Prairie Island Nuclear Generating Plant

Process Control Program Manual
Revision 1

In accordance with the Prairie Island Technical Specifications, Section 6.5.D, Process Control Program (PCP), the following changes to the Prairie Island PCP are reported:

A. A reference to the Technical Specifications was added to Section 1.4.

B. A note was added to Section 3.2 giving the Radwaste Engineer the choice of using RPIP 1306 for certain solidification activities.

These changes do not reduce the overall conformance of the solidified waste product to existing criteria for solid wastes for the following reasons:

A. The revision to section 1.4 is editorial and does not affect the waste solidification process.

B. RPIP 1306 is equivalent to the method described in Section 3, Manual Solidification of Waste Liquids. Therefore, the change to section 3.2, which allows the use of RPIP 1306 in certain cases, does not reduce the conformance of the solidified waste product to existing criteria.

These changes were reviewed and approved by the Prairie Island Operations Committee on September 10, 1987.

Instructions for Entering Revision 1 to the Prairie Island PCP

Replace Revision 0 of manual section D59, pages 1 through 17, with Revision 1, pages 1 through 17.

PROCESS CONTROL PROGRAM FOR SOLIDIFICATION OF RADIOACTIVE WASTE FROM LIQUID SYSTEMS

****

OC REVIEW: 9-10-87

REVIEWED BY: John M. Friedrich DATE: 9-1-87

APPROVED BY: D.A. Schuelke DATE: 9-10-87

IBM

1.0 GENERAL

1.1 Purpose

The purpose of this Process Control Program (PCP) is to detail the means of which the solidification of radioactive waste from liquid systems can be assured:

Specifically the PCP shall:

1.1.1 Provide assurance that systems for solidification of liquid waste are operated as designed.

1.1.2 Assure that the final product is completely solidified.

1.1.3 Assure that the final product contains no free water.

1.1.4 Identify interfaces with other plant systems.

1.1.5 Identify the sampling requirements prior to processing.

1.1.6 Specify process parameters and limiting conditions within which a particular solidification system can be operated.

1.1.7 Define acceptance criteria for solidified product.

1.1.8 Define remedies to be implemented in the event that the acceptance criteria for solidification are not met.

1.2 Scope

This PCP provides for the solidification of:

1.2.1 Liquid waste concentrates using the Atcor System.

1.2.2 Manual solidification of liquid waste.

1.2.3 Spent ion exchange resin.

1.3 Definitions

1.3.1 Batch - A quantity of liquid waste concentrates (for example, the contents of #121 Waste Concentrates Tank) to be solidified. A batch can normally be drummed in not more than two days.

1.3.2 Solidification - The conversion of wet radioactive wastes into a form that meets shipping and burial ground requirements.

1.4 Applicable Tech. Spec. - TS 3.9.C

2.0 SOLIDIFICATION OF LIQUID WASTE CONCENTRATES

2.1 Purpose

To establish the process parameters which provide reasonable assurance of complete solidification of liquid waste concentrates.

2.2 Applicability

This section of the PCP is applicable to solidification of liquid waste concentrates using the Atcor Solidification System and related equipment.

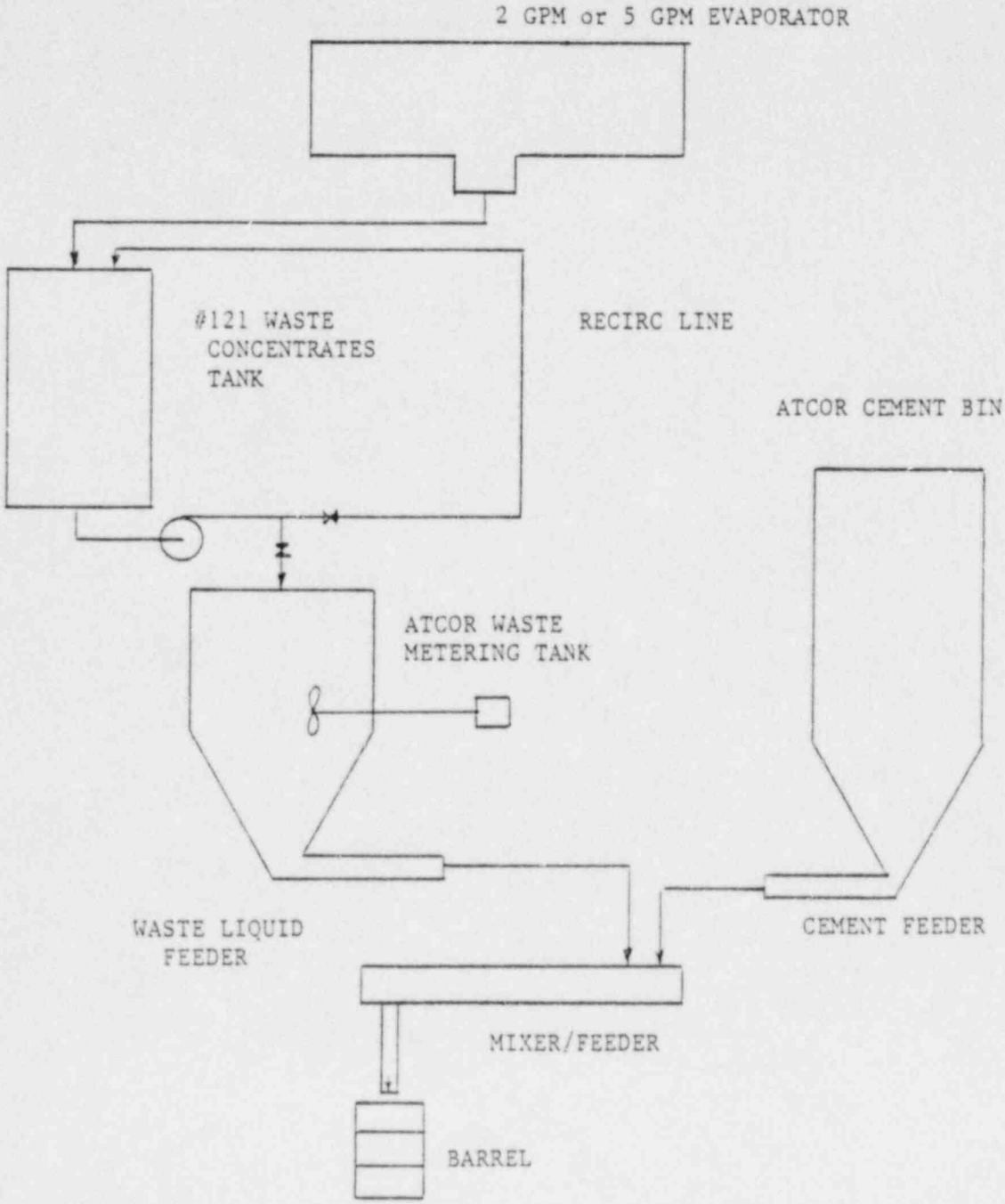
2.3 References

2.3.1 C21.2 Solid Radioactive Waste Operating Procedure

2.4 System Description

2.4.1 General Description

The solidification system for liquid waste concentrates includes #121 Waste Concentrates Tank (WCT), the Atcor Solidification System and related pumps, piping and equipment. Concentrates are accumulated from the 5 GPM ADT evaporator or the 2 GPM waste evaporator and stored in #121 WCT. When a sufficient quantity exists in #121 WCT, the contents are transferred to the Atcor system for solidification in 55 gallon drums. The filled drums are held in the Atcor drum storage aisles until solidification can be confirmed. The drums are then capped, deconned, and surveyed prior to storage for subsequent shipment and disposal. A flow diagram is shown on Figure 2.4.1-1.



SOLID RADWASTE FLOW DIAGRAM

FIGURE 2.4.1-1

2.4.2 Detailed Description

2.4.2.1 #121 Waste Concentrates Tank

#121 WCT is an upright cylindrical, vented tank of approximately 1700 gal. capacity. The tank is electrically heated to keep the contents in solution.

