

BYRON STATION PROCESS CONTROL PROGRAM  
CEMENT SYSTEM

A. STATEMENT OF APPLICABILITY:

The purpose of the Byron Station Cement Process Control Program is to establish the process parameters which provide reasonable assurance of complete solidification of various radioactive "wet wastes" including resin slurries and evaporator bottoms in accordance with applicable Department of Transportation (DOT), Nuclear Regulatory Commission (NRC), State and licensed burial facilities acceptance criteria for packaging and shipment to an approved burial site. Compliance with these criteria will be achieved through implementation of the PCP and related Byron Procedures.

B. REFERENCES:

1. The following references contain commitments for cement PCP and 10CFR61 implementation.
  - a. Byron Technical Specifications
    - 1). Section 3/4.11.3, Solid Radioactive Waste System
    - 2). Section 6.7, Process Control Program (PCP)
  - b. Byron Procedures
    - 1). See Attachment B
  - c. Commonwealth Edison Program for Implementation of 10CFR Part 61 and 10CFR Part 20.311 Dated: 22 Dec. 83
  - d. Commonwealth Edison Quality Assurance Manual
  - e. 10 CFR Part 20.311, Transfer for disposal and manifests
  - f. 10CFR Part 61, Licensing Requirements for Land Disposal of Radioactive Waste
2. The following references are utilized in this PCP for information only.
  - a. NUREG 0133, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants - Oct. 1978
  - b. Byron/Braidwood Final Safety Analysis Report
    - 1). Section 11.4 Solid Waste Management System

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C. MAIN BODY:

1. Byron Solidification System Description.

Byron utilizes a permanently installed radwaste solidification system supplied by Stock Equipment Company. This system has been designed with numerous features to provide process control for reasonable assurance that waste is solidified with no free standing water. Section 11.4 of the Byron/Braidwood Final Safety Analysis Report (FSAR) gives a general description of the operation of the solidification system and notes the various process control features. The solidification system is operated by Byron personnel in accordance with approved Byron Station Procedures.

2. Characteristics of Byron Solidification System Feeds. Wastes are solidified in the Byron cement system from two sources:

- a. Spent Resin Tank. The spent resin tank receives ion exchange bead resins from the blowdown, radwaste and letdown mixed bed demineralizers and boron thermal regenerative, letdown cation bed, spent fuel pit, recycle evaporator feed and recycle evaporator condensate demineralizers. The resins are discharged to the solidification system or a Commonwealth Edison Company (CECo) approved vendor solidification system after appropriate recirculation, sampling and analysis.
- b. Concentrate Holding Tank. The Concentrate Holding Tank receives concentrates from the boric acid recycle evaporators and radwaste evaporators. The concentrates may consist of demineralizer regenerant wastes, floor drain wastes, recycle evaporator concentrates, equipment drain wastes, laundry wastes, and chemical drains. After appropriate recirculation, sampling, and analysis, concentrates are transferred to the permanently installed or a CECO approved vendor solidification system. In the future they could also be transferred to a fluidized bed drier. This process is described in a separate PCP.

3. Solidification Formulas.

- a. Byron solidification formulas. Specific formulas for each type of waste are incorporated into Byron operating procedures BOP WX-32 and BOP WX-38. The formulas include the required amount of cement, the amount of waste, slurry settling and mixing times, and in-drum mixing times. Process control parameters for each drum of waste are recorded, and reviewed per Byron Operating Surveillance (BOS) - 11.3-2 to verify that the proper solidification formulas have been used.

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- b. The formulas for Byron spent resin should remain relatively constant. When these formulas are first used on actual Byron wastes, an initial waste drum(s) will be opened and visually inspected to assure proper solidification with no free-standing water. The formulas will be modified if necessary to provide solidification. Thereafter, waste drums will be periodically opened and inspected to verify solidification as part of the Byron surveillance program.
- c. The Byron operating procedures provide for the sampling and analysis of each batch of concentrate waste. The solidification formulas for each batch of waste are based on the boric acid content and the total solids content of the batch sample. Graphs and instructions are provided in the operating procedures. When a formula is first used to solidify a batch, an initial waste drum(s) will be opened and visually inspected to verify solidification with no free-standing water. The formulas will be modified if necessary to provide solidification. Thereafter, waste drums will be periodically opened and inspected to verify solidification as part of the Byron surveillance program.
- d. New Byron solidification formulas may be developed and added to the operating procedures to optimize drum radiation levels, waste processing, or to accommodate changes in the waste stream characteristics. For new formulas, an initial waste drum(s) will be opened and inspected to verify proper solidification with no free-standing water. The formulas will be modified if necessary to provide solidification. Thereafter, waste drums will be periodically opened and inspected to verify solidification as part of the Byron surveillance program.
- e. The Byron solidification formulas are provided in Attachment A. The formulas provide solidification within the following tolerances for waste and cement quantities;

Cement	± 5%
Slurries	± 10%
Evap. Wastes	± 5%

NOTE: Should variation in waste and cement occur for the same drum, the limits of acceptability for each ingredient is half of that shown above.

