A PROGRAM FOR VOLUME REDUCTION, PACKAGING AND DISPOSAL OF

ACTIVATED CORE COMPONENTS STORED IN BWR FUEL POOLS

P. Roth
Commonwealth Edison Company

M. J. Hauf, D. N. Enegess
WasteChem Corporation

ABSTRACT

The volume reduction and disposal of discharged Boiling Water Reactor (BWR) core components stored in the spent fuel pools is discussed, including the application of state-of-the-art waste processing and characterization technology. The results of applying these technologies to a fuel pool cleanup project are reduced in-pool processing time and substantially reduced shipping and burial charges to the utility.

The vendor, WasteChem Corporation, employed their Underwater Shear Compactor (USC) technology at Commonwealth Edison's Dresden Station to volume reduce control rod blades and Local Power Range Monitors (LPRMs). Volume reduction yielded substantially more payload per shipment through an increased packaging efficiency. In addition, shipments were optimized on the basis of volume, heat load, Curie content, and shielding considerations to permit the selection of the least expensive cask available for a given type of waste. A description is provided of the following:

1. Project management and coordination among operating departments.
2. 10CFR61 waste classification methodology.
3. Processing and shipping technology.
4. Economic factors.

INTRODUCTION

Over the last several years, utilities have been faced with the problem of decreasing storage space for spent fuel since a fuel reprocessing facility or spent fuel storage alternative is unavailable. In most cases, this problem has been solved with the installation of high density spent fuel racks which allow a plant to store significantly more spent fuel until an alternative is available. However, at certain plants, especially earlier generations of Boiling Water Reactors (BWRs), a large inventory of discharged, activated core components exists, causing significant amounts of space to be unavailable for storing spent fuel.

Faced with limited pool space, Dresden Station anticipated the need and began planning for the removal of activated core components to complete the re-racking of the Units 2 and 3 spent fuel pools. The result was a decision to begin a Pool Cleanup Campaign which would characterize, process, package, transport, and dispose of 93 control blades and over 370 LPRM strings.

Based on the requirements of 10CFR61 for waste nuclide characterization and the tremendous impact that cost and burial volume allocations currently have on a nuclear station, Dresden developed a set of objectives, whereby, if maintained, the project could be completed in a successful, cost effective manner. These objectives were:

1. Select a volume reduction technology which would minimize the volume of waste shipped.
2. Specifically characterize the waste components for disposal in accordance with 10CFR61.
3. Optimize the packaging of the wastes.
4. Maximize communication between working departments and minimize scheduling interferences with other plant operations.
5. Minimize and control project costs.

Dresden Station has successfully achieved these objectives and disposed of the station's inventory of discharged control blades and LPRMs using WasteChem's USC technology and waste optimization methodology. The achievements of this project are further discussed below in the areas of project management, waste characterization, processing and shipping and economic factors.

PROJECT MANAGEMENT

The Project Manager from Dresden interfaced directly with WasteChem's Project Manager and together they coordinated the efforts of their respective working departments to successfully complete the project. The extent of coordination required for a project of this type and size is evident from reviewing the number of organizational elements involved. The following table shows the working departments that existed under the station and the contractor:

Dresden Station

- Project Manager (Technical Staff - Nuclear Group)
- Fuel Handling (Operations)
- Radiation-Chemistry
- Waste Systems Engineering
- Quality Assurance
- Quality Control
- Corporate Radwaste
- Corporate Station Nuclear Engineering

WasteChem

- Project Manager
- Fuel Pool Services Engineering
- Corporate Engineering
- Field Supervisors
- Field Technicians
- Various Subcontractors

Although this project is one of the largest pool cleanup campaigns to date, neither the number of involved organizations nor the types of required activities change with the project size. The scheduling of activities and communication among working departments are critical in a Pool Cleanup Campaign and frequent project meetings were held during the early phases of our project. The result of these discussions was a detailed schedule and delegation of responsibilities which were formulated by the Project Managers and distributed to each working department. Any changes to the schedule were handled in the same manner. A simplified version of our schedule is shown in Fig. 1. In accordance with one of our objectives, we felt that this schedule presented an optimum approach to completing the job while minimizing any disturbances to other station activities. The schedule for a project such as this can be interpreted as having three major categories:

1. Preparation (planning, site training, procedure development, and waste characterization).
2. Processing and Packaging.
3. Shipping and Disposal.

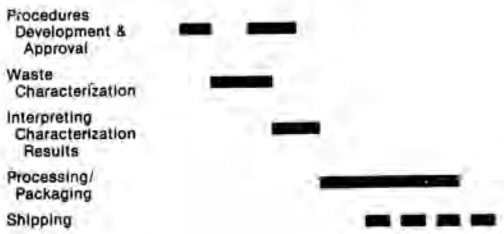

Fig. 1. Sequence of Project Activities.

Although the duration of each category will change with the project scope, the preparatory phase must be a significant portion of a Pool Cleanup schedule. An interesting feature to this schedule is that approximately 40% of the work on this project is dedicated to preparatory activities before any equipment is brought on site to begin processing the components. Specifically, waste characterization is required to be performed as early as possible since the results of the analysis have an overwhelming impact on the remaining activities in the schedule. We feel that our emphasis on preparation is one of the major reasons the project succeeded in meeting our objectives.

