SOLID WASTE PROCESSING EXPERIENCE

AT SUSQUEHANNA STEAM ELECTRIC STATION

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ABSTRACT

This paper reviews the first year's operation at the Susquehanna Steam Electric Station (SSES) with respect to the Westinghouse Hittman Nuclear Incorporated (Hittman) mobile solidification system and the dry activated waste generation, handling and processing. Experiences pertinent to the mobile solidification system are reviewed with emphasis on the integration of the system into the plant, problems associated with unexpected waste properties and the myriad of operating procedures that had to be prepared. The processing history for 1983 is reviewed in terms of the volumes of waste, including solidified wastes, dewatered wastes and DAW. Factors that must be considered in evaluating processing alternatives, i.e., dewatering vs. solidification; steel liners vs. HICs, are discussed. Actions taken by Hittman and SSES to maximize the processing economics are also discussed. Finally, recommendations are provided to the utility considering implementing mobile solidification services to ensure a smooth and timely integration of services into the plant.

INTRODUCTION

In January of 1981, Pennsylvania Power & Light Company (PP&L) contracted with Westinghouse Hittman Nuclear Incorporated (Hittman) to provide mobile solidification services at the Susquehanna Steam Electric Station (SSES), a two-unit 1050 MWe BWR. These services were initiated at the time of plant start-up in July 1982 for the solidification of bead resin, sodium sulfate, and filter sludges consisting primarily of powdered resin and diatomaceous earth. Dry active wastes are handled by plant staff under a rigorous set of administrative procedures which have been extremely successful in minimizing the volume of these wastes shipped to the burial site.

The purpose of this paper is to relate the experiences at SSES as they pertain to the mobile solidification process with particular attention to:

- o The complexities associated with replacing an in-plant system with a mobile solidification system at a large BWR;
- o The progress which has been made in overcoming these complexities at SSES through a close working relationship between the utility and the radwaste contractor;
- o The problems associated with unexpected waste properties immediately after start-up, for example high dirt loading on filters and demineralizers;
- o The myriad of operating procedures, chemistry procedures and supporting data sheets developed prior to plant start-up and the additional procedures developed to handle the unexpected problems as they arose.

First let's look at some of the complexities encountered:

- o The area in which the equipment is set-up was not originally designed for the purpose of housing a mobile solidification system. This was resolved by first deciding to use the waste storage vaults, next to the designated processing area, as the solidification area. This moved both the liner and cement hopper out of the process area leaving more room for the control equipment and pumps. It also eliminated the need for separate radiation shields in which to conduct processing operations. Later the Hittman waste feed control valve was mounted on the wall and a second liner fill head supplied. This allows work on more than one liner at a time. Lastly, the two electrical control panels were mounted on the wall thus freeing up valuable floor space. We later used some of this space for the RADLOK high integrity containers dewatering equipment.
- o New piping had to be routed into this area prior to plant start-up.
- o The installed plant equipment was not intended to supply slurried waste in a mode consistent with the most efficient operation of a mobile processing system. The original design was based on using the concentrated *sodium* sulfate to slurry the contents of the waste mixing tanks to the in-plant solidification system. Since a mobile solidification system can solidify heavier slurries than an in-plant system,

the waste transfer operation was modified. The contents of the waste mixing tank (the backwashes from the radwaste filters) is pumped into the liners and concentrated by either dewatering or decanting. Thus very large volumes of pumpable slurry can be concentrated into comparatively small volumes of sludge. The concentrated sodium sulfate is then added directly to the liner. This required some basic rethinking of the waste transfer methods.

Once the system was set-up and operating, various operational situations arose which required immediate action to prevent serious problems. Typical incidents included:

- o Large quantities of dirt building up on the condensate demineralizer system. This resulted in a waste processing problem in that the resin slurries did not behave at all like normal spent resins. Procedural changes had to be developed and implemented without impacting on plant operations.
- o Filter start-up problems resulted in more frequent backflushes than expected with a corresponding increase in the expected quantity of filter media to process.
- o Due to operational problems and the need to perform work in the phase separator room, the entire contents of one phase separator had to be transfered to 13 disposable liners over a 16-hour period.
- o Oil was encountered in quantities that required processing operations not planned for - procedures had to be written, approved and implemented in a hurry.
- o Heavy requirements for crane availability were handled by training Hittman personnel to operate the crane.

