# PROCESS CONTROL PROGRAM
# FOR
# {CALVERT CLIFFS NUCLEAR POWER PLANT UNIT 3}

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## 1.0 INTRODUCTION

The purpose of this Process Control Program (PCP) is to assure that the final disposal product from {Calvert Cliffs Nuclear Power Plant Unit 3, CCNPP Unit 3} meets applicable Federal, State, and Disposal Site requirements for low-level radioactive waste classification and characterization, waste transfers and shipping manifests, shipping regulations, and waste acceptance criteria of authorized disposal facilities.

This PCP describes the administrative and operational controls and surveillance requirements used for the processes of drying-out of liquid or wet radioactive wastes, the dewatering of wet radioactive wastes, and the processing of dry solid wastes produced at the {CCNPP Unit 3}. These processes involve the treatment of the following primary waste streams from {CCNPP Unit 3}: radioactive concentrates (evaporator concentrates and sludge waste from the liquid waste tanks), centrifuge sludge, spent resins from the coolant purification unit, spent resins from a radioactive waste demineralizer, filter cartridges, wet active wastes, dry active wastes, and mixed wastes.

## 2.0 APPLICABILITY

The reporting requirements of the process control program (PCP) are implemented as part of the Technical Specifications for Administrative Controls Section 5.6.2 “Radioactive Effluent Release Report”. The contents of this PCP are described in Sections 11.4.2.4 “Packaging, Storage, and Shipping” and 11.4.3 “Radioactive Effluent Releases” of the U.S. Evolutionary Power Reactor (EPR) Final Safety Analyses Report (FSAR). This PCP provides elements necessary to support the annual production of the Radioactive Effluent Release Report and to demonstrate compliance with regulatory requirements on low-level radioactive waste classification, waste characterization, waste transfer and shipping requirements, and waste acceptance criteria of authorized disposal facilities.

For the solid wastes released from {CCNPP Unit 3}, the application of this PCP and its implementing procedures will demonstrate:

The application of reporting requirements specified in 10 CFR 50.36a.

- The proper classification and characterization of these low-level radioactive wastes per the criteria specified in 10 CFR 61.55 and 10 CFR 61.56.
- The implementation of the applicable waste transfer and shipping manifest requirements of 10 CFR 20 Appendix G.
- The implementation of the applicable Nuclear Regulatory Commission (NRC) shipping regulations specified in 10 CFR 71.
- The implementation of the applicable Department of Transportation (DOT) shipping regulations specified in 49 CFR Parts 171–180.
- These low-level wastes will be safely stored in the onsite waste storage facilities.
- These low-level wastes will satisfy the applicable waste acceptance criteria of authorized disposal facilities.
- The design of the solid waste system as described herein and based on descriptions provided in Section 11.4 of the U.S. EPR FSAR and Section 3.5.4 of the {CCNPP Unit 3} Environmental Report (ER) ensure the waste types described below will be treated in a manner such that the above requirements will be satisfied prior to being released from the site.
- Records generated by implementation of the PCP procedures will be retained until termination of the license by the NRC in accordance with 10 CFR 20.2108.
- The dry active wastes potentially processed offsite by a waste broker or specialized facility (e.g., sorting facility for waste reduction) will be certified by this vendor to have been properly processed prior to being sent to a licensed disposal site.

## 3.0 ACRONYMS AND DEFINITIONS

**ALARA (As Low As is Reasonably Achievable)** – 10 CFR 20.1003 concept of "making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest."

**Chelating Agent** – compounds, often organic, that form two or more bonds with a metal ion to essentially hold the metal in place. 10 CFR 61.2 defines chelating agents as amine polycarboxylic acids (e.g., EDTA, DTPA), hydroxy-carboxylic acids, and polycarboxylic acids (e.g., citric acid, carbolic acid, and glucinic acid). The chelating agent used to sequester metal ions in the {CCNPP Unit 3} waste treatment processes is ethylenediamine-tetracetic acid (EDTA).

**DAW (Dry Active Waste)** – radioactive contaminated or possibly contaminated solid wastes containing no more than incidental moisture (no significant free water) generated in the controlled areas of the plant and consisting of materials like paper, plastic, wood, textiles, concrete, glass, fiberglass, metal, soil, and electrical pieces.

**Dewatering** – the process of removing free standing liquid from solid wastes in order to ensure the limits established in 10 CFR 61.56 are satisfied (i.e., less than 1% of the waste volume when in a HIC or less than 0.5% of the waste volume when processed into a stable form).

**DTD (Drum Transfer Device)** – remotely operated equipment that allows for the handling of waste drums containing low level radioactive waste around the drum drying stations, drum capping/decapping station, drum sampling device, and the drum storage crane.

**EDTA (EthyleneDiamine-Tetracetic Acid) –** a specific chelating agent used to sequester metal ions in waste.

**FAL (Fuel Pool Purification System)** – the processing unit that purifies the water in the Fuel Building and Reactor Building pools.

**FKE (Decontamination Equipment for Apparatus and Vessels)** – equipment used to decontaminate various vessels and apparatus and includes a filter cartridge used to remove corrosion particles and other impurities from the decontamination solution.

**FSL (Free Standing Liquid)** – liquid in a waste container that is not bound by the waste in the container and hence, could be released if the container boundary is breached. The amount of FSL in a radioactive waste disposal container shall be less than a specified threshold required to satisfy limits established in 10 CFR 61.56 (i.e., less than 1% of the waste volume when in a HIC or less than 0.5% of the waste volume when processed into a stable form).

**Hazardous Material** – per 49 CFR 171.8 "a substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and has designated as hazardous under section 5103 of Federal hazardous materials transportation law (49 U.S.C. 5103)." Designation of hazardous materials for transportation are established in 49 CFR 172.101, 49 CFR 172.102, and 49 CFR 173.2.

**Hazardous Waste –** waste that meets the criteria listed in 40 CFR 261.3.

**HIC (High Integrity Container)** – disposal containers approved by the NRC for disposal of Class A, Class B, or Class C LLW and meet the long term stability requirements established in 10 CFR 61.56(b) and Department of Transportation requirements for Type A package (49 CFR 173).

**JEW (Chemical and Volume Control System)** – the processing unit that provides the interface between the high pressure reactor coolant system and the low pressure systems in the nuclear auxiliary and fuel building. This system is equipped with three cartridge filters used to remove corrosion particles and other impurities from the reactor coolant in the pump seal injection.

**KBE (Coolant Purification System)** – the processing unit that in part flushes spent resins from the mixed bed ion exchangers into the spent resin storage tanks. These resins include those from the two parallel mixed bed ion exchangers used to continuously purify the reactor coolant, the mixed bed ion exchanger used to purify the excess water discharged from the reactor coolant system to the coolant supply and storage tanks, and the mixed bed ion exchanger used to purify the fuel pool water. In addition, this unit contains filter cartridges used to remove corrosion particles and other impurities from the reactor coolant. Other portions of this unit are not directly relevant to this PCP.

**KLF (Radioactive Waste Building Ventilation System)** – provides fresh supply air, filters exhaust air, and maintains a negative pressure inside the Radioactive Waste Building.

**KPC (Solid Waste System)** – the processing unit that treats and prepares LLW from {CCNPP Unit 3} for either onsite storage or shipment offsite.

**KPD (Filter Changing Equipment) –** the equipment that remotely processes contaminated filters to reduce personnel exposure (ALARA).

**KPF (Liquid Waste Processing System)** – the processing unit designed to process and handle liquid radioactive waste generated as the result of normal plant operations and anticipated operational occurrences from {CCNPP Unit 3}.

**KPK (Liquid Waste Storage System)** – the unit designed to collect, temporarily store, and pre-treat LLW from {CCNPP Unit 3} in preparation for processing by KPF and/or KPC.

**KTA (Nuclear Island Drain and Vent System)** – the unit that collects, temporarily stores, and discharges radioactive fluids from the nuclear area to other systems in a controlled manner. This system is equipped with one cartridge filter used to remove corrosion particles and other impurities from the effluents collected in this unit.

**ODCM (Offsite Dose Calculation Manual)** – a manual containing the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents. In addition, this manual contains the radioactive effluent controls and radiological environmental monitoring activities, and descriptions of the information that should be included in the Annual Radiological Environmental Operating and Radioactive Effluent Release Reports.

**PCP (Process Control Program)** – program that describes the systems, administrative controls, surveillances, and operational controls used for the solidification of liquid or wet radioactive wastes, the dewatering of wet radioactive wastes, the drying-out of wet radioactive wastes, and the processing of dry solid wastes produced at nuclear power plants.

**Quality Assurance** - all those planned and systematic actions necessary to provide adequate confidence that a treatment process will perform in the proper and effective manner as it was designed to do (e.g., production of a dried monolithic block of waste in a drum).

**Quality Control -** comprises the actions necessary to execute the planned and systematic actions of the quality assurance program.

**Scaling Factor** – a dimensionless number relating the concentration of one easily measured radionuclide to another more difficult to measure radionuclide.

**Solidification** – the process of converting liquid and solid radioactive materials into a monolithic, immobilized solid with definite volume and shape and is bounded by a stable surface of distinct outline on all sides (free standing), with a water content of less than that prescribed in 10 CFR 61.56.

**UKS (Radioactive Waste Processing Building)** – this building contains the radioactive waste treatment processes including the liquid waste processing (KPF) and storage systems (KPK) and the solid waste unit (KPC).

**WAC (Waste Acceptance Criteria)** – criteria required to be satisfied by low level wastes and their containers prior to receiving authorization for disposal (see Refs. 4.2.31 and 4.2.32 as examples).

# 4.0 REGULATORY REFERENCES

## 4.1 Regulatory Requirements

This PCP addresses the applicable requirements established in the following regulations:

4.1.1 10 CFR 20 – "Standards for Protection Against Radiation"

4.1.2 10 CFR 50 – "Domestic Licensing of Production and Utilization Facilities"

4.1.3 10 CFR 61 – "Licensing Requirements for Land Disposal of Radioactive Waste"

4.1.4 10 CFR 71 – "Packaging and Transportation of Radioactive Materials"

4.1.5 40 CFR 266 – "Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities"

4.1.6 49 CFR 171 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: General Information, Regulations, and Definitions"

4.1.7 49 CFR 172 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements"

4.1.8 49 CFR 173 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: Shippers – General Requirements for Shipments and Packages"

4.1.9 49 CFR 174 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: Carriage by Rail"

4.1.10 49 CFR 175 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: Carriage by Aircraft"

4.1.11 49 CFR 176 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: Carriage by Vessel"

4.1.12 49 CFR 177 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: Carriage by Public Highway"

4.1.13 49 CFR 178 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: Specifications for Packagings"

4.1.14 49 CFR 180 – "Pipeline and Hazardous Materials Safety Administration, Department of Transportation: Continuing Qualification and Maintenance of Packagings"

4.1.15 {Code of Maryland Regulations (COMAR) 26.12.01.01 "Regulations for the Control of Ionizing Radiation"}

4.1.16 {Code of Maryland Regulations (COMAR) 26.15.01.00 "Disposal of Controlled Hazardous Substances – Radioactive Hazardous Substances (RHS)"}

4.1.17 40 CFR 261 – "Identification and Listing of Hazardous Waste"

4.1.18 40 CFR 262 - "Standards Applicable to Generators of Hazardous Waste"

4.1.19 40 CFR 263 – “Standards Applicable to Transporters of Hazardous Waste”

## 4.2 Regulatory Guidance

To ensure compliance with the above regulatory requirements, the following regulatory guidance documents were considered in the development of this PCP:

4.2.1 NUREG-0800, Section 11.4 “Solid Waste Management System”

4.2.2 NUREG-0133 “Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, A Guidance Manual for Users of Standard Technical Specifications”

4.2.3 NUREG/BR-0204 “Instructions for Completing NRC’s Uniform Low-Level Radioactive Waste Manifest”, Rev. 2

4.2.4 Regulatory Guide 1.21 “Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants,” Revision 1, June 1974.

4.2.5 Regulatory Guide 1.33 “Quality Assurance Program Requirements (Operation)”

4.2.6 Regulatory Guide 1.143 “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants”

4.2.7 Regulatory Guide 1.206 “Combined License Applications for Nuclear Power Plants” (Part I, Section C.I.11 “Radioactive Waste Management”)

4.2.8 Regulatory Guide 8.8, “Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable.”

4.2.9 Branch Technical Position (BTP) 11-3 “Design Guidance for Solid Radioactive Waste Management Systems Installed in Light-Water-Cooled Nuclear Power Reactor Plants”

4.2.10 NRC, “Revised Staff Technical Position on Waste Form (SP-91-13),” January 30, 1991.

4.2.11 ANSI/ANS-55.1-1992 (Reaffirmed 2000) “Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants”

4.2.12 ANSI/ANS-55.6-1993 (Reaffirmed 1999) “Liquid Radioactive Waste Processing System for Light Water Reactor Plants”

4.2.13 Generic Letter 80-09 “Low Level Radioactive Waste Disposal”

4.2.14 Generic Letter 81-38 “Storage of Low-Level Radioactive Wastes at Power Reactor Sites” [Note that this letter does not apply to the designed facility, however is listed herein in case in the future additional storage onsite storage is needed.]

4.2.15 Generic Letter 81-39 “NRC Volume Reduction Policy”

4.2.16 Generic Letter 84-12 “Compliance with 10 CFR Part 61 and Implementation of the Radiological Effluent Technical Specifications (RETS) and Attendant Process Control Program (PCP)”

4.2.17 Generic Letter 89-01 “Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program”

4.2.18 Generic Letter 91-02 “Reporting Mishaps Involving LLW Forms Prepared for Disposal”

4.2.19 Information Notice No. 84-72 “Clarification of Conditions for Waste Shipments Subject to Hydrogen Gas Generation”

4.2.20 Information Notice No.86-20 “Low-Level Radioactive Waste Scaling Factors, 10 CFR Part 61”

4.2.21 Information Notice No. 87-07 “Quality Control of Onsite Dewatering / Solidification Operations by Outside Contractors”

4.2.22 Information Notice No. 88-08 “Chemical Reactions with Radioactive Waste Solidification Agents”

4.2.23 Information Notice No. 89-27 “Limitations on the Use of Waste Forms and High Integrity Containers for the Disposal of Low-Level Radioactive Waste”

4.2.24 Information Notice No. 90-09 “Extended Interim Storage of Low-Level Radioactive Waste by Fuel Cycle and Materials Licensees” [Note that this notice does not apply to the designed facility, however is listed herein in case in the future additional storage onsite storage is needed.]

4.2.25 Information Notice No. 90-31 “Update on Waste Form and High Integrity Container Topical Report Review Status, Identification of Problems with Cement Solidification, and Reporting of Waste Mishaps”

4.2.26 IE Bulletin No. 79-19, “Packaging of Low-Level Radioactive Waste for Transportation and Burial,” August 10, 1979.

4.2.27 NRC, “Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation,” January 17, 1995.

4.2.28 NRC, “Final Waste Classification and Waste Form Technical Position Papers,” May 11, 1983.

4.2.29 Information Notice No. 83-14 “Dewatered Spent Ion Exchange Resin Susceptibility to Exothermic Chemical Reaction,” March 21, 1985.

4.2.30 Information Notice No. 90-50 “Minimization of Methane Gas in Plant Systems and Radwaste Shipping Containers,” August 8, 1990.

4.2.31 Licensed radioactive waste burial site criteria, S20-AD-010, Barnwell Waste Management Facility Site Disposal.

4.2.32 Licensed radioactive waste burial site criteria, Energy Solutions, So. Clive Disposal Facility Waste Acceptance Criteria.

# 5.0 WASTE TYPES

Figure 6.0-1 shows the various treatment processes of the solid waste system (KPC). This section of the PCP discusses the types of waste each of these treatment processes receives in preparation for onsite storage, offsite processing, and/or disposal. These waste types include: radioactive concentrates; centrifuge sludge; spent coolant purification resins (KBE) and spent fuel pool purification resins (FAL); spent rad waste demineralizer resins; spent filter cartridges from FAL, FKE (Decontamination Equipment for Apparatus and Vessels), JEW (Chemical and Volume Control system), KBE, and KTA (Nuclear Island Drain and Vent system); wet active waste; dry active waste; and mixed waste. Table 5.0-1 summarizes the waste types, the sources of the waste, the treatment method, and the confinement boundary after treatment (additional packaging may occur to meet transportation and/or disposal criteria) for each of the waste types processed by the solid waste system. These waste types are packaged within the KPC unit into various containers that subsequently are either stored onsite or shipped offsite, for disposal or for additional treatment by a vendor and eventual disposal.

## 5.1 Radioactive Concentrates

The radioactive concentrates are composed of concentrates from the evaporator of the liquid waste processing system and radioactive sludge from the tanks of the liquid waste storage system.

### 5.1.1 Evaporator Concentrates

The liquid waste processing system (KPF) is designed with an evaporator used to remove radioactive and chemical contaminants from liquid waste streams and to concentrate these contaminants prior to processing in the solid waste system. Evaporators treat wastes with high radioactivity but low concentrations of organic and/or particulate solids. The {CCNPP Unit 3} liquid waste streams satisfying these criteria include:

- Wastewater from the fuel pool cooling and fuel pool purification systems,
- Wastewater from decontamination systems, for apparatus and vessels, and for small machine components,
- Wastewater from process drains and sumps collected in the Nuclear Auxiliary Building,
- Wastewater drained from the evaporator column in the liquid waste processing system,
- Wastewater decanted from the concentrate tanks and liquid waste returned from the radioactive concentrates processing system,
- Wastewater from sampling,
- Wastewater collected from the floor drains and sumps of the Nuclear Island and Radioactive Waste Processing Building (UKS), and
- Steam generator blowdown demineralizer system flushing wastewater (if Cs-137 concentration is high).

Prior to treatment by the evaporator, the tank(s) containing these wastes is sampled for pH, radioactivity (total and isotopic), and chemical content (e.g., total solids, boron, and chlorine). Chemicals are added to appropriately adjust the pH to a neutral value: an acid (e.g., sulfuric acid) is used to lower the pH and a base (e.g., sodium hydroxide) is used to raise the pH. The chemical content of the liquid wastes may be adjusted to ensure the solid waste form produced from these wastes meet the acceptance criteria listed in Section 8.0.

The evaporator is of the vapor-compressor type with forced recirculation. In the evaporator, the liquid waste separates into distillates (evaporated water) and concentrates (non-volatile constituents). The total solids content of these concentrates will be approximately 20 to 25 percent by weight in the evaporator. They are drained to the concentrate storage tanks of the liquid waste storage system (KPK). The distillates (vapors) from the evaporator are cooled (condensed), collected, and subsequently transferred to an effluent monitoring tank or to the demineralizer system for further processing, if required. Non-condensables in the distillates are directed to the radioactive waste processing building ventilation system.

The contents of the KPK concentrate storage tanks are stored to allow the decay of short lived radionuclides and are periodically transferred to the concentrate buffer tank of the solid waste system (KPC). Samples taken from the KPK concentrate storage tanks provide, for each processed batch, documentation of the content, pH, and radioactivity (total and isotopic) of this waste stream.

### 5.1.2 Radioactive Sludge

The primary sources that contribute to the radioactive sludge category of wastes include: radionuclides precipitated in a tank due to a chemical reaction, radioactive sludge that has collected at the bottom of the liquid storage tanks as a result of normal operations, solids separated from water in a centrifuge, and wastes associated with the aerobic bacteria used to decompose organic compounds. The radioactive sludge produced from the decomposition of the organic compounds (a patented process) is ordinarily processed by the centrifuge and is considered a subset of the solids separated from water in the decanter of the centrifuge. This waste is not mixed with the other sources of sludge and is not added to the radioactive concentrates to be processed through the concentrates buffer tank of the solid waste system. This centrifuge sludge will be sent to a dedicated waste drum and hence, will be discussed as a separate waste type (centrifuge sludge). The other two sources of sludge, usually referred to as “tank bottoms,” are sent to the KPK concentrate storage tanks and mixed with the evaporator concentrates in these tanks, if available, prior to being transferred to the solid waste system.

Radionuclides may precipitate in a KPK liquid storage tank as a result of the treatment of the liquid wastes in preparation for processing in an evaporator, centrifuge, or demineralizer. The liquid wastes sent to this equipment may require chemical treatment to: properly adjust the pH to a neutral value; precipitate radionuclides that react to form an insoluble solid; remove other impurities such as corrosion products via adsorption and mixed crystal formation; and pre-treat the waste to prevent precipitation of solids during a liquid waste treatment process. These precipitated radionuclides along with corrosion products and any other solids collected in the conical bottom of the KPK liquid waste storage tanks resulting from these operations and from normal plant operations form a radioactive sludge. This sludge is sent to a KPK concentrate tank dedicated to the collection of this sludge. Samples taken from this KPK concentrate tank document the radioactivity (total and isotopic), pH, and total solids of the radioactive sludge in the tank. From the KPK concentrate tank, this sludge is sent to the KPC concentrates buffer tank.

## 5.2 Centrifuge Sludge

The radioactive sludge produced from the centrifuge is considered a separate waste type as it is decanted prior to directly being disposed from the centrifuge to a dedicated waste drum that is subsequently transferred to the solid waste system. The centrifuge system employs both a decanter and a separator to concentrate and separate solids from the liquid wastes. The solid wastes removed from the waste stream by the decanter of the centrifuge are continuously dewatered and placed into a waste drum. The solid wastes removed from the waste stream by the separator of the centrifuge are transferred to a sludge tank to allow for agglomeration of the solids and eventually transferred through the decanter to the above mentioned waste drum which is dedicated to the centrifuge system. The supernatant from this centrifuge system is transferred to a liquid effluent monitoring tank or to the demineralizer system for further processing, if required.

The centrifuge system treats wastes with low radioactivity, but with potentially high concentrations of organic and/or suspended solids. The {CCNPP Unit 3} liquid waste streams satisfying these criteria include:

- Wastewater from the hot laboratory transferred through the sumps of the Nuclear Auxiliary Building,
- Wastewater from the showers and washrooms in the Nuclear Auxiliary Building,
- Distillate from the reactor coolant treatment system,
- Wastewater collected from the floor drains and sumps of the Nuclear Island and Radioactive Waste Processing Building, and
- Wastewater from the flushing of the steam generator blowdown demineralizer system (if undissolved solids content is high and radioactivity level is high, but total Cs-137 concentration is low).

The decanter of the centrifuge system is mounted horizontally and uses a motor-driven screw to inertially separate large particles from the water. The solids collected in the decanter are discharged directly to a dedicated waste drum. The water continues to the separator. The separator is mounted vertically and inertially separates the remaining smaller particles out of the water stream. The small particles separated by the separator are collected in the sludge tank. From the sludge tank, this material is decanted again to further dewater it and eventually discharge it to a waste drum which, after treatment in the solid waste system, is either stored onsite or transferred to an offsite disposal facility.

## 5.3 Spent Coolant Purification System Resins and Spent Fuel Pool Purification Resins

The coolant purification system (KBE) contains a centrifugal resin flush pump used to remove resins from: (1) the two parallel mixed bed ion exchangers used to continuously purify the reactor coolant; (2) the mixed bed ion exchanger used to purify the excess water discharged from the reactor coolant system to the coolant supply and storage tanks, and (3) the mixed bed ion exchanger used to purify the fuel pool water. The flush pump transfers these resins to one of the two resin waste tanks in the Radioactive Waste Processing Building (UKS) for storage.

The two parallel mixed bed ion exchangers used to purify the reactor coolant perform two different functions. One mixed bed ion exchanger acts as the main purification ion exchanger and is saturated with lithium and boron, whereas the other mixed bed ion exchanger is not saturated with lithium and boron and acts as the lithium/cesium removal ion exchanger. The mixed bed ion exchanger used to purify the excess water discharged from the reactor coolant system serves to remove ionic and solid impurities not eliminated by the two parallel mixed bed ion exchangers. The mixed bed ion exchanger used to purify the fuel pool water also serves to remove ionic and solid impurities. The resin in each of these ion exchangers is in the form of water insoluble synthetic beads of cations ($H^+$) and anions ($OH^-$).

When the ion exchanger is exhausted or the differential pressure across it reaches a specified limit, the resins are discharged to the resin waste tanks by the resin flush pump. Since reactor coolant and other contaminated fluids pass through these resins, they can become highly radioactive. Hence, the spent resins are stored in the spent resins tank for up to several years to allow for radioactive decay before being sent to the solid waste system.

## 5.4 Spent Rad Waste Demineralizer Resins

The liquid waste processing system (KPF) is designed with a radioactive waste demineralizer skid unit capable of treating any of the waste types in the liquid waste system. This demineralizer consists of an anion, a cation, and/or a mixed anion/cation resin bed used to chemically bind contaminants carried in the waste stream and an ultra-filtration unit to screen out fine particles. Liquid wastes routed to this demineralizer first pass through a pre-filter, which removes large particles. The waste stream is then routed through the demineralizer, the ultra-filter, or through both devices in either sequence. The resin beds are replaced when the resin in the radioactive waste demineralizer is spent based on plant criteria. The spent resin is pumped to a HIC located within the radioactive waste demineralizer skid or to the concentrate buffer tank in the solid waste system if available.

## 5.5 Spent Filter Cartridges

{CCNPP Unit 3} is equipped with 14 removable filter cartridges that are utilized to perform the following filtration actions:

- Purify the reactor coolant circulating in the Fuel Pool Purification system (FAL) [3 filters]
- Remove corrosion particles and other impurities from the reactor coolant in the pump seal injection of the Chemical and Volume Control system (JEW) [3 filters]
- Remove corrosion particles and other impurities from the reactor coolant in the Coolant Purification System (KBE) [6 filters]
- Remove corrosion particles and other impurities from the effluents collected in the Nuclear Island Drain and Vent System (KTA) [1 filter]
- Remove corrosion particles and other impurities from the decontamination solution used to flush equipment in the Decontamination Equipment for Apparatus and Vessels (FKE) [1 filter]

Since reactor coolant and other contaminated fluids pass through these filters, they can become highly radioactive. Hence, for ALARA purposes these filters are remotely replaced by the Filter Changing Equipment (KPD). The Filter Changing Equipment places used filters into a drum located within a shielding cask. Once loaded into the drum, the drum and shielding cask are sealed and loaded onto a carriage that transports them from the Nuclear Auxiliary Building to the drum transfer station of the solid waste system (KPC) in the Radioactive Waste Processing Building. The vehicle entrance crane lifts the lid off of the cask and the drum store crane takes the drum out of the cask and transfers it onto the conveyor of the drum transfer device in KPC or into the tubular shaft store. In the tubular shaft store, the short-lived radionuclides are allowed to decay prior to treatment for offsite disposal in KPC.

## 5.6 Wet Active Wastes

There are two categories of wet active waste including: (1) waste associated with the back-flush of the ultra-filters of the radioactive waste demineralizers and (2) solid waste (e.g., wet rags, clothes, paper, and textiles) containing moisture. Although these two categories of waste are classified as wet active wastes, they are not mixed in the solid waste system.

The liquid waste processing system is designed with a radioactive waste demineralizer skid unit that contains a pre-filter and an ultra-filter. Large particulate contaminants are screened out by the pre-filter. When the differential pressure across the pre-filter reaches its set-point, the pre-filter media must be replaced. The replaced pre-filter is taken to the solid waste system for treatment and eventual disposal. Unlike the pre-filter, contaminants collected by the ultra-filter are removed by back-flushing when the differential pressure across it exceeds predetermined levels. Hence the ultra-filter is not regularly replaced. The back-flushed contaminants are part of the wet active waste type and are transferred to the resin HIC located within the radioactive waste demineralizer skid.

Solid wastes containing moisture, such as clothes, paper and textiles produced mainly during outages, are separated from dry active wastes to avoid wetting the dry active wastes. These wet active wastes are collected in temporary storage bins located in the controlled area of the plant. The bins are transferred to the solid waste system where the wet active wastes are placed in a HIC or into a drum that can be drum dried.

## 5.7 Dry Active Wastes

The dry active waste (DAW) type consists of radioactive contaminated or possibly contaminated dry solid wastes generated in the controlled areas of the plant and mainly consisting of paper, plastic, wood, HEPA filters, textiles, concrete, glass, and electrical pieces. The wastes are collected in suitable bins or stored short term in the storage area for untreated waste. DAW is initially categorized and separated in the solid waste system into combustible, compressible, or non-compressible and non-combustible waste types.

The combustible solid waste, like paper, plastic, wood, and textiles, are collected in plastic bags and inserted into local storage containers placed in various locations of the controlled area. Once the bags are filled, they are transported to an area reserved for untreated combustible waste in the solid waste system. In this area, the bags are placed either directly into a drum or into the sorting box where they are sorted, shredded, and/or in-drum compacted, as appropriate.

Similarly, the compressible waste, such as electrical waste, cables, thin walled metal pieces, and glass, are collected in plastic bags and inserted into local storage containers placed in various locations of the controlled area. Once the bags are filled, they are transported to an area reserved for untreated compressible waste in the solid waste system. In this area, the bags are placed either directly into a drum or into the sorting box where they are sorted, shredded, and/or in-drum compacted, as appropriate.

The non-combustible and non-compressible waste, which consists of materials like metal pieces, concrete, and soil, are generated in different areas of the plant during normal operation, but especially during outages. The waste is placed into drums and transported to a storage room to be temporarily stored until further treatment. The large or bulky items which won’t fit into drums (e.g., thick metal parts) may be transported to the hot workshop, fragmented, and transferred into a drum.

## 5.8 Mixed Wastes

The mixed waste type includes radioactive contaminated or possibly contaminated solid wastes that contain or may contain RCRA hazardous chemical wastes that might be generated in the controlled areas of the plant, but are mainly expected to be produced in the laboratory. The quantity of this waste type produced at this plant is expected to be small and will be collected in dedicated containers compatible with this waste type. This waste type is then either sent to an authorized vendor for treatment and subsequent disposal or to a disposal site if the site specific waste acceptance criteria are satisfied.

**Table 5.0-1 Waste Type Processing Information (Page 1 of 3)**

| Waste Type | | Source of Waste | Solid Waste Treatment Method [1] | Confinement Boundary after Treatment [2] |
|---|---|---|---|---|
| **Radioactive Concentrates** | Evaporator Concentrates | Concentrates from the KPF Evaporator | • Mixed with resins<br>• Drummed<br>• Drum dried | Drum |
| | Radioactive Sludge | Tank bottoms from the KPK storage tanks | • Mixed with resins<br>• Drummed<br>• Drum dried<br>**- OR -**<br>• Sent to demin. system<br>• Placed in demin. system resin HIC<br>• Dewatered | Drum<br>**- OR -**<br>Demineralizer system resin HIC |
| **Centrifuge Sludge** | | Sludge from the KPF centrifuge | • Drummed<br>• Drum dried | Drum |
| **Spent Coolant Purification System Resins and Spent Fuel Pool Purification Resins** | | • Spent coolant purification resins from KBE<br>• Spent fuel pool resins from KBE | • Mixed with radioactive concentrate s<br>• Drummed<br>• Drum dried<br>**- OR -**<br>• Placed in solid waste system resin HIC<br>• Dewatered | Drum<br>**- OR -**<br>Solid waste system resin HIC |
| **Spent Rad Waste Demineralizer Resins** | | Resins from radioactive waste demineralizer | • Placed in demin. system resin HIC<br>• Dewatered<br>**- OR -**<br>• Mixed with radioactive concentrate s<br>• Drummed<br>• Drum dried | Demineralizer system resin HIC<br>**- OR -**<br>Drum |

[1] If multiple options for treatment method are provided, the first listed method is the normally planned treatment and any additional methods listed are alternatives.

[2] If multiple confinement boundaries are listed, then there is a one-to-one correlation with the treatment methods.

**Table 5.0-1 Waste Type Processing Information (Page 2 of 3)**

| Waste Type | Source of Waste | Solid Waste Treatment Method [1] | Confinement Boundary after Treatment [2] |
|---|---|---|---|
| **Spent Filter Cartridges** | • Filter for purification of reactor coolant circulating in the Fuel Pool Purification system (FAL)<br>• Filter for impurities and corrosion particles from the reactor coolant in the pump seal injection of the Chemical and Volume Control system (JEW)<br>• Filter for impurities and corrosion particles from the reactor coolant in the pump seal injection of the Coolant Purification system (KBE)<br>• Filter for impurities and corrosion particles from the effluents collected in the Nuclear Island Drain and Vent system (KTA)<br>• Filter for impurities and corrosion particles from decontamination solution used to flush equipment in Decontamination Equipment for Apparatus and Vessels (FKE) | • Drummed<br>• Encapsulated in cement<br>**- OR -**<br>• Placed in solid waste system filter HIC<br>• Dewatered | Drum<br>**- OR -**<br>Solid waste system filter HIC |
| **Wet Active Wastes** – Demineralizer Wet Wastes | Solid waste from back-flushing of radioactive waste processing skid filters | • Placed in demin. system resin HIC<br>• Dewatered | Demineralizer system resin HIC |
| **Wet Active Wastes** – Solid Wastes | Temporary storage bins in the controlled area of the plant | • Drummed<br>• Drum dried<br>**- OR -**<br>• Placed in a solid waste system resin HIC<br>• Dewatered | Drum<br>**- OR -**<br>Solid waste system resin HIC |

[1] If multiple options for treatment method are provided, the first listed method is the normally planned treatment and any additional methods listed are alternatives.

[2] If multiple confinement boundaries are listed, then there is a one-to-one correlation with the treatment methods.

**Table 5.0-1 Waste Type Processing Information (Page 3 of 3)**

| Waste Type | | Source of Waste | Solid Waste Treatment Method [1] | Confinement Boundary after Treatment [2] |
|---|---|---|---|---|
| Dry Active Wastes | Combustible | Temporary storage bins in the controlled area of the plant | • Sorted<br>• Shredded [3]<br>• Drummed<br>• Compacted<br>**- OR -**<br>• Sorted<br>• Bagged<br>• Placed in SeaLand for transport to vendor | Drum<br>**- OR -**<br>SeaLand |
| | Compressible | Temporary storage bins in the controlled area of the plant | • Sorted<br>• Shredded<br>• Drummed<br>• Compacted<br>**- OR -**<br>• Sorted<br>• Bagged<br>• Placed in SeaLand for transport to vendor | Drum<br>**- OR -**<br>SeaLand |
| | Non-compressible | Temporary storage bins in the controlled area of the plant | • Sorted<br>• Fragmented [3]<br>• Drummed<br>**- OR -**<br>• Sorted<br>• Bagged<br>• Placed in SeaLand for transport to vendor | Drum<br>**- OR -**<br>SeaLand |
| **Mixed Wastes** | | Laboratory waste stream | • Drummed<br>• Over-packed for transport to vendor/ disposal site | Drum in over pack or other appropriate level of secondary confinement |

[1] If multiple options for treatment method are provided, the first listed method is the normally planned treatment and any additional methods listed are alternatives.

[2] If multiple confinement boundaries are listed, then there is a one-to-one correlation with the treatment methods.

[3] This part of the treatment only occurs for specific wastes within the waste type.

## 6.0 PROCESS DESCRIPTIONS

The solid waste system treats both dry and wet solid waste to produce suitable solid waste forms for transport offsite for further waste processing or direct shipment to a licensed radioactive waste disposal facility. The in-plant process system consists of three subsystems: the radioactive concentrates processing system, the solid waste processing system, and the solid waste storage system. These subsystems provide the equipment and devices necessary for the collection, handling, treatment, and storage of the various types of solid radioactive waste produced during operation of the plant. The solid waste system reduces the total volume of waste material by compaction (including shredding), evaporation and centrifuge processes for concentrating solid wet waste, and in-container dewatering of spent resins.

Figure 6.0-1 provides a flow diagram of the solid waste treatment methods for the various waste types expected to be produced at {CCNPP Unit 3}. The design of the solid waste system allows for the liquid waste subsystems to operate in any one of the following configurations:

1. with an evaporator, centrifuge, radioactive waste demineralizer, and drum dryer
2. with an evaporator, centrifuge, and drum dryer
3. with a radioactive waste demineralizer

These different configurations allow for flexibility in waste treatment and an optimization of waste reduction costs and the ability to minimize the quantity of disposable wastes given the potential limited access to future disposal sites. The first option allows for the most flexibility of matching processing equipment capabilities with waste stream characteristics. The treatments of the wastes produced from this configuration are detailed in the following text. In the second option (no radioactive waste demineralizer), wastes treated by the radioactive waste demineralizer system are instead treated by the evaporator and centrifuge liquid waste treatment systems. In the first and second options, spent resins from the coolant purification system and the radioactive waste demineralizer are processed along with liquid concentrates and sludges in the drum dryers. Alternatively, these spent resins may be placed in HICs and dewatered to acceptable levels for free standing liquid. In the last option (radioactive waste demineralizer only), wastes normally treated by the evaporator or centrifuge are instead treated by the radioactive waste demineralizer, the spent resins normally placed in drums and dried are instead sluiced into HICs designed for resins and dewatered of free liquid in the container.

Spent filter cartridges are placed in HICs or encapsulated in drums with cement.

Dry Active Waste (DAW) is processed by onsite compaction (including shredding of appropriate materials) or packaged as-collected for further offsite processing under a separate contract. Approximately 85% of the total annual waste volume is DAW. DAW sent to an offsite processor for volume reduction will go directly to an appropriate disposal facility after having been processed. If disposal site availability is limited, the waste will be stored until such time that a viable/economical disposal solution becomes available. Storage may be contracted offsite or the waste may be shipped back to {CCNPP Unit 3} for storage.

Only small quantities of mixed waste are expected annually (less than 0.1% of the total annual waste volume), potentially from laboratory tests. Mixed wastes are collected separately from other solid wastes and are placed in a compatible container suitable for temporary storage and transport offsite for treatment and final disposal under a separate contract. No onsite treatment or long term storage of mixed waste is provided. Mixed waste sent to an offsite processor for treatment will go directly to an appropriate disposal facility after having been treated. If disposal site availability is limited, the waste will be stored until such time that a viable/economical disposal solution becomes available. Storage may be contracted offsite or the waste may be shipped back to {CCNPP Unit 3} for storage. Waste shipped back to {CCNPP Unit 3} will not be mixed waste due to the treatment process rendering the hazardous substances non-hazardous in accordance with References 4.1.16 through 4.1.18.

The following described processes have been designed to be mostly automated and remotely operated in support of maintaining personnel doses ALARA. Furthermore, shielding, local collection of liquid leaks, and venting of processes potentially creating airborne contamination have been incorporated into the design to maintain personnel doses ALARA and well below the limits of 10 CFR 20.1201.

## 6.1 Radioactive Concentrates and Spent Resin Processing

**Radioactive Concentrates and Spent Resins**

The radioactive concentrates processing system receives concentrates and sludge from the liquid waste treatment system and dries these influents to produce a monolithic salt block inside a storage drum. These concentrates and sludge both originate from liquid wastes contained in the KPK storage. The concentrates are produced by processing these liquid wastes with an evaporator and the sludge is the waste material collected from the bottom of these tanks.

Prior to transferring the liquid waste from these KPK storage tanks, samples are taken to verify that the wastes are prepared for treatment by the evaporator and can be effectively dried in the drum drying station. These samples allow for the proper pre-treatment of these wastes in the storage tanks to occur. The samples taken from these tanks are for pH, radioactivity, and chemical composition. The pH sample verifies that the solution has a neutral pH (e.g., a pH of 6 to 8) to ensure crystallization during drum drying. If the pH is too low a base (e.g., sodium hydroxide) will be added to the concentrates to increase it. If the pH is too high an acid (e.g., sulfuric acid) will be added to the concentrates to decrease it. The radioactivity sample establishes the total gamma and beta radioactivity and the radionuclides present in the waste. The chemical composition sample examines the total solids in the waste and may also examine for salt (e.g., calcium), boron, and chlorine concentration and organic content depending on the expected characteristics of the waste. The total solids content is limited to a maximum of approximately 25% to the evaporator, the boron concentration is examined to minimize boron leakage from the system and potential precipitation issues in tank and piping systems (the boron concentration is limited to less than approximately 45,000 ppm to the evaporator), and the chlorine concentration is limited to minimize potential corrosion/pitting of the metal components of the treatment system.

A sample may also be pulled from the evaporator during operation. This sample would examine the total solids, undissolved solids, sodium and boron concentration, radioactivity, and chlorine in the evaporator. This sample may be pulled multiple times per batch and is performed to monitor the evaporation process.

Following processing by the evaporator and having been transferred from the KPK storage tanks, the evaporator concentrates and radioactive sludge (now collectively known as the radioactive concentrates) are sampled once per batch in the KPK concentrate tanks for pH, radioactivity, and chemical composition prior to transfer to the solid waste system. The pH measurement again ensures that the waste product is neutral. The sample for radioactivity is performed for documentation purposes: establishing the total radioactivity and the radionuclides in the waste and allowing for the pre-classification of the solid waste end product if no resins are added. The sample for chemical composition establishes the total solid content and, since chelating agents may be added to the evaporator, verifies the limited quantity of chelating agents in this waste stream. The main controls for the quantity of chelating agent added to the evaporator are however the process monitors (e.g., flow and level measurements), as a chelating agent is usually only added with demineralized water to the evaporator to clean the lower part of the evaporator.

From the KPK concentrates tanks, the radioactive concentrates are transferred to the KPC concentrate buffer tank. In this buffer tank, the radioactive concentrates are mixed and sampled for pH and radioactivity approximately once per processed batch. This sample occurs prior to the addition of resins to the buffer tank. An agitator works to mix the contents of the buffer tank into a homogeneous mixture. The concentrate recirculation pump also works to circulate the waste and enhance the mixing process. The wastes are circulated through a closed loop that transverses a sampling box where the sample is taken. The sample for pH will allow for the final adjustment of the solution to a neutral value with an acid or base, as appropriate. The radioactivity sample allows for the pre-classification of the solid waste end product. After sampling the concentrate buffer tank, spent resins may be added to the buffer tank from the resin proportioning tank or from the radioactive waste demineralizer system. To ensure homogeneity with the resin present, the buffer tank is continuously mixed with an agitator and the concentrate recirculation pump prior to sending waste from this buffer tank to a drum in one of the three drum drying stations.

Prior to the drum drying stations receiving radioactive concentrates from the KPC buffer tank, a drum must be prepared to accept this waste. An empty drum is positioned onto the manual drum input/output position on the conveyor of the Drum Transfer Device (DTD). From the pick-up position on the conveyor, the drum is remotely transferred by the drum handling device (e.g., a hoist) to a drum drying station. The heating segments of the shell heater are remotely closed around the drum and the drum is lifted to the filling hood. An inflatable seal is used to seal the drum to the filling hood to direct possible off-gas contamination during the filling and evaporation processes to the Radioactive Waste Processing Building Ventilation system (KLF). Once attached to the filling hood, two level measurements are lowered into the drum to control the flow of the wastes into the drum. The first measurement is used to establish the level in the drum and the second measurement serves to prevent over-filling of the drum.

Once the drum is prepared for receiving radioactive concentrates, the valve on the dosing line is opened and the waste is dosed into the drum. After reaching the pre-determined level, the inlet valve on the dosing line is closed. During the filling process the amount of liquid filled into the drum is measured for documentation purposes. Once the filling level is reached, both level measurements are removed from the drum and the measurement isolation valves are closed, thereby preventing any airborne material or splatter from going up the instrument line. The drum and the station are then ready for a negative pressure to be applied.

The negative pressure is generated by a vacuum unit which serves to provide a pressure of approximately -11.5 psig during the drying process. The vacuum is controlled by a control valve located on a bypass line between the suction line of the vacuum and the ventilation pipe. After the pressure has reached its operating value, the electrical heating system is started and the contents of the drum are heated to a temperature at which the liquid begins to evaporate (approximately 266°F). The evaporated liquid is removed from the drum by the vacuum, condensed in the condenser drying unit, and collected in the condensate counter. After a set volume is reached, a valve is opened and the condensate is discharged into the condensate buffer sluice and eventually is transferred to the KPK storage tanks for processing. The evaporation continues until a preset volume of water is condensed and collected in the condensate counter. Once this amount is reached, the heating system is turned off and the vacuum is broken. The level measurements are reinserted in the drum and the drum is refilled by opening the inlet valve on the dosing line. Note that the contents of the KPC concentrate buffer tank are continuously mixed during this time, thereby preventing the potential for any separation or settling of its contents.

This process of filling and drying is repeated until a negligible amount of liquid is collected in the condensate counter. During each of these drying steps, the concentration of salts and solids in the drum steadily increases and the salts in the liquid precipitate. By increasing the concentration and precipitating the salts, the evaporation rate decreases. Once the evaporation rate decreases to the point that the condensate counter does not receive the required amount of liquid in an allotted time, the evaporation process is stopped and the drum is “topped-off” with concentrates. The drum is then heated again until the required amount of liquid in an allotted time does not reach the condensate counter, after which the drum is heated a final time for at least 72 hours.

Once the residual moisture value has been reached, the shell and bottom heaters are turned off and remotely disengaged from the drum. After a set time, the vacuum on the drum is broken and the drum drying station vented directly to the KLF system. The drum remains connected to the KLF system until the product cools to less than 140˚F.

The whole drying process is performed automatically which means that the system can be operated 24 hours a day and unattended. Only during the drum exchange process does an operator have to be at the control panel to perform the different drum exchange steps. During the drying process, radiation sensors constantly monitor the environment for any possible radioactivity that may have resulted from a leak or break in the drying system components.

During the final drying process the volume in the drum shrinks to about 90% of the volume of the drum. When drying is complete, the drum is lowered from the filling position and transferred to the conveyor. Cameras on the drum handling equipment (e.g., the drum store crane) and in the KPC system provide additional verification the drums are dried and filled. The conveyor transfers the uncapped drum to the drum sampling position where a core sample can be taken from the center of the dried contents to a depth of approximately 4 inches. This sample is taken at least once per batch of treated radioactive concentrates. The core sample is analyzed for radioactivity and chemical composition. Gamma spectroscopy and solid waste scaling factors (used to relate the concentration of one easily measured radionuclide to another more difficult to measure radionuclide) are utilized to properly classify the treated waste per 10 CFR 61.55 and to verify the total expected dose from the drum will be less than specified in the waste acceptance criteria listed in Section 8.1.1.

The drum is then transferred to the drum capping/decapping device where it is remotely sealed and capped. The drum is then picked up by the drum store crane and transferred to the drum measuring device where the dose rate is obtained, main gamma-emitting radionuclides are identified, and the weight of the drum is measured. Finally, the waste drum is transported to the Radioactive Waste Processing Building's drum store or tubular shaft store, if additional shielding of the waste contents is needed.

**Centrifuge Sludge**

Liquids in the KPK storage tanks with high suspended solid waste and/or organic content are processed by the liquid waste centrifuge which is comprised of a decanter and a separator. Prior to transferring liquids from these storage tanks to the centrifuge, samples are taken to assess the pH, radioactivity, and chemical composition. The pH sample ensures that the solution has a neutral pH (the pH is adjusted as previously noted for the radioactive concentrates). The radioactivity samples establish the total radioactivity and the radionuclides presents in the waste, allowing for classification or pre-classification of the solid waste end product depending on the applied solid waste treatment process. This information is also utilized by operators to establish if the wastes can be properly treated by the centrifuge. For example, Cs-137 cannot be removed by the centrifuge system, hence if the radioactivity measurement indicates the presence of a significant quantity of Cs-137 then this waste is diverted to either the evaporator or the radioactive waste demineralizer. The sample for chemical composition examines the total solids in the waste and may also sample for salt (e.g., calcium), boron, and chlorine concentration and organic content depending on the expected characteristics of the waste. If organic is detected then an aerobic bacteria may be added to this tank to destroy it. To destroy the bacteria and to reduce the volume of waste requiring further treatment, hydrogen peroxide is added to the centrifuge sludge in the downstream sludge tank (creates carbon dioxide and water).

Concentrates from the centrifuge separator are collected in a sludge tank and metered to the centrifuge decanter. Dewatered centrifuge sludge from the decanter is transferred directly into a 55-gallon drum dedicated to the centrifuge system. This drum is located in a filling station equipped with a hood that vents to KLF and a level measurement to prevent over-filling of the drum. Once the drum is established to be full, the feed to the decanter is interrupted and a three-way-valve is switched to divert any residual flow from the decanter to the sludge tank. An empty drum is positioned in the filling station and the three-way-valve is switched back to direct the flow from the decanter to this drum and the feed to the decanter is restarted. The contents of the filled drum are visually inspected and then the drum is capped and manually transferred to the drum drying stations for evaporation of the remaining liquid or, if the drum contains a negligible quantity of liquid, to the drum store, potentially being compacted first.

If this drum containing centrifuge sludge is to be transferred to the drum store, then the drum is manually taken to the drum transfer area, the drum is then transferred to the drum measuring device where the dose rate is obtained, the radionuclides are identified, and the weight of the drum is measured, and finally the drum store crane transports the waste drum to the drum store.

If this drum is to be drum-dried, then the drum is manually taken to the drum transfer area, transferred to the drum capping/decapping device which removes the drum lid, and then is remotely transferred to a drum drying station. Similar to the drying of the radioactive concentrates, heating segments of the shell heater are remotely closed around the drum and the drum is lifted into the drying station; an inflatable seal is used to seal the drum to the drying station; a vacuum is drawn on the drum and station; the evaporated liquids are removed from the drum, condensed, and collected in the condensate counter; once the drying is complete (as established from the collection of the condensates), the drum is heated a final time for at least 72 hours; the vacuum is then broken and the drum allowed to cool; the drum is then visually inspected by cameras on the drum handling equipment (e.g., the drum store crane) and in the KPC system; and finally the drum is transferred to the conveyor where it is capped, measured, and placed into the drum store. This process is also performed remotely, thereby minimizing personnel exposure. Note also that this drum containing centrifuge sludge will not be filled with any other material while in the drum drying station nor will a core sample be taken from it. However, the contents of the drum can be sampled and/or visually inspected prior to recapping.

**Spent Resins**

Alternatively to mixing the spent resins into the KPC concentrates buffer tank and then drum drying, spent resins from the coolant purification and fuel pool purification systems can be transferred directly from the resin storage tank to a High Integrity Container (HIC) for in-container dewatering to remove free standing liquid to acceptable levels for disposal of the waste in a licensed disposal facility. The water removed from the HIC is collected and routed to the storage tanks of the KPK system for further processing. Spent resin from the radioactive waste demineralizer/ultra filtration skid can also be sent directly to HICs for in-container dewatering. In addition to spent resins, the radioactive waste demineralizer system produces a small amount of solid waste from the back flush of the ultra filtration portion of the radioactive waste demineralizer skid. This waste stream is handled similar to spent resins for the removal of free standing liquid from the final storage or disposal container.

Resins from the Steam Generator Blowdown Demineralizing system that may have become contaminated as the result of an abnormal event, such as a steam tube leak, are flushed out to the resin truck transfer station in the Radioactive Waste Processing Building and shipped to an offsite vendor to be processed. Contamination of these wastes is an abnormal event and therefore, this potential waste stream is not included in the average annual radioactive waste estimate. Potentially contaminated resin is shipped offsite for treatment and/or disposal on a case by case basis, as needed.

## 6.2 Spent Filter Cartridge Treatment

The plant design includes the use of disposable mechanical filter cartridges to permit the removal of potentially contaminated solids from the reactor coolant or other liquids. These cartridges are used to filter the flow in the Coolant Purification system (KBE), Fuel Pool Purification system (FAL), pump seal injection of the Chemical and Volume Control system (JEW), Decontamination Equipment for

Apparatus and Vessels (FKE), and the Nuclear Island Drain and Vent system (KTA), as well as a pre-filter in the radioactive waste demineralizer skid.

In-plant spent filter cartridges are designed to be replaced by the Filter Changing Equipment (KPD). The Filter Changing Equipment primarily consist of the remote-controlled filter changing machine, the lifting hoist, and the shielded transfer cask containing a waste drum. The filter changing machine moves on rails across a service floor that is immediately above the filters. Prior to removal of the filter cartridge from its housing, the filter cartridge is depressurized and drained. Filter Changing Equipment removes a spent filter from its service vessel and places it in a drum contained within a shielded transport cask. The drum is capped and then the cask is closed and transferred to the solid waste treatment area in the Radioactive Waste Processing Building.

In the solid waste treatment area, the drum is removed from the shielded cask by the drum store crane, sent to the drum measuring device, and then sent to the drum store or the tubular shaft store, depending on its radioactivity level. The drum measuring device establishes the total radioactivity and the radionuclide content of the cartridge filter in the drum by using direct dose rate measurements and calculating the curie content based on established characterization (radionuclide distribution) of the waste type. This process also establishes the time the drum will be stored to allow for the radioactivity level to reach an appropriate level.

When the radioactivity level for several drums containing cartridge filters is sufficiently low, cement is mixed outside the radioactive waste area and prepared to encapsulate the filter elements and fill the void spaces in the waste container. The drum store crane retrieves a drum containing a cartridge filter and places it on the conveyor which transfers the drum to the drum capping/decapping device where the lid is remotely removed from the drum. The uncapped drum is transferred along the conveyor to a vibration table and concrete is remotely added to the drum. The concrete will be added in sufficient quantity to nearly fill the drum as observed by the various cameras in the processing area. Once the filter has been encapsulated, the conveyor transports the drum back to the drum capping/decapping device where the drum lid is reattached. The drum is then sent to the drum measuring device where the dose rate is obtained, main radionuclides are identified, and the weight of the drum is measured. Finally, the drum is transported for curing to the drum store area of the Radioactive Waste Processing Building, to the tubular shaft storage of the Radioactive Waste Processing Building if additional shielding of the waste contents is needed, or prepared for offsite shipment.

Alternatively to encapsulation, spent cartridge filters can be remotely placed into a HIC, potentially with spent demineralizer resins and disposed of offsite or placed into storage after the container is dewatered. The water removed from the HIC is collected and routed to the storage tanks of the KPK system for further processing.

## 6.3 Dry Active Waste Processing

Solid radioactive wastes consist of paper, plastic, cloth, wood, metal parts, worn-out items, concrete, glass, electrical parts, and other discarded materials generated throughout the controlled area. These wastes are collected, segregated, and treated according to their properties. The wastes are placed in different containers to simplify handling, storage, and transport of the waste in the plant. Typical waste containers used are plastic bags, drums, or bins, which are transferred and placed in storage areas within the Radioactive Waste Processing Building. Solid waste treatment facilities include the sorting box for sorting waste, a shredder, and a compactor for drum compaction of compressible waste.

Wastes are initially classified and collected as combustible, compressible, or non-combustible and non-compressible in the in-place collection areas. The wastes may be further segregated based on properties, sizes, materials, and radioactivity level of the waste material. Waste containing moisture is collected and stored separately to avoid wetting dry active waste and to allow short-term treatment to prevent decomposition and hydrogen formation.

The combustible and compressible wastes are transferred from the in-place collections areas to the treatment area where they are sorted in the sorting box or directly placed in a storage container (e.g., a SeaLand). The sorting of these wastes allows for their proper disposition into one or more of the following treatments: shredding, drumming, in-drum compacting, and/or bagging. The shredder and compactor are vented to the KLF system to capture any airborne contamination that might be released during processing. Compressible waste is usually compacted to reduce its volume. Combustible wastes may be further treated by incineration at an offsite licensed treatment facility.

From the in-place collections areas, the non-combustible and non-compressible wastes (e.g., thick metal parts) are transferred: to the treatment area where they are sorted in the sorting box; to the hot workshop where they may be fragmented and placed into a storage container; or directly into a storage container.

## 6.4 Wet Active Waste Processing

As noted previously, wet active waste such as clothes, paper and textiles are manually placed into drums separate from dry active waste. Drums containing these wetted solid wastes are manually placed onto the drum input/output position of the DTD. From the pick-up position, the drum is conveyed to the drum capping/decapping device where it will be decapped. The drum handling device then remotely transfers the drum to a drum drying station. Similar to the drying of the radioactive concentrates, heating segments of the shell heater are remotely closed around the drum and the drum is lifted into the drying station; an inflatable seal is used to seal the drum to the drying station; a vacuum is drawn on the drum and station; the evaporated liquids are removed from the drum, condensed, and collected in the condensate counter; once the drying is complete (as established from the collection of the condensates), the drum is heated a final time for at least 72 hours; the vacuum is then broken and the drum allowed to cool; and finally the drum is transferred to the conveyor where it is capped, measured, and placed into the drum store. Note that this drum will not be filled with any other material while in the drum drying station nor will a core sample be taken from it. However, the contents of the drum can be sampled and/or visually inspected prior to recapping.

As an alternative to drum drying, the wet active wastes can be placed into a HIC for in-container dewatering to remove free standing liquid to acceptable levels for disposal of the waste in a licensed disposal facility. The liquid removed from the HIC is collected and routed to the storage tanks of the KPK system for further processing.

## 6.5 Mixed Waste

Only small quantities of mixed waste are expected annually, potentially from laboratory tests. Mixed wastes are collected separately from other solid wastes and are placed in a compatible container suitable for temporary storage and transport offsite for treatment and final disposal under a separate contract. No onsite treatment or long term storage is provided for this waste form.

## 6.6 Solid Active Waste Storage Areas

The drum store and tubular shaft store are located in a room found on the lower floor of the Radioactive Waste Processing Building and are used for temporary storage of low level radioactive waste treated by the solid waste system. This room protects the waste drums from the elements found outside (e.g., rain, snow, etc.) and is connected to KLF which shields it from the outdoor extremes of temperature and humidity.

The drum store crane has access to both the drum store and the tubular shaft store and is used to transport the drums containing solid, dewatered, or dried waste from the drum transfer position to the drum measuring device to determine radiation levels on the drum surfaces. After dose rate measuring is complete, the crane moves the drums to a temporary storage location in the drum store or tubular shaft store, depending upon radiation levels from the drum. Higher radioactivity waste needing additional shielding is stored in tubular shafts which are formed from concrete and are part of the building structure. These wastes primarily include solid waste, such as spent filter cartridges, as well as treated spent resins that may be combined with sludge and evaporator concentrates from the radioactive waste concentrates processing system.

The drum store crane is used to place waste drums into and remove waste drums from the tubular shaft store and the drum store. The drums can be stacked a maximum of five drums high to optimize the available storage space. The drums are stored for a sufficient time to allow the short-lived radionuclides to decay before shipping offsite and/or until a sufficient quantity can be accumulated to make-up an offsite shipment.

Figure 6.0-1 Solid Waste System Flow Diagram

# 7.0 PRODUCT CONTROL CRITERIA

The process controls used to ensure the proper operation of the waste treatment processes are described in Section 7.1. The combination of these process controls and adherence to the quality control and assurance program described in Section 7.2 results in the production of solid wastes in containers that satisfy the acceptance criteria specified in Section 8.0 and allow for offsite shipment and for disposal of these wastes.

## 7.1 Process Controls

This section describes the controls utilized to verify the processes described in Section 6.0 will operate effectively (preparation controls), are operating effectively (process controls), and have operated effectively (product controls). The ultimate result of these controls is to verify the proper preparation of the wastes prior to treatment, to verify the treatment process properly operated, and to verify the wastes and waste containers satisfy the acceptance criteria, listed in Section 8.0, prior to shipment offsite. In addition to these described controls and prior to shipment for disposal, a topical report will be produced as necessary for approval by the appropriate authority for specific solid waste treatment processes described below (e.g., dewatering of resins in a HIC).

### 7.1.1 Radioactive Concentrates Processing Controls

Radioactive concentrates processing, as described in Section 6.1, consists of the processing of the following waste types: radioactive concentrates (evaporator concentrates and radioactive sludge from the liquid storage system storage tanks), centrifuge sludge, radioactive waste demineralizer spent resins, and spent resins from the coolant and fuel pool purification systems. The radioactive concentrates and spent resins may be mixed prior to being processed in the drum dryer. The centrifuge sludge is treated separate from these other waste types. This section describes the process controls utilized to produce the final solid waste form for each of these waste types.

**<u>Drum Dried Radioactive Concentrates and Resins</u>**

The radioactive concentrates consist of sludges collected from the bottom of the KPK storage tanks and evaporator concentrates produced by the KPF evaporator which processes liquid wastes from some of these same storage tanks**.** The drying of these wastes in drums is performed to approved procedures that ensure all applicable regulatory and disposal site criteria are met. The specific waste processing technology and method and process parameters used to process waste are described in {CCNPP Unit 3} procedures. The controlled process parameters include:

- waste pH: controlled (neutralization) via sampling at source tank (KPC concentrate buffer tank) to ensure acceptable range in drum.
- water content: measured with condensate counter indicating the rate of accumulated liquid collected from drum. Drummed waste is dry when the rate falls below specified value.
- oil content: controlled via sampling (for organic content) at source tank (KPK storage tanks) to ensure acceptable level in drum.
- content of chelating agents: controlled via sampling at source tank (KPK concentrate tanks) to ensure acceptable level at drum.
- waste form: core sample and remote cameras allow visual inspection of final waste form (dry monolithic salt block).

- pre-solidification hazardous waste characterization: samples taken at source tanks (KPK storage tanks, and KPK concentrate tanks) ensure the absence, or an acceptable concentration, of hazardous waste and other constituents (boron, solids, chelating agents, etc.) supplied to the drum.

- specific activity and gamma analysis: direct sampling (core sample) of final processed waste is performed per batch and gamma survey for each drum via drum measuring device allow specific activity and total activity quantification.

- void fraction: a level transmitter provides drum fill level indication.

- additional drying time: redundant drying (72 hours) to ensure no liquid is present after drum is considered to be dried.

- drum waste sampling: waste is accessible for sampling to verify other quantitative acceptance criteria are met as defined in Section 8.1.1.

The minimum drying acceptance criteria include free standing liquid criteria, physical criteria, and chemical criteria based on the disposal site. A representative sample of the waste to be dried is obtained for bench scale testing based on a frequency identified by the disposal site, or at a minimum, per batch from source tank. The bench scale testing allows for source pre-treatment and adjustment to process procedures and process parameters.

Surveillance requirements include a minimum of one random drum to be sampled from each batch. Core sampling is provided remotely by the drum sampling device. The post process sample is used to verify that the drum drying process was successful in fulfilling the PCP requirements and demonstrate that the applicable disposal site's waste acceptance criteria are met.

In summary, the process controls used to produce an acceptable final waste form for the radioactive concentrates and spent resins processed by the drum drying station are:

4. samples from the KPK storage tanks (preparation and product [e.g., organic content] controls)

5. samples from the KPF evaporator during operation (process control)

6. samples from the KPK concentrates tanks (preparation, process, and product [e.g., chelating agent content] controls)

7. samples from the KPC concentrate buffer tank (preparation, process, and product [e.g., pH] control)

8. homogeneity in the KPC concentrate buffer tank by continuous stirring (process control)

9. vacuum pressure controls for the drum in the drum drying station to verify process is drying when heaters are applied (process control)

10. temperature controls on the drum dryers of the drum drying station to verify process is drying (process control)

11. condensate counting in the condenser drying unit to verify drying process is complete (process and product [water content] controls)

12. in-drum level measurements to ensure a filled drum in the drum drying station (process and product [void fraction] controls)

13. temperature monitored over final 72 hour heating period after drum is considered filled and dried (process and product [water content] controls)

14. visual observation for no free standing liquid in the drum after drying by process cameras (product [waste form] control)

15. total and isotopic radioactivity and solid content established by the core sample taken from the contents of a dried drum (product [waste form, specific activity] control)

16. total and isotopic radioactivity and weight measurements performed in the drum measuring device (product [specific activity] control)

17. drum waste sampling (product [e.g., radioactivity] control)

**Centrifuge Sludge**

The KPK storage tanks also supply the liquid waste stream treated by the KPF centrifuge. Liquids with high suspended solid waste and/or organic content are processed by this centrifuge. The drying of these wastes in drums is performed to approved procedures that ensure all applicable regulatory and disposal site criteria are met. The specific waste processing technology and method and process parameters used to process waste are described in {CCNPP Unit 3} procedures. The process parameters include:

- waste pH: controlled (neutralization) via sampling at source tank (KPK storage tanks) to ensure acceptable range in drum.

- water content: measured with condensate counter indicating the rate of accumulated liquid collected from drum. Drummed waste is dry when the rate falls below specified value. If the drum is not to be dried, then the monitoring of the rpm's on the decanter and the visual observation for any free standing liquid prior to capping the drum are utilized to verify the water content in the drum is acceptable.

- oil content: controlled via controlled addition of aerobic bacteria to sludge to destroy organic material and subsequent controlled addition of hydrogen peroxide to destroy bacteria.

- content of chelating agents: no chelating agent added to this waste processing stream.

- waste form: visual inspection prior to capping the drum and remote cameras allow visual inspection of final waste form after drying.

- pre-solidification hazardous waste characterization: samples taken at source tanks (KPK storage tanks) ensure the absence, or an acceptable concentration, of hazardous waste and other constituents (boron, solids, chelating agents, etc.) supplied to the centrifuge and in turn to the drum.

- specific activity and gamma analysis: gamma survey for each drum via drum measuring device allow for specific activity and total activity quantification.

- void fraction: a level transmitter in the filling station provides drum fill level indication. Drum drying will not significantly reduce the volume of the sludge.

- additional drying time: redundant drying (72 hours) to ensure no liquid is present after drum is considered to be dried.

- drum waste sampling: waste is accessible for sampling to verify other quantitative acceptance criteria are met as defined in Section 8.1.1.

The minimum drying acceptance criteria include free standing liquid criteria, physical criteria, and chemical criteria based on the disposal site. A representative sample of the waste to be dried is obtained for bench scale testing based on a frequency identified by the disposal site. The bench scale testing allows for source pre-treatment and adjustment to process procedures and process parameters. The post process sample is used to verify that the drum drying process was successful in fulfilling the PCP requirements and demonstrate that the applicable disposal site's waste acceptance criteria have been met.

In summary, the process controls used to produce an acceptable waste form from the centrifuge sludge processed by the drum drying station are:

1. samples from the KPK storage tanks (preparation, process, and product [e.g., pH] controls)

2. potential for controlled aerobic bacteria addition to destroy organic in waste stream (process and product [oil content] controls)

3. potential hydrogen peroxide addition to sludge in the sludge tank to destroy any remaining bacteria (preparation and product [organic content] controls)

4. in-drum level measurement to ensure a filled drum from the centrifuge system (process and product [void fraction] controls)

5. vacuum pressure controls for the drum in the drum drying station to verify process is drying when heaters are applied (process control)

6. temperature controls on the drum dryers of the drum drying station to verify process is drying (process control)

7. condensate counting in the condenser drying unit to verify drying process is complete (process and product [water content] controls)

8. temperature monitored over final 72 hour heating period after drum is considered filled and dried (process and product [water content] controls)

9. visual observation for no free standing liquid in the drum after drying by process cameras (product [waste form] control)

10. total and isotopic radioactivity and weight measurements performed in the drum measuring device (product [specific activity] control)

11. drum waste sampling (product [e.g., radioactivity] control)

If the centrifuge sludge in the drum is not to be processed by a drum dryer, then the drum drying process controls (numbers 5, 6, 7, 8, and 9) are replaced by the process controls of monitoring the rpm's on the decanter and the visual observation for any free standing liquid, performed before capping the drum.

**Resins to be Placed into a HIC**

Alternatively to adding the resins to the KPC concentrates buffer tank and then drum drying, spent resins from the coolant purification, fuel pool purification, and radioactive waste demineralizer systems can be transferred directly to HICs after the resins are decayed to acceptable levels. The methods used for removal of liquid from wet waste for final disposal comply with the specific disposal site requirements where the waste will be disposed. Dewatering of wet wastes is performed in a manner equivalent to the process guidelines described below using approved procedures with sufficient detail to implement applicable requirements.

Dewatering of “slurried” wet wastes, such as resins, removes the interstitial liquid from solids such that the disposal container meets the applicable regulatory and burial free standing liquid criteria for disposal as outlined in Section 8.1.3. {CCNPP Unit 3} approved vendor dewatering procedures shall include the following process parameter requirements as defined in the respective vendor-supplied HIC Topical Report and subsequent information notices:

- Settling time: provide sufficient time between dewatering cycles for interstitial liquid to fall out of suspension.
- Pumping time: provide sufficient time during dewatering to confirm no significant liquid output over a predetermined duration.
- Dewatering pump suction vacuum: installation of pressure device to indicate range of normal operation, clog, or broken vacuum (absence of liquid).
- Additional dewatering cycles: redundant dewatering to verify no liquid is present after HIC is considered to be dewatered.
- HIC waste sampling: waste is accessible for monitoring and representative sampling to verify other quantitative acceptance criteria are met as defined in Section 8.1.3.

In summary, the process controls used to package resins in a HIC are:

1. resin decay to acceptable radioactivity level (preparation control)
2. vendor-supplied HIC dewatering procedure (process and product [FSL $<$ 1.0% by volume] controls)
3. HIC waste sampling (product [e.g., void space $<$ 15% and radioactivity $< 10^8$ rads] control)

These HIC filling activities are designed to take place at the radioactive waste demineralizer system.

### 7.1.2 Spent Filter Cartridge Processing Controls

Spent filter cartridges are encapsulated in a drum or remotely placed into a HIC. Drums containing encapsulated spent filter cartridges are placed in HIC overpacks prior to shipment offsite for disposal.

For the encapsulation process, cement is used to immobilize the filter cartridge and fill in the void spaces. This cement is mixed to specifications that meet the acceptance criteria specified in Section 8.1.5. The cement is remotely added to the drum containing the filter cartridge which sits on a vibrating table to reduce the amount of void space present in the drum. The cement is added in sufficient quantity to nearly fill the drum as observed by the various cameras in the processing area. The drum is then capped and placed on to a rotating table in the drum measuring device where the surface dose rate, total radioactivity, radionuclide content, and weight are measured. The rotating table allows for measurements to be performed around the entire drum. The drum is then transferred to the drum store to allow the cement to cure and reach an optimal compressive strength.

In summary, the process controls used to encapsulate filter cartridges in a drum are:

1. filter cartridge draining (preparation control)

2. filter cartridge radioactivity measurement by the drum measuring device to establish decay time in the drum or tubular shaft store (preparation control)

3. cement structural stability specification (process and product [structural stability] controls)

4. cement filling of void spaces through use of a vibrating table (process and product [void space] controls)

5. filling of drum by visual observation from process cameras (process and product [void space] controls)

6. total and isotopic radioactivity and weight measurements performed in the drum measuring device (product [radioactivity] control)

7. curing time in drum store to allow cement to reach an optimal compressive strength (product [structural stability] control)

Alternatively, spent filter cartridges can be transferred directly to HICs. Similarly to resins, the methods used for removal of liquid from spent filter cartridges for final disposal comply with the specific disposal site requirements where the waste will be disposed. Dewatering of wet wastes is performed in a manner equivalent to the process guidelines described below using approved procedures with sufficient detail to implement applicable requirements.

Spent filter cartridges are dewatered so that accumulation of free standing liquid in the disposal container does not exceed disposal site limits as outlined in Section 8.1.4. {CCNPP Unit 3} approved vendor dewatering procedures shall include the following process parameter requirements as defined in the respective vendor-supplied HIC Topical Report and subsequent information notices:

- Drain time: provide sufficient time between dewatering cycles for interstitial liquid to fall out of suspension.

- Pumping time: provide sufficient time during dewatering to confirm no significant liquid output over a predetermined duration.

- Dewatering pump suction vacuum: installation of pressure device to indicate range of normal operation, clog, or broken vacuum (absence of liquid).

- Additional dewatering cycles: redundant dewatering to ensure no liquid is present after HIC is considered to be dewatered.

- HIC waste sampling: waste is accessible for monitoring and representative sampling to verify other quantitative acceptance criteria are met as defined in Section 8.1.4.

In summary, the process controls used to package filter cartridges in a HIC are:

1. filter cartridge draining (preparation control)

2. filter cartridge radioactivity measurement by the drum measuring device to establish decay time in the drum or tubular shaft store prior to transferring filter to a HIC (preparation control)

3. vendor-supplied HIC dewatering procedure (process and product [FSL < 1.0% by volume] controls)

4. HIC waste sampling (product [e.g., void space < 15% and radioactivity < $10^8$ rads] control)

### 7.1.3 Dry Active Waste Processing Controls

Untreated solid waste consists of wet and dry active wastes which are collected in separate containers to prevent wetting the dry wastes. In addition, the radioactivity of these wastes is established at the source of their production. The dry active wastes are then further segregated (e.g., into combustible and compressible wastes), treated (e.g., shredded), and then placed in containers, such as drums. Compressible wastes are then compacted to reduce volume and eliminate void space. Section 8.1.6 summarizes the acceptance criteria for these dry active wastes.

In summary, the process controls used to package dry active wastes in a waste container are:

1. separation of wet and dry active wastes at their source (preparation and product [no FSL] controls)

2. radioactivity measurement at the source of the waste (preparation and product [radioactivity] controls)

3. compression of compressible wastes to eliminate void spaces (process and product [void space] controls)

### 7.1.4 Wet Active Waste Processing Controls

The wet active wastes are collected in waste containers near the point in the plant that they were generated. The radioactivity of these wastes is measured in this area and the wastes are subsequently transferred to the solid waste system and placed in drums to be drum dried or in HICs to be dewatered.

A drum that has been filled or partly filled with wet active wastes is placed in the drum drying station and the same process controls established for the drum drying treatment of the centrifuge sludge are applied to this drum. Hence in summary, the process controls used to produce an acceptable waste form (per Section 8.1.2) from the wet active waste placed in a drum and processed by the drum drying station are:

1. radioactivity measurement at the source of the waste (preparation control)

2. vacuum pressure controls for the drum in the drum drying station to verify process is drying when heaters are applied (process control)

3. temperature controls on the drum dryers of the drum drying station to verify process is drying (process control)

4. condensate counting in the condenser drying unit to verify drying process is complete (process and product [water content] controls)

5. temperature monitored over final 72 hour heating period after drum is considered filled and dried (process and product [water content] controls)

6. visual observation for no free standing liquid in the drum after drying by process cameras (product [waste form] control)

7. total and isotopic radioactivity and weight measurements are performed in the drum measuring device (product [specific activity] control)

8. drum waste sampling (product [e.g., radioactivity] control)

Alternatively to placing the wet active wastes into a drum, these wastes can be placed into a HIC if the contents can be dewatered and the residual or interstitial moisture does not create additional issues (e.g., production of methane). Similarly to spent filter cartridges and resins, the methods used for removal of liquid from wet active wastes for final disposal comply with the specific disposal site requirements where the waste is being disposed. Dewatering of wet wastes is performed in a manner equivalent to the process guidelines described below using approved procedures with sufficient detail to implement applicable requirements.

Wet active wastes are dewatered so that accumulation of free standing liquid in the disposal container does not exceed disposal site limits as outlined in Section 8.1.4. {CCNPP Unit 3} approved vendor dewatering procedures shall include the following process parameter requirements as defined in the respective vendor-supplied HIC Topical Report and subsequent information notices:

- Drain time: provide sufficient time between dewatering cycles for interstitial liquid to fall out of suspension.
- Pumping time: provide sufficient time during dewatering to confirm no significant liquid output over a predetermined duration.
- Dewatering pump suction vacuum: installation of pressure device to indicate range of normal operation, clog, or broken vacuum (absence of liquid).
- Additional dewatering cycles: redundant dewatering to ensure no liquid is present after HIC is considered to be dewatered.
- Drying time: evaporation may be used for the removal of incidental liquid (not HIC specific).
- Absorbent media addition: absorption of incidental free-standing liquid (not HIC specific).
- HIC waste sampling: waste is accessible for monitoring and representative sampling to verify other quantitative acceptance criteria are met as defined in Section 8.1.4.

In summary, the process controls used to package wet active wastes in a HIC are:

1. radioactivity measurement at the source of the waste (preparation control)
2. vendor-supplied HIC dewatering procedure (process and product [FSL < 1.0% by volume] controls)
3. HIC waste sampling (product [e.g., void space < 15% and radioactivity < $10^8$ rads] control)

### 7.1.5 Waste and Transport Container Processing Controls

Once wastes have been treated by the solid waste system and placed in containers, such as drums, samples/surveys are taken to verify the acceptance criteria in Section 8.4 are met. Specifically, measurements are made to ensure the container used to transport wastes offsite from {CCNPP Unit 3} meet the dose, surface contamination, and weight acceptance criteria established by the regulations cited in Section 8.4. As previously noted, the solid waste system is equipped with a drum measuring device that measures weight, radioactivity, and dose rate.

The weight measurement establishes if special lifting devices are required for the drum and allows for the total shipping package weight to be calculated. A multi-channel analyzer is utilized to establish a gamma spectrum of the waste in the drum. This spectrum establishes the predominant radionuclides and their radioactivity levels in the waste and allows for the solid waste scaling factors to be utilized to establish the radioactivity for the difficult to measure radionuclides in the drum. These measurements are utilized to establish the final classification of the waste in the drum. In addition, the dose rates at the surface of the drum and one-meter from the surface of the drum are measured in this device. During these measurements, the drum is placed in a turntable to verify there are no local hot spots on or around the surface of the drum.

Finally, radiation surveys and surface smears are taken to confirm the dose rates external to the package and the surface contamination are acceptable and a visual inspection is performed to verify the integrity and leak tightness of the container have not been compromised due to potential handling processes in the UKS prior to shipping a transport container offsite.

## 7.2 Quality Assurance and Quality Control

The salient quality assurance (QA) and quality control (QC) elements for the operation of the {CCNPP Unit 3} solid waste system are addressed in the formal UniStar Nuclear QA Program Description (Ref. [1]). This program includes provisions for the QA and QC of the solid waste system process operations, process samples/surveys, vendor-supplied waste treatment equipment, and vendor-supplied waste containers (based on Refs. 4.1.2, 4.1.4, 4.1.16, 4.2.5, 4.2.6, 4.2.9, 4.2.15, 4.2.17, 4.2.21, 4.2.23, and 4.2.26), as discussed below:

- Verify through procedures for checking, auditing, and inspection that activities impacting the processing of solid wastes have been performed correctly (e.g., sampling, surveillance, and testing of waste and final waste form)
- Provide sufficient authority to persons and organizations performing these procedures to:
    - Identify quality problems
    - Initiate, recommend, or provide solutions
    - Verify implementation of the solutions
    - Maintain sufficient independence from cost and schedule limitations
    - Have direct access to the levels of management necessary to perform this function.
- Control of the design including the materials and components utilized in the system design
- A test program may be used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes
- Control (including revisions) of procurement documents, instructions, procedures, and drawings
- Provisions for periodic surveillances of the operations and inspections of the processing equipment
- Provisions for receipt inspections and/or functional testing of purchased waste containers
- Provisions for periodic audits of the analytic analyses, the calculation methods, and the collected data from samples taken from the process
- Retention of records
- Corrective actions

If vendor-supplied equipment is utilized in the treatment and/or for the storage or transportation of {CCNPP Unit 3} wastes, then it is placed on a QA approved supplier list for {CCNPP Unit 3}. Placement on the {CCNPP Unit 3} approved supplier list ensures that vendor-supplied QA programs remain under the responsibility of the {CCNPP Unit 3} QA program and are subject to the audits and surveillances contained therein. Vendor-supplied equipment (e.g., a HIC) and/or services are subject to reviews and approvals required by the {CCNPP Unit 3} QA program. Specific criteria that the vendor-supplied equipment and/or services shall meet (e.g., DOT regulations for transportation) will be identified.

The processes described in Section 6.0 are designed to treat and process solid wastes such that the wastes are made acceptable for offsite disposal. Operation of these designed processes is controlled by implementing the procedures outlined in Section 9.2. Assurance that these procedures are properly followed is through the implementation of the {CCNPP Unit 3} QA program and its associated controls. Currently there are no vendor operated processes used onsite for solid waste processing and handling activities.

Liquid and solid waste samples from these processes are analyzed in an analytical laboratory or in a sample box. Each sample is uniquely tracked such that any data collected from analyses of the sample and calculated from this analyses data is tracked with the sample. Waste container surveys are conducted for drums in the drum measuring device and for containers prepared for shipment offsite in the vehicle entrance area of the radioactive waste processing building. The surveys performed by the drum measuring device are performed remotely and automatically, whereas the surveys of the shipping containers are performed manually. The data acquisition equipment of the drum measuring device automatically produces records for each drum that will be stored. Data collected from the manual surveys of the shipping containers is recorded and saved as part of the complete data package for the shipping container. The specific tracking mechanism, analytical analyses, data collection, and calculational methods are identified in specific implementing procedures. The QA program and its associated controls provide assurance that these procedures are properly followed.

# 8.0 ACCEPTANCE CRITERIA

Acceptance criteria for processed waste are discussed in the following categories:

- Waste Form
- Waste Classification
- Transportation Characterization and Packaging
- Waste Manifest and Shipping Records
- Non-compliance

All processed waste shall result in a waste form that is packaged for storage, transport, or disposal. The packaged waste form requirements for storage, transport and disposal are called acceptance criteria. Each waste type offered for processing and packaging will have a set of acceptance criteria specific to its waste form. Acceptance criteria are identified by federal, state and available disposal or processor facility licenses. Federal requirements are contained in References 4.1.1 though 4.1.14. {Maryland COMARs} (Refs. 4.1.15 and 4.1.16) requirements basically reflect federal requirements as {Maryland} is an Agreement State.

Disposal facilities or processors available throughout the lifetime of the plant's operating/decommissioning licenses will have acceptance criteria based on its individual license. If a disposal facility does not presently exist, the waste shall be packaged for storage or transported to an offsite processor prior to storage. Acceptance criteria for storage may include requirements based on industry experience, such as the requirements from presently unavailable disposal facilities, or retrievability.

Packaging and documentation for transport to an offsite processor or disposal facility follow the federal and state (route specific) requirements, as well as any present/future administrative commitments that may be made between the licensee and identified agencies.

Non-compliance actions are also described for processed waste identified as not meeting the acceptance criteria.

## 8.1 Waste Form

Acceptance criteria are outlined by the following processed final waste forms:

- Dried concentrates, sludge, and resin in a 55-gallon drum
- Dried filter cartridges and wet DAW in a 55-gallon drum
- Dewatered spent resin, filter media, and sediments in a HIC
- Dewatered filter cartridges and wet DAW in a HIC
- Cement encapsulated filter cartridges in a 55-gallon drum
- DAW in a metal container
- Mixed waste in a container

In addition, applicable disposal site or processor facility waste form acceptance criteria shall be met prior to shipment. Each facility has specific requirements for waste form. A copy of the facilities current license and WAC shall be on file and used to ensure compliance.

### 8.1.1 Dried concentrates, sludge, and resin in a 55-gallon drum

The drum drying process outlined in Section 6.1 generates 55-gallon drums containing one or more of the following dried waste types:

- Evaporator concentrates
- Tank or centrifuge sludge
- Ion exchange resins from various demineralizers

Aqueous filter media (such as resins), dried sludge, and concentrates shall be processed into a final form for storage, transport, or disposal. The federal waste form requirements are defined in 10 CFR 61.56 and Reference 4.2.10. The requirements applicable to this waste form are as follows:

- Liquid content - free standing non-corrosive liquid shall be:
  - Less than 0.5% by volume in the drum or
  - Less than 1.0% by volume if placed in a HIC over-pack.
- Packaged waste shall not pressurize with combustible gases from decomposition in accordance with Information Notice 84-72 (Ref. 4.2.19).
- Void spaces must be reduced to extent practicable for disposal:
  - Clive, UT: 15% void maximum.
  - Barnwell, SC: 15% void maximum, unless in HIC or waste is irradiated metal for disposal in slit trench
- Additional requirements for Class B and C wastes (applies also to wastes for Barnwell, SC with > 1.0 $Ci/m^3$):
- Structurally stable container, such as HIC over-pack within burial vault (Barnwell, SC).
- Waste containing resins or packaged in HICs shall not have radioactivity loading greater than 1.0E+8 rads.
- HIC usage in accordance with Certificate of Compliance and approved by disposal site.
- Trace amounts of oil shall not exceed 1.0% by volume (Barnwell, SC).
- Chelating agents:
  - Shall be less than 0.1% by weight or
  - Less than 8.0% by weight when placed into a HIC (Barnwell, SC).
- Drums greater than 1,000 pounds require special lifting devices (Barnwell, SC).

### 8.1.2 Dried filter cartridges and wet DAW in a 55-gallon drum

The drum drying process outlined in Sections 6.2 and 6.4 generates 55-gallon drums containing one or more of the following dried waste types:

- Filter cartridges
- Wet DAW

Aqueous filter media such as filter cartridges shall be processed in a final form for storage, transport, or disposal. The federal waste form requirements are defined in 10 CFR 61.56 and Reference 4.2.10. The requirements applicable to this waste form are as follows:

- Liquid content - free standing non-corrosive liquid shall be:
  - Less than 0.5% by volume in the drum or
  - Less than 1.0% by volume if placed in a HIC over-pack.
- Packaged waste shall not pressurize with combustible gases from decomposition in accordance with Information Notice 84-72 (Ref. 4.2.19).
- Void spaces must be reduced to extent practicable for disposal:
  - Clive, UT: 15% void maximum.
  - Barnwell, SC: 15% void maximum, unless in HIC or waste is irradiated metal for disposal in slit trench
- Additional requirements for Class B and C wastes (applies also to wastes for Barnwell, SC with > 1.0 Ci/$m^3$):
  - Structurally stable container, such as HIC over-pack with burial vault (Barnwell, SC).
- Waste packaged in HICs shall not have radioactivity loading greater than 1.0E+8 rads.
- HIC usage in accordance with Certificate of Compliance and approved by disposal site.
- Trace amounts of oil shall not exceed 1.0% by volume (Barnwell, SC).

### 8.1.3 Dewatered spent resin, filter media, and sediments in a HIC

The HIC dewatering process outlined in Sections 6.1 and 6.2 generates wastes requiring large HICs containing one or more of the following dewatered waste types:

- Spent resins from Coolant Purification System
- Spent resins from the Spent Fuel Pool Purification System
- Spent resins from a radioactive waste demineralizer system
- Sluicable filter media (backflushable filter or charcoal bed, tank sediments, etc.) from in-house filter system

Aqueous filter media such as resins, charcoal, and small amounts of tank sediment shall be processed in a final form for storage, transport, or disposal. The federal waste form requirements are defined in 10 CFR 61.56 and Reference 4.2.10. The requirements applicable to this waste form are as follows:

- Liquid content - free standing non-corrosive liquid shall be:
  - Less than 1.0% by volume in a dewatering HIC.
- Packaged waste shall not pressurize with combustible gases from decomposition in accordance with Information Notice 84-72 (Ref. 4.2.19).
- Void spaces must be reduced to extent practicable for disposal:
  - Clive, UT: 15% void maximum.
  - Barnwell, SC: 15% void maximum, unless in HIC or waste is irradiated metal for disposal in slit trench
- Waste shall not have radioactivity loading greater than 1.0E+8 rads.
- HIC usage in accordance with Certificate of Compliance and approved by disposal site.
- Trace amounts of oil shall not exceed 1.0% by volume (Barnwell, SC).
- Chelating agents:
  - Shall be less than 0.1% by weight, or
  - Less than 8.0% by weight when placed into a HIC (Barnwell, SC).

### 8.1.4 Dewatered filter cartridges and wet DAW in a HIC

The HIC dewatering process outlined in Sections 6.1 and 6.2 generates wastes requiring medium or large HICs containing one or more of the following dewatered waste types:

- Filter cartridges from the Fuel Pool Purification system (FAL)
- Filter cartridges from the Chemical and Volume Control system (JEW)
- Filter cartridges from the Coolant Purification system (KBE)
- Filter cartridges from the Nuclear Island Drain and Vent system (KT-)
- Filter cartridges from the Decontamination Equipment for Apparatus and Vessels (FKE)
- Backflush filter media from radioactive waste demineralizer system
- Sluicable filter media from in-house filter system
- Sluicable sediment from tank bottoms

Aqueous filter media such as cartridge filters and wet consumable wastes shall be processed in a final form for storage, transport, or disposal. The federal waste form requirements are defined in 10 CFR 61.56 and Reference 4.2.10. The requirements applicable to this waste form are as follows:

- Liquid content - free standing non-corrosive liquid shall be:
    - Less than 1.0% by volume in a dewatering HIC.
- Packaged waste shall not pressurize with combustible gases from decomposition in accordance with Information Notice 84-72 (Ref. 4.2.19).
- Void spaces must be reduced to extent practicable for disposal:
    - Clive, UT: 15% void maximum.
    - Barnwell, SC: 15% void maximum, unless in HIC or waste is irradiated metal for disposal in slit trench.
- Waste shall not have radioactivity loading greater than 1.0E+8 rads.
- HIC usage in accordance with Certificate of Compliance and approved by disposal site.
- Trace amounts of oil shall not exceed 1.0% by volume (Barnwell, SC).

### 8.1.5 Cement encapsulated filter cartridges in a 55-gallon drum

The filter encapsulation process outlined in Section 6.2 generates 55-gallon drums containing the following waste type:

- Cartridge filters

Aqueous filter media such as filter cartridges shall be processed in a final form for storage, transport, or disposal. The federal waste form requirements are defined in 10 CFR 61.56 and Reference 4.2.10. The requirements applicable to this waste form are as follows:

- Liquid content - free standing non-corrosive liquid shall be:
    - Less than 0.5% by volume in the drum or
    - Less than 1.0% by volume if placed in a HIC over-pack.
- Packaged waste shall not pressurize with combustible gases from decomposition in accordance with Information Notice 84-72 (Ref. 4.2.19).
- Void spaces must be reduced to extent practicable for disposal:
    - Clive, UT: 15% void maximum.
    - Barnwell, SC: 15% void maximum, unless in HIC or waste is irradiated metal for disposal in slit trench.
- Additional requirements for Class B and C wastes (applies also to wastes for Barnwell, SC with > 1.0 $Ci/m^3$)
    - Structural stability may be provided by encapsulation via approved topical and in accordance with the stability guidance in Reference 4.2.27, or
    - Structurally stable container, such as HIC over-pack with burial vault (Barnwell, SC).

- Waste in a HIC over-pack shall not have radioactivity loading greater than 1.0E+8 rads.

- HIC usage in accordance with Certificate of Compliance and approved by disposal site.
- Trace amounts of oil shall not exceed 1.0% by volume (Barnwell, SC).
- Drums greater than 1,000 pounds require special lifting devices (Barnwell, SC).

### 8.1.6 DAW in a Metal Container

The direct packaging, segmentation, or shredding and compaction of DAW outlined in Section 6.3 generates 55-gallon drums, bulk SeaLands, or other appropriately sized containers containing one or more of the following waste types:

- Combustible DAW
- Compressible DAW
- Non-compressible, non-combustible DAW

DAW shall be processed in a final form for storage, transport or disposal. The federal waste form requirements are defined in 10 CFR 61.56 and Reference 4.2.10. The requirements applicable to this waste form are as follows:

- Liquid content: there shall be no free standing non-corrosive liquid. Absorbent material may be added to absorb incidental liquids such as condensation.
- Void spaces must be reduced to extent practicable for disposal:
    - Clive, UT: 15% void maximum.
    - Barnwell, SC: 15% void maximum, unless in HIC or waste is irradiated metal for disposal in slit trench.
- Additional requirements for Class B and C wastes (applies also to wastes for Barnwell, SC with > 1.0 $Ci/m^3$)
    - Structurally stable container, such as HIC with burial vault (Barnwell, SC).
    - Waste in a HIC shall not have radioactivity loading greater than 1.0E+8 rads.
- HIC usage in accordance with Certificate of Compliance and approved by disposal site.
- Drums greater than 1,000 pounds require special lifting devices (Barnwell, SC).

### 8.1.7 Mixed Waste in a Container

The direct packaging or lab-packing of mixed waste outlined in Section 6.5 generates 35-gallon drums, 55-gallon drums, or other appropriately sized containers containing one or more of the following waste types:

- Specification oil
- Non-specification oils and solvents

- Used laboratory chemicals
- Associated DAW

Mixed waste shall be processed in a final form for storage, transport or disposal. The federal waste form requirements are defined in 10 CFR 61.56, and 40 CFR 261. The requirements applicable to this waste form are as follows:

- Liquids shall be transported for offsite processing:
  - Use of over-packs in accordance with 49 CFR.
  - Use of lab-pack for compatible waste may be used.
  - Due to the hazardous constituents, each waste type offered for processing or disposal shall have specific acceptance criteria and written approval from the receiving licensor.
- Solids may be shipped for processing or directly to approved disposal site:
  - Due to the hazardous constituents, each waste type offered for processing or disposal shall have specific acceptance criteria and written approval from the receiving licensor.

## 8.2 Waste Classification

Personnel who classify waste must satisfy the training requirements of 49 CFR 172 Subpart H, and NRC IEB 79-19 (Ref. 4.2.26).

Waste classification is based on the comparison of the radioactivity concentrations in the waste mass to the limits prescribed in Table 1 and 2 limits defined in 10 CFR 61.55 as described in References 4.2.10, 4.2.27, and 4.2.28, and applicable burial site criteria. Each waste packaged for disposal shall be classified and labeled as Class A, B, or C in accordance with 10 CFR 61.57. Greater than Class C (GTCC) waste must receive disposal site approval prior to shipment of the waste for disposal.

Commingled waste types, forms, and batches may be classified either by the highest waste class in the container, or in accordance with the concentration averaging guidelines defined in Reference 4.2.27.

Each packaged waste shall be classified based on the total radioactivity per radionuclide and waste mass. Encapsulated filter cartridges may follