

John T. Conway, Chairman
A.J. Eggenberger, Vice Chairman
Joseph J. DiNunno
Herbert John Cecil Kouts
John E. Mansfield

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004
(202) 208-6400



November 18, 1997

The Honorable Alvin L. Alm
Assistant Secretary for Environmental Management
Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585-0113

Dear Mr. Alm:

In Recommendation 94-1, the Defense Nuclear Facilities Safety Board (Board) cited the urgent need for the Department of Energy (DOE) to remediate plutonium-bearing materials and spent nuclear fuel in the defense nuclear complex. In its response to Recommendation 94-1, DOE concurred in the need for urgent action and, among other actions, committed to initiating removal of the deteriorating spent nuclear fuel from the K-Basins at Hanford by December 1997 and to providing stable interim storage on site.

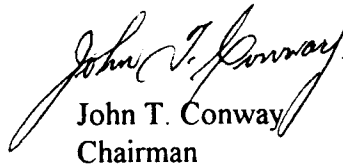
Extensive delays in the schedule for placing the spent fuel in safe and secure long-term interim storage pending its ultimate disposal were announced to the Board during briefings in August and September 1997. As a result, the Board initiated an in-depth review of the reasons for the delays, possible steps that might be taken to recover some of the delays, and measures to ensure that further slippage in the schedule will not occur. A report of this review by the Board's staff is enclosed for your consideration in developing the corrective actions needed to successfully complete the Spent Nuclear Fuel Project (SNFP).

Key observations from the staff review were discussed with you during our meeting on October 14, 1997. The Board is concerned that the significant and unexpected delays in the SNFP were caused by a lack of sound project management, which is essential to successful integration of diverse organizations and activities and vital for project success. Although key management personnel have been added to the contractor's organization, the DOE Richland Operations Office (DOE-RL) still has little confidence that the new contractor-proposed schedule dates will be met. DOE and its contractors must still develop the technical management strength needed to ensure successful completion of stabilization of the N-Reactor fuel in a manner that is safe, timely, and cost-effective. Early identification and rigorous resolution of technical issues, and emphasis on the coordinated planning and scheduling of equipment delivery, installation, and preoperational testing for the various subprojects, will contribute to the safe, expeditious initiation of fuel removal.

The Board recognizes that DOE-RL and the contractors are giving increased management attention to the SNFP, although a sound recovery plan has still not been formulated. The Board requests that DOE provide a report describing DOE and contractor plans for the path forward for the SNFP, including identification of critical path items, actions to be taken to recover schedule slippages, revised milestones and confidence level for achieving revised commitments. There is particular concern with the low confidence level associated with the proposed schedules that have been briefed to the Board.

The Board has excerpted from the enclosed staff report, a list of actions the Board believes need to be undertaken if DOE is to avert further schedule delays. To assist DOE in its recovery plan, those conclusions are also enclosed for your consideration.

Sincerely,



John T. Conway
Chairman

c: Mr. Mark B. Whitaker, Jr.
Mr. John Wagoner

Enclosures: (2)

**Excerpted Conclusions from the October 1997 Board Staff Report
on the Review of the Hanford Spent Nuclear Fuel Project Schedule Delays**

1. Project Management

There should be a systematic identification and evaluation of problems to date; identification and institutionalizing of specific actions to permanently address and resolve the problems; and communication of these changes and individual performance expectations to project personnel. (III.A.1, IV.A.3)

2. Integration

- a. A work control management function for K-Basins should be established with responsibility and control of the resources needed for the daily management of the installation of basin modifications, the Integrated Water Treatment System, and the Fuel Retrieval System. (III.B.2, IV.B.2.c, IV.B.3.c)
- b. A comprehensive evaluation of the integrated utilization of facility systems (all SNFP facilities, systems, equipment and operations personnel resources that move fuel from the K-Basins to storage in the Canister Storage Building) to ensure the safe expeditious *completion* of fuel removal and storage, once it has started. (III.B.2, IV.B.8)

3. Vendor Interface

- a. Vendor delivery incentives should be evaluated and established that would provide opportunities for schedule *improvement*. (III.A.2)
- b. Aggressive expediting of vendors is required to ensure no further slippage in schedule. (III.B.2) This includes vendors for the following equipment:
 - K-Basin Gantry Crane (IV.B.4.c)
 - Multi-Canister Overpack Hoist (IV.B.5.c)
 - Cold Vacuum Drying Processing Units (IV.B.6.c)

4. Technical Confidence Measures

These measures will help ensure that SNFP schedules will be met:

- a. Establishment of acceptance criteria for water removal in the cold vacuum drying process (III.B.1.b)
- b. Establishment of adequate preoperational testing requirements for the Integrated Water Treatment System in the K-Basins, including the use of actual fuel and sludge. (III.B.1.d, IV.B.2.c)

Water Treatment System in the K-Basins, including the use of actual fuel and sludge. (III.B.1.d, IV.B.2.c)

- c. Determination of the applicability of safety-class design criteria for various SNFP cranes. (III.B.1.a, IV.B.3.c)
- d. Obtaining of additional experienced safety analysis personnel. (III.B.1.e, IV.B.9.c)

5. Other Opportunities for Ensuring or Improving the Schedule

- a. Pursuit of alternate procurement strategies for the K-Basin manipulator, and hydraulic actuator. (III.B.3.a.1, IV.B.1.c)
- b. Immediate installation of Fuel Retrieval System control equipment, followed by software modifications at the Hanford site when available from the vendor. (III.B.3.a.2, IV.B.1.c)
- c. Development of effective methods for operator training, using mockups or trainers, prior to equipment delivery and installation. (III.B.3.c)

- d. Development of contingency planning for the following:

K-Basin manipulator failure (III.B.3.a.3, IV.B.1.c)

Delivery of storage tube plugs and hold-downs for the Canister Storage Building (III.B.3.b, IV.B.7.c)

Response to the need for cold vacuum drying equipment modifications resulting from first-article testing (III.B.1.c, IV.B.6.c)

Note: Shown in parentheses are the numbers of the sections in the report where supporting discussions for each conclusion is presented.

Review of the Hanford Spent Nuclear Fuel Project

Defense Nuclear Facilities Safety Board

Technical Report



October 1997

Review of the Hanford Spent Nuclear Fuel Project

This paper was prepared for the Defense Nuclear Facilities Safety Board by the following staff members:

R. Arcaro	J. Roarty
R. Barton	S. Stokes
D. Grover	D. Thompson
A. Gwal	D. Wille
A. Hadjian	W. Yeniscavich
M. Moury	R. Zavadoski
D. Ogg	

With advice from the following outside expert:

D. Volgenau

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I. EXECUTIVE SUMMARY

The need for safe, expeditious stabilization of the most hazardous residual materials from the nuclear weapons program was identified by the Defense Nuclear Facilities Safety Board in Recommendation 94-1, and acknowledged by the Secretary of Energy in accepting that recommendation. The importance of this matter was further reflected in commitments made by the Department of Energy in its Implementation Plan for Recommendation 94-1, which was accepted by the Defense Nuclear Facilities Safety Board.

The Spent Nuclear Fuel Project, a key element of the Implementation Plan for Recommendation 94-1, is one of the most critical projects at the Hanford Site. This project was established to remove deteriorating spent nuclear fuel from the K-Basins safely and expeditiously, stabilize the fuel by suitable processes, and place it in safe interim storage pending its ultimate disposal.

The K-Basins, which are located only a few hundred yards from the Columbia River, were not designed for long-term storage of spent nuclear fuel. Their structural integrity could be threatened by natural phenomena, especially by potentially damaging earthquakes. As long as deteriorating spent nuclear fuel remains in the K-Basins, a serious threat to the health and safety of the public and of on-site workers remains at Hanford. A significant slippage in the schedule for the safe removal, stabilization, and interim storage of this fuel therefore represents a major safety concern to the Defense Nuclear Facilities Safety Board.

The staff of the Defense Nuclear Facilities Safety Board has completed a review of the schedule problems associated with spent nuclear fuel stabilization at Hanford. A schedule slip of 14 months for the start of fuel removal was briefed to the Defense Nuclear Facilities Safety Board in August 1997. This was in addition to a 5-month slip announced in January 1997. The critical path events leading to this 19-month total slip in the date committed to by the Secretary of Energy in the Implementation Plan for Recommendation 94-1 (July 1999 proposed versus the December 1997 commitment in the Implementation Plan) appear to a large extent to have already occurred.

The principal reason for the significant and unexpected breach of schedule has been a lack of sound project management, that is, a lack of experienced personnel applying appropriate processes and tools for the management and tracking of the Spent Nuclear Fuel Project schedule. Although several competent key management personnel have been added to the contractor organization, there has been an inadequate systematic identification and evaluation of problems to date; a deficiency in the identification and institutionalization of specific actions to address and resolve those problems (i.e., codification, proceduralization, and formal organizational communication); and a failure to communicate these changes and individual performance expectations to project personnel.

Successful integration of a number of activities is necessary for project success. Placing emphasis on coordinated planning and scheduling of equipment delivery and on installation and preoperational testing for K-Basin modifications, the Integrated Water Treatment System, and the Fuel Retrieval System will contribute to the safe, expeditious initiation of fuel removal. In addition, emphasis on timely evaluation of the integrated utilization of facility systems (all facilities, systems, equipment, and operations personnel that move fuel from the K-Basins to storage in the Canister Storage Building) will foster the safe, expeditious completion of fuel removal and storage.

Although the Defense Nuclear Facilities Safety Board's staff did not identify technology issues that would prevent the project from moving forward, the Department of Energy apparently has little confidence that the proposed schedule can be met. Draft performance agreements for fiscal year 1998 prepared by the Department of Energy Richland Operations Office use the milestones in the proposed schedule as the "stretch" milestone dates for earning maximum fee. There is no apparent incentive to reduce the schedule duration. For example, there are currently no vendor incentives in place for early delivery of equipment, nor are there penalties for late delivery. There are possible remedies to these deficiencies. In addition to expediting vendor deliveries to prevent further schedule slippage, potential incentive structures for equipment suppliers offer opportunities for improvements in procurement schedules that would contribute in turn to improvements in the overall schedule for the Spent Nuclear Fuel Project.

A summary of additional observations by the Defense Nuclear Facilities Safety Board's staff appears in Section III of this report.

As a follow-up to the review documented in this report, the Defense Nuclear Facilities Safety Board's staff will review the proposed change in technical strategy recently submitted to Department of Energy Richland Operations Office. Any resulting change package for the Spent Nuclear Fuel Project will also receive close staff attention when issued.

II. BACKGROUND

A. General

During the latter portion of 1993 and the early part of 1994, the Defense Nuclear Facilities Safety Board's (Board's) staff prepared a comprehensive report describing problems associated with the extremely large inventory of special nuclear material and radioactive waste existing in tanks, process lines, and storage facilities throughout the defense nuclear complex. Much of this material was in configurations and states that were potentially unstable, especially in those instances in which production operations had been abruptly terminated. Irradiated nuclear fuel and target elements in spent fuel storage pools awaiting processing at the Savannah River and Hanford Sites constituted a large portion of the special nuclear material.

When weapons production was at its peak, in-basin residence time of irradiated fuel elements was relatively short—only long enough to permit the short-lived volatile and gaseous fission products to decay and radiation levels to drop to the point that the fuel elements could be handled with less danger to the workers and less radiation damage to processing chemicals. In addition, the wall thickness of the fuel cladding for weapons production was much less than that for commercial fuel, to facilitate dissolution. When production was stopped in the late 1980s, the spent fuel elements remaining in the fuel storage basins were simply left in place. Longer in-basin residence times and thinner cladding promote greater penetration by basin water and resultant corrosion.

Based on the information in DNFSB/TECH-1, *Plutonium Storage Safety at Major Department of Energy Facilities* (April 14, 1994), the Board issued its formal Recommendation 94-1, *Improved Schedule for Remediation*, on May 26, 1994, calling on the Department of Energy (DOE) to establish expeditiously a program to characterize, stabilize, and provide for safe long-term interim storage of this residue of the nation's nuclear weapons program. The Secretary of Energy accepted Recommendation 94-1 in late-August 1994, and an acceptable Implementation Plan was submitted by DOE in February 1995.

The situation regarding spent nuclear fuel remains particularly acute at the Hanford Site, where a large number of fuel elements are stored in fuel storage basins near the Columbia River. Most of these fuel elements have been stored for many years under conditions that have contributed to their continuing deterioration through corrosion. All spent fuel from the N-Reactor at Hanford is in the K-East and K-West Basins, neither of which was designed for long-term storage of spent fuel. Both of these basins are located only a few hundred yards from the Columbia River, and the structural integrity of the basins could be threatened by natural phenomena, especially by potentially damaging earthquakes. In the event of a loss of structural integrity of the basins, the probability of radioactive contamination reaching the river and surrounding environment would be high.