#### 4. Administrative Controls On Byron Solidification.

- a. Use of Procedures. Approved station procedures are used to implement the Byron PCP and applicable DOT, State, NRC and burial site acceptance criteria. The station procedures address the following aspects of implementation:
  - 1). Step-by-step directions are provided for operation of the solidification system.
  - 2). Solidification Formulas are provided for each Byron Waste Stream.

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- 3). Each waste container is assigned a unique identification number. Operational parameters are recorded for each container per the checklist in procedure BOP WX-38.
  - 4). The container operational parameters are reviewed per operating surveillance BOS 11.3-2 to verify that the drumming formula was followed.
  - 5). Waste containers are periodically inspected per operating surveillance BOS 11.3-1 to verify solidification with no free-standing water.
- b. Station Procedures which implement the Process Control Program are listed in Attachment B.
  - c. At least one batch of solidification waste in ten batches of each waste type will be tested to verify solidification. The test consists of removing a container cap 24 to 72 hours after mixing and inspecting for the presence of free-standing water. If any visible free-standing water is detected that cannot be attributed to operator error, system malfunction, or resolved by station evaluation, further solidification of that type of waste will be suspended until the waste solidification formula is modified and verified. Inspections will be performed prior to shipment of the solidified waste.
  - d. If any test of a batch fails to verify solidification, the succeeding batches of the same type of waste will be tested until 3 consecutive batch tests verify proper solidification.
  - e. A batch shall consist of a particular amount of wastes requiring solidification (ie., the amount of waste content within a tank requiring solidification, or, the amount of waste content within two tanks requiring solidification if the contents of the two tanks are to be solidified together within a common drum). If new material is added to a tank's contents which is currently being processed, a new batch is created and further sampling must be performed prior to solidification.
5. Control of Process Parameters Which Could Affect Byron Solidification.
- a. Cement Type. Type 2 Portland Cement is used as the solidification agent at Byron Station. The cement is certified by the suppliers to meet the specifications of ASTM C150. Plant inspection of cement shipments will verify proper certification.
  - b. pH of Waste Stream. The recommended range for waste stream pH is 7 to 9 inclusive.
    - 1). The batches of wastes are sampled and analyzed for pH. This pH may be adjusted prior to solidification if it is found outside of the recommended range.

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- c. Solids Concentration and Type of Waste
- 1). Byron operating procedures BOP WX-32 and BOP WX-38 provide formulas for each specific waste stream. The parameters for the waste containers are reviewed per BOS 11.3-2 to verify that the correct formulas were used for the type of waste solidified.
  - 2). Waste batches are sampled and analyzed. The formulation used to solidify a particular batch is based on the boric acid content and measured total solids content. When a particular formulation is first used, an initial container(s) of solidified waste is inspected to verify solidification without free-standing water.
- d. Slurry Settling times (Decanting Tanks). In order to obtain a consistent slurry, the Byron operating procedure BOP WX-38 provides specific settling times. The recommended range is 30 to 60 minutes for bead resins which are used at Byron.
- e. Drum Mixing Times. The Byron operating procedures specify drum mixing times for each waste type. The mixing times are automatically controlled by adjustable timers. Recommended mixing times vary with waste type in a range of 10 to 17 minutes.
- f. Solidification (Set) Time. A range of 24 to 72 hours is recommended to assure solidification of wastes.
- g. Concentrate Waste Temperatures. A concentrate waste temperature range of 120°F to 160°F is recommended and is monitored with a thermocouple. In the event of waste temperatures exceeding 160°F, the waste metering pump is tripped.
- h. Resin Slurry Temperature. The recommended temperature range is 40°F to 130°F for resin slurries. Due to the indoor location of this waste stream, these limits are not expected to be exceeded.
- i. Presence of Oil in Waste Streams. Solidification tests performed by Stock Equipment Company involving typically encountered oil types indicated that up to 1% concentrations (by weight) do not adversely affect solidification. Byron samples waste stream sources to the solidification system for organics per Byron procedure BAP 599-35. This establishes guidelines below the limit of 1%. In addition, solidified Byron waste is periodically inspected to verify solidification per Byron operating surveillance BOS 11.3-1.
- j. Maintenance of Cement Quality During Storage. Cement used for solidification is stored indoors in an atmosphere controlled by plant ventilation. This provides reasonable assurance that cement quality will be maintained.

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- k. Type and Condition of Solidification Containers. New solidification drums are inspected to verify adherence to DOT specifications. The inspection may include verification that drum wall thickness is within tolerance and that seams are tight. Prior to loading with cement and waste, each drum is inspected to verify the absence of unacceptable dents and holes and the presence of the required "Radioactive LSA" markings. The inspection also verifies that a 4-inch cap and gasket are installed in DOT 17C drums.
  - l. Water to Cement Ratio. The recommended range for the water to cement ratio is 0.4 to 1.0 and varies with the waste stream. This ratio is controlled by formulas included in the operating procedures.
  - m. Equipment Parameters. Equipment parameters such as alarms, monitors and interlocks are required to be functional during the solidification process. Key parameters are visually displayed on the control panel. The operator verifies the absence of annunciator alarms prior to commencement of the solidification process.
6. Shipment Of Solidified Waste and 10CFR61 Implementation.
- a. Waste Classification
    - 1). Waste Classification of Solidified Waste. Based upon isotopic analysis and scaling factors, each processed barrel is classified to meet the requirements of 10CFR 61.55. This classification is performed per procedure BRP 1540-1, "Classification of Radioactive Waste for Near Surface Burial."
    - 2). Isotopic Analysis of Resin and Concentrates. The spent resin and concentrate holding tanks are sampled on a batch basis and are analyzed for gamma-ray emitting radionuclides using gamma-ray spectrometry. The relative concentrations of non-gamma ray emitting radionuclides and transuranic radionuclides are based on either calculational methods, available analytical results, or a combination of calculational methods and analytical results. Available analytical results are combined to establish the relative radionuclide concentrations. (Byron Administrative Procedure BAP 599-54).
    - 3). Waste stream sample analysis will be performed on an annual basis. Based on the results, calculational methods will be updated as required.

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- 4). To allow for the contingency that a plant operational change could result in a significant change in the radionuclide composition of a specific primary waste stream, we will examine the results of such analyses as follows: If such analyses indicate a greater-than-1E02-factor change in the concentration ratio of any two major (greater than 1%) contributors, we will send an appropriate sample to a commercial laboratory for further analyses as indicated above.

b. Waste Characteristics

- 1). The minimum requirements of 10CFR 61.56(a) will be met for all classes of waste to which these requirements apply.
- 2). Solidified waste will meet the intent of 10CFR56(b)(1), waste structural stability requirement.
- 3). Waste Form. The cement solidification system operated according to site procedures ensures consistent production of a fully solidified product with not more than 0.5% liquid which meets the stability requirements of 10CFR 61.56(b)(2). Vendor solidification services, when utilized must:
  - a). Be on the CEC approved bidders list.
  - b). Utilize either cement, vinyl ester/styrene, or asphalt, and
  - c). Have initiated an NRC approved waste form testing program.
- 4). Void Space [10CFR 56(b)(3)]. This program does all that is reasonably possible to eliminate unnecessary void spaces within the waste packages. However, to ensure production of a stable waste form, void spaces are left within each container. Such void spaces are necessary to allow for proper mixing of the stabilization medium. Therefore, processing does not eliminate void spaces to the extent that our ability to produce a stable waste form within a container is compromised.

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- c. Curie Content of Solidified Waste. The curie content of each processed barrel is determined using conservative calculations and established dose-rate-to-curie conversion factors. Procedure BRP 1520-2, "Curie Content for Common Radioactive Shipping Containers" is used to perform the conversion.
- d. Prior to shipping, drums are inspected for removeable contamination and general condition. Drums found to be damaged will be placed in overpack drums prior to shipment off site. Operating procedures ensure the minimum requirements of 10CFR Part 61.56a are implemented and strong tight containers are used for disposal.

- e. Expended cartridge-type filter elements. Filter cartridge-type elements are not normally expected to exceed the Class A criteria of 10CFR Part 61.55. In general, the station does not intend to stabilize filter cartridge waste packages. However, some filter cartridges might be processed using one of the installed or a vendor-supplied solidification system. Such packages will be characterized as unstable for the purposes of 10CFR Part 61.56(b). Alternatively, Byron might package spent filter cartridges in high integrity containers (HIC) for disposal.
- f. Labeling. Labeling is accomplished per procedure BRP 1520-1 to implement the requirements of 10CFR Part 61.57 for all low-level radioactive wastes to which the requirements apply.
- g. Transfers for Disposal and Manifests, Record Keeping, and Quality Control Program. The requirements of 10CFR Part 20.311 are included in Byron procedures BRP 1520-1 and BOP WX-44. The quality control program consists of Byron procedures which implement the PCP, the Program for Implementation of 10CFR Part 61 and 10CFR Part 20.311 dated 22 Dec 83 and a forthcoming revision to Q.P. 13-52 of Commonwealth Edison's Quality Assurance Manual. The above are subject to audits by personnel independent of the activities performed and reviewed by appropriate management personnel.

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