25.1.2. 1

ARGONNE NATIONAL LABORATORY - WEST
P.O. Box 2528, Idaho Falls, Idaho 83403-2528 Telephone: (208) 533-7166

November 9, 2000

RECEIVED
NOV 1 0 2000
ARGONNE GROUP-WEST

Robert Lange, NE-40
Office of Nuclear Energy
Department of Energy
Germantown
19901 Germantown Road
Germantown, MD 20874-1290

Dear Bob:

The approved version of the Spent Fuel Treatment Implementation Plan is enclosed for your records. This version includes the changes that were agreed upon during our October 18 program review in Germantown and will be considered the baseline for Spent Fuel Treatment activities. We will issue monthly performance reports and follow the change control process as detailed in this plan. If you have any questions, please call my office (208-533-7166).

Cordially,

Robert W Benedict

Robert Benedict
Director, Spent Fuel Treatment Project

RWB:ljc

Attachment

cc: [redacted]

ARGONNE NATIONAL LABORATORY

SPENT FUEL TREATMENT IMPLEMENTATION PLAN

DOCUMENT NUMBER
F0000-0061-ES-00
10/18/2000

APPROVED:

Robert W Benedict
Argonne Spent Fuel Treatment Director

10/18/2000
Date

RE Wunderlich
DOE CH - Argonne

10/18/2000
Date

Robert Lange
DOE NE

10/18/2000
Date

TABLE OF CONTENTS

Executive Summary

Within the Department of Energy (DOE) complex, there is a quantity of spent nuclear fuel containing elemental sodium that was used within the fuel elements to provide a thermal bond between the fuel matrix and the cladding. Most of this fuel was generated during operation of the Experimental Breeder Reactor II (EBR-II) at Argonne National Laboratory-West (ANL-W) in Idaho and Fermi I in Michigan. Some sodium-bonded experimental fuel was also produced as part of testing in the Fast Flux Test Facility (FFTF) at Hanford. Because sodium within the fuel matrix is highly reactive, the fuel is unsuitable for direct disposal in a geologic repository and requires treatment.

Argonne National Laboratory has demonstrated the electrometallurgical treatment technology to prepare these fuel types for eventual disposal. A subcommittee of the National Research Council was established to evaluate the results and noted the following:

> Finding: The committee finds no technical barriers to the use of electrometallurgical technology to process the remainder of the EBR-II fuel. [1]

As required by the National Environmental Protection Act (NEPA), an Environmental Impact Statement (EIS) [2] was prepared to evaluate available and appropriate treatment options for DOE sodium-bonded fuel. In the September 2000 Record of Decision, DOE identified electrometallurgical treatment for all sodium-bonded fuel, except Fermi-1 blanket fuel. Because of the different characteristics of the Fermi-1 blanket fuel, DOE decided to continue to store this material while alternative treatments are evaluated. Should no alternative prove more cost affective, EMT of Fermi-1 fuel remains a key option.

Spent Fuel Treatment (SFT) is the title of the necessary activities to treat the remaining EBR-II and FFTF fuel and recover the uranium for interim storage. Also, the fission products and transuranic elements from this fuel and the previously treated Demonstration fuel will be placed in waste forms suitable for geologic disposal. The uranium from the driver fuel will be isotopically diluted from high enriched uranium to low enriched uranium and the uranium product will be stored on the ANL-W site until the DOE decides on its future use or disposal. Likewise, the waste forms will be stored in retrievable containers at the ANL-W Radioactive Scrap and Waste Facility.

This Implementation Plan describes the management organization, scope, assumptions and risks, costs, schedules, reporting, change control and environmental and safety issues. The total cost is estimated to be $435 million without contingency and $537 million with contingency. The scheduled completion date is September 2013.

1.0 Introduction

Within the Department of Energy (DOE) complex, there is a quantity of spent nuclear fuel containing elemental sodium that was used within the fuel elements to provide a thermal bond between the fuel matrix and the cladding. Most of this fuel was generated during operation of the Experimental Breeder Reactor II (EBR-II) at Argonne National Laboratory-West (ANL-W) in Idaho and Fermi-1 in Michigan. Both were fast reactors using metallic fuel and sodium coolant. Some sodium-bonded experimental fuel was also produced as part of testing in the Fast Flux Test Facility (FFTF) at Hanford. The sodium within the fuel matrix is highly reactive. Because of its presence, the fuel is unsuitable for direct disposal in a geologic repository and requires treatment.

Argonne National Laboratory has demonstrated the electrometallurgical treatment technology to prepare these fuel types for eventual disposal. During this demonstration, which was conducted between June 1996 and August 1999, 100 EBR-II driver and 13 EBR-II blanket assemblies were treated. This was a small but representative quantity of sodium-bonded fuel. The development of waste forms for stabilizing the fission products and transuranics was part of the demonstration. A subcommittee of the National Research Council was established to review the progress and to evaluate the results. An additional 5 blanket assemblies (18 total) were processed after the completion of the formal demonstration. These assemblies were treated to minimize technical uncertainty while the formal demonstration evaluation was being completed by the National Research Council Committee. The final report from the National Research Council committee noted the following:

> Finding: The Committee finds that ANL has met all of the criteria developed for judging the success of its electrometallurgical demonstration project.
>
> Finding: The committee finds no technical barriers to the use of electrometallurgical technology to process the remainder of the EBR-II fuel. [1]

As required by the National Environmental Protection Act (NEPA), an Environmental Impact Statement (EIS) [2] was prepared to evaluate available and appropriate treatment options for DOE sodium-bonded fuel which is shown in Table 1. DOE has identified electrometallurgical treatment as its Preferred Alternative for the treatment and management of all sodium-bonded fuel, except Fermi-1 blanket fuel. Because of the different physical characteristics of the Fermi-1 sodium-bonded blanket spent nuclear fuel (about 34 metric tons of heavy metal), DOE has decided to continue to store this material while alternative treatments are evaluated. Should no alternative prove more cost affective for this spent nuclear fuel, electrometallurgical treatment (EMT) of the Fermi-1 spent nuclear fuel remains a key option. An EIS Record of Decision (ROD) was issued in September 2000, and production operations will begin by the end of FY2000.

Table 1: DOE Sodium-bonded Fuel Covered by EIS

Fuel Type	Spent Fuel Treatment Demonstration (kg HM)	Spent Fuel Treatment (kg HM)	Miscellaneous Fuels (kg HM)	Fermi-1 Blanket Fuel (kg HM)	Total DOE Sodium-bonded Fuel (kg HM)
Driver Fuel	400	2,950	84	0	3,434
Blanket Fuel	600	21,800	0	34,200	56,600
Total	1,000	24,750	84	34,200	60,034

The Spent Fuel Treatment activities will treat the remaining EBR-II and FFTF fuel and recover the uranium for interim storage. Also, the fission products and transuranic elements from this fuel and the previously treated demonstration fuel will be placed in waste forms suitable for geologic disposal. Table 2 details these fuel quantities and their present storage locations.

Table 2. Sodium-Bonded Fuel Included in Spent Fuel Treatment Activities

Fuel Type	EBR-II Driver at ANL-West (kg HM)	EBR-II Driver at INTEC (kg HM)	EBR-II Blanket at ANL-West (kg HM)	FFTF Fuel at FFTF (kg HM)	Total Fuel (kg HM)
Driver Fuel	700	2000	0	250	2950
Blanket Fuel	0	0	21,800	0	21,800
Total	700	2000	21,800	250	24,750

Uranium is recovered from both blanket and driver fuel. For driver fuel, the uranium is isotopically diluted from high enriched uranium to low enriched uranium (<20% U-235). The uranium product from the spent fuel treatment will be stored on the ANL-W site until the DOE decides on its future use or disposal. Likewise, the waste forms will be handled as high-level waste and stored in retrievable containers at the ANL-W Radioactive Scrap and Waste Facility (RSWF). The specific descriptions and quantities of sodium bonded fuel and the waste volume and waste management strategy are described in "Production Operations for Electrometallurgical Treatment of Sodium-bonded Spent Nuclear Fuel", Argonne National Laboratory-West Report, ANL-NT-107, which is considered to be the technical baseline [3].

In support of these treatment operations, the supporting activities include the engineering, fabrication and installation of additional production scale equipment, process development activities to increase throughput capacity, waste process development and waste form qualification.

2.0 Management Organization

The SFT Organization has the following responsibilities:

- Provide process improvements to increase throughputs necessary for production-scale treatment and waste operations.
- Provide in-cell process equipment and facility modifications necessary for production-scale treatment and waste operations.
- Conduct the sodium-bonded spent fuel treatment operations and recover uranium for interim storage.
- Conduct the high-level waste process operations and place the waste into retrievable interim storage.
- Complete the high-level waste qualification activities so the waste forms are shown as equivalent to defense high level waste glass.
- Manage and dispose of indirect process wastes that are produced during treatment operations.

A Work Breakdown Structure (WBS) was created to correspond with guidance provided from DOE [4]. As shown in Figure 1, WBS Level 1 includes overall scope, and changes to which must be approved by DOE-HQ. WBS Level 2 has two components: Electrometallurgical Treatment (EMT) and Fuel and Waste Disposition Technology Activities (TA) and changes to which must be approved by DOE-CH/ARG. The EMT activities are associated with the treatment of fuel and production of the waste forms. The Technology Activities are required to increase the process throughput to 5 metric tons heavy metal (MTHM) per year, to implement waste production operations and to establish the performance data of the high-level waste forms for geological disposal. The Argonne team has structured eleven Level 3 WBS elements (WBS 1 through WBS 11) that group functionally similar activities. The EMT activities include Treatment Operations (WBS 1), Equipment and Facility Modifications (WBS 2), Direct Process Support (WBS 3), Environmental and Safety Support Tasks (WBS 10) and Spent Fuel Treatment Implementation (WBS 11). The Technology Activities (TA) activities are Process Improvements (WBS 4), Metal Waste Treatment Development (WBS 5), Metal Waste Form Qualification (WBS 6), Ceramic Waste Treatment Development (WBS 7), Ceramic Waste Qualification Testing (WBS 8) and High-Level Waste Disposition (WBS 9). The Level 3 work elements are described in detail in the Spent Fuel Treatment Work Breakdown Structure [5]. The budget and schedules require the full funding and resources for all activities.

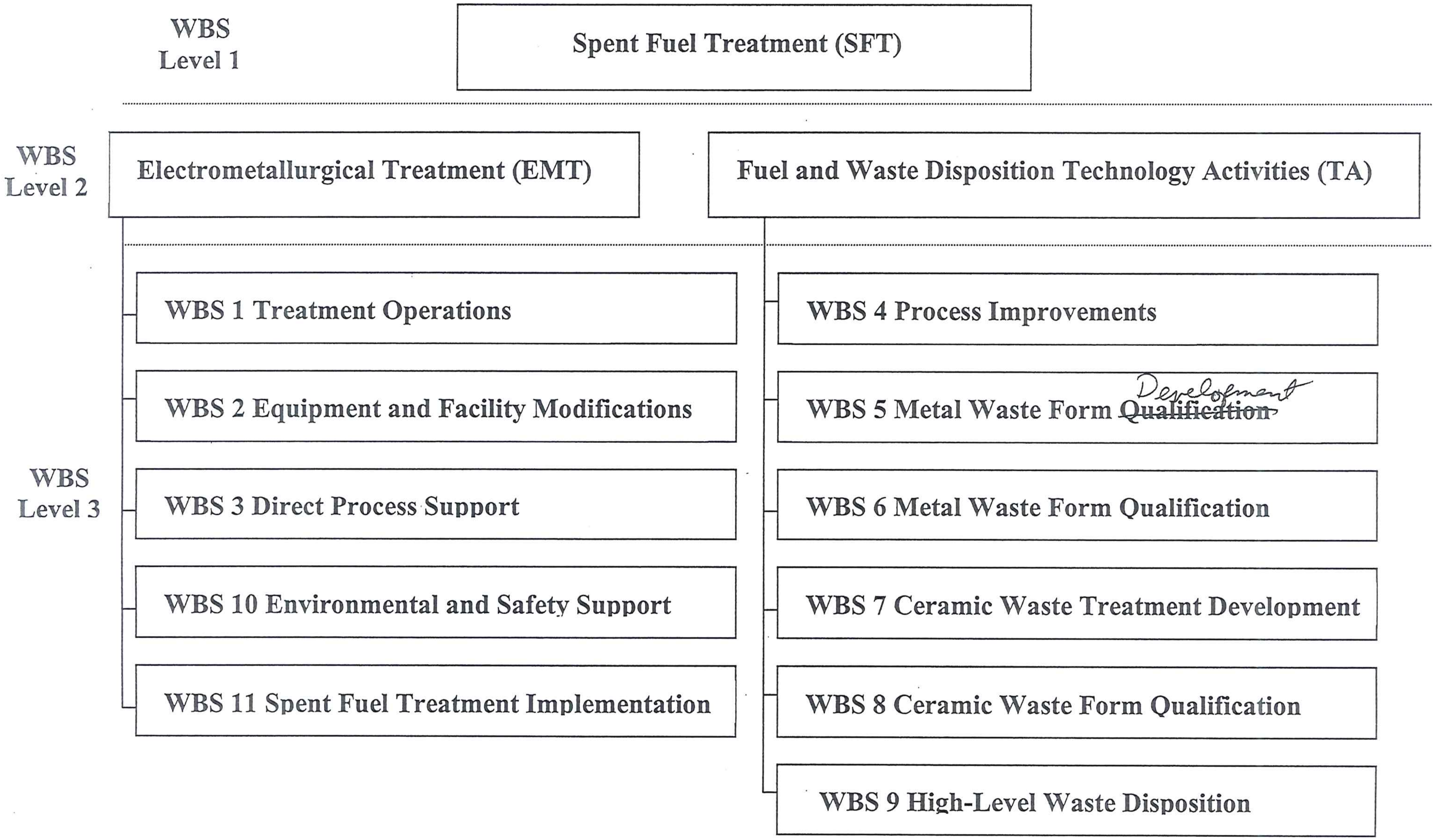


Figure 1. Spent Fuel Treatment Work Breakdown Structure

The Spent Fuel Treatment activities are managed within the Argonne Engineering Research (ER) organization and utilizes resources from the different ER divisions and various facilities at both ANL-East and ANL-West. The management team integrates work scope, resource requirements, schedules, and costs.