B. Description of the Spent Nuclear Fuel Project (SNFP)

The SNFP at Hanford is engaged in the design, safety analysis, and construction of facilities and equipment needed to remove the deteriorating N-Reactor spent fuel from the K-Basins, condition the fuel, and provide interim storage in the new Canister Storage Building (CSB) until a permanent national repository is available. In addition, sludge and debris will be removed from the K-Basins to prepare for future decommissioning of the K reactors. The SNFP process is shown in Figure 1, and the project is divided into separate subprojects as follows.

1. Fuel Retrieval System (FRS)

The purpose of the FRS is to remove the spent fuel from existing canisters and transfer it into baskets. The fuel is cleaned, intact fuel elements are separated from damaged fuel, and the separated fuel is placed into appropriate baskets. The baskets are then transferred to a queue to await insertion into the Multi-Canister Overpack (MCO). The system consists of a fuel washing machine, canister tipping station, fuel sorting table, remote manipulators, basket loading station, flex transfer crane, and MCO loading queue.

2. Integrated Water Treatment System (IWTS)

The IWTS will be installed in the K-West Basin to take suction from the decapping station and the primary wash system of the FRS in order to capture the sludge and soluble contaminants released from the canisters and fuel elements. Solid particles from the sludge are removed in knock-out pots, particulate settling tanks, and sand filters. Soluble contaminants are removed via ion exchange. The cleaned water is returned to the basin.

3. K-Basin Facility Modifications

Although modifications to the K-Basins were not designated as a subproject, the Board's staff examined the interactions of the several concurrent activities under way or about to commence in the K-West Basin. These included modification to fuel storage racks and other in-basin infrastructure; structural upgrades to support the new hoists and manipulators; upgrades to the 30-ton crane to increase its capacity to 32 tons and to add position controllers to ensure proper alignment of MCO, transportation cask, and transportation trailer; interfaces between existing water treatment system and IWTS; and installation of MCO loadout systems.

Spent Nuclear Fuel Project Process

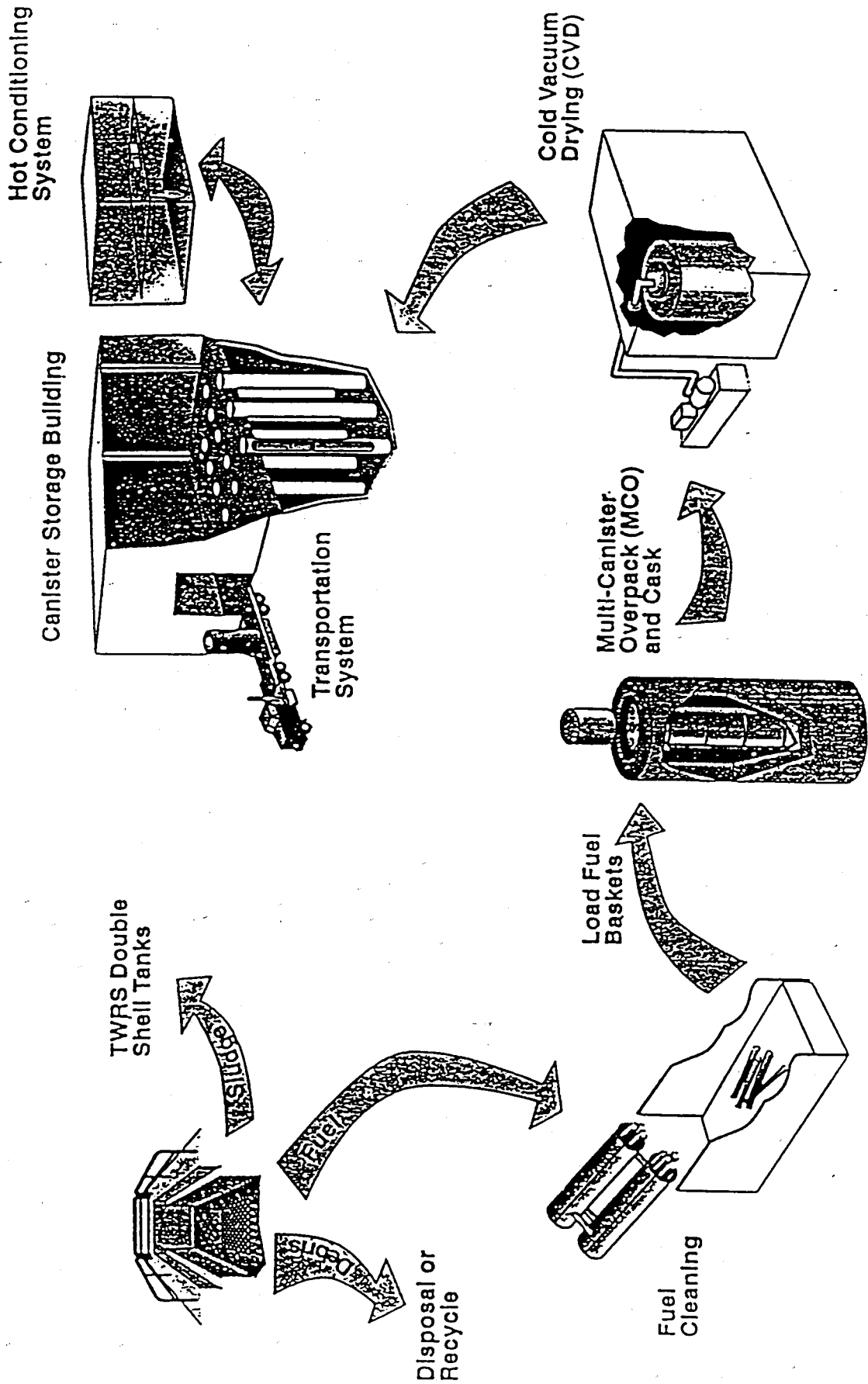


Figure 1

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4. MCO and Transportation

The MCO loadout and transportation system consists of the following major components: (a) the MCO and basket structure; (b) the underwater conveyor and gantry crane used to transfer the loaded baskets from the basin and load them into the MCO; (c) the immersion pail and pail lifting equipment used to raise and lower the combined MCO-Transport Cask into and out of the basin south loadout pit; and (d) the Transport Cask and Transport Cask Trailer used to transport the MCO to the Cold Vacuum Drying (CVD) and the CSB facilities.

5. Cold Vacuum Drying Facility (CVD)

A new facility will be constructed adjacent to the K-West Basin to remove free water and a portion of the hydrated water from each MCO. The CVD first pumps bulk water from the MCO, then continues to dry the interior of the canister using helium at temperatures up to 75°C. A drying cycle of approximately 60 hours results in the removal of all free water and about half of the hydrated water in the MCO.

6. Canister Storage Building (CSB)

The CSB is a new, reinforced concrete, underground vault with a steel superstructure that will provide temporary, monitored staging of drained and dried MCOs transferred from the Cold Vacuum Drying facility, and long-term interim storage of conditioned MCOs from the Hot Conditioning CSB annex until shipment to a repository. The main structure has 220 storage tubes below a shield deck with the capability to store 2 loaded MCOs per storage tube. Natural circulation cooling around the outside of the tubes is used to remove decay heat from the spent fuel.

7. Hot Conditioning System (HCS)

This system was planned as part of the CSB for hot conditioning of the spent fuel to remove additional bound water. Fuel would be conditioned by flowing inert gas over spent fuel at temperatures up to 300°C in special cells below the deck containing the process equipment. The need for this step has been questioned in recent studies, and its inclusion in the SNFP process is currently being reevaluated. It is likely that HCS will be eliminated from the project design, which would simplify the overall project by eliminating the need to develop the HCS technology.

C. Project Schedule

The schedule for SNFP included in DOE's Recommendation 94-1 Implementation Plan, now referred to as the *original schedule*, called for starting to remove fuel from the K-Basins in December 1997 and completing removal of all fuel by December 1999. In January 1997, DOE and its new management contractor for the Hanford Site, Fluor-Daniel Hanford Company (FDH), and the SNFP subcontractor, Duke Engineering and Services Company Hanford (DESH),

informed the Board that the commencement of fuel removal from the K-West Basin had slipped to May 1998, on what is now referred to as the *baseline or current schedule*. This past June, the Board was informed that an additional slippage of 5 to 6 months appeared likely. By August, that additional slippage was reported to be 14 months (i.e., commencement of fuel removal in July 1999 versus December 1997 in the original schedule), on what is now referred to as the *proposed schedule*. This represents a total slip of 19 months from the date committed to by the Secretary of Energy in the original schedule included in DOE's Implementation Plan for Recommendation 94-1. The additional schedule slip of 14 months for the start of fuel removal appears largely to have already occurred. In addition, the Board was informed that there was little confidence that the proposed schedule could be met.

A simplified chart depicting the proposed schedule at a high level is provided in Figure 2. It should be noted that although the CVD subproject was identified by DOE and contractors as being on the SNFP critical path, other subprojects are within a few months of being on the critical path and could easily become pacing items.

At its most recent briefing by DOE, FDH, and DESH, on September 24, 1997, the Board expressed its dissatisfaction at the continuing delays in completing productive work on the basic problem identified in Recommendation 94-1, and subsequently directed its staff to: (1) initiate an in-depth assessment of the causes for the slippage, (2) suggest possible ways of increasing the probability that further delays will not occur, and (3) identify possible ways of regaining some of the lost time.

Summary observations and a discussion of the staff's assessment are provided in Sections III and IV, respectively. A brief description of the assessment approach is given in Appendix A.

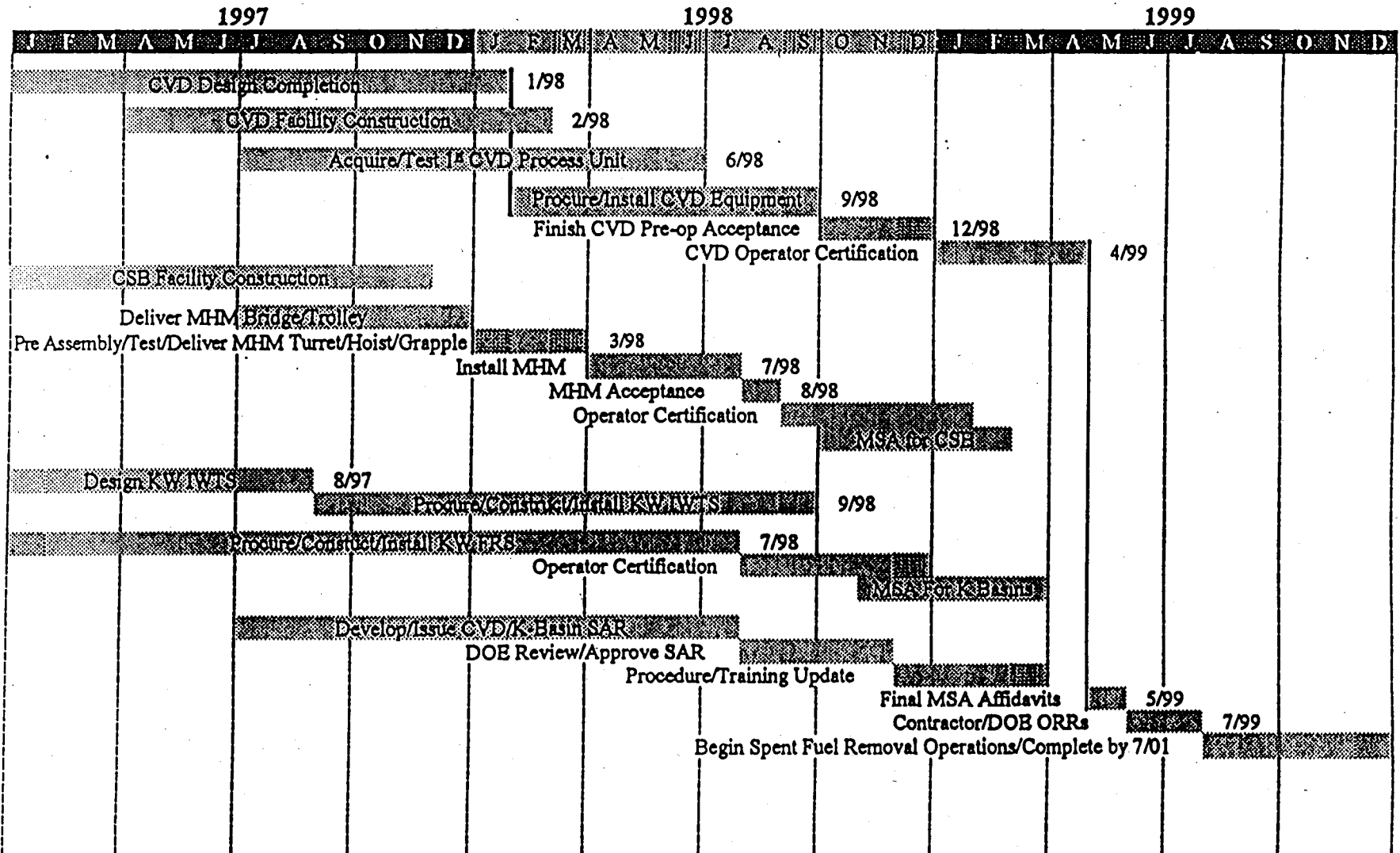


Figure 2
Proposed Schedule for SNFP

III. SUMMARY OBSERVATIONS

A. Project Management

1. Adequacy of Changes Made to Date

Although there were a number of factors that resulted in the SNFP project's significant slip in schedule, a principal reason was the lack of sound project management, i.e., adequately experienced personnel, and appropriate processes and tools, that would serve to identify potential problems early so that they could be resolved in a timely manner. This fact does not appear to be fully appreciated by the Department of Energy-Richland Operations Office (DOE-RL), FDH, or DESH. Neither DOE-RL nor FDH had in place suitable processes and progress measures required to adequately oversee and report the progress and status of the SNFP. It is not clear that the recent actions will be sufficient to ensure future effective oversight.

