sealed Window

  The second sealed window is a 3/4" thick piece of lime white tempered plate glass. Three individual seals (one each on each face, one at the base) ensure containment. The seals on each face are 3/8" neoprene while the seal at the base is 1/8" polyvinylchloride.

- Leaded Glass/Plate Glass Outer Shielding Window

  The final shielding window consists of three layers - an inner clear plate glass, the lead glass, and finally a second piece of plate glass. The pieces of lime white tempered plate glass are 1/4" thick and have neoprene seals (3/8"). The lead glass (6.2 density) is one inch thick is sealed with 3/8" neoprene gasketing material on the faces and 3/16" packed lead wool at the bases.

The bulk-shield (water-filled) window assemblies have an air chamber in front of the glass forming the front of the water tank and in back of the glass forming the back of the water tank. Over a period of time, moisture would accumulate, condense, and distort the view from the Control Room. Argon, which is essentially dry, was used to purge the air chambers. The argon which purged the back chamber discharged through a common discharge line, through a filter, into the trench under Cells 1-5. The argon which purged the front chamber discharged through a vent, located in the upper right hand corner of the window, into the Control Room. The trench air stream discharges through the annulus around each cell into the room exhaust header. The argon system has been isolated from the PUFF Facility cells by de-energizing the blower units and physically valving closed argon service lines into and out of the cells. Ventilation is maintained on the cells through the maintenance exhaust system.

MAINTENANCE SIDE SHIELDING WINDOW ASSEMBLY

The window assembly on the Maintenance side of the Eastline Cells 1-5 consists of an inner containment window, a four inch (typical) thick gelatin filled shielding window, followed by a final piece of lead glass protected by two thin layers of plate glass.

- Inner Containment Window (Direct Contact to Cells)

  The inner containment window is a 1/2" thick piece of annealed (tempered) plate glass. The seals on each face are neoprene.

- Gelatin Filled Window

  The gelatin filled windows are typically four inches thick and are located at those places through which equipment would be routinely operated by personnel. The design calls for a cement seal to the gelatin container.

- Lead Glass/Plate Glass Outer Shielding Window

  The final shielding window consists of three layers - an inner clear plate glass, the lead glass, and finally a second piece of plate glass. The pieces of annealed plate glass are 1/8" thick and have are laminated to the lead glass. The lead glass (6.2 density) is one inch thick. The entire lead/plate glass window is sealed with neoprene gasketing material on the faces and packed with lead wool at the bases. Type 3-M (#2262) sealer was used around edges of the glass between the neoprene and lead wool.

SPHINCTER GLOVE PORT ASSEMBLY

The sphincter glove port assembly provides a positive seal system in which to operate through gloveports as well as replace gloves as needed without exposing the maintenance area to the cell atmosphere. The sphincter assembly shares a seal with the Maintenance side inner containment window (neoprene gaskets). It also has a separate neoprene o-ring seal with the gelatin filled window area.

ELECTRICAL THRU TUBE CONNECTORS

Two types of electrical thru tube assemblies exist in the PuFF Facility. The first is a smaller (7") thru tube for use in the gloveboxes (wing cabinets). The second (24") type is used for an electrical pass through into the cell itself.

- Glovebox (Wing Cabinet) Electrical Thru Tube

  This electrical thru tube has two independent sealing areas along the contacting surface with the wall. They are neoprene gaskets which are compressed separately to expand and seal with the glovebox wall. The space at both ends of the thru tube is sealed with an epoxy (e.g., Scotchcast Resin).

- Cell Electrical Thru Tube

  This electrical thru tube also has two independent sealing areas along the contacting surface with the wall. They are neoprene gaskets which are compressed together to expand and seal with the cell wall. The space at the outer end of the thru tube is sealed with an epoxy (e.g., Scotchcast Resin).

END

DATE FILMED

01/24/92