INSTALLATION OF THE SEABROOK RADWASTE SYSTEM

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ABSTRACT

The Seabrook Nuclear Generating Station has installed a fully integrated radwaste system designed to process liquid wastes and dry active wastes. This paper presents a summary of the installation phase of this project including discussions of the unique installation concepts including fixed price contracts employed in completion of the radwaste system installation.

INTRODUCTION

Seabrook Station is a two unit 1150 MWe Westinghouse PWR with a common waste processing building servicing both units. In 1983, Public Service Company of New Hampshire (PSNH) purchased an integrated solid waste management system for Seabrook. The selection process and systems procured were described in a paper presented at Waste Management '84. Equipment deliveries and system installation are now complete and the system is currently undergoing start-up and testing.

SEABROOK SOLID WASTE MANAGEMENT SYSTEM DESCRIPTION

The solid waste management system at Seabrook is a fully integrated radwaste system designed to process the wastes generated by both nuclear units. This system performs the following functions:

a. Volume reduce to the maximum extent practical all liquid and spent resins produced by the generating units.
b. Solidify this volume reduced waste for off-site disposal in accordance with the requirements of 10CFR61.
c. Provide for encapsulation/solidification of non-volume reduced waste such as spent filter cartridges, contaminated tools and equipment, and like items generated during plant operation and maintenance.
d. Volume reduce dry active wastes for on-site storage or off-site burial.
e. Extend existing on-site storage capability for low level waste.

The Seabrook Solid Waste System (see Fig. 1) is comprised of several subsystems. These subsystems are as follows:

1. Waste Concentrates Handling
2. Spent Resin Handling
3. *Liquid Waste Volume* Reduction
4. Volume Reduction and Solidification
5. Container Handling
6. DAW Volume Reduction
7. Alternate Solidification Station

Supplied by one vendor as a single integrated radwaste system, the major process equipment includes a WasteChem VRS™ system using an extruder-evaporator to volume reduce and asphalt solidify resin and concentrates, an HPD crystallizer to concentrate boric acid solutions and provide redundancy for the plant's existing evaporators, and a CGR box compactor for volume reduction of compactible dry active waste.

With the exception of the DAW Volume Reduction System and the Alternate Solidification Station, these systems are all integrated and controlled from two main control panels which are located in a dedicated solid waste control room.

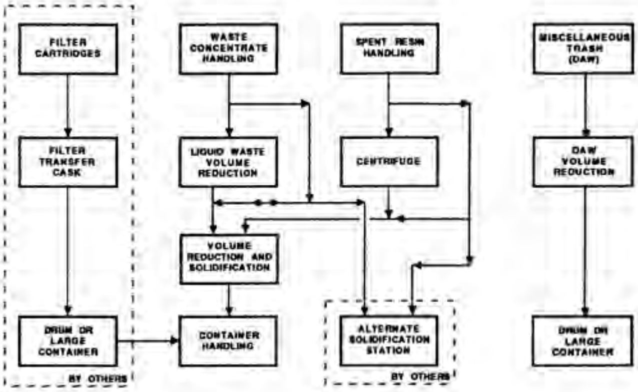

Fig. 1. Seabrook Solid Waste System.

RETROFIT CONSIDERATIONS

The Seabrook Solid Waste System was a retrofit to the extent that the radwaste building, its main interior walls and several original radwaste system components were existing when the new solid waste system was purchased.

The radwaste building had been constructed with the intent of installing a previously purchased urea formaldehyde solidification system. However, after installation of the UF system equipment had already begun, the burial sites began rejecting UF solidified wastes, and the balance of system installation was put on hold. As a result, some of the original UF process equipment and drum handling equipment was in place and required upgrade or removal to accommodate the new solid waste system. In addition, budget constraints demanded that the new system be installed in the existing radwaste building with no external modifications and minimal impact on internal systems and structures.

Figure 2 shows a general arrangement of the radwaste building as originally designed with the UF system. Figure 3 shows the new Solid Waste System in this space.

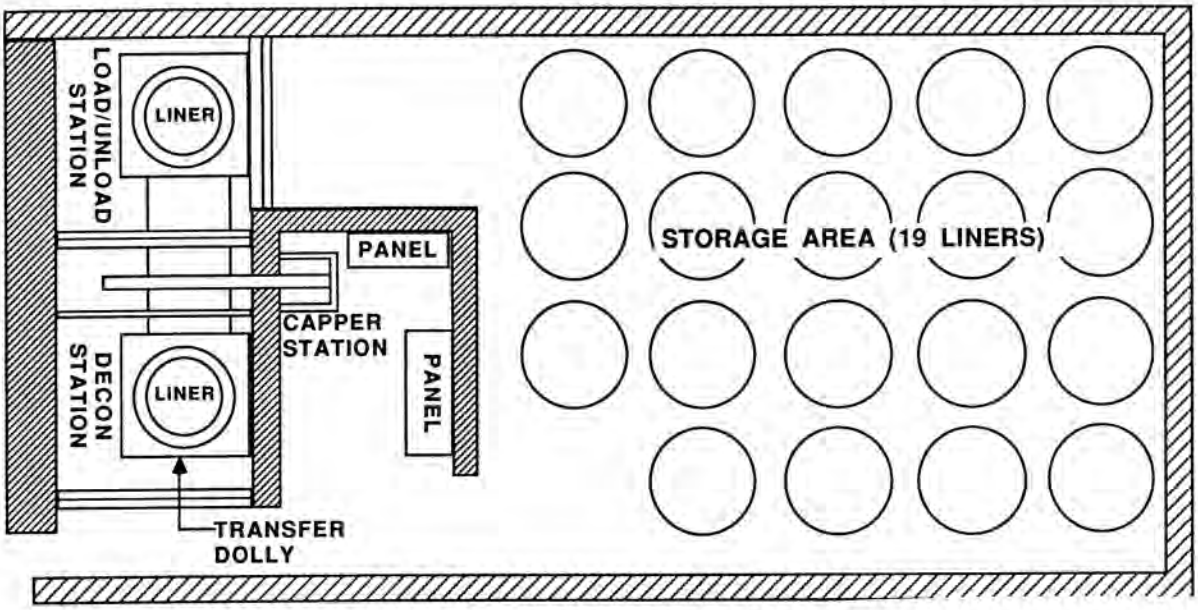

Fig. 2. General Arrangement Drawing Original-Urea-Formaldehyde System at Seabrook.

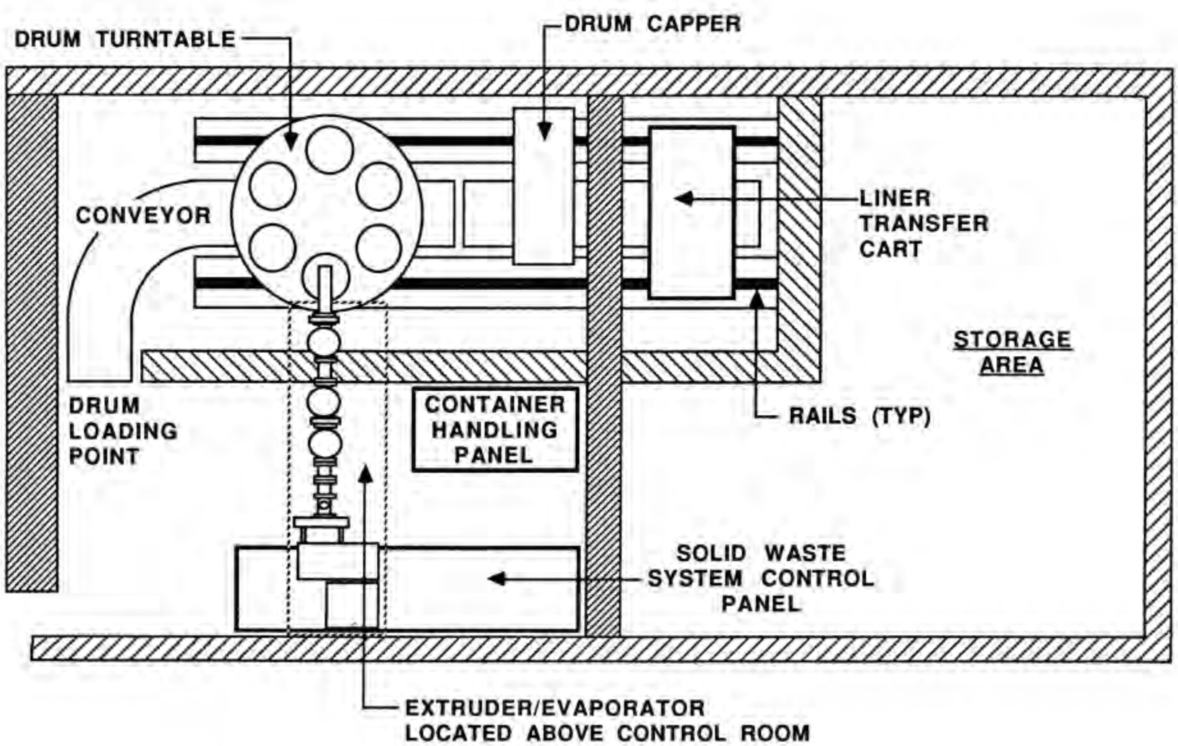

Fig. 3. General Arrangement Drawing-New Solid Waste System at Seabrook.

SOLID WASTE SYSTEM BACKGROUND

In May 1983, Public Service Company of New Hampshire issued a contract to WasteChem Corporation for design and supply of the integrated solid waste management system. Simultaneously, United Engineers and Constructors (UE&C), the plant's architect-engineer, was authorized to proceed with completion of the radwaste building design.

At the time of system selection, the engineering responsibility for the solid waste system was divided between WasteChem and UE&C with WasteChem assuming technical responsibility for the system process design, equipment selection and procurement, and system equipment arrangement. UE&C assumed responsibility for interconnecting piping, pipe support design and electrical interconnection between system components. UE&C was also responsible for the building structural design and related facilities such as HVAC and service systems.

As the project progressed, PSNH imposed stricter financial controls on the Seabrook project. Consequently, a new division was formed, New Hampshire Yankee (NHY), whose sole responsibility was to manage the completion of the Seabrook project. Subsequently, NHY appointed a Solid Waste System Project Coordinator who was solely responsible for managing the entire Solid Waste System project.

Shortly thereafter, NHY and UE&C entered into discussions on a fixed price concept for completion of the solid waste system engineering and system installation. These discussions continued through March 1985 at which time the radwaste system status was as follows:

Activity	Status
. Process design	100% complete
. System equipment deliveries	85% complete
. General Arrangement Drawings	100% complete
. Building structural design	100% complete
. Equipment foundation and mounting details	50% complete
. Piping composite drawings	50% complete
. Piping isometrics	0% complete
. Pipe support design	0% complete
. Electrical interconnect design	0% complete
. Equipment installation	0% complete

FIXED PRICE CONTRACT AWARD

Beginning in March 1985, UE&C entered into a fixed price contract for completion of the solid waste system engineering and installation. In doing so, the primary advantages achieved by NHY were as follows:

- Engineering costs fixed
- Installation costs fixed
- Schedule fixed with 2/24/86 completion deadline

This contract resulted in UE&C's appointment of a dedicated engineering and construction team whose responsibility was to complete the solid waste system installation. In doing so, this contract allowed the remainder of the Seabrook project to concentrate on more immediate project milestone activities.

FIXED PRICE CONTRACT SCHEDULE

The fixed price contract required that all engineering and installation activities be completed within one year from the date of contract award.

In order to achieve this schedule commitment, substantial pre-installation planning was performed including coordination of the engineering and installation efforts and efficient sequencing of construction activities. Critical to this planning was the scheduling of equipment deliveries from WasteChem thereby ensuring an efficient installation effort. In addition, procurement and delivery of piping and electrical materials needed to be performed on accelerated schedules to satisfy the installation requirements. The schedule for completion of the solid waste system installation, as established by UE&C, is presented in Fig. 4.

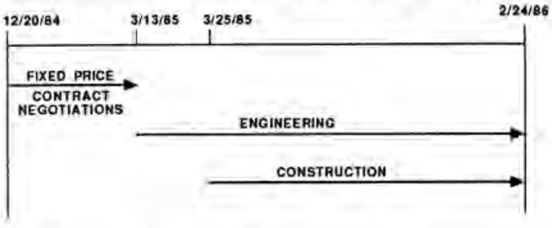

Fig. 4. Solid Waste System Completion Schedule.

COMPLETION OF SOLID WASTE SYSTEM ENGINEERING

During the negotiation process for the fixed price contract, UE&C engineering and construction personnel developed an integrated engineering schedule considering which areas of installation could be worked in parallel. As a result, priority levels were established for completion of engineering design with the requirement that completed designs be issued on a weekly basis. The engineering schedule is shown in Fig. 5.

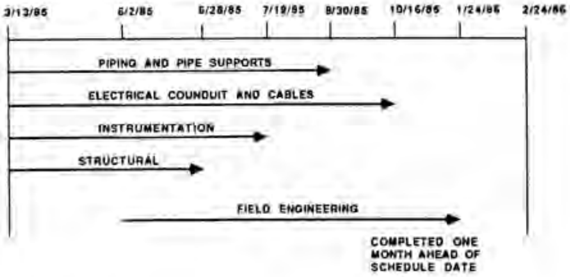

Fig. 5. Solid Waste System Engineering Schedule.

In order to support this schedule, UE&C established a dedicated project team, at its Philadelphia headquarters, that was separate from the overall Seabrook project. Charged with completing the engineering scope of the contract, this project team was directed by a dedicated project manager and included an Engineering Task Leader who was UE&C's responsible engineer for the solid waste system when it was a part of the overall Seabrook Project.

Other key engineering personnel from the original design effort were also assigned to the project team thereby assuring that design continuity was maintained through completion of engineering.

A listing of the engineering deliverables is presented in Figure 6 all of which were developed under the scope of the fixed price contract. The details of completion of these design efforts are presented in the following paragraphs.

Document	Quantity
Piping & Instrument Diagrams	11 (as-builts)
General Arrangement Drawings	12 (as-builts)
Piping Composite Drawings	39
Piping Isometrics	74
Pipe Support Drawings	733
Equipment Mounting Drawings	19
Power Distribution Diagrams	2
Electrical Conduit Drawings	9
Electrical Schematics	236
Electrical Cable Pull/Termination Slips	640
Instrumentation Drawings	9

Fig. 6. Engineering Deliverables

The structural design activities remaining for the solid waste system consisted of equipment support and mounting details. These designs were completed early in the engineering effort to accommodate equipment installation activities.

The piping design activities required completion of the composite piping drawings and development of piping isometrics and pipe support drawings. For the most part, completion of these tasks followed the standard design approach whereby piping composite drawings were prepared and used to develop piping isometrics. These isometrics were then reviewed for flexibility requirements, support locations and material take off requirements. However, in performing these activities, certain tasks received special attention in order to meet the demanding engineering schedule. These tasks are as follows:

A. The cognizant piping designer utilized in development of the piping composite drawing was also made responsible for development of the piping isometrics. In this fashion, continuity in design of the piping arrangement was retained and the final designs proceeded efficiently.

B. Prior to completion of the piping designs, a blanket order for piping materials (pipe and fittings) was issued for purchase. As material take-off's were performed, the required quantities of piping materials were subtracted from the blanket order list and the balance adjusted. When remaining quantities reached the 50% level, additional material was ordered based on the estimated quantities required for remaining isometrics. Pipe support materials were also ordered and controlled in the same fashion. This approach substantially reduced the time required for construction materials to arrive on-site.

C. During the development of the piping isometrics and pipe support designs, a field walkdown was performed to assure the constructability of the piping arrangement and verify pipe support locations. The results of this walkdown were then incorporated into the construction issue of the piping isometric and pipe support drawings. This walkdown program served to resolve potential field interferences and resulted in a more efficient installation process.

The electrical design activities were conducted in parallel with the piping design effort and consisted of electrical conduit design, cable routing and termination information. Cable and conduit routings were performed using an interactive CASP system which provided daily updates for cable and conduit quantities. Cable sizing and type were also determined at this time and the electrical materials were procured.

In-line instrument location drawings and installation details were developed with either the piping isometric or electrical routing drawings, depending on the type of instrument provided.

As the piping and electrical designs proceeded toward completion, UE&C transferred the project team personnel to a dedicated engineering office at the jobsite. The primary purpose for locating the project team at the jobsite was to provide direct support for UE&C's fixed price construction team and to resolve field questions and installation problems in a more expedient manner.

SOLID WASTE SYSTEM INSTALLATION

Initial installation efforts were directed at evaluating the preliminary construction sequence and establishing a detailed construction schedule. This effort provided feedback for engineering schedule adjustments and initiated equipment and material transfers from storage to the radwaste building. The construction schedule is shown in Fig. 7.

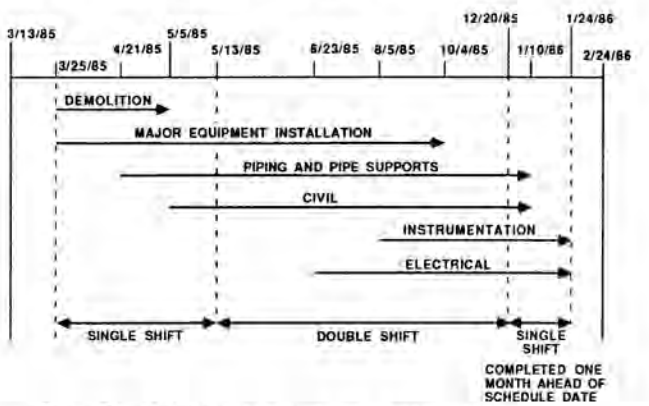

Fig. 7. Solid Waste System Construction Schedule.

The limited workspace and accelerated schedule demands required that two construction shifts be utilized throughout most of the installation period.

The peak workforce is presented below:

Peak Construction Workforce

Craft	1st Shift	2nd Shift
Pipefitters	56	40
Electricians	34	24
Carpenters	16	6
Laborers	15	5
Ironworkers	10	0

Figure 8 lists the equipment and quantities of materials that were used in installation of the solid waste system.

Equipment/Material	Quantity
Extruder-Evaporator	1
Tanks	10
Pumps	12
Skids/Racks	8
Auxiliary Boiler	1
Trash Compactor	1
Conveyors	2
Container Handling Equipment	11
30 Ton Crane	1
Control Panels	4
Electrical Panels	3
Motor Control Center (58 Starters)	1
Substation (13.8 KV to 480V)	1
CCTV Cameras	9
Loose Instruments	100
Piping	9,400 ft (16% large bore)
Pipe Supports	733 (10% large bore)
Electrical Cable	166,000 ft (640 cables)
Conduit	8,000 ft
Air Tubing	1,000 ft
Process Tubing	500 ft
Reinforced Concrete	300 yd^3

Fig. 8. System Equipment and Construction Materials

System installation began with the removal or modification of some previously installed facilities and components. Simultaneously, the major equipment components were sequentially installed in areas that were known to become piping constrained and where structural activities required completion. Once in place, the associated piping and electrical installations were initiated.

Due to the relative equipment locations and the associated process piping geometry requirements, piping and pipe support installation were assigned the highest priority. During this installation phase, the piping and pipe supports were fabricated within the radwaste building in the same area where the pipe was to be installed. In addition, individual pipe fitter crews were assigned work by isometric drawing with each crew installing the piping that they fabricated. This approach eliminated lost time due to crew/task transfers and minimized rework resulting from installation interferences.

This same approach was used for pipe support installation. In addition, permanent pipe supports were installed prior to piping installation, where feasible, thereby minimizing the use of temporary supports.

Installation of electrical conduit received a lower priority since its arrangement was not governed by process requirements and could be field-routed through remaining unoccupied spaces. The crew/task concept was also used for the conduit installation thereby maximizing productivity through familiarization of equipment arrangement and consistency in area conduit routings.

Civil activities, such as asphalt storage building completion, construction opening pour-backs, and equipment foundations and platforms, were sequenced so as not to impact the piping and conduit activities.

Instrument tubing installation was also sequenced so as not to interfere with piping and electrical installation. Also, in an effort to minimize the potential for accidental damage, the installation of instruments and delicate equipment (swipe tools, shield windows, cameras) was deferred to just prior to system turnover to the Start-Up and Test Department.

CONCLUSION

Installation of the solid waste management system has been completed at the Seabrook Nuclear Generating Station. This installation has demonstrated two important results to the industry.

Firstly, this project demonstrates that major nuclear installation projects can be successfully accomplished on a fixed price contract basis.

Secondly, installation of complete radwaste processing systems can be performed on substantially abbreviated schedules. In the case of the Seabrook Solid Waste System, the entire system installation had been completed within an 11 month period. This was accomplished through NHY's aggressive management techniques, UE&C's appointment of a dedicated project team, and mutual cooperation between NHY, UE&C and WasteChem Corporation.