FDH and DOE-RL have little confidence that the proposed schedule to commence moving fuel by July 1999 can be met.

The following critical items are missing from DESH's path forward:

- a. A systematic identification of the problems encountered to date in project management, including an evaluation of:
 - (1) the project organization
 - (2) personnel roles and responsibilities
 - (3) project management procedures and routines
 - (4) lines of communication and effectiveness of reporting methods
- b. A systematic identification of the project management needs that follow from item a.
- c. Specifically delineated improvement actions, including communication of these actions to the project personnel.
- d. Communicated expectations of improved performance by the project personnel.

2. Effectiveness of Performance Agreements

Interviews of DOE, FDH, and DESH personnel and review of related documents, (including, monthly SNFP progress reports to DOE-RL by FDH/DESH, fiscal year (FY) 1997 performance agreements for the SNFP, and draft FY1998 performance agreements), reveal that past performance agreements have not been effective in driving the SNFP to safe, expeditious completion, and future proposed actions do not promise success.

Monthly SNFP progress reports for the past several months indicate a project that seems to have consistently underspent but also consistently underachieved.

The draft FY1998 performance agreements provide no incentive to do better than the milestones associated with the proposed schedule which represents a 19 month slip from the original Recommendation 94-1 Implementation Plan commitment. Maximum fee is earned by meeting these milestones, which are considered "stretch" objectives. Partial fee is earned by meeting later dates.

Many vendor contracts were put in place before the new contractors came on board. In general, these contracts did not include provisions for either incentives for early delivery or penalties for late delivery. The SNFP managers have viewed this situation as beyond their control. There does appear to be slow recognition of the need to expedite critical acquisitions, and some actions are now being taken in this area. These recent activities are positive since well-planned expediting can accomplish several things, including (1) specific focus in the vendor's shop on those critical aspects of design, manufacturing, or testing that are key to successful performance in the field, and (2) identification of problems that could impact manufacture and delivery, along with timely resolution and/or work-arounds that preserve the equipment integrity and the delivery schedule.

To improve equipment delivery schedules, however, there generally needs to be a source of funds for incentive payments to vendors if they meet accelerated delivery milestones. Appropriate management control is required to produce a sufficiently developed and credible schedule, that would enable a well-run project organization to identify those specific equipment deliveries (and associated vendors) that, if improved, would result in a corresponding improvement to the important schedule milestones (e.g., an earlier start or end date for fuel removal from the K-Basins). Therefore, the SNFP contractors (FDH/DESH) need contractual authority to enter into incentive arrangements with vendors, including those vendors already under contract, and they also need to have a clear enough picture of the value of a shortened schedule from DOE-RL, as reflected in SNFP performance measures.

Schedule milestones that are potential candidates for performance agreements are provided in the individual subproject and related activities subsections of Section IV.

B. Subprojects and Related Activities

1. Technical Approach

There are currently no technical issues that would prevent the project from moving forward.

The recently submitted SNFP proposal from FDH/DESH for a revised technical strategy and a simplified process of applying the technology reduces the complexity of equipment and

facility systems. It could also provide improvements in facility operations and maintenance. The technical bases for this approach, and the resulting SNFP design change package that will be prepared by DESH for submittal to DOE-RL, will be reviewed by the Board's staff in the near future. This subject is, therefore, not addressed in detail in this report. However, a preliminary evaluation is provided in Section IV.B.11.

The following items will provide improved confidence in the technical approach to the project.

- a. The pending determination by FDH/DESH, requested by DOE-RL, of how and to which cranes the safety-class criteria of DOE Order 6430.1A might apply, could have a serious impact on the schedule for completion of in-basin projects and of the CSB. This matter therefore requires priority attention.
- b. Closure of the following items is necessary to confirm the technical adequacy of the MCO/Transport Cask:
 - (1) Establishing acceptance criteria to ensure that any water remaining in MCOs does not cause excessive internal pressure during storage.
 - (2) Confirming the adequacy of the pressurization analysis of the MCOs.
 - (3) Establishing appropriate surveillance, monitoring, and testing programs for stored MCOs.
- c. First-article testing of the CVD processing units needs to be conducted on an expedited schedule in order to avoid schedule slippage, and any required modifications must be processed immediately upon disclosure of the need for them. It would be judicious to have contingency plans in place to provide required engineering, technician, and hardware modification resources in the vendor's shop or at the Hanford Site.
- d. Consideration should be given to the addition of preoperational tests of the IWTS using real fuel/sludge. This approach would use time currently off the overall project critical path to validate the effectiveness of the current design.
- e. A key element in the ultimate success of the SNFP is the timely completion of a number of subproject safety analyses that would subsequently be approved by DOE with only a minimal need for review and revision. In order to ensure success in this effort, experienced safety analysis personnel need to participate in the formative stages of design and operation. As planned by DESH, personnel recruitment efforts must seek out qualified experts who can influence the selection of design options to preempt

hazard/accident conditions and provide a high level of assurance that residual safety uncertainties are very few and small in magnitude.

- f. Operational Readiness Review (ORR) plans appear technically adequate, although the schedule is aggressive and optimistic based on experience with the startup of other new defense nuclear facilities in the DOE complex.

2. Integration of Project Activities

Successful integration of activities is necessary for project success. This includes the coordinated planning and scheduling of equipment delivery, and installation and preoperational testing for K-Basin modifications, the IWTS, and the FRS, which will ensure the safe, expeditious *start* of fuel removal. It also includes the timely evaluation of the integrated utilization of facility systems (all facilities, systems, equipment, and operations personnel that move fuel from the K-Basins to storage in the CSB) to ensure the safe, expeditious *completion* of fuel removal and storage. Specific suggestions for improvement are provided below.

- a. Improved integration of the installation of both the FRS and the IWTS, as well as the in-basin facility modifications, could be accomplished by establishing the function of work control manager, with appropriate space and staff to ensure that multiple conflicting schedules and activities are managed both within and outside the basin area on a daily basis.
- b. Additional model studies, using existing SNFP modeling software, should be performed as soon as possible (i.e., within the next few months) to determine whether adequate facilities exist to ensure needed throughput for expected operational conditions. Contracts for equipment need to be rewritten or renegotiated to include options for the purchase of additional units if this is shown to be necessary to ensure that fuel retrieval proceeds expeditiously.
- c. The SNFP training program and procedure development are closely linked to completion of the safety analysis for each subproject. Timely integration with the Safety Analysis Report (SAR) writers would ensure that these key elements do not slip, and could potentially lead to accelerating their completion. However, the procedure development schedule could slip if DOE-RL does not concur in the current plan for screening which procedures must be in place prior to startup.

3. Opportunities for Schedule Enhancement

The proposed schedule was identified as having a low probability of success because all the subprojects have critical paths that could easily affect the start of fuel removal. During the review of subprojects by the Board's staff, a number of opportunities to reduce subproject critical paths or provide contingencies to cover future unexpected activities were identified.

- a. The K-West Basin IWTS subproject is currently on hold, with a day-for-day schedule slip occurring until DOE-RL, FDH, DESH, and DESH's subcontractor (Chem Nuclear) resolve DOE-RL's design issues with the design package submitted by DESH for Critical Decision 3 (CD-3). This is the decision by DOE-RL to allow equipment fabrication and installation to proceed. Several strategies may be available to recover part of what is currently being lost and/or prevent additional schedule slippages. For example:
- (1) Improvement in the schedule for installation of the remote manipulators is dependent on quicker acquisition of the hydraulic actuator (HYLAC), the hydraulic actuator at the base of the manipulator. Such an improvement would require either DESH or the manipulator vendor to query other previous buyers of the HYLAC to determine if any of them have spare HYLACs that might be made available. Resolution of this issue could shorten the subproject schedule by several months.
 - (2) Consideration should be given to accelerating Electronic Operations Center (EOC) installation in the FRS by installing equipment now, with software updates to be provided later on site, and with test plan revisions to account for the two phases of testing—before and after software updates.
 - (3) An evaluation and an appropriate contingency plan should be developed for the possible scenario where, upon failure of a manipulator, the only spare is the unit needed for operator training in Building 305.
- b. It would be desirable to reevaluate and adjust the extended delivery dates for the CSB storage tube plugs and hold-downs, where appropriate, to provide schedule contingency for potential delays in fabrication and delivery.
- c. Developing methods for effective operator training on mockups or trainers before all the equipment is available may permit early completion of some training and move operator training off the critical path.



IV. DISCUSSION

A. Project Management

1. DOE and Contractor Personnel Interviewed

The review by the Board's staff was conducted through interviews and discussions with the following key DOE-RL, FDH, and DESH personnel with project management or project oversight responsibilities:

- C. A. Hansen, DOE-RL Assistant Manager for Waste Management
- T. L. McConnell, DESH President and General Manager (effective October 1, 1997)
- E. D. Sellers, DOE-RL Project Director, SNFP
- N. H. Williams, FDH Project Director, SNFP
- F. G. Hudson, DESH Vice President and Project Director, SNFP (VP/PD)
- A. S. Daughtridge, DESH Deputy Project Director, SNFP Engineering and Construction Projects
- R. W. Rasmussen, DESH Manager, SNF Storage Projects (MCO, Transport Cask)
- G. Chevrier (NUMATEC), DESH Director, SNF Conditioning Projects (HCS, CVD)
- A. H. McNeil, DESH Director, CSB Project
- J. E. Loomis (Consultant), DESH Acting Director, K-Basin Projects (FRS, IWTS)

A list of specific questions related to project management aspects was generated to permit some consistency in the results of the interviews and discussions.

2. Historical Perspective

Upon accepting the contract for the SNFP in August 1996, and starting work on October 1, 1996, DESH and FDH identified as a preexisting condition the lack of an integrated schedule for the SNFP. The schedule that was being used by Westinghouse was, in fact, artificially constrained at over 100 milestone dates. With this original schedule, when problems and delays were encountered, milestone dates did not change. Durations of activities were simply shrunk. DESH developed the integrated schedule by first removing the artificial constraints from the original schedule and incorporating the interfaces between the subprojects. By January 1997, DESH realized that the date to begin removal of fuel from the basins would be 5 months later than committed to. As additional delays became apparent, a schedule risk assessment was performed. The term "schedule risk assessment" is somewhat misleading since FDH and DESH stated that the entire schedule logic was reviewed and scrubbed by project personnel and schedulers, in addition to assigning risk to activities. This assessment, completed in August 1997, determined there would be an additional 14 months delay in the start of fuel removal from the basins, beyond the 5 months identified in January 1997 (19 months beyond the original schedule).

Upon assuming control of the project in October 1996, the DESH VP/PD believed that DOE-RL considered the SNFP a "stellar" project. Because of this reputation, DESH was restricted in the organizational changes they were to make, and meeting the existing schedule (December 1997 fuel move) was a major driver. These perceived pressures appear to have had an impact on the VP/PD, and to have resulted in slow action to make required organizational changes and to his summary rejection of the discussion of issues, ideas, or problems that might adversely affect the project schedule.

The perceptions of the DOE-RL Assistant Manager for Waste Management did not entirely match those of the contractor representatives that were interviewed. For example, he indicated that he had suggested to DESH, early during their project assumption, that they should consider replacing the existing top managers and perhaps a number of others, and that he had not forced the existing project schedule on DESH. He expressed general dissatisfaction with the engineering capability of the Project Hanford Management Contract contractors and expressed particular concern regarding a design package for the IWTS that had recently been submitted by DESH for DOE-RL approval.

3. The Problem That Existed

The root cause of the significant schedule delays encountered is arguably the lack of dedicated sound project management by DOE-RL and its contractors. Evidence supporting this conclusion was discovered during interviews with responsible project managers from DESH, FDH, and DOE-RL. These deficiencies have led both to the delay itself and to the late identification and communication of the schedule problems.

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While several of the delays can be traced to the previous contractor, deficiencies in DESH project management contributed to further schedule slippage and certainly led to late identification of the project delays.

- a. In discussions with the Board's staff, the DESH VP/PD stated that when he took over the SNFP, it was considered by DOE-RL, Board, and others as being well under control and an exemplary project. His intention was to minimize changes to the project infrastructure and keep up this momentum.
- b. Interaction between the subprojects was left to the initiative of the subproject managers. There was no institutionalized process by which interaction was ensured by the VP/PD.
- c. Although there was significant evidence of major overall project schedule slippage, this information was not collected and synthesized as soon as it was obvious that schedules would not be met.

- d. The maintenance of the overall SNFP schedule is performed by a separate group outside of the projects group (Project Planning & Integration). After April 1997, FDH noticed that this group was unilaterally moving scheduled completion of milestones to later dates and often providing inaccurate or out-of-date information. Resolution of technical issues was not integrated into the schedule. As a result of these deficiencies, FDH recently assumed control of the project baseline.
- e. Until September 1997, monthly status reports to DOE-RL concentrated on accomplishments of the project rather than real and potential problems that were significantly delaying the project or were eroding schedule float for activities not currently on the critical path. The format for these monthly status reports was the same as that used by the previous contractor, Westinghouse.
- f. The DESH VP/PD believes he has sufficient contact with his subordinate managers through weekly and monthly meetings to ensure adequate oversight of the SNFP. Further, he considers that there is no disincentive to bringing forth problems and that his current organization, with the exception of the addition of another direct report, is optimally configured. Results from later interviews indicated that these conclusions could not be substantiated.
- g. The DESH VP/PD indicated that his managers were working to the proposed schedule (July 1999 start of fuel retrieval), but reporting performance against the current schedule (May 1998 start of fuel retrieval) as required by the contract. He admitted that this situation was causing significant confusion for his subordinates.
- h. The DESH VP/PD believes the communication between subprojects is lacking and that the leaders hesitate to bring up issues if their project is not on the critical path. Almost all of the subprojects are within 90 days of the critical path. Given the nearly 2 years before the start of fuel movement, any of these subprojects could experience delays and become critical path elements. This vulnerability does not appear to be appreciated by the VP/PD.

Fluor-Daniel Hanford

The FDH Project Director responsible for the SNFP is an experienced manager with a firm understanding of the principles of management of large projects. Several of the project management deficiencies identified by the Board's staff were either already known to the FDH Project Director or readily agreed with. Despite this understanding, FDH has not directed substantial changes in the project management structure of DESH. The FDH Project Director cited the following as reasons for slow action in this regard:

- a. There is a reluctance on the part of some managers at Hanford to consider the FDH-DESH association a traditional contractor-subcontractor relationship. Strong directed

leadership by FDH is viewed as inflexible and contrary to the teaming concept desired by these managers.

- b. In the past, the DESH president had gone over the head of the FDH manager and senior FDH management to complain directly to DOE-RL about intrusive direction and oversight (e.g., FDH seeking baseline schedule control vs control by DESH's Project Planning and Integration group).

Department of Energy Richland Operations Office

It is apparent that DOE-RL was not sufficiently cognizant of the technical details of the project and had not delineated sufficiently specific requirements of the system to prevent the 14-month delay that is now being experienced.

The DOE-RL Project Director cited Westinghouse's pursuit of a technical strategy different from the one desired by DOE as a primary reason for the delay. From 1995 until the change of contractors in October 1996, Westinghouse originally had been pursuing a strategy using vented fuel storage canisters, then, after strong DOE objection, changed their approach to one that used sealed canisters with pressure relief capability. Both of these strategies entail significant surveillance and facility operation costs that were not desired by DOE.

The delay until July 1997 of the investigation of completely sealed containers by the new contractor could have been avoided if DOE-RL had been more forceful in communicating the requirements for limited surveillance and if DOE-RL had been quicker to redirect the contractor to pursue the sealed container strategy.

The DOE-RL Project Director does feel that there has been an atmosphere that prevented the airing of project problems, such as schedule variance. She opined that both DESH and FDH management had significant difficulty in this regard over the last year.

Until recently, DOE-RL did not have an effective process to accurately determine the status of the SNFP project on a routine basis. The effectiveness of recent changes in DOE-RL's oversight effort has yet to be determined.

4. Problem Solution and Path Forward

Recently, DESH has taken corrective actions that are having a positive effect on the SNFP. However, no corrective action plan that incorporates an understanding of the causal factors and provides a path forward has been documented. Although the actions taken so far appear to be necessary, their sufficiency has not been determined. It is not clear that DESH management fully appreciates the actions required to stabilize the project and to develop a clear path forward considering causal factors. There appears to be reluctance on the part of DESH to respond favorably to suggestions and guidance for improvement in the management of the SNFP.

Recent corrective actions include:

- a. Reportedly strong managerial talent has been brought in to address technical and schedule issues. In particular:
 - (1) A new manager responsible for the Technical Baseline, W. H. Rasin, Deputy Project Director, was assigned in July 1997. His responsibilities include assuming the technical integration responsibilities formerly under the DESH Project Planning and Integration group;
 - (2) A new manager, R. B. Wilkinson, was assigned as Director of Project Execution in September 1997 to ensure that critical path and near critical path activities are identified, tracked, and driven to completion; and
 - (3) A deputy project director, J. Foster, has been assigned to drive all the subprojects and identify issues before they become serious impacts on the critical path. Foster is the former DESH Radiation Protection Manager.
- b. Weekly meetings are being held by the Director of Project Execution to analyze and drive the critical path (third meeting the week of October 1, 1997). The meetings are attended by the responsible subproject managers and are intended to bring about a cultural change by driving down the organization the message about the importance of reporting up to management any problems that need to be resolved.
- c. Weekly meetings are also being held by the DOE-RL Assistant Manager, Waste Management. These meetings, attended by senior SNFP managers from DESH, FDH, and DOE-RL, address current issues requiring timely resolution by DOE and contractor organizations.

These corrective actions, while reasonable temporary fixes, are not the result of a systematic evaluation. Such an evaluation is necessary to ensure that the project management of the SNFP is significantly and sufficiently improved.

The DOE-RL Project Director has little confidence that the proposed (July 1999) schedule can be achieved. The proposed schedule and estimate of cost increase (~\$238M) resulting from the most recent delay (14 months) have just been received by DOE. The Project Director believes the underlying documentation associated with this submittal must be reviewed carefully before submission to higher authority. She does believe that recurrence of a similar schedule delay will be prevented since most of the project milestones are covered under the FY 1998 performance agreements.

DOE-RL has developed performance agreements that will reportedly provide incentives for the contractor to develop a technically justifiable project baseline and keep to the proposed schedule of beginning fuel removal by July 1999. There is no incentive to accelerate this schedule.

B. Subprojects and Related Activities

1. Fuel Retrieval System

a. Current Status of Work

Design work has been completed on the FRS subproject, and procurement is under way. In addition, fuel canisters have been removed from construction areas of K-West Basin. Project construction planning is about to commence. A mockup of the remote manipulator arm in Building 305 was used for development of the final design, and is now being used to prepare preliminary operating procedures and to familiarize operators with the FRS prior to additional training.

b. Adequacy of Technical Baseline

During discussion with the Board's staff, the FRS subproject manager stated that there were no outstanding technical issues that could potentially jeopardize the successful conclusion of his subproject. Four open issues were identified:

- (1) Office of Civilian Radioactive Waste Management (OCRWM) requirements are presently being reviewed for applicability to FRS. These requirements relate to inspection activities and affect only the quality of the video system. This issue is being resolved by purchasing the best available camera and recording devices for the inspection camera.
- (2) The potential for rapid unexplained oxidation of uranium metal fuel in water has been observed in France, and has been raised as a potential problem for the K-West Basin FRS. This potentially unreviewed safety question is being resolved by showing that the consequences are bounded by the current SAR.
- (3) A drop of an MCO basket on a seismic restraint could result in a subsequent failure of the restraint during a seismic event. This item is being resolved by minimizing fuel movement over seismic restraints and adding swing limiters to prevent lateral basket movement.
- (4) Analyses have identified several scenarios where a potential criticality accident could result from a load drop. This item is being resolved by use of the swing limiters mentioned in item 3 and by upgrading of the MCO baskets.

On review, the Board's staff concurs that there is no technical reason for work not to proceed because of these issues.

c. Schedule Risk, Compensating Measures, and Opportunities for Improvement

There are schedule risks associated with the procurement of the manipulator arm, the HYLAC, and the associated EOC. Specific expediting of vendor deliveries will help ensure that the proposed schedule is maintained. Potential in-basin construction scheduling conflicts and work area conflicts among facility modifications, the FRS installation, and the IWTS installation could also cause schedule delays on this subproject. Strong and effective integrating project management is necessary in the construction planning and execution for all in-basin work to avoid these delays.

Project management intends to qualify all operators to work in all subproject areas. This will require 120 SNFP operators to undergo the 4-week remote manipulator training. Prior to initiating fuel retrieval operations, enough operators will be trained to process fuel, with the rest being trained during operations. This plan will require reserving the spare manipulator for training, making it unavailable for use should one of the four basin manipulators (both basins) fail. There is no evidence of any contingency planning for this scenario.

Current design of the Flex Transfer Crane utilizes an electric trolley for movement of loaded MCO fuel baskets from the FRS sorting table to the loading queue. A safety concern exists because the crane uses an unshielded 480 volt, 3-phase bus bar on the trolley system, 7 feet above the deck grating. Current design activities are aimed at resolving this safety problem. The subproject manager informed the Board's staff that if the problem cannot be resolved expeditiously, a mechanical hoist will be used in lieu of the electric trolley. If this becomes the accepted solution, no schedule delays will result, provided the decision is reached by no later than November 1997, as presently planned. Furthermore, use of the mechanical hoist would not be expected to slow down fuel retrieval operations during routine operations, since operators are expected to be available to operate the hoist when they are not otherwise occupied.

Procurement and fabrication of the FRS remote manipulators are the limiting schedule activities; they are appropriate for priority attention by engineering, procurement, and management. These schedule items are also the most likely to affect timely completion of the FRS subproject primarily because of the unavailability of the 360 degree HYLAC at the base of the manipulator arm. The HYLAC supplier is currently out of stock on this item and is presently in a production run of a different component. The supplier had stated that the HYLAC would become available only after the current production run was finished and the line was again producing the HYLAC component. This situation delayed delivery by 20 weeks. Leveraging the FRS order to the head of the next production queue did result in reducing this time period by 3 weeks. It is unclear to what extent DESH's or

the manipulator vendor's procurement officials have attempted to identify other users of the critical component who might have spare units on hand, and who might provide a potential means of locating alternate sources of supply and improving the schedule or ensuring no further slippage.

EOC installation is a second item limiting schedule improvement. This equipment is the control center for the remote manipulators. Software is currently being modified at the vendor's shop to incorporate nuclear operations demands. EOC installation could potentially be accelerated by installation prior to software modifications. This approach would entail altering the test plan to account for the shortcoming, with software updates to be completed on site.

Accelerated procurement of the HYLAC and installation of the EOC could improve the FRS schedule by, at most, 2 months.

If these activities can be successfully accelerated, in-basin construction becomes the third limiting item to schedule improvement. This activity involves necessary facility modifications, and installation of the IWTS and the MCO loadout system, as well as installation of the FRS system. Aggressive management of facility modifications and installation of FRS components, MCO loadout systems, and the IWTS could potentially improve the schedule for in-basin construction. This improvement could be achieved by a work control manager with appropriate space and staff to ensure that multiple conflicting schedules and activities are managed daily, both within and outside the basin area. It would be advisable for DESH to examine these activities fully in the upcoming construction planning period.

The use of schedule incentives or penalties, as might be appropriate in the case of the HYLAC supplier, and possibly for other key vendors (e.g., for the EOC), is not a promising approach, since these contracts were let with neither incentive nor penalty clauses included. A general discussion of this issue, including consideration of the use of incentives for selected procurement actions, is provided in Section III.A.2.

Providing incentives to FDH and DESH for completion of milestones for the 30-day burn-in period for the remote manipulators in Building 305 (February 8, 1998, for K-West Basin and March 30, 1998, for K-East Basin) could serve as a driver for accelerating the procurement of the HYLAC, as well as for Building 305 installation and testing activities.

It is suggested that intermediate milestones for installation of the FRS system (July 16, 1998, for K-West Basin and December 31, 1998, for K-East Basin), coupled with incentives for the other in-pool installation projects (FRS, IWTS, MCO loadout, facility modifications), could serve as valuable psychological incentives. These milestones would represent practical culminations of major elements of the subproject, marking the start of preoperational testing.

2. Integrated Water Treatment System

a. Current Status of Work

DOE-RL is currently reviewing the IWTS design, and is dissatisfied with DESH's Design Package submitted for approval for CD-3. DOE-RL approval is required to proceed with procurement and fabrication actions. DOE-RL has raised substantial issues in their design review, including: (1) the design basis for particulate removal is insufficient to meet the design specification; (2) the lack of adequate evidence of a quality assurance program; and (3) the use of an air sparging step in the backwash cycle raises issues related to offgas treatment, primarily high-efficiency particulate air (HEPA) filtration efficiency and operability. Each of these issues is discussed in greater detail below.