Set up as a matrix drawing personnel and expertise from different ER divisions, the attached organization chart (Fig. 2) shows reporting responsibilities. The work activities have been grouped into areas with technical leads who are responsible for identifying the necessary tasks, establishing detailed schedules, monitoring the day-to-day activities and reporting results and problem areas to the management team. The successful Spent Fuel Treatment Demonstration was managed in a similar manner, and the Director and many of the technical leads served the same roles.

Three Assistant Managers interface between the different lead areas and to make sure that the detailed plans and resources will meet the overall objectives. These Assistant Managers work with the leads and the ER division line managers to resolve priorities and resource assignments. The SFT Director has the responsibility of interfacing with the Department of Energy, reporting progress to Argonne management and others, and negotiating priority conflicts with other programs and Laboratory commitments.

Although the management team is responsible for establishing and meeting the requirements and schedules for Spent Fuel Treatment, the division line managers are responsible for assignment of personnel and their technical quality. Also, line managers provide administrative support for their matrixed personnel. SFT draws resources from and establishes funding for the Divisions. The matrix organization shown complements the ANL line organization that is established in the individual Divisions' organization charts and management plans.

Fig. 2 shows the Assistant Manager's specific responsibility for integrating the activities in different Level 3 WBS elements. Within each scheduled activity, a Management Representative, Task Manager, and Responsible Engineer are defined. The Assistant Manager that is responsible for the WBS element in which an activity falls is assigned as the Management Representative. The technical leads serve as the Task Managers. They are responsible for closely tracking the activities and formally updating the progress every two weeks. The Responsible Engineers are the personnel performing the work described by the activity.

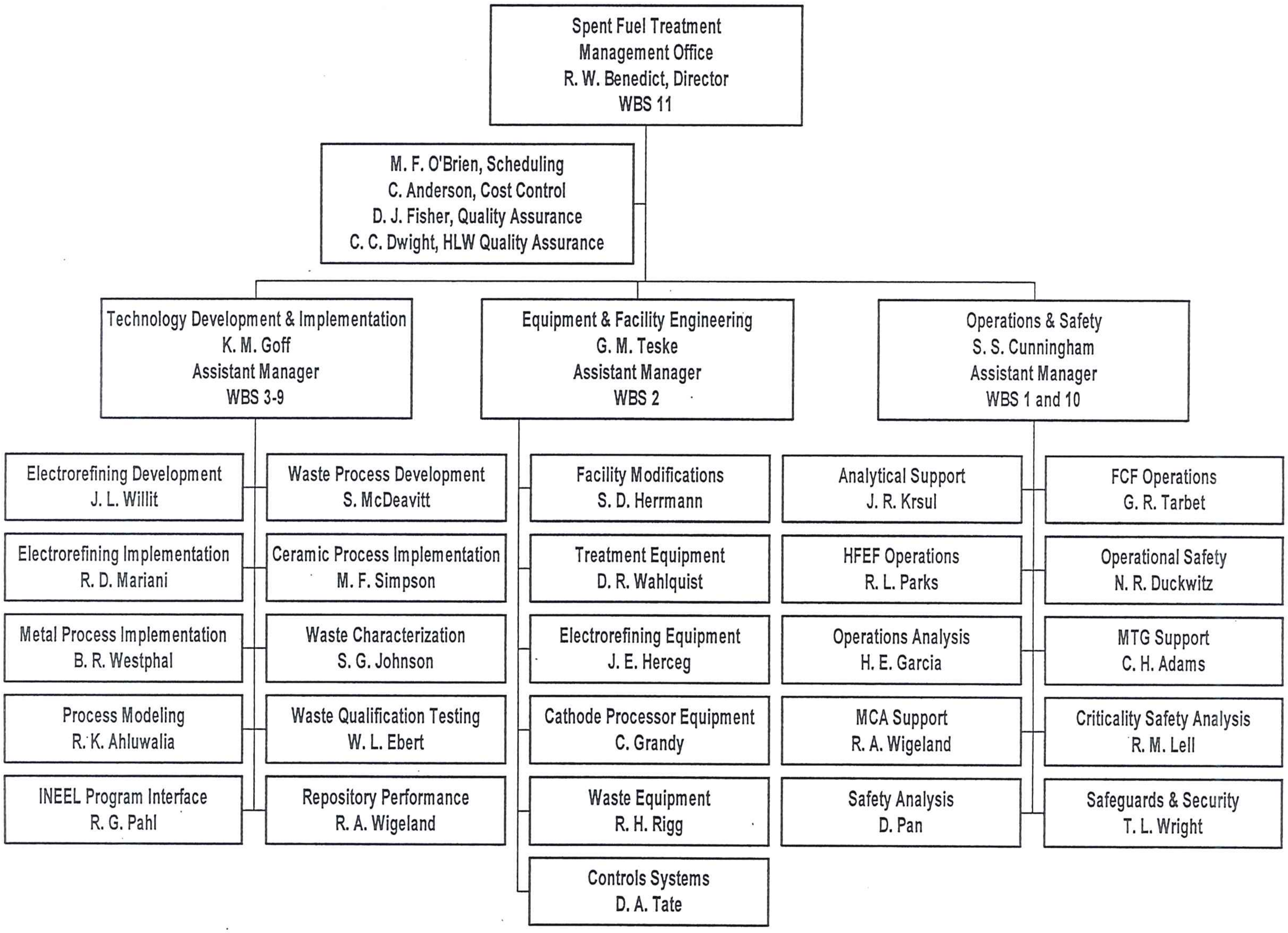


Figure 2. EBR-II Spent Fuel Treatment Management Team

3.0 Baseline

The Baseline is the quantitative expression of projected costs, schedule, and technical requirements and risks. The baseline is also the established plan that is used to measure the status of resources and progress.

3.1 Scope

As described in Section 1, SFT will treat the sodium-bonded fuel in Table 2, recover the uranium for interim storage, and immobilize the fission products and transuranics into high level waste forms. The general flowsheet for these operations and mass balances are shown in Fig. 3. The uranium product from the spent fuel treatment will be stored on the ANL-W site until the DOE decides on its future use or disposal. Likewise, the waste forms will be handled as high-level waste and stored in retrievable containers at the ANL-W RSWF. The scope does not include shipping the materials to their final destination and decommissioning the facilities used for treatment operations.

Electrometallurgical Treatment (EMT, WBS Level 2) are the operations and supporting activities that are necessary for the treatment of fuel and production of the waste forms. These Level 2 activities have been divided into five Level 3 work elements: WBS 1, 2, 3, 10 and 11.

WBS 1 Treatment Operations include Fuel Conditioning Facility (FCF) process operations, Hot Fuel Examination Facility (HFEF) waste operations, Analytical Chemistry Laboratory (ACL) analyses of process samples, maintenance for supporting operations; and process material handling. These operations require a level of effort staffing and are based on increasing the current staffing levels to full production operations (5 MTHM/yr). Full-scale production operations require FCF to operate 24 hours per day and 7 days per week. Full-scale waste operations require HFEF to operate 12 hours per day and 7 days per week. Sample analysis operations require the ACL to operate 16 hours per day and 5 days per week. The necessary time for hiring, training and qualifying operations staff are included in the work scope.

WBS 2 Equipment and Facility Modifications include the design, fabrication, qualification, and installation of the new equipment and modifications that are necessary to meet the production operations. The fuel treatment equipment from the demonstration requires improvements in individual components to increase the throughput capacity, which is currently estimated to be 2200 kg/yr with 24 hr/day and 7 day per week operations. Metal and ceramic waste production scale equipment does not exist and needs to be designed, fabricated, and installed after process development and qualification activities (WBS 5 & 7) are completed. Special material handling equipment is needed for some of the fuels and wastes, and improved sample and waste handling equipment is required for the ACL. Since process operations will increase the use of some facility system, modifications and improvements are planned for FCF and HFEF in support of SFT activities.

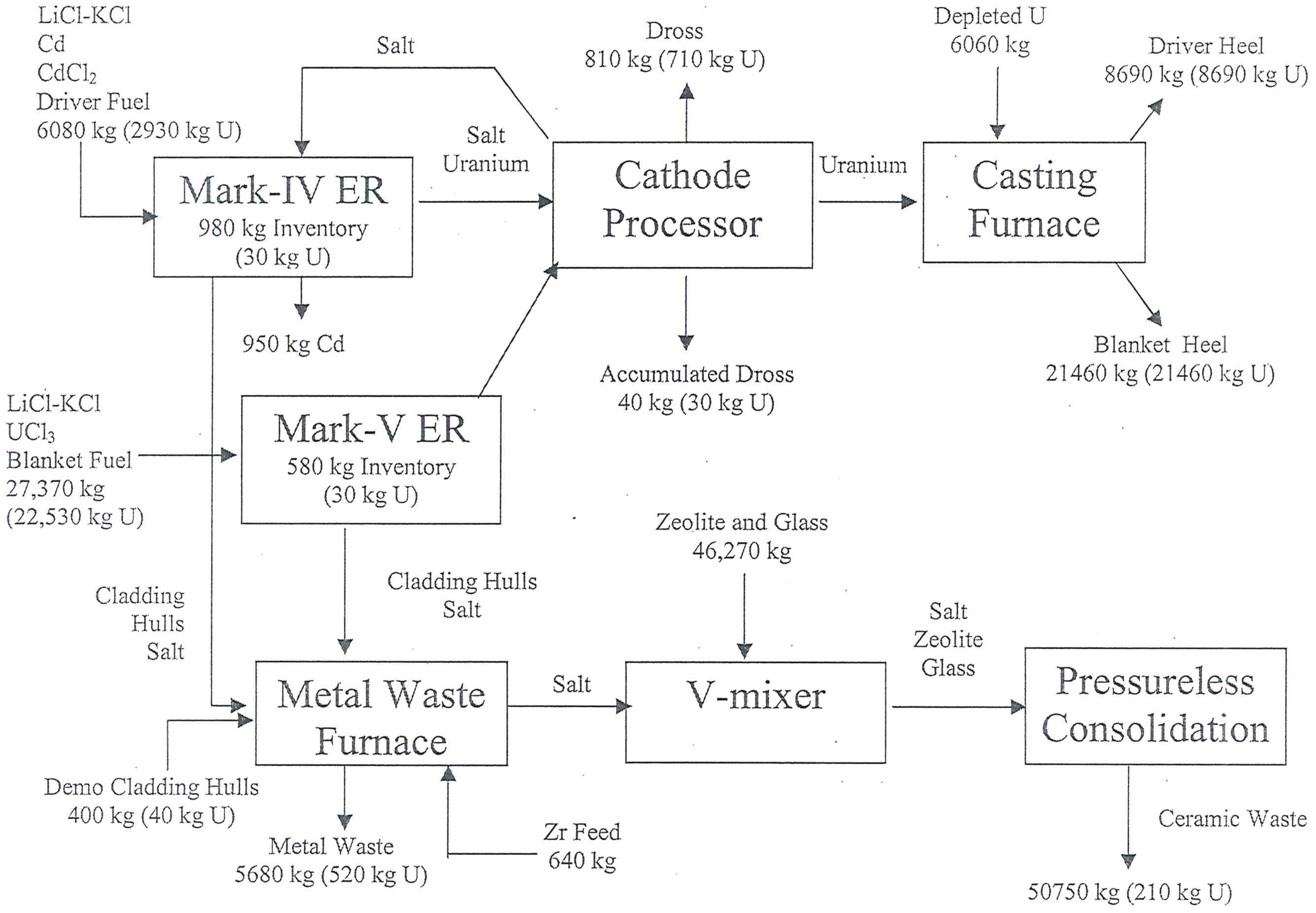


Figure 3. Spent Fuel Treatment Process Material Balance (values given as total kilograms for entire life of process)

WBS 3, Direct Process Support, provides the necessary data analysis, materials testing, analytical methods development, fuel composition modeling, mass tracking analysis and process modeling to keep the processes operating and to troubleshoot problems.

WBS 10, Environmental and Safety Support Tasks, include the necessary analysis, evaluations, and documentation to support the proposed operations in FCF, HFEF and ACL. These activities also include ongoing support for process upsets and required assessments. WBS 11, Management Implementation, includes the necessary activities for developing, monitoring and reporting progress on the schedules and budgets.

Fuel and Waste Disposition Technology Activities (TA) include the necessary process development, process implementation and waste qualification activities. This work is required to increase the process throughput from 2200 kg/yr to 5000 kg/yr, scale-up the waste processes from demonstration scale to production scale and develop the data to show the waste forms are equivalent to defense high level waste glass. WBS 4, Process Improvements, involves process development, material testing and concept testing for electrorefining and cathode processing improvements. WBS 5, Metal Waste Treatment Development, provides the necessary concept testing and materials development so the two step metal waste process which was demonstrated in the existing cathode processor and casting furnace can be combined into one production scale system. WBS 6, Metal Waste Form Qualification, involves the necessary testing, characterization and modeling to develop the data to support waste acceptance. WBS 7, Ceramic Waste Treatment Development, provides the process development, process qualification and concept testing for full scale operations using the new pressureless consolidation method for manufacturing ceramic waste while maintaining necessary data and experience so hot isostatic pressing can be a viable back-up process. In addition, DOE has requested work be included to understand the fundamental ion exchange mechanism so that zeolite columns can be evaluated for their potential to reduce waste volumes. WBS 7 also includes fabricating enough laboratory samples to support the waste qualification activities in WBS 8. WBS 8, Ceramic Waste Qualification Testing, involves the necessary testing, characterization and modeling to develop the data to support waste acceptance. WBS 9, High Level Waste Disposition, involves the interaction with the high level waste repository program so the performance assessment can be completed on the metal and ceramic wastes. Also, necessary interfaces will be established to assure our waste packages are compatible with the proposed repository system

3.2 Assumptions and Risks

The following specific conditions and assumptions, which are derived from previous decisions, anticipated authorization, and expected progress, form the basis for the work scope. Other implicit conditions and assumptions are contained in the plan's discussion.

