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Hanford Spent Nuclear Fuel Project Recommended Path Forward

Volume II: Alternatives and Path Forward Evaluation

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Prepared for the U. S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company Richland, Washington
Hanford Operations and Engineering Contractor for the
U. S. Department of Energy under Contract DE-AC06-87RL10930

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Spent Nuclear Fuel Project
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EXECUTIVE SUMMARY

The Hanford Spent Nuclear Fuel Project has completed an evaluation of four alternatives for expediting the removal of spent nuclear fuel from the K Basins and stabilizing and placing the fuel into interim storage. Four alternative paths were compared: (1) Containerizing fuel in the K Basins, transporting contained fuel to a facility for stabilization, and interim storage of stabilized fuel in a dry storage facility, (2) Containerizing fuel in the K Basins, transporting contained fuel to a wet temporary staging facility, moving fuel to a facility for stabilization, and transporting stabilized fuel to an interim dry storage facility, (3) Containerizing fuel in the K Basins in multi-canister overpacks, transporting overpacked fuel directly to a stabilization facility for passivation in the overpack, and interim storage of stabilized fuel in a dry storage facility, (4) Packaging fuel for transport overseas and shipping packed fuel to a foreign reprocessing facility for reprocessing with eventual return of uranium, plutonium and vitrified high level waste.

The comparative evaluation process consisted of a multi-attribute utility decision analysis, a public, worker and environmental health risk assessment, and a programmatic risk evaluation. The basis of the comparative evaluation was the development of fundamental objectives and associated criteria. Comparative cost and schedule data were developed for each alternative. Important stakeholder values were identified and incorporated in the

objectives and criteria. Expressed in terms of the objectives, the stakeholder values are summarized as:

> Remove the fuel and sludge from the K Basins, away from the Columbia river, with a high probability of meeting, or exceeding the 2002 Tri-Party Agreement milestone, paying attention to worker health risk and total costs.

The four alternatives were evaluated quantitatively using the comparative evaluation process. The evaluation illustrated that a combination of functions or activities for one alternative better achieved some objectives and satisfied some criteria than those of another alternative. Yet, each Alternative had some potential disadvantages. As examples, for Alternative 2 the fuel and sludge was removed from the K Basins in the shortest time. Alternative 3 had a better developed fuel stabilization process and the lowest life-cycle costs. Alternatives 1, 2, and 3 considered a dry vault interim storage facility. The public, worker and environmental health risks were acceptable for each Alternative. In Alternative 3 the fuel and sludge was handled the fewest number of times. The final fuel form appeared best for Alternative 4.

As the evaluation continued, discussions became synergistic, and the focus turned to the concepts of specific alternatives, which when combined best satisfied the objectives and criteria. It became apparent that this was the most effective approach. Therefore, the evaluation concluded that the best Path Forward combines the following concepts:

1. Removal of K Basin fuel and sludge is uncoupled from the operation of a stabilization facility.

2. A storage capability is provided to act as a lag storage or staging operation for overpack fuel containers as they are removed from the K Basins.
3. Metal fuel drying and passivation should be maintained as the fuel stabilization process with the option of further refinements as more information becomes available.
4. The near term NEPA strategy should focus on expeditious removal of fuel and sludge from K Basins and placing overpacked fuel in temporary storage.

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LIST OF TERMS

AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act of 1980
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DOH	Washington State Department of Health
DOT	U.S. Department of Transportation
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESCM	Eckert, Seamans, Cherin, and Mellott
FMEF	Fuels and Materials Examination Facility
FONSI	Finding of No Significant Impact
HAMMER	Hazardous Materials Management Emergency Response Training Center
IOSRs	Interim Operational Safety Requirements
ISFSI	independent spent fuel storage installation
ITA	Independent Technical Assessment Team
LWR	light water reactor
MRS	monitored retrievable storage installation
NEPA	National Environmental Policy Act of 1969
NOC	Notice of Construction
NRC	Nuclear Regulatory Commission
ORR	Official Readiness Review
OSRs	Operational Safety Requirements
PC	Primary Container
PDC	Packaging Design Criteria
PEIS	Programmatic Environmental Impact Statement
PPG	Priority Planning Grid
PUREX	Plutonium Uranium Extraction facility
PSE	preliminary safety evaluation
RCRA	Resource Conservation and Recovery Act
SAR	Safety Analysis Report
SARP	safety analysis report for packaging
SE	safety evaluation
SNF	spent nuclear fuel
TPA	Tri-Party Agreement
TRU	transuranic
TSAR	Topical Safety Analysis Report
TSD	Treatment, Storage, and Disposal
TSRs	Technical Safety Requirements
TWRS	Tank Waste Remediation System
USQ	unreviewed safety question
WAC	Washington Administrative Code
WRAP	Waste Receiving and Packaging

1.0 INTRODUCTION

1.1 PURPOSE

The Hanford Site has a large portion of the U.S. Department of Energy (DOE)-owned inventory of spent nuclear fuel. The process for management and ultimate disposition of the spent nuclear fuel includes assessment of several Alternatives for stabilization, transportation, and safe interim storage until determination of the ultimate disposition of the spent nuclear fuel can be made.

In the Spent Fuel Working Group Report (DOE 1993) the Hanford Site K Basins were cited as having high priority for resolution of environmental, health and safety vulnerabilities. Renegotiation of the *Hanford Federal Facility Agreement and Consent Order*, known as the Tri-Party Agreement, (Ecology et. al., 1994) subsequently resulted in the target date to remove the spent nuclear fuel from the K Basins by the year 2002.

The Spent Fuel Working Group assessment identified deficiencies in existing spent nuclear fuel management. Most of these deficiencies result from degradation of the spent nuclear fuel and the type and age of the spent nuclear fuel storage facilities. Planned corrective actions include the following.

- Encapsulation (or containerization) of fuel stored in the 105 K-East Basin to isolate a potential pathway of fuel constituents to the environment.
- Removal of all fuel and sludge from the 105 K-East and K-West Basins.
- Preparation of a Hanford Site Spent Nuclear Fuel Environmental Impact Statement (EIS) and issuance of the record of decision to provide for management of spent nuclear fuel at the Hanford Site. Management activities would include spent fuel storage siting and configuration and Path Forward for ultimate disposition.
- Technical evaluation and characterization of 100-N Reactor fuel to support development of the Hanford Site Spent Nuclear Fuel EIS.

Four Alternatives were proposed for undertaking the first two of the above listed corrective actions. A comparative evaluation of these Alternatives has been performed to allow an informed selection.

1.2 SCOPE

The principal inventories of 100-N spent nuclear fuel and the storage conditions are as follows:

- 105 K-West Basin--952 metric tons of uranium in 3,815 closed canisters. The condition of the fuel inside the closed containers is uncertain. The basin water has only low levels of radionuclide contamination.

- 105 K-East Basin--1,144 metric tons of uranium in 3,666 open canisters. A significant fraction of the fuel elements are suspected to be breached or to possess cladding failures. The water in the basin is contaminated with radionuclides. There is a thick layer of sludge on the basin floor.

An expedited program for removal of fuel and sludge from the Hanford K Basins has been determined to be necessary and feasible. Based on a Systems Engineering approach to define the problem and delimit the program endpoint, four Alternatives were defined.

- Alternative 1: Containerization and Storage in K Basins--Containerization and storage in existing K Basins with subsequent transfer to a spent nuclear fuel conditioning facility, then to interim dry storage.

- Alternative 2: Wet Pre-Interim Storage--Expedited transfer to new wet storage with subsequent transfer to a conditioning facility followed by transfer to interim dry storage.

- Alternative 3: Dry New Facility Storage--Direct transfer to, and stabilizing for, expedited interim dry storage.

- Alternative 4: Foreign Processing--Direct turnover of fuel to a foreign processor for processing, and subsequent return of residue (conditioned waste) for interim dry storage.

These Alternatives, consistent with the DOE risk based programmatic decision process, are evaluated on programmatic considerations, project cost/schedule parameters, stakeholder values, regulatory compliance and technical feasibility/maturity. For all Alternatives, the Path Forward is defined as starting with spent nuclear fuel in storage in the present condition in the K Basins and concluding with the spent nuclear fuel stored in a new, interim dry storage facility, designed for a 40-year operational life.

The evaluation of these Alternatives encompasses those processes and project activities necessary to achieve acceptable interim dry storage of the spent nuclear fuel. Excluded from the comparison bases and parameters is final dispositioning of the spent nuclear fuel in a Federal Waste Repository.

In the sections that follow specific information is succinctly presented to provide the essence of the topic being discussed. More detailed, technical information is provided in the appendices that are correlated and referenced to each topic.

2.0 ASSUMPTIONS

To permit consistent evaluation of the Alternatives, these assumptions have been put forth by the Spent Nuclear Fuel Project Staff and approved by DOE:

1. Spent nuclear fuel is not waste.
2. Sludge is considered to be spent nuclear fuel (sludge in canisters, both K-East and K-West Basins, pool sludge in K-East).
3. The evaluation is limited to the current four Alternatives.
4. The path forward for evaluation process ends with receipt and custodianship of K Basin fuel in interim dry storage.
5. The annual interim dry storage costs are the same for all Alternatives.
6. Any new facilities will meet Nuclear Regulatory Commission (NRC) licensing requirements.
7. Modifications to existing facilities will be in accordance with DOE orders and requirements.
8. Forty-year interim dry storage will meet NRC licensing requirements.
9. Selection of Alternative will not prejudice complex-wide Programmatic EIS.
10. Alternatives will accommodate disposition of K Basin water and debris. The waste from, and decontamination and decommissioning of, any new or modified facilities other than interim dry storage will also be accommodated.

A basis for each assumption is provided in Appendix A.

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3.0 DECISION ELEMENTS

3.1 KEY DECISION ELEMENTS

During the course of their deliberations over the information relative to the evaluation of the Path Forward Alternatives the K Basin Spent Nuclear Fuel Task Team recognized certain key elements as significant to the Path Forward decision-making process. These Key Decision Elements are discussed in the sections that follow.

3.1.1 National Environmental Policy Act

DOE must complete the *National Environmental Policy Act of 1969* 42 USC 4321, et seq. (NEPA) process before reaching a final decision on the disposition of spent nuclear fuel in the K Basins. The NEPA process will include the public in the DOE decision making process. DOE will determine the appropriate level of NEPA review for the actions. According to DOE NEPA Implementing Procedures, *Compliance with the National Environmental Policy Act*, (10 CFR 1021), the proposed relocation of spent nuclear fuel from K Basins to an interim storage facility may require an EIS. DOE currently is preparing a programmatic EIS to determine the appropriate management of spent nuclear fuel throughout the DOE complex *Spent Nuclear Fuel Management and Idaho Nationaal Engineering Laboratory Environmental Restoration and Waste Management Program Draft Environmental Impact Statement*, (DOE/EIS-0203D). DOE will not take any action with adverse environmental impact, nor limit the reasonable alternatives for spent nuclear fuel management unless the action is independently justified, accompanied by an EIS, and does not prejudice the ultimate decision on the programmatic EIS (40 CFR 1506.1).

An expedited response means, getting the fuel and sludge containerized and away from the river as directly as possible. The initial activity, characterization of fuel and sludge currently in the basins, is underway. The next activities are: fabrication, or procurement, and use of overpacks in K Basins; preparations for movement of fuel in the K Basins; and, providing for transportation.

DOE currently is preparing a programmatic EIS to determine the appropriate management of spent nuclear fuel throughout the DOE Complex. Further, the programmatic decision on interim storage would be reviewed by a future Hanford Site Spent Nuclear Fuel Management EIS. These actions are not expected to be complete for at least two years.

Stabilization and subsequent interim storage would probably require an EIS as discussed in Appendix B, Section B.1.0. Since these activities are further in the future, there is the opportunity for the programmatic EIS and the Hanford Site Spent Nuclear Fuel Management EIS to be completed.

3.1.2 Regulatory Considerations

The effort to complete the expedited fuel removal can be minimized by designing, constructing, and operating the new facilities in accordance with requirements already established within DOE Site requirements.

The DOE has established safety requirements for its facilities as reflected in the DOE orders and rules that are supplemented by directives, notices, instructions, safety guides and technical standards. Based on these requirements, each contractor negotiates specific facility safety requirements that are imposed through contract conditions. These negotiated design and operational requirements become the facility's Authorization Basis, defined as those aspects of the facility design basis and operation requirements relied upon by DOE to authorize operation. The Authorization Basis is described in documents such as the facility Safety Analysis Report and other safety documentation, as well as through facility-specific commitments made to comply with DOE orders.

New facilities will be designed to meet the intent of NRC regulations and requirements including reference national codes and standards. "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," (10 CFR 72) is currently in place to license the independent storage facilities for the large quantities of commercial power spent fuel. The Project safety documentation will have to address the K Basin metal fuel and its operational experience in the N-Reactor.

3.1.3 Special Nuclear Material Accountability

Conventional methods of accounting will be difficult to apply to the spent nuclear fuel in its current degraded state. Alternate methods to assure adequate safeguards must be developed and applied to meet the intent of the Safeguards requirements. There is expected to be a documented loss of special nuclear material during the processing of the fuel at K Basins. This loss is due to the use of pre-irradiated fuel weights in the current inventory, and the fact that there have been no adjustments to the inventory to account for the small fuel fragment and corrosion loss during storage and K-East segregation activities. The loss will be reduced as the sludge is packaged, characterized, and inventoried. During the engineering phase of the Path Forward, policies need to be established to effectively deal with this issue.

3.1.4 Wet vs. Dry Interim Storage

An exhaustive comparison of wet versus dry interim storage has not been undertaken for this effort. However, a dry interim storage system was assumed for the following reasons:

- Wet storage inherently results in continued degradation of exposed metallic fuel with an associated release of corrosion products and other fuel constituents to water in contact with the fuel. Additionally, radiolytic decomposition of the water requires venting of wet storage containers and active monitoring.

- Assuming proper fuel preparation and appropriate dry storage conditions, dry storage of most fuels significantly reduces the environmental and safety risks associated with fuel degradation in wet storage by reducing mobility of high activity fuel constituents.

- Because of this reduced risk, the relative environmental and safety performance of engineered dry storage systems are considered superior to wet storage systems for the assumed 40 year period.

- Previous evaluation indicates that operations and maintenance costs for wet storage are higher than for dry storage (Feizillahi and Shropshire 1993).

- Active systems required to maintain wet storage result in higher relative waste generated in the wet storage system than projected for the dry storage system.

Based on these and other factors, the DOE Integrated Spent Fuel Program previously identified plans to develop and implement interim dry storage, where feasible, for DOE-owned spent nuclear fuels *DOE Integrated Spent Nuclear Fuel Technology Integration Plan*, (DOE 1994a). These factors provide a adequate bases to assume dry interim storage without detailed evaluation.

3.1.5 Passivation vs. Oxidation

Passivation for dry storage (e.g., the Independent Technical Assessment process) involves drying, decomposition of hydrides, controlled oxidation to passivate uranium metal surfaces, inerting, and seal welding in high integrity containers, which may then be placed in a storage cask, multi-purpose canister, or a vault for dry storage.

The oxidation options considered are representative of the general class of fuel oxidation options. They convert the fuel from metallic to oxide forms. It seems premature to judge whether any given process would have overweighing merits as waste forms requiring no further processing/packaging. The oxides may seem relevant to the oxides in commercial fuels, but surface areas and particle sizes may enter into concerns about repository source terms. The metal forms, in their passivated, doubly-contained status, should not be summarily judged as unacceptable waste forms until the final repository criteria are defined.

The passivation process provides for safe and stable interim storage, although engineering aspects remain to be demonstrated. This does not foreclose future options--if oxidation is eventually regarded as essential, it can be accomplished, but with a technology that may have been developed to yield a product that is optimum for final repository criteria.

On the other hand, the oxidized products may have a higher prospect of acceptability for direct disposal or are readily converted to glass or ceramic forms if required.

3.2 COMMON DECISION ELEMENTS

Again, the Spent Nuclear Fuel Task Team identified elements germane to all the Path Forward Alternatives which were considerations in the Path Forward decision process. These common decision elements are discussed in the following sections.

3.2.1 Requirements

The Task Team adopted the project requirements set forth in the draft *Spent Nuclear Fuel Project Technical Baseline Document* (WHC 1994a). Following the format of that document, the initial effort in reviewing these requirements involved the decomposition of the requirements of elements 4.1.1, "Deactivate K Basin (and support systems)," and 4.7, "Store, Stabilize, and Disposition Spent Nuclear Fuel" to find those functions which applied explicitly to this Project. This review revealed the need to look further at the Environmental and licensing requirements and identified the spent nuclear fuel project functions associated with the Path Forward. The four Path Forward Alternatives were then reviewed for compliance with the requirements allocated to these functions by the spent nuclear fuel Project Staff. It was concluded that all four Alternatives were capable of complying with the requirements.

Regulatory requirements include the safety documentation prerequisite to the start of construction and operation. Generally, the early functions of the four Alternatives will be performed under the usual DOE orders, viz., Nuclear Safety Analysis Reports, Technical Safety Requirements, Unreviewed Safety Questions, Nuclear Criticality Safety, Startup and Restart of Nuclear Facilities, and General Design Criteria. Regulatory compliance is expected to significantly affect cost and schedule.

3.2.2 Tribal, Regulator, and Stakeholders Values

DOE, in conjunction with regulators and other federal, tribal, state, and local government entities, have sponsored two Hanford stakeholder forums that have provided values to be considered in K Basin spent nuclear fuel cleanup decisions: (1) *The Hanford Future Site Uses Working Group* was charged with developing future use options for the Site and assessing their implications on cleanup. Future uses were thus proposed for each of six major geographic areas of the Site, and the necessary cleanup scenarios described. Of these six the two areas most affected by the K Basin remediation are the Columbia River, and the land between it and the 100 Areas. For these two areas the Working Group cites cleaning up contamination affecting the River as an immediate priority. The Working Group also advanced general recommendations on the Project; and (2) *The Hanford Tank Waste Task Force* was convened in May, 1993 by the DOE, the U.S. Environmental Protection Agency, and Washington State Department of Ecology (Ecology), the three agencies renegotiating the Tri-Party Agreement. The Task Force's key message to the agencies was "Get on with cleanup!" (i.e., use available technology and resources now without precluding the use of improved, emerging technology).

Recent presentations were also made to the Confederated Tribes and Bands of the Yakima Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, the Nez Perce Tribe, the U.S. Environmental Protection Agency and Ecology, and the Hanford Advisory Board's Major Safety and Waste Management Issues Committee specifically to obtain their values as input to the Spent Nuclear Fuel Project decision process.

The tribes have legal rights regarding the Hanford Site. It is, therefore, incumbent on the management of the Spent Nuclear Fuel Project to ensure that the Project's strategic direction is aligned with their values. General values regarding the Hanford Strategic Plan, the Hanford Mission Plan, and Hanford Environmental Remediation and Waste Management have been transmitted to DOE-Richland Operations Office (RL). However, to ensure that specific tribal values are incorporated into Project's decision process the local tribes were consulted.

Appendix B, Section B.3.0 provides an expanded treatise on the tribal and stakeholder values related to the spent nuclear fuel Project.

3.2.3 Characterization

The current characterization program consists of four principal elements: (1) establishing the pathway to the hot cells so that quantitative measurements can be made as needed, (2) sampling the contents of the sealed canisters, (3) obtaining sludge samples, and (4) using underwater video cameras to establish the extent to which fuel is broken. Information currently being gathered is not oriented toward a specific Path Forward Alternative; rather, it is useful regardless of the Alternative chosen. However, characterization activities will be oriented toward the selected Alternative, and will support process design, process control, and product control (WHC 1994a).

3.2.4 Sludge Management

Sludge is assumed, for the purpose of this evaluation, to be spent nuclear fuel. Three disposition options for basin sludge are available at this time. These options consists of: (1) storing sludge with fuel, (2) managing sludge with Hanford Site tank waste, or (3) managing sludge with Hanford Site solid waste. Selection of one or more of these options for portions of the basin sludge is dependent on whether sludge is designated to be fuel or not, and if not designated fuel, whether the sludge exhibits dangerous characteristics. If designated fuel, it is clear that a disposition option to store all sludge with fuel would be selected. Management of the sludge as spent nuclear fuel obviates having to consider the different regulatory options for the disposition of the sludge alone. When managed as a waste, however, the question of regulatory authority arises. If sludge is designated as non-fuel material and exhibits dangerous characteristics, permitting requirements, impacts on schedules for design construction, and operation of fuel stabilization and storage systems become a concern for expedited actions.

The presence of sludge, combined with fuel in processing systems, can also generate technical challenges that must be addressed during the design process and system operation. These challenges include the following.

- Provision of adequate drying for the combined fuel/sludge system to preclude significant gas generation from water radiolysis. Sludge if present in unknown quantities and composition, will provide an additional degree of uncertainty that drying is complete.

- Addressing the increased potential for particulate fines transmitted to off-gas equipment to the point that shielded filter systems are required.

Solutions to these design challenges may indicate that sludge management in a separate process system from fuel is desirable independent of whether sludge is, or is not, designated to be fuel.

Appendix B, Section B.4.0, gives a more extensive discussion of the affect of sludge management in the K Basin spent nuclear fuel removal project.

3.2.5 Water Removal

Water quality in K-East Basin must be improved to meet Tri-Party Agreement milestones and also the water treatment system must be improved to maintain water quality during fuel and sludge removal operations. The Tri-Party Agreement milestone requires water disposition to start by March 1999 if the fuel and sludge have been removed, or to reduce the tritium concentration to 300,000 pCi/L. The latter would be accomplished by starting in September, 1996, a 2M gal/year feed and bleed process to achieve an order-of-magnitude reduction in 6 years. The March 1999 date was based on fuel and sludge encapsulation, which will not be performed at this time. Consequently, the focus has been to reduce tritium concentration, starting September, 1996. Westinghouse Hanford Company is submitting a report to DOE, *Options for Disposition of KE-Basin Water*, WHC-SD-SNF-ES-005 (WHC 1994b), describing six options: (1) treat bleed water by ion exchange and filtration, and dispose of water by evaporation, or into river at K Area; (2) treat at 100K Area, send to Effluent Treatment Facility and dispose of in State Approved Land Disposal Site; (3) treat at 242-A evaporator and Effluent Treatment Facility and dispose of in State Approved Land Disposal Site; (4) Treat at evaporator and Effluent Treatment Facility and detritiate with developmental technology; (5) process water behind seismic isolation barrier (10% of basin volume); and, (6) do no processing because isolation barrier meets intent of milestone. All of these except option 1 can be operational by September, 1996. Option 1 would be operational by FY 1998. None of these options would impact Path Forward. Regardless of the option selected, the basin water system will require upgrades to maintain water quality during fuel and sludge dispositioning to reduce dose rates and maintain visibility. This can be accomplished by September, 1996 and will not impact Path Forward for spent nuclear fuel removal. Water removal from the basins will occur after fuel and sludge removal and will not affect Path Forward.

3.2.6 Debris Removal

K-East Basin has significant quantities of debris piled at random in auxiliary pit areas and throughout the main basin. Debris is any material in the basin that is not fuel, water, or sludge and consists of 2,000 empty canisters, old tools, cables, gloves, etc. The volume is sufficient to interfere with near-term activities including seismic barrier installation, equipment piloting, and fuel and sludge removal. The scope of this task is to remove the debris, decontaminate it to non-transuranic (TRU) levels and package it as solid radioactive waste. It will then be disposed of at the Hanford Site, or possibly shipped to another licensed site for metal recovery. This effort is described in *105-KE Basin Debris Removal Functions and Requirements*, WHC-SD-ND-FDR-004, (WHC 1994c). This effort will not impact Path Forward schedules. Solid waste will also be generated as part of fuel, sludge and water processes. Cleanup of this waste will be concurrent with processing activities in both K Basins, will be handled as a radioactive solid waste stream for these processes, and will not affect the Path Forward.

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4.0 SUMMARY OF ALTERNATIVES

For purposes of evaluating the Alternatives a common starting point was chosen, namely, the current configurations and spent nuclear fuel inventories of the K Basins. Interim dry storage of the spent nuclear fuel on the Hanford Site is the common endpoint. The set of Alternatives are illustrated in the top-level functional flow diagram in Figure 1. Each function block, in turn, represents a set of options which fulfill that function. However, one option in each function was chosen as primary for the evaluation, e.g., "Repack and Passivate" for the stabilization function of Alternative 1. The dotted line indicates the regulatory authority with which the functions are assumed to comply (i.e., the DOE orders or NRC Licensability).

Initial approaches to the disposition of K Basin fuel were based on placing a barrier around the fuel, allowing the spent nuclear fuel to safely remain in K Basins for a relatively extended period until the requirements for final disposition are understood. For this interim, candidate processes of passivation or oxidation would have emerged as acceptable for producing a product for final disposition. However, work done by the Independent Technical Assessment team has shown that passivation is viable for stabilizing fuel. This, together with the delay of the availability of a final repository, has led to the possibility of using passivation to expeditiously provide a product suitable for interim storage. This led to the design of Alternative 1 as Containerize fuel and sludge and then maintain in K Basin storage until a stabilization facility is available. Alternative 2 was also based on pre-interim storage period to allow technology development, but the selection of passivation for stabilization again has allowed the schedules to be based on the earliest times for design and construction, constrained only by engineering and regulatory requirements. Thus, with the adoption of passivation as advanced by the Independent Technical Assessment study (Devine 1994), the Alternatives have become more similar to each other, and differ more from earlier concepts.

No

4.1 GLOSSARY

The following is a function glossary defining the major functions associated with the Path Forward Alternatives.

1. Spent Nuclear Fuel Characterization--This function pertains to establishing the degree of degradation of the K-East Basin inventory and the condition of the spent nuclear fuel in the sealed containers in the K-West Basin.

2. Spent Nuclear Fuel Containerization or Encapsulation or Overpack--This function is common to all Alternatives. Selection between these options depends on the Alternative selected. Facility and equipment requirements vary from minimal containerization for onsite transport, to some degree of spent nuclear fuel preparation and final packaging for interim dry storage.

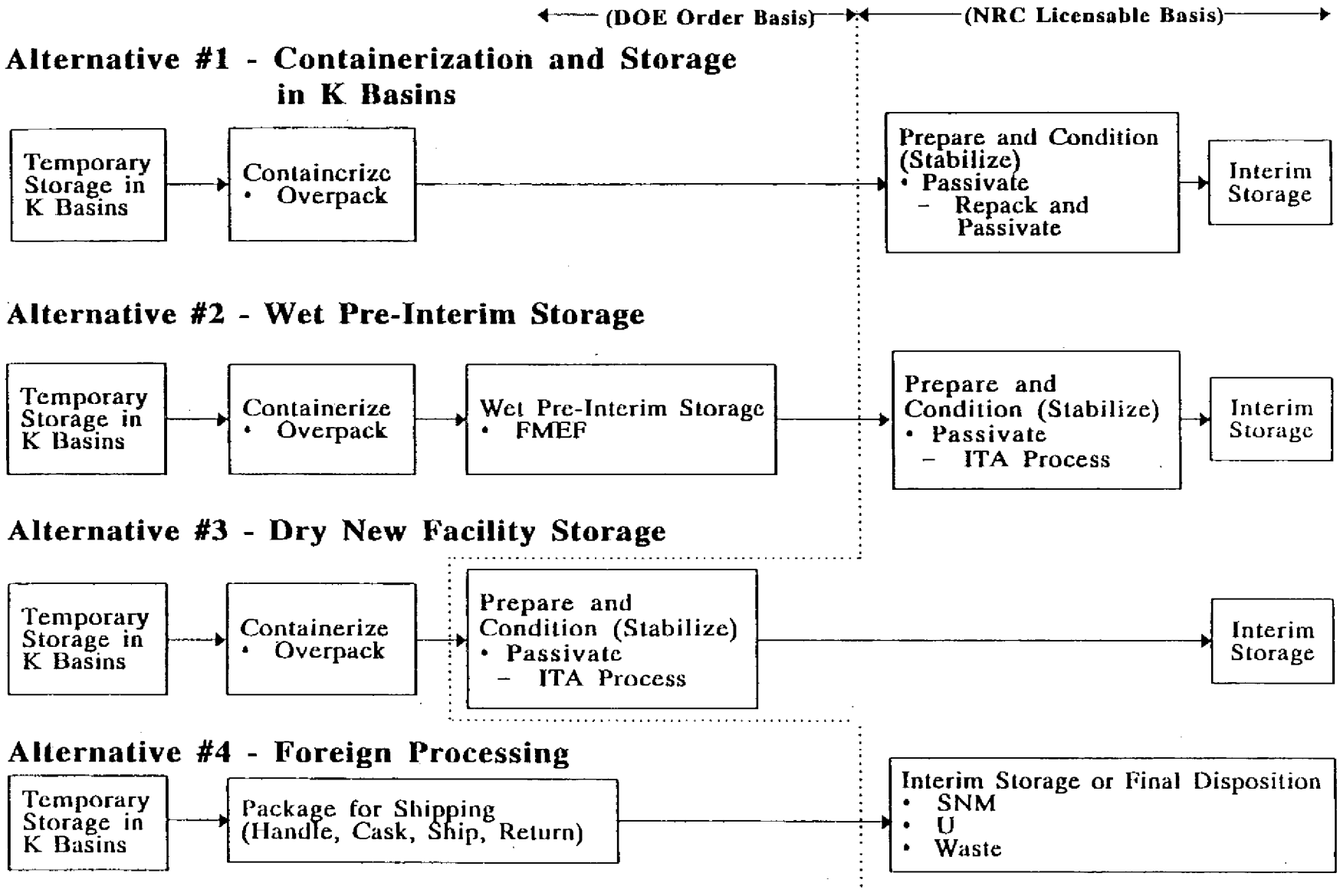

Figure 1. K Basin Spent Nuclear Fuel Removal Path Forward Alternatives.

3. Onsite Transport--Provisions for transport are required for all Alternatives. Packaging requirements (item 2, above) are determined, in part, by transport mode (rail or truck) and by type of shipping cask which, in turn, is determined by the destination and the degree of regulation.

4. Stabilization--This function applies only to Alternatives 1, 2, and 3. In Alternative 4, reprocessing is provided as an offsite service.

5. Pre-Interim Wet Storage--This function applies only to Alternatives 1 and 2. In the former, the function is accomplished in the K Basins; in the latter, in modified facilities elsewhere on the Hanford Site.

6. Interim Dry Storage--This function is defined as the endpoint of all the Alternatives selected for comparison. At this point the spent nuclear fuel has been stabilized such that a safe, environmentally compliant extended storage is possible, requiring only minimal surveillance until provisions for final disposition are in place.

4.2 ALTERNATIVE SUMMARIES

4.2.1 Alternative 1: Containerization and Storage in K Basins

Alternative 1 begins with overpacking the fuel stored in the K-East Basins and storing the overpacked and encapsulated fuel within the K Basins until a fuel stabilization and interim storage system is available. The fuel stabilization process is assumed for comparison purposes to be based on repackaging and passivation of the fuel, once it is received in the fuel stabilization facility. The repackaged/passivated fuel is then transferred to an interim storage facility which is assumed to be based on a vault storage concept.

This Alternative, described in more detail in Appendix C, Section C.1.0, consists of upgrading the existing K Basins (retrofit and life extension), packaging of the current K-East Basin inventory, and some period of pre-interim wet storage in the existing K Basins until a stabilization facility is available. The stabilization facility selected is a modification to the Fuels and Material Examination Facility hot cells. A new facility in the 200 Area provides Interim dry storage.

4.2.2 Alternative 2: Wet Pre-Interim Storage

This Alternative is based on overpacking the fuel stored in the Basins and transferring the overpacked fuel to a wet pre-interim (an existing facility modified for wet storage) storage facility. The fuel is stored in this wet storage facility, a pool connected to Fuels and Material Examination Facility, until a stabilization and interim storage system is available. The fuel stabilization process for comparison purposes is assumed to be based on the fuel passivation concept proposed by the Independent Technical Assessment team. The Independent Technical Assessment process transfers the fuel from

the overpacks employed for the pre-interim wet storage to the package configuration developed for the passivation system, within the pre-interim wet storage facility. The repackaged fuel is then transferred to the fuel stabilization facility constructed in the Fuels and Material Examination Facility Truck Lock for passivation. The passivated fuel is then transferred to the dry interim storage facility which is based on a vault storage concept and located in the 200 Area. Additional description is found in Appendix C, Section C.2.0.

In this Alternative, the principal feature is the prompt removal of the spent nuclear fuel from the K Basins to an another location on the Hanford Site for some period of pre-interim wet storage.

4.2.3 Alternative 3: Dry New Facility Storage

This Alternative is based on the concepts proposed by the Independent Technical Assessment team. Prior to removal, the spent nuclear fuel and sludge are placed in multi-canister overpacks which provide primary containment for the transition from wet storage in the K Basins, through stabilization by passivation, to the interim dry storage. The multi-canister overpack is designed to contain a 5-high stack of canisters with 2 canisters at each level (i.e., 10 canisters/multi-canister overpack [see Appendix C, Figure C-12]).

From the K Basins multi-canister overpacks, containing the spent nuclear fuel and sludge, are transported to a new stabilization facility which is co-located with a new interim dry storage facility in the 200 Area. At the stabilization facility the spent nuclear fuel and sludge are dried and passivated. The multi-canister overpacks are backfilled with inert gas and then moved into the new interim dry storage facility.

4.2.4 Alternative 4: Foreign Processing

In this Alternative, the custody of the packaged spent nuclear fuel is transferred to a foreign enterprise that assumes responsibility for transoceanic transport and for processing to stable residues (conditioned wastes). In the nominal configuration, the uranium, plutonium, and vitrified high-level waste from reprocessing are returned to the Hanford Site for interim dry storage to await final disposition.

Alternative 4 includes modifications to the K Basins cask out loading facilities to accommodate the British Nuclear Fuel Laboratories casks, packaging N Reactor spent nuclear fuel from both Basins, shipping the spent nuclear fuel to the British Nuclear Fuel Laboratories Sellafield Plant located in the United Kingdom, processing the spent nuclear fuel in the Sellafield Plant and returning the residues to the Hanford Site for interim dry storage. The low- and intermediate-level wastes would be retained in the United Kingdom. Primary options within this Alternative include: (1) shipping of fuel in the British Nuclear Fuel Laboratories' cask; and, (2) retention of conditioned, intermediate and low-level waste/residue in the United Kingdom instead of return to the Hanford Site for interim dry storage. The Alternative is further described in Appendix C, Section C.4.0.

5.0 EVALUATION OF ALTERNATIVES

5.1 FUNCTIONS AND PROCESSES FRAMEWORK FOR ALTERNATIVES EVALUATION

The four Path Forward Alternatives proposed for removing and dispositioning the spent nuclear fuel and sludge from the K Basins are presented in Figure 2 as a Functional Flow Block Diagram. The purpose of the Functional Flow Block Diagram is to provide a common basis for evaluating the four proposed Alternatives. The 20 functions in Figure 2 are referenced throughout this report. The specific functions included in each Path Forward Alternative are identified in the description given for each in Appendix C. No one Alternative requires all 20 functions. The Functional Flow Block Diagram provided guidance for gathering data, including input and output quantities, and requirements and resources for each function.

For the Multi-Attribute Utility Decision Analysis, the Assessment of Environmental, Safety, and Health Risks, and the Programmatic Risk Evaluation (discussed in Sections 5.3, 5.4, and 5.5, respectively), each function of the Functional Flow Block Diagram was evaluated by holding interviews with individuals familiar with each Path Forward Alternative. During these interviews information was obtained to supplement that provided by the engineering reports on each Alternative.

The cost and schedule evaluation (see Section 5.2) was performed in a manner to ensure commonality of approach and data content among the four Alternatives. The cost and schedule evaluation is organized by the structure identified by the Functional Flow Block Diagram.

5.2 COST AND SCHEDULE DATA

5.2.1 Methodology

Cost and schedule estimates were developed for the Path Forward Alternatives. The schedules are organized consistent with the Path Forward Alternatives Functional Flow Block Diagram in Figure 2. A cost and schedule methodology was provided to individuals associated with each Path Forward Alternative for use in development of the report on each Path Forward Alternative.

Using PRIMAVERA* project planner software a generic schedule model was developed which provides:

- typical logical relationships among activities,
- a basis for modeling constraints on performance of the activities,
- commonality of schedule basis among the Alternatives.

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*PRIMAVERA is a trademark of Primavera Systems, Inc.

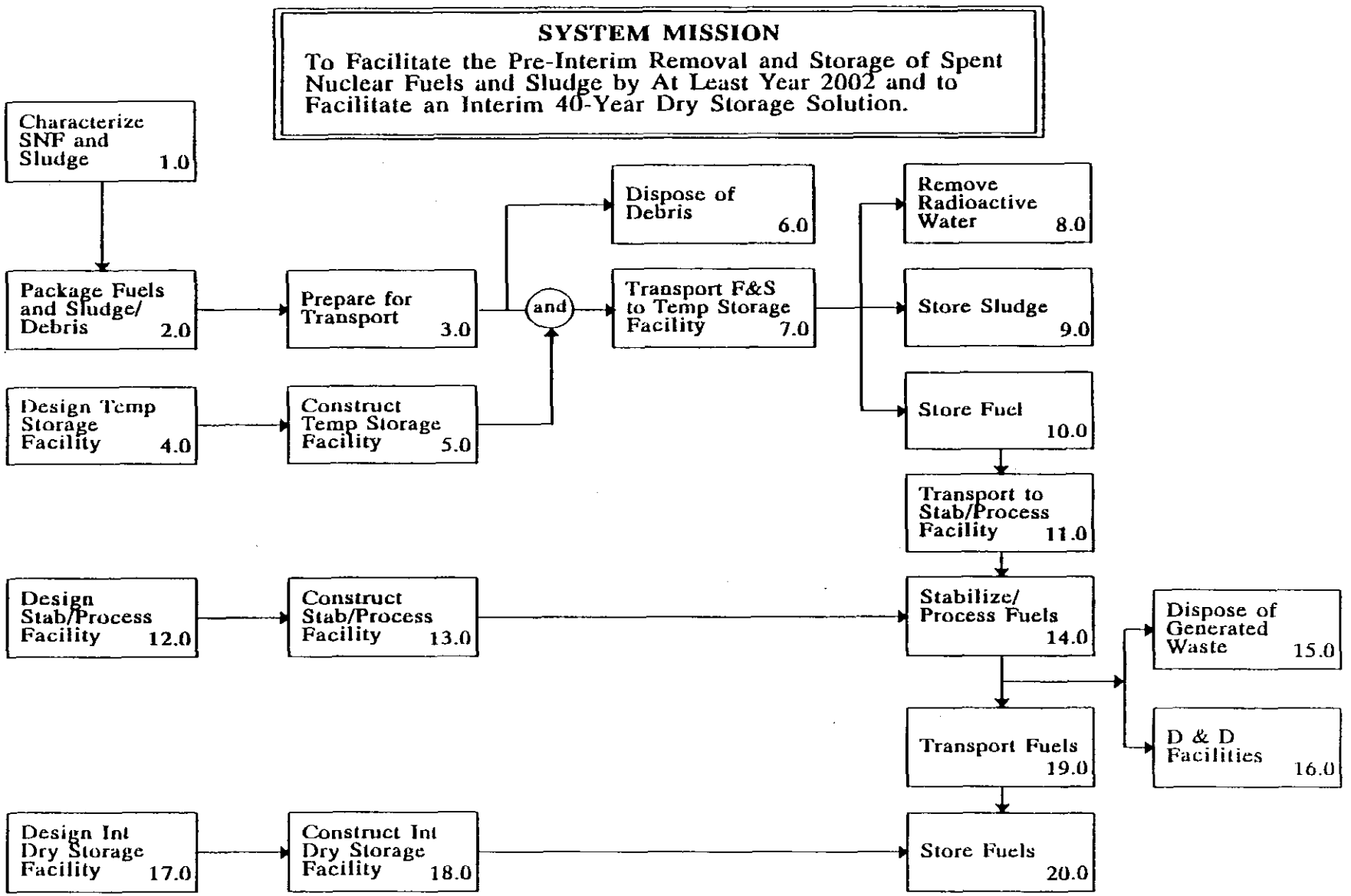

Figure 2. Path Forward Alternatives Functional Flow Block Diagram.

Based on inputs, activities were adjusted for differences in scope and logic. Estimates were established for cost and schedule for each Alternative. Time durations are nominal values with a 50% confidence of achievement. Costs are life cycle costs in FY 1994 constant dollars. Where appropriate contingency is included in the estimate.

The cost and schedule information received relative to each Alternative varied both in assumptions, estimating techniques, and scope. Consequently, these data could not be compared directly. To facilitate a comparison of the Alternatives, an effort was made to normalize the cost and schedule estimates. This effort included adjustments to original cost and time duration estimates; unnecessary scope was deleted and missing scope was added; and cost adders were made on a common basis. Each cost and schedule element for each Alternative was reviewed line-by-line through meetings with individuals knowledgeable with K Basin operations, and engineering and construction activities.

It should be emphasized that the cost and schedule information for each Alternative was normalized in order to have a relative cost and schedule comparison. These cost and schedule estimates are not intended for establishing actual project budgets. Rather, once the Recommended Path Forward is selected, appropriate cost and schedule estimates will need to be developed from preliminary engineering designs.

Normalized cost and schedule packages are provided in Appendix D for each of the four Path Forward Alternatives. Tables 1 and 2 list the key milestones and costs for the four Alternatives.

Table 1. Spent Nuclear Fuel - Key Schedule Milestone Comparisons.

Milestone	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Implementing Decision	11/94	11/94	11/94	11/94
Fuel Containerization	04/98	11/00	06/03	04/04
Fuel and Sludge Removal from K Basins	11/03	11/00	06/03	04/04
Transfer to Interim Dry Storage Complete	11/03	03/03	06/03	NA

5.2.2 Cost and Schedule Data Analysis

The schedule analysis assumes the selection of the Recommended Path Forward by November 1, 1994. Based on the schedule analysis, Alternative 2, which provides pre-Interim wet storage in a new pool facility adjacent to the Fuels and Material Examination Facility, is the only Alternative that achieves removal of fuel and sludge from the K Basins by the 2002 Tri-Party Agreement milestone. Both Alternatives 1 and 3 complete the fuel and sludge removal during 2003, and Alternative 4, Foreign Processing, finishes shipping of fuel from the K Basins during 2004. Alternative 1 has the advantage of achieving early containerization of the spent nuclear fuel in the K Basins.

Table 2. Spent Nuclear Fuel - Cost Comparisons (in $ millions).

Cost Element	Alternative 1	Alternative 2	Alternative 3	Alternative 4
K Basins Operations	397	273	377	415
K Basins Activities[a]	94	91	118	134
Transportation	47	50	21	10
Pre-Interim Fuel Storage	NA	132	NA	NA
Fuel Stabilization	286	259	238	57
Interim Storage	50	61	60	46
D&D Costs	220	266	180	135
Project Management/Compl/Public Involvement	95	88	91	100
Other Program Costs	3	2	1	1,000 - 2,500[b]
Total	1,192	1,223	1,086	1,897 - 3,397

[a] K Basins activities include characterization, fuel packaging, sludge, debris, and water.
[b] The cost range for British Nuclear Fuel Laboratories transport, processing, and storage is $1 to $2.5 billion.

Several features of the cost analysis for Alternatives 1 through 3 are noted below.

- Alternative 3 is evaluated to have the lowest costs.
- Alternative 2 includes the cost for a pre-Interim storage pool; but this added cost is balanced by reduced costs for K Basins operations (i.e., fuel is removed from the K Basins earlier).
- Transportation costs for Alternatives 1 and 2 are larger than for Alternative 3 because of the need to transport all of the fuel twice instead of once.
- The cost of in-Basin activities are higher for Alternative 3 due to canister handling and de-sludging tasks.
- Alternative 1 has higher fuel stabilization facility costs (i.e., repack fuel and passivate in a hot cell), but the costs are balanced by the less expensive overpacks and a reduced number of fuel containers for passivation and storage achieved by the repackaging step.
- Interim storage facility costs are slightly lower for Alternative 1 due to the reduced number of containers required for storage.
- Limited information for estimating decontamination and decommissioning costs for new facilities is available. If the costs in Table 2 are totaled without the decontamination and decommissioning costs, then the costs for each Alternative are nearly the same.

5.3 MULTI-ATTRIBUTE UTILITY DECISION ANALYSIS

The four Path Forward Alternatives were evaluated using decision analysis and multi-attribute utility theory. These techniques were chosen because they help:

- Create logically, defensible decisions by documenting the decision process.
- Specify what criteria are to be considered, how the criteria are to be measured and evaluated, and the relative importance of the criteria.
- Clarify the underlying rationale or logic upon which the decision is based, and
- Produce a well-documented decision which can be clearly explained and justified.

Another major characteristic of decision analysis and multi-attribute utility theory is that the process is based upon the assumption that the best strategy for making complex decisions is to analyze the various components separately and then integrate the individual judgements to arrive at an overall decision. This decision analysis process also assumes that the preferred Alternative is the one which addresses the objectives of the decision the "best." Also, decision analysis provides the ability to address qualitative considerations in a quantitative methodology.

The process used in this decision analysis process consisted of the following:

1. Identifying the fundamental objectives of the decision (e.g., minimize risks or costs).
2. Identifying criteria (or attributes) associated with those objectives, which, if realized, will lead to the achievement of the objectives.
3. Identifying the ranges of the criteria.
4. Weighing the relative importance of the various objectives and criteria.
5. Developing scales (natural or constructed) which relate the values of the decision maker(s) to the criteria.
6. Specifying an objective function for the evaluation of Alternatives, in this case the sum of the individual criteria.
7. Comparing the Alternatives and obtaining an overall score.

The results of these steps are described in detail in Appendix E and are summarized below.

5.3.1 Objectives and Criteria

Six fundamental objectives were identified through discussions with the decision-maker, an advisory panel, the DOE, and stakeholders. The fundamental objectives were arranged in an hierarchical tree, along with their criteria (see Figure 3).

5.3.2 Scales, Utility Curves, and Weights

Utility curves were developed for each criterion shown in Figure 3. These utility curves had numerical scales corresponding to the data associated with each Alternative. Weights were assigned to the criteria by the analysis team and confirmed by the program manager. These weights were then used to determine overall scores for the three local Path Forward Alternatives from the appropriate utility curves. The utility curves are shown in Attachment 2 to Appendix E.

Analysis of the weights indicates that five of the criteria constitute about three-fourths of the total weight. These criteria are: (a) time for removal of the spent nuclear fuel from the K Basins (200), (b) probability of meeting the Tri-Party Agreement 2002 milestone (180), (c) moving the spent nuclear fuel away from the Columbia river (160), (d) worker radiological risk (120), and (e) life-cycle costs (100). This weight distribution emphasizes that the most important factors in the Path Forward decision involve removing the fuel from the K Basins as quickly as possible, meeting the Tri-Party Agreement milestone, and getting the fuel away from the Columbia river. Worker risk and life-cycle costs are also important, but less so than the other criteria.

5.3.3 Results of Multi-Attribute Utility Analysis

The results of the multi-attribute utility analysis are presented in Table 3. The results indicate that Alternative 2 had the highest score (609) from the multi-attribute utility analysis, with the score for Alternative 3 being very close (545). The score for Alternative 1 did not compare as well as the other scores, largely because the fuel was not removed from the K Basins until November 2003.

Despite the larger costs, Alternative 2 had the best score because this Alternative met the three most important criteria. The importance placed in the decision process of moving the fuel out of the K Basins as quickly as possible, meeting the Tri-Party Agreement milestone, and protecting the Columbia river turn out to be critical drivers relative to the decision.

5.3.4 Comparison With Alternative 4

Alternative 4 was not compared using the multi-attribute utility process because of fundamental differences in the data. For example, the foreign processing Alternative returns the fuel in a form that may be more suitable for final disposition in a repository. However, the decision on the specific requirements for waste in a final repository will not be made for many years.

Figure 3. Spent Nuclear Fuel Decision Obectives and Criteria.

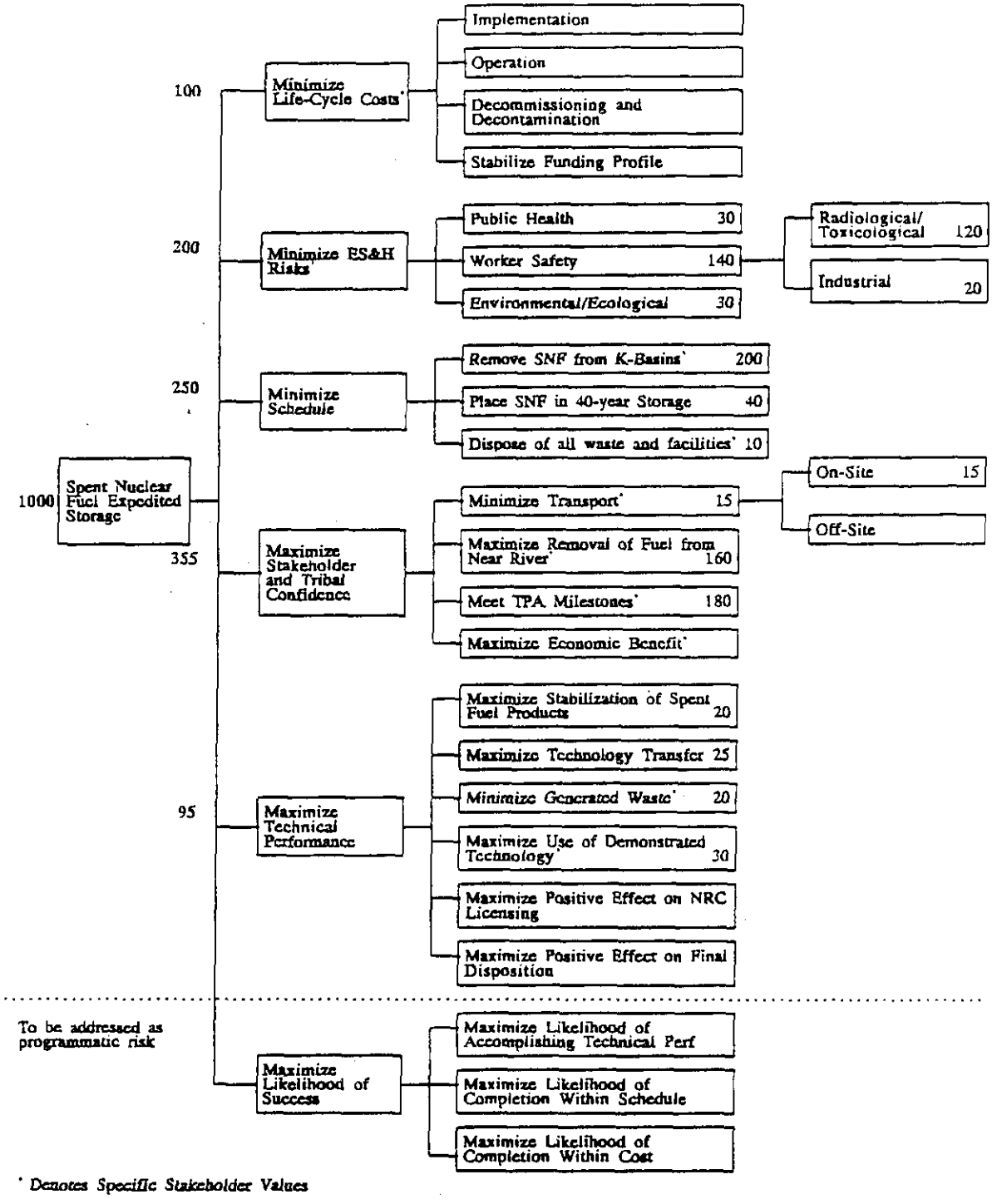

Table 3. Spent Nuclear Fuels Score Sheet

		Alternative 1			Alternative 2		
Criteria	Weight	Data	Value	Score	Data	Value	Score
Life-Cycle Costs	100	$1192M	0.22	22	$1223M	0	0
Public Health Risks	30	1.5 E-06 fatalities/year	1	30	4.7 E-06 fatalities/year	0	0
Worker RAD Risks	120	6.9 E-04 fatalities/year	1	120	11 E-04 fatalities/year	0	0
Worker Industrial Risks	20	1.5 E-03 fatalities/year	0.65	13	.73 E-03 fatalities/year	1	20
Environmental Risks	30	$7M/year	1	30	$10M/year	0	0
Time for Removal of SNF from Basins	200	Nov 2003	0	0	Nov 2000	1	200
Time for Placement in Interim Storage	40	Nov 2003	0	0	Mar 2003	1	40
Time for Disposal of all Waste, D&D Compl.	10	Nov 2008	0	0	Mar 2008	1	10
Transport of SNF On-Site	15	910 railcars to FMEF	0	0	910 railcars to FMEF	0	0
SNF removed from near River	160	1/4 mi pre-interim	0	0	4.5 mi (FMEM)	0.8	128
Probability of Meeting 2002 TPA Milestone	180	0.3	0.1	18	0.98	1	180
Stabilizes Condition of SNF Products	20	degradation in water	0	0	degradation in water	0	0
Provides for Technology Transfer	25	minimal technology transfer	0	0	New stabilization process	0.5	12.5
Demonstrated Technology	20	Known pre-interim; new	1	20	Known tech for pre-interim	0.5	10
Generated Waste	30	3800 canisters, casks, liners	0	0	2.5M gal water in new pool,	0.3	9
		water for stab, TRU,MW,LLW			casks, 2800 overpacks,		
					ITA waste		
Total	1000		Total	253		Total	609.5
		Alternative 3			Alternative 4		
Criteria	Weight	Data	Value	Score	Data	Value	Score
Life-Cycle Costs	100	$1086M	1	100	$1895M	N/A	
Public Health Risks	30	2.4 E-06 fatalities/year	0.95	28.5	1.6 E-06 fatalities/year	N/A	
Worker RAD Risks	120	8.5 E-04 fatalities/year	0.9	108	10 E-04 fatalities/year	N/A	
Worker Industrial Risks	20	1.8 E-03 fatalities/year	0	0	0.96 E-03 fatalities/year	N/A	
Environmental Risks	30	$10M/year	0	0	$10M/year	N/A	
Time for Removal of SNF from Basins	200	Jun 2003	0.1	20	Apr 2004	N/A	
Time for Placement in Interim Storage	40	Jun 2003	0.6	24	Mar 2012 (return US)	N/A	
Time for Disposal of all Waste	10	Jun 2008	0.6	6	Apr 2009	N/A	
Transport of SNF On-Site	15	870 railcars to 200 area	1	15	210 railcars to Port of Benton	N/A	
SNF removed from near River	160	10 miles to 200 area	1	160	Shipped overseas	N/A	
Probability of Meeting 2002 TPA Milestone	180	0.2	0.05	9	0.15	N/A	
Stabilizes Condition of SNF Products	20	ITA process stabilizes fuel	1	20	SNF stabilized	N/A	
Provides for Technology Transfer	25	Pilot process for dry storage;	1	25	Little technology transfer	N/A	
Demonstrated Technology	20	New technology required	0	0	Technology demonstrated	N/A	
Generated Waste	30	Drill waste from canisters;	1	30	K-West water contaminated	N/A	
		ITA waste; minimal otherwise			All canisters become waste	N/A	
Total	1000		Total	545.5		Total	N/A

Similarly, the foreign processing cost estimates ranged from $1 billion to $2.5 billion, depending upon whether or not shearing facilities had to be developed. Also, it was not clear that Alternative 4 had to return the fuel to the Hanford Site, or whether or not an interim storage facility would be required (i.e, if sludge could be dealt with in other ways). There are also other uncertainties associated with foreign processing of fuel, such as non-proliferation of plutonium and shipments of spent nuclear fuel down the Columbia river.

Despite the disparate data, Alternative 4 was subjectively compared with Alternatives 2 and 3. The details are provided in Appendix E. The overall results were as follows.

- Alternative 2 appears to be better than Alternative 4 for almost all of the criteria. The largest discriminators were costs, schedule to remove fuel from the K Basins and meet the Tri-Party Agreement milestone, the final form of the fuel and waste, and the uncertainty of being able to execute the foreign processing option.

- Alternative 3 appears to be much more comparable to Alternative 4, because neither Alternative meets the schedule objectives. Alternative 3 has lower costs and less uncertainty in meeting the schedules. However, the potential for placing the waste in a final repository makes Alternative 4 more attractive, especially if the schedule for getting the fuel out of the K Basins can be delayed.

5.4 ASSESSMENT OF ENVIRONMENTAL, SAFETY, AND HEALTH RISKS

The health risk to the public, workers and environment from the release of ionizing radiation and hazardous materials was evaluated for each of the four Alternatives. The details are provided in Appendix F. The health risk to workers from industrial activities involved in the processes were also considered. The process used the same method of evaluation that would be conducted in completing a safety analysis for a new project. However, because much of the information available for each Alternative is only in the pre-conceptual design phase, the analysis was qualitative in nature. It should be emphasized that any Alternative or process selected to remove fuel and sludge from the K Basins and stabilizing these materials for safe storage would include in the design and construction any protective barriers necessary to ensure that the risk to the public, workers, and environment are acceptable.

A qualitative preliminary hazards analysis was completed for each function of the Functional Flow Block Diagram for each Alternative. The hazardous materials at risk were identified for each function. Potential accident sequences were identified along with potential consequences to the workers, public, and environment. The potential consequence of each accident for each function of an Alternative was placed in common, or similar consequence groups for the worker, public and environment. Industrial worker accident consequence groups were independently identified in order to separate the consequences from accidents involving the release of ionizing radiation and hazardous materials from the consequences of industrial accidents.

The likelihood or frequency of each accident sequence was qualitatively established by using defined frequency groups. The individual risk for each accident was established as the frequency of the group times the consequence of the group. The uncertainty of the risk is, therefore, expressed in terms of the uncertainty of the frequency (i.e., the range of the frequency group) and the uncertainty of the consequence (i.e., the range of the consequence group). Since the units of risk are different for each accident consequence group (consequence per year), a normalization constant was used to establish a constant set of units for the individual accident risks. The normalization constant established a relative risk index for each of the consequence and frequency groups.

The relative risk index for a set of accident sequences for each function were added to obtain a total risk index for that function for each receptor group (e.g. public, worker, and environment). The risk index for each receptor group was then integrated over the duration of the function, and the risk index for each time step for each function was added. This provided a total risk index which is the sum of the total risk index for each time step. The time averaged risk index was obtained by averaging the total risk index over the number of time steps.

The time averaged risk indices were converted to worker risk, societal risk, or environmental risk for each of the Alternatives. In making this conversion, one should remember that the total risk, in consequences per year, is not an exposure to a particular receptor (i.e., worker or public). Rather, total risk is a sum over all potential accident sequences of the accident consequence times the accident frequency.

The rate of construction fatalities in the U.S. is 3×10^{-4} fatalities/worker-year, and the rate for all accident fatalities in the U.S. is 4×10^{-4} fatalities/person-year. For the four Path Forward Alternatives, the total risks for industrial workers ranged from 5.6×10^{-4} fatalities/worker-year to 18×10^{-4} fatalities/worker-year, which is a reasonable comparison considering the uncertainty in the present analysis.

The societal risks for the Alternatives ranged from 1.5×10^{-6} fatalities/person-year to 4.7×10^{-6} fatalities/person-year which is very comparable to the DOE Nuclear Safety Policy Goal of 2×10^{-6} fatalities/person-year. This reasonable agreement reinforces the judgment that actual risks involved with removal of fuel and sludge from the K Basins and their stabilization are within acceptable societal risk limits.

Additional insights derived from the analysis are as follows.

- The major contribution to the total risk from the operations considered in each Alternative is the risk to workers, either in terms of industrial risk or risk due to radiological exposure.

- Public risks and environmental risks are two to three orders of magnitude smaller than the industrial worker risk and radiological worker risks.

- Public risks and environmental risks for each of the four Path Forward Alternatives are nearly the same. Hence, public and environmental risks are not a discriminator in the decision process.

- For each Alternative there will be an additional small risk to the public and environment in the short term resulting from the fuel and sludge removal and stabilization activities. However, the removal activities will result in a much larger decrease in the total risk in the long term.

- Worker radiological risk will be directly related to the fuel handling activities involved.

Alternative 1 is best for limited fuel handling activities, since the second fuel handling activity for this Alternative is completed in a hot cell. Alternative 3 has an advantage in relation to radiological worker risk in that fuel is handled only once during the cask loading activity. However, the process of drilling holes in the canisters and flushing sludge from the canisters for Alternative 3 provides an opportunity for further worker exposure. Alternative 2 has a disadvantage relative to worker radiological risk because the fuel will be handled twice; once when placed in overpacks to be transported to the new wet storage basin and once when removed from the canisters in the wet storage basin in preparation for stabilization. Alternative 4 only handles the fuel once. However, the task of removing all fuel elements from the Mark II canisters in K-West Basin and placing the fuel in overpacks, and placing the fuel in K-East Basin in overpacks is labor intensive, and provides an extended opportunity for worker exposure.

I think the same overpack will be used the whole way thru.

Industrial risks are dominated by potential industrial accidents during the construction phase of a facility. Industrial risks are largest for Alternative 3 which will construct two new facilities. Alternative 1 will construct a dry interim storage facility and a stabilization facility in the Fuels and Materials Examination Facility. Alternative 2 will construct a dry interim storage facility, a new wet storage facility and modifications in a hot cell in the Fuels and Materials Examination Facility for fuel stabilization.

5.5 PROGRAMMATIC RISK EVALUATION

The objective of the programmatic risk evaluation is to assess the impact of uncertainties associated with individual program tasks on the likelihood that the Alternatives will achieve the schedule and cost goals established for the project. The programmatic risk evaluation complements the cost and schedule estimates by addressing uncertainties of activities that may be discriminators for the Path Forward decision. The programmatic risk evaluation describes the activities in terms of cost and duration distributions, and logic rules that specify precedents, dependencies and correlations among the distributions.

The programmatic risk evaluation was developed in conjunction with the project schedule and contains essentially the same task precedent relationships. The evaluation also uses the analysis assumptions discussed in Chapter 2. Important boundary conditions unique to the programmatic risk evaluation are listed below and discussed further in Appendix G, Section G.2.4.

- No distinction was made among the Alternatives regarding the licensing environment. In particular, the evaluation assumes that licensing issues regarding the passivation process and the long term stability of passivated fuel will not cause long delays in the construction and operation of the passivation facilities.

- The schedule uncertainty estimates represent the potential variability in the tasks due to normal or anticipated problems associated with the variability of Total Operating Efficiency over long periods. Catastrophic events, such as licensing issues that generate long review cycles, legal challenges, or accidents that could lead to long delays in the schedule, are not currently addressed.

- The cost uncertainty estimates were applied only to major design and construction costs, based on contingency factors applied for a first estimate of typical facility configurations. A large majority of the life-cycle costs are associated with common costs, which are currently estimated as point values. Therefore, actual cost uncertainties are larger than these initial results indicate.

Figures G-9 through G-11 in Section G.3 compare the four Alternatives in terms of the three programmatic decision criteria: (1) date of removal of fuel and sludge from the K Basins, (2) date that fuel is stabilized, and (3) total costs. The key parameters of these distributions are summarized in Table 4.

Table 4. Distribution Results for Important Decision Criteria.

Criteria	Parameter	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Fuel Removed from K Basins	95%-tile	09/2006	03/2002	06/2007	02/2005
	Mean	11/2003	04/2001	04/2004	01/2004
	10%-tile	04/2002	09/2000	07/2002	02/2003
Fuel Stabilized	95%-tile	09/2006	05/2007	06/2007	05/2005
	Mean	11/2003	04/2004	04/2004	01/2004
	10%-tile	04/2002	06/2002	07/2002	02/2003
Total Costs ($ millions)	95%-tile	$1,360	$1,400	$1,340	$3,120
	Mean	$1,170	$1,270	$1,150	$2,650
	10%-tile	$1,060	$1,200	$1,040	$2,200

It will be noticed that the mean values developed by the programmatic risk evaluation are different than the cost and schedule point estimates provided earlier. This result is to be expected for the following reasons:

- The programmatic risk evaluation used the cost and schedule estimates as median values for distributions to express the fact that the estimates have uncertainty. The cost or duration have an equal probability of being larger or smaller than the median.

- Uncertainties on the lower side of the distribution are limited, because at some point it becomes physically impossible to accomplish a task faster or cheaper. However, this is not the case on the high side of the distribution. History has demonstrated there can be significant delays and larger costs associated with a task. Hence, the distribution has a longer tail on the high side, especially when a process is being attempted for the first time.

- A milestone that depends on the completion of two or more parallel tasks can not start until the longest task is completed. Consequently, the likelihood of all tasks being completed at or ahead of schedule is small (e.g., 0.5 * 0.5 = 0.25 for two tasks and a lower value for more tasks). Any one task can delay that milestone.

Although individual task estimates may be very reasonable, their uncertainty and interaction make the duration and cost of the integrated project larger.

All observations and conclusions are presented in Appendix G. However, the following general observations will influence the decision process.

- Alternative 2 provides a pre-interim wet storage facility that can be constructed in time to provide high confidence that the fuel and sludge can be removed from K Basins by March 2002 to meet the Tri-Party Agreement. The other Alternatives do not provide confidence of achieving this objective.

- Alternative 2 is the most expensive of the three local processing options, but the uncertainties associated with the costs make the cost differences less significant.

- Currently, the uncertainty in the licensing time for a passivation facility is only slightly larger than for the pre-interim storage facility. The K Basins can be deactivated under Alternative 2 without relying on the passivation facility. Thus, if licensing issues arise for the passivation facility, the costs associated with the other Alternatives will rise relative to Alternative 2.

- Alternatives 1 and 3 both require that the passivation facility be constructed and operated before fuel can be moved from the basin. The uncertainties in that process are reflected by the later dates at which fuel removal will be completed and the larger spread between the 10th and 95th percentile dates. As a result, with these

Alternatives there is not a high confidence of being able to remove fuel from the K Basin even within a couple of years of the Tri-Party Agreement.

- Alternative 4 is by far the most expensive. Because this Alternative requires complete repackaging of fuel and load out in the K Basins before shipment overseas (which requires six years), Alternative 4 does not meet the Tri-Party Agreement.

- Since the costs of continued operation of existing K Basin facilities is high, selection of an option with a higher construction cost, but with excellent likelihood for shortening or reducing the uncertainty in the schedule to deactivate K Basins, can be cost beneficial.

6.0 SUMMARY OF THE EVALUATIONS

Table 5 provides a summary of the analysis results in terms of the five major objectives. Refer to the discussion in Section 5.0 regarding the reasons for the differences between the cost and schedule point estimates and the mean values of the programmatic risk assessment. There are some insights in Table 5 relative to the four Path Forward Alternatives.

- Alternative 3 has the advantage of the lowest life-cycle costs. This is true even though the normalized costs were significantly higher than indicated in the *Dry Storage of N-Reactor Fuel Independent Technical Assessment* (Devine 1994).

- The public risk and environmental risk are non-discriminators in the decision process. All of the Alternatives have acceptable public and environmental risks.

- Alternatives 1, 3, and 4 have the lowest worker radiological risks. Generally, Alternative 1 has the lowest health risks, and had the highest multi-attribute utility score for health risks.

- Alternative 2 has the advantage relative to removing the fuel and sludge from the K Basins and meeting the 2002 Tri-Party Agreement. For Alternative 2 there is a 95% confidence level that the fuel can be removed from the K Basins by March 2002. Alternative 2 also received the highest multi-attribute utility score for minimizing the schedule.

- Alternative 2 had the highest multi-attribute utility score for maximizing stakeholder confidence, largely because this Alternative's performance in meeting the Tri-Party Agreement milestone for removing fuel from K Basins.

- Alternative 3 had the highest multi-attribute utility score for maximizing technical performance.

The important stakeholder values expressed relative to the Path Forward objectives and criteria, which are mirrored in the relative weights of the multi-attribute utility process, can be stated as:

> Remove the fuel and sludge from the K Basins, away from the Columbia river, with a high probability of meeting, or exceeding, the 2002 Tri-Party Agreement milestone, paying attention to worker health risk and total costs.

To succeed in achieving these values there are specific attributes of each Alternative which if considered collectively may tend to maximize the likelihood of realizing success. For instance, Alternative 2 has the highest probability of meeting or exceeding the Tri-Party Agreement milestone of removing fuel and sludge from the K Basins. This schedule is achieved by simplifying the process of placing fuel and sludge in overpacks, removing the overpacks to a near term storage, removing the debris from the K Basins, and

Table 5. Summary of Analysis Results.

Key Objectives	Units	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1. Minimize Life-Cycle Costs					
Point Estimate Costs	$M	$1,192	$1,223	$1,086	$3,397
95% Confidence Value	$M	$1,360	$1,400	$1,340	$3,120
Mean	$M	$1,170	$1,270	$1,150	$2,650
10% Confidence Value	$M	$1,060	$1,200	$1,040	$2,200
Multi-Attribute Utility Score		22	0	100	
2. Minimize Health Risks					
Public Risk	Fat/yr	1.5 E-06	4.7 E-06	2.4 E-06	2.3 E-06
Worker Risk (radiological)	Fat/yr	6.9 E-04	11 E-04	8.5 E-04	7.4 E-04
Environmental Risk	$M/yr	7	10	10	10
Industrial Worker Risk	Fat/yr	15 E-04	7.3 E-04	18 E-04	5.6 E-04
Multi-Attribute Utility Score		193	20	136	
3. Minimize Schedule					
Removal of Spent Nuclear Fuel from K Basins (Point)	Year	11/2003	11/2000	06/2003	04/2004
95% Confidence Value	Year	09/2006	03/2002	06/2007	02/2005
Mean	Year	11/2003	04/2001	04/2002	01/2004
10% Confidence Value	Year	04/2002	09/2000	07/2002	02/2003
Placement of Spent Nuclear Fuel in Storage (Point)	Year	11/2003	03/2003	06/2003	
95% Confidence Value	Year	09/2006	05/2007	06/2007	05/2005
Mean	Year	11/2003	04/2004	04/2004	01/2004
10% Confidence Value	Year	04/2002	06/2002	07/2002	02/2003
Multi-Attribute Utility Score		0	250	50	
4. Maximize Stakeholder and Tribal Confidence		18	308	184	
5. Maximize Technical Performance		20	32	75	
Total Multi-Attribute Utility Score		253	610	545	

NOTE: Black outlined boxes indicate the best Alternative for each key objective.

treating the K Basin water. In this concept the removal of fuel and sludge from the K Basins is uncoupled from the necessity of having a stabilization facility constructed and operational before fuel and sludge can be moved.

Likewise, many aspects of Alternative 3 have lead the way relative to the fuel stabilization process. Alternatives 1 and 2 had not been specific in regard to a stabilization process. Largely, because of the efforts of the Independent Technical Assessment team, these Alternatives also considered passivation as the fuel stabilization process. The process of developing Alternative 3 also led to some important conclusions relative to the interim 40-year dry storage of metallic spent nuclear fuel.

First, the Independent Technical Assessment team (Devine 1994) and others have evaluated wet versus dry storage (see Section 3.1.4) and concluded that dry storage of metallic fuel is preferable. Long term wet storage of damaged metallic fuel will result in continued degradation of the fuel and will require higher life cycle costs compared to monitored retrievable dry storage systems. Wet stored fuel also has the potential of continued radiolytic decomposition of water to generate hydrogen gas. On the other hand, drying removes the free water, bound water, and water of hydration from metallic fuel, thus, leaving the fuel in a fairly stable state with minimum generation of hydrogen gas.

Second, the Independent Technical Assessment team evaluated conditioning of metallic fuel. The conditioning process consisted of three steps: (1) a two-stage fuel drying process where free water, adsorbed and absorbed water, and water of hydration are removed from the fuel; (2) a passivation stage where oxygen is admitted to the fuel in a controlled manner to oxidize any remaining uranium hydride and uranium fines; and (3) a stage where an inert cover gas is added to the fuel container, and the container sealed.

To succeed in achieving the desired stakeholder values with the highest probability of success, the evaluation concludes that the best process is a combined concept where:

- K Basins' fuel and sludge removal is uncoupled from the operations of a stabilization facility, and the process of removing fuel and sludge from the K Basins is as simple as possible.

- A storage capability is provided to act as a lag storage or staging operation for the overpack fuel containers as they are removed from the K Basins. The lag storage capability should combine the features of a dry storage facility to reduce the necessity of constructing two storage facilities.

- Metal fuel drying and passivation should be maintained as the fuel stabilization process with the option of further refinements as the fuel characterization program is completed and other information becomes available.

- The NEPA strategy should separate K Basin fuel and sludge removal and placing overpacked fuel in pre-interim storage from the longer term fuel stabilization activities which are covered by the DOE's more extensive programmatic EIS.

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7.0 EVALUATION OF THE PATH FORWARD

7.1 GENERAL DESCRIPTION OF THE RECOMMENDED PATH FORWARD

The Recommended Path Forward capitalizes on the schedule advantages available from expeditious removal of the entire K Basin fuel and sludge inventory to a new storage location away from the Columbia River. Multiple storage facilities are avoided by developing an interim storage system design which is initially used as temporary lag storage for packages of fuel and transitioned to the dry storage system as fuel conditioning is completed.

The fuel stabilization process will provide steps for fuel drying and passivation. Additional stabilization steps may be considered as more information becomes available.

The existing K Basin operating capabilities will be maintained to provide for the removal of fuel, sludge, debris, and ultimately conditioning of the basin water. The fuel canisters from the K-East and K-West Basins will be loaded into overpacks and the overpacks will be loaded into a cask for rail transfer to the interim storage system. Within the K-East Basin, sludge remaining on the basin floor will be accumulated and packaged, then loaded into a similar overpack such that all material transferred to the lag storage system are stored in a common package envelop.

The interim storage system would first be used as temporary lag storage for fuel and sludge packages removed from the K Basins. The storage facility would also provide a staging area for fuel and sludge during the fuel stabilization process. Finally, the storage facility becomes the dry fuel storage facility as fuel stabilization is completed.

7.2 ANALYSIS RESULTS OF THE RECOMMENDED PATH FORWARD

Table 6 provides the schedule data comparisons for the four Alternatives and the Recommended Path Forward. Table 7 provides similar cost comparisons. Table 8 provides a summary of all the results. Note that Table 8 is a duplicate of Table 5 in Section 6.0, with the exception that the results of the Recommended Path Forward have been added. Again, refer to the discussion in Section 5.0 regarding the reasons for the differences between the cost and schedule point estimates and the mean values of the programmatic risk assessment.

The Recommended Path Forward is equivalent to Alternative 2 in removing the fuel and sludge from the K Basins by November 2000. There is a 95% confidence level that the fuel and sludge will be removed by April 2002. The Recommended Path Forward life-cycle costs are slightly higher than Alternative 3 and slightly lower than Alternative 1. There is a 95% confidence level that the life-cycle costs of the Recommended Path Forward will not exceed $1,298 million, the smallest of all Alternatives. The worker risks for the Recommended Path Forward are nearly the same as for Alternative 2, and slightly higher than Alternative 3.

The Multi-Attribute Utility Scores for the Recommended Path Forward compared to the other Alternatives are as follows: (a) the life-cycle cost score is comparable to Alternative 3 (92 versus 100), (b) the schedule score is comparable to Alternative 2 (200 versus 250), (c) the Stakeholder score is larger than Alternative 2 (346 versus 308), (d) the technical performance score is between Alternatives 2 and 3 (55 versus 32 and 75), and (e) the final score is the larger than Alternative 2 and 3 (788 versus 610 and 545).

The Recommended Path Forward is, thus, responsive to the Stakeholder values of removing fuel and sludge from the K Basins, away from the Columbia river, with a high probability of meeting, or exceeding, the 2002 Tri-Party Agreement milestone, paying attention to worker health risk and total costs.

Further, the Path Forward focuses on:

- Uncoupling the removal of fuel and sludge from the K Basins from the operations of a stabilization facility.
- Simplifying the process of removing fuel and sludge from the K Basins.
- Providing a storage capability to act as a staging operation for the overpack fuel containers as they are removed from the K Basins.
- Combining in the storage facility the features of an interim dry storage facility to reduce the necessity of constructing two facilities.
- Maintaining a flexible fuel stabilization process capability to use the metal fuel drying and passivation process, or the option of further refinements as the more data becomes available.

Table 6. Spent Nuclear Fuel - Key Schedule Milestone Comparisons.

Milestone	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Recommended Path Forward
Implementing Decision	11/1994	11/1994	11/1994	11/1994	11/1994
Fuel Containerization	04/1998	11/2000	06/2003	04/2004	11/2000
Fuel and Sludge Removal from K Basins	11/2003	11/2000	06/2003	04/2004	11/2000
Transfer to Interim Dry Storage Complete	11/2003	03/2003	06/2003	NA	04/2006

Table 7. Spent Nuclear Fuel - Cost Comparisons (in $ millions).

Cost Element	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Recommended Path Forward
K Basins Operations	397	273	377	415	271
K Basins Activities(a)	94	91	118	134	139
Transportation	47	50	21	10	21
Pre-Interim Fuel Storage	NA	132	NA	NA	NA
Fuel Stabilization	286	259	238	57	248
Interim Storage	50	61	60	46	151
Decontamination and Decommissioning Costs	220	266	180	135	180
Project Management/Compl/Public Involvement	95	88	91	100	100
Other Program Costs	3	2	1	1,000 - 2,500(b)	1
Total	1,192	1,223	1,086	1,897 - 3,397	1,145

(a)K Basins activities include characterization, fuel packaging, sludge, debris, and water.
(b)The cost range for British Nuclear Fuels Laboratory transport, processing, and storage is $1 to $2.5 billion.

Table 8. Summary of Analysis Results.

Key Objectives	Units	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Recommended Path Forward
1. Minimize Life-Cycle Costs						
Point Estimate Costs	$M	$1,192	$1,223	$1,086	$3,397	$1,145
95% Confidence Value	$M	$1,360	$1,400	$1,340	$3,120	$1,298
Mean	$M	$1,170	$1,270	$1,150	$2,650	$1,208
10% Confidence Value	$M	$1,060	$1,200	$1,040	$2,200	$1,147
Multi-Attribute Utility Score		22	0	100	NA	92
2. Minimize Health Risks						
Public Risk	Fat/yr	1.5 E-06	4.7 E-06	2.4 E-06	2.3 E-06	5.2 E-06
Worker Risk (radiological)	Fat/yr	6.9 E-04	11 E-04	8.5 E-04	7.4 E-04	10 E-04
Environmental Risk	$M/yr	7	10	10	10	11
Industrial Worker Risk	Fat/yr	15 E-04	7.3 E-04	18 E-04	5.6 E-04	12 E-04
Multi-Attribute Utility Score		193	20	136	NA	0
3. Minimize Schedule						
Removal of Spent Nuclear Fuel from K Basins (Point)	Year	11/2003	11/2000	06/2003	04/2004	11/2000
95% Confidence Value	Year	09/2006	03/2002	06/2007	02/2005	04/2002
Mean	Year	11/2003	04/2001	04/2002	01/2004	06/2001
10% Confidence Value	Year	04/2002	09/2000	07/2002	02/2003	11/2000
Placement of Spent Nuclear Fuel in Storage (Point)	Year	11/2003	03/2003	06/2003	NA	04/2004
95% Confidence Value	Year	09/2006	05/2007	06/2007	05/2005	11/2008
Mean	Year	11/2003	04/2004	04/2004	01/2004	04/2006
10% Confidence Value	Year	04/2002	06/2002	07/2002	02/2003	10/2004
Multi-Attribute Utility Score		0	250	50	NA	200
4. Maximize Stakeholder and Tribal Confidence		18	308	184	NA	346
5. Maximize Technical Performance		20	32	75	NA	55
Total Multi-Attribute Utility Score		253	610	545	NA	788

table 6 & 8 conflict

these dates don't jive with the stated [illegible]

8.0 REFERENCES

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National Environmental Policy Act of 1969, 42 USC 4321, et seq.

10 CFR 1021, "Compliance with the National Environmental Policy Act," *Code of Federal Regulations*, as amended.

40 CFR 1506.1, "Council on Environmental Equality," *Code of Federal Regulations*, as amended.

10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," *Code of Federal Regulations*, as amended.

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WHC, 1994c, *105-KE Basin Debris Removal Functions and Requirements*, WHC-SD-ND-FRD-004, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

ASSUMPTIONS AND REQUIREMENTS

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A.1.0 ASSUMPTIONS

There are assumptions that may be either future requirements, or are necessary to provide consistency, or act as discriminators in the comparison of the four Alternatives. A number of assumptions were made as an overview for potential requirements, or that may be discriminators in evaluating the four Alternatives.

Listed below are the underlying assumptions of the evaluation, and the basis for each:

1. **Spent nuclear fuel (SNF) is not waste.**

   Basis: The N-Reactor SNF presently stored in K-East and K-West Reactor Basins is SNF and not waste. This material is incorporated into the U.S. Department of Energy (DOE) national program of SNF. The deteriorated condition of this SNF will be addressed, as described in Appendix C, and it will be placed in dry interim storage until its disposition has been determined.

2. **Sludge is considered to be SNF (in-canister sludge in both K-East and K-West Basins, and pool sludge in K-East).**

   Basis: The sludge in the K Basins consists of: (1) that contained within the canisters stored in K-East and K-West Basins; and, (2) the uncontained pool sludge primarily in K-East Basin. The sludge in the SNF canisters are corrosion products from uranium, containing plutonium and fission products, as well; and, aluminum from the canisters. The pool sludge also contains dust, wind blown sand that has accumulated, and other products of corrosion associated with equipment used in the basin, the storage canisters and the SNF itself. The pool sludge should contain more non-fuel corrosion products, but several samples indicate concentrations of greater than 11% uranium. The approximate 1,700 ft^3 of sludge in K-East Basin is estimated to contain between 0.5 and 1 metric tons of uranium.

   Each of the four Path Forward Alternatives assumes the sludge to be SNF and manages it accordingly. Each Alternative recovers the sludge, conditions it, and packages it for interim dry storage.

3. **The evaluation is limited to the current four Path Forward Alternatives.**

   Basis: Four Alternatives were selected for comparative analysis:

   1. Alternative 1--Containerization and Storage in K Basins
   2. Alternative 2--Wet Pre-Interim Storage
   3. Alternative 3--Dry New Facility Storage
   4. Alternative 4--Foreign Processing.

   These alternatives were selected to bound the range of possible approaches, and to demonstrate the feasibility of each.

4. **The Path Forward for this evaluation process ends with receipt and custodianship of K Basin fuel in interim dry storage.**

   Basis: It became obvious in establishing the ground rules for the Path Forward study that the same end point must be used for all four Path Forward Alternatives. For this evaluation, then, the endpoint was assumed to be all of the fuel and sludge into interim dry storage, which turns out to be in the year 2012.

5. **The annual interim dry storage costs are the same for all Path Forward Alternatives.**

   Basis: Each of the four Alternatives assumes interim dry storage, probably in a modular vault. The number of storage modules may vary but the annual surveillance cost should not be appreciably affected. Alternative 4 (Foreign Processing) will have the largest variance.

6. **Any new facilities will meet NRC licensing requirements.**

   Basis: As described in the basis for Assumption 8, below, interim dry storage facilities will be designed to meet Nuclear Regulatory Commission (NRC) requirements but not go through the NRC licensing review. DOE has judged these technical standards reasonable, and therefore, plan to use the same licensability rules for any new facility required by the four Alternatives.

   This licensing decision for all the new facilities, adds assurance of an acceptable, technically sound, and well documented approach, and begins the DOE initiative of independent oversight of its programs and activities.

7. **Modifications to existing facilities will be in accordance with DOE Orders and requirements.**

   Basis: Modifications to existing facilities will be made according to existing DOE Orders and requirements. This assumption is consistent with current DOE facility upgrading and is well understood.

   When an existing facility is modified and a new storage pool is added (e.g., as in Alternative 2), the Fuels and Materials Examination Facility (FMEF) modifications will be performed in accordance with DOE orders and the new storage pool will be designed to the NRC technical requirements, as was discussed under Assumption 6, above.

8. **40-year Interim Dry Storage will meet NRC Licensing Requirements.**

   Basis: New interim storage facilities will very likely come under the NRC jurisdiction to meet waste acceptance criteria for geologic disposal. Further, the DOE is working with NRC to develop details of this effort for DOE-owned SNF. It appears that the design, construction, and operational standards that would be required for NRC licensability of any facility associated with SNF storage or

disposal are reasonable. DOE has, therefore, provided direction that interim dry storage facilities should be included in the current regulatory framework and requirements associated with NRC licensability.

DOE is currently evaluating a range of NRC licensing/licensability options that include the following:

- Design facility to comply with NRC technical requirements and proceed to construction without NRC review.
- Have NRC conduct a licensability review of the interim storage facility design.
- Design interim storage facilities to comply with NRC requirements, and delay construction until a NRC license is obtained.

This study of K Basin SNF Removal Path Forward Alternatives is based on the first option described above. The interim dry storage facilities in all of the Path Forward Alternatives will be designed and constructed to NRC technical requirements, but no NRC licensability/licensing review is included.

9. **Selection of an Alternative will not prejudice complex-wide Programmatic Environmental Impact Statement (EIS).**

   Basis: The *National Environmental Policy Act of 1969* (NEPA) process is an integral part of each Path Forward Alternative. The evaluation of the Alternatives and the Path Forward decision provide additional information to the process and should help in the decision-making for the Record of Decision.

10. **Path Forward Alternatives will accommodate disposition of K Basin debris and water, and the debris and waste from decontamination and decommissioning (D&D) of any new or modified facilities other than interim dry storage.**

    Basis: In order to show that there is an integrated Path Forward for each Alternative, several common activities (debris, water, and waste removal) have been assessed. The impact of D&D of all new facilities (other than interim dry storage facilities) is also included.

    It is acknowledged that the actual conditions and requirements for each of these common activities may be ill-defined and may change before implementation. They are added here to highlight the needed program development and to show any difference among Alternatives. They also demonstrate that the Path Forward decision has considered all aspects of minimizing the K Basin risks, stabilizing the SNF and getting it into safe, monitorable, interim dry storage.

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A.2.0 REQUIREMENTS

The Task Team formed to address the issues related to the removal of SNF from the Hanford Site K Basins recognized that considerable effort had already been expended in identifying requirements related to both the Hanford Site SNF and the national SNF projects. Following a review of all requirements that had been identified for these efforts, the Task Team concluded that additional effort in defining new requirements was unnecessary. Rather, the results of the Hanford SNF Systems Engineering effort was considered sufficient for Task Team's purposes. Therefore, the Task Team adopted the requirements set forth in the unnumbered draft *Spent Nuclear Fuel Project Functions and Requirements Document* (WHC 1994).

A.2.1 REVIEW OF REQUIREMENTS

A review of these requirements was performed following the format in the unnumbered draft WHC (1994). The initial effort involved following the decomposition of the requirements of elements 4.1.1, "Deactivate K Basin (and support systems"), and 4.7, "Store, Stabilize, and Disposition SNF" to find those functions which applied explicitly to the expedited removal of spent fuel from the K Basins. This effort revealed the need to look at the Environmental and NRC licensing requirements in greater detail. The review of Functions 4.1.1 and 4.7 indicated that the Path Forward is associated with the SNF Project Functions listed in Table A-1.

Table A-1. Project Function Review (4.1.1 and 4.7).

SNF Project Function	Path Forward
4.1.1.2.1	Characterize K Basin initial state
4.1.1.3	Disposition SNF
4.1.1.3.1	Categorize and characterize SNF
4.1.1.3.2	Collect SNF materials
4.1.1.3.3	Prepare materials for transportation and storage
4.1.1.3.3.1	Stabilize reactive materials
4.1.1.3.3.2	Package materials
4.1.1.3.4	Temporarily store SNF
4.1.1.3.5	Transport materials
4.7	Store, stabilize, and disposition SNF
4.7.1	Maintain SNF safety/security envelope
4.7.2	Administer SNF storage program
4.7.3	Receive SNF
4.7.4	Stabilize and store SNF

The four Alternatives being evaluated by the Task Team for the K Basin SNF Removal Project were reviewed for compliance with the requirements allocated to the above functions by the SNF Project. It was concluded that all four Alternatives were capable of complying with the requirements allocated to these functions. Thus, these requirements do not eliminate any of the four Alternatives.

A.2.2 REGULATORY REQUIREMENTS

Regulatory requirements include the safety documentation prerequisite to the start of construction and operation. Generally, the early functions of the four Alternatives will be performed under the usual DOE orders, viz., Nuclear Safety Analysis Reports, Technical Safety Requirements, Unreviewed Safety Questions, Nuclear Criticality Safety, Startup and Restart of Nuclear Facilities, and General Design Criteria. However, there is presently no clear understanding of the applicable NRC licensing requirements. Although, the assumption is that the stabilization and conditioning processes, and interim storage must comply with, at least, the intent of the NRC licensing requirements. Regulatory compliance is expected to significantly affect cost and schedule, especially for those areas where it is intended to meet NRC licensing requirements.

A.2.3 ENVIRONMENTAL REQUIREMENTS

As part of the regulatory requirements review, environmental requirements were reviewed for their specific affect on the four Alternatives. The following requirements were identified. It was concluded that they must be uniformly applied to each of the four alternatives.

- For new facilities, or modified existing facilities, in which fuel is stabilized or stored, it is likely that an EIS will be required. Completion and approval of an EIS could take 15 months, or more. The cost has not been estimated.

- A draft of a complex-wide EIS has been submitted for public review. A Path Forward Decision must not prejudice this Programmatic Environmental Impact Statement. Development of NEPA documentation occurs early in the project, and provides some constraints on design, procurement of materials and equipment, and start of construction.

- Although SNF or sludge is not considered waste, it is possible that waste or waste streams from preparation and stabilization activities could create the need for *Resource Conservation and Recovery Act of 1976* (RCRA) permits.

A.2.4 IMPACT OF REQUIREMENTS ON OBJECTIVES AND SELECTION CRITERIA

The objectives and resulting criteria for the SNF Path Forward selection process were developed to be consistent with the requirements in the unnumbered draft WHC (1994).

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A.3.0 REFERENCES

National Environmental Policy Act of 1969, 42 U.S.C. 4321, et seq.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

WHC, 1994, *Spent Nuclear Fuel Project Functions and Requirements Document*, Unnumbered Draft in U.S. DOE Review, Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

INFORMATION ON COMMON FUNCTIONS

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B.1.0 NEPA/CERCLA

B.1.1 NEPA REQUIREMENTS FOR THE ALTERNATIVES

B.1.1.1 Containerization

In 1992 a finding of no significant impact (FONSI) was issued in response to an environmental assessment prepared for encapsulation of irradiated fuel stored in the 105-K East Basin. Encapsulation in the environmental assessment was described as removing the irradiated fuel from the existing canisters and placing the fuel elements that were intact into new canisters. The new canisters were to be returned to the storage racks.

If containerization in Alternatives 1 and 2 deviate from containerization as described in the approved environmental assessment, an evaluation must be done against the chosen Alternative to determine the appropriate level of NEPA documentation. It is presumed that the fuel will remain in the basin if either the encapsulation or overpack option is chosen. Construction of a new facility was not included. The evaluation is estimated to cost $50,000 to $100,000, and will require 8 to 12 months to complete.

In March 1993, the *Notice of Construction of the 105-KE Encapsulation Activities*, DOE/RL-93-13 (RL 1993a) was submitted to the Washington State Department of Health (DOH); and, to the U.S. Environmental Protection Agency (EPA), the *Application For Approval of Modification For 105-KE Basin Encapsulation Activity*, DOE/RL-93-14 (RL 1993b). In August, 1993 approvals were granted by both DOH and EPA to proceed with the encapsulation activity as described in the Notices of Construction.

If containerization in Alternatives 1 and 2 deviate from containerization as described in the approved Notices of Construction, new Notices of Construction or revisions to the approved Notices of Construction must be submitted to the DOH and to the EPA. Changes to the Notice of Construction are estimated to cost $100,000, and take 6 to 12 months to complete.

If air emissions from the activities proposed in Alternatives 1 and 2 include constituents other than radionuclides, an Notice of Construction must also be submitted to the Washington State Department of Ecology (Ecology). Specifically, if the proposed activities of Alternatives 1 and 2 should emit toxic air pollutants, Washington Administrative Code (WAC) 173-460, "Controls for New Sources of Toxic Air Pollutants," would apply. An evaluation of the source term and associated air emissions would need to be reviewed. The Cost is estimated at $50 -$100 K, and will take 8 to 12 months to complete.

Air emission source information will need to be included in the Hanford Site Air Operating permit. This information will cost $25,000, and it will take 6 months to obtain the permit.

The discussion above also applies to Alternatives 3 and 4, but an environmental assessment and an EIS are more likely requirements for them because of differences in the containerization function. Alternative 3 has a

substantially different overpacking process, employing the 5-high Multi-Canister Overpack. For this Alternative it likely that an environment assessment will be required. The cost is estimated at $125 K, and the schedule is estimated at 12 months.

Alternative 4 has as its first major function "Package for Shipping." The element of "shipping," aside from the details of packaging, will require an Environmental Impact Statement estimated to require 15 months in the schedule (cost not estimated).

B.1.1.2 Wet Pre-Interim Storage or Wet New Facility Storage

Alternative 2 uniquely has a "pre-interim storage" or new facility storage function prior to preparation and stablilization for Interim Storage. Modification to an existing facility or construction of a new wet facility storage will require an EIS. The cost is unavailable; the schedule is approximately 15 months, including receipt of Record-of-Decision.

Notices of Construction must be submitted to the EPA and to the Washington State DOH for new or existing fuel storage facilities, if other than the K Basins. The Cost is estimated at $50 - $100 K for each, and will take approximately 10 months.

If air emissions from the activities proposed for Alternative 2 include constituents other than radionuclides, an Notice of Construction must be submitted to Ecology. Specifically, if the proposed Alternative should emit toxic air pollutants, "Controls for New Sources of Toxic Air Pollutants" (WAC 173-460), would apply. An evaluation of the source term and associated air emissions would need to be reviewed. The Cost is estimated at $50 - $100 K, and the schedule is estimated at 8 to 12 months.

Air emission source information will need to be included in the Hanford Site Air Operating Permit. The Cost is estimated at $25 K, and the schedule is estimated at 6 months.

B.1.1.3 Prepare and Stabilize

Alternatives 1, 2, and 3 have a "prepare and stabilize function." It is presumed that the stabilization process (i.e., Independent Technical Assessment process, MIOX etc.) will be performed in a new or modified existing facility, which will likely require an Environmental Impact Statement. The cost for the Environmental Impact Statement is not readily estimated, but will require 15 months including the Record of Decision.

Notices of Construction must be submitted to the EPA and to the Washington State DOH for new or existing fuel storage facilities, if other than the K Basins. The Cost is estimated at $50-$100 K for each, and will take approximately 10 months.

If air emissions from the activities proposed for Alternative 1 include constituents other than radionuclides, an Notice of Construction must be submitted to Ecology. Specifically, if the proposed Alternative should emit

toxic air pollutants, (WAC 173-460) would apply. An evaluation of the source term and associated air emissions would need to be reviewed. The Cost is estimated at $50 -$100 K, and will take 8 to 12 months to complete.

Air emission source information will need to be included in the Hanford Site Air Operating Permit. The information will cost approximately $25 K, and will take 6 months to complete. Alternative 4 has no prepare and stabilize function.

B.1.1.4 Interim Storage

Alternatives 1, 2, and 3 have essentially the same interim storage function. Two pathways exist for the NEPA documentation, neither of which has been defined. A separate Environmental Impact Statement may be required. If an Environmental Impact Statement is developed for the "Prepare and Stabilize" function, it may be required to also evaluate "Interim Storage" in it. The cost is unavailable and will take 15 months, including receipt of Record-of-Decision.

Notices of Construction must be submitted to both the EPA and the Washington State EPA for new or existing fuel storage facilities, if other than the K Basins. The Cost is estimated at $50-$100 K for each, and the schedule at 6-10 months.

If air emissions from the activities proposed for Alternative 1 include constituents other than radionuclides, an Notice of Construction must be submitted to Ecology. Specifically, if the proposed Alternative should emit toxic air pollutants, (WAC 173-460) would apply. An evaluation of the source term and associated air emissions would need to be reviewed. The cost is estimated at $50-$100 K, and the schedule is estimated at 8-12 months.

Air emission source information will need to be included in the Hanford Site Air Operating Permit. The cost is estimated at $25 K, and the schedule is estimated at 6 months.

Alternative 4 could result in interim storage or, if requirements were compatible, "Final Disposition" of the uranium, plutonium, and high level waste. If interim storage were required the requirements may be similar to those above. "Final Disposition" is being further defined by the Programmatic Environmental Impact Statement currently under review, with a Record-of-Decision anticipated in June, 1995.

B.1.2 UNCERTAINTIES AND CONSIDERATIONS

B.1.2.1 National Environmental Policy Act of 1971

A Programmatic Environmental Impact Statement is currently in draft form and in public review. This Environmental Impact Statement will determine the management of SNF complex-wide for the DOE. Any decision made by the DOE must not prejudice the preliminary environmental impact statement.

Development of NEPA documentation occurs early in the project. Completion constrains some design, procurement of materials and equipment, and start of construction. It is not certain if some of the functions within the Alternatives will be evaluated together in a single Environmental Impact Statement, as they appear to be interrelated.

B.1.2.2 Clean Air Act

Approval of the Notices of Construction constrains start of construction. Much of the information required to complete the Notice of Construction is sometimes only available at 80-100% design. Clean Air Act regulations contain specific requirements for monitoring and sampling air emissions. In order to comply, the design of the facility must integrate these requirements.

Construction cannot begin until approval is given for the Notice of Construction. Also, a notice of start-up is required approximately 30 days prior to operation. Following submittal of the Notice of Construction, the regulatory agency has 30 days to respond with a letter of completeness, or a notice of deficiencies in the application. If deficiencies are noted, the regulatory agency has another 30 days to issue a letter of completeness once the deficiencies have been addressed by the applicant. Following the letter of completeness, the regulatory agency has 60 days to finalize the Notice of Construction. Notices of Construction required for different regulatory agencies are prepared concurrently.

B.1.2.3 Comprehensive Environmental, Response, Compensation, and Liability Act of 1980

U.S. Department of Energy Secretarial Policy states that NEPA values and public involvement procedures are to be addressed by the CERCLA process for review of actions to be taken under CERCLA. An evaluation of this issue as it pertains to the alternatives indicates that no advantages exist by placing the activity under CERCLA.

B.1.2.4 Resource Conservation and Recovery Act of 1969

In the evaluation of Alternatives, it must be considered that although it is assumed that the spent nuclear fuel or associated sludge is not a waste, it is possible that wastes which may be subject to RCRA may be generated from the processes in the Function: "Prepare and Stabilize." An evaluation against RCRA requirements may be necessary including preparation of the appropriate RCRA Permits.

B.2.0 REGULATORY CONSIDERATIONS

Herein is provided a comparison of the nuclear safety regulatory requirements for the four Alternatives being considered for the disposition of the SNF and sludge in K Basins. The Alternatives are: (1) Containerization and Storage in K Basins, (2) Wet Pre-Interim or Wet New Facility Storage, (3) Dry New Facility Storage, and (4) Foreign Processing. The regulatory requirements for each Alternative are identified and estimates of cost and schedule are provided. The cost and schedule for all regulatory compliance activities (all disciplines subtracting out those activities quoted here and in the environmental regulations section of this report) are included in project management cost and schedule. For full regulatory compliance support, it is estimated that about 1.1% of total project or function cost is required. The schedule for this activity would start at project or function initiation and end whenever defined to end (e.g., initiation of operations or sometime during operations). The environmental regulations (e.g., RCRA, CERCLA, *Clean Air Act of 1977*, 42 USC 7401, et seq. [CAA], CWA, etc.) are addressed in Section B.1.0 of this report.

A comparison of the first three Alternatives shows few differences indicating that the nuclear safety regulatory requirements will be similar. One difference is the time within which the requirements must be met, with Alternative 3 having the most ambitious schedule. The effort to complete the expedited fuel removal can be kept to a minimum by designing, constructing, and operating the new facilities in accordance with requirements already established within the DOE.

The DOE has established safety requirements for its facilities as reflected in the DOE orders and rules (DOE Directives and Rulemaking System). In addition, the DOE issues directives, notices, instructions, safety guides and technical standards to supplement and clarify the orders and rules. Based on these requirements each contractor negotiates specific facility safety requirements which are imposed through contract conditions. These negotiated design and operational requirements become the facility's authorization basis, which is those aspects of the facility design basis and operation requirements relied upon by the DOE to authorize operation. The authorization basis is described in documents such as the facility safety analysis report and other safety documentation and facility specific commitments made in order to comply with DOE orders.

The Spent Nuclear Fuel Project is legally and contractually committed to follow the DOE directives system and rules as described above. As such the cost and schedule provided for inclusion in the decision making process within this report are based on the DOE directives system and rules. Additionally, in anticipation of licensability applicability this report also includes cost estimates and schedules for certain functions based on the high-level NRC regulations and requirements. This was provided for information reasons to address licensability, if later pursued. Licensability is defined as applying NRC regulations and requirements including specified national codes and standards.

The effort to accomplish this licensability task is unknown at this time and will be dependent on the changes and additions to the regulations and

requirements to address differences in NRC regulations and DOE regulations (e.g., commercial power reactor spent fuel versus metal fuel), and which regulator provides the standard review guidance review, and approval (NRC, DOE, or another regulatory agency). Those activities that may be a nuclear safety regulatory cost and schedule driver are briefly described in the following paragraphs.

The authorization basis is described in documents such as the facility Safety Analysis Report (SAR) and other safety analyses; Hazard Classification Documents, the DOE issued safety evaluation reports and facility specific commitments made in order to comply with DOE orders and policies. The Technical Safety Requirements (TSR) as required by DOE Order 5480.22, *Technical Safety Requirements* (DOE 1992a), then assures that facility operation is maintained within the authorization basis. The DOE Order 5480.23, *Nuclear Safety Analysis Reports* (DOE 1992b), governs facility Safety Analysis Reports.

Any proposed modification to existing facilities to support the fuel stabilization program must be reviewed and evaluated against the facilities' authorization bases to determine if the proposed activities constitute an unreviewed safety question (USQ). The guidelines for performing a safety evaluation (SE) are provided in DOE Order 5480.21, *Unreviewed Safety Questions* (DOE 1991), which provides that if the proposed or modification is outside of the facility's current authorization basis then revisions to the authorization basis documentation must be made and approved.

Using the guidance provided in DOE Order 5480.31, *Startup and Restart of Nuclear Facilities* (DOE 1993a), are performed for any of the following activities:

- Construction of a new operational facility or major system
- Modification to an existing facility or to a major system, process, or operating mode that potentially affects operational readiness
- Initiation of a major new process or operation.

The purpose of the operating readiness review is to demonstrate that the facility: is constructed as designed; can be operated safely and securely; will be operated by trained and competent personnel; have been given adequate consideration with respect to all hazards; and, will be operated so that no undue risk to employees, the public or the environment is created.

A foundation for readiness is an approved safety basis as defined in approved facility safety documentation, approved environmental documentation, a satisfactory safe work environment, and compliance with the DOE orders and requirements. The Official Readiness Review team must verify that the necessary approved requirements documentation is in place and that procedures, personnel and equipment and systems support the approved requirements. Critical to a determination of the facility's compliance with the DOE orders and requirements is verification that a review of the facility's conformance to applicable DOE orders and requirements has been performed, and non-conformance issues addressed.

The breadth of the Official Readiness Review will include the core requirements provided in (DOE 1993a) which address 20 major areas. The depth of the evaluation of core requirements will be determined according to the situations associated with the magnitude of hazard, and level of complexity associated with the proposed facility operating mode through use of the graded approach.

For packaging and transport of radioactive material, DOE Order 5480.3, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes* (DOE 1993b) provides the safety requirements. Further DOE guidance is provided for onsite transfer of radioactive materials at Hanford in RL Order 5480.1A, *Environmental, Safety, and Health Program for DOE Operations for Richland Operations*, Change 1, Chapter III, which contains provisions that permit onsite packaging and transfers of radioactive materials in packages that are in accordance with the U.S. Department of Transportation (DOT) regulations; or, if not practicable, packages that have been shown to provide an equivalent degree of safety. At Westinghouse Hanford Company (WHC), packages that do not fully comply with all aspects of the DOT regulations, are proven to provide an equivalent degree of safety as documented in a safety analysis report for packaging (SARP), or a safety evaluation for packaging, prepared and approved.

B.2.1 ALTERNATIVE 1 - CONTAINERIZATION AND STORAGE IN K BASINS

B.2.1.1 Containerize

Three containerization options are being considered for Alternative 1.

- No Containerization--Leave the SNF in the K-East Basin as is.
- Containerize K-East Fuel in Mark II Canisters--This is the encapsulation process as described and evaluated in the K Basin's current authorization basis.
- Overpack Containers--The term Primary Container (PC) has been adopted to reflect the overpack container style for deposit of the SNF.

The applicable body of nuclear safety regulations for containerization is the DOE Directives and Rulemaking System. Nuclear Safety regulations which have the potential for driving schedule are those which pertain to the Safety Analysis Report, safety analysis report for packaging, Technical Safety Requirements, safety evaluation report/unreviewed safety question and Official Readiness Review. It may be prudent to design a new cask to meet the intent of the 10 CFR 72 requirements, or purchase a cask with an existing NRC Topical Safety Analysis Report, which would allow, with the support of an onsite safety analysis report for packaging, the onsite transfers and eventual storage in the same cask.

The intent of this program is to prevent further degradation of the fuel elements, therefore, the "No Containerization" option will not be considered.

The next containerization option, "Containerize K-East Fuel in Mark II Canisters" has already been incorporated into the K Basin authorization basis. HAZOPS, unreviewed safety question/safety evaluation report, Safety Analysis Report, interim safety basis and Interim Operational Safety Requirements have been developed. The safety documentation is in review, but on hold awaiting project direction/decision. The estimated cost to finish the licensing/safety documentation is $15,000 for resolution of DOE comments.

For the "Overpack Containers" option, it is assumed that minimal modifications would be required to the K Basin. Safety documentation would need to be developed and approved (e.g., perform HAZOPS to verify and determine worst case accidents, safety evaluation report/unreviewed safety question evaluation, and revise Safety Analysis Report accordingly). Assuming that current K Basin safety envelop is maintained, the estimated cost and schedule for the safety documentation development, review and approval are $300,000 and 8 months. The safety documentation required to address sludge was estimated at the same cost of $300,000, but the schedule was increased to allow for technology development input to be incorporated, 12 months.

It is assumed that an Official Readiness Review will be conducted for the function or activity related to each facility. Several Official Readiness Reviews would be anticipated for the SNF activities, including the following:

- K Basin Operations and Containerization
- Packaging and Shipping from K Basin
- Pre-Interim Storage Facility, if Applicable
- Passivate and Condition (Stabilize) Facility
- Interim Dry Storage Facility.

The K Basin operations and containerization Official Readiness Review would be extensive to address all ongoing activities to support continued operation plus facility modifications and new procedures for containerization activities. Based on recent PFP Official Readiness Review activities, this could entail a multi-year schedule and 20-30 man years.

B.2.1.2 Onsite Packaging and Transfer from K Basins to Processing Facility within WHC Boundaries

Onsite packaging and transport of radioactive material is assumed to be performed with RL approval of the related safety documentation that demonstrates onsite equivalency to DOT/NRC/DOE packaging in accordance with RL Order 5480.1, and NRC Information Notice 84-72.

Engineering review shows an overpacked set of Mark IIs would not fit in the current Site transportation configuration, and therefore a new cask would need to be designed and fabricated. This would entail preparation of the Packaging Design Criteria (PDC) and preparation of a new safety analysis report for packaging. It should be noted that both the PDC and safety analysis report for packaging must be reviewed and approved by the DOE-Richland Operations Office (RL). Table 3.0 of WHC-SD-TP-ES-001 gives the cost of new casks as $1.5 million for design and safety documentation plus $1 million/cask for fabrication (safety analysis report for packaging development and review/approval was provided a cost estimated of $500K and

$100K, plus $100K contingency, respectively, with a schedule of 18 months and 4 months respectively). In accordance with the latest design information approximately 2.5 years would be required for the design, development, and fabrication of the cask.

Again, it may be prudent to design any new cask to meet the intent of the 10 CFR 72 requirements or to purchase a cask with an existing NRC Topical Safety Analysis Report (TSAR).

The Official Readiness Review for packaging and shipping would address shipping of the selected container in a transportation cask from K Basin to the stabilization or pre-interim storage facility. The Official Readiness Review should focus on the hardware involved since the container is included in the K Basin Operation Official Readiness Review, and receipt of the shipment will be covered by the receiving facility Official Readiness Review. Thus, the cost and schedule are estimated at 5 man years and 10-12 months, and it could be performed concurrently with the K Basin Operation Official Readiness Review.

B.2.1.3 Prepare and Condition (Stabilize)

If this facility were to be designed and constructed under DOE directives the nuclear safety regulations that have the most potential for affecting the cost and schedule are those pertaining to Safety Analysis Report, Technical Safety Requirements, safety evaluation report/unreviewed safety question and Official Readiness Review. The following DOE Orders would apply:

- DOE Order 5480.21, *Unreviewed Safety Question*
- DOE Order 5480.22, *Technical Safety Requirements*
- DOE Order 5480.23, *Nuclear Safety Analysis Reports*
- DOE Order 5480.24, *Nuclear Criticality Safety*
- DOE Order 5480.31, *Startup and Restart of Nuclear Facilities*
- DOE Order 6430.1A, *General Design Criteria.*

For utilization of an existing facility with such a mission change, the facility's current Safety Analysis Report would be extensively rewritten as if it were a new facility. For a new facility a hazard classification, preliminary safety evaluation (PSE), SAR, FSAR and Technical Safety Requirements would be developed. The level of analysis and documentation of the Safety Analysis Report will be based on the hazard classification. For a new facility approach, the following safety documentation would be developed using DOE Directives:

PSE/PSAR	DOE Order 5480.23	$1,100K	18 months
FSAR	DOE Order 5480.23	$1,100K	19 months
Contingency		$600K	

Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type), (ANSI/ANS [1984]), provides design criteria for systems and equipment of an installation for the receipt and interim dry storage of SNF solidified high-level radioactive waste. Section 5.2.2, "Fuel Unit Preparation (Fuel Unit Handling Area)," of ANSI/ANS (1984) states that "Fuel Unit preparation could include such operations as canning in sealed or unsealed containers, evacuation and backfilling containers with a non-oxidizing gas, removal of loosely adhering crud, Fuel Unit cleaning, or Fuel Unit Drying." Therefore, the facility required to perform these functions would be licensed under 10 CFR 72. 10 CFR 72 provides for a one-step licensing process in that the license application is required to be essentially complete when it is initially submitted. As such, the design details of those independent spent fuel storage installation (ISFSI) or monitored retrievable storage installation (MRS) components, systems, and structures that are important to safety must be provided in the safety analysis report. The existing regulatory guides that may be applicable to an independent spent fuel storage installation or monitored retrievable storage are listed in Regulatory Guide 3.53, "Applicability of Existing Regulatory Guides to the Design and Operation of an Independent Spent Fuel Storage."

As noted in *Commercially Available Dry Storage Systems for Storage of Irradiated Fuel on the Hanford Site*, WHC-SD-CP-ES-155 (Monthey and Bergsman 1994) commercially available dry storage systems that have been designed, licensed and constructed under NRC regulatory authority, do exist. However, the existing commercially available systems address the needs and requirements for light water reactor fuel. Thus, the preparation/conditioning portion of the interim storage facility described for Alternative 1 is without NRC licensing precedent. So, it is assumed that to demonstrate "licensability" the safety documentation would meet the intent of NRC requirements. The safety documentation would then be reviewed and approved by one regulatory agency, assumed to be the NRC.

Since the proposed preparation/conditioning operations are conducted in hot cells and employ processes utilized at other DOE-owned facilities, e.g., the Plutonium Uranium Extraction facility (PUREX), etc., there is some precedent with both DOE and Westinghouse Hanford Company for the regulatory requirements. The development and subsequent review and approval of the safety documentation should, therefore, be less costly and more timely using DOE rather than NRC requirements. For this reason the cost and schedule for demonstrating NRC "licensability" may be as little as 50% more than that for the safety documentation associated with DOE directives.

For initial startups of new Hazard Category 1 and 2 facilities, the Secretary of Energy has startup authority. It is assumed that SNF activities will be Category 2 facilities. Final approval for facility startup cannot be granted until the FSAR has been approved by the DOE- Headquarters and the contractor Official Readiness Review and the DOE Official Readiness Review have been completed and all pre-start findings have been resolved. Following completion of the DOE Official Readiness Review and resolution of restart findings, DOE management will recommend to the approval authority that startup approval be granted.

The Official Readiness Reviews of the three new facilities, viz., Pre-Interim Storage Facility, Stabilization Facility, and Interim Dry Storage

Facility, are similar and most of the readiness review team certification package preparation could be done in parallel with the construction activities. Upon completion of construction and OTP activities, the formal Official Readiness Review activities could be performed in about 3 months. These Official Readiness Reviews would take about a year culminating in the 3 month Official Readiness Review, with an expenditure of 10-15 man years.

B.2.1.4 Onsite Packaging and Transfer from Conditioning Facility to Interim Storage (Cask or housing module type)

Again, onsite packaging and transport of radioactive material is assumed to be performed with RL approval of the related safety documentation that demonstrates onsite equivalency to DOT/NRC/DOE packaging in accordance with RL Order 5480.1, and NRC Information Notice 84-72. However, it is expected that this transfer packaging system would be part of the interim storage facility, and therefore, be designed to meet the intent of the 10 CFR 72 requirements. Therefore, the nuclear safety documentation for this cask would be developed using the guidance of NRC Regulatory Guide 3.61, *Standard Format and Content for a Topical Safety Analysis Report for a Spent Fuel Dry Storage Cask*. Additionally, an onsite safety analysis report for packaging would be written to address the transfer from the conditioning facility to the interim storage facility. It may be prudent to license or purchase a cask with an existing NRC Topical Safety Analysis Report that may be amended to 10 CFR 71 requirements to facilitate any future offsite shipments. Moreover, Subpart K contains provisions for a general license for storage of spent fuel at licensed power reactor sites. Under this provision, a licensee may store spent fuel in casks previously approved by the NRC (via a Topical Safety Analysis Report) provided that the licensee prepares a written safety evaluation to determine whether activities related to storage of spent fuel involve any unreviewed safety questions or change in the facility technical specifications (Operational Safety Requirements/Technical Safety Requirements), as provided under 10 CFR 59 (unreviewed safety question). This provision can be implemented at the Hanford Site by using a cask with an existing Topical Safety Analysis Report and conducting an unreviewed safety question evaluation against the authorization basis of the facility where the casks will be stored.

If it is assumed that the cask design will be based on an NRC reviewed and approved non-site specific Topical Safety Analysis Report. It is expected that the safety documentation for this option would involve the modification and/or update of the Topical Safety Analysis Report to reflect the specific fuel application and an onsite safety analysis report for packaging would be written. Additionally, an unreviewed safety question evaluation would be performed at the facility where the cask will be stored to determine whether activities related to storage of spent fuel involve any unreviewed safety questions or change in the facility technical specifications (operational safety requirements/Technical Safety Requirements). It is estimated that this safety documentation can be prepared and approved by RL in about 17 months, for approximately $250K.

However, a new cask may be required. If so, Table 3.0 of WHC-SD-TP-ES-001 gives the cost of new casks, under DOE directives, as $1.5 million for design and safety documentation plus $1 million/cask for fabrication (safety analysis report for packaging development, review, and approval was estimated to cost $500K and $100K, respectively; with a $100K contingency and schedule estimate of 18 months and 4 months, respectively); in accordance with the latest design information approximately 2.5 years would be required for the design, development, and fabrication of the cask.

The Official Readiness Review for packaging and shipping would address shipping of the selected container in a transportation cask from the conditioning facility to the interim storage facility. The cost and schedule are estimated at 5 man-years and 10-12 months and it could be performed concurrently with the preparation and conditioning facility Official Readiness Review.

B.2.1.5 Interim Storage (Water Pool or Vault Type)

It is assumed that the interim storage facility would meet the intent of NRC requirements for spent fuel storage facilities. A NRC Part 72 (10 CFR 72) license is required to receive, transfer, and possess power reactor spent fuel and other radioactive materials associated with spent fuel storage in an independent spent fuel storage installation or monitored retrievable storage. The information that must be provided in an application for a monitored retrievable storage or independent spent fuel storage installation license is specified in Subpart B of (10 CFR 71 through 10 CFR 72). As per 10 CFR 72 each application must include a Safety Analysis Report, prepared to the guidance in Regulatory Guide 3.48, "Standard Format and Content for Safety Analysis Reports for an Independent Spent Fuel Storage Installation (Dry Storage)" or Regulatory Guide 3.44, "Standard Format and Content for Safety Analysis Reports for an Independent Spent Fuel Storage Installation (Water-Basin Type)." If the storage cask has been previously reviewed and approved by the NRC in a Topical Safety Analysis Report then the Safety Analysis Report can be shortened by reference to the Topical Safety Analysis Report. In addition to a Safety Analysis Report, the license application must include the following:

- Decommissioning Plan
- Emergency Plan
- Environmental Report
- Quality Assurance Plan
- Physical Security Plan
- Personnel Training Program
- Proposed License Conditions, including Technical Specifications.

It is assumed that only minor revisions to the existing DOE and Westinghouse Hanford Company programs would be required to meet the corresponding NRC programmatic requirements (material accountability, emergency plan, quality assurance plan, physical security plan and personnel training program); and, that the schedule for these minor revisions is within that provided for development of the Safety Analysis Report.

Assuming that the interim storage facility would utilize a modular dry storage vault system similar to the Fort St. Vrain independent spent fuel storage installation, the cost and schedule is estimated at $800K with $300K for contingency, 13 months for preparation of the Licensing application, FSAR, and response to regulator (NRC) questions.

The cask design should be based on an NRC reviewed and approved non-site specific Topical Safety Analysis Report. Therefore, the safety documentation for an interim storage facility (vault or water pool type) would require the preparation of a site specific Safety Analysis Report which references that Topical Safety Analysis Report, and documents that the site specific conditions are within the scope of the Topical Safety Analysis Report analyses.

If the interim storage facility was to be designed and constructed using DOE directives, the following DOE Orders would apply:

- DOE Order 5480.21, *Unreviewed Safety Question*
- DOE Order 5480.22, *Technical Safety Requirements*
- DOE Order 5480.23, *Nuclear Safety Analysis Reports*
- DOE Order 5480.24, *Nuclear Criticality Safety*
- DOE Order 5480.31, *Startup and Restart of Nuclear Facilities*
- DOE Order 6430.1A, *General Design Criteria*
- Hanford Plant Standards Design Criteria.