- (1) Filtration. Insufficient characterization data, as well as a lack of operational experience specifically related to removal of particles from K-West Basin fuel canisters, have contributed to reduce DOE-RL's confidence in the current design. DOE-RL has suggested that additional stages of filtration and/or the use of coagulants (if used appropriately) may be adequate solutions to their concerns. DOE-RL strongly favors additional filtration over coagulation for technical reasons, e.g., (a) reduced waste volume, and (b) compatibility with tank farm acceptance criteria. The Board's staff concurs with DOE-RL's technical evaluation. Moreover, DOE-RL believes that any alternative(s) currently under consideration should be addressed now rather than waiting until initiation of operations. The primary advantage is the avoidance of additional lost time due to IWTS failure and any subsequent redesign, modification, fabrication, testing, installation, and/or startup issues once the available schedule float has lapsed. This issue is also tied to developing preoperational tests that utilize real fuel/sludge for the reasons cited above (i.e., avoidance of potentially greater problems later), since a more robust system design could not be otherwise "proven" until initiation of operations.
- (2) Quality Assurance. DOE-RL's comments on the DESH Design Package cited several inconsistencies indicating that the adequacy of the design products may not have been verified or validated by individuals or groups other than those who performed the work. Though these issues appear to be resolvable, additional time will be required for this purpose. Since the design is on the IWTS critical path, additional focus placed on resolving the current concerns would also help avoid them in the future, particularly since many were associated with calculations and safety-class equipment.
- (3) Offgas system. The current design calls for air sparging of the sand filters as an aid in the backwashing cycle. DOE-RL raised concerns with the effects of air sparging on the operability of the downstream HEPA filtration units, given the lack of demisters or other dehumidifying device. This issue appears to be resolvable.

b. Adequacy of Technical Baseline

The current design approach is appropriate for its intended purpose. However, operational testing is needed to validate the meeting of performance specifications. Current sludge characterization data are insufficient to predict sludge behavior within the system's particulate removal steps. The canister decapping and fuel washing steps will produce particulate material of unknown size and distribution. These are the key parameters for determining system operating efficiencies and performance characteristics. Though simulant testing will be performed, there is no sound technical basis for simulant makeup (selection of surrogates that replicate the size, density, and distribution of the particles to be encountered). This testing is crucial to successful use of simulants.

c. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

Key activities having potential schedule impact include:

- (1) Preoperational testing involving actual fuel, particularly from decapping and washing operations, would provide the necessary experience data to understand IWTS operating behavior. The primary benefits of these confirmatory tests would be: (a) avoidance of downtime associated with system optimization during initial fuel retrieval activities, since any difficulties encountered would be during the preoperational period; (b) additional time off the critical path if modification and/or redesign is needed because of system failures; and (c) gains in experience for engineering and operations personnel.
- (2) Final regulatory approval of the Notice of Construction must precede in-basin construction of the IWTS. This milestone is currently well off the subproject critical path, but since it involves an external entity outside the immediate control of DOE-RL, it would be prudent to place attention on aggressive management of this activity.
- (3) If coagulant/flocculent materials are required to meet IWTS performance objectives, their compatibility with tank farm waste acceptance criteria is necessary since the current disposal path is via the tank farms. Early development of a list of acceptable coagulants would avoid potentially lengthy delays due to system unavailability and allow for preoperational testing since coagulant efficacy is system dependent.

Activities that appear to be appropriate for priority attention from project engineering and management personnel are discussed below:

- (1) Release of the design to initiate procurement and fabrication of equipment

The current schedule is incurring a day-for-day slip because DOE-RL missed the October 10, 1997, milestone for completion of its review of DESH's CD-3 Design Package. DOE-RL has issued comments that must be resolved by DESH and their

vendor (Chem Nuclear). Activities that eliminate routing of comments/resolutions between parties as much as possible (e.g., concurrent review meetings) are strongly suggested to facilitate early completion of this activity.

(2) Procurement contract incentives

Virtually all IWTS critical path activities are outside DESH's direct control. Fabrication, installation, and testing of IWTS components are all controlled by the vendor(s). Since no incentives or penalties appear to exist in vendor contracts issued by DESH or in contracts already in place when FDH/DESH took over the SNFP, neither DESH nor DOE-RL has significant leverage. If problems did develop in the above activities, additional schedule slippage would be highly likely, indicating a need for aggressive expediting to maintain the schedule.

(3) Aggressive management of in-basin construction activities to support facility modifications and IWTS equipment installation

In-basin construction activities must proceed successfully to support IWTS installation. Day-for-day slippage would result from delays in IWTS installation. Additionally, analysis of the manpower requirements to support IWTS, FRS, and facility upgrades in support of MCO transport suggest that up to 65 personnel will be required to support all in-basin activities simultaneously. IWTS/FRS project management recognizes that coordination of craft and other personnel is critical to concurrent completion of these three separate activities. Aggressive management, similar to approaches used during commercial nuclear plant outages, has been suggested by IWTS project management personnel as a viable alternative. This matter is also discussed in Section IV.B.1.c. The Board's staff supports this approach as one method to focus the efforts of all involved. Other approaches might also be explored to maximize opportunities for effective integration and timely completion of these activities.

(4) Development of preoperational test plans to include fuel decapping and washing operations

As addressed earlier, IWTS operating characteristics will not be fully understood until canister decapping and fuel washing operations commence. Including these activities in preoperational tests would be important as a means to enhance understanding of IWTS operational capabilities. It would also improve predictions of system throughput, as well as improve the ability to address several safety matters, such as determination of needed frequencies of sand filter backwash, knockout box changeout, and/or ion exchange module changeout. These matters are directly related to system availability. Preoperational testing would also provide valuable estimates of potential radiation doses.

Using real fuel/sludge in preoperational tests would drive early completion of procedure preparation, training and qualification, ORRs, and required review and approval actions by DOE-RL. Key completion dates for these activities would be good candidates for FDH/DESH contract incentives. This preoperational testing could serve as a catalyst for numerous other elements within the project. For example, in order to decap canisters, sort and load fuel, and operate the FRS head end and the IWTS, the contractor would have to demonstrate its readiness to proceed safely with all these activities. This demonstration would, in turn, require that critical milestones in the IWTS and FRS subprojects, as well as elements of the readiness process training/qualification, and the DOE-RL review and approval process, come together earlier than currently planned, thereby providing impetus to the overall project. Under this scenario, several other benefits are also likely to accrue. In particular, issues associated with IWTS, FRS, and the other subprojects would surface earlier and potentially be resolved off the overall project critical path. Furthermore, this would serve to demonstrate that both the contractor and DOE-RL are capable of initiating hazardous operations in a safe and timely manner.

The current contract structure does not incorporate incentives or penalties for early or late delivery of designs or equipment, or completion of factory acceptance testing. The critical elements of this subproject are related to procurement, fabrication, testing, and installation of IWTS components. Incentives related to each of these actions would provide drivers to recover lost time or to decrease the probability of additional schedule delays. DOE may have the opportunity to provide incentives in these contracts, since the design is currently on hold, and the procurement contract for fabrication of components is separate from the design contract.

3. K-West Basin Facility Modifications

a. Current Status of Work

Facility modifications are proceeding on an aggressive schedule, with the exception of the installation of the MCO loading system, which has suffered delays in procurement described in more detail in Section IV.B.4.a.

In the K-West Basin, upgrades to the 30-ton crane used to lift the MCO are under way and are expected to be completed by late November 1997. This completion date reflects a slip of 1 month from the original schedule. Comparable crane upgrades in the K-East Basin are forecast for completion in early March 1998, the baseline schedule date.

Interfaces between the FRS and IWTS systems and needed facility modifications are currently being managed to permit installation as rapidly as possible. For example, piping T-joints and valves will be added to the water treatment systems in advance to allow quick hook-up of the IWTS system when available.

b. Adequacy of Technical Baseline

There are no new one-of-a-kind systems being designed as part of the facility modifications for the K-Basins. The technical bases for the FRS and IWTS, that are being installed along with facility modifications, are discussed in Sections IV.B.1 and 2.

c. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

In-basin construction scheduling and work area conflicts among facility modifications, the FRS, and the IWTS have the potential to cause schedule delays on this subproject unless strong and effective integrating project management is included in the construction planning and execution.

Aggressive management of facility modifications and installation of FRS components, MCO loadout systems, and the IWTS will ensure that the proposed schedule is maintained, and may provide opportunities for schedule improvement for in-basin construction. This could be brought about by establishing a work control management function and making available the appropriate space and staff to ensure that activities are managed both within and outside the basin area on a day-for-day basis, in an efficient, integrated manner. This is an important requirement that is not currently included in planning.

The DOE-RL Assistant Manager, Waste Management Weekly Senior Management Meeting on October 7, 1997, addressed ongoing discussions concerning the application of safety-class designation to equipment used for handling spent fuel in the SNFP, including the K-Basin 30-ton cranes and the CSB receiving crane. DOE-RL issued a letter to FDH on October 8, 1997, stating that the system design for protecting spent fuel from drops is required to consider safety-class criteria per DOE Order 6430.1A. The contractor was requested to respond by October 24, 1997, with an explanation of how it complies with the Order or a justification for noncompliance which the Board's staff will review when available. This requirement has the potential to lengthen the project schedule significantly because existing equipment does not meet the safety-class criteria of Order 6430.1A, and any new or replacement equipment would have to be acquired from certified suppliers.

4. **MCO/Transport Cask**

a. Current Status of Work

At the present time, there are no technical or design problems delaying delivery of the 400 MCOs and 2000 fuel/scrap baskets required for the proposed SNFP schedule. A purchase order for five MCOs has been placed with a local fabricator, and delivery is scheduled for May 1998. The remaining MCOs are to be procured as an option to this purchase order on or about October 1, 1998, with delivery scheduled to begin in

March 1999. Fuel/scrap baskets are planned to be made in the Hanford shops. Twenty-five baskets are to be ordered during the next month, with delivery scheduled for May 1998. The remaining baskets are to be ordered at the beginning of FY 1999. The delay in procurement of the bulk of the MCOs and baskets is driven by the desire to limit FY 1998 expenditures, and by recognition that delivery during FY 1999 will be adequate to support the overall proposed project schedule.

The underwater conveyor and gantry crane design, delayed by approximately 2 months because of design changes in the fuel/scrap baskets, was finalized in June 1997. However, the procurement was further delayed until this fiscal year. These components are currently scheduled for installation in the K-West Basin by October 1998.

The two immersion pails have been procured and are on site. The K-West immersion pail support structure has also been procured and installed in the basin loadout pit.

There are no technical or design problems delaying procurement of the transport casks and transportation trailers. Five casks and trailers are to be provided for the SNFP. Two have already been fabricated and delivered to Hanford. The Board's staff observed these two loaded trailers during discussions in the 100K area. The remaining three casks and trailers are to be completed during FY 1998, with delivery scheduled for late in the fiscal year. Some components have been completed and are currently in storage.

b. Adequacy of Technical Baseline

There are no technical concerns currently delaying this subproject. The components have been designed, and procurement is under way.

c. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

Expediting the procurement of the long lead component of the gantry crane, a ball shaft requiring 6 months fabrication time, would help ensure that the proposed scheduled delivery date is maintained. This is vital.

In addition, the procurement and delivery dates for MCOs and the basket structure that have been deferred based on the need dates for the proposed schedule should be reexamined and adjusted as appropriate to ensure that there is adequate schedule float as a contingency for unexpected delivery problems in the future.

The MCO Topical Report, needed to support the SARs for CVD and CSB, is currently scheduled for approval and issuance the third week of June 1998. Adding a key intermediate milestone would help ensure that the quality of the final document will be acceptable. For example, an intermediate milestone should be established for completion

of an initial draft by January 1998, with submittal to DOE for approval not later than March 1998.

5. MCO Handling Machine

The MCO Handling Machine (MHM) is a shielded cask and turret system mounted on a gantry crane. It is used to manipulate and move the MCOs in the CSB, as well as to handle impact absorbers and shield plugs for the storage tubes. The machine is composed of three main elements: a bridge girder section that traverses the CSB floor, a trolley section that moves along the bridge girder, and a shielded cask and turret assembly mounted on the trolley section.

a. Current Status of Work

At the present time, the bridge girder has been fabricated and installed in the CSB¹; the trolley section is still in manufacturing, but is expected to be delivered in late November. Because the bridge girder and the trolley are fabricated by the same supplier, placement of the trolley onto the bridge girder should not pose any field erection problems. Installation of the trolley is scheduled for late December 1997.