#121 WCT receives concentrates from either the 5 GPM ADT Evaporator the 2 GPM Waste Evaporator or the coagulation tank. The tank is located in a shielded vault for radiation protection and is equipped with a high level alarm to prevent over-filling. A direct reading float-type level gauge provides level indication from outside of the shielded vault.

#121 WCT pump and discharge piping are arranged for recirculation and mixing of the tank contents or for pumping the contents to the Atcor System for solidification. A sample valve is provided near the pump discharge.

2.4.2.2 Atcor Solidification System

The Atcor Solidification System is designed to mix waste liquid concentrates with cement, to convey the blended mass into 55 gal. drums and to store the filled drums in a shielded area for curing. The system consists of the following principle components:

(a) <u>Waste Metering Tank</u>

The waste metering tank is a tank of approximately 700 gal. process capacity. The tank is equipped with heaters to maintain contents in solution and is equipped with an agitator to ensure homogeneity of liquid. The tank is equipped with a positive displacement discharge pump having discharge rate variable up to 10 GPM. The pump discharges directly into the mixer feeder.

(b) Cement Bin

The cement bin is a bin of approx. 100 cu. ft. process capacity. The bin is equipped with a vibrating lower cone to preclude bridging of cement and to ensure uniform flow of material having a consistent bulk density. The cement bin is fitted with a discharge auger having a discharge rate variable from 0.3 to 3.3 CFM. The auger discharges directly into the mixer/feeder.

(c) Mixer/Feeder

The mixer/feeder is a double enveloping screw type mixer which simultaneously blends the liquid waste and cement while conveying the mass to the discharge chute. The discharge chute directs the blended mass into the shipping container by gravity flow.

(d) Controls

Controls for the solidification system are contained on a panel shielded from the waste materials.

Gauges indicating feed rate of cement and waste liquid are located on the control panel.

Rates of cement feed and liquid feed are adjustable from the control panel during processing.

A closed circuit TV camera and monitor are provided for viewing drum movements from the control panel.

(e) Cement Type

Cement normally used is type "M" masonry cement having 50% lime and 50% portland cement, conforming to ASTM-C-91-64 and ASTM-C-270-61T.

2.6 Sequence of Operation

2.6.1 Recirculation of #121 WCT

Before beginning the solidification process, the contents of #121 WCT should be recirculated for at least three volume changes to assure complete mixing and homogeneity.

2.6.2 After recirculation, a sample of the #121 WCT is to be drawn and analyzed for isotopic content, pH and % boric acid.

If pH is greater than 5.0, no adjustments need be made. If the pH is less than 5.0 it must be increased to between 5.5 and 7.0 with the addition of lime. Adjustments to pH, if required, should be made to the liquid in #121 WCT. As an alternate, pH adjustments may be made in the Atcor Metering Tank.

2.6.3 After sampling and pH adjustment, if required, the waste liquid is transferred to the Atcor Waste Metering Tank for solidification.

Filled drums are stored in the Atcor Drum Storage Aisles until solidification can be verified.

2.6.4 Flowrates

Normal flowrates with operating tolerance together with the discharge volume are as follows for typical evaporator bottoms:

Waste Liquid Flow	5.0 ± 2% gpm
Masonry Cement	0.8 ± 10% cfm
Product Discharge	1.0 cfm

Other flowrates may be used if demonstrated to result in solidification.

2.6.5 Cure Time

Cure time is variable and depends upon waste pH, Boron concentration, and mix ratios. Normally, a two to three week cure time can be expected for complete solidification.

2.6.6 Verification of Solidification

Representative barrels of each batch are to be inspected to verify solidification and the absence of free water. A drum may be considered solid when the cemented mass offers significant resistance to penetration by a hammer, or similar object. Absence of free water may be determined visually.

If solidification fails to take place, the process shall be suspended until the cause is determined and remedies are defined.

2.6.7 When solidification and absence of free water has been verified, the drums may be capped, deconned and removed from the Atcor Drum Storage Aisles. As an alternate to this sequence and in the interest of minimizing personnel exposure, the drums may be removed individually for capping and deconning.

2.6.8 When the drums are removed from the Atcor Drum Storage Aisles, and after they are capped and deconned, the drum number is recorded together with the batch number, contents and radiation level. The drums are then placed in storage to await shipping and burial.

2.7 Sample Solidification of Liquid Waste Concentrates

2.7.1 Sampling Requirements

2.7.1.1 If it is not feasible to verify solidification and the absence of free water in the full-scale product, sample solidification shall be conducted for at least every tenth batch of liquid waste concentrates.

2.7.2 Prerequisites

2.7.2.1 Before drawing a specimen from #121 WCT for sample solidification, the contents must be adequately mixed to achieve a representative mixture.

2.7.3 Sample Preparation

2.7.3.1 Obtain a specimen from #121 WCT in the required volume. The volume required will be approximately 200 ml for each sample mixed plus 10 ml for a boric acid analysis.

2.7.3.2 Remove approximately 10 ml for boric acid analysis. Record % boric acid on Attachment 1A.

2.7.3.3 Place the remaining waste liquid in a beaker. Maintain the temperature of the liquid to prevent precipitation of boron. Record the volume of waste in the beaker on Attachment 1A.

2.7.3.4 Check the mixture pH and record this value on Attachment 1A. If the pH is less than 5.0, slowly add lime to the liquid while continuously stirring until a pH value of 5.5 to 7.0 is achieved. Record the final pH and the weight of lime added on Attachment 1A.

2.7.3.5 Because of the relatively long cure time required three samples should be mixed from the initial test specimen using different liquid/cement ratios. One sample will be mixed at the recommended full scale operating mix ratio. The other two samples should have more and less liquid than recommended for full scale mixing.

Additional samples may be mixed from the initial test specimen at the discretion of the Rad Waste System Engineer using additional mix ratios or using different pH values. The following table defines the mix ratios which should be used:

VOLUME OF WASTE LIQUID (ml)	VOLUME CEMENT (ml) (Note #1)	WT OF CEMENT (gm)	LIQUID/CEMENT RATIO (volume)
176	200	218	0.88
166	200	218	0.83 (Note #2)
156	200	218	0.78

Note #1: Cement volume is theoretical and is listed for reference only. For accurate sample preparation, cement must be measured by weight.

Note #2: Liquid/cement ratio (volume) recommended by Atcor for full scale mixing.

2.7.3.6 Place the required amount of cement in a beaker. Measure out the correct amount of waste liquid for the sample. Thoroughly mix the liquid and cement together to ensure homogeneity.

2.7.3.7 Cover the sample and store in a shielded area.

2.7.3.8 Observe the sample immediately after mixing and intermittently thereafter as appropriate till solidification is complete. Record the results in the space provided on Attachment 1B.

NOTE: Some water may appear on the surface and be re-absorbed during solidification.

2.7.3.9 Set the sample aside for future disposal.

2.7.3.10 Complete Attachment 1A before proceeding with full scale solidification.

2.7.4 Sample Acceptance Criteria

2.7.4.1 Visual inspection after mixing will confirm that the sample is homogeneous.

2.7.4.2 Visual inspection of the sample after curing will confirm that no free water exists on the surface of the sample.

2.7.4.3 Physical inspection of the sample after curing will confirm that the end product is a uniform, liquid free, free standing solid that resists penetration when probed with a pencil-sized probe.

2.7.4.4 If test samples from the initial specimen fail to produce a mixture which will solidify, additional specimens shall be drawn and mixed to determine the proper solidification parameters before full scale solidification can commence.

Additionally, if test samples from the initial specimen fail to produce a mixture which will solidify, sample solidification of specimens from successive batches shall be conducted until at least three samples from consecutive batches demonstrate solidification.