WASTE CHARACTERIZATION

Waste characterization and classification are performed for the following reasons:

1. To meet the requirements of 10CFR61, 10CFR71, and 49CFR173.
2. To define a logical, optimum sequence to the processing of the components.
3. To realize a substantial overall economic benefit on the project.

There are several accepted methods for the characterization of activated core components. For the Pool Cleanup Campaign at Dresden, *characterization by direct* measurement was performed using SAIC's QuantiScan system. The system consists of an on site quantitative gamma spectroscopy, sampling of components, radiochemical analysis of the samples, and evaluation of nuclide data to determine scaling factors, curie concentrations, and component waste classifications. This allows waste classification to be determined by basing it on actual nuclide concentrations and reduces the number of conservative assumptions which are used in purely calculational methods.

This is especially important for highly activated components such as control rod blades and LPRMs. Therefore, the use of this methodology can provide the following direct benefits, each having a significant economic impact on the total cost of the project.

1. Increased confidence in knowing the actual nuclide content of the waste and therefore the accuracy of the waste classification.
2. Reduced curie concentrations result in potentially lower waste classification.
3. Allows optimization of cask selection.
4. Reduced curies per shipment results in lower disposal costs.

A typical set up of a QuantiScan system at the side of a spent fuel pool is shown in Fig. 2.

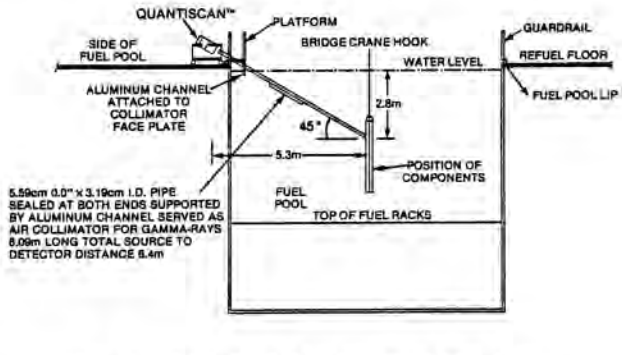

Fig. 2. Fuel Pool Set-Up and Gamma-Scan Geometries.

PROCESSING AND SHIPPING TECHNOLOGY

The processing of highly activated core components requires careful planning to achieve the minimum processing time while ensuring that the components are packaged in an efficient, optimum manner. After the results of the waste characterization study are obtained, a detailed review of the data is performed. All of this information is input to the contractor's waste optimization methodology and a processing and packaging scheme is determined for the components. Three major components of the processing phase of the project are discussed below.

Documentation

The most extensive documentation requirements for the Dresden Pool Cleanup Campaign (also true for similar projects), were the development and approval of site-specific procedures for the control of project activities. Both Dresden and WasteChem personnel worked closely in developing station specific procedures for characterization, processing, and shipping of the activated components which were approved by the station's On-Site Review Committee. The sequence of project activities (generalized in

Fig. 1) requires that waste characterization procedures be submitted almost immediately after contract award to permit the in-pool characterization activities to begin and the results to be obtained as soon as possible. Other procedures can be submitted and approved as a parallel effort to the characterization work or as they are required by the project schedule.

The need for careful record keeping to support the formulation of shipping documents cannot be over-emphasized. Waste component inventories were established, and reviewed daily, to track all waste materials placed in each cask liner and maintain a corresponding curie inventory. These records were routinely compared with the original packaging plan established for the project to ensure compliance and make any required changes to the project plan.

Equipment and Tools

Equipment used on this project included the USC, LPRM cutter, underwater grapples, manipulators, liners and various tools for maintenance and cask operations. The number and variety of equipment used on this project required that inventory records be maintained for accountability. In addition, consideration must be given to establishing load paths and documenting safe support and positioning of the major equipment within the pool.

Personnel

WasteChem field supervisors and technicians established interface relationships with the CECo Project Manager, the station's Fuel Handing Department, and the Radiation-Chemistry Department. Crew sizes, shift length, and number of shifts varied for the different jobs on the project and were determined by schedule considerations, station operations, and personnel availability. In general, work was performed 5, 6, and 7 days per week and one 8 or 10 hour shift with a crew of 7 to 8 people (station and contractor combined).

ECONOMIC FACTORS

Of all the costs associated with a pool cleanup campaign, the three major contributing factors are transportation costs, disposal costs (particularly curie surcharges), and processing time. An underlying theme of completing the project in the most economical way ran through all of the station's objectives. As a result of our efforts and the use of volume reduction techniques, Dresden Station has realized a reduction in the number of shipments and the amount of disposal charges by at least 60%.

CONCLUSIONS

The following results, observations, and recommendations can be made based on our experience with executing a pool cleanup campaign:

1. Planning and Coordination - A project such as this is a complex endeavor requiring numerous parties to work together as a team to complete the various activities. The planning and set-up phase of this project represented 40% of the total project schedule and was a major factor in the successful completion of the Dresden Pool Cleanup Campaign.

2. Waste Characterization - A number of techniques are available for the characterization of activated core components. The selection of a method should consider the confidence level achieved as well as the expected impact on disposal costs. The project schedule must permit the early completion of data gathering for the components and the interpretation of the results.

3. Processing and Shipping Technology - As a result of this project, it has been demonstrated that a volume reduction technology can be used successfully to significantly reduce the number of shipments and disposal costs of activated core components stored in BWR spent fuel pools.