- The NEPA Environmental Impact Statement (EIS) Record of Decision (ROD) specifies that the DOE sodium-bonded spent fuel inventory, except Fermi-1 blanket, should be treated using electrometallurgical technology. Although the ROD includes all sodium bonded fuel except Fermi-1, only the EBR-II driver and blanket sodium-bonded metallic fuel at ANL-West, EBR-II driver at INTEC and FFTF sodium bonded fuel will be treated under this plan. Miscellaneous sodium bonded fuels are not included.

- The baseline schedules are based on the funding profiles in Section 3.3 which assume a 4% annual inflation rate.

- The treatment operations will eventually utilize FCF on a 24 hours per day and seven days per week schedule, HFEF on a 12 hour per day and seven day per week schedule, and ACL on a 16 hour per day and 5 day per week schedule. Since these facilities require a level of effort staffing which cannot easily be reassigned to other non-SFT tasks, any major interruptions from an accident, new DOE requirements, or mandated operations standdown will significantly increase the total cost.

- Equipment upgrades, process improvements, and technology activities are still required to increase the throughput to production-scale rates. The success of these advances is assumed.

- The technical expertise that the people in the development program have acquired and the supporting data are vital and will provide necessary troubleshooting expertise for operations.

- The high level waste forms are being prepared for geologic repository disposal at the proposed Yucca Mountain site and the waste acceptance requirements are based on the "Civilian Radioactive Waste Management System Waste Acceptance Requirements Document, Draft Revision 04 D" [6]. Waste qualification activities are based on other DOE HLW form activities and the interactions with the National Research Council Committee on Electrometallurgical Treatment.

- The uranium product will be processed in the same manner as it was during the EBR-II Spent Fuel Treatment Demonstration. This material will be stored and managed with the other uranium at ANL-West pending a DOE decision on its final disposition.

- The process materials will be removed from the hot cell facilities and prepared for disposal. However, the SFT scope does not include the removal of process equipment and the establishment of a radiologically and industrially safe configuration for minimum long-term monitoring.

- The increased staffing for operations will be able to be filled by the local talented personnel resource pool.

Safety and environmental risks have been identified in the approved safety documentation for the associated operating nuclear facilities. These risks have been incorporated into work plans and there is an ongoing effort to update the safety basis (WBS 10). Additionally, schedule and cost risks have been identified and included in the baseline plans. In the Final Report from the National Research Council's (NRC) Committee on Electrometallurgical Techniques for DOE Spent Fuel [1], further work was identified for qualification of the high-level waste forms and development of new equipment to meet the increased throughput requirements. Although SFT plans address these two issues, most of the technical risks are associated with implementation of these technology activities. These risks and additional ones that were identified based on the experience of the demonstration follow. Additionally, areas within the WBS that are focused on minimizing these risks are noted for each risk.

Complete Qualification of High-Level Waste Forms

The activities of WBS 5 and 7 are focused on producing waste forms in a qualified manner and scaling the demonstration-scale processes to production scale. The demonstration-scale ceramic waste form was 1.5 kg and the production size is at least 60 kg. The metal waste form needs to be increased from 9 kg to 30 kg. WBS 6 and 8 are focused on obtaining the required characterization data to qualify the waste forms, and WBS 9 is focused on the interactions with non-ANL personnel responsible for accepting waste forms into the repository.

Develop and Implement Improvements to Increase Process Throughput

As part of the activities of WBS 3.7, a discrete event process model is under development to assess process operations. During the demonstration, this model was first developed and validated for operations in FCF. It is now being expanded to include waste operations in HFEF, and sample analysis in ACL. This model has been used to determine what operations and equipment are bottlenecks and what improvements need to be made to increase throughput.

Based on the model the throughput capability for fuel treatment operations in FCF is 2.2 Metric Tons of Heavy Metal (MTHM) per year without contingency. For this throughput FCF needs to be operated 24 hours per day, 7 days per week. The initial yearly throughputs assumed in this plan (0.6 MTHM) are lower because funding levels only allow the facility to be staffed 8 hours per day, 5 days per week. The plan does assume that technical advances will be made and staffing levels increased so, production throughput of 5 MTHM per year is reached. The model was used to determine what advances need to be made and how much the throughput is increased by each advance.

Table 3 provides a more specific list of improvements and benefits. As noted in the table, the benefit is not always shown as increased throughput. The benefit can also be reduced handling operations and manipulator usage that indirectly lead to increased throughput due to lower repair problems.

The technical risks in the process throughput area are being managed by the following activities:

Electrorefiner Improvements

Effort is focused on increasing the Mark V (Mk-V) electrorefiner batch size and product size. WBS 3.1 and 4.2 include work to increase the product density, to decrease the maintenance activities on items such as scrapers, and to test advanced anode concepts that increase batch size and processing rate. The result of this work will lead to design of new equipment in WBS 2.1. Equipment engineering to handle fuel designs not encountered during the demonstration is also covered in this area. The amount of sampling required for materials control and accountability is also being assessed in WBS 3.10 to lessen the increased load on ACL.

Table 3. Process Improvements and Benefits

Process Improvement	Benefit
Increase the Mark IV Electrorefiner loading	Reduce handling operations and manipulator usage
Increase the Cathode Processor batch size for driver fuel	Increase throughput by 100 kg HM per year
Increase MK-V product collector fill rate from 300 to 400 g HM/ hr	Support future Mark V electrorefiner advances
Increase the quantity of fuel (4 to 6 driver assemblies and 8 to 12 blanket assemblies) treated between electrorefiner batch close-out	Decrease sample load on ACL and handling operations in FCF
Increase cathode processor batch size (30 to 64 kg HM) for blanket fuel	Increase throughput by 1000 kg HM per year
Increase Mark V electrorefiner anode loading from 24 to 48 kg HM.	Increase throughput by 400 kg HM per year
Increase Mark V electrorefiner collector product loading from 8 to 24 kgHM	Increase throughput by 700 kg HM per year
Eliminate CP crucible conditioning.	Increase throughput by 600 kg HM per year

Cathode Processor Improvements

Work is being performed in WBS 3.5 and 4.6 to increase the cathode processor throughput. This work is focused on increasing the batch size and obtaining reusable crucibles to lessen material handling requirements. The amount of sampling required for materials control and accountability is also being assessed in WBS 3.3 and 3.10 to lessen the increased load on ACL.

Environmental and Safety Support

In addition to the equipment and process issues, additional analyses (WBS 10) will be needed to account for the increased material flows. This work includes environmental analyses for issues such as air permitting and disposal of indirect process waste streams (WBS 1.6), safety analyses to support modification to Facility Safety Analysis Reports, and criticality analyses to account for the increased quantity of fissile material. The criticality analyses are also needed to increase the allowed plutonium content in the Mark V electrorefiner to minimize the amount of ceramic high-level waste produced.

Maintain Trained Staff and Process Support Facilities

The budget profiles in Section 3.3 are assumed to be available. If the money is not available technical risks are increased in both the EMT and TA elements. For EMT operations, personnel that perform remote operations with radioactive materials require significant training and experience. For personnel with nuclear operations experience at Argonne, one year training is required before they are proficient for remote process operations. For new personnel, two years are needed before they become fully capable. Hot cell equipment and facility design is a specialized area of mechanical and electrical engineering that is learned by working with experienced professionals. Several years are required to become proficient assuming experienced mentors are on the staff. For the TA element, significant investment has been made to establish the glovebox facilities, the radioactive material examination capability, the process development laboratories and the necessary staff. If these facilities or personnel are transferred to other programs due to lack of funding for SFT, the schedules and costs will substantially increase.

Implement Pressureless Consolidation

In May 2000, pressureless consolidation was chosen to be the reference ceramic waste production method. Examining this option during the demonstration was strongly encouraged by the NRC review committee [**1**]. Less effort was focused on this activity than was spent on hot isostatic press (HIP) development. The work in WBS 7.3 is now focused on implementing pressureless consolidation. A small amount of effort is being maintained on HIP activities in order to retain this option as a backup. The technical risks with pressureless consolidation impose the following requirements: decrease product porosity, control of slight cesium volatility, and determination of final process parameters for full-scale operations.

Treatment of Disrupted Fuels

The EBR-II fuel at INTEC was stored in water basins, and some of these fuel containers leaked. The fuel in these containers is degraded and additional front-end treatment operations may be required. Work to assess this issue is addressed in WBS 4.5.

3.3 Costs

Since DOE has requested a total cost including contingency, estimates were developed with and without contingency. The budget was first developed assuming no contingency and using the level of funding that was received for FY00 and DOE guidance [4] of the "required" available funding for FY01 through FY05. Although this funding constraint does not enable the total cost to be minimized, Level 3 schedules and budgets were developed to minimize the risk and the costs. Because of the significant fixed costs, the total cost is minimized by increasing the treatment throughput to 5 MTHM per year while waste process implementation and qualification activities continue in parallel so that the lack of production size waste treatment does not interrupt operations.

The costs for Spent Fuel Treatment are largely based on level of effort by ANL personnel and only a small portion of the expenditures is for outside work. Still the budget and costs provided do include materials and supply (M&S) expenditures including the new equipment and modifications. A large fraction of the level of effort costs include the staff and operators required in the various facilities. In developing the budget, the management team assumed FCF would be staffed up in order to reach higher process throughputs as shown in Fig. 4. FCF would first be staffed-up from start-up operations which supports a process rate of 0.6 MTHM per year to interim operations which supports 2 MTHM. Interim operations require some process equipment improvements and 12 hours per day and 7 days per week operations.

Due to the large reduction in available funds from FY99 ($40 Million) to FY01 ($24 Million), many of the process operators and supporting staff were reassigned to other programs. This action has required revising the schedules and budgets to reflect retraining and rehiring for the 12 hours per day and 24 hours per day operations. New operator training requirements strongly affect process throughput. Once the staffing level is increased to the required levels, the process throughput does not immediately increase because training requirements for operators limit their effectiveness for 1 to 2 years. After 2 years of training, a new operator is considered fully qualified for hot-cell operations. Throughput is not increased until the operators are qualified.

In order to minimize risk, the budgets were established to install process improvements before all the staff is hired. Also, the full scale waste equipment in HFEF and increased HFEF and ACL staffing are scheduled before reaching full FCF production operations (5 MTHM per year). The budgets are based primarily on a level-of-effort funding so that any interruptions will have a major effect on total costs.

As noted, the budget was first developed with no contingency. For this budget, the total cost was $435 million and the duration extended through FY10. In June 2000, DOE performed a review of the Management Systems for Spent Fuel Treatment. One recommendation was that the Implementation Plans needed to include contingency [7]. The budget and schedule were therefore developed including contingency. For contingencies, values were based on guidance from the American Association of Cost Engineers [8] where budget estimates are expected to be accurate within +30% or –15% and definitive estimates are within +15% or –5%.