The cask and turret assembly is 9 months behind the original schedule because of delay by the original MCO hoist vendor. This delay is caused primarily by three significant changes/modifications:

- (1) Application of a single-failure criterion for the MCO hoist and grapple system was directed by DOE-RL, as a result of the determination that dropping an MCO in a storage tube posed an untenable recovery risk, even though no release of radioactive material would necessarily occur. A Failure Modes and Effects Analysis (FMEA) to identify credible failures was issued in mid-August 1997. After DOE-RL's decision, it was ascertained that the expected fabricator of the hoist was not qualified to incorporate this new single-failure criterion according to American Society of Mechanical Engineers Rules for Construction of Overhead and Gantry Cranes, NOG-1. The contract with that supplier was canceled, and the hoist fabrication was turned over to another fabricator.
- (2) To reduce uncertainty regarding fit and leak tightness associated with the helium inerting requirement, preassembly and testing of the MHM will be completed at the fabricator's shop in the United Kingdom. This preassembly specification is characterized as "new" in the proposed schedule, although the Board's staff

¹Delays in the construction of the CSB due to workplace safety problems allowed assembly of the bridge girder to take place before the closure of the CSB. In the original construction plan, assembly of the bridge girder would have occurred after building closure, a very unusual decision in that assembly would have been much more difficult and would have taken much longer.

understands that the option to do preassembly was included in the purchase specification. The decision to test the MHM in England is sound since the integrating vendor is best qualified to accomplish the stated objective. Delivery of the Turret/Hoist/Grapple system is scheduled for June 1998.

(3) In June 1997, DESH decided to have the 90 percent Design Package for the MHM independently reviewed by Newport News Shipbuilding while fabrication of long-lead-time items was in progress. Newport News Shipbuilding made a number of recommendations to simplify or improve the design. Recommendations that were judged by DESH to be appropriate were adopted.

b. Adequacy of Technical Baseline

The technical baseline is established. The planned confirmatory fitup and operational test is needed to verify the leak tightness of the MHM.

c. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

Near-term activities calling for priority attention include completion of the FMEA and the redesign of the hoist and grapple to meet the single-failure criterion. The single-failure criterion will be met by doubling of the safety factors on yield and ultimate strength and the addition of a second brake on the drum shaft. These changes add to the complexity of the hoist and grapple and require control system modifications. In addition, expediting procurement, fabrication, and testing of the MCO hoist would increase the likelihood that no additional schedule slippage will occur with the new vendor. This is vital.

6. **Cold Vacuum Drying Facility**

a. Current Status of Work

Detailed design changes are required to incorporate newly identified instrumentation and control safety system upgrades for the helium injection system, portions of the purge system, and the water level and temperature monitoring systems. These design changes are results of an FMEA initiated in May 1997. The systems involved were designated as safety systems based on their functions to prevent a runaway fuel oxidation incident with a resulting subsequent release of radioactivity to the atmosphere. These design changes are to be completed by the end of October 1997 per the proposed schedule. This schedule also shows that 2.5 months of review and reconciliation will be required prior to final approval and issuance of the revised CVD design report in January 1998.

In parallel with these design changes, a purchase order was scheduled for placement in mid-October for the first of four CVD process units, with delivery scheduled for the end of February 1998. The first CVD unit will be used for first-article design confirmation testing.

Long-lead-time items needed for the three remaining CVD units will be ordered in January 1998 to expedite fabrication of these three units. The option for these three units is scheduled to be exercised in mid-April 1998 and delivery is scheduled for mid-June 1998.

The Phase 2 SAR for CVD is currently scheduled for submittal to DOE for approval in mid-February 1998 and for issuance in mid-April.² This SAR is presently required for release of the three follow-on CVD units to fabrication.

The CVD building is now scheduled to be completed and ready to receive processing equipment in the second week of March 1998.

b. Adequacy of Technical Baseline

A detailed thermal analysis of the fuel scrap basket in the MCO during cold vacuum drying showed that a runaway uranium oxidation reaction due to residual water in the MCO is incredible when helium is used as the inerting gas, and copper cooling plates are added to the basket. Other details of the process, including pumping and drying, which will be finalized at a later date, do not present significant technical risk for this subproject.

The recently identified safety system upgrades resulting from the FMEA appear to be technically sound.

The thermal model of the CVD process will be used to conduct process simulation runs during the period October–December 1997. These process simulations will provide added insight regarding potential runaway uranium oxidation reactions during off-normal processing conditions.

The first-article testing of the first CVD production processing unit is intended to confirm the suitability and operability of the hardware. The test is scheduled to start in early March and to continue through mid-June 1998. The test will mock up the fuel and sludge contents of the MCO and will be used to verify that the MCO can be dried as expected. By mid-April 1998, sufficient testing will have been completed to allow the manufacturing release of the remaining three CVD processing units.

The Board's staff believes that no additional characterization is needed to proceed with CVD equipment procurement and installation. The process simulations, confirmatory

² See Section III.B.9. for a discussion of phased SARs.

tests of the thermal model, and first-article testing can and should be done concurrently with procurement and installation of CVD process equipment.

c. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

Procurement and installation of the CVD processing units are on the SNFP critical path and should be followed closely, including expediting deliveries by vendors/suppliers of CVD hardware.

Completion of the CVD building in March 1998, as scheduled, is essential to avoid conflicts with installation of the CVD processing units.

CVD first-article testing could result in design modifications and delays. The Board's staff believes that contingency plans should be developed, including identifying availability of engineering, design, and technician personnel; ensuring access to machine shop services; and expediting by competent technical personnel in vendor and subvendor shops, starting with release of the purchase order.

The intermediate milestones listed below would help ensure that the schedule will be met. They are therefore suggested as potential candidates for FDH/DESH contract incentives. Dates shown are from the proposed schedule.

- Placement of order for long-lead-time items for processing units 2, 3, and 4 1/13/98
- Complete CVD building construction 3/17/98
- Placement of order for CVD processing units 2, 3, and 4 4/17/98
- Completion of testing phase for first CVD processing unit 4/30/98
- Delivery of CVD processing units 2, 3, and 4 6/15/98

7. **Canister Storage Building**

a. Current Status of Work

The main structure of the CSB is complete. Work is in progress on other facility-related items, such as the stack and the roads. The steel exhaust stack has already been delivered to the site. The remaining major items for the CSB are the storage tubes and the tube plugs.

There are 220 storage tubes in the manufacturing process all of which are currently scheduled for delivery by April 1998.

Five lead unit tube plugs are scheduled to be ordered in November 1997, with delivery scheduled for May 1998. The remaining plugs are scheduled to be ordered in early FY 1999, with delivery scheduled for April 1999.

b. Adequacy of Technical Baseline

The technical basis for the CSB design is sound. The technical basis for the MHM, which is to be installed in the CSB, is discussed in Section IV.B.5.

c. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

Final design is complete, with no significant outstanding technical issues of significance.

There is risk associated with extending the intentional delay in fabrication of storage tube plugs and hold-downs. Accelerating the schedule for delivery of these items could provide sufficient contingency in schedule float for unexpected future problems.

The pending determination between FDH/DESH and DOE-RL of how and to which cranes the safety-class criteria of DOE Order 6430.1A might apply could have serious adverse effects on the CSB completion schedule (see the discussion in Section IV.B.3.c.).

8. Facility System Integration

Facility system integration is the application of systems engineering principles to the entire fuel retrieval process, from lifting of the fuel canisters out of their current location in the K-Basins to placement of the sealed MCOs in the CSB storage tubes for interim storage. This systems engineering effort takes into account each process step described in Sections IV.B.1 through 7 to optimize the process and achieve the shortest safe fuel retrieval schedule.

a. Current Status of Work

The flow of spent fuel through the system (from K-Basin through CVD to CSB) is being modeled using the Witness computer modeling software. This software is a general discrete simulation language commonly used by manufacturing industries to analyze production line operations. Parameters that can be examined include capability, capacity, efficiency, equipment utilization, queues, and bottlenecks, among others. Several cases have been run, varying the number of system components, operating times, operating efficiencies, and work shifts. The model computes the time to completion. The case having a 2-year operating time, reasonable efficiencies, and optimized components led to a

decision to have 4 CVD units and 5 Transport Cask Systems. Some of the general observations (GOs) of the results of this modeling were:³

- GO-1: Fuel retrieval is the limiting process in this model.
- GO-2: Marginal increases in breakdown severity cause proportionate increases in the basin emptying time.
- GO-3: Speeding up fuel retrieval by improving the production rates, working more days per week, or increasing operating efficiency will directly and significantly reduce the basin emptying time.

b. Adequacy of Technical Baseline

GO-1 assumes that the FRS availability is 70 percent. However, if the FRS system is able to run at its full design production capacity (i.e., with no system unavailability in either basin for short durations), quick calculations have shown that FRS operations will have to slow down after 4 days because the inability of CVD and cask transportation to process or move the MCOs. In addition, preliminary training on the FRS has suggested that production throughput may be higher than anticipated and that FRS may be able to run with even higher throughputs for fuel elements that are not severely damaged.

The availability of systems used in the model is based on short outages at regular intervals. As a result of using this availability assumption, the "system design" resulted in an insufficient number of CVD processing units to cope with outages lasting longer than a few days or to accelerate the schedule by retrieving fuel more rapidly than expected. This undercapacity was recognized in GO-2.

The Board's staff believes additional parametric studies should be run on FRS system availability and production capacity in a timely manner; i.e., within the next few months, to ensure that sufficient facilities and equipment (e.g., CVD and cask transportation units) are available to fully support FRS operations at a reasonably high production capacity, and to identify potential operational problems that might lead to conditions affecting safe, expeditious retrieval and storage of spent nuclear fuel. This effort may result in the need to include options in existing contracts for the purchase of additional units.

c. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

Additional parametric studies will determine, among other things, whether FRS is the choke point of the SNFP operations, assuming the maximum reasonable production rate.

³Cleveland, Kevin J., "Spent Nuclear Fuel Project Design Basis Capacity Study," WHC-SD-SNF-RPT-011, September 9, 1996, page 3.

Estimates by the Board's staff have shown that the system can operate for only 4 days before slowing down because of insufficient availability of CVD or cask transportation. If the studies show that additional units are necessary to avoid choke points in the CVD facility or with cask transportation, the numbers of these units could be increased to keep the FRS as the system choke point even while operating at the maximum expected production rate three shifts per day, 7 days per week. This action would result in reduced emptying time associated with the increased FRS productivity alluded to in GO-3.

Additional parametric studies also may show that the system will be unable to recover from outage durations lasting longer than a few days unless additional facility equipment is available. These types of work stoppages have occurred at other Hanford facilities and are considered probable during the expected removal campaign. An outage of this type would result in day-for-day schedule slippage on the fuel removal milestone. Other accelerating factors, e.g., a 7-day work week, could obviously also help alleviate such slippage, with the common goal being the safe, expeditious movement of all of the fuel into safe interim storage.

In addition, the work control manager function discussed in Section IV.B.3 would help ensure that fuel removal would proceed as quickly as possible, e.g., having fuel staged on shift startup so remote manipulator operations could proceed while operators were entering the basin. It would be helpful to extend these work control functions throughout the system (K-Basins, CVD, CSB) to ensure that backups would not occur outside the basin and to expedite the recovery of fuel from any upset conditions.

9. Safety Analysis Reports and Related Documentation

The SNFP was originated with the approach of using a SAR phased in time to support construction of facility structures, procurement of equipment, and installation of systems in the facility.

Certain assumptions had to be made to enable DOE to review and approve individual phases of the SAR when they were submitted by the contractor. These enabling assumptions (EAs) were then tracked as issues for resolution as technical information became available.

a. Current Status of Work

The phased SAR approach that originated with the previous management and operations contractor was identified as contributing to delay of the SNFP because the DOE reviewers expected a level of detail normally found only in a FSAR. This approach resulted in delays in approving equipment purchases, as well as in Critical Decisions necessary for project progress. The solution proposed by the new contractors' Key Drivers Resolution Committee (KDRC) was to revise the phased SAR approach by requiring typical

Preliminary Safety Analysis Report (PSAR) content⁴ in documents required for approval of equipment purchases and other critical decisions. During discussions with the Board's staff, DOE indicated that the SAR review delays were caused primarily by poor-quality design and analysis effort, rather than the level of detail expected at that particular phase of the project. The Board's staff also determined that appropriate input from safety analysts during the formative stage of the process design had not been provided.

The KDRC report dated August 15, 1997, defined the level of detail needed in safety documentation in order to proceed with procurement, installation, and operation of physical modifications to the operating K-Basins. DOE and the contractors are developing a specific approach for determining exactly what form and content would be required for submittal of this safety documentation for DOE approval. DESH expected to apply this approach to the request for approval of the first-article test for the CVD. Providing this information in a format appropriate for sections or portions of the K-Basins FSAR, where possible, would permit easy incorporation into the SAR development process at a later date, and would reduce the effort and time required for review.

The KDRC recommended that the current process for preparation of phased SARs should incorporate the following guidance:

- (1) Selected procurements of CVD, CSB, and HCS process equipment can proceed, provided: (a) system design supports safety-class determination; (b) codes/standards, specifications, and quality requirements are consistent with the facility mission; and (c) appropriate safety overview and risk-benefit evaluations are completed.
- (2) Phased SARs will be consistent with PSAR requirements. Prior to final release for construction, the SARs should encompass a review of facility configuration for compliance with safety guidelines.
- (3) The MCO Topical Report will be referenced in the CVD and CSB FSARs, and needs to be of final report quality.
- (4) Completion of the MCO Topical Report should not constrain procurement of major components if the procurement can be based on a risk evaluation review of key design features.
- (5) All EAs should be closed prior to DOE-RL approval of the FSAR and the MCO Topical Report. Enabling assumptions should be managed in three categories, according to whether they are: (a) High Risk Impact EAs; (b) Lower Impact EAs, with data development and analysis ongoing; or (c) closed. (Resolution of the EAs

⁴*Key Drivers Resolution Committee Agreements, August 15, 1997.*

has been incorporated into the project schedule, and there is no constraint on the design and procurement effort.)

- (6) Major modifications to operating facilities require Unreviewed Safety Question Determinations and/or SAR revisions that are DOE-approved and comply with applicable DOE Orders.

The Board's staff considers this guidance to be reasonable.

DOE has indicated to the contractor that future submittal of phased SARs for CVD and CSB should include all chapters of the SAR to comply with DOE Order 5480.23. The Board's staff suggested that the CVD SAR reference those chapters of the K-Basins SAR that apply, since the CVD SAR would be incorporated into the K-Basins SAR prior to operation of the CVD. Figure 3 provides a comprehensive listing of the SNFP SAR program, including scheduled milestones.

The Board's staff reviewed the SAR/Safety Analysis Documentation subproject milestones as defined in Level 3 schedules to ensure compatibility with the overall SAR schedule for all safety analysis activity (Figure 3). The safety analysis work is not on the critical path, but it drives many activities that are close to being on the critical path, such as procedure development and training. Additional manpower is being secured to ensure timely completion of SARs and to restore DOE-RL's confidence in this activity.

b. Adequacy of Technical Baseline

The current ongoing approach for timely preparation of the SARs, Safety Analysis Documents and PSARs is technically sound, as a result of the definitive guidance provided by the KDRC. This approach has been integrated with safety analysis work activities and provides a reasonable basis for procurement activities prior to the completion of FSARs.

The long-term structural integrity of the MCOs and the associated assurance of their safety during storage are based on sound technical data. In spite of the fact that conservative design assumptions have been made in fuel characterization and chemical reactions, as well as the thermal analysis of heat release, the need for monitoring, surveillance, and prototypical MCO testing should be evaluated. Currently, such information is to be obtained on lead production units, and plans are being developed to instrument the lead units.

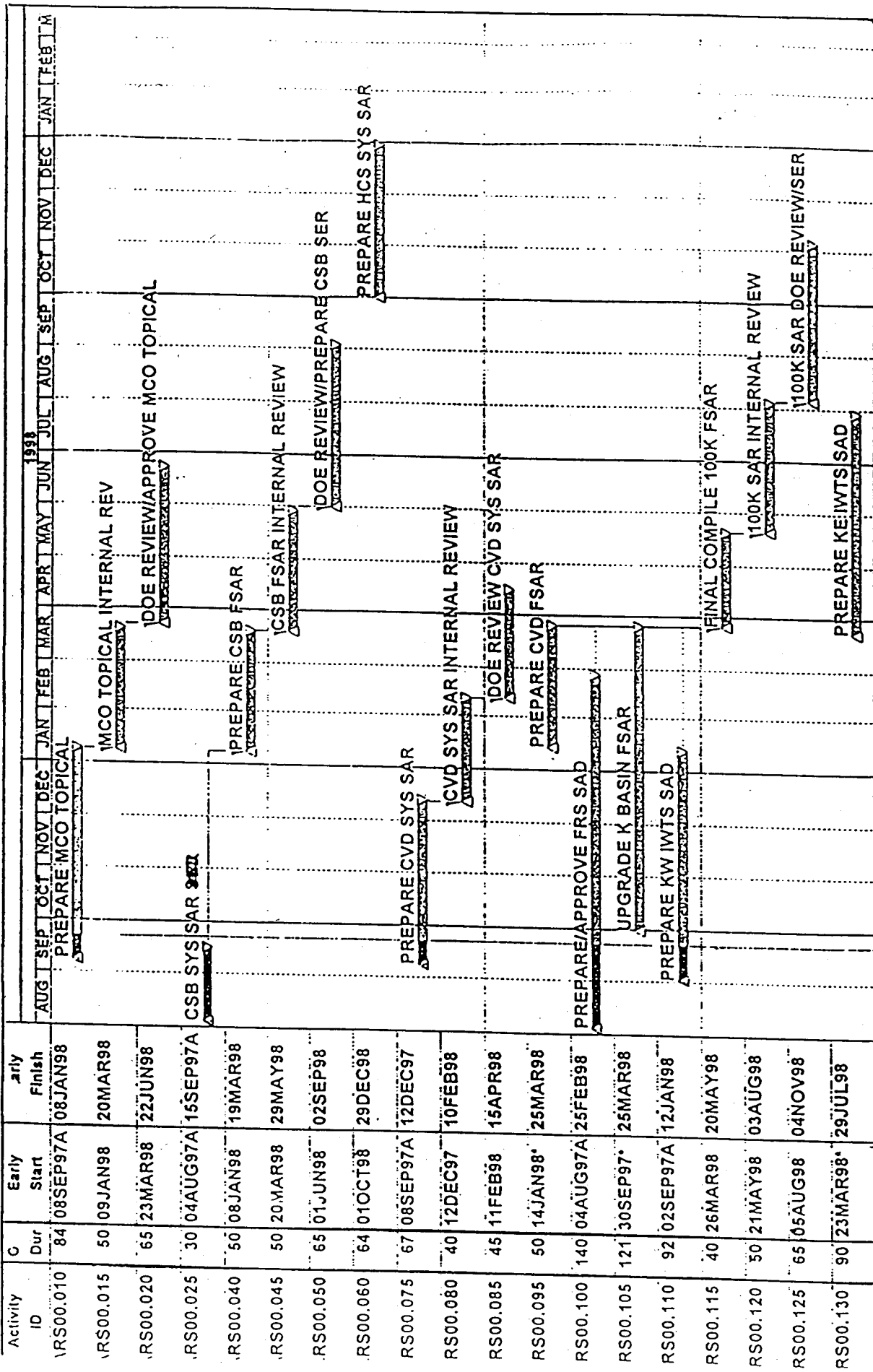


Figure 3
SAR Schedule for SNFP

c. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

Capturing the KDRC SAR approach in clear procedures is key to ensuring the timely preparation of SAR/Safety Analysis Documentation/PSAR documents to facilitate releases for procurement and various process operational steps in each subproject.

Timely completion and review of safety analysis work, including hazards analyses, definition and designation of safety systems, and incorporation of structures, systems, and components that implement the results of safety analyses are essential to meeting subproject scheduled completion dates. Timely preparation of technical specifications is also needed.

DOE-RL review of preliminary submittals of the following documents is desirable to ensure that the quality of the final product is acceptable, thereby avoiding any unnecessary schedule delays:

- MCO Topical Report
- CSB FSAR
- CVD System SAR (PSAR Level)
- 100K Area FSAR
- FRS FSAR
- K-West Basin IWTS Safety Analysis

The Board's staff believes the technical competence of the safety analysis staff should be improved by augmenting the staff with experienced personnel. DESH indicated that plans are in place to augment the safety analysis staff with about 12 experienced SAR specialists in the next few weeks. Monitoring this near-term need closely would be prudent. The Board's staff also noted that without compromising DOE independence, workplace participation by DOE-RL personnel could reduce the frequency of SAR comments and the time required to develop DOE-RL comments on SARs, as well as minimize the time required to prepare Safety Evaluation Reports and approvals. If safety reviewers from DOE-RL were to have a greater presence during the design effort, significant improvement in SAR quality and review effort could be obtained. In addition, safety issues could be identified and resolved earlier, with less impact on project cost and schedule.

An example of late-breaking interpretation of safety requirements with significant impact, based on review of safety documentation, is the DOE-RL direction in August 1997 to design the MCO hoist in the MHM to meet the single-failure criterion, as discussed in Section IV.B.5. DOE-RL has recently issued direction to FDH to review the need for safety-class lifting equipment for handling the MCO, based on interpretation of safety requirements in DOE Order 6430.1A (see Section IV.B.3.c). Such a change would

impact the design and construction of the main cranes in the K-Basins, as well as the receiving crane and the MHM in the CSB. In view of the fact that this equipment has already been fabricated or delivered, some accommodation of specific requirements may be necessary to avoid costly delays. Clearly, review of such basic requirements at the early design stages with personnel responsible for safety review could have prevented this situation. DOE-RL attention to early involvement of safety reviewers is especially important with the additional and revised safety analyses that will be necessary for the reduced safety basis supporting process simplification.

10. Procedure Preparation/Training/Operational Readiness Review

a. Current Status of Work

(1) Plan for Preparation of Procedures

The SNFP is using a nontraditional approach to procedure development because of the desire to have smooth procedures as soon as possible after facilities are completed. The process is less efficient, but will be faster than waiting until all safety documentation is complete before proceeding with procedure development. It consists of several iterations of each procedure—from initial formatting, adding information as it becomes available from safety analyses, job task analyses, and vendor manuals, to completion of the procedure after the process is finalized.

The procedures will also be reviewed, walked down, validated and verified, and finally approved. The group writing the procedures currently states that 193 procedures are to be prepared prior to startup. The group also estimates that an average of approximately 80 hours per procedure will be required. This amount of effort equates to about 8 man-years of work. Current staffing for the group stands at five contractor personnel. The responsible manager stated that this manning level is expected to increase as designs and safety documentation are finalized. He does not consider preparation of procedures to be a schedule risk.

The procedures currently under development are those required to be in place prior to operations, or “pre-ORR” in project terminology. In general, the criterion for determining if a procedure is “pre-ORR” is that it be related to the process or that it ensure the functionality of a safety system. Based on this informal screening process, the procedure development group has assigned lower priority to “prior to use” and “defer to work control” procedures. “Prior to use” procedures are typically routine maintenance procedures that will be developed prior to use, but after the start of operations. “Defer to work control” procedures are typically nonroutine maintenance procedures, and will be written by work control personnel as needed. Formally defining these screening criteria and obtaining DOE-RL concurrence will preclude

schedule delays that could arise if DOE-RL later determines that additional procedures must be in place prior to startup.

(2) Training Program

The development of operator training is only in the formative stages. Job Task Analyses that dictate required training programs are being developed for each subproject. The CSB Job Task Analysis is done. All others are in varying stages of completion. The general format of the operator qualification process will consist of classroom training, on-the-job training, and then qualification through job performance measures. The final determination of which operators and supervisors will require certification in addition to qualification has not been made. As a minimum, operators of the FRS will be certified.

Training for process engineers, shift operations managers, and facility managers does not appear on the schedules provided to the Board's staff. Although the operations startup manager admitted that the scope and duration of this training have not been established, he believes he would have sufficient resources available to develop and conduct the training. However, given that these trainees may be intensely involved in the startup testing, their availability to receive the training may be limited. This scheduling problem could affect the startup schedule adversely.

(3) Plans for Operational Readiness Review

SNFP ORR plans are in compliance with DOE Order 425.1, *Startup and Restart of Nuclear Facilities*, although the schedules are very aggressive and optimistic. There does not appear to be an opportunity for shortening the duration of ORR activities. SNFP will have one ORR that will review all the subprojects. Contractor plans call for performance of a management self assessment (MSA) that will run for approximately 1 year, starting in April 1998. The MSA is not a critical path item and can be accelerated by applying more resources to completing the MSA affidavits.

The contractor ORR, scheduled for May 1999, will run for 2 weeks. A 2-week period to correct findings will follow. The DOE ORR is also scheduled to run for 2 weeks, with a 2-week correction period, before operation is scheduled to begin in July 1999.

The contractors and DOE-RL have solicited assistance from DP-45 in developing the ORR plan of action and in providing ORR training and personnel to serve on the DOE ORR team, particularly in the positions of team leader and/or senior advisor.

The DOE-RL method for verifying the contractors' readiness to begin the ORR appears to be thorough. The effort involves Facility Representatives and DOE-RL subject matter experts who will perform an assessment of the contractors beginning in October 1997 and

will continue to evaluate the process through the contractor ORR and issuance of an endorsement letter certifying readiness to proceed. After startup, the assessment program will continue, but at a lower intensity.

b. Schedule Risk, Compensatory Measures, and Opportunities for Improvement

Because procedure development and training are tied to completion of safety documentation, delays in issuance of SARs will also delay procedures and training that are critical path items. Schedules for procedure preparation could be extended if DOE-RL does not concur.