Note that DOE Order 6430.1A references 10 CFR 72 for design criteria. If it was decided to authorize operation under the DOE Directives, a vault type of interim storage facility similar to the Fort St. Vrain configuration, the safety documentation could be developed for approximately $1 Million.

Commercially Available Dry Storage Systems for Storage of Irradiated Fuel on the Hanford Site (WHC 1994) evaluates the currently available commercial dry storage systems.

For the Official Readiness Reviews of the three new facilities, viz., Pre-Interim Storage Facility, Stabilization Facility, and Interim Dry Storage Facility, most of the readiness review team certification package preparation could be done in parallel with the construction activities. Upon completion of construction, the formal Official Readiness Review activities could be performed after OTP type activities in about 3 months. These Official Readiness Reviews would take about a year culminating in the 3 month Official Readiness Review, with an expenditure of 10-15 manyears.

B.2.2 ALTERNATIVE 2 - WET PRE-INTERIM OR WET NEW FACILITY STORAGE

B.2.2.1 Containerize

As it was for Alternative 1, the applicable Nuclear Safety regulations for the Alternate 2 "Containerize" function will be the DOE Directives and Rulemaking Systems; and, the nuclear safety regulations which will affect schedule are those which pertain to the Safety Analysis Report, safety

analysis report for packaging, Topical Safety Analysis Report, Technical Safety Requirements, safety evaluation report/unreviewed safety question, and Official Readiness Review.

Assuming the "Overpack Containers" concept similar to that proposed for Alternative 1 would be used for Alternative 2, the safety documentation would need to be developed, reviewed, and approved (e.g., perform HAZOPS to verify and determine worst case accidents, safety evaluation report/unreviewed safety question evaluation, and revise Safety Analysis Report accordingly). Assuming the current K Basin safety envelop is maintained, the cost and schedule estimates for safety documentation development, review and approval are $300,000 and 8 months. The safety documentation required to address sludge was estimated at the same cost of $300,000, but the schedule was increased to allow for technology development input to be incorporated, 12 months.

The K Basin operations and containerization Official Readiness Review would be extensive to address the activities to support continued operation, plus facility modifications and new procedures for the containerization activities. Based on recent PFP Official Readiness Review activities, this could entail a multi-year schedule and 20-30 man years.

B.2.2.2 Onsite Packaging and Transfer from K Basins to Pre-Interim Storage

Onsite packaging and transport of radioactive material is assumed to be performed with RL approval of the related safety documentation that demonstrates onsite equivalency to DOT/NRC/DOE packaging in accordance with RL Order 5480.1, and NRC Information Notice 84-72.

The transfer portion of this Alternative would employ the previously described existing transfer packaging system for the basins with some modifications and/or the design and fabrication of new casks. As with the other Alternatives, it is assumed that the transfer would be performed as an onsite transfer and would be documented within an onsite safety analysis report for packaging, or SEP. It is also assumed that an Official Readiness Review as previously described would be conducted.

Therefore, the cost and schedule are as given in Alternative 1 for this function, i.e., the cost of new casks is $1.5 million for design and safety documentation plus $1 million/cask for fabrication (safety analysis report for packaging development and review/approval was provided a cost estimate of $500K and $100K plus $100K contingency, with a schedule of 18 months and months, respectively); in accordance with the latest design information approximately 2.5 years would be required for the design, development, and fabrication of the cask.

B.2.2.3 Pre-Interim Storage

For the pre-interim wet storage of Alternative 2, it is assumed that a new storage pool would be built adjacent to the Fuels and Materials Examination Facility (FMEF). The pool, and the pool's containment building would be Safety Class 1, per HPS SDC 4.1, Rev. 12.

Examination Facility (FMEF). The pool, and the pool's containment building would be Safety Class 1, per HPS SDC 4.1, Rev. 12.

The following DOE orders would be applicable in the design and safety documentation for this facility, as provided by the DOE Directive System:

- DOE Order 5480.21, *Unreviewed Safety Question*
- DOE Order 5480.22, *Technical Safety Requirements*
- DOE Order 5480.23, *Nuclear Safety Analysis Reports*
- DOE Order 5480.24, *Nuclear Criticality Safety*
- DOE Order 5480.31, *Startup and Restart of Nuclear Facilities*
- DOE Order 6430.1A, *General Design Criteria.*

Additional requirements for the storage of the K Basin fuel were established in a 1993 engineering study (WHC-SD-NR-010).

The cost for preparing, reviewing, and approving the PSAR and FSAR, per DOE Order 5480.23, for this facility is $1,100K, respectively with $600K contingency; the schedule for PSAR and FSAR development, WHC and RL review and approval is estimated at 18 months and 19 months, respectively.

The Official Readiness Reviews of the three new facilities, viz., Pre-Interim Storage Facility, Stabilization Facility, and Interim Dry Storage Facility, are similar and most of the readiness review team certification package preparation could be done in parallel with the construction activities. Upon completion of construction, the formal Official Readiness Review activities could be performed after OTP type activities in about 3 months. These Official Readiness Reviews would take about a year culminating in the 3 month Official Readiness Review, with an expenditure of 10-15 man-years.

The NRC license requirements for the new pre-interim spent fuel pool to be located at the east end of the FMEF are specified in 10 CFR 72. 10 CFR 72 entitled "Licensing Requirements for the Storage of Spent Fuel and High Level Radioactive Waste" covers both dry and wet storage in an independent spent fuel storage installation or a monitored retrievable storage. The independent spent fuel storage installation or monitored retrievable storage is permitted to be interconnected with the FMEF including the sharing of common utilities and services providing the probability or consequences of accidents is not increased and the margin of safety is maintained.

Subpart F of 10 CFR 72 describes the General Design Criteria for the independent spent fuel storage installation or monitored retrievable storage. Sections 72.24 through 72.34 describe the required content of the license application. The application contents are spelled out in Regulatory Guide 3.50, "Standard Format and Content for a License Application to Store Spent Fuel and High-Level Radioactive Waste." The application includes the Safety Analysis Report which describes how the facility will be operated, its design features, the design bases relative to the design criteria and, an analysis of potential accidents; Technical Specifications, and an Environmental Report (see similar discussion in Section 3.6.1). The Safety Analysis Report is prepared using the guidance provided in Regulatory Guide 3.44, "Standard Format and Content for Safety Analysis Reports for an Independent Spent Fuel Storage Installation (Water Basin Type)," January 1989. This Regulatory Guide

is established for a stand-alone type installation. Section 8, "Accident Analysis" refers to ANSI/ANS 57.7-1981, "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" for definition of the four categories of design events that may be used in establishing design requirements to satisfy operational and safety criteria. This ANSI/ANS Standard which has been revised in 1988 is endorsed by the NRC Regulatory Guide 3.49, "Design of an Independent Spent Fuel Storage Installation (Water Basin Type)," December, 1981. The ANSI/ANS 57.7-1988 provides the codes and standards and corresponding references to be utilized in the independent spent fuel storage installation or monitored retrievable storage design. These may or may not be endorsed by the NRC.

NRC Regulatory Guide 3.53, "Application of existing Regulatory Guides to the Design and Operation of an Independent Spent Fuel Storage Installation," July 1982, identifies the then existing regulatory guides that may be applicable to the design and operation of an independent spent fuel storage installation.

No cost or schedule estimates have been generated at this time for licensability applied to the pre-interim storage pool.

B.2.2.4 Prepare and Condition (Stabilize)

This Alternative 2 will utilize the regulatory requirements, and cost and schedule for the "Preparation and Conditioning" discussed for Alternative 3 (Independent Technical Assessment) in Section B.2.3.3.

B.2.2.5 Onsite Packaging and Transfer from Conditioning Facility to Interim Storage

Section B.2.1.4 discusses the regulatory requirements and the cost and schedule for the onsite transfer of fuel from the conditioning facility to the interim storage facility. The requirements cited, and estimates provided therein are applicable to this function for Alternative 2.

B.2.2.6 Interim Storage

The regulatory requirements and the cost and schedule information for the "Interim Storage" functions are the same for all the Alternatives being considered, and are as discussed for Alternative 1, Section B.2.1.5.

B.2.3 ALTERNATIVE 3 - DRY NEW FACILITY STORAGE (INDEPENDENT TECHNICAL ASSESSMENT)

B.2.3.1 Containerize

The process for Canister Preparation and Loading into the MCO described in the Independent Technical Assessment report differs from what is now in the K Basin's authorization basis for Encapsulation. Therefore, a safety

evaluation must be performed, per DOE Order 5480.21, to determine if the proposed activities constitutes an unreviewed safety question (USQ).

As for Alternative 1 (Section B2.1.1), the applicable nuclear safety regulations for Containerization in Alternative 3 will be the DOE directives and Rulemaking System; and, the nuclear safety regulations which may affect schedule are those which pertain to the Safety Analysis Report, safety analysis report for packaging, Technical Safety Requirements, safety evaluation report/unreviewed safety question and Official Readiness Review. As described in the Independent Technical Assessment engineering report for Alternative 3, the MCO is intended as an integral part of the interim storage facility and therefore should be designed to meet the intent of the 10 CFR 72 requirements; and, the nuclear safety documentation for it would be developed using the guidance NRC Regulatory Guide 3.61. Additionally, an onsite safety analysis report for packaging would be written to address the transfer from the basin to the conditioning facility. Again, it may be prudent to license, or purchase, a transfer cask with an existing NRC Topical Safety Analysis Report that may be amended to 10 CFR Part 71 requirements to facilitate any future offsite shipments.

Since the proposed activities are considerably different from the current authorization basis, Safety Analysis Report revisions with facility configuration changes based on a safety evaluation report/unreviewed safety question would be required. The safety documentation would likely include HAZOPS, unreviewed safety question/safety evaluation report, Safety Analysis Report, interim safety basis and Interim Operational Safety Requirements, and would require RL review and approval. The Cost is estimated at $400K, and would take approximately 13 months. The safety documentation required to address sludge was estimated at $300,000 with a schedule of 12 months to allow for technology development input to be incorporated.

The Official Readiness Review for K Basin operations and containerization would be extensive to address ongoing activities to support continued operation plus facility modifications and new procedures for containerization activities. In comparison to recent PFP Official Readiness Review activities, this could entail a multi-year schedule activity with a manpower expenditure of 20-30 man years.

B.2.3.2 Onsite Packaging and Transfer from K Basins to Processing Facility within WHC Boundaries

Onsite packaging and transport of radioactive material is to be done with DOE-RL approval of the related safety documentation that demonstrates onsite equivalency to DOT/NRC/DOE packaging in accordance with RL Order 5480.1.

Transport proposed in Alternative 3 would require the design and fabrication of a new transfer cask. As presented in Table 3.0 of WHC-SD-TP-ES-001, it is estimated that new cask could be fabricated for 1 million dollars per cask. The design and safety documentation associated with this new transfer cask was estimated at 1.5 million dollars (safety analysis report for packaging development and review/approval was provided a

cost estimate of $500K and $100K, respectively, with a $100K contingency and a schedule of 18 and 4 months, respectively) with a latest schedule estimate of 2.5 years for design, development, and fabrication.

As stated in Section B.2.1.2, the Official Readiness Review for packaging and shipping would address shipping of the selected container in a transportation cask from K Basin to the stabilization or pre-interim storage facility. The Official Readiness Review should focus on the hardware involved since the container is included in the K Basin Operation Official Readiness Review, and receipt of the shipment will be covered by the receiving facility Official Readiness Review. Thus, the cost and schedule are estimated at 5 man-years and 10 - 12 months, and it could be performed concurrently with the K Basin Operation Official Readiness Review.

B.2.3.3 Prepare and Condition (Stabilize)

For this function, the DOE directives and rulemaking systems provide the applicable nuclear safety regulations. Thus, the nuclear safety regulations that have the most potential for affecting cost and schedule are those pertaining to Safety Analysis Report, Technical Safety Requirements, safety evaluation report/unreviewed safety question and Official Readiness Review. The discussion provided in Section B.2.1.3 is applicable.

Although the Independent Technical Assessment engineering report for Alternative 3 implies that the conditioning plant could be designed and constructed as a non-nuclear facility, because of the anticipated inventory loading of the MCOs the facility would likely be designed and constructed using the DOE initiatives as a new non-reactor nuclear facility. Thus, for the development review and approval of the PSE and PSAR, per DOE Order 5480.23, $1,100K and 18 months will be required; and, the FSAR, also performed per DOE Order 5480.23 will require $1,100K, and 19 months with a $600K total contingency. Also, as mentioned in Section B.2.1.3, to demonstrate NRC "licensability" for the conditioning facility this estimate should be increased by approximately 50%. Finally, the Official Readiness Review requirements and cost and schedule estimates in Section B.2.1.3 are also applicable.

B.2.3.4 Onsite Packaging and Transfer from Conditioning Facility to Interim Storage

Section B.2.1.4 discusses the regulatory requirements and cost and schedule estimates for the onsite transfer of fuel from the conditioning facility to the interim storage facility for Alternative 1. They are applicable to Alternative 3, as well.

B.2.3.5 Interim Storage

The regulatory requirements and the cost and schedule information for the "Interim Storage" functions are the same for all the Alternatives and are as discussed for Alternative 1, Section B.2.1.5.

B.2.4 ALTERNATIVE 4 - FOREIGN PROCESSING

B.2.4.1 Assumptions/Constraints/General Issues

- For Alternative 4 to succeed, the requirement for NEPA evaluation needs to be addressed. The DOE NEPA review schedule envisioned by British Nuclear Fuel Laboratories (BNFL) seems optimistic. An early start on the Hanford SNF Environmental Impact Statement is recommended, in any event, with the BNFL concept included in the programmatic Environmental Impact Statement.

- DOE will retain title to the N-Reactor spent fuel throughout the entire process including treatment and storage of the materials in the U.K. Also, that DOE would be responsible for the safety of all activities up to the time the casks were loaded on the BNFL ship, when safety responsibility would then transfer to BNFL.

- In both the U.S. and the U.K., the SNF would be subject to International Atomic Energy Agency inspection and controls throughout the transportation, storage, treatment and disposal.

- BNFL would be expecting the contract to be established by February, 1997. So, BNFL would procure licensed shipping casks in U.S. based on their existing design for the internationally licensed type B(M) cask, and construct/modify facilities on Site as needed. BNFL would obtain a Certificate of Competent Authority prior to the use of their cask.

- BNFL would use its fleet of specially designed ships to transport the spent fuel from a Northwest port to Sellafield. Ships comply with Irradiated Nuclear Fuel Code of the International Marine Organization, and satisfy the requirements of the U.S. Coast Guard.

- The storage and processing capacity at Sellafield is sufficient to accommodate shipment of all the N-Reactor fuel by the year 2003 and completion of processing by the year 2006.

- BNFL has stated that their process and procedures, from transportation through processing and waste treatment, are approved for damaged (hydrided) metal fuel. Specific safety authorization would be obtained for the N-Reactor fuel.

- Each of the final waste forms (residues) produced by the BNFL process have been highly characterized and detailed specifications developed.

- BNFL has designed a new 110 ton cask for transporting the vitrified high level waste container produced by their waste encapsulation facilities. The cask will transport 21 vitrified containers and should be available for international shipments by the year 1996. Again, BNFL would obtain a Certificate of Competent Authority for the use of the cask.

B.2.4.2 Applicable Policy, Regulations, and Issues

U.S. State Department--The transportation of fissile material from one nation to another, and overseas processing of U.S. spent reactor fuel will probably require high level Administration approval to ensure IAEA safeguards and U.S./U.K. national policies are maintained.

U.S. Coast Guard--The Captain of the Port may impose certain restrictions for movement and handling of hazardous materials such as number of tugs, time of tow, control of traffic, etc.

Restrictions Applicable to Foreign Reprocessing--The Nuclear Nonproliferation Treaty, U.S. legislation supporting it, and the Atomic Energy Act (AEA) have been examined for provisions which could bar or impede the shipment and processing BNFL proposes. While there are procedures which must be followed, nothing in the treaty, the supporting legislation, or the Atomic Energy Act appears to prohibit the steps BNFL suggests.

Nuclear Nonproliferation Treaty--Initiated with the intent of preventing increases in the number of nation states possessing nuclear weapons or the capability to manufacture them. BNFL proposes a shipment between weapons states for peaceful purposes. Nothing in the treaty precludes this concept. Domestic legislation supporting the treaty is similar in content to the treaty itself, and would not impede shipment.

Atomic Energy Act--Contains certain provisions which may impose procedural requirements on the BNFL concept, but none to prohibit it. For example, reprocessing SNF outside the U.S. normally requires either an agreement for cooperation or Secretary of Energy authorization. So, the BNFL concept may be implemented under the existing U.S./U.K. agreement for cooperation on the uses of atomic energy for mutual defense purposes. This agreement provides for transfer of materials between countries, recognizes the transfer of materials for general atomic energy purposes as opposed to direct defense purposes, and also recognizes the Atomic Energy Act in its entirety. Further, the agreement is broadly stated; its terms are consistent with a reading of "defense purposes" which includes stabilization and disposition of materials produced for defense purposes. If this agreement is deemed not applicable any new agreement could potentially be subject to congressional veto for a 60 day period.

Separating Plutonium from Spent Nuclear Fuel--In September, 1993 President Clinton established a framework for U.S. efforts to prevent the proliferation of weapons of mass destruction. This announcement, combined with the National Academy of Sciences Report on the management and disposition of excess weapons plutonium and other recent government reports on this subject could lead to the perception that the BNFL concept is inconsistent with U.S. nonproliferation policy. However, review of the applicable documents and current planning for the storage, treatment and disposal of DOE-owned SNF indicates that there is no established policy which precludes the BNFL concept.

This policy discourages the reprocessing of SNF for nuclear power or nuclear explosives, and seeks to eliminate, where possible, the stockpiling of plutonium. It is silent on the use of reprocessing technology for the

treatment of degraded, unstable DOE defense program SNF prior to disposal. Further, it specifically acknowledges existing U.S. commitments regarding the continuation of reprocessing programs in Western Europe and Japan. While some might argue that the BNFL concept would increase rather than decrease our stockpile, the plutonium in the N-Reactor spent fuel already exists and is usually included by DOE in the stockpile of "excess plutonium" to be disposed of.

B.2.4.3 Containerize

The casks to be utilized for the containerization, packaging and shipping to the U.K. for processing must comply with U.S. DOT regulations. Since the BNFL concept utilizes casks based on a licensed design used to transport damaged metal fuels internationally, the BNFL assertion that the casks could be certified for use in the U.S. seems valid. Issues evaluated as part of the U.S. certification review would include the following:

- Acceptability of a the BNFL cask venting design (typically, venting is not allowed by U.S. regulations)
- Loss of water in the container, and the potential of a pyrophoric reaction if fuel is exposed to air
- Adequacy of the container to meet U.S. leak tightness criteria
- The acceptability of the design for wet shipment of the fuel (e.g., adequacy of pressure relief design, provisions for avoiding over-fill with water, etc.)
- Differences in cladding metals.

Additional evaluation of the technical issues regarding DOT certification of the BNFL cask for shipments in the U.S. (e.g., the issue of cask venting) should be completed early because of the short time estimated to accomplish this activity in the schedule outlined by BNFL.

The DOT regulations are applicable within the U.S. navigable and territorial waters and must be met (e.g., maximum allowable exposure rate of 200 mr at the surface or 10 mrem/h at two meters from accessible external surfaces of the package, re: 49 CFR 173.393, 173.471, and 173.472). For shipments in BNFL casks that are certified by non-U.S. regulatory authorities, the DOT would be responsible for reviewing and determining the acceptability of the shipping container for shipments in the U.S. Normally, this can be done by reciprocity without a large review effort.

Receipt of the Certificate of Competent Authority must be obtained prior to loading the casks in the K Basins. It is assumed that BNFL would obtain the Certificate of Competent Authority. Assuming extended reviews because of the cask issues described above, three months to one year may be required to obtain the necessary reviews and approvals for the Certificate.

As discussed in Section B.2.1.1, the applicable nuclear safety regulations for this function will be the DOE Directives and Rulemaking

Systems. So, the nuclear safety regulations which may have the most affect on schedule are those which pertain to the Safety Analysis Report, Technical Safety Requirements, safety evaluation report/unreviewed safety question, and Official Readiness Review.

The current BNFL information does not describe their proposed containerization process. Therefore, it is assumed the BNFL containerization may be performed by either encapsulation or overpack. In either case, the approach would need to be assessed against the current K Basin's authorization basis, via a safety evaluation using the guidance provided in DOE Order 5480.21 to determine if the proposed activities constitutes an unreviewed safety question. If the proposed activities are similar to the current authorization basis then the cost and schedule estimated in Section B.2.1.1, and the Official Readiness Review requirements discussed there would be applicable for Alternative 4, as well.

If the containerization scheme is considerably different from the current authorization basis, SAR revisions with facility configuration changes based on a safety evaluation report/unreviewed safety question would be required. The safety documentation would include HAZOPS, unreviewed safety question/safety evaluation report, Safety Analysis Report, interim safety basis and Interim Operational Safety Requirements, and the safety documentation would require RL review and approval. The cost and schedule are similar to those documented in Section 2.3.1 for safety documentation development, RL review and approval.

B.2.4.4 Shipping to U.K., Processing, and Return to U.S. Port of Entry

The regulatory approvals and issues associated with the international shipping, packaging and transfer, processing and return will be the responsibility of BNFL. BNFL will ensure that all necessary certification and licensing is provided.

The law firm, Eckert, Seamans, Cherin, and Mellott was consulted for a preliminary opinion regarding the regulatory aspects of Alternative 4. They offer concern over the implications of the NEPA requirement, as stated in SAIC Report "BNFL Concept Review Regulatory and Policy Issues" (SAIC 1994), that before the proposal is implemented, the potential consequences of this process to the U.K. environment be evaluated. Eckert, Seamans, Cherin, and Mellott further notes that the SAIC Report makes no reference to the role of the Defense Nuclear Facilities Safety Board and does not acknowledge that DOE has consistently requested NRC advise in these matters, although NRC does not have jurisdiction.

Eckert, Seamans, Cherin, and Mellott recommends a review of the regulatory and policy issues involved in the BNFL concept to exhaustively identify those applicable to Alternative 4; then, as a second step establish feasibility of concept, and its implementation requirements. This second step requires consultation with representatives of the government organizations involved in resolution of the identified issues. The cost and schedule for

the regulatory and policy issues review is estimated at $25K and one month. Any need for any additional work would be based on the results of this initial review.

B.2.4.5 Packaging and Transfer from Port of Entry to Interim Storage

It is assumed that the material being transported would be classified as a fissile Class III shipment. 49 CFR 173.457 would apply. In addition, the requirements specified in 10 CFR 71 for type B package must also be met. For shipments in BNFL casks that are certified by non-U.S. regulatory authorities, the DOT would be responsible for reviewing and determining the acceptability of the shipping container for shipments in the U.S. Normally, this can be accomplished through reciprocity without a large review effort. Any casks that are used would require a CoC or a Certificate of Competent Authority.

The Certificate of Competent Authority must be obtained prior to entering U.S. waters. It is assumed that BNFL would obtain the Certificate of Competent Authority, which may take two months to one year.

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B.3.0 TRIBAL, REGULATOR, AND STAKEHOLDERS VALUES

The U.S. Department of Energy (DOE) has, in conjunction with regulators and other federal, tribal, state, and local government entities, sponsored two Hanford stakeholder forums that have provided value statements that should be considered as cleanup decisions are made. These two stakeholder forums, the *Hanford Future Site Uses Working Group* and the *Hanford Tank Waste Task Force* included representatives of federal, tribal, state, and local governments; business, agricultural, and economic interests; academia; environmental groups; and groups with a special interest in Hanford. A third such forum, the *Hanford Advisory Board*, adopted without change the recommendations, principles and values of the two other bodies. Another source of values is the *Policy Guidance Statement on Hanford Waste Management and Environmental Restoration*, (Ecology 1993) the State of Washington Department of Ecology (Ecology). The Statement is intended to provide direction to Ecology management and staff, but the guidance therein can be inferred to be values that should considered in Project decision-making.

Discussed herein are the Hanford Stakeholder Groups and those stakeholder values considered particularly relevant to the Spent Nuclear Fuel Project, which should, therefore, be considered in the evaluation of the alternative means for expeditiously removing fuel from the K Basins.

Formal presentations were also made recently to the Confederated Tribes and Bands of the Yakama Indian Nation (September 20, 1994), the Confederated Tribes of the Umatilla Indian Reservation (September 26, 1994), the Nez Perce Tribe (October 3, 1994), the U.S.-Environmental Protection Agency and Ecology (September 22, 1994), and the Hanford Advisory Board's Major Safety and Waste Management Issues Committee (August 16, 1994). The purpose of these presentations was to obtain specific tribal, regulator, and stakeholder values as input to the expedited fuel removal decision process.

The following summarizes the input received and incorporated into the decision process.

Tribal. As sovereign nations, the aforementioned tribes have specific legal rights and interests regarding the Hanford site. While it is not the purview or intent of the Spent Nuclear Fuel Project to intercede in tribal legal issues, it is incumbent on the management of the Spent Nuclear Fuel Project to ensure that the Project's strategic direction is aligned with tribal values. General values regarding the Hanford Strategic Plan, the Hanford Mission Plan, and Hanford Environmental Remediation and Waste Management have been transmitted to DOE-RL. However, in order to ensure that specific tribal values relative to the Project's strategic direction are incorporated into the expedited fuel removal decision process the local tribes were consulted. The following is a synopsis of tribal values provided directly to Project personnel.

Values provided by representatives of the Yakama Indian Nation

- Protect the Columbia River
- Expedite the removal of the spent fuel from the K-Basins so that the K area can undergo D&D activities as fast as possible; empty K-East basin first.
- It is more important to go to a dry storage configuration even if it takes longer than wet
- Shipping fuel off-site is agreeable as long as a new capital facility is not made; however, we should plan on storing fuel on site until the ultimate repository is ready
- Minimize cost of associated actions, maximize flexibility of the interim storage facility
- Minimize waste generation
- Assume Spent Nuclear Fuel is waste and design accordingly
- Sludge in the K-Basins should be considered high level radioactive waste and disposed of in the repository
- Any new facilities should meet indian applicable regulations and requirements (ARRs)
- Any transportation of fuel should be in a dry state

Values provided by representatives of the Confederated Tribes of the Umatilla Indian Reservation

- Protect the Columbia River
- Hanford SNF should not be sent to INEL
- Do not create inter-generational problems. A solution with long range value is more important than cost considerations
- New facilities should have multiple missions an integrate overall with the site
- Spent fuel from other sites should not be sent to Hanford
- Leaving the material in the K-Basins is not acceptable
- Hanford should ensure what the end state of the fuel will ultimately be in order to get there most efficiently.

Values provided by representatives of the Nez Perce Tribe

- Protect the Columbia River
- Foreign reprocessing is a viable alternative
- The relative cost and schedule impacts of moving native bones and artifacts should be considered
- Maximize tribal economic benefit such as intertribal nursery project
- Minimize land disturbance
- All SNFP activities should be consistent with a Cultural Resources Management Plan developed in conjunction with the tribes
- Employee training should be provided to ensure employee understanding of tribal values and issues.

The *Hanford Future Site Uses Working Group* was charged with developing a range of future use options for the site and assessing the implications of those uses on cleanup. The range of options subsequently developed by the Working Group are being further evaluated in the *Hanford Remedial Action Environmental Impact Statement*. The Working Group proposed future uses for each of six major geographic areas of the site, identifying cleanup scenarios to describe the cleanliness needed to accommodate those future uses for the area. Values stated were either geographic area-specific, or overall site recommendations, and are described in the Working Group's final report, "The Future of Hanford: Uses and Cleanup," December 1992.

Of the six areas, two are most directly impacted by the K-Basin remediation. They are the Columbia River itself, its islands and immediate shoreline; and, the "Reactors on the River" (100 Area NPL Site), i.e., the area containing the nine retired plutonium production reactors (100 Areas) and the land in between. For these two areas the Working Group in its final report cites cleaning up contamination affecting the River as an immediate priority, especially N Reactor and associated springs and seeps, groundwater contamination flowing into the River, and K Basins. The Working Group also advanced a number general recommendations relevant to the removal of SNF from K Basin.

The *Hanford Tank Waste Task Force* was convened in May, 1993 by the DOE, the U.S. Environmental Protection Agency (EPA), and Ecology. The three agencies, engaged in renegotiating the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), charged the Task Force with providing the negotiators with values relative to the Tank Waste Remediation System, and with principles for the overall Tri-Party Agreement package.

The Task Force's key message to the three parties was "Get on with cleanup!," i.e., use available technology and resources now without precluding the use of improved, emerging technology. The principles and values identified by the Task Force are documented in their "Final Report: Hanford Tank Waste Task Force", September 1993. Several of the values identified were

directed specifically at the Tri-Party Agreement or the Tank Waste Remediation System, but they are relevant to broader cleanup issues, including the Spent Nuclear Fuel Project.

Hanford Future Site Uses Working Group. The *Hanford Future Site Uses Working Group* was charged with developing a range of future use options for the Site and assessing their implications on cleanup. The options developed by the Working Group are being evaluated in the *Hanford Remedial Action Environmental Impact Statement*. The Working Group proposed future uses for each of six major geographic areas of the site, identifying cleanup scenarios to describe the cleanliness needed to accommodate those future uses for the area. Values stated were either geographical area-specific, or overall Site recommendations, and are described in the Working Group's Final Report, "The Future of Hanford: Uses and Cleanup," (Drumand et al. 1992).

Of the six areas, two are most directly impacted by the K-Basin remediation. They are the Columbia River itself, its islands and immediate shoreline; and, the "Reactors on the River" (100 Area NPL Site), i.e., the area containing the nine retired plutonium production reactors (100 Areas) and the land in between. For these two areas the Working Group in its final report cites cleaning up contamination affecting the River as an immediate priority. The Working Group also advanced a number general recommendations relevant to the removal of SNF from K Basin.

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The Task Force's key message to the three parties was "Get on with cleanup!" i.e., use available technology and resources now without precluding the use of improved, emerging technology. The principles and values identified by the Task Force are documented in their "Final Report: Hanford Tank Waste Task Force," September 1993. Several of the values identified were directed specifically at the Tri-Party Agreement or the Tank Waste Remediation System, but they are relevant to broader cleanup issues, including the Spent Nuclear Fuel Project.

Because of their obvious mutual interests, the **Hanford Tank Waste Task Force and the Hanford Future Site Uses Wording Group** espouse values having common themes, and can be grouped to better evaluate the overall influence they should have on the activities of the Spent Nuclear Fuel Project. The values relevant to the Project are categorized as follows.

1. Protection of the Columbia River, Groundwater, Environment, and Public

    - Protect the Columbia River

    - Deal Realistically and Forcefully With Groundwater Contamination

- Integrate Natural Resource Protection With Cleanup
- Base Project priorities on protection of the environment and public/worker health and safety and on reduction/elimination of the high-cost of maintaining these facilities.

2. Disposition of Fuel and Wastes

- Use the Central Plateau Wisely for Waste Management
- Transport waste safely and be prepared
- Conserve and reuse resources including contaminated materials that might otherwise be considered wastes, putting them in an environmentally safe and retrievable form
- Let the ultimate best waste form drive decisions, not the timing or location of a repository
- Interim storage of wastes is a reality
- Minimize the amount of wastes and hazardous materials transported to and from the site
- Strive to minimize the creation, volume, and toxicity of waste requiring onsite disposal.

3. Community Participation

- Capture economic development opportunities locally
- Involve the public and tribes in future decisions about Hanford
- Provide public and tribes with information needed to make informed recommendations on cleanup issues
- Implement the concepts contained in the report of EPA's Federal Facility Environmental Restoration Dialogue Committee
- Advise the public and the tribes of progress or problems.

4. Project Management

- Seek full funding to meet Tri-Party Agreement (TPA) milestones
- The Agreement should establish a way to demonstrate accountability for the use of public funds
- The Agreement should promote a sense of partnership and cooperation

- Establish management practices that ensure accountability, efficiency, and allocation of funds to high priority items.

5. Employee Involvement

   - Employees should be informed of hazards and feel free to voice their concerns

   - Training for everyone onsite is critically important and should include emergency response measures.

6. Technology

   - The Agreement should drive the use of the most practical, available technology, leaving room for future innovation

   - Periodic technical reviews should be conducted.

B.4.0 SLUDGE MANAGEMENT

In selecting the preferred Alternative for removal of the SNF from the K Basins, the disposal of the approximately 100 m^3 of sludge which has accumulated from fuel handling operations and oxidation must also be considered. In the K-East Basin the SNF storage canisters are open allowing the oxidation products from the SNF assemblies to fall to the floor, where they have accumulated with other metal oxides and dust from the outside environment up to about 12 in. deep in places. In the K-West Basin, however, the fuel is stored in sealed, water-filled canisters wherein oxidation is presumably still occurring but not free to fall to the floor. The floor of the K-West Basin is, therefore, free of sludge.

The sludge when wet appears as a sandy, muddy material. It consists of corrosion products from the fuel, canisters, storage racks, basin walls, and other materials in contact with the water in the K Basins. From limited analysis of K-East Basin sludge it appears to consist mostly of hydrated iron oxides, hydrated aluminum oxides, some uranium oxide, and a large amount of unidentified acid-insoluble matter, possibly sand or zeolite. The sludge contained in the closed canisters in the K-West Basin has yet to be analyzed, but it is expected to contain higher concentrations of uranium and other oxides, as well as fission product nuclides, than the K-East Basin sludge.

The sludge volume on the K-East Basin floor, including the Sand Filter Backwash and Weasel Pits is estimated to be 50 m^3. The volume of sludge contained in the K Basin canisters is unknown, but based on the assumption that 1% of the total fuel mass in the Basins has corroded, approximately 50 m^3 of sludge is in the K Basin canisters. Thus, the total sludge volume in the K Basins is roughly 100 m^3.

The potential also exists for more sludge to be generated, regardless of the Alternative selected for the Spent Nuclear Fuel Project, as failed fuel will continue to disintegrate during handling, transporting and conditioning. Its presence and the likelihood of more being generated as the SNF is moved is significant to the SNF removal process, and the timing and method employed for its collection, removal, treatment and interim storage must be compatible with the Spent Nuclear Fuel Interim storage plan. The options for management of the sludge areas follows.

- Treat it as SNF, disposing of it accordingly with the SNF assemblies and pieces.

- Treat it as a liquid waste, using the Tank Waste Remediation System (TWRS) to dispose of it; or, as a solid waste, using the Solid Waste Program to dispose of it.

B.4.1 REGULATORY COMPLIANCE

The SNF is managed now in accordance with the Atomic Energy Act of 1954. Management of the sludge as SNF obviates having to consider the different regulatory options for the disposition of the sludge alone. When managed as a waste, however, the question of regulatory authority arises.

The DOE has historically managed SNF (including sludge since it typically contains pieces of SNF) as product material for the recovery of source and special nuclear materials in accordance with the Atomic Energy Act of 1954 and applicable DOE Orders without regard to RCRA applicability. Section 1004(27) of RCRA excludes source, special nuclear and by-product materials from the definition of a solid waste. However, on May 1, 1987 the DOE issued its by-product rule clarifying RCRA applicability to the DOE generated mixed waste. This clarification stated that, "The effect of this ruling is that all DOE radioactive waste which is hazardous under RCRA will be subject to regulation under both RCRA and the Atomic Energy Act" (52 Federal Register [FR] 15937). The question that remains is, if the DOE determined all or only certain SNF types to be waste, would the non-Atomic Energy Act components of SNF be defined as a solid and hazardous waste under RCRA? This same question exists for the issue of sludge by itself, i.e., if the sludge were declared waste (regardless of the SNF), would RCRA then be the regulating authority?

To comply with RCRA regulations, certain cleanup performance levels must be met regarding residual material. To determine whether a facility complies with current RCRA codes and standards, a facility assessment must be performed. RCRA requirements are enforced through a permitting process. Facilities that operate under RCRA do so under a Part B permit which allows them to function as a Treatment, Storage, and Disposal (TSD) facility. Were all the SNF on site declared waste and regulated under RCRA, all facilities that currently store the fuel and sludge would need a Part B permit, including those facilities that still have residual material, such as the spent fuel basins at the eight retired reactors in the 100 Area of the Hanford Site. The Part B permit application process can take up to 3 years or more. While awaiting a Part B permit, a Part A permit must be granted for interim operation.

If the sludge were declared a waste (regardless of the SNF issue) and placed under the authority of RCRA, then the K Basins would require the necessary permits to function as a TSD facility. The Basins would be subject to stringent regulations regarding secondary containment, integrity assessments, and release detection requirements, among others. Irrespective of the unit classification (be it tank systems or a container storage unit), significant documentation is required for any unit used for the management of RCRA regulated SNF, including development of waste analysis, inspection, contingency, training and closure plans. Additional documentation would also be required for treatment of the SNF for storage, including any pilot plant activities. However, if the sludge and/or SNF is indeed determined to be waste, and therefore under RCRA authority, an alternative to RCRA regulation and its attendant stringent regulatory and documentation requirements may be to seek exclusions to RCRA regulation.

A waste pre-determination for chemicals present has been completed on four samples of sludge. Results show that based on chemicals present (excluding radionuclides), the sludge could be classified as a Dangerous Waste under RCRA due to the concentration of cadmium, chromium, and lead (Lipinski, 1994). Again, the pre-determination only evaluated the total metals present in the samples, no tests were done to determine characteristics such as reactivity, corrosivity, toxicity, or ignitability.

B.4.2 SLUDGE RETRIEVAL

Sludge retrieval methods under investigation use the best available technology. Assumptions regarding retrieval options are as follows: (1) the process used for sludge retrieval from the K Basins is independent of the method used for its final disposal, but the retrieval process should not preclude any future final disposal option; (2) retrieval operations will be considered complete when all the sludge in the K Basins has been collected; (3) the sludge will be stored in containers in a "wet" condition; and, (4) no physical or chemical modifier will be introduced to the sludge in the retrieval process. Requirements for sludge retrieval and packaging include the following:

- Maintain criticality control at all times
- Minimize water surface disturbance and sludge dispersion to prevent airborne release of radioactivity
- Minimize turbidity of pool water for operator efficiency
- Minimize operator dose commitment
- Minimize cost of retrieval and packaging
- Minimize quantity of contaminated solids needing ultimate disposal (waste minimization)
- Consider logistics of working around the fuel racks during removal of SNF and sludge, and their final disposition.

B.4.3 SLUDGE DISPOSAL

When considered as SNF and handled in accordance with the methods inherent to the Spent Nuclear Fuel Project Alternative ultimately selected, provisions will be required for retrieval, packaging, transport, processing and storage of the sludge concurrently with the SNF, with the aforementioned constraint that nothing in the sludge processing method precludes any future final disposal option. Retrieval and transport are assumed to be independent of the Spent Nuclear Fuel Project Alternative selected and will likely involve wet vacuuming, and rail or truck transport to the processing point. Again, if considered a SNF then the packaged sludge will be routed to the input of the selected Spent Nuclear Fuel Project Alternative.

When considered as waste, though, the sludge may be routed, apart from the SNF, to the TWRS to await permanent dispositioning through the Vitrification Facility; or, to the Solid Waste Program Facilities. Although, these latter facilities are only proposed.

There are no regulatory or environmental compliance problems associated with sending the sludge to Tank Farms provided the sludge has been characterized and the facility has the appropriate permit. The Tank Farms' permit deals with the current heavy metal codes, and should cover the sludge as well. Per the Tank Farms' Interim Operational Safety Requirements (Interim

Operational Safety Requirements), extensive characterization of the sludge will be required to determine its thermodynamic properties and reactivity, and its compatibility with existing tank contents if it is to be mixed with other waste.

Following retrieval from the Basin floor, the sludge would be packaged and then transported via rail or truck to a double-shell tank for storage, and depending on its characterization, mixed with existing tank waste, or segregated into a separate tank to await final dispositioning into its high- and low-level constituents in the vitrification process.

The planned Vitrification Facility would be the appropriate processing point for high-level waste treatment. Following vitrification, the sludge, in glass form, would be placed into interim storage to await placement in a permanent repository.

A waste receiving and packaging facility may be an alternative to vitrification. It will make either grout or rubber-type blocks (with polyethylene). However, waste receiving and packaging IIA is being designed for treatment of low-level mixed waste, and will probably not accept transuranic (>100 Ci/g) waste. So, the sludge may not be accepted for treatment by waste receiving and packaging IIA. The module planned for mixed transuranic waste is waste receiving and packaging IIB, which is also only proposed. Thus, if the sludge were handled separately from the SNF as a waste, it would be most appropriately routed to TWRS.

B.4.4 COSTS AND SCHEDULES

There is considerable uncertainty in the estimates regarding the character of the sludge and the effort needed for the extensive characterization of it that is required for processing in the TWRS, or by the Solid Waste facilities. The material balance assumes that retrieval operations recover all of the estimated 100 m^3 of sludge in the Basins.

Vitrification--The estimated 100 m^3 (130MT) of sludge would produce 520 MT of glass, requiring 155 canisters sized 2 ft by 15 ft tall.

waste receiving and packaging--Assuming the waste receiving and packaging IIB, or another appropriate facility will immobilize the dried sludge using a grout formulation, 420 MT of solid waste (grouted sludge) in 1,260 55-gal. drums would result.

Sludge Retrieval from the floors of the K Basins is assumed to be the same for all Project Alternatives, i.e., some form of wet vacuuming process, and will not be affected by the means ultimately selected for its disposal.

How it is packaged and subsequently handled, however, may well be unique to the Project Alternative. Design and procurement costs for Wet vacuuming are estimated, as follows:

Vendor design and sludge retrieval equipment, and receptacles for the sludge	$ 14.0 M
Development and evaluation (of vendor design)	2.6 M
Sludge retrieval from the Basins	6.9 M
Total	23.5 M

The cost to send the K Basin sludge as solid waste to the Waste Isolation Pilot Plant is approximately $4.0 M ($3,000/drum) which includes immobilizing/stabilizing and packaging at the Solid Waste Program Facility (waste receiving and packaging IIB, or equivalent) certification, and transportation. There is no cost to the generator for emplacement of the solid waste in the Waste Isolation Pilot Plant due to "direct-funding" by the DOE-Headquarters.

The cost of processing the sludge as high-level waste in High-Level Waste Vitrification could be as high as $200M, depending on its characterization, the most limiting factor in HWVP glass production being the amount of aluminum in the waste (25% limit). The limited sample analyses done to date, however, suggest much less concentrations of Aluminum. The Repository disposal fee will likely vary for different container types. It is estimated that for the 2 x 15 ft. canisters, each containing 1.4 m^3 of vitrified high-level glass, the fee would be $217,000/canister, or for 155 glass canisters, the total Repository disposal fee would be approximately $34M.

However, if characterization demonstrates that all the sludge can be dispositioned by TWRS, and if, again, the amount of aluminum in the sludge is small, so that it may be added to existing tank waste as a "neutral" substance, there would be no appreciable additional cost for sludge treatment (e.g., it could be considered part of normal tank waste treatment).

It is assumed that retrieval of the sludge from the floors of the K Basins will be done concurrently, as much a possible, with fuel removal operations. The schedule for sludge retrieval is estimated at two years, beginning in FY 1998 and completed in FY 2000.

Placing the estimated 100 m^3 of sludge through the Tank Waste Remediation System should have no impact on the Project schedule. And given the uncertainty regarding the availability of the Vitrification or Solid Waste Program waste receiving and packaging IIB Facilities, TWRS may well represent the optimal routing for it. It could also be stored with the SNF until waste receiving and packaging IIB or Vitrification could receive it. For management of the sludge along with the SNF, the 130 MT of sludge added to the 2,100 MT of fuel represents a 6% increase in total material to be taken into account when designing processing and/or storage facilities.

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APPENDIX C

DESCRIPTION OF PATH FORWARD ALTERNATIVES

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C.1.0 ALTERNATIVE 1 DESCRIPTION

C.1.1 PATH TECHNICAL DESCRIPTION

This Alternative for the expedited removal of N Reactor fuel and sludge currently stored in the K Basins is based on overpacking the fuel stored in the K-East Basins and storing the overpacked and encapsulated fuel within the K Basins until a fuel stabilization and interim storage system are available. The fuel stabilization process is based on repackaging and passivation of the fuel in the fuel stabilization facility. The repackaged/passivated fuel is then transferred to an interim storage facility which is based on a vault storage concept. Figure C-1 provides a process flow diagram of the Alternative 1 path. With reference to Figure C-2, the following activities constitute the functional logic:

- The fuel, sludge and debris in the K Basins are characterized (1.0)
- The fuel in K-West Basin is maintained in the current closed canisters for storage and eventual shipping to the fuel stabilization facility (2.0, 3.0).
- K-East Basin fuels is placed in a new design overpack without removing the fuel from the open-top canisters (2.0, 3.0).
- Sludge is accumulated and placed in containers of similar design to the overpacks used for the K-East Basin fuel (2.0, 3.0).
- Debris is accumulated, compacted and packaged as solid waste (2.0, 3.0)
- The containerized fuel is shipped using existing cask cars (with upgrades) to a newly constructed passivation facility (11.0)
- The fuel and sludge are passivated (14.0)
- The K Basin water is treated (8.0)
- The interim dry storage facility is designed and constructed (17.0, 18.0)
- The passivated, repackaged fuel is placed in storage until final dispositioning (20.0).

Design of Temporary Storage Facility (4.0), Construction of Temporary Storage Facility (5.0), Transport Fuel and Sludge to Temporary Storage Facility (7.0), Store Sludge (9.0), Store Fuel (10.0) are not functional parts of the Alternative 1 path as indicated by the dotted-line blocks, Dispose of Generated Waste (15.0), and Decontaminate and Decommission Facilities (16.0), are common to all alternatives.

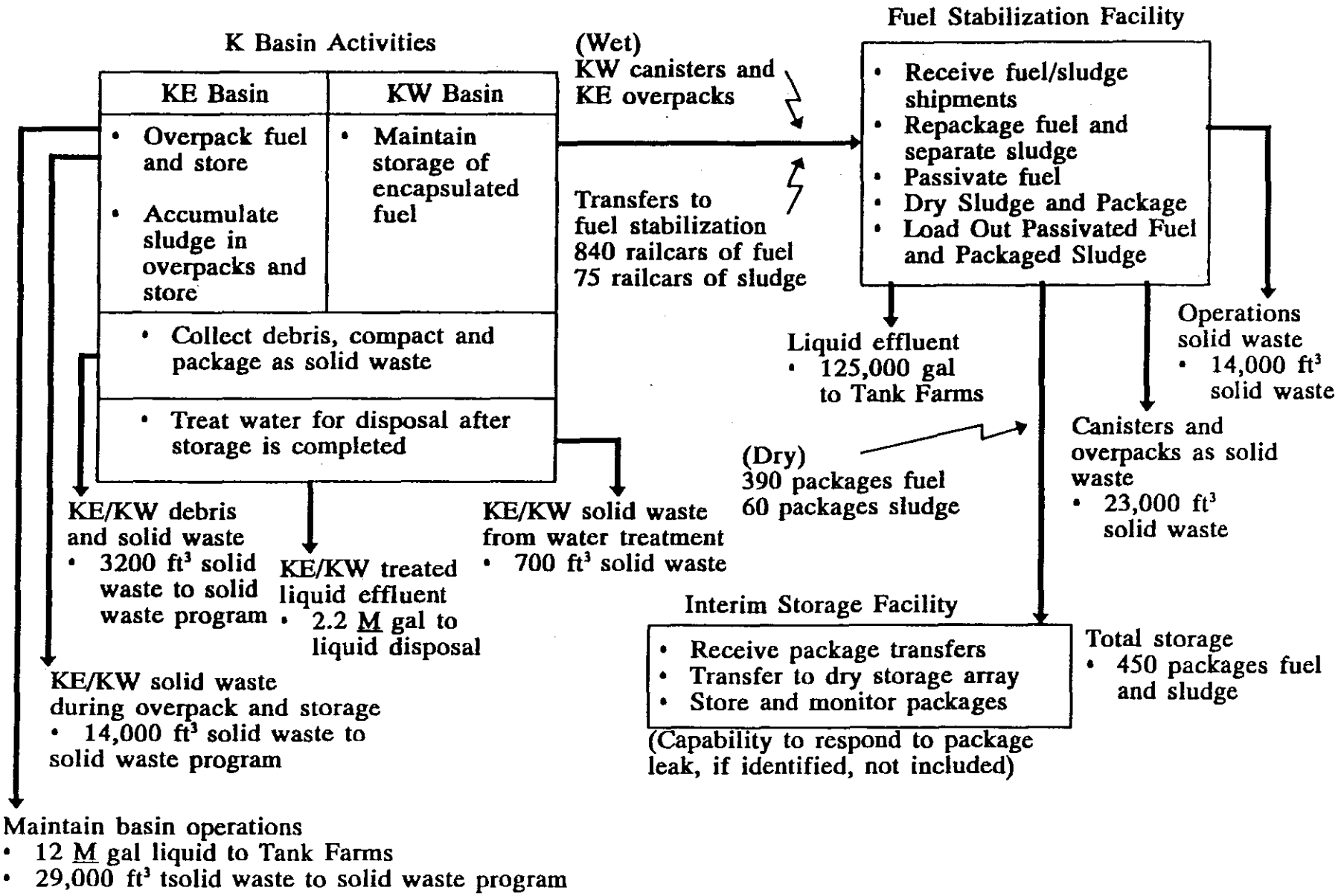

Figure C-1. Path Forward Alternative 1 - Process Flow Diagram and Mass Balance.

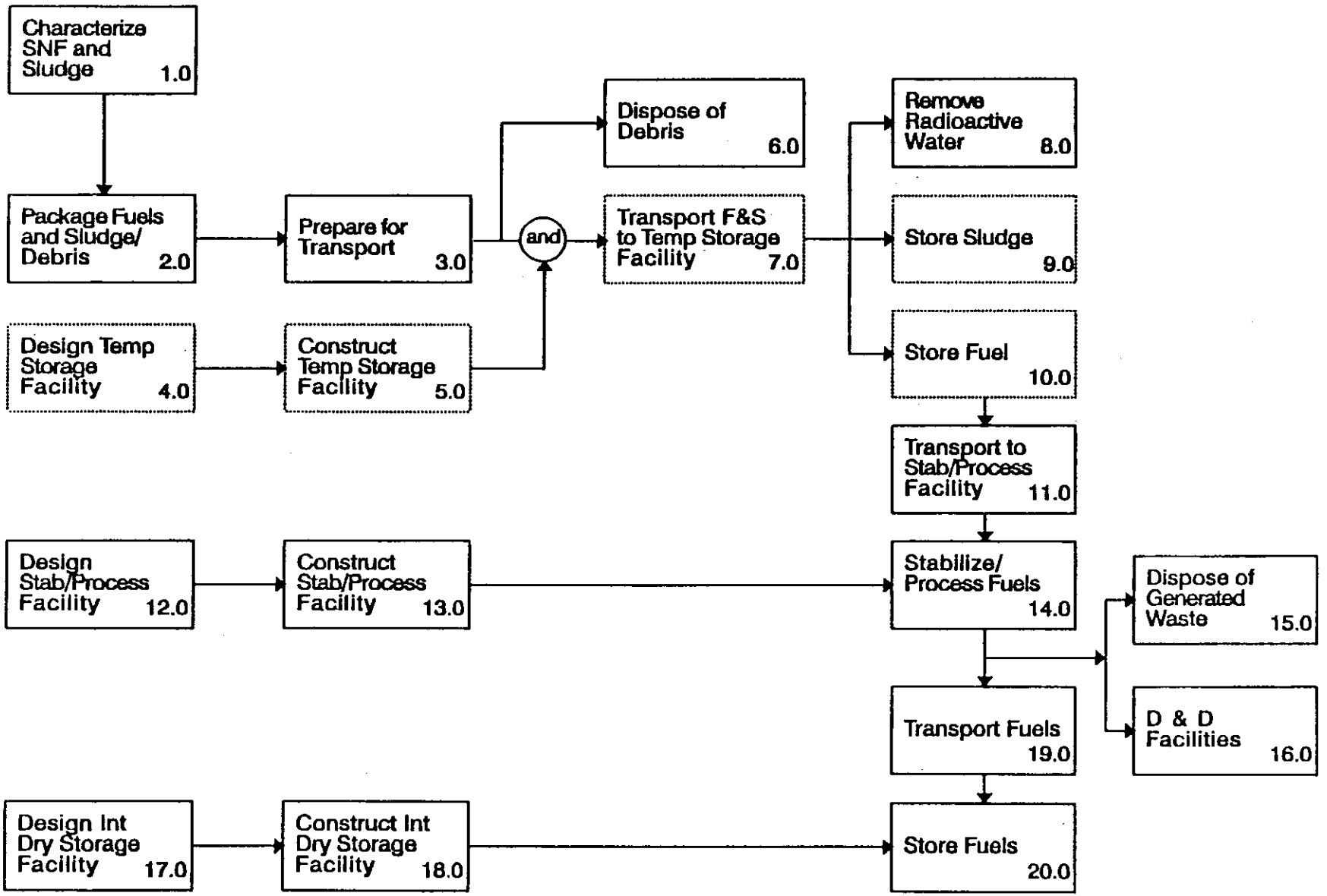

Figure C-2. Path Forward Alternative 1 - Functional Flow Block Diagram.

C.1.1.1 Fuel and Sludge Characterization

Characterization is required of the previously containerized fuel in K-West Basin, the fuel in K-East Basin, which is in open containers and therefore, exposed to basin water, and the sludge on the K-East Basin floor.

C.1.1.2 Fuel and Sludge Containerization

The fuel in K-West Basin is to be maintained in the current closed canisters for storage and shipping to the fuel stabilization facility. K-East Basin fuel is to be placed in a new design overpack without removing it from the open-top canisters. Sludge is accumulated and placed in containers of similar design to the overpacks used for the K-East Basin fuel. Debris is accumulated, compacted and packaged as solid waste.

Encapsulation is an alternative option to the described overpacking. Encapsulation would retrieve K-East Basin fuel from the open canisters and repackage it into closed canisters containing a dilute potassium nitrite solution with a nitrogen filled gas space above it which is vented to the basin pool through a diving-bell gas trap. Encapsulation is labor intensive so there are as low as reasonably achievable (ALARA) concerns; and, it is likely to introduce considerably more sludge material into the Basin water.

C.1.1.3 Transportation

Once the fuel and sludge are packaged, the preparations for transport are primarily limited to upgrading the cask and railcar system. The transport system is based on upgrading the existing K Basin cask and railcar system to provide a degree of safety equivalent to 10 CFR 71 performance requirements and co-located in the 200 Area. The cask assembly would be modified to meet design requirements for confinement, and the SARP upgraded.

The existing system that interfaces with the K-East and K-West Basins consists of the 50 ft, 200-ton capacity Three Compartment Railcar capable of carrying three K Basin Casks in individual water filled cooling wells. The railcar is equipped with hinged doors over the wells actuated by a hand wheel-operated mechanism. The doors help to contain the water in the wells but do not seal. There are two cask cars currently available for service. These cask cars have none of the containment features now required for onsite casks, or 10 CFR 71 certified casks. It is assumed that the casks would be modified and approved through the onsite SARP process.

C.1.1.4 Interim Wet Storage

Modifications to the existing K Basins are required to support interim wet storage of the encapsulated fuel and sludge until the passivation facility becomes operational. Identified facility deficiencies include seismic resistance, and utilities and service system deficiencies (electrical distribution, fire protection, etc).

In addition to modification of the existing K Basins to correct identified deficiencies, the 105 K-East Basin must be modified to allow loading, storage, and movement of overpacked fuel/containerized sludge. These modifications would include: (1) removal of fuel storage racks (as they are emptied), (2) installation of equipment to overpack fuel, (3) installation of equipment to retrieve and containerize sludge, (4) upgrades to fuel movement system including hoist replacement and potentially monorail upgrades, and (5) potential upgrades to basin load out system to allow overpacked fuel/ containerized sludge to be loaded into new or modified casks.

C.1.1.5 Processing and Stabilization

The facility for repackaging, drying and passivating fuel would provide the capability to prepare fuel sufficiently to meet requirements for 40 year interim storage (assuming a 20 year license, with 20 year renewal) at a Nuclear Regulatory Commission licensed facility. Encapsulated fuel and sludge would be retrieved from current K Basin storage and transported to the fuel repackaging and passivation hot cell facility, stabilized, and transferred to the storage facility. The major process functions are shown on the attached block flow diagram, Figure C-3. A schematic of this repack and passivate facility is also shown in Figure C-4. A description of the process steps follow. Note that while the described process steps apply to either FMEF or a new hot cell facility, FMEF would specifically utilize its Shipping and Receiving Bays, Entry Tunnel and Transporter, plus a new floor supported cart.

Receive Fuel. Casks of fuel, loaded in existing basin loading pits using current procedures, are brought to the fuel stabilization hot cell via the existing well car, or a new cask transport system. The shielding plug on the load-in compartment of the hot cell is removed with an overhead crane and the crane then lifts the cask into the hot cell and replaces the shield plug. An in-cell crane removes the cask lid and the canisters of fuel for stabilization.

Pretreat Fuel. Actual fuel stabilization is started by dumping fuel from the existing canisters into trays in fuel pre-treatment tanks. The fuel pretreatment tanks hold the fuel in an air sparged hot (80 °C) water environment. Fuel pre-treatment cleans the fuel, removing loose particulate from the fuel for processing in the sludge stabilization system. Fuel pre-treatment also holds the fuel in an oxidizing water environment for sufficient time to allow significant oxidation of uranium hydride that may have been formed in closed canisters. The trays of fuel are removed from the pretreatment tanks and the fuel elements are picked up individually and placed vertically into a new can at one or two can loading stations. The can is designed to prevent damage to the fuel during transport, which would increase its reactivity, during fuel movement of transportation. When the cans of fuel are filled a mechanically sealed lid is installed and leak-checked to confirm that the seal is adequate for vacuum drying and passivation.

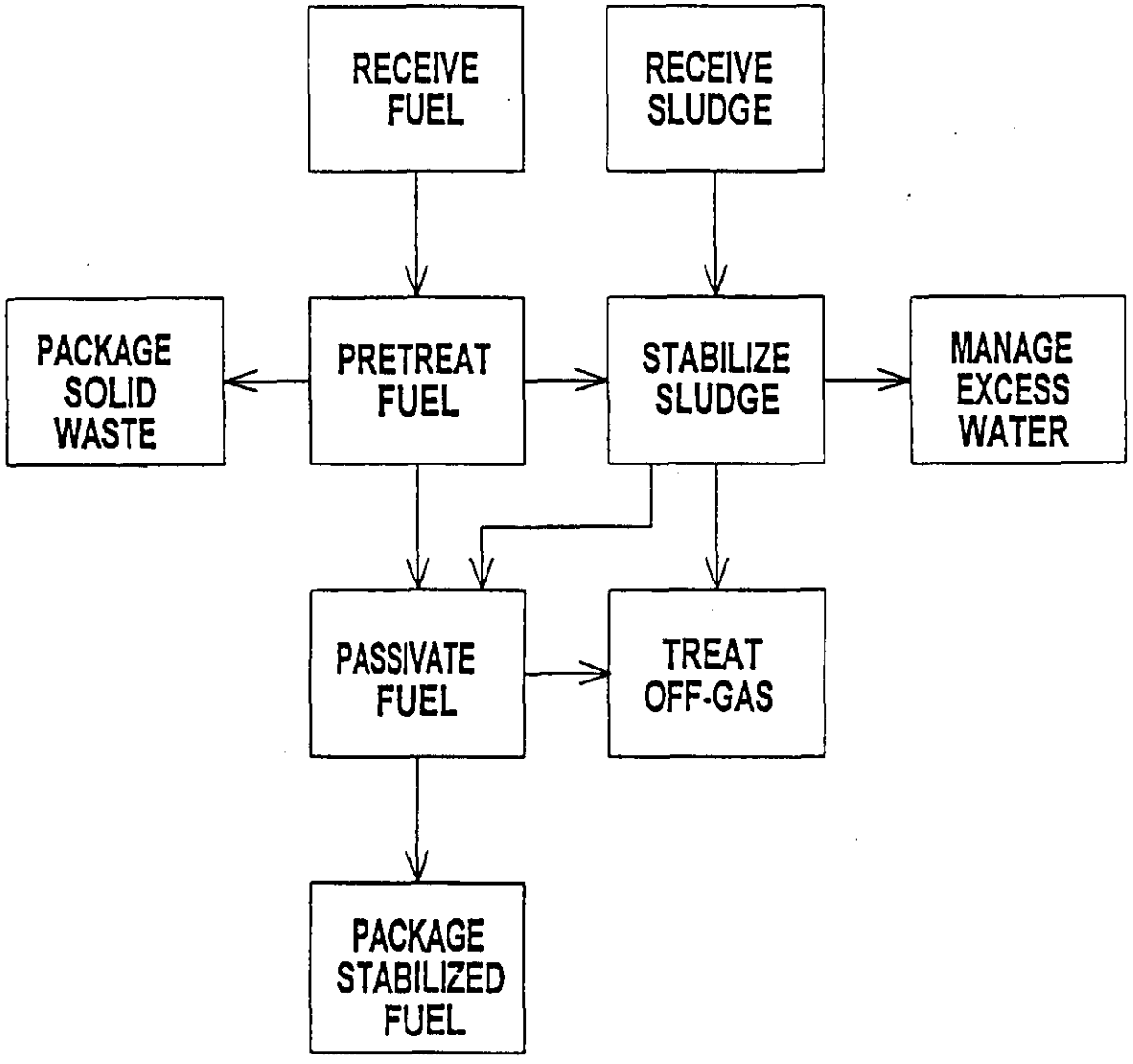

Figure C-3. Path Forward Alternative 1 - Passivation Block Flow Diagram.

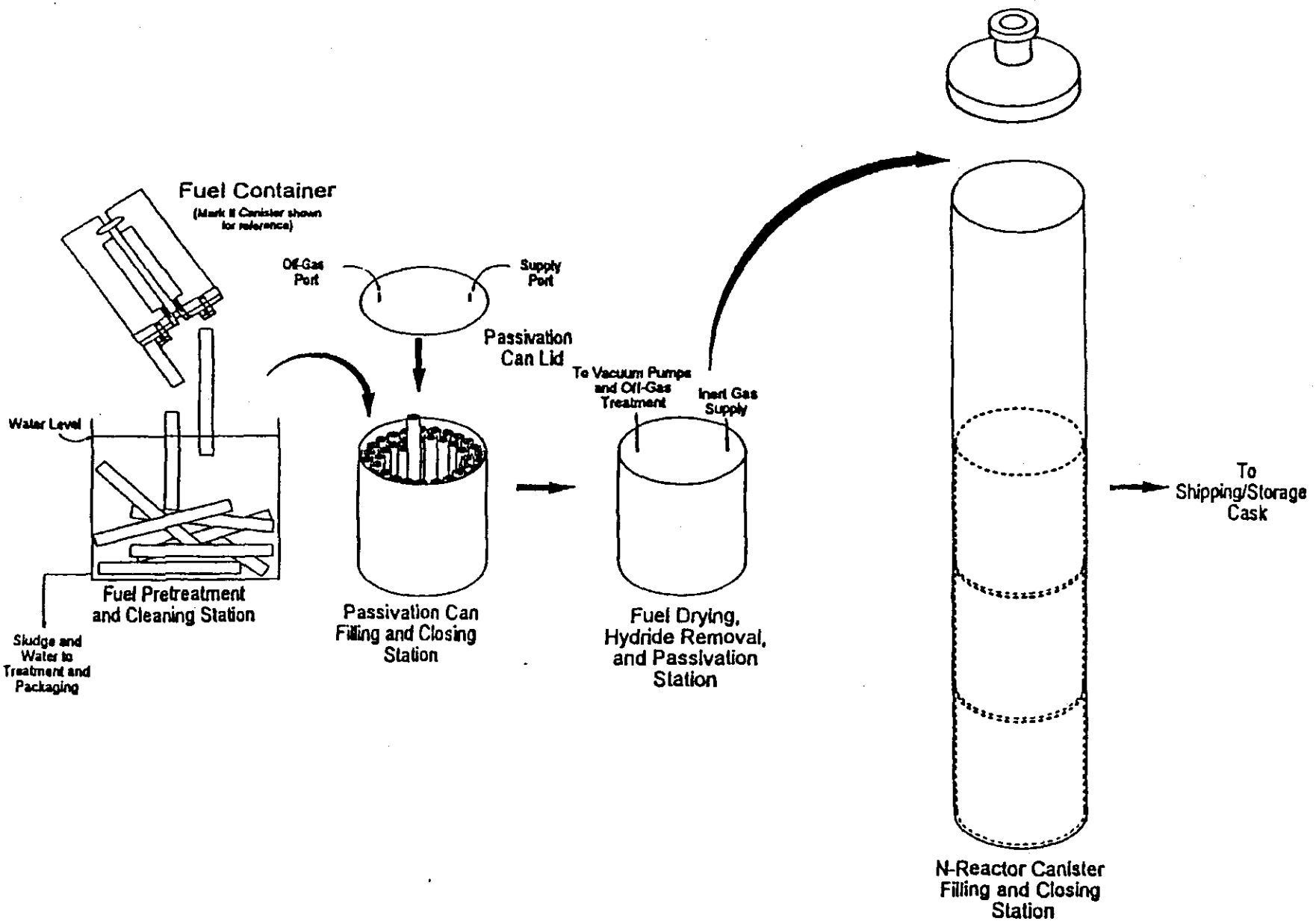

Figure C-4. Path Forward Alternative 1 - Passivation Process Schematic. (sheet 1 of 2)

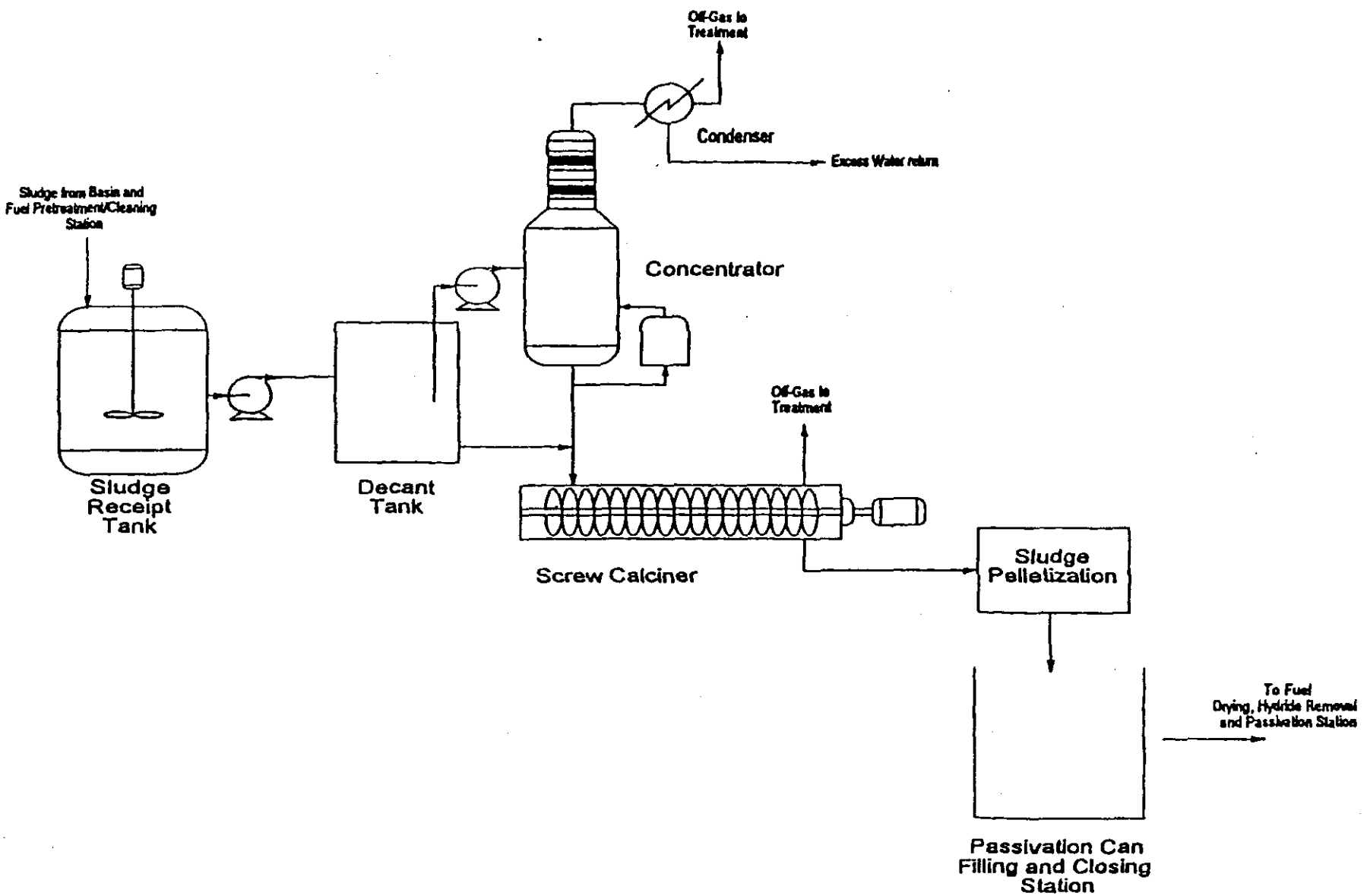

Figure C-4. Path Forward Alternative 1 - Passivation Process Schematic. (sheet 2 of 2)

Passivate Fuel. The sealed can of fuel is then placed into one of 10 fuel drying and passivation stations where the fuel is conditioned over a period of 30 hours. The can of fuel is first vacuum dried via a roughing vacuum pump (about 20 mm Hg) at ambient temperature to remove surface water from the fuel. The fuel is then heated to about 150 °C under vacuum and held at that temperature to drive off any interstitial water, water that is bound by hydration, and water that may be adsorbed on oxidized surfaces of the fuel. With the majority of the water removed from the fuel a high vacuum system (<5 mm Hg) is valved into the conditioning station and the fuel temperature is raised to about 280 °C. The fuel is held at this temperature and pressure to release hydrogen from the fuel by converting uranium hydride to uranium metal. When the hydride reduction is completed the fuel is allowed to cool down to about 180 °C, the vacuum system is isolated and a flow of dry inert gas is started through the canisters of fuel. Small amounts of dry air are metered into the flowing inert gas stream to allow controlled oxidation of any highly reactive sites on the fuel. The fuel temperature and off gas parameters are closely monitored to ensure that the fuel is not reacting at an excessive rate and to allow determination of the completion of fuel passivation. When the process instrumentation indicates that the fuel passivation is completed, the can of fuel is back-filled with dry inert gas, cooled down, and its off gas ports are mechanically sealed.

Receive Sludge. Along with solid rods of fuel, a significant portion of the SNF inventory has corroded and is in the form of sludge. A significant portion of which will enter with the fuel inside the fuel canisters and overpacks. The remainder of the sludge will be collected, containerized at the basin, and loaded into the hot cell in containers similar to the 105 K-East Basin overpacks. This sludge will also contain non-fuel particulates (mostly iron, aluminum, and silicon oxides) which will be stabilized along with the fuel. The containerized sludge from the Basins, overpack water containing sludge from movement of open canisters of fuel, and water bearing sludge from the fuel pre-treatment tanks are transferred to a sludge receipt tank.

Manage Excess Water. Sludge and water from the sludge receipt tank are transferred to a decant station where it is allowed to settle. After the majority of the sludge has settled, water with a residual amount of suspended sludge is decanted to a small concentrator. Any other water used in the hot cell for equipment flushes, waste cleaning etc. is also routed to this small concentrator. Water boiled off in the concentrator is then condensed, and collected along with water removed via the fuel passivation station, and sludge calciner off gas condensers. This excess water is then collected and batch transferred to existing 200 area liquid effluent disposal systems.

Stabilize Sludge. The concentrator bottoms containing higher levels of suspended sludge are slowly bled off to a sludge calciner along with the partially de-watered sludge from the decant station. In the sludge calciner water associated with the sludge is boiled off, and the temperature of the sludge is raised sufficiently to allow complete conversion of fuel in the sludge to a stable oxide. The stabilized sludge leaving the calciner is then combined with a binder and extruded into "green pellets" the pellets of stabilized sludge are loaded into cans which are then placed into a fuel conditioning station and sintered. The can of dry sintered sludge pellets is sealed and packaged in along with sealed cans of passivated fuel.

Package Stabilized Fuel. Sealed cans of passivated fuel are weighed, assayed and transferred into the bottle filling station via an air lock. The can is placed into a specially designed container. When five sealed cans of fuel are placed in the canister a lid is placed on the canister. The canister is then purged, filled with dry inert gas, and the lid is welded shut. After verification of weld integrity, the canister is transferred, via an airlock, into a commercial fuel transportation cask. After the sealed can(s) are placed in the cask, a shielding plug and seal plate are inserted into the cask. An automatic welding machine is remotely fitted to the cask, the seal plate is welded and the cask is filled with inert gas. The weld is inspected with a weld-following sniffer and a moveable remote camera. A second seal plate is then welded in place and inspected. The stabilized fuel transport cask is then removed from the hot cell and placed onto a survey/ decontamination area near the hot cell. The filled cask is surveyed and any non-fixed contamination is removed. The fuel passivation cycle is completed when the cask is placed on the rail car for transfer to the storage site.

Treat Off Gas. Off gas from the fuel pretreatment tanks, sludge calciner, concentrator, and fuel conditioning stations individually pass through in cell condensers where water is removed and routed to the excess water collection system. The off-gas then passes through in-cell metal HEPA filters, leaves the hot cell, passes through conventional HEPA filters and is routed to process off-gas blowers or vacuum pumps as appropriate. The off gas leaving the blowers or vacuum pumps is combined with the hot cell exhaust. This gaseous effluent stream is filtered, sampled and discharged via a new stack. Because only a small amount of fuel will be converted from a metallic form to an oxide form (which releases volatile radionuclides trapped in the metallic fuel) no active system is needed to remove volatile or inert gaseous radionuclides.

Package Solid Waste. Solid waste enters the hot cell with the fuel in the form of used canisters, sludge containers and overpacks. This waste is cleaned at a cleaning station is assayed and then returned to the cleaning station for additional cleaning, or is sent to the waste size reduction area. The cleaned and compacted canisters, sludge containers, and overpacks are then staged for removal from the hot cell via the waste removal station. Hot cell operation will generate a significant amount of waste as a result of equipment failures, and manipulator maintenance debris. This waste is compacted as necessary, cleaned of fuel as necessary, assayed and characterized. This waste, along with the compacted canisters, sludge containers, and overpacks are placed into containers and loaded out through the waste load out station. When these waste containers are removed from the hot cell, preparation for disposal is completed, and they are transported to solid waste for disposal.

C.1.1.6 Interim Dry Storage

A dry vault storage facility was selected as the interim storage system for each Alternative. This facility consists of metal tubes arranged vertically in a below grade concrete structure enclosed by an above grade, precast concrete structure. Natural convection is used for cooling the packages of fuel which is stored in the metal tubes.

C.1.2 REGULATORY COMPLIANCE ISSUES

Chapter 3, Sections 3.1.1 and 3.1.2, and Appendix B, Sections B.1.0 and B.2.0 discuss the applicable requirement of the NEPA, RCRA, and CAA.

The facility ultimately selected for the pre-interim wet storage function must comply with current DOE facility design and operating criteria. Alternative 1 recommends using the K Basins which would require a detailed code and standards compliance analysis to assure compliance or equivalency to current and emerging design and operating criteria. Any identified non-compliant features will require dispositioning.

Furthermore, it must be assured that Alternative 1 schedules could meet the Tri-Party Agreement milestone (M-34-02), for removing the SNF from K Basin, to be established by June, 1996.

C.1.3 GENERAL ISSUES/RECOMMENDATIONS

C.1.3.1 Initial Fuel State

The condition of the SNF in the 105 K Basins is not well known. Visual inspections are currently underway and additional characterization data will be gathered in the near term. Characterization needs now may be driven more by transportation system qualification than any other attribute. The extent of uranium hydride formation is a significant design issue.

Records and earlier, less comprehensive visual inspections, indicate some damage to at least 6 to 12% of the elements. Damaged fuel elements being defined as those having observable corrosion products. In addition, the cladding on an unknown number of elements may be cracked such that the element can be considered broken.

C.1.3.2 Fuel Corrosion and Reactions

Uranium metal in those fuel elements that have breached cladding will oxidize after contact with water and generate corrosion products. Uranium oxide and hydride products formed from these reactions will cause swelling of the metal within the cladding, which can cause additional cladding damage and even complete severing of fuel elements. Any additional uranium metal exposed will oxidize as well creating a perpetual cycle of cladding damage and uranium oxidation. Ultimately, the uranium completely oxidizes and forms sludge. The free hydrogen created by these oxidizing reactions is released into the surrounding water.

One of the major issues with the failed metallic fuel is that uranium and zirconium metals are chemically reactive in both water and air. Their reactivity can be increased by a number of factors, including the amount of metal surface area in contact with air and water, temperature, and the presence of alloys and impurities. In particular, small pieces of these

metals are more reactive than large pieces and, under the right conditions, are pyrophoric. Consequently, precautions are required when handling or processing uranium and zirconium metals.

C.1.3.3 Issues Pertaining to the Proposed Regulatory Strategy

NEPA strategy includes proceeding with design and construction at risk in parallel with the NEPA process.

CAA requires a permit prior to start of construction. Application for the permit should start immediately. WHC should work with the DOE, the State of Washington, and the EPA early to determine which pre-construction activities can be performed in parallel with the permit application.

C.1.4 ESTIMATED COST AND SCHEDULE

Cost estimates and implementation schedules for Alternative 1 are presented in Chapter 5, Section 5.2, "Cost and Schedule Data."

C.2.0 ALTERNATIVE 2 DESCRIPTION

C.2.1 Path Technical Description

Alternative 2, which allows for the expedited removal of N Reactor fuel and sludge currently stored in the K Basins, involves utilization of a pre-Interim wet storage location on the Hanford Site. This study concluded that it is feasible to relocate the fuel and sludge to another facility, on a schedule considerably shorter than Alternative 1, the current "reference" Alternative. The options attendant to this "pre-Interim Wet Storage" Alternative involve the fuel and sludge containerization, the on-site transport logistics, and the storage facility itself. A process flow block diagram for Alternative 2 is given in Figure C-5.

The Alternative 2 study considered the process functions and related options necessary to realize the expeditious transfer of the fuel and sludge from the 105 K Basins to another, existing, on-site wet storage facility. These process functions attendant to Alternative 2 are listed below with reference to the process function number in Figure C-6, "Path Forward Alternative 2 Functional Flow Block Diagram":

- Characterize fuel, sludge, and debris (1.0)
- Package Fuels and Sludge/Debris (2.0, 3.0)
- Design Temporary ("pre-Interim") storage facility (4.0)
- Construct Temporary ("pre-Interim") storage facility (5.0)
- Disposal of debris (6.0)
- Remove the containers from the Basins and Transport Fuel and Sludge to another, existing, "pre-Interim" wet storage facility on the Hanford Site (7.0)
- Remove Radioactive Water in the K Basins to an on-site treatment facility (8.0)
- Store the fuel and sludge in pre-Interim storage (9.0, 10.0)
- Transfer the fuel to the stabilization and processing facility (11.0)
- Design and construct the stabilization/process facility (12.0, 13.0)
- Passivate the fuel (14.0)
- Design and construct the Interim Dry Storage Facility (17.0, 18.0)
- Dispose of generated waste (15.0)
- Store fuel and sludge product in interim storage (20.0)
- Decontaminate and Decommission facilities (16.0).

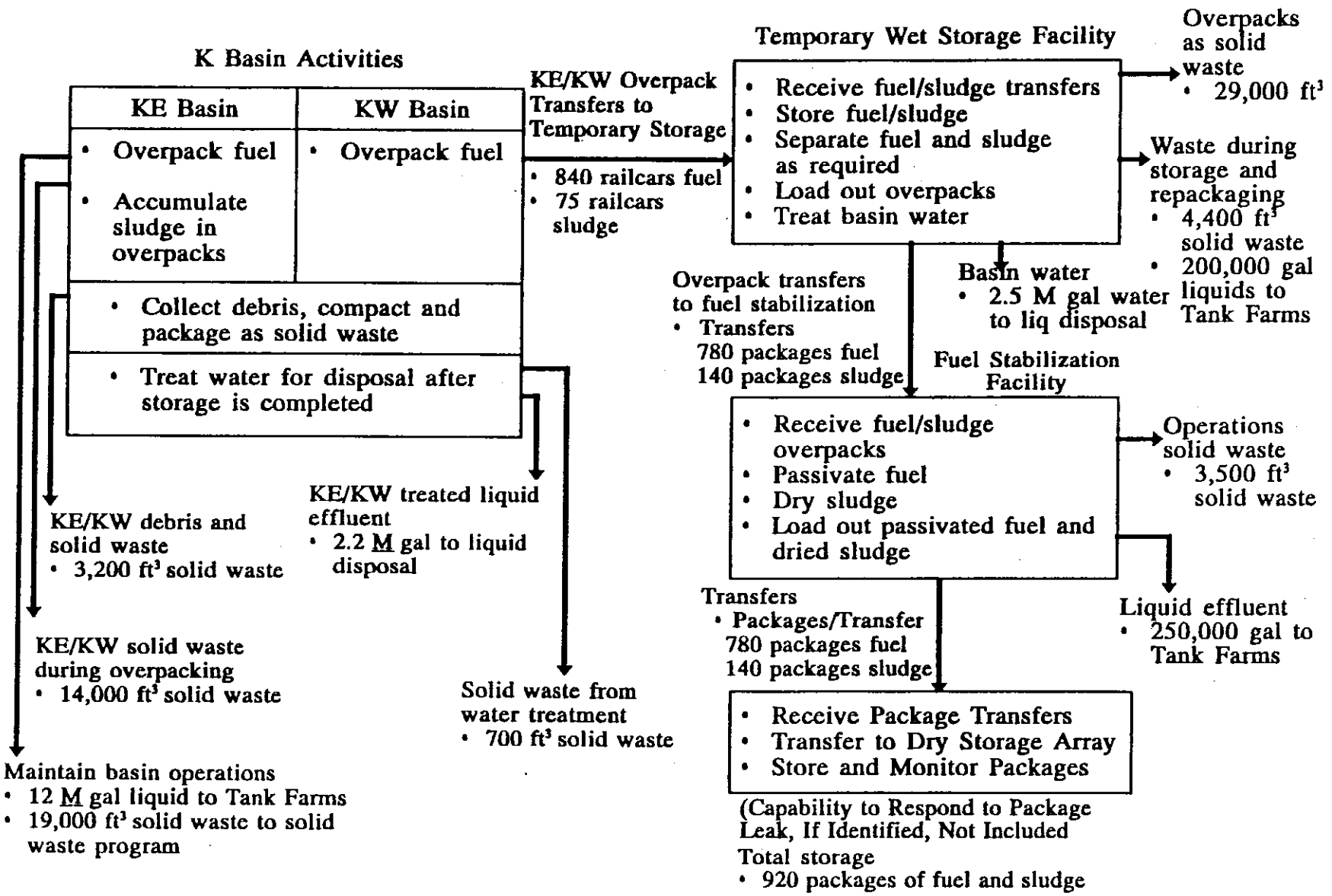

Figure C-5. Path Forward Alternative 2 - Process Flow Diagram and Mass Balance.

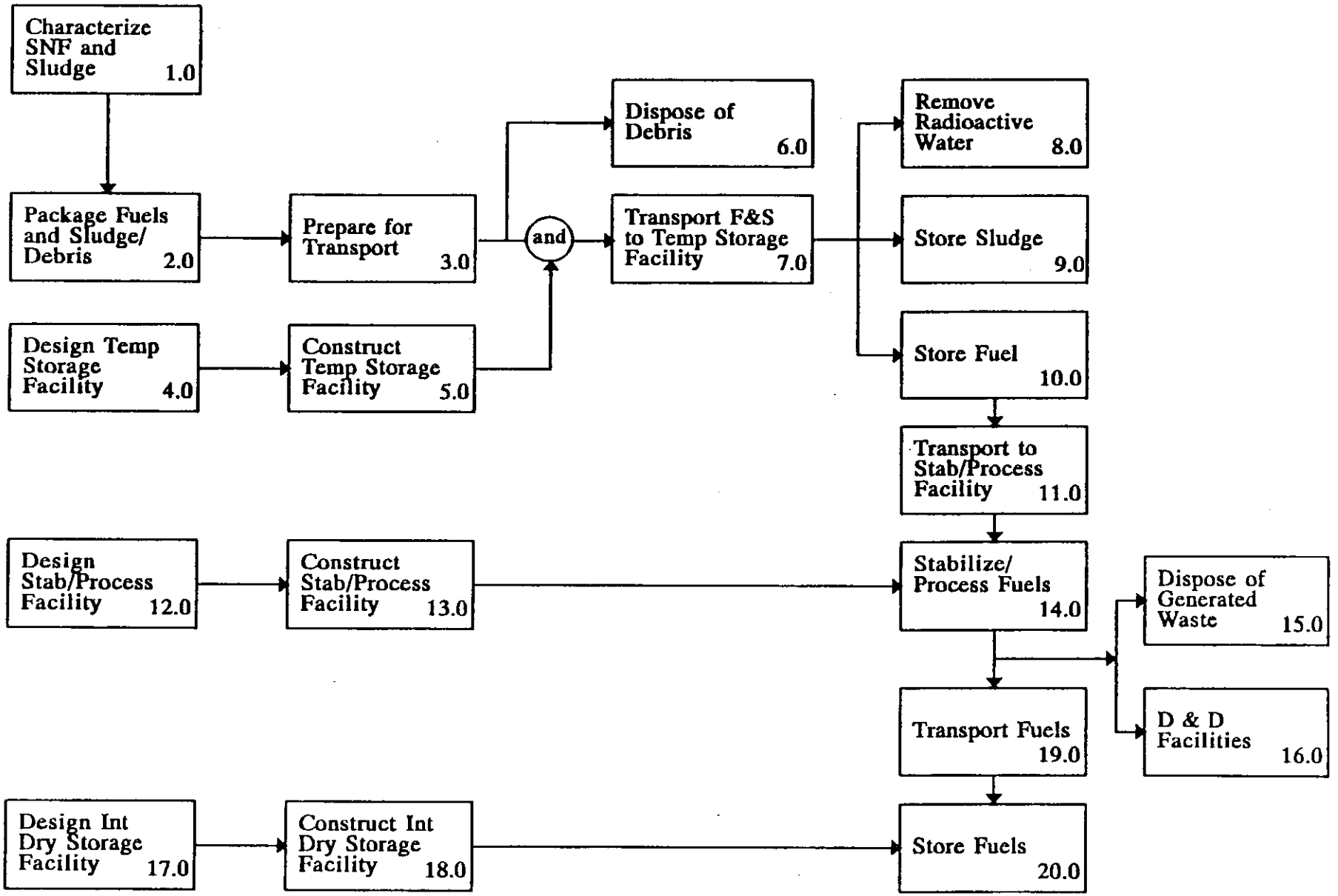

Figure C-6. Path Forward Alternative 2 - Functional Block Diagram.

C.2.1.1 Fuel and Sludge Containerization

The fuel encapsulation process utilized previously in the K-West Basin, and overpacking are two means evaluated for placing the K-East Basin fuel and sludge into wet pack containers. Encapsulation would retrieve K-East Basin fuel from the open canisters and repackage it into closed canisters. The closed canisters would contain a dilute potassium nitrite solution with a nitrogen filled gas space above it which is vented to the basin pool through a diving-bell gas trap. This process is labor intensive so there are ALARA concerns; and, it is likely to introduce considerably more sludge material into the basin water.

Wet overpacking places the existing fuel canisters, undisturbed, directly into larger stainless steel storage containers as shown in Figure C-7. As currently envisioned, three open canisters are placed in a single overpack which will be provided with the requisite sealed closures and gas trap vents. At issue with the concept of overpacking is that the overpacks do not exist, nor even does an approved design. Regarding handling, overpacking also represents ALARA concerns given that the containers are to be loaded underwater, and in the K-East Basin they will become surface contaminated. Further, it may be difficult and dose intensive to provide a transportation quality seal on an overpack assuming that it must be underwater within the basin while being sealed.

Debris is accumulated, decontaminated, compacted and packaged as solid waste.

C.2.1.2 Transportation

The use of existing K Basin casks and the cask rail cars originally designed to transport irradiated fuel from N Reactor to an onsite reprocessing facility is assumed. The casks interface with the load-out facilities in the K Basins and are sized to contain three fuel canisters. The railcars can carry three casks in individual water-filled cooling wells. They have hinged doors over the wells that help to contain the water in the wells but do not completely prevent water spillage. Two such cask cars currently exist in good condition.

The SARP for the K Basin Cask (SD-RE-SAP-014) must be updated prior to commencing these shipments since the proposed payload is not as described in the current SARP payload description. Also, the cask QA documentation must be reviewed to assure compliance. Finally, since the packaging system has few of the containment features currently required for either onsite casks or 10 CFR 71 (offsite) certified casks, it is assumed that cask modifications will be designed and approved by an onsite SARP (per 5480.1); and, if the packaging system ultimately does not meet 10 CFR 71, public access to the transportation route during transport will be controlled.

There are other licensed casks which could be used. Several are described in WHC-SD-TP-ES-001, "Engineering Study of the Transfer of Irradiated Fuels on the Hanford Site." In each case, the packaging SARP will need to be revised to address the K Basin material payloads.

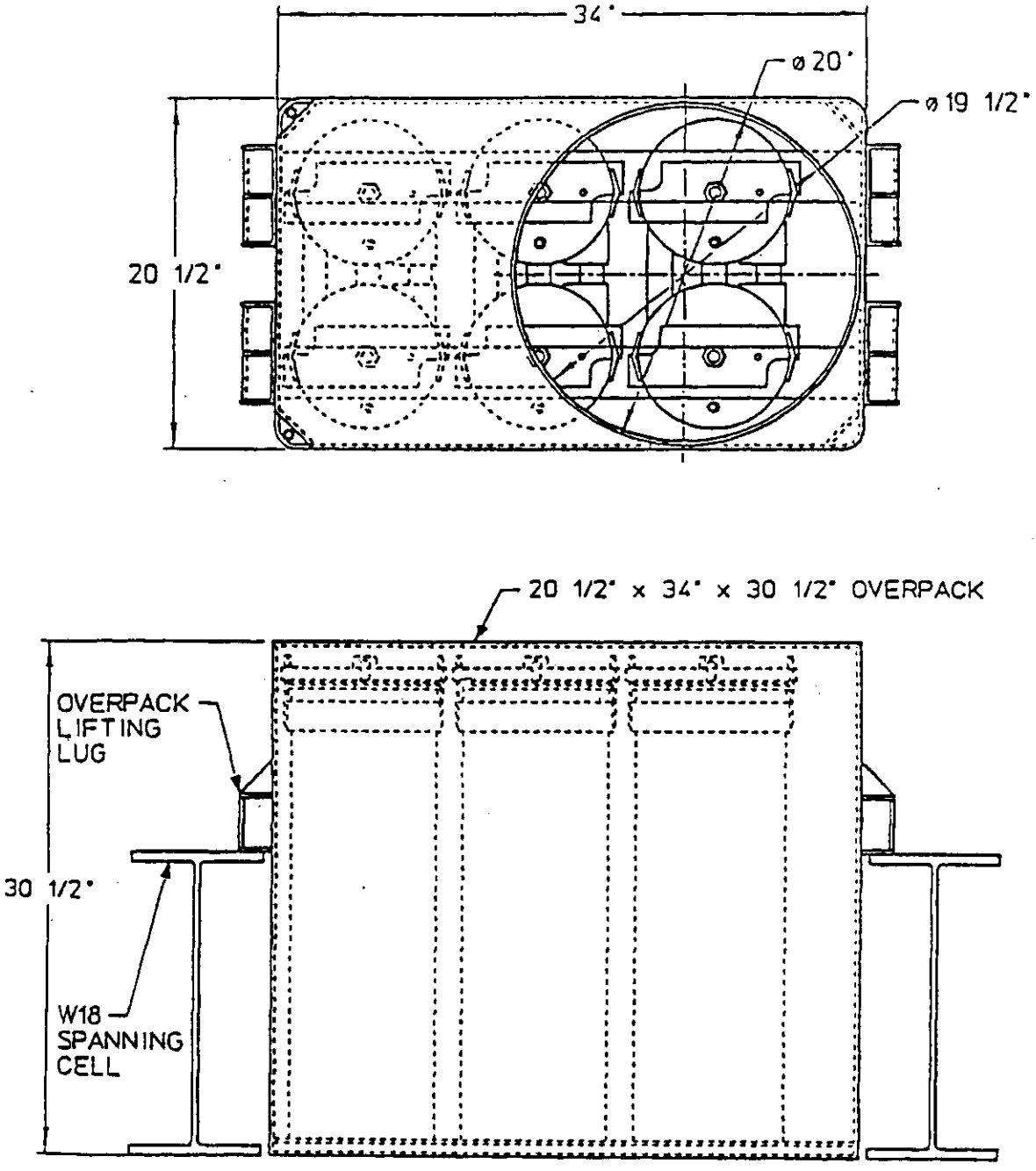

Figure C-7. Path Forward Alternative 2 - Overpack Concept.

C.2.1.3 Pre-Interim Wet Storage

Three existing onsite wet storage facilities were considered for modification and use for pre-Interim wet storage of the fuel and sludge removed from the K Basins. They are: FMEF, the Washington Public Power Supply System WNP-4 spray pond, and an unused canyon facility in the 200 Area, such as PUREX. Existing facilities were considered as a means to reduce the overall schedule. An entirely new facility proposed for the 200 East Area was also studied.

The Fuels and Materials Examination Facility. The FMEF was originally designed and constructed to support the U.S. Breeder Reactor Program. All facility functions are installed and operable, and the building is uncontaminated, facilitating modification. An additional one-half mile of railway would be needed to connect it to the Hanford rail system. FMEF is seismically qualified (circa 1980) and the ventilation system is Safety Class 1 (SC-1).

Two FMEF options were considered. The first places all containers within the cells inside the facility for pre-Interim storage; and, the second places the containers in a newly constructed pool adjacent to the facility (shown in Figure C-8), with the FMEF being used for subsequent conditioning of the fuel prior to interim storage. The first option, in-cell pre-Interim storage, is regarded as unattractive because of the limited storage capacity within FMEF, the logistics of the proposed storage arrangement, handling and monitoring, and the uncertainties imposed by the additional structural and seismic loadings. Thus, the second option is recommended should the FMEF be utilized for pre-Interim storage.

A new, covered, pre-Interim storage pool, located at the east end of FMEF close to the Entry Tunnel extension, would be constructed with water tight concrete walls and floor fitted with waterstops at all joints, and lined with 1/4-in. thick stainless steel plate. The pool would have complete crane coverage for in-pool transport of the overpacks with provisions for spacing and seismic constraint of the overpacks (see Figure C-9). Provisions for water cleanup, and monitoring the overpacks for leakage, as well as for any repair or repackaging of overpacks would also be included. The pool, its confinement building and the related support equipment and building would be Safety Class 1, per the current revision of Hanford Plant Standard Seismic Design Criteria 4.1. The requirements for the storage of the K Basin fuel were established in a 1993 study (WHC-SD-NR-010, Rev. 0).

The Washington Public Power Supply System WNP-4 Spray Pond. The WNP-4 spray pond is an existing, seismically qualified reinforced concrete structure originally built as the ultimate heat sink for the canceled Washington Public Power Supply System WNP-4 commercial reactor. It is located within the Supply System security perimeter so Washington Public Power Supply System site services are available, as well as rail access within 900 ft. The capabilities of a pre-Interim storage facility utilizing the WNP-4 Pond would be similar to that described for the FMEF concept. The modifications necessary involve reducing its current capacity by approximately two-thirds by means of a seismically-qualified wall, installation of a rail spur to the pond and terminated within a fuel handling bay, and all other provisions as

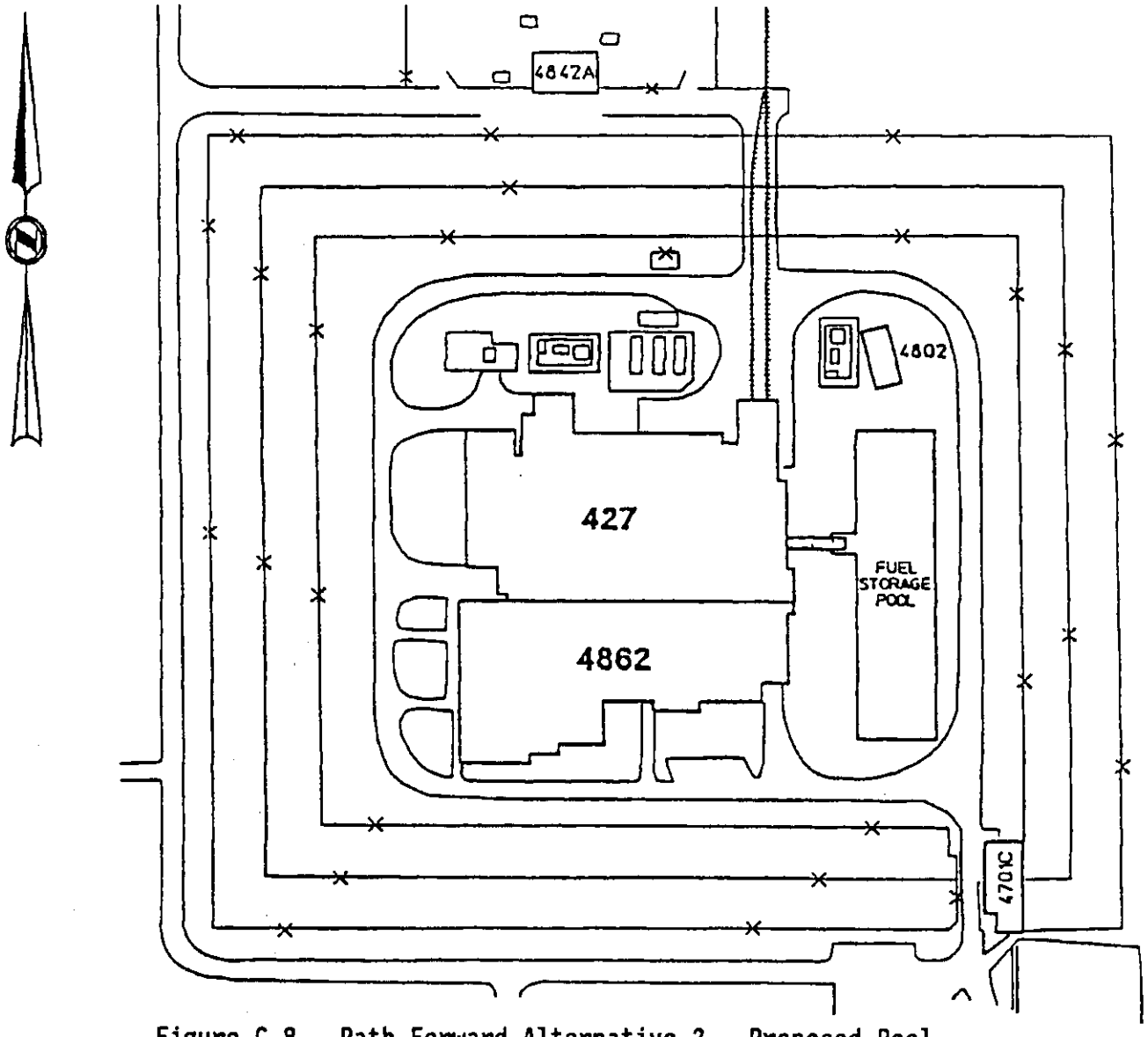

Figure C-8. Path Forward Alternative 2 - Proposed Pool Storage at Fuels and Material Examination Facility.

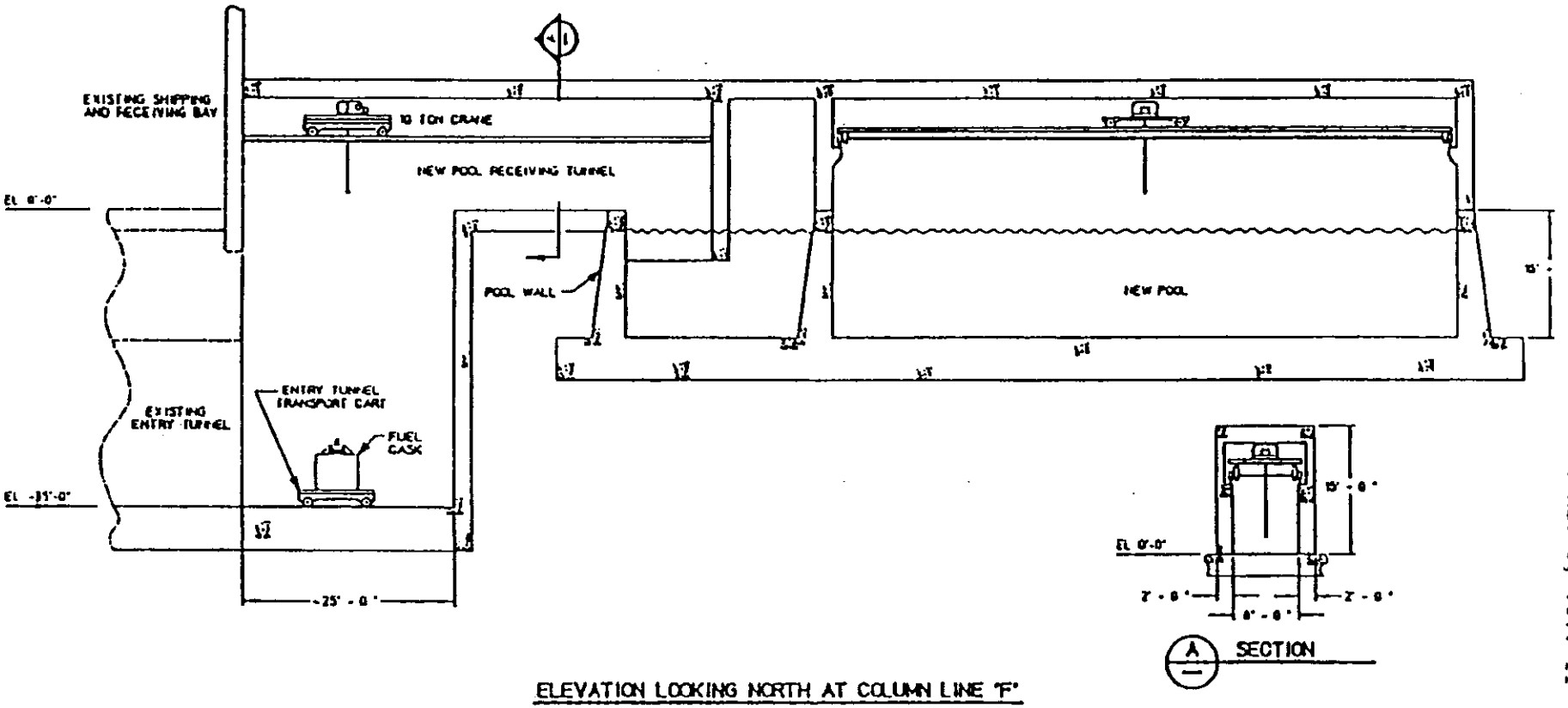

Figure C-9. Path Forward Alternative 2 - Proposed Storage Pool and Receiving Tunnel at Fuels and Materials Examination Facility.

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described above for the FMEF option. The major modification to be made to the WNP-4 spray pond is the installation of a Safety Class 1 confinement building and ventilation system.

Both the FMEF and WNP-4 storage pond concepts are viable: a seismically-qualified pond currently exists at WNP-4 and an unload facility currently exists at the FMEF; both facilities require only modest extensions of existing rail service to connect with K Basins; and, the cost and schedule for the two are comparable. The FMEF does, however, have some advantages over the WNP-4 concept.

Although the pond currently exists at WNP-4, the cost of installing a pond at the FMEF is only a small fraction of the total cost. The most important reason for not recommending use of the WNP-4 spray pond is the uncertainty about its timely availability. Ownership of the WNP-4 site is entangled and the sale to the DOE could be less than straightforward. Further, the WNP-4 spray pond option would not permit final processing and Interim Storage of the stabilized material at the same location as does FMEF, where the SNF could be provided pre-Interim storage, subsequent conditioning, and then Interim storage without leaving the existing protected area.

200 Area Canyon Facility. The PUREX facility in the 200 Area was also examined as a pre-Interim storage location. PUREX commenced operation (circa 1955) processing spent fuel, including N Reactor fuel and is currently in transition to permanent shutdown pending final decontamination and decommissioning. The plan to store N Reactor Fuel and sludge in PUREX would be to install a series of water filled troughs on top of the process cells shield blocks. The overpacks containing fuel and sludge would be placed in the troughs. About 2/3 of the canyon length would be required to store the K Basins fuel and sludge. Because of its former mission PUREX has a number of systems well suited to the support of pre-Interim storage, including rail spur, cask handling capability and a structure and ventilation to provide confinement. Fire protection and extensive water system upgrades would likely be necessary, however. Furthermore, analyses done circa 1980 to assess the seismic capacity of the PUREX facility suggest that extensive structural improvements would be required to qualify it for pre-Interim storage, rendering this option economically unattractive compared to other options.

200 Area New Wet Storage Facility. An entirely new facility located in the 200 Area was also considered. Locating a temporary or pre-Interim wet storage facility in the 200 Area has several advantages. One is that it is consistent with the Hanford long range land use planning which would locate all of the radioactive waste on the 200 Area plateau well above the ground water and away from the Columbia River. A second is that rail transportation between the 100 K Area and the 200 Area does not cross public highways, so licensing a package may be facilitated. The disadvantages are primarily associated with the cost and schedule for a new building as compared to modifying an existing structure. It has been estimated that the cost of an entirely new wet storage facility would be two or three times the cost of modifying either FMEF or WNP-4 Spray Pond. While the actual construction time may not be substantially longer, the site evaluation and preparation time may be appreciable.

C.2.1.4 Fuel Stabilization Facility

The stabilization facility used for Alternative 2 is based on the concept developed by the ITA team. Fuel within the existing canisters (stored in overpacks within the pre-Interim wet storage facility) is removed from overpacks, any lids removed, and residual sludge flushed from the canisters and collected. The flushed fuel is then inserted into a new overpack designed to be used as a processing and interim storage container. These operations are performed within an area in the temporary storage facility specifically designed and constructed for these purposes.

The fuel, now in processing/storage containers is then transferred to the fuel stabilization facility using a bottom loading transfer cask. Within the stabilization facility, the passivation canister is drained, backfilled with inert gas, and heated to dry the fuel. The heated fuel is then contacted with selected gases for a predetermined time period to passivated the fuel. The passivated fuel is then transferred to the interim storage system.

The FMEF truck lock would be modified and used to perform the fuel stabilization operations. Processing and process equipment would be identical to the ITA Alternative, only the support facility would be different. The FMEF Alternative would use the truck lock, rail spur, hoist, utilities, radiation waste water systems, and the ventilation system. The proposed layout would be a temporary system that would be dismantled and the truck lock returned to its original condition and function when all the fuel and sludge had been transferred to the interim storage facility.

Sludge is assumed to be processed in the same equipment, with modification to the passivation container internals, and will be completed after all fuel passivation activities are finished. Pilot demonstration tests will be required.

C.2.1.5 Interim Dry Storage

A dry vault storage facility was selected as the interim storage system for each Alternative. A new facility located in the 200 Area consistent with the Hanford long-range planning to consolidate waste storage activities on the 200 Area plateau was assumed for this Alternative. The fuel and sludge in the processing/storage would be transferred to the dry vault storage facility by rail from the FMEF. This facility consists of metal tubes arranged vertically in a below grade concrete structure enclosed by an above grade precast concrete structure. Natural convection is used for cooling the packages of fuel which is stored in the metal tubes. Alternatively, the FMEF Main Process cell could be modified to perform the same interim storage function with the fuel remaining in the 400 Area.

C.2.2 REGULATORY COMPLIANCE ISSUES

Chapter 3, Sections 3.1.1 and 3.1.2, and Appendix B, Sections B.1.0 and B.2.0 discuss the applicable requirements of NEPA, RCRA, and CAA.

The facility selected for the expedited pre-Interim wet storage function must comply with current DOE facility design and operating criteria. The reference choice, FMEF, is now about 18 years old (since completion of construction) so a code and standards compliance analysis is required to assure compliance, or equivalency to current and emerging design and operating criteria.

C.2.3 GENERAL ISSUES/RECOMMENDATIONS

C.2.3.1 Initial Fuel State

The condition of the SNF is not well known. Visual inspections are currently underway and additional characterization data will be gathered in the near term. Characterization needs may be driven more by transportation system qualification than any other attribute. Because Alternative 2 employs wet shipment and storage followed by a passivation process designed to destroy uranium hydride, the extent of uranium hydriding is not a significant factor.

Records and earlier, less comprehensive visual inspections, indicate some damage to at least 6 to 12% of the elements. Damaged fuel elements being defined as those having observable corrosion products. In addition, the cladding on some number of elements may be cracked such that the element can be considered broken. This information, though qualitative, suggests that the issue of failed fuel may be a factor to be considered in the transport of fuel. However, because of the wet shipping and storage conditions coupled with fuel drying and passivation for interim storage, failed fuel will not present significant issues for Alternative 2.

C.2.3.2 Fuel Corrosion and Reactions

Uranium metal in those fuel elements that have breached cladding will continue to corrode, generating corrosion products (oxides), forming hydrides and releasing hydrogen gas.

While fuel corrosion will continue during the additional exposure to water following overpacking and placement in another basin for pre-interim storage, the amount is expected to be low. Analysis shows that for the approximately twenty years that the N Reactor fuel has been stored in the K-East Basin, only about 1% has corroded. Furthermore, corrosion can be significantly reduced by lowering the temperature. A ten degree centigrade reduction in storage temperature would reduce the corrosion rate by a factor of about two. This lower corrosion rate in conjunction with the sealed (and vented) overpack containers to be utilized for Alternative 2 should eliminate any significant concern about corrosion during the less than ten years the fuel will remain in pre-Interim storage.

C.2.3.3 Issues Pertaining to Transportation

An onsite SARP is required for transportation. The system would be modernized including testable double containment and vents but may not meet drop or fire tests.

Cask availability is a concern. Only three casks are immediately available for modification. Using just the three casks, transportation of just the fuel would take approximately four years. Other existing casks must be decontaminated prior to rework, or new casks could be fabricated to make up the required fleet. Sufficient cask and rail cars should be on hand to make 2 round trips per day. At this rate, the containerized fuel and sludge could be removed from K Basins in about 2.6 years (Refer to Figure C-5).

C.2.3.4 Issues Pertaining to the Proposed Regulatory Strategy

NEPA strategy includes proceeding with design and construction at risk in parallel with the NEPA process. CAA requires a permit prior to start of construction. CAA permit application therefore needs to be started immediately. WHC should work with the State of Washington and EPA early to determine preconstruction activities that can be performed in parallel with the permit application. The project could be delayed if other than DOE orders are to be used for this system.

C.2.3.5 Issues Pertaining to Alternative 2 Optimization

Alternative 2 assumes, above all, that the fuel and sludge are relocated from the K Basins to a new pre-Interim wet storage facility in the safest, most expeditious and cost effective manner. Options for repackaging, processing and dry storage need to be finalized through the systems engineering process to provide the best solution that meets all the criteria for not only each operation, but the integrated whole leading to successful staging for final disposition. Decisions on location of the fuel/sludge processing facility, and the interim dry storage facility should carefully evolve through that process. Expedited relocation of the fuel sludge to a pre-Interim wet storage facility, as provided in Alternative 2, maximizes flexibility in making those decisions.

C.2.4 COST AND SCHEDULE DATA

Utilization of the FMEF with a new storage pool adjacent to it, is the preferred option within Alternative 2, Pre-Interim Wet Storage, since the facility modifications and the attendant processes are viable and represent no significant technical problems. The cost estimates and implementation schedules for Alternative 2 are presented in Chapter 5, Section 5.2, "Cost and Schedule Data."

C.3.0 ALTERNATIVE 3 DESCRIPTION

C.3.1 PATH TECHNICAL DESCRIPTION

C.3.1.1 Overall Process Description

Prior to removal, the SNF and sludge are placed in multi-canister overpacks which provide primary containment for the transition from wet storage in the K Basins into interim dry storage. From K Basin, the SNF and sludge are transported to a new conditioning facility where they are dried and passivated. The multi-canister overpacks are backfilled with helium and then moved into the new interim dry storage facility. Each of these new facilities will be designed and constructed to meet Nuclear Regulatory Commission licensing requirements. The process flow diagram for Alternative 3 is given in Figure C-10 and Figure C-11 gives a schematic representation of the processes involved.

The process functions attendant to Alternative 3 are listed below and reference Figure C-12, "Path Forward Alternative 3, Functional Flow Block Diagram."

- Characterize fuel (1.0)
- Package fuel in multi-canister overpacks (2.0, 3.0)
- Transport to the Stabilization and Process Facility (11.0)
- Design and construct Stabilization and Processing Facility (12.0, 13.0)
- Stabilize and Process Fuel (14.0)
- Design and construct an Interim Storage Facility (17.0, 18.0)
- Store Fuel in Interim Dry Storage (20.0).

The functions Design and Construction of a temporary storage facility, (4.0, 5.0), Transport Fuel and Sludge to Temporary Storage Facility (7.0), Store Fuel and Sludge in Temporary Storage Facility (9.0, 10.0), and are represented in the dotted-line because they are unnecessary in the Alternative 3 Path Forward. In the case of Functions 6.0, 8.0, 15.0, and 16.0, they are common functions to all the Path Forward Alternatives.

The expedited dry storage options used as the basis for Alternative 3 has been developed and documented for RL by the ITA, MAC Technical Services. This report, *Dry Storage of N-Reactor Fuel*, September 15, 1994, selects a preferred path from a set of options that it presented for expedited dry storage of N Reactor fuel. The ITA report did not address the removal of sludge, debris, and water from K-West and K-East Basins, nor did it provide for the disposition of process effluents and the decontamination and decommissioning of the new facilities created by the alternative.

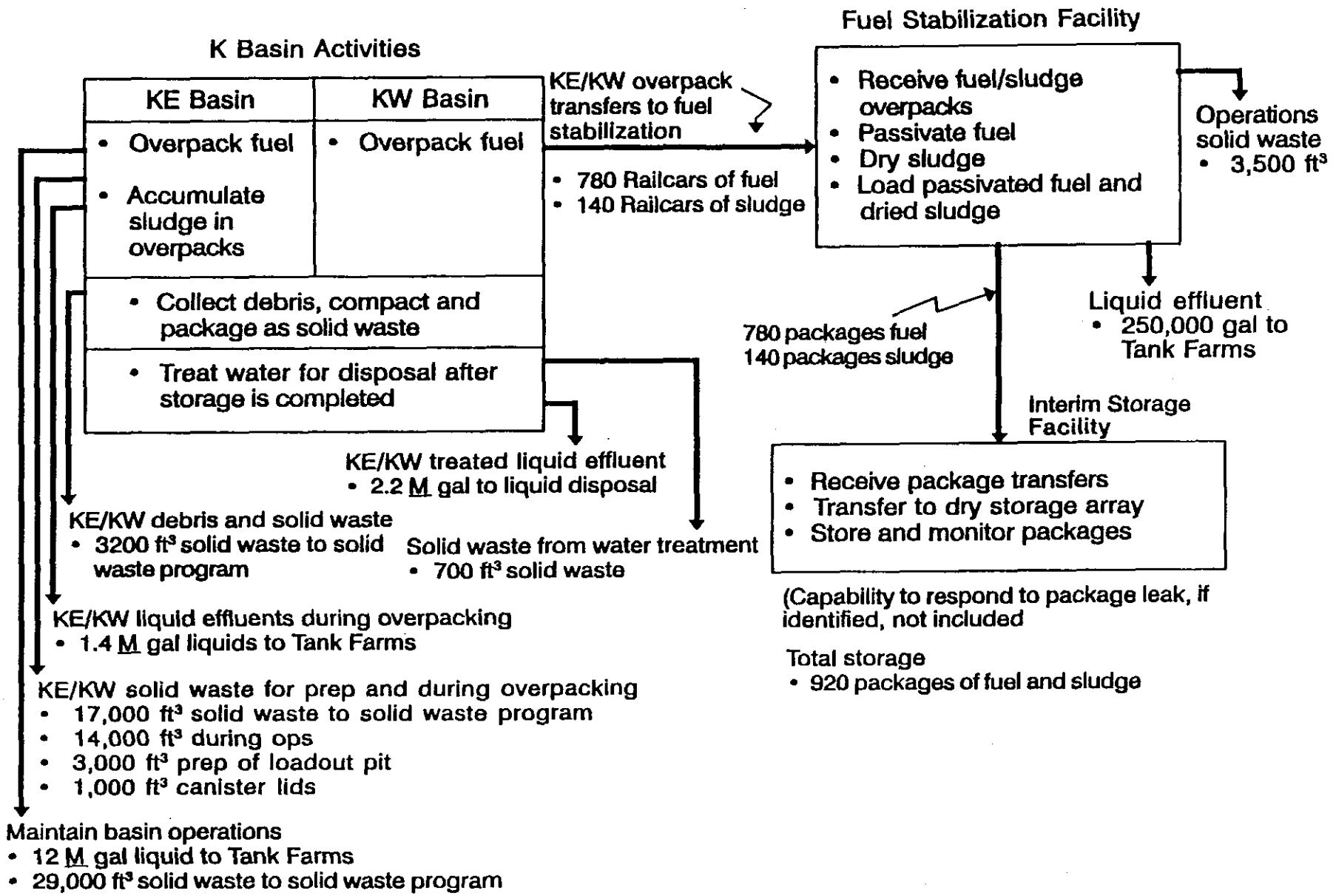

Figure C-10. Path Forward Alternative 3 - Process Flow Diagram and Mass Balance.