Finally, a myriad of operating procedures, chemistry procedures and data sheets had to be developed. SSES first required a governing Administrative procedure covering quality assurance. This is not an operating procedure in that in itself it does not contain any actual instructions on how to process waste. It does contain the data sheets that are filled out for each liner processed, from the time it is selected for use until it is shipped.

Next were the waste transfer procedures, a total of four, followed by four decanting or dewatering procedures, seven test solidification procedures and six solidification procedures for a total of 21 procedures that were written in plant format. The plant transfer procedures are unique to SSES and had to be developed from scratch. The dewatering, solidification and test solidification procedures were, for the most part, adapted from existing Hittman procedures.

The entire process, including reviews by the Plant Operations Review Committee, took nearly six months of consistent effort, with Hittman dedicating one person virtually full time on-site to this task.

Previous evaluations of the SSES waste streams had predicted that Class B wastes would not be generated for some time. In fact, with Unit 2 coming on line soon, it was felt that the rad levels would stay well below the Class B level through most, if not all, of 1984. However, the change implemented by the disposal site at Barnwell, that the stability criteria be invoked at essentially 1μCi/cc Co-60 rather than the 700μCi/cc limit in 10CFR61, prompted an expedited review of the RADLOK-High Integrity Container procedures. These are currently being reviewed and will be used as soon as possible. The procedures involved include receipt inspection, storage and use, and dewatering.

PROCESSING HISTORY

As a result of efforts by PP&L and Hittman, during 1983 SSES Unit 1 generated a total of only 28,000 cubic feet of solidified waste. The total volume of waste buried in 1983, including several liners solidified in 1982, came to 40,000 cubic feet. This was approximately 5 percent lower than estimated in the Safety Evaluation Report (SER). Dry active waste (DAW) volumes during the same period totalled only 7,000 cubic feet. This was approximately 50 percent of the SER value. The monthly totals and cumulative totals for the solidified waste are shown in Table I. Figures la and b show the monthly volumes of waste shipped to the burial site for solidified wastes and DAW respectively.

As Table I shows, during the first half of the year the processing records for powdered resin and filter sludge were combined. The concentrated sodium sulfate was processed separately. Starting in August, the sodium sulfate was mixed with the filter sludge prior to solidification. This represents a more efficient solidification process and helps maximize the quantity of waste solidified in each liner.

One problem that has not yet been solved has been the presence of chlorides in the evaporator concentrates tank. The maximum chloride concentration permitted is 10 ppm which, in turn, results in lower than desired concentrations of sodium sulfate. Typical concentrations run between 5 and 10 percent while the evaporators were designed for operation at 20 to 25 percent.

It is presently projected that an increase in the concentration of the sodium sulfate to a nominal 20% would result in a decrease of up to 20% in the annual solidified volume of this waste stream.

During 1983, a total of 226 solidifications were performed using both the standard HN-100 and HN-600 in-container solidification liners. While several of the liners could have been shipped as dewatered wastes, other factors relating to transportation made solidification a more cost effective option. For example, dewatering bead resin in a steel liner allows for the disposal of more raw waste per liner than does solidification. However, it is the policy of both Hittman and PP&L that all unsolidified waste be shipped in appropriate transportation equipment, i.e. casks, even though the cask is not required from a shielding standpoint. Therefore, by solidifying the resin it is more economical to send two unshielded solidified liners in one shipment, paying the one way freight for a flatbed, than to pay for two round trip cask shipments.

As the radiation levels increase such that unshielded shipments are no longer possible, the

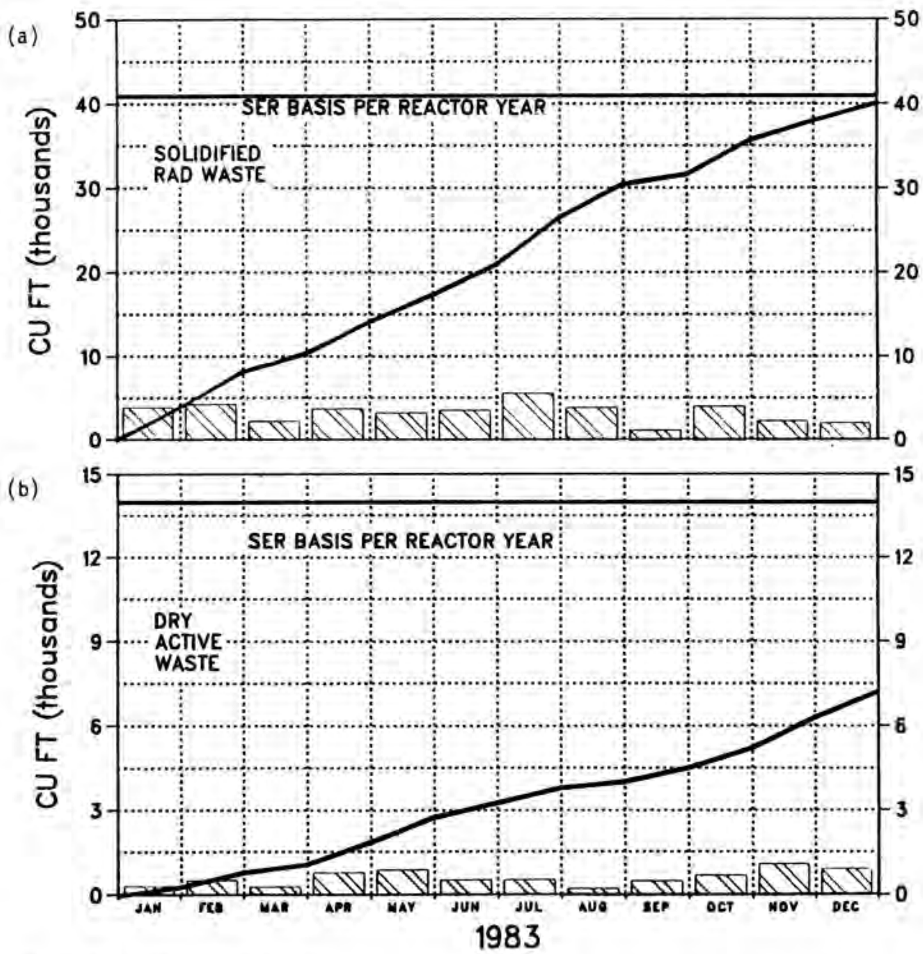

Fig. 1 Solid Radioactive Waste:

(a) Cu. Ft. of Solidified Waste

(b) Cu. Ft. of Dry Active Waste

TABLE I

SOLIDIFIED WASTE VOLUMES

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	TOTAL
Powdered Resin (1)	682					62	0	0	0	0	357	0	
		1523	533	772	346								6516
Filter Sludge (2)	135					955	1151	0	0	0	0	0	
Bead Resin (3)	702	0	127	0	443	302	2636	1230	419	541	820	695	7915
Sodium Sulfate	283	1175	1166	1242	1671	647	855	0	0	1460	0	0	8499
Sodium Sulfate mixed w/1,2 or 3								1682	558	1225	544	1109	5118
Carbon								106					106
TOTAL	1802	2699	1826	2014	2460	1966	4642	3018	977	3226	1721	1804	28154

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economics then convert back to the dewatered waste stream, using HICs as the specific radionuclide concentrations require.

Other steps taken to maximize the processing economics include use of oversized liners to take maximum advantage of the truck weight capacity without exceeding gross vehicle weight limitations or individual axle limitations. We also made a complete re-evaluation of the solidification parameters used at the plant. The original formulations were based on testing performed in support of the in-plant solidification system using Portland Type II cement. Towards the end of last year it was decided to convert the process to a Type I chemistry to take advantage of the higher hydration capability of Type I cement (Portland Type II cement contains up to 20% by weight silicon dioxide) and to be consistent with the Class B waste formulations that would be going into effect early this year. This conversion also provided the opportunity to use waste formulations that accurately modeled actual plant waste streams versus generic waste previously tested.

DRY ACTIVE WASTE

Commencing with fuel load, Susquehanna undertook an active waste segregation effort designed not only to minimize the amount of waste disposed of, but to also ensure a high degree of quality on those packages shipped for burial.

Waste segregation is performed in a prefabricated room within the Radwaste Building. The room is equipped with stainless steel sorting tables, its own ventilation system, and permanently installed air sampling equipment. Dry waste, after being delivered to the sorting area, is hand-sorted by station laborers using G.M. pancake detectors. At this time, recoverable materials are reclaimed, radioactive materials are separated from non-radioactive materials, and materials suspected of containing moisture are removed. The sorted radioactive material is then transferred to an adjoining room for compaction into 55-gallon drums. The compaction process, performed by laborers, is witnessed by a member of the Station Quality Control organization who ensures that no liquids or non-compactible material that could affect the integrity of the package are placed in the drum. Upon completion of compaction, the drum is sealed, numbered, and placed on a pallet to await disposal.

The non-radioactive trash from the sorting is transferred to an adjoining room and resorted by a Sr. Health Physics Technician prior to release from the station. This effort is also witnessed by the Quality Control organization. After this sorting is complete, the waste is re-bagged and labeled with the date and surveyor's name. It is then sent to sanitary waste.

The sorting of trash at SSES has resulted in a marked improvement in the amount of waste disposed of as radioactive. In its Safety Equivalent Report on Susquehanna, the NRC estimated that approximately 14,000 ft^3 of DAW would be generated per unit per year of operation. In 1983, less than 7,500 ft^3 of DAW was shipped for shallow land disposal. This 7,500 ft^3 could have been further improved on by improving the performance of the station compactor. During 1983, the net weight density of compacted waste averaged 28.7 lbs/ft^3. This density was achieved by using anti-springback devices and by paying close attention to the compacting process.

In the coming year, a number of improvements to DAW management are being considered, with the purchase of a new compactor or use of a rented supercompactor a strong possibility. In addition, consideration is being given to enlarging the sorting area in order to provide more work room, as well as to lowering the background in the room. Also, the use of a clean waste shredder may be used in order to allow for the disposal of clean yellow trash.

SUMMARY

In summary, I would like to pass along the following recommendations based upon Hittman and PP&L experience at SSES:

- The mobile services contractor should be brought in on the job early to assist in the development of the Plant's Process Control Program.
- Procedures governing the contractors work should be developed long before those services are implemented, and the contractor should be fully integrated into the development of these procedures. This includes the procedures covering waste transfer, dewatering and decanting, test solidifications, operating procedures and QA procedures.
- The mobile services contractor should be involved in the decison making process involving plant modifications which effect his operations.
- Once radwaste system operations stabilize, a program should be implemented to refine the solidification process parameters to address the plant specific waste streams with particular attention to changes in the physical and chemical characteristics of the waste.
- Carefully evaluate the options - don't assume that dewatering is the most economical disposal method just because more raw waste can be put in a single container. Evaluate the total disposal operation: processing (dewatering vs. solidification), packaging (steel containers vs. high integrity containers), transportation, and disposal.
- Work together - this is the most important aspect of all. By keeping an open dialogue between parties the development of plant specific procedures, the optimization of the solidification and dewatering operations, and the rapid and effective resolution of problems that impact the waste volumes processed can be maintained.

It is only with a work together attitude, proper planning, and foresight by both the utility and the mobile services contractor that many potential problems can be averted before they become real problems.