SAMPLE VERIFICATION FORM

RPS _____ Date_____ Time_____

Waste Type _____

PRETREATMENT

P1 Initial pH _____ Initial Temp _____°F % Boric Acid _____

P2 Specimen Volume _____ml

P3 Lime Added _____gm

P4 Final pH _____

$$\text{Lime Ratio} = \frac{P3}{P2} \times 8.34 = \_\_\_\_\_ \ \frac{\text{lbs}}{\text{gal}}$$

SAMPLE PROPORTIONS

Sample No. _____

S1 Sample Waste Liquid Vol _____ml

S2 Sample Cement wt _____gm

$$\text{Liquid/Cement Ratio (vol)} = \frac{S1}{S2} \times 1.089^{*} = \_\_\_\_\_$$

*Density correction factor.

ATTACHMENT 1A

SAMPLE VERIFICATION FORM

Sample No. _____

Describe sample appearance, water amount, hardness, etc.

CURE TIME	CONDITIONS NOTED
0 HRS	

Sample is/is not solid _____ Date _____

RPS Signature

ATTACHMENT 1B

3.0 MANUAL SOLIDIFICATION OF WASTE LIQUIDS

3.1 Purpose

To establish parameters which provide reasonable assurance of complete solidification of waste liquids when mixed manually.

3.2 Applicability

This section of the PCP is applicable to manual solidification of waste liquids with masonry cement. Manual solidification may include the use of a portable, power-operated mixer.

Waste liquids which are normally solidified manually include:

- 1 Laundry sludge
- 2 Decon solutions, etc. not suitable for evaporation
- 3 Water-cement mix produced for the purpose of solidifying contaminated wet trash such as mopheads

NOTE: At the discretion of the Rad Waste Engineer (or designee) [illegible] trash may be solidified using RP[illegible]306.

3.3 Sequence of Operation

3.3.1 Place desired amount of liquid in 55 gal. drum (normally 1/2 to 2/3 full).

3.3.2 Commence mixing.

3.3.3 Add cement while continuing to mix at the rate of 1 ft^3 (1 bag) per 6.25 gal. of liquid or until mixture begins to thicken. Continue to mix until all of the cement is incorporated and the mixture is smooth.

Remove the mixer. (If applicable).

3.3.4 Wet trash (if applicable) should be submerged into the cemented mass with a stick or similar device.

3.4 Cure Time

Solidification can normally be expected within two to three days.

3.5 Verification of Solidification

Each drum of manually solidified waste liquid shall be inspected to verify solidification and the absence of free water. A drum may be considered solid when the cemented mass offers significant resistance to penetration by a hammer or similar object. Absence of free water may be determined visually.

If solidification fails to take place, the process shall be suspended until the cause is determined and remedies are defined.

3.6 When solidification and absence of free water has been verified, the drum may be capped and deconned. The drum number is recorded together with the batch number, contents and radiation level. The drum is then placed in storage to await shipment and burial.

APPENDIX A

Process Control Program for In-Container Solidification of Bead Resin

GENERAL:

Bead resin is normally shipped in the bulk dewatered form. However, high activity resin may be solidified if desired.

Following a brief system description, the Hittman Nuclear and Development Corp. PCP for In-Container Solidification of Bead Resin is appended.

This document is proprietary and is reproduced in its entirety as an appendix to the Prairie Island Process Control Program for Solidification of Waste From Liquid Systems.

Certain plant specific exceptions to the Hittman document are noted in the system description.

SYSTEM DESCRIPTION:

The resin disposal system for the purposes of this PCP consists of 121 Spent Resin Tank, #122 Spent Resin Pump, a portable dewatering pump and related piping, hoses and valves. In addition are included those items furnished by the resin disposal contractor including a shipping cask, shipping liner, solidification equipment and related controls and appurtenances.

Resin is pumped in a water slurry from #121 Spent Resin Tank to the shipping liner in the proper amount. The water is then pumped out to the drains system, after which the solidification process will begin in accordance with the contractor's procedures.

Because of the high activity of the resin requiring solidification, sample solidification using nonradioactive resin is normal. References in the PCP to sampling the spent resin tank therefore do not apply.

NOTE: Because of its proprietary nature, the Hittman Nuclear and Development Corporation Process Control Program for In-Container Solidification of Bead Resin #STD-P-05-004 is retained in the Rad Protection Files for reference.