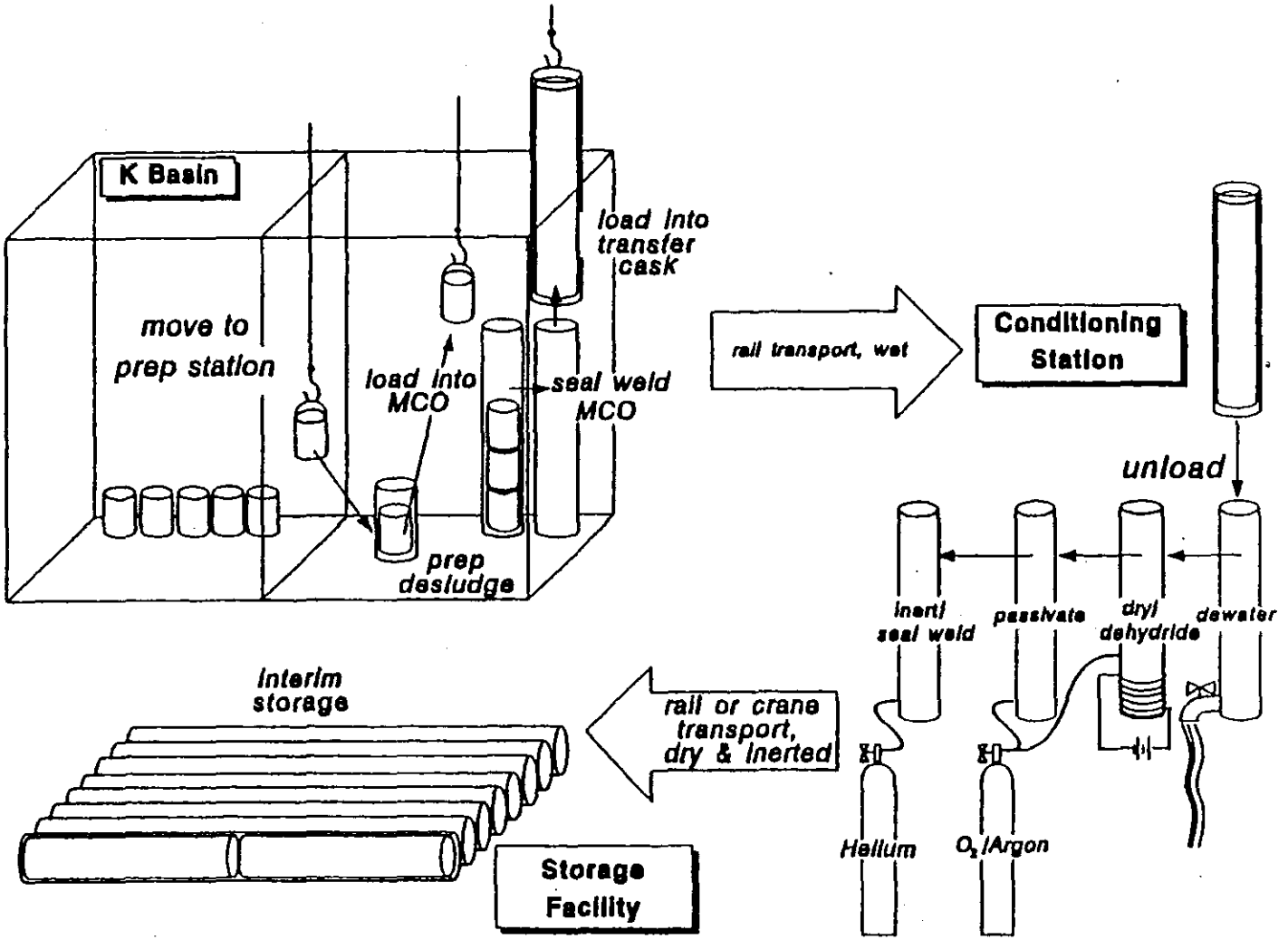

Figure C-11. Path Forward Alternative 3 - ITA Process Schematic.

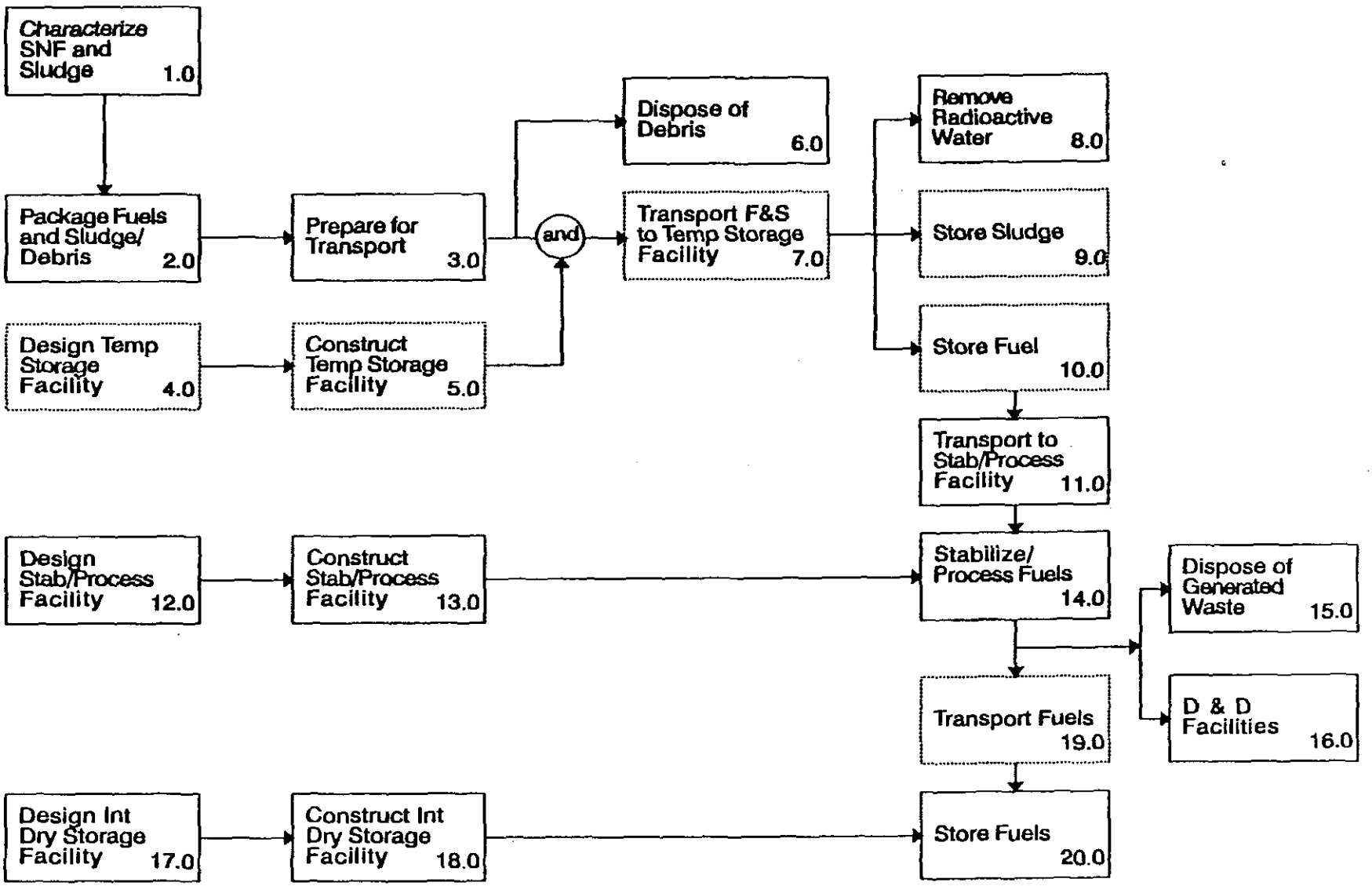

Figure C-12. Path Forward Alternative 3 - Functional Flow Block Diagram.

Alternative 3 utilizes a slightly different set of dry storage options from those described in the ITA report, viz., Alternative 3:

- Provides a secondary containment for the multi-canister overpack during drying/passivation (required for containment when process connections are made or broken)

- Adds a sludge collection and drying system which is based on filling sintered metal filters, loading them into multi-canister overpacks and processing them as fuel.

Preparation of the fuel canisters for loading into the multi-canister overpack consists of moving the canisters to an enclosed, underwater drilling station located in the K Basin, where lids are removed (K-West only), holes are drilled in the bottom of each canister (also gas traps on MK II), as much sludge as possible is washed from the canisters, and the sludge is captured on filters. In K-West Basin, water is removed from the enclosed drilling station and processed through a separate Ion-Exchange system before transport to disposal. Water from canisters in K-West will not be mixed with K-West Basin water. The drilled and flushed canisters are places five high in a newly designed multi-canister overpack. Each overpack contains 10 canisters. After loading into the multi-canister overpacks the SNF undergoes the entire transition from wet storage in the K Basins to a dry storage environment in the multi-canister overpacks which provide the primary containment boundary for the SNF.

To remove a multi-canister overpack loaded with fuel from the K Basin, a bottom loading transfer cask (new design) is positioned in the cask loading adapter (new design). This cask loading adapter is permanently installed in the existing K Basin cask pit and provides the necessary shielding for transfer from the basin water into the dry transfer cask. A shield plug is placed in the top of the multi-canister overpack before lifting. The loaded multi-canister overpack assembly is lifted from the basin water into the cask through the cask loading adapter which rinses the multi-canister overpack to remove surface contamination. A few liters of water are siphoned from the multi-canister overpack to unwet the shield plug so that it can be welded and to provide head space for expansion. After the shield plug is welded, the bottom door and top lid of the transfer cask are bolted and sealed. The transfer cask is then loaded onto a newly designed rail car and transferred some 10 mi to the new 200 Area Conditioning (Stabilization/Process) Facility. The shipments will use existing railroad spurs at K Basins, and the railroad lines between the K Basins and the 200 Area.

Regarding sludge collection operations there are differences between K-East and K-West. In K-West, since there is little contamination in the basin water, a closed system is used for the canister opening and sludge rinse functions. Rinse water, which is isolated from the basin and disposed of separately, is filtered through sintered metal filters the same size as fuel elements. Fifty four of these filters are manifolded together. The water flow is from the inside to the outside so that the sludge is deposited inside the filters. When filled with sludge the filter assemblies are loaded into a multi-canister overpack, five assemblies per multi-canister overpack. Each filter assembly is expected to hold approximately 100 kg of sludge. In

K-East Basin, the rinse water from the canisters can be mixed with the basin water but it will also be filtered. To maintain basin clarity, and to collect the fuel rich sludge.

Two hundred filter assemblies and 50 additional multi-canister overpacks are estimated to be required for the sludge. The major cost for the sludge component of Alternative 3 ($3.1 millon) derives from the additional multi-canister overpacks required and the storage locations. The sintered filters will add another $1.6 millon. Assuming 20 days for the drying cycle, processing the additional 50 sludge containing multi-canister overpacks would take 140 days (using the ITA design basis of 8 Stabilization/Conditioning stations).

In addition to in-canister sludge associated with the fuel (K-East and K-West), there is also sludge existing on the K-East Basin floor. This sludge is primarily sand, corrosion products from basin components, and dust. These are mixed with smaller amounts of corroded fuel. The final disposition of this material may be based on designation as waste rather than SNF, but the estimated sixty eight cubic meters of sludge could also be processed in multi-canister overpack containers. The larger volume would require 140 additional multi-canister overpacks and over a year to process. For K-East Basin sludge, the cost of multi-canister overpacks, filters, and storage locations would be $15 million. These estimates are based on projected sludge density when filtered and the expected drying times. Characterization of the sludge materials is needed to reduce the range of uncertainty for sludge processing.

At the Conditioning Facility, the multi-canister overpacks are transferred into one of eight Conditioning Stations where there the water is drained and the multi-canister overpack is filled with an inert gas atmosphere. The multi-canister overpack payload is then heated to 100 °C for initial drying. The multi-canister overpack is than evacuated and its payload (fuel or sludge) is further dried at 300 °C to remove adsorbed and absorbed water, water of hydration, and to achieve some further disassociation of uranium hydride. Next, the payload is passivated in the presence of oxygen at 150-250 °C to achieve a suitably stable condition for interim dry storage. Following passivation, the multi-canister overpack is cooled to 100 °C and backfilled with a tagged helium cover gas and sealed for interim dry storage.

Process Control. Operation of the conditioning process will be computer (PC) controlled. The end point of each step will be based on adequately conservative times developed during the demonstration phase. Other process parameters, including temperatures, pressures, hydrogen release quantities, and moisture content will be measured but will be confirmatory rather than controlling.

Once fuel conditioning is completed the multi-canister overpack is transferred to the storage facility. In storage, two sealed barriers separate the SNF from the external environment. The first barrier is the multi-canister overpack and the second barrier is the sealed storage container which is part of the dry storage facility. The space between primary and secondary containment will be monitored during interim dry storage. Any in-leakage from

the external environment or out-leakage from primary containment will be detected. No leakage then verifies the integrity of the multi-canister overpack (primary) containment boundary, and the storage (secondary) container boundary.

Material Accountability. Material accountability will be based upon the weight of fuel and sludge collected in the basin and the inventory reconciled with present records from K Basins, including those from the repackaging and classification campaign conducted in the early 1980's to segregate fissile material. The new inventory may not match existing inventory records (Ref. to Chapter 3, Section 3.1.2, "Special Nuclear Material Accountability."

C.3.2 KEY ISSUES

C.3.2.1 Characterization

The uncertainty about the condition and behavior of the fuel and sludge stored in the K Basins suggests a need to validate the process needed to achieve dry storage on an accelerated basis. Confirmatory testing is primarily intended to provide technical information to support process parameter development for the fuel conditioning. Conditioning process parameters have direct bearing on the effectiveness of drying, dehydriding and passivation. For example, the in-basin canister desludging step, the conditioning process temperature of 300 °C, and the 150 psig multi-canister overpack design pressure were all selected to provide confidence that sludge-based residual water in the multi-canister overpacks will not cause a problem during dry storage, even for long periods. Sludge characterization will prove useful in validating the conservatism of, and possibly refinements in this approach.

Planned Characterization Work. WHC has been proceeding on a program to characterize fuel and sludge in both K Basins. In fuel characterization, the primary areas of interest are the fuel's physical condition (degree of failure, general structural integrity, etc.), hydride inventory, and amount and characteristics of adherent corrosion product. With respect to the sludge characterization, WHC plans to examine both K Basins' (ex-canister and in-canister) sludge. Of these, the latter is valuable to the dry storage program, with primary interest in the quantity of in-canister sludge, its physical, chemical and radiochemical composition, and its drying characteristics. Information desired from this characterization work include:

- Dry out characteristics of expected N Reactor fuel corrosion products, as functions of time, temperature, pressure, gas environment, etc.

- Dry out characteristics of expected in-canister sludge material, as functions of time, temperature, pressure, gas environment, etc.

- Radiolysis Effects. The degree to which residual water (particularly water of hydration, bound to fuel and sludge corrosion products) will radiolytically dissociate, in a multi-canister overpack loaded with N Reactor spent fuel.

- Hydride Decomposition Behavior. The degree to which the uranium hydride dissociates as a function of in-multi-canister overpack conditions (time, temperature, pressure, gas) during the planned dry out step.

For both fuel and sludge characteristics, it is expected that there will be differences between K-East and K-West Basins, as well as variations within each pool. The characterization effort should take this into account.

Potential Consequences. It is noteworthy that if the Nuclear Regulatory Commission review does not accept the data on the fuel as being adequate and more characterization is required before the metal fuel can be stored, the multi-canister overpacks will have to be opened. As Alternative 3 does not provide the facility to open a multi-canister overpack after processing, a major cost will be incurred. A new hot cell would be required or space must be found in an existing hot cell. The cell must be equipped to open the multi-canister overpack, remove fuel for characterization, and close the multi-canister overpack. The cost, with only a few samples, could be as high as the operating cost to dry and passivate all the fuel.

The "worst case" result of the Nuclear Regulatory Commission review would require another form of fuel such as oxide to meet the requirement for storage. In this case all multi-canister overpacks would be opened, fuel removed and processed, and the processed fuel placed in new containers, and the containers returned to storage. The cost of starting from stored multi-canister overpacks rather than K Basin would only be less by the cost of packaging and loading out fuel from the basin.

C.3.2.2 Regulatory Compliance

Regulatory and permit requirements for the siting, construction, and operation of a dry storage facility at the Hanford Site includes Federal and Washington State environmental laws applicable to SNF management at the Hanford Site.

One regulatory matter that must be addressed to achieve an expedited design and construction schedule is the one related to DOE regulations for implementing the NEPA. DOE regulations for implementing 10 CFR 1021, Appendix D, require the preparation of an EIS for the siting, construction, and operation of SNF storage facilities. A draft programmatic environmental impact statement addressing all DOE SNF was published in June 1994 (DOE/EIS-0203-D). The programmatic record of decision is expected to be issued by June 1995. The programmatic environmental impact statement will be followed by the preparation of a Hanford Site-Specific environmental impact statement with its record of decision being published as early as June 1996, a possible outcome of which could be a decision to place the Hanford SNF in dry storage at the Hanford Site.

Until the Hanford Site-Specific Record of Decision is issued, and in accordance with Council for Environmental Quality regulations [40 CFR 1506.1 (a)], the DOE may neither acquire major components or systems for, nor begin construction of, a dry fuel storage facility.

The schedules shown in Appendix D for Alternative 3 show the project proceeding in two phases: a demonstration phase (3-5% of the SNF), followed by a production phase (the rest of the SNF). The demonstration and conditioning components would be full-size prototypes of the production system. The acquisition of equipment and the construction of both the demonstration Conditioning Facility and demonstration storage facility would begin prior to the earliest anticipated date for issuance of the Hanford Site-specific record of decision in June 1996.

Such activities would be consistent with the Council for Environmental Quality regulations which recognize that certain situations require that some actions need to be taken prior to the issuance of a record of decision. Such actions are referred to as "interim actions." Specifically, Council for Environmental Quality regulations 40 CFR 1506.1 (c) require that, while work on a program environmental impact statement is underway, agencies not take any major Federal action which may affect the quality of the human environment, unless such action:

- Is justified independently of the program
- Is itself accompanied by an adequate environmental impact statement
- Will not prejudice the ultimate decision on the program.

It is believed that proceeding with the demonstration program as envisioned can be justified independently of the national Spent Nuclear Fuel Project storage program. That justification is based on the fact that removing 3-5% of the fuel will begin to eliminate the risk posed by its continued storage in the K-East Basin, and is in response to the DNFSB Recommendation 94-1 of May, 1994 to convert the SNF at the K-East Basin to a stable configuration for interim storage within two to three years.

However, again, as stipulated by 40 CFR 1506.1 (c), the demonstration program must be accompanied by its own environmental impact statement. So, an interim action environmental impact statement must be written and a record of decision documenting the decision to proceed with the demonstration program issued prior to constructing and equipping the demonstration conditioning or storage facility. Therefore, at the point that the DOE should decide on the Alternative 3 Path Forward recommended that the DOE should initiate an interim action environmental impact statement to address the demonstration program.

The interim action environmental impact statement would be limited in scope to 3-5% of the K-East Basin SNF, to dry storage only and perhaps to a select number of alternative locations on the 200 Areas Plateau. Based on recent Hanford experience with development of another interim action environmental impact statement, it appears that if the DOE were to decide to proceed soon, a record of decision could be issued by July 1995, in time to support the schedule proposed for Alternative 3.

It is also required in 40 CFR 1506.1 (c) that the demonstration program not prejudice the ultimate decision that will be reached on the national SNF storage program. Specifically, the demonstration program must not preclude a decision that the fuel will be put in interim wet storage. The conditioned fuel from K-East Basin can be removed from dry storage and returned to wet storage or be prepared for processing at any time. Thus, this Council for Environmental Quality stipulation is met.

The Hanford Site-specific environmental impact statement mentioned earlier would still need to be developed. The scope of that environmental impact statement would include the remainder of the fuel in K-East Basin; all the fuel in the K-West Basin; the other spent fuels at Hanford; and, whatever other offsite fuels and offsite locations are required to be considered as a result of the programmatic record of decision. This environmental impact statement would also address both dry and wet storage systems unless the programmatic record of decision precluded one.

To meet the proposed schedule to equip and build the production conditioning and storage facilities, the record of decision for the Hanford Site-specific environmental impact statement must be issued by July 1997. Assuming that the Notice of Intent to prepare the site-specific environmental impact statement would be published shortly after the programmatic record of decision is issued, the DOE would have about two years to complete that NEPA review process, a very reasonable schedule. For perspective, Secretary O'Leary's June 13, 1994, Secretarial Policy on NEPA included guidance that the mean time for completion of the DOE environmental impact statements shall be 15 months.

In keeping with another aspect of Secretary O'Leary's guidance regarding NEPA, should Alternative 3 be selected, this NEPA schedule strategy should be reviewed for concurrence by DOE-HQ (EM-37,-OGC, EH-25), RL (project staff, GC, NEPA Compliance Officer), Ecology, and other stakeholders very early in the program.

C.3.2.3 K Basin Modifications

Minor structural modifications and new equipment installations are required in the K Basins to accommodate the equipment needed to prepare, load, and handle the multi-canister overpack, viz.

- Removal of structural steel used to guide the existing SNF transfer cask from the cask pit.

- Installation of the transfer cask support structure in the cask pit, and attached multi-canister overpack decontamination spray nozzles. The multi-canister overpack loading support frame will be placed on the floor of the cask pit. A new auxiliary hoist will be attached to the existing overhead crane.

- Installation of the Canister Preparation Station in the chute areas[1] of K Basins, and Canister Water Cleanup System. The Canister Preparation Station of the preferred ITA option consists of a mechanical enclosure with pneumatic drills for drilling holes in the canister bottoms and gas traps, a hydraulically actuated lid

[1]Efforts are underway to isolate the discharge chutes from the KE and KW Basins due to the consequence of seismic events. Any activities noted here for the discharge chutes can be performed elsewhere in the K-Basins.

containing spray nozzles for sludge removal, and a suction/drain port for removing the water and sludge for processing, as appropriate.

The multi-canister overpack is designed to be compatible with available dry SNF transfer and storage systems and with the Multi-Purpose Canister System under development by the DOE OCRWM for storage of light water reactor spent fuel. The multi-canister overpack is designed and will be constructed in accordance with ASME Code, Section III, Subsection NB for the service conditions associated with SNF handling, transferring, and conditioning, which enables the multi-canister overpack to provide the failed fuel confinement that is required by 10 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste. About 780 multi-canister overpacks will be needed for the entire N Reactor dry storage campaign.

The container multi-canister overpack and handling equipment can be accommodated within the existing physical constraints and crane capacities at the K Basins. In-basin modifications are required to install equipment for handling, preparing, loading, and removing fuel canisters which will be prepared for loading into the multi-canister overpacks in the canister preparation station.

Operations for each of the K Basins will be similar. The difference is that water and sludge removed from K-West Basin canisters is filtered, processed, and controlled to avoid contamination of the K-West Basin water. Water removed from K-East Basin canisters is placed back in the basin without processing.

An auxiliary hoist is used to place an empty multi-canister overpack in the multi-canister overpack support frame located on the floor of the cask load out pit. Existing SNF handling equipment and long-handle tools will be used to load the canisters into the multi-canister overpack.

C.3.2.4 Process Performance

Dewatering and Drying. The acceptance criterion for adequate dryness of the fuel is that subsequent container pressurization from gases generated by corrosion and/or radiolysis shall not cause multi-canister overpack pressure to exceed 0.3 atm. This criterion provides a measure of reactive materials remaining in the package. Degradation may be in the form of uranium oxidation or uranium hydride formation. [Sludge characterization work, performed as part of the demonstration phase of the program, will relate this criterion to a water vapor pressure.] This will allow determination of the drying time required to reduce the amount of remaining bound water to an acceptable level. The 300 °C drying step is expected to remove essentially all water from the uranium oxides and most of the water from the aluminum oxides.

The 300 °C part of the drying step will result in some disassociation of uranium hydride. The equilibrium hydrogen pressure in contact with solid uranium hydride at this temperature is relatively low (~2 cm Hg). It is

unlikely that complete removal of hydride will occur. The main objective of the high-temperature stage is to provide adequate drying rather than complete uranium hydride decomposition. It is expected that this step will require approximately 25 hours.

Release of radioactive species during elevated temperature conditioning treatments is a consideration. The principal modes of release are oxidation of the metal by water evolved during drying, and diffusion or other release mechanisms during the heating cycles. The inventory of mobile active species released by oxidation has not been estimated because the area of exposed uranium is not known. Water is being constantly removed during the drying cycle, but some reaction with exposed uranium is to be expected. The fission product inventories in the fuel are relatively low because of low burn up and extended decay periods. Amounts of isotopes released by oxidation will be low, but this should be verified in the testing program.

Releases of fission products by diffusion are also expected to be low. Most of the fuel operated in the reactor at centerline temperatures of 400 to 600 °C, considerably higher than the 300 °C maximum conditioning temperature.

Passivation. During the passivation step, oxygen will be admitted to the multi-canister overpack in a controlled manner. The main objective is to oxidize remaining uranium hydride and any uranium fines resulting from uranium hydride disassociation. The temperature at which the oxygen is admitted to the multi-canister overpack is controlled, because temperature affects the degree to which the oxygen reacts with exposed uranium. If oxygen were to be admitted at a temperature at which oxidation of massive uranium is significant, much of the oxygen would be consumed by exposed uranium metal rather than by oxidation of uranium hydride. The rate of oxidation of exposed solid uranium as a function of oxygen partial pressure and temperature is well known. For the N Reactor fuel, oxygen will be admitted at a temperature in the range of 150-250 °C. The uranium fines will oxidize readily at 100 °C.

The oxygen concentration in the inert (argon) gas will be 2% for the initial step in the passivation process. The oxygen concentration will restrict the available oxygen supply and potential heat release from uranium hydride and metal oxidation.

Passivation will be achieved in a sequence of steps in which the oxygen fraction in the gas is fixed and the total pressure is cycled. To ensure adequate penetration and replenishment of oxygen, a pressure pulsing technique and oxygen concentration augmentation will be used. The oxygen partial pressure is increased from an initial value of approximately two percent to a value of 20% for the final pulse. A 10-hour passivation duration is expected to be adequate.

C.3.2.5 Facility Siting Considerations

A siting criterion for the Conditioning and Dry Storage Facilities is that it permits onsite transfer of SNF under 10 CFR Part 72. To meet this requirement, all facilities and areas traversed must be under the jurisdiction

of the DOE, so that public access to the equipment is controlled. All locations considered for Alternative 3 siting are within the controlled access area of the Hanford Site and meet this requirement (WHC, 1993).

The 200 Area is the general location proposed for the Conditioning Facility and the Dry Storage Facility. Collocation is the most cost-effective approach and agrees with recommendations to consolidate facilities which were developed by the Hanford Future Site Users Working Group discussed in Chapter 3, Section 3.2.2.

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C.4.0 ALTERNATIVE 4 DESCRIPTION

C.4.1 PATH TECHNICAL DESCRIPTION

This Alternative for the expedited removal of N Reactor fuel (SNF) and sludge currently stored in the K Basins involves custodial transfer of the SNF only to BNFL for processing in the United Kingdom. The scope proposed by BNFL in combination with provisions by WHC (or others) constitute the path through Alternative 4, as depicted in Figure C-13. Prior to commencement of the proposed BNFL program scope, modifications to K Basin would be necessary to accommodate utilization of the BNFL internationally licensed casks for off-Hanford Site shipments to the U.K. Also, provisions would be required to conduct all loading operations at the K Basins, since the BNFL scope commences after the casks are loaded onto the railcar. Furthermore, BNFL assumes no liability for SNF shipment in territorial waters enroute to port of transoceanic embarkation.

Following shipment to the United Kingdom, BNFL will process the SNF in their Sellafield plant, after some modification to the headend, to produce stable high-level residues, and uranium/plutonium products suitable for transport and long term storage. BNFL would then store the high level waste residues through the year 2020, and the U and Pu products for five years. BNFL believes it feasible to transfer custody of the fuel to BNFL and accomplish the complete off-site shipment to the Sellafield Plant prior to the Tri-Party Agreement milestone for resolution of the K Basin situation.

Except for the SNF off-loading functions in K Basin (2.0, and 3.0 in Figure C-14), the Alternative 4 path process functions deviate from the other three Path Forward Alternatives in that the SNF is shipped to off-Site processing, and the end products may be suitable for placement in a permanent repository rather than an interim storage facility. Thus, the Functional Flow Diagram presented in Figure C-14 does not apply precisely for the intermediate and end points. The common Project functions, e.g., those related to disposition of the sludge, debris, basin water, etc., have not been considered in the Alternative 4 study but would likely utilize the concepts discussed for the other Path Forward Alternatives. The functions not required are indicated by the dotted-line blocks on Figure C-14. The following discussion, therefore, deals only with the scope of work proposed by BNFL, which with reference again to Figure C-14, includes the following functions:

- Load shipping cask with "as found" SNF (both basins) (2.0, 3.0)
- Transfer the fuel via cask shipment to Sellafield plant (11.0)
- Process fuel in modified Sellafield plant in United Kingdom (14.0)
- Store high level waste in U.K. until the year 2020; store special nuclear material for five years (20.0).

It is noteworthy that BNFL contends that "Characterization" of the SNF (1.0), and "Containerization" are unnecessary preparatory functions for their proposed workscope.

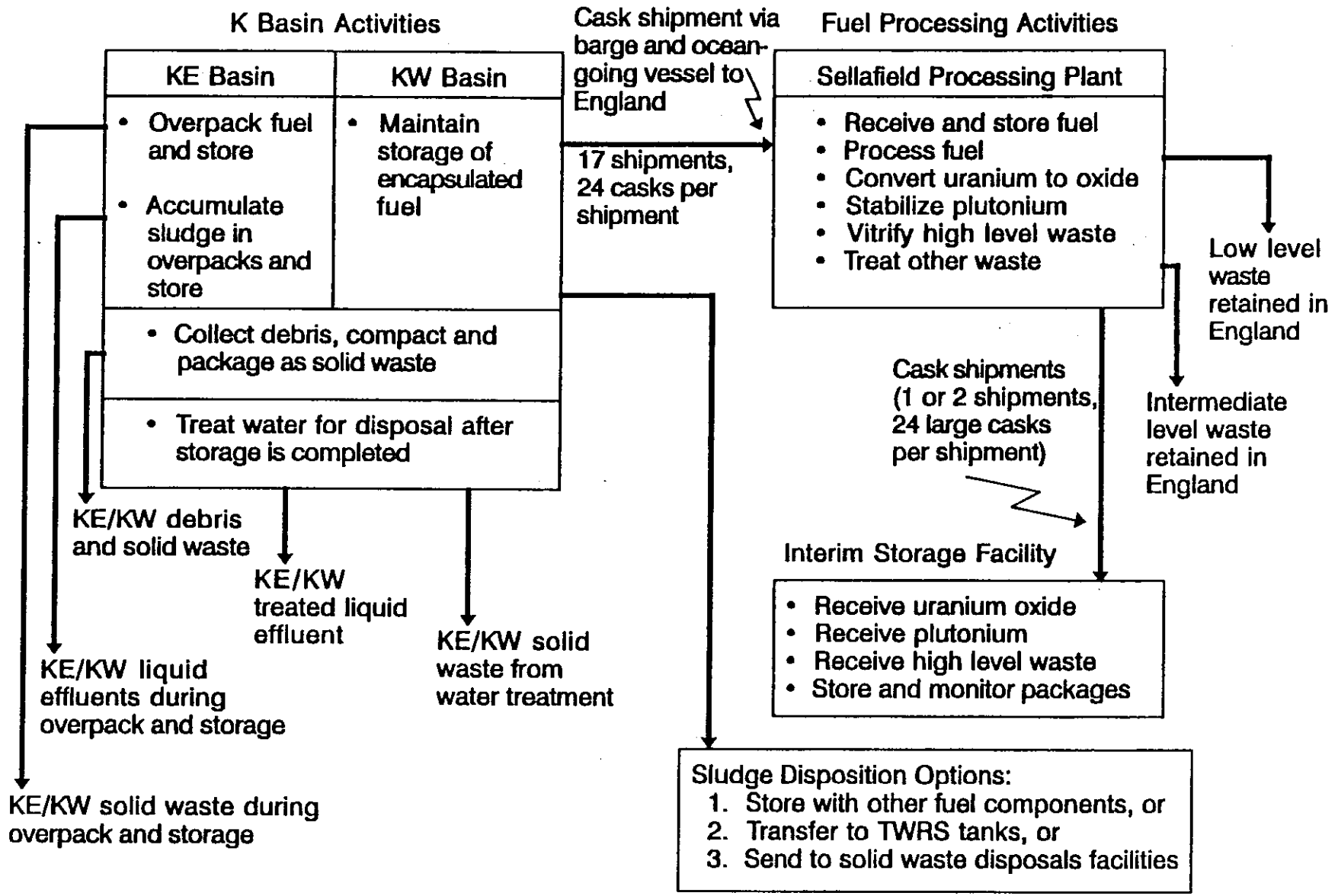

Figure C-13. Path Forward Alternative 4 - Process Flow Diagram and Mass Balance.

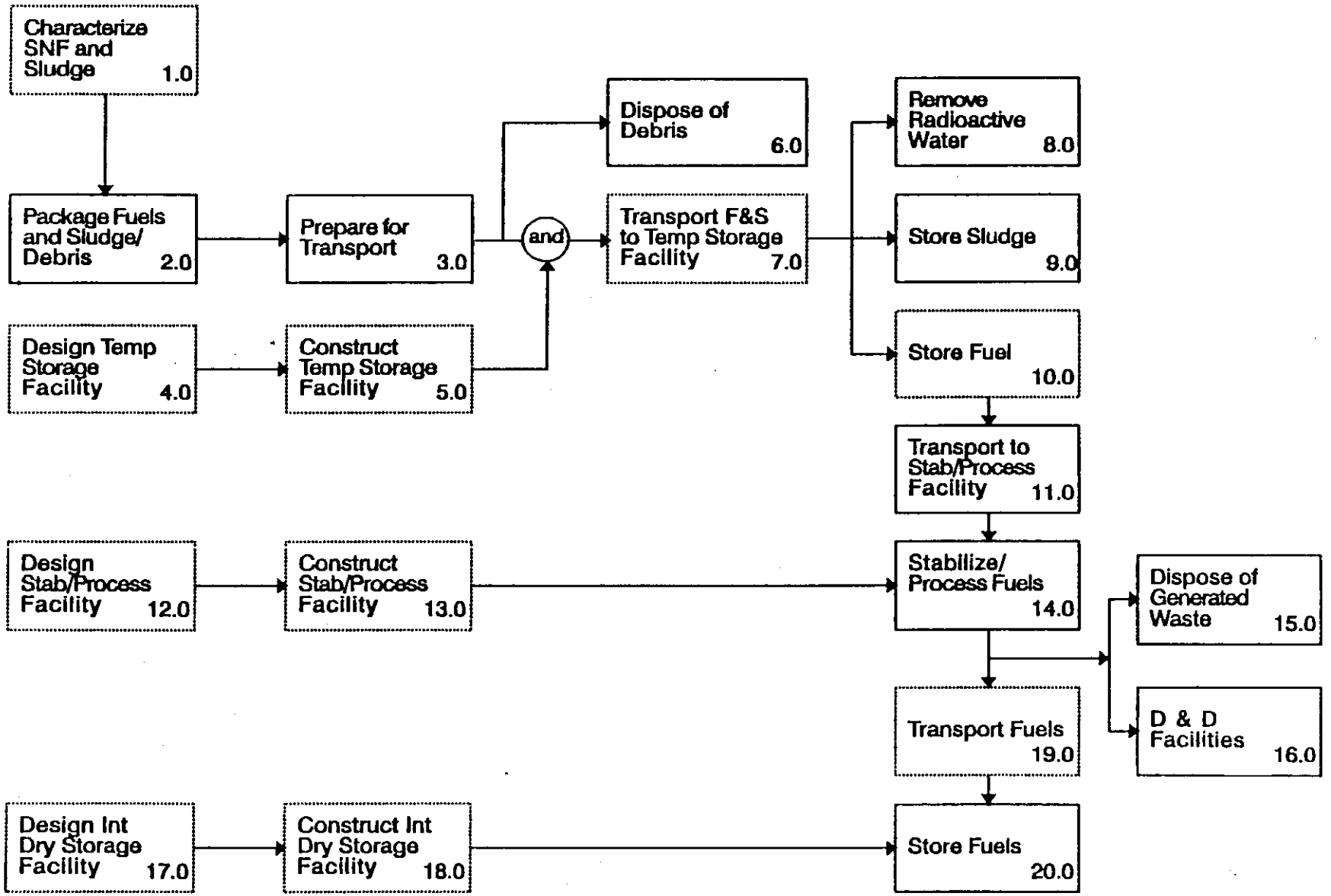

Figure C-14. Path Forward Alternative 4 - Functional Flow Block Diagram.

C.4.1.1 Fuel and Sludge Containerization

The BNFL cask is licensed for transport of unencapsulated, damaged, metallic fuel and has previously been so utilized; and, BNFL states that this application is reasonably within the cask design envelope. However, a literal interpretation of the requirements of 10 CFR 72, and DOE 6430.1a would be that a secondary containment would be required or that equivalent containment be proven. The fuel assemblies would be carried in the cask in a large rectangular box (skip) fabricated from carbon steel. The fuel is shipped wet.

C.4.1.2 Transportation

Again, use of an existing, licensed (U.K., Japan and Italy) BNFL cask design is proposed, and this application falls within the cask design envelope. Thus, licensing by both the U.K. and U.S. authorities is not anticipated to be an issue. BNFL believes only DOT validation is required.

The casks would interface with the to-be-modified K Basin load-out facilities, and are sized to contain about 5 tons of N fuel. The loaded casks are transferred from Hanford to a BNFL ship at a Northwest port. The casks may be transported by road, rail, or barge from Hanford Site to the port. For purposes of evaluation, the preferred option is to transport by road or rail to a location on the Columbia river suitable for loading the casks on a barge for shipment to a point down river from Portland, Oregon. The proposed barge capacity of 24 casks corresponds to a BNFL shipload.

The BNFL ships comply with international agreements governing shipment of irradiated materials. The ships are currently in use and are approved by the U.S. Coast Guard.

C.4.1.3 Processing and Stabilization

The processing of the N Fuel at Sellafield uses existing processes once the fuel is dissolved. A new chop/leach (shear-leach) headend must be developed, designed, demonstrated, and installed to dissolve the N Fuel.

The fuel is dissolved in the new chop/leach process. The resulting solution contains the dissolved uranium, plutonium, and fission products. The fuel hulls, and any shear overcans do not dissolve in the chop/leach process. The hulls and shear overcans are mixed with other solid waste and cemented in intermediate waste containers.

The separations processes at Sellafield produce uranium, plutonium and high level waste streams. The recovered uranium is converted to UO_3 and placed in 55-gallon drums. The plutonium is converted to PuO_2. BNFL will consult with the DOE to determine preferred alternatives. Currently, the recommended configuration is high fired oxide although other forms such as mixed oxide or vitrified in glass may be chosen. The intermediate waste, including the fuel hulls and other solid waste, is cemented in 500 liter containers. The high level waste is vitrified in borosilicate glass. Low level waste is packaged in standard low level waste containers.

C.4.1.4 Conditioned Waste Return

In the recommended path through Alternative 4 the uranium, plutonium, and high level waste are returned to the U.S. BNFL has proposed to retain and store the special nuclear material for five years and the vitrified high level waste until such time as a permanent geologic repository becomes available, or 2020. Return shipment would be anticipated as essentially the reverse of the SNF shipment, however, the cost of the return shipment was not included in BNFL's proposal.

BNFL anticipates that treatment of all the N-reactor spent fuel (assuming substitution) would result in the return of less than 500 half-ton vitrified waste containers to the U.S. This is in addition to ~2,000 tons of purified uranium as UO_2 and ~4.6 tons of plutonium in a form specified by the DOE. Incorporating the plutonium in glass with the high level waste would approximately double the number of glass containers returned assuming a plutonium concentration limit of 1%.

If another destination than the Hanford Site for the returning materials is identified (e.g., a waste repository site for the vitrified waste), the transportation requirements would then be determined. BNFL has a newly designed, 110 ton cask for transporting the vitrified high level waste container produced by their waste vitrification facilities. This new cask will transport 21 vitrified containers and is expected to be available for international shipments of high level waste by 1996. Five hundred vitrified waste containers (500 Kg each) would require 24 casks in one or two shipments.

C.4.2 REGULATORY CONSIDERATIONS SPECIFIC TO ALTERNATIVE 4

Shipment offsite and foreign custody of DOE SNF require consideration of not only applicable DOE requirements, but also interactions with other affected federal state, local, and any supranational agencies that will become involved.

The Nuclear Nonproliferation Treaty, U.S. legislation supporting the treaty, and the AEA have been examined for provisions which could bar or impede the shipment and processing BNFL proposes. While there are procedures laid out which would have to be followed, nothing in the treaty, the supporting legislation, or the Atomic Energy Act appears to prohibit the steps BNFL suggests.

C.4.2.1 U.S. Department of Energy

The DOE has a variety of requirements pertaining to these activities. Most are listed in various DOE orders.

C.4.2.2 U.S. Code of Federal Regulations

Various sections of the CFR Regulations would be applicable to the Alternative 4 activities. Most provisions are applied by direction in governing DOE orders. Pertinent sections include the following:

- 10 CFR 71 (Subpart C) - regulations on transporting radioactive materials
- 10 CFR 72 - regulations pertaining to modifications to K Basins and design, construction and operation of a new interim dry storage facility
- 10 CFR 1021 - The DOE implementation of NEPA
- 10 CFR 830 Series (as issued) - 820 is Price-Anderson Amendment Act (PAAA) implementation, 835 pertains to radiation protection (issued), 830.120 governs Quality Assurance (and covers exemptions) (issued), 830.400 governs material management (subpart D) (to be issued). These CFRs codify DOE Orders as law and provisions are in place to assess criminal and civil penalties
- 49 CFR 71 (Subpart D) - package approval, if not already approved.

C.4.2.3 State Department

The transportation of fissile material from one nation to another, and overseas processing of DOE-owned SNF will probably require high level Administration approval to ensure that International Atomic Energy Act safeguards and U.S./U.K. national policies are maintained.

C.4.2.4 U.S. Department of Transportation

Transportation regulations within the U.S. navigable and territorial waters must be met, viz., maximum allowable exposure rate of 10 mrem/h at six feet from accessible external surfaces of the package (49 CFR 173.393, 173.471, and 173.472). For shipments in BNFL casks that are certified by non-U.S. regulatory authorities, the DOT would be responsible for reviewing and determining the acceptability of the shipping container for shipments in the U.S. Normally, this can be done using a reciprocity approach without a large review effort.

C.4.2.5 Environmental Protection Agency

Environmental Assessment/Impact Statement must be prepared for facilities that have the potential for environmental impact.

C.4.2.6 U.S. Coast Guard

The Captain of the Port may impose certain restrictions for movement and handling of hazardous materials such as number of tugs, time of tow, control of traffic, etc.

C.4.2.7 Nuclear Regulatory Commission

The Nuclear Regulatory Commission would not have jurisdictional authority over import/export shipments or DOE shipments of the type contemplated by the BNFL proposal. Nuclear Regulatory Commission regulates domestic shipments of licensed radioactive materials in the U.S. However, DOT may request the Nuclear Regulatory Commission technical staff to review a container to support their reciprocity recertification process.

C.4.3 GENERAL ISSUES/RECOMMENDATIONS

C.4.3.1 Initial Fuel State

The condition of the SNF in the 105 K Basins is not well known. Visual inspections are currently underway and addition characterization data will be gathered in the near term. Characterization needs now may be driven more by transportation system qualification than any other attribute. The extent of uranium hydride formation is a significant design issue.

Records and earlier, less comprehensive visual inspections, indicate 6 to 12% of the elements are damaged, i.e., elements having observable corrosion products. In addition, the cladding on an unknown number of elements may be cracked, and thus can be considered broken.

C.4.3.2 Fuel Corrosion and Reactions

Uranium metal in those fuel elements that have breached cladding will oxidize after contact with water and generate corrosion products. Uranium oxide and hydride products formed from these reactions will cause swelling of the metal within the cladding, which can cause additional cladding damage and even complete severing of fuel elements. Any additional uranium metal exposed will oxidize as well creating a perpetual cycle of cladding damage and uranium oxidation. Ultimately, the uranium completely oxidizes and forms a mud-like mixture with the water commonly referred to as sludge. The free hydrogen created by these oxidizing reactions is released into the surrounding water.

One of the major issues with the failed metallic fuel is that uranium and zirconium metals are chemically reactive in both water and air. Their reactivity can be increased by a number of factors, including the amount of metal surface area in contact with air and water, temperature, and the presence of alloys and impurities. In particular, small pieces of these metals are more reactive than large pieces and, under the right conditions,

are pyrophoric. Both uranium and zirconium metal powders are definitely considered pyrophoric. Consequently, precautions are required when handling or processing uranium and zirconium metals.

C.4.3.3 Cask Interface with K Basin

The issues associated with the off-loading of the SNF into the BNFL casks, and effort to complete this task have not been addressed in this study.

C.4.4 COST AND SCHEDULE DATA

Information on the Cost and Schedule for Alternative 4 is presented in Chapter 5, Section 5.2, "Cost and Schedule Data."

C.5.0 REFERENCES

WHC, 1993, *Hazardous Material Packaging and Shipping*, WHC-CM-2-14, Westinghouse Hanford Company, Richland, Washington.

APPENDIX D

SPENT NUCLEAR FUEL EXPEDITED REMOVAL DECISION COST & SCHEDULE DEVELOPMENT & ANALYSIS

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ALTERNATIVE 4 - Schedule, Cost Report, Cost Basis
PATH FORWARD CASE - Schedule, Cost Report, Cost Basis
Notes for Cost and Schedule Bases

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D.1.0 METHODOLOGY

Schedule and cost estimates were developed for the 4 options being evaluated by the decision process. The methodology for developing the schedule and cost estimates is depicted in Figure D-1. The schedules are organized consistent with the basic functional block diagram that is being used for the decision analysis. A cost and schedule methodology which defines the scope of the major activities was documented and provided to option advocates for their use in the development of reports on each option.

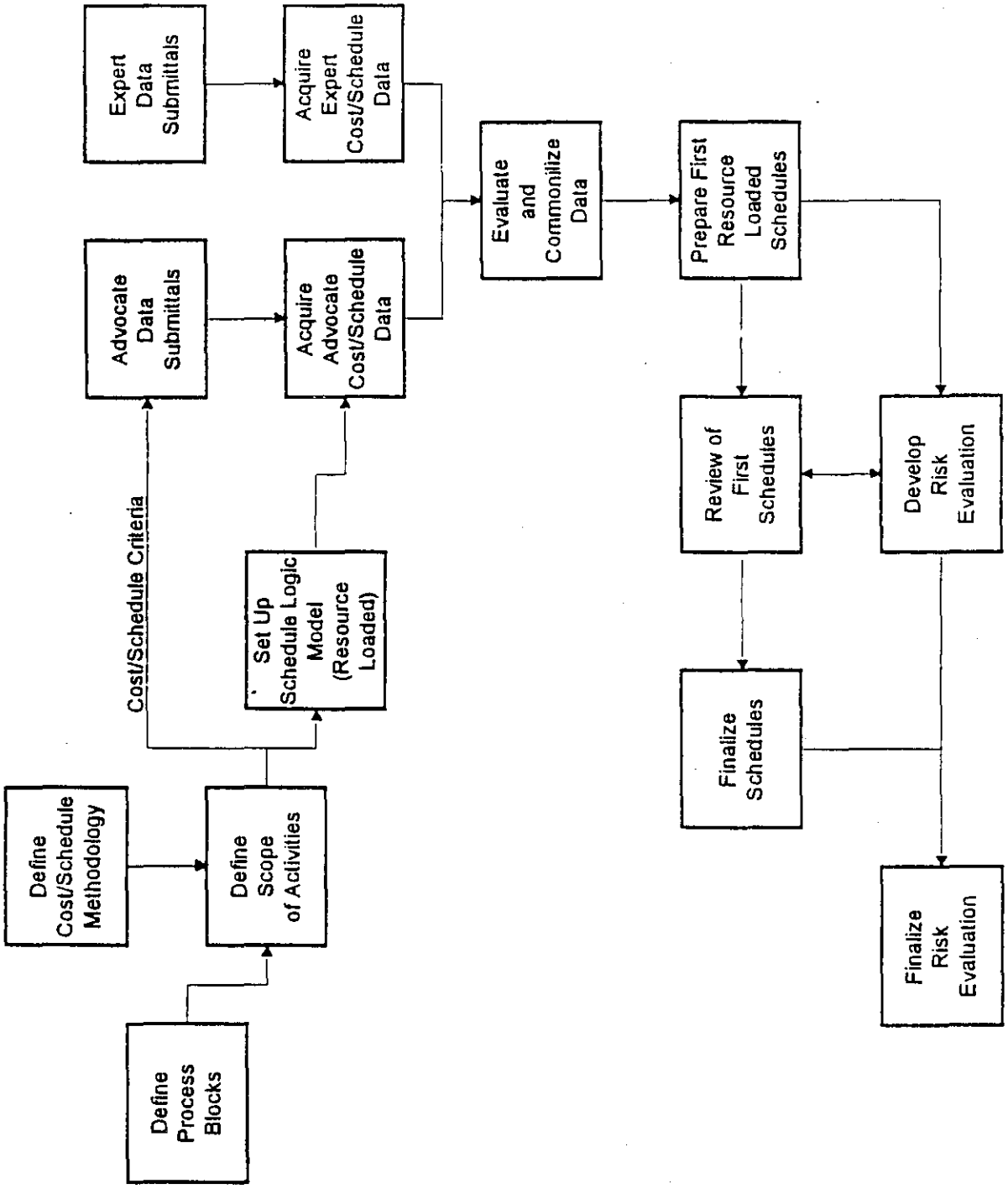
The methodology involved development of a generic schedule model using the PRIMAVERA project planner software. The generic model provides:

- typical logical relationships between activities,
- a basis for modeling constraints on performance of activities, and
- commonality of schedule basis between options.

Based on inputs from advocates, activities were adjusted for scope and logic differences between options and estimates for cost and schedule activity durations were established for each activity. Appropriate contingency values were included in the estimates.

The schedule and cost information received from the option advocates varied widely in assumptions and estimating techniques used to develop the data. Consequently, these data could not be compared directly. In order to facilitate comparison of Alternatives for the decision process, an effort was undertaken to place the schedule durations and cost on a common basis. The development of a common basis for advocate data involved numerous adjustments to cost and duration data, addition of missing scope, deletion of inappropriate scope, and adjustment of percentage adders to a common basis. The adjustment of data involved reference to analogies and expert judgement. Achievement of relative cost and schedule comparisons between Alternatives for the decision process was the goal. In many cases, a later effort will be needed to validate cost and schedule duration estimates used for establishing project budgets and for managing the project once a path forward is selected.

Figure D-1. Decision Process - Cost and Schedule Evaluation Process.



D.2.0 DEVELOPMENT BASIS

The Alternatives are described in the context of the configuration aspects important to the development of the cost and schedule estimate. The specific technical detail is consistent with that identified in the appropriate sections of the report.

Alternative 1 Contain fuel in the K Basin until a conditioning capability can be put in place.

The fuel in K-East is overpacked and stored in the basin. K-West fuel remains in the existing containers.

The fuel is transported to FMEF for conditioning. The conditioning process is performed in the Main Process Cell. The conditioning process removes the fuel from existing canisters. It is desludged and repacked into a conditioning canister, and loaded into the final storage overpack.

K-East sludge is collected in sludge containers, overpacked and transported to the FMEF conditioning process.

Conditioned fuel and sludge is transported to a new dry storage facility to be located in the 200 Area.

Basin debris is collected during the fuel loadout process for disposal as solid waste.

K-East Basin water is treated for tritium removal by a feed and removal process for 7 years.

Alternative 2 Overpack the fuel canisters in both basins, transport to a pre-interim storage facility, and store in the wet environment until a conditioning capability can be put in place

Both K-East and West Basins are overpacked and transported in a combined operation starting at the time the pre-interim storage facility is operational.

The Pre-Interim Storage Facility is a lined, enclosed pool, located next to the FMEF and utilizing the FMEF cask handling system.

K-East sludge is collected in sludge containers, overpacked and transported to the FMEF conditioning process.

Pre-interim storage continues until the conditioning capability becomes available,

Conditioning is performed in the FMEF railroad bay utilizing an Independent Technical Assessment type process. The existing canisters are desludged and placed into multi-canister overpack canisters for conditioning and interim dry storage.

After conditioning, the fuel storage canisters are transported to a dry storage area in the 200 Area.

Alternative 3 Overpack the K-East and West in multi-canister overpack type overpacks, transport to a conditioning facility as it becomes available.

Both K-East and West Basins are overpacked and transported in a continuous operation starting at the time the pre-interim storage facility is operational.

K-East sludge is collected in sludge containers, overpacked and transported in multi-canister overpack containers to the conditioning process.

Conditioning is performed in a new facility located in the 200 Area utilizing an Independent Technical Assessment type process.

After conditioning, the fuel storage canisters are transported to an adjacent dry storage area.

Alternative 4 The fuel in both basins is emptied from their existing canisters, repacked and transported in BNFL Magnox shipping casks to a barge facility located at the Port of Benton for shipment to the United Kingdom.

Under a contract with BNFL, fuel is processed into PuO_2, UO_3, and vitrified (borated glass) high level waste containers for return to the United States.

Both K-East and West Basins are loaded and transported in a continuous operation starting at the time barge facility is operational and the first transport ship is available.

Fuel is loaded in BNFL containers and transported in BNFL casks.

Transportation involves 17 ocean voyages over a six year period. Each voyage transports 24 BNFL Magnox casks.

K-East sludge is collected in sludge containers, overpacked and transported to the conditioning process.

Conditioning is performed in a new facility located in the 200 Area utilizing an Independent Technical Assessment type process.

After conditioning, the sludge storage canisters are transported to an adjacent dry storage area.

D.3.0 EVALUATION PROCESS

The economic evaluation calculates costs for the life cycle of the fuel and sludge handling process. The evaluation period is continued until all Alternatives have transported all the fuel and sludge to the dry storage period and facilities D&D have be completed. The evaluation period ends on March 31, 2012.

The estimate data was adjusted to a common level of confidence between the Alternatives. The results of the schedule durations and their cost resource estimates is intend to represent a level of confidence such that 50% of the time the ultimate cost or activity duration will fall below the estimate value.

The life cycle for each Alternative, except Alternative 4, includes removal of fuel, sludge and debris from the basins, transportation, acquisition of new facilities, stabilization of fuel and sludge, D&D of the processing facilities, and dry storage of fuel and sludge to the end of the evaluation period. The process performed within each of the Alternatives is defined by the process block diagram developed for the evaluation.

Alternative 4 includes a proposal by BNFL to process the fuel into 150 liter high level waste containers for return shipment to the United States. The cost provided is in the range from $1.0 to $2.5 billion. Since the final form of the process fuel is markedly different from the other Alternatives, the life cycle cost is not directly comparable to the other Alternatives. The work scope that is comparable, packaging and transportation of the fuel, is estimated and scheduled. The facilities and processes to process and store sludge are also identified.

The evaluation utilizes cost resource loaded schedules to specify the time expenditure of the estimated cost. Schedules are prepared defining the logically related activities necessary to perform the Alternative's scope. The scope contained within each activity is defined by inclusion criteria.

Activities with scope and cost common to all Alternatives are included in the evaluation because of potential time related differences.

Cost and schedule source data is acquired from the Alternative advocates. This information is reviewed and adjusted to establish a consistent scope definition, the FY 1994 pricing base date, an equivalent pricing basis and a constant level of confidence in the estimate results.

Domain expertise is utilized to define processes such as NEPA and safety analysis. These definitions are applied to all Alternatives.

The adjustment process utilizes cost and schedule expertise to establish cost and activity durations appropriate for expedited work at the Hanford Site. DOE Orders and administrative processes are recognized in the performance of the Alternatives' work scope.

The cost and schedule estimate is prepared in conjunction with the risk analysis prepared by others. Risk analysis establishes the uncertainty distribution of outcomes varying from the evaluated cost and schedule.

The cost and schedule are based on preliminary technical definition. The estimates and schedule durations reflect this lack off definition by an inherent degree of uncertainty. Estimates are prepared on an order of magnitude basis. Emphasis is placed on assuring the relative magnitude of the differences between Alternative activities is identified.

D.3.1 ESTIMATE BASIS ELEMENTS

NEPA Elements

The NEPA process will be conducted in accordance with DOE compliance orders. The following basis defines the restraints to the initiation of activities while the components of the NEPA process are being performed.

- DOE Spent Nuclear Fuel Programmatic EIS

  Restrains initiation of the Hanford Site SNF EIS.

- Hanford Site EIS

  Restrains the start of construction of facilities which will modify the chemical form of the existing K Basins fuel.

- Existing K Basin Environmental Assessment

  Activities associated with the packaging and moving fuel with the K Basins are not restrained.

- SNF Interim Action Environmental Assessment

  Restrains the start of design of basin modifications and the procurement of basis equipment and overpacks.

- SNF Interim Action EIS

  Restrains the start of construction of pre-interim storage facilities which do not change the existing fuel form.

Safety Analysis

Performance of the Alternatives will be conducted in accordance with DOE Orders and processes. For certain aspects of the scope, the work will be performed to meet NRC criteria. No schedule impact is identified for potential NRC involvement.

D.3.2 ESTIMATE SOURCE DATA AND ADJUSTMENT DESCRIPTION

For Alternatives 1 and 2 the estimates for capital facilities were prepared by Kaiser Engineers Hanford (KEH). These estimates were provided as part of the advocates' documentation. The initial development of Alternative 3 capital cost was developed by the advocate team. A subsequent estimate was prepared by KEH for the same scope of work to provide a comparison basis. Estimates by both KEH and the advocates were reviewed by the cost and schedule evaluation team for consistency of scope inclusion and estimating basis. In general, the KEH estimates were used after adjustment for scope elements. The KEH estimates used are:

- The repack and process facility in FMEF (Alternative 1)
- The Independent Technical Assessment process facility in the 200 Area (Alternative 3)
- The Independent Technical Assessment process conducted in the FMEF truck bay (Alternative 2)
- The pre-interim storage facility located at FMEF (Alternative 2).

The contingency identified on the KEH estimates was 50 percent. This percentage was deemed to represent a higher level of confidence than the basis of the evaluation. Hence, the percentage was reduced to 25 percent.

The capital estimate for the dry storage facility was established with respect to current commercial installations.

Staffing levels for plant operations were adjusted from the initial presentations by the advocates. The final staff levels are established to provide a number of full-time equivalents commensurate with the size and complexity of the processes. The initial data for Alternative 1 was reduced by approximately one half to reflect the short time period of the process (minimum capital upgrades and major maintenance) and the use of partial full-time equivalents. The initial data for Alternative 3 was increased to reflect the need for technical and administrative personnel required to support Hanford operations under DOE order compliance.

In basin operations staff levels were estimated by discussion with K Basin operations managers. The emphasis is to assure recognition of the relative difference in the scope of work between the Alternatives. A limit of 1 Rem per year for workers was utilized.

The cost of transportation includes the acquisition of new transport casks, rail cars, operations personnel, road security and rail maintenance fee.

Order of magnitude estimates were developed for the cost of D&D of new facilities that must be constructed to process the fuel and sludge from the basins. However, lack of information to estimate D&D costs results in low confidence in these estimates. It is recommended that the D&D estimates not be considered major factors in the decision analysis process based on these estimates.

A more specific basis of estimates is provided by the basis description documented for the significant activities in each Alternative. The documentation is enclosed.

D.4.0 ANALYSIS

D.4.1 DATA

The results of the cost and schedule are enclosed. The scheduled activities are shown at their early start time. Smoothing of cost-time profiles has not been performed. The information for each Alternative includes:

- A summary schedule bar chart, with cost identified for each process block.
- A detail schedule bar chart, with cost identified for each activity.
- A cost report, with cost shown for each fiscal year for each activity.

D.4.2 DRIVING COST ELEMENTS AND TRADEOFFS

Alternative 3, the Independent Technical Assessment passivation process, appears to be the lowest cost Alternative; although, costs for this option are evaluated to be significantly higher than indicated in the Independent Technical Assessment report. Several features of the cost analysis for Alternatives 1 through 3 are noted below:

- Alternative 2 includes the cost for a pre-interim storage pool; but this added cost is balanced by reduced costs for K Basins operation (i.e., fuel is removed from the basins earlier).
- Transportation cost for Alternatives 1 and 2 are larger than for Alternative 3 because of the need to transport all of the fuel twice instead of once.
- The cost of in-basin activities are higher for Alternative 3 due to canister handling and de-sludging tasks.
- Alternative 1 has higher fuel stabilization facility cost (i.e., repack and passivate in a hot cell), but this is some what balanced by less expensive overpacks and a reduced number of fuel containers for passivation and storage achieved by the repackaging step.
- Interim storage facility cost is slightly lower for Alternative 1 also due to the reduced number of containers for storage.
- Limited information for estimating D&D cost for new facilities was available; therefore it is recommended that D&D cost not be considered a discriminator between options.

Finally, the costs for Alternative 4, foreign processing, are much larger than the other Alternatives and have a wide range due to the estimate supplied by BNFL. BNFL indicated a cost range of $1.0 to $2.5 billion for their cost to ship, process, and store the K Basins fuel. Costs were also estimated for

processing and storing sludge from the basins and for continuing operation during the 6 year shipping period. The result is an Alternative 4 cost range of $1.9 to $3.4 billion.

D.4.3 SCHEDULE AND CRITICAL PATH ANALYSIS

The schedule analysis assumes that a decision to proceed on a selected path forward is reached by November 1, 1994. Based on the schedule analysis, Alternative 2, which provides temporary wet storage in a pre-interim facility near FMEF, is the only case that achieves removal of fuel and sludge by the 2002 TPA milestone. Both Alternative 1 and 3 complete the fuel and sludge removal during 2003 and Alternative 4, the foreign processing option, finishes shipping of fuel from the K Basins during 2004. Alternative 1 has the advantage of achieving early containerization of fuel in the K Basins compared to other options.

Alternative 1

The critical path is established by the availability of the processing facility in FMEF. The sequence of activities leading to its availability include the design, construction, operational testing, Official Readiness Review.

Once processing capability is available, the actions to load from the basins, transport, process, and transport to dry storage are performed simultaneously. A breakdown in any of these actions preclude performance of the other actions. The potential for a schedule delay is significant.

Overpacking of the fuel in the K-East Basin is not on the critical path. This action allows primary containment of the fuel at the earliest time.

Design and construction of the dry storage facility is a routine process in the commercial industry. A total of 48 months are available before these actions drive the critical path.

Alternative 2

The acquisition of the pre-interim storage removes the process facility from the initial critical path. The packaging and movement of fuel from the K Basins is constrained by the design, construction and startup of this facility.

The acquisition of the processing capability in FMEF forms the later critical path because of the advocate assumption to process the stored fuel as soon as the processing capability is available. Modification of this strategy to include an extended time in the pre-interim storage pool, removes the processing facility from the critical path.

Alternative 3

The processing facility establishes the critical path for this Alternative. Alternative 3 employs the concept of a full scale, reduced capacity plant as a demonstration unit. The operation of this unit

requires nearly complete design and construction, a full safety analysis, and complete availability of transportation. Further, the demonstration period and the subsequent performance analysis and construction completion extended the completion of fuel processing by approximately 12 months.

As with Alternative 1, the co-performance of loadout, transportation and processing present the risk of potential schedule upsets to complete removal of the fuel from the basins.

Alternative 4

The critical path will probably be established by the timing required to get a contract with BNFL in place. The evaluation does not explicitly consider this activity because of the lack of information. Without the contract issue, the critical path is established by the availability of BNFL to begin shipping and processing the fuel. NEPA compliance and the attainment of permits to transport the fuel to the barge facility could be driving activities.

Collection and processing of the sludge for a separate critical path to completing cleanup of the basins.

D.4.4 ANALYSIS RESULTS SUMMARY

Cost and schedule analysis results are summarized in Table D-1 below:

Table D-1. Total Life Cycle Costs and Key Schedule Dates.

Alternative	Fuel Containerization Complete	Removal from K Basins Complete	Transfer to Dry Storage Complete	Total Cost ($Millions)
Alt 1	4/30/98	11/30/03	11/30/03	$ 1,192
Alt 2	11/30/00	11/30/00	3/31/03	$ 1,223
Alt 3	6/30/03	6/30/03	6/30/03	$ 1,086
Alt 4	4/30/04	4/30/04	NA	$ 1,896 to 3,396

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D.5.0 RECOMMENDED PATH FORWARD COST AND SCHEDULE

During the course of the decision analysis for Alternatives 1 through 4, a path forward strategy emerged which combines certain attractive features of Alternatives 2 and 3. This Recommended Path Forward involves packaging the fuel and sludge in multi-canister overpack containers (without desludging) and transporting it to a staging and storage facility where the fuel is stored wet until a processing facility is completed. When the processing facility is ready fuel is desludged and processed in the multi-canister overpacks using an Independent Technical Assessment passivation process.

Schedule and cost estimates were developed for the Recommended Path Forward approach for comparison with the four primary Alternatives. Conceptual drawings and detailed cost estimates were not prepared for the staging and storage facility. Costs were estimated by analogy with estimates developed for Alternatives 2 and 3. The schedules are not based strictly on an early start approach. Instead fuel is removed to the staging facility on an expedited basis. The processing facility design and construction is phased to avoid as much as practical construction and operation of several major facilities at the same time.

Results of the Recommended Path Forward case are shown below:

- Removal of Fuel from K Basins: 11/30/00
- Transfer to Dry Storage Complete: 4/30/06
- Life Cycle Cost ($millions): $ 1,146

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D.6.0 REFERENCES

National Environmental Policy Act of 1969, 42 U.S.C. 4321, et seq.

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ATTACHMENT

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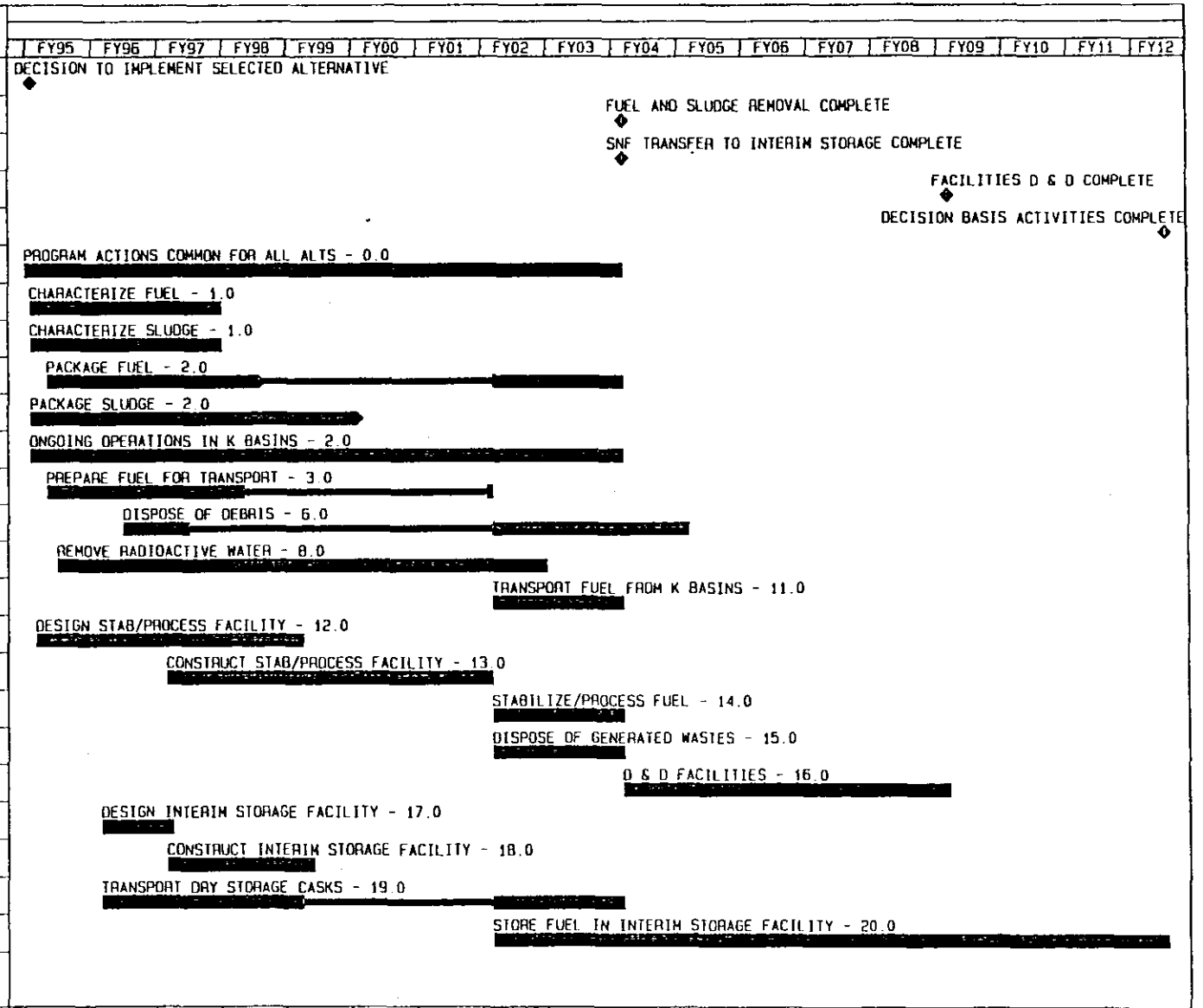
EARLY START	EARLY FINISH	BUDGET COST
1NOV94	31OCT94	0
1DEC03	30NOV03	0
1DEC03	30NOV03	0
1DEC08	30NOV08	0
1APR12	31MAR12	0
1OCT94	30NOV03	95
1NOV94	30SEP97	13
1NOV94	30SEP97	5
1FEB95	30NOV03	25
1NOV94	31OCT99	23
1NOV94	30NOV03	397
1FEB95	30NOV01	19
1APR96	30NOV04	10
1APR95	30SEP02	18
1DEC01	30NOV03	10
1DEC94	31DEC98	56
1DEC96	30NOV01	162
1DEC01	30NOV03	68
1DEC01	30NOV03	3
1DEC03	30NOV08	220
1DEC95	31DEC96	2
1DEC96	28FEB99	29
1DEC95	30NOV03	18
1DEC01	31MAR12	19



Plot Date 18OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

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Inactive
Summary Bar/Early Dates
Critical Designator
Milestone/Flag Activity

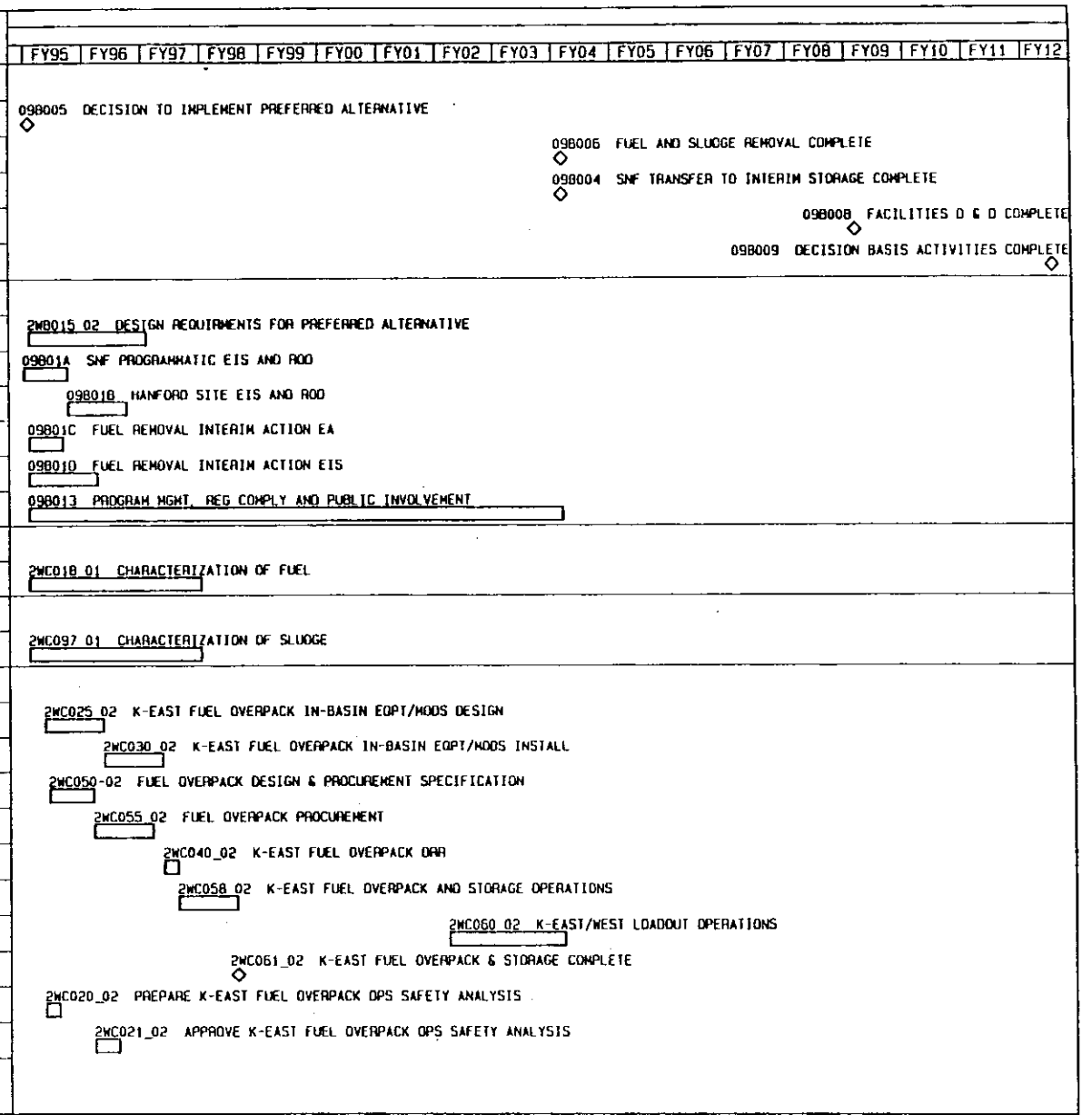
K BASIN
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 1 - SUMMARY

Sheet 1 of 1

REVISION F 10/13/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
DECISION BASIS KEY DATES - 0.0					
00A	100	1NOV94		0	.0
00A	100		30NOV03	0	.0
00A	200		30NOV03	0	.0
00A	300		30NOV08	0	.0
00A	400		31MAR12	0	.0
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0					
00B	100	1NOV94	31OCT96	24	.0
00B	310	1OCT94	30JUN95	9	.0
00B	320	1JUL95	30JUN96	12	.0
00B	320	1NOV94	31MAY95	7	.0
00B	320	1NOV94	31DEC95	14	.0
00B	400	1NOV94	30NOV03	109	95.4
CHARACTERIZE FUEL - 1.0					
01A	100	1NOV94	30SEP97	35	13.0
CHARACTERIZE SLUDGE - 1.0					
01B	100	1NOV94	30SEP97	35	5.0
PACKAGE FUEL - 2.0					
02A	100	1FEB95	31JAN96	12	5.5
02A	100	1FEB96	31JAN97	12	7.4
02A	200	1MAR95	30NOV95	9	.2
02A	200	1DEC95	30NOV96	12	5.2
02A	300	1FEB97	30APR97	3	.1
02A	400	1MAY97	30APR98	12	5.1
02A	400	1DEC01	30NOV03	24	1.4
02A	400		30APR98	0	.0
02A	500	1FEB95	30APR95	3	.2
02A	500	1DEC95	30APR96	5	.1



Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

KAJF

Sheet 1 of 4

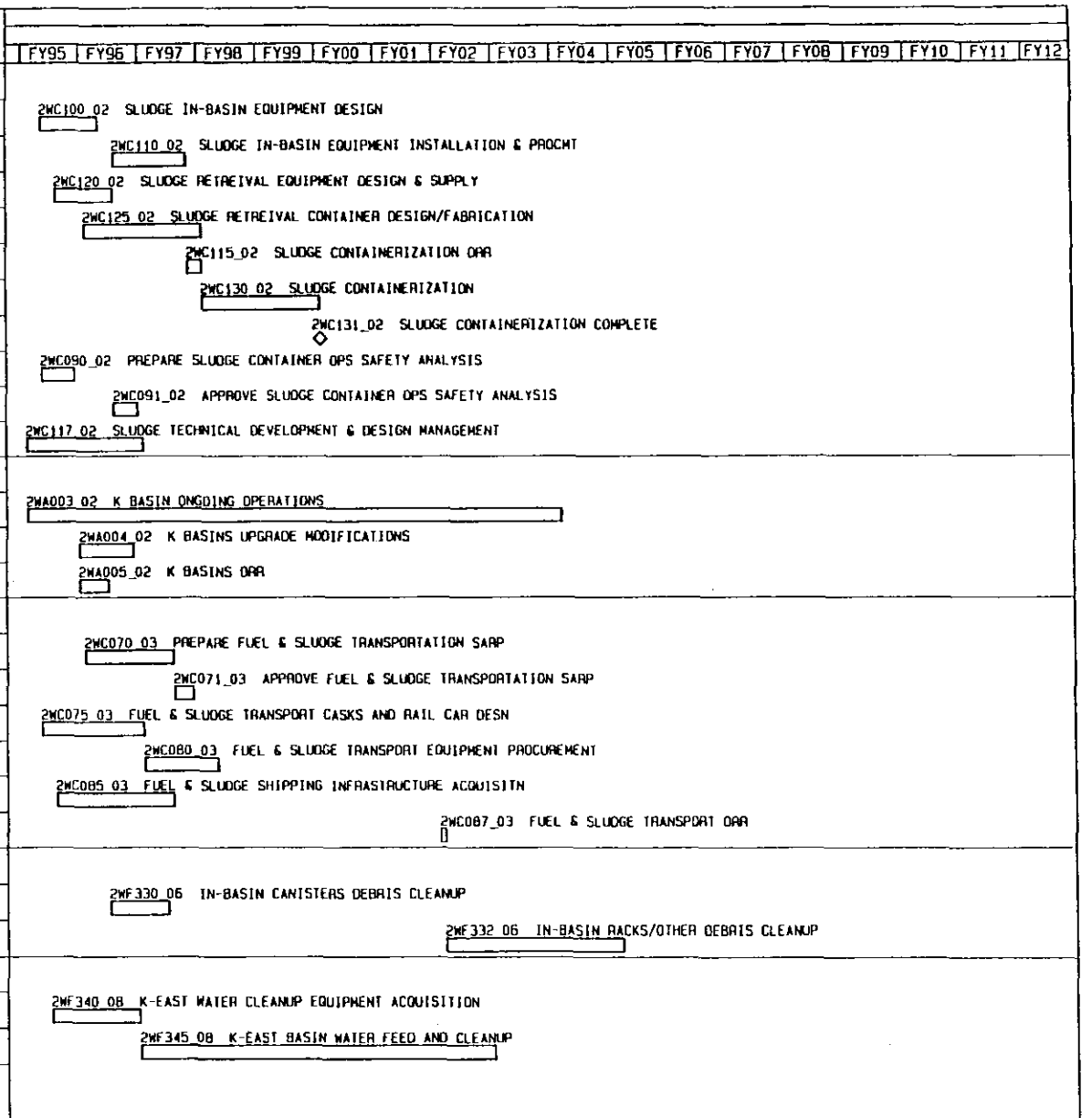
K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 1

REVISION F 10/13/94

Date	Revision	Checked	Approved

C:\VPC

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
PACKAGE SLUDGE - 2.0					
02B	100	1FEB95	31JAN96	12	2.6
02B	100	1MAY96	31JUL97	15	2.5
02B	200	1MAY95	30APR96	12	10.0
02B	200	1NOV96	31OCT97	24	4.0
02B	300	1AUG97	31OCT97	3	.2
02B	400	1NOV97	31OCT99	24	.8
02B	400	1NOV99	31OCT99	0	.0
02B	500	1FEB95	31AUG95	7	.2
02B	500	1MAY96	30SEP96	5	.1
02B	500	1NOV94	31OCT96	24	2.6
ONGOING OPERATIONS IN K BASINS - 2.0					
02C	100	1NOV94	30NOV03	109	381.5
02C	100	10CT95	31AUG96	11	13.1
02C	300	10CT95	31MAR96	6	2.4
PREPARE FUEL FOR TRANSPORT - 3.0					
03A	100	1NOV95	30APR97	18	.6
03A	100	1MAY97	31AUG97	4	.1
03A	100	1FEB95	31OCT96	21	3.0
03A	100	1NOV96	31JAN98	15	15.0
03A	200	1MAY95	30APR97	24	.0
03A	300	1NOV01	30NOV01	1	.0
DISPOSE OF DEBRIS - 6.0					
060	100	1APR96	31MAR97	12	3.4
060	200	1DEC01	30NOV04	36	6.6
REMOVE RADIOACTIVE WATER - 8.0					
080	100	1APR95	30SEP96	18	6.6
080	200	10CT96	30SEP02	72	11.4



Plot Date 13OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

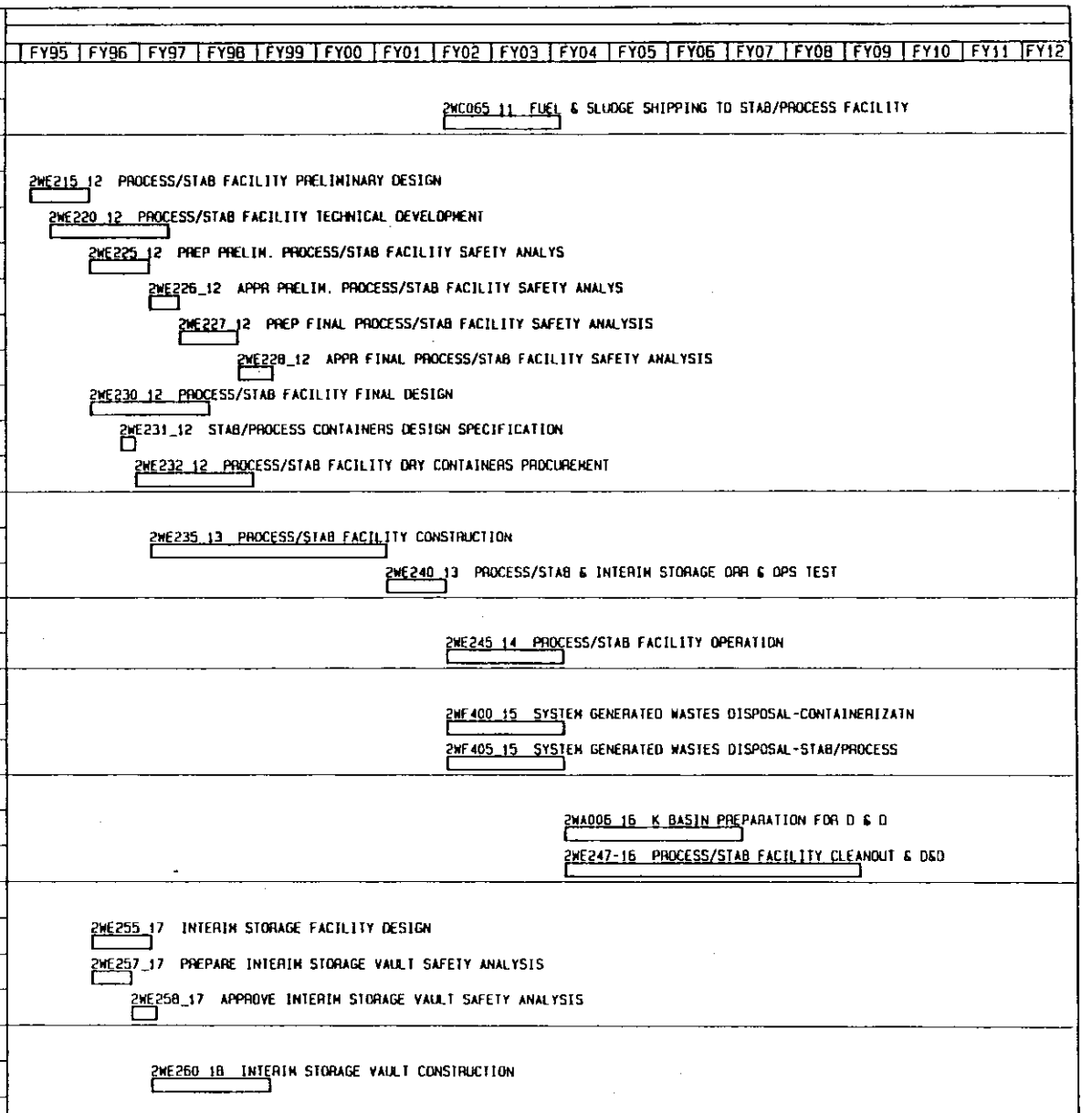
K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 1

Sheet 2 of 4

REVISION F 10/13/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
TRANSPORT FUEL FROM K BASINS - 11.0					
11A	100	1DEC01	30NOV03	24	10.0
DESIGN STAB/PROCESS FACILITY - 12.0					
120	100	1DEC94	30NOV95	12	2.3
120	200	1APR95	31MAR97	24	19.7
120	300	1DEC95	30NOV96	12	1.0
120	300	1DEC96	31MAY97	6	.4
120	300	1JUN97	31MAY98	12	.9
120	300	1JUN98	31DEC98	7	.5
120	400	1DEC95	30NOV97	24	20.1
120	600	1JUN96	31AUG96	3	.0
120	600	1SEP96	31AUG98	24	11.0
CONSTRUCT STAB/PROCESS FACILITY - 13.0					
130	100	1DEC96	30NOV00	48	127.6
130	200	1DEC00	30NOV01	12	34.0
STABILIZE/PROCESS FUEL - 14.0					
140	100	1DEC01	30NOV03	24	68.0
DISPOSE OF GENERATED WASTES - 15.0					
150	100	1DEC01	30NOV03	24	.0
150	200	1DEC01	30NOV03	24	2.6
D & D FACILITIES - 16.0					
160	100	1DEC03	30NOV06	36	90.0
160	300	1DEC03	30NOV08	60	130.0
DESIGN INTERIM STORAGE FACILITY - 17.0					
170	100	1DEC95	30NOV96	12	1.0
170	200	1DEC95	31JUL96	8	.7
170	200	1AUG96	31DEC96	5	.4
CONSTRUCT INTERIM STORAGE FACILITY - 18.0					
180	100	1DEC96	30NOV98	24	29.0



Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

(c) Primavera Systems, Inc.

Sheet 3 of 4

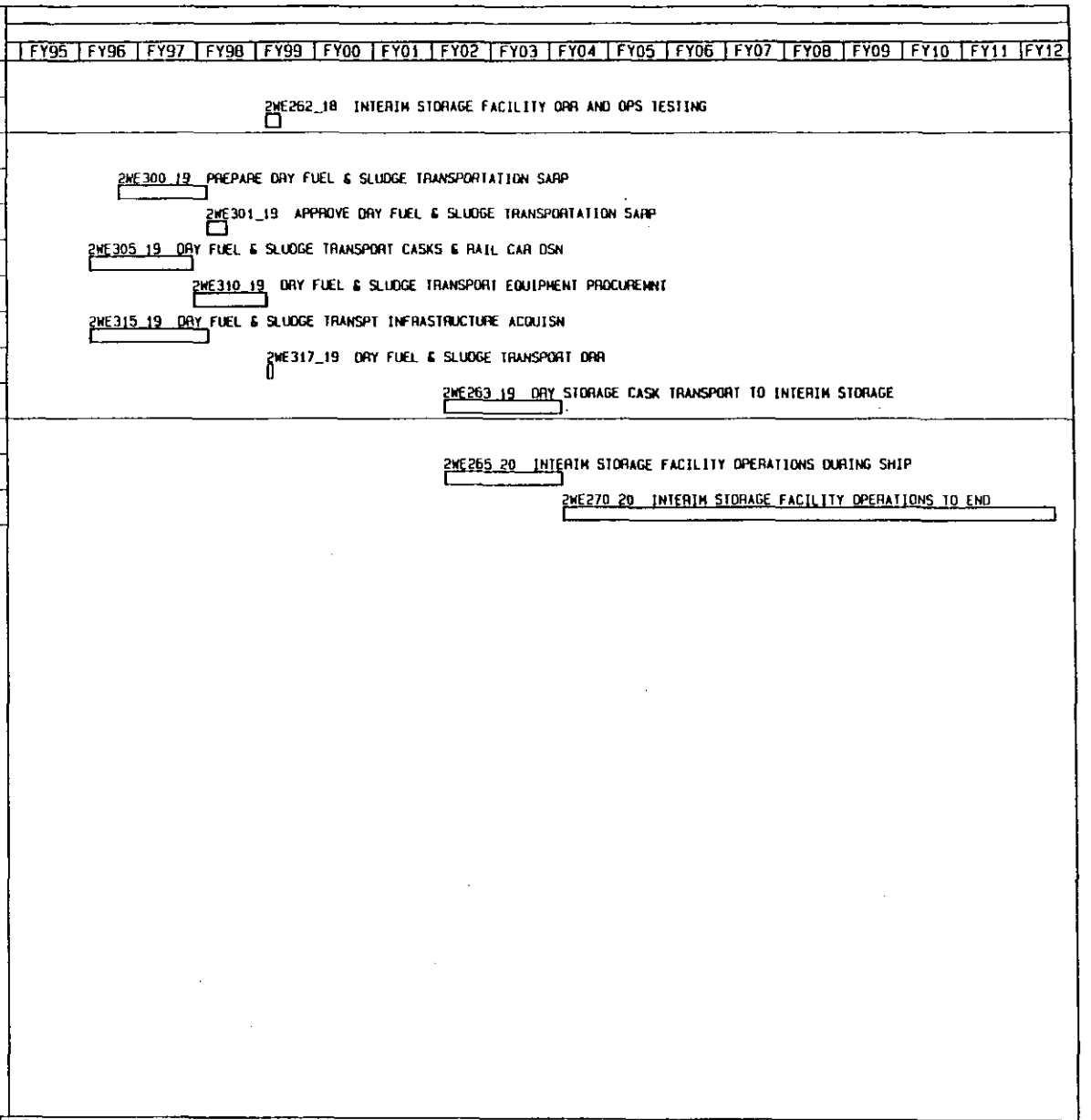
K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 1

REVISION F 10/13/94

Date	Revision	Checked	Approved

C:\PBC

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
CONSTRUCT INTERIM STORAGE FACILITY - 18.0					
180	300	10DEC98	28FEB99	3	2
TRANSPORT DRY STORAGE CASKS - 19.0					
190	100	1JUN96	30NOV97	18	6
190	100	10DEC97	31MAR98	4	.1
190	100	10DEC95	31AUG97	21	2.0
190	100	1SEP97	30NOV98	15	8.0
190	200	10DEC95	30NOV97	24	.0
190	300	10DEC98	31DEC98	1	.1
190	400	10DEC01	30NOV03	24	7.0
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0					
200	300	10DEC01	30NOV03	24	6.6
200	400	10DEC03	31MAR12	100	12.5



Plot Date 13OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 1

Sheet 4 of 4

REVISION F 10/13/94

Date	Revision	Checked	Approved

PRIMAVERA PROJECT PLANNER — ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241 15:02 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 1- 1

ALTERNATIVE 1 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT	95.4	9.6	10.5	10.5	10.5	10.5	10.5	10.5
TOTAL	00B	95.4	9.6	10.5	10.5	10.5	10.5	10.5	10.5
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL	13.0	4.1	4.5	4.5				
TOTAL	01A	13.0	4.1	4.5	4.5				
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE	5.0	1.6	1.7	1.7				
TOTAL	01B	5.0	1.6	1.7	1.7				
PACKAGE FUEL - 2.0									
2WC020_02	PREPARE K-EAST FUEL OVERPACK OPS SAFETY ANALYSIS	0.2	0.2						
2WC021_02	APPROVE K-EAST FUEL OVERPACK OPS SAFETY ANALYSIS	0.1		0.1					
2WC025_02	K-EAST FUEL OVERPACK IN-BASIN EQPT/MODS DESIGN	5.5	3.7	1.8					
2WC030_02	K-EAST FUEL OVERPACK IN-BASIN EQPT/MODS INSTALL	7.4		4.9	2.5				
2WC040_02	K-EAST FUEL OVERPACK ORR	0.1			0.1				
2WC050-02	FUEL OVERPACK DESIGN & PROCUREMENT SPECIFICATION	0.2	0.2	0.0					
2WC055_02	FUEL OVERPACK PROCUREMENT	5.2		4.3	0.9				
2WC058_02	K-EAST FUEL OVERPACK AND STORAGE OPERATIONS	5.1			2.1	3.0			
2WC060_02	K-EAST/WEST LOADOUT OPERATIONS	1.4							
TOTAL	02A	25.2	4.0	11.2	5.6	3.0			
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINER OPS SAFETY ANALYSIS	0.2	0.2						
2WC091_02	APPROVE SLUDGE CONTAINER OPS SAFETY ANALYSIS	0.1		0.1					
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN	2.6	1.7	0.9					
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT	2.5		0.8	1.7				
2WC115_02	SLUDGE CONTAINERIZATION ORR	0.2			0.1	0.1			
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT	2.6	1.2	1.3	0.1				
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY	10.0	4.2	5.8					
2WC125_02	SLUDGE RETREIVAL CONTAINER DESIGN/FABRICATION	4.0		1.8	2.0	0.2			
2WC130_02	SLUDGE CONTAINERIZATION	0.8				0.4	0.4	0.0	
TOTAL	02B	23.0	7.3	10.8	3.9	0.6	0.4	0.0	
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS	381.5	38.5	42.0	42.0	42.0	42.0	42.0	42.0
2WA004_02	K BASINS UPGRADE MODIFICATIONS	13.1		13.1					
2WA005_02	K BASINS ORR	2.4		2.4					
TOTAL	02C	397.0	38.5	57.5	42.0	42.0	42.0	42.0	42.0
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP	0.6		0.4	0.2				
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP	0.1			0.1				
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN	3.0	1.1	1.7	0.1				
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT	15.0			11.0	4.0			
TOTAL	03A	18.7	1.1	2.1	11.5	4.0			

PRIMAVERA PROJECT PLANNER — ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241 15:02 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 2- 1

ALTERNATIVE 1 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
DISPOSE OF DEBRIS - 6.0									
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP	3.4		1.7	1.7				
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP	6.6							
TOTAL	060	10.0		1.7	1.7				
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION	6.6	2.2	4.4					
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP	11.4			1.9	1.9	1.9	1.9	1.9
TOTAL	080	18.0	2.2	4.4	1.9	1.9	1.9	1.9	1.9
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_11	FUEL & SLUDGE SHIPPING TO STAB/PROCESS FACILITY	10.0							
TOTAL	11A	10.0							
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12	PROCESS/STAB FACILITY PRELIMINARY DESIGN	2.3	1.9	0.4					
2WE220_12	PROCESS/STAB FACILITY TECHNICAL DEVELOPMENT	19.7	4.9	9.9	4.9				
2WE225_12	PREP PRELIM. PROCESS/STAB FACILITY SAFETY ANALYS	1.0		0.8	0.2				
2WE226_12	APPR PRELIM. PROCESS/STAB FACILITY SAFETY ANALYS	0.4			0.4				
2WE227_12	PREP FINAL PROCESS/STAB FACILITY SAFETY ANALYSIS	0.9			0.3	0.6			
2WE228_12	APPR FINAL PROCESS/STAB FACILITY SAFETY ANALYSIS	0.5				0.3	0.2		
2WE230_12	PROCESS/STAB FACILITY FINAL DESIGN	20.1		8.4	10.1	1.7			
2WE232_12	PROCESS/STAB FACILITY DRY CONTAINERS PROCUREMENT	11.0		0.5	5.5	5.0			
TOTAL	120	55.9	6.8	19.9	21.3	7.6	0.2		
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13	PROCESS/STAB FACILITY CONSTRUCTION	127.6			26.6	31.9	31.9	31.9	5.3
2WE240_13	PROCESS/STAB & INTERIM STORAGE ORR & OPS TEST	34.0							28.3
TOTAL	130	161.6			26.6	31.9	31.9	31.9	33.6
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14	PROCESS/STAB FACILITY OPERATION	68.0							
TOTAL	140	68.0							
DISPOSE OF GENERATED WASTES - 15.0									
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS	2.6							
TOTAL	150	2.6							
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARATION FOR D & D	90.0							
2WE247-16	PROCESS/STAB FACILITY CLEANOUT & D&D	130.0							
TOTAL	160	220.0							
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE255_17	INTERIM STORAGE FACILITY DESIGN	1.0		0.8	0.2				
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS	0.7		0.7					

PRIMAVERA PROJECT PLANNER — ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241 15:02 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 3- 1

ALTERNATIVE 1 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS	0.4		0.2	0.2				
TOTAL	170	2.1		1.7	0.4				
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18	INTERIM STORAGE VAULT CONSTRUCTION	29.0			12.1	14.5	2.4		
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING	0.2					0.2		
TOTAL	180	29.2			12.1	14.5	2.6		
TRANSPORT DRY STORAGE CASKS - 19.0									
2WE263_19	DRY STORAGE CASK TRANSPORT TO INTERIM STORAGE	7.0							
2WE300_19	PREPARE DRY FUEL & SLUDGE TRANSPORTATION SARP	0.6		0.1	0.4	0.1			
2WE301_19	APPROVE DRY FUEL & SLUDGE TRANSPORTATION SARP	0.1				0.1			
2WE305_19	DRY FUEL & SLUDGE TRANSPORT CASKS & RAIL CAR DSN	2.0		1.0	1.0				
2WE310_19	DRY FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMNT	8.0			0.5	6.4	1.1		
2WE317_19	DRY FUEL & SLUDGE TRANSPORT ORR	0.1					0.1		
TOTAL	190	17.8		1.1	2.0	6.6	1.2		
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP	6.6							
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END	12.5							
TOTAL	200	19.1							
	REPORT TOTAL	1191.6	75.3	127.0	145.6	122.5	90.7	86.3	88.1

PRIMAVERA PROJECT PLANNER — ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241 15:02 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 1- 2

ALTERNATIVE 1 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT	10.5	10.5	1.8					
TOTAL	00B	10.5	10.5	1.8					
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL								
TOTAL	01A								
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE								
TOTAL	01B								
PACKAGE FUEL - 2.0									
2WC020_02	PREPARE K-EAST FUEL OVERPACK OPS SAFETY ANALYSIS								
2WC021_02	APPROVE K-EAST FUEL OVERPACK OPS SAFETY ANALYSIS								
2WC025_02	K-EAST FUEL OVERPACK IN-BASIN EQPT/MODS DESIGN								
2WC030_02	K-EAST FUEL OVERPACK IN-BASIN EQPT/MODS INSTALL								
2WC040_02	K-EAST FUEL OVERPACK ORR								
2WC050-02	FUEL OVERPACK DESIGN & PROCUREMENT SPECIFICATION								
2WC055_02	FUEL OVERPACK PROCUREMENT								
2WC058_02	K-EAST FUEL OVERPACK AND STORAGE OPERATIONS								
2WC060_02	K-EAST/WEST LOADOUT OPERATIONS	0.6	0.7	0.1					
TOTAL	02A	0.6	0.7	0.1					
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINER OPS SAFETY ANALYSIS								
2WC091_02	APPROVE SLUDGE CONTAINER OPS SAFETY ANALYSIS								
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN								
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT								
2WC115_02	SLUDGE CONTAINERIZATION ORR								
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT								
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY								
2WC125_02	SLUDGE RETREIVAL CONTAINER DESIGN/FABRICATION								
2WC130_02	SLUDGE CONTAINERIZATION								
TOTAL	02B								
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS	42.0	42.0	7.0					
2WA004_02	K BASINS UPGRADE MODIFICATIONS								
2WA005_02	K BASINS ORR								
TOTAL	02C	42.0	42.0	7.0					
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP								
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP								
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN								
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT								
TOTAL	03A								

PRIMAVERA PROJECT PLANNER — ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241 15:02 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 2- 2

ALTERNATIVE 1 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DISPOSE OF DEBRIS - 6.0									
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP								
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP	1.8	2.2	2.2	0.4				
TOTAL	060	1.8	2.2	2.2	0.4				
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION								
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP	1.9							
TOTAL	080	1.9							
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_11	FUEL & SLUDGE SHIPPING TO STAB/PROCESS FACILITY	4.2	5.0	0.8					
TOTAL	11A	4.2	5.0	0.8					
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12	PROCESS/STAB FACILITY PRELIMINARY DESIGN								
2WE220_12	PROCESS/STAB FACILITY TECHNICAL DEVELOPMENT								
2WE225_12	PREP PRELIM. PROCESS/STAB FACILITY SAFETY ANALYS								
2WE226_12	APPR PRELIM. PROCESS/STAB FACILITY SAFETY ANALYS								
2WE227_12	PREP FINAL PROCESS/STAB FACILITY SAFETY ANALYSIS								
2WE228_12	APPR FINAL PROCESS/STAB FACILITY SAFETY ANALYSIS								
2WE230_12	PROCESS/STAB FACILITY FINAL DESIGN								
2WE232_12	PROCESS/STAB FACILITY DRY CONTAINERS PROCUREMENT								
TOTAL	120								
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13	PROCESS/STAB FACILITY CONSTRUCTION								
2WE240_13	PROCESS/STAB & INTERIM STORAGE ORR & OPS TEST	5.7							
TOTAL	130	5.7							
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14	PROCESS/STAB FACILITY OPERATION	28.3	34.0	5.7					
TOTAL	140	28.3	34.0	5.7					
DISPOSE OF GENERATED WASTES - 15.0									
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS	1.1	1.3	0.2					
TOTAL	150	1.1	1.3	0.2					
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARATION FOR D & D*	*		25.0	30.0	30.0	5.0		
2WE247-16	PROCESS/STAB FACILITY CLEANOUT & D&D			21.7	26.0	26.0	26.0	26.0	4.3
TOTAL	160			46.7	56.0	56.0	31.0	26.0	4.3
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE255_17	INTERIM STORAGE FACILITY DESIGN								
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS								

PRIMAVERA PROJECT PLANNER — ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241 15:02 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 3- 2

ALTERNATIVE 1 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS								
TOTAL	170								
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18	INTERIM STORAGE VAULT CONSTRUCTION								
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING								
TOTAL	180								
TRANSPORT DRY STORAGE CASKS - 19.0									
2WE263_19	DRY STORAGE CASK TRANSPORT TO INTERIM STORAGE	2.9	3.5	0.6					
2WE300_19	PREPARE DRY FUEL & SLUDGE TRANSPORTATION SARP								
2WE301_19	APPROVE DRY FUEL & SLUDGE TRANSPORTATION SARP								
2WE305_19	DRY FUEL & SLUDGE TRANSPORT CASKS & RAIL CAR DSN								
2WE310_19	DRY FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMNT								
2WE317_19	DRY FUEL & SLUDGE TRANSPORT ORR								
TOTAL	190	2.9	3.5	0.6					
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP	2.8	3.3	0.6					
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END			1.3	1.5	1.5	1.5	1.5	1.5
TOTAL	200	2.8	3.3	1.8	1.5	1.5	1.5	1.5	1.5
	REPORT TOTAL	101.7	102.5	66.8	57.9	57.5	32.5	27.5	5.8

PRIMAVERA PROJECT PLANNER — ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241 15:02 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 1- 3

ALTERNATIVE 1 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0				
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT			
TOTAL	00B			
CHARACTERIZE FUEL - 1.0				
2WC018_01	CHARACTERIZATION OF FUEL			
TOTAL	01A			
CHARACTERIZE SLUDGE - 1.0				
2WC097_01	CHARACTERIZATION OF SLUDGE			
TOTAL	01B			
PACKAGE FUEL - 2.0				
2WC020_02	PREPARE K-EAST FUEL OVERPACK OPS SAFETY ANALYSIS			
2WC021_02	APPROVE K-EAST FUEL OVERPACK OPS SAFETY ANALYSIS			
2WC025_02	K-EAST FUEL OVERPACK IN-BASIN EQPT/MODS DESIGN			
2WC030_02	K-EAST FUEL OVERPACK IN-BASIN EQPT/MODS INSTALL			
2WC040_02	K-EAST FUEL OVERPACK ORR			
2WC050-02	FUEL OVERPACK DESIGN & PROCUREMENT SPECIFICATION			
2WC055_02	FUEL OVERPACK PROCUREMENT			
2WC058_02	K-EAST FUEL OVERPACK AND STORAGE OPERATIONS			
2WC060_02	K-EAST/WEST LOADOUT OPERATIONS			
TOTAL	02A			
PACKAGE SLUDGE - 2.0				
2WC090_02	PREPARE SLUDGE CONTAINER OPS SAFETY ANALYSIS			
2WC091_02	APPROVE SLUDGE CONTAINER OPS SAFETY ANALYSIS			
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN			
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT			
2WC115_02	SLUDGE CONTAINERIZATION ORR			
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT			
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY			
2WC125_02	SLUDGE RETREIVAL CONTAINER DESIGN/FABRICATION			
2WC130_02	SLUDGE CONTAINERIZATION			
TOTAL	02B			
ONGOING OPERATIONS IN K BASINS - 2.0				
2WA003_02	K BASIN ONGOING OPERATIONS			
2WA004_02	K BASINS UPGRADE MODIFICATIONS			
2WA005_02	K BASINS ORR			
TOTAL	02C			
PREPARE FUEL FOR TRANSPORT - 3.0				
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP			
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP			
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN			
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT			
TOTAL	03A			

PRIMAVERA PROJECT PLANNER — ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241 15:02 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 2- 3

ALTERNATIVE 1 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
DISPOSE OF DEBRIS - 6.0				
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP			
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP			
TOTAL	060			
REMOVE RADIOACTIVE WATER - 8.0				
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION			
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP			
TOTAL	080			
TRANSPORT FUEL FROM K BASINS - 11.0				
2WC065_11	FUEL & SLUDGE SHIPPING TO STAB/PROCESS FACILITY			
TOTAL	11A			
DESIGN STAB/PROCESS FACILITY - 12.0				
2WE215_12	PROCESS/STAB FACILITY PRELIMINARY DESIGN			
2WE220_12	PROCESS/STAB FACILITY TECHNICAL DEVELOPMENT			
2WE225_12	PREP PRELIM. PROCESS/STAB FACILITY SAFETY ANALYS			
2WE226_12	APPR PRELIM. PROCESS/STAB FACILITY SAFETY ANALYS			
2WE227_12	PREP FINAL PROCESS/STAB FACILITY SAFETY ANALYSIS			
2WE228_12	APPR FINAL PROCESS/STAB FACILITY SAFETY ANALYSIS			
2WE230_12	PROCESS/STAB FACILITY FINAL DESIGN			
2WE232_12	PROCESS/STAB FACILITY DRY CONTAINERS PROCUREMENT			
TOTAL	120			
CONSTRUCT STAB/PROCESS FACILITY - 13.0				
2WE235_13	PROCESS/STAB FACILITY CONSTRUCTION			
2WE240_13	PROCESS/STAB & INTERIM STORAGE ORR & OPS TEST			
TOTAL	130			
STABILIZE/PROCESS FUEL - 14.0				
2WE245_14	PROCESS/STAB FACILITY OPERATION			
TOTAL	140			
DISPOSE OF GENERATED WASTES - 15.0				
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS			
TOTAL	150			
D & D FACILITIES - 16.0				
2WA006_16	K BASIN PREPARATION FOR D & D			
2WE247-16	PROCESS/STAB FACILITY CLEANOUT & D&D			
TOTAL	160			
DESIGN INTERIM STORAGE FACILITY - 17.0				
2WE255_17	INTERIM STORAGE FACILITY DESIGN			
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS			

PRIMAVERA PROJECT PLANNER

ALTERNATE 1, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 241
15:02

COST LOADING REPORT

START DATE 01OCT93 FIN DATE 31MAR12

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ALTERNATIVE 1 , REVISION F, 10/13/94

TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
DESIGN INTERIM STORAGE FACILITY - 17.0				
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS			
TOTAL	170			
CONSTRUCT INTERIM STORAGE FACILITY - 18.0				
2WE260_18	INTERIM STORAGE VAULT CONSTRUCTION			
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING			
TOTAL	180			
TRANSPORT DRY STORAGE CASKS - 19.0				
2WE263_19	DRY STORAGE CASK TRANSPORT TO INTERIM STORAGE			
2WE300_19	PREPARE DRY FUEL & SLUDGE TRANSPORTATION SARP			
2WE301_19	APPROVE DRY FUEL & SLUDGE TRANSPORTATION SARP			
2WE305_19	DRY FUEL & SLUDGE TRANSPORT CASKS & RAIL CAR DSN			
2WE310_19	DRY FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMNT			
2WE317_19	DRY FUEL & SLUDGE TRANSPORT ORR			
TOTAL	190			
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0				
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP			
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END	1.5	1.5	0.8
TOTAL	200	1.5	1.5	0.8
	REPORT TOTAL	1.5	1.5	0.8

Summary Cost Basis Information
Alternative 1 - Containerize and Store in K Basin

Scenario:

Alternative 1 includes the following major activities:

- K Basin modifications to the K East basin and containerization of the canisters in the 20x34 overpack which will be returned to the basin for continued storage. No action is taken in the K West Basin.
- Delayed transport of material from K Basins when passivation facility is available. Overpacks will be transported from K East and Mark II canisters will be transported from K West without overpacks.
- Repackage and passivate at FMEF (WHC process including Hot Cell repackaging of fuel into passivation containers and sludge processing including calciner-not ITA process).
- Direct transport of passivated fuel to interim dry storage facility located in 200 Areas.
- Interim dry storage of passivated fuel and sludge at 200 Areas as costed for Alternative 3.

This alternative requires longer storage in the K Basins (at $42M/yr), but does not require a pre-interim storage facility. The passivation process at FMEF is more expensive and also requires a second shipment of the fuel in the passivation overpack which also requires new shipping casks. Sludge processing in the process facility hot cell was specifically addressed in the stabilization design. Interim storage will be the same for all three options utilizing the ITA vault (cost adjusted to $40M). Since the vault is not co-located, additional operations staffing for the vault is required during 2-year shipping period ($2.6M)

Cost and Schedule Activity Bases:

(Activity numbers are identified in parenthesis, i.e, [09B013].)

0.0 Program Actions Common for All Alternatives

Program management, regulatory compliance, and public involvement = $10.5M/yr from SNF MYPP, (Note 4) (09B013). No cost estimates included for other actions common for all alternatives.

1.0 Characterize Fuel and Sludge

Total 3 year costs = $18 M. ($13M-fuel, $5M-sludge). From prior program planning documents and discussions with R. Omberg (Note 31). (2WC018, 2WC097)

2.0 (a) Package Fuel

1) Basin equipment design = $ 4.5 M (Note 13) plus $1M additional for return of overpacks to pool(crane rail mods, basin mod, re-rack)=$5.5M. (2WC025)

2) Basin equipment installation = $ 2.5 M (from ref 13) plus an additional 2.4M from re-rack cost estimate = $4.9M+2.4(cont.) = $7.4M. (2WC030)

3) Design specification = $0.2 M. Vendor provides container design. (2WC050)

4) Purchase one-half the overpacks required for both basins which was $10.4M (ref.5,pg 28)=$5.2M. (2WC055)

5) ORR = $0.1 M. Generic K Basins ORR covers most of this and is costed at $2.4M in sect. 2.0. (2WC040)

6) Fuel containerization = $ 5.1 M from discussions with K Basins operations staff (Leon Hoffer). Cost includes cost for crews for containerizing fuel (at 80% efficiency factor a total of 1400 shifts required) and allowance for personnel burnout due to radiation exposure. Total exposure = 51 rem with limit of 1 rem/yr assumed. (see calc worksheets). (2WC058)

7) K-E and K-W loadout operations for shipment = $ 1.4 M. Similar basis as discussed in 6) above. (2WC060)

8) SAR = 110 K from K. Daschke report (rounded up to $0.2 M). (2WC020)

9) SAR Approval = 100 K per discussions with K. Daschke and A. Ramble. (2WC021)

2.0 (b) Package Sludge

1) Sludge equip. design=$2.6M from communication with advocate (Note 21). (2WC100)

2) Sludge equipment installation = $ 2.5 M from communication with advocate. (2WC110)

3) Sludge retrieval and containerization equipment = $10 M from communication with advocate. (2WC120)

4) Sludge container procurement = $ 4 M from communication with advocate. (2WC125)

5) ORR = $0.2 M SAIC estimate. Most aspects covered by generic K Basins ORR, but more complex than fuel packaging ORR due to new equipment and procedures. (2WC115)

6) Containerization labor = $0.8 M from discussion with Leon Hoffer, K Basins Operations. Includes additional operators only. Other support already in ongoing K Basins operation cost. (2WC130)

7) SAR = $110 K from K. Daschke report (Note 17) (rounded up to $0.2 M). (2WC090)

8) SAR Approval = $0.1M, per discussion with K. Daschke and A. Ramble. (2WC091)

9) Sludge technology development = $2.6M (Note 21). (2WC117)

2.0 (c) Ongoing Operations in K Basins

1) Ongoing operations at $42M/year (Note 4) until processing complete. (2WA003)

2) Upgrade modification=$13.1M (Note 5, overpack) and MYPP (Note 4). (2WA004)

3) K Basin ORR = 20 manyears @ $120K = $2.4M per K. Daschke report (Note 17). (2WA005)

3.0 Prepare Fuel and Sludge for Transport

1) SAR = $ 0.7 M from communications with K. Daschke. (2WC070, 2WC071)

2&3) Cask and rail car design and procurement = $ 20 M from draft advocate report (Note 18). Reduced to $18 M based on discussions with advocate Design = 3.0 and procurement = 15.0 (15 casks and 4 railcars). (2WC075, 2WC080)

4.0 Design Pre-Interim Storage Facility

NA

5.0 Construct Pre-Interim Storage Facility

NA

6.0 Dispose of Debris

1) Debris disposal includes removal of racks, approximately 2000 empty canisters, and misc. scrap including lights, conduit, tools, scaffolding, etc. = $2 M for disposal in burial boxes (Note 30). (2WF330, 2WF332)

7.0 Transport Fuel from Pre-Interim Storage

NA

8.0 Remove Radioactive Water

1) KE feed and bleed activities = $1.9 M/yr to the year 2002 = $11.4 M per discussions with advocate (Note 24). (2WF345)

2) KE cleanup equipment = $6.6M per discussions with advocate (Note 24).

9.0 Store Sludge

NA

10.0 Per-Interim Storage of Fuel

NA

11.0 Transport Fuel from K Basin

1) $ 1.4 M railroad maintenance cost + 6 FTEs/shift times 3 shifts times 120K each = $3.5 M per year x 2yrs = $ 7.0 M + $3 M to block off roads (per advocate discussion = $3K per shipment) = $10 M. (2WC065)

12.0 Design Stabilization/Processing Facility

1) Design costs (Note 5) - Repackage and passivate in FMEF. Cost estimates provided by KEH. Preliminary design = $2.3M. (2WE215)

2) Technology development plus hot cell testing costs (Note 5) and discussion with advocate that reduced the hot cell testing costs from $30 to $10 M = $19.7M. (2WE220)

3&4) SAR costs from K. Daschke report (Note 17) PSAR = 1.0 (prepare) + 0.4 (approval). FSAR = 0.9 (prepare) + 0.5 (approval). (2WE225, 2WE226, 2WE227, 2WE228)

5) Design costs (Note 5) - Repackage and passivate in FMEF. Cost estimates provided by Kaiser. Final design = $20.1M. Originally estimated by Kaiser with 50% contingency; later reduced to 25% based on discussions with advocates. (2WE230)

6) Cost of storage containers = $ 11.2 M based on discussion with advocate (Note 22) (C. Miska--660 @ $13.5K + 3300 @ $600). (2WE232)

13.0 Construct Stabilization/Processing Facility

1) Construction cost = $127.6M. Construction costs (Note 5) - Repackage and passivate in FEMF. Cost estimates provided by KEH. Originally estimated with 50% contingency; later reduced to 25% based on discussions with advocates (2WE235)

2) ORR costs from K. Daschke report plus OTP costs estimated by SAIC = $34 M. Includes the cost of a full operating staff during OTP phase. (2WE240)

14.0 Stabilize/Process Fuel

1) Operations costs (Note 5) reduced by SAIC evaluation of facility staffing. 217 staffing level + 8 M for utilities and materials costs. (217 @ 120K)+8M= $34M/yr. (2WF245)

15.0 Dispose of Generated Wastes

1) Stabilization wastes include Mark 0, I, & II canisters, overpacks, and misc. other waste.
   7490 canisters compacted to 2 cubic feet
   1250 overpacks compacted to 6 cubic feet
   = 22,500 cubic feet @ $80/cubic foot= $1.8M
   misc. + .8M
   $2.6M

16.0 D&D Facilities

1) K Basins preparation for D&D (i.e., transition costs) = $30 M/yr x 3 yrs = $90 M from MYPP (Note 4). D&D cost for existing facilities not included based on DOE estimating guideline. (2WA006)

2) Processing facility cleanout and D&D = $130 M (2WE247)
   Estimate (Note 5) of $254 M for repack and passivate at FMEF reduced based on reduced construction and operating costs.

   Method 1 - D&D approximately equal to construction cost = $127 M.
   Method 2 - 30% construction + 3 years operating cost = 38 + 3 (34) = $140M
   SAIC judgement = $130 M.

17.0 Design Interim Storage Facility

1) Design costs = $1M for site. Vendor Design costs included in $ 29 M construction estimate in 15.0 below. (2WE255)

2) SAR = $750K from K. Daschke report = $0.7 M. SAR approval = $0.4 M. (2WE257, 2WE258)

18.0 Interim Storage Facility Construction

1) From ITA report (Ref 11) adjusted by SAIC to account for sludge storage and Hanford adders (+20%) and increased contingency from 15% to 50%, then cost reduced 25% for reduced number of canisters produced by repackage approach. New estimated cost = [$21.5M + (20%)] x 75% = 19.7M + 50% = $29 M. (2WE260)

2) Vault ORR = $0.2 M. (2WE262)

19.0 Transport Dry Storage Casks

This second transport from FMEF to 200 Area in passivation canisters is equivalent to the cast transport for Alternative 3 from K Basin to 200 Area in MCOs.

1) SARP = $0.6 M (prepare) + $0.1 M (approval) per K. Daschke report (Note 17). (2WE300, 2WE301)

2) Cask and railcar Design = $2M modified from ITA cost estimate (Note 11). (2WE305)

3) Cask procurement = $8M modified from ITA cost estimate (Ref.11). (2WE310)

4) Transportation Infrastructure--none identified.

5) Transportation ORR = $.1 M. Same as Section 3.0, Item 4.

6) Cask Transport = $7..0 M. Same as Section 11.0, Item 1, except the number of containers reduced by ~1/2.

