DEWATERING OF BEAD AND POWDERED RESIN AT THREE MILE ISLAND UNIT 1

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ABSTRACT

In an attempt to standardize a disposable shipping container for dewatered powered resin and bead resin utilized at Three Mile Island, a systematic program was developed to approve a shipping container. The container in addition to meeting the free-standing dewatering requirement of 0.5% of waste volume or one gallon, which ever is less, had to meet minimum design process capabilities of 25 gallons per minute during resin transfer operation.

Specifically, the program resulted in:

a. Container definition to be used with commonly supplied casks.

b. Design and fabrication of a mobile dewatering skid.

c. Design and assembly of the dewatering internals for the container.

d. Assembly instructions and procedures for equipment operation and dewatering.

e. Procurement of hardware.

f. Equipment assembly.

g. Equipment set up and check out.

h. Process control plan.

Considerable manpower and cost benefits will be realized by having this in-house radwaste dewatering capability because vendor services will be eliminated and the quantity of radwaste liners, shipments, burial fees and burial space will be reduced.

INTRODUCTION

As a precautionary measure, an expanded secondary water treatment system was installed at the plant. This water treatment capability for the secondary side of the once through stream generators will, in the presence of primary to secondary leakage, result in increased spent powered resin wastes generation and subsequent costs for packaging, transportation and disposal. Since the waste generated would be regarded as radioactive waste, it was realized that effective processing and packaging of these wastes would minimize disposal costs. Furthermore there is a desire on the part of GPUN to realize the benefits of in-house processing of radwaste. It was decided that a good starting point would be to develop a GPU Nuclear dewatering program for powdered and bead resin waste streams. A test program was developed which was designed to verify compliance with dewatering criteria for free-standing water (one gallon in the case of a 6' x 6' liner) and maintain a minimum process capability of 25 gpm for Three Mile Island Nuclear Station Unit 1.

HARDWARE DESCRIPTION

The hardware developed in this program consists of containers with dewatering internals, a fill/dewatering skid and a visual fill status package.

A commonly used container design throughout the nuclear industry is a 6' diameter x 6' high metal container (nominally 170 cu. ft. internal capacity) with adaptability to a variety of internal designs for various process streams. This type of package provides a cost effective package with minimum handling and transportation requirements as opposed to a smaller container. The container can be readily transported to burial facilities in existing available shipping casks.

The particular dewatering liners designed in this program are fabricated from high carbon steel and are equipped with all lifting slings, dewatering internals and penetrations. All welding is done in accordance with AWS D1.1. The minimum loading capacity for the liner is specified to be 12,000 lbs. The design incorporates the false bottom liner and pancake verification element design developed by GPUN for the Epicore II system. The container conical bottom is sloped to the center of the liner. A manway mounted on the liner top is a standard 55 gallon drum closure opening. The liners are subject to hydrostatic, liquid penetrate and air pressurization tests at appropriate steps of the fabrication. The liners are coated inside and outside. The liners also are labeled as per criteria as specified to the fabricator.

The fabricator is required by GPUN to have a quality assurance program that meets 10 CFR 71 sub-part H. Inspection at the fabricators shop is documented by the Vendor Surveillance and Inspection form. This extensive (30 major check a items) sign-off document covers all the material specification, documentation, approval, fabrication, testing, acceptance and verification aspects of liner manufacturer. Each shipment of liners must have a certificate of conformance certifying that the liners comply withthe GPU Nuclear Specification for Liner Fabrication, associated drawings, applicable codes, standards and procedures. The plants have an Inspection Surveillance Plan for receipt inspection upon delivery which covers methods of verification and acceptance criteria.

The dewatering skid was designed to process liquids from the 6' x 6' liner to a sump during the resin sluice operation at minimum flow rates of 25 gallons per minute. The skid is also utilized for final dewatering and verification in meeting the criteria of free standing water in the liner.