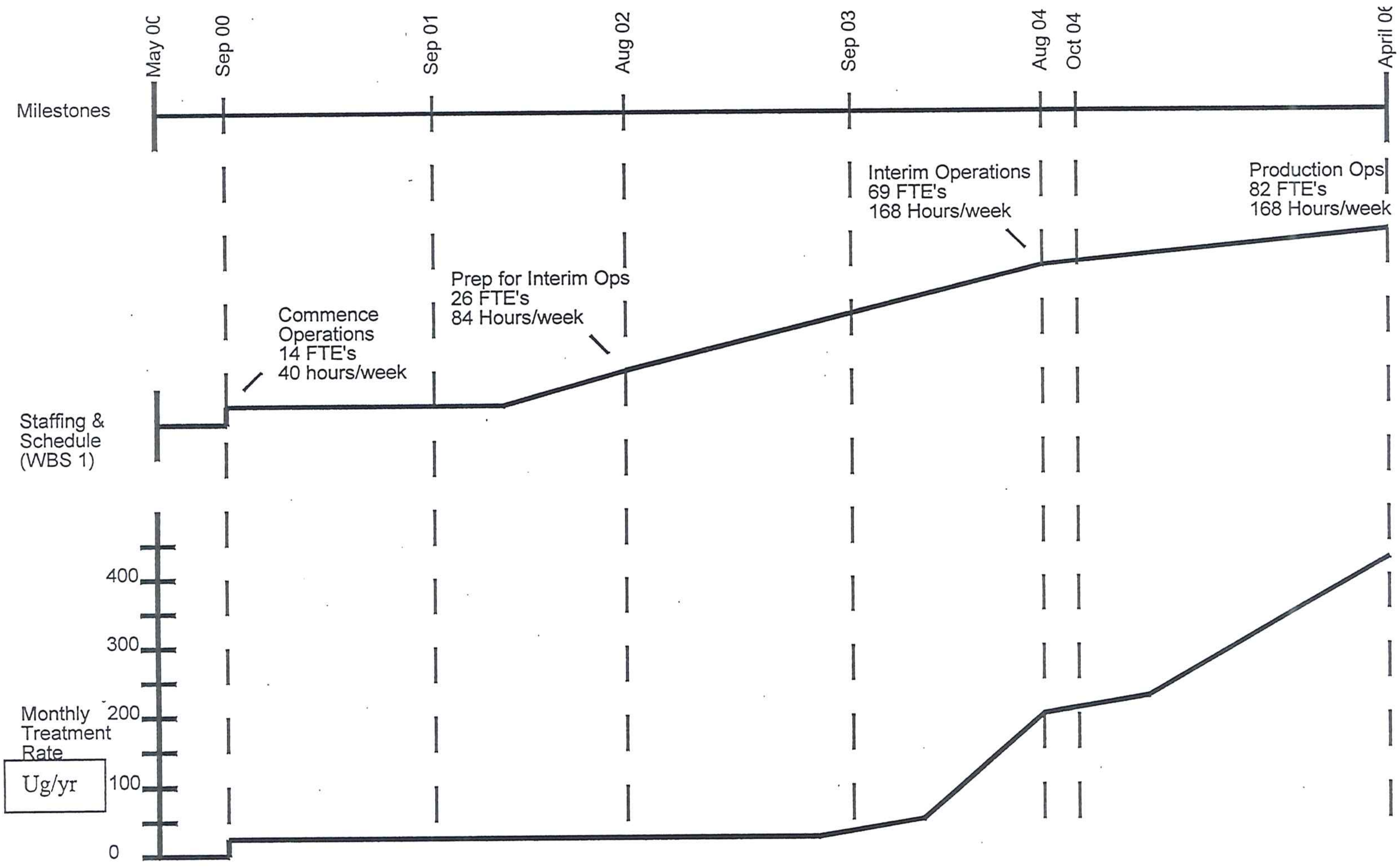


Figure 4. Fuel Conditioning Facility Staffing and Treatment Throughput

Since the DOE typically does not provide contingency funding for operating funds and the FY values have been established for the short term future, the contingency budget for the Baseline assumes that the budget will not be increased annually. The contingency will instead be applied to the processing rates and associated milestones. For start-up operations, the process throughput, 0.6 MTHM, was lowered by 10%. This small contingency was chosen because relatively little technology activities are needed and the required personnel are experienced from the demonstration operations. The interim processing rate was lowered by 20% because some technology activities are needed and the efficiency of the new staff is unproven. The production processing rate, 5 MTHM, was decreased by 30% since obtaining this rate is largely dependent on the success of technology activities and the uncertainties associated with 24 hours per day of production operations at rates for which there is no previous experience. The new processing rates of 0.54, 1.6, and 3.5 MTHM per year were then used to determine the new duration and funding. The 30% contingency was also applied to the HLW processing rates since these activities are strongly dependent on the technology activities. At these processing rates, the SFT would instead be completed in FY13 and the total cost would be $537 million. The detailed baseline budget by WBS element as determined with contingency is provided in Appendix A. Table 4 provides the staffing and budget profiles for the costs without contingency and with contingency. Appendix B provides an alternate method for including contingency by increasing the funding on a yearly basis.

These personnel estimates and costs were based on the data and experience from the demonstration. The personnel requirements are expressed as full time equivalents (FTEs). Full time equivalents (FTE) are the number of programmatic personnel that are directly working on SFT activities. In addition to the programmatic personnel, supporting personnel are necessary to complete the work. FTE numbers need to be multiplied by 1.7 to calculate the total number of personnel who are supported by SFT. The summary costs include the costs for the FTEs plus the additional support personnel, necessary materials and services, and costs for equipment and facility modifications.

Although the SFT utilizes resources based on technical expertise and availability, DOE often requests the number of employees that are working at ANL-East and ANL-West. Table 5 shows the current estimate of FTEs who are working on EMT and TA activities at ANL-East and West. For total employees, the programmatic FTEs number should be multiplied by 1.7.

Table 4. Costs and Throughputs With and Without Contingencies

Description	Units	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
		EMT	TA	EMT	TA	EMT	TA	EMT	TA	EMT	TA
Programmatic Personnel	FTEs	80	53	67	44	92	47	138	47	144	45
Total Employees	FTEs	136	90	114	75	156	80	235	80	245	77
Nominal Annual Costs w/out Contingencies	Costs $000	$20,171	$11,019	$15,395	$9,508	$23,205	$11,008	$29,085	$10,911	$31,094	$10,038
Inventory Remaining*	MTHM	24.7		24.5		23.9		23.3		22.6	
Actual Fuel Treated	Kghm	230		600		600		700		1300	
Annual metal waste Processed	Kg	0		0		0		0		60	
Annual Ceramic Waste processed	Kg	0		0		0		0		0	
Annual Baseline Costs w/Contingencies	**Costs $000**	**$20,171**	**$11,019**	**$15,395**	**$9,508**	**$23,205**	**$11,008**	**$29,085**	**$10,911**	**$31,094**	**$10,038**
Inventory Remaining*	**MTHM**	**24.7**		**24.5**		**24.0**		**23.4**		**22.8**	
Annual Fuel Treated	**Kg hm**	**230**		**540**		**540**		**630**		**1100**	
Annual Metal Waste Processed		**0**		**0**		**0**		**0**		**0**	
Annual Ceramic Waste Processed		**0**		**0**		**0**		**0**		**0**	

Description	Units	FY 2005		FY 2006		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY2012	FY2013	Total
		EMT	TA	EMT	TA	Total	Total	Total	Total	Total	Total	Total	
Programmatic Personnel	FTEs	160	42	169	37	201	198	189	174	174	174	56	
Total Employees	FTEs	272	72	287	63	342	337	321	296	296	296	95	
Nominal Annual Costs w/out Contingencies	Costs $000	$33,499	$9,387	$36,203	$8,435	$45,296	$45,432	$44,550	$40,940				$435,176
Inventory Remaining*	MTHM	21.3		19.3		15.0	10.0	5.0	0.0				
Fuel Treated	Kghm	2000		4300		5000	5000	5000	0				
Annual Metal Waste Processed	kg	180		366		1320	1320	1320	1290				
Annual Ceramic Waste processed	kg	120		240		11,000	11,000	11,000	17,840				
Annual Baseline Costs w/Contingencies	**Costs $000**	**$33,499**	**$9,387**	**$36,203**	**$8,435**	**$45,296**	**$45,432**	**$44,550**	**$40,940**	**$42,578**	**$44,281**	**$14,958**	**$536,993**
Inventory Remaining*	**MTHM**	**21.7**		**20.1**		**16.9**	**13.4**	**9.9**	**6.4**	**2.9**	**0.0**	**0.0**	
Fuel Treated	**Kghm**	**1600**		**3210**		**3500**	**3500**	**3500**	**3500**	**2850**	**0**	**0**	
Annual Metal Waste Processed	**Kg**	**120**		**250**		**920**	**920**	**920**	**920**	**920**	**880**	**0**	
Annual Ceramic Waste processed	**Kg**	**0**		**160**		**7700**	**7700**	**7700**	**7700**	**7700**	**7700**	**4840**	

* Fuel remaining at the beginning of the fiscal year.

Table 5. Programmatic Personnel (FTEs) at ANL-East and West

	FY00		FY01		FY02		FY03		FY04		FY05		FY06	
	East	West	East	West	East	West	East	West	East	West	East	West	East	West
EMT	20	60	16	51	21	71	20	118	18	126	18	142	17	152
TA	35	18	28	16	32	15	33	14	31	14	30	12	27	10
Total	55	78	44	67	53	86	53	132	49	140	48	154	44	162

These costs and staffing requirements can be compared to the data in the Cost Study for EIS Alternative 1 [9]. The Cost Study had assumed that the facilities and processes were brought to full capacity as quickly as possible so the total life cycle costs would be minimized. Table 6 shows that the cost study had assumed much higher funding and staffing levels with higher throughputs. This cost study had assumed contingencies of 10% for existing operations and 20% for process operations. Lower levels of available funding will result in higher life cycle costs because the facility operations, which are a fixed cost, dominates the overall treatment costs and the process equipment is not used efficiently.

Table 6. Cost Study Summary Costs and Throughputs

Description	Units	FY 2000		FY 2001		FY 2002	
		EMT	TA	EMT	TA	EMT	TA
Programmatic Personnel	FTEs	137	63	167	43	197	34
Total Employees	FTEs	233	107	284	73	335	58
Annual Costs	$000s	29,800	16,800	38,400	13,000	43,700	10,700
Fuel Treated	kg	500		2350		5000	

3.4 Schedules

The schedules have been developed in parallel with the budgets. An iterative approach was taken with the following objectives:

- complete the scope in the shortest period of time with projected available funding,
- minimize budget and schedule risk by delivering process improvements,
- implement new equipment with adequate time to allow for correction of problems, and
- utilize the resources as efficiently as possible recognizing the level of effort cost for the work scope.

The management team established a list of Level 1 and Level 2 milestones and a preliminary list of associated tasks in each of the major technical areas. The technical leads were given guidance on the money that would be available and developed detailed activity based schedules for the next 3 to 4 years. Also, future tasks were estimated for long range tasks and tied to the milestones. With these detailed schedules at the 3rd and

4th level based on available resources, milestone dates and processing rates were established without contingency. For contingency funding, the annual processing rates were lowered by 10% for start-up treatment operations, by 20% for interim operations and by 30% for production treatment and all waste operations. Also, milestones for equipment engineering (WBS 2) were increased in duration by 20% and technology activities were increased by 30%. Tables 7 and 8 lists the Level 1 and Level 2 milestones with contingency, respectively. The net effect of the contingency was to extend the schedule from a completion date of September 2010 to September 2013. Although contingencies have been established, the day-to-day schedules will be managed to the no contingency dates so appropriate actions can be taken when activities start using the contingency.

After establishing milestone dates, a critical path schedule was established. Since SFT has a very significant research and development component and has some significant schedule and cost risks as discussed in Section 3.2, the critical path was established based on the managers' assessment of necessary accomplishments to help minimize the risks. Figure 5 shows the critical path schedules with the relevant milestones. Appendix C provides the critical path schedules showing the milestone with and without contingencies.

Table 7: Level 1 Milestones with Contingency-**Baseline**

Milestones	Baseline Date
Complete Assessment of Ceramic Waste Processes	May 2000, 5/00 A
Resume Treatment Operations	September 2000, 9/00 A
Update Waste Degradation and Release Models	November 2000, 9/00 A
Issue Draft Waste Form Disposal Report to DOE-NE	December ~~2001~~ 2000
Complete Treatment 540 kg Fuel FY01	September 2001
Complete Treatment of 540kg Fuel in FY02	September 2002
Complete Treatment 630 kg Fuel FY03	September 2003
Complete Treatment 1100 kg Fuel in FY04	September 2004
Reassess Total Costs and Contingencies	March 2005
Decision Zeolite Column Prototype Implementation	June 2005
Complete Treatment 1600 kg Fuel in FY05	September 2005
Complete Treatment 3210kg Fuel in FY06	September 2006
Complete Treatment 3500kg Fuel in FY07	September 2007
Complete Treatment 3500kg Fuel in FY08	September 2008
Complete Treatment 3500kg Fuel in FY09	September 2009
Complete Treatment 3500kg Fuel in FY10	September 2010
Complete Treatment 2850kg Fuel in FY11	September 2011

Table 8: Level 2 Milestones with Contingency-**Baseline**

Milestones	Baseline Date
Accept Facility Readiness Checklist	September 2000, 9/00 A
Interact with EM and RW for Disposal Plans	January 2001
Confirm PC Selection	February 2002
Establish INTEC Agreement for Fuel Receipts	May 2002
Revise Metal Waste Process Qualification Plan	November 2002
Complete CP Capacity Upgrades	October 2003
Complete Training of Transferred Operators for Interim Rate	December 2003
Complete Mk-V ACM Upgrades	February 2004
Start Metal Waste Process Operation	January 2005
Start Ceramic Waste Process Operations	January 2005
Reach Interim Treatment Operations Capacity	March 2005
On-line Monitoring Systems Operational	July 2005
Process 120kg MWF FY05	September 2005
Change FCF to 24 Hour Operations	December 2005
Complete CP Crucible Upgrade	April 2006
Process 250kg MWF FY06	September 2006
Process 160kg CWF FY06	September 2006
Reach Production Treatment Operations Capacity	January 2007
Process 920kg MWF FY07	September 2007
Process 7700kg CWF FY07	September 2007
Process 920kg MWF FY08	September 2008
Process 7700kg CWF FY08	September 2008
Process 920kg MWF FY09	September 2009
Process 7700kg CWF FY09	September 2009
Process 920kg MWF FY10	September 2010
Process 7700kg CWF FY10	September 2010
Process 920kg MWF FY11	September 2011
Process 7700kg CWF FY11	September 2011
Process 880kg MWF FY12	September 2012
Process 7700kg CWF FY12	September 2012
Process 4840kg CWF FY13	September 2013

Activity Description	FY00 FY01 FY02 FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15
RESUME TREATMENT OPERATIONS W/CONT	13SEP00A
ISSUE DRAFT DISPOSAL REPORT TO DOE W/CONT	21DEC00*
CONFIRM PC SELECTION WITH CONT.	28FEB02*
ESTABLISH INTEC AGREEMENT FUEL RECEIPTS W/CONT.	17MAY02*
REVISE METAL WASTE PROCESS QUAL PLAN W/CONT.	26NOV02*
COMPLETE PHASE I MWF PROCESS TESTS WITH CONT.	28FEB03*
COMPLETE INSTALL METAL WASTE PROD EQUIP W/CONT.	03JUL03*
REVISE CERAMIC WASTE PROCESS QUALIF PLAN W/CONT.	01AUG03*
COMPLETE CP CAPACITY UPGRADES W/CONT.	16OCT03*
COMPLETE TRAINING TRANSFERRED OPERATORS W/CONT.	18DEC03*
COMPLETE MK - V ACM UPGRADES W/CONT.	05FEB04*
DECISION ON ALTERNATIVE CP CRUCIBLE W/CONT.	21FEB05*
REACH INTERIM TREATMENT OPS CAPACITY W/CONT.	01MAR05*
ON-LINE MONITORING SYSTEMS OPERATIONAL W/CONT.	15JUL05*
CHANGE FCF TO 24 HOUR OPERATIONS W/CONT.	12DEC05*
COMPLETE CP CRUCIBLE UPGRADE W/CONT.	26APR06*
PROCESS 250kg MWF FY06	29SEP06*
REACH PRODUCTION TREATMENT OPES CAPACITY W/CONT.	11JAN07*
EQUIP RETREIVE EBR-II AXIAL BLANKET W/CONT.	26SEP07*
PROCESS 7700kg CWF FY07	28SEP07*
TREAT 3500kg FUEL FY08	30SEP08*
TREAT 3500kg FUEL FY09	30SEP09*
PROCESS 7700kg CWF FY10	30SEP10*
TREAT 3500 kg FUEL FY10	30SEP10*
TREAT 2850 kg FUEL FY11	30SEP11*
PROCESS 7700 kg CWF FY12	28SEP12*
PROCESS 4840 kg CWF FY13	30SEP13*

Start Date 01OCT99
Finish Date 30SEP13
Data Date 30OCT00
Run Date 09NOV00 14:24

◆ MILESTONE

SFT
Sheet 1 of 1

ARGONNE NATIONAL LABORATORY

SPENT FUEL TREATMENT

CRITICAL PATH MILESTONES
FIGURE 5

ARGONNE NATIONAL LABORATORY • UNIVERSITY OF CHICAGO •

4.0 Performance Measuring and Reporting

Performance measures and reports have been established to measure progress regularly and to communicate this information to management and sponsors.

4.1 Performance Measures

The schedules, budgets with contingency and technical scope in this document are considered the baseline and will be the basis for documenting progress and significant changes. The following definitions are provided to give a uniform understanding of the terms used for performance reporting and change control:

Technical Scope is the treatment of the quantity of sodium-bonded spent nuclear fuel in Table 2 under the assumptions noted in this plan.

Scheduled Completion is September 30, 2013 when the entire inventory of EBR-II and FFTF sodium bonded metal fuel is treated and the resulting two high level waste forms are placed in retrievable interim storage.

Milestones are divided between Level 1 (Entire Work Elements which are approved by DOE-NE), Level 2 (Electrometallurgical Treatment [EMT] and Technology Activities [TA] which are approved by DOE-ARG) and Level 3 (Constraints at the WBS 1-11 elements which are approved by ANL). Level 1 and 2 milestones are shown in Section 3.4. Level 3 Constraints are managed in the detailed schedules.

Actual Cost is the money that is charged and is collected at the Third Level WBS accounts that have been officially established in the Argonne financial system.

Total Cost is the sum of the actual costs to date and the remaining estimated costs to complete the scope including contingency. The total cost is currently projected as $537 million.

Annual SFT Cost is the fiscal year actual and estimated costs shown in Section 3.3 for EMT, TA and Total (sum of the two).

BCWS is budgeted cost for work scheduled and is shown for each fiscal year in Table 4. Monthly values will be established for each fiscal year 30 days after program guidance is received from DOE-NE.

BCWP is budgeted cost for work performed and will be calculated based on progress in **Performance Measures** and **Milestone Completion %.** The **BCWP Factor** establishes the weighting ratio for these two terms.

ACWP is actual cost for work performed and will be compiled from the ANL financial system.

Cost Variance % is the percentage from (BCWP-ACWP)/BCWP.

Schedule Variance % is the percentage from (BCWS-ACWP)/BCWS.

Schedule Compliance is the BCWP divided by the BCWS.

Cost Compliance is the BCWP divided by the ACWP.

EMT Performance Measures will be based on the amount of fuel treated (kg) and waste processed (kg). The fuel will be considered treated when the fuel is in the electrorefiner and waste will be considered processed when the furnaces produce the final waste forms. The monthly scheduled values for a fiscal year will be established 30 days after program guidance is received from DOE-NE.

TA Performance Measures will be based on the process support experiments and waste qualification samples. Process support experiments are the number of experimental runs completed for electrorefining, cathode processing, and metal and ceramic waste processing. The monthly scheduled values for a fiscal year will be established 30 days after program guidance is received from DOE-NE.

Milestone Completion % is determined by management for scheduled work with contingency and actual work performed.

BCWP Factor is the weighting ratio between **Performance Measures** and **Milestone Completion %** for each fiscal year and is based on relative costs and overall importance to completion. The value for a fiscal year will be established 30 days after program guidance is received from DOE-NE.

4.2 Performance Reports

Performance reports will be issued monthly and provide documentation of the progress and actions being taken to address any performance issues. The report format is shown in Appendix D with a sample calculation of performance measures. The general content will be organized as follows:

- **Director's Summary** describes the overall progress, an assessment of any problem areas and actions being implemented.
- **Highlight Narrative** provides a brief list of major accomplishments since the last report.
- **Schedule Summary** lists the actively worked near-term milestones, and their scheduled and actual % complete. Differences between scheduled and actual milestone % completion >15% and corrective actions are explained.

- **Performance Summary** lists the monthly scheduled and actual performance measures. This section will discuss reasons for >15% differences between scheduled and actual values, and corrective actions or the potential impact on the completion date.
- **Financial Summary** lists the BCWS, BCWP, ACWP, CV%, SV%, schedule compliance, cost compliance and contingency usage for EMT, TA and Total Negative variance differences >15% and corrective actions are discussed.
- **Baseline Changes** discusses approved and potential formal baseline change control items.
- **Operational Events Affecting SFT** explains reportable occurrences, and audit and assessment findings that have the potential to affect the SFT work elements. Reportable occurrences and their reference number are listed for SFT related operations. Findings from audits and assessments during the reporting period that pertains to the work elements and the impacts on cost and schedule are explained.
- **Photographs of Significant Events** provides a pictorial history.

4.3 Other Reporting

Progress will be reported to DOE in different methods: two bi-weekly meetings (one for EMT and one for TA), monthly reports, and annual DOE program reviews. An Argonne Group West representative typically attends the two bi-weekly meetings where the detailed critical path schedules are reviewed. These meetings bring all the different expertise together so that problems can be discussed, any corrective actions can be implemented and the schedules can be met. Also, any health and safety issues, and specific SFT meetings are discussed so the staff is aware of upcoming decisions. This meeting and its resulting action items are documented in meeting minutes.

The monthly reports are issued as an Argonne Nuclear Technology Report and provide the detailed technical information on the EMT operations and TA activities. These reports are extremely important to provide an ongoing history to support the final acceptance of the final waste products in a geologic repository.

Typically, progress will be reviewed by the DOE-NE on an annual basis at program review meetings. Formal presentations will be made on current and planned activities.

5.0 Change Control

This implementation plan serves to establish the baseline scope, schedule and costs for Spent Fuel Treatment. Due to the substantial research and development aspect, funding on a yearly basis, and long duration, changes will be made to the baseline plans. Formal changes are initiated when the baseline has been altered by circumstances that could not be reasonably anticipated. The change control process is not intended to be used for documenting excuses for poor planning. Aanticipated changes are routinely documented against the approved baseline as part of the performance reports. The significant unanticipated changes that alter the baseline plans should be documented and approved by an appropriate level of authority.

Two types of changes will be implemented by the same system: directed and SFT initiated changes. Directed changes are typically initiated by a letter from DOE and SFT can only evaluate the impacts and proposed actions. SFT changes usually are initiated by an unanticipated event that exceeds the available contingencies. The change request will typically be initiated from the technical leads for milestone and schedule issues and from division management for financial issues. For these changes, the unanticipated event, proposed corrective action and impacts on the baseline are documented in the change control letter.

The changes are divided into three areas: technical scope, schedule, and costs. Each of the three areas are divided into three levels. A different organization is responsible for approval of each change level: Level 1 changes by DOE-NE, Level 2 changes by DOE-ARG, and Level 3 changes by ANL management. Table 9 defines the change control thresholds.

The change control process will be initiated by the SFT Director. For the proposed changes, the director decides if the change affects other NE sponsored projects or just internal resources and milestones. For changes that affect resources external to SFT, a change control board (CCB) including affected parties will be convened to discuss the changes and their impacts. For internal changes, the SFT Director chairs a CCB with members including the assistant managers and affected technical leads

For Level 3 changes, the proposed baseline changes, the impacts, the discussion of alternatives and the approved changes are documented in the SFT files. For Level 1 and 2 changes, the Director sends a letter to the appropriate DOE organization notifying them of the initiating event, the affects on the schedules, and the proposed baseline change. The letter will specify a date by which the approval is needed. This date will be at least 20 working days after notification of the requested change. The request may be either approved or denied. If a change is denied, specific guidance must be given to fix the problem or an appropriate action that is required to be taken. If a response is not received by the specified date, the change will be considered approved. Notification and approval of changes may be made verbally or by email, but formal transmittal letters are also required for SFT files.

Table 9. Change Control Thresholds for Spent Fuel Treatment

Change Areas	DOE-NE	DOE-ARG	ANL
Technical Scope	Changes to **Baseline** scope as detailed in Table 2 and the assumptions in Section 3.2.	Changes to **Baseline** scope as detailed in Table 2 and the assumptions in Section 3.2.	Changes to planned Process Improvements in Table 3 and waste form test matrices.
Schedule	Delays in **total completion** or delays in Level 1 **Milestones** >2 months.	Delays in Level 2 **Milestones** >2 months	Delays in **Milestones**.
Cost	**Increases** in **Total Costs or Total Annual Cost Variance %** > 15% of baseline.	**EMT or TA Annual Cost Variance %** > 15% of baseline.	Level 3 **Annual Cost Variance %** > 15% of baseline

6.0 Environment, Safety and Health

6.1 National Environmental Protection Act Process

Prior to starting the Spent Fuel Treatment Demonstration in 1996, an Environmental Assessment was prepared [10]. This assessment addressed the treatment of up to 100 driver fuel assemblies and 25 blanket assemblies. A Finding of No Significant Impact (FONSI) was issued in May 1996. The FONSI for this action required that an EIS be prepared if electrometallurgical treatment or another technology were proposed for production-scale treatment of the remaining sodium-bonded fuel.

In February 1999, the Notice of Intent to prepare an EIS for production operations was issued. Scoping meetings were held with the public in March 1999, and the Draft Environmental Impact Statement was issued in July 1999 [11]. Public hearings occurred in August 1999, and the Final EIS was issued in July 2000. Electrometallurgical treatment was noted as the preferred alternative for treatment of all sodium-bonded fuel except for the Fermi-1 blankets for which the no-action alternative was chosen for the present time. The treatment options for this fuel will be reassessed after additional results from SFT are available in approximately four years. A ROD was issued on September 11, 2000 and treatment operations will commence by the end of FY2000.

Some SFT operations are also addressed in more programmatic Environmental Impact Statements. Most of the fuel to be treated is already at the INEEL. Some of the FFTF and miscellaneous fuels will require shipment to the INEEL. The relocation of this fuel to the INEEL is addressed in the "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement" [12]. The disposal of the high-level waste forms are assessed as part of the "Draft

Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada" [13].

6.2 Integrated Safety Management Process

ANL-West has implemented the ISMS program which meets the seven guiding principles of the DOE Policy P 450.4, *Safety Management System Policy*, complies with the DOE Acquisition Regulation (DEAR) clause 970.5204-2 as defined in the ANL contract, and is defined in the ANL-West Environment, Safety, and Health Manual, *Section 1.3, ANL-West Integrated Safety Management System.* Integrated Safety Management System is a structured, comprehensive, common sense approach to *"Doing Work Safely."* *"Doing Work Safely"* is the principle objective of an Integrated Safety Management System. The Spent Fuel Treatment follows this Integrated Safety Management System. Integration means that all parts of work planning and execution, including programs, organization, and activities, are used to ensure that safety aspects that apply to each task are addressed.

Activities will be performed in accordance with the ANL-W Environment, Safety and Health Manual, the Radiological Control Manual, and the Argonne – West Procedures Manual (AWP). Integrated safety management is an essential component of these documents. Additionally, activities within individual facilities are performed in accordance with the *"Conduct of Operations"* procedures for that facility. Integrated safety management principles are incorporated into these procedures.

Integrated safety management principles are also applied during the bi-weekly process meetings. Work planning and discussions of safety issues, including lessons learned are an integral part of these meetings.

7.0 REFERENCES

1. Electrometallurgical Techniques for DOE Spent Fuel Treatment: Final Report, National Research Council, National Academy Press, Washington, DC (2000).

2. Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel, Vol. 1, U.S. DOE Office of Nuclear Energy, Science and Technology, DOE/EIS-0306 (July 2000).

3. K. M. Goff, L. L. Briggs, R. W. Benedict, J. R. Liaw, M. F. Simpson, E. E. Feldman, R. A. Uras, H. E. Bliss, A. M. Yacout, D. D. Keiser, K. C. Marsden, and C. Nielsen, "Production Operations for the Electrometallurgical Treatment of Sodium-Bonded Spent Nuclear Fuel," Argonne National Laboratory Report, ANL-NT-107 (June 1999).

4. R. G. Lange, DOE Memorandum, "Fiscal Year 2000 Program Guidance for Termination Activities" (December 1999).

5. Spent Fuel Treatment Project Level 3 Work Breakdown Structure, F0000-0035-ES-01, (September 2000).

6. "Civilian Radioactive Waste Management System Waste Acceptance System Requirements Document," Draft Revision 04D, U. S. Department of Energy, Office of Civilian Radioactive Waste Management (February 2000).

7. "Project Management Systems Report for EBR-II Plant Closure Project and the Spent Fuel Treatment Project,"(July 17, 2000).

8. "Skills and Knowledge of Cost Engineering" American Association of Cost Engineers, (1992).

9. "Cost Study of Alternatives Presented in the Draft Environmental Impact Statement for the Treatment and Management of Sodium-bonded Spent Nuclear Fuel" (August 1999).

10. Department of Energy, "Environmental Assessment Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at Argonne National Laboratory-West," DOE/EA-1148 (May 1996).

11. U. S. Department of Energy, "Draft Environmental Impact Statement for the Treatment and Management of Sodium Bonded Spent Nuclear Fuel," DOE/EIS-0306D (July 1999).

12. U. S. Department of Energy, "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement," DOE/EIS-0203F (April 1995).

13. U. S. Department of Energy, "Draft Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High Level Radioactive Waste at Yucca Mountain, Nye County, Neveda," DOE/EIS-0250D (July 1999).

ACRONYMS

ACL	Analytical Chemistry Laboratory
ACWP	Actual Cost for Work Performed
ALD	Associate Laboratory Director
ANL-W	Argonne National Laboratory-West
ARG	Argonne Group
AWP	Argonne National Laboratory-West Procedures
BCWP	Budgeted Cost for Work Performed
BCWS	Budgeted Cost for Work Scheduled
DOE	Department of Energy
EBR-II	Experimental Breeder Reactor-II
EIS	Environmental Impact Statement
EMT	Electrometallurgical Treatment
FCF	Fuel Conditioning Facility
FFTF	Fast Flux Test Facility
FONSI	Finding of No Significant Impact
FTE	Full Time Equivalents
HFEF	Hot Fuel Examination Facility
HIP	Hot Isostatic Press
INEEL	Idaho National Engineering and Environmental Laboratory
ISMS	Integrated Safety Management System
INTEC	Idaho Nuclear Technology and Engineering Center
M&S	Materials and Supplies
Mk	Mark
MTHM	Metric Tons of Heavy Metal
NE	Office of Nuclear Energy, Science and Technology
NEPA	National Environmental Policy Act
NRC	National Research Council
ROD	Record of Decision
RSWF	Radioactive Scrap and Waste Facility
SFT	Spent Fuel Treatment
SPI	Schedule Performance Index
TA	Fuel and Waste Disposition Technology Activities
WBS	Work Breakdown Structure

Appendices A

WBS Cost Estimates for SFT Baseline

Table A-1. Baseline Staffing and Budgets for EMT Activities

Work Element	Units	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	**FY 00-13**
		Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	**Total**
WBS 1	FTEs	37	33	47	98	106	125	133	134	134	134	134	134	134	35	
	Cost $000	5,715	5,385	7,715	15,584	17,880	21,164	23,470	24,446	25,424	26,441	27,499	28,599	29,743	7,829	**266,894**
WBS 2	FTEs	24	18	23	19	19	17	18	18	18	16	12	12	12	7	
	Cost $000	4,246	3,679	4,658	4,035	4,102	3,814	4,060	4,222	4,391	3,811	2,929	3,046	3,168	1,977	**51,432**
WBS 3	FTEs	13	10	15	14	12	11	11	11	11	11	6	6	6	1	
	Cost $000	3,233	2,702	5,536	5,128	4,729	4,592	4,697	4,885	5,080	5,283	2,847	2,961	3,080	170	**54,923**
WBS 10	FTEs	4	3	4	4	4	4	4	4	4	4	3	3	3	2	
	Cost $000	754	589	816	839	864	889	915	952	990	1,029	790	821	854	533	**11,635**
WBS 11	FTEs	2	3	3	3	3	3	3	3	3	3	3	3	3	2	
	Cost $000	363	394	480	499	519	540	561	583	607	631	656	683	710	443	**7669**
Work Project	FTEs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Cost $000	5,860	2,646	4,000	3,000	3,000	2,500	2,500	2,600	2,163	2,250	2,340	2,433	2,531	1,579	**39,402**
Total	**FTEs**	**80**	**67**	**92**	**138**	**144**	**160**	**169**	**170**	**170**	**168**	**158**	**158**	**158**	**47**	
	Cost $000	**20,171**	**15,395**	**23,205**	**29,085**	**31,094**	**33,499**	**36,203**	**37,688**	**38,655**	**39,445**	**37,061**	**38,543**	**40,086**	**12,531**	**432,661**

Table A-2. Baseline Staffing and Budgets for Technology Activities

Work Element	Units	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	**FY 00-10**
		Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	**Total**
WBS 4	FTEs	12	10	8	8	8	6	5	3	3	1	1	1	1	0	
	Cost $000	2,828	2,584	2,181	2,012	1,968	1,554	1,359	886	745	325	282	293	305	0	**17,322**
WBS 5	FTEs	9	7	5	5	5	5	4	2	2	1	1	1	1	1	
	Cost $000	1,704	1,489	1,242	1,276	1,161	1,104	828	594	379	304	260	270	281	175	**11,067**
WBS 6	FTEs	7	6	8	8	8	8	8	8	7	6	4	4	4	2	
	Cost $000	1,455	1,226	1,706	1,689	1,718	1,714	1,709	1,777	1,604	1,281	923	960	998	623	**19,383**
WBS 7	FTEs	12	11	14	14	12	11	8	6	4	3	2	2	2	1	
	Cost $000	2,326	2,148	3,104	3,130	2,357	2,185	1,713	1,411	1,152	771	509	529	550	343	**22,228**
WBS 8	FTEs	10	7	9	9	9	9	9	9	9	8	7	7	7	4	
	Cost $000	2,017	1,488	2,042	2,069	2,096	2,090	2,083	2,166	2,093	1,904	1,593	1,657	1,723	1,075	**26,096**
WBS 9	FTEs	3	3	3	3	3	3	3	3	3	2	1	1	1	1	
	Cost $000	689	573	733	735	738	740	743	773	804	520	312	325	338	211	**8,234**
Total	**FTEs**	**53**	**44**	**47**	**47**	**45**	**42**	**37**	**31**	**28**	**21**	**16**	16	16	9	
	Cost $000	**11,019**	**9,508**	**11,008**	**10,911**	**10,038**	**9,387**	**8,435**	**7,607**	**6,777**	**5,105**	**3,879**	**4,034**	**4,195**	**2,427**	**104,330**

Appendix B

Selection of Cost and Schedule Contingency Method

Since DOE has requested a total cost including contingency, estimates were developed with and without contingency. The budget was first developed assuming no contingency and the level of funding that was received for FY00 and DOE guidance [4] of the "required" available funding for FY01 through FY05. Although this funding constraint does not enable the total cost to be minimized, Level 3 schedules and budgets were developed to minimize the risk and the costs. Because of the significant fixed costs, the total cost is minimized by increasing the treatment throughput to 5 MTHM per year as quickly as possible while waste process implementation and qualification activities continue in parallel. The latter is necessary in order to ensure that production-scale waste treatment is in place before the backlog of waste material can disrupt the throughput.

The costs for Spent Fuel Treatment are largely based on level of effort by ANL personnel and only a small portion of the expenditures is for outside work. Still the budget and costs provided do include materials and supply (M&S) expenditures including the new equipment and modifications. A large fraction of the level of effort costs include the staff and operators required in the various facilities. In developing the budget, the management team assumed FCF would be staffed up rapidly in order to reach higher process throughputs. FCF would first be staffed-up from start-up operations which supports a process rate of 0.6 MTHM per year to interim operations which supports 2 MTHM. Interim operations require some process equipment improvements and 12 hours per day and 7 days per week operations.

Due to the large reduction in available funds from FY99 ($40 Million) to FY01 ($24 Million), many of the process operators and supporting staff were reassigned to other projects. This action has required revising the schedules and budgets to reflect retraining and rehiring for the 12 hours per day, and 24 hour per day operations. New operator training requirements strongly effect process throughput. Once the staffing level is increased to these various levels, the process throughput does not immediately increase because training requirements for operators limit their effectiveness for 1 to 2 years. After 2 years of training, a new operator is considered fully qualified for hot-cell operations. Throughput is not increased until the operators are qualified.

In order to minimize risk, the budgets were established to install the waste equipment in HFEF and increase HFEF and ACL staffing before reaching full FCF production operations (5 MT HM per year). The budgets for all activities are primarily a level of effort funding so any major interruptions will have a major effect on total costs.

As noted, the budget was first developed with no contingency. For this budget the total cost was $435 million and the duration extended through FY10. In June 2000, DOE performed a review of the Management Systems for Spent Fuel Treatment. One recommendation was that the Implementation Plans needed to include contingency [7]. The budget and schedule were therefore developed including contingency. In developing this contingency budget two approaches were taken. The simplest method would be to determine the contingency budget for each year based on the allocations without contingencies. In doing this, an established contingency amount would be applied to the budgeted costs for the various WBS elements. For contingencies, values were based on guidance from the American Association of Cost Engineers [8] where budget estimates are expected to be accurate within +30% or –15% and definitive estimates are within +15% or –5%. Table B-1 provides the values used for the various tasks. Using this method, the SFT duration still extends to FY10, and the total cost is $509 million. The contingency budget would have to be provided to Spent Fuel Treatment annually in order to still complete operations by FY10.

Table B-1. Contingency Percentage for WBS Activities

WBS Activity	Contingency (%)
WBS 1	10%
WBS 2	20%
WBS 3	20%
WBS 4	30%
WBS 5	30%
WBS 6	30%
WBS 7	30%
WBS 8	30%
WBS 9	30%
WBS 10	20%
WBS 11	10%

The second method for determining the contingency budget assumes that the budget will not be increased annually, so the contingency is instead provided as additional years of funding to complete the objectives. Since the DOE typically does not provide contingency funding and the FY values have been established for the short term future, this method would be considered to be the Baseline. For this method, contingency percentages were instead applied to process throughput values. For the early process throughput, 0.6 MTHM, this value was lowered by 10%. This small contingency was chosen because relatively little technology activities are needed to support this value. The interim processing rate was lowered by 20% because some technology activities are needed and the efficiency of the new staff is unproven. The production processing rate, 5 MTHM, was decreased by 30% since obtaining this rate is largely dependent on the technology activities and the uncertainties with 24 hours per day of production operations at a research and development institution. The new processing rates of 0.54, 1.6, and 3.5 MTHM per year were then used to determine the new duration and funding. At these processing rates, the SFT operations would instead be completed in FY13 and the total cost would be $537 million. Table B-2 provides the staffing and budget profiles for the costs without contingency and with contingency by the two different methods.

These personnel estimates and costs were based on the data and experience from the demonstration. The personnel requirements are expressed as full time equivalents (FTEs). Full time equivalents (FTE) are the number of programmatic personnel that are directly working on SFT activities. In addition to the programmatic personnel, supporting personnel are necessary to complete the work. FTE numbers need to be multiplied by 1.7 to calculate the total number of FTEs who are supported by the SFT activities. The summary costs include the costs for the FTEs including the additional support personnel, necessary materials and services, and costs for equipment and facility modifications.

Table B-2. Costs and Throughputs With and Without Contingencies

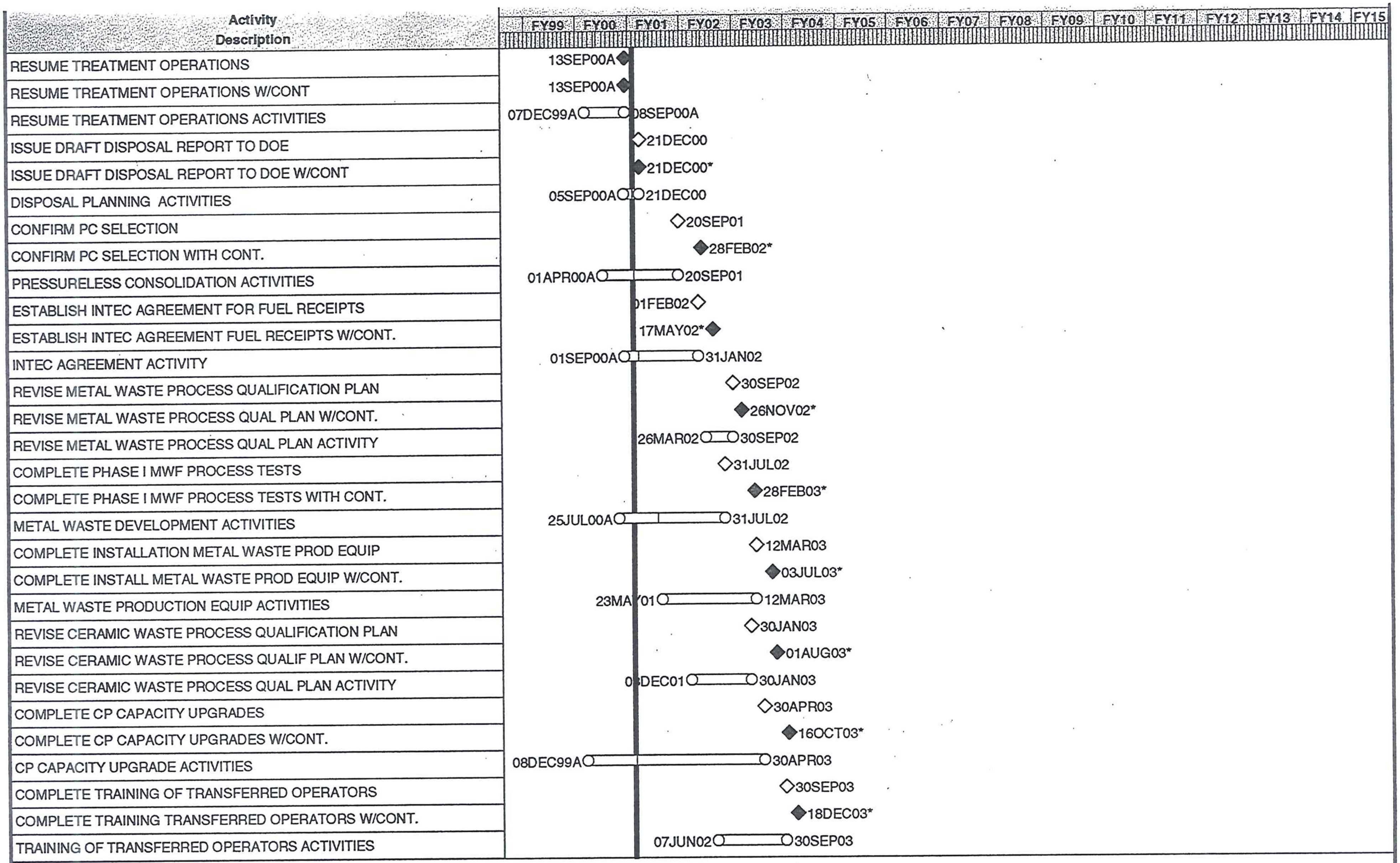
Description	Units	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
		EMT	TA	EMT	TA	EMT	TA	EMT	TA	EMT	TA
Programmatic Personnel	FTEs	80	53	67	44	92	47	138	47	144	45
Total Employees	FTEs	136	90	114	75	156	80	235	80	245	77
Nominal Costs w/out Contingencies	Costs $000	$20,171	$11,019	$15,395	$9,508	$23,205	$11,008	$29,085	$10,911	$31,094	$10,038
Inventory Remaining*	MTHM	24.7		24.5		23.9		23.3		22.6	
Fuel Treated	kghm	230		600		600		700		1300	
Annual Costs w/Contingencies (Method 1)	Costs $000	$23,597	$14,325	$17,896	$12,360	$27,027	$14,310	$33,294	$14,184	$35,473	$13,049
Inventory Remaining*	MTHM	24.7		24.5		23.9		23.3		22.6	
Fuel Treated	kghm	230		600		600		700		1300	
Annual Costs w/Contingencies (Method 2) Baseline	Costs $000	$20,171	$11,019	$15,395	$9,508	$23,205	$11,008	$29,085	$10,911	$31,094	$10,038
Inventory Remaining*	MTHM	24.7		24.5		24.0		23.4		22.8	
Annual Fuel Treated	Kg hm	230		540		540		630		1100	

Description	Units	FY 2005		FY 2006		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY2012	FY2013	Total
		EMT	TA	EMT	TA	Total	Total	Total	Total	Total	Total	Total	
Programmatic Personnel	FTEs	160	42	169	37	201	198	189	174	174	174	56	
Total Employees	FTEs	272	72	287	63	342	337	321	296	296	296	95	
Nominal Costs w/out Contingencies	Costs $000	$33,499	$9,387	$36,203	$8,435	$45,296	$45,432	$44,550	$40,940				$435,176
Inventory Remaining*	MTHM	21.3		19.3		15.0	10.0	5.0	0.0				
Fuel Treated	Kghm	2000		4300		5000	5000	5000	0				
Annual Costs w/Contingencies (Method 1)	Costs $000	$37,778	$12,203	$40,791	$10,966	$52,352	$52,377	$51,038	$46,466				$509,487
Inventory Remaining*	MTHM	21.3		19.3		15.0	10.0	5.0	0.0				
Fuel Treated	Kghm	2000		4300		5000	5000	5000	0				
Annual Costs w/Contingencies (Method 2) Baseline	Costs $000	$33,499	$9,387	$36,203	$8,435	$45,296	$45,432	$44,550	$40,940	$42,578	$44,281	$14,958	$536,993
Inventory Remaining*	MTHM	21.7		20.1		16.9	13.4	9.9	6.4	2.9	0.0	0.0	
Fuel Treated	Kghm	1600		3210		3500	3500	3500	3500	2850	0	0	

* Fuel Inventory at the beginning of the fiscal year.

Appendix C Critical Path Schedule

The figure C-1 provided in this appendix is the critical path schedule showing milestones with and without contingency. Figure 4 in Section 3 depicted the critical path schedule but only showed the contingency milestones. The SFT schedule has been established so that the activities are managed to the milestones without contingency or SFT goals. Using this approach the management team can better assess the progress of activities and the degree to which the contingency is being used. The figure also shows the predecessor activities that are feeding into the completion of the critical path schedule. These progress made on these tasks are used to assess the SFT performance.



Activity Description		
RESUME TREATMENT OPERATIONS	13SEP00A	
RESUME TREATMENT OPERATIONS W/CONT	13SEP00A	
RESUME TREATMENT OPERATIONS ACTIVITIES	07DEC99A	08SEP00A
ISSUE DRAFT DISPOSAL REPORT TO DOE		21DEC00
ISSUE DRAFT DISPOSAL REPORT TO DOE W/CONT		21DEC00*
DISPOSAL PLANNING ACTIVITIES	05SEP00A	21DEC00
CONFIRM PC SELECTION		20SEP01
CONFIRM PC SELECTION WITH CONT.		28FEB02*
PRESSURELESS CONSOLIDATION ACTIVITIES	01APR00A	20SEP01
ESTABLISH INTEC AGREEMENT FOR FUEL RECEIPTS	01FEB02	
ESTABLISH INTEC AGREEMENT FUEL RECEIPTS W/CONT.	17MAY02*	
INTEC AGREEMENT ACTIVITY	01SEP00A	31JAN02
REVISE METAL WASTE PROCESS QUALIFICATION PLAN		30SEP02
REVISE METAL WASTE PROCESS QUAL PLAN W/CONT.		26NOV02*
REVISE METAL WASTE PROCESS QUAL PLAN ACTIVITY	26MAR02	30SEP02
COMPLETE PHASE I MWF PROCESS TESTS		31JUL02
COMPLETE PHASE I MWF PROCESS TESTS WITH CONT.		28FEB03*
METAL WASTE DEVELOPMENT ACTIVITIES	25JUL00A	31JUL02
COMPLETE INSTALLATION METAL WASTE PROD EQUIP		12MAR03
COMPLETE INSTALL METAL WASTE PROD EQUIP W/CONT.		03JUL03*
METAL WASTE PRODUCTION EQUIP ACTIVITIES	23MAY01	12MAR03
REVISE CERAMIC WASTE PROCESS QUALIFICATION PLAN		30JAN03
REVISE CERAMIC WASTE PROCESS QUALIF PLAN W/CONT.		01AUG03*
REVISE CERAMIC WASTE PROCESS QUAL PLAN ACTIVITY	03DEC01	30JAN03
COMPLETE CP CAPACITY UPGRADES		30APR03
COMPLETE CP CAPACITY UPGRADES W/CONT.		16OCT03*
CP CAPACITY UPGRADE ACTIVITIES	08DEC99A	30APR03
COMPLETE TRAINING OF TRANSFERRED OPERATORS		30SEP03
COMPLETE TRAINING TRANSFERRED OPERATORS W/CONT.		18DEC03*
TRAINING OF TRANSFERRED OPERATORS ACTIVITIES	07JUN02	30SEP03

Start Date	01OCT99
Finish Date	30SEP13
Data Date	30OCT00
Run Date	09NOV00 14:23

◇ GOAL

◆ MILESTONE

⊂⊃ PREREQUISITE ACTIVITIES

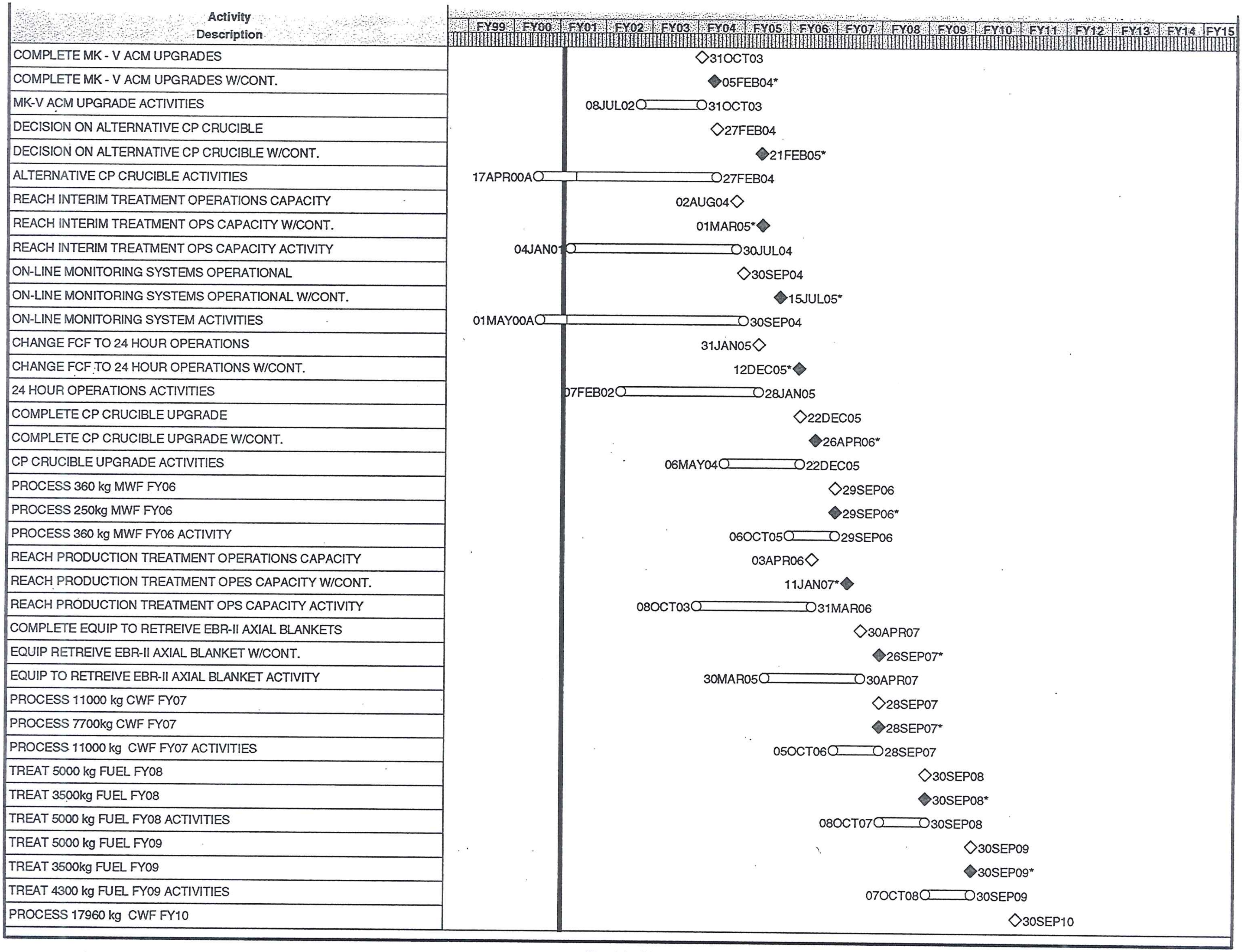
SFT

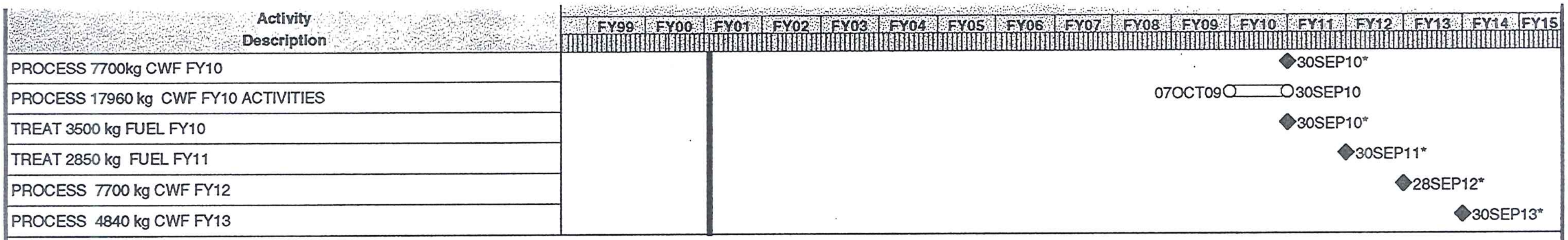
Sheet 1 of 3

ARGONNE NATIONAL LABORATORY

SPENT FUEL TREATMENT

CRITICAL PATH
FIGURE C-1


Activity Description
FY99
FY00
FY01
FY02
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
COMPLETE MK - V ACM UPGRADES 31OCT03
COMPLETE MK - V ACM UPGRADES W/CONT. 05FEB04*
MK-V ACM UPGRADE ACTIVITIES 08JUL02 31OCT03
DECISION ON ALTERNATIVE CP CRUCIBLE 27FEB04
DECISION ON ALTERNATIVE CP CRUCIBLE W/CONT. 21FEB05*
ALTERNATIVE CP CRUCIBLE ACTIVITIES 17APR00A 27FEB04
REACH INTERIM TREATMENT OPERATIONS CAPACITY 02AUG04
REACH INTERIM TREATMENT OPS CAPACITY W/CONT. 01MAR05*
REACH INTERIM TREATMENT OPS CAPACITY ACTIVITY 04JAN01 30JUL04
ON-LINE MONITORING SYSTEMS OPERATIONAL 30SEP04
ON-LINE MONITORING SYSTEMS OPERATIONAL W/CONT. 15JUL05*
ON-LINE MONITORING SYSTEM ACTIVITIES 01MAY00A 30SEP04
CHANGE FCF TO 24 HOUR OPERATIONS 31JAN05
CHANGE FCF TO 24 HOUR OPERATIONS W/CONT. 12DEC05*
24 HOUR OPERATIONS ACTIVITIES 07FEB02 28JAN05
COMPLETE CP CRUCIBLE UPGRADE 22DEC05
COMPLETE CP CRUCIBLE UPGRADE W/CONT. 26APR06*
CP CRUCIBLE UPGRADE ACTIVITIES 06MAY04 22DEC05
PROCESS 360 kg MWF FY06 29SEP06
PROCESS 250kg MWF FY06 29SEP06*
PROCESS 360 kg MWF FY06 ACTIVITY 06OCT05 29SEP06
REACH PRODUCTION TREATMENT OPERATIONS CAPACITY 03APR06
REACH PRODUCTION TREATMENT OPES CAPACITY W/CONT. 11JAN07*
REACH PRODUCTION TREATMENT OPS CAPACITY ACTIVITY 08OCT03 31MAR06
COMPLETE EQUIP TO RETREIVE EBR-II AXIAL BLANKETS 30APR07
EQUIP RETREIVE EBR-II AXIAL BLANKET W/CONT. 26SEP07*
EQUIP TO RETREIVE EBR-II AXIAL BLANKET ACTIVITY 30MAR05 30APR07
PROCESS 11000 kg CWF FY07 28SEP07
PROCESS 7700kg CWF FY07 28SEP07*
PROCESS 11000 kg CWF FY07 ACTIVITIES 05OCT06 28SEP07
TREAT 5000 kg FUEL FY08 30SEP08
TREAT 3500kg FUEL FY08 30SEP08*
TREAT 5000 kg FUEL FY08 ACTIVITIES 08OCT07 30SEP08
TREAT 5000 kg FUEL FY09 30SEP09
TREAT 3500kg FUEL FY09 30SEP09*
TREAT 4300 kg FUEL FY09 ACTIVITIES 07OCT08 30SEP09
PROCESS 17960 kg CWF FY10 30SEP10


Activity Description
FY99
FY00
FY01
FY02
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
PROCESS 7700kg CWF FY10
30SEP10*
PROCESS 17960 kg CWF FY10 ACTIVITIES
07OCT09
30SEP10
TREAT 3500 kg FUEL FY10
30SEP10*
TREAT 2850 kg FUEL FY11
30SEP11*
PROCESS 7700 kg CWF FY12
28SEP12*
PROCESS 4840 kg CWF FY13
30SEP13*

Appendix D

Performance Reports

An example monthly report for SFT follows in this appendix. This example report is for the quarter ending in June 2000. Future reports will have the same format but will instead be prepared monthly. The information provided in the Financial Summary requires further explanation on the method for determining the various values.

The financial data will be provided for total and EMT and TA totals. The data provided will include BCWS, BCWP, ACWP, Cost Variance %, Schedule Variance %, schedule compliance, and cost compliance. The definitions of these terms are provided in Section 4.1.

To determine the variances and compliance values, the BCWS, BCWP, and ACWP must be established. The values for BCWS and ACWP are relatively easy to determine. BCWS is just the amount of funds allocated for the tasks for that month. These values are established for the fiscal year within 30 days after program guidance is received from DOE-NE. ACWP is the amount of money spent for that quarter. This value is determined from the ANL financial system at the third WBS Level.

The complicated value to determine is BCWP which is BCWS multiplied by a factor where the factor is the Schedule Performance Index (SPI) or the schedule compliance value. This factor is an indicator of how well the SFT activities are meeting its schedule and its expected expenditures. The % complete data provided with the milestone reports and the status of the performance measures will be used to establish this factor for both EMT and TA.

The EMT activities fall into WBS elements 1, 2, 3, 10, and 11. WBS elements 1, 3, 10, and 11 are focused on treating the fuel in a safe and timely manner. The performance measure for fuel treated will be used to establish the factor for these elements. If all the proposed fuel has been treated for the quarter, the factor for these WBS elements would be 1. If 80% of the expected fuel were treated then the factor would be 0.8. For the month of June in the example report, all the expected fuel had been treated so the schedule compliance value for those WBS elements was 1.

WBS 2 is focused on maintaining and developing new equipment to support treatment operations. Its factor will be determined based on the equipment status to support milestones. In the section of the Performance Report discussing milestones, % complete data for tasks associated with WBS 2 will be used to determine the factor. If an equipment related task supporting a milestone is 50% complete but it was expected to be 60% complete, then the factor would be 0.83. In the June report three equipment tasks supported the milestones. The average factor for these WBS tasks was 0.89. The overall factor for EMT activities will be determined from a budget-weighted average of the WBS 2 factor and WBS 1, 3, 10, and 11 factor. If the budget for WBS 2 were the same as the combined budget for WBS 1, 3, 10, and 11, then the two factors would be weighted evenly to determine the total factor for EMT activities. This is the case for the June monthly so the EMT factor becomes 0.94.

The factor for technology activities (WBS 4-9) will also be determined from the status of the performance measures and % complete data for the milestones. For the June report, an equally weighted average of these two indicators was used. If all the experiments and analyses have been performed that were expected, then that portion of the factor would be 1. If the % complete value for WBS 4-9 elements that affect near term milestones is at the anticipate value, then that portion of the factor would also be 1. Both of these portions of the factor for the technology activities would be average to give the total factor for TA. For the June monthly these two factors provided an average TA factor of 1.03. This value is greater than 1 because more experiments were performed than expected for the given budget.

With these factors, the BCWP for each of these areas can be determined. With the BCWP, BCWS, and ACWP all known, the Cost Variance %, Schedule Variance %, cost compliance, and schedule compliance can be calculated and reported.

Example Performance Report

Draft Spent Fuel Treatment Quarterly Performance Report
June 30, 2000 Closing

Scope: Treat EBR-II and FFTF spent nuclear fuel and immobilize the fission products into two high level waste forms and place waste forms and uranium into retrievable interim storage.

Director's Summary

During this quarter the maintenance activities in the Fuel Conditioning Facility were started. These activities were delayed some during the previous quarter, but the delay is not expected to cause a change in the date for resuming treatment operations. In May, pressureless consolidation was chosen as the reference consolidation method for the ceramic waste. Use of a hot isostatic press will be maintained as a backup. The work to support updating the waste forms degradation models is progressing to meet the September milestone.

Highlight Narrative Since Last Update

- The Fuel Conditioning Facility maintenance was started.
- Pressureless consolidation (PC) was chosen as the reference ceramic waste form production method.
- The metal waste form degradation model was updated.

Current Fiscal Year and Near Term Milestone Status

Near term Milestones	Start Date		Completion Date		Percent Complete[1]	
	Baseline[2]	Forecast/ Actual[3]	Baseline[2]	Forecast/ Actual[3]	Baseline[2]	Estimate[4]
Select ceramic waste process for production operations			**3/00**	**5/00A**		
PC Development Tests	10/98	10/98A	3/00	4/00A	100%	100%
PC Characterization Tests	10/98	10/98	3/00	4/00A	100%	100%
Resume Treatment Operations			**9/00**	**9/00F**		
Modifications work package preparation	12/99	12/99A	6/00	6/00A	100%	100%
Maintenance shutdown	2/00	4/00A	9/00	9/00F	75%	50%
Readiness checklist	8/00	8/00F	9/00	9/00F	0%	0%
Update Radionuclide Release Models			**9/00**	**9/00F**		
Update Metal Waste Model	9/99	9/99A	6/00	6/00A	100%	100%
Update Ceramic Waste Model	9/99	9/99A	6/00	7/00F	100%	90%
Update Performance Assess Model	9/99	9/99A	9/00	9/00F	50%	50%
Treat 600 kg fuel in FY01	**10/00**	**10/00F**	**9/01**	**9/01F**		

1. Percent complete are the estimates at the close of the reporting date based on the baseline schedules and the current status.
2. Baseline refers to the late start/finish scheduled dates as detailed in the Implementation Plan and as modified by approved baseline control changes.
3. Forecast/Actual are the forecasted (F) or actual dates (A) from the detailed schedules.
4. Estimate is based on the managers percent completion of all the tasks that are required to meet the listed milestone or subtasks. The baseline and estimate are used for BCWS and BCWP comparisons for engineering design and fabrication (WBS 2) activities.

Schedule Summary:

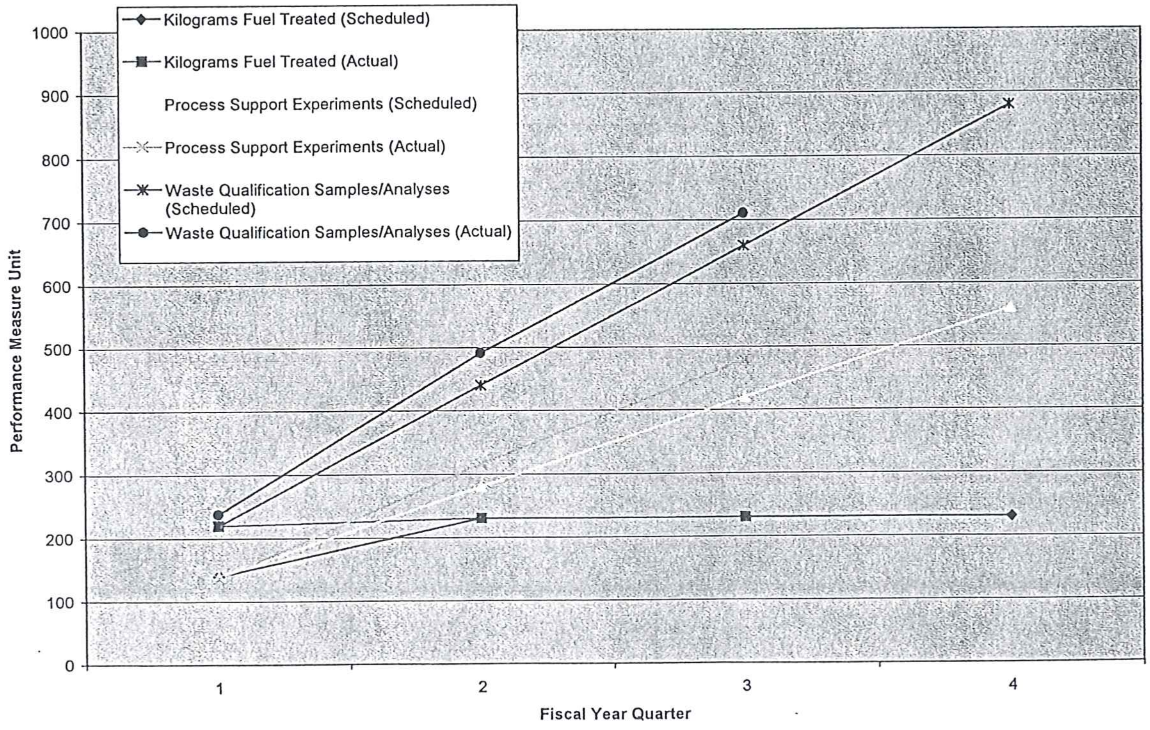
The milestone for selecting the ceramic waste process for production operations was completed in early May 2000. Pressureless consolidation was chosen as the reference method over production with a hot isostatic press. The possible Unreviewed Safety Question regarding a feedthru drop accident was resolved. FCF maintenance operations were started and good progress was made. The metal waste form degradation model was updated based on data generated since the end of the demonstration. The ceramic waste form degradation model was also updated, but documentation is still required.

Performance Measures

		Q1	Q2	Q3	Q4	FY2000[5]	SFT Total[6]	
						Total	Cumulative	Total
Kilograms Fuel Treated	Scheduled	140	230	230	0	230	230	24,750
	Actual	220	230	230	0	230A	230A	24,750
Process Support Experiments[7]	Scheduled	140	280	420	560	560		
	Actual	136	316	479		560F		
Waste Qualification samples/analyses[8]	Scheduled	220	440	660	880	880		
	Actual	238	491	711		880F		

5. Quarterly amounts for FY2000 are cumulative at the end of the reporting period. Totals are based on FY program guidance for scheduled and forecast for actuals.
6. Cumulative include all values since FY2000 and totals are based on baselines plus approved baseline changes.
7. Process support experiments are the number of experimental runs completed or planned for electrorefining, cathode processing, metal and ceramic waste processing technology activities.
8. Waste qualification sample/analyses are the number of samples and individual analyses that are planned as detailed in the waste form testing matrices.

Spent Fuel Treatment Project Quarterly Performance Measures



Performance Summary:
The Fuel Conditioning Facility completed operations necessary to place the facility into secure mode. Prior to these operations all fuel planned for treatment this year was processed. Process support experiments and waste qualification samples were performed in large part to support the decision on the reference ceramic waste consolidation method.

Financial Status

		Q1	Q2	Q3	Q4	FY2000	SFT[6]	
	$000s					Total	Cum.	Total
Electrometallurgical Treatment *(WBS 1-3, 10 & 11)*	BCWS[9]		10,900	15,536	20,171	15,536	15,536	341,501
	BCWP		8,781	14,672		14,672	14,672	
	ACWP		11,634	15,661		15,661	15,661	
	CV%		-32.5	-6.7				
	SV%		-19.4	-5.6				
Technology Activities *(WBS 4-9)*	BCWS		5,510	8,264	11,019	8,264	8,264	93,674
	BCWP		5,791	8,521		8,521	8,521	
	ACWP		5,353	8,375		8,375	8,375	
	CV%		7.6	1.7				
	SV%		5.1	3.1				
SFT Totals	BCWS		16,410	23,800	31,190	23,800	23,800	435,175
	BCWP		14,572	23,193		23,193	23,193	
	ACWP		16,987	24,036		24,036	24,036	
Total Variance %	CV%		-16.6	-3.6				
	SV%		-11.2	-2.5				
SFT Compliance	Schedule		0.89	0.97				
	Cost		0.86	0.96				

9. BCWS, BCWP, ACWP, Cost Variance % are defined in Section 4.1 of Implementation Plan with work performed established by SFT managers.

Financial Summary:
The maintenance shutdown was delayed because cell preparations were delayed by the extended secure mode that was required while addressing a possible Unreviewed Safety Question regarding a feedthru drop accident. Maintenance tasks that were scheduled in series were performed in parallel to recover some of the delay. Treatment operations should be able to resume in September as planned, but time that was going to be available to perform waste handling operations will be reduced considerably.

Approved and Potential Baseline Changes

Approved Baseline Changes:
None

Potential Baseline Changes:
None

Operational Events Affecting SFT Operation

Reportable Occurrences:
CH-AA-ANLW-FCF-2000-0007 – On 6/14/2000, a 7100 dpm particle was found above the right eyebrow of a construction worker during egress from the roof Hot Repair Area (HRA). This is a contaminated work area and personnel protective equipment is required but did not

include respiratory or face protection. Daily surveys of construction workers safety glasses and hard hats were instituted following this event. Work resumed on 6/15/2000.

Photographs of Significant Activities