- Truck fee = (1.4)2 = 2.8 M
- Staff cost = 2.7 M
- Road closure = (3) 1/2 = 1.5 M

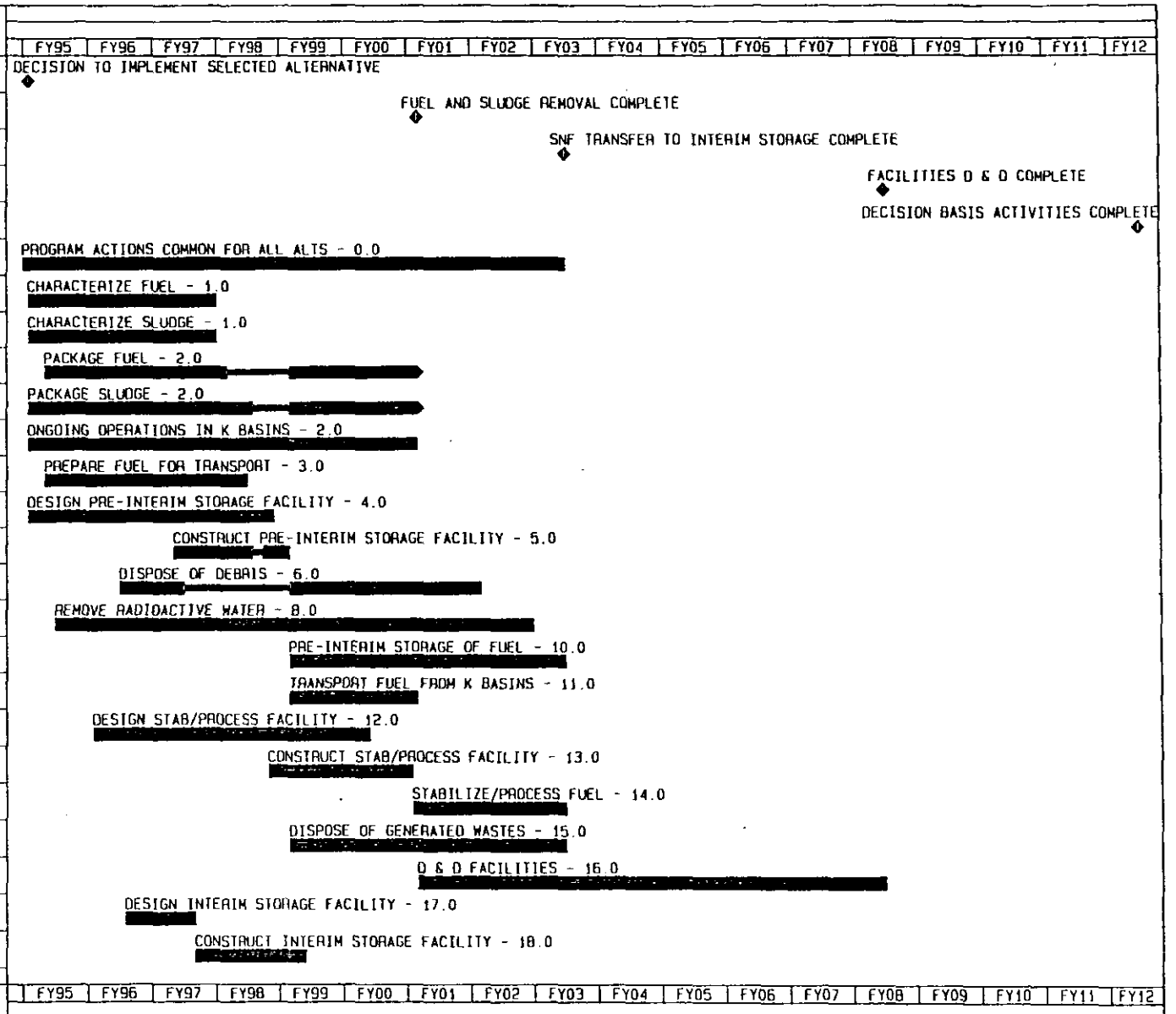
7.0 M

20.0 Store Fuel in Interim Storage Facility

1) Operating cost during shipping since facility is not co-located requires the base operating cost of $1.5 M from below plus 5 FTEs/shift times 3 shift = $3.3 M/yr.

2) Operating cost increased from 360 K/yr to $1.5 M/yr based on SAIC judgement. Basis for 1.5 M is 10 FTE @ 120 K/yr + 300 K in materials, utilities, and overheads.

EARLY START	EARLY FINISH	BUDGET COST
1NOV94	31OCT94	0
1DEC00	30NOV00	0
1APR03	31MAR03	0
1APR08	31MAR08	0
1APR12	31MAR12	0
1OCT94	31MAR03	88
1NOV94	30SEP97	13
1NOV94	30SEP97	5
1FEB95	30NOV00	22
1NOV94	30NOV00	23
1NOV94	30NOV00	273
1FEB95	31MAR98	19
1NOV94	31AUG98	14
1FEB97	30NOV98	54
1APR96	30NOV01	10
1APR95	30SEP02	18
1DEC98	31MAR03	64
1DEC98	30NOV00	10
1NOV95	29FEB00	88
1AUG98	31OCT00	108
1NOV00	31MAR03	63
1DEC98	31MAR03	2
1DEC00	31MAR08	266
1MAY96	31MAY97	2
1JUN97	28FEB99	39



Plot Date 18OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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Inactive
Summary Bar/Early Dates
Critical Designator
Milestone/Flag Activity

KAZF

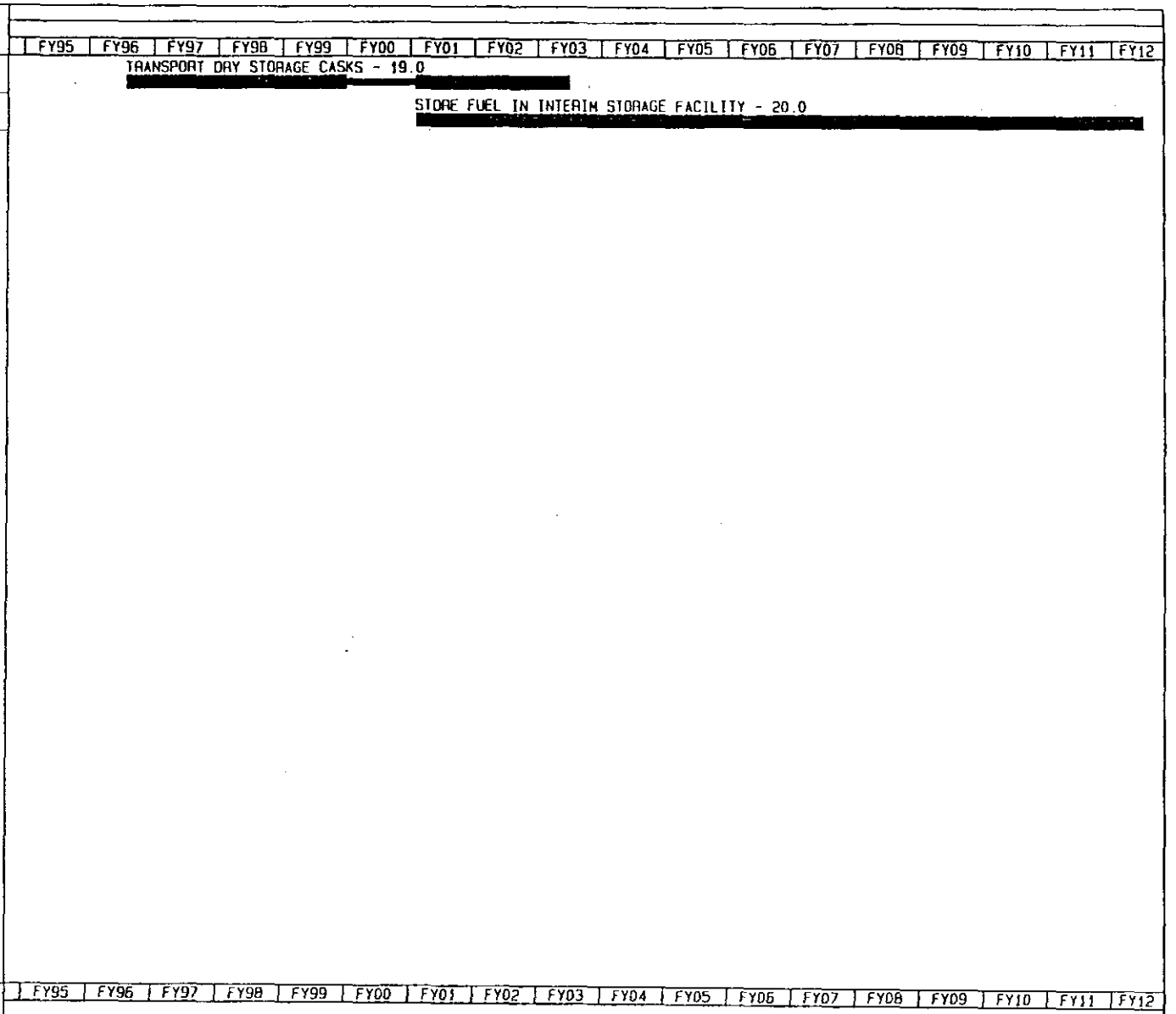
Sheet 1 of 2

K BASIN
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 2 - SUMMARY

REVISION F 10/13/94

Date	Revision	Checked	Approved

EARLY START	EARLY FINISH	BUDGET COST
1MAY96	31MAR03	21
1NOV00	31MAR12	20



Plot Date 18OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

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Inactive
Summary Bar/Early Dates
Critical Designator
Milestone/Flag Activity

KAZF

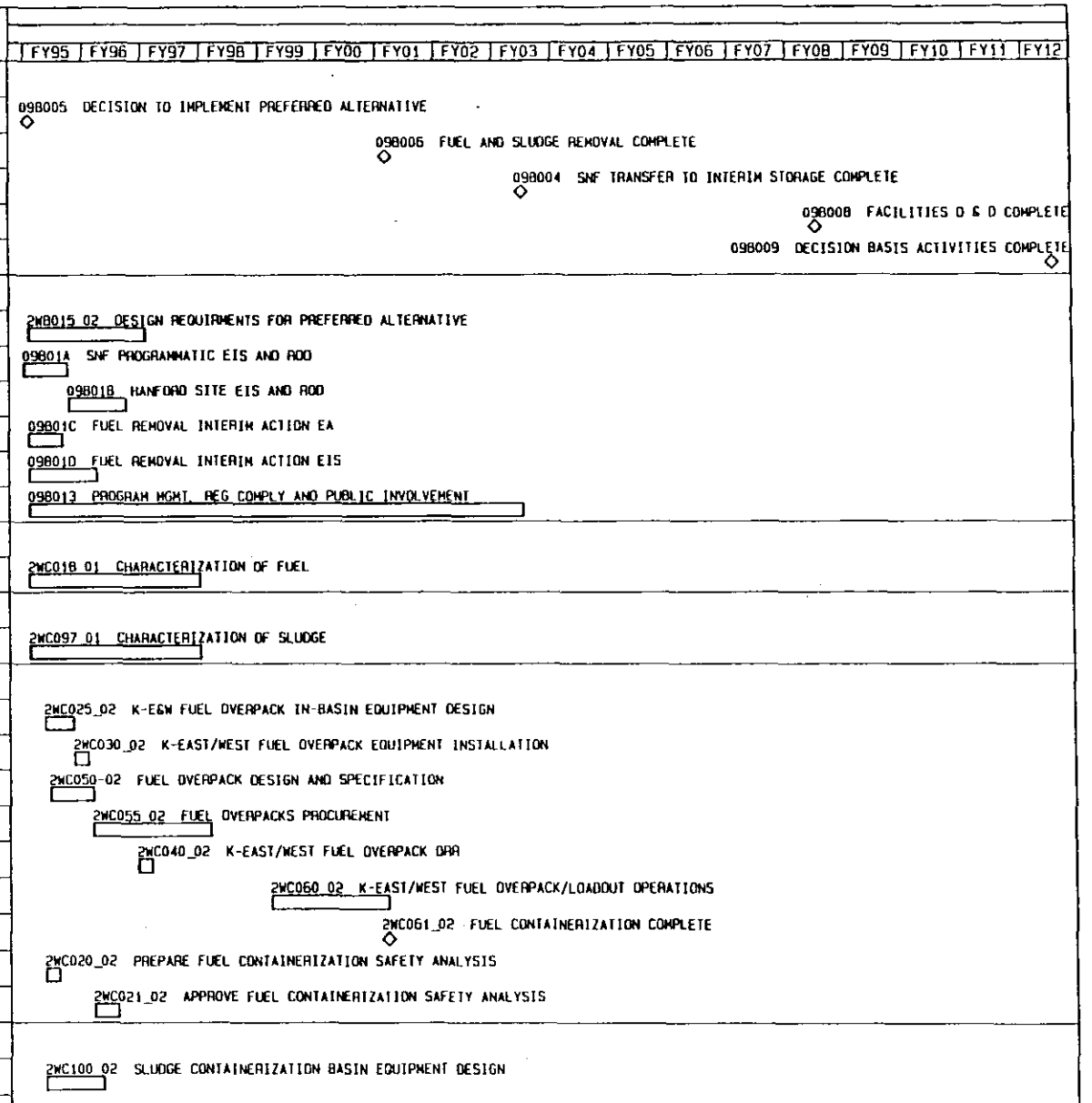
Sheet 2 of 2

K BASIN
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 2 - SUMMARY

REVISION F 10/13/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
DECISION BASIS KEY DATES - 0.0					
00A	100	1NOV94		0	.0
00A	100		30NOV00	0	.0
00A	200		31MAR03	0	.0
00A	300		31MAR08	0	.0
00A	400		31MAR12	0	.0
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0					
00B	100	1NOV94	31OCT96	24	.0
00B	310	1OCT94	30JUN95	9	.0
00B	320	1JUL95	30JUN96	12	.0
00B	320	1NOV94	31MAY95	7	.0
00B	320	1NOV94	31DEC95	14	.0
00B	400	1NOV94	31MAR03	101	88.4
CHARACTERIZE FUEL - 1.0					
01A	100	1NOV94	30SEP97	35	13.0
CHARACTERIZE SLUDGE - 1.0					
01B	100	1NOV94	30SEP97	35	5.0
PACKAGE FUEL - 2.0					
02A	100	1FEB95	31JUL95	6	4.5
02A	100	1AUG95	31OCT95	3	2.5
02A	200	1MAR95	30NOV95	9	.2
02A	200	1DEC95	30NOV97	24	10.4
02A	300	1SEP96	30NOV96	3	.1
02A	400	1DEC98	30NOV00	24	4.3
02A	400		30NOV00	0	.0
02A	500	1FEB95	30APR95	3	.2
02A	500	1DEC95	30APR96	5	.1
PACKAGE SLUDGE - 2.0					
02B	100	1FEB95	31JAN96	12	2.6



Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

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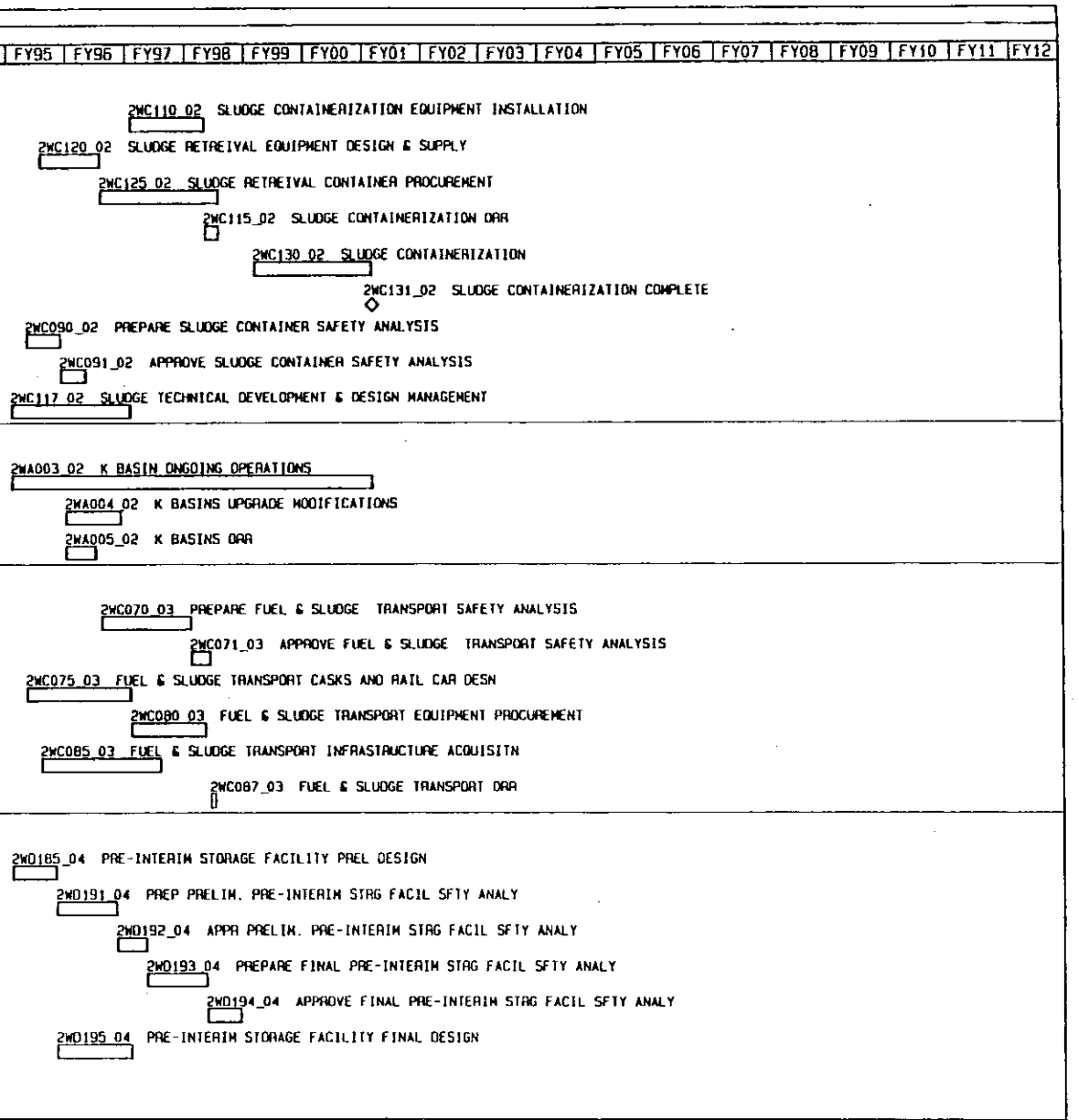
K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 2

Sheet 1 of 4

REVISION F 10/13/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
PACKAGE SLUDGE - 2.0					
02B	100	1NOV96	31JAN98	15	2.5
02B	200	1MAY95	30APR96	12	10.0
02B	200	1MAY96	30APR98	24	4.0
02B	300	1FEB98	30APR98	3	.2
02B	400	1DEC98	30NOV00	24	.8
02B	400	1DEC00	30NOV00	0	.0
02B	500	1FEB95	31AUG95	7	.2
02B	500	15EP95	31JAN96	5	.1
02B	500	1NOV94	31OCT96	24	2.6
ONGOING OPERATIONS IN K BASINS - 2.0					
02C	100	1NOV94	30NOV00	73	255.5
02C	100	1OCT95	31AUG96	11	13.1
02C	300	1OCT95	31MAR96	6	4.8
PREPARE FUEL FOR TRANSPORT - 3.0					
03A	100	1MAY96	31OCT97	18	.6
03A	100	1NOV97	28FEB98	4	.1
03A	100	1FEB95	31OCT96	21	3.0
03A	100	1NOV96	31JAN98	15	15.0
03A	200	1MAY95	30APR97	24	.0
03A	300	1MAR98	31MAR98	1	.1
DESIGN PRE-INTERIM STORAGE FACILITY - 4.0					
040	100	1NOV94	31JUL95	9	1.5
040	300	1AUG95	31JUL96	12	1.0
040	300	1AUG96	31JAN97	6	.4
040	300	1FEB97	31JAN98	12	.9
040	300	1FEB98	31AUG98	7	.5
040	400	1AUG95	31OCT96	15	10.0



Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

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Sheet 2 of 4

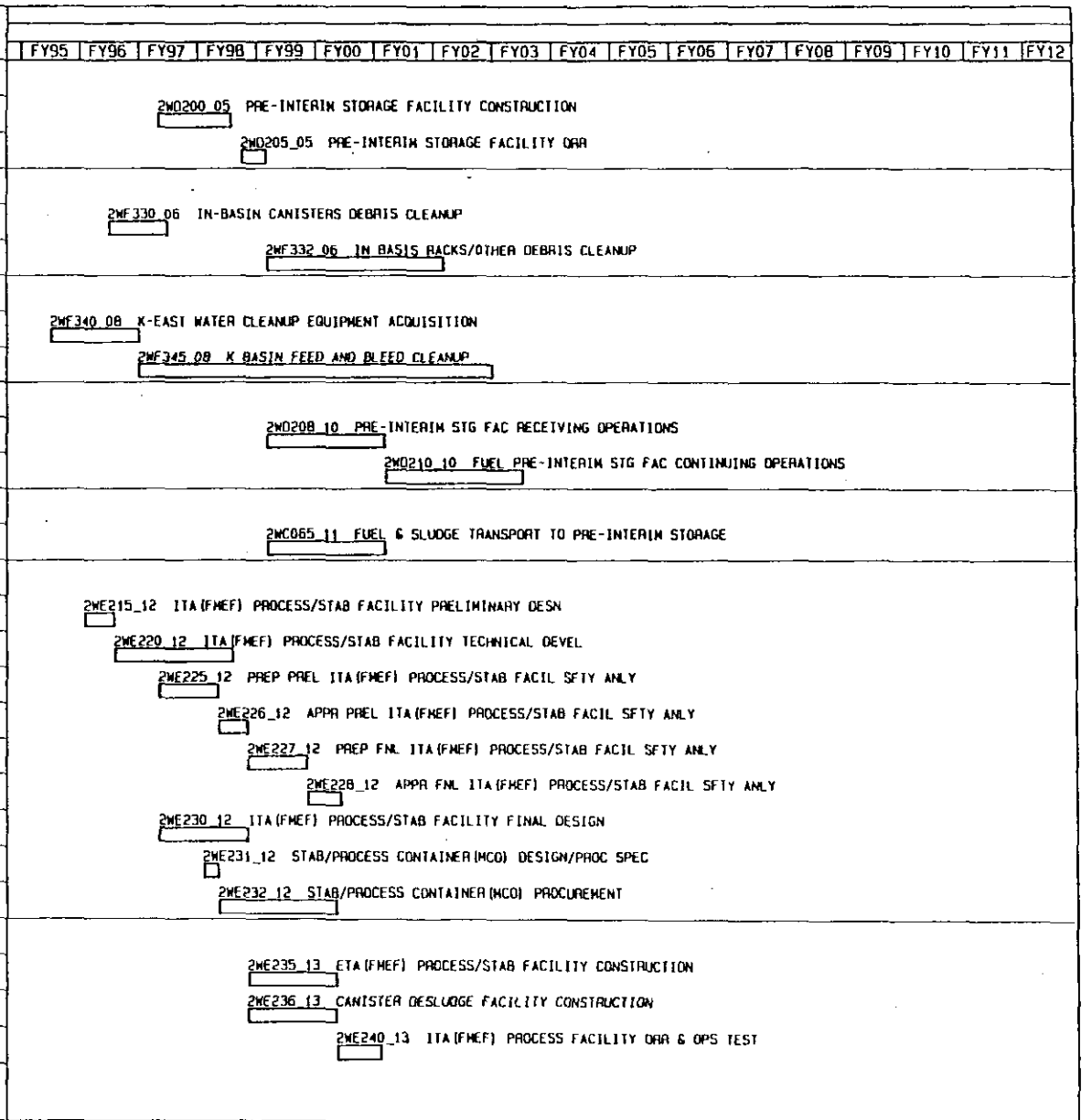
K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 2

REVISION F 10/13/94

Date	Revision	Checked	Approved

C:\3BC

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
CONSTRUCT PRE-INTERIM STORAGE FACILITY - 5.0					
050	100	1FEB97	30APR98	15	52.6
050	200	1JUL98	30NOV98	5	1.5
DISPOSE OF DEBRIS - 6.0					
060	100	1APR96	31MAR97	12	3.4
060	200	1DEC98	30NOV01	36	6.6
REMOVE RADIOACTIVE WATER - 8.0					
080	100	1APR95	30SEP96	18	6.6
080	200	1OCT96	30SEP02	72	11.4
PRE-INTERIM STORAGE OF FUEL - 10.0					
100	100	1DEC98	30NOV00	24	36.0
100	100	1DEC00	31MAR03	28	28.0
TRANSPORT FUEL FROM K BASINS - 11.0					
11A	100	1DEC98	30NOV00	24	10.0
DESIGN STAB/PROCESS FACILITY - 12.0					
120	100	1NOV95	30APR96	6	1.3
120	200	1MAY96	30APR98	24	19.7
120	300	1FEB97	31JAN98	12	1.0
120	300	1FEB98	31JUL98	6	.4
120	300	1AUG98	31JUL99	12	.9
120	300	1AUG99	29FEB00	7	.5
120	400	1FEB97	31JUL98	18	14.8
120	500	1NOV97	31JAN98	3	.5
120	500	1FEB98	31JAN00	24	48.6
CONSTRUCT STAB/PROCESS FACILITY - 13.0					
130	100	1AUG98	31JAN00	18	64.5
130	100	1AUG98	31JAN00	18	23.8
130	200	1FEB00	31OCT00	9	19.5



Plot Date 13OCT94
Data Date 10OCT93
Project Start 10OCT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

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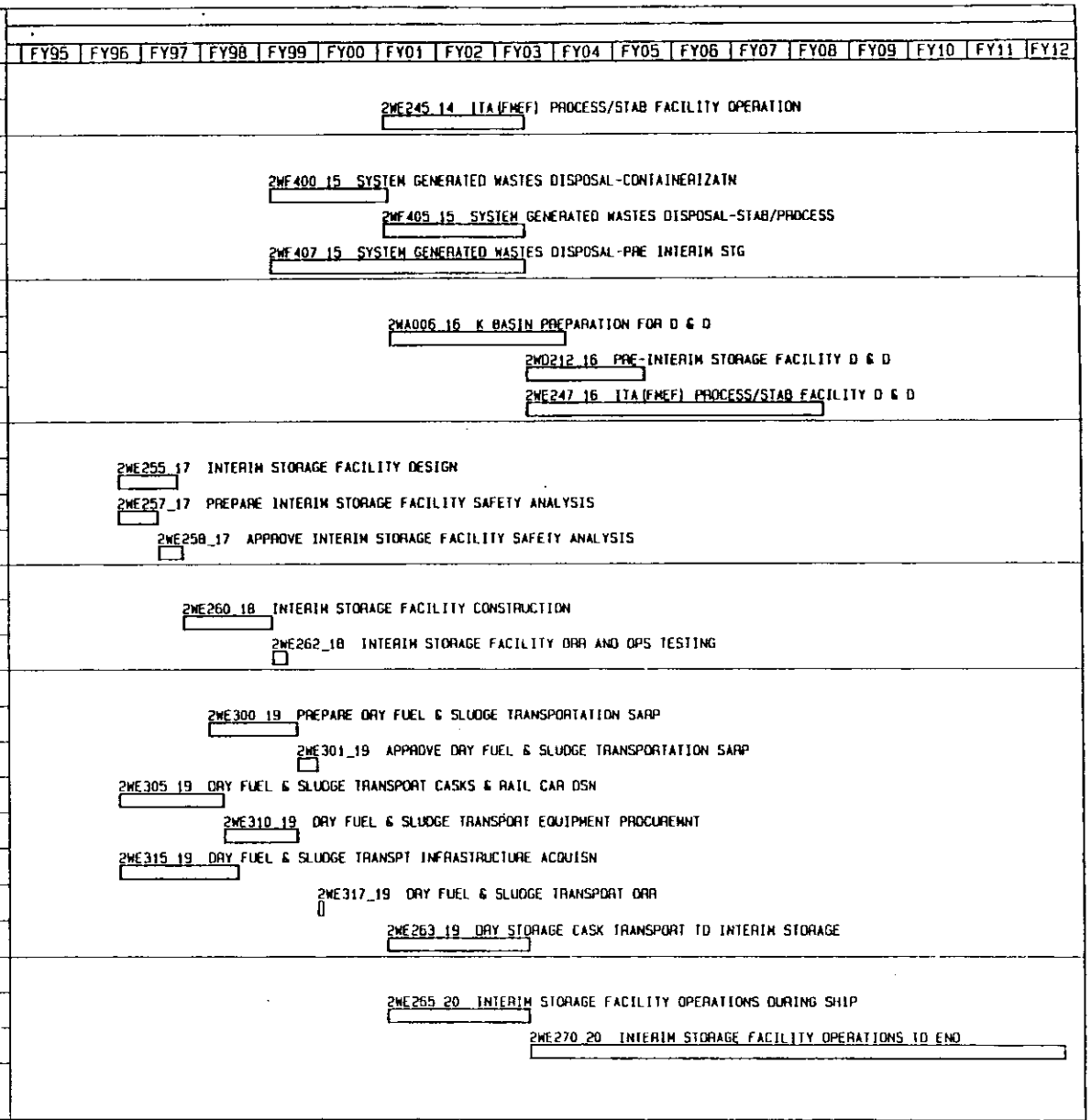
K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 2

REVISION F 10/13/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
STABILIZE/PROCESS FUEL - 14.0					
140	100	1NOV00	31MAR03	29	63.0
DISPOSE OF GENERATED WASTES - 15.0					
150	100	1DEC98	30NOV00	24	.3
150	200	1NOV00	31MAR03	29	2.0
150	300	1DEC98	31MAR03	52	.0
D & D FACILITIES - 16.0					
160	100	1DEC00	30NOV03	36	90.0
160	200	1APR03	31MAR05	24	86.0
160	300	1APR03	31MAR08	60	90.0
DESIGN INTERIM STORAGE FACILITY - 17.0					
170	100	1MAY96	30APR97	12	1.0
170	300	1MAY96	31DEC96	8	.7
170	300	1JAN97	31MAY97	5	.4
CONSTRUCT INTERIM STORAGE FACILITY - 18.0					
180	100	1JUN97	30NOV98	18	38.7
180	300	1DEC98	28FEB99	3	.2
TRANSPORT DRY STORAGE CASKS - 19.0					
190	100	1NOV97	30APR99	18	.6
190	100	1MAY99	31AUG99	4	.1
190	100	1MAY96	31JAN98	21	2.0
190	100	1FEB98	30APR99	15	8.0
190	200	1MAY96	30APR98	24	.0
190	300	1SEP99	30SEP99	1	.1
190	400	1NOV00	31MAR03	29	10.0
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0					
200	100	1NOV00	31MAR03	29	6.6
200	100	1APR03	31MAR12	108	13.5



Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
◇/P Milestone/Flag Activity

K2F

Sheet 4 of 4

K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 2

REVISION F 10/13/94

Date	Revision	Checked	Approved

C:\abc

PRIMAVERA PROJECT PLANNER — ALTERNATE 2, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 175 15:03 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 1- 1

ALTERNATIVE 2 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT	88.4	9.6	10.5	10.5	10.5	10.5	10.5	10.5
TOTAL	00B	88.4	9.6	10.5	10.5	10.5	10.5	10.5	10.5
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL	13.0	4.1	4.5	4.5				
TOTAL	01A	13.0	4.1	4.5	4.5				
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE	5.0	1.6	1.7	1.7				
TOTAL	01B	5.0	1.6	1.7	1.7				
PACKAGE FUEL - 2.0									
2WC020_02	PREPARE FUEL CONTAINERIZATION SAFETY ANALYSIS	0.2	0.2						
2WC021_02	APPROVE FUEL CONTAINERIZATION SAFETY ANALYSIS	0.1		0.1					
2WC025_02	K-E&W FUEL OVERPACK IN-BASIN EQUIPMENT DESIGN	4.5	4.5						
2WC030_02	K-EAST/WEST FUEL OVERPACK EQUIPMENT INSTALLATION	2.5	1.7	0.8					
2WC040_02	K-EAST/WEST FUEL OVERPACK ORR	0.1		0.0	0.1				
2WC050-02	FUEL OVERPACK DESIGN AND SPECIFICATION	0.2	0.2	0.0					
2WC055_02	FUEL OVERPACKS PROCUREMENT	10.4		4.3	5.2	0.9			
2WC060_02	K-EAST/WEST FUEL OVERPACK/LOADOUT OPERATIONS	4.3					1.8	2.1	0.4
TOTAL	02A	22.3	6.5	5.3	5.3	0.9	1.8	2.1	0.4
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINER SAFETY ANALYSIS	0.2	0.2						
2WC091_02	APPROVE SLUDGE CONTAINER SAFETY ANALYSIS	0.1	0.0	0.1					
2WC100_02	SLUDGE CONTAINERIZATION BASIN EQUIPMENT DESIGN	2.6	1.7	0.9					
2WC110_02	SLUDGE CONTAINERIZATION EQUIPMENT INSTALLATION	2.5			1.8	0.7			
2WC115_02	SLUDGE CONTAINERIZATION ORR	0.2				0.2			
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT	2.6	1.2	1.3	0.1				
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY	10.0	4.2	5.8					
2WC125_02	SLUDGE RETREIVAL CONTAINER PROCUREMENT	4.0		0.8	2.0	1.2			
2WC130_02	SLUDGE CONTAINERIZATION	0.8					0.3	0.4	0.1
TOTAL	02B	23.0	7.3	8.9	3.9	2.0	0.3	0.4	0.1
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS	255.5	38.5	42.0	42.0	42.0	42.0	42.0	7.0
2WA004_02	K BASINS UPGRADE MODIFICATIONS	13.1		13.1					
2WA005_02	K BASINS ORR	4.8		4.8					
TOTAL	02C	273.4	38.5	59.9	42.0	42.0	42.0	42.0	7.0
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORT SAFETY ANALYSIS	0.6		0.2	0.4	0.0			
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORT SAFETY ANALYSIS	0.1				0.1			
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN	3.0	1.1	1.7	0.1				
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT	15.0			11.0	4.0			
2WC087_03	FUEL & SLUDGE TRANSPORT ORR	0.1				0.1			
TOTAL	03A	18.8	1.1	1.9	11.5	4.2			

PRIMAVERA PROJECT PLANNER — ALTERNATE 2, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 175 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12
15:03

DATA DATE 01OCT93 PAGE NO. 2- 1

ALTERNATIVE 2 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
DESIGN PRE-INTERIM STORAGE FACILITY - 4.0									
2WD185_04	PRE-INTERIM STORAGE FACILITY PREL DESIGN	1.5	1.5						
2WD191_04	PREP PRELIM. PRE-INTERIM STRG FACIL SFTY ANALY	1.0	0.2	0.8					
2WD192_04	APPR PRELIM. PRE-INTERIM STRG FACIL SFTY ANALY	0.4		0.1	0.3				
2WD193_04	PREPARE FINAL PRE-INTERIM STRG FACIL SFTY ANALY	0.9			0.6	0.3			
2WD194_04	APPROVE FINAL PRE-INTERIM STRG FACIL SFTY ANALY	0.5				0.5			
2WD195_04	PRE-INTERIM STORAGE FACILITY FINAL DESIGN	10.0	1.3	8.0	0.7				
TOTAL	040	14.3	3.0	9.0	1.5	0.8			
CONSTRUCT PRE-INTERIM STORAGE FACILITY - 5.0									
2WD200_05	PRE-INTERIM STORAGE FACILITY CONSTRUCTION	52.6			28.1	24.5			
2WD205_05	PRE-INTERIM STORAGE FACILITY ORR	1.5				0.9	0.6		
TOTAL	050	54.1			28.1	25.4	0.6		
DISPOSE OF DEBRIS - 6.0									
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP	3.4		1.7	1.7				
2WF332_06	IN BASIS RACKS/OTHER DEBRIS CLEANUP	6.6					1.8	2.2	2.2
TOTAL	060	10.0		1.7	1.7		1.8	2.2	2.2
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION	6.6	2.2	4.4					
2WF345_08	K BASIN FEED AND BLEED CLEANUP	11.4			1.9	1.9	1.9	1.9	1.9
TOTAL	080	18.0	2.2	4.4	1.9	1.9	1.9	1.9	1.9
PRE-INTERIM STORAGE OF FUEL - 10.0									
2WD208_10	PRE-INTERIM STG FAC RECEIVING OPERATIONS	36.0					15.0	18.0	3.0
2WD210_10	FUEL PRE-INTERIM STG FAC CONTINUING OPERATIONS	28.0							10.0
TOTAL	100	64.0					15.0	18.0	13.0
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_11	FUEL & SLUDGE TRANSPORT TO PRE-INTERIM STORAGE	10.0					4.2	5.0	0.8
TOTAL	11A	10.0					4.2	5.0	0.8
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12	ITA(FMEF) PROCESS/STAB FACILITY PRELIMINARY DESN	1.3		1.3					
2WE220_12	ITA(FMEF) PROCESS/STAB FACILITY TECHNICAL DEVEL	19.7		4.1	9.9	5.7			
2WE225_12	PREP PREL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY	1.0			0.7	0.3			
2WE226_12	APPR PREL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY	0.4				0.4			
2WE227_12	PREP FNL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY	0.9				0.2	0.8		
2WE228_12	APPR FNL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY	0.5					0.1	0.4	
2WE230_12	ITA(FMEF) PROCESS/STAB FACILITY FINAL DESIGN	14.8			6.6	8.2			
2WE231_12	STAB/PROCESS CONTAINER(MCO) DESIGN/PROC SPEC	0.5				0.5			
2WE232_12	STAB/PROCESS CONTAINER(MCO) PROCUREMENT	48.6				16.2	24.3	8.1	
TOTAL	120	87.7		5.4	17.1	31.6	25.2	8.5	
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13	ETA(FMEF) PROCESS/STAB FACILITY CONSTRUCTION	64.5				7.2	43.0	14.3	
2WE236_13	CANISTER DESLUDGE FACILITY CONSTRUCTION	23.8				2.6	15.9	5.3	

PRIMAVERA PROJECT PLANNER — ALTERNATE 2, SNF EXPEDITED REMOVAL

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ALTERNATIVE 2 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE240_13	ITA(FMEF) PROCESS FACILITY ORR & OPS TEST	19.5						17.3	2.2
TOTAL	130	107.8				9.8	58.9	37.0	2.2
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14	ITA(FMEF) PROCESS/STAB FACILITY OPERATION	63.0							23.9
TOTAL	140	63.0							23.9
DISPOSE OF GENERATED WASTES - 15.0									
2WF400_15	SYSTEM GENERATED WASTES DISPOSAL-CONTAINERIZATN	0.3					0.1	0.2	0.0
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS	2.0							0.8
TOTAL	150	2.3					0.1	0.2	0.8
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARATION FOR D & D	90.0							25.0
2WD212_16	PRE-INTERIM STORAGE FACILITY D & D	86.0							
2WE247_16	ITA(FMEF) PROCESS/STAB FACILITY D & D	90.0							
TOTAL	160	266.0							25.0
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE255_17	INTERIM STORAGE FACILITY DESIGN	1.0		0.4	0.6				
2WE257_17	PREPARE INTERIM STORAGE FACILITY SAFETY ANALYSIS	0.7		0.4	0.3				
2WE258_17	APPROVE INTERIM STORAGE FACILITY SAFETY ANALYSIS	0.4			0.4				
TOTAL	170	2.1		0.9	1.2				
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18	INTERIM STORAGE FACILITY CONSTRUCTION	38.7			8.6	25.8	4.3		
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING	0.2					0.2		
TOTAL	180	38.9			8.6	25.8	4.5		
TRANSPORT DRY STORAGE CASKS - 19.0									
2WE263_19	DRY STORAGE CASK TRANSPORT TO INTERIM STORAGE	10.0							3.8
2WE300_19	PREPARE DRY FUEL & SLUDGE TRANSPORTATION SARP	0.6				0.4	0.2		
2WE301_19	APPROVE DRY FUEL & SLUDGE TRANSPORTATION SARP	0.1					0.1		
2WE305_19	DRY FUEL & SLUDGE TRANSPORT CASKS & RAIL CAR DSN	2.0		0.5	1.1	0.4			
2WE310_19	DRY FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMNT	8.0				4.3	3.7		
2WE317_19	DRY FUEL & SLUDGE TRANSPORT ORR	0.1					0.1		
TOTAL	190	20.8		0.5	1.1	5.0	4.2		3.8
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP	6.6							2.5
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END	13.5							
TOTAL	200	20.1							2.5
	REPORT TOTAL	1223.0	74.0	114.5	140.7	160.0	171.0	127.7	94.0

PRIMAVERA PROJECT PLANNER — ALTERNATE 2, SNF EXPEDITED REMOVAL

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DATA DATE 01OCT93 PAGE NO. 1- 2

ALTERNATIVE 2 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT	10.5	5.3						
TOTAL	00B	10.5	5.3						
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL								
TOTAL	01A								
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE								
TOTAL	01B								
PACKAGE FUEL - 2.0									
2WC020_02	PREPARE FUEL CONTAINERIZATION SAFETY ANALYSIS								
2WC021_02	APPROVE FUEL CONTAINERIZATION SAFETY ANALYSIS								
2WC025_02	K-E&W FUEL OVERPACK IN-BASIN EQUIPMENT DESIGN								
2WC030_02	K-EAST/WEST FUEL OVERPACK EQUIPMENT INSTALLATION								
2WC040_02	K-EAST/WEST FUEL OVERPACK ORR								
2WC050-02	FUEL OVERPACK DESIGN AND SPECIFICATION								
2WC055_02	FUEL OVERPACKS PROCUREMENT								
2WC060_02	K-EAST/WEST FUEL OVERPACK/LOADOUT OPERATIONS								
TOTAL	02A								
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINER SAFETY ANALYSIS								
2WC091_02	APPROVE SLUDGE CONTAINER SAFETY ANALYSIS								
2WC100_02	SLUDGE CONTAINERIZATION BASIN EQUIPMENT DESIGN								
2WC110_02	SLUDGE CONTAINERIZATION EQUIPMENT INSTALLATION								
2WC115_02	SLUDGE CONTAINERIZATION ORR								
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT								
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY								
2WC125_02	SLUDGE RETREIVAL CONTAINER PROCUREMENT								
2WC130_02	SLUDGE CONTAINERIZATION								
TOTAL	02B								
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS								
2WA004_02	K BASINS UPGRADE MODIFICATIONS								
2WA005_02	K BASINS ORR								
TOTAL	02C								
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORT SAFETY ANALYSIS								
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORT SAFETY ANALYSIS								
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN								
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT								
2WC087_03	FUEL & SLUDGE TRANSPORT ORR								
TOTAL	03A								

PRIMAVERA PROJECT PLANNER — ALTERNATE 2, SNF EXPEDITED REMOVAL

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ALTERNATIVE 2 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DESIGN PRE-INTERIM STORAGE FACILITY - 4.0									
2WD185_04	PRE-INTERIM STORAGE FACILITY PREL DESIGN								
2WD191_04	PREP PRELIM. PRE-INTERIM STRG FACIL SFTY ANALY								
2WD192_04	APPR PRELIM. PRE-INTERIM STRG FACIL SFTY ANALY								
2WD193_04	PREPARE FINAL PRE-INTERIM STRG FACIL SFTY ANALY								
2WD194_04	APPROVE FINAL PRE-INTERIM STRG FACIL SFTY ANALY								
2WD195_04	PRE-INTERIM STORAGE FACILITY FINAL DESIGN								
TOTAL	040								
CONSTRUCT PRE-INTERIM STORAGE FACILITY - 5.0									
2WD200_05	PRE-INTERIM STORAGE FACILITY CONSTRUCTION								
2WD205_05	PRE-INTERIM STORAGE FACILITY ORR								
TOTAL	050								
DISPOSE OF DEBRIS - 6.0									
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP								
2WF332_06	IN BASIS RACKS/OTHER DEBRIS CLEANUP	0.4							
TOTAL	060	0.4							
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION								
2WF345_08	K BASIN FEED AND BLEED CLEANUP	1.9							
TOTAL	080	1.9							
PRE-INTERIM STORAGE OF FUEL - 10.0									
2WD208_10	PRE-INTERIM STG FAC RECEIVING OPERATIONS								
2WD210_10	FUEL PRE-INTERIM STG FAC CONTINUING OPERATIONS	12.0	6.0						
TOTAL	100	12.0	6.0						
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_11	FUEL & SLUDGE TRANSPORT TO PRE-INTERIM STORAGE								
TOTAL	11A								
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12	ITA(FMEF) PROCESS/STAB FACILITY PRELIMINARY DESN								
2WE220_12	ITA(FMEF) PROCESS/STAB FACILITY TECHNICAL DEVEL								
2WE225_12	PREP PREL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY								
2WE226_12	APPR PREL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY								
2WE227_12	PREP FNL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY								
2WE228_12	APPR FNL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY								
2WE230_12	ITA(FMEF) PROCESS/STAB FACILITY FINAL DESIGN								
2WE231_12	STAB/PROCESS CONTAINER(MCO) DESIGN/PROC SPEC								
2WE232_12	STAB/PROCESS CONTAINER(MCO) PROCUREMENT								
TOTAL	120								
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13	ETA(FMEF) PROCESS/STAB FACILITY CONSTRUCTION								
2WE236_13	CANISTER DESLUDGE FACILITY CONSTRUCTION								

PRIMAVERA PROJECT PLANNER — ALTERNATE 2, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 175 15:03 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

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ALTERNATIVE 2 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE240_13	ITA(FMEF) PROCESS FACILITY ORR & OPS TEST								
TOTAL	130								
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14	ITA(FMEF) PROCESS/STAB FACILITY OPERATION	26.1	13.0						
TOTAL	140	26.1	13.0						
DISPOSE OF GENERATED WASTES - 15.0									
2WF400_15	SYSTEM GENERATED WASTES DISPOSAL-CONTAINERIZATN								
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS	0.8	0.4						
TOTAL	150	0.8	0.4						
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARATION FOR D & D	30.0	30.0	5.0					
2WD212_16	PRE-INTERIM STORAGE FACILITY D & D		21.5	43.0	21.5				
2WE247_16	ITA(FMEF) PROCESS/STAB FACILITY D & D		9.0	18.0	18.0	18.0	18.0	9.0	
TOTAL	160	30.0	60.5	66.0	39.5	18.0	18.0	9.0	
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE255_17	INTERIM STORAGE FACILITY DESIGN								
2WE257_17	PREPARE INTERIM STORAGE FACILITY SAFETY ANALYSIS								
2WE258_17	APPROVE INTERIM STORAGE FACILITY SAFETY ANALYSIS								
TOTAL	170								
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18	INTERIM STORAGE FACILITY CONSTRUCTION								
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING								
TOTAL	180								
TRANSPORT DRY STORAGE CASKS - 19.0									
2WE263_19	DRY STORAGE CASK TRANSPORT TO INTERIM STORAGE	4.1	2.1						
2WE300_19	PREPARE DRY FUEL & SLUDGE TRANSPORTATION SARP								
2WE301_19	APPROVE DRY FUEL & SLUDGE TRANSPORTATION SARP								
2WE305_19	DRY FUEL & SLUDGE TRANSPORT CASKS & RAIL CAR DSN								
2WE310_19	DRY FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMNT								
2WE317_19	DRY FUEL & SLUDGE TRANSPORT ORR								
TOTAL	190	4.1	2.1						
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP	2.7	1.4						
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END		0.8	1.5	1.5	1.5	1.5	1.5	1.5
TOTAL	200	2.7	2.1	1.5	1.5	1.5	1.5	1.5	1.5
	REPORT TOTAL	88.5	89.4	67.5	41.0	19.5	19.5	10.5	1.5

PRIMAVERA PROJECT PLANNER — ALTERNATE 2, SNF EXPEDITED REMOVAL

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ALTERNATIVE 2 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0				
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT			
TOTAL	00B			
CHARACTERIZE FUEL - 1.0				
2WC018_01	CHARACTERIZATION OF FUEL			
TOTAL	01A			
CHARACTERIZE SLUDGE - 1.0				
2WC097_01	CHARACTERIZATION OF SLUDGE			
TOTAL	01B			
PACKAGE FUEL - 2.0				
2WC020_02	PREPARE FUEL CONTAINERIZATION SAFETY ANALYSIS			
2WC021_02	APPROVE FUEL CONTAINERIZATION SAFETY ANALYSIS			
2WC025_02	K-E&W FUEL OVERPACK IN-BASIN EQUIPMENT DESIGN			
2WC030_02	K-EAST/WEST FUEL OVERPACK EQUIPMENT INSTALLATION			
2WC040_02	K-EAST/WEST FUEL OVERPACK ORR			
2WC050-02	FUEL OVERPACK DESIGN AND SPECIFICATION			
2WC055_02	FUEL OVERPACKS PROCUREMENT			
2WC060_02	K-EAST/WEST FUEL OVERPACK/LOADOUT OPERATIONS			
TOTAL	02A			
PACKAGE SLUDGE - 2.0				
2WC090_02	PREPARE SLUDGE CONTAINER SAFETY ANALYSIS			
2WC091_02	APPROVE SLUDGE CONTAINER SAFETY ANALYSIS			
2WC100_02	SLUDGE CONTAINERIZATION BASIN EQUIPMENT DESIGN			
2WC110_02	SLUDGE CONTAINERIZATION EQUIPMENT INSTALLATION			
2WC115_02	SLUDGE CONTAINERIZATION ORR			
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT			
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY			
2WC125_02	SLUDGE RETREIVAL CONTAINER PROCUREMENT			
2WC130_02	SLUDGE CONTAINERIZATION			
TOTAL	02B			
ONGOING OPERATIONS IN K BASINS - 2.0				
2WA003_02	K BASIN ONGOING OPERATIONS			
2WA004_02	K BASINS UPGRADE MODIFICATIONS			
2WA005_02	K BASINS ORR			
TOTAL	02C			
PREPARE FUEL FOR TRANSPORT - 3.0				
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORT SAFETY ANALYSIS			
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORT SAFETY ANALYSIS			
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN			
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT			
2WC087_03	FUEL & SLUDGE TRANSPORT ORR			
TOTAL	03A			

PRIMAVERA PROJECT PLANNER — ALTERNATE 2, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 175 15:03 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

ALTERNATIVE 2 , REVISION F, 10/13/94 — TOTAL USAGE FOR YEAR — DATA DATE 01OCT93 PAGE NO. 2- 3

ACT ID	DESC	FY 2010	FY 2011	FY 2012
DESIGN PRE-INTERIM STORAGE FACILITY - 4.0				
2WD185_04	PRE-INTERIM STORAGE FACILITY PREL DESIGN			
2WD191_04	PREP PRELIM. PRE-INTERIM STRG FACIL SFTY ANALY			
2WD192_04	APPR PRELIM. PRE-INTERIM STRG FACIL SFTY ANALY			
2WD193_04	PREPARE FINAL PRE-INTERIM STRG FACIL SFTY ANALY			
2WD194_04	APPROVE FINAL PRE-INTERIM STRG FACIL SFTY ANALY			
2WD195_04	PRE-INTERIM STORAGE FACILITY FINAL DESIGN			
TOTAL	040			
CONSTRUCT PRE-INTERIM STORAGE FACILITY - 5.0				
2WD200_05	PRE-INTERIM STORAGE FACILITY CONSTRUCTION			
2WD205_05	PRE-INTERIM STORAGE FACILITY ORR			
TOTAL	050			
DISPOSE OF DEBRIS - 6.0				
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP			
2WF332_06	IN BASIS RACKS/OTHER DEBRIS CLEANUP			
TOTAL	060			
REMOVE RADIOACTIVE WATER - 8.0				
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION			
2WF345_08	K BASIN FEED AND BLEED CLEANUP			
TOTAL	080			
PRE-INTERIM STORAGE OF FUEL - 10.0				
2WD208_10	PRE-INTERIM STG FAC RECEIVING OPERATIONS			
2WD210_10	FUEL PRE-INTERIM STG FAC CONTINUING OPERATIONS			
TOTAL	100			
TRANSPORT FUEL FROM K BASINS - 11.0				
2WC065_11	FUEL & SLUDGE TRANSPORT TO PRE-INTERIM STORAGE			
TOTAL	11A			
DESIGN STAB/PROCESS FACILITY - 12.0				
2WE215_12	ITA(FMEF) PROCESS/STAB FACILITY PRELIMINARY DESN			
2WE220_12	ITA(FMEF) PROCESS/STAB FACILITY TECHNICAL DEVEL			
2WE225_12	PREP PREL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY			
2WE226_12	APPR PREL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY			
2WE227_12	PREP FNL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY			
2WE228_12	APPR FNL ITA(FMEF) PROCESS/STAB FACIL SFTY ANLY			
2WE230_12	ITA(FMEF) PROCESS/STAB FACILITY FINAL DESIGN			
2WE231_12	STAB/PROCESS CONTAINER(MCO) DESIGN/PROC SPEC			
2WE232_12	STAB/PROCESS CONTAINER(MCO) PROCUREMENT			
TOTAL	120			
CONSTRUCT STAB/PROCESS FACILITY - 13.0				
2WE235_13	ETA(FMEF) PROCESS/STAB FACILITY CONSTRUCTION			
2WE236_13	CANISTER DESLUDGE FACILITY CONSTRUCTION			

PRIMAVERA PROJECT PLANNER

ALTERNATE 2, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 175
15:03

COST LOADING REPORT

START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 3- 3

ALTERNATIVE 2 , REVISION F, 10/13/94

TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
CONSTRUCT STAB/PROCESS FACILITY - 13.0				
2WE240_13	ITA(FMEF) PROCESS FACILITY ORR & OPS TEST			
TOTAL	130			
STABILIZE/PROCESS FUEL - 14.0				
2WE245_14	ITA(FMEF) PROCESS/STAB FACILITY OPERATION			
TOTAL	140			
DISPOSE OF GENERATED WASTES - 15.0				
2WF400_15	SYSTEM GENERATED WASTES DISPOSAL-CONTAINERIZATN			
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS			
TOTAL	150			
D & D FACILITIES - 16.0				
2WA006_16	K BASIN PREPARATION FOR D & D			
2WD212_16	PRE-INTERIM STORAGE FACILITY D & D			
2WE247_16	ITA(FMEF) PROCESS/STAB FACILITY D & D			
TOTAL	160			
DESIGN INTERIM STORAGE FACILITY - 17.0				
2WE255_17	INTERIM STORAGE FACILITY DESIGN			
2WE257_17	PREPARE INTERIM STORAGE FACILITY SAFETY ANALYSIS			
2WE258_17	APPROVE INTERIM STORAGE FACILITY SAFETY ANALYSIS			
TOTAL	170			
CONSTRUCT INTERIM STORAGE FACILITY - 18.0				
2WE260_18	INTERIM STORAGE FACILITY CONSTRUCTION			
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING			
TOTAL	180			
TRANSPORT DRY STORAGE CASKS - 19.0				
2WE263_19	DRY STORAGE CASK TRANSPORT TO INTERIM STORAGE			
2WE300_19	PREPARE DRY FUEL & SLUDGE TRANSPORTATION SARP			
2WE301_19	APPROVE DRY FUEL & SLUDGE TRANSPORTATION SARP			
2WE305_19	DRY FUEL & SLUDGE TRANSPORT CASKS & RAIL CAR DSN			
2WE310_19	DRY FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMNT			
2WE317_19	DRY FUEL & SLUDGE TRANSPORT ORR			
TOTAL	190			
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0				
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP			
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END	1.5	1.5	0.8
TOTAL	200	1.5	1.5	0.8
	REPORT TOTAL	1.5	1.5	0.8

Summary Cost Basis Information
Alternative 2 - Containerize and Store in FMEF Pool

Scenario:

Alternative 2 includes the following major activities:

- K Basin modifications and containerization in 20x34 overpacks for both basins.
- Direct transport as overpacks are filled to pre-interim storage pool located at FMEF.
- Wet transfer of canister from 20x34 overpacks to MCOs and direct transfer to passivation facility.
- Conditioning facility proposed in ITA Alternative 3 located at the FMEF.
- Direct transport from conditioning facility of passivated fuel and sludge to interim dry storage facility located in the 200 Areas.
- Interim dry storage of passivated fuel and sludge in the 200 Areas using the ITA vault as costed in Alternative 3.

This alternative requires a pre-interim storage facility but relocates the fuel out of K Basins earlier, reducing K Basin expenditures (@ $42M/yr). This alternative requires a repackaging of fuel canister from overpacks to MCOs which results in the discard of 2500 overpacks ($10M) as radioactive waste. Storage and passivation at FMEF also requires a second shipment of the material in new shipping casks ($25M). Interim storage is the same for all options except this option requires operations staffing of the storage vault during 2 year shipping period.

Cost and Scheduling Activity Bases:

(Activity numbers are identified in parenthesis, i.e., (09B013)).

0.0 Program Actions Common for All Alternatives

Program management, regulatory compliance, and public involvement = $10.5M/yr from SNF MYPP (Note 4). No cost estimates included for other actions. Common for all options. (09B013)

1.0 Characterize Fuel and Sludge

Total 3 year costs = $18 M. ($13M-fuel, $5M-sludge). From prior program planning documents and discussions with R. Omberg (Note 31). (2WC018, 2WC097)

2.0 (a) Package Fuel

1) Basin equipment design = $4.5 M (Note 13). (2WC025)

2) Basin equipment installation = $2.5 M (Note 13). (2WC030)

3) Design specification = $0.2 M. Vendor provides container design. (2WC050)

4) Purchase the overpacks required for both basins which is $10.4M (Note 5). (2WC055)

5) ORR = $0.1 M. Generic K Basins ORR covers most of this and is costed at $2.4M in sect. 2.0.c. (2WC040)

6) Fuel containerization and loadout = $4.3 M from discussions with K Basins Operations, L. Hoffer (Note 32). Estimate 1000 shifts + burnout costs associated with 35 rem total exposure. See Alt #1 file. (2WC0060)

7) SAR = $0.2 K (prepare) + $0.1 (approval) from K. Daschke report. (2WC020, 2WC021)

8) SAR Approval = $0.1. (2WC021)

2.0 (b) Package Sludge

1) Sludge equip. design=$2.6M from communication with advocate. (2WC100)

2) Sludge equipment installation = $ 2.5 M from communication with advocate. (2WC110)

3) Sludge retrieval and containerization equipment = $10 M from communication with advocate. (2WC120)

4) Sludge container procurement = $ 4 M from communication with advocate. (2WC125)

5) ORR = $0.2 M SAIC estimate. Most aspects covered by generic K Basins ORR. (2WC115)

6) Containerization labor = $0.8 M from discussion with Leon Hoffer (Note 32), K Basins Operations. (2WC130)

7) SAR = 110 K from K. Daschke report (rounded up to $0.2 M). (2WC090). Approval = $0.1M (2WC091)

8) Sludge technology development = $2.6M (Note 4). (2WC117)

2.0 (c) Ongoing Operations in K Basins

1) Ongoing operations at $42M/year until processing complete. (2WA003)

2) Upgrade modification = $13.1M (Note 5 overpack sheets) and MYPP (Note 4). (2WA004)

3) K Basin ORR = 20 manyears @ $120K = $2.4M per K. Daschke report (Note 17). (2WA005)

3.0 Prepare Fuel and Sludge for Transport

1) SAR = $ 0.7 M from communications with K. Daschke. (2WC070, 2WC071)

2&3) Cask and rail car design and procurement = $ 20 M from draft advocate report (Note 13). Reduced to $18 M based on discussions with advocate Design = 3.0 and procurement = 15.0 (15 casks and 4 railcars). (2WC075, 2WC080)

4.0 Design Pre-Interim Storage Facility

1) Preliminary design = $1.5M per WHC cost estimate from advocate (Ruge) (Note 1) modified per KEH guidelines (Note 12). (2WD185)

2) Technology development not required for standard pool design.

3) Safety Analysis; PSAR = $1.0 (prepare) + 0.4 (approval) and FSAR = $0.9 (prepare) + 0.5 (approval) per K. Daschke report (Note 17). (2WD191, 192, 193, 194)

4) Final design= $10.0 M. WHC cost estimate (Note 1) for pool at FMEF was modified to make it consistent with KEH guidelines and contingency approach. [Final design = $5.9 M + 1.5 (contingency) + 2.6 (desludging) = 10.0]. (2WD195)

5.0 Construct Pre-Interim Storage Facility

1) Construction = $52.6M. WHC cost estimate (Note 1) modified using KEH guidelines and 25% contingency. Added cost of $10.8 M for desludging station in the pool. [Const = $33.4 + $8.6 + $10.8 = $52.6] (2WD200)

2) ORR cost = $1.5 per K. Daschke report). (2WD205)

6.0 Dispose of Debris

1) Debris disposal includes removal of racks, approximately 2000 empty canisters, and misc. scrap including lights, conduit, tools, scaffolding, etc.= $2M for disposal in burial boxes (Note 30).

7.0 Transport Fuel to Pre-Interim Storage

NA

8.0 Remove Radioactive Water

1) KE feed and bleed activities = $1.9 M/yr to the year 2002 = $11.4 M per discussions with advocate (Note 24). (2WF345)

2) KE cleanup equipment = $6.6M per discussions with advocate (Note 24).

9.0 Store Sludge

NA

10.0 Pre-Interim Storage of Fuel

1) Operating cost during receiving operations = $18M/yr. This is 50% higher than base operating cost below. (2WD208)

2) Operating cost= $12M/yr. Staff cost based upon 10 people/shift times 5 shifts for 7 day, 24 hr a day coverage, plus a 25 person day shift including maintenance. Additional cost of consumables @ $3M. [(10x5)+25]x$120K= $9M+3M= $12M/yr. (2WD210)

11.0 Transport of Fuel from Pre-Interim Storage

1) $ 1.4 M railroad maintenance cost + 6 FTEs/shift times 3 shifts times 120K each = $3.5 M per year x 2yrs = $ 7.0 M + $3 M to block off roads (per advocate discussion $3 K per shipment) = $10 M. (2WC065)

12.0 Design Stabilization/Processing Facility

1) Preliminary Design costs= $1.3M from KEH estimate to passivate with ITA process (Note 20a). (2WE215)

2) Technology development plus hot cell testing costs (Note 5) and discussion with advocate that reduced the hot cell testing costs from $30 to $10 M = $19.7M. (2WE220)

3&4) FSAR = 0.9 (prepare) + 0.4 (approval) and FSAR = 0.9 (prepare) + 0.5 (approval). SAR costs from K. Daschke report. (2WE225, 226, 227, 228)

5) Design costs from KEH estimate to passivate utilizing the ITA process with 25% contingency. Final design = $11.2M (Note 20a). (2WE230)

6) MCO procurement specification = $0.5 M. (2WE231)

7) Cost of storage containers = $48.6 M based on KEH estimate (Note 20a). (2WE232)

13.0 Construct Stabilization/Processing Facility

1) Construction cost = $64.5M. Construction costs from KEH estimate to passivate using ITA process. Reduced by $10.3 M because facility is in FMEF (Note 20a). (2WD200)

2) ORR costs from K. Daschke report plus OTP costs estimated by SAIC = $19.5M. Assume full operating staff during OTP. (2WD240)

14.0 Stabilize/Process Fuel

1) Operations costs generated by SAIC evaluation of facility staffing. 150 person staffing level + 8 M for utilities and materials costs. (150 @ 120K)+8M= $26M/yr. (2WC245)

15.0 Dispose of Generated Wastes

1) Stabilization wastes include Mark 0, I, & II canisters, overpacks, and misc. other waste. (2WF405)
   2500 overpacks compacted to 6 cubic feet
   = 15,000 cubic feet @ $80/cubic foot= $1.2M
   misc. + .8M
   $2.0M

2) Containerization wastes = 300 K per discussion with WHC advocate. (2WF400)

16.0 D&D of Facilities

Estimates (Note 5) for K Basins and processing facility.

1) K Basin--$30M/yr for 3 years= $90 M. (2WA006)

2) Pre-Interim Storage facility= $86 M. (2WD212)

3) Passivation facility= $90 M. (2WE247)

17.0 Design Interim Storage Facility

1) Design costs = $1M for site. Vendor Design costs included in $38.7 M construction estimate in 15.0 below. (2WE255)

2) SAR = $750K from K. Daschke report = $0.7 M. Approval = $0.4 M. (2WE257, 258)

18.0 Interim Storage Facility Construction

1) From ITA report (Note 11) adjusted by SAIC to account for sludge storage (+20%) and increased contingency from 15% to 50%. New estimated cost =[$21.5M+(20%)]= $25.8+50%= $38.7M. (2WE260)

19.0 Transport Dry Storage Casks

This second transport from FMEF to 200 Area in passivation canisters is equivalent to the cask transport for Alternative 3B from K Basin to 200 Area in MCOs.

1) SARP = $0.6 M (prepare) + 0.1 (approve) per K. Daschke report. (2WE300, 301)

2) Cask and railcar Design = $2M modified from ITA cost estimate. (see Alternative 3) (2WE305)

3) Cask procurement = $8M modified from ITA cost estimate. (see Alternative 3) (2WE310)

4) Transportation Infrastructure--none identified.

5) Transportation ORR= $.1M. Same as Section 3.0, item 4. (2WE317)

6) Cask Transport= $10.0M. Same as Section 11.0, item 1. (2WE263)

20.0 Store Fuel in Interim Storage Facility

1) Operating cost during shipping since facility is not co-located requires the base operating cost of $1.5M from below plus 5 FTEs/ shift times 3 shifts=$3.3M/yr. (2WE265)

2) Operating cost increased from 360 K/yr to $1.5 M/yr based on SAIC judgement. Basis for 1.5 M is 10 FTE @ 120 K/yr + 300K in materials, utilities, and overheads. (2WE270)

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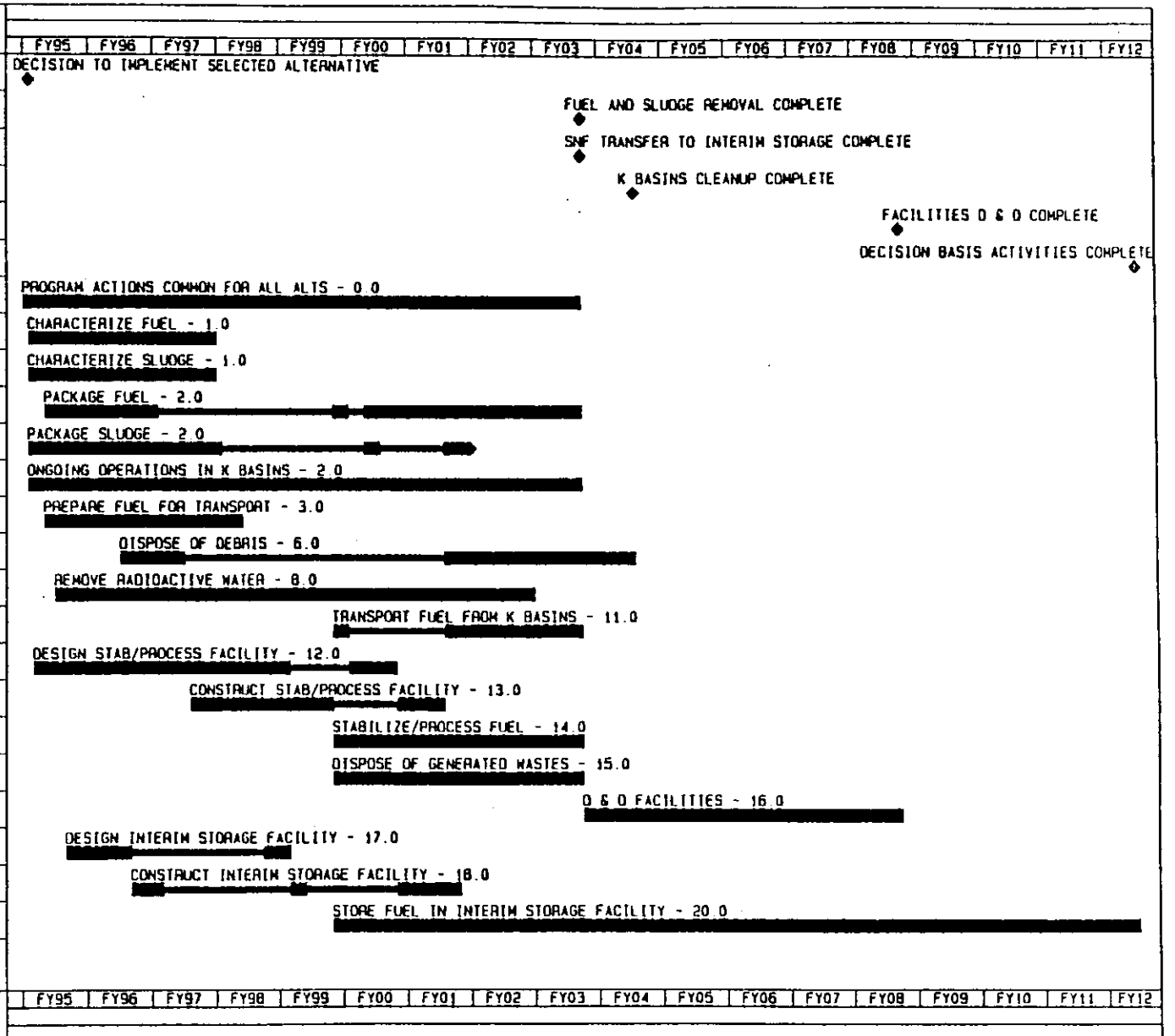
EARLY START	EARLY FINISH	BUDGET COST
1NOV94	31OCT94	0
1JUL03	30JUN03	0
1JUL03	30JUN03	0
1MAY04	30APR04	0
1JUL08	30JUN08	0
1APR12	31MAR12	0
1OCT94	30JUN03	91
1NOV94	30SEP97	13
1NOV94	30SEP97	5
1FEB95	30JUN03	97
1NOV94	30SEP01	24
1NOV94	30JUN03	377
1FEB95	28FEB98	11
1APR96	30APR04	10
1APR95	30SEP02	18
1AUG99	30JUN03	10
1DEC94	31JUL00	35
1MAY97	30APR01	92
1AUG99	30JUN03	63
1AUG99	30JUN03	1
1JUL03	30JUN08	180
1JUN95	30NOV98	2
1JUN96	31JUL01	39
1AUG99	31MAR12	19



Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

(c) Primavera Systems, Inc.

Inactive
Summary Bar/Early Dates
Critical Designator
Milestone/Flag Activity

K BASIN
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 3 - SUMMARY

Sheet 1 of 1

REVISION E 10/13/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST	FY95 FY96 FY97 FY98 FY99 FY00 FY01 FY02 FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12
DECISION BASIS KEY DATES - 0.0						
00A	100	1NOV94		0	.0	098005 DECISION TO IMPLEMENT PREFERRED ALTERNATIVE
00A	100		30JUN03	0	.0	098006 FUEL AND SLUDGE REMOVAL COMPLETE
00A	200		30JUN03	0	.0	098004 SNF TRANSFER TO INTERIM STORAGE COMPLETE
00A	300		30APR04	0	.0	098007 K BASIN CLEANUP COMPLETE
00A	300		30JUN08	0	.0	098008 FACILITIES D & D COMPLETE
00A	400		31MAR12	0	.0	098009 DECISION BASIS ACTIVITIES COMPLETE
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0						
00B	100	1NOV94	31OCT95	12	0	2W8015_02 DESIGN REQUIRMENTS FOR PREFERRED ALTERNATIVE
00B	310	1OCT94	30JUN95	9	0	09801A SNF PROGRAMMATIC EIS AND ROD
00B	320	1JUL95	30JUN96	12	0	098018 HANFORD SITE EIS AND ROD
00B	320	1NOV94	31MAY95	7	0	098010 FUEL REMOVAL INTERIM ACTION EA
00B	320	1NOV94	31DEC95	14	0	098010 FUEL REMOVAL INTERIM ACTION EIS
00B	400	1NOV94	30JUN03	104	91.0	098013 PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT
CHARACTERIZE FUEL - 1.0						
01A	100	1NOV94	30SEP97	35	13.0	2WC018_01 CHARACTERIZATION OF FUEL
CHARACTERIZE SLUDGE - 1.0						
01B	100	1NOV94	30SEP97	35	5.0	2WC097_01 CHARACTERIZATION OF SLUDGE
PACKAGE FUEL - 2.0						
02A	100	1FEB95	31JUL95	6	2.6	2WC025_02A DEMO K-WEST FUEL MCO PKG IN-BASIN EQPT/MODS DESN
02A	100	1AUG95	31JAN96	6	10.8	2WC030_02A DEMO K-WEST FUEL MCO PACK IN-BSN EQPT/MODS INSTL
02A	200	1FEB95	31OCT95	9	3	2WC050-02A DEMO FUEL MCO DESIGN & PROCUREMENT SPECIFICATION
02A	200	1NOV95	31JUL96	9	2.5	2WC055_02A DEMO FUEL MCO PROCUREMENT
02A	300	1AUG96	31OCT96	3	1	2WC040_02A DEMO K-WEST FUEL MCO PACKAGING DRR
02A	400	1AUG99	31OCT99	3	9	2WC060_02A DEMO K-WEST FUEL MCO PACKAGING AND LOADOUT
02A	500	1FEB95	30SEP95	8	3	2WC020_02A PREP DEMO K-WEST FUEL MCO OVPK OPS SAFE ANALYSIS
02A	500	1NOV95	31MAR96	5	1	2WC021_02A APPROVE DEMO K-WEST FUEL MCO OVPK OPS SAFE ANALY
02A	900	1AUG95	31OCT95	3	2.6	2WC025_02B K-EAST FUEL MCO PACK IN-BASIN EQPT/MODS DESIGN
02A	900	1NOV95	30APR96	6	13.0	2WC030_02B K-EAST FUEL MCO PACK IN-BSN EQPT MODS INSTL

Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

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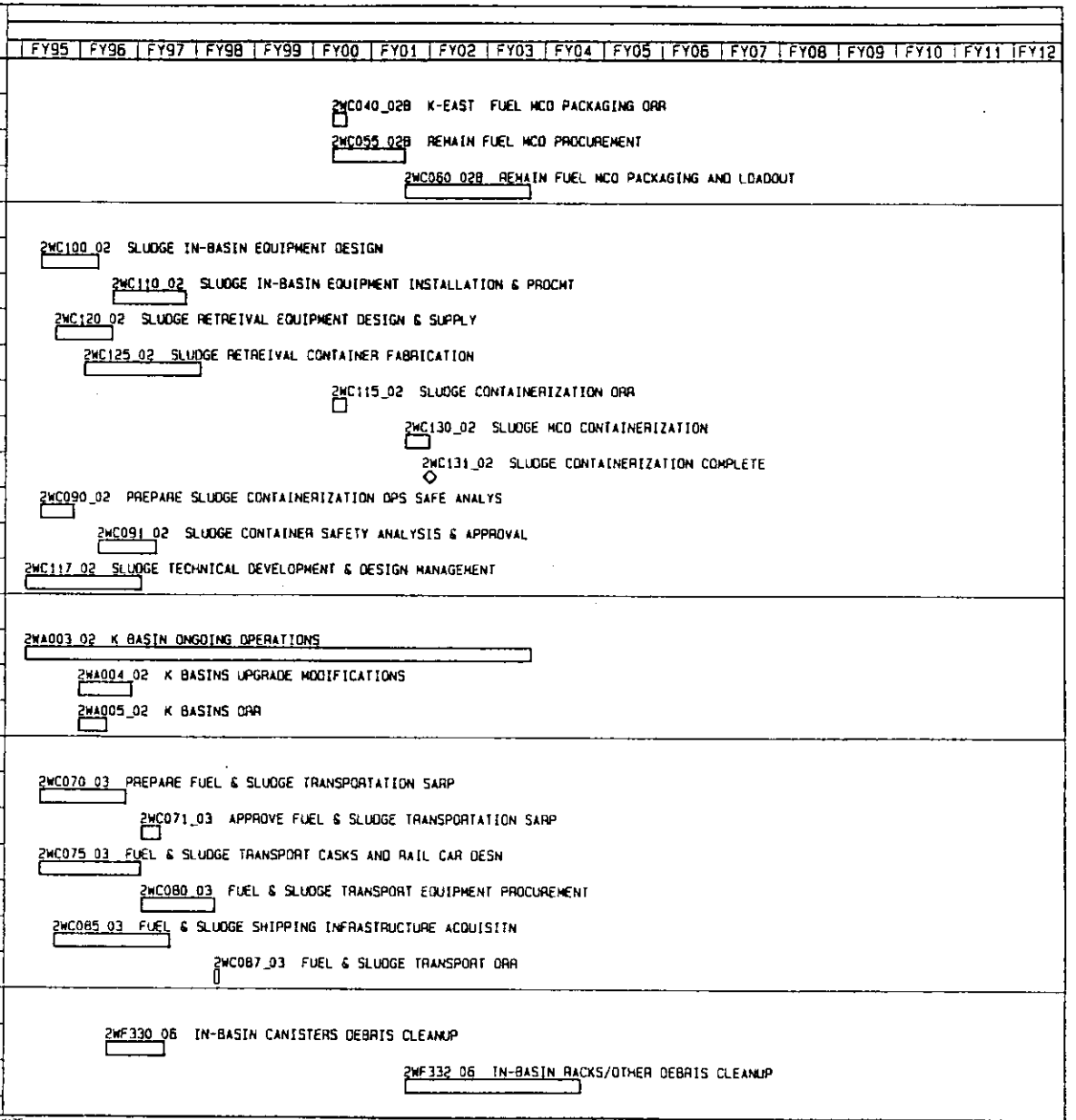
Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 3

REVISION E 10/13/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST	Activity
PACKAGE FUEL - 2.0						
02A	900	1FEB00	30APR00	3	0	2WC040_02B K-EAST FUEL MCO PACKAGING ORR
02A	900	1FEB00	30APR01	15	46.3	2WC055_02B REMAIN FUEL MCO PROCUREMENT
02A	900	1MAY01	30JUN03	26	17.6	2WC060_02B REMAIN FUEL MCO PACKAGING AND LOADOUT
PACKAGE SLUDGE - 2.0						
02B	100	1FEB95	31JAN96	12	2.6	2WC100_02 SLUDGE IN-BASIN EQUIPMENT DESIGN
02B	100	1MAY96	31JUL97	15	2.5	2WC110_02 SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT
02B	200	1MAY95	30APR96	12	10.0	2WC120_02 SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY
02B	200	1NOV95	31OCT97	24	4.0	2WC125_02 SLUDGE RETREIVAL CONTAINER FABRICATION
02B	300	1FEB00	30APR00	3	.2	2WC115_02 SLUDGE CONTAINERIZATION ORR
02B	400	1MAY01	30SEP01	5	1.6	2WC130_02 SLUDGE MCO CONTAINERIZATION
02B	400	1OCT01	30SEP01	0	.0	2WC131_02 SLUDGE CONTAINERIZATION COMPLETE
02B	500	1FEB95	31AUG95	7	2	2WC090_02 PREPARE SLUDGE CONTAINERIZATION OPS SAFE ANALYS
02B	500	1FEB96	31JAN97	12	.1	2WC091_02 SLUDGE CONTAINER SAFETY ANALYSIS & APPROVAL
02B	500	1NOV94	31OCT96	24	2.6	2WC117_02 SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT
ONGOING OPERATIONS IN K BASINS - 2.0						
02C	100	1NOV94	30JUN03	104	364.0	2WA003_02 K BASIN ONGOING OPERATIONS
02C	100	1OCT95	31AUG96	11	13.1	2WA004_02 K BASINS UPGRADE MODIFICATIONS
02C	300	1OCT95	31MAR96	6	.0	2WA005_02 K BASINS ORR
PREPARE FUEL FOR TRANSPORT - 3.0						
03A	100	1FEB95	31JUL96	18	.6	2WC070_03 PREPARE FUEL & SLUDGE TRANSPORTATION SARP
03A	100	1NOV96	28FEB97	4	.1	2WC071_03 APPROVE FUEL & SLUDGE TRANSPORTATION SARP
03A	100	1FEB95	31OCT96	21	2.0	2WC075_03 FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN
03A	100	1NOV96	31JAN98	15	8.0	2WC080_03 FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT
03A	200	1MAY95	30APR97	24	.0	2WC085_03 FUEL & SLUDGE SHIPPING INFRASTRUCTURE ACQUISITN
03A	300	1FEB98	28FEB98	1	1	2WC087_03 FUEL & SLUDGE TRANSPORT ORR
DISPOSE OF DEBRIS - 6.0						
060	100	1APR96	31MAR97	12	3.4	2WF330_06 IN-BASIN CANISTERS DEBRIS CLEANUP
060	200	1MAY01	30APR04	36	6.6	2WF332_06 IN-BASIN RACKS/OTHER DEBRIS CLEANUP



Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

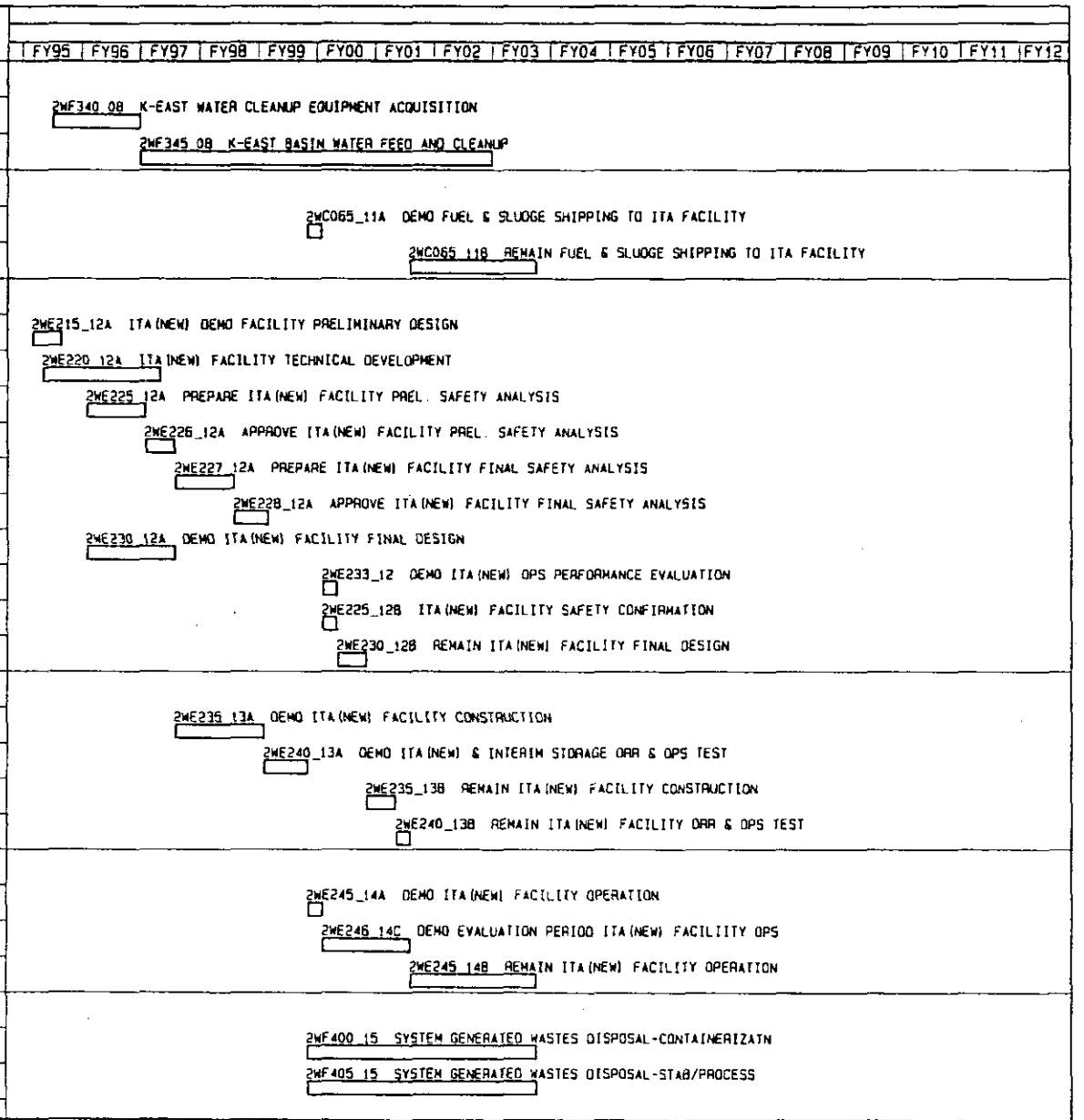
K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 3

Sheet 2 of 4

REVISION E 10/13/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
REMOVE RADIOACTIVE WATER - 8.0					
080	100	1APR95	30SEP96	18	6.6
080	200	1OCT96	30SEP02	72	11.4
TRANSPORT FUEL FROM K BASINS - 11.0					
11A	100	1AUG99	31OCT99	3	6
11A	900	1MAY01	30JUN03	26	9.4
DESIGN STAB/PROCESS FACILITY - 12.0					
120	100	1DEC94	31MAY95	6	1.4
120	200	1FEB95	31JAN97	24	19.7
120	300	1NOV95	31OCT96	12	1.0
120	300	1NOV95	30APR97	6	4
120	300	1MAY97	30APR98	12	9
120	300	1MAY98	30NOV98	7	5
120	400	1NOV95	30APR97	18	7.5
120	600	1NOV99	31JAN00	3	6
120	900	1NOV99	31JAN00	3	6
120	900	1FEB00	31JUL00	6	1.9
CONSTRUCT STAB/PROCESS FACILITY - 13.0					
130	100	1MAY97	31OCT98	18	51.0
130	200	1NOV98	31JUL99	9	12.0
130	900	1AUG00	31JAN01	6	23.8
130	900	1FEB01	30APR01	3	5.0
STABILIZE/PROCESS FUEL - 14.0					
140	100	1AUG99	31OCT99	3	5.0
140	800	1NOV99	30APR01	18	15.0
140	900	1MAY01	30JUN03	26	43.0
DISPOSE OF GENERATED WASTES - 15.0					
150	100	1AUG99	30JUN03	47	0
150	200	1AUG99	30JUN03	47	8



Plot Date 13OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 3

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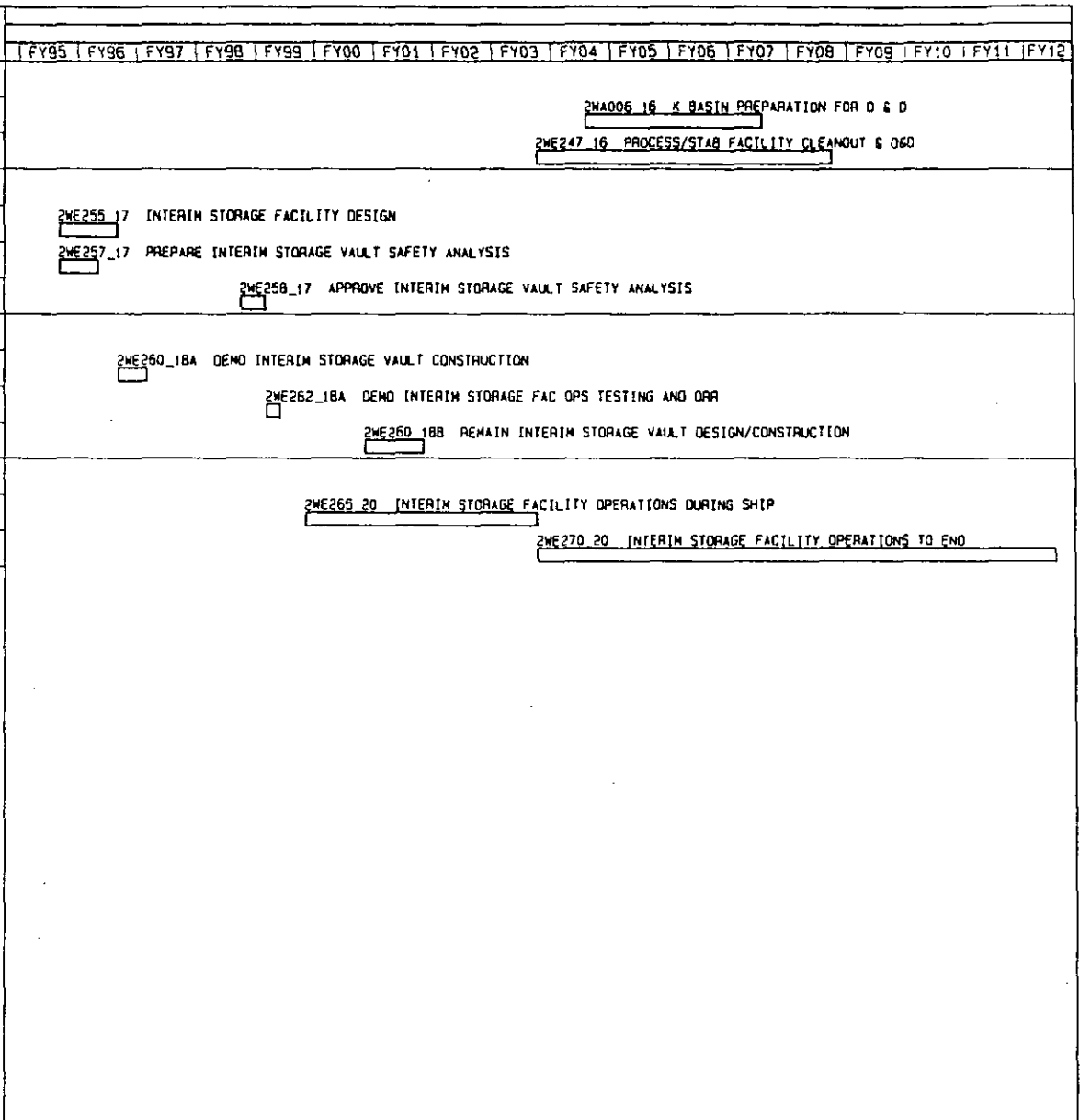
REVISION E 10/13/94

Date	Revision	Checked	Approved

P8K1	P8K2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
D & D FACILITIES - 16.0					
160	100	1MAY04	30APR07	36	90.0
160	300	1JUL03	30JUN08	60	90.0
DESIGN INTERIM STORAGE FACILITY - 17.0					
170	100	1JUN95	31MAY96	12	1.0
170	200	1JUN95	31JAN96	8	.7
170	200	1JUL98	30NOV98	5	.4
CONSTRUCT INTERIM STORAGE FACILITY - 18.0					
180	100	1JUN96	30NOV96	6	19.3
180	300	1DEC98	28FEB99	3	2
180	900	1AUG00	31JUL01	12	19.4
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0					
200	300	1AUG99	30JUN03	47	6.3
200	400	1JUL03	31MAR12	105	13.1



Plot Date 13OCT94
Data Date 1OCT93
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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 3

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REVISION E 10/13/94

Date	Revision	Checked	Approved

PRIMAVERA PROJECT PLANNER — ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279 15:03 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 1- 1

ALTERNATIVE 3 , REVISION E, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT	91.0	9.6	10.5	10.5	10.5	10.5	10.5	10.5
TOTAL	00B	91.0	9.6	10.5	10.5	10.5	10.5	10.5	10.5
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL	13.0	4.1	4.5	4.5				
TOTAL	01A	13.0	4.1	4.5	4.5				
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE	5.0	1.6	1.7	1.7				
TOTAL	01B	5.0	1.6	1.7	1.7				
PACKAGE FUEL - 2.0									
2WC020_02A	PREP DEMO K-WEST FUEL MCO OVPK OPS SAFE ANALYSIS	0.3	0.3						
2WC021_02A	APPROVE DEMO K-WEST FUEL MCO OVPK OPS SAFE ANALY	0.1		0.1					
2WC025_02A	DEMO K-WEST FUEL MCO PKG IN-BASIN EQPT/MODS DESN	2.6	2.6						
2WC025_02B	K-EAST FUEL MCO PACK IN-BASIN EQPT/MODS DESIGN	2.6	1.7	0.9					
2WC030_02A	DEMO K-WEST FUEL MCO PACK IN-BSN EQPT/MODS INSTL	10.8	3.6	7.2					
2WC030_02B	K-EAST FUEL MCO PACK IN-BSN EQPT MODS INSTL	13.0		13.0					
2WC040_02A	DEMO K-WEST FUEL MCO PACKAGING ORR	0.1		0.1	0.0				
2WC040_02B	K-EAST FUEL MCO PACKAGING ORR								
2WC050-02A	DEMO FUEL MCO DESIGN & PROCUREMENT SPECIFICATION	0.3	0.3	0.0					
2WC055_02A	DEMO FUEL MCO PROCUREMENT	2.5		2.5					
2WC055_02B	REMAIN FUEL MCO PROCUREMENT	46.3						24.7	21.6
2WC060_02A	DEMO K-WEST FUEL MCO PACKAGING AND LOADOUT	0.9					0.6	0.3	
2WC060_02B	REMAIN FUEL MCO PACKAGING AND LOADOUT	17.6							3.4
TOTAL	02A	97.1	8.5	23.8	0.0		0.6	25.0	25.0
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINERIZATION OPS SAFE ANALYS	0.2	0.2						
2WC091_02	SLUDGE CONTAINER SAFETY ANALYSIS & APPROVAL	0.1		0.1	0.0				
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN	2.6	1.7	0.9					
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT	2.5		0.8	1.7				
2WC115_02	SLUDGE CONTAINERIZATION ORR	0.2						0.2	
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT	2.6	1.2	1.3	0.1				
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY	10.0	4.2	5.8					
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION	4.0		1.8	2.0	0.2			
2WC130_02	SLUDGE MCO CONTAINERIZATION	1.6							1.6
TOTAL	02B	23.8	7.3	10.7	3.8	0.2		0.2	1.6
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS	364.0	38.5	42.0	42.0	42.0	42.0	42.0	42.0
2WA004_02	K BASINS UPGRADE MODIFICATIONS	13.1		13.1					
TOTAL	02C	377.1	38.5	55.1	42.0	42.0	42.0	42.0	42.0
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP	0.6	0.3	0.3					
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP	0.1			0.1				
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN	2.0	0.8	1.1	0.1				
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT	8.0			5.9	2.1			

PRIMAVERA PROJECT PLANNER — ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279 15:03 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 2- 1

ALTERNATIVE 3 , REVISION E, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC087_03	FUEL & SLUDGE TRANSPORT ORR	0.1				0.1			
TOTAL	03A	10.8	1.0	1.5	6.1	2.2			
DISPOSE OF DEBRIS - 6.0									
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP	3.4		1.7	1.7				
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP	6.6							0.9
TOTAL	060	10.0		1.7	1.7				0.9
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION	6.6	2.2	4.4					
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP	11.4			1.9	1.9	1.9	1.9	1.9
TOTAL	080	18.0	2.2	4.4	1.9	1.9	1.9	1.9	1.9
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_11A	DEMO FUEL & SLUDGE SHIPPING TO ITA FACILITY	0.6					0.4	0.2	
2WC065_11B	REMAIN FUEL & SLUDGE SHIPPING TO ITA FACILITY	9.4							1.8
TOTAL	11A	10.0					0.4	0.2	1.8
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12A	ITA(NEW) DEMO FACILITY PRELIMINARY DESIGN	1.4	1.4						
2WE220_12A	ITA(NEW) FACILITY TECHNICAL DEVELOPMENT	19.7	6.6	9.9	3.3				
2WE225_12A	PREPARE ITA(NEW) FACILITY PREL. SAFETY ANALYSIS	1.0		0.9	0.1				
2WE225_12B	ITA(NEW) FACILITY SAFETY CONFIRMATION	0.6						0.6	
2WE226_12A	APPROVE ITA(NEW) FACILITY PREL. SAFETY ANALYSIS	0.4			0.4				
2WE227_12A	PREPARE ITA(NEW) FACILITY FINAL SAFETY ANALYSIS	0.9			0.4	0.5			
2WE228_12A	APPROVE ITA(NEW) FACILITY FINAL SAFETY ANALYSIS	0.5				0.4	0.1		
2WE230_12A	DEMO ITA(NEW) FACILITY FINAL DESIGN	7.5		4.6	2.9				
2WE230_12B	REMAIN ITA(NEW) FACILITY FINAL DESIGN	1.9						1.9	
2WE233_12	DEMO ITA(NEW) OPS PERFORMANCE EVALUATION	0.6						0.6	
TOTAL	120	34.5	8.0	15.4	7.1	0.9	0.1	3.1	
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13A	DEMO ITA(NEW) FACILITY CONSTRUCTION	51.0			14.2	34.0	2.8		
2WE235_13B	REMAIN ITA(NEW) FACILITY CONSTRUCTION	23.8						7.9	15.9
2WE240_13A	DEMO ITA(NEW) & INTERIM STORAGE ORR & OPS TEST	12.0					12.0		
2WE240_13B	REMAIN ITA(NEW) FACILITY ORR & OPS TEST	5.0							5.0
TOTAL	130	91.8			14.2	34.0	14.8	7.9	20.9
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14A	DEMO ITA(NEW) FACILITY OPERATION	5.0					3.3	1.7	
2WE245_14B	REMAIN ITA(NEW) FACILITY OPERATION	43.0							8.3
2WE246_14C	DEMO EVALUATION PERIOD ITA(NEW) FACILITY OPS	15.0						9.2	5.8
TOTAL	140	63.0					3.3	10.8	14.1
DISPOSE OF GENERATED WASTES - 15.0									
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS	0.8					0.0	0.2	0.2

PRIMAVERA PROJECT PLANNER — ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12
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ALTERNATIVE 3 , REVISION E, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
DISPOSE OF GENERATED WASTES - 15.0									
TOTAL	150	0.8					0.0	0.2	0.2
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARATION FOR D & D	90.0							
2WE247_16	PROCESS/STAB FACILITY CLEANOUT & D&D	90.0							
TOTAL	160	180.0							
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE255_17	INTERIM STORAGE FACILITY DESIGN	1.0	0.3	0.7					
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS	0.7	0.3	0.3					
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS	0.4				0.2	0.2		
TOTAL	170	2.1	0.7	1.0		0.2	0.2		
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18A	DEMO INTERIM STORAGE VAULT CONSTRUCTION	19.3		12.9	6.4				
2WE260_18B	REMAIN INTERIM STORAGE VAULT DESIGN/CONSTRUCTION	19.4						3.2	16.2
2WE262_18A	DEMO INTERIM STORAGE FAC OPS TESTING AND ORR	0.2					0.2		
TOTAL	180	38.9		12.9	6.4		0.2	3.2	16.2
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP	6.3					0.3	1.6	1.6
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END	13.1							
TOTAL	200	19.4					0.3	1.6	1.6
	REPORT TOTAL	1086.3	81.5	143.1	99.8	91.9	74.4	106.7	136.7

PRIMAVERA PROJECT PLANNER — ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279 15:03 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

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ALTERNATIVE 3 , REVISION E, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT	10.5	7.9						
TOTAL	00B	10.5	7.9						
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL								
TOTAL	01A								
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE								
TOTAL	01B								
PACKAGE FUEL - 2.0									
2WC020_02A	PREP DEMO K-WEST FUEL MCO OVPK OPS SAFE ANALYSIS								
2WC021_02A	APPROVE DEMO K-WEST FUEL MCO OVPK OPS SAFE ANALY								
2WC025_02A	DEMO K-WEST FUEL MCO PKG IN-BASIN EQPT/MODS DESN								
2WC025_02B	K-EAST FUEL MCO PACK IN-BASIN EQPT/MODS DESIGN								
2WC030_02A	DEMO K-WEST FUEL MCO PACK IN-BSN EQPT/MODS INSTL								
2WC030_02B	K-EAST FUEL MCO PACK IN-BSN EQPT MODS INSTL								
2WC040_02A	DEMO K-WEST FUEL MCO PACKAGING ORR								
2WC040_02B	K-EAST FUEL MCO PACKAGING ORR								
2WC050-02A	DEMO FUEL MCO DESIGN & PROCUREMENT SPECIFICATION								
2WC055_02A	DEMO FUEL MCO PROCUREMENT								
2WC055_02B	REMAIN FUEL MCO PROCUREMENT								
2WC060_02A	DEMO K-WEST FUEL MCO PACKAGING AND LOADOUT								
2WC060_02B	REMAIN FUEL MCO PACKAGING AND LOADOUT	8.1	6.1						
TOTAL	02A	8.1	6.1						
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINERIZATION OPS SAFE ANALYS								
2WC091_02	SLUDGE CONTAINER SAFETY ANALYSIS & APPROVAL								
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN								
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT								
2WC115_02	SLUDGE CONTAINERIZATION ORR								
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT								
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY								
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION								
2WC130_02	SLUDGE MCO CONTAINERIZATION								
TOTAL	02B								
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS	42.0	31.5						
2WA004_02	K BASINS UPGRADE MODIFICATIONS								
TOTAL	02C	42.0	31.5						
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP								
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP								
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN								
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT								

PRIMAVERA PROJECT PLANNER — ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279 15:03 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

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ALTERNATIVE 3 , REVISION E, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC087_03	FUEL & SLUDGE TRANSPORT ORR								
TOTAL	03A								
DISPOSE OF DEBRIS - 6.0									
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP								
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP	2.2	2.2	1.3					
TOTAL	060	2.2	2.2	1.3					
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION								
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP	1.9							
TOTAL	080	1.9							
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_11A	DEMO FUEL & SLUDGE SHIPPING TO ITA FACILITY								
2WC065_11B	REMAIN FUEL & SLUDGE SHIPPING TO ITA FACILITY	4.3	3.3						
TOTAL	11A	4.3	3.3						
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12A	ITA(NEW) DEMO FACILITY PRELIMINARY DESIGN								
2WE220_12A	ITA(NEW) FACILITY TECHNICAL DEVELOPMENT								
2WE225_12A	PREPARE ITA(NEW) FACILITY PREL. SAFETY ANALYSIS								
2WE225_12B	ITA(NEW) FACILITY SAFETY CONFIRMATION								
2WE226_12A	APPROVE ITA(NEW) FACILITY PREL. SAFETY ANALYSIS								
2WE227_12A	PREPARE ITA(NEW) FACILITY FINAL SAFETY ANALYSIS								
2WE228_12A	APPROVE ITA(NEW) FACILITY FINAL SAFETY ANALYSIS								
2WE230_12A	DEMO ITA(NEW) FACILITY FINAL DESIGN								
2WE230_12B	REMAIN ITA(NEW) FACILITY FINAL DESIGN								
2WE233_12	DEMO ITA(NEW) OPS PERFORMANCE EVALUATION								
TOTAL	120								
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13A	DEMO ITA(NEW) FACILITY CONSTRUCTION								
2WE235_13B	REMAIN ITA(NEW) FACILITY CONSTRUCTION								
2WE240_13A	DEMO ITA(NEW) & INTERIM STORAGE ORR & OPS TEST								
2WE240_13B	REMAIN ITA(NEW) FACILITY ORR & OPS TEST								
TOTAL	130								
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14A	DEMO ITA(NEW) FACILITY OPERATION								
2WE245_14B	REMAIN ITA(NEW) FACILITY OPERATION	19.8	14.9						
2WE246_14C	DEMO EVALUATION PERIOD ITA(NEW) FACILIITY OPS								
TOTAL	140	19.8	14.9						
DISPOSE OF GENERATED WASTES - 15.0									
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS	0.2	0.2						

PRIMAVERA PROJECT PLANNER — ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12
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ALTERNATIVE 3 , REVISION E, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DISPOSE OF GENERATED WASTES - 15.0									
TOTAL	150	0.2	0.2						
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARATION FOR D & D			12.5	30.0	30.0	17.5		
2WE247_16	PROCESS/STAB FACILITY CLEANOUT & D&D		4.5	18.0	18.0	18.0	18.0	13.5	
TOTAL	160		4.5	30.5	48.0	48.0	35.5	13.5	
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE255_17	INTERIM STORAGE FACILITY DESIGN								
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS								
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS								
TOTAL	170								
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18A	DEMO INTERIM STORAGE VAULT CONSTRUCTION								
2WE260_18B	REMAIN INTERIM STORAGE VAULT DESIGN/CONSTRUCTION								
2WE262_18A	DEMO INTERIM STORAGE FAC OPS TESTING AND ORR								
TOTAL	180								
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP	1.6	1.2						
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END		0.4	1.5	1.5	1.5	1.5	1.5	1.5
TOTAL	200	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.5
	REPORT TOTAL	90.7	72.0	33.3	49.5	49.5	37.0	15.0	1.5

PRIMAVERA PROJECT PLANNER — ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279 15:03 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 1- 3

ALTERNATIVE 3 , REVISION E, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0				
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT			
TOTAL	00B			
CHARACTERIZE FUEL - 1.0				
2WC018_01	CHARACTERIZATION OF FUEL			
TOTAL	01A			
CHARACTERIZE SLUDGE - 1.0				
2WC097_01	CHARACTERIZATION OF SLUDGE			
TOTAL	01B			
PACKAGE FUEL - 2.0				
2WC020_02A	PREP DEMO K-WEST FUEL MCO OVPK OPS SAFE ANALYSIS			
2WC021_02A	APPROVE DEMO K-WEST FUEL MCO OVPK OPS SAFE ANALY			
2WC025_02A	DEMO K-WEST FUEL MCO PKG IN-BASIN EQPT/MODS DESN			
2WC025_02B	K-EAST FUEL MCO PACK IN-BASIN EQPT/MODS DESIGN			
2WC030_02A	DEMO K-WEST FUEL MCO PACK IN-BSN EQPT/MODS INSTL			
2WC030_02B	K-EAST FUEL MCO PACK IN-BSN EQPT MODS INSTL			
2WC040_02A	DEMO K-WEST FUEL MCO PACKAGING ORR			
2WC040_02B	K-EAST FUEL MCO PACKAGING ORR			
2WC050-02A	DEMO FUEL MCO DESIGN & PROCUREMENT SPECIFICATION			
2WC055_02A	DEMO FUEL MCO PROCUREMENT			
2WC055_02B	REMAIN FUEL MCO PROCUREMENT			
2WC060_02A	DEMO K-WEST FUEL MCO PACKAGING AND LOADOUT			
2WC060_02B	REMAIN FUEL MCO PACKAGING AND LOADOUT			
TOTAL	02A			
PACKAGE SLUDGE - 2.0				
2WC090_02	PREPARE SLUDGE CONTAINERIZATION OPS SAFE ANALYS			
2WC091_02	SLUDGE CONTAINER SAFETY ANALYSIS & APPROVAL			
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN			
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT			
2WC115_02	SLUDGE CONTAINERIZATION ORR			
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT			
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY			
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION			
2WC130_02	SLUDGE MCO CONTAINERIZATION			
TOTAL	02B			
ONGOING OPERATIONS IN K BASINS - 2.0				
2WA003_02	K BASIN ONGOING OPERATIONS			
2WA004_02	K BASINS UPGRADE MODIFICATIONS			
TOTAL	02C			
PREPARE FUEL FOR TRANSPORT - 3.0				
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP			
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP			
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN			
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT			

PRIMAVERA PROJECT PLANNER — ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12
15:03

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ALTERNATIVE 3 , REVISION E, 10/13/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
PREPARE FUEL FOR TRANSPORT - 3.0				
2WC087_03	FUEL & SLUDGE TRANSPORT ORR			
TOTAL	03A			
DISPOSE OF DEBRIS - 6.0				
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP			
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP			
TOTAL	060			
REMOVE RADIOACTIVE WATER - 8.0				
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION			
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP			
TOTAL	080			
TRANSPORT FUEL FROM K BASINS - 11.0				
2WC065_11A	DEMO FUEL & SLUDGE SHIPPING TO ITA FACILITY			
2WC065_11B	REMAIN FUEL & SLUDGE SHIPPING TO ITA FACILITY			
TOTAL	11A			
DESIGN STAB/PROCESS FACILITY - 12.0				
2WE215_12A	ITA(NEW) DEMO FACILITY PRELIMINARY DESIGN			
2WE220_12A	ITA(NEW) FACILITY TECHNICAL DEVELOPMENT			
2WE225_12A	PREPARE ITA(NEW) FACILITY PREL. SAFETY ANALYSIS			
2WE225_12B	ITA(NEW) FACILITY SAFETY CONFIRMATION			
2WE226_12A	APPROVE ITA(NEW) FACILITY PREL. SAFETY ANALYSIS			
2WE227_12A	PREPARE ITA(NEW) FACILITY FINAL SAFETY ANALYSIS			
2WE228_12A	APPROVE ITA(NEW) FACILITY FINAL SAFETY ANALYSIS			
2WE230_12A	DEMO ITA(NEW) FACILITY FINAL DESIGN			
2WE230_12B	REMAIN ITA(NEW) FACILITY FINAL DESIGN			
2WE233_12	DEMO ITA(NEW) OPS PERFORMANCE EVALUATION			
TOTAL	120			
CONSTRUCT STAB/PROCESS FACILITY - 13.0				
2WE235_13A	DEMO ITA(NEW) FACILITY CONSTRUCTION			
2WE235_13B	REMAIN ITA(NEW) FACILITY CONSTRUCTION			
2WE240_13A	DEMO ITA(NEW) & INTERIM STORAGE ORR & OPS TEST			
2WE240_13B	REMAIN ITA(NEW) FACILITY ORR & OPS TEST			
TOTAL	130			
STABILIZE/PROCESS FUEL - 14.0				
2WE245_14A	DEMO ITA(NEW) FACILITY OPERATION			
2WE245_14B	REMAIN ITA(NEW) FACILITY OPERATION			
2WE246_14C	DEMO EVALUATION PERIOD ITA(NEW) FACILIITY OPS			
TOTAL	140			
DISPOSE OF GENERATED WASTES - 15.0				
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS			

PRIMAVERA PROJECT PLANNER

ALTERNATE 3, SNF EXPEDITED REMOVAL

REPORT DATE 14OCT94 RUN NO. 279
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COST LOADING REPORT

START DATE 01OCT93 FIN DATE 31MAR12

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ALTERNATIVE 3 , REVISION E, 10/13/94

TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
DISPOSE OF GENERATED WASTES - 15.0				
TOTAL	150			
D & D FACILITIES - 16.0				
2WA006_16	K BASIN PREPARATION FOR D & D			
2WE247_16	PROCESS/STAB FACILITY CLEANOUT & D&D			
TOTAL	160			
DESIGN INTERIM STORAGE FACILITY - 17.0				
2WE255_17	INTERIM STORAGE FACILITY DESIGN			
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS			
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS			
TOTAL	170			
CONSTRUCT INTERIM STORAGE FACILITY - 18.0				
2WE260_18A	DEMO INTERIM STORAGE VAULT CONSTRUCTION			
2WE260_18B	REMAIN INTERIM STORAGE VAULT DESIGN/CONSTRUCTION			
2WE262_18A	DEMO INTERIM STORAGE FAC OPS TESTING AND ORR			
TOTAL	180			
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0				
2WE265_20	INTERIM STORAGE FACILITY OPERATIONS DURING SHIP			
2WE270_20	INTERIM STORAGE FACILITY OPERATIONS TO END	1.5	1.5	0.7
TOTAL	200	1.5	1.5	0.7
	REPORT TOTAL	1.5	1.5	0.7

Summary Cost Basis Information
Alternative 3 - ITA Passivation Process

Scenario:

Alternative 3 includes the following major activities:

- K Basin modifications and containerization into MCO overpack containers (24 inch diameter).
- Direct transport in a shielded cask by rail to a conditioning facility in the 200 Areas.
- Conditioning of the fuel in the MCOs involving draining, drying, and passivating in batch furnaces.
- Co-located interim dry storage facility at the 200 Area site.

This alternative is a modified cost approach to the proposed ITA process. Original costs included in the original ITA report have been adjusted to be more realistic at the Hanford site. The major adjustments were based on Kaiser Engineers Hanford cost estimates of the ITA process that were performed at the request of WHC. Other adjustments such as staffing, ORR, SAR, OTP, etc. are identified in this cost basis discussion.

This alternative requires significant modifications to the K Basins to accommodate the tall 24 inch diameter MCO overpack. It only requires one containerization step and no repackaging. Co-location of the conditioning facility with the interim dry storage vault eliminates a second transport activity required in the other alternatives. Primary concerns are process technology finalization and approvals required on very short term schedule to accomplish task completion.

Cost and Schedule Activity Bases:

0.0 Program Actions Common for All Alternatives

Program management, regulatory compliance, and public involvement = $10.5M/yr from SNF MYPP (Note 4). No cost estimates included for other actions common for all alternatives. (09B013)

1.0 Characterize Fuel and Sludge

Total 3 year costs = $18 M. ($13M-fuel, $5M-sludge). From prior program planning documents and discussions with R. Omberg (Note 31). (2WC018, 2WC097)

2.0 (a) Package Fuel

K Basin cost estimate for ITA Process prepared by Kaiser Engineers Hanford was general basis (Note 19A). Demo portion is split out based on the cost ratio shown in the ITA report.

1) Demo KW Basin equipment design = $ 2.6 M. (2WC025A)

2) Demo KW Basin equipment installation = $ 10.8 M. (2WC030A)

3) Demo design specification for MCO = $0.3 M. Vendor provides container design. (2WC050)

4) Purchase the MCOs required for Demo= $2.5M (5%). (2WC055)

5) ORR = $0.1 M. Generic K Basins ORR covers most of this and is costed at $2.4M in sect. 2.0. (2WC040A)

6) Fuel containerization = $0.9 M (5%). See 12) below. (2WC060A)

7) SAR = $0.3 M (prepare) + 0.1 M (approval) from K. Daschke report (Note 17). (2WC020, 021)

8) KE Basin equipment design = $ 2.6 M. (2WC025B)

9) KE Basin equipment installation = $ 13.0 M. (2WC030B)

10) ORR = $0.0 M. ORR covers all in 5) above packaging. (2WC040)

11) Purchase the remaining MCOs required= $46.3M. (2WC055B)

12) Fuel containerization remaining = $ 17.6M. Based on discussion with K Basin Operations for labor costs, ITA timeline and total burnout cost (171 Rem) (Note 32.). (2WC060)

2.0 (b) Package Sludge

1) Sludge equip. design=$2.6M from communication with advocate (Note 21). (2WC100)

2) Sludge equipment installation = $ 2.5 M from communication with advocate. (2WC110)

3) Sludge retrieval and containerization equipment = $10 M from communication with advocate. (2WC120)

4) Sludge container procurement = $ 4 M from communication with advocate. (2WC125)

5) ORR = $0.2 M SAIC estimate. Most aspects covered by generic K Basins ORR. (2WC115)

6) Containerization labor = $0.8 M from discussion with Leon Hoffer, K Basins Operations (Note 32). (2WC130)

7) SAR = 110 K from K. Daschke report (rounded up to $0.2 M). (2WC090).

8) Approval = $0.1M (2WC091)

9) Sludge technology development = $2.6M (Note 21). (2WC117)

2.0 (c) Ongoing Operations in K Basins

1) Ongoing operations at $42M/year (Note 4) until processing complete, then $30M/yr for three year transition. (2WA003)

2) Upgrade modification=$13.1M (Note 5, overpack sheets) and MYPP (Note 4). (2WA004)

3) K Basin ORR = 20 manyears @ $120K = $2.4M per K. Daschke report (Note 17). (2WA005)

3.0 Prepare Fuel and Sludge for Transport

1) SAR = $0.6 M (prepare) + 0.1 (approval) from K. Daschke report. (2WC070, 071)

2) Cask and rail car design= $2M as modified from ITA (Note 11) cost estimate. (2WC075)

3) Procure casks and railcars= $8M as modified from ITA (Note 11) cost estimate. (2WC080)

4) Shipping infrastructure=none identified

5) Transport ORR=$.1M (Note 17). (2WC087)

4.0 Design Pre-Interim Storage Facility

NA

5.0 Construct Pre-Interim Storage Facility

NA

6.0 Dispose of Debris

1) Debris disposal includes removal of racks, approximately 2000 empty canisters, and misc. scrap including lights, conduit, tools, scaffolding, etc.= $2 M for disposal in burial boxes (Note 30). (2WF330, 2WF332)

7.0 Transport Fuel to Pre-Interim Storage

NA

8.0 Remove Radioactive Water

1) KE feed and bleed activities = $11.4M per discussions with advocate.

2) KE cleanup equipment = $6.6M per discussions with advocate (Note 24).

9.0 Store Sludge

NA

10.0 Pre-Interim Storage of Fuel

NA

11.0 Transport of Fuel from Pre-Interim Storage

$1.4 M railroad maintenance cost + 6 FTEs/shift times 3 shifts times 120K each = $3.5 M per year x 2yrs + $3 M for road closures = $10 M. (2WC065A, 2WC065B)

1) Demo= $0.6 M

2) Production= $9.4 M.

12.0 Design Stabilization/Processing Facility

1) Preliminary Design costs= $1.4M from KEH (Note 20) estimate to passivate with ITA process. (2WE215)

2) Technology development plus hot cell testing costs (Note 5) and discussion with advocate that reduced the hot cell testing costs from $30 to $10 M = $19.7M. (2WE220)

3&4) SAR costs from K. Daschke report (Note 17). (2WE225A, 226, 227, 228)

5) Final design costs from KEH estimate (Note 20) to passivate utilizing the ITA process with 25% contingency. Final design = $9.4 M. Demo portion = $7.5 M.

6) Remaining final design= $1.9 M. (2WE230A, 2WE230B)

7) Demo performance evaluation= $0.6 M allowance to ITA activity. (2WE225B)

8) Facility safety confirmation= $0.6 M allowance to ITA activity. (2WE233)

13.0 Construct Stabilization/Processing Facility

1) Demo construction cost ratioed from ITA report at 68% of Construction cost($74.8M)= $51.0M. Construction costs from KEH (Note 20) estimate to passivate using ITA process with 25% contingency. (2WE235A)

2) ORR costs from K. Daschke report plus OTP costs estimated by SAIC = $12.0 M. (2WE240A)

3) Remaining construction= $23.8M for second process train. (2WE235B)

4) Final ORR and OTP= $5.0M. (2WE240B)

14.0 Stabilize/Process Fuel

Operations costs generated by SAIC evaluation and increase of facility staffing estimate provided by the ITA team. 100 person staffing level + 8 M for utilities and materials costs. (100 @ 120K)+8M= $20M/yr.