The intermediate milestones listed below are suggested as candidates for FDH/DESH contract incentives. Dates referred to are from the proposed schedule:

For each subproject:

Completion of Rev 0 Procedures	Various 1998 dates
Completion of Operator Training/Certification	Various 1998-99 dates

For SNFP as a whole:

Completion of Management Self-Assessment	May 17, 1999
Completion of Contractor ORR	June 8, 1999

Current activities that DESH can undertake now as near-term priorities include additional planning and integration among the procedure writers, the schedulers, and the individual subproject staffs. Early cooperation among these groups can improve the schedule logic ties from design and testing activities to procedure development and training. Coordination with the SAR developers may identify additional efficiencies in the overall schedule, as discussed in Section IV.B.9.

The training group can also benefit from early identification of procedure writing and training resources that will be needed during periods of higher demand later in the SNFP schedule.

Upon detailed review of the proposed schedule, the Board's staff found that, for some subprojects, procedure development and operator training will be on the critical path. These periods of critical path training, lasting as long as 5 weeks, occur late in the project while equipment that is otherwise ready to go awaits trained operators for dry-run testing. Through timely integration with the SAR writers, this procedure development and training effort might be accelerated. This is vital.

For example, writing the second draft (Rev 0) of the CVD operating procedures is scheduled to start September 17, 1998, 6 weeks after the 100-K SAR is to be submitted to DOE-RL for review and approval (the 100-K SAR will include the CVD facility). While

there may be changes to the procedures as a result of the DOE-RL review of the SAR, procedure development and operator training should proceed concurrently, so that they do not become critical path activities. Updates to some training will be required if significant changes in the safety requirements are demanded by DOE-RL, but the Board's staff believes this risk is manageable.

11. Spent Nuclear Fuel Project Technical Strategy Change

a. Description

The SNFP has proposed to DOE-RL⁵ a change in technical strategy based on a revised bounding estimate for hydrogen generation in an MCO that will:

- (1) seal the MCOs without pressure relief after completion of CVD, and
- (2) eliminate the HCS.

This change in technical strategy is based on SNFP characterization data and more realistic estimates of the magnitude of the MCO water inventory that is expected to remain following completion of the CVD. The bounding estimates for hydrogen generation during storage result in maximum pressures of approximately 100 pounds per square inch (Gage) (psig) in the MCO, which has a design pressure of 150 psig and a much higher rupture pressure. Therefore, SNFP managers have proposed that physical failure of an MCO with resultant loss of radiological confinement and air ingress is an incredible event. This approach leads to possible changes to the existing subproject designs, and affects schedules as described in the following sections.

b. Anticipated Changes to the Existing Subprojects and Related Activities

The Board's staff intends to perform a thorough review of the technical basis for the DESH process simplification proposal and the resulting SNFP design change package when detailed information is available. The results of this thorough review are not included in this report. However, a preliminary evaluation is provided below.

- (1) K-West Basin major modifications for fuel retrieval and loading of MCOs are not expected to be affected by process simplification.
- (2) Multi-Canister Overpack/Transport Cask

⁵FDH letter to DOE-RL, dated October 3, 1997, with attachments: (1) *DESH Position Paper on Sealed Storage of MCOs*, and (2) Fauske & Associates Technical Report, *K-Basins Sludge Water Content, Behavior, and Impact*, September 1997.

Process simplification would reduce the complexity of the MCO closure head by eliminating a rupture disk and relief valve with HEPA filter. The DESH proposal for sealing the MCO after CVD is not expected to affect the schedule adversely. The existing MCO closure head can be modified to provide either mechanical or welded sealing of the MCO with little or no modification, although welding would require some joint preparation. The only change in design would be to omit the penetrations for the pressure relief valve and the rupture disk, simplifying design and fabrication. Installation of a welded cap to cover the closure head following HCS was already required by the current design and would provide a second sealed boundary.

(3) Cold Vacuum Drying Facility (Presently on the critical path to start of fuel removal)

This subproject design is not expected to be affected by process simplification, although the change in safety basis will require revised safety analyses.

(4) Canister Storage Building

The DESH proposal for process simplification should result in cost savings associated with the storage tube plugs and the plug hold-downs. In anticipation of process simplification, the fabrication of the storage tube plugs and hold-downs is being intentionally delayed. This delay strategy needs to be followed closely as it could have adverse effects on the procurement of the storage tube plugs and result in unnecessary loss in schedule float that may be needed as contingency for potential future fabrication, delivery, and installation problems. This is important.

Process simplification would affect design and operations by:

- (a) Eliminating relief valves and HEPA filters in the storage tube plugs
- (b) Eliminating the need for the hold-down mechanism in the storage tube plugs
- (c) Eliminating the need for inert gas fill and purge systems and carts
- (d) Eliminating the HCS processing step
- (e) Adding a welding station for sealing the MCO (may be separate from CSB)

It is not believed that the CSB startup schedule would be improved, but the resulting simpler operation would provide greater assurance of completing the safe storage of K-Basin fuel in a timely manner. Revised hazards analyses and safety analyses will be required based on the change in safety basis and the system design changes.

(5) Multi-Canister Overpack Handling Machine (installed in the CSB)

The MCO hoist is the key limiting item to conducting the fitup, leak, and operating test of the cask and turret assembly. The Board's staff agrees with DESH's tentative conclusion that if the proposed process simplification of eliminating inerting is

approved, it would still be desirable to conduct the fitup and mechanical operating test of the cask and turret assembly in England, as planned. Without the need for the inerting test, the fitup could be done without the MCO hoist, following which the cask and turret assembly could be shipped to Hanford, with the MCO hoist to be delivered at a later date, when available. This approach would help provide assurance of maintaining the proposed delivery schedule and should also provide greater confidence in MHM availability in operation.

Process simplification would reduce the fabrication time and complexity of the MHM by:

- (a) Eliminating the need for inerting and sealing (including the integrated leak test of the cask and turret at the manufacturer's shop)
- (b) Eliminating pressure retaining capability
- (c) Simplifying the control system and eliminating many interlocks
- (d) Eliminating the collision avoidance system

(6) Facility System Integration

The DESH process simplification could result in two major changes to the process flow. First, the availability of the MHM in the CSB would increase because anticipated inerting problems will not shut down the CSB, and recovery from any shutdowns would most likely be of shorter duration. Second, the MCO cap would no longer be welded on after HCS. Welding the cap on in the former HCS process cell would most likely not affect the schedule. Using the cask trailer as the welding location would make the trailers unavailable for transport for an additional day per cask and could create a choke point in the system. Decisions on this issue should be reached prior to running additional parametric studies. This is important.

(7) Safety Analysis Reports and Associated Safety Documentation

The DESH proposal to simplify the SNFP process offers the potential to eliminate a number of facilities, operations, and equipment that require hazards analyses and safety system preventive and mitigative systems. Attendant to such simplification, however, is the need to assess residual conservatism in the database to ensure the safety of the public, workers, and the environment. The need for MCO surveillance, monitoring, and prototypical testing should be evaluated.

Technical Specification requirements constitute another input to support process simplification that must be reviewed carefully.

APPENDIX A: ASSESSMENT APPROACH

A. Inquiries

The Board's concern about the SNFP schedule delays was reflected in a set of five questions that was subsequently expanded by the staff to the list of inquiries set forth in Table 1.

In response to the Board's direction, a staff assessment team was formed and briefed on the mission during the week of September 22, 1997. The team was dispatched to the Hanford Site from September 29 through October 6, 1997, to interview cognizant DOE and contractor personnel, examine applicable documentation, and visit the SNFP facilities as necessary to determine answers to the Board's questions.

Section IV of this report discusses responses to these inquiries as they relate to the subprojects and related activities that were reviewed.

B. Teams

The Board's staff team was led by a senior staff member, Ronald W. Barton, Group Leader for Engineering. He was assisted by Donald J. Wille, the Cognizant Engineer for SNFP; Ralph Arcaro, Lead Engineer for the Hanford Site; Daniel G. Ogg, Site Representative at the Hanford Site; and nine other members of the Board's staff, including David Grover, Ajit K. Gwal, Asadour Hadjian, Matthew B. Moury, Joseph D. Roarty, Steven A. Stokes, Dudley Thompson, William Yeniscavich, and Roger W. Zavadoski. Additional assistance was provided by Douglas Volgenau, an outside expert retained by the Board as a consultant.

Prior to leaving for the Hanford Site, each member of the team was assigned to one or more subteams to examine in depth applicable documentation available at the Board's offices in Washington and to plan on-site activities during the time the team was to be in the field. Subteams were established to examine particular subprojects of the overall SNFP or to be responsible for particular activities, as indicated in Table 2.

C. Deployment

At Hanford, the team was provided workspace, including individual cubicles or offices, copier and facsimile machines, personal computers, a small reference library containing copies of pertinent documentation, and limited administrative support in Building 2704-HV, adjacent to offices of the Board's Hanford Site Representatives, enhancing the team's ability to communicate with each other and with Board offices in Washington.

Each subteam reviewed applicable documentation and interviewed cognizant DOE and contractor personnel as necessary to obtain answers to the questions insofar as they applied to the subproject or activity at hand. All interviews and meetings with DOE or contractor personnel

were scheduled to minimize diversion of interviewees and meeting attendees from their normal duties, and where practical, were conducted at or near DOE and contractor normal work sites.

At the beginning of every day, informal "out-briefs" were provided to DOE and FDH managers. At the end of each day, the entire team gathered to exchange information and to plan the details of the next day's sessions.

As draft text was developed by subteams, it was entered into a database providing timely access to up-to-date significant observations on either an inquiry-by-inquiry (Table 1) or a subproject (Table 2) basis. This approach to initial drafts proved to be extremely valuable, as it allowed the subteams to stay abreast of the progress of the entire assessment effort, and afforded team leadership the opportunity to redirect subteams readily, where appropriate, and to ensure that applicable questions were addressed by the subteams in sufficient depth.

Table 1. Inquiries Pursued by Assessment Team

Inquiry	Subject
1	What is the current status of work?
2	Is there sufficient technical basis to proceed with design, procurement, fabrication, construction, and preoperational testing?
3	What characterization or confirmatory activities are necessary or desirable?
4	Can these characterization or confirmatory activities be performed concurrently with ongoing work?
5	What schedule or other risks are involved?
6	What important near-term (1–3 months) activities or issues should receive priority attention?
7	Are there key intermediate milestones that could or should be tied to contract performance incentives or penalties? If so, what are they?
8	Are there specific, reasonable design simplifications that could or should be made to expedite the start and/or completion of fuel movement? If so, what are they?
9	What other specific changes to activities or processes are necessary or desirable to improve the schedule and/or to provide better assurance that further schedule slippage will not occur?
10	What schedule benefits or penalties are likely to ensue from DESH's process simplification proposal?

Table 2. Spent Nuclear Fuel Project Review Teams

Subteam No.	Subproject or Activity Examined	Staff Members Assigned
1	Fuel Retrieval System (FRS)	Grover , Gwal, Stokes, Thompson, Zavadoski
2	Integrated Water Treatment System (IWTS)	Grover , Gwal, Stokes, Thompson, Zavadoski
3	K-Basins Facility Modifications	Grover , Zavadoski
4	Multi-Canister Overpack (MCO) and Transport	Grover , Yeniscavich
5	MCO Handling Machine (MHM)	Gwal, Hadjian , Wille
6	Cold Vacuum Drying (CVD) Facility	Gwal, Moury, Wille, Yeniscavich
7	Canister Storage Building (CSB)	Gwal, Hadjian , Ogg
8	Facility System Integration	Grover , Zavadoski
9	Safety Analysis Reports and Related Documentation	Roarty , Wille
10	Procedure Preparation, Training, and Operational Readiness Reviews	Arcaro, Moury , Ogg
11	Project Management	Arcaro, Barton , Ogg, Wille, Volgenau (OE)
12	Report Integration and Coordination	Thompson
13	Oversight/Coordination (in addition to other assignments)	Arcaro, Barton , Ogg, Thompson, Wille

Note: Team Leaders are indicated by boldface.

APPENDIX B: LIST OF ACRONYMS AND ABBREVIATIONS

Board	Defense Nuclear Facilities Safety Board
CD	Critical Decision
CSB	Canister Storage Building
CVD	Cold Vacuum Drying (Facility)
DESH	Duke Engineering and Services Hanford (Company)
DOE	Department of Energy
DOE-RL	Department of Energy, Richland Operations Office
EA	Enabling Assumption
EOC	Electronic Operations Center
FDH	Fluor-Daniel Hanford Company
FMEA	Failure Modes and Effects Analysis
FRS	Fuel Retrieval System
FSAR	Final Safety Analysis Report
GO	General Observations
HCS	Hot Conditioning System
HEPA	High-Efficiency Particulate Air (Filter)
HYLAC	Hydraulic Actuator
IWTS	Integrated Water Treatment System
KDRC	Key Drivers Resolution Committee
MCO	Multi-Canister Overpack
MHM	Multi-Canister Overpack Handling Machine
MSA	Management Self Assessment
ORR	Operational Readiness Review
PSAR	Preliminary Safety Analysis Report
SAR	Safety Analysis Report
SNFP	Spent Nuclear Fuel Project
VP/PD	Vice President and Project Director