

**DEPARTMENT OF ENERGY MANAGEMENT OF THE HANFORD
WASTE TREATMENT AND IMMOBILIZATION PLANT**

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ABSTRACT

The US Department of Energy Office of River Protection is currently overseeing the construction of the new Hanford Site Waste Treatment and Immobilization Plant (more commonly referred to as the Waste Treatment Plant). In December 2000, a contract was awarded to Bechtel National, Inc. for the design, construction, and commissioning of the \$5.8 billion facility to treat and vitrify a significant portion of the waste currently stored in large underground tanks on the Hanford Site. As the owner, the Office of River Protection has developed an organization to oversee the design, construction, and commissioning of the facility. A Federal Project Director is responsible for all aspects of the project, including safety, design, construction, commissioning, and the baseline (scope, cost, and schedule). The Project Director reports to the Manager of the Office of River Protection and recommends changes to the contract requirements, safety basis documents, or the baseline. Approximately 30 engineers, scientists, and other support personnel have been assigned to a unique organization that supports the Federal Project Director in providing oversight of each phase of the project (i.e., design, construction, and commissioning). The organization includes an Engineering Division, a Programs and Projects Division, a Safety Authorization Basis Team, and an Operations and Commissioning Team. This organization is unique within the Department of Energy and provides a focused team to resolve issues of safety, cost, schedule, technical design changes, and construction. This paper will describe this team and show how the Office of River Protection utilizes this oversight team to manage this complex, accelerated project. The size and technical complexity of the facility poses unique challenges for safety, permitting, commissioning, engineering, and baseline control. A robust training and qualification program has been developed that will insure the Departmental personnel working closely with contractor personnel obtain intimate knowledge of the research and technology, engineering, design, and construction operations. In all aspects, Departmental personnel are assessing contractor proposals, design, and construction to ensure compliance with contractual commitments and to ensure the facility will meet long term Department of Energy mission needs.

INTRODUCTION

Beginning in the 1940's, the Hanford Site was utilized for the production of plutonium for the World War II and Cold War era weapons program. At various times, nine reactors and four processing facilities produced and concentrated plutonium that was shipped off site to be used in the program. A by-product of the plutonium production was liquid radioactive waste containing suspended solids which settled to the bottom of storage tanks over time. The waste now consists of sludge, salt cake, and liquid, and is stored in 177 underground storage tanks located in the Tank Farms. Much of the waste requires stabilization for final disposal. The Waste Treatment and Immobilization Plant, or more commonly the Waste Treatment Plant is being built to

stabilize this waste. The Plant will vitrify a significant portion of the waste for disposal either on-site or at an off-site National Geologic Repository. It is the goal of the Department of Energy to complete all vitrification activities by 2028.

In December 2000, the Department of Energy awarded a contract to Bechtel National, Inc. to design, build, and commission the \$5.8 billion facility. The operations of the facility will take place under a follow-on contract. The Waste Treatment Plant complex includes five major facilities: the Pretreatment Facility; the High Level Waste Vitrification (HLW) Facility; the Low Activity Waste Vitrification (LAW) Facility; the Analytical Laboratory; and the Balance of Facility (BOF), consisting of approximately 20 infrastructure support facilities. The Pretreatment Facility is a chemical processing facility which receives the waste from the Tank Farms. The waste undergoes various processing steps such as filtration, cesium ion exchange, and evaporation to allow separation of the HLW fractions from the LAW portion of the waste. The separated waste is then either transferred to the HLW Facility or the LAW Facility. In these facilities, glass formers are added and the waste is vitrified in a high temperature melter. The resulting glass is contained in canisters which are either disposed on-site in the case of LAW canisters or shipped off-site for disposal for HLW canisters. The Analytical Laboratory is used to support the myriad of sampling that occurs during the processing steps for the waste. Although the Hanford Site has other analytical laboratories, a dedicated laboratory is being constructed to support the unique testing required for the Waste Treatment Plant and to provide the faster turnaround time required to meet production needs. The BOF support facilities include electrical distribution, cooling towers, sanitation disposal, and other services common to industrial facilities. Construction is forecast to be complete by the summer of 2008 with a three year commissioning and start-up phase to follow. The plant is expected to be operational by 2011.

As the owner, the Department of Energy is responsible for ensuring the facility is designed, built, and commissioned in a manner that meets the mission needs of the Department. The contracting mechanism being employed is a design-build contract. In order to provide for the appropriate oversight, a dedicated project management team has been assembled with a Federal Project Director and a number of organizations under the Project Director. This organization is unique within the Department of Energy and was put in place in order to streamline reviews and to provide cross-cutting Federal capability to review all aspects of the Waste Treatment Plant. The personnel assigned to the Project must have strong technical capability and a number of unique qualification programs have been instituted to ensure the staff has the knowledge to effectively perform the oversight function.

Federal Project Director

The Office of River Protection has developed a unique organization to oversee the construction of the Waste Treatment Plant. The organization is based on project management concepts and the construction has been designated as a federal project. A Federal Project Director has been assigned with overall responsibility for the design, cost, schedule, and safety of the facility. The

Federal Project Director has the authority to authorize the use of up to \$5 million in contingency funding for changes in design. The Federal Project Director reports to the Manager of the Office of River Protection and recommends changes to the contract requirements, safety basis documents, or the baseline. The Manager has overall responsibility for all aspects of the Waste Treatment Plant and the Hanford Tank Farms. The Manager has the authority to authorize the use of up to \$25 million in contingency for design changes. Any higher amounts must be approved by Headquarters.

To support the Federal Project Director, a dedicated organization has been developed to review all aspects of the design and construction and to analyze the impacts. Under the Federal Project Director, two divisions and two teams provide support: the Engineering Division, the Programs and Projects Division, the Safety Authorization Basis Team, and the Operations and Commissioning Team. Each of these four groups provides support on various aspects of the project. For example, technical changes are reviewed by the Engineering Division, cost and schedule impacts by the Programs and Projects Division, and construction operations by the Operations and Commissioning Team. Although the project is mostly self-contained, some support is provided from other organizations within the Office of River Protection. For example, the environmental permitting interface with the state regulator is supported by the Office of River Protection Environmental Division. An organization chart is shown in Figure 1 and the individual responsibilities of each group discussed further.

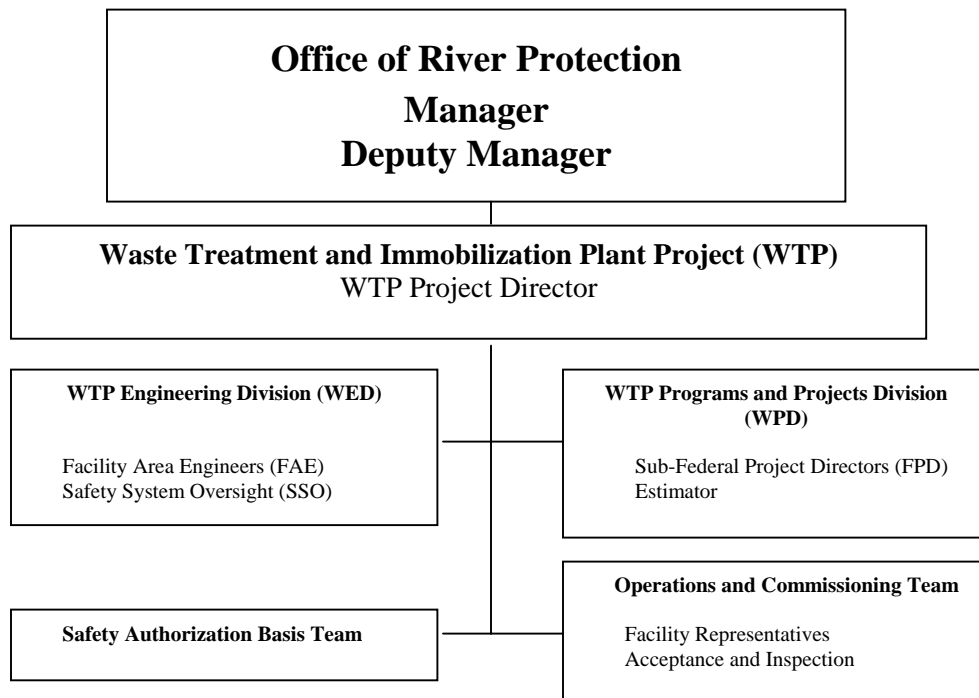


Fig. 1. Department of Energy waste treatment plant project organization chart

Programs and Projects

The main interface organization between the contractor and the Department of Energy for Waste Treatment Plant construction is the Waste Treatment Plant Programs and Projects Division (WPD). Within this division, sub-Federal Project Directors act directly for the Federal Project Director, with a sub Project Director assigned to each of the facilities. The WPD organization is responsible for assessing overall project progress against the baseline for scope, cost, and schedule. It is rare to have more than one Federal Project Director on a single project but due to the size and cost of the Waste Treatment Plant Project, the extra oversight was required.

Federal Project Directors

The Federal Project Director (FPD) position is being developed throughout the Department of Energy. For years, the Department of Energy operated many of its sites through a management and operations contract in which there were a number of Federal program managers that performed oversight of the contractor's activities. With the change in mission at many of the Environmental Management sites, many of the contracts were changed to either closure contracts or in the case of the Waste Treatment Plant, a design-build contract for the new facility. With this, the role of the Federal staff evolved from contractor management to contract management. The program manager was changed to a project director with an emphasis on contract oversight and holding the contractor accountable for completion of contractually required work. Due to the size and complexity of the Waste Treatment Plant Project, the position of sub-Federal Project Director was created. There is a sub-FPD assigned to each of the five WTP facilities with an additional sub-FPD assigned to Site Services functions. The sub-FPD is the primary interface point between the contractor and the Department of Energy and is responsible for providing oversight of all aspects of design and construction for the assigned facility. As such, each sub-FPD is expected to have intimate knowledge of the facility baseline. When issues arise that require assistance, the sub-FPD can call on support from the other organizations such as engineering, safety, environmental permitting, and contracting. These assignments are somewhat atypical within the Department of Energy, as FPD's are usually not utilized for separate facilities within an overall project.

The sub-FPD qualification program is new and has been tailored to this project. In order to become fully qualified, the FPD must pass a functional area qualification in a technical discipline, a project specific qualification, and the Department of Energy project management qualification. The functional area qualification is satisfied through the Department of Energy Technical Qualification Program. The more focused facility specific qualification requires general knowledge of the specific facility. Finally, in order to align the project with the Department of Energy Complex, the sub-FPD's are obtaining a Project Management qualification that focuses on project management skills and is certified by Headquarters. The qualification process is expected to take approximately one year.

In addition to baseline oversight, the sub-FPD interacts with the contractor on a daily basis. The sub-FPD's participate in daily contractor Plan of the Day (POD) meetings in order to understand the day's design and construction activities. Status is communicated to senior Federal management during the Waste Treatment Plant Project POD. An example of the daily

interaction with the contractor is the identification of any Government Furnished Services or Items (GFSI) such as approval of the safety basis, submittals of permit changes to regulatory agencies, and approval of National Environmental Policy Act (NEPA) documents, that are required by the contractor to perform work. Sub-FPD's evaluate the completion of work by the contractor at predetermined milestones. Sub-FPD's determine if the work was satisfactorily completed and provide a recommendation to management on the appropriateness of paying fee. Another important responsibility of the sub-FPD is to perform field walkdowns of the cognizant facility. The purpose of the walkdowns is to verify facility construction matches contractor reported progress. Finally, as the primary point of contact for the Department of Energy for each of the facilities within the Waste Treatment Plant, the sub-FPD is responsible for reviewing all deliverables and correspondence related to the facility and for obtaining input from appropriate organizations such as safety or engineering.

Estimators

The Waste Treatment Plant Project has a dedicated estimator responsible for providing oversight of all aspects of cost and schedule performance for the Project. Where the FPD's have "vertical" responsibility of a single facility, the estimator has "horizontal" responsibility across all of the facilities. An example of an estimator area of responsibility would be to investigate the reasons for a change in project cost or schedule. Traditionally, estimators within the Department of Energy are assigned to central organizations and are matrixed to programs or projects as needed. The Waste Treatment Plant estimator works directly for the project. The project estimator will be qualified by completing a certified cost estimator program and will also complete a functional area qualification through the Department of Energy Technical Qualification Program.

Engineering

A key component in the Office of River oversight strategy for the Waste Treatment Plant is the Waste Treatment Plant Engineering Division (WED). The WED organization is responsible for assessing all technical issues associated with the design of the Waste Treatment Plant and provides direct support to the Federal Project Director and the sub-FPD's. WED is somewhat unique in that it is an entire engineering division dedicated to a single project. In most Department of Energy organizations, engineering is performed by a central organization that supports the projects as required.

Facility Area Engineers

The Facility Area Engineering (FAE) position is a newly developed unique position within the Department of Energy. The FAE is responsible for providing technical oversight of all aspects of engineering and design for the assigned facility. As such, each FAE is expected to have a strong technical background and to be thoroughly familiar with the facility. In order to ensure a proper level of oversight, there is a FAE assigned to each of the five WTP facilities. Traditionally within the Department of Energy, personnel are assigned to facilities and have programmatic responsibilities to ensure contract requirements are being met. Technical reviews are usually provided by matrixed individuals from a central engineering organization. This is

where the FAE differs from historical Departmental oversight. The FAE is dedicated to a single facility and must become qualified on the facility. The FAE qualification program is new and based on the traditional facility representative qualification program. In order to become fully qualified, the FAE must pass a functional area qualification in a subject such as mechanical systems or chemical processing. This qualification is satisfied through the Department of Energy Technical Qualification Program in these disciplines. A second more focused qualification is also required. This is a facility specific qualification requiring detailed and in-depth knowledge of all facility systems and functions. In order to become qualified, the FAE must satisfactorily complete an informal oral knowledge review of each facility system, perform a facility walkdown with management, pass a written test, and complete an oral board with senior Office of River Protection management. The qualification process is expected to take approximately one year.

The FAE day to day work functions can be roughly divided into four areas. First, the FAE attends contractor design and production meetings in order to remain knowledgeable of current engineering issues for the facility. The FAE is expected to participate as needed to ensure the Government, as represented by the FAE, is aware of design decisions and potential technical impacts to the facility. Second, the FAE is responsible for performing field walkdowns of the cognizant facility. The purpose of the walkdowns is to verify the facility is being built as designed. (As a secondary walkdown responsibility, the FAE, as with all Federal staff, performs oversight of construction activities to ensure the work is being performed safely.) Thirdly, the FAE performs focused reviews of different aspects of the design to ensure the facility satisfactorily meets mission needs and complies with contractual requirements. For example, a review was performed of the Pretreatment Facility evaporator systems to ensure they would operate in a manner that meets safety requirements and supports contract deliverables. Finally, as the primary technical point of contact for the Department of Energy for each of the facilities within the Waste Treatment Plant, the FAE reviews all deliverables and correspondence related to the facility. This includes changes in design, cost, and schedule; authorization basis changes; and environmental permit submittals. These reviews are focused on the technical aspects of design and evaluate any impacts, particularly with respect to changes in mission schedule or production goals.

Safety System Oversight

The Safety System Oversight (SSO) position is being newly developed throughout the Department of Energy in response to the recognized need for increased technical capability among federal staff with oversight responsibilities. For the Waste Treatment Plant Project, the SSO is responsible for providing technical oversight of all aspects of safety systems across the entire Waste Treatment Plant. Where the FAE has “vertical” responsibility for a single facility, the SSO has “horizontal” responsibility for a type of safety system across all facilities. Examples of safety systems include confinement ventilation, instrument and control, and hydrogen mitigation. Each SSO is assigned to a safety system functional area such as ventilation, nuclear safety, or chemical processing. Each SSO is expected to have a strong technical background and be thoroughly familiar with the safety systems of each of the facilities within the Plant. Traditionally, safety personnel within the Department of Energy are assigned to central engineering organizations and are matrixed to programs or projects as needed. The Waste

Treatment Plant Project SSO program differs in that the personnel are assigned full time to the Project and report up through the Waste Treatment Plant Project Manager. The SSO qualification program for the Waste Treatment Plant is driven by the Department-wide SSO program. In order to become fully qualified, the SSO must pass a functional area qualification in a subject such as mechanical systems or chemical processing. This qualification is satisfied through the Department of Energy Technical Qualification Program in these disciplines. A second, more focused and rigorous safety system specific qualification is also required. The qualification requires knowledge of the safety systems in all of the facilities applicable to the assigned function. For example, for the ventilation SSO qualification, the SSO must develop a working level knowledge of all ventilation systems that serve a containment function. Note that ventilation systems that do not have a safety function are not included in the qualification program. To become qualified, the SSO must satisfactorily complete an informal oral knowledge review of each safety system, perform a facility walkdown with management, pass a written test, and complete an oral board with senior Office of River Protection management. The qualification process is expected to take approximately one year.

The SSO day to day work functions can be divided into three primary areas. First, the SSO performs focused reviews of different aspects of safety system design to ensure the systems satisfactorily meet mission needs and comply with contract requirements. For example, a review of hydrogen mitigation strategies was performed to ensure that the system will safely eliminate or mitigate the risks associated with hydrogen. In addition, the review identified conservatisms in the design that may be eliminated and allow for a faster processing rate. Second, SSO's review all deliverables and correspondence related to the assigned safety systems. These reviews include changes in design, cost, and schedule; the authorization basis; and environmental permits. These reviews focus on the technical aspects of design and evaluate any impacts, particularly with respect to changes in mission schedule or production goals. Finally, the SSO performs field walkdowns of the cognizant safety systems to verify the systems are being constructed as designed.

Safety Authorization Basis Team

As a government owned, contractor operated facility, the Waste Treatment Plant Authorization Basis (also known as the Safety Basis) is, in effect, the license the Department of Energy grants to the contractor to perform work. All work operations must be allowed by the Authorization Basis. With the importance of this document, a dedicated four person team has been organized to review proposed changes to the Authorization Basis. The primary responsibility of the Safety Authorization Basis Team (SABT) is to ensure the safety of the public and workers both within and outside of the facility by ensuring that all safety analyses performed by the contractor are well documented, accurately describe the work processes, and the implementation does not significantly change the risk associated with operation of the Waste Treatment Plant.

In most Department of Energy organizations, responsibility for review of the Authorization Basis is assigned to a central organization that is independent of the program or line organization responsible for the work. However, partly due to the evolution of the contracting mechanisms used for the construction of this facility, the SABT is part of the line organization and is under

the Waste Treatment Plant Project Director. When initially planned, the construction and initial operation of the Waste Treatment Plant was to be performed through a privatized contract in which the application of Department of Energy orders and regulations would be minimized. Safety oversight was provided through a Regulation Unit that was based more on a Nuclear Regulatory Commission model. Due to increased costs, the privatization contract was cancelled and replaced with a design-build contract requiring more oversight. The Regulation Unit became the Office of Safety Regulation and provided safety oversight in a more traditional manner. Finally, with the realignment of the Department's Office of Environmental Management towards a more project based business approach, a significant portion of the Office of Safety Regulation workscope was transferred to the Waste Treatment Plant Project and the SABB was formed.

The SABB reviews all of the documents included as part of the Authorization Basis. Some examples of Authorization Basis documents include the Safety Requirements Document, the Quality Assurance Manual, and the Preliminary Safety Analysis Report (PSAR). The PSAR was implemented in a phased manner. The initial PSAR analyzed hazards associated with construction of the facility and its approval allowed construction to begin. As the design has progressed, the PSAR has been revised to include analysis of accidents associated with production activities. Once design is complete, and prior to operations, the Final Safety Analysis Report (FSAR) will be issued and approved by the Department of Energy. This document will define the operations that can occur within the Waste Treatment Plant. In order to review and understand the changes to the PSAR, and to approve the FSAR, SABB must have extensive knowledge of nuclear safety principles. As such, all team members are required to obtain a Nuclear Safety qualification through the Department of Energy Technical Qualification Program.

Operations and Commissioning Team

The most traditional position utilized by the Office of River Protection for oversight of the Waste Treatment Plant is the Facility Representative (FR). The FR's are part of the Operations and Commissioning Team. This team is responsible for the daily oversight of the construction activities and includes acceptance and inspection personnel in addition to the FR's. The FR's and inspection personnel spend a significant amount of time in the field observing work and assessing the contractor against applicable regulations and requirements. As with all FR's, a qualification program is required. However, being a new facility, the qualification program is still being developed. Thus, the FR's maintain a qualification from other related facilities and are working to develop a Waste Treatment Plant specific qualification to be utilized during operations. Another key responsibility of this team is the development of a commissioning strategy. A significant readiness activity will be required for the Waste Treatment Plant prior to the Department of Energy issuing an authorization to operate. Because different portions of the facility are completed at different times, a strategy has to be developed for when the Operational Readiness Reviews or Readiness Assessments will be performed. For example, the LAW Facility will be completed prior to the Pretreatment Facility. A key activity will be the hot testing of the melters. However, melters can suffer damage if thermally cycled and it is preferable to continuously operate the melters once heated up. In this case however, because the Pretreatment Facility will not be available to provide waste to the LAW facility, the melters would have to be shut back down until the Pretreatment Facility completes readiness activities. Thus, readiness activities and commissioning would be delayed on the LAW facility, which

poses risks that institutional knowledge will be lost prior to start-up. The Waste Treatment Plant commissioning schedule will be developed as the construction activities near completion.

Process Review

To understand how the entire Waste Treatment Plant Project Team works together, the following example is provided. A key safety concern identified by the SABB was the generation of hydrogen in mixing vessels due to radiolytic disassociation of water and other mechanisms. If not mitigated, the hydrogen concentration in the vessel headspace could rise above the lower flammability limit thus posing a deflagration or explosion hazard. The contractor reviewed the problem and proposed the use of pulse jet mixers to periodically agitate the waste with air, thus liberating any trapped hydrogen. The vessel headspace is swept with a ventilation system to remove the hydrogen. The proposal was reviewed from a number of perspectives. The SABB reviewed the design to ensure the proposal would provide mitigation of the hazard and thus allow safe operation of the facility. The review included investigating which parts of the system were critical enough to require full redundancy and hardening from seismic events. The FAE's reviewed the proposed technical design to ensure it would function as proposed and allow the Plant to meet mission goals. The sub-FPD's and estimator evaluated the cost and schedule impacts for the project. The FR's provided worksite oversight of the construction of vessels containing pulse jet mixers. Finally, the SSO's performed a design review of the mechanisms used for calculating the hydrogen generation rate. All of these groups provided input to the Federal Project Director who presented the proposed change to Headquarters. (The approximate cost of the proposal was \$85 million and thus required Headquarters approval of the use of contingency for implementation). The project received approval to use the contingency funding in late 2004. The team, working as a whole, ensured through a thorough review that the interests of the Government were being protected through this approach.

CONCLUSION

The Waste Treatment and Immobilization Plant Project is one of the most technically challenging and costly environmental projects in the world. The stabilization of a significant portion of the radioactive waste in the 177 underground tanks on the Hanford Site will require vitrification in the \$5.8 billion facility currently under construction. In order to ensure that the mission will be met, the United States Department of Energy Office of River Protection has assembled the Waste Treatment Plant Project headed by a Federal Project Director and supported by a dedicated staff that performs the required oversight functions. The staff personnel are completing extensive training and qualification programs to ensure a strong technical capability. The staff has already demonstrated its ability to review complex problems from a number of disciplines including safety, engineering, cost, schedule, and construction. Once the training and qualification programs have been completed it is expected the staff ability will be increased and be even more effective as the project moves from the construction phase to the commissioning phase in the next few years.