1) Demo period at $20M. (2WE245A)

2) Demo evaluation period at reduced staffing ($10M/yr) (2WE245B)

3) Production operation at 20M/yr. (2WE245C)

15.0 Dispose of Generated Wastes

1) Stabilization wastes include Mark 0, I, & II canisters, overpacks, and misc. other waste. (2WF405)
   2500 overpacks compacted to 6 cubic feet
   = 15,000 cubic feet @ $80/cubic foot= $1.2M
   misc. + .8M
   $2.0M

2) Containerization wastes = $300 K per discussion with WHC advocate. (2WF400)

16.0 D&D of Facilities

1) K Basins preparation for D&D (i.e., transition costs) = $30 M/yr x 3 yrs = $90 M from MYPP. D&D cost for existing facilities not included based on DOE estimating guidelines. (2WA006)

2) Processing facility cleanout and D&D cost = $90 M (30% construction + 3 years operating cost). (2WE247)

17.0 Design Interim Storage Facility

1) Design costs = $1M for site. Vendor Design costs included in $ 38.7 M construction estimate in 15.0 below. (2WE255)

2) SAR = $750K from K. Daschke report = $0.7 M. Approval = $0.4 M. (2WE257, 258)

18.0 Interim Storage Facility Construction

1) From ITA report (Note 11) adjusted by SAIC to account for sludge storage (+20%) and increased contingency from 15% to 50%. New estimated cost =[$21.5M+(20%)]= $25.8+50%= $38.7M.

   a) Half of vault modules constructed= $19.3M. (2WE260A)

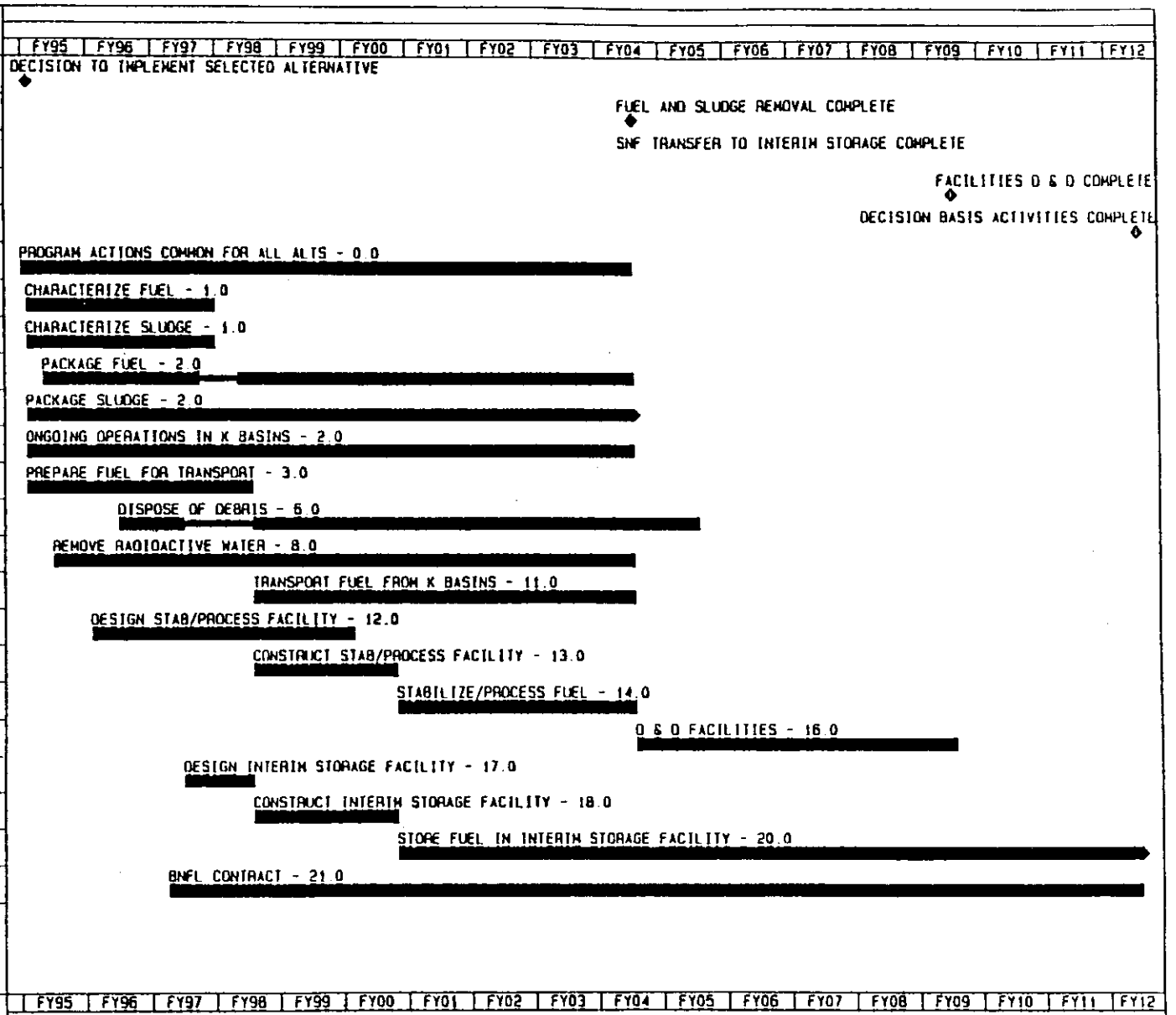
   b) Other half of vault constructed= $19.4M. (2WE260B)

20.0 Store Fuel in Interim Storage Facility

1) No additional operating cost during shipping since facility is co-located, but facility still requires the base operating and maintenance cost of $1.5M as discussed below. (2WE265)

2) Operating cost increased from 360 K/yr to <u>$1.5 M/yr</u> based on SAIC judgement to include system maintenance. Basis for 1.5 M is 10 FTE @ 120 K/yr + 300K in materials, utilities, and overheads. (2WE270)

EARLY START	EARLY FINISH	BUDGET COST
1NOV94	31OCT94	0
1MAY04	30APR04	0
10CT93	30SEP93	0
1MAY09	30APR09	0
1APR12	31MAR12	0
10CT94	30APR04	100
1NOV94	30SEP97	13
1NOV94	30SEP97	5
1FEB95	30APR04	55
1NOV94	30APR04	29
1NOV94	30APR04	415
1NOV94	30APR98	7
1APR96	30APR05	10
1APR95	30APR04	22
1MAY98	30APR04	3
1NOV95	30NOV99	20
1MAY98	31JUL00	20
1AUG00	30APR04	18
1MAY04	30APR09	135
1APR97	30APR98	2
1MAY98	31JUL00	29
1AUG00	31MAR12	15
1JAN97	31MAR12	2500



Plot Date 14OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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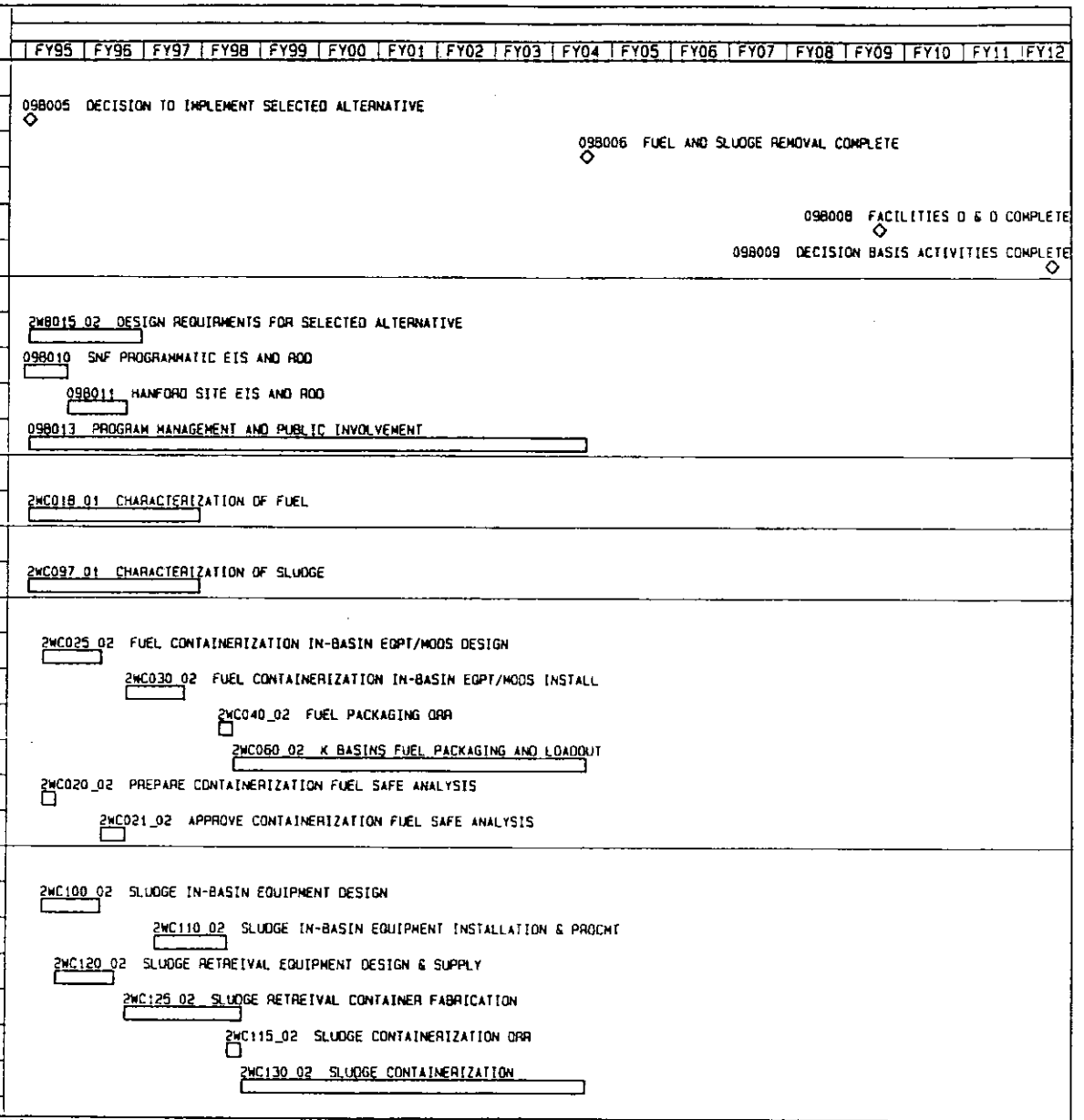
K BASIN
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 4 - SUMMARY

REVISION G 10/14/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
DECISION BASIS KEY DATES - 0.0					
00A	100	1NOV94		0	0
00A	100		30APR04	0	0
00A	200		30SEP93	0	0
00A	300		30APR09	0	0
00A	400		31MAR12	0	0
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0					
00B	100	1NOV94	30SEP96	23	0
00B	310	10CT94	30JUN95	9	0
00B	320	1JUL95	30JUN96	12	0
00B	400	1NOV94	30APR04	114	100 0
CHARACTERIZE FUEL - 1.0					
01A	100	1NOV94	30SEP97	35	13.0
CHARACTERIZE SLUDGE - 1.0					
01B	100	1NOV94	30SEP97	35	5.0
PACKAGE FUEL - 2.0					
02A	100	1FEB95	31JAN96	12	5.5
02A	100	1JUL96	30JUN97	12	12.5
02A	100	1FEB98	30APR98	3	1
02A	100	1MAY98	30APR04	72	37 0
02A	500	1FEB95	30APR95	3	1
02A	500	1FEB96	30JUN96	5	1
PACKAGE SLUDGE - 2.0					
02B	100	1FEB95	31JAN96	12	2.6
02B	100	1JAN97	31MAR98	15	2.5
02B	200	1MAY95	30APR96	12	10.0
02B	200	1JUL96	30JUN98	24	4.0
02B	300	1APR98	30JUN98	3	2
02B	400	1JUL98	30APR04	70	6.9



Plot Date 19OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

KAAG

Sheet 1 of 3

K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 4

REVISION G 10/14/94

Date	Revision	Checked	Approved

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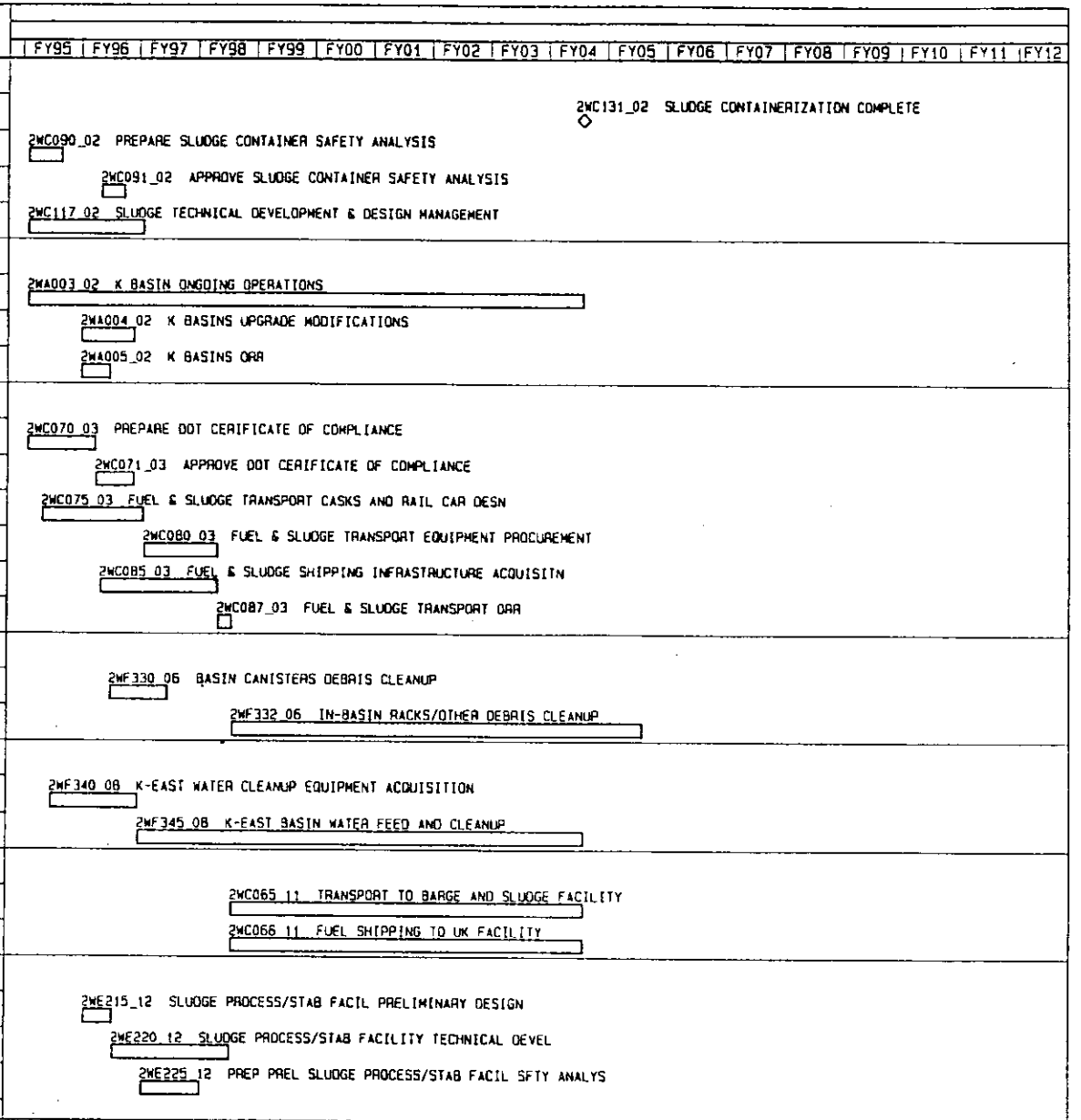
PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
PACKAGE SLUDGE - 2.0					
028	400	1MAY04	30APR04	0	.0
028	500	1NOV94	31MAY95	7	.2
028	500	1FEB96	30JUN96	5	.1
028	500	1NOV94	31OCT96	24	2.6
ONGOING OPERATIONS IN K BASINS - 2.0					
02C	100	1NOV94	30APR04	114	399.0
02C	100	10CT95	31AUG96	11	13.1
02C	300	10CT95	31MAR96	6	2.4
PREPARE FUEL FOR TRANSPORT - 3.0					
03A	100	1NOV94	31DEC95	14	1.0
03A	100	1JAN96	31AUG96	8	.5
03A	100	1FEB95	31OCT96	21	1.0
03A	100	1NOV96	31JAN98	15	2.0
03A	200	1FEB96	31JAN98	24	2.0
03A	300	1FEB98	30APR98	3	.6
DISPOSE OF DEBRIS - 6.0					
060	100	1APR96	31MAR97	12	3.4
060	100	1MAY98	30APR05	84	6.6
REMOVE RADIOACTIVE WATER - 8.0					
080	100	1APR95	30SEP96	18	6.6
080	200	10CT96	30APR04	91	14.9
TRANSPORT FUEL FROM K BASINS - 11.0					
11A	100	1MAY98	30APR04	72	3.0
11A	100	1MAY98	30APR04	72	.0
DESIGN STAB/PROCESS FACILITY - 12.0					
120	100	1NOV95	30APR96	6	1.3
120	100	1MAY96	30APR98	24	9.8
120	100	1NOV96	31OCT97	12	1.0



Plot Date 19OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

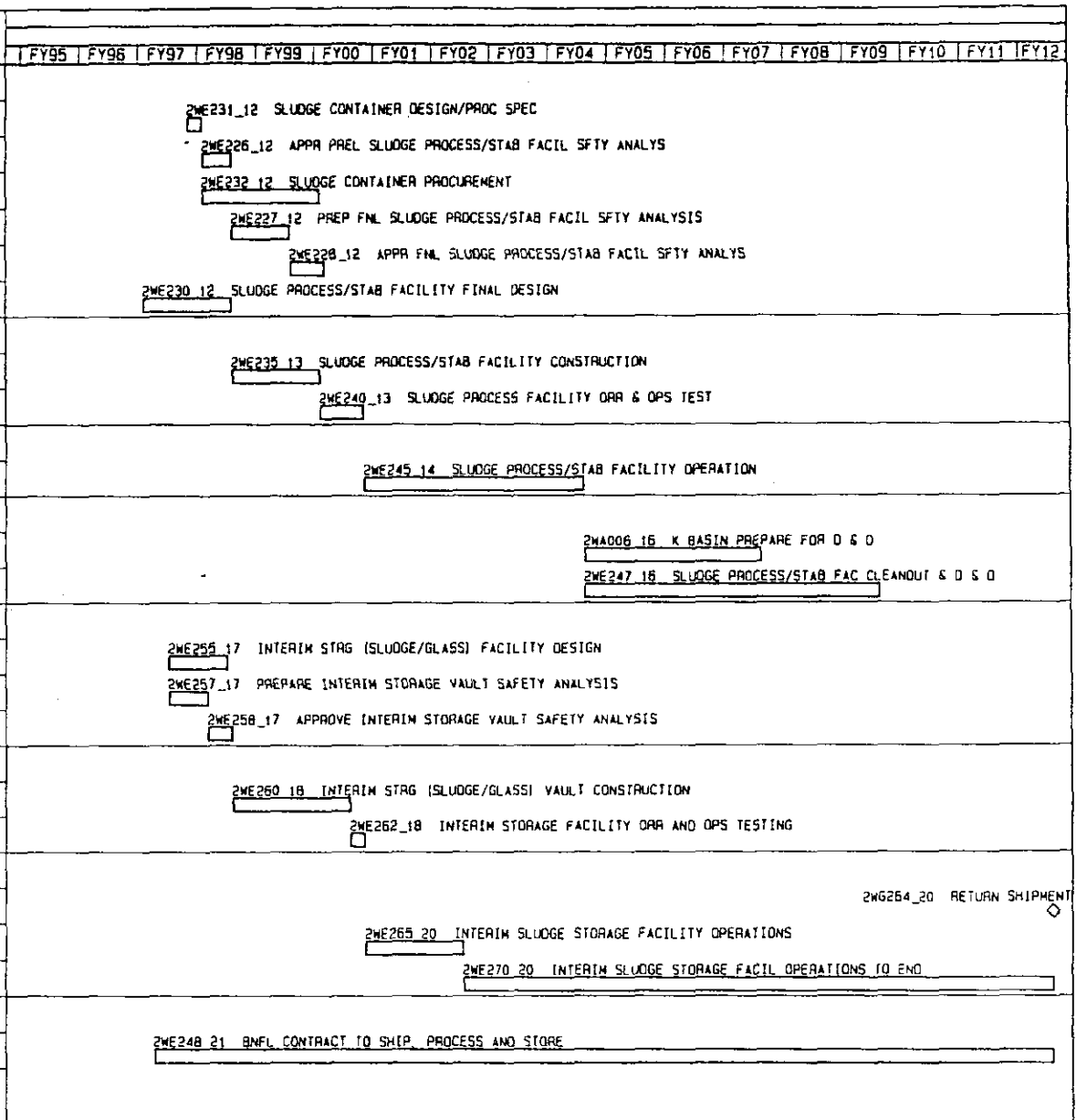
K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 4

Sheet 2 of 3

REVISION G 10/14/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST	Activity
DESIGN STAB/PROCESS FACILITY - 12.0						
120	100	1AUG97	31OCT97	3	.1	2WE231_12 SLUDGE CONTAINER DESIGN/PROC SPEC
120	100	1NOV97	30APR98	6	.4	2WE226_12 APPR PREL SLUDGE PROCESS/STAB FACIL SFTY ANALYS
120	100	1NOV97	31OCT99	24	1.0	2WE232_12 SLUDGE CONTAINER PROCUREMENT
120	100	1MAY98	30APR99	12	.9	2WE227_12 PREP FNL SLUDGE PROCESS/STAB FACIL SFTY ANALYSIS
120	100	1MAY99	30NOV99	7	.5	2WE228_12 APPR FNL SLUDGE PROCESS/STAB FACIL SFTY ANALYS
120	200	1NOV96	30APR98	18	4.7	2WE230_12 SLUDGE PROCESS/STAB FACILITY FINAL DESIGN
CONSTRUCT STAB/PROCESS FACILITY - 13.0						
130	100	1MAY98	31OCT99	18	16.1	2WE235_13 SLUDGE PROCESS/STAB FACILITY CONSTRUCTION
130	100	1NOV99	31JUL00	9	3.6	2WE240_13 SLUDGE PROCESS FACILITY ORR & OPS TEST
STABILIZE/PROCESS FUEL - 14.0						
140	100	1AUG00	30APR04	45	18.0	2WE245_14 SLUDGE PROCESS/STAB FACILITY OPERATION
D & D FACILITIES - 16.0						
160	100	1MAY04	30APR07	36	90.0	2WA006_16 K BASIN PREPARE FOR D & D
160	100	1MAY04	30APR09	60	45.0	2WE247_16 SLUDGE PROCESS/STAB FAC CLEANOUT & D & D
DESIGN INTERIM STORAGE FACILITY - 17.0						
170	100	1APR97	31MAR98	12	1.0	2WE255_17 INTERIM STRG (SLUDGE/GLASS) FACILITY DESIGN
170	200	1APR97	30NOV97	8	.5	2WE257_17 PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS
170	200	1DEC97	30APR98	5	.3	2WE258_17 APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS
CONSTRUCT INTERIM STORAGE FACILITY - 18.0						
180	100	1MAY98	30APR00	24	29.0	2WE260_18 INTERIM STRG (SLUDGE/GLASS) VAULT CONSTRUCTION
180	300	1MAY00	31JUL00	3	.2	2WE262_18 INTERIM STORAGE FACILITY ORR AND OPS TESTING
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0						
200	100	1APR12	31MAR12	0	0	2WG264_20 RETURN SHIPMENT
200	100	1AUG00	31MAR02	20	3.3	2WE265_20 INTERIM SLUDGE STORAGE FACILITY OPERATIONS
200	200	1APR02	31MAR12	120	11.3	2WE270_20 INTERIM SLUDGE STORAGE FACIL OPERATIONS TO END
BNFL CONTRACT - 21.0						
210	100	1JAN97	31MAR12	183	2500.0	2WE248_21 BNFL CONTRACT TO SHIP, PROCESS AND STORE



Plot Date 19OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

(c) Primavera Systems, Inc.

K BASINS
SNF EXPEDITED REMOVAL DECISION
ALTERNATIVE 4

Sheet 3 of 3

REVISION G 10/14/94

Date	Revision	Checked	Approved

PRIMAVERA PROJECT PLANNER — ALTERNATE 4, REV G, 10/14/94

REPORT DATE 14OCT94 RUN NO. 237 15:04 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12

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ALTERNATIVE 4 , REVISION G, 10/14/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B010	SNF PROGRAMMATIC EIS AND ROD	0.0	0.0						
09B013	PROGRAM MANAGEMENT AND PUBLIC INVOLVEMENT	100.0	9.6	10.5	10.5	10.5	10.5	10.5	10.5
TOTAL	00B	100.0	9.7	10.5	10.5	10.5	10.5	10.5	10.5
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL	13.0	4.1	4.5	4.5				
TOTAL	01A	13.0	4.1	4.5	4.5				
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE	5.0	1.6	1.7	1.7				
TOTAL	01B	5.0	1.6	1.7	1.7				
PACKAGE FUEL - 2.0									
2WC020_02	PREPARE CONTAINERIZATION FUEL SAFE ANALYSIS	0.1	0.1						
2WC021_02	APPROVE CONTAINERIZATION FUEL SAFE ANALYSIS	0.1		0.1					
2WC025_02	FUEL CONTAINERIZATION IN-BASIN EQPT/MODS DESIGN	5.5	3.7	1.8					
2WC030_02	FUEL CONTAINERIZATION IN-BASIN EQPT/MODS INSTALL	12.5		3.1	9.4				
2WC040_02	FUEL PACKAGING ORR	0.1				0.1			
2WC060_02	K BASINS FUEL PACKAGING AND LOADOUT	37.0				2.6	6.2	6.2	6.2
TOTAL	02A	55.3	3.8	5.1	9.4	2.7	6.2	6.2	6.2
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINER SAFETY ANALYSIS	0.2	0.2						
2WC091_02	APPROVE SLUDGE CONTAINER SAFETY ANALYSIS	0.1		0.1					
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN	2.6	1.7	0.9					
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT	2.5			1.5	1.0			
2WC115_02	SLUDGE CONTAINERIZATION ORR	0.2				0.2			
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT	2.6	1.2	1.3	0.1				
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY	10.0	4.2	5.8					
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION	4.0		0.5	2.0	1.5			
2WC130_02	SLUDGE CONTAINERIZATION	6.9				0.3	1.2	1.2	1.2
TOTAL	02B	29.1	7.3	8.6	3.6	3.0	1.2	1.2	1.2
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS	399.0	38.5	42.0	42.0	42.0	42.0	42.0	42.0
2WA004_02	K BASINS UPGRADE MODIFICATIONS	13.1		13.1					
2WA005_02	K BASINS ORR	2.4		2.4					
TOTAL	02C	414.5	38.5	57.5	42.0	42.0	42.0	42.0	42.0
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE DOT CERIFICATE OF COMPLIANCE	1.0	0.8	0.2					
2WC071_03	APPROVE DOT CERIFICATE OF COMPLIANCE	0.5		0.5					
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN	1.0	0.4	0.6	0.0				
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT	2.0			1.5	0.5			
2WC085_03	FUEL & SLUDGE SHIPPING INFRASTRUCTURE ACQUISITN	2.0		0.7	1.0	0.3			
2WC087_03	FUEL & SLUDGE TRANSPORT ORR	0.6				0.6			
TOTAL	03A	7.1	1.2	2.0	2.5	1.5			

PRIMAVERA PROJECT PLANNER — ALTERNATE 4, REV G, 10/14/94

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ALTERNATIVE 4 , REVISION G, 10/14/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
DISPOSE OF DEBRIS - 6.0									
2WF330_06	BASIN CANISTERS DEBRIS CLEANUP	3.4		1.7	1.7				
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP	6.6				0.4	0.9	0.9	0.9
TOTAL	060	10.0		1.7	1.7	0.4	0.9	0.9	0.9
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION	6.6	2.2	4.4					
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP	14.9			2.0	2.0	2.0	2.0	2.0
TOTAL	080	21.5	2.2	4.4	2.0	2.0	2.0	2.0	2.0
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_11	TRANSPORT TO BARGE AND SLUDGE FACILITY	3.0				0.2	0.5	0.5	0.5
TOTAL	11A	3.0				0.2	0.5	0.5	0.5
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12	SLUDGE PROCESS/STAB FACIL PRELIMINARY DESIGN	1.3		1.3					
2WE220_12	SLUDGE PROCESS/STAB FACILITY TECHNICAL DEVEL	9.8		2.0	4.9	2.9			
2WE225_12	PREP PREL SLUDGE PROCESS/STAB FACIL SFTY ANALYS	1.0			0.9	0.1			
2WE226_12	APPR PREL SLUDGE PROCESS/STAB FACIL SFTY ANALYS	0.4				0.4			
2WE227_12	PREP FNL SLUDGE PROCESS/STAB FACIL SFTY ANALYSIS	0.9				0.4	0.5		
2WE228_12	APPR FNL SLUDGE PROCESS/STAB FACIL SFTY ANALYS	0.5					0.4	0.1	
2WE230_12	SLUDGE PROCESS/STAB FACILITY FINAL DESIGN	4.7			2.9	1.8			
2WE231_12	SLUDGE CONTAINER DESIGN/PROC SPEC	0.1			0.1	0.0			
2WE232_12	SLUDGE CONTAINER PROCUREMENT	1.0				0.5	0.5	0.0	
TOTAL	120	19.7		3.3	8.8	6.0	1.4	0.2	
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13	SLUDGE PROCESS/STAB FACILITY CONSTRUCTION	16.1				4.5	10.7	0.9	
2WE240_13	SLUDGE PROCESS FACILITY ORR & OPS TEST	3.6						3.6	
TOTAL	130	19.7				4.5	10.7	4.5	
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14	SLUDGE PROCESS/STAB FACILITY OPERATION	18.0						0.8	4.8
TOTAL	140	18.0						0.8	4.8
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARE FOR D & D	90.0							
2WE247_16	SLUDGE PROCESS/STAB FAC CLEANOUT & D & D	45.0							
TOTAL	160	135.0							
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE255_17	INTERIM STRG (SLUDGE/GLASS) FACILITY DESIGN	1.0			0.5	0.5			
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS	0.5			0.4	0.1			
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS	0.3				0.3			
TOTAL	170	1.8			0.9	0.9			

PRIMAVERA PROJECT PLANNER — ALTERNATE 4, REV G, 10/14/94

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ALTERNATIVE 4 , REVISION G, 10/14/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18	INTERIM STRG (SLUDGE/GLASS) VAULT CONSTRUCTION	29.0				6.0	14.5	8.5	
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING	0.2						0.2	
TOTAL	180	29.2				6.0	14.5	8.7	
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE265_20	INTERIM SLUDGE STORAGE FACILITY OPERATIONS	3.3						0.3	2.0
2WE270_20	INTERIM SLUDGE STORAGE FACIL OPERATIONS TO END	11.3							
TOTAL	200	14.6						0.3	2.0
BNFL CONTRACT - 21.0									
2WE248_21	BNFL CONTRACT TO SHIP, PROCESS AND STORE	2500.0			123.0	163.9	163.9	163.9	163.9
TOTAL	210	2500.0			123.0	163.9	163.9	163.9	163.9
	REPORT TOTAL	3396.5	68.2	99.3	210.4	243.6	253.8	241.7	234.0

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ALTERNATIVE 4 , REVISION G, 10/14/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B010	SNF PROGRAMMATIC EIS AND ROD								
09B013	PROGRAM MANAGEMENT AND PUBLIC INVOLVEMENT	10.5	10.5	6.1					
TOTAL	00B	10.5	10.5	6.1					
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL								
TOTAL	01A								
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE								
TOTAL	01B								
PACKAGE FUEL - 2.0									
2WC020_02	PREPARE CONTAINERIZATION FUEL SAFE ANALYSIS								
2WC021_02	APPROVE CONTAINERIZATION FUEL SAFE ANALYSIS								
2WC025_02	FUEL CONTAINERIZATION IN-BASIN EQPT/MODS DESIGN								
2WC030_02	FUEL CONTAINERIZATION IN-BASIN EQPT/MODS INSTALL								
2WC040_02	FUEL PACKAGING ORR								
2WC060_02	K BASINS FUEL PACKAGING AND LOADOUT	6.2	6.2	3.6					
TOTAL	02A	6.2	6.2	3.6					
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINER SAFETY ANALYSIS								
2WC091_02	APPROVE SLUDGE CONTAINER SAFETY ANALYSIS								
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN								
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT								
2WC115_02	SLUDGE CONTAINERIZATION ORR								
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT								
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY								
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION								
2WC130_02	SLUDGE CONTAINERIZATION	1.2	1.2	0.7					
TOTAL	02B	1.2	1.2	0.7					
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS	42.0	42.0	24.5					
2WA004_02	K BASINS UPGRADE MODIFICATIONS								
2WA005_02	K BASINS ORR								
TOTAL	02C	42.0	42.0	24.5					
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE DOT CERIFICATE OF COMPLIANCE								
2WC071_03	APPROVE DOT CERIFICATE OF COMPLIANCE								
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN								
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT								
2WC085_03	FUEL & SLUDGE SHIPPING INFRASTRUCTURE ACQUISITN								
2WC087_03	FUEL & SLUDGE TRANSPORT ORR								
TOTAL	03A								

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ALTERNATIVE 4 , REVISION G, 10/14/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DISPOSE OF DEBRIS - 6.0									
2WF330_06	BASIN CANISTERS DEBRIS CLEANUP								
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP	0.9	0.9	0.9	0.6				
TOTAL	060	0.9	0.9	0.9	0.6				
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION								
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP	2.0	2.0	1.1					
TOTAL	080	2.0	2.0	1.1					
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_11	TRANSPORT TO BARGE AND SLUDGE FACILITY	0.5	0.5	0.3					
TOTAL	11A	0.5	0.5	0.3					
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12	SLUDGE PROCESS/STAB FACIL PRELIMINARY DESIGN								
2WE220_12	SLUDGE PROCESS/STAB FACILITY TECHNICAL DEVEL								
2WE225_12	PREP PREL SLUDGE PROCESS/STAB FACIL SFTY ANALYS								
2WE226_12	APPR PREL SLUDGE PROCESS/STAB FACIL SFTY ANALYS								
2WE227_12	PREP FNL SLUDGE PROCESS/STAB FACIL SFTY ANALYSIS								
2WE228_12	APPR FNL SLUDGE PROCESS/STAB FACIL SFTY ANALYS								
2WE230_12	SLUDGE PROCESS/STAB FACILITY FINAL DESIGN								
2WE231_12	SLUDGE CONTAINER DESIGN/PROC SPEC								
2WE232_12	SLUDGE CONTAINER PROCUREMENT								
TOTAL	120								
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13	SLUDGE PROCESS/STAB FACILITY CONSTRUCTION								
2WE240_13	SLUDGE PROCESS FACILITY ORR & OPS TEST								
TOTAL	130								
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14	SLUDGE PROCESS/STAB FACILITY OPERATION	4.8	4.8	2.8					
TOTAL	140	4.8	4.8	2.8					
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARE FOR D & D			12.5	30.0	30.0	17.5		
2WE247_16	SLUDGE PROCESS/STAB FAC CLEANOUT & D & D			3.8	9.0	9.0	9.0	9.0	5.3
TOTAL	160			16.3	39.0	39.0	26.5	9.0	5.3
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE255_17	INTERIM STRG (SLUDGE/GLASS) FACILITY DESIGN								
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS								
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS								
TOTAL	170								

PRIMAVERA PROJECT PLANNER — ALTERNATE 4, REV G, 10/14/94

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ALTERNATIVE 4 , REVISION G, 10/14/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18	INTERIM STRG (SLUDGE/GLASS) VAULT CONSTRUCTION								
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING								
TOTAL	180								
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE265_20	INTERIM SLUDGE STORAGE FACILITY OPERATIONS	1.0							
2WE270_20	INTERIM SLUDGE STORAGE FACIL OPERATIONS TO END	0.6	1.1	1.1	1.1	1.1	1.1	1.1	1.1
TOTAL	200	1.6	1.1	1.1	1.1	1.1	1.1	1.1	1.1
BNFL CONTRACT - 21.0									
2WE248_21	BNFL CONTRACT TO SHIP, PROCESS AND STORE	163.9	163.9	163.9	163.9	163.9	163.9	163.9	163.9
TOTAL	210	163.9	163.9	163.9	163.9	163.9	163.9	163.9	163.9
	REPORT TOTAL	233.6	233.1	221.4	204.6	204.1	191.6	174.1	170.3

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ALTERNATIVE 4 , REVISION G, 10/14/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0				
09B010	SNF PROGRAMMATIC EIS AND ROD			
09B013	PROGRAM MANAGEMENT AND PUBLIC INVOLVEMENT			
TOTAL	00B			
CHARACTERIZE FUEL - 1.0				
2WC018_01	CHARACTERIZATION OF FUEL			
TOTAL	01A			
CHARACTERIZE SLUDGE - 1.0				
2WC097_01	CHARACTERIZATION OF SLUDGE			
TOTAL	01B			
PACKAGE FUEL - 2.0				
2WC020_02	PREPARE CONTAINERIZATION FUEL SAFE ANALYSIS			
2WC021_02	APPROVE CONTAINERIZATION FUEL SAFE ANALYSIS			
2WC025_02	FUEL CONTAINERIZATION IN-BASIN EQPT/MODS DESIGN			
2WC030_02	FUEL CONTAINERIZATION IN-BASIN EQPT/MODS INSTALL			
2WC040_02	FUEL PACKAGING ORR			
2WC060_02	K BASINS FUEL PACKAGING AND LOADOUT			
TOTAL	02A			
PACKAGE SLUDGE - 2.0				
2WC090_02	PREPARE SLUDGE CONTAINER SAFETY ANALYSIS			
2WC091_02	APPROVE SLUDGE CONTAINER SAFETY ANALYSIS			
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN			
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT			
2WC115_02	SLUDGE CONTAINERIZATION ORR			
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT			
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY			
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION			
2WC130_02	SLUDGE CONTAINERIZATION			
TOTAL	02B			
ONGOING OPERATIONS IN K BASINS - 2.0				
2WA003_02	K BASIN ONGOING OPERATIONS			
2WA004_02	K BASINS UPGRADE MODIFICATIONS			
2WA005_02	K BASINS ORR			
TOTAL	02C			
PREPARE FUEL FOR TRANSPORT - 3.0				
2WC070_03	PREPARE DOT CERIFICATE OF COMPLIANCE			
2WC071_03	APPROVE DOT CERIFICATE OF COMPLIANCE			
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN			
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT			
2WC085_03	FUEL & SLUDGE SHIPPING INFRASTRUCTURE ACQUISITN			
2WC087_03	FUEL & SLUDGE TRANSPORT ORR			
TOTAL	03A			

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ALTERNATIVE 4 , REVISION G, 10/14/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
DISPOSE OF DEBRIS - 6.0				
2WF330_06	BASIN CANISTERS DEBRIS CLEANUP			
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP			
TOTAL	060			
REMOVE RADIOACTIVE WATER - 8.0				
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION			
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP			
TOTAL	080			
TRANSPORT FUEL FROM K BASINS - 11.0				
2WC065_11	TRANSPORT TO BARGE AND SLUDGE FACILITY			
TOTAL	11A			
DESIGN STAB/PROCESS FACILITY - 12.0				
2WE215_12	SLUDGE PROCESS/STAB FACIL PRELIMINARY DESIGN			
2WE220_12	SLUDGE PROCESS/STAB FACILITY TECHNICAL DEVEL			
2WE225_12	PREP PREL SLUDGE PROCESS/STAB FACIL SFTY ANALYS			
2WE226_12	APPR PREL SLUDGE PROCESS/STAB FACIL SFTY ANALYS			
2WE227_12	PREP FNL SLUDGE PROCESS/STAB FACIL SFTY ANALYSIS			
2WE228_12	APPR FNL SLUDGE PROCESS/STAB FACIL SFTY ANALYS			
2WE230_12	SLUDGE PROCESS/STAB FACILITY FINAL DESIGN			
2WE231_12	SLUDGE CONTAINER DESIGN/PROC SPEC			
2WE232_12	SLUDGE CONTAINER PROCUREMENT			
TOTAL	120			
CONSTRUCT STAB/PROCESS FACILITY - 13.0				
2WE235_13	SLUDGE PROCESS/STAB FACILITY CONSTRUCTION			
2WE240_13	SLUDGE PROCESS FACILITY ORR & OPS TEST			
TOTAL	130			
STABILIZE/PROCESS FUEL - 14.0				
2WE245_14	SLUDGE PROCESS/STAB FACILITY OPERATION			
TOTAL	140			
D & D FACILITIES - 16.0				
2WA006_16	K BASIN PREPARE FOR D & D			
2WE247_16	SLUDGE PROCESS/STAB FAC CLEANOUT & D & D			
TOTAL	160			
DESIGN INTERIM STORAGE FACILITY - 17.0				
2WE255_17	INTERIM STRG (SLUDGE/GLASS) FACILITY DESIGN			
2WE257_17	PREPARE INTERIM STORAGE VAULT SAFETY ANALYSIS			
2WE258_17	APPROVE INTERIM STORAGE VAULT SAFETY ANALYSIS			
TOTAL	170			

PRIMAVERA PROJECT PLANNER

ALTERNATE 4, REV G, 10/14/94

REPORT DATE 14OCT94 RUN NO. 237
15:04

COST LOADING REPORT

START DATE 01OCT93 FIN DATE 31MAR12

DATA DATE 01OCT93 PAGE NO. 3- 3

ALTERNATIVE 4 , REVISION G, 10/14/94

TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
CONSTRUCT INTERIM STORAGE FACILITY - 18.0				
2WE260_18	INTERIM STRG (SLUDGE/GLASS) VAULT CONSTRUCTION			
2WE262_18	INTERIM STORAGE FACILITY ORR AND OPS TESTING			
TOTAL	180			
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0				
2WE265_20	INTERIM SLUDGE STORAGE FACILITY OPERATIONS			
2WE270_20	INTERIM SLUDGE STORAGE FACIL OPERATIONS TO END	1.1	1.1	0.6
TOTAL	200	1.1	1.1	0.6
BNFL CONTRACT - 21.0				
2WE248_21	BNFL CONTRACT TO SHIP, PROCESS AND STORE	163.9	163.9	82.0
TOTAL	210	163.9	163.9	82.0
	REPORT TOTAL	165.1	165.1	82.5

Summary Cost Basis Information
Alternative 4 - Overseas Processing

Scenario:

Alternative 4 includes the following major activities:

- K Basin modifications to accommodate the BNFL Magnox shipping flask.
- Remove all fuel from existing canisters in both K-East and K-West and place fuel only into shipping containers.
- Transport shipping cask via railroad to the Port of Benton.
- Transport via barge from Port of Benton to a lower Columbia River location (e.g., Tidewater facility near Vancouver) where cask are transferred to specially equipped BNFL ships for transport to the United Kingdom. Shipping duration is six years.
- Facilities are included to collect, process, and store sludge.

This alternative requires continued operation of K Basins at $42 M/yr for the entire shipping period. Cost and schedules are developed for K Basin modifications, transportation to the Port of Benton and sludge processing and storage (including collection, transportation, drying/processing, and interim storage). Interim storage capacity is provided for both the processed sludge and the vitrified waste that maybe returned from England. Cost for transport form the Port of Benton to England, processing, and storage in the UK were estimated by BNFL to be in the range of $1 to $2.5 billion. No additional detail associated with this estimate was available. Shipping and processing duration were also supplied by the BNFL advocate.

Cost and Schedule Activity Bases:

(Activity numbers are identified in parenthesis, i.e., (09B013).)

0.0 Program Actions Common for All Alternatives

Program management, regulatory compliance, and public involvement = $10.5M/yr from SNF MYPP (Note 4). No cost estimates included for other actions, common for all alternatives. (09B013)

1.0 Characterize Fuel and Sludge

Total 3 year costs = $18 M. ($13M-fuel, $5M-sludge). From prior program planning documents and discussions with R. Omberg (Note 31). (2WC018, 2WC097)

2.0 (a) Package Fuel

1) Basin equipment design = $ 4.5 M (Note 13) plus $1M additional for return of overpacks to pool(crane rail mods, basin mod, re-rack)=$5.5M. (2WC025)

2) Basin equipment installation = $12.5 M from analogy with Alternate 3. (2WC030)

3) ORR = $0.1 M. Generic K Basins ORR covers most of this and is costed at $2.4M in sect. 2.0. (2WC040)

4) Fuel packaging and loadout = $37 M. By analogy with Alternate 3 this activity was judged to be approximately 2x the cost because of the need to remove all fuel in both basins from existing containers. Radiation burnout cost is included. (2WC058)

5) SAR = $0.1 M for preparation and $0.1 for approval (Note 17). (2WC020, 2WC021)

2.0 (b) Package Sludge

1) Sludge equip. design=$2.6M from communication with advocate (Note 21). (2WC100)

2) Sludge equipment installation = $ 2.5 M from communication with advocate. (2WC110)

3) Sludge retrieval and containerization equipment = $10 M from communication with advocate. (2WC120)

4) Sludge container procurement = $ 4 M from communication with advocate. (2WC125)

5) ORR = $0.2 M SAIC estimate. Most aspects covered by generic K Basins ORR. (2WC115)

6) Containerization labor = $0.8 M from discussion with Leon Hoffer, K Basins Operations (Note 32). (2WC130)

7) SAR = 110 K from K. Daschke report (rounded up to $0.2 M). (2WC090).

8) Approval = $0.1M (2WC091)

9) Sludge technology development = $2.6M (Note 21). (2WC117)

2.0 (c) Ongoing Operations in K Basins

1) Ongoing operations at $42M/year (Note 4) until processing complete. (2WA003)

2) Upgrade modification=$13.1M (Note 5 overpack sheets) and MYPP (Note 4). (2WA004)

3) K Basin ORR = 20 manyears @ $120K = $2.4M per K. Daschke report (Note 17). (2WA005)

3.0 Prepare Fuel and Sludge for Transport

WHC cost for these activities are shown here. Sludge transportation is included. All BNFL cost for transportation, cask procurement and licensing support are included in the $1 to 2.5 billion estimate. Estimates were prepared by analogy to other alternates.

1) Prepare DOT certificate of compliance = $1.0 M. (2WC070)

2) Approve DOT certificate of compliance = $0.5 M. (2WC071)

3) Fuel and sludge cask and rail care design = $1.0 M. (2WC075)

4) Fuel and sludge transport equipment procurement = $2.0 M. (2WC080)

5) Shipping infrastructure acquisition = $20 M (extension of rail tracks to the Port of Benton = $1.5 M + dock and security improvements = $0.5 M). (2WC085)

6) Shipping ORR = $0.6 M. (2WC087)

4.0 Design Pre-Interim Storage Facility

NA

5.0 Construct Pre-Interim Storage Facility

NA

6.0 Dispose of Debris

1) Debris disposal includes removal of racks, approximately 2000 empty canisters, and misc. scrap including lights, conduit, tools, scaffolding, etc.= $2 M for disposal in burial boxes (Note 30). (2WF330, 2WF332)

7.0 Transport Fuel from Pre-Interim Storage

NA

8.0 Remove Radioactive Water

1) KE feed and bleed activities = $1.9 M/yr to the year 2002 = $11.4 M per discussions with advocate (Note 24). (2WF345)

2) KE cleanup equipment = $14.9M per discussions with advocate. Feed and bleed clean up assumed to continue at $1.9 M/yr until shipping is complete.

9.0 Store Sludge

NA

10.0 Per-Interim Storage of Fuel

NA

11.0 Transport Fuel from K Basin

1) A total 17 shipments of 24 cask each to Port of Benton. (i.e., 24 cask per ship load. Casks staged in K Basins Area) = $1.0 M.

2) Sludge shipment (20%) of fuel + $2.0M.

12.0 Design Stabilization/Processing Facility

Estimates are developed from adjustment of Alternate 3 - for sludge capability only.

1) Preliminary design costs = $1.3M. (2WE215)

2) Technology development = $9.8M. (2WE220)

3&4) SAR costs from K. Daschke report PSAR = 1.0 (prepare) + 0.4 (approval). FSAR = 0.9 (prepare) + 0.5 (approval). (2WE225, 226, 227, 228)

5) Final design costs = $4.7 M. (2WE230)

6) Sludge container specification = $0.1 M (2WE231)

7) Cost of sludge containers = $1.0 M. (2WE232)

13.0 Construct Stabilization/Processing Facility

1) Construction cost = $16.1 M. Discussion with WHC to adjust from Alternate 3. (2WE235)

2) ORR costs from K. Daschke report plus OTP costs estimated by SAIC = $3.6 M. Includes the cost of a full operating staff during OTP phase. (2WE240)

14.0 Stabilize/Process Fuel

1) Operations costs from Note 5 reduced by SAIC evaluation of facility staffing. $9.0 M/yr for 2 years = $18 M. (2WF245)

15.0 Dispose of Generated Wastes

NA

16.0 D&D Facilities

1) K Basins preparation for D&D (i.e., transition costs) = $30 M/yr x 3 yrs = $90 M from MYPP (Note 4). D&D cost for existing facilities not included based on DOE estimating guideline. (2WA006)

2) Sludge processing facility cleanout and D&D = $45 M (2WE247)

17.0 Design Interim Storage Facility

1) Design costs = $1M for site. Vendor Design costs included in $ 29 M construction estimate in 18.0 below. (2WE255)

2) SAR from K. Daschke report = $0.5 M. SAR approval = $0.3 M. (2WE257, 2WE258)

18.0 Interim Storage Facility Construction

1) Reduced scope storage facility = $29 M. (2WE260)

2) Vault ORR = $0.2 M. (2WE262)

19. Transport Dry Storage Casks

NA

20.0 Store Fuel in Interim Storage Facility

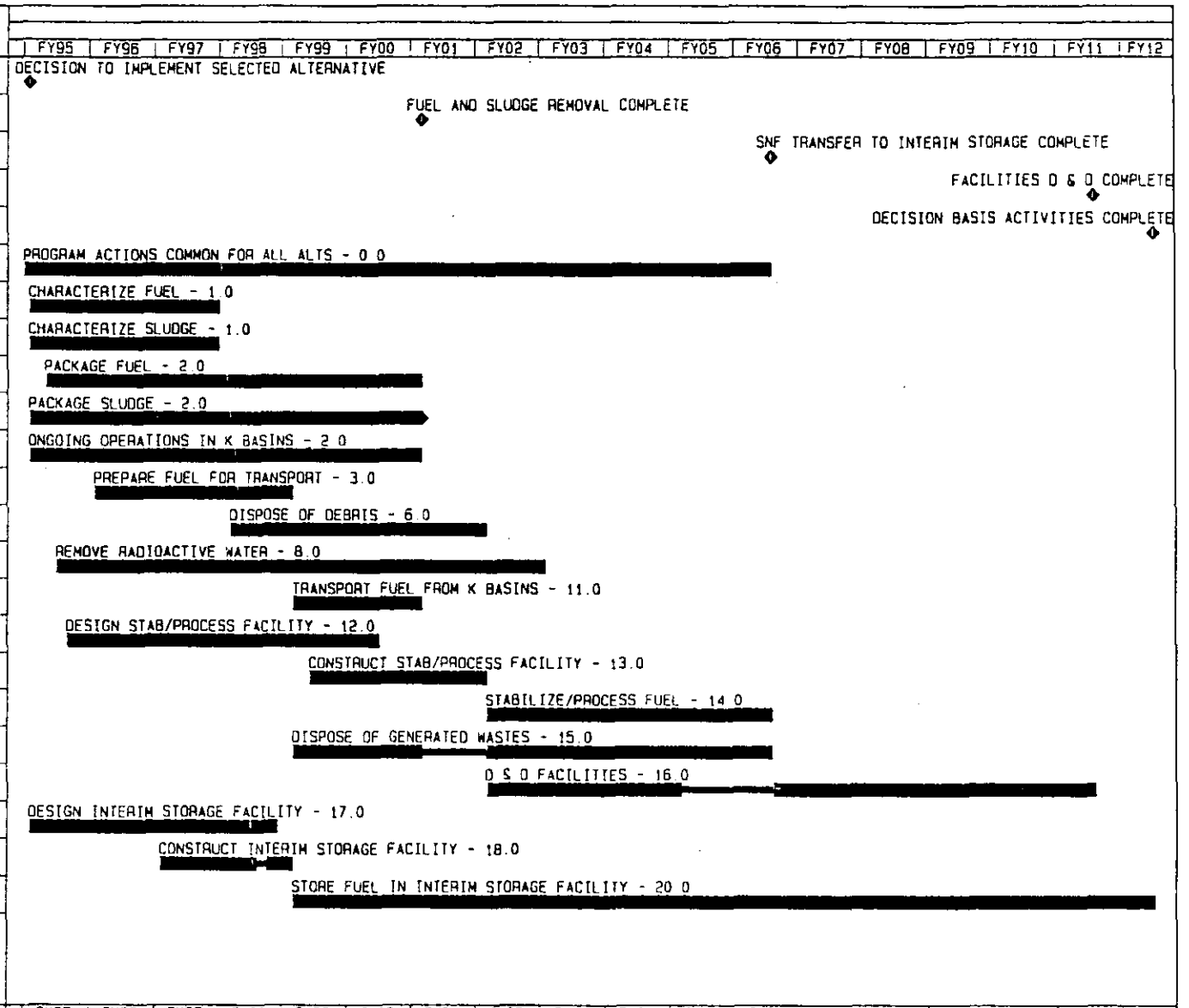
1) Operating cost during shipping since facility is not co-located requires the base operating cost of $1.5 M from below plus 5 FTEs/shift times 3 shift = $3.3 M/yr.

2) Operating cost increased from 360 K/yr to $1.5 M/yr based on SAIC judgement. Basis for 1.5 M is 10 FTE @ 120 K/yr + 300 K in materials, utilities, and overheads.

21.0 BNFL Contract to Ship, Process, and Store

1) BNFL contract range = $1 to 2.5 billion per BNFL advocate.

EARLY START	EARLY FINISH	BUDGET COST
1NOV94	31OCT94	0
1DEC00	30NOV00	0
1MAY06	30APR06	0
1MAY11	30APR11	0
1APR12	31MAR12	0
1OCT94	30APR06	121
1NOV94	30SEP97	13
1NOV94	30SEP97	5
1FEB95	30NOV00	69
1NOV94	30NOV00	24
1NOV94	30NOV00	277
1NOV95	30NOV98	11
1DEC97	30NOV01	10
1APR95	31OCT02	18
1DEC98	30NOV00	10
1JUN95	31MAR00	41
1MAR99	30NOV01	140
1DEC01	30APR06	68
1DEC98	30APR06	1
1DEC01	30APR11	180
1NOV94	31AUG98	12
1NOV96	30NOV98	77
1DEC98	31MAR12	69



Plot Date 18OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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Inactive
Summary Bar/Early Dates
Critical Designator
Milestone/Flag Activity

KASG

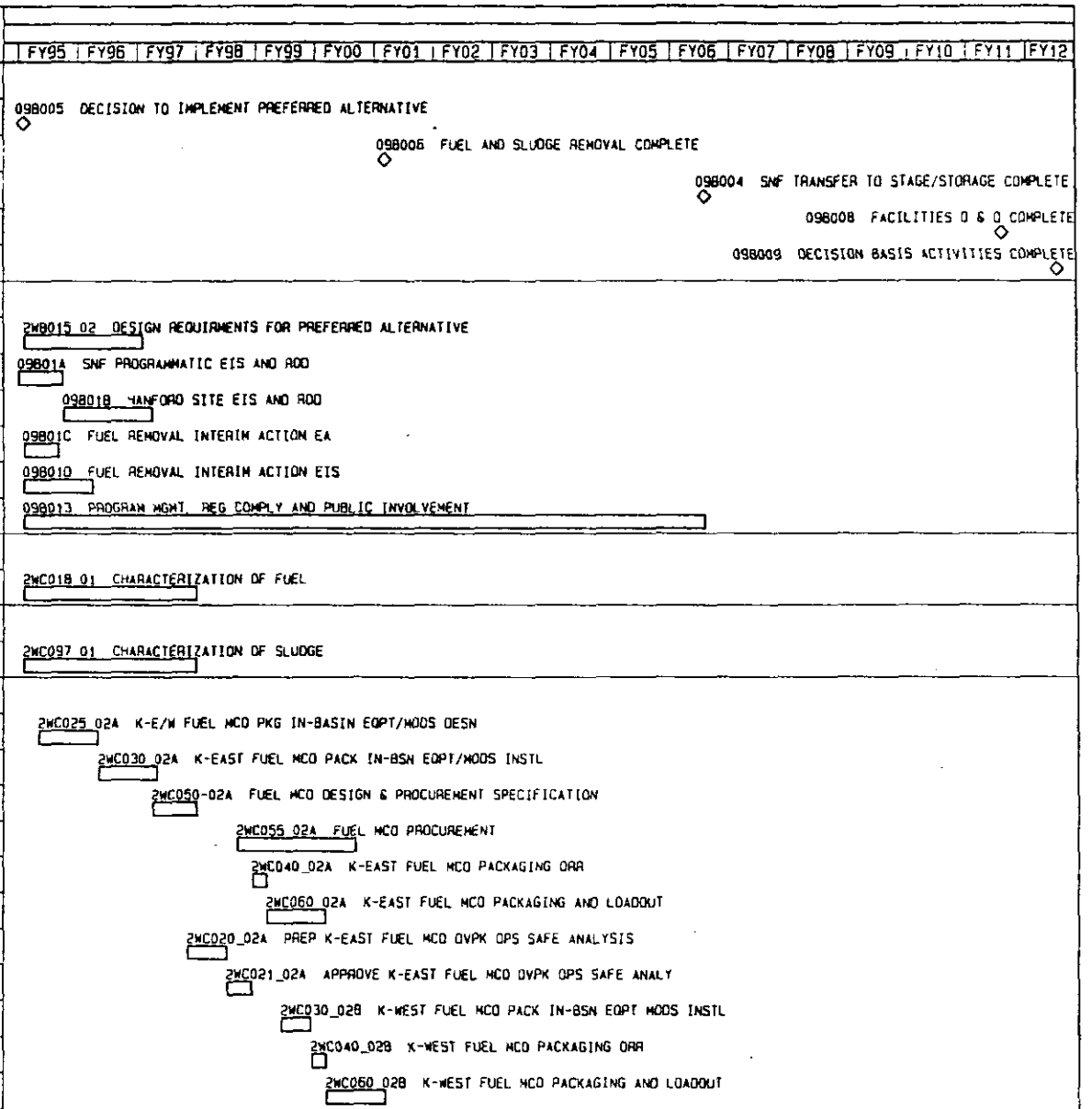
Sheet 1 of 1

K BASIN
SNF EXPEDITED REMOVAL DECISION
FORWARD PATH (SUMMARY)

REVISION F 10/14/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
DECISION BASIS KEY DATES - 0.0					
00A	100	1NOV94		0	0
00A	100		30NOV00	0	0
00A	200		30APR06	0	0
00A	300		30APR11	0	0
00A	400		31MAR12	0	0
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0					
00B	100	1NOV94	31OCT96	24	0
00B	310	10CT94	30JUN95	9	0
00B	320	1JUL95	31DEC96	18	0
00B	320	1NOV94	31MAY95	7	0
00B	320	1NOV94	31DEC95	14	0
00B	400	1NOV94	30APR06	138	120.8
CHARACTERIZE FUEL - 1.0					
01A	100	1NOV94	30SEP97	35	13.0
CHARACTERIZE SLUDGE - 1.0					
01B	100	1NOV94	30SEP97	35	5.0
PACKAGE FUEL - 2.0					
02A	100	1FEB95	31JAN96	12	2.6
02A	100	1FEB96	31JAN97	12	6.3
02A	200	1JAN97	30SEP97	9	.3
02A	200	1JUN98	31MAY00	24	48.6
02A	300	1SEP98	30NOV98	3	1
02A	400	10EC98	30NOV99	12	3.7
02A	500	1AUG97	31MAR98	8	.3
02A	500	1APR98	31AUG98	5	1
02A	900	1MAR99	31AUG99	6	5.0
02A	900	1SEP99	30NOV99	3	1
02A	300	10EC99	30NOV00	12	2.0



Plot Date 18OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

KASG

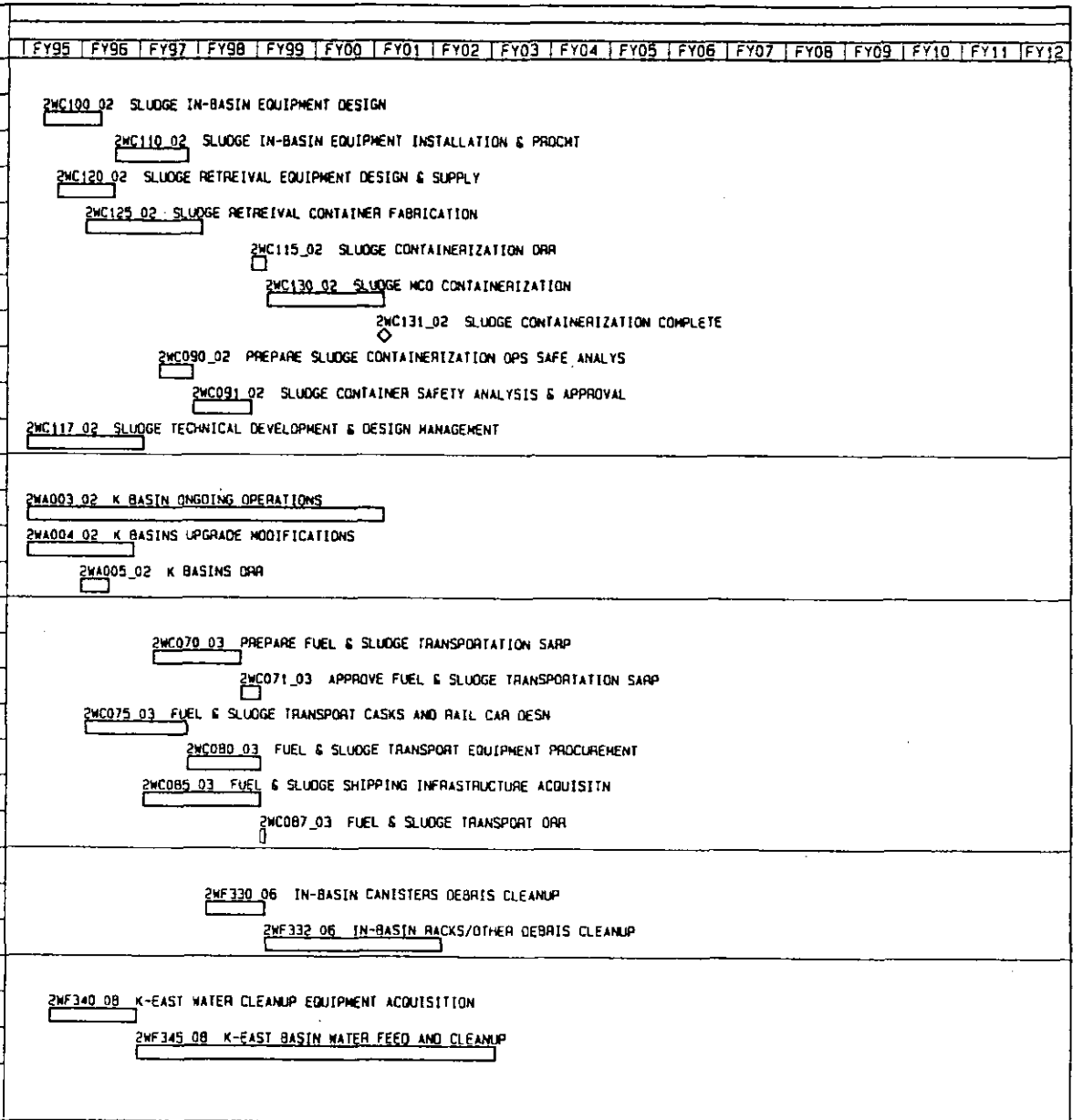
Sheet 1 of 4

K BASINS
SNF EXPEDITED REMOVAL DECISION
PATH FORWARD

REVISION H 10/17/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
PACKAGE SLUDGE - 2.0					
028	100	1FEB95	31JAN96	12	2.6
028	100	1MAY96	31JUL97	15	2.5
028	200	1MAY95	30APR96	12	10.0
028	200	1NOV95	31OCT97	24	4.0
028	300	1SEP98	30NOV98	3	.2
028	400	1DEC98	30NOV00	24	1.6
028	400	1DEC00	30NOV00	0	.0
028	500	1FEB97	31AUG97	7	.2
028	500	1SEP97	31AUG98	12	.1
028	500	1NOV94	31OCT96	24	2.6
ONGOING OPERATIONS IN K BASINS - 2.0					
02C	100	1NOV94	30NOV00	73	258.2
02C	100	1NOV94	31AUG96	22	16.1
02C	300	1OCT95	31MAR96	6	2.4
PREPARE FUEL FOR TRANSPORT - 3.0					
03A	100	1JAN97	30JUN98	18	.6
03A	100	1JUL98	31OCT98	4	.1
03A	100	1NOV95	31JUL97	21	2.0
03A	100	1AUG97	31OCT98	15	8.0
03A	200	1NOV96	31OCT98	24	.0
03A	300	1NOV98	30NOV98	1	.1
DISPOSE OF DEBRIS - 6.0					
060	100	1DEC97	30NOV98	12	3.4
060	200	1DEC98	30NOV01	36	6.6
REMOVE RADIOACTIVE WATER - 8.0					
080	100	1APR95	30SEP96	18	6.6
080	200	1OCT96	31OCT02	73	11.4



Plot Date 18OCT94
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

KASG

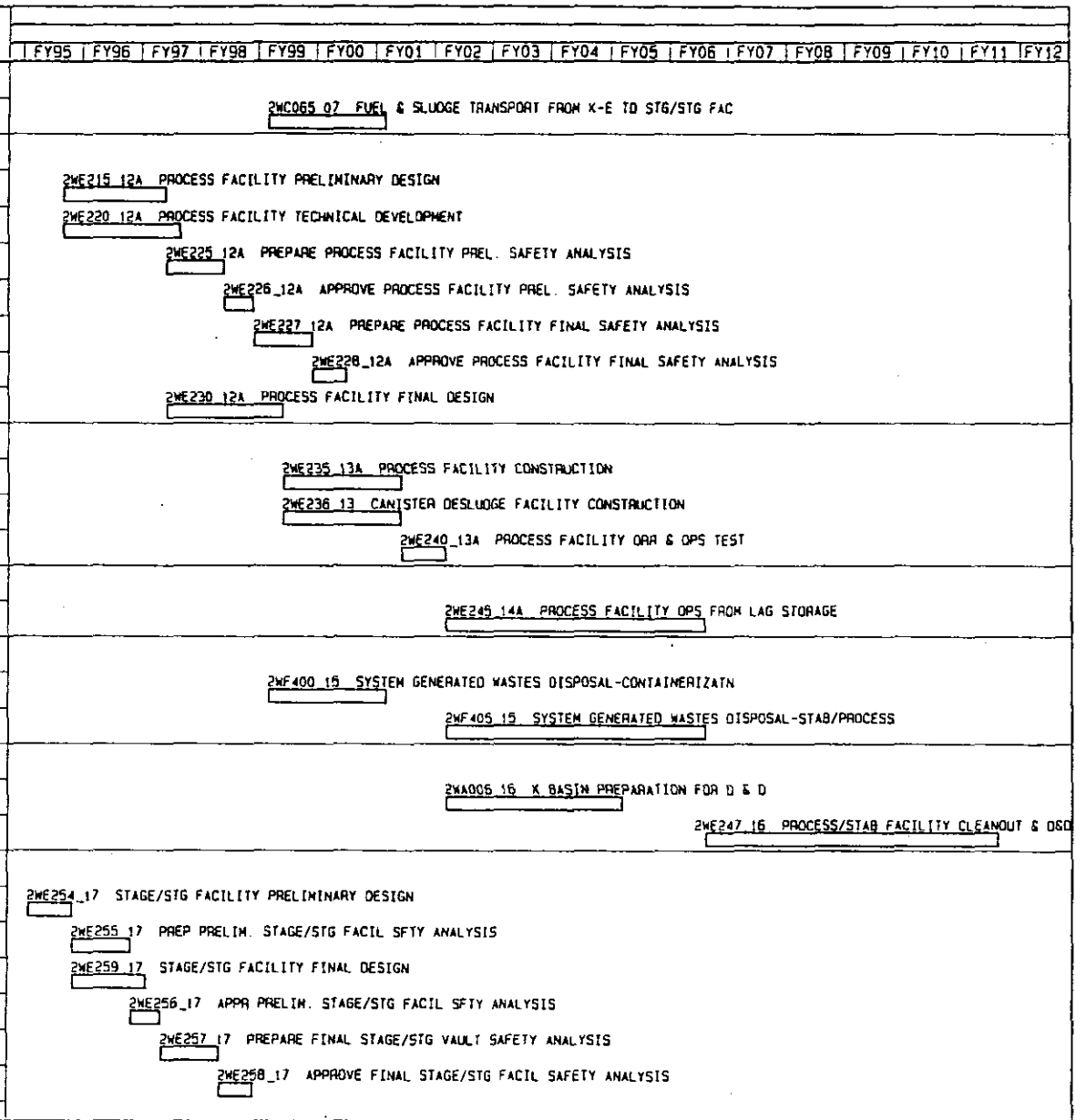
Sheet 2 of 4

K BASINS
SNF EXPEDITED REMOVAL DECISION
PATH FORWARD

REVISION H 10/17/94

Date	Revision	Checked	Approved

P8K1	P8K2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
TRANSPORT FUEL FROM K BASINS - 11.0					
11A	100	1DEC98	30NOV00	24	10.0
DESIGN STAB/PROCESS FACILITY - 12.0					
120	100	1JUN95	28FEB97	21	4.0
120	200	1JUN95	31MAY97	24	19.7
120	300	1MAR97	28FEB98	12	1.0
120	300	1MAR98	31AUG98	6	.4
120	300	1SEP98	31AUG99	12	9
120	300	1SEP99	31MAR00	7	.5
120	400	1MAR97	28FEB99	24	14.6
CONSTRUCT STAB/PROCESS FACILITY - 13.0					
130	100	1MAR99	28FEB01	24	74.8
130	100	1MAR99	28FEB01	24	43.8
130	200	1MAR01	30NOV01	9	21.0
STABILIZE/PROCESS FUEL - 14.0					
140	100	1DEC01	30APR06	53	67.6
DISPOSE OF GENERATED WASTES - 15.0					
150	100	1DEC98	30NOV00	24	.3
150	200	1DEC01	30APR06	53	.9
D & D FACILITIES - 16.0					
160	100	1DEC01	30NOV04	36	90.0
160	300	1MAY06	30APR11	60	90.0
DESIGN INTERIM STORAGE FACILITY - 17.0					
170	100	1NOV94	31JUL95	9	1.5
170	100	1AUG95	31JUL96	12	1.0
170	100	1AUG95	31OCT96	15	8.0
170	200	1AUG96	31JAN97	6	.4
170	200	1FEB97	31JAN98	12	.9
170	200	1FEB98	31AUG98	7	.5



Plot Date 18OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

K456

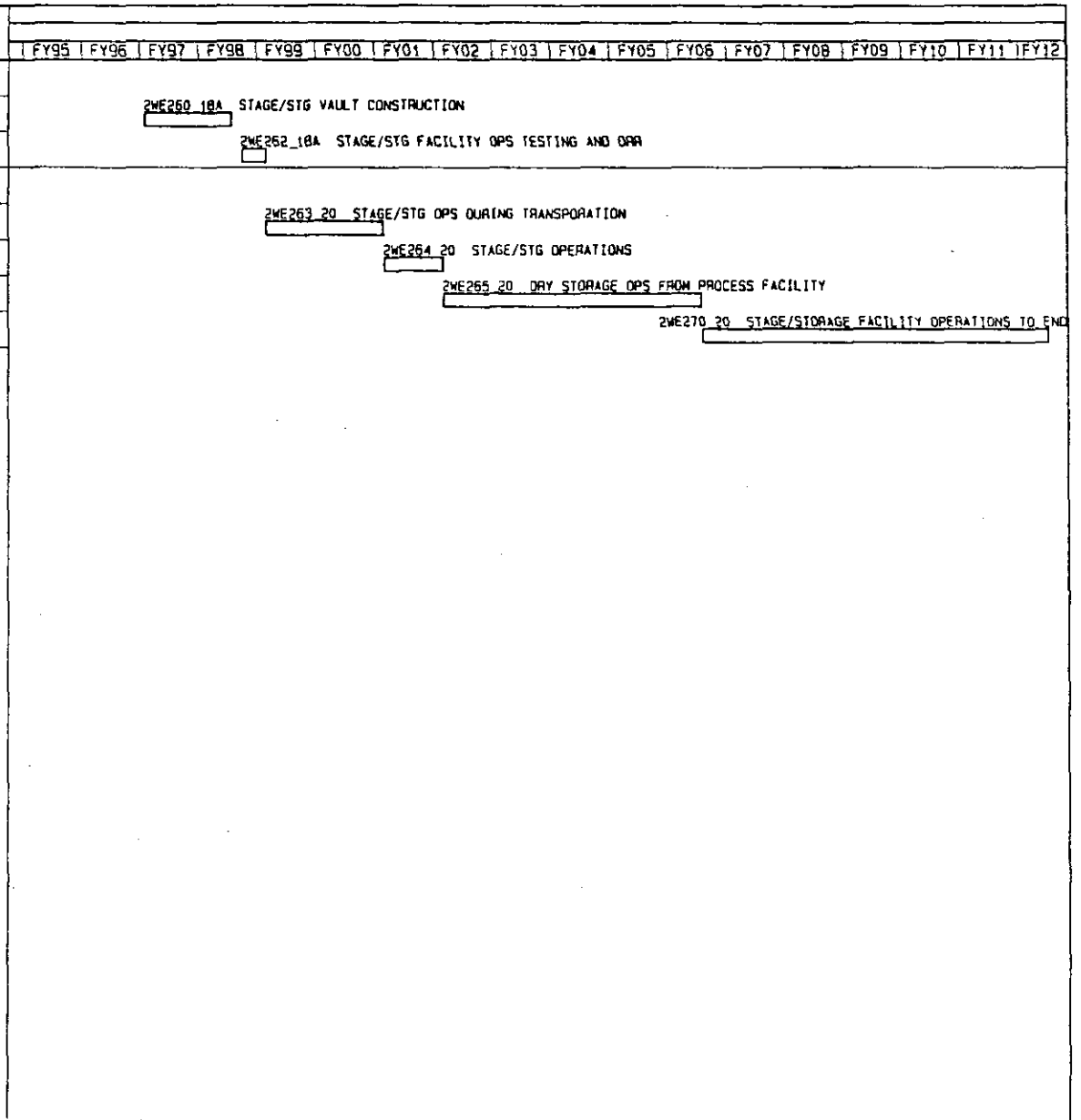
Sheet 3 of 4

K BASINS
SNF EXPEDITED REMOVAL DECISION
PATH FORWARD

REVISION H 10/17/94

Date	Revision	Checked	Approved

PBK1	PBK2	EARLY START	EARLY FINISH	ORIG DUR	BUDGET COST
CONSTRUCT INTERIM STORAGE FACILITY - 18.0					
180	100	1NOV96	30APR98	18	72.0
180	300	1JUL98	30NOV98	5	5.0
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0					
200	300	1DEC98	30NOV00	24	18.0
200	300	1DEC00	30NOV01	12	2.8
200	300	1DEC01	30APR06	53	39.8
200	400	1MAY06	31MAR12	71	8.9



Plot Date 18OCT94
Data Date 10CT93
Project Start 10CT93
Project Finish 31MAR12

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Activity Bar/Early Dates
Critical Activity
Milestone/Flag Activity

KASG

Sheet 4 of 4

K BASINS
SNF EXPEDITED REMOVAL DECISION
PATH FORWARD

REVISION H 10/17/94

Date	Revision	Checked	Approved

PRIMAVERA PROJECT PLANNER — PATH FORWARD

REPORT DATE 18OCT94 RUN NO. 364 — COST LOADING REPORT — START DATE 01OCT93 FIN DATE 31MAR12
11:04

DATA DATE 01OCT93 PAGE NO. 1- 1

FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT	120.8	9.6	10.5	10.5	10.5	10.5	10.5	10.5
TOTAL	00B	120.8	9.6	10.5	10.5	10.5	10.5	10.5	10.5
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL	13.0	4.1	4.5	4.5				
TOTAL	01A	13.0	4.1	4.5	4.5				
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE	5.0	1.6	1.7	1.7				
TOTAL	01B	5.0	1.6	1.7	1.7				
PACKAGE FUEL - 2.0									
2WC020_02A	PREP K-EAST FUEL MCO OVPK OPS SAFE ANALYSIS	0.3			0.1	0.2			
2WC021_02A	APPROVE K-EAST FUEL MCO OVPK OPS SAFE ANALY	0.1				0.1			
2WC025_02A	K-E/W FUEL MCO PKG IN-BASIN EQPT/MODS DESN	2.6	1.7	0.9					
2WC030_02A	K-EAST FUEL MCO PACK IN-BSN EQPT/MODS INSTL	6.3		4.2	2.1				
2WC030_02B	K-WEST FUEL MCO PACK IN-BSN EQPT MODS INSTL	5.0					5.0		
2WC040_02A	K-EAST FUEL MCO PACKAGING ORR	0.1				0.0	0.1		
2WC040_02B	K-WEST FUEL MCO PACKAGING ORR	0.1					0.0	0.1	
2WC050-02A	FUEL MCO DESIGN & PROCUREMENT SPECIFICATION	0.3			0.3				
2WC055_02A	FUEL MCO PROCUREMENT	48.6				8.1	24.3	16.2	
2WC060_02A	K-EAST FUEL MCO PACKAGING AND LOADOUT	3.7					3.1	0.6	
2WC060_02B	K-WEST FUEL MCO PACKAGING AND LOADOUT	2.0						1.7	0.3
TOTAL	02A	69.1	1.7	5.1	2.5	8.5	32.5	18.5	0.3
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINERIZATION OPS SAFE ANALYS	0.2			0.2				
2WC091_02	SLUDGE CONTAINER SAFETY ANALYSIS & APPROVAL	0.1			0.0	0.1			
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN	2.6	1.7	0.9					
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT	2.5		0.8	1.7				
2WC115_02	SLUDGE CONTAINERIZATION ORR	0.2				0.1	0.1		
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT	2.6	1.2	1.3	0.1				
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY	10.0	4.2	5.8					
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION	4.0		1.8	2.0	0.2			
2WC130_02	SLUDGE MCO CONTAINERIZATION	1.6					0.7	0.8	0.1
TOTAL	02B	23.8	7.1	10.7	4.0	0.3	0.8	0.8	0.1
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS	258.2	41.2	42.0	42.0	42.0	42.0	42.0	7.0
2WA004_02	K BASINS UPGRADE MODIFICATIONS	16.1	3.0	13.1					
2WA005_02	K BASINS ORR	2.4		2.4					
TOTAL	02C	276.7	44.2	57.5	42.0	42.0	42.0	42.0	7.0
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP	0.6			0.3	0.3			
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP	0.1				0.1	0.0		
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN	2.0		1.0	1.0				
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT	8.0			1.1	6.4	0.5		
2WC085_03	FUEL & SLUDGE SHIPPING INFRASTRUCTURE ACQUISITN	0.0			0.0	0.0	0.0		

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FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC087_03	FUEL & SLUDGE TRANSPORT ORR	0.1					0.1		
TOTAL	03A	10.8		1.0	2.3	6.8	0.7		
DISPOSE OF DEBRIS - 6.0									
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP	3.4				2.8	0.6		
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP	6.6					1.8	2.2	2.2
TOTAL	060	10.0				2.8	2.4	2.2	2.2
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION	6.6	2.2	4.4					
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP	11.4			1.9	1.9	1.9	1.9	1.9
TOTAL	080	18.0	2.2	4.4	1.9	1.9	1.9	1.9	1.9
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_07	FUEL & SLUDGE TRANSPORT FROM K-E TO STG/STG FAC	10.0					4.2	5.0	0.8
TOTAL	11A	10.0					4.2	5.0	0.8
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12A	PROCESS FACILITY PRELIMINARY DESIGN	4.0	0.8	2.3	1.0				
2WE220_12A	PROCESS FACILITY TECHNICAL DEVELOPMENT	19.7	3.3	9.9	6.6				
2WE225_12A	PREPARE PROCESS FACILITY PREL. SAFETY ANALYSIS	1.0			0.6	0.4			
2WE226_12A	APPROVE PROCESS FACILITY PREL. SAFETY ANALYSIS	0.4				0.4			
2WE227_12A	PREPARE PROCESS FACILITY FINAL SAFETY ANALYSIS	0.9				0.1	0.8		
2WE228_12A	APPROVE PROCESS FACILITY FINAL SAFETY ANALYSIS	0.5					0.1	0.4	
2WE230_12A	PROCESS FACILITY FINAL DESIGN	14.6			4.3	7.3	3.0		
TOTAL	120	41.1	4.0	12.1	12.4	8.2	3.9	0.4	
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13A	PROCESS FACILITY CONSTRUCTION	74.8					21.8	33.4	19.6
2WE236_13	CANISTER DESLUDGE FACILITY CONSTRUCTION	43.8					12.8	17.9	13.1
2WE240_13A	PROCESS FACILITY ORR & OPS TEST	21.0							16.3
TOTAL	130	139.6					34.6	51.3	49.0
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14A	PROCESS FACILITY OPS FROM LAG STORAGE	67.6							
TOTAL	140	67.6							
DISPOSE OF GENERATED WASTES - 15.0									
2WF400_15	SYSTEM GENERATED WASTES DISPOSAL-CONTAINERIZATN	0.3					0.1	0.2	0.0
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS	0.9							
TOTAL	150	1.2					0.1	0.2	0.0
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARATION FOR D & D	90.0							
2WE247_16	PROCESS/STAB FACILITY CLEANOUT & D&D	90.0							

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FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	TOTAL	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
D & D FACILITIES - 16.0									
TOTAL	160	180.0							
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE254_17	STAGE/STG FACILITY PRELIMINARY DESIGN	1.5	1.5						
2WE255_17	PREP PRELIM. STAGE/STG FACIL SFTY ANALYSIS	1.0	0.2	0.8					
2WE256_17	APPR PRELIM. STAGE/STG FACIL SFTY ANALYSIS	0.4		0.1	0.3				
2WE257_17	PREPARE FINAL STAGE/STG VAULT SAFETY ANALYSIS	0.9			0.6	0.3			
2WE258_17	APPROVE FINAL STAGE/STG FACIL SAFETY ANALYSIS	0.5				0.5			
2WE259_17	STAGE/STG FACILITY FINAL DESIGN	8.0	1.1	6.4	0.5				
TOTAL	170	12.3	2.7	7.4	1.4	0.8			
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18A	STAGE/STG VAULT CONSTRUCTION	72.0			44.0	28.0			
2WE262_18A	STAGE/STG FACILITY OPS TESTING AND ORR	5.0				3.0	2.0		
TOTAL	180	77.0			44.0	31.0	2.0		
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE263_20	STAGE/STG OPS DURING TRANSPORATION	18.0					7.5	9.0	1.5
2WE264_20	STAGE/STG OPERATIONS	2.8							2.3
2WE265_20	DRY STORAGE OPS FROM PROCESS FACILITY	39.8							
2WE270_20	STAGE/STORAGE FACILITY OPERATIONS TO END	8.9							
TOTAL	200	69.4					7.5	9.0	3.8
	REPORT TOTAL	1145.5	77.3	114.9	127.1	112.8	143.1	141.8	75.8

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FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0									
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT	10.5	10.5	10.5	10.5	6.1			
TOTAL	00B	10.5	10.5	10.5	10.5	6.1			
CHARACTERIZE FUEL - 1.0									
2WC018_01	CHARACTERIZATION OF FUEL								
TOTAL	01A								
CHARACTERIZE SLUDGE - 1.0									
2WC097_01	CHARACTERIZATION OF SLUDGE								
TOTAL	01B								
PACKAGE FUEL - 2.0									
2WC020_02A	PREP K-EAST FUEL MCO OVPK OPS SAFE ANALYSIS								
2WC021_02A	APPROVE K-EAST FUEL MCO OVPK OPS SAFE ANALY								
2WC025_02A	K-E/W FUEL MCO PKG IN-BASIN EQPT/MODS DESN								
2WC030_02A	K-EAST FUEL MCO PACK IN-BSN EQPT/MODS INSTL								
2WC030_02B	K-WEST FUEL MCO PACK IN-BSN EQPT MODS INSTL								
2WC040_02A	K-EAST FUEL MCO PACKAGING ORR								
2WC040_02B	K-WEST FUEL MCO PACKAGING ORR								
2WC050-02A	FUEL MCO DESIGN & PROCUREMENT SPECIFICATION								
2WC055_02A	FUEL MCO PROCUREMENT								
2WC060_02A	K-EAST FUEL MCO PACKAGING AND LOADOUT								
2WC060_02B	K-WEST FUEL MCO PACKAGING AND LOADOUT								
TOTAL	02A								
PACKAGE SLUDGE - 2.0									
2WC090_02	PREPARE SLUDGE CONTAINERIZATION OPS SAFE ANALYS								
2WC091_02	SLUDGE CONTAINER SAFETY ANALYSIS & APPROVAL								
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN								
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT								
2WC115_02	SLUDGE CONTAINERIZATION ORR								
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT								
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY								
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION								
2WC130_02	SLUDGE MCO CONTAINERIZATION								
TOTAL	02B								
ONGOING OPERATIONS IN K BASINS - 2.0									
2WA003_02	K BASIN ONGOING OPERATIONS								
2WA004_02	K BASINS UPGRADE MODIFICATIONS								
2WA005_02	K BASINS ORR								
TOTAL	02C								
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP								
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP								
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN								
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT								
2WC085_03	FUEL & SLUDGE SHIPPING INFRASTRUCTURE ACQUISITN								

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FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
PREPARE FUEL FOR TRANSPORT - 3.0									
2WC087_03	FUEL & SLUDGE TRANSPORT ORR								
TOTAL	03A								
DISPOSE OF DEBRIS - 6.0									
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP								
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP	0.4							
TOTAL	060	0.4							
REMOVE RADIOACTIVE WATER - 8.0									
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION								
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP	1.9	0.2						
TOTAL	080	1.9	0.2						
TRANSPORT FUEL FROM K BASINS - 11.0									
2WC065_07	FUEL & SLUDGE TRANSPORT FROM K-E TO STG/STG FAC								
TOTAL	11A								
DESIGN STAB/PROCESS FACILITY - 12.0									
2WE215_12A	PROCESS FACILITY PRELIMINARY DESIGN								
2WE220_12A	PROCESS FACILITY TECHNICAL DEVELOPMENT								
2WE225_12A	PREPARE PROCESS FACILITY PREL. SAFETY ANALYSIS								
2WE226_12A	APPROVE PROCESS FACILITY PREL. SAFETY ANALYSIS								
2WE227_12A	PREPARE PROCESS FACILITY FINAL SAFETY ANALYSIS								
2WE228_12A	APPROVE PROCESS FACILITY FINAL SAFETY ANALYSIS								
2WE230_12A	PROCESS FACILITY FINAL DESIGN								
TOTAL	120								
CONSTRUCT STAB/PROCESS FACILITY - 13.0									
2WE235_13A	PROCESS FACILITY CONSTRUCTION								
2WE236_13	CANISTER DESLUDGE FACILITY CONSTRUCTION								
2WE240_13A	PROCESS FACILITY ORR & OPS TEST	4.7							
TOTAL	130	4.7							
STABILIZE/PROCESS FUEL - 14.0									
2WE245_14A	PROCESS FACILITY OPS FROM LAG STORAGE	12.8	15.3	15.3	15.3	8.9			
TOTAL	140	12.8	15.3	15.3	15.3	8.9			
DISPOSE OF GENERATED WASTES - 15.0									
2WF400_15	SYSTEM GENERATED WASTES DISPOSAL-CONTAINERIZATN								
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS	0.2	0.2	0.2	0.2	0.1			
TOTAL	150	0.2	0.2	0.2	0.2	0.1			
D & D FACILITIES - 16.0									
2WA006_16	K BASIN PREPARATION FOR D & D	25.0	30.0	30.0	5.0				
2WE247_16	PROCESS/STAB FACILITY CLEANOUT & D&D					7.5	18.0	18.0	18.0

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FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
D & D FACILITIES - 16.0									
TOTAL	160	25.0	30.0	30.0	5.0	7.5	18.0	18.0	18.0
DESIGN INTERIM STORAGE FACILITY - 17.0									
2WE254_17	STAGE/STG FACILITY PRELIMINARY DESIGN								
2WE255_17	PREP PRELIM. STAGE/STG FACIL SFTY ANALYSIS								
2WE256_17	APPR PRELIM. STAGE/STG FACIL SFTY ANALYSIS								
2WE257_17	PREPARE FINAL STAGE/STG VAULT SAFETY ANALYSIS								
2WE258_17	APPROVE FINAL STAGE/STG FACIL SAFETY ANALYSIS								
2WE259_17	STAGE/STG FACILITY FINAL DESIGN								
TOTAL	170								
CONSTRUCT INTERIM STORAGE FACILITY - 18.0									
2WE260_18A	STAGE/STG VAULT CONSTRUCTION								
2WE262_18A	STAGE/STG FACILITY OPS TESTING AND ORR								
TOTAL	180								
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0									
2WE263_20	STAGE/STG OPS DURING TRANSPORATION								
2WE264_20	STAGE/STG OPERATIONS	0.5							
2WE265_20	DRY STORAGE OPS FROM PROCESS FACILITY	7.5	9.0	9.0	9.0	5.3			
2WE270_20	STAGE/STORAGE FACILITY OPERATIONS TO END					0.6	1.5	1.5	1.5
TOTAL	200	8.0	9.0	9.0	9.0	5.9	1.5	1.5	1.5
	REPORT TOTAL	63.3	65.2	65.0	40.0	28.6	19.5	19.5	19.5

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FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
PROGRAM ACTIONS COMMON FOR ALL ALTS - 0.0				
09B013	PROGRAM MGMT, REG COMPLY AND PUBLIC INVOLVEMENT			
TOTAL	00B			
CHARACTERIZE FUEL - 1.0				
2WC018_01	CHARACTERIZATION OF FUEL			
TOTAL	01A			
CHARACTERIZE SLUDGE - 1.0				
2WC097_01	CHARACTERIZATION OF SLUDGE			
TOTAL	01B			
PACKAGE FUEL - 2.0				
2WC020_02A	PREP K-EAST FUEL MCO OVPK OPS SAFE ANALYSIS			
2WC021_02A	APPROVE K-EAST FUEL MCO OVPK OPS SAFE ANALY			
2WC025_02A	K-E/W FUEL MCO PKG IN-BASIN EQPT/MODS DESN			
2WC030_02A	K-EAST FUEL MCO PACK IN-BSN EQPT/MODS INSTL			
2WC030_02B	K-WEST FUEL MCO PACK IN-BSN EQPT MODS INSTL			
2WC040_02A	K-EAST FUEL MCO PACKAGING ORR			
2WC040_02B	K-WEST FUEL MCO PACKAGING ORR			
2WC050-02A	FUEL MCO DESIGN & PROCUREMENT SPECIFICATION			
2WC055_02A	FUEL MCO PROCUREMENT			
2WC060_02A	K-EAST FUEL MCO PACKAGING AND LOADOUT			
2WC060_02B	K-WEST FUEL MCO PACKAGING AND LOADOUT			
TOTAL	02A			
PACKAGE SLUDGE - 2.0				
2WC090_02	PREPARE SLUDGE CONTAINERIZATION OPS SAFE ANALYS			
2WC091_02	SLUDGE CONTAINER SAFETY ANALYSIS & APPROVAL			
2WC100_02	SLUDGE IN-BASIN EQUIPMENT DESIGN			
2WC110_02	SLUDGE IN-BASIN EQUIPMENT INSTALLATION & PROCMT			
2WC115_02	SLUDGE CONTAINERIZATION ORR			
2WC117_02	SLUDGE TECHNICAL DEVELOPMENT & DESIGN MANAGEMENT			
2WC120_02	SLUDGE RETREIVAL EQUIPMENT DESIGN & SUPPLY			
2WC125_02	SLUDGE RETREIVAL CONTAINER FABRICATION			
2WC130_02	SLUDGE MCO CONTAINERIZATION			
TOTAL	02B			
ONGOING OPERATIONS IN K BASINS - 2.0				
2WA003_02	K BASIN ONGOING OPERATIONS			
2WA004_02	K BASINS UPGRADE MODIFICATIONS			
2WA005_02	K BASINS ORR			
TOTAL	02C			
PREPARE FUEL FOR TRANSPORT - 3.0				
2WC070_03	PREPARE FUEL & SLUDGE TRANSPORTATION SARP			
2WC071_03	APPROVE FUEL & SLUDGE TRANSPORTATION SARP			
2WC075_03	FUEL & SLUDGE TRANSPORT CASKS AND RAIL CAR DESN			
2WC080_03	FUEL & SLUDGE TRANSPORT EQUIPMENT PROCUREMENT			
2WC085_03	FUEL & SLUDGE SHIPPING INFRASTRUCTURE ACQUISITN			

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FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
PREPARE FUEL FOR TRANSPORT - 3.0				
2WC087_03	FUEL & SLUDGE TRANSPORT ORR			
TOTAL	03A			
DISPOSE OF DEBRIS - 6.0				
2WF330_06	IN-BASIN CANISTERS DEBRIS CLEANUP			
2WF332_06	IN-BASIN RACKS/OTHER DEBRIS CLEANUP			
TOTAL	060			
REMOVE RADIOACTIVE WATER - 8.0				
2WF340_08	K-EAST WATER CLEANUP EQUIPMENT ACQUISITION			
2WF345_08	K-EAST BASIN WATER FEED AND CLEANUP			
TOTAL	080			
TRANSPORT FUEL FROM K BASINS - 11.0				
2WC065_07	FUEL & SLUDGE TRANSPORT FROM K-E TO STG/STG FAC			
TOTAL	11A			
DESIGN STAB/PROCESS FACILITY - 12.0				
2WE215_12A	PROCESS FACILITY PRELIMINARY DESIGN			
2WE220_12A	PROCESS FACILITY TECHNICAL DEVELOPMENT			
2WE225_12A	PREPARE PROCESS FACILITY PREL. SAFETY ANALYSIS			
2WE226_12A	APPROVE PROCESS FACILITY PREL. SAFETY ANALYSIS			
2WE227_12A	PREPARE PROCESS FACILITY FINAL SAFETY ANALYSIS			
2WE228_12A	APPROVE PROCESS FACILITY FINAL SAFETY ANALYSIS			
2WE230_12A	PROCESS FACILITY FINAL DESIGN			
TOTAL	120			
CONSTRUCT STAB/PROCESS FACILITY - 13.0				
2WE235_13A	PROCESS FACILITY CONSTRUCTION			
2WE236_13	CANISTER DESLUDGE FACILITY CONSTRUCTION			
2WE240_13A	PROCESS FACILITY ORR & OPS TEST			
TOTAL	130			
STABILIZE/PROCESS FUEL - 14.0				
2WE245_14A	PROCESS FACILITY OPS FROM LAG STORAGE			
TOTAL	140			
DISPOSE OF GENERATED WASTES - 15.0				
2WF400_15	SYSTEM GENERATED WASTES DISPOSAL-CONTAINERIZATN			
2WF405_15	SYSTEM GENERATED WASTES DISPOSAL-STAB/PROCESS			
TOTAL	150			
D & D FACILITIES - 16.0				
2WA006_16	K BASIN PREPARATION FOR D & D			
2WE247_16	PROCESS/STAB FACILITY CLEANOUT & D&D	18.0	10.5	

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FORWARD PATH, REV H, 10/17/94 — TOTAL USAGE FOR YEAR

ACT ID	DESC	FY 2010	FY 2011	FY 2012
D & D FACILITIES - 16.0				
TOTAL	160	18.0	10.5	
DESIGN INTERIM STORAGE FACILITY - 17.0				
2WE254_17	STAGE/STG FACILITY PRELIMINARY DESIGN			
2WE255_17	PREP PRELIM. STAGE/STG FACIL SFTY ANALYSIS			
2WE256_17	APPR PRELIM. STAGE/STG FACIL SFTY ANALYSIS			
2WE257_17	PREPARE FINAL STAGE/STG VAULT SAFETY ANALYSIS			
2WE258_17	APPROVE FINAL STAGE/STG FACIL SAFETY ANALYSIS			
2WE259_17	STAGE/STG FACILITY FINAL DESIGN			
TOTAL	170			
CONSTRUCT INTERIM STORAGE FACILITY - 18.0				
2WE260_18A	STAGE/STG VAULT CONSTRUCTION			
2WE262_18A	STAGE/STG FACILITY OPS TESTING AND ORR			
TOTAL	180			
STORE FUEL IN INTERIM STORAGE FACILITY - 20.0				
2WE263_20	STAGE/STG OPS DURING TRANSPORATION			
2WE264_20	STAGE/STG OPERATIONS			
2WE265_20	DRY STORAGE OPS FROM PROCESS FACILITY			
2WE270_20	STAGE/STORAGE FACILITY OPERATIONS TO END	1.5	1.5	0.8
TOTAL	200	1.5	1.5	0.8
	REPORT TOTAL	19.5	12.0	0.8

Summary Cost Basis Information
Path Forward Alternative - ITA Passivation Process with Lag Storage

Scenario:

The path forward alternative includes the following major activities:

- K Basin modifications and containerization into MCO overpack containers (24 inch diameter).
- Direct transportation of the MCOs in a shielded cask by rail for temporary wet storage in a storage vault in the 200 Areas. The storage vault will serve a dual purpose, i. e., wet lag storage prior to conditioning and dry interim 40 year storage following passivation.
- When the processing/stabilization facility is available fuel canisters will be removed from each MCO. Canisters will be drilled, desludged, and returned to the MCO container.
- Fuel in the MCOs will then be dried and passivated in batch furnaces using the ITA process. Processing is conducted over a longer time period (53 months) than is assumed for alternatives 1 through 3.
- Following passivation, MCOs will be stored in the co-located interim dry storage facility at the 200 Area site.

This alternative is a modified cost approach to the proposed ITA process. Original costs included in the original ITA report have been adjusted to be more realistic at the Hanford site. The major adjustments were based on Kaiser Engineers Hanford cost estimates of the ITA process that were performed at the request of WHC. Other adjustments such as staffing, ORR, SAR, OTP, etc. are identified in this cost basis discussion.

This alternative requires modifications to the K Basins to accommodate the tall 24 inch diameter MCO overpack, but does not drill and desludge canister at the K Basins. Co-location of the conditioning facility with the staging and storage facility eliminates a second transport activity required in the other alternatives. This alternative combines the feature of early removal and temporary wet storage of K Basins fuel (similar to Alternative 2) with the ITA passivation and MCO concept proposed ITA (Alternative 3).

Cost and Schedule Activity Bases:

0.0 Program Actions Common for All Alternatives

Program management, regulatory compliance, and public involvement = $10.5M/yr from SNF MYPP (Note 4). No cost estimates included for other actions common to all alternatives. (09B013)

1.0 Characterize Fuel and Sludge

Total 3 year costs = $18 M. ($13M-fuel, $5M-sludge). From prior program planning documents and discussions with R. Omberg (Note 31). (2WC018, 2WC097)

2.0 (a) Package Fuel

K Basin cost estimate for ITA Process prepared by Kaiser Engineers Hanford was general basis (Note 19A). In-basin costs were limited to loadout portion of the estimate, not drilling and desludging.

1) Basin equipment design = $ 2.6 M. (2WC025)

2) Basin equipment installation = $ 6.3 M for K-E and $ 5.0 M for K-W. (2WC030A & B)

3) Design specification for MCO = $0.3 M. Vendor provides container design. (2WC050)

4) Purchase the MCOs= $48.6 M. (2WC055)

5) ORR = $0.2 M. Generic K Basins ORR covers most of this and is costed at $2.4M in sect. 2.0. (2WC040 A&B)

6) MCO packaging and loadout = $3.7 M for K-E and $2.0 for K-W. (2WC060A&B)

7) SAR = $0.3 M (prepare) + 0.1 M (approval) from K. Daschke report (Note 17). (2WC020, 021)

2.0 (b) Package Sludge

1) Sludge equip. design=$2.6M from communication with advocate (Note 21). (2WC100)

2) Sludge equipment installation = $ 2.5 M from communication with advocate. (2WC110)

3) Sludge retrieval and containerization equipment = $10 M from communication with advocate. (2WC120)

4) Sludge container procurement = $ 4 M from communication with advocate. (2WC125)

5) ORR = $0.2 M SAIC estimate. Most aspects covered by generic K Basins ORR. (2WC115)

6) Containerization labor = $1.6 M from discussion with Leon Hoffer, K Basins Operations (Note 32). (2WC130)

7) SAR = 110 K from K. Daschke report (rounded up to $0.2 M). (2WC090).

8) SAR Approval = $0.1M (2WC091)

9) Sludge technology development = $2.6M (Note 5). (2WC117)

2.0 (c) Ongoing Operations in K Basins

1) Ongoing operations at $41.2 M for 11 months in FY95 and $42M/year until fuel and sludge removal from both Basins is completed. (2WA003)

2) Upgrade modification=$ 3.0 in FY95 (MYPP per discussion with K Basins staff) and $13.1M in FY96 (Note 5 overpack sheets). (2WA004)

3) K Basin ORR = 20 manyears @ $120K = $2.4M per K. Daschke report (Note 17). (2WA005)

3.0 Prepare Fuel and Sludge for Transport

1) SAR = $0.6 M (prepare) + 0.1 (approval) from K. Daschke report. (2WC070, 071)

2) Cask and rail car design= $2M as modified from ITA (Note 11) cost estimate. (2WC075)

3) Procure casks and railcars= $8M as modified from ITA (Note 11) cost estimate. (2WC080)

4) Shipping infrastructure=none identified

5) Transport ORR=$.1M (Note 17). (2WC087)

4.0 Design Pre-Interim Storage Facility

Capability for pre-interim storage of MCOs is costed under the interim storage process block, Sections 17, 18, and 20 below.

5.0 Construct Pre-Interim Storage Facility

Capability for pre-interim storage of MCOs is costed under the interim storage process block, Sections 17, 18, and 20 below.

6.0 Dispose of Debris

1) Debris disposal includes removal of racks, approximately 2000 empty canisters, and misc. scrap including lights, conduit, tools, scaffolding, etc.= $2 M for disposal in burial boxes. (Note 30) (2WF330, 2WF332)

7.0 Transport Fuel to Pre-Interim Storage

NA

8.0 Remove Radioactive Water

1) KE feed and bleed activities ($1.9 M/yr from 10/1/96 through 10/30/02) = $11.4M per discussions with advocate (Note 24).

2) KE cleanup equipment = $6.6M per discussions with advocate.

9.0 Store Sludge

NA

10.0 Pre-Interim Storage of Fuel

NA

11.0 Transport of Fuel from Pre-Interim Storage

$1.4 M railroad maintenance cost + 6 FTEs/shift times 3 shifts times 120K each = $3.5 M per year x 2yrs + $3 M for road closures = $10 M. (2WC065A, 2WC065B)

12.0 Design Stabilization/Processing Facility

1) Preliminary Design costs= $4.0 M from KEH (Note 20) estimate to passivate with ITA process. Adjusted to account for increased scope associated with the desludging station and associated equipment. (2WE215)

2) Technology development plus hot cell testing costs (Note 5) and discussion with advocate that reduced the hot cell testing costs from $30 to $10 M = $19.7M. (2WE220)

3&4) SAR costs by analogy with information in K. Daschke report. PSAR = $1.0 M (prepare) + 0.4 M (approval). FSAR = $0.9 (prepare) + 0.5 M (approval). (2WE225A, 226, 227, 228)

5) Final design = $14.6 M. Final design costs from KEH (KEH 20) estimate to passivate utilizing the ITA process with 25% contingency. Increased by $5.2 M for design of canister drilling and desludging equipment and associated structures and support equipment. Desludging estimated based on Kaiser estimate for this equipment in K Basins for Alternative 3. (2WE230)

13.0 Construct Stabilization/Processing Facility

1) Construction cost = $74.8 M. Construction costs from KEH (Note 20) estimate to passivate using ITA process with 25% contingency. (2WE235)

2) Canister desludging facility construction cost = $43.8 M. Estimate based on the procurement and installation cost in K Basins estimated by Kaiser for Alternative 3 with 25% contingency ($23.8M) + $ 20 M for associated structures and support equipment. (2WE236)

2) ORR costs from K. Daschke report plus OTP costs estimated by SAIC = $21.0 M. Assumes full operating staff required during OTP period. (2WE240)

14.0 Stabilize/Process Fuel

Operations costs generated by SAIC evaluation and analogy with other alternatives = $15.3M/yr. (Operating staff of 86 FTEs +$ 5 M/yr for fixed costs). Assumes low personnel exposure during desludging thus low burnout costs. (2WE245)

15.0 Dispose of Generated Wastes

1) Stabilization wastes include Mark 0, I, & II canisters, overpacks, and misc. other waste. (2WF405)
   2500 overpacks compacted to 6 cubic feet
   = 15,000 cubic feet @ $80/cubic foot= $1.2M
   misc. + .8M
   $2.0M

2) Containerization wastes = $300 K per discussion with WHC advocate. (2WF400)

16.0 D&D of Facilities

1) K Basins preparation for D&D (i.e., transition costs) = $30 M/yr x 3 yrs = $90 M from MYPP. D&D cost for existing facilities not included based on DOE estimating guidelines. (2WA006)

2) Processing facility clean out and D&D cost = $90 M (same as Alternative 3). (2WE247)

17.0 Design Interim Storage Facility

1) Staging and storage facility preliminary design costs = $1.5 M. Same as the pre-interim storage pool for alternative 2. (2WE255)

2) Final design cost for staging and storage facility = $ 8.0 M. (2WE259)

2) Safety analysis cost: PSAR = $1.0 M (prepare) + $ 0.4 M (approval). FSAR = $ 0.9 M (prepare) + $0.5 M (approval). The same as the pre-interim storage facility in alternative 2. (2WE257, 258)

18.0 Interim Storage Facility Construction

1) Construction of the stage and storage facility = $72.0 M. Estimated by analogy to Alternative 2 pre-interim pool at FMEF ($52 M) and commercial interim storage vault ($ 38.7 M). Basis = $52 + $20 = $72 M. (2WE260)

2) ORR = $5.0 M. (2WE262)

20.0 Store Fuel in Interim Storage Facility

1) Stage and storage facility operating cost during transportation and loading of fuel = $ 9.0 M/yr x 2 years = $18.0 M. Same as alternative 2. (2WE263)

2) Operating cost during period of wet storage(12 months) = $ 2.8 M. (2WE264)

3) Operating cost of staging and storage facility during processing phase (53 months) = $ 9 M/year = $ 39.8 M.

4) Operating cost for dry storage = $ 1.5 M/year. Same for all alternatives.

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6. Facsimile Transmittal, Lewis D. Muhlestein to Distribution, "Fuel Removal Decision Process," September 14, 1994.

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25. Presentation, Ron Omberg, "Options for Sisposition of K-East Basin Water," September, 1994.

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31. Telecon Notes, Ron Omberg to Don Bouchey, "Cost of Characterization," September, 1994.

32. Meeting Notes, Leon Hoffer to Don Bouchey, "Operations Manpower for Basin Handling Actions," October, 1994.

APPENDIX E

MULTI-ATTRIBUTE DECISION PROCESS

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E.1.0 GENERAL APPROACH

The Path Forward Alternatives were evaluated using Decision Analysis and Multi-Attribute Utility Theory. These techniques were chosen because they make explicit the rationale by which the Alternatives were evaluated, promote clarity in the thought process, and aided the specification of the Alternatives.

Decision analysis has its theoretical foundation in a set of axioms that captures the basic principles of rational decision making. Its decision rules are derived as a consequence of these axioms. Some of the salient characteristics of Decision Analysis are:

It creates defensible decisions by documenting the decision process

It specifies what criteria are to be considered, how they are measured and evaluated, and their relative importance

It clarifies the underlying rationale upon which the decision is based

It produces a well-documented, straightforward, easily justified decision.

Another characteristic of Decision Analysis and Multi-Attribute Utility Theory is its basis on the assumption that the best strategy for complex decisions is to analyze the components separately, then integrate the individual judgements to arrive at a decision. It also assumes the preferred alternative is the one which best addresses the objectives of the decision, assuring all relevant factors are considered. Decision Analysis also provides the ability to address qualitative considerations in a quantitative methodology.

The process of Decision Analysis consists of:

1. Identifying the fundamental objectives of the decision (e.g., minimize risks or costs)

2. Identifying criteria (or attributes) associated with the objectives, which, if achieved, will lead to the realization of the objectives

3. Identifying the ranges of the criteria

4. Weighing the relative importance of the various objectives and criteria

5. Developing scales (natural or constructed) which relate the values of the decision maker(s) to the criteria

6. Specifying an objective function for the evaluation of options

7. Comparing options and obtaining an overall score.

While Decision Analysis provides useful input to the decision maker by helping eliminate infeasible options, it may not consider every input to the decision process. Thus, it should be considered merely a tool for decision makers, not a replacement for experienced judgement.

Decision analysis can provide input to the decision maker for his or her consideration. It may help eliminate those Alternatives which are not good candidates for implementation; however, it often does not consider every input to the decision process. It should be considered a tool for decision makers; it certainly does not replace the measured judgement of managers.

Originally the analysis was to compare all four Alternatives. However, since Alternative 4 differs in so many aspects, it was decided to compare the first three Alternatives against each other, then compare the resulting preferred Alternative with Alternative 4. Some of the aspects of Alternative 4 that made it unsuitable for inclusion into the multi-attribute process were:

1. Alternative 4 costs are dependent upon potential modifications to the foreign processor fuel shearing capability, and varied from $1,000M to $2,500M. Note that Alternative 4 still requires considerable investment at Hanford to process sludge, remove and treat debris and water, and for D&D the K Basins.

2. Since fuel could be stored by the foreign processor after stabilization, an interim, 40-year storage facility in the U.S. may not be needed. Costs for storage by the foreign processor are unknown.

3. Alternative 4 returns plutonium, uranium, and glass logs of waste to the U.S. The waste could be shipped directly to the national repository, if the final disposal form is suitable for such storage.

4. U.S. policies on shipping SNF overseas and nonproliferation of plutonium and contractual uncertainties mean the schedule estimates had a large variance.

5. Risks for Alternative 4 were not comparable to the other Alternatives, because the work would be done by a foreign entity. From the U.S. perspective, the foreign processor has agreed to assume those risks, and comparing their worker risks to those at the Hanford Site was not appropriate. There were similar considerations for environmental and public health risks.

6. Two stakeholder values impact Alternative 4: shipment of fuel off-site and impact on the economy.

E.2.0 OBJECTIVES AND CRITERIA

This study identified six overall objectives for the recommended path forward decision:

- Minimize life-cycle costs
- Minimize environmental, worker safety, and public health risks
- Minimize schedule
- Maximize stakeholder confidence
- Maximize technical performance
- Maximize the likelihood of success (i.e., minimize programmatic risk).

These objectives were arranged hierarchically starting with the overall goal of facilitating the pre-interim storage of SNF and sludge by at least 2002 and facilitating an interim 40-year storage of the SNF. These objectives are shown in Figure E-1.

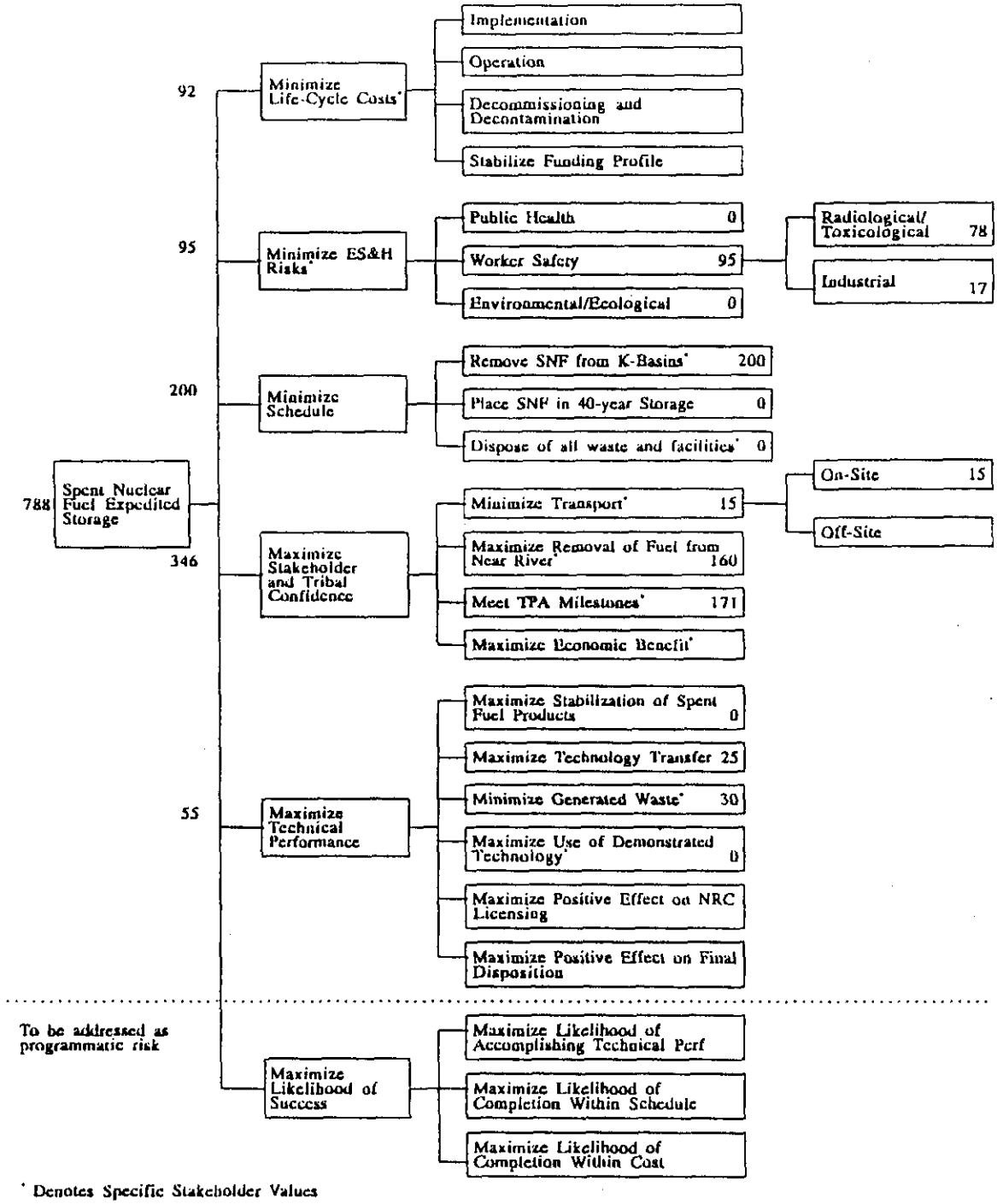
Criteria (also called attributes) were established for each objective to measure the degree to which objectives are achieved. Fundamental objectives were broken down until a specific criterion could be identified against which data could be collected and utility curves could be developed. For example, the objective of minimizing schedule was broken down to the times to remove SNF from the basins, place the SNF in 40-year interim storage, and dispose of all waste and facilities (including K Basins). In some cases, worker safety, for example, third level criteria were developed. The criteria are shown on Figure E-1. A complete description of all criteria is contained in Attachment E-1 to this Appendix.

Stakeholder and tribal values, as expressed by such forums as the Future Site Uses Working Group and the Tank Waste Task Force, appear in several places. The objective of maximizing stakeholder confidence captures several of these values. For example, protecting the Columbia by getting the SNF away from the river is a frequently expressed value. However, many of the objectives reflect stakeholder and tribal values to some extent. For this reason, we have indicated with an asterisk those criteria which specifically can be related to stated values. These include costs, risks, etc.

Not all criteria in Figure E-1 proved to be discriminators. The ones that were eliminated, either because they mostly impacted Alternative 4, as discussed above, or because they were not helpful in choosing among Hanford Alternatives 1, 2 and 3 were:

1) <u>Stabilize Funding Profile</u>. Funding profile was originally included, but later deleted when it was considered that meeting a feasible funding profile was a requirement if any Alternative were to be considered viable. The funding profiles were examined later and found within reasonable fiscal constraints.

Figure E-1. SNF Objectives and Criteria.



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2) Minimize Off-Site Transport. This stakeholder value only impacted Alternative 4 and was not used for evaluating Alternatives 1, 2 and 3.

3) Maximize Economic Benefit. The Alternatives 1, 2 and 3 had similar impact on the local economy, including the 40-year interim storage. The foreign processing Alternative has a potential detrimental impact on local workers. We did not consider economic benefit in comparing Alternatives 1, 2 and 3.

4) Maximize Positive Effect on NRC Licensing and Final Disposition. Analyses of the first three Alternatives indicate no significant different effects among them. Obviously, Alternative 4 could have a major impact on final disposition, if waste is returned to the U.S. in a form suitable for ultimate storage.

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E.3.0 SCALES AND UTILITY CURVES

The scales for the criteria were developed from the data collected from the advocate of Alternative 1, 2 and 3. The range of data for any given criterion established the horizontal axis for the utility curves. For example, consider the utility curve reflecting the stakeholder desire to move the fuel away from the Columbia River illustrated in page 2 of Attachment E-2. Alternative 1 kept the fuel in the K Basins 1/4 of a mile from the river, while Alternative 3 moved the SNF to the 200 area, about 10 miles from the river. In this example, the curve approximates $y = a + b\ Ln(x)$, where x is the distance from the river in miles. The curve represents the public's attitude about the river and indicates a decreasing marginal value of each additional mile.

A linear utility curve is illustrated in page 1 Attachment E-2 for life cycle costs. One dollar was assumed just as valuable as another, thus the linear relationship. Attachment E-2 contains the utility curves for all criteria.

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E.4.0 WEIGHTS

Whereas the utility curves represent the value of an individual criterion or attribute, weights reflect the tradeoffs among criteria. It is important that the decision maker decide what criteria are most and least important, before evaluating any Alternative against those criteria.

Weights were determined through a standard process called swing weighing. First, all criteria were ranked, 1 to n. Then, the ratios of relative importance were identified. To obtain the swing ranks, the decision maker and study team members were asked to consider a situation in which an Alternative hypothetically had the worst outcome for every attribute. Then, they were asked to imagine that if the Alternative could be improved to the best level on one of the criteria, which criterion would they choose. This reflects their opinion as to the most important criterion for this decision. The process was repeated n-1 times, asking each time for the evaluators to indicate which of the remaining criteria they would choose. Attachment E-3 contains the swing weighing forms and the scoring forms.

After ranks were assigned and agreed upon, weights were determined by assigning a value of 10 to the lowest criterion and asking how the next-to-lowest criterion compared. It was then given a score of 10 or more (10 representing equal rank; 20 representing twice as important), reflecting the difference between the two criteria. This process was repeated, checked for consistency, and examined by the group. A consensus was reached and the decision maker ultimately assigned the weights. Table E-1 shows the weights assigned for each of the criteria; they were normalized to add to 1,000.

Analysis of the weights indicates that five of the attributes constitute about three-fourths of the total weight: time for removal of the SNF from the basins (200), probability of meeting the Tri-Party Agreement 2002 milestone (180), moving the SNF away from the river (160), worker radiological risk (120) and life-cycle costs (100). This says that the most important factors in the decision involve actually removing the fuel from the basins as quickly as possible, meeting the milestone, and getting the fuel away from the river. Worker risk and costs are also important, but less so than these other criteria. Obviously, using these criteria, any Alternative which takes longer to remove the fuel, fails to meet the 2002 milestone, or leaves the fuel near the river will not compare favorably to ones which get the fuel away from the river soon enough to meet the milestone.

It is apparent that these criteria are not independent. In fact, almost all of the attributes relate to the others in some fashion. Schedule and costs are related, risks and costs are related, time to remove the fuel is related to the time it takes to get it into interim storage, etc. This relationship among criteria is common in decisions of this sort, and it is not surprising that the three top attributes have something in common - getting the fuel out of the basins as soon as possible. Double counting is not occurring, however, since these are three separate attributes reflecting three values.

Table E-1. SNF Criteria and Weights.

Criteria	Weight
Life-Cycle Costs	100
Public Health Risks	30
Worker Radiation Risks	120
Environmental Risks	30
Time for Removal of Spent Nuclear Fuel from Basins	200
Time for Placement in Interim Storage	40
Time for Disposal of all Waste, D&D Completion	10
Transport of Spent Nuclear Fuels On-Site	15
Spent Nuclear Fuels removed from near River	160
Probability of Meeting 2002 Tri-Party Agreement Milestone	180
Stabilizes Condition of Spend Nuclear Fuels Products	20
Provides for Technology Transfer	25
Demonstrated Technology	20
Generated Waste	30
Total	1000

In the first criteria, the time to get the fuel out of the basins, the high weight attests to the importance of time. On the other hand, meeting the 2002 milestone is important for a different reason. DOE has committed itself to meeting this milestone, and stakeholders are very sensitive to the government fulfilling its obligations. Many stakeholders think the government looks for reasons to renegotiate the Tri-Party Agreement agreement and will use any excuse not to keep their part of the deal. So, meeting the 2002 date is important because it is important to the stakeholders - and it is not just a matter of schedule.

Similarly, removing the material from near the river is a stakeholder value, because they view protecting the Columbia as just about the most important thing we do. Any proposal to leave the fuel in the basins, no matter how well protected, will not be viewed favorably by the stakeholders. They want the fuel moved!

The concept of independence in decision analysis does not require that every attribute be independent of every other (which is usually impossible), but rather that the attributes are measuring different things, especially in so far as judgements about them are concerned.

The other remaining criteria for Alternatives 1, 2 and 3 have considerably less weight. For the most part, any of these other criteria is unlikely to play much of a role in the decision. Nevertheless, they are all evaluated for completeness.

Weights for criteria can be summed to determine the overall weights assigned to the five fundamental objectives. The results are as follows:

Life-cycle costs	100
Environmental, safety, and health risks	200
Schedule	250
Stakeholder and tribal confidence	355
Technical performance	95
Total	1000

These figures imply that costs and technical performance are about equally important; risks are twice as important as costs; and schedule is more important than either. Also, maximizing stakeholder and tribal confidence by getting the fuel away from the river and meeting the Tri-Party Agreement milestone is the most important objective of all. Perhaps two or three years ago, the significance placed on stakeholder input would have been less. This implies that the team took very seriously the values and concerns expressed by stakeholders in various forums of recent years.

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E.5.0 COMPARISON OF PATH FORWARD ALTERNATIVES

The Alternatives were compared by obtaining a score from the utility curve associated with each attribute. The utility curve for the criterion for distance removed from the river (see page 2, Attachment E-2), illustrates the process. It shows the score obtained from the curve for each of the first three Alternatives. In this case, Alternative 1 received zero points for leaving the fuel near the river; Alternative 2 received 80% of the weight for moving the fuel to the FMEF; Alternative 3 received an even higher score because the SNF is moved to the 200 area. These scores were multiplied by the weight for this criteria, 160, to obtain a score.

Attachment E-4 contains the score associated with each Alternative for all criteria.

Information on costs and schedule are contained in Appendix D. Information on risks is contained in Appendix F. Other objectives are discussed below.

a. Transport of SNF on-Site. Alternatives 1 and 2 assume the same amount of transport to the FMEF in the 400 area, a distance of about 25 miles from K Basins and crossing public highways. These two Alternatives assume about 910 railcars of SNF material. Alternative 3 requires less transport (about 870 railcars) to a new facility in the 200 area. Alternative 4 assumes the SNF will be loaded on barges at the Port of Benton. Only 210 railcars are required.

b. Transport of SNF Off-Site. Obviously only Alternative 4 ships any SNF off-Site. That shipment would be by barge at Richland down the Columbia to a port of embarkation (probably Vancouver, WA, or Astoria, OR). Seventeen ship loads would be transported to Great Britain. This attribute was not considered when comparing the other three Alternatives.

c. Removal of SNF from the River. A key objective of the SNF program is the removal of the SNF from near the Columbia River. Alternative 1 retains the SNF in the K Basins until November 2003, after which it is transported to the FMEF for stabilization processing. Conversely, Alternative 2 gets the fuel out of the basins earliest (November 2000) and moves it to the FMEF, about 4.5 miles from the river. Alternative 3 moves fuel about 10 miles from the river in the 200 area, and obviously Alternative 4 removes it from the Site altogether. It is realized, of course, that all Alternatives leave the fuel in the basins for the immediate future.

d. Probability of Meeting the 2002 Tri-Party Agreement Milestone. All Alternatives have some likelihood of meeting this milestone; however, the probability is only 0.2 for Alternative 3 and 0.3 for Alternative 1. Alternative 2, on the other hand, has a 97% chance of making the Tri-Party Agreement milestone. Alternative 4 is least likely, 15%.

e. Economic Benefit to the Region. The first three Alternatives are common in that they continue employment for the pre-interim removal, treatment, and storage of the SNF. This includes construction in Alternatives 2 and 3 and upgrade of the basins in Alternative 1. All assume interim storage in the 200 area for 40 years. Alternative 4, on the other hand, pays the foreign processor to treat and store the fuel, which would have a detrimental effect on employment here.

Alternative 2 could have some benefit from the pool constructed near the FMEF for wet storage, although it is unlikely that fuel stored in such a manner will be brought to Hanford. Alternatives 2 and 3 could have some long-term benefit because of the dry storage stabilization facilities, which could be used for other SNF. Alternative 4 would require an upgrade to the Port of Benton, which would be a residual benefit.

For purposes of comparison, Alternatives 1, 2 and 3 were considered comparable in terms of economic benefit, with Alternative 4 having less favorable impact. For that reason, economic benefit was not considered when comparing the first three Alternatives.

f. Stabilization of SNF. Alternatives 1 and 2 allow the fuel to continue to degrade while stored in water, although the degree of degradation is not fully known. Alternatives 3 and 4 will arrest degradation and lead to early stabilization. Note that all Alternatives stabilize the fuel at some point through the stabilization process; this attribute reflects the importance of arresting the further degradation of the fuel as soon as possible.

g. Technology Transfer and Demonstrated Technology. These attributes are, in a sense, complementary, because they address similar characteristics. The potential for technology transfer is similar across the first three Alternatives, if the stabilization process is considered, since all Alternatives develop new processes for stabilization. Alternatives 1 and 2 use known technology for the pre-interim storage phase, while Alternative 3 requires the development of new technology to get the SNF into a dry storage state. Alternative 4 uses existing, proven technology with minimal potential for technology transfer.

h. Generated Waste. The Alternatives differ considerably in type and degree of waste they generate. Alternative 1 calculated the waste generated during the pre-Interim storage and the stabilization process. It would require treatment, storage, and disposal of the 3,800 canisters from K-East, the shipping casks and liners, the water used for stabilization, and estimated amounts of TRU, mixed, and low-level waste.

Alternative 2 adds 2.5M gallons of water in the new cooling pool at FMEF, shipping casks, 2,800 overpacks, and all waste associated with the Independent Technical Assessment stabilization process, which would include some TRU and low-level waste.

Alternative 3 has waste associated with drilling holes in the canisters and the Independent Technical Assessment waste. Overall, it has the least amount of generated waste of the first three Alternatives.

Alternative 4 has two major considerations in so far as generated waste at the Hanford Site is concerned: the contamination of the K-West Basin and the requirement to deal with all canisters, since they are left in the basins. Generated waste in Britain is not considered in this evaluation.

i. Effect on NRC Licensing. It is not clear how the Alternatives will affect NRC licensing or facilitate interim or final disposition. Alternative 1 will not require NRC licensing of the basins or the FMEF, since it modifies existing facilities. However, the Alternative does permit parallel development of the interim dry-storage facility, thus allowing time for NRC review and approval. Similarly, Alternative 2 probably would not require licensing of the new storage pond at FMEF. Alternative 3 would require licensing of the new stabilization facility in the 200 Area. It also has that form of storage most compatible with the form to be used in the interim period. If the fuel were examined and approved by the NRC during the pre-interim phase, it could lead to easier licensing during interim storage. In the final analysis, the effect on NRC licensing not considered to be a discriminator among Alternatives 1, 2 and 3.

The largest potential impact by far, however, is the final form of the SNF products in Alternative 4. The foreign processor proposes to return waste in vitrified glass logs suitable for final disposition in a repository. This eliminates any NRC licensing requirements for pre-interim storage, and could eliminate interim storage itself.

E.5.1 RESULTS FOR PATH FORWARD ALTERNATIVES 1, 2 AND 3

The multi-attribute decision process was used to evaluate the first three Alternatives. Out of one thousand points possible, the results were:

Alternative 1:	Retain fuel in K Basins	253
Alternative 2:	Store fuel in wet storage in FMEF	609.5
Alternative 3:	Remove fuel and stabilize in dry storage	545.5

It is clear that Alternative 1 does not compare well with the other Alternatives. This is so mostly because it gets the fuel out later than the other Alternatives, keeps the fuel near the river, and has a low chance of meeting the 2002 milestone.

Alternatives 2 and 3 scored considerably better than Alternative 1. Alternative 2 does best on the schedule and Tri-Party Agreement milestone, and second best on the distance from the river and cost. On the other hand, Alternative 3 is best on cost and distance from the river, but it loses many points because of delay in getting the fuel out of the basins.

Again, it is clear that the main drivers for the decision involve the important objectives of getting the fuel out of the basin and moving it away from the river as quickly as possible.

E.5.2 COMPARISON OF PATH FORWARD ALTERNATIVES 1, 2 AND 3 WITH ALTERNATIVE 4, FOREIGN PROCESSING

As mentioned above, the Alternative 4 is so different from the others that a meaningful comparison is difficult. If the same criteria and weights are applied to comparing Alternatives 2 to Alternative 4 (assuming the data are equally accurate), the results are as follows:

1. Costs: Alternative 2 costs are about two-thirds of Alternative 4

2. Risks: risks are comparable

3. Alternative 4 does not meet the Tri-Party Agreement milestone, and takes about 3.5 years longer to get the fuel out of the basin.

4. Alternative 4 gets the fuel farther from the river (overseas) than does Alternative 2; however, that advantage is balanced by the need to ship the fuel overseas, which stakeholders will object to.

5. Alternative 4 will have a detrimental effect on the local economy, especially if no interim storage facility is built at the Hanford Site. This impact may be mitigated somewhat because sludge (which could require an interim storage facility), water, debris, and K Basin facilities would have to be treated and disposed of.

6. Alternative 4 does better on demonstrating technology, but worse on potential for technology transfer.

7. Alternative 4 would have considerable benefit in the long-run if the disposal form is suitable for the national repository. If it is not, the positive impact on licensing, etc. is unknown.

8. Neither Alternative has an obvious advantage over the other for the minor criteria.

9. There is considerable programmatic risk and uncertainty in the estimates for schedule, contracting, U.S. policy for overseas shipment, non-proliferation, etc. associated with the Foreign Processing option. Alternative 2's primary programmatic risk is in getting the fuel out of the basins as early as 2000.

Overall, Alternative 2 is better than Alternative 4 by almost all measures, unless major assumptions are made about the final disposition of the fuel.

Alternative 3 was also compared to Alternative 4. In general, Alternative 3 is better than 4 for costs and does not require shipments down the Columbia. It also has less programmatic risk. However, the biggest discriminator between Alternatives 3 and 4 is the final form of the SNF once

it is returned from Britain. If the waste is suitable for the repository (a big unknown) and the contractual/policy challenges can be addressed, it may very well be worth the extra cost to pay the British to process the fuel, especially if the schedule can be slipped.

See Attachment E-5 to this appendix for a table summarizing the comparison of Alternatives 2, 3 and 4.

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E.6.0 EVALUATION OF THE RECOMMENDED PATH FORWARD

After comparing the original four alternatives, the Path Forward Team recommended a combination of many of the best attributes of Alternatives 2 and 3. This combination became the Recommended Path Forward and was compared against the original criteria used to evaluate the Hanford alternatives. In so doing, the decision maker could see how the Recommended Path Forward recommendation compared with the original study alternatives in terms of their achievement of program objectives. Attachment E-6 contains the resulting scores.

Total multi-attribute utility analysis score for the Recommended Path Forward is 788, almost 30% better than alternative II, which was second best. The Path Forward scored well on costs (92), worker radiological risk (78), time to get the fuel out of the basins (200), distance removed from the river (160), and probability of meeting the Tri-Party Agreement 2002 milestones.

Several assumptions were made about the Recommended Path Forward, as follows:

- On-site transport was comparable to Alternative 3
- Probability of meeting the Tri-Party Agreement milestone was 0.95, just slightly less than that of Alternative 2 (at 0.98)
- Time to complete D&D was similar to Alternative 1 (due to longer time to get fuel into interim storage)
- Fuel degradation would continue similar to Alternatives 1 and 2
- Potential for technology transfer, degree of demonstrated technology, and amount of generated waste were similar to Alternative 3.

As compared to the BNFL alternative, the Recommended Path Forward is preferable in terms of cost and schedule, shipment off-site, economic impact on the region, and programmatic risk. BNFLs main advantages continue to be use of known technology and the final form of the fuel and waste; however, these advantages are unlikely to compensate adequately for the uncertainty of execution and schedule shortfalls.

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ATTACHMENT E-1

SPENT NUCLEAR FUEL STORAGE OBJECTIVES AND CRITERIA

Introduction. Described below are the fundamental objectives of the Spent Nuclear Fuel Program decision process. Associated with each fundamental objective are criteria (or attributes) which, if satisfied, will lead to accomplishment of the fundamental objectives. One stated objective is to Maximize Stakeholder and Tribal Confidence, and four criteria are used directly to evaluate performance against that objective. There are many other criteria however, which contribute to Stakeholder Confidence (e.g., Minimize Environmental, Safety, and Health Risks); these are indicated by an "*". Note the Department of Energy is a stakeholder, as well.

1. **Minimize Total Life-Cycle Costs.** The SNF program desires to minimize total life-cycle costs during the period of pre-Interim storage. These objectives include:

   a. Minimize Implementation Costs. These costs include design and construction costs. These costs do not include costs associated with operations, preparation of fuel, etc. Costs are in FY95 dollars.

   b. Minimize Operation Costs. These costs include, removal of debris, removal of water, transport, operation of K Basins and any other storage and process facilities, preparation of fuel, and safeguards and security. Costs are in FY95 dollars.

   c. Minimize Decommissioning and Decontamination Costs. These costs are associated with the final disposition of K Basins and any facilities specifically constructed or utilized for the pre-interim storage of SNF. Costs are in FY95 dollars.

   d. Stabilize Funding Profile. It is desired, for budgetary planning purposes, that funding be stable over the pre-Interim period. This attribute will be addressed subjectively by the decision maker as to the feasibility of the funding profile required for each Alternative.

2. **Minimize Health, Safety, and Environmental Risks.** The SNF program must minimize risks to the public, workers, and the environment, including the ecological system.

   a. Minimize Public Health Risks. Public health risks include those risks to the offsite public from accidental release of radiological and toxicological materials by water and air pathways. The measure of public health risks will be obtained from subjective judgements by experts from the modified Priority Planning Grid (PPG) over a common period. The measure is the estimated annual public deaths.

b. Minimize Worker Risks. Worker risks include risks from radiological and toxicological exposure to the workers during all phases of the pre-interim storage period, including D&D. Radiological risks will be in Rem per worker per year for a common period.

Worker risks also include industrial accidents from construction and operation activities, including transport. Worker risks will be estimated by experts for each function in the pre-interim storage process and will be stated as estimated annual worker deaths.

c. Minimize Environmental Impact. Environmental risks include contamination or destruction of the environment or ecological system. Environmental impact will be estimated by the costs of restoring any contaminated area. Costs are annual estimates for a common period.

3. **Minimize Schedule.** The SNF program must reduce health and safety risks and to prepare fuels for interim storage as soon as possible. Three aspects of the schedule will be considered as described below. In all cases, schedule estimates will be obtained for each Alternative using expert judgement for each function in the pre-interim storage process. Schedules will be aggregated to determine the below times.

a. Minimize Time For Removal of SNF from K Basins. The time to get the spent fuel and associated materials (fuel, sludge, debris, and water, as appropriate) out of the K basins.

b. Minimize Time For Placement in Interim Storage. The time until placement of all spent nuclear fuel into the 40-year interim dry storage.

c. Minimize Time For Disposal of Waste. The time until all waste, including generated waste, is disposed. The waste includes debris, sludge, and water from K basins and other storage facilities, as well as the facilities, themselves.

4. **Maximize Stakeholder Confidence.** The SNF program must maximize stakeholder confidence in the safe disposition of spent nuclear fuels and associated waste. Confidence is increased by the inclusion of stakeholder values, as determined from such efforts as the Future Site Uses Working Group and the Tank Waste Task Force. In addition to criteria which reflect the contribution of stakeholder values to the accomplishment of Program objectives, additional values are specifically addressed as follows.

a. Minimize Transport of SNF and Associated Waste. The public desires that transport of fuel and waste be minimized, especially off-site. For Alternatives 1-3, on-site transport will be measured by the number of railcars and the distance

traveled. Travel outside the barricade is considered undesirable. Off-Site transport will be considered a separate attribute when comparing Alternative 4.

b. Maximize Removal of SNF and Waste from near the River. The public desires that the River and groundwater not be contaminated, and that fuel and waste not be stored near the River. This value will be measured by the distance to the river from the pre-Interim storage site. All Alternatives leave the fuel in the basins for some period; however, some move the fuel to a safer storage location. That distance will be used in this criterion.

c. Meet Tri-Party Agreement Milestone. The public desires that the government comply with the Tri-Party Agreement and meet the 2002 milestone for removal of SNF from the K Basins described in that Agreement. This criterion is evaluated by comparing the probability of a given Alternative meeting the milestone.

d. Maximize Economic Benefit. The public desires that Hanford decisions consider the long-term economic impact on the region. Also, one mission of the Site is to partner in the economic transition of the region. This criterion will be measured by the estimated impact on the local economy during the period of the pre-interim storage. Such impact will consider the potential for establishing new companies and for leveraged outsourcing of Hanford work.

5. **Maximize Technical Performance.** The SNF program must maximize the technical performance of the pre-Interim storage process. Technical performance also considers the potential impact on the 40-year interim storage. The criteria below define technical performance.

a. Maximize Stabilization of Stored Products. This criterion deals with preventing the further deterioration of fuel elements and stabilizing its present condition. Stabilization is measured by the estimate of continued degradation of stored products. This estimate will be qualitative, ranging from none to considerable.

b. Maximize Technology Transfer. A Site mission is the development of science and technology for national purposes. This criterion measures an Alternative's contribution to technology which may be used elsewhere for similar or related problems. The criterion will be measured by the estimate of the likelihood that technology developed for an Alternative will be used elsewhere. The qualitative estimate will range from none to considerable.

c. Minimize Generated Waste. A stakeholder value and a measure of technical performance is the amount of waste generated by a given Alternative. Waste, in this sense, includes the amount and toxicity of liquid effluents and solid waste. The measure

is description of the waste (e.g., number of canisters, overpacks, etc.). Waste will be scored relatively according to the cost of dealing with the waste.

d. Maximize Use of Demonstrated Technology. A stakeholder value and a measure of technical performance is the degree to which an Alternative demonstrates that its technology is proven. This is a subjective measure, ranging from mostly proven technology to significant technology development required.

6. **Maximize Likelihood of Programmatic Success.** The program must maximize the likelihood that the mission will be accomplished and the technical requirements will be met within budget and schedule estimates.

a. Maximize Likelihood of Accomplishing Technical Performance. This criterion measures the uncertainty associated with an Alternative's ability to accomplish the functions described in the process flow diagram. Data on technical performance will be obtained for each function, and estimates will be obtained from technical experts on the likelihood of a given Alternative to accomplish the technical performance required to accomplish the function successfully.

b. Maximize Likelihood of Performing the Required Work Within the Schedule. This criterion measures the uncertainty associated with the ability to do the work within schedule constraints. Like Technical Performance, each Alternative will provide estimates of its ability to meet schedules associated with each function in the process flow diagrams. An overall estimate of schedule success will be calculated.

c. Maximize Likelihood of Performing the Required Work Within Budget. This criterion measures the uncertainty associated with the ability to do the work within budget. Each Alternative will provide cost estimates associated with each function in the process flow diagrams, and an overall estimate of the ability of an Alternative to meet budget constraints will be calculated.

e. Maximize Positive Effect on NRC Licensing. This criterion considers the degree to which an Alternative leads to eventual NRC licensing of the interim storage. This is a qualitative estimate, ranging from no facilitation to considerable.

f. Maximize Positive Effect on Final Disposition. This criterion considers the degree to which an Alternative positively impacts the eventual disposition of spent fuel following the 40-year dry storage. This is a qualitative estimate, ranging from no facilitation to considerable.

ATTACHMENT E-2

SPENT NUCLEAR FUEL UTILITY CURVES (ALTERNATIVES 1, 2 AND 3)

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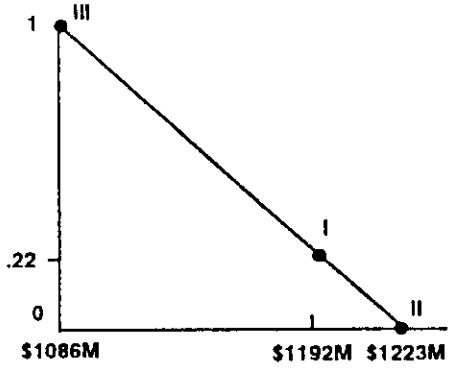
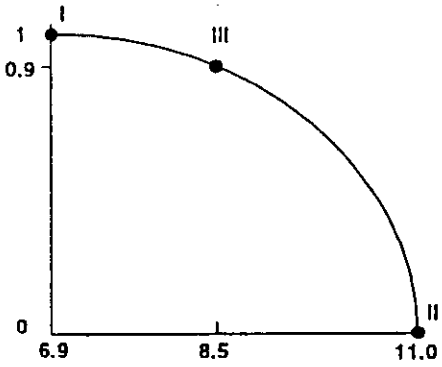
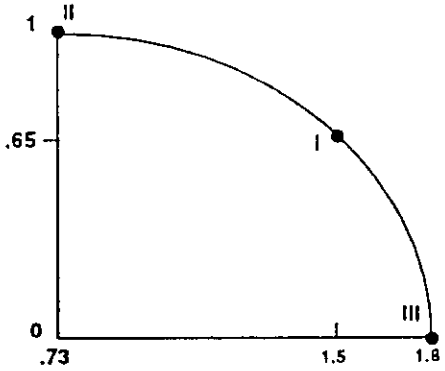


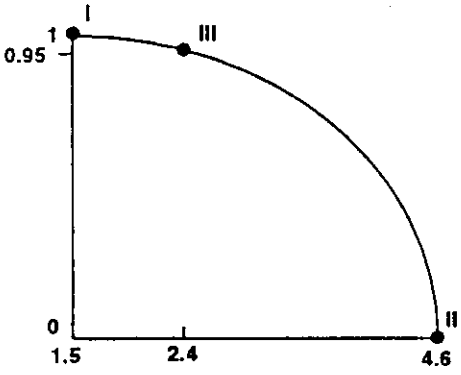
Life-Cycle Costs



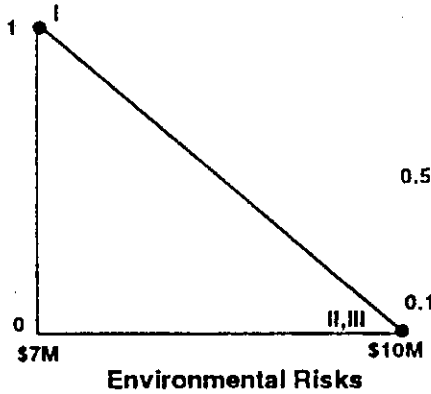
Worker Rad Risks
(fatalities/yr*E-04)



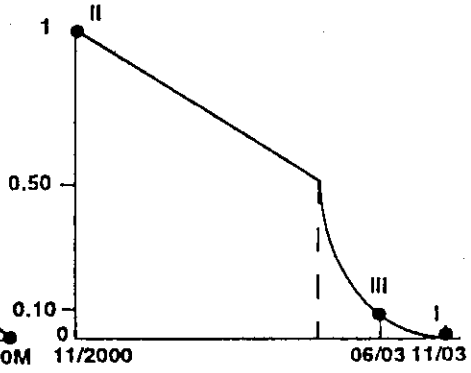
Worker Industrial Risks
(Fatalities/yr *E-03)



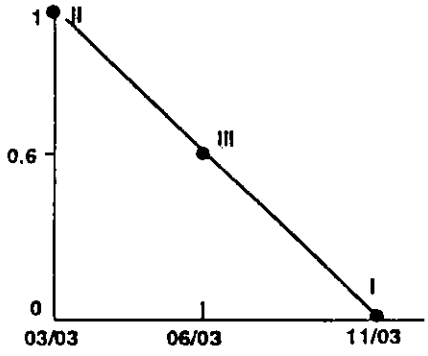
Public Health Risks
(fatalities/yr*E-06)



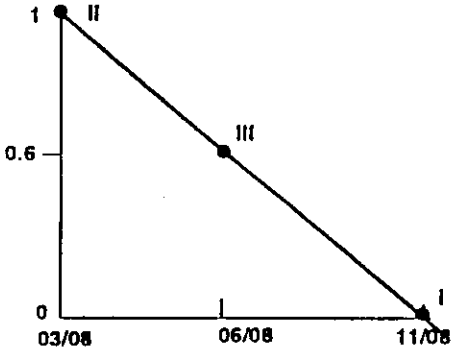
Environmental Risks
(Annual Costs)



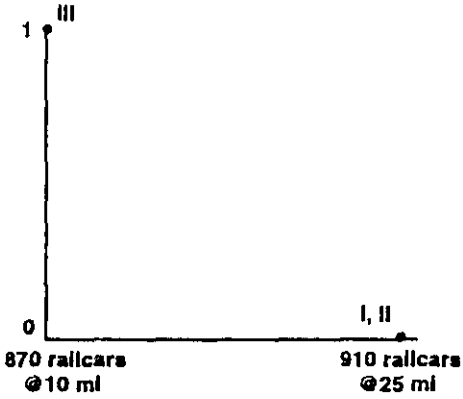
Removal from K-Basins



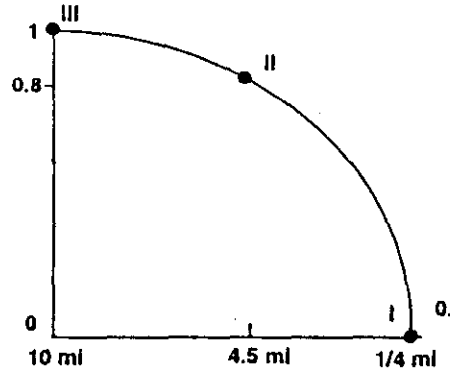
SNF in Interim Storage



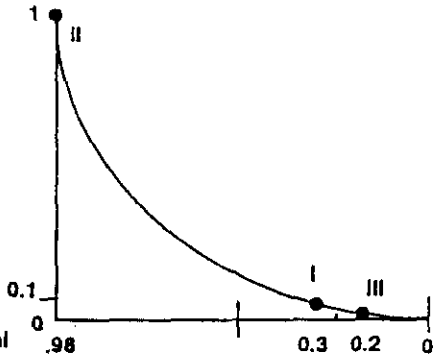
Waste Disposed, D&D Complete



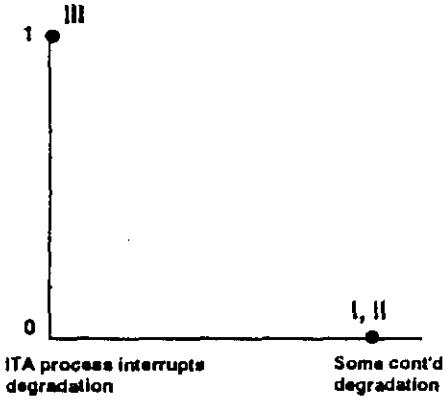
On-Site Transport



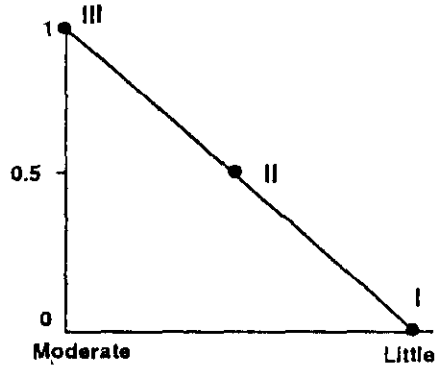
Distance Removed From River



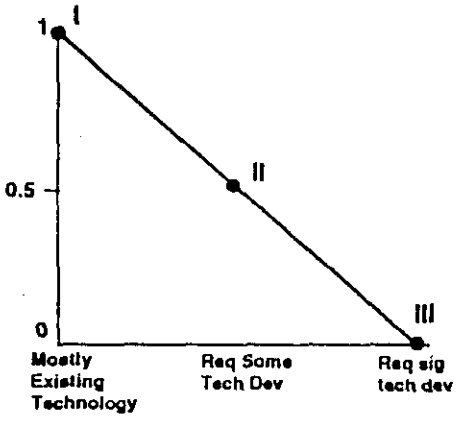
Probability of Meeting 2002 TPA Milestone



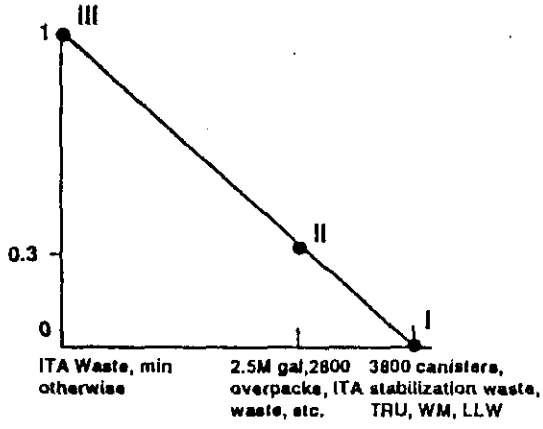
Stabilization of SNF Stored Products



Potential for Technology Transfer



Degree of Demonstrated Technology



Amount of Generated Waste

ATTACHMENT E-3

SPENT NUCLEAR FUEL SWING WEIGHING AND SCORING FORMS

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Spent Nuclear Fuels Weighting Forms

Criterion	Worst Condition	Best Condition	Swing Rank	Swing Ratio
Life-Cycle Costs	$1223M	$1086M	5	100
Public Health Risks	4.7 E-06 fatalities/year	1.5 E-06 fatalities/year	8	30
Worker RAD Risks	11.0 E-04 fatalities/year	6.9 E-04 fatalities/year	4	120
Worker Industrial Risks	1.8 E-03fatalities/Year	0.73 E-03 Fatalities/Year	11	20
Environmental Risks	$10M/Year	$7M/Year	7	30
Time for Removal of SNF from Basins	Removal of SNF from Basins by Nov 2003	Removal of SNF from Basins by Nov 2000	1	200
Time for Placement in Interim Storage	Interim Storage placement by Nov 2003	Interim Storage placement by Mar 2003	6	40
Time for Disposal of all Waste	All waste disposed of by Nov 2008	All waste disposed of by Mar 2008	15	10

Criterion	Worst Condition	Best Condition	Swing Rank	Swing Ratio
Transport of SNF On-Site	910 railcars transported on-site @25 mi	870 railcars transported on-site 10 mi to 200 area	14	15
SNF removed from near River	SNF remains in Basins during pre-interim; FMEF during Stabilization (1/4 Mi)	SNF removed to 200 area (10 Mi)	3	160
Probability of Meeting 2002 TPA Milestone	Probability of .2	Probability of .98	2	180
Stabilizes Condition of SNF Products	Some degradation continues during water storage pending stabilization	Degradation halted early by removal from water and stabilization through ITA process	13	20
Provides for Technology Transfer	Little potential for technology transfer	Moderate potential for technology transfer	10	25
Demonstrated Technology	Significant technology development required	Mostly demonstrated technology used	12	20
Generated Waste	Stabilization waste, plus 3800 canisters, casks,liners, water for stab, TRU, MW, LLW	ITA waste, drill waste, minimum otherwise	9	30

ATTACHMENT E-4

SPENT NUCLEAR FUEL SCORE SHEET

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		Alternative 1			Alternative 2		
Criteria	Weight	Data	Value	Score	Data	Value	Score
Life-Cycle Costs	100	$1192M	0.22	22	$1223M	0	0
Public Health Risks	30	1.5 E-06 fatalities/year	1	30	4.7 E-06 fatalities/year	0	0
Worker RAD Risks	120	6.9 E-04 fatalities/year	1	120	11 E-04 fatalities/year	0	0
Worker Industrial Risks	20	1.5 E-03 fatalities/year	0.65	13	.73 E-03 fatalities/year	1	20
Environmental Risks	30	$7M/year	1	30	$10M/year	0	0
Time for Removal of SNF from Basins	200	Nov 2003	0	0	Nov 2000	1	200
Time for Placement in Interim Storage	40	Nov 2003	0	0	Mar 2003	1	40
Time for Disposal of all Waste, D&D Compl.	10	Nov 2008	0	0	Mar 2008	1	10
Transport of SNF On-Site	15	910 railcars to FMEF	0	0	910 railcars to FMEF	0	0
SNF removed from near River	160	1/4 mi pre-interim	0	0	4.5 mi (FMEM)	0.8	128
Probability of Meeting 2002 TPA Milestone	180	0.3	0.1	18	0.98	1	180
Stabilizes Condition of SNF Products	20	degradation in water	0	0	degradation in water	0	0
Provides for Technology Transfer	25	minimal technology transfer	0	0	New stabilization process	0.5	12.5
Demonstrated Technology	20	Known pre-interim; new	1	20	Known tech for pre-interim	0.5	10
Generated Waste	30	3800 canisters, casks, liners	0	0	2.5M gal water in new pool,	0.3	9
		water for stab, TRU,MW,LLW			casks, 2800 overpacks,		
					ITA waste		
Total	1000		Total	253		Total	609.5
		Alternative 3			Alternative 4		
Criteria	Weight	Data	Value	Score	Data	Value	Score
Life-Cycle Costs	100	$1086M	1	100	$1895M	N/A	
Public Health Risks	30	2.4 E-06 fatalities/year	0.95	28.5	1.6 E-06 fatalities/year	N/A	
Worker RAD Risks	120	8.5 E-04 fatalities/year	0.9	108	10 E-04 fatalities/year	N/A	
Worker Industrial Risks	20	1.8 E-03 fatalities/year	0	0	0.96 E-03 fatalities/year	N/A	
Environmental Risks	30	$10M/year	0	0	$10M/year	N/A	
Time for Removal of SNF from Basins	200	Jun 2003	0.1	20	Apr 2004	N/A	
Time for Placement in Interim Storage	40	Jun 2003	0.6	24	Mar 2012 (return US)	N/A	
Time for Disposal of all Waste	10	Jun 2008	0.6	6	Apr 2009	N/A	
Transport of SNF On-Site	15	870 railcars to 200 area	1	15	210 railcars to Port of Benton	N/A	
SNF removed from near River	160	10 miles to 200 area	1	160	Shipped overseas	N/A	
Probability of Meeting 2002 TPA Milestone	180	0.2	0.05	9	0.15	N/A	
Stabilizes Condition of SNF Products	20	ITA process stabilizes fuel	1	20	SNF stabilized	N/A	
Provides for Technology Transfer	25	Pilot process for dry storage;	1	25	Little technology transfer	N/A	
Demonstrated Technology	20	New technology required	0	0	Technology demonstrated	N/A	
Generated Waste	30	Drill waste from canisters;	1	30	K-West water contaminated	N/A	
		ITA waste; minimal otherwise			All canisters become waste	N/A	
Total	1000		Total	545.5		Total	N/A

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ATTACHMENT E-5

SUMMARY COMPARISON OF ALTERNATIVES 1, 2, 3, AND 4

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SUMMARY COMPARISON OF ALTERNATIVES II, III, AND IV

Criteria	Wet	Dry	BNFL
Life-Cycle Costs	$1223M	$1086M	$1895M
Risks	Acceptable	Acceptable	Acceptable
Time to remove fuel from basins	Nov 2000	Jun 2003	Apr 2004
Meets TPA milestone?	Almost certainly	Very Unlikely	Very Unlikely
Distance fuel is removed from river	4.5 MI to FMEF	10 MI to 200 area	Overseas
Fuel shipped off-Site?	No	No	Yes
Effect on local economy	Positive	Positive	Negative
Technology	Existing technology for removal; new technology for stabilization	New technology for removal andstabilization	Proven technology
Impact on NRC licensing or final disposition	Unknown	Unknown	Potential form for final disposition
Uncertainty of execution	Little	Some	Considerable
Other minor criteria	No big issues	No big issues	No big issues

Conclusions:
(1) Alternatives II and III are comparable for most criteria. The biggest discriminators are cost and schedule for removing the fuel and meeting the TPA milestone.

(2) Alternative II is better than alternative IV for almost all criteria. Biggest discriminators are costs, schedule to remove fuel from the basins and meeting TPA milestone, final form of SNF/waste, and uncertainty of execution.

(3) Alternative III is better than IV in cost and the requirement for overseas shipment; however, the potential for receiving waste from the UK in a form suitable for final disposition makes alternative IV attractive, if the uncertainties of program execution can be overcome.

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ATTACHMENT E-6

SUMMARY COMPARISON OF ALTERNATIVES 1, 2, 3, AND 4 WITH THE RECOMMENDED PATH FORWARD

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		Alternative 1			Alternative 2		
Criteria	Weight	Criteria	Value	Score	Criteria	Value	Score
Life-Cycle Costs	100	$1192M	0.22	22	$1223M	0	0
Public Health Risks	30	1.5 E-06 fatalities/year	1	30	4.7 E-06 fatalities/year	0	0
Worker RAD Risks	120	6.9 E-04 fatalities/year	1	120	11 E-04 fatalities/year	0	0
Worker Industrial Risks	20	1.5 E-03 fatalities/year	0.65	13	.73 E-03 fatalities/year	1	20
Environmental Risks	30	$7M/year	1	30	$10M/year	0	0
Time for Removal of SNF from Basins	200	Nov 2003	0	0	Nov 2000	1	200
Time for Placement in Interim Storage	40	Nov 2003	0	0	Mar 2003	1	40
Time for Disposal of all Waste, D&D Compl.	10	Nov 2008	0	0	Mar 2008	1	10
Transport of SNF On-Site	15	910 railcars to FMEF	0	0	910 railcars to FMEF	0	0
SNF removed from near River	160	1/4 mi pre-interim	0	0	4.5 mi (FMEM)	0.8	128
Probability of Meeting 2002 TPA Milestone	180	0.3	0.1	18	0.98	1	180
Stabilizes Condition of SNF Products	20	degradation in water	0	0	degradation in water	0	0
Provides for Technology Transfer	25	minimal technology transfer	0	0	New stabilization process	0.5	12.5
Demonstrated Technology	20	Known pre-interim; new	1	20	Known tech for pre-interim	0.5	10
Generated Waste	30	3800 canisters, casks, liners	0	0	2.5M gal water in new pool,	0.3	9
		water for stab, TRU,MW,LLW			casks, 2800 overpacks,		
					ITA waste		
Total	1000		Total	253		Total	609.5
		Alternative 3			Recommended Path Forward		
Criteria	Weight	Criteria	Value	Score	Criteria	Value	Score
Life-Cycle Costs	100	$1086M	1	100	$1111M	0.92	92
Public Health Risks	30	2.4 E-06 fatalities/year	0.95	28.5	5.2 E-06 fatalities/year	0	0
Worker RAD Risks	120	8.5 E-04 fatalities/year	0.9	108	10 E-04 fatalities/year	0.65	78
Worker Industrial Risks	20	1.8 E-03 fatalities/year	0	0	1.2 E-03 fatalities/year	0.85	17
Environmental Risks	30	$10M/year	0	0	$11M/year	0	0
Time for Removal of SNF from Basins	200	Jun 2003	0.1	20	Nov 2000	1	200
Time for Placement in Interim Storage	40	Jun 2003	0.6	24	Apr 2004	0	0
Time for Disposal of all Waste	10	Jun 2008	0.6	6	Nov 2008	0	0
Transport of SNF On-Site	15	870 railcars to 200 area	1	15	870 railcars to 200 area	1	15
SNF removed from near River	160	10 miles to 200 area	1	160	10 miles	1	160
Probability of Meeting 2002 TPA Milestone	180	0.2	0.05	9	0.95	0.95	171
Stabilizes Condition of SNF Products	20	ITA process stabilizes fuel	1	20	SNF stabilized	0	0
Provides for Technology Transfer	25	Pilot process for dry storage;	1	25	Little technology transfer	1	25
Demonstrated Technology	20	New technology required	0	0	Technology demonstrated	0	0
Generated Waste	30	Drill waste from canisters	0	0	Drill waste from canisters;	1	30
					ITA waste; minimal otherwise		
Total	1000		Total	545.5		Total	788

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APPENDIX F

ASSESSMENT OF ENVIRONMENTAL, SAFETY, AND HEALTH RISKS

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F.1.0 SUMMARY

This appendix describes the process used to evaluate the health risk to the public, workers and environment for each of the Alternatives from the release of ionizing radiation and hazardous materials. Also considered were the health risk to workers from industrial activities involved in the processes. A preliminary hazards analysis process was used to identify potential accident conditions. A qualitative determination of the accident sequence consequence and frequency was completed to provide a relative risk index. The total relative risk index and the relative risk index as a function of time were evaluated for each Alternative. A comparison of the relative risk for each Alternative was completed. Conclusions relative to the public, worker, and environmental risk are provided.

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F.2.0 DEVELOPMENT OF THE PROCESS

The process followed the same line of evaluation that would be conducted in completing a safety analysis for a new project. However, because much of the information available for each Alternative is only in the pre-conceptual design phase, the analysis was qualitative in nature.

It should be emphasized that in proceeding to remove fuel and sludge from the K-Basins and processing them that the design and construction of facilities will include necessary protective barriers to ensure that the risk to the public, workers, and environment are acceptable. Therefore, the following analysis is based on an evaluation of potential accident events as they are imagined and not on actual events that may occur. It is the thought process of imagining conceivable accident sequences that leads to the identification of potential barriers that are provided to protect the public, workers and environment. In the concept of a risk analysis, all potential accident sequences are identified, those with relatively small consequence and those with relatively large consequence. The consequence and frequency of the accident sequences are quantified, multiplied together, and then summed over all potential accident sequences. The units of risk are consequence per year. Therefore, a normalization constant is included with the product of consequence times frequency in order that the individual accident sequence risks can be added together to form a total risk. One should remember that the total risk, in consequence per year, is not an exposure to a particular receptor (i.e., worker or public). Rather, total risk is a sum over all potential accident sequences of the accident consequence times the accident frequency.

F.2.1 PRELIMINARY HAZARDS ANALYSIS

A qualitative preliminary hazards analysis was completed for each function of the functional flow block diagram (see Figure 2, main text) for each Alternative. Information was obtained for the preliminary hazards analysis during the interview evaluation with the advocates of each Alternative. The first step was to identify the hazardous materials (hazardous materials at risk) used or available in the function. The types of materials considered were those that could release ionizing radiation such as the fission products in the fuel assemblies, sludge, and debris. Also, materials that could be the source of fixed radioactive contamination were identified. Hazardous and/or caustic materials that may be used in each function were also identified.

The following questions were used during the interview process to identify the hazardous materials at risk:

1. What are the materials used in each activity (e.g., fuel, sludge, debris, other hazardous or caustic materials)? [Identification of Hazardous Materials]

2. How much of these materials are available for each activity (number of fuel elements, amount of sludge, amount of hazardous materials, etc.)? [Hazardous Material Inventory]

The second step was to identify the potential events that could occur that might result in the release of ionizing radiation or hazardous materials and the potential consequences to the workers, public, and environment. Also, potential events were identified that could result in workers being contaminated or injured and the likely consequences. Preventative or mitigative features of the process design were also identified. The following questions were used in this part of the inquiry:

3. What types of upset conditions or events might occur in each activity (drop fuel, react chemicals, furnace run-away, etc.)? [Potential Upset Events]

4. How might radioactivity or hazardous materials be released during the activity (drop fuel, chemical reactions, etc.)? [Potential Upset Events]

5. What features of an activity would limit the extent or consequences of an upset condition (shielded cask or container, cask or container designed to be dropped or struck, confinement buildings)? [Identify Preventative or Mitigative Design Features]

6. What would be the extent of the results if radioactivity or hazardous materials were released (only effect those workers immediately working in the area, might effect workers in the building, might effect others in near-by facilities, might effect the off-site public)? [Identify Extent of Consequences]

The third step was to solicit information from the Alternative advocate or from K-Basin operations personnel that would assist in a qualitative evaluation of the likelihood of such events occurring during the function. Information was obtained relative to the functions in each process by addressing the following question:

7. How often might this upset condition occur during an operation (once a day, once a month, once a year, very rarely happens during an operation, can't conceive of the event happening during an operation, can't even imagine the event could happen during an operation)? [Identify Likelihood of Occurrence]

At the conclusion of the interview session, a table was completed that contained the function number and title, list of hazardous materials, and potential energy sources that could release the hazardous materials (see Table F-1). The table also contained the identified accidents for the function along with potential barriers that may be part of the design, and the extent of the impact (workers, public, environment).

Function: x.0 Title	
Hazardous Materials:	
Energy Sources:	
A.	Thermal
B.	Chemical
C.	Mechanical
D.	Other

	Description of Potential Accidents:	Potential Barriers	Major Impact		
			Pub.	Work	Env.
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

Table F-1. Typical Table of Preliminary Hazards Analysis Information.

The preliminary hazards analysis for each Alternative consisted of twenty completed tables, one for each function of the Alternative. If a function was not part of a specific Alternative, the table simply noted the fact and no information was provided. If a function was considered to be common for all Alternatives (e.g., Dispose of Debris), then information relative to that specific function was used for each Alternative. If an Alternative had not adequately considered a specific function (e.g., Dispose of Generated Waste), then information from another, closely related Alternative was used. The tables for an Alternative thus contained the potential inventory of hazardous materials, energy sources to release the material, accident conditions, barriers, and extent of the impact relative to the workers, public and environment.

F.2.2 QUALITATIVE EVALUATION OF RISK

The qualitative evaluation of the risk assumed that the total risk for each function of the Alternative could be divided into the risk to the workers, risk to the public, and risk to the environment. That is,

$$R_T = \sum_{j=1}^{N} p_j \, f_j \, C_j$$
$$= \sum_{worker} p_j \, f_j \, C_j + \sum_{public} p_j \, f_j \, C_j + \sum_{Env.} p_j \, f_j \, C_j \qquad [1]$$

where:

p_j = a normalization constant,
f_j = the frequency of the event, and
C_j = the consequences of the event.

It was further assumed that the consequences for either the worker, public, or environment could be placed into groups, or bins, of common, or similar consequences. That is, for example,

$$\sum_{worker} p_j \, f_j \, C_j = \sum_{bin} \sum_{k=1}^{M} p_b \, f_k \, C_k$$
$$= \sum_{bin} p_b \, C_b \sum_{k=1}^{M} f_k = \sum_{bin} p_b \, C_b \, f_b \qquad [2]$$
$$where \;\; f_b = \sum_{k=1}^{M} f_k$$

and

f_b = the combined frequency for all events in the group, and
C_b = the similar consequences for all events in a group.

The common, or similar consequences for the worker, public and environment were grouped into qualitative consequence bins as identified below. Industrial worker safety consequence groups were independently identified in order to separate the consequences from accidents involving the release of ionizing radiation and hazardous materials from the consequences of industrial accidents.

Public Safety Consequence Groups

1. Any loss of public life.
2. Permanent impairment to off-site individuals.
3. Multiple excessive off-site exposures.
4. Moderate exposures of public and or moderate injuries.
5. Low-level radiation or chemical exposure.
6. Minor radiological or toxicological events affecting public.

Worker Safety Consequence Groups

1. Radiation or chemical exposures resulting in multiple worker deaths.
2. Radiation or chemical exposures resulting in a worker death.
3. Radiation or chemical exposures resulting in long-term irreversible health effects.
4. Radiation or chemical exposures much greater than allowed limits.
5. Radiation or chemical exposures above or near limits.
6. Radiation or chemical exposures with significant skin contamination (or internal damage for chemical exposures).

Environmental Safety Consequence Groups

1. Uncontained contamination spread beyond site boundary (either ground water or surface contamination for both radiological and toxicological materials).
2. Excessive on-site contamination damage requiring action (either ground water or surface contamination for both radiological and toxicological materials).
3. Moderate contamination beyond the site boundary (either ground water or surface contamination for both radiological and toxicological materials).

4. Measurable on-site contamination damage; no further action (either ground water or surface contamination for both radiological and toxicological materials).

Industrial Worker Safety Consequence Groups

1. Industrial events resulting in worker deaths.

2. Industrial events resulting in permanent worker injury.

3. Industrial events resulting in serious lost time injuries.

4. Industrial events resulting in emergency room injuries.

5. Industrial events requiring management follow-up.

The consequence of each accident listed in the preliminary hazards analysis table (Table F-1) for each function of an Alternative was placed in one of the above accident consequence groups. Note that some accidents may result in consequences to the worker, public and environment, while other accidents may only effect the immediate workers (e.g., skin contamination from a contaminated piece of material).

The next step was to identify the likelihood or frequency for each accident. This was accomplished by establishing frequency groups according to the definitions in Table F-2. The frequency of each accident was assigned to one of the above accident frequency groups.

Table F-2. Definition of Accident Frequency Groups.

Index	Description	Frequency of Events (1/year)
0	Does not apply	
1	Anticipated	$1 - 1 \times 10^{-2}$
2	Unlikely	$1 \times 10^{-2} - 1 \times 10^{-4}$
3	Extremely Unlikely	$1 \times 10^{-4} - 1 \times 10^{-6}$
4	Beyond Extremely Unlikely	$< 1 \times 10^{-6}$

Note that the individual risk for each accident can now be qualitatively established as the frequency of the group times the consequence of the group, but the units of risk are different for each accident consequence group (consequence per year). Also note that the uncertainty of the risk is expressed in terms of the uncertainty of the frequency (i.e., the range of the frequency group) and the uncertainty of the consequence (i.e., the range of the consequence group).

The normalization constant, p_j, is used to establish a constant set of units for the individual accident risks. The process is similar to that used in the Priority Planning Grid (Ritts 1990) application, except only the public safety, site personnel safety, and environmental protection elements of the Priority Planning Grid were used. In the Priority Planning Grid process, specific costs were established for averted consequence groups. The costs were weighted by an impact factor and a factor that represents the "unwillingness" of the public, worker, or corporation to accept specific consequences. The impact factor represents a measure of the hazard and the expected number of people exposed to the hazard. The "Unwillingness" factor is related to the unwillingness of individuals to accept an involuntary risk.

Table F-3 provides a list of the public safety, worker safety, industrial worker safety, and environmental safety consequence groups, and a list of the frequency groups. Table F-3 also provides the relative risk index for each of the consequence groups and frequency groups. Once the consequence of a potential accident has been placed in a consequence group and the frequency of the accident has been placed in a frequency group, the relative risk index table is read to provide the relative risk index for that accident.

The relative risk index for a set of accidents identified for each function of an Alternative are additive to obtain a total risk index for that function for each receptor group (e.g., public, worker, and environment). However, the relative risk indices for each function are not additive since the time duration for each function is different. Rather, the time-dependent risk index for each receptor is integrated over the duration of the function, and the risk index for each time step for each function are added. The total risk index is then the sum of the total risk index for each time step. The time averaged risk index is then obtained by averaging the total risk index over the number of time steps.

For convenience the time step for each function was taken to be one year. The risk index for each time step for each function is

$$R\,\Delta t \quad \text{(Consequence Units)} \qquad [3]$$

over the length of time designated in the schedule for the function. If appropriate, the initial and final time step for a function was adjusted for partial year effort (e.g., 2 months out of 12). To better understand the process, refer to the second page of Attachment F-1 for industrial worker risk for Alternative 1. In this table, the function titles have been omitted in order to provide a complete analysis on one sheet of paper. The subtotals at the bottom of Attachment F-1 are the total risk index for each time step (or year). The total risk index is the sum of the risk indices for each time step (291 CU in this case). The time averaged risk index is 15 CU/yr.

The time averaged risk index can be related to societal risks, worker risks, and environmental risks by the conversions given in Table F-4. For example, a time averaged risk index for the industrial worker of 15 CU/year would correspond to a worker risk of 1.5×10^{-3} fatalities/year.

Frequency of Event (1/yr)	Freq. No.	RELATIVE RISK INDEX						
		0	1	2	3	4	5	6
Does not apply	0	0	0	0	0	0	0	0
1 - 1E-02	1	0	1.0E+04	5.0E+03	5.0E+02	2.5E+02	2.5E+01	2.5E+00
1E-02 - 1E-04	2	0	1.0E+02	5.0E+01	5.0E+00	2.5E+00	2.5E-01	2.5E-02
1E-04 - 1E-06	3	0	1.0E+00	5.0E-01	5.0E-02	2.5E-02	2.5E-03	2.5E-04
< 1E-06	4	0	1.0E-02	5.0E-03	5.0E-04	2.5E-04	2.5E-05	2.5E-06

Consequence Groups

	1	2	3	4	5	6
Public Safety	Any loss of public life	Permanent impairment of off-site individuals	Multiple excessive off-site exposures	Moderate exposures of public and/or moderate inj.	Low-level radiation or chemical exposure	Minor rad. or toxic. events affecting public
Worker Safety	Radiation or chemical exp. resulting in multiple worker deaths.	Radiation or chemical exposure resulting in worker deaths	Radiation or chemical exp. resulting in long-term irrev. health effects	Radiation or chemical exp. much greater than allowed limits	Radiation or chemical exposure above or near limits	Radiation or chemical exposure with signific. skin contamination
Industrial Worker Safety		Industrial events resulting in worker deaths	Industrial events resulting in permanent worker injury	Industrial events resulting in serious lost time injuries	Industrial events resulting in emergency room injuries	Industrial events requiring management follow-up
Environmental Safety			Uncontained contamination spread beyond site boundary	Excessive on-site ecological damage requiring action	Moderate contamination beyond site boundary	Measurable on-site contamination damage - no further action

Table F-3. Relative Risk Index Table and Consequence Groups.

Table F-4. Risk Conversion Units.

Risk	Conversion	Units
Societal Risk	1×10^{-4}	Fatalities/relative risk index
Worker Risk	1×10^{-4}	Fatalities/relative risk index
Environmental Risk	200	Million dollars/relative risk index

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F.3.0 PUBLIC, WORKER AND ENVIRONMENTAL HEALTH RISKS

F.3.1 ANALYSIS RESULTS

Attachments F-1 through F-4 present a summary of the analysis for each of the Alternatives. The consequence and frequency of each potential accident sequence for each function have been placed in appropriate frequency and consequence groups, and a relative risk index has been identified. The relative risk indices for the accidents have been totaled for each function by receptor group. The tables list function numbers, titles and total relative risk indices for each function for the industrial worker risk, radiological worker risk, public risk and environmental risk. Start and finish dates for each of the functions taken from the master schedule for this Alternative are shown. Tables of time integrated results for each function for industrial worker risks, radiological worker risks, public risk, and environmental risk are also provided. The total risk index and the time averaged risk index are shown at the bottom of each table.

A summary of the total results are presented in Table F-5. However, more insight is obtained from the comparative results presented later. In Table F-5 each of the time averaged risk indices have been converted to worker risk, societal risk, or environmental risk for each of the Alternatives using the conversions in Table F-4. It should be remembered that the total risks presented in Table F-5 do not represent an exposure to a particular receptor (i.e., worker, public or environment). Rather, the total risk is a sum over all potential accident sequences of the accident consequence times the accident frequency converted to an appropriate consequence unit per year. For example, the total environmental risk presented in Table F-5 in millions of dollars per year does not represent a real expenditure. Rather, the number represents the potential relative cost that may be incurred if adequate barriers were not provided to protect the environment. Similarly comments apply to the worker risk and societal risk.

One can, however, compare the total risk results in Table F-5 to commonly accepted worker and societal risks. In the 1992 Edition of Accident Facts (National Safety Council 1992) the rate of construction fatalities is 3×10^{-4} fatalities/year. The rate for all accident fatalities is 4×10^{-4} fatalities/year. The total risks for industrial workers presented in Table F-5 (5.6 to 18×10^{-4} fatalities/year) are very comparable to the above worker risk rates when one considers the large uncertainty in the total risk numbers in Table F-5.

The DOE Nuclear Safety Policy (DOE 1991) provides a societal latent cancer safety goal for the operation of DOE facilities as 2×10^{-6} fatalities/year. The societal risks presented in Table F-5 (1.5 to 4.7×10^{-6} fatalities/year) are again very comparable to the DOE Nuclear Safety Policy when one considers the large uncertainties involved in the present calculations. It is perhaps fortuitous that there is such good agreement between the worker and societal risks presented in Table F-5 and commonly accepted risks. However, the good agreement reinforces the notion that the actual risks involved with removal of fuel and sludge from the K-Basins and their conditioning are very acceptable.

Table F-5. Summary of Worker and Societal Risks.

Radiological Worker	Total Risk Index	Time Averaged Risk Index	Worker Risk (Fatalities/year)
Alternative 1	130	7	7×10^{-4}
Alternative 2	201	11	11×10^{-4}
Alternative 3	161	8.5	8.5×10^{-4}
Alternative 4	141	7.4	7.4×10^{-4}

Public	Total Risk Index	Time Averaged Risk Index	Societal Risk (Fatalities/year)
Alternative 1	0.29	0.015	1.5×10^{-6}
Alternative 2	0.89	0.047	4.7×10^{-6}
Alternative 3	0.45	0.024	2.4×10^{-6}
Alternative 4	0.43	0.023	2.3×10^{-6}

Environment	Total Risk Index	Time Averaged Risk Index	Environmental Risk ($M/year)
Alternative 1	0.69	0.036	7
Alternative 2	0.96	0.05	10
Alternative 3	0.91	.048	10
Alternative 4	0.92	0.048	10

Industrial Worker	Total Risk Index	Time Averaged Risk Index	Worker Risk (Fatalities/year)
Alternative 1	292	15	15×10^{-4}
Alternative 2	139	7.3	7.3×10^{-4}
Alternative 3	346	18	18×10^{-4}
Alternative 4	106	5.6	5.6×10^{-4}

The total risk index listed in Table F-5 for each receptor and each Alternative are presented in Figure F-1 on a logarithmic scale (figures are presented at the end of the text). This figure illustrates two major points. First, the major contribution to the total risk in removing fuel and sludge from the K-Basins and processing fuel and sludge is from the potential risk to workers, either in terms of industrial risk or risk due to radiological exposure. As noted earlier, the actual risk to workers will be minimized by preventative or mitigative protective barriers, technical safety requirements, and adequate worker training. In general the industrial worker risks are a factor of two times larger than the radiological worker risks.

Second, the public risks and environmental risks are two to three orders of magnitude smaller than the industrial worker risk and radiological worker risks. Although these results are not surprising, they do emphasize that the risk to the public and the environment from the operations outlined in each Alternative are very small and, as noted above, are within acceptable risk limits.

The time integrated relative risk indices for each of the Alternative are presented in Figures F-2, F-3, F-4, and F-5 for the radiological worker risk, public risk, environmental risk, and industrial worker risk, respectively. The integrated results presented in Figures F-2, F-3, F-4 and F-5 represent the combination of several functions occurring in a single time step (year). For example, in Figure F-2, the peak in the radiological worker risk index during 1995 and 1996 for Alternative 3 is due to packaging of fuel and sludge in the K-Basins, preparing fuel and sludge for transport, disposing of debris during 1996, and treatment of K-basin water during 1996. Likewise, the peak in the radiological worker risks during 1999 through 2001 for Alternative 2 is due to multiple events. These events are disposal of debris in the K-Basins, activities associated with stored fuel in the new temporary wet storage facility, treatment of K-Basin water, and disposing of generated waste. The results of similar multiple events occurring during a time step are also visible as peaks in the relative risk index for public risk, environmental risk, and industrial worker risks. These peaks in the relative risk can be understood by referring to the corresponding functions underway during a time step in the appropriate tables in Attachments F-1 through F-4.

During the fuel and sludge packaging, and preparations for transport, the radiological worker risks are nearly the same for Alternatives 1, 2 and 4. However, the radiological worker risks are higher during the time to complete these functions for Alternative 3. The reason is the additional complication, and hence additional potential worker exposure, in Alternative 3 from drilling holes in the Mark-II fuel canisters, flushing the sludge from the canisters, and placing the canisters into the Multi-Canister Overpack. Alternative 2 has a larger radiological worker exposure during the years 1999 to 2002 essentially due to additional efforts performed in the new wet storage basin to prepare the fuel and sludge for conditioning.

There are two items that need to be addressed relative to the data presented in Figure F-3 and Figure F-4. First, there is a small additional risk to the public and environment in removing the fuel and sludge from the K-Basins, removing the debris, treating the K-Basin water, and conditioning the fuel and sludge for storage. However, in time this additional risk decreases, and the total risk is then much smaller than if the fuel, sludge

and debris were left in the K-Basins. That is, a small additional risk to the public and environment is accepted in the short term for a much larger decrease in the total risk in the long term. The present public and environmental risks, assuming no change from the present state, are presented in Figures F-3 and F-4 as a dashed constant line. Note that for most Alternatives, the public and environmental risks decrease significantly near the year 2004 when final stabilization and processing of the fuel and sludge have been completed.

Second, the public and environmental risks for each of the four Alternatives are nearly the same. This is evident from the total public and environmental risk indices from Table F-5. The scales in Figures F-3 and F-4 were expanded only to illustrate the data. If the scales in Figures F-3 and F-4 were the same as the scales for Figure F-2 (radiological worker risks), the public and environmental risks would appear as straight lines near zero.

The industrial worker risk for Alternative 3 is peaked between 1996 and 2001 because of two simultaneous construction projects; construction of a Stabilization/Process Facility and a Dry Interim Storage Facility. Alternative 1 and Alternative 2 have one construction project, a Dry Interim Storage Facility, and modifications of FMEF to handle the stabilization process. Construction of the Dry Interim Storage Facility and modifications to FMEF are expedited for Alternative 2 relative to Alternative 1 by one year and three years, respectively. Further, modifications of FMEF for Alternative 1 are more extensive than for Alternative 2 (a hot cell versus an operations bay. These differences in the construction projects and schedules are responsible for the differences in the industrial worker risks for these Alternatives.

F.3.2 CONCLUSIONS

The activities involved with any Alternative concerned with removing fuel and sludge from the K-Basins, any storage, if required, and fuel and sludge processing will include necessary protective barriers to ensure that the risk to the public, workers, and environment are acceptable. However, the comparative risk analysis demonstrated that the actual risks to the public and environment for any proposed Alternative are within acceptable limits.

The public and environmental risks for each of the four Alternatives are nearly the same. For each Alternative there will be a small additional risk to the public and environment in the short term resulting from the fuel and sludge removal and conditioning activities. However, the removal activities will result in a much larger decrease in the total risk in the long term.

The major contribution to the total risk is from the potential risk to workers, either in terms of industrial risk or risk due to radiological exposure. Industrial risks are dominated by potential industrial accidents during the construction phase of a facility. The major contribution to the worker radiological risk is from the near proximity of the worker to the fuel and sludge. Therefore, worker radiological risk will be minimized if the fuel handling activities are minimized. Limited fuel handling activities are best for Alternative 1, since the second fuel handling activity is completed in a hot cell.

Alternative 2 has a disadvantage relative to worker radiological risk because the fuel will be handled twice; once when placed in overpacks to be transported to the new wet storage basin and once when removed from the canisters in the wet storage basin in preparation for conditioning. Alternative 3 has an advantage in that fuel is handled only once during the cask loading activity. However, the process of drilling holes in the canisters and flushing sludge from the canisters for Alternative 3 provides an opportunity for further worker exposure.

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F.4.0 PATH FORWARD ANALYSIS

The proposed Path Forward capitalizes on the schedule advantages available from expeditious removal of the entire K-Basin fuel and sludge inventory to a new storage location away from the Columbia River. Multiple storage facilities are avoided by developing an interim storage system design which is initially used as temporary lag storage for packages of wet stored fuel and transitioned to the dry storage system as fuel conditioning is completed.

The fuel conditioning process will provide steps for fuel drying and passivation. Additional stabilization steps may be considered, ranging from controlled oxidation of the metal fuel, to complete oxidation of the metal fuel if required.

The interim storage system is first used as temporary lag storage for the wet fuel and sludge packages removed from the K Basins. The interim storage facility enters a second operational phase at the start of the fuel conditioning process. The remaining operating activities of the interim storage facility include (a) accumulation, decontamination, compaction, and packaging of solid debris for loadout as low level solid waste, and (b) treatment of basin water for disposal. The interim storage facility then enters the third operational phase when fuel conditioning is completed and all interim storage positions have been modified to support dry storage.

The public, worker, and environmental health risks were also analyzed for the Path Forward as described above. Table F-6, which is a duplication of Table F-5 with the Path Forward results added, compares the public, worker, and environmental health risks for the Path Forward with each of the Alternatives. The public and environmental risks for the Path Forward are nearly the same as for the other Alternatives. For the Path Forward there is also a small additional risk to the public and environment in the short term resulting from the fuel and sludge removal and conditioning activities. However, the removal activities result in a much larger decrease in the total risk in the long term.

The radiological worker risks for the Path Forward are between the radiological worker risks for Alternatives 2 and 3, as would be expected. However, they are all still very comparable. The industrial worker risks for the Path Forward are larger than for Alternative 2, but smaller than for Alternative 3. Again the results are as expected, and are all very comparable.

As noted earlier, any activities related to removing fuel and sludge from the K-Basins, providing storage, if required, and fuel and sludge conditioning will include necessary barriers to protect the public, workers, and environment. Thus, the public, worker, and environmental risk are not a major discriminator among the Alternatives and the selected Path Forward.

Table F-6. Summary of Worker and Societal Risks.

Radiological Worker	Total Risk Index	Time Averaged Risk Index	Worker Risk (Fatalities/year)
Alternative 1	130	7	7×10^{-4}
Alternative 2	201	11	11×10^{-4}
Alternative 3	161	8.5	8.5×10^{-4}
Alternative 4	141	7.4	7.4×10^{-4}
Path Forward	198	10.4	10×10^{-4}

Public	Total Risk Index	Time Averaged Risk Index	Societal Risk (Fatalities/year)
Alternative 1	0.29	0.015	1.5×10^{-6}
Alternative 2	0.89	0.047	4.7×10^{-6}
Alternative 3	0.45	0.024	2.4×10^{-6}
Alternative 4	0.43	0.023	2.3×10^{-6}
Path Forward	0.98	0.052	5.2×10^{-6}

Environment	Total Risk Index	Time Averaged Risk Index	Environmental Risk ($M/year)
Alternative 1	0.69	0.036	7
Alternative 2	0.96	0.05	10
Alternative 3	0.91	0.048	10
Alternative 4	0.92	0.048	10
Path Forward	1.04	0.055	11

Industrial Worker	Total Risk Index	Time Averaged Risk Index	Worker Risk (Fatalities/year)
Alternative 1	292	15	15×10^{-4}
Alternative 2	139	7.3	7.3×10^{-4}
Alternative 3	346	18	18×10^{-4}
Alternative 4	106	5.6	5.6×10^{-4}
Path Forward	232	12.2	12×10^{-4}

F.5.0 REFERENCES

DOE, 1991, U. S. Department of Energy, Secretary of Energy Notice, "Nuclear Safety Policy," SEN-35-91, September 9, 1991.

National Safety Council, 1992, "Accident Facts - 1992 Edition," Chicago, Illinois.

Ritts, J. J., 1990, *Westinghouse Hanford Company Basis Document For Priority Planning Grid Application Of The Risk Ranking Technique*, November, 1990, Tenera, L. P., transmitted by Westinghouse Hanford Company, Letter 9004346B R1, dated November 26, 1990.

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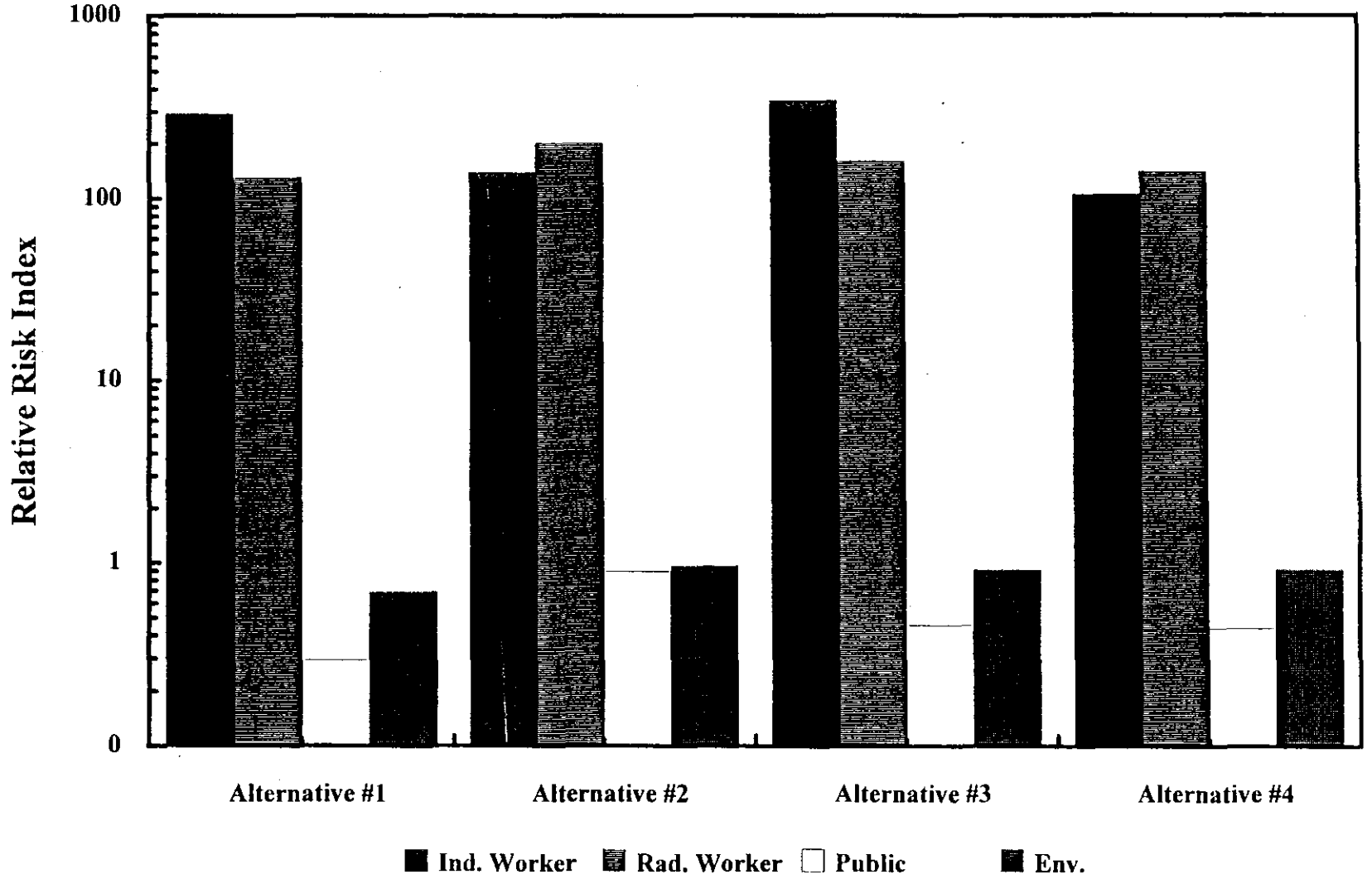

Figure F-1. Total Relative Risk Index.

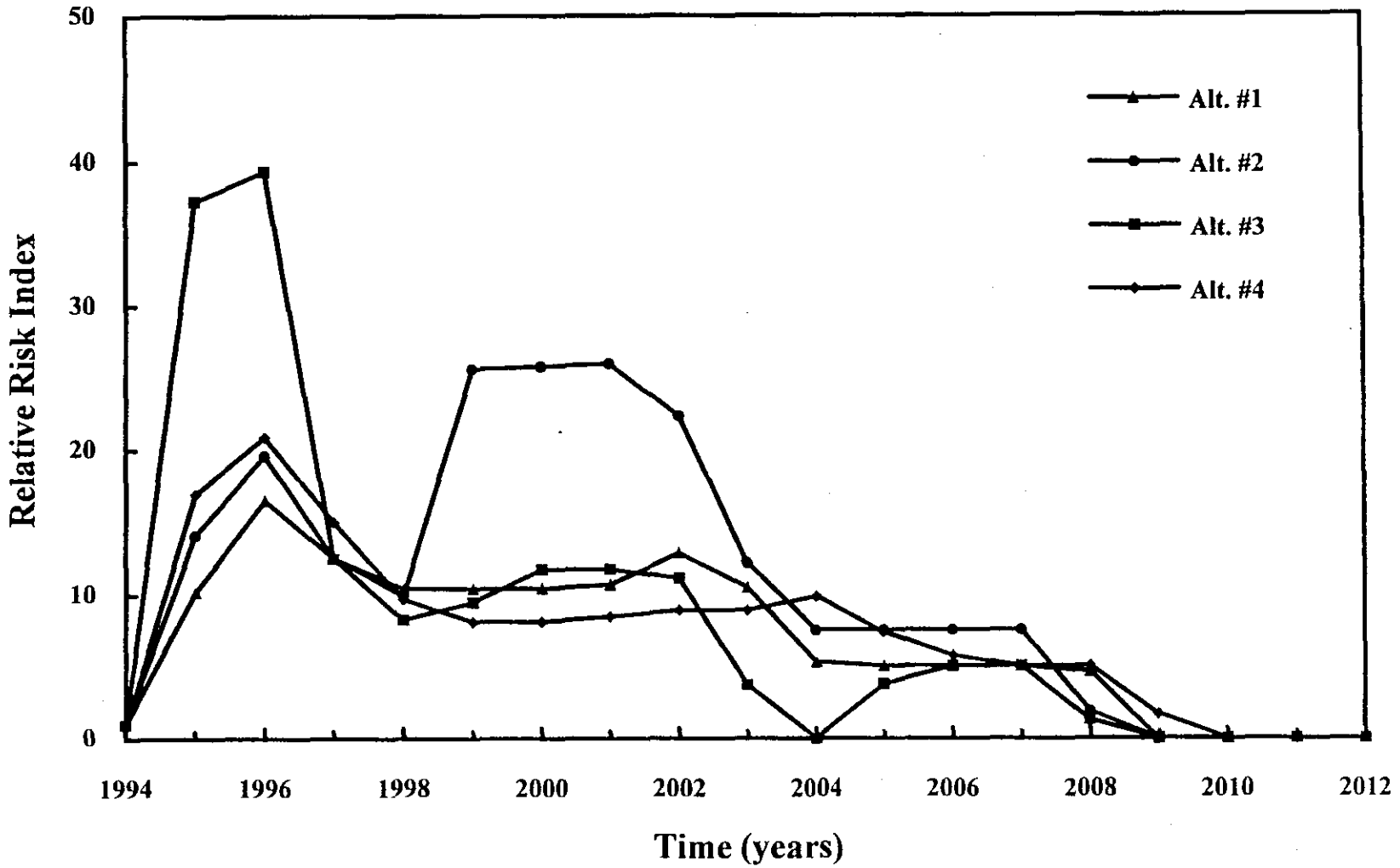

Figure F-2. Relative Radiological Worker Risk Index.

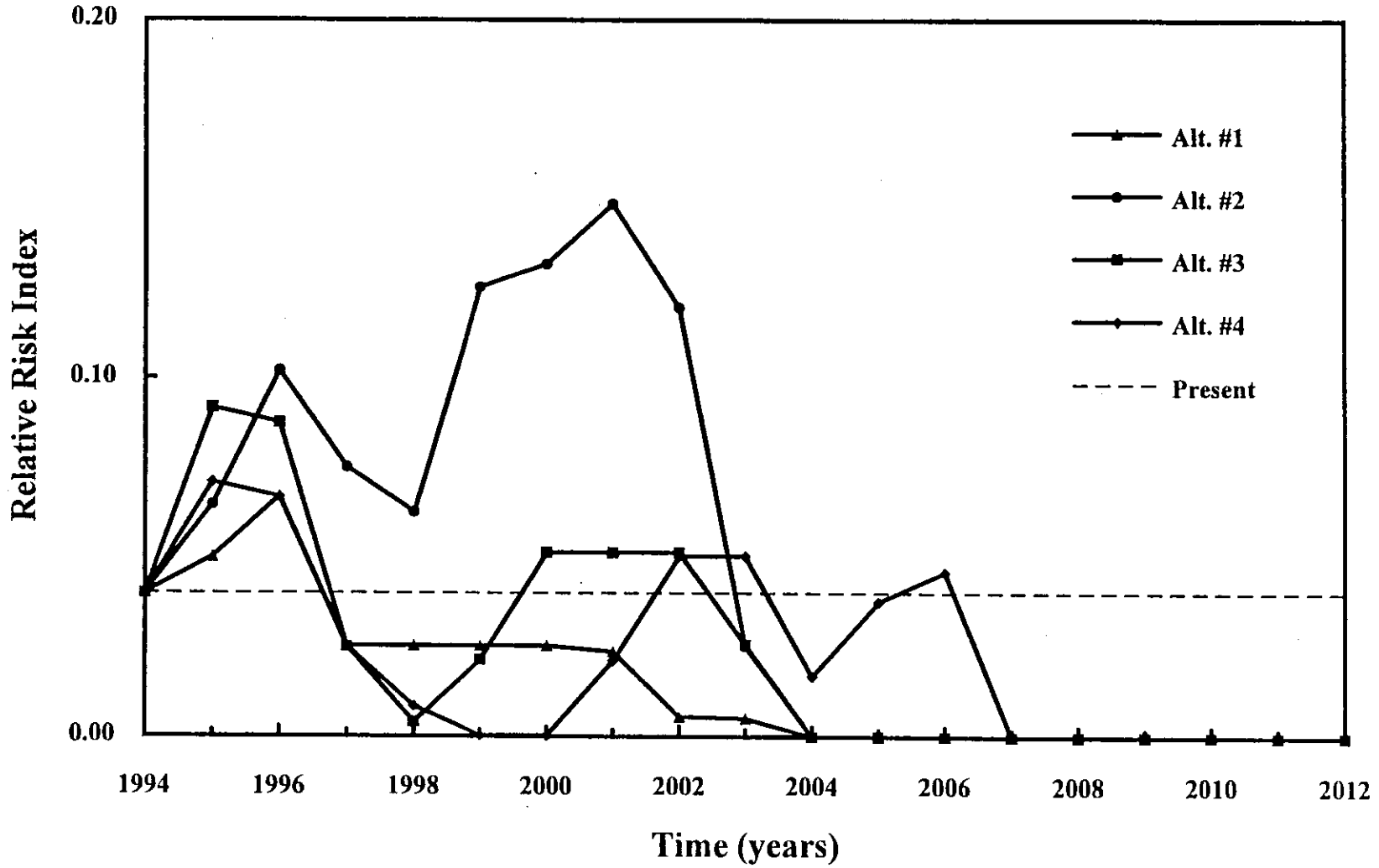

Figure F-3. Relative Public Risk Index.

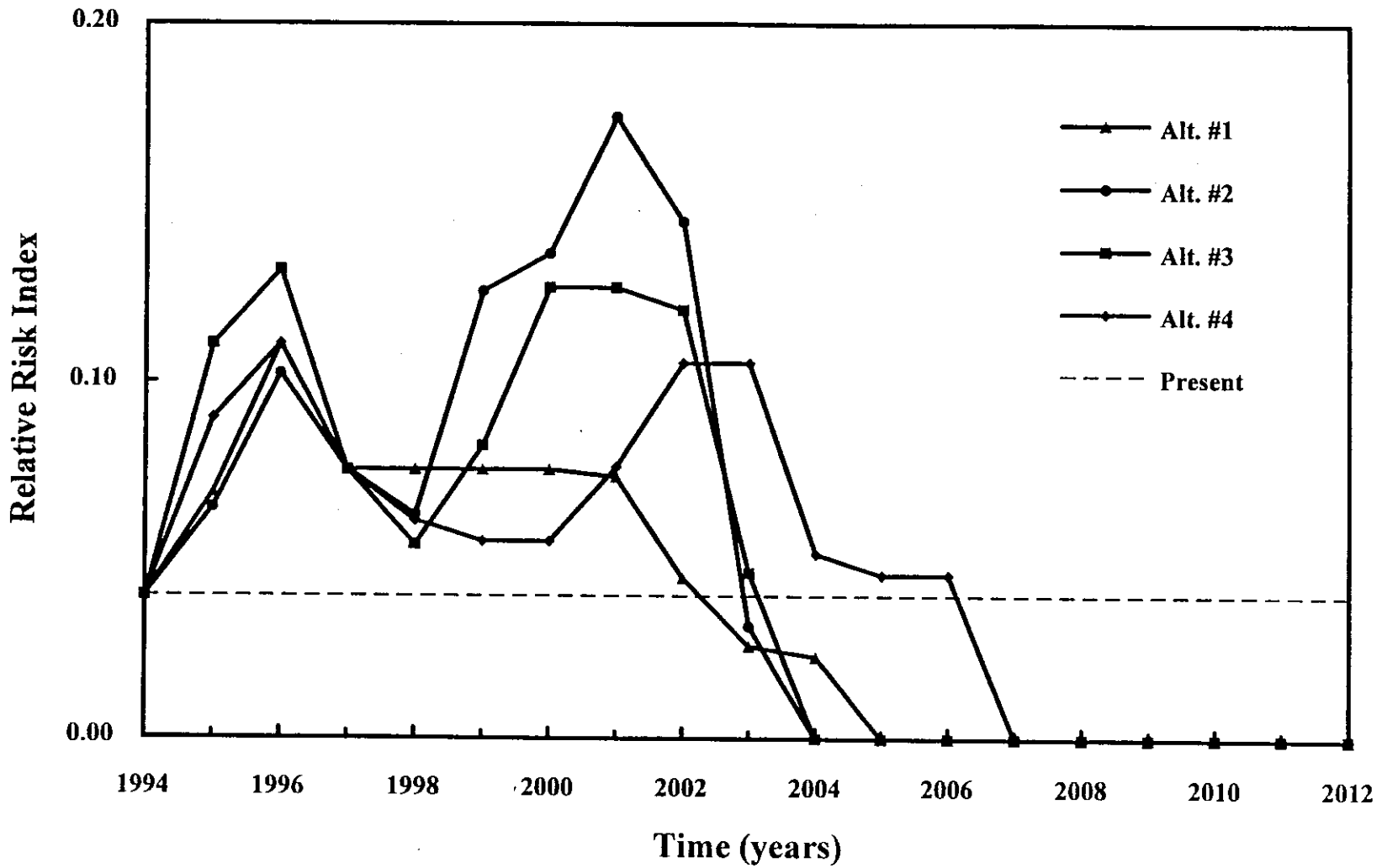

Figure F-4. Relative Environmental Risk Index.

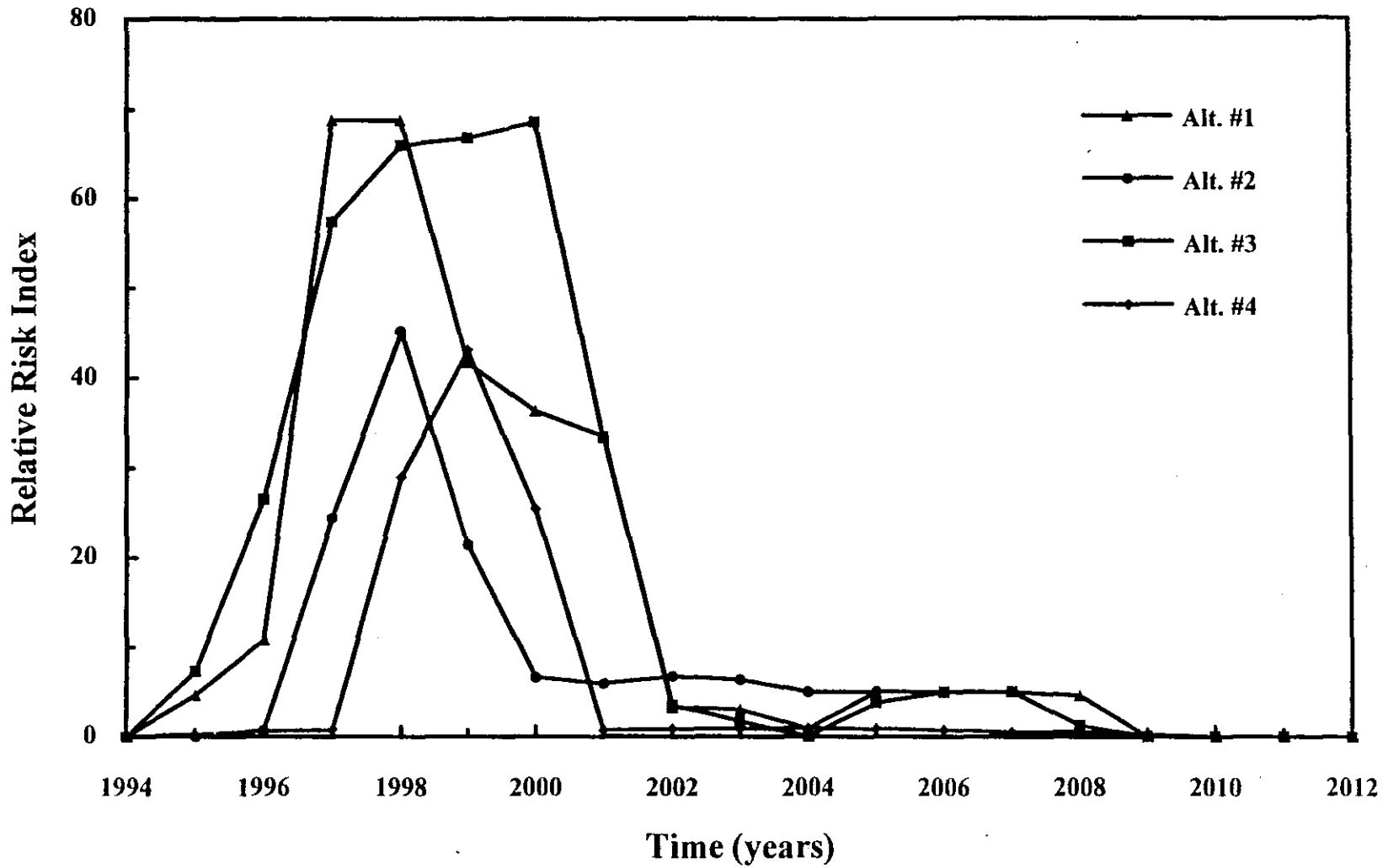

Figure F-5. Relative Industrial Worker Risk Index.

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Attachment F-I. Containerization and Storage in K-Basins.

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#1 Containerization and Storage in K-Basins

Number	Function	Indust. Worker	Relative Risk Index Worker	Public	Env.	Start Date	Finish Date
1.0	Characterize SNF and Sludge	0.0E+00	2.8E+00	0.0E+00	0.0E+00	11/1/94	9/30/97
2	Package Fuels and Sludge/Debris	5.0E+00	5.5E+00	5.0E-02	5.0E-02	2/1/95	10/31/96
3	Prepare for Transport	5.3E-01	2.6E+00	2.5E-02	2.5E-02	11/1/95	11/30/01
4	Design Temp Storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
5	Contruct Temp Storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
6	Dispose of Debris	5.0E-01	5.3E+00	0.0E+00	2.5E-02	4/1/96	11/30/04
7	Transport Fuel & Sludge to Temp Storage	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
8	Remove Radioactive Water	0.0E+00	2.5E+00	0.0E+00	2.5E-02	4/1/95	9/30/02
9	Store Sludge	0.0E+00	2.8E-02	0.0E+00	2.5E-02		
10	Store Fuel	0.0E+00	2.5E+00	0.0E+00	2.5E-02		
11	Transport to Stabilization/Process Facility	2.5E-02	3.3E-01	2.5E-04	0.0E+00	12/1/01	11/30/03
12	Design Stabilization/Process Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00	12/1/94	8/31/98
13	Construct Stabilization/Process Facility	3.5E+01	0.0E+00	0.0E+00	0.0E+00	12/1/96	11/30/01
14	Stabilize/Process Fuels	0.0E+00	2.8E+00	5.3E-03	7.5E-04	1/12/01	11/30/03
15	Dispose of Generated Waste	2.5E+00	2.5E+00	0.0E+00	2.5E-04	12/1/01	11/30/03
16	Decontaminate and Decommission Facilities	5.0E+00	5.0E+00	0.0E+00	0.0E+00	12/1/04	11/30/08
17	Design Interim Dry storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00	12/1/95	12/31/96
18	Construct Interim Dry storage Facility	3.3E+01	0.0E+00	0.0E+00	0.0E+00	12/1/96	2/28/99
19	Transport Fuels	2.5E-01	0.0E+00	0.0E+00	0.0E+00	6/1/96	11/30/03
20	Store Fuels	2.5E-02	2.5E-02	0.0E+00	0.0E+00	12/1/01	3/31/12
		8.1E+01	3.2E+01	8.1E-02	1.8E-01		

Attachment F-1. Containerization and Storage in K-Basins. (sheet 1 of 5)

#1 Containerization and Storage in K-Basins

Industrial Worker

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.0	0.0	0.0	0.0															
2		4.6	4.2																
3	0.0	0.1	0.5	0.5	0.5	0.5	0.5	0.5											
4																			
5																			
6			0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5								
7																			
8		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
9																			
10																			
11								0.0	0.0	0.0									
12	0.0	0.0	0.0	0.0	0.0														
13			2.9	35.0	35.0	35.0	35.0	32.1											
14								0.0	0.0	0.0									
15								0.2	2.5	2.3									
16											0.4	5.0	5.0	5.0	4.6				
17		0.0	0.0																
18			2.7	32.5	32.5	5.4													
19			0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.2									
20								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	4.7	10.8	68.8	68.8	41.7	36.3	33.5	3.3	3.1	0.9	5.0	5.0	5.0	4.6	0.0	0.0	0.0	0.0

Total	292 CU
Avg.	15.3 CU/yr

Attachment F-1. Containerization and Storage in K-Basins. (sheet 2 of 5)

#1 Containerization and Storage in K-Basins

Radiological Worker

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	1.0	2.8	2.8	2.1															
2		5.1	4.6																
3	0.0	0.4	2.6	2.6	2.6	2.6	2.6	2.4											
4																			
5																			
6			4.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	4.9								
7																			
8		1.9	2.5	2.5	2.5	2.5	2.5	2.5	1.9										
9																			
10																			
11								0.0	0.3	0.3									
12	0.0	0.0	0.0	0.0	0.0														
13			0.0	0.0	0.0	0.0	0.0	0.0											
14								0.2	2.8	2.5									
15								0.2	2.5	2.3									
16											0.4	5.0	5.0	5.0	4.6				
17		0.0	0.0																
18			0.0	0.0	0.0	0.0													
19			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
20								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.0	10.2	16.5	12.5	10.4	10.4	10.4	10.7	12.8	10.5	5.3	5.0	5.0	5.0	4.6	0.0	0.0	0.0	0.0

Total	130 CU
Avg.	6.9 CU/yr

Attachment F-1. Containerization and Storage in K-Basins. (sheet 3 of 5)

#1 Containerization and Storage in K-Basins

Public

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.00	0.00	0.00	0.00															
2	0.04	0.05	0.04																
3	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.02											
4																			
5																			
6			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00								
7																			
8		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										
9																			
10																			
11								0.00	0.00	0.00									
12	0.00	0.00	0.00	0.00	0.00														
13			0.00	0.00	0.00	0.00	0.00	0.00											
14								0.00	0.01	0.00									
15								0.00	0.00	0.00									
16											0.00	0.00	0.00	0.00	0.00				
17		0.00	0.00																
18			0.00	0.00	0.00	0.00													
19			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
20								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.05	0.07	0.03	0.03	0.03	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
																	Total	0.29 CU	
																	Avg.	0.02 CU/yr	

Attachment F-1. Containerization and Storage in K-Basins. (sheet 4 of 5)

#1 Containerization and Storage in K-Basins

Environment

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.00	0.00	0.00	0.00															
2	0.04	0.05	0.04																
3	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.02											
4																			
5																			
6			0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02								
7																			
8		0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02										
9																			
10																			
11								0.00	0.00	0.00									
12	0.00	0.00	0.00	0.00	0.00														
13			0.00	0.00	0.00	0.00	0.00	0.00											
14								0.00	0.00	0.00									
15								0.00	0.00	0.00									
16											0.00	0.00	0.00	0.00	0.00				
17		0.00	0.00																
18			0.00	0.00	0.00	0.00													
19			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
20								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.07	0.11	0.08	0.08	0.08	0.08	0.07	0.05	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Total	0.69 CU
Avg.	0.04 CU/yr

Attachment F-1. Containerization and Storage in K-Basins. (sheet 5 of 5)

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Attachment F-2. Expedited Fuel and Sludge Removal.

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#2 Expedited Fuel and Sludge Removal

Number	Function	Indust. Worker	Relative Risk Index Worker	Public	Env.	Start Date	Finish Date
1.0	Characterize SNF and Sludge (Same as Alt.	0.0E+00	2.8E+00	0.0E+00	0.0E+00	11/1/94	9/30/97
2	Package Fuels and Sludge/Debris	2.5E-02	1.0E+01	5.0E-02	5.0E-02	2/1/95	10/31/96
3	Prepare for Transport	5.0E-01	2.6E+00	2.5E-02	2.5E-02	5/1/96	3/31/98
4	Design Temp Storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00	11/1/94	10/31/96
5	Contruct Temp Storage Facility	7.8E+00	0.0E+00	0.0E+00	0.0E+00	2/1/97	11/30/98
6	Dispose of Debris (Same as Alt. #1)	5.0E-01	5.3E+00	2.5E-02	2.5E-02	4/1/96	11/30/01
7	Transport Fuel & Sludge to Temp Storage	0.0E+00	2.8E-01	2.5E-02	2.5E-02	12/1/98	11/30/00
8	Remove Radioactive Water (Same as Alt. #1	0.0E+00	2.5E+00	2.5E-02	2.5E-02	4/1/95	9/30/02
9	Store Sludge	2.5E+00	5.0E+00	2.5E-02	2.5E-02	12/1/98	3/31/03
10	Store Fuel	0.0E+00	1.0E+01	2.5E-02	2.5E-02	12/12/98	3/31/03
11	Transport to Stabilization/Process Facility	2.5E-01	2.5E-01	2.5E-02	2.5E-02		
12	Design Stabilization/Process Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00	11/1/95	1/31/00
13	Construct Stabilization/Process Facility	1.0E+01	0.0E+00	0.0E+00	0.0E+00	8/1/98	10/31/00
14	Stabilize/Process Fuels (Same as Alt. #3)	2.5E-01	1.0E+00	5.1E-02	7.6E-02	11/1/00	3/31/03
15	Dispose of Generated Waste (Same as Alt. #	2.5E+00	2.5E+00	0.0E+00	2.5E-04	12/1/98	3/31/03
16	Decontaminate and Decommission Facilities	5.0E+00	7.5E+00	0.0E+00	0.0E+00	10/1/02	3/31/08
17	Design Interim Dry storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5/1/96	5/31/97
18	Construct Interim Dry storage Facility (Sa	3.3E+01	0.0E+00	0.0E+00	0.0E+00	6/1/97	2/28/99
19	Transport Fuels	2.5E-01	0.0E+00	0.0E+00	0.0E+00	11/1/97	3/31/03
20	Store Fuels	2.5E-02	2.5E-02	0.0E+00	0.0E+00	11/1/00	3/31/12
		6.2E+01	5.0E+01	2.8E-01	3.0E-01		

Attachment F-2. Expedited Fuel and Sludge Removal. (sheet 1 of 5)

#2 Expedited Fuel and Sludge Removal

Industrial Worker

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.0	0.0	0.0	0.0															
2		0.0	0.0																
3			0.3	0.5	0.1														
4	0.0	0.0	0.0																
5				7.1	7.1														
6			0.4	0.5	0.5	0.5	0.5	0.5											
7					0.0	0.0	0.0												
8		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
9					0.2	2.5	2.5	2.5	2.5	0.6									
10					0.0	0.0	0.0	0.0	0.0	0.0									
11																			
12		0.0	0.0	0.0	0.0	0.0	0.0												
13					4.3	10.3	0.9												
14							0.0	0.3	0.3	0.1									
15					0.2	2.5	2.5	2.5	2.5	0.6									
16									1.3	5.0	5.0	5.0	5.0	5.0	1.3				
17			0.0	0.0															
18				16.3	32.5	5.4													
19				0.0	0.3	0.3	0.3	0.3	0.3	0.1									
20							0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.7	24.4	45.2	21.4	6.6	6.0	6.8	6.4	5.0	5.0	5.0	5.0	1.3	0.0	0.0	0.0	0.0

Total	139 CU
Avg.	7.3 CU/yr

Attachment F-2. Expedited Fuel and Sludge Removal. (sheet 2 of 5)

#2 Expedited Fuel and Sludge Removal

Radiological Worker

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.5	2.8	2.8	2.1															
2	0.5	9.4	8.6																
3			1.7	2.6	0.6														
4	0.0	0.0	0.0																
5				0.0	0.0														
6			4.0	5.3	5.3	5.3	5.3	4.9											
7					0.0	0.3	0.3												
8		1.9	2.5	2.5	2.5	2.5	2.5	2.5	1.9										
9					0.4	5.0	5.0	5.0	5.0	1.3									
10					0.8	10.0	10.0	10.0	10.0	2.5									
11																			
12		0.0	0.0	0.0	0.0	0.0	0.0												
13					0.0	0.0	0.0												
14							0.2	1.0	1.0	0.3									
15					0.2	2.5	2.5	2.5	2.5	0.6									
16									1.9	7.5	7.5	7.5	7.5	7.5	1.9				
17			0.0	0.0															
18				0.0	0.0	0.0													
19				0.0	0.0	0.0	0.0	0.0	0.0	0.0									
20							0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.0	14.1	19.6	12.5	10.0	25.6	25.8	26.0	22.3	12.2	7.5	7.5	7.5	7.5	1.9	0.0	0.0	0.0	0.0

Total	201 CU
Avg.	10.6 CU/yr

Attachment F-2. Expedited Fuel and Sludge Removal. (sheet 3 of 5)

#2 Expedited Fuel and Sludge Removal

Public

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.00	0.00	0.00	0.00															
2	0.04	0.05	0.04																
3			0.02	0.03	0.01														
4	0.00	0.00	0.00																
5				0.00	0.00														
6			0.02	0.03	0.03	0.03	0.03	0.02											
7					0.00	0.03	0.02												
8		0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02										
9					0.00	0.03	0.03	0.03	0.03	0.01									
10					0.00	0.03	0.03	0.03	0.03	0.01									
11																			
12		0.00	0.00	0.00	0.00	0.00	0.00												
13					0.00	0.00	0.00												
14							0.01	0.05	0.05	0.01									
15					0.00	0.00	0.00	0.00	0.00	0.00									
16									0.00	0.00	0.00	0.00	0.00	0.00	0.00				
17			0.00	0.00															
18				0.00	0.00	0.00													
19				0.00	0.00	0.00	0.00	0.00	0.00	0.00									
20							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.06	0.10	0.08	0.06	0.13	0.13	0.15	0.12	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Total	0.89 CU
Avg.	0.05 CU/yr

Attachment F-2. Expedited Fuel and Sludge Removal. (sheet 4 of 5)

#2 Expedited Fuel and Sludge Removal

Environmental

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.00	0.00	0.00	0.00															
2	0.04	0.05	0.04																
3			0.02	0.03	0.01														
4	0.00	0.00	0.00																
5				0.00	0.00														
6			0.02	0.03	0.03	0.03	0.03	0.02											
7					0.00	0.03	0.02												
8		0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02										
9					0.00	0.03	0.03	0.03	0.03	0.01									
10					0.00	0.03	0.03	0.03	0.03	0.01									
11																			
12		0.00	0.00	0.00	0.00	0.00	0.00												
13					0.00	0.00	0.00												
14							0.01	0.08	0.08	0.02									
15					0.00	0.00	0.00	0.00	0.00	0.00									
16									0.00	0.00	0.00	0.00	0.00	0.00	0.00				
17			0.00	0.00															
18				0.00	0.00	0.00													
19				0.00	0.00	0.00	0.00	0.00	0.00	0.00									
20							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.06	0.10	0.08	0.06	0.13	0.14	0.17	0.15	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Total	0.96 CU
Avg.	0.05 CU/yr

Attachment F-2. Expedited Fuel and Sludge Removal. (sheet 5 of 5)

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Attachment F-3. Dry New Facility Storage.

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#3 Dry New Facility Storage

Number	Function	Indust. Worker	Relative Risk Index Worker	Public	Env.	Start Date	Finish Date
1.0	Characterize SNF and Sludge (same as Alt.	0.0E+00	2.8E+00	0.0E+00	0.0E+00	11/1/94	9/30/97
2	Package Fuels and Sludge/Debris	5.3E+00	3.3E+01	7.5E-02	7.5E-02	2/1/95	10/31/96
3	Prepare for Transport	2.8E+00	2.5E+00	2.5E-02	2.5E-02	2/1/95	2/28/98
4	Design Temp Storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
5	Contruct Temp Storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
6	Dispose of Debris (same as Alt. #1)	5.0E-01	5.3E+00	0.0E+00	2.5E-02	4/1/96	4/30/04
7	Transport Fuel & Sludge to Temp Storage	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
8	Remove Radioactive Water (same as Alt. #1	0.0E+00	2.5E+00	0.0E+00	2.5E-02	4/1/95	9/30/02
9	Store Sludge (sludge in basins not addressed	0.0E+00	2.8E-02	0.0E+00	2.5E-02		
10	Store Fuel	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
11	Transport to Stabilization/Process Facility	2.8E-01	3.3E-01	5.0E-04	2.5E-04	8/1/99	6/30/03
12	Design Stabilization/Process Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00	12/1/94	7/31/00
13	Construct Stabilization/Process Facility	3.3E+01	0.0E+00	0.0E+00	0.0E+00	5/1/97	4/30/01
14	Stabilize/Process Fuels	2.5E-01	1.0E+00	5.1E-02	7.6E-02	8/1/99	6/30/03
15	Dispose of Generated Waste (same as Alt. #	2.5E+00	2.5E+00	0.0E+00	2.5E-04	8/1/99	6/30/03
16	Decontaminate and Decommission Facilities	5.0E+00	5.0E+00	0.0E+00	0.0E+00	5/1/04	6/30/08
17	Design Interim Dry storage Facility (same a	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6/1/95	11/30/98
18	Construct Interim Dry storage Facility (sam	3.3E+01	0.0E+00	0.0E+00	0.0E+00	6/1/96	7/31/01
19	Transport Fuels (on integral rail system)	2.5E-01	0.0E+00	0.0E+00	0.0E+00		
20	Store Fuels	2.5E-02	2.5E-02	0.0E+00	0.0E+00	8/1/99	3/31/12
		8.2E+01	5.5E+01	1.5E-01	2.5E-01		

Attachment F-3. Dry New Facility Storage. (sheet 1 of 5)

#3 Dry New Storage Facility

Industrial Worker

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.0	0.0	0.0	0.0															
2		4.8	4.4																
3		2.5	2.8	2.8	0.5														
4																			
5																			
6			0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.2									
7																			
8		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
9																			
10																			
11						0.1	0.3	0.3	0.3	0.1									
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0												
13				21.7	32.5	32.5	32.5	10.8											
14						0.1	0.3	0.3	0.3	0.1									
15						1.0	2.5	2.5	2.5	1.3									
16												3.8	5.0	5.0	1.3				
17		0.0	0.0	0.0	0.0														
18			19.0	32.5	32.5	32.5	32.5	19.0											
19																			
20						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	7.3	26.5	57.4	66.0	66.8	68.5	33.3	3.5	1.7	0.0	3.8	5.0	5.0	1.3	0.0	0.0	0.0	0.0

Total	346 CU
Avg.	18.2 CU/yr

Attachment F-3. Dry New Facility Storage. (sheet 2 of 5)

#3 Dry New Storage Facility

Radiological Worker

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.5	2.8	2.8	2.1															
2	0.5	30.3	27.5																
3		2.3	2.5	2.5	0.4														
4																			
5																			
6			4.0	5.3	5.3	5.3	5.3	5.3	5.3	1.8									
7																			
8		1.9	2.5	2.5	2.5	2.5	2.5	2.5	1.9										
9																			
10																			
11						0.1	0.3	0.3	0.3	0.2									
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0												
13				0.0	0.0	0.0	0.0	0.0											
14						0.4	1.0	1.0	1.0	0.5									
15						1.0	2.5	2.5	2.5	1.3									
16												3.8	5.0	5.0	1.3				
17		0.0	0.0	0.0	0.0														
18			0.0	0.0	0.0	0.0	0.0	0.0											
19																			
20						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.0	37.3	39.3	12.5	8.3	9.5	11.7	11.7	11.1	3.7	0.0	3.8	5.0	5.0	1.3	0.0	0.0	0.0	0.0

Total	161 CU
Avg.	8.5 CU/yr

Attachment F-3. Dry New Facility Storage. (sheet 3 of 5)

#3 Dry New Storage Facility

Public

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.00	0.00	0.00	0.00															
2	0.04	0.07	0.06																
3		0.02	0.03	0.03	0.00														
4																			
5																			
6			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
7																			
8		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00										
9																			
10																			
11						0.00	0.00	0.00	0.00	0.00									
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
13				0.00	0.00	0.00	0.00	0.00											
14						0.02	0.05	0.05	0.05	0.03									
15						0.00	0.00	0.00	0.00	0.00									
16												0.00	0.00	0.00	0.00				
17		0.00	0.00	0.00	0.00														
18			0.00	0.00	0.00	0.00	0.00	0.00											
19																			
20						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.09	0.09	0.03	0.00	0.02	0.05	0.05	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Total	0.45 CU
Avg.	0.02 CU/yr

Attachment F-3. Dry New Facility Storage. (sheet 4 of 5)

#3 Dry New Storage Facility

Environment

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.00	0.00	0.00	0.00															
2	0.04	0.07	0.06																
3		0.02	0.03	0.03	0.00														
4																			
5																			
6			0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.01									
7																			
8		0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02										
9																			
10																			
11						0.00	0.00	0.00	0.00	0.00									
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
13				0.00	0.00	0.00	0.00	0.00											
14						0.03	0.08	0.08	0.08	0.04									
15						0.00	0.00	0.00	0.00	0.00									
16												0.00	0.00	0.00	0.00				
17		0.00	0.00	0.00	0.00														
18			0.00	0.00	0.00	0.00	0.00	0.00											
19																			
20						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.11	0.13	0.08	0.05	0.08	0.13	0.13	0.12	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Total	0.92 CU
Avg.	0.05 CU/yr

Attachment F-3. Dry New Facility Storage. (sheet 5 of 5)

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Attachment F-4. Foreign Processing.

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#4 Foreign Processing

Number	Function	Indust. Worker	Relative Risk Index Worker	Public	Env.	Start Date	Finish Date
1.0	Characterize SNF and Sludge	0.0E+00	2.8E+00	0.0E+00	0.0E+00	11/1/94	9/30/97
2	Package Fuels and Sludge/Debris	2.5E-02	7.8E+00	5.0E-02	5.0E-02	2/1/95	10/31/96
3	Prepare for Transport	2.5E-01	5.1E+00	2.5E-02	2.5E-02	11/1/94	4/30/98
4	Design Temp Storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
5	Contruct Temp Storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
6	Dispose of Debris	5.0E-01	5.3E+00	0.0E+00	2.5E-02	4/1/96	4/30/05
7	Transport Fuel & Sludge to Temp Storage	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
8	Remove Radioactive Water	0.0E+00	2.5E+00	0.0E+00	2.5E-02	4/1/95	4/30/04
9	Store Sludge	0.0E+00	2.8E-02	0.0E+00	2.5E-02		
10	Store Fuel	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
11	Transport to Stabilization/Process Facility	1.0E-01	2.8E-01	2.5E-04	5.0E-03	5/1/98	4/30/04
12	Design Stabilization/Process Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00	11/1/95	4/30/98
13	Construct Stabilization/Process Facility	1.0E+01	0.0E+00	0.0E+00	0.0E+00	5/1/98	7/31/00
14	Stabilize/Process Fuels	2.5E-01	7.8E-01	5.0E-02	5.0E-02	8/1/00	4/30/04
15	Dispose of Generated Waste	2.5E+00	2.5E+00	0.0E+00	2.5E-04		
16	Decontaminate and Decommission Facilities	5.0E-01	5.0E+00	0.0E+00	0.0E+00	5/1/04	4/30/09
17	Design Interim Dry storage Facility	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4/1/97	4/30/98
18	Construct Interim Dry storage Facility	3.3E+01	0.0E+00	0.0E+00	0.0E+00	5/1/98	7/31/00
19	Transport Fuels	2.5E-01	0.0E+00	0.0E+00	0.0E+00		
20	Store Fuels	2.5E-02	2.5E-02	0.0E+00	0.0E+00	8/1/00	3/31/12
		4.7E+01	3.2E+01	1.3E-01	2.1E-01		

Attachment F-4. Foreign Processing. (sheet 1 of 5)

#4 Foreign Processing

Industrial Worker

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.0	0.0	0.0	0.0															
2		0.0	0.0																
3	0.0	0.3	0.3	0.3	0.1														
4																			
5																			
6			0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.2							
7																			
8		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0								
9																			
10																			
11					0.1	0.1	0.1	0.1	0.1	0.1	0.0								
12		0.0	0.0	0.0	0.0														
13					6.7	10.0	5.8												
14								0.1	0.3	0.3	0.1	0.2	0.2						
15																			
16											0.3	0.5	0.5	0.5	0.5	0.2			
17				0.0	0.0														
18					21.7	32.5	19.0												
19																			
20							0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.3	0.6	0.8	29.0	43.1	25.4	0.7	0.9	0.9	1.0	0.9	0.8	0.5	0.5	0.2	0.0	0.0	0.0

Total	106 CU
Avg.	5.6 CU/yr

Attachment F-4. Foreign Processing. (sheet 2 of 5)

#4 Foreign Processing

Radiological Worker

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.2	2.8	2.8	2.1															
2	0.8	7.2	6.5																
3	0.0	5.1	5.1	5.1	1.7														
4																			
5																			
6			4.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	1.8							
7																			
8		1.9	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.8								
9																			
10																			
11					0.1	0.3	0.3	0.3	0.3	0.3	0.1								
12		0.0	0.0	0.0	0.0														
13					0.0	0.0	0.0												
14								0.3	0.8	0.8	0.3	0.6	0.7						
15																			
16											3.3	5.0	5.0	5.0	5.0	1.7			
17				0.0	0.0														
18					0.0	0.0	0.0												
19																			0.0
20							0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.0	16.9	20.9	15.0	9.7	8.1	8.1	8.5	8.9	8.9	9.9	7.4	5.7	5.0	5.0	1.7	0.0	0.0	0.0

Total	141 CU
Avg.	7.4 CU/yr

Attachment F-4. Foreign Processing. (sheet 3 of 5)

#4 Foreign Processing

Public

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.00	0.00	0.00	0.00															
2	0.04	0.05	0.04																
3	0.00	0.03	0.03	0.03	0.01														
4																			
5																			
6			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
7																			
8		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00								
9																			
10																			
11					0.00	0.00	0.00	0.00	0.00	0.00	0.00								
12		0.00	0.00	0.00	0.00														
13					0.00	0.00	0.00												
14								0.02	0.05	0.05	0.02	0.04	0.05						
15																			
16											0.00	0.00	0.00	0.00	0.00	0.00			
17				0.00	0.00														
18					0.00	0.00	0.00												
19																			0.00
20							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.07	0.07	0.03	0.01	0.00	0.00	0.02	0.05	0.05	0.02	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00

Total	0.43 CU
Avg.	0.02 CU/yr

Attachment F-4. Foreign Processing. (sheet 4 of 5)

#4 Foreign Processing

Environment

Function Number	Years																		
	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
1	0.00	0.00	0.00	0.00															
2	0.04	0.05	0.04																
3	0.00	0.03	0.03	0.03	0.01														
4																			
5																			
6			0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01							
7																			
8		0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01								
9																			
10																			
11					0.00	0.01	0.01	0.01	0.01	0.01	0.00								
12		0.00	0.00	0.00	0.00														
13					0.00	0.00	0.00												
14								0.02	0.05	0.05	0.02	0.04	0.05						
15																			
16											0.00	0.00	0.00	0.00	0.00	0.00			
17				0.00	0.00														
18					0.00	0.00	0.00												
19																			0.00
20							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.09	0.11	0.08	0.06	0.06	0.06	0.08	0.11	0.11	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00

Total	0.92 CU
Avg.	0.05 CU/yr

Attachment F-4. Foreign Processing. (sheet 5 of 5)

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APPENDIX G

PROGRAMMATIC RISK EVALUATION

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G.1.0 PROGRAMMATIC RISK EVALUATION OVERVIEW

G.1.1 GENERAL PROGRAMMATIC RISK EVALUATION CONCEPTS

The objective of the programmatic risk evaluation is to assess the impact of uncertainties impacting the program tasks on the likelihood that the various Alternatives will achieve the schedule and cost goals established for the project. The process is illustrated schematically in Figure G-1. Individual tasks involved in the program are logically related through contingency relationships or precedents. The duration and cost to accomplish the individual tasks with available resources and technology are uncertain because of a number of internal and external influences. The outputs of the programmatic risk evaluation reflect these uncertainties, thus assisting the decision maker to judge not only whether an Alternative can achieve the required goals, but also the magnitude of risk of delays and overruns associated with it.

The comprehensive treatment of uncertainty in the development of the programmatic risk evaluation model for input is a fundamental part of the analysis effort. The point value results that appear in a programmatic risk evaluation model are produced from calculations made using the mean values of probability distributions. These distributions were developed from data available to the concerned party and supplemented with the judgment of the programmatic risk evaluation team. (A summary of the data distributions used in the Hanford Spent Fuel programmatic risk evaluation model quantification are presented in Attachment G-1).

The point value results based on rigorously developed mean values represent a significant advancement in quality and integrity compared with results calculated from judgmental "best estimates." The comprehensive treatment of uncertainty in this analysis provides much more, however, than just better point values with an uncertainty band. The incorporation of uncertainty in the calculation of project lead time actually increases the expected duration above that calculated from point values alone. A key phenomenon, termed "schedule push," that produces this effect is discussed below.

Schedule push is the phenomenon that occurs when two or more activities must be completed before a third can begin. Consider the simple example shown in Figure G-2. In this example, Tasks A and B run in parallel and are estimated on a point value basis to finish 12 periods into the project, at which time Task C can begin. If uncertainty is now included in the calculation, a different result for Task C start will be obtained. If the probability of an on-time completion for Tasks A and B is assumed to be normally distributed at about 12 with a standard deviation of 3, then the resulting mean start date for Task C is 13.65 periods into the project, not 12. This result is easily verified by a simple thought experiment. If A and B are normally distributed, the probability of finishing each by period 12 is 0.5. Then, the probability of completing both tasks on time should be 0.25 (0.5 x 0.5). The percentile output from the simulation example confirms that the 25th percentile of the distribution for Task C start is 12.

Due to these and other phenomena, even with well-founded point estimates, deterministic analyses may produce seriously flawed results for complex programs.

G.1.2 APPROACH TO PROGRAMMATIC RISK EVALUATION FOR THE HANFORD SPENT FUEL DECISION ANALYSIS

Within the decision framework established for evaluating K Basin spent nuclear fuel (SNF) interim storage options, the programmatic risk evaluation complements the schedule and cost estimates being prepared by the team. Both model the contingency relations of the various tasks and incorporate task duration and cost information to project the occurrence of milestones and accumulated cost. However, the scheduling task is oriented towards resource allocation planning, whereas the programmatic risk evaluation focuses on identifying and representing those influences and uncertainties that may influence the commitment of the decision maker to the overall project. To accomplish this, the programmatic risk evaluation consolidated tasks where they did not influence the critical path and incorporated additional tasks and/or events to assist the decision maker in focusing on the elements important to the decision.

The first step in programmatic risk evaluation model development is to identify the objectives of the decision maker for the project. Typically, the objective will be to maximize or minimize one or more stated goals. Sometimes, the objective is evaluating various options against a set of criteria. Once the objectives are clear, parameters, which are quantitative representations of objectives and are easily communicable, need to be specified. The relationship between the selected parameter and the project goal should be clear.

For a complex program such as K Basin SNF interim storage, the outcome of different options may not necessarily be the same. For instance, the four options for removing and storing the SNF in the K Basin currently produce at least two different forms of fuel in interim storage. These end points and their impacts on the decision criteria must be carefully documented so that the decision maker can compare the options from a similar perspective. Often, Alternative approaches will present the decision makers with tradeoffs between key decision Alternatives. For example, an Alternative may offer a better schedule performance in exchange for early (more risky) financial commitments. These tradeoffs are being addressed by the multi-attribute part of the decision with major input from the programmatic risk evaluation and other evaluations.

The next step in programmatic risk evaluation development is identification of the activities (subtasks of the program) to be evaluated. For the K Basin SNF interim storage decision, the work breakdown structure identified in the schedules being developed by SAIC are used as the starting point for the activity breakdown of the programmatic risk evaluation. These tasks are consolidated and/or expanded to explicitly identify those tasks and influences that are expected to have a significant impact on the schedule and cost of the individual options.

After the determination of the level of aggregation and the identification of activities, the constraints among activities are identified. The constraints reflect the logic of the program development. For this programmatic risk evaluation, these constraints are very similar to those established in the schedule and cost task, but may include some additional external influences as well. The constraints are specified to be not only logically sound but also practical and feasible. For instance, if only one team is available for activities specified to occur in parallel, then the actual duration for the project would be the same as if the activities were arranged in series.

Explicit treatment of dependencies is one of the key elements of programmatic risk evaluation. For a complex program of numerous activities, it is usually very difficult to achieve pairwise statistical independence of all activities, although it is commonly assumed in traditional analysis. To model various dependencies in programmatic risk evaluation, they are usually classified into the following categories:

- Intra-Activity Dependencies
- Inter-Activity Dependencies
- External Events Dependencies.

The intra-activity dependence is used to describe the phenomenon in which a variable (or measured parameter) is dependent on another variable within the same activity. For example, activity direct cost is often a function of duration. Usually, the intra-activity dependencies can be incorporated through mathematical expressions or correlation between distributions.

The inter-activity dependencies are used to describe the phenomenon in which the value or distribution of a measured parameter within one activity may be dependent on the outcome of parameters from another activity. For example, expected duration for an activity late in a project may be changed by the outcome of similar activities early in the project. To account for this type of dependency, distributions in different activities can be correlated (to match the degree of dependence), rather than independently sampled randomly.

External events shape the political, bureaucratic, and social-economic environment under which an activity or project must be conducted. They are important for programs that have long durations and are controversial. Examples of external events include accidents (at Hanford or other facilities), U.S. government regulatory policies and attitudes, public attitude, economic conditions, and interest rates. External events are generally outside the control of the project team but may influence the outcome of multiple activities simultaneously. External events can be modeled as global, random variables to which a number of activities are correlated, or they can be used to define boundary conditions for computing conditional project outcomes.

Data development is an important step in programmatic risk evaluation modeling since, together with activity constraints, input data accuracy ultimately determines the quality of outcomes. Although it may be desirable to comprehensively develop all data, it is not always practical (due to time and resource constraints) and necessary (due to the insignificance of certain

activity) to obtain the most comprehensive data. Trade-offs need to be considered. Therefore, the first step in data development is a screening process to determine the importance of and our state of knowledge about various activities. Based on the screening results, either point estimates or uncertainty distributions will be developed for each task.

A point estimate of either engineering judgment based on past experience or current knowledge of the activity is judged to be sufficient if the potential impact of the task on total results is small. For instance, in duration estimation, less than 1% or another specified amount of the total can be considered as not important. The point estimate is also applicable if we have great confidence about the estimation of the task. For instance, for some tasks, there will be a firm price quote from vendors; therefore, the uncertainty can be neglected. Caution should be exercised in point estimation. The analyst should always know what point (mean, median, or mode) the analyst is estimating. If the estimated value will be combined with other data to produce outcomes, then the mean is the value the analyst should be estimating.

If uncertainties about a parameter cannot be neglected, a probability distribution should be specified to characterize our knowledge of the parameter. The distribution is used to reflect the range and skewness of the parameter based on the available evidence. It usually takes two steps to develop the distribution as follows:

- Choose the applicable distribution based on the central tendency and skewness that the evidence suggests.
- Determine the major attributes (such as mean or variance) of the distribution based on the degree of uncertainty reflected in the evidence.

A variety of distributions can be conveniently modeled using the software package selected for the programmatic risk evaluation. These include normal, lognormal, uniform, triangular, custom user-defined histograms, and discrete distributions.

Data on the duration and cost of tasks is being developed by a variety of members of the decision analysis team. For many of the tasks, the available data are incomplete, and many judgments are involved in data development. When using generic data to make estimates, the applicability needs to be justified. For using expert evidence, the applicability of relevant data also needs to be documented. It is very likely that assumptions made in data development will be identified to be critical by preliminary quantification results. This will prompt the reconsideration of these assumptions. The data analysis forms, shown in Table G-1, are designed to record and reference applicable evidence, and trace all of the assumptions and judgments employed to incorporate it into this decision analysis.

G.2.0 DESCRIPTION OF THE SPENT FUEL PROGRAMMATIC RISK EVALUATION MODEL

G.2.1 OVERVIEW

The primary purpose of the spent fuel programmatic risk evaluation model is to calculate the projected dates for spent fuel removal from the K Basins, the time to achieve interim storage for the fuel and total project cost, all including uncertainty. This is done from data describing the start constraints, duration, and costs for the individual project tasks. Secondary outputs include the projected start and finish dates of the individual tasks and the present value of the project expenditures. The functional layout of the programmatic risk evaluation model showing the major inputs and outputs is depicted in Figure G-3.

Three WINDOWS-based (Microsoft 1992a) application programs were used to develop the construction model for operation on IBM compatible PCs. The application programs are Microsoft™ Excel® (Microsoft 1992b), Crystal Ball® (Decisioneering 1992) by Decisioneering, Inc. and ABC Flowcharter (Micrografix 1992) from Micrografix Inc. The architecture of the model and the interfaces between the application programs are shown in Figure G-4. The layout of the Excel model is described in the paragraphs below.

G.2.2 MODEL LAYOUT

Figure G-5 shows a typical spreadsheet model. Each cell of the spreadsheet is defined by two specifications: task and task attribute. Each row contains the lead time and cost calculations for a project task or sub-task.

The first two columns of the construction cost and lead time spreadsheet define the task identification code and description. Both the task identification code and description cells are manual user entries.

Columns 4, 5, and 6 define the starting date, duration, and finishing date of each task. The timing of a task is completely determined when one of the following doublets has been specified:

- Starting Date, Duration
- Starting Date, Finishing Date
- Finishing Date, Duration.

Two of the three needed parameters must be defined by the user and entered to calculate the third. For most tasks, start constraints and duration are specified, and the finish data is then calculated as the start date plus the duration. The constraints reflect the logic of the project development. The detailed constraints specification for each task can be seen in Attachment G-1.

Column 7 is labeled as the "center date" and is used in the present value cost calculations that follow to the right. The center date generally equals the start date plus one half of the task duration, but can be adjusted as desired to reflect a weighting of expenditures more toward the beginning or end of a task. The center dates are also constrained to be equal or later than the project base year.

G.2.3 UNCERTAINTY ANALYSIS

G.2.3.1 Model Inputs

Both point estimates and probability distributions can be used as inputs for the interest rate, task duration, and task base year costs. The point estimate value or mean value of the probability distribution can be seen directly from the spreadsheet. The distributions for these parameters can be viewed and modified via the Cell Assumption menu when Crystal Ball is used in conjunction with Excel. Figure G-6 shows a Crystal Ball window where typical modifications to the distribution (normal) can be performed by changing the mean and/or the standard deviation.

In general, point estimates have been limited to two situations as follows:

1. The item is common to all Alternatives and, therefore, will not be critical to the decision process.

2. Input is less critical, for instance, a cost of less than 1% of the total.

For all other inputs, probability distributions have been developed and a full explanation is given in Attachment G-1 on the development of the distribution.

G.2.3.2 Model Outputs

The main outputs are the projected dates for fuel removal, stabilization, and total cost. Results shown on the spreadsheet are mean values, which can be (user specified) the real mean or estimated mean values. Uncertainties associated with these outputs are depicted by the probability distributions that are calculated by Crystal Ball. These distributions can be shown as frequency charts, as well as statistical attributes contained in reports created by Crystal Ball. Figure G-7 shows a typical Crystal Ball report with a cumulative frequency chart. There is no automatic computer-generated link between the spreadsheet model and the chart or report, and each update of the spreadsheet requires a new simulation.

The frequency charts are direct results of either Monte Carlo or Latin Hyper Cube simulation, which shows the percentages of cases against the parameters of interest. The X-axis of the frequency chart for the project in-service date shows the date (formatted as xx/xx/xx), and the Y-axis shows the percentages of simulated cases. If the date interval about 3/14 had a

value of 0.10 in the frequency chart, there would be 10% chance the project would be finished on about 3/14. The same information used in creating the frequency chart is used in determining the statistical attributes such as mean or percentiles. A number of attributes calculated in Crystal Ball can be shown in the report. For our present purpose, the mean, 20th and 80th percentiles, are selected to represent our state of knowledge of the outputs.

G.2.4 ASSUMPTIONS FOR THE HANFORD SPENT FUEL PROGRAMMATIC RISK EVALUATION

The following analysis assumptions and boundary conditions were used:

- The programmatic risk evaluation was developed in conjunction with the project schedule and contains essentially the same task precedent relationships. The model currently assumes that sufficient resources can be committed to the project to complete parallel tasks when they impact the project schedule.

- It is assumed that National Environmental Policy Act of 1969 compliance can be obtained for construction of temporary wet fuel storage facilities with an interim environmental impact statement, because they do not prejudice the decision for final disposition of fuel. Actions to construct stabilization facilities or procure associated equipment must wait on the Hanford site-specific environmental impact statement, which will take longer.

- No distinction was made regarding the licensing environment among the various Alternatives. Times for preparation and review of safety analysis reports were formulated as common durations for the design approaches of all Alternatives, with the only exception being a larger uncertainty associated with the review cycle of safety analysis reports for the stabilization versus storage facilities. In particular, durations and uncertainties for the review cycle represent an environment of continuing cooperative and constructive interaction between the project engineers and the reviewers to move the project ahead while achieving reasonable confidence that the health and safety of the public and workers are maintained.

- The schedule uncertainty estimates were developed through coordination with WHC engineers, operations, and licensing personnel having experience in this area, considering the rate at which work can be reasonably accomplished under the physical limitations of the facilities. These distributions represent the potential variability in the tasks due to normal or anticipated problems associated with the variability of total operating efficiency over long periods.

- The cost uncertainty estimates were applied only to major design and construction costs, based on the contingency factors applied by Kaiser for a first estimate of typical facility configurations. A large majority of the life-cycle costs is associated with common

costs, which are currently estimated as point values. Therefore, the cost uncertainties in the programmatic risk evaluation results are smaller than actually expected. They do not yet reflect the combined judgement of the design team considering programmatic changes, etc.

- The initial version of the programmatic risk evaluation does not address the likelihood of catastrophic events, such as legal challenges that generate court delays, accidents that stop work for long periods of time, formal review communications and requests for information that generate second and third review cycles, or programmatic decisions that limit our ability to commit resources to the project.

G.2.5 DATA SOURCES

Point estimate data for the programmatic risk evaluation was obtained in close coordination with the cost and schedule model. In many cases, it was taken directly from that model. In other cases, the risk and cost/schedule analyst jointly queried the relevant experts to obtain the needed information.

Program tasks were subjected to a screening evaluation to determine the quantities whose uncertainties would have the most impact on the decision. As meeting Tri-Party Agreement commitments have a large impact on stakeholder values and would also produce reduction in the costs of continued operation of facilities that will be decommissioned and decontaminated, uncertainties in the schedule were given the majority of consideration in the programmatic risk evaluation.

G.2.5.1 Task Duration Uncertainty Estimates

The schedule uncertainty estimates were developed through coordination with WHC engineers, operations, and licensing personnel having experience in this area, considering the rate at which work can be reasonably accomplished under the physical limitations of the facilities. These distributions represent the potential variability of the tasks due to normal or anticipated problems associated with the variability of total operating efficiency over the duration of the task.

First, the point estimates provided to the cost and schedule model by the proponent or responsible engineer were verified. The uncertainty distributions were then developed using evidence provided by, and/or the engineering judgement of, key WHC engineers and operations personnel during elicitation meetings and follow-up conversations.

The available information regarding the tasks is either very preliminary or incomplete. Therefore, engineering judgment was an important part of the development of the uncertainty distribution parameters. The elicited expert

evidence and the application of this information are documented on data element records following the format in Table G-1. A data element record has been created for each programmatic task in the programmatic risk evaluation model and is available in supporting documentation.

It is very likely that assumptions made in data development will be identified as being critical during the review of the quantification results. This will prompt the reconsideration of these assumptions. The data element record forms will be a valuable starting point for further analysis and evaluations of the sensitivity of the decision to the current state of knowledge.

G.2.5.2 Cost Estimates

The cost uncertainty estimates were applied only to major design and construction costs. They were based on the contingency factors applied by Kaiser for a first estimate of typical facility configurations. They were developed as follows:

- The baseline cost estimate was taken to be the 20th percentile of the cost distribution.
- The baseline cost estimate plus the 50% contingency used by Kaiser was taken to be the 80th percentile of the cost distribution.
- Distribution parameters were derived assuming the cost is lognormally distributed (e.g., the probability that the median cost will by multiplied by a factor of A is the same as the probability that it will be divided by that factor. This generates a larger range of higher costs than lower costs).

A large majority of the life-cycle costs are associated with common costs not related to facility construction, which are currently estimated as point values. Therefore, actual cost uncertainties are larger than the cost results indicate.

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G.3.0 RESULTS AND CONCLUSIONS

G.3.1 DESCRIPTION OF ALTERNATIVES EVALUATED

The four Alternatives evaluated for the Hanford Spent Fuel decision are summarized in Chapter 4 and described in detail in Appendix C. To assist in programmatic risk evaluation logic development, the task relationships were shown graphically in activity flowcharts that summarize program breakdown and activity constraints for each major Alternative. The flowcharts use rectangular blocks to represent the events and activities. The arrows represent the flow and constraints of activities. The amount of detail in the activity flowchart is directly correlated with the task breakdown. The main (Level 1) chart shows the top level tasks normally of interest to higher management. More elaborate supplemental (Level 2 and Level 3) flowcharts are built as necessary to more completely describe the precedents and dependencies among the events. Flowcharts for the four spent fuel Alternatives are shown on Figure G-8, consisting of 16 sheets labeled A through D for each of the four Alternatives with sheet A being the top level chart for each Alternative.

G.3.2 MODEL OUTPUT

Figures G-9 through G-11 compare the four Alternatives in terms of three programmatic decision criteria: (1) date of removal of fuel and sludge from the K Basins, (2) date that fuel is stabilized at Hanford or shipped out-of-country, and (3) total cost. The key parameters of these distributions are summarized in Table G-2. However, the following general observations influence the decision process:

- Durations and uncertainties for the regulatory review cycle assumed in the programmatic risk evaluation represent an environment of continuing cooperative and constructive interaction between the project engineers and the reviewers to move the project ahead while also achieving reasonable confidence that the health and safety of the public and workers will be maintained. This environment must be established and enforced at all levels of management throughout the life cycle of the facility.

- All Alternatives (except Alternative 4) are vulnerable to a regulatory decision that extensive canister level testing will be required to demonstrate that passivated fuel is stable. This question is addressed in other sections of this report. The potential efforts of this issue are not fully reflected in the uncertainties used in the programmatic risk evaluation at this time.

- Since the costs of continued operation of existing facilities are high, selection of an option with a higher construction cost but with excellent potential for shortening or reducing the uncertainty in the schedule to shutdown can be cost beneficial.

- Alternative 2 provides a pre-interim storage facility that can be constructed in time to provide high confidence that the fuel and sludge can be removed from the K Basin by December 31, 2002, to meet the Tri-Party Agreement. The other Alternatives do not provide confidence of achieving this objective.

- Alternative 2 is the most expensive of the three local processing options, but the uncertainties associated with the costs make the differences in cost less significant. Currently, the uncertainty in licensing time for the passivation facility is only slightly larger than for the pre-interim storage facility, since the K Basin can be shutdown under Alternative 2 without relying on the passivation facility. If the licensing issues arise for the passivation facility, the costs associated with the other Alternatives will rise relative to Alternative 2.

- Alternatives 1 and 3 both require that the passivation facility be constructed and operated before fuel can be moved from the basin. The uncertainties in that process are reflected by the later dates at which fuel removed will be completed and the larger spread between the 10th and 95th percentile dates. As a result, one can not have high confidence of removing the fuel from the K Basin, even within a couple of years of the Tri-Party Agreement commitment.

Conclusions with respect to individual Alternatives are summarized below:

- **Alternative 1**

  - Overall uncertainty in the time to remove fuel from the K Basins is great because fuel movement is dependent on the resolution of technical and regulatory issues for processing. Also, ALARA concerns resulting from the extensive fuel packaging operations required in the K Basins increase the total time, cost, and uncertainty predicted for these tasks.

  - Achieves good cost performance because temporary storage is accomplished in the K Basins rather than at a new facility. This is counteracted, however, by the need to repack all fuel before processing.

  - NEPA compliance uncertainty is minimized because the final disposition of the fuel is not prejudiced by temporary storage.

- **Alternative 2**

  - Achieves the best results for removal of fuel from K Basins by minimizing required packing operations and decoupling fuel movement from processing.

  - Cost performance is not as good as Alternatives 1 or 3 due to the costs for construction operation and decommissioning of the temporary storage facility.

- NEPA compliance uncertainty is minimized because the final disposition of the fuel is not prejudiced by temporary storage.

- **Alternative 3**

  - ALARA concerns resulting from the extensive fuel packaging operations required in the K Basins increase the total time, cost, and uncertainty predicted for these tasks. This, combined with the need to completely repack all fuel before processing, produces longer predicted time and greater schedule uncertainty for fuel removal than Alternatives 2 or 3.

  - NEPA compliance uncertainty is high because the final disposition of the fuel is prejudiced by commitment to a specific process, even though the commitment is not irreversible.

  - Alternative 3 offers the best overall costs performance because temporary storage is not needed, and fuel handling is done only once.

  - Uncertainties in the schedule for the desludging and fuel loading operations have the potential to cause significant delays in the removal of fuel and sludge from the K Basin in Alternative 3. Achieving the target schedule of 24 months requires operating with 20 shifts per week across both basins at a total operating efficiency of 75%, with 85% being the maximum practical sustained total operating efficiency. With the concentrated effort in both basins and the complexity of the operations in the basin, it was judged that there is a 20% probability that the total operating efficiency could drop to 50%. This results in Alternative 3 to have the longest schedule for removal of fuel from K Basin.

- **Alternative 4**

  - Alternative 4 offers the worst performance on cost measures, even if foreign processing costs were reduced to the minimum value of the quoted price range.

  - Schedule performance is driven by the requirement to repack all fuel (K east and west) for shipment to Sellafield and the 5-year period required to complete shipment. Alternative 4 will not meet the Tri-Party Agreement as a result.

  - Cost performance is driven by the need to build processing and storage facilities for sludge, none of which can be shipped with the fuel.

  - This is the only option that yields materials ready for final disposition. Reprocessing products to be returned are plutonium oxide, uranium oxide, and vitrified high-level waste, all compatible with existing defense material inventories.

Detailed model output for Alternatives 1 through 4 is included in Attachment G-2. Detailed input and output for the Recommended Path Forward can be found in Attachment G-3.

G.4.0 PATH FORWARD ANALYSIS

The Programmatic Risk Evaluation analysis results for the composite path forward Alternatives are presented and compared to the base four Alternatives in Table G-3 and Figures G-12 through G-14.

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G.5.0 REFERENCES

Microsoft Corporation, 1992a, *User's Guide for the Microsoft Windows Operating System*, Version 3.1, Redmond, Washington.

Microsoft Corporation, 1992b, *Microsoft Excel User's Guide*, Version 4.0, Redmond, Washington.

Decisioneering Inc., 1992, *Crystal Ball for Windows*, Version 2.0.

Micrografix, Inc., 1992, *ABC FlowCharter User's Guide*, Version 2.0.

Table G-1. Data Element Record Form

TASK DATA SHEET OUTLINE

- TASK DESCRIPTION
  - Scope of Activities and Differences between Alternatives for this Task
  - Associated Work Breakdown Structure Tasks
- CONSTRAINT
  - Task Begins on June 1, 1994
  - Constraints for Each Alternative
  - Correlations with the Durations of Other Tasks (When Appropriate)
- COST AND SCHEDULE DATA

Alt. No.	Task Duration Data Attributes					Cost Data Attributes				
	Type	20	Mean	80	Source	Type	20	Mean	80	Source
1										
2										
3										
4										

- PROGRAMMATIC RISK/EVIDENCE
  - Technological Uncertainty
  - Regulatory Uncertainty
  - Dependencies on External Events
  - Any Other Key Factors or Events that will Influence the Outcome of this Task

Table G-2. Results of Programmatic Risk Assessment

Criteria	Parameter	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Date Fuel Removed from K-Basin	95th %-tile	09/2006	03/2002	06/2007	02/2005
	Mean	11/2003	04/2001	04/2004	10/2003
	10th %-tile	04/2002	09/2000	07/2002	11/2002
Date Fuel Stabilized	95th %-tile	09/2006	05/2007	06/2007	05/2005
	Mean	11/2003	04/2004	04/2004	01/2004
	10th %-tile	04/2002	06/2002	07/2002	02/2003
	95th %-tile	$1,358	$1,400	$1,342	$3,122
Total Costs	Mean	$1,168	$1,271	$1,151	$2,654
	10th %-tile	$1,063	$1,196	$1,036	$2,199

Table G-3. Results of Programmatic Risk Assessment

Criteria	Parameter	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Path Forward
Date Fuel Removed from K-Basin	95th %-tile	09/2006	03/2002	06/2007	02/2005	04/2002
	Mean	11/2003	04/2001	04/2004	10/2003	06/2001
	10th %-tile	04/2002	09/2000	07/2002	11/2002	11/2000
Date Fuel Stabilized	95th %-tile	09/2006	05/2007	06/2007	05/2005	11/2008
	Mean	11/2003	04/2004	04/2004	01/2004	04/2006
	10th %-tile	04/2002	06/2002	07/2002	02/2003	10/2004
Total Costs	95th %-tile	$1,358	$1,400	$1,342	$3,122	$1,298
	Mean	$1,168	$1,271	$1,151	$2,654	$1,208
	10th %-tile	$1,063	$1,196	$1,036	$2,199	$1,147

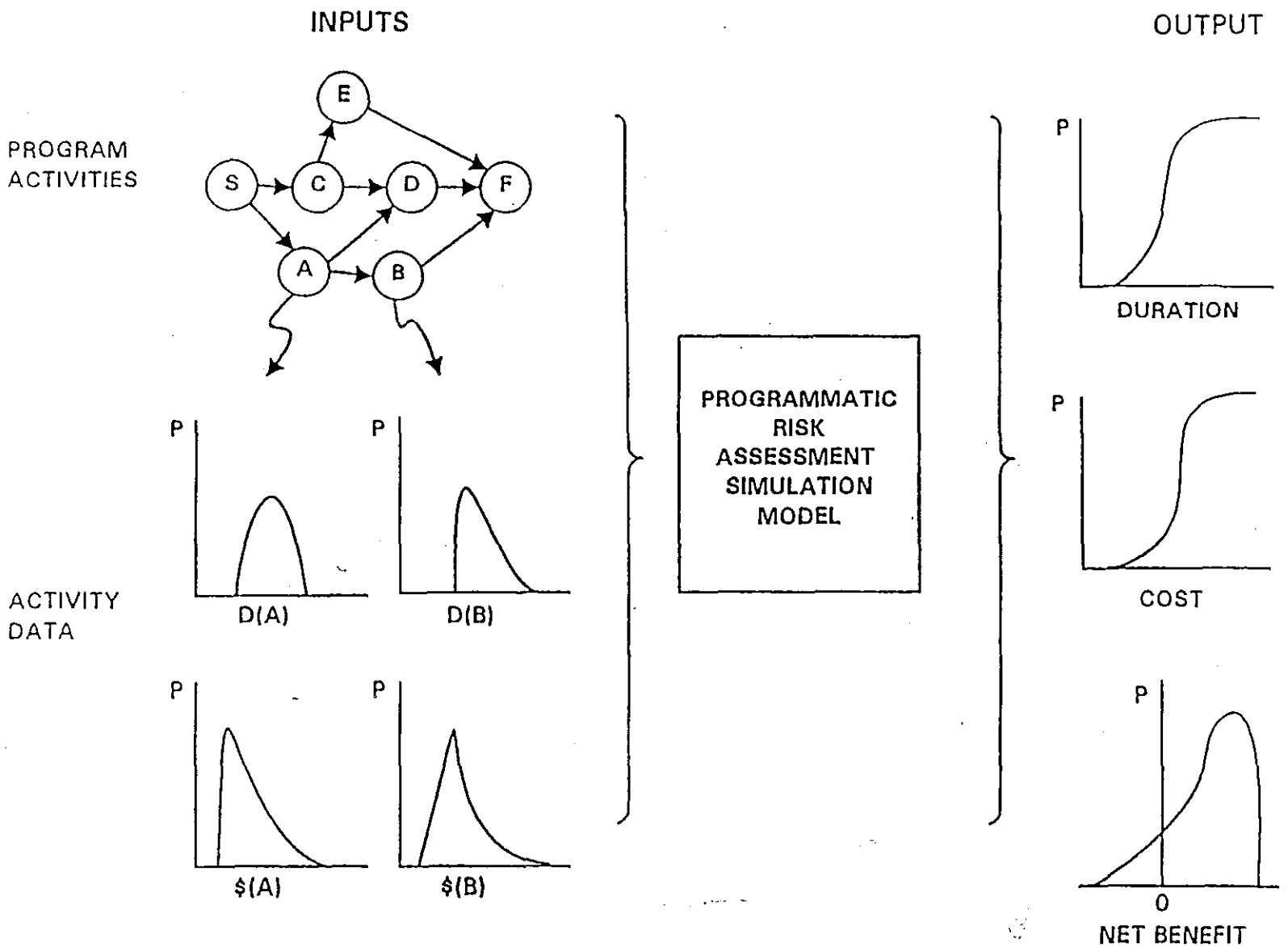
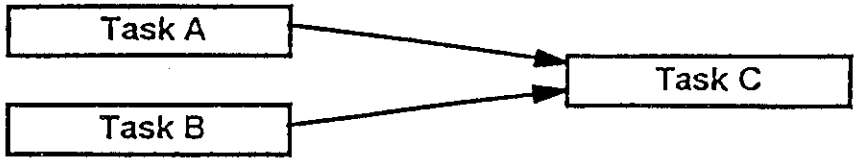


Figure G-1. Programmatic Risk Assessment



	Task A Duration	Task B Duration	Task C Start
Point Value Result	12.00	12.00	12.00

Simulation Results for Task C Start:

Statistics:		Percentile	Task C Start
Trials	2500	0%	6.39
Mean	13.75	5%	9.82
Median	13.64	25%	11.99
Mode	13.02	50%	13.63
Standard Deviation	2.49	75%	15.46
		95%	17.95
		100%	21.99

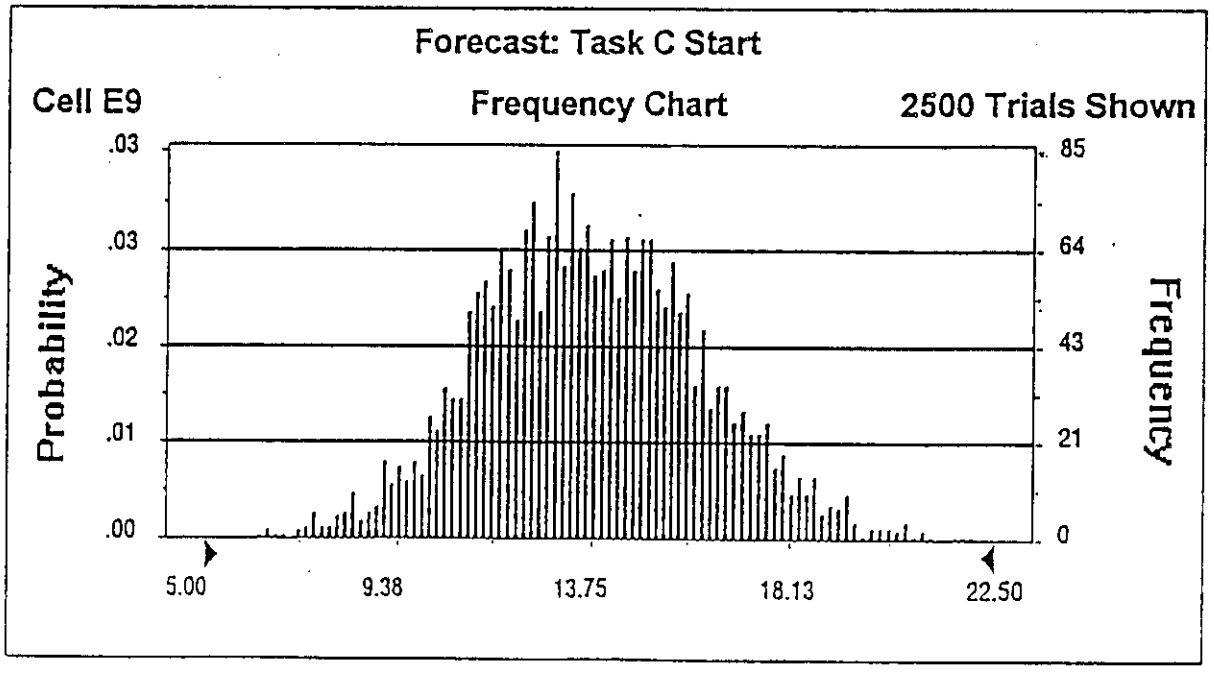


Figure G-2. Schedule Push

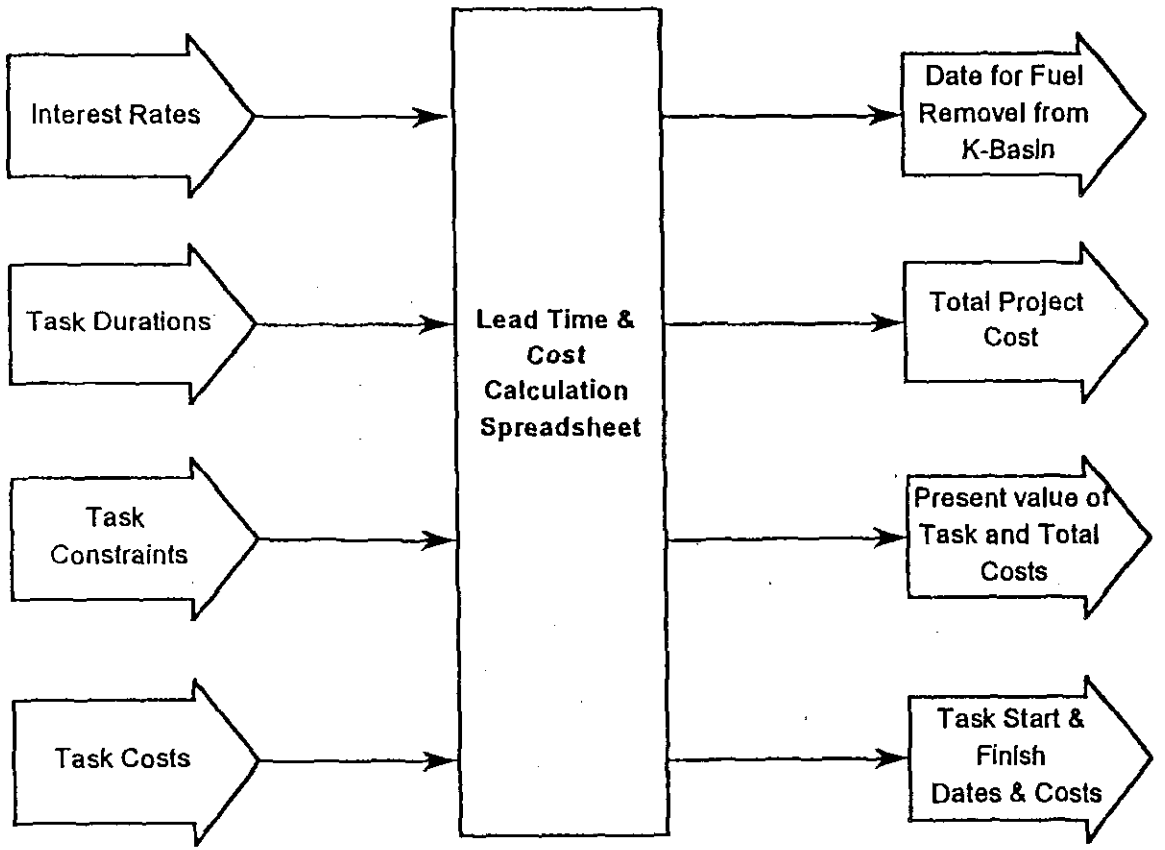


Figure G-3. Functional Layout of Spent Fuel PgRE Model

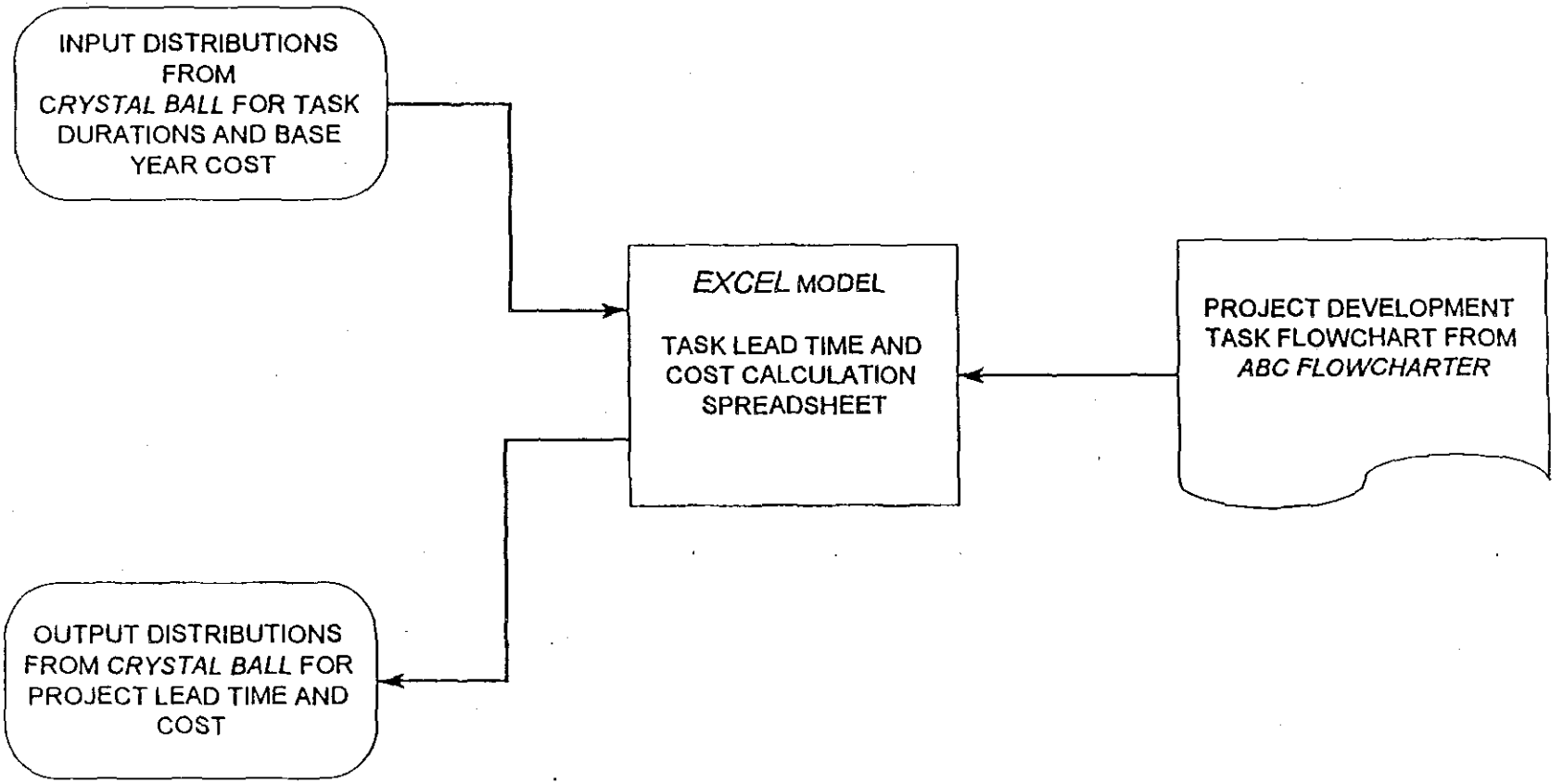


Figure G-4. Spent Fuel PgRE Model Architecture and Program Interfaces

ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	KBO	K-Basin Operations	6/1/94	117.539	3/17/04	4/24/99	36	365.62	$316
	KBSD	K-Basin Shutdown	3/18/03	36.000	3/18/06	9/16/04		90.00	$66
	DEC	Decision on Spent fuel Storage path forward	11/1/94	0.000	11/1/94	11/1/94		0.00	$0
	ADM	Prepare, review & approve NEPA ADM	11/1/94	5.799	4/26/95	1/28/95		0.20	$0
	EIS	Prepare, review & approve interim action EIS & ROD	1/31/95	28.530	6/17/97	4/9/96		2.00	$2
1.0	CHAR	Characterization of Fuel & Sludge	6/1/94	41.178	11/5/97	2/17/96		13.30	$13
2.0	PAC	Packaging Fuel & Sludge in K-Basin							
	KBSAR	Design of K-Basin equipment & SAR update	4/26/95	3.000	7/26/95	6/11/95		0.08	$0
	KBOK	DOE Approval of K-Basin SAR	7/26/95	5.000	12/26/95	10/10/95		0.03	$0
	GETOP	Procure Fuel & Sludge Overpacks	7/26/95	48.521	8/11/99	8/3/97		11.00	$10
	GETBEQ	Procure K-Basin Overpack Equipment	7/26/95	6.772	2/17/96	11/6/95		4.50	$4
	INBEQ	Install K-Basin Overpack Equipment	6/17/97	2.847	9/12/97	7/31/97		4.50	$4
	GETSLGEQ	Procure Sludge Removal Equipment	7/26/95	16.764	12/18/96	4/6/96		20.20	$19
	INSLGEQ	Install Sludge Removal Equipment	6/17/97	17.853	12/13/98	3/16/98		2.50	$2
	KBORR	K-Basin ORR	12/18/96	34.757	11/10/99	5/31/98		5.00	$4
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport							

Figure G-5. Sample Spreadsheet Model

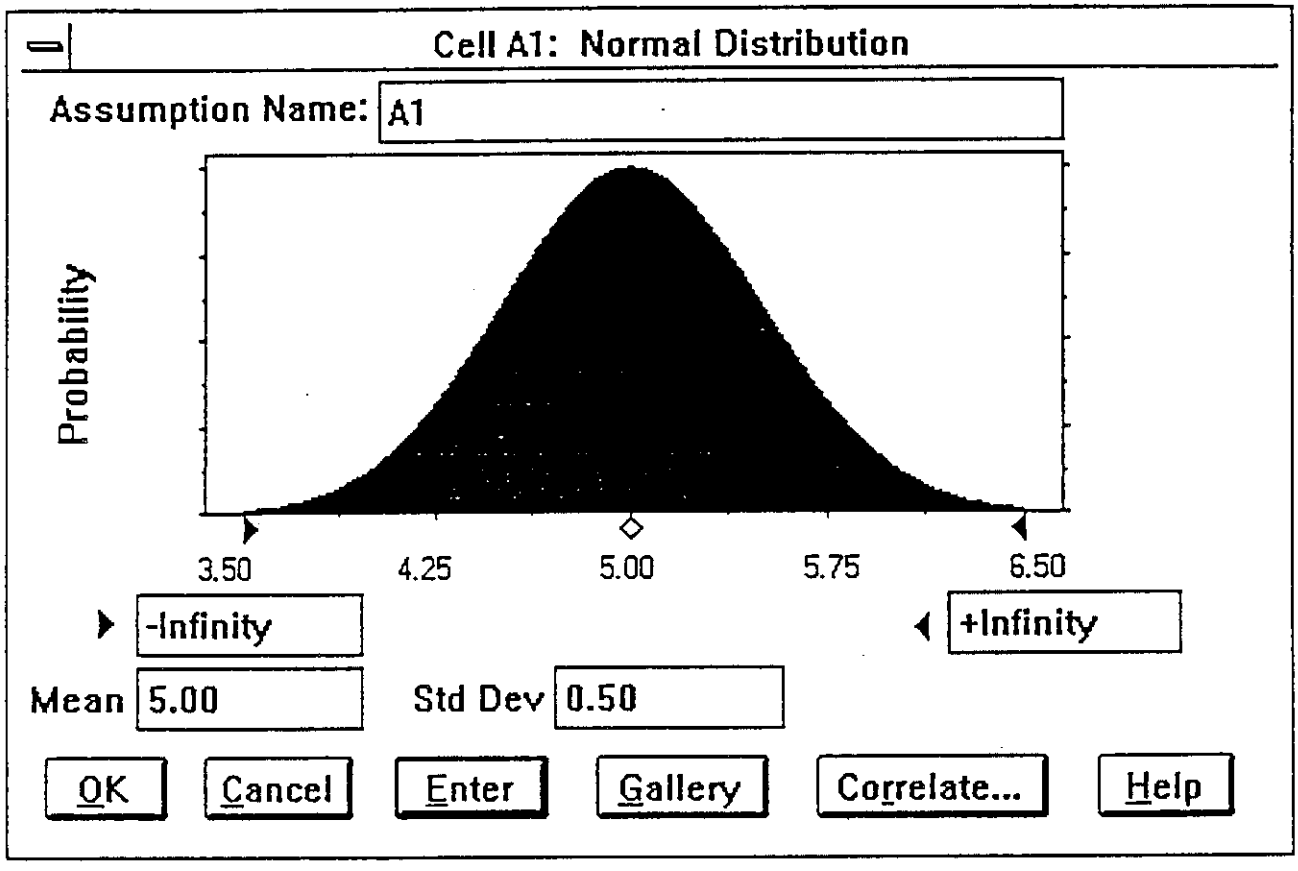
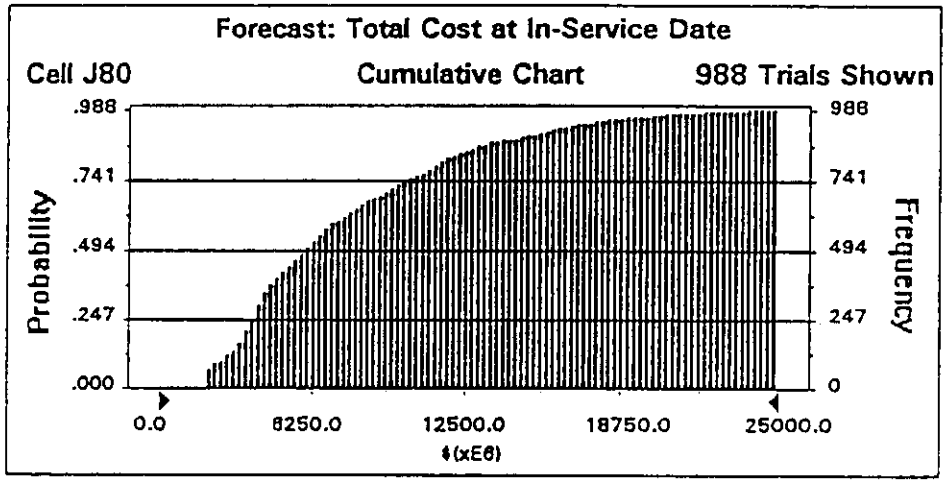


Figure G-6. Sample Crystal Ball Window

Forecast: Total Cost at In-Service Date **Cell: J80**

Statistics:	Value
Trials	1000
Mean	7983.4
Median (approx.)	6238.2
Mode (approx.)	3962.4
Standard Deviation	6223.7
Mean Std. Error	196.81



Percentile	$(xE6) (approx.)
0%	1912.7
10%	2780.1
20%	3734.6
30%	4260.8
40%	5070.7
50%	6238.2
60%	7542.5
70%	9519.3
80%	11660.0
90%	15611.3
100%	83899.5

Figure G-7. Sample Simulation Output

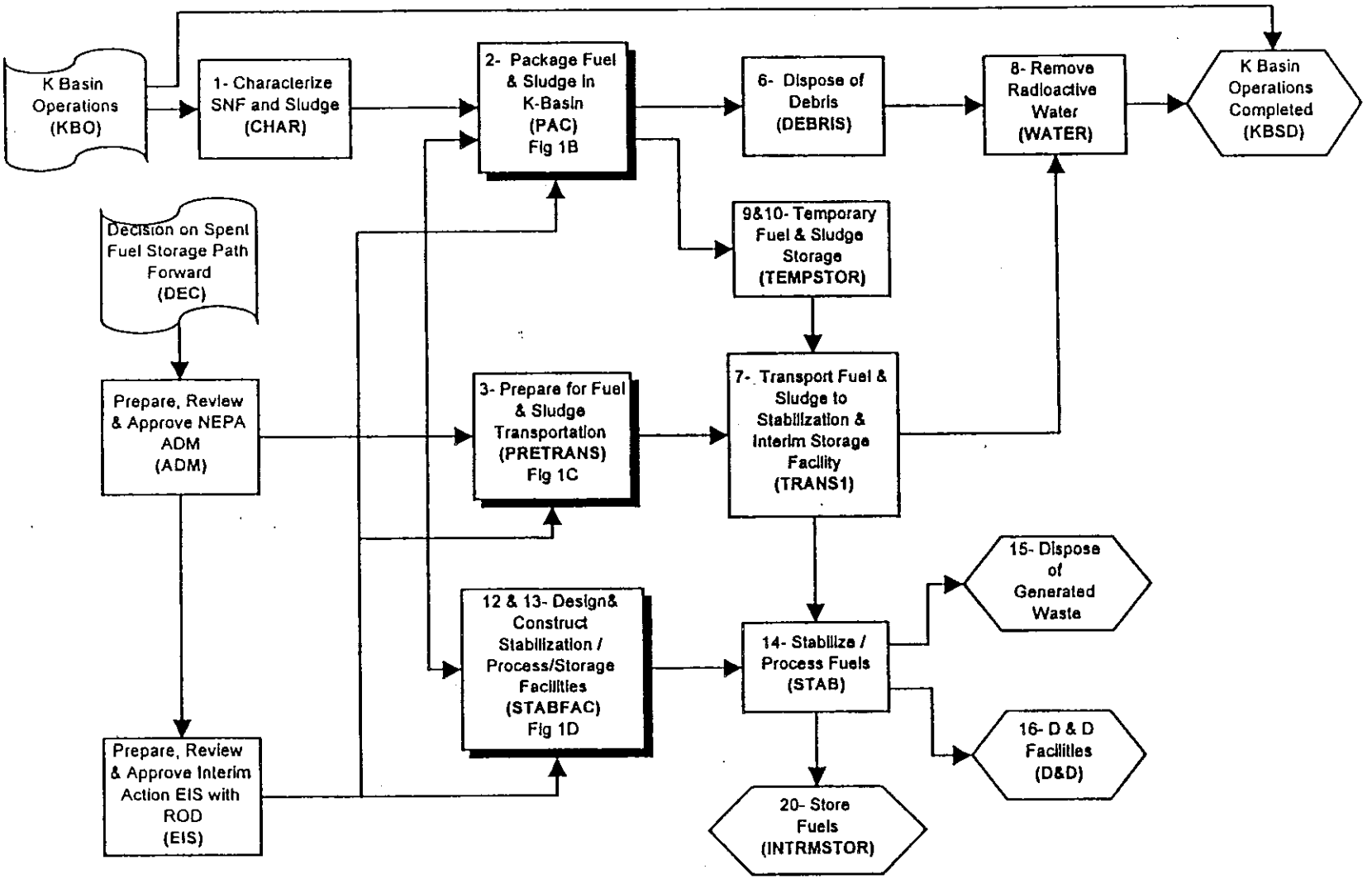


Figure G-8 (Page 1 of 16). Alternative 1 Top Level Flowchart

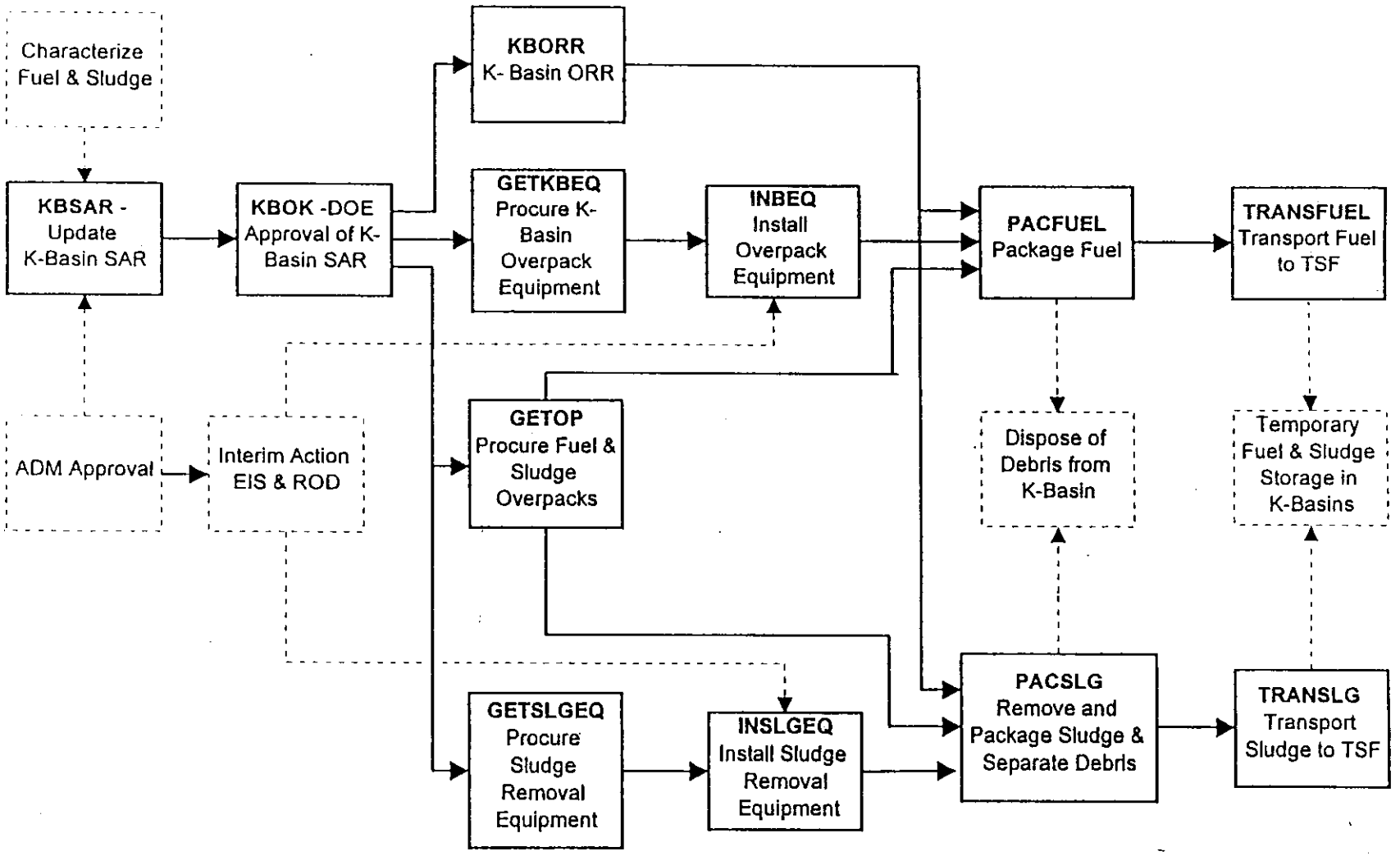


Figure G-8 (Page 2 of 16). Alternative 1 Package and Transport Fuel and Sludge

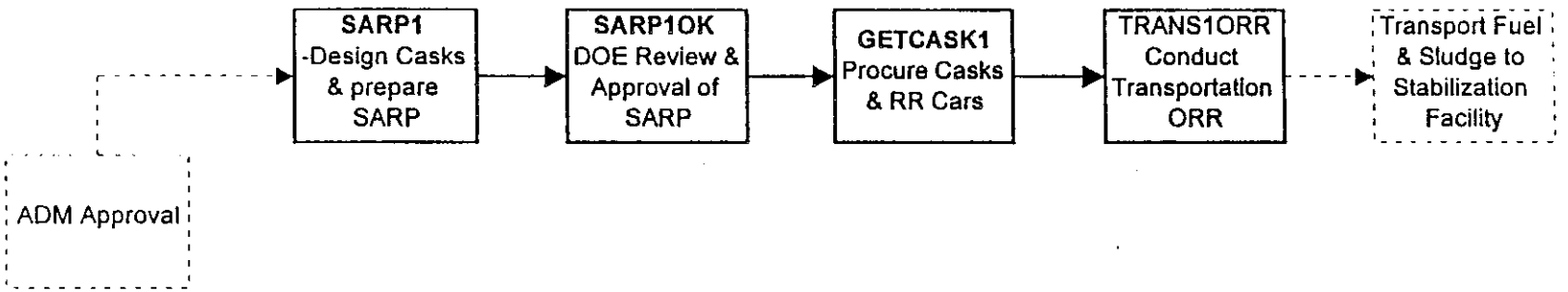


Figure G-8 (Page 3 of 16). Alternative 1 Level 2 Tasks

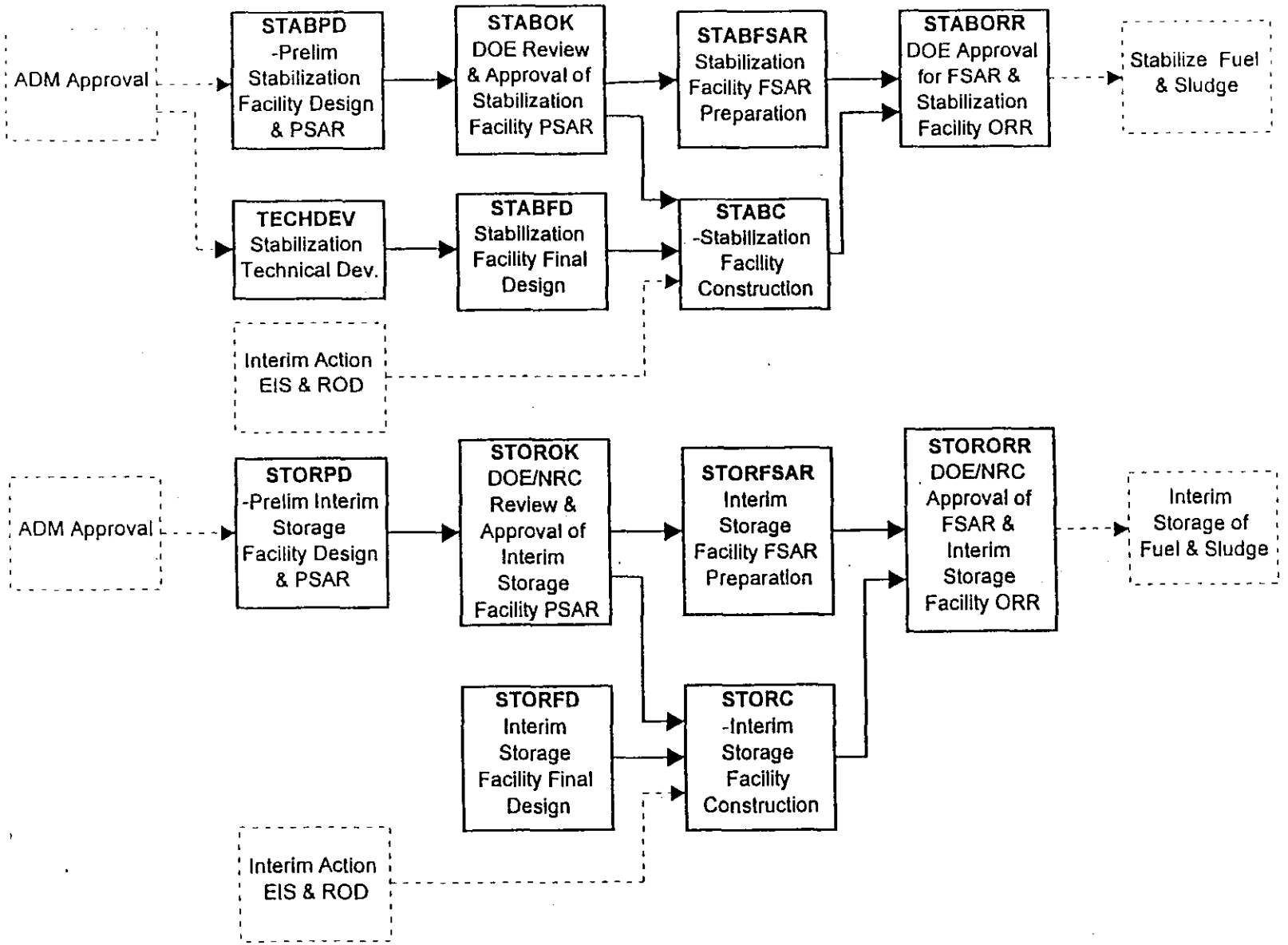


Figure G-8 (Page 4 of 16). Alternative 1 Level 2 Tasks

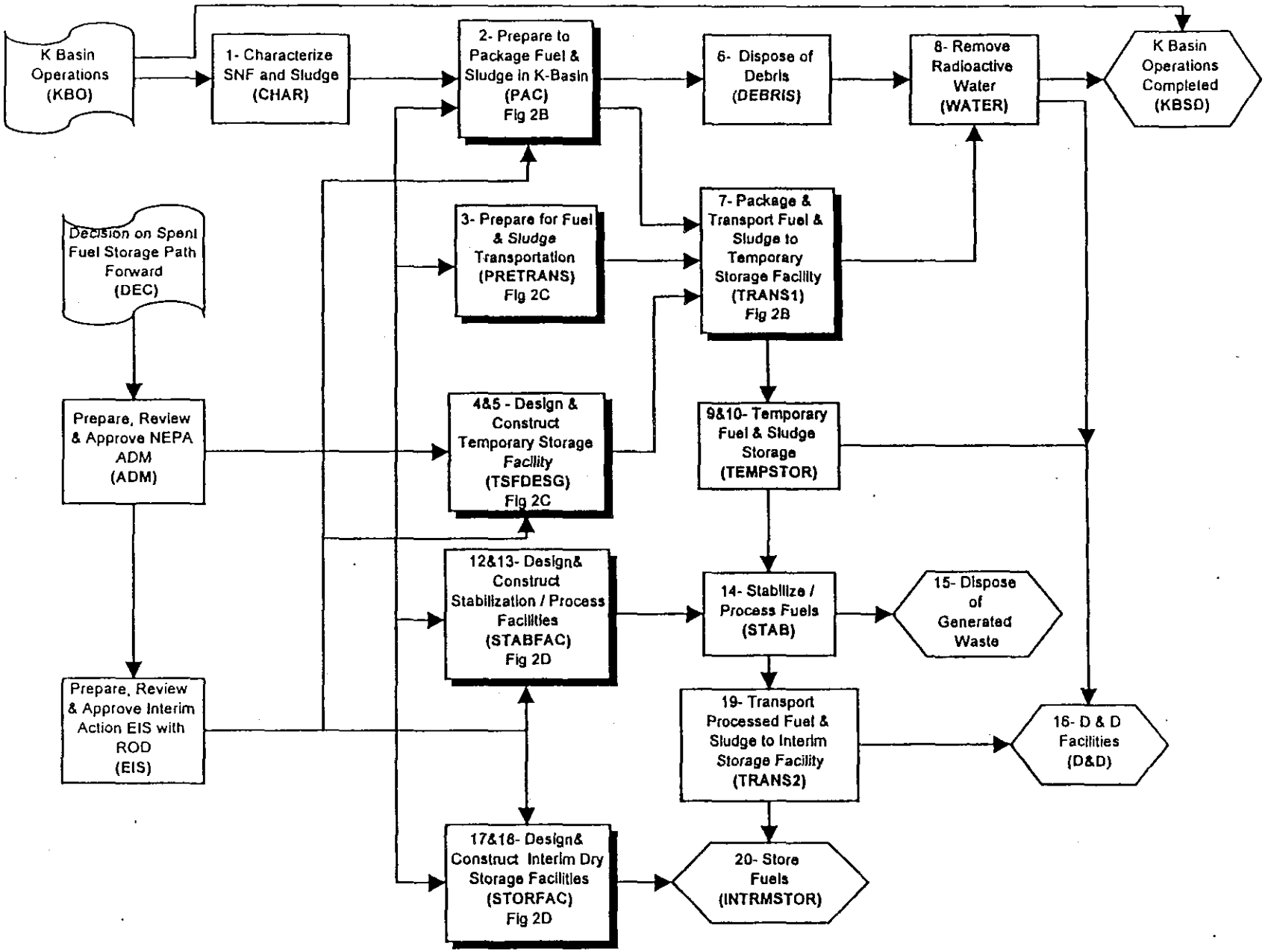


Figure G-8 (Page 5 of 16). Alternative 2 Top Level Flowchart

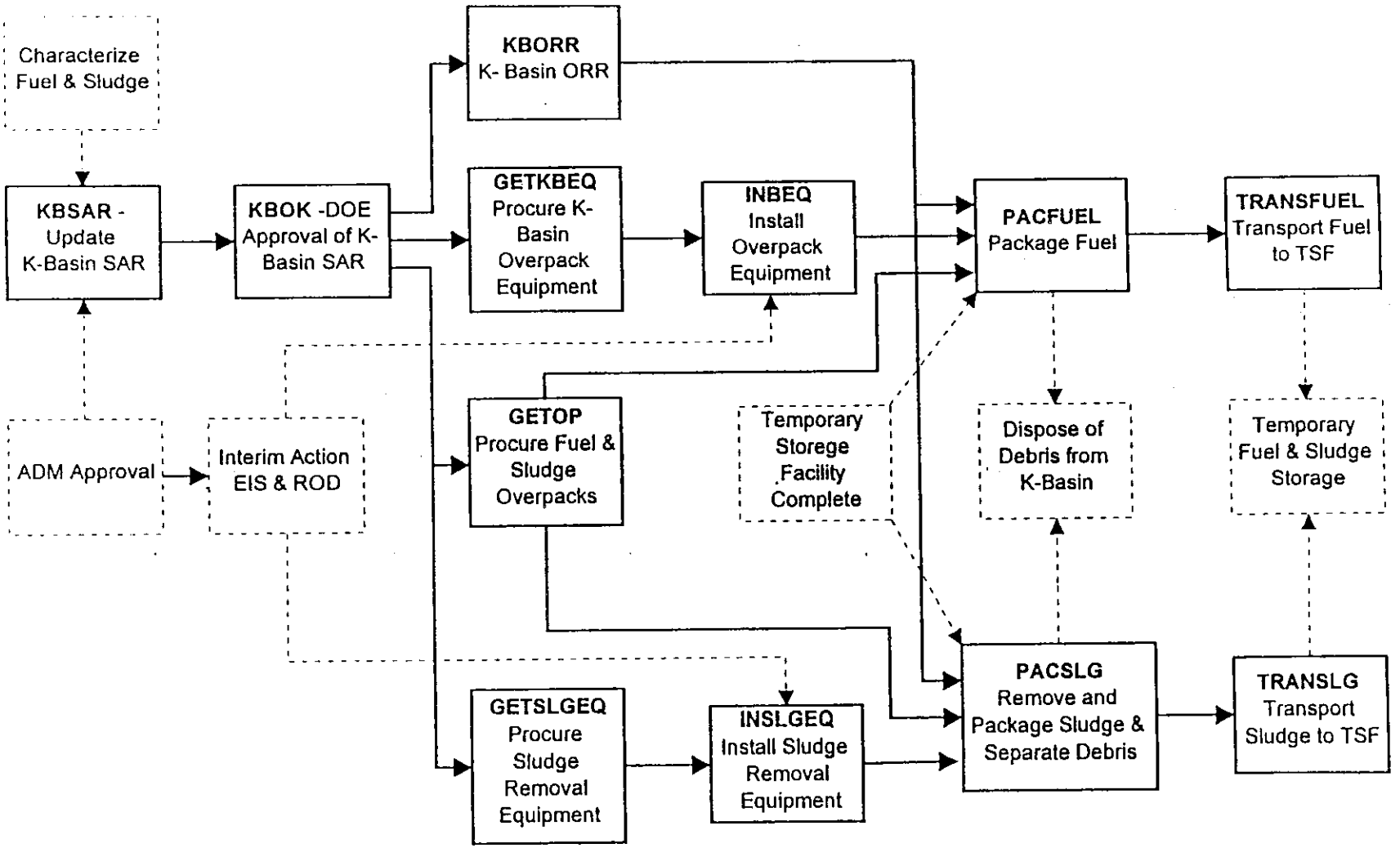


Figure G-8 (Page 6 of 16). Alternative 2 Package and Transport Fuel and Sludge

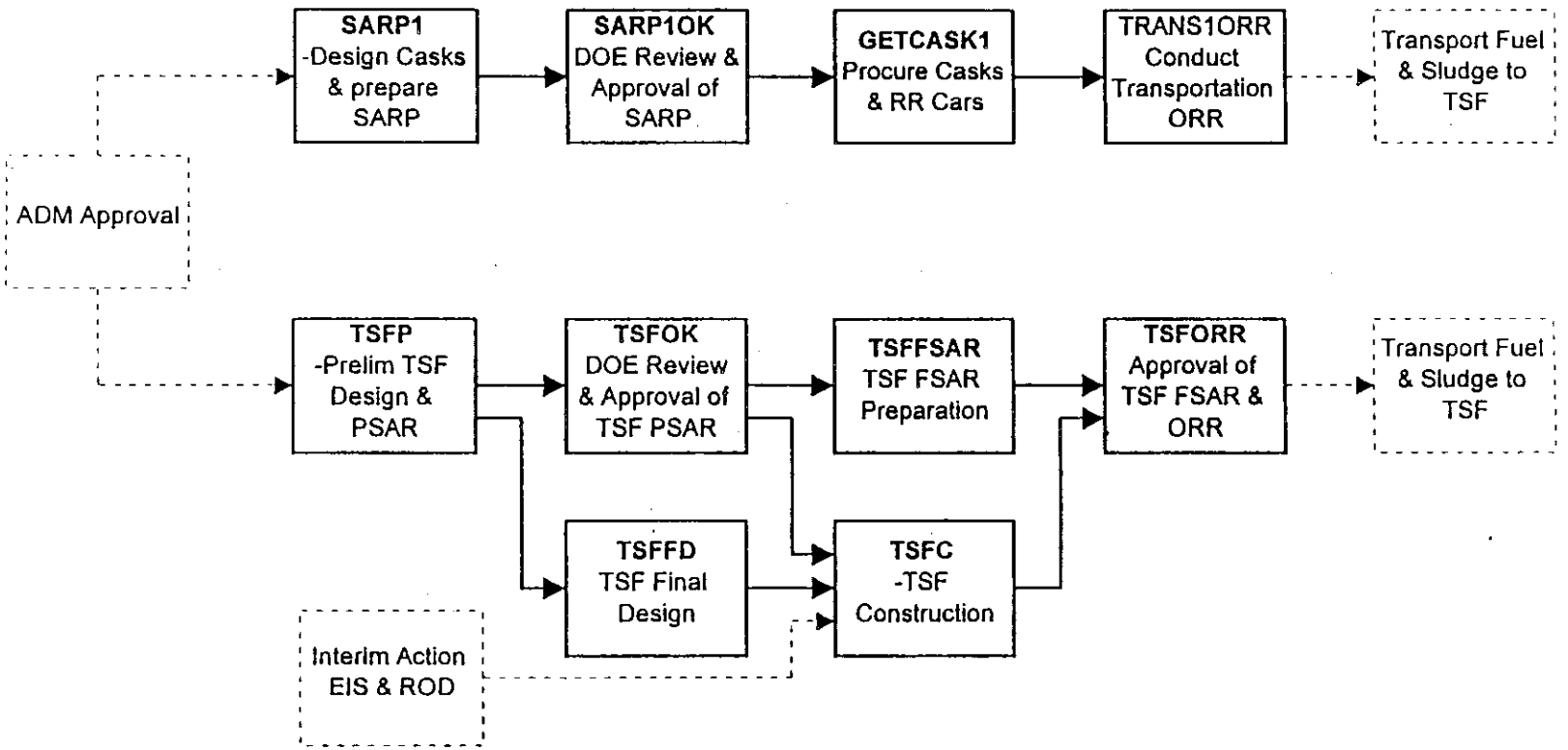


Figure G-8 (Page 7 of 16). Alternative 2 Level 2 Tasks

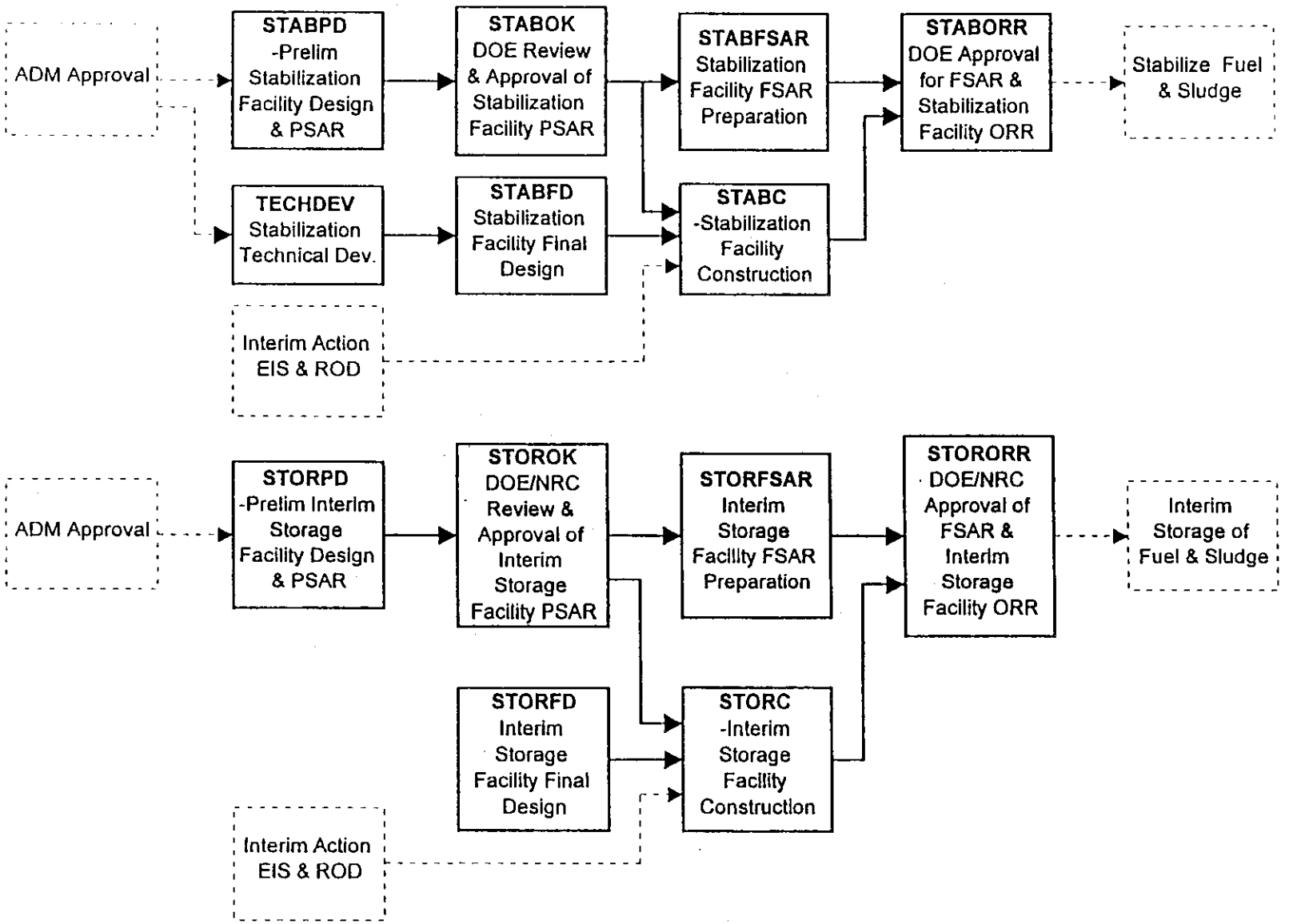


Figure G-8 (Page 8 of 16). Alternative 2 Level 2 Tasks

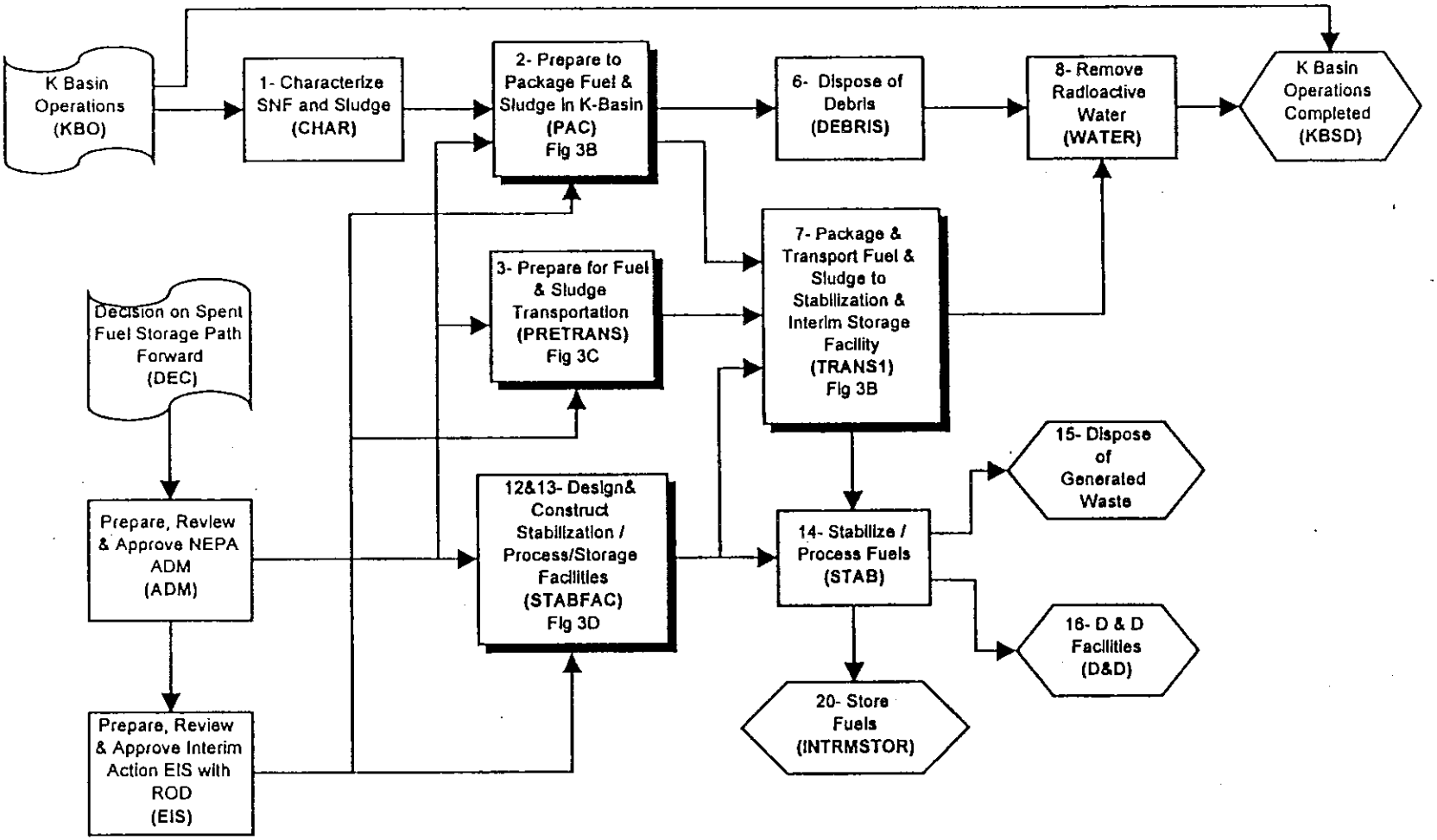


Figure G-8 (Page 9 of 16). Alternative 3 Top Level Flowchart

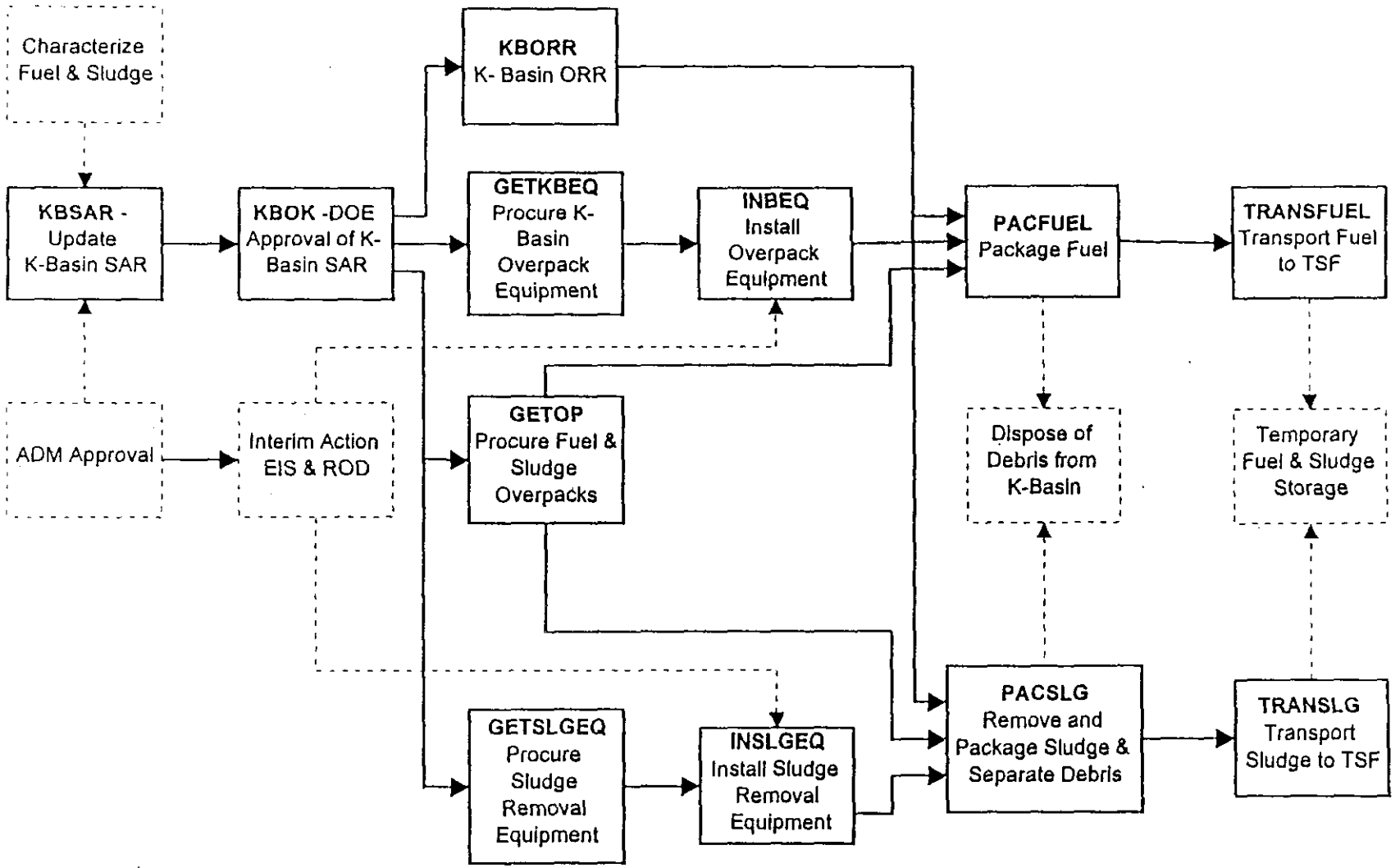


Figure G-8 (Page 10 of 16). Alternative 3 Package and Transport Fuel and Sludge

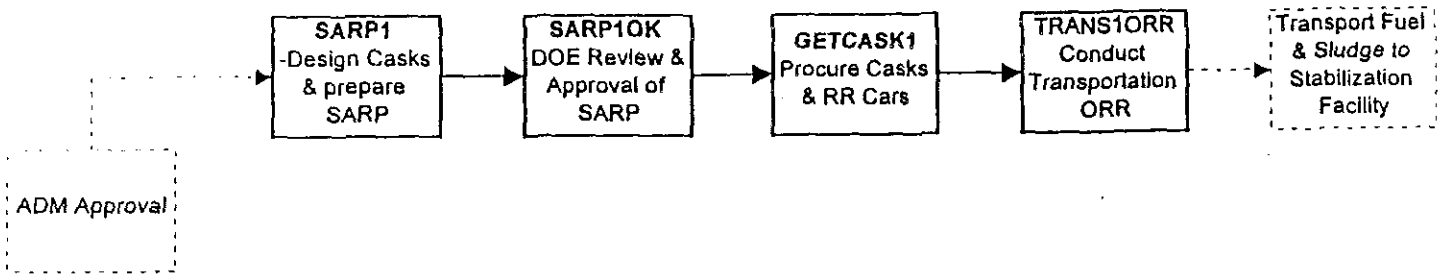


Figure G-8 (Page 11 of 16). Alternative 3 Level 2 Tasks

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PLG

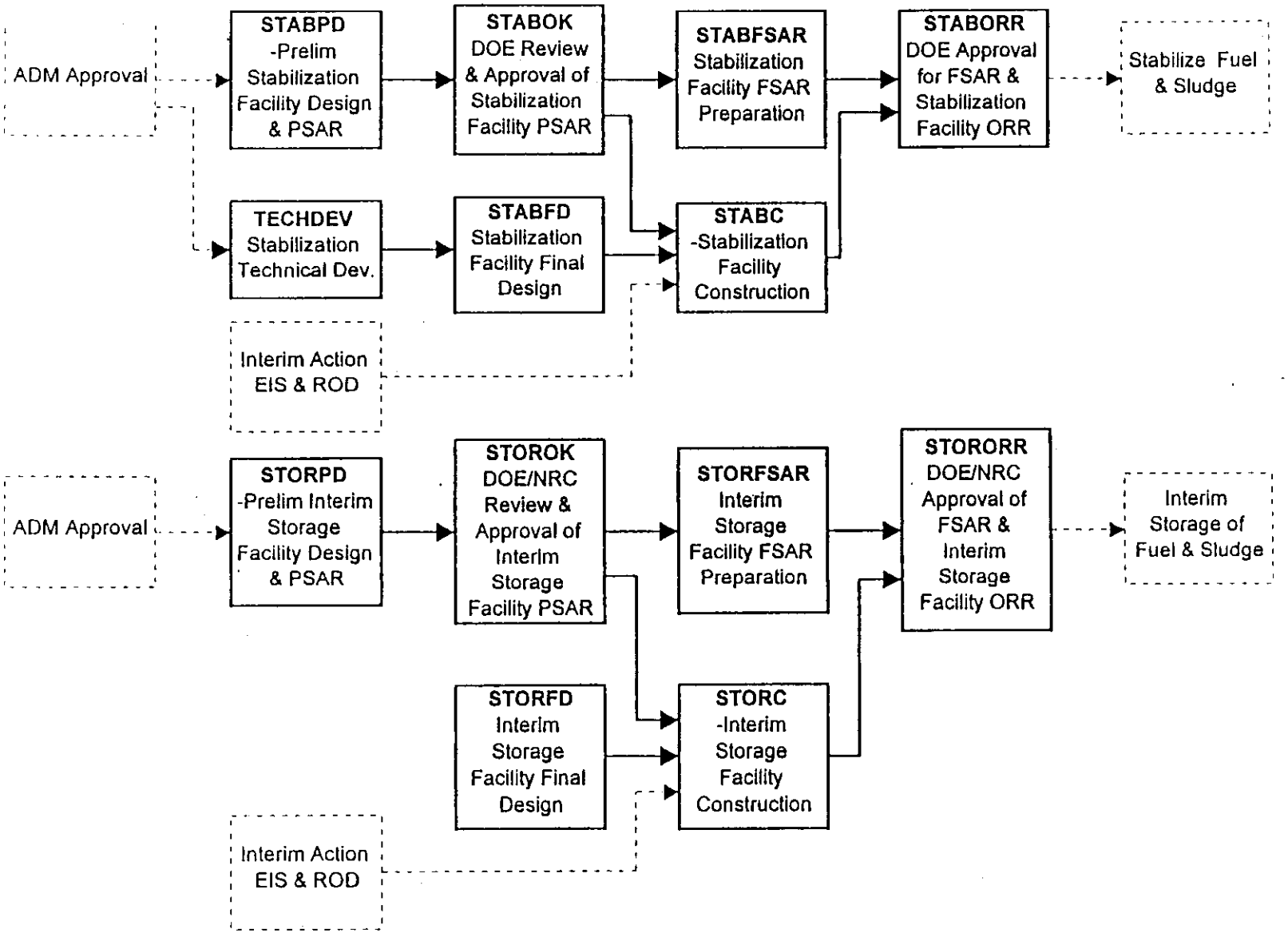

Figure G-8 (Page 12 of 16). Alternative 3 Level 2 Tasks

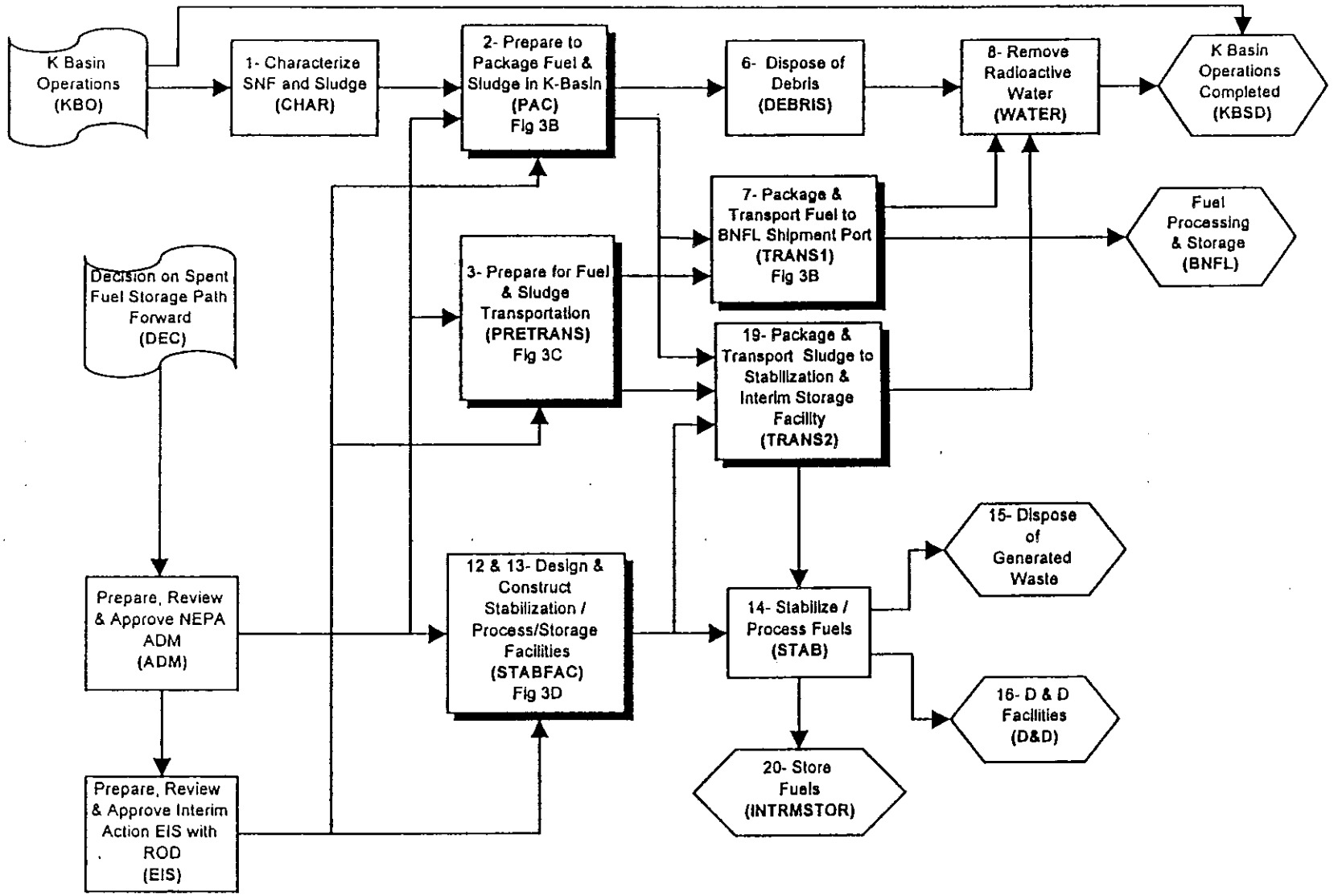

Figure G-8 (Page 13 of 16). Alternative 4 Top Level Flowchart

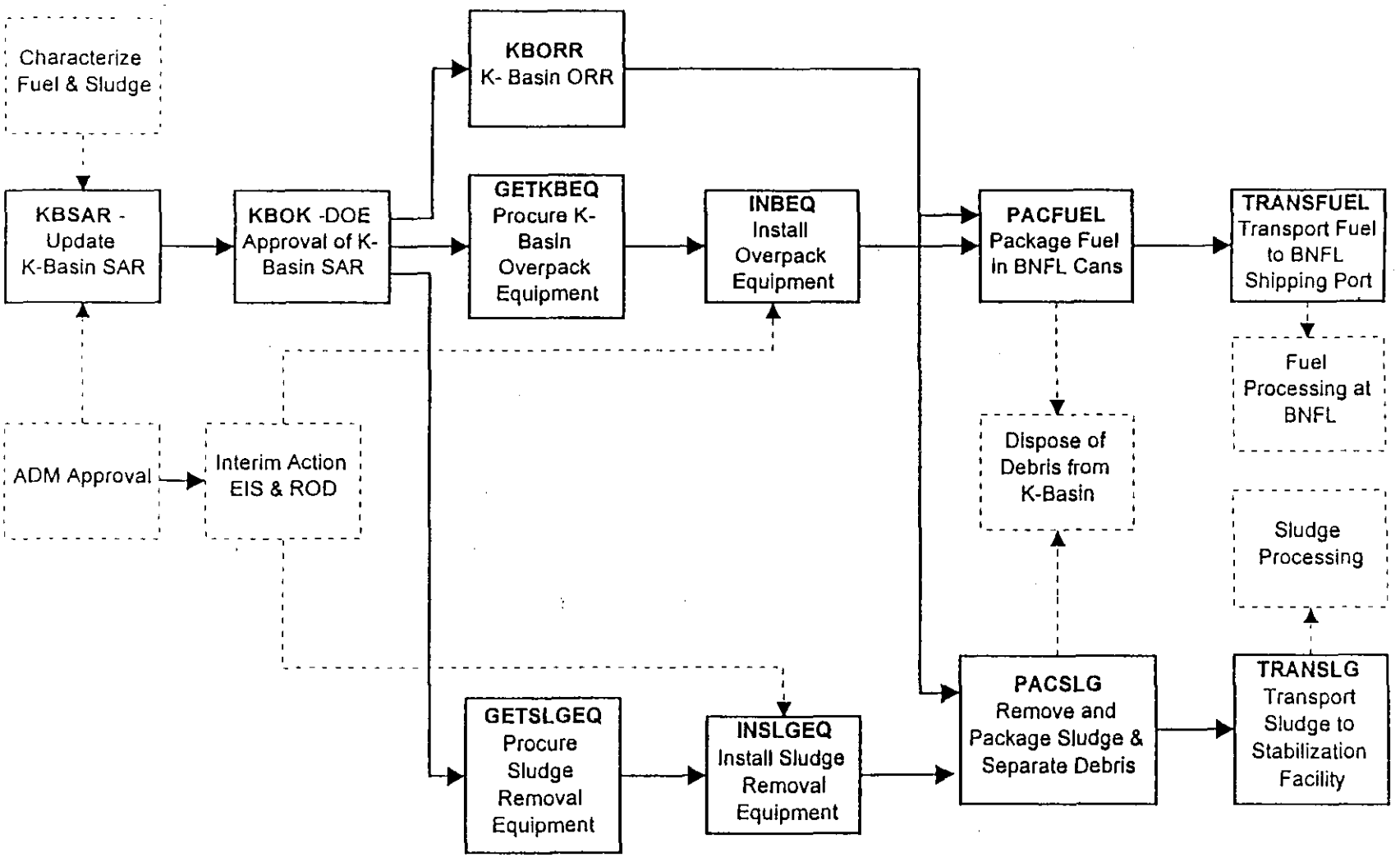

Figure G-8 (Page 14 of 16). Alternative 4 Package and Transport Fuel and Sludge

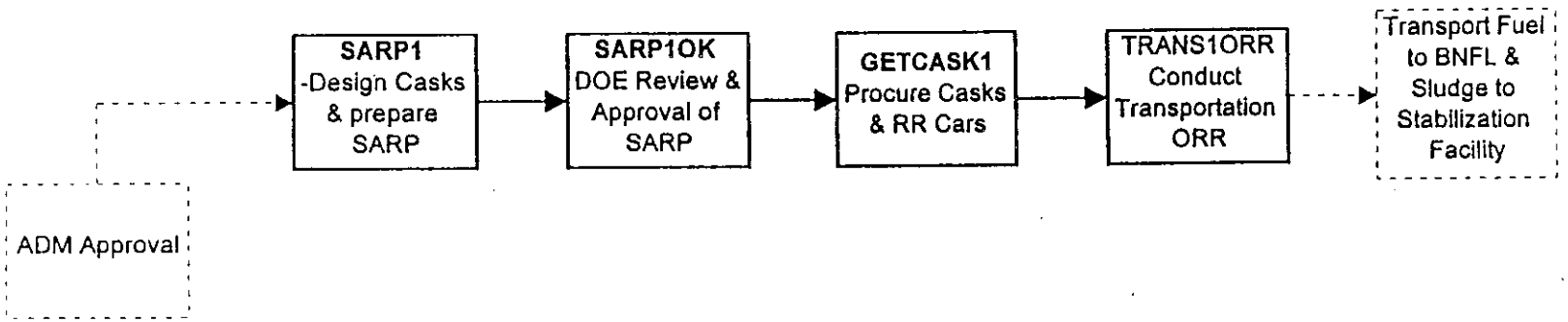

Figure G-8 (Page 15 of 16). Alternative 4 Level 2 Tasks

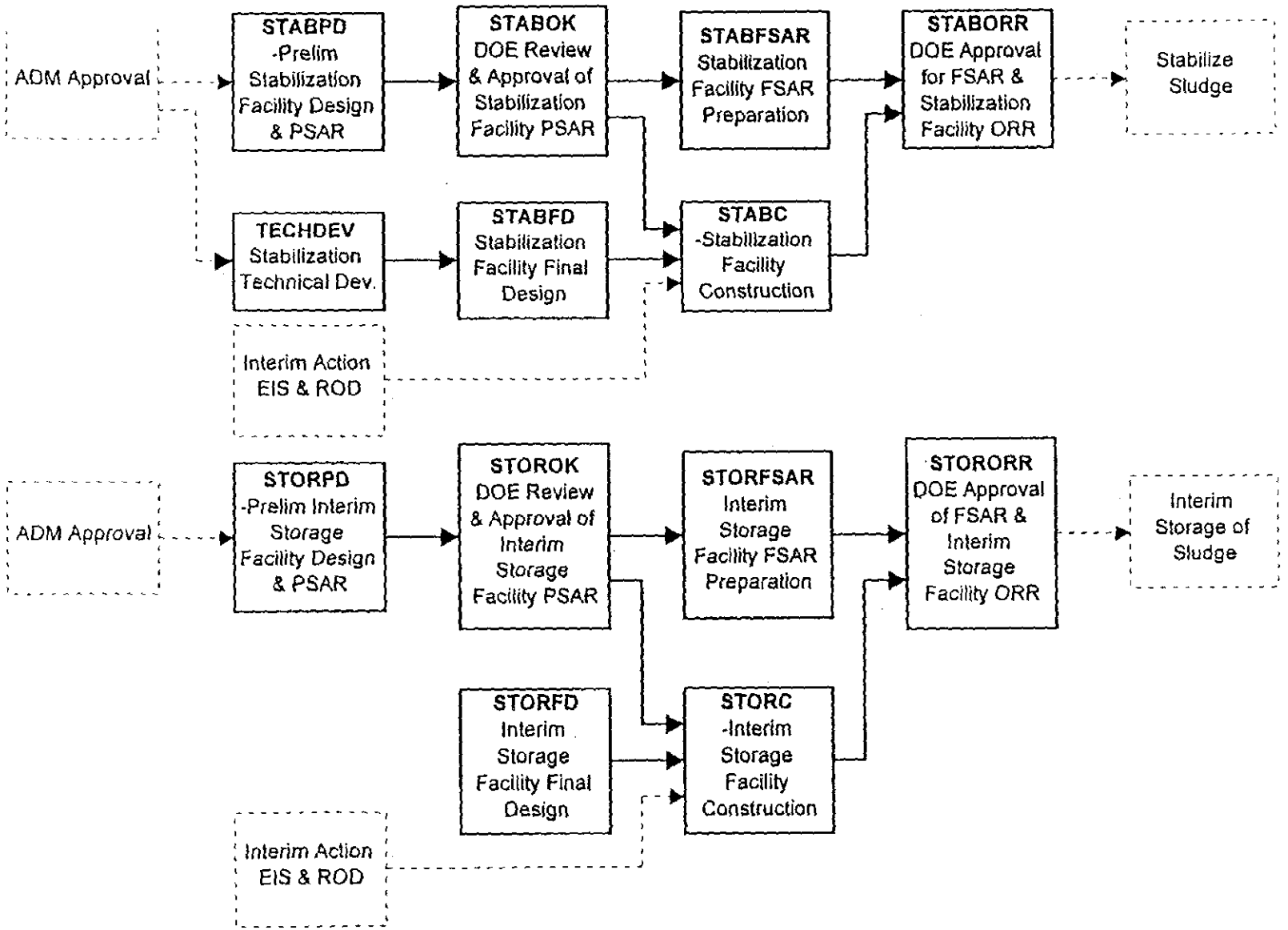

Figure G-8 (Page 16 of 16). Alternative 4 Level 2 Tasks

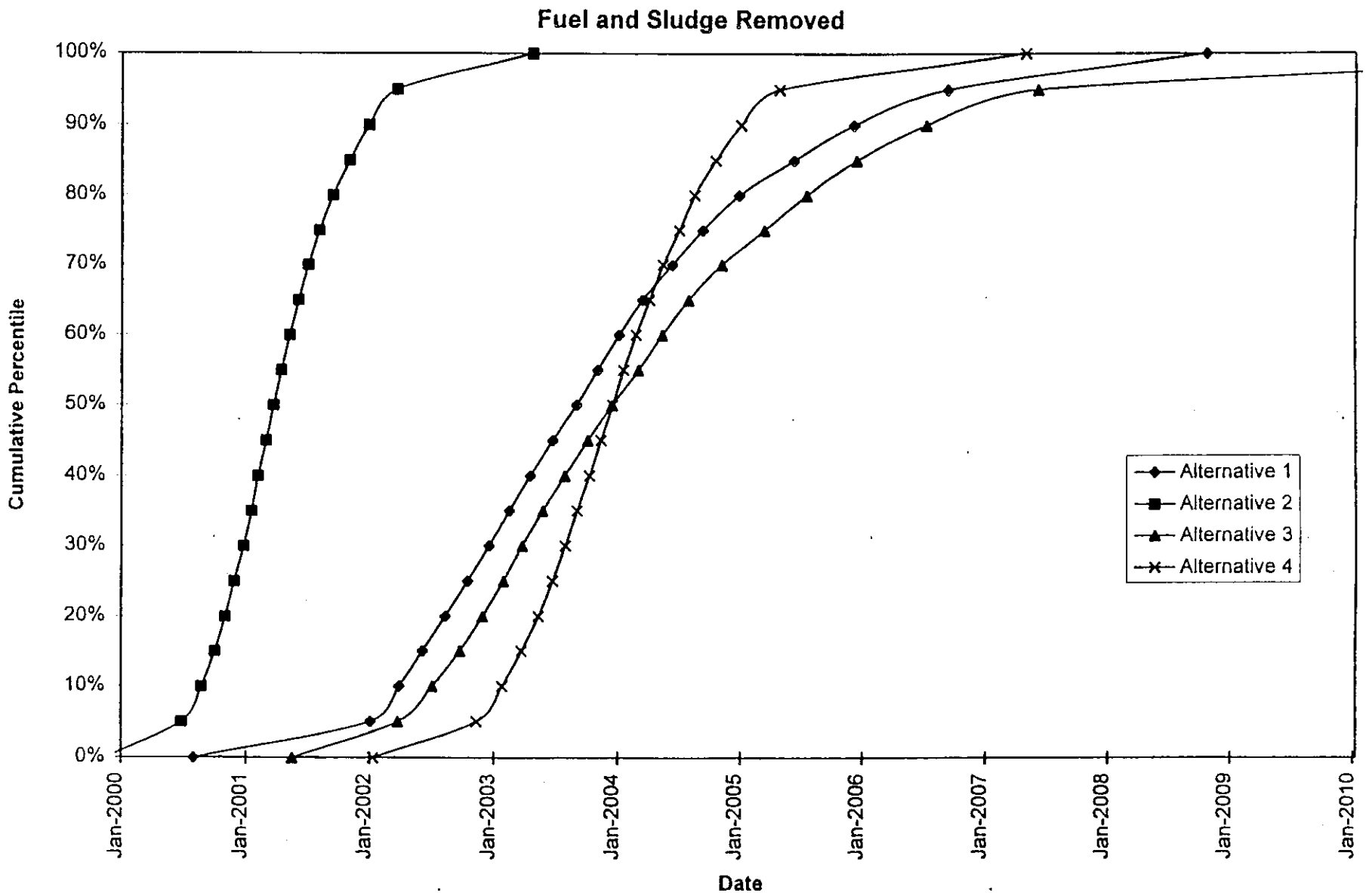

Figure G.9. Distributions for Fuel and Sludge Removed from K Basins, Alternatives 1-4.

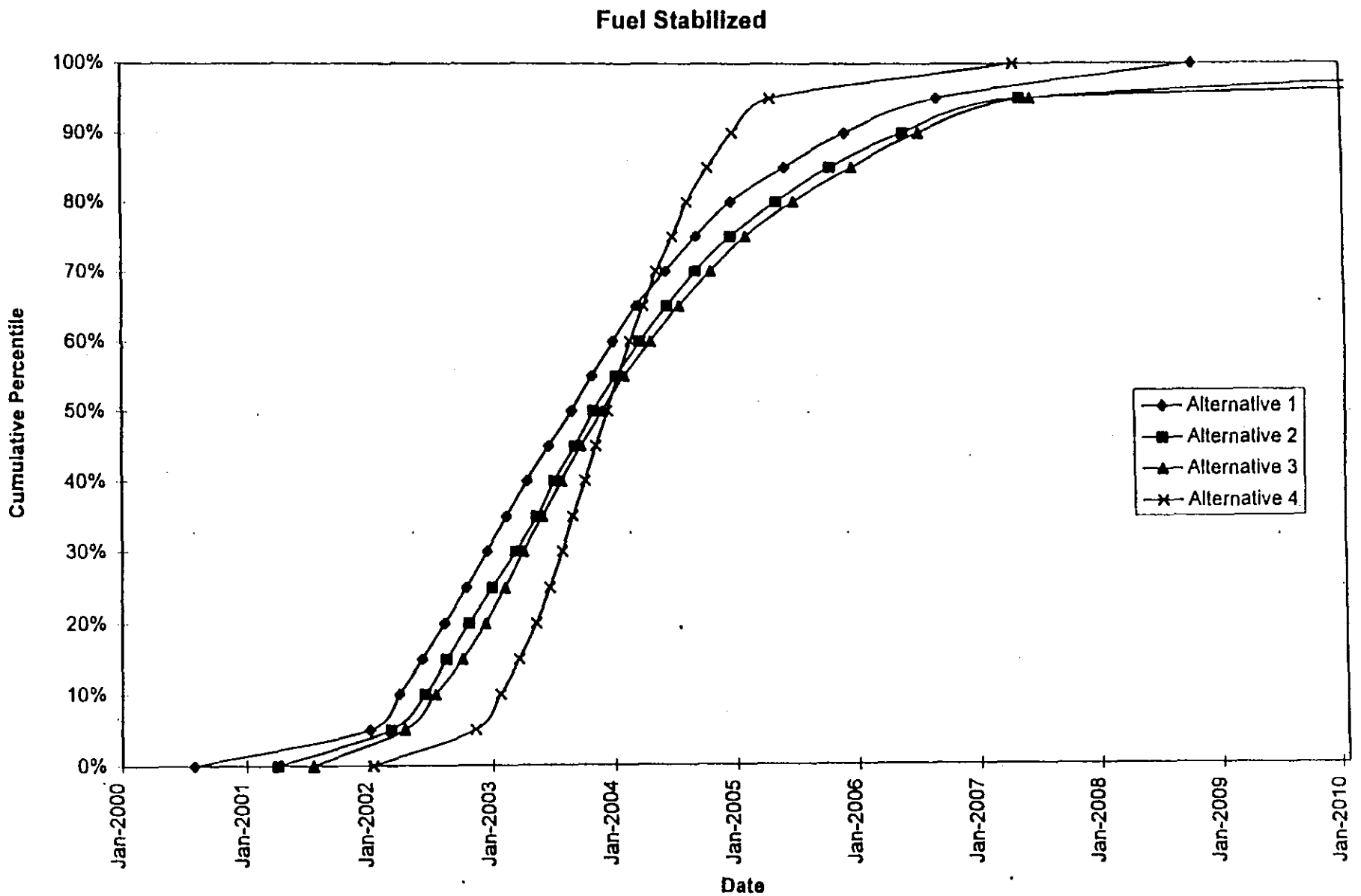

Figure G.10. Distributions for Fuel Stabilized Date, Alternatives 1-4.

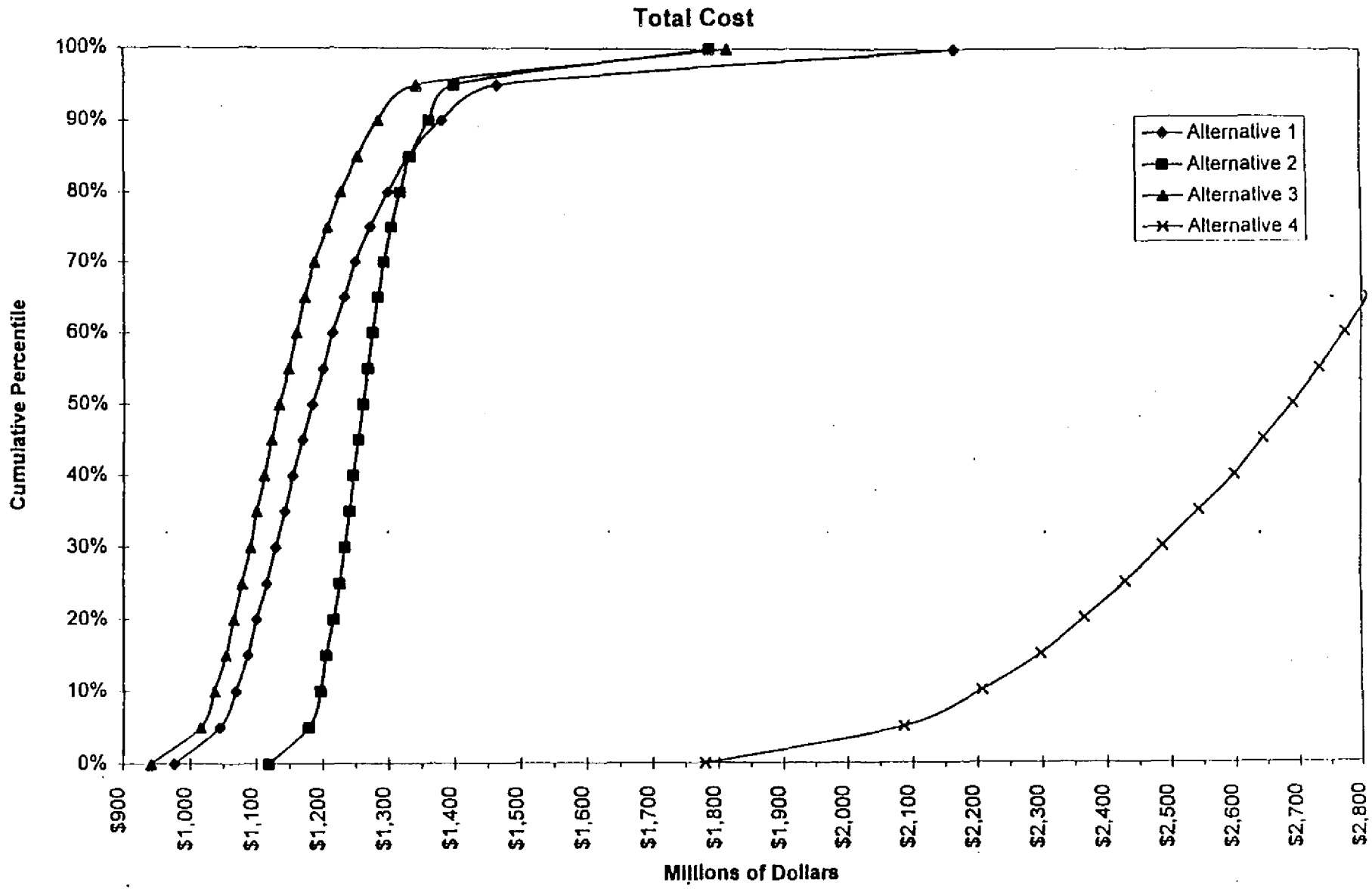

Figure G.11. Distributions for Total Cost, Alternatives 1-4.

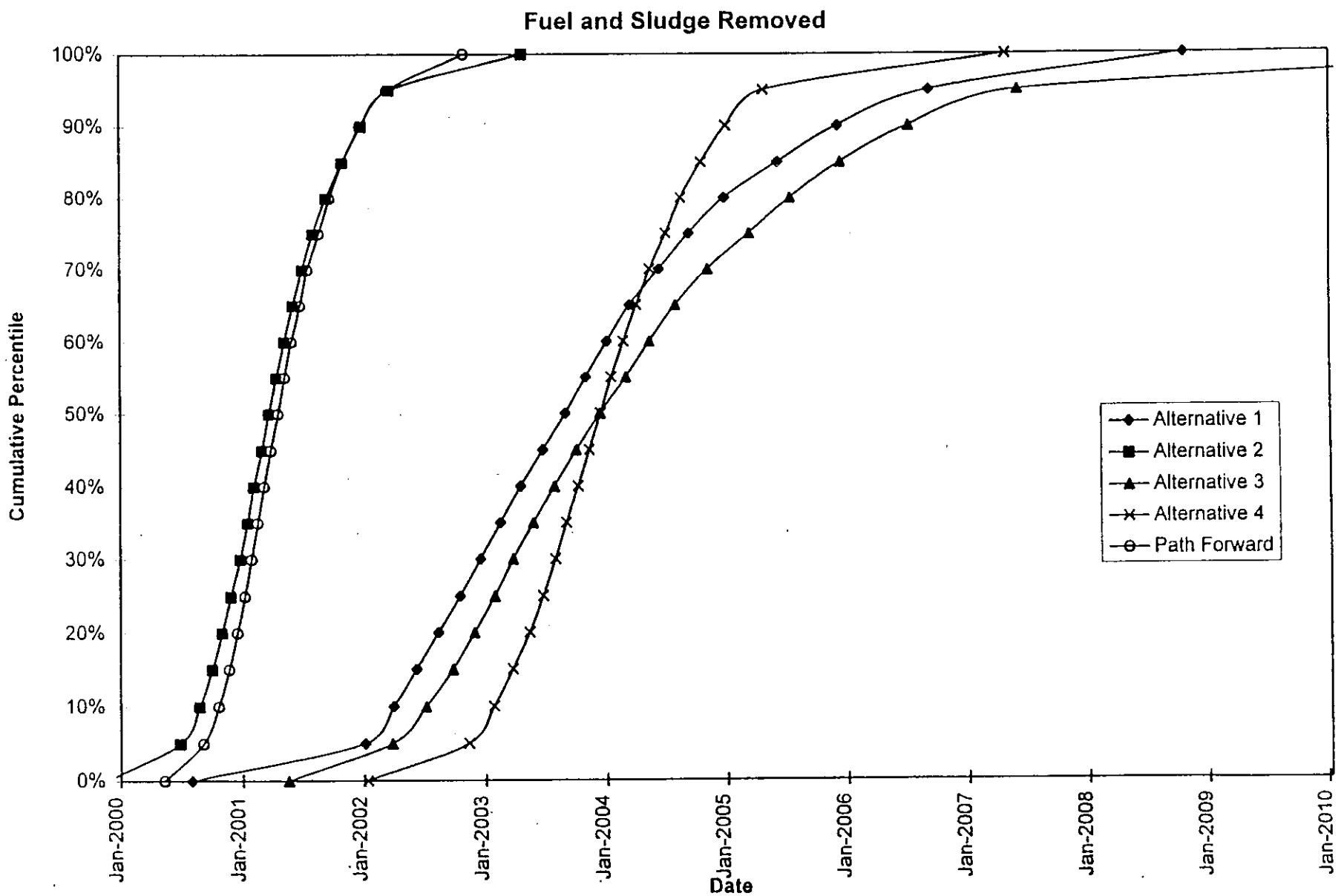

Figure G.12. Distributions for Fuel and Sludge Removed Date, Alternatives 1-4 and Recommended Path Forward.

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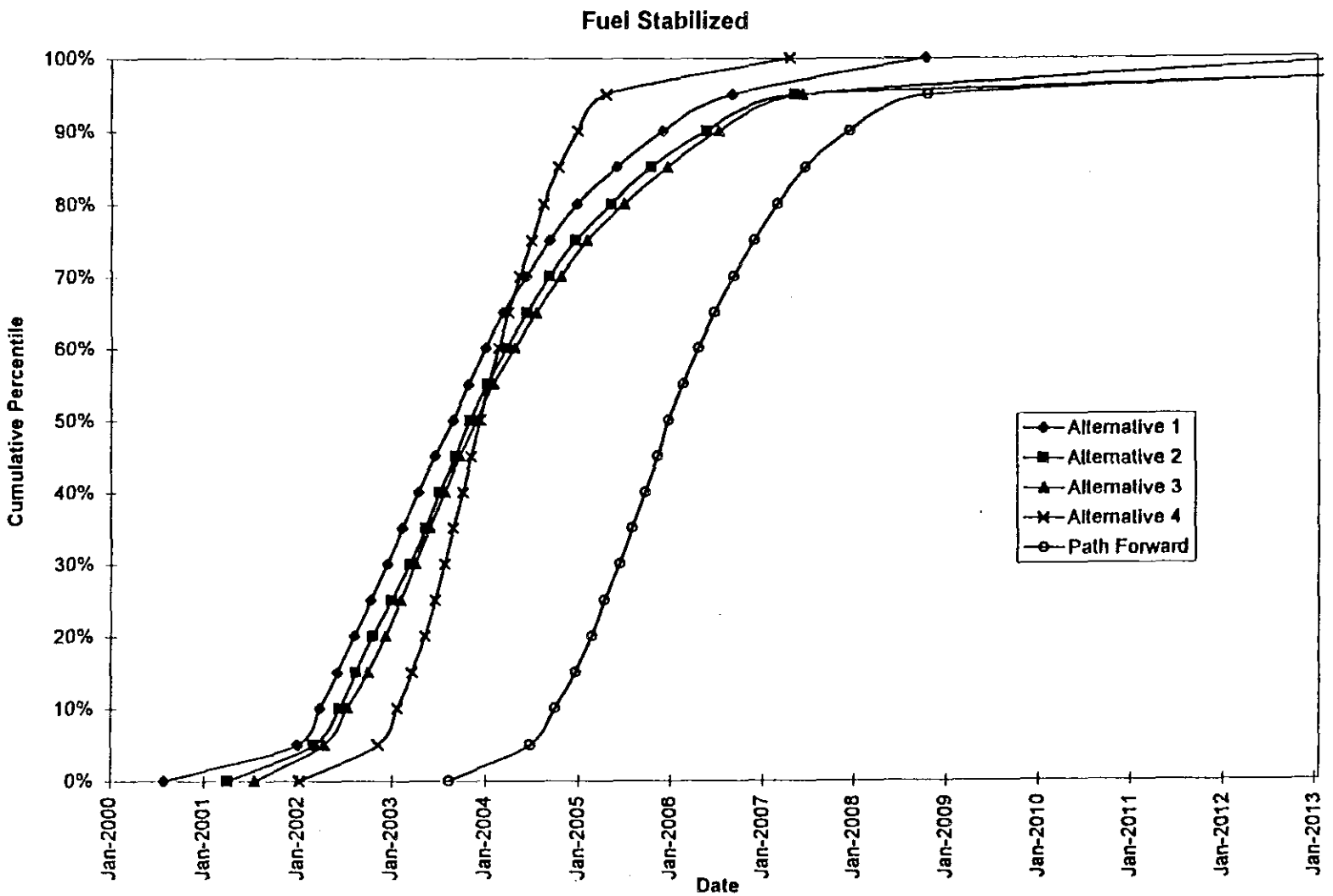

Figure G.13. Distributions for Fuel Stabilized Date, Alternatives 1-4 and Recommended Path Forward.