The skid contains ball valves, air operated pumps, flow glasses, an air operated valve, air lines, flush lines and quick disconnects. The skid was fabricated in accordance with ANSI B31.1. All fabrication and material specifications of the components are in accordance with ANSI B31.1. In order to contain spillage when connecting and disconnection hoses, a drip pan was built as an integral part of the piping skid.

The controls for the air operated valve, pumps, level control and level monitoring are all located on a central control panel.

The internal design for the container was based on achieving two objectives. The container internals must be able to process water at a minimum flow rate of 25 gpm. The container internals must allow dewatering of the liner resulting in one gallon or .5% by volume of free-standing water, whichever is less. In the case of a 6' x 6' liner, this is one gallon.

These design conditions were met utilizing commercial grade filters. The flow achieved through these filters is 12-20 gallons per minute per 40" element. Three sets of three filters, 40" long (9 elements total) were installed into the liner at three different elevations to maximize water removal. The internals provided for the liners are of a commercial grade and no special quality inspection or documentation is required. Installation of the internals is in accordance with specification drawings. Inspection of the installed internals is used to verify their conformance to the design drawing.

There must be a means available to verify that compliance with the dewatering criteria has been satisfied. This design condition was met by installing five "pancake" type dewatering elements on the sloped bottom which are utilized only after the dewatering process is completed. These elements are made with 100 mesh wire screen design "pancakes" with external vacuum connections which will allow detection of free-standing water.

The liner must be capable of absorbing any water released by the resin during handling and transportation. This design condition was met by utilizing a false-bottom compartment filled with absorbent material. Its function is to absorb any water and moisture entrapped in the resin which is released during transportation due to vibrations. The design must be such that water does not enter the lower compartment during normal operation. The liner design contains the sloped bottom with a false compartment which was utilized previously at Three Mile Island Station 2.

In order to view and verify levels inside the 6' x 6' liner, a television camera with monitor and control functions for close-ups are mounted on a plexiglass top on the liner's manway penetration. This provided the operator with information as to consistency of the waste entering the liner, and a remote visual level indication in situations where the automatic control panel functions are bypassed.

DEWATERING TESTS

The first dewatering test involved the utilization of 123 cu. ft. of dry bead resin which were added to a dewatering liner. Water was then added and recirculated through the liner to simulate actual condition of water flow and resin compaction in the liner. A total of one hour was required to remove all water from the liner prior to start of the dewatering process. The liner dewatering process started and was completed within three days. Verification of free-standing water criteria was done four days after the dewatering was completed. A total of 0.62 gallons was removed.

The second dewatering test utilized approximately 125 cu. ft. of powdered resin. The process logic is as follows. The station tank, which contains spent resin, is valved to drain to the 6' x 6' liner. A reusable level probe on the liner signals the air operated valve on the dewatering skid to open. When the water level rises to the level probe, the valve begins to modulate to control liner water level within a preset span. Introduction of air to the pump (Controlled from the panel) initiates the start of water removal from the liner. This continues until the plant tank is empty or processing stops due to a full liner. Dewatering in accordance with the approved procedure is then commenced.

The powdered resin was initially used in the plant filter/demineralizer system during plant system testing of the secondary ride clean-up system and, consequently, was sluiced through actual process conditions to the 6' x 6' liner. Water was removed from the liner at a rate of 110 gallons per minute while inlet flows to the liner from the phase separator tank were approximated at 100 gallons per minute. Achieving this condition minimized lengthy water removal requirements normally associated with dewatering of powdered resin. The operating performance of the pumping skid and the liner internals indicated that its capabilities exceeded design specifications. A total of one-half hour was required to remove all the water from the liner prior to start of the dewatering process. A total of three days were required to load and dewater the resin. A total of 0.0026 gallons was removed after the dewatering test was complete.

CONCLUSIONS

The dewatering verification program was completed with the results that the processing and dewatering capabilities achieved met the required objectives.

Based on the results achieved during the verification program, future consideration of eliminating the absorbent materials compartment, thereby reducing fabrication costs will be reviewed based on operational experience.