ALTTOTAL.XLS 10/17/94 6:38 PM

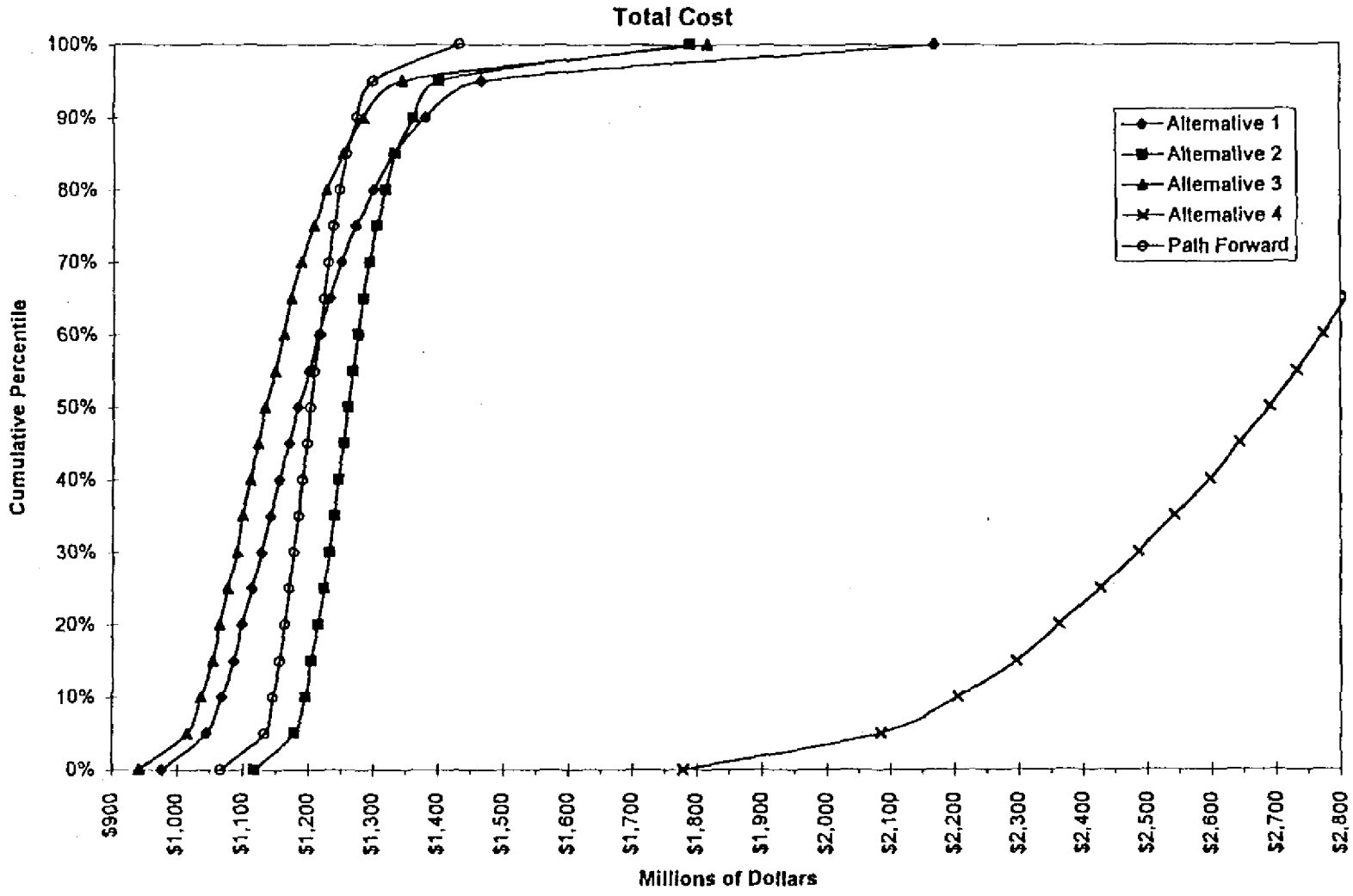

Figure G.14. Distributions for Total Cost, Alternatives 1-4 and Recommended Path Forward.

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Attachment G-1. Model Input.

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INPUT FOR ALTERNATIVE 1

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST					
FUNCT BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS	START
	KBO	K-Basin Operations	Starts 6/1/94. Ends when water is removed.			F-S			PE		13M+ 36/yr		Alt#2 Ind. Review	6/1/94
	KBSD	K-Basin Shutdown	Starts when fuel and sludge is removed.	PE		36		Alt#2 Ind. Review	PE		90		Alt#2 Ind. Review	3/18/03
	DEC	Decision on Spent fuel Storage path forward	Assumed 11/1/1994			0					0			11/1/94
	ADM	Prepare, review & approve NEPA ADM	Starts after SF path forward decision	LN	4	5	6	10/6 NEPA presentation	PE		0.2		PLG estimate	11/1/94
	EIS	Prepare, review & approve interim action EIS & ROD	Starts 3m after ADM starts	LN	18	24	30	10/8 NEPA presentation, Hanford site EIS	PE		2		PLG estimate	1/31/95
1.0	CHAR	Characterization of Fuel & Sludge	Starts 6/1/94	LN	30	46.2	60	PLG analysis of SAIC data	U	6	12	18	Alt#2 Ind. Review	6/1/94
2.0	PAC	Packaging Fuel & Sludge in K-Basin												
	KBSAR	Design of K-Basin equipment & SAR update	Starts after SF storage ADM approved	PE		3		Licensing analysis, Rev2.	PE		80K		Licensing analysis, Rev2.	4/26/95
	KBOK	DOE Approval of K-Basin SAR	Starts after SAR is completed	PE		5		Licensing analysis, Rev2.	PE		30K		Licensing analysis, Rev2.	7/26/95
	GETOP	Procure Fuel & Sludge Overpacks	Starts after SAR is completed	LN	30.9	36.8	42	PLG analysis of SAIC data	PE		11M		Est from Alt 2 Ind rev	7/26/95
	GETBEQ	Procure K-Basin Overpack Equipment	Starts after SAR is completed	LN	4	6.7	9	PLG analysis of SAIC data	PE		4.5M		SAIC Data	7/26/95
	INBEQ	Install K-Basin Overpack Equipment	Starts when procurement done & EIS approved	LN	1.5	4.2	6	PLG analysis of SAIC data	PE		3.8M		SAIC Data	6/17/97
	GETSLGEQ	Procure Sludge Removal Equipment	Starts after SAR is completed	LN	10.7	16.2	21	PLG analysis of SAIC data	PE		20.2M		SAIC Data	7/26/95
	INSLGEQ	Install Sludge Removal Equipment	Starts when procurement done & EIS approved	LN	12.5	15.4	18	PLG analysis of SAIC data	PE		2.5M		SAIC Data	6/17/97
	KBORR	K-Basin ORR	Start after sludge equip procured. Finished 3m after K-B ready to pack			F-S		Licensing analysis, Rev2.	PE		5M		Licensing analysis, Rev2.	12/18/96
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport												
	SARP1	Design Casks & Prepare SARP	Starts after SF storage ADM approved	LN	15.4	18.3	21	PLG analysis of SAIC data	PE		1		Licensing analysis, Rev2.	4/26/95
	SARP1OK	DOE Review & Approval of SARP	Starts after SARP is completed			4		PLG analysis of SAIC data	PE		0.5		Licensing analysis, Rev2.	5/17/97
	GETCASK1	Procure Casks & RR Cars	Start when SARP1 is half done.	LN	24	29.7	35	PLG analysis of SAIC data	PE		20		9/22 Presentation	5/6/98
	TRANS1ORR	Conduct Transportation ORR	Starts after SARP approved. Ends 1m after casks & RR car delivered.			F-S		Licensing analysis, Rev2.	PE		1		Licensing analysis, Rev2.	9/16/97
6.0	DEBRIS	Dispose of Debris	Starts with sludge removal. Finishes 12m after sludge removal complete.			F-S			PE		10			1/1/01

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST					
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS	START
8.0	WATER	Cleanup Rad Water from K-B	Starts after fuel, and sludge are removed.	PE		24		PLG analysis of SAIC data	PE		18		SAIC Data	3/18/03
	PACFUEL	Package Fuel	Start when K-B equip, ORR & overpacks ready	LN	21	24.3	27.4	PLG analysis of SAIC data	PE		10/Yr		PLG estimate from SAIC data	1/1/01
11.0	TRANSFUEL	Transport Fuel to Stabilization Facility	Starts when PACFUEL, TRANSORR & STAB ready and finishes with Stabilization.						PE		5/Yr		SAIC Data	1/1/01
	PACSLG	Remove and Package Sludge & Separate Debris	Start when sludge equip, ORR & overpacks ready. Finishes with fuel removal.			F-S			PE		7M		SAIC Data	1/1/01
	TRANSLG	Transport Sludge to Stabilization Facility	Starts when PACSLG, TRANSORR & STAB ready and finishes when PACSLG & STAB complete.										Included with PACFUEL	1/1/01
9.0 & 10.0	TEMPSTOR	Store Fuel & Sludge in K-Basin	Starts with fuel or sludge packaging. Finishes when stabilization is complete.			F-S			PE		36M+ 12/Yr		Alt#2 Ind. Review & SAIC data	1/1/01
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility												
	STABPD	Preliminary Stabilization Facility Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		2		SAIC Data	4/26/95
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	Starts after PSAR is completed	LN	6	9.2	12	PLG analysis of SAIC data	PE		0.7		SAIC Data	4/25/96
	TECHDEV	Stabilization Technology Development	Starts after SF storage ADM approved	LN	15.2	27.8	37.8	PLG analysis of SAIC data	PE		19.7		SAIC Data	4/26/95
	STABFD	Stabilization Facility Final Design & FSAR	Starts after PSAR is approved. Finishes 3m after technology dev.	LN	13.5	17.6	21.3	PLG analysis of SAIC data	T	7.5	10	12.6	SAIC Data	4/25/96
	STABFSAR	Stabilization Facility FSAR Preparation	Starts after PSAR is approved.			12		PLG analysis of SAIC data	PE		1.4		SAIC Data	3/1/97
	STABC	Construction of Stabilization Facility	Starts after PSAR & EIS are approved & final design complete.	LN	13.5	19.1	24	PLG analysis of SAIC data	LN	100	123	145	SAIC Data	9/23/98
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	Starts after FSAR is complete. Finishes 12m after construction is complete.			F-S			PE		5M		Same as KBORR	9/23/98
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility												
	STORPD	Preliminary Interim Storage Facility Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		1		SAIC Data	4/26/95
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	Starts after SAR is completed	LN	5	7.7	10	PLG analysis of SAIC data	PE		.3M		SAIC Data	4/25/96
	STORFD	Interim Storage Facility Final Design	Starts after PSAR is approved.	LN	9.6	12.4	15	PLG analysis of SAIC data	PE		0.5		SAIC Data	4/25/96
	STORFSAR	Interim Storage Facility FSAR Preparation	Starts after PSAR is approved.			12		PLG analysis of SAIC data	PE		1.4		SAIC Data	1/1/97

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST					
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS	START
	STORC	Construction of Interim Storage Facility	Starts after PSAR & EIS are approved & final design complete.	LN	15.4	18.3	21	PLG analysis of SAIC data	LN	26	33	39	SAIC Data	6/17/97
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	Starts after FSAR is complete. Finishes 3m after construction is complete.			F-S			PE		5M		Same as KBORR	3/1/98
14.0	STAB	Stabilize Fuel & Sludge	Starts when fuel or sludge transport begins and stabilization and storage facilities are complete.	LN	16	27	38	PLG analysis of SAIC data	PE		40M /Yr		SAIC Data	1/1/01
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage	Starts and finishes with stabilization.											
15.0	WASTE	Dispose of Wastes	Starts and finishes with stabilization.	PE		29		PLG analysis of SAIC data	PE		300K		SAIC Data	1/1/01
16.0	D&D	D&D Conditioning Facility	Starts when stabilization is complete.	PE		60		PLG analysis of SAIC data	PE		130		SAIC Data	3/18/03
20.0	INTERIM STOR	Interim Storage Operations	Starts when stabilization begins. Finishes 12/31/10			F-S					1.5/Yr		Alt#2 Ind. Review	1/1/01
	PM	Program management	Starts 6/1/94, finishes when all fuel is in interim storage			F-S					1/m		PLG estimate from SAIC Data	6/1/94

INPUT FOR ALTERNATIVE 2

ALT2 XLS 10/14/94 2:40 PM

ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST						
FUNCT BLOCK DIAG #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS	START	DURATION
	KBO	K-Basin Operations	Starts 6/1/94. Ends when water is removed.			F-S			PE		13M+ 36/yr		Alt#2 Ind. Review	6/1/94	100.927
	KBSD	K-Basin Shutdown	Starts when fuel and sludge is removed.	PE		36		Alt#2 Ind. Review	PE		90		Alt#2 Ind. Review	10/28/00	36.000
	DEC	Decision on Spent fuel Storage path forward	Assumed 11/1/1994			0					0			11/1/94	0.000
	ADM	Prepare, review & approve NEPA ADM	Stars after SF path forward decision	LN	4	5	6	10/6 NEPA presentation	PE		0.2		PLG estimate	11/1/94	5.000
	EIS	Prepare, review & approve interim action EIS & ROD	Starts 3m after ADM starts	LN	13	15.6	18	10/6 NEPA presentation	PE		1		PLG estimate	1/31/95	15.600
1.0	CHAR	Characterization of Fuel & Sludge	Starts 6/1/94	LN	30	46.2	60	PLG analysis of SAIC data	U	6	12	18	Alt#2 Ind. Review	6/1/94	46.200
2.0	PAC	Packaging Fuel & Sludge in K-Basin													
	KBSAR	Design of K-Basin Equipment and Update of SAR	Starts after SF storage ADM approved	PE		3		Licensing analysis, Rev2.	PE		80K		Licensing analysis, Rev2.	4/2/95	3.000
	KBOK	DOE Approval of K-Basin SAR	Starts after SAR is completed	PE		5		Licensing analysis, Rev2.	PE		30K		Licensing analysis, Rev2.	7/2/95	5.000
	GETOP	Procure Fuel & Sludge Overpacks	Start after SAR completed	LN	30.9	36.6	42	PLG analysis of SAIC data	PE		11M		Est from Alt 2 Ind rev	7/2/95	36.600
	GETBEQ	Procure K-Basin Overpack Equipment	Start after SAR completed	LN	4	6.7	9	PLG analysis of SAIC data	PE		4.5M		SAIC Data	7/2/95	6.700
	INBEQ	Install K-Basin Overpack Equipment	Starts when procurement done & EIS approved			3		PLG analysis of SAIC data	PE		3.8M		SAIC Data	5/20/96	3.000
	GETSLGEQ	Procure Sludge Removal Equipment	Start after SAR completed	LN	10.7	16.2	21	PLG analysis of SAIC data	PE		20.2M		SAIC Data	7/2/95	16.200
	INSLGEQ	Install Sludge Removal Equipment	Starts when procurement done & EIS approved	LN	12.5	15.4	18	PLG analysis of SAIC data	PE		2.5M		SAIC Data	11/6/96	15.400
	KBORR	K-Basin ORR	Start after sludge equip procured. Finished 3m after K-B ready to pack			F-S		Licensing analysis, Rev2.	PE		5M		Licensing analysis, Rev2.	11/6/96	23.400
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport													
	SARP1	Design Casks & Prepare SARP	Starts after SF storage ADM approved	LN	15.4	18.3	21	PLG analysis of SAIC data	PE		1		Licensing analysis, Rev2.	4/2/95	18.300
	SARP1OK	DOE Review & Approval of SARP	Starts after SARP is completed			4		PLG analysis of SAIC data	PE		0.5		Licensing analysis, Rev2.	10/19/96	4.000
	GETCASK1	Procure Casks & RR Cars	Start when SARP1 is half done.	LN	24	29.7	35	PLG analysis of SAIC data	PE		20		9/22 Presentation	1/10/96	29.700
	TRANS1ORR	Conduct Transportation ORR	Starts after SARP approved. Ends 1m after casks & RR car delivered.			F-S		Licensing analysis, Rev2.	PE		1		Licensing analysis, Rev2.	2/18/97	17.400
6.0	DEBRIS	Dispose of Debris	Starts with sludge removal. Finishes 12m after sludge removal complete.			F-S			PE		10			10/19/98	38.300
8.0	WATER	Cleanup Rad Water from K-B	Starts after fuel and sludge are removed.	PE		24		PLG analysis of SAIC data	PE		18		SAIC Data	10/28/00	24.000
4.0 & 5.0	TSF	Design & Construct TSF													

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST						
FUNCT BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS	START	DURATION
	TSFPD	Preliminary TSF Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		3		9/22 Presentation	4/2/95	12.000
	TSFOK	DOE Review & Approval of TSF PSAR	Starts after PSAR is completed	LN	6	7.6	9	PLG analysis of SAIC data	PE		1		Licensing analysis, Rev2.	4/1/96	7.600
	TSFFD	TSF Final design	Starts after PSAR is approved.	LN	13.2	15.2	17	PLG analysis of SAIC data	PE		7.5		SAIC Data	10/1/95	15.200
	TSFFSAR	TSF FSAR preparation	Starts when PSAR is approved			12		PLG analysis of SAIC data	PE		0.3		SAIC Data	11/18/96	12.000
	TSFC	TSF Construction	Starts after PSAR & EIS are approved & final design complete	LN	12.5	15.4	18	PLG analysis of SAIC data	LN	33	42	50	9/22 Presentation	1/6/97	15.400
	TSFORR	TSF FSAR approval & ORR	Starts after FSAR is complete. Finishes 3m after construction is complete.			F-S			PE		1		Same as TRANS1ORR	11/19/97	8.000
7.0	TRANS1	Package and Transport Fuel & Sludge to TSF													
	PACFUEL	Package Fuel	Start when K-B equip, ORR, overpacks & TSF ready	LN	21	24.3	27.4	PLG analysis of SAIC data	PE		10/Yr		PLG estimate from SAIC data	10/19/98	23.300
11.0	TRANSFUEL	Transport Fuel to TSF	Starts and finishes with PACFUEL.						PE		5/Yr		SAIC Data	10/19/98	24.300
	PACSLG	Remove and Package Sludge & Separate Debris	Start when sludge equip, ORR, overpacks & TSF ready. Finishes with fuel removal.			F-S			PE		7M		SAIC Data	10/19/98	24.300
	TRANSLG	Transport Sludge to TSF	Starts and finishes with PACSLG.										Included with PACFUEL	10/19/98	24.300
9.0 & 10.0	TEMPSTOR	Store Fuel & Sludge in TSF	Starts with fuel or sludge transfers. Finishes when stabilization is complete.			F-S			PE		36M+ 12/Yr		Alt#2 Ind. Review & SAIC data	10/19/98	49.100
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility													
	STABPD	Preliminary Stabilization Facility Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		2		SAIC Data	4/2/95	12.000
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	Starts after PSAR is completed	LN	6	9.2	12	PLG analysis of SAIC data	PE		0.7		SAIC Data	4/1/98	9.200
	TECHDEV	Stabilization Technology Development	Starts after SF storage ADM approved	LN	15.2	27.8	37.8	PLG analysis of SAIC data	PE		19.7		SAIC Data	4/2/95	27.800
	STABFD	Stabilization Facility Final Design & FSAR	Starts after PSAR is approved. Finishes 3m after technology dev.	LN	13.5	17.6	21.3	PLG analysis of SAIC data	T	12.8	15.3	17.8	SAIC Data	10/1/95	17.600
	STABFSAR	TSF FSAR Preparation	Starts after PSAR is approved.			12		PLG analysis of SAIC data	PE		1.4		SAIC Data	1/6/97	12.000
	STABC	Construction of Stabilization Facility	Starts after PSAR & EIS are approved & final design complete.	LN	19.2	24.9	30	PLG analysis of SAIC data	LN	123.8	149.5	169	SAIC Data	10/25/97	24.900
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	Starts after FSAR is complete. Finishes 9m after construction is complete.			F-S			PE		5M		Same as KBORR	10/25/97	33.900
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility													
	STORPD	Preliminary Interim Storage Facility Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		1		SAIC Data	4/2/95	12.000

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST						
FUNCT BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS	START	DURATION
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	Starts after SAR is completed	LN	5	7.7	10	PLG analysis of SAIC data	PE		.3M		SAIC Data	4/1/98	7.700
	STORFD	Interim Storage Facility Final Design	Starts after PSAR is approved.	LN	9.6	12.4	15	PLG analysis of SAIC data	PE		0.5		SAIC Data	10/1/95	12.400
	STORFSAR	TSF FSAR Preparation	Starts after PSAR is approved.			12		PLG analysis of SAIC data	PE		1.4		SAIC Data	11/21/96	12.000
	STORC	Construction of Interim Storage Facility	Starts after PSAR & EIS are approved & final design complete	LN	15.4	18.3	21	PLG analysis of SAIC data	LN	26	33	39	SAIC Data	11/21/96	18.300
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	Starts after FSAR is complete. Finishes 3m after construction is complete.			F-S			PE		5M		Same as KBORR	1/6/98	7.800
14.0	STAB	Stabilize Fuel & Sludge	Starts when fuel or sludge transport begins and stabilization and storage facilities are complete.	LN	16	27	36	PLG analysis of SAIC data	PE		40M /Yr		SAIC Data	8/22/00	27.000
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage	Starts and finishes with stabilization.	PE		5		PLG analysis of SAIC data	PE		12		SAIC Data	8/22/00	27.000
15.0	WASTE	Dispose of Wastes	Starts and finishes with stabilization.	PE		29		PLG analysis of SAIC data	PE		300K		SAIC Data	8/22/00	27.000
16.0	D&D	D&D Conditioning Facility	Starts when stabilization is complete	PE		60		PLG analysis of SAIC data	PE		170		SAIC Data	11/22/02	60.000
20.0	INTERIM STOR	Interim Storage Operations	Starts when stabilization begins. Finishes 12/31/10			F-S					1.5/Yr		Alt#2 Ind. Review	8/22/00	124.271
	PM	Program management	Starts 6/1/94, finishes when all fuel is in interim storage			F-S					1/m		PLG estimate from SAIC Data	6/1/94	101.727

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	KBO	K-Basin Operations	Starts 6/1/94. Ends when water is removed.			F-S			PE		13M+ 36/yr		Alt#2 Ind. Review
	KBSD	K-Basin Shutdown	Starts when fuel & sludge is removed	PE		36		Alt#2 Ind. Review	PE		90		Alt#2 Ind. Review
	DEC	Decision on Spent fuel Storage path forward	Assumed 11/1/1994			0					0		
	ADM	Prepare, review & approve NEPA ADM	Stars after SF path forward decision	LN	4	5	6	10/6 NEPA presentation	PE		0.2		PLG estimate
	EIS	Prepare, review & approve Hanford Site EIS & ROD	Starts 3m after ADM starts	LN	18	24	30	10/6 NEPA presentation	PE		2		PLG estimate
1.0	CHAR	Characterization of Fuel & Sludge	Starts 6/1/94	LN	30	46.2	60	PLG analysis of SAIC data	U	6	12	18	Alt#2 Ind. Review
2.0	PAC	Packaging Fuel & Sludge in K-Basin											
	KBSAR	Update K-Basin SAR	Starts after SF storage ADM approved	PE		3		Licensing analysis, Rev2.	PE		80K		Licensing analysis, Rev2.
	KBOK	DOE Approval of K-Basin SAR	Starts after SAR is completed	PE		5		Licensing analysis, Rev2.	PE		30K		Licensing analysis, Rev2.
	GETOP	Procure Fuel & Sludge Overpacks	Starts after SAR is completed	LN	36.8	42.5	48	PLG analysis of SAIC data	U	36	48.6	54	
	GETBEQ	Procure K-Basin Overpack Equipment	Starts after SAR is completed	LN	3	8.4	12	PLG analysis of SAIC data	PE		4.5M		SAIC Data
	INBEQ	Install K-Basin Overpack Equipment	Starts when procurement done & EIS approved	LN	3	8.4	12	PLG analysis of SAIC data	PE		3.8M		SAIC Data
	GETSLGEQ	Procure Sludge Removal Equipment	Starts after SAR is completed	LN	10.7	16.2	21	PLG analysis of SAIC data	PE		20.2M		SAIC Data
	INSLGEQ	Install Sludge Removal Equipment	Starts when procurement done & EIS approved	LN	12.5	15.4	18	PLG analysis of SAIC data	PE		2.5M		SAIC Data
	KBORR	K-Basin ORR	Start after sludge equip procured. Finished 3m after K-B ready to pack			F-S		Licensing analysis, Rev2.	PE		5M		Licensing analysis, Rev2.
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport											
	SARP1	Design Casks & Prepare SARP	Starts after SF storage ADM approved	LN	15.4	18.3	21	PLG analysis of SAIC data	PE		1		Licensing analysis, Rev2.
	SARP1OK	DOE Review & Approval of SARP	Starts after SARP is completed			4		PLG analysis of SAIC data	PE		0.5		Licensing analysis, Rev2.
	GETCASK1	Procure Casks & RR Cars	Start when SARP1 is half done.	LN	24	29.7	35	PLG analysis of SAIC data	PE		20		SAIC Data
	TRANS1ORR	Conduct Transportation ORR	Starts after SARP approved. Ends 1m after casks & RR car delivered.			F-S		Licensing analysis, Rev2.	PE		1		Licensing analysis, Rev2.

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
6.0	DEBRIS	Dispose of Debris	Starts with sludge removal and finishes 12 mo. after SR complete			F-S					10		SAIC Data
8.0	WATER	Clean-Up Rad Water from K-B	Starts after fuel & sludge are removed.	PE		24		PLG analysis of SAIC data	PE		18		SAIC Data
7.0	TRANS1	Package and Transport Fuel & Sludge to TSF											
	PACFUEL	Package Fuel	Start when K-B equip, ORR, overpacks & TSF ready	LN	16	27	36	PLG analysis of SAIC data	PE		10/Yr		PLG estimate from SAIC data
	TRANSFUEL	Transport Fuel to TSF	Starts and finishes with PACFUEL.						PE		10M		SAIC Data
	PACSLG	Remove and Package Sludge & Separate Debris	Start when sludge equip, ORR, overpacks & SF ready. Finishes with fuel removal.			F-S			PE		7M		SAIC Data
	TRANSLG	Transport Sludge to TSF	Starts and finishes with PACSLG.										Included with PACFUEL
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility											
	STABPD	Preliminary Stabilization Facility Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		2		SAIC Data
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	Starts after PSAR is completed	LN	6	9.2	12	PLG analysis of SAIC data	PE		0.7		SAIC Data
	TECHDEV	Stabilization Technology Development	Starts after SF storage ADM approved	LN	15.2	27.8	37.8	PLG analysis of SAIC data	PE		19.7		SAIC Data
	STABFD	Stabilization Facility Final Design & FSAR	Starts after PSAR is approved. Finishes 3m after technology dev.	LN	13.5	17.6	21.3	PLG analysis of SAIC data	T	7.5	10	12.6	SAIC Data
	STABFSAR	TSF FSAR Preparation	Starts after PSAR is approved.	LN	9.6	12.4	15	PLG analysis of SAIC data	PE		1.4		SAIC Data
	STABC	Construction of Stabilization Facility	Starts after PSAR & EIS are approved & final design complete.	LN	19.2	24.9	30	PLG analysis of SAIC data	LN	100	123	145	SAIC Data
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	Starts after FSAR is complete. Finishes 12m after construction is complete.			F-S			PE		5M		Same as KBORR
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility											
	STORPD	Preliminary Interim Storage Facility Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		1		SAIC Data
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	Starts after SAR is completed	LN	6	7.6	9	PLG analysis of SAIC data	PE		.3M		SAIC Data
	STORFD	Interim Storage Facility Final Design	Starts after PSAR is approved.	LN	9.6	12.4	15	PLG analysis of SAIC data	PE		0.5		SAIC Data
	STORFSAR	TSF FSAR Preparation	Starts after PSAR is approved.			12		PLG analysis of SAIC data	PE		1.4		SAIC Data

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	STORC	Construction of Interim Storage Facility	Starts after PSAR & EIS are approved & final design complete.	LN	15.4	18.3	21	PLG analysis of SAIC data	LN	26	33	39	SAIC Data
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	Starts after FSAR is complete. Finishes 3m after construction is complete.			F-S			PE		5M		Same as KBORR
14.0	STAB	Stabilize Fuel & Sludge	Starts when fuel or sludge transport begins and stabilization and storage facilities are complete.	LN	16	27	36	PLG analysis of SAIC data	PE		20M /Yr		SAIC Data
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage	Starts and finishes with stabilization.	PE		5		PLG analysis of SAIC data	PE		12		SAIC Data
15.0	WASTE	Dispose of Wastes	Starts and finishes with stabilization.	PE		29		PLG analysis of SAIC data	PE		2		SAIC Data
16.0	D&D	D&D Conditioning Facility	Starts when stabilization is complete.	PE		60		PLG analysis of SAIC data	PE		90		SAIC Data
20.0	INTERIM STOR	Interim Storage Operations	Starts when stabilization begins. Finishes 12/31/10			F-S					5/Yr		Alt#2 Ind. Review
	PM	Program management	Starts 6/1/94, finishes when all fuel is in interim storage			F-S					1/m		PLG estimate from SAIC Data

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	KBO	K-Basin Operations	Starts 6/1/94. Ends when water is removed.			F-S			PE		13M+ 36/yr		Alt#2 Ind. Review
	KBSD	K-Basin Shutdown	Starts when fuel & sludge is	PE		36		Alt#2 Ind. Review	PE		90		Alt#2 Ind. Review
	DEC	Decision on Spent fuel Storage path forward	Assumed 11/1/1994			0					0		
	ADM	Prepare, review & approve NEPA ADM	Stars after SF path forward decision	LN	4	5	6	10/6 NEPA presentation	PE		0.2		PLG estimate
	EIS	Prepare, review & approve interim action EIS & ROD	Starts 2m after ADM starts	LN	18	24	30	10/6 NEPA presentation, Hanford Site EIS	PE		2		PLG estimate
1.0	CHAR	Characterization of Fuel & Sludge	Starts 6/1/94	LN	30	46.2	60	PLG analysis of SAIC data	U	6	12	18	Alt#2 Ind. Review
2.0	PAC	Packaging Fuel & Sludge in K-Basin											
	KBSAR	Preliminary design of K-Basin equipment & update of SAR	Starts after SF storage ADM approved	PE		3		Licensing analysis, Rev2.	PE		80K		Licensing analysis, Rev2.
	KBOK	DOE Approval of K-Basin SAR	Starts after SAR is completed	PE		5		Licensing analysis, Rev2.	PE		30K		Licensing analysis, Rev2.
	GETOP	Procure Fuel & Sludge Overpacks	Starts after SAR is completed										
	GETBEQ	Procure K-Basin Overpack Equipment	Starts after SAR is completed	LN	4	6.7	9	PLG analysis of SAIC data	PE		5.2M		SAIC Data
	INBEQ	Install K-Basin Overpack Equipment	Starts when procurement done & EIS approved			3		PLG analysis of SAIC data	PE		5.4M		SAIC Data
	GETSLGEQ	Procure Sludge Removal Equipment	Starts after SAR is completed	LN	10.7	16.2	21	PLG analysis of SAIC data	PE		20.2M		SAIC Data
	INSLGEQ	Install Sludge Removal Equipment	Starts when procurement done & EIS approved	LN	12.5	15.4	18	PLG analysis of SAIC data	PE		2.5M		SAIC Data
	KBORR	K-Basin ORR	Start after sludge equip procured. Finished 3m after K-B ready to pack			F-S		Licensing analysis, Rev2.	PE		5M		Licensing analysis, Rev2.
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport											
	SARP1	Design Casks & Prepare SARP	Starts after SF storage ADM approved	LN	15.4	18.3	21	PLG analysis of SAIC data	PE		1		SAIC data
	SARP1OK	DOE Review & Approval of SARP	Starts after SARP is completed	LN	14	17.2	21	Double Alt 2	PE		0.5		Licensing analysis, Rev2.
	GETCASK1	Procure Casks & RR Cars	Start when SARP1 is half done.	LN	12	15	24	Half Alt 2	PE		11		SAIC Data
	TRANS1ORR	Conduct Transportation ORR	Starts after SARP approved. Ends 3m after casks & RR car delivered.			F-S			PE		2		Double Alt 2
6.0	DEBRIS	Dispose of Debris	Starts with sludge removal. Finishes 12 m after SR complete			F-S					10M		SAIC Data

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
8.0	WATER	Clean-Up Rad Water from K-B	Starts after fuel & sludge are removed.						PE		18		SAIC Data
7.0	TRANS1	Package and Transport Fuel & Sludge to BNFL & Stabilization Facility											
	PACFUEL	Package Fuel	Start when K-B equip, ORR, overpacks & TRANSORR ready	LN		60		BNFL Proposal	PE		20/Yr		PLG estimate from SAIC data
	TRANSFUEL	Transport Fuel to BNFL Shipping Port	Starts and finishes with PACFUEL.						PE		10M		SAIC Data
	PACSLG	Remove and Package Sludge & Separate Debris	Start when sludge equip, ORR, overpacks & SF ready. Finishes with fuel removal.			F-S			PE		7M		SAIC Data
	TRANSLG	Transport Sludge to Stabilization Facility	Starts and finishes with PACSLG.										Included with PACFUEL
9.0 & 10.0	BNFL	Shipment to GB & processing of fuel at BNFL	Starts with fuel transfers. Continues to end date.						T	1000	2000	2500	From BNFL 10/4/94 presentation
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility											
	STABPD	Preliminary Stabilization Facility Design & PSAR	Starts after SF storage ADM approved	PE		6		PLG analysis of SAIC data	PE		0.5		1/4 of Alt 2
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	Starts after PSAR is completed	PE		4.5		PLG analysis of SAIC data	PE		0.2		1/4 of Alt 2
	TECHDEV	Stabilization Technology Development	Starts after SF storage ADM approved	LN	7.6	13.9	18.9	Half Alt 2	PE		5		1/4 of Alt 2
	STABFD	Stabilization Facility Final Design & FSAR	Starts after PSAR is approved. Finishes with technology dev.	LN	7	9	11	Half Alt 2	T	7.5	2.5	12.6	1/4 of Alt 2
	STABFSAR	SF FSAR Preparation	Starts after PSAR is approved.	LN	5	6	7.5	Half Alt 2	PE		0.4		1/4 of Alt 2
	STABC	Construction of Stabilization Facility	Starts after PSAR & EIS are approved & final design complete.	LN	9.6	12.4	15	Half Alt 2	LN	25	30.75	36	1/4 of Alt 2
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	Starts after FSAR is complete. Finishes 12m after construction is complete.			F-S			PE		5M		Same as KBORR
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility											
	STORPD	Preliminary Interim Storage Facility Design & PSAR	Starts after SF storage ADM approved	PE		6		Half of Alt 2	PE		1		1/4 of Alt 2
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	Starts after SAR is completed	PE		4		Half of Alt 2	PE		.3M		1/4 of Alt 2
	STORFD	Interim Storage Facility Final Design	Starts after PSAR is approved.	LN	5	6	7.5	Half of Alt 2	PE		0.5		1/4 of Alt 2

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	STORFSAR	Storage Facility FSAR Preparation	Starts after PSAR is approved.	PE		6		Half of Alt 2	PE		1.4		1/4 of Alt 2
	STORC	Construction of Interim Storage Facility	Starts after PSAR & EIS are approved & final design complete.	LN	8	10	12	Half of Alt 2	LN	26	33	39	1/4 of Alt 2
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	Starts after FSAR is complete. Finishes 3m after construction is complete.			F-S			PE		5M		Same as KBORR
14.0	STAB	Stabilize Sludge	Starts when sludge transport begins and stabilization and storage facilities are complete. Finishes 3m after sludge transport complete.	LN		F-S		Half of Alt 2	PE		5M /Yr		1/4 of Alt 2
15.0	WASTE	Dispose of Wastes	Starts and finishes with stabilization.	PE		29		PLG analysis of SAIC data	PE		2		SAIC Data
16.0	D&D	D&D Conditioning Facility	Starts when stabilization is complete.	PE		15		PLG analysis of SAIC data	PE		15		1/4 of Alt 3
20.0	INTERIM STOR	Interim Storage Operations	Starts when stabilization begins. Finishes 12/31/10			F-S					1/Yr		1/4 of Alt 3
	PM	Program management	Starts 6/1/94, finishes when all fuel is in interim storage			F-S					1/M		PLG estimate from SAIC Data

Attachment G-2. Detailed Model Output.

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OUTPUT FOR ALTERNATIVE 1

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ACTIVITY								
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	KBO	K-Basin Operations	117.539	3/17/04	4/24/99	36	365.62	$316
	KBSD	K-Basin Shutdown	36.000	3/18/06	9/16/04		90.00	$66
	DEC	Decision on Spent fuel Storage path forward	0.000	11/1/94	11/1/94		0.00	$0
	ADM	Prepare, review & approve NEPA ADM	[illegible]	4/26/95	1/28/95		0.20	$0
	EIS	Prepare, review & approve Interim action EIS & ROD	[illegible]	6/17/97	4/9/96		2.00	$2
1.0	CHAR	Characterization of Fuel & Sludge	[illegible]	11/5/97	2/17/96		[illegible]	$13
2.0	PAC	Packaging Fuel & Sludge in K-Basin						
	KBSAR	Design of K-Basin equipment & SAR update	3.000	7/26/95	6/11/95		0.08	$0
	KBOK	DOE Approval of K-Basin SAR	5.000	12/26/95	10/10/95		0.03	$0
	GETOP	Procure Fuel & Sludge Overpacks	[illegible]	8/11/99	8/3/97		11.00	$10
	GETBEQ	Procure K-Basin Overpack Equipment	[illegible]	2/17/98	11/6/95		4.50	$4
	INBEQ	Install K-Basin Overpack Equipment	[illegible]	9/12/97	7/31/97		4.50	$4
	GETSLGEQ	Procure Sludge Removal Equipment	[illegible]	12/18/96	4/6/98		20.20	$19
	INSLGEQ	Install Sludge Removal Equipment	[illegible]	12/13/98	3/16/98		2.50	$2
	KBORR	K-Basin ORR	34.757	11/10/99	5/31/98		5.00	$4
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport						
	SARP1	Design Casks & Prepare SARP	[illegible]	5/17/97	5/6/96		1.00	$1
	SARP1OK	DOE Review & Approval of SARP	4.000	9/16/97	7/17/97		0.50	$0
	GETCASK1	Procure Casks & RR Cars	[illegible]	9/5/97	1/4/97		20.00	$19
	TRANS1ORR	Conduct Transportation ORR	0.618	10/5/97	9/26/97		1.00	$1
6.0	DEBRIS	Dispose of Debris	38.472	3/17/04	8/10/02		10.00	$8

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ACTIVITY								
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
8.0	WATER	Cleanup Rad Water from K-B	12.000	3/17/04	9/16/03		18.00	$14
	PACFUEL	Package Fuel	[redacted]	3/15/03	2/6/02	10.00	21.97	$18
11.0	TRANSFUEL	Transport Fuel to Stabilization Facility	26.472	3/18/03	2/8/02	5.00	11.03	$9
	PACSLG	Remove and Package Sludge & Separate Debris	26.472	3/18/03	2/8/02	2.50	5.51	$4
	TRANSLG	Transport Sludge to Stabilization Facility	26.472	3/18/03	2/8/02	0.00	0.00	$0
9.0 & 10.0	TEMPSTOR	Store Fuel & Sludge in K-Basin	26.472	3/18/03	2/8/02	12.00	62.47	$50
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility	[redacted]					
	STABPD	Preliminary Stabilization Facility Design & PSAR	12.000	4/25/96	10/26/95		2.00	$2
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	[redacted]	3/1/97	9/27/96		0.70	$1
	TECHDEV	Stabilization Technology Development	[redacted]	8/23/98	11/23/96		19.70	$18
	STABFD	Stabilization Facility Final Design & FSAR	[redacted]	9/23/98	3/12/97		[redacted]	$10
	STABFSAR	Stabilization Facility FSAR Preparation	12.000	3/1/98	8/31/97		1.40	$1
	STABC	Construction of Stabilization Facility	[redacted]	1/2/00	5/14/99		[redacted]	$91
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	27.317	1/1/01	11/12/99		5.00	$4
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility	[redacted]					
	STORPD	Preliminary Interim Storage Facility Design & PSAR	12.000	4/25/96	10/26/95		1.00	$1
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	[redacted]	1/1/97	8/29/96		0.30	$0
	STORFD	Interim Storage Facility Final Design	[redacted]	5/23/97	11/8/96		0.50	$0
	STORFSAR	Interim Storage Facility FSAR Preparation	12.000	3/1/98	7/3/97		1.40	$1

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ACTIVITY								
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	STORC	Construction of Interim Storage Facility	[redacted]	1/3/99	3/27/98		[redacted]	$29
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	13.107	4/4/99	9/17/98		5.00	$4
14.0	STAB	Stabilize Fuel & Sludge	[redacted]	3/18/03	2/8/02	40	88.24	$70
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage						
15.0	WASTE	Dispose of Wastes	26.472	3/18/03	2/8/02		0.30	$0
16.0	D&D	D&D Conditioning Facility	60.000	3/17/08	9/16/05		130.00	$93
20.0	INTERIM STOR	Interim Storage Operations	119.931	12/31/10	12/31/05	1.5	14.99	$11
	PM	Program management	105.539	3/18/03	10/24/98	1	105.54	$93
							1090	$903

K-Basin PV of Total Costs $565

Input Assumptions		
Average days per month	30.4375	DAYS
Real interest rate	3%	IRATE
Project start	6/1/94	START

Forecast: Alt #1 Fuel Stabilized **Cell: Q45**

Statistics for Display Range:	Value
Trials	1966
Mean	11/28/03
Median (approx.)	9/9/03
Mode (approx.)	2/13/03
Standard Deviation	526.25
Variance	276,938.08
Skewness	0.81
Kurtosis	3.35
Coeff. of Variability	0.01
Range Minimum	8/12/00
Range Maximum	10/29/08
Range Width	3,000.00
Mean Std. Error	11.87

Percentiles for Display Range:

Percentile	Date (approx.)
0%	8/12/00
5%	1/12/02
10%	4/7/02
15%	6/15/02
20%	8/19/02
25%	10/25/02
30%	12/27/02
35%	2/25/03
40%	4/27/03
45%	7/3/03
50%	9/9/03
55%	11/10/03
60%	1/13/04
65%	3/22/04
70%	6/20/04
75%	9/20/04
80%	1/4/05
85%	6/15/05
90%	12/14/05
95%	9/18/06
100%	10/29/08

End of Forecast

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Forecast: Alt #1 Fuel Removed from K-Basin **Cell: Q26**

Statistics for Display Range:	Value
Trials	1966
Mean	11/28/03
Median (approx.)	9/9/03
Mode (approx.)	2/13/03
Standard Deviation	526.25
Variance	276,938.08
Skewness	0.81
Kurtosis	3.35
Coeff. of Variability	0.01
Range Minimum	8/12/00
Range Maximum	10/29/08
Range Width	3,000.00
Mean Std. Error	11.87

Percentiles for Display Range:

Percentile	Date (approx.)
0%	8/12/00
5%	1/12/02
10%	4/7/02
15%	6/15/02
20%	8/19/02
25%	10/25/02
30%	12/27/02
35%	2/25/03
40%	4/27/03
45%	7/3/03
50%	9/9/03
55%	11/10/03
60%	1/13/04
65%	3/22/04
70%	6/20/04
75%	9/20/04
80%	1/4/05
85%	6/15/05
90%	12/14/05
95%	9/18/06
100%	10/29/08

End of Forecast

Forecast: Alt #1 Total Cost **Cell: T51**

Statistics for Display Range:	Value
Trials	1965
Mean	1168
Median (approx.)	1151
Mode (approx.)	1112
Standard Deviation	99
Variance	9725
Skewness	0.86
Kurtosis	3.55
Coeff. of Variability	0.08
Range Minimum	950
Range Maximum	1500
Range Width	550
Mean Std. Error	2.22

Percentiles for Display Range:

Percentile	M$ (approx.)
0%	950
5%	1035
10%	1058
15%	1072
20%	1085
25%	1097
30%	1108
35%	1118
40%	1127
45%	1139
50%	1151
55%	1165
60%	1177
65%	1188
70%	1203
75%	1220
80%	1240
85%	1273
90%	1307
95%	1363
100%	1500

End of Forecast

OUTPUT FOR ALTERNATIVE 2

ACTIVITY							
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	KBO	K-Basin Operations	10/28/02	8/14/98	36	315.78	$279
	KBSD	K-Basin Shutdown	10/29/03	4/29/02		90.00	$71
	DEC	Decision on Spent fuel Storage path forward	11/1/94	11/1/94		0.00	$0
	ADM	Prepare, review & approve NEPA ADM	4/2/95	1/16/95		0.20	$0
	EIS	Prepare, review & approve interim action EIS & ROD	5/20/96	9/25/95		1.00	$1
1.0	CHAR	Characterization of Fuel & Sludge	4/7/98	5/4/96		12.00	$11
2.0	PAC	Packaging Fuel & Sludge in K-Basin					
	KBSAR	Design of K-Basin Equipment and Update of SAR	7/2/95	5/17/95		0.08	$0
	KBOK	DOE Approval of K-Basin SAR	12/1/95	9/16/95		0.03	$0
	GETOP	Procure Fuel & Sludge Overpacks	7/20/98	1/9/97		11.00	$10
	GETBEQ	Procure K-Basin Overpack Equipment	1/22/96	10/12/95		4.50	$4
	INBEQ	Install K-Basin Overpack Equipment	8/19/96	7/4/96		4.50	$4
	GETSLGEQ	Procure Sludge Removal Equipment	11/6/96	3/5/96		20.20	$19
	INSLGEQ	Install Sludge Removal Equipment	2/18/98	6/28/97		2.50	$2
	KBORR	K-Basin ORR	10/19/98	10/28/97		5.00	$5
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport					
	SARP1	Design Casks & Prepare SARP	10/19/96	1/10/96		1.00	$1
	SARP1OK	DOE Review & Approval of SARP	2/18/97	12/19/96		0.50	$0
	GETCASK1	Procure Casks & RR Cars	7/2/98	4/6/97		20.00	$18
	TRANS1ORR	Conduct Transportation ORR	8/1/98	11/9/97		1.00	$1
6.0	DEBRIS	Dispose of Debris	10/28/01	4/24/00		10.00	$8
8.0	WATER	Cleanup Rad Water from K-B	10/28/02	10/28/01		18.00	$14
4.0 & 5.0	TSF	Design & Construct TSF					

ACTIVITY							
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	TSFPD	Preliminary TSF Design & PSAR	4/1/96	10/1/95		3.00	$3
	TSFOK	DOE Review & Approval of TSF PSAR	11/18/96	7/26/96		1.00	$1
	TSFFD	TSF Final design	1/6/97	5/20/96		7.50	$7
	TSFFSAR	TSF FSAR preparation	11/19/97	5/20/97		0.30	
	TSFC	TSF Construction	4/20/98	8/28/97		41.00	$38
	TSFORR	TSF FSAR approval & ORR	7/20/98	3/20/98		1.00	$1
7.0	TRANS1	Package and Transport Fuel & Sludge to TSF					
	PACFUEL	Package Fuel	10/28/00	10/24/99	10.00	20.25	$17
11.0	TRANSFUEL	Transport Fuel to TSF	10/28/00	10/24/99	5.00	10.13	$9
	PACSLG	Remove and Package Sludge & Separate Debris	10/28/00	10/24/99	2.50	5.06	$4
	TRANSLG	Transport Sludge to TSF	10/28/00	10/24/99	0.00	0.00	$0
9.0 & 10.0	TEMPSTOR	Store Fuel & Sludge in TSF	11/22/02	11/5/00	12.00	85.10	$70
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility					
	STABPD	Preliminary Stabilization Facility Design & PSAR	4/1/96	10/1/95		2.00	$2
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	1/6/97	8/19/96		0.70	$1
	TECHDEV	Stabilization Technology Development	7/26/97	5/29/96		19.70	$19
	STABFD	Stabilization Facility Final Design & FSAR	10/25/97	6/25/96		16.30	$14
	STABFSAR	TSF FSAR Preparation	1/6/98	7/8/97		1.40	$1
	STABC	Construction of Stabilization Facility	11/22/99	11/8/98		149.50	$131
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	8/22/00	3/25/99		5.00	$4
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility					
	STORPD	Preliminary Interim Storage Facility Design & PSAR	4/1/96	10/1/95		1.00	$1

ACTIVITY							
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	11/21/96	7/27/96		0.30	$0
	STORFD	Interim Storage Facility Final Design	10/13/96	4/7/96		0.50	$0
	STORFSAR	TSF FSAR Preparation	1/6/98	5/23/97		1.40	$1
	STORC	Construction of Interim Storage Facility	6/1/98	8/27/97		52.00	$30
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	9/1/98	5/5/98		5.00	$4
14.0	STAB	Stabilize Fuel & Sludge	11/22/02	10/7/01	40	90.00	$72
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage	11/22/02	10/7/01		12.00	$10
15.0	WASTE	Dispose of Wastes	11/22/02	10/7/01		0.30	$0
16.0	D&D	D&D Conditioning Facility	11/22/07	5/23/05		170.00	$123
20.0	INTERIM STOR	Interim Storage Operations	12/31/10	10/26/05	1.5	15.53	$11
	PM	Program management	11/22/02	8/27/98	1	101.73	$90
						1215	$1,027

K-Basin PV of Total Costs $601

Input Assumptions		
Average days per month	30.4375	DAYS
Real interest rate	3%	IRATE
Project start	6/1/94	START

Forecast: Alt #2 Fuel Stabilized **Cell: Q53**

Statistics:	Value
Trials	2000
Mean	4/1/04
Median (approx.)	11/14/03
Mode (approx.)	5/17/03
Standard Deviation	664.82
Variance	441,988.64
Skewness	2.39
Kurtosis	15.97
Coeff. of Variability	0.02
Range Minimum	4/15/01
Range Maximum	3/30/23
Range Width	8,018.86
Mean Std. Error	14.87

Percentiles:

Percentile	Date (approx.)
0%	4/15/01
5%	3/15/02
10%	6/23/02
15%	8/26/02
20%	11/1/02
25%	1/13/03
30%	3/24/03
35%	5/27/03
40%	7/18/03
45%	9/19/03
50%	11/14/03
55%	1/20/04
60%	4/2/04
65%	6/22/04
70%	9/19/04
75%	1/2/05
80%	5/22/05
85%	10/29/05
90%	6/8/06
95%	5/26/07
100%	3/30/23

End of Forecast

Forecast: Alt #2 Fuel Removed from K-Basin **Cell: Q34**

Statistics:	Value
Trials	2000
Mean	4/22/01
Median (approx.)	4/1/01
Mode (approx.)	2/4/01
Standard Deviation	193.87
Variance	37,585.61
Skewness	0.62
Kurtosis	3.58
Coeff. of Variability	0.01
Range Minimum	11/30/99
Range Maximum	5/4/03
Range Width	1,251.35
Mean Std. Error	4.34

Percentiles:

Percentile	Date (approx.)
0%	11/30/99
5%	7/8/00
10%	9/4/00
15%	10/13/00
20%	11/12/00
25%	12/8/00
30%	1/5/01
35%	1/28/01
40%	2/15/01
45%	3/11/01
50%	4/1/01
55%	4/24/01
60%	5/18/01
65%	6/13/01
70%	7/11/01
75%	8/12/01
80%	9/21/01
85%	11/10/01
90%	1/6/02
95%	3/31/02
100%	5/4/03

End of Forecast

Forecast: Alt #2 Total Cost **Cell: T59**

Statistics:	Value
Trials	2000
Mean	1271
Median (approx.)	1261
Mode (approx.)	1255
Standard Deviation	69
Variance	4719
Skewness	1.20
Kurtosis	6.26
Coeff. of Variability	0.05
Range Minimum	1118
Range Maximum	1789
Range Width	671
Mean Std. Error	1.54

Percentiles:

Percentile	M$ (approx.)
0%	1118
5%	1179
10%	1196
15%	1205
20%	1216
25%	1225
30%	1233
35%	1240
40%	1247
45%	1254
50%	1261
55%	1269
60%	1276
65%	1284
70%	1294
75%	1305
80%	1318
85%	1333
90%	1362
95%	1400
100%	1789

End of Forecast

OUTPUT FOR ALTERNATIVE 3

ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	KBO	K-Basin Operations	6/1/94	113.927	11/28/03	2/28/99	36	354.78	$308
	KBSD	K-Basin Shutdown	11/28/02	36.000	11/28/05	5/29/04		90.00	$67
	DEC	Decision on Spent fuel Storage path forward	11/1/94	0.000	11/1/94	11/1/94		0.00	$0
	ADM	Prepare, review & approve NEPA ADM	11/1/94	5.000	4/2/95	1/16/95		0.20	$0
	EIS	Prepare, review & approve Hanford Site EIS & ROD	1/31/95	24.000	1/30/97	1/31/96		1.00	$1
1.0	CHAR	Characterization of Fuel & Sludge	6/1/94	46.000	4/1/98	5/1/96		10.00	$11
2.0	PAC	Packaging Fuel & Sludge in K-Basin							
	KBSAR	Update K-Basin SAR	4/2/95	3.000	7/2/95	5/17/95		0.20	$0
	KBOK	DOE Approval of K-Basin SAR	7/2/95	5.000	12/1/95	9/16/95		0.03	$0
	GETOP	Procure Fuel & Sludge Overpacks	7/2/95	43.000	1/31/99	4/16/97		40.60	$45
	GETBEQ	Procure K-Basin Overpack Equipment	7/2/95	6.000	3/2/96	11/1/95		5.20	$5
	INBEQ	Install K-Basin Overpack Equipment	1/30/97	6.000	10/1/97	6/1/97		5.40	$5
	GETSLGEQ	Procure Sludge Removal Equipment	7/2/95	16.000	10/31/96	3/2/96		20.20	$19
	INSLGEQ	Install Sludge Removal Equipment	1/30/97	16.000	5/2/98	9/16/97		2.50	$2
	KBORR	K-Basin ORR	10/31/96	30.000	5/2/99	1/31/98		5.00	$4
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport							
	SARP1	Design Casks & Prepare SARP	4/2/95	76.000	10/10/96	1/5/96		1.00	$1
	SARP1OK	DOE Review & Approval of SARP	10/10/96	9.000	7/11/97	2/24/97		0.50	$0
	GETCASK1	Procure Casks & RR Cars	1/5/96	90.000	7/6/98	4/6/97		11.00	$10
	TRANS1ORR	Conduct Transportation ORR	7/11/97	12.850	8/6/98	1/22/98		1.00	$1

ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
6.0	DEBRIS	Dispose of Debris	8/28/00	39.000	11/28/03	4/14/02		10.00	$8
8.0	WATER	Clean-Up Rad Water from K-B	11/28/02	12.000	11/28/03	5/30/03		18.00	$14
7.0	TRANS1	Package and Transport Fuel & Sludge to TSF							
	PACFUEL	Package Fuel	8/28/00	27.000	11/28/02	10/13/01	20.00	45.00	$36
	TRANSFUEL	Transport Fuel to TSF	8/28/00	27.000	11/28/02	10/13/01	5.00	11.25	$9
	PACSLG	Remove and Package Sludge & Separate Debris	8/28/00	27.000	11/28/02	10/13/01	2.50	5.63	$5
	TRANSLG	Transport Sludge to TSF	8/28/00	27.000	11/28/02	10/13/01	0.00	0.00	$0
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility							
	STABPD	Preliminary Stabilization Facility Design & PSAR	4/2/95	12.000	4/1/96	10/1/95		2.00	$2
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	4/1/96	9.000	12/31/96	8/16/96		0.70	$1
	TECHDEV	Stabilization Technology Development	4/2/95	28.000	8/1/97	6/1/96		19.70	$19
	STABFD	Stabilization Facility Final Design & FSAR	12/31/96	18.000	10/31/97	10/1/97		10.00	$9
	STABFSAR	TSF FSAR Preparation	12/31/96	12.000	12/31/97	7/2/97		1.40	$1
	STABC	Construction of Stabilization Facility	10/31/97	23.900	11/28/99	11/14/98		126.00	$110
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	10/31/97	33.900	8/28/00	3/31/99		5.00	$4
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility							
	STORPD	Preliminary Interim Storage Facility Design & PSAR	4/2/95	12.000	4/1/96	10/1/95		1.00	$1
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	4/1/96	7.000	11/18/96	7/26/96		0.30	$0
	STORFD	Interim Storage Facility Final Design	11/18/96	12.000	11/19/97	5/20/97		0.50	$0
	STORFSAR	TSF FSAR Preparation	11/18/96	12.000	12/31/97	5/20/97		1.40	$1

ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	STORC	Construction of Interim Storage Facility	11/19/97	[redacted]	5/20/99	8/19/98		[redacted]	$29
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	12/31/97	19.600	8/20/99	10/25/98		5.00	$4
14.0	STAB	Stabilize Fuel & Sludge	8/28/00	[redacted]	11/28/02	10/13/01	40	90.00	$72
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage	8/28/00	27.000	11/28/02	10/13/01		12.00	$10
15.0	WASTE	Dispose of Wastes	8/28/00	27.000	11/28/02	10/13/01		0.30	$0
16.0	D&D	D&D Conditioning Facility	11/28/02	60.000	11/28/07	5/29/05		90.00	$65
20.0	INTERIM STOR	Interim Storage Operations	8/28/00	124.071	12/31/10	10/29/05	2	15.51	$11
	PM	Program management	6/1/94	101.927	11/28/02	8/30/98	1	101.93	$90
								1062	$893

K-Basin PV of Total Costs $552

Input Assumptions		
Average days per month	30.4375	DAYS
Real interest rate	3%	IRATE
Project start	6/1/94	START

Forecast: Alt #3 Fuel and Sludge Removed from K-Ba **Cell: Q26**

Statistics:	Value
Trials	2000
Mean	4/26/04
Median (approx.)	12/23/03
Mode (approx.)	3/11/03
Standard Deviation	614.85
Variance	378,044.14
Skewness	1.29
Kurtosis	5.64
Coeff. of Variability	0.02
Range Minimum	5/27/01
Range Maximum	9/29/13
Range Width	4,508.39
Mean Std. Error	13.75

Percentiles:

Percentile	Value (approx.)
0%	5/27/01
5%	4/3/02
10%	7/13/02
15%	10/2/02
20%	12/8/02
25%	2/7/03
30%	4/4/03
35%	6/3/03
40%	8/7/03
45%	10/13/03
50%	12/23/03
55%	3/10/04
60%	5/21/04
65%	8/8/04
70%	11/14/04
75%	3/19/05
80%	7/22/05
85%	12/21/05
90%	7/18/06
95%	6/14/07
100%	9/29/13

End of Forecast

Forecast: Alt #3 Fuel Stabilized **Cell: Q45**

Statistics:	Value
Trials	2000
Mean	4/26/04
Median (approx.)	12/10/03
Mode (approx.)	4/8/03
Standard Deviation	615.67
Variance	379,051.26
Skewness	1.40
Kurtosis	6.12
Coeff. of Variability	0.02
Range Minimum	7/28/01
Range Maximum	2/14/14
Range Width	4,584.64
Mean Std. Error	13.77

Percentiles:

Percentile	Date (approx.)
0%	7/28/01
5%	4/24/02
10%	7/23/02
15%	10/13/02
20%	12/20/02
25%	2/19/03
30%	4/15/03
35%	6/12/03
40%	8/9/03
45%	10/7/03
50%	12/10/03
55%	2/14/04
60%	5/4/04
65%	7/29/04
70%	11/4/04
75%	2/16/05
80%	7/12/05
85%	1/3/06
90%	7/25/06
95%	6/26/07
100%	2/14/14

End of Forecast

Forecast: Alt #3 Total Cost **Cell: T51**

Statistics:	Value
Trials	2000
Mean	1151
Median (approx.)	1134
Mode (approx.)	1094
Standard Deviation	103
Variance	10660
Skewness	1.10
Kurtosis	5.40
Coeff. of Variability	0.09
Range Minimum	941
Range Maximum	1815
Range Width	875
Mean Std. Error	2.31

Percentiles:

Percentile	Millions of Dollars (approx.)
0%	941
5%	1015
10%	1036
15%	1055
20%	1065
25%	1078
30%	1091
35%	1100
40%	1112
45%	1123
50%	1134
55%	1149
60%	1161
65%	1173
70%	1188
75%	1208
80%	1228
85%	1254
90%	1285
95%	1342
100%	1815

End of Forecast

OUTPUT FOR ALTERNATIVE 4

ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	KBO	K-Basin Operations	6/1/94	115.027	1/1/04	3/17/99	36	358.08	$311
	KBSD	K-Basin Shutdown	10/1/03	36.000	10/1/06	4/1/05		90.00	$65
	DEC	Decision on Spent fuel Storage path forward	11/1/94	0.000	11/1/94	11/1/94		0.00	$0
	ADM	Prepare, review & approve NEPA ADM	11/1/94	[illegible]	4/2/95	1/16/95		0.20	$0
	EIS	Prepare, review & approve interim action EIS & ROD	1/31/95	[illegible]	1/30/97	1/31/96		1.00	$1
1.0	CHAR	Characterization of Fuel & Sludge	6/1/94	[illegible]	4/6/98	5/3/96		[illegible]	$6
2.0	PAC	Packaging Fuel & Sludge in K-Basin							
	KBSAR	Preliminary design of K-Basin equipment & update of SAR	4/2/95	3.000	7/2/95	5/17/95		0.08	$0
	KBOK	DOE Approval of K-Basin SAR	7/2/95	5.000	12/1/95	9/16/95		0.03	$0
	GETOP	Procure Fuel & Sludge Overpacks							
	GETBEQ	Procure K-Basin Overpack Equipment	7/2/95	[illegible]	1/1/96	10/1/95		4.50	$4
	INBEQ	Install K-Basin Overpack Equipment	1/30/97	3.000	5/2/97	3/17/97		4.50	$4
	GETSLGEQ	Procure Sludge Removal Equipment	7/2/95	[illegible]	10/31/96	3/2/96		20.20	$19
	INSLGEQ	Install Sludge Removal Equipment	1/30/97	[illegible]	5/2/98	9/16/97		2.50	$2
	KBORR	K-Basin ORR	10/31/96	3.000	1/30/97	12/16/96		5.00	$5
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport							
	SARP1	Design Casks & Prepare SARP	4/2/95	[illegible]	10/1/96	1/1/96		1.00	$1
	SARP1OK	DOE Review & Approval of SARP	10/1/96	[illegible]	7/2/97	2/15/97		0.50	$0
	GETCASK1	Procure Casks & RR Cars	1/1/96	[illegible]	7/2/98	4/1/97		11.00	$10
	TRANS1ORR	Conduct Transportation ORR	7/2/97	15.000	10/1/98	2/15/98		1.00	$1
6.0	DEBRIS	Dispose of Debris	10/1/98	72.000	10/1/04	10/1/01		10.00	$8

ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
8.0	WATER	Clean-Up Rad Water from K-B	10/1/03	3.000	1/1/04	11/16/03		18.00	$14
7.0	TRANS1	Package and Transport Fuel & Sludge to BNFL & Stabilization Facility							
	PACFUEL	Package Fuel	10/1/98	60.000	10/1/03	4/1/01	20.00	100.00	$82
	TRANSFUEL	Transport Fuel to BNFL Shipping Port	10/1/98	60.000	10/1/03	4/1/01	2.32	11.60	$9
	PACSLG	Remove and Package Sludge & Separate Debris	10/1/98	60.000	10/1/03	4/1/01	2.50	12.50	$10
	TRANSLG	Transport Sludge to Stabilization Facility	10/1/98	60.000	10/1/03	4/1/01	0.00	0.00	$0
9.0 & 10.0	BNFL	Shipment to GB & processing of fuel at BNFL.	10/1/98	146.971	12/31/10	11/15/04		200.00	$1,468
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility							
	STABPD	Preliminary Stabilization Facility Design & PSAR	4/2/95	3.000	7/2/95	5/17/95		2.00	$2
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	7/2/95	4.500	11/16/95	9/8/95		0.70	$1
	TECHDEV	Stabilization Technology Development	4/2/95	[illegible]	6/1/96	11/1/95		19.70	$19
	STABFD	Stabilization Facility Final Design & FSAR	11/16/95	[illegible]	8/31/96	4/1/96		2.50	$2
	STABFSAR	SF FSAR Preparation	11/16/95	[illegible]	5/26/96	2/20/96		0.40	$0
	STABC	Construction of Stabilization Facility	1/30/97	[illegible]	2/12/98	8/7/97		[illegible]	$29
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	8/31/96	20.400	5/14/98	7/8/97		5.00	$5
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility							
	STORPD	Preliminary Interim Storage Facility Design & PSAR	4/2/95	4.500	8/17/95	6/9/95		1.00	$1
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	8/17/95	4.000	12/16/95	10/17/95		0.30	$0
	STORFD	Interim Storage Facility Final Design	12/16/95	[illegible]	6/25/96	3/21/96		0.50	$0

ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	STORFSAR	Storage Facility FSAR Preparation	12/16/95	4.000	5/26/96	2/15/96		1.40	$1
	STORC	Construction of Interim Storage Facility	1/30/97	10.000	12/1/97	7/2/97		8.00	$7
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	5/26/96	21.200	3/2/98	4/13/97		5.00	$5
14.0	STAB	Stabilize Sludge	10/1/98	63.000	1/1/04	5/17/01	10	52.50	$43
15.0	WASTE	Dispose of Wastes	10/1/98	63.000	1/1/04	5/17/01		2.00	$2
16.0	D&D	D&D Conditioning Facility	1/1/04	30.000	7/2/06	4/1/05		15.00	$11
20.0	INTERIM STOR	Interim Storage Operations	10/1/98	135.012	1/1/10	5/17/04	1.5	16.88	$13
	PM	Program management	6/1/94	115.027	1/1/04	3/17/99	1	115.03	$100
								2822	$2,161

K-Basin PV of Total Costs $553

Input Assumptions		
Average days per month	30.4375	DAYS
Real interest rate	3%	IRATE
Project start	6/1/94	START

Forecast: Alt #4 Fuel Removed from K-Basin **Cell: Q29**

Summary:

Display Range is from 4/19/01 to 2/2/06
Entire Range is from 12/14/01 to 12/8/06
After 2,000 Trials, the Std. Error of the Mean is 1/6/00

Statistics:	Value
Trials	2000
Mean	10/15/03
Median (approx.)	9/25/03
Mode (approx.)	9/21/03
Standard Deviation	279.39
Variance	78,059.77
Skewness	0.48
Kurtosis	3.37
Coeff. of Variability	0.01
Range Minimum	12/14/01
Range Maximum	12/8/06
Range Width	1,819.92
Mean Std. Error	6.25

Percentiles:

Percentile	Value (approx.)
0%	12/14/01
5%	8/27/02
10%	11/4/02
15%	1/3/03
20%	2/19/03
25%	4/1/03
30%	5/11/03
35%	6/14/03
40%	7/21/03
45%	8/25/03
50%	9/25/03
55%	10/24/03
60%	12/2/03
65%	1/9/04
70%	2/18/04
75%	4/12/04
80%	5/27/04
85%	7/31/04
90%	10/9/04
95%	2/7/05
100%	12/8/06

End of Forecast

Forecast: Alt #4 Fuel Stabilized **Cell: Q46**

Summary:

Display Range is from 12/25/01 to 2/2/06 Date
Entire Range is from 3/15/02 to 3/9/07 Date
After 2,000 Trials, the Std. Error of the Mean is 1/6/00

Statistics:	Value
Trials	2000
Mean	1/14/04
Median (approx.)	12/25/03
Mode (approx.)	12/21/03
Standard Deviation	279.39
Variance	78,059.77
Skewness	0.48
Kurtosis	3.37
Coeff. of Variability	0.01
Range Minimum	3/15/02
Range Maximum	3/9/07
Range Width	1,819.92
Mean Std. Error	6.25

Percentiles:

Percentile	Date (approx.)
0%	3/15/02
5%	11/26/02
10%	2/3/03
15%	4/5/03
20%	5/21/03
25%	7/1/03
30%	8/10/03
35%	9/14/03
40%	10/20/03
45%	11/25/03
50%	12/25/03
55%	1/23/04
60%	3/2/04
65%	4/9/04
70%	5/19/04
75%	7/13/04
80%	8/27/04
85%	10/30/04
90%	1/9/05
95%	5/9/05
100%	3/9/07

Forecast: Alt #4 Total Cost **Cell: T51**

Summary:

Display Range is from 1750 to 3500 Millions of Dollars
Entire Range is from 1804 to 3326 Millions of Dollars
After 2,000 Trials, the Std. Error of the Mean is 7

Statistics:	Value
Trials	2000
Mean	2654
Median (approx.)	2685
Mode (approx.)	2846
Standard Deviation	316
Variance	100120
Skewness	-0.30
Kurtosis	2.33
Coeff. of Variability	0.12
Range Minimum	1804
Range Maximum	3326
Range Width	1522
Mean Std. Error	7.08

Percentiles:

Percentile	Millions of Dollars (approx.)
0%	1804
5%	2088
10%	2199
15%	2291
20%	2359
25%	2418
30%	2484
35%	2537
40%	2596
45%	2639
50%	2685
55%	2735
60%	2780
65%	2816
70%	2850
75%	2895
80%	2936
85%	2999
90%	3054
95%	3122
100%	3326

Attachment G-3. Recommended Path Forward Analysis.

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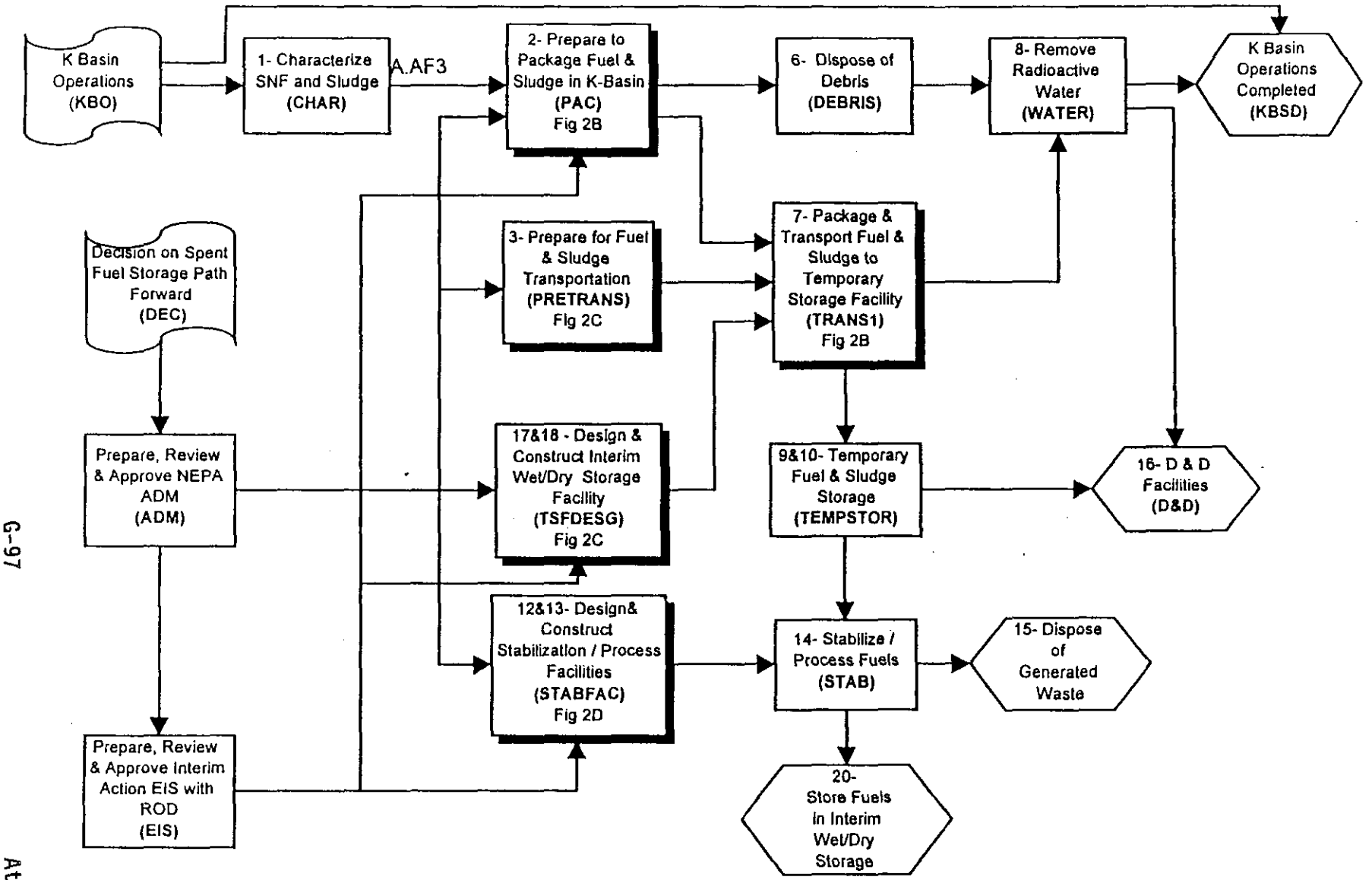

FIGURE 5A - PATH FORWARD TOP LEVEL FLOWCHART

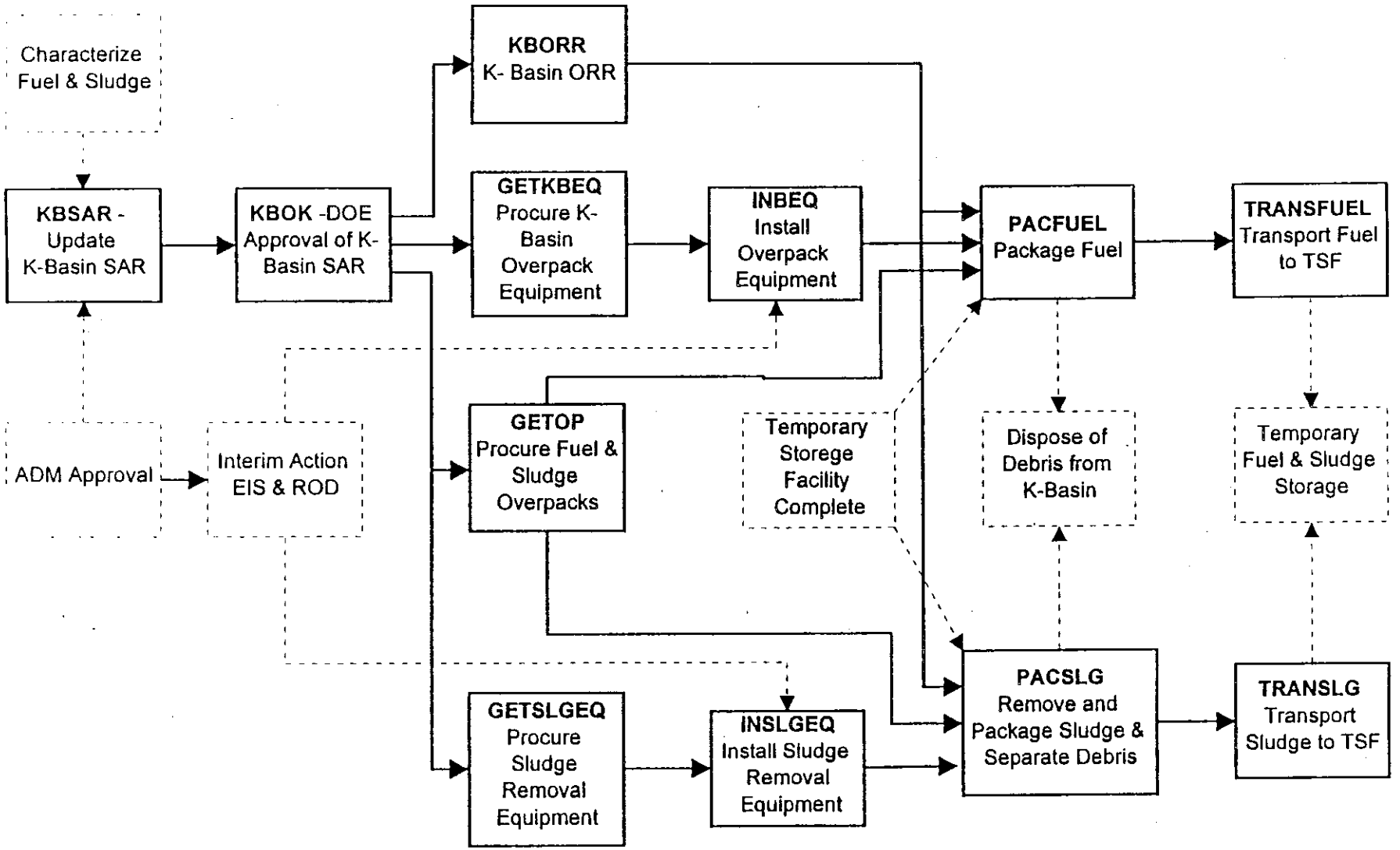

FIGURE 5B - PATH FORWARD PACKAGE AND TRANSPORT FUEL & SLUDGE

PF_5B.AF3

10/8/94

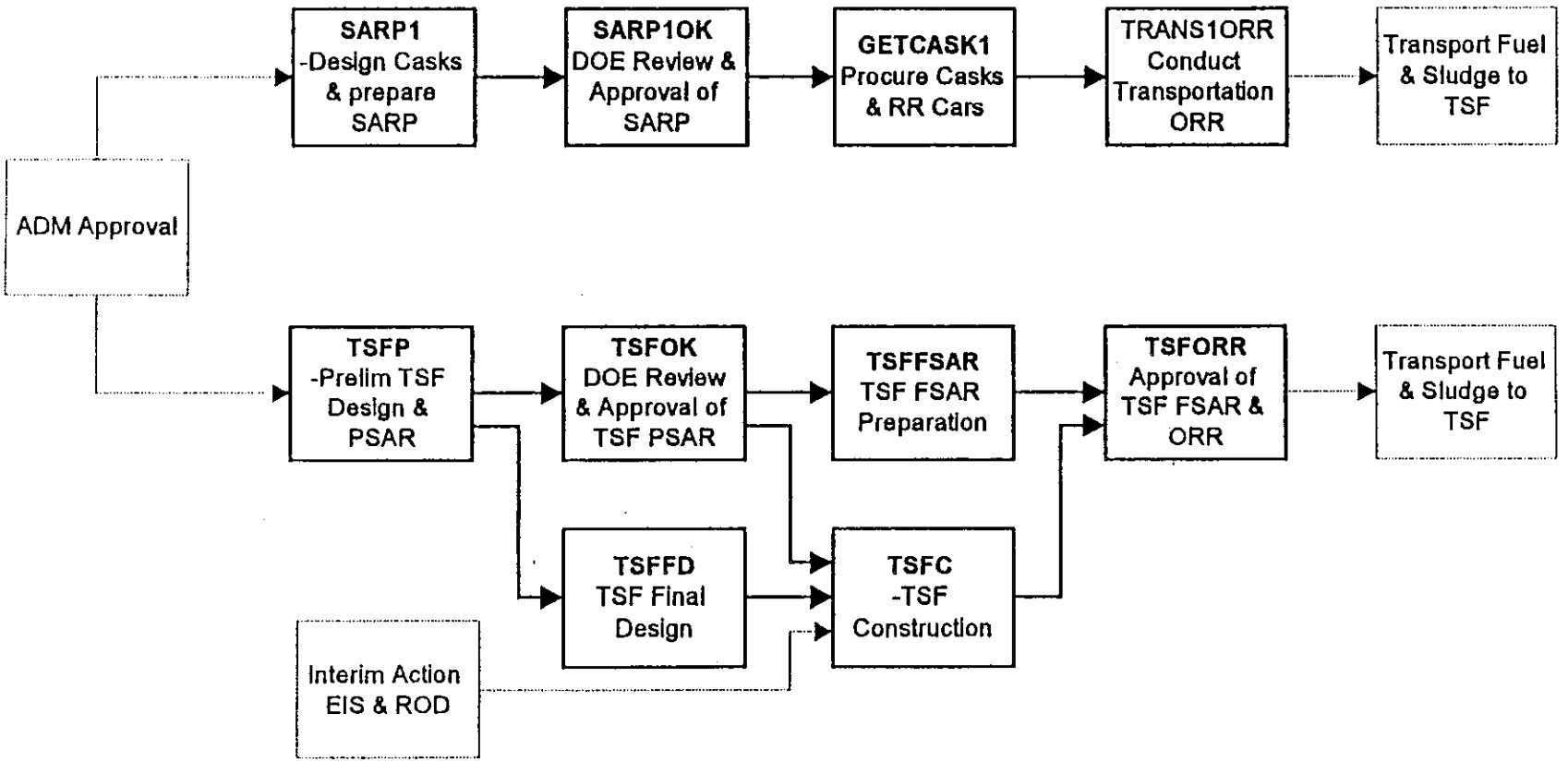

FIGURE 5C - PATH FORWARD LEVEL 2 TASKS

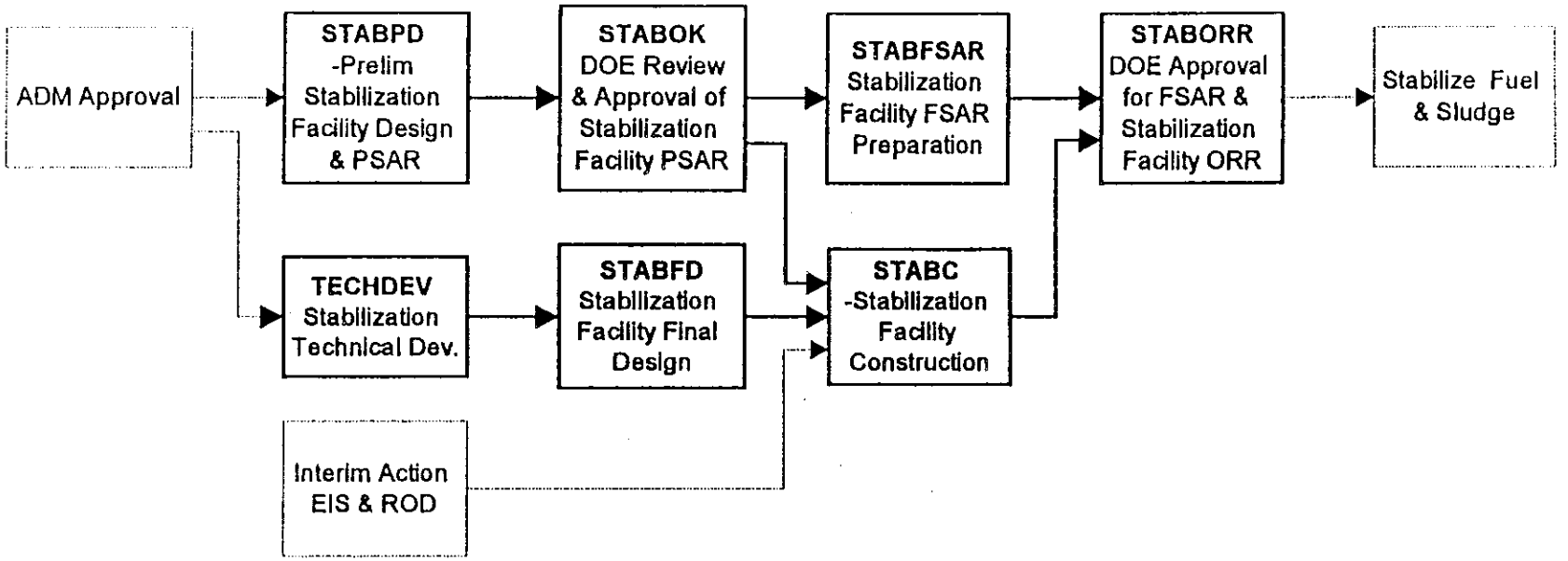

FIGURE 5D - PATH FORWARD LEVEL 2 TASKS

PATHFWD.XLS 10/17/94 6:18 PM

ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	KBO	K-Basin Operations	Starts 6/1/94. Ends when fuel and sludge is removed.			F-S			PE		13M+ 42/yr		Alt#2 Ind. Review
	KBSD	K-Basin Shutdown	Starts when fuel & sludge are removed.	PE		36		Alt#2 Ind. Review	PE		90		Alt#2 Ind. Review
	DEC	Decision on Spent fuel Storage path forward	Assumed 11/1/1994			0					0		
	ADM	Prepare, review & approve NEPA ADM	Stars after SF path forward decision	LN	4	5	6	10/6 NEPA presentation	PE		0.2		PLG estimate
	EIS	Prepare, review & approve interim action EIS & ROD	Starts 3m after ADM starts	LN	13	15.6	18	10/6 NEPA presentation	PE		1		PLG estimate
1.0	CHAR	Characterization of Fuel & Sludge	Starts 6/1/94	LN	30	46.2	60	PLG analysis of SAIC data	U	6	12	18	Alt#2 Ind. Review
2.0	PAC	Packaging Fuel & Sludge in K-Basin											
	KBSAR	Update K-Basin SAR	Starts after SF storage ADM approved	PE		3		Licensing analysis, Rev2.	PE		80K		Licensing analysis, Rev2.
	KBOK	DOE Approval of K-Basin SAR	Starts after SAR is completed	PE		5		Licensing analysis, Rev2.	PE		30K		Licensing analysis, Rev2.
	GETOP	Procure Fuel & Sludge Overpacks	Starts after SAR is completed	LN	30.9	36.6	42	PLG analysis of SAIC data	PE	36M	45M	54M	SAIC Data
	GETBEQ	Procure K-Basin Overpack Equipment	Starts after SAR is completed	LN	4	6.7	9	PLG analysis of SAIC data	PE		4.5M		SAIC Data
	INBEQ	Install K-Basin Overpack Equipment	Starts when procurement done & EIS approved			3		PLG analysis of SAIC data	PE		3.8M		SAIC Data
	GETSLGEQ	Procure Sludge Removal Equipment	Starts after SAR is completed	LN	10.7	16.2	21	PLG analysis of SAIC data	PE		20.2M		SAIC Data
	INSLGEQ	Install Sludge Removal Equipment	Starts when procurement done & EIS approved	LN	12.5	15.4	18	PLG analysis of SAIC data	PE		2.5M		SAIC Data
	KBORR	K-Basin ORR	Start after sludge equip procured. Finished 3m after K-B ready to pack			F-S		Licensing analysis, Rev2.	PE		5M		Licensing analysis, Rev2.
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport											
	SARP1	Design Casks & Prepare SARP	Starts after SF storage ADM approved	LN	15.4	18.3	21	PLG analysis of SAIC data	PE		1		Licensing analysis, Rev2.
	SARP1OK	DOE Review & Approval of SARP	Starts after SARP is completed			4		PLG analysis of SAIC data	PE		0.5		Licensing analysis, Rev2.
	GETCASK1	Procure Casks & RR Cars	Start when SARP1 is half done.	LN	24	29.7	35	PLG analysis of SAIC data	PE		11		SAIC Data
	TRANS1ORR	Conduct Transportation ORR	Starts after SARP approved. Ends 1m after casks & RR car delivered.			F-S		Licensing analysis, Rev2.	PE		1		Licensing analysis, Rev2.
6.0	DEBRIS	Dispose of Debris	Starts with sludge removal and finishes 12m after sludge removal complete.			F-S			PE		10		SAIC Data
8.0	WATER	Clean-up Rad Water from K-B	Starts after fuel, sludge & debris are removed.	PE		24		PLG analysis of SAIC data	PE		18		SAIC Data
4.0 & 5.0	TSF	Design & Construct TSF											

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	TSFPD	Preliminary TSF Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		2		SAIC Data
	TSFOK	DOE Review & Approval of TSF PSAR	Starts after PSAR is completed	LN	6	9	12	PLG analysis of SAIC data	PE		0.7		SAIC Data
	TSFFD	TSF Final design	Starts after PSAR is approved.	LN	9.6	12.4	15	PLG analysis of SAIC data	PE		19.7		SAIC Data
	TSFFSAR	TSF FSAR preparation	Starts when PSAR is approved			12		PLG analysis of SAIC data	T	7.5	10	12.6	SAIC Data
	TSFC	TSF Construction	Starts after PSAR & EIS are approved & final design complete	LN	15.4	18	21	PLG analysis of SAIC data	LN	55	64	72	SAIC Data
	TSFORR	TSF FSAR approval & ORR	Starts after FSAR is complete. Finishes 5m after construction is complete.			F-S		PLG analysis of SAIC data	PE		5		SAIC Data
7.0	TRANS1	Package and Transport Fuel & Sludge to TSF				F-S			PE		5M		Same as KBORR
	PACFUEL	Package Fuel	Start when K-B equip, ORR, overpacks & TSF ready	LN	21	24.3	27.4	PLG analysis of SAIC data	PE		10/Yr		PLG estimate from SAIC data
	TRANSFUEL	Transport Fuel to TSF	Starts and finishes with PACFUEL.						PE		5M/yr+ 9M/yr		SAIC Data includes transportation and loading temp storage
	PACSLG	Remove and Package Sludge & Separate Debris	Start when sludge equip, ORR, overpacks & SF ready. Finishes with fuel removal.			F-S			PE		7M		SAIC Data
	TRANSLG	Transport Sludge to TSF	Starts and finishes with PACSLG.										Included with PACFUEL
9.0 & 10.0	TEMPSTOR	Store Fuel & Sludge in TSF between K-Basin Complete and Processing Start	Starts with fuel or sludge transfer complete. Finishes when stabilization is started.			F-S			PE		2.8M/yr		Alt#2 Ind. Review & SAIC data
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility											
	STABPD	Preliminary Stabilization Facility Design & PSAR	Starts after SF storage ADM approved	PE		12		PLG analysis of SAIC data	PE		2		SAIC Data
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	Starts after PSAR is completed	LN	6	9.2	12	PLG analysis of SAIC data	PE		0.7		SAIC Data
	TECHDEV	Stabilization Technology Development	Starts after SF storage ADM approved	LN	15.2	27.8	37.8	PLG analysis of SAIC data	PE		19.7		SAIC Data
	STABFD	Stabilization Facility Final Design & FSAR	Starts after PSAR is approved. Finishes 3m after technology dev.	LN	13.5	17.6	21.3	PLG analysis of SAIC data	T	12.3	15.3	18.3	SAIC Data
	STABFSAR	TSF FSAR Preparation	Starts after PSAR is approved.			12		PLG analysis of SAIC data	PE		1.4		SAIC Data
	STABC	Construction of Stabilization Facility	Starts after PSAR & EIS are approved & final design complete.	LN	19.2	24.9	30	PLG analysis of SAIC data	LN	100	123	145	SAIC Data
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	Starts after FSAR is complete. Finishes 12m after construction is complete.			F-S			PE		5M		Same as KBORR
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility											

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	STORPD	Preliminary Interim Storage Facility Design & PSAR	Starts after SF storage ADM approved										
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	Starts after SAR is completed										
	STORFD	Interim Storage Facility Final Design	Starts after PSAR is approved.										
	STORFSAR	TSF FSAR Preparation	Starts after PSAR is approved.										
	STORC	Construction of Interim Storage Facility	Starts after PSAR & EIS are approved & final design complete.										
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	Starts after FSAR is complete. Finishes 3m after construction is complete.										
14.0	STAB	Stabilize Fuel & Sludge plus store fuel during processing	Starts when fuel or sludge transport begins and stabilization and storage facilities are complete.	LN	48	53.4	59	PLG analysis of SAIC data	PE		15.3M /Yr+12 M/yr		SAIC Data for processing and storage
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage	Starts ad finishes with stabilization.										
15.0	WASTE	Dispose of Wastes	Starts ad finishes with stabilization.	PE		29		PLG analysis of SAIC data	PE		.3M		SAIC Data
16.0	D&D	D&D Conditioning Facility	Starts when stabilization is complete.	PE		60		PLG analysis of SAIC data	PE		120		SAIC Data
20.0	INTERIM STOR	Interin Storage Operations	Starts when stabilization begins. Finishes 12/31/10			F-S					1.5/Yr		Alt#2 Ind. Review
	PM	Program management	Starts 6/1/94, finishes when all fuel is in interim storage			F-S					1/m		PLG estimate from SAIC Data

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ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	KBO	K-Basin Operations	6/1/94	77.227	11/6/00	8/19/97	42	283.29	$258
	KBSD	K-Basin Shutdown	11/6/00	36.000	11/7/03	5/8/02		90.00	$71
	DEC	Decision on Spent fuel Storage path forward	11/1/94	0.000	11/1/94	11/1/94		0.00	$0
	ADM	Prepare, review & approve NEPA ADM	11/1/94	[illegible]	4/2/95	1/16/95		0.20	$0
	EIS	Prepare, review & approve interim action EIS & ROD	1/31/95	[illegible]	5/20/96	9/25/95		1.00	$1
1.0	CHAR	Characterization of Fuel & Sludge	6/1/94	[illegible]	4/7/98	5/4/96		[illegible]	$11
2.0	PAC	Packaging Fuel & Sludge in K-Basin							
	KBSAR	Update K-Basin SAR	4/2/95	3.000	7/2/95	5/17/95		0.08	$0
	KBOK	DOE Approval of K-Basin SAR	7/2/95	5.000	12/1/95	9/16/95		0.03	$0
	GETOP	Procure Fuel & Sludge Overpacks	7/2/95	[illegible]	7/20/98	1/9/97		[illegible]	$42
	GETBEQ	Procure K-Basin Overpack Equipment	7/2/95	[illegible]	1/22/96	10/12/95		4.50	$4
	INBEQ	Install K-Basin Overpack Equipment	5/20/96	3.000	8/19/96	7/4/96		4.50	$4
	GETSLGEQ	Procure Sludge Removal Equipment	7/2/95	[illegible]	11/6/96	3/5/96		20.20	$19
	INSLGEQ	Install Sludge Removal Equipment	11/6/96	[illegible]	2/18/98	6/28/97		2.50	$2
	KBORR	K-Basin ORR	11/6/96	23.400	10/19/98	10/28/97		5.00	$5
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport							
	SARP1	Design Casks & Prepare SARP	4/2/95	[illegible]	10/10/96	1/5/96		1.00	$1
	SARP1OK	DOE Review & Approval of SARP	10/10/96	4.000	2/8/97	12/10/96		0.50	$0
	GETCASK1	Procure Casks & RR Cars	1/5/96	[illegible]	6/27/98	4/1/97		11.00	$10
	TRANS1ORR	Conduct Transportation ORR	2/8/97	17.550	7/28/98	11/3/97		1.00	$1
6.0	DEBRIS	Dispose of Debris	10/28/98	36.300	11/6/01	5/3/00		10.00	$8
8.0	WATER	Clean-up Rad Water from K-B	11/6/00	24.000	11/7/02	11/6/01		18.00	$14
4.0 & 5.0	TSF	Design & Construct TSF							

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ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	TSFPD	Preliminary TSF Design & PSAR	4/2/95	12.000	4/1/96	10/1/95		1.00	$1
	TSFOK	DOE Review & Approval of TSF PSAR	4/1/96	[illegible]	11/18/96	7/26/96		0.30	$0
	TSFFD	TSF Final design	10/1/95	[illegible]	10/13/96	4/7/96		0.50	$0
	TSFFSAR	TSF FSAR preparation	11/18/96	12.000	11/19/97	5/20/97		1.40	
	TSFC	TSF Construction	11/18/96	[illegible]	5/29/98	8/24/97		[illegible]	$58
	TSFORR	TSF FSAR approval & ORR	11/19/97	11.300	10/28/98	5/9/98		5.00	$4
7.0	TRANS1	Package and Transport Fuel & Sludge to TSF							
	PACFUEL	Package Fuel	10/28/98	[illegible]	11/6/00	11/2/99	10.00	20.25	$17
	TRANSFUEL	Transport Fuel to TSF	10/28/98	24.300	11/6/00	11/2/99	14.00	28.35	$24
	PACSLG	Remove and Package Sludge & Separate Debris	10/28/98	24.300	11/6/00	11/2/99	2.50	5.06	$4
	TRANSLG	Transport Sludge to TSF	10/28/98	24.300	[illegible]	11/2/99	0.00	0.00	$0
9.0 & 10.0	TEMPSTOR	Store Fuel & Sludge in TSF between K-Basin Complete and Processing Start	11/6/00	0.500	11/21/00	11/14/00	2.80	0.12	$0
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility							
	STABPD	Preliminary Stabilization Facility Design & PSAR	4/2/95	12.000	4/1/96	10/1/95		2.00	$2
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	4/1/96	[illegible]	1/6/97	8/19/96		0.70	$1
	TECHDEV	Stabilization Technology Development	4/2/95	[illegible]	7/26/97	5/29/96		19.70	$19
	STABFD	Stabilization Facility Final Design & FSAR	4/1/96	[illegible]	10/25/97	12/25/96		[illegible]	$14
	STABFSAR	TSF FSAR Preparation	1/6/97	12.000	1/6/98	7/8/97		1.40	$1
	STABC	Construction of Stabilization Facility	10/25/97	[illegible]	11/22/99	11/8/98		[illegible]	$129
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	10/25/97	36.900	11/21/00	5/10/99		5.00	$4
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility							

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ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	STORPD	Preliminary Interim Storage Facility Design & PSAR							
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR							
	STORFD	Interim Storage Facility Final Design							
	STORFSAR	TSF FSAR Preparation							
	STORC	Construction of Interim Storage Facility							
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR							
14.0	STAB	Stabilize Fuel & Sludge plus store fuel during processing	11/21/00	53.000	[illegible]	2/6/03	27	120.58	$93
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage							
15.0	WASTE	Dispose of Wastes	11/21/00	53.000	4/22/05	2/6/03		0.30	$0
16.0	D&D	D&D Conditioning Facility	4/22/05	60.000	4/23/10	10/23/07		90.00	$61
20.0	INTERIM STOR	Interin Storage Operations	11/21/00	121.271	12/31/10	12/11/05	2	15.16	$11
	PM	Program management	6/1/94	130.727	4/22/05	11/11/99	0.9	114.39	$97
								[illegible]	[illegible]

K-Basin PV of Total Costs $563

Input Assumptions		
Average days per month	30.4375	DAYS
Real interest rate	3%	IRATE
Project start	6/1/94	START

PATHFWD.XLS

Forecast: Recommended Path Forward Fuel Removed from K-Basin **Cell: Q36**

Statistics:	Value
Trials	2000
Mean	6/6/01
Median (approx.)	5/6/01
Mode (approx.)	4/21/01
Standard Deviation	183.81
Variance	33,787.83
Skewness	1.16
Kurtosis	6.22
Coeff. of Variability	0.00
Range Minimum	5/24/00
Range Maximum	4/27/05
Range Width	1,799.20
Mean Std. Error	4.11

Percentiles:

Percentile	Value (approx.)
0%	5/24/00
5%	10/5/00
10%	11/10/00
15%	12/8/00
20%	1/3/01
25%	1/28/01
30%	2/19/01
35%	3/12/01
40%	4/3/01
45%	4/19/01
50%	5/6/01
55%	5/30/01
60%	6/22/01
65%	7/18/01
70%	8/16/01
75%	9/17/01
80%	10/20/01
85%	12/3/01
90%	1/30/02
95%	4/26/02
100%	4/27/05

End of Forecast

PATHFWD.XLS

Forecast: Recommended Path Forward Fuel Stabilized Cell: Q53

Statistics:	Value
Trials	2000
Mean	4/11/06
Median (approx.)	1/5/06
Mode (approx.)	11/25/05
Standard Deviation	516.66
Variance	266,938.43
Skewness	1.75
Kurtosis	10.84
Coeff. of Variability	0.01
Range Minimum	8/26/03
Range Maximum	5/1/20
Range Width	6,092.85
Mean Std. Error	11.55

Percentiles:

Percentile	Value (approx.)
0%	8/26/03
5%	7/4/04
10%	10/11/04
15%	12/30/04
20%	3/6/05
25%	4/27/05
30%	6/26/05
35%	8/15/05
40%	10/4/05
45%	11/23/05
50%	1/5/06
55%	3/8/06
60%	5/4/06
65%	7/8/06
70%	9/19/06
75%	12/13/06
80%	3/13/07
85%	7/8/07
90%	12/31/07
95%	11/6/08
100%	5/1/20

End of Forecast

PATHFWD.XLS

Forecast: Recommended Path Forward Total Cost **Cell: T59**

Statistics:	Value
Trials	2000
Mean	1208
Median (approx.)	1204
Mode (approx.)	1203
Standard Deviation	51
Variance	2564
Skewness	0.49
Kurtosis	3.44
Coeff. of Variability	0.04
Range Minimum	1066
Range Maximum	1432
Range Width	365
Mean Std. Error	1.13

Percentiles:

Percentile	M$ (approx.)
0%	1066
5%	1133
10%	1147
15%	1156
20%	1164
25%	1171
30%	1178
35%	1185
40%	1191
45%	1198
50%	1204
55%	1210
60%	1218
65%	1224
70%	1231
75%	1239
80%	1248
85%	1259
90%	1275
95%	1298
100%	1432

End of Forecast

Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	KBO	K-Basin Operations	Starts 6/1/94. Ends when fuel and sludge is removed.			F-S			PE		13M+ 42/yr		Alt#2 Ind. Review
	KBSD	K-Basin Shutdown	Starts when fuel & sludge are removed.	PE		36		Task 006 19	PE		90		Alt#2 Ind. Review
	DEC	Decision on Spent fuel Storage path forward	Assumed 11/1/1994			0					0		
	ADM	Prepare, review & approve NEPA ADM	Stars after SF path forward decision	LN	4	5	6	EA 01C	PE		0.2		PLG estimate
	EIS	Prepare, review & approve Interim action EIS & ROD	Starts 3m after ADM starts	LN	13	15.6	18	Task 217	PE		1		PLG estimate
1.0	CHAR	Characterization of Fuel & Sludge	Starts 6/1/94	LN	30	46.2	60	Task 217	U	6	12	18	Alt#2 Ind. Review
2.0	PAC	Packaging Fuel & Sludge in K-Basin											
	KBSAR	Update K-Basin SAR	Starts after SF storage ADM approved	PE		3		020_02A?	PE		80K		Licensing analysis, Rev2.
	KBOK	DOE Approval of K-Basin SAR	Starts after SAR is completed	PE		5		021_02A?	PE		30K		Licensing analysis, Rev2.
	GETOP	Procure Fuel & Sludge Overpacks	Starts after SAR is completed	LN	30.9	36.6	42	Tasks, 050, 055	PE	36M	45M	54M	SAIC Data
	GETBEQ	Procure K-Basin Overpack Equipment	Starts after SAR is completed	LN	4	6.7	9	Task 025	PE		4.5M		SAIC Data
	INBEQ	Install K-Basin Overpack Equipment	Starts when procurement done & EIS approved			3		Task 030	PE		3.8M		SAIC Data
	GETSLGEQ	Procure Sludge Removal Equipment	Starts after SAR is completed	LN	10.7	16.2	21	Task 100,120	PE		20.2M		SAIC Data
	INSLGEQ	Install Sludge Removal Equipment	Starts when procurement done & EIS approved	LN	12.5	15.4	18	Task 110	PE		2.5M		SAIC Data
	KBORR	K-Basin ORR	Start after sludge equip procured. Finished 3m after K-B ready to pack			F-S		Ext of Task 115 & 021 past Construction	PE		5M		Licensing analysis, Rev2.
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport											
	SARP1	Design Casks & Prepare SARP	Starts after SF storage ADM approved	LN	**17.1**	**18**	**19**	Task 070	PE		1		Licensing analysis, Rev2.
	SARP1OK	DOE Review & Approval of SARP	Starts after SARP is completed			4		Task 071	PE		0.5		Licensing analysis, Rev2.
	GETCASK1	Procure Casks & RR Cars	Start when SARP1 is half done.	LN	**27.1**	**29**	**31**	Tasks 071, 075, 080, 085	PE		11		SAIC Data
	TRANS1ORR	Conduct Transportation ORR	Starts after SARP approved. Ends 1m after casks & RR car delivered.			F-S		Task 087	PE		1		Licensing analysis, Rev2.
6.0	DEBRIS	Dispose of Debris	Starts with sludge removal and finishes 12m after sludge removal complete.			F-S		Task 330	PE		10		SAIC Data
8.0	WATER	Clean-up Rad Water from K-B	Starts after fuel, sludge & debris are removed.	PE		24		Task 350	PE		18		SAIC Data
4.0 & 5.0	TSF	Design & Construct TSF											

* Changed Distributions are in bold print and underlined.

Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	TSFPD	Preliminary TSF Design & PSAR	Starts after SF storage ADM approved	PE		9		254_17	PE		2		SAIC Data
	TSFOK	DOE Review & Approval of TSF PSAR	Starts after PSAR is completed	LN	6	9	12	256_17	PE		0.7		SAIC Data
	TSFFD	TSF Final design	Starts after PSAR is approved.	LN	9.6	12.4	15	259_17	PE		19.7		SAIC Data
	TSFFSAR	TSF FSAR preparation	Starts when PSAR is approved			12		257_17	T	7.5	10	12.6	SAIC Data
	TSFFSOK	TSF FSAR Approval						258_17					
	TSFC	TSF Construction	Starts after PSAR & EIS are approved & final design complete	LN	**17.1**	**18**	**19**	260_17	LN	55	64	72	SAIC Data
	TSFORR	ORR Duration After Finish of construction	Starts after after construction complete. Finishes in 5 m, or 3 m after FSAR complete, whichever is latest			5		262_17	PE		5		SAIC Data
7.0	TRANS1	Package and Transport Fuel & Sludge to TSF											
	PACFUEL	Package Fuel	Start when K-B equip, ORR, overpacks & TSF ready	LN	**22**	**24**	**25.6**	Task 060	PE		10/Yr		PLG estimate from SAIC data
	TRANSFUEL	Transport Fuel to TSF	Starts and finishes with PACFUEL.			F-S		Task 065	PE		5M/yr+ 9M/yr		SAIC Date includes transportation and loading temp storage
	PACSLG	Remove and Package Sludge & Separate Debris	Start when sludge equip, ORR, overpacks & SF ready. Finishes with fuel removal.			F-S		130_02	PE		7M		SAIC Data
	TRANSLG	Transport Sludge to TSF	Starts and finishes with PACSLG.			F-S		065_07					Included with PACFUEL
9.0 & 10.0	TEMPSTOR	Store Fuel & Sludge in TSF between K-Basin Complete and Processing Start	Starts with fuel or sludge transfer complete. Finishes when stabilization is started.			F-S		264_20	PE		2.8M/yr		Alt#2 Ind. Review & SAIC data
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility											
	STABPD	Preliminary Stabilization Facility Design & PSAR	Starts after SF storage ADM approved	PE		12		Task 215 12	PE		2		SAIC Data
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	Starts after PSAR is completed	LN	6	9.2	12	Task 220	PE		0.7		SAIC Data
	TECHDEV	Stabilization Technology Development	Starts after SF storage ADM approved	LN	15.2	27.8	37.8	Task 226	PE		19.7		SAIC Data
	STABFD	Stabilization Facility Final Design & FSAR	Starts after PSAR is approved. Finishes 3m after technology dev.	LN	13.5	17.6	21.3	Task 230	T	12.3	15.3	18.3	SAIC Data
	STABFSAR	TSF FSAR Preparation	Starts after PSAR is approved.			12		Task 227	PE		1.4		SAIC Data
	STABC	Construction of Stabilization Facility	Starts after PSAR & EIS are approved & final design complete.	LN	19.2	24.9	30	Task 235, 236_13	LN	100	123	145	SAIC Data
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	Starts after FSAR is complete. Finishes 12m after construction is complete.			F-S		Task 240	PE		5M		Same as KBORR
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility											
	STORPD	Preliminary Interim Storage Facility Design & PSAR	Starts after SF storage ADM approved										

* Changed Distributions are in bold print and underlined.

Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks

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ACTIVITY			CONSTRAINT	DURATION					1994 DIRECT COST				
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION		TYPE	20%	MEAN	80%	DISTRIBUTION SOURCE/COMMENTS	TYPE	20%	MEAN (M$)	80%	DISTRIBUTION SOURCE/COMMENTS
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR	Starts after SAR is completed										
	STORFD	Interim Storage Facility Final Design	Starts after PSAR is approved.										
	STORFSAR	TSF FSAR Preparation	Starts after PSAR is approved.										
	STORC	Construction of Interim Storage Facility	Starts after PSAR & EIS are approved & final design complete.										
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR	Starts after FSAR is complete. Finishes 3m after construction is complete.										
14.0	STAB	Stabilize Fuel & Sludge plus store fuel during processing	Starts when fuel or sludge transport begins and stabilization and storage facilities are complete.	LN	48	53.4	59	245_14A	PE		15.3M /Yr+12 M/yr		SAIC Data for processing and storage
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage	Starts ad finishes with stabilization.										
15.0	WASTE	Dispose of Wastes	Starts ad finishes with stabilization.	PE		29		Tasks 400,405,407	PE		.3M		SAIC Data
16.0	D&D	D&D Conditioning Facility	Starts when stabilization is complete.	PE		60		Tasks 006,212,247	PE		120		SAIC Data
20.0	INTERIM STOR	Interin Storage Operations	Starts when stabilization begins. Finishes 12/31/10			F-S					1.5/Yr		Alt#2 Ind. Review
	PM	Program management	Starts 6/1/94, finishes when all fuel is in interim storage			F-S					1/m		PLG estimate from SAIC Data

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Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks

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ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	KBO	K-Basin Operations	6/1/94	77.227	11/6/00	8/19/97	42	283.29	$258
	KBSD	K-Basin Shutdown	11/6/00	36.000	11/7/03	5/8/02		90.00	$71
	DEC	Decision on Spent fuel Storage path forward	11/1/94	0.000	11/1/94	11/1/94		0.00	$0
	ADM	Prepare, review & approve NEPA ADM	11/1/94	[illegible]	4/2/95	1/16/95		0.20	$0
	EIS	Prepare, review & approve interim action EIS & ROD	1/31/95	[illegible]	5/20/96	9/25/95		1.00	$1
1.0	CHAR	Characterization of Fuel & Sludge	6/1/94	46.200	4/7/98	5/4/96		[illegible]	$11
2.0	PAC	Packaging Fuel & Sludge in K-Basin							
	KBSAR	Update K-Basin SAR	4/2/95	3.000	7/2/95	5/17/95		0.08	$0
	KBOK	DOE Approval of K-Basin SAR	7/2/95	5.000	12/1/95	9/16/95		0.03	$0
	GETOP	Procure Fuel & Sludge Overpacks	7/2/95	36.600	7/20/98	1/9/97		[illegible]	$42
	GETBEQ	Procure K-Basin Overpack Equipment	7/2/95	[illegible]	1/22/96	10/12/95		4.50	$4
	INBEQ	Install K-Basin Overpack Equipment	5/20/96	3.000	8/19/96	7/4/96		4.50	$4
	GETSLGEQ	Procure Sludge Removal Equipment	7/2/95	[illegible]	11/6/96	3/5/96		20.20	$19
	INSLGEQ	Install Sludge Removal Equipment	11/6/96	[illegible]	2/18/98	6/28/97		2.50	$2
	KBORR	K-Basin ORR	11/6/96	18.400	5/20/98	8/13/97		5.00	$5
3.0	PREPTRANS	Prepare for Fuel & Sludge Transport							
	SARP1	Design Casks & Prepare SARP	4/2/95	18.300	10/10/96	1/5/96		1.00	$1
	SARP1OK	DOE Review & Approval of SARP	10/10/96	4.000	2/8/97	12/10/96		0.50	$0
	GETCASK1	Procure Casks & RR Cars	1/5/96	29.700	6/27/98	4/1/97		11.00	$10
	TRANS1ORR	Conduct Transportation ORR	2/8/97	17.550	7/28/98	11/3/97		1.00	$1
6.0	DEBRIS	Dispose of Debris	10/28/98	36.300	11/6/01	5/3/00		10.00	$8
8.0	WATER	Clean-up Rad Water from K-B	11/6/00	24.000	11/7/02	11/6/01		18.00	$14
4.0 & 5.0	TSF	Design & Construct TSF							

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Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks

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ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	TSFPD	Preliminary TSF Design & PSAR	4/2/95	12.000	4/1/96	10/1/95		1.00	$1
	TSFOK	DOE Review & Approval of TSF PSAR	4/1/96	[illegible]	11/18/96	7/26/96		0.30	$0
	TSFFD	TSF Final design	10/1/95	[illegible]	1/9/97	5/21/96		0.50	$0
	TSFFSAR	TSF FSAR preparation	11/18/96	12.000	11/19/97	5/20/97		1.40	
	TSFFSOK	TSF FSAR Approval	11/19/97	7.000	6/20/98				
	TSFC	TSF Construction	11/18/96	18.300	5/29/98	8/24/97		[illegible]	$58
	TSFORR	ORR Duration After Finish of construction	11/19/97	5.000	[illegible]	2/3/98		5.00	$4
7.0	TRANS1	Package and Transport Fuel & Sludge to TSF							
	PACFUEL	Package Fuel	10/28/98	24.300	11/6/00	11/2/99	10.00	20.25	$17
	TRANSFUEL	Transport Fuel to TSF	10/28/98	24.300	11/6/00	11/2/99	14.00	28.35	$24
	PACSLG	Remove and Package Sludge & Separate Debris	10/28/98	24.300	11/6/00	11/2/99	2.50	5.06	$4
	TRANSLG	Transport Sludge to TSF	10/28/98	24.300	[illegible]	11/2/99	0.00	0.00	$0
9.0 & 10.0	TEMPSTOR	Store Fuel & Sludge in TSF between K-Basin Complete and Processing Start	11/6/00	0.500	11/21/00	11/14/00	2.80	0.12	$0
12.0 & 13.0	STABFAC	Design & Construct Stabilization Facility							
	STABPD	Preliminary Stabilization Facility Design & PSAR	4/2/95	12.000	4/1/96	10/1/95		2.00	$2
	STABOK	DOE/NRC Review & Approval of Stabilization Facility PSAR	4/1/96	[illegible]	1/6/97	8/19/96		0.70	$1
	TECHDEV	Stabilization Technology Development	4/2/95	[illegible]	7/26/97	5/29/96		19.70	$19
	STABFD	Stabilization Facility Final Design & FSAR	4/1/96	[illegible]	10/25/97	12/25/96		[illegible]	$14
	STABFSAR	TSF FSAR Preparation	1/6/97	12.000	1/6/98	7/8/97		1.40	$1
	STABC	Construction of Stabilization Facility	10/25/97	[illegible]	11/22/99	11/8/98		[illegible]	$129
	STABORR	DOE/NRC Approval of FSAR & Stabilization Facility ORR	10/25/97	36.900	11/21/00	5/10/99		5.00	$4
17.0 & 18.0	STORFAC	Design & Construct Interim Storage Facility							
	STORPD	Preliminary Interim Storage Facility Design & PSAR							

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Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks

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ACTIVITY									
FUNCT. BLOCK DIAG. #	PgRA MODEL CODE	ACTIVITY DESCRIPTION	START	DURATION	FINISH	CENTER DATE	COST PER PERIOD	TOTAL COST	PRESENT VALUE
	STOROK	DOE/NRC Review & Approval of Storage Facility PSAR							
	STORFD	Interim Storage Facility Final Design							
	STORFSAR	TSF FSAR Preparation							
	STORC	Construction of Interim Storage Facility							
	STORORR	DOE/NRC Approval of FSAR & Storage Facility ORR							
14.0	STAB	Stabilize Fuel & Sludge plus store fuel during processing	11/21/00	53.000	[illegible]	2/6/03	27	120.58	$93
19.0	TRANS2	Transport Processed Fuel & Sludge to Interim Storage							
15.0	WASTE	Dispose of Wastes	11/21/00	53.000	4/22/05	2/6/03		0.30	$0
16.0	D&D	D&D Conditioning Facility	4/22/05	60.000	4/23/10	10/23/07		90.00	$61
20.0	INTERIM STOR	Interin Storage Operations	11/21/00	121.271	12/31/10	12/11/05	2	15.16	$11
	PM	Program management	6/1/94	130.727	4/22/05	11/11/99	0.9	114.39	$97
								[illegible]	[illegible]

K-Basin PV of Total Costs $563

Input Assumptions		
Average days per month	30.4375	DAYS
Real interest rate	3%	IRATE
Project start	6/1/94	START

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Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks
Forecast: Recommended Path Forward Fuel Removed from K-Basin **Cell: Q36**

Statistics:	Value
Trials	500
Mean	12/16/00
Median (approx.)	11/28/00
Mode (approx.)	9/24/00
Standard Deviation	148.63
Variance	22,091.04
Skewness	0.97
Kurtosis	4.75
Coeff. of Variability	0.00
Range Minimum	1/24/00
Range Maximum	11/29/02
Range Width	1,040.52
Mean Std. Error	6.65

Percentiles:

Percentile	Value (approx.)
0%	1/24/00
5%	5/26/00
10%	7/1/00
15%	7/25/00
20%	8/15/00
25%	9/10/00
30%	9/25/00
35%	10/10/00
40%	10/26/00
45%	11/12/00
50%	11/28/00
55%	12/12/00
60%	12/28/00
65%	1/16/01
70%	2/3/01
75%	3/5/01
80%	3/27/01
85%	5/4/01
90%	6/20/01
95%	9/25/01
100%	11/29/02

End of Forecast

PATHFWDS.XLS

Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks
Forecast: Recommended Path Forward Fuel Stabilized **Cell: Q53**

Statistics:	Value
Trials	500
Mean	3/13/06
Median (approx.)	12/11/05
Mode (approx.)	4/30/05
Standard Deviation	464.28
Variance	215,558.82
Skewness	1.25
Kurtosis	5.27
Coeff. of Variability	0.01
Range Minimum	2/4/04
Range Maximum	1/23/12
Range Width	2,909.64
Mean Std. Error	20.76

Percentiles:

Percentile	Value (approx.)
0%	2/4/04
5%	8/6/04
10%	11/18/04
15%	1/10/05
20%	2/21/05
25%	4/15/05
30%	6/3/05
35%	7/21/05
40%	9/11/05
45%	10/26/05
50%	12/11/05
55%	1/31/06
60%	4/8/06
65%	5/31/06
70%	8/13/06
75%	11/14/06
80%	2/4/07
85%	5/26/07
90%	10/29/07
95%	6/13/08
100%	1/23/12

End of Forecast

PATHFWDS.XLS

Sensitivity Case: Impact of Reduced Uncertainty of Selected K-Basin Tasks
Forecast: Recommended Path Forward Total Cost **Cell: T59**

Statistics:	Value
Trials	500
Mean	1181
Median (approx.)	1176
Mode (approx.)	1176
Standard Deviation	47
Variance	2205
Skewness	0.38
Kurtosis	3.03
Coeff. of Variability	0.04
Range Minimum	1036
Range Maximum	1325
Range Width	289
Mean Std. Error	2.10

Percentiles:

Percentile	M$ (approx.)
0%	1036
5%	1110
10%	1124
15%	1133
20%	1140
25%	1147
30%	1154
35%	1159
40%	1165
45%	1170
50%	1176
55%	1182
60%	1188
65%	1195
70%	1202
75%	1208
80%	1219
85%	1233
90%	1245
95%	1262
100%	1325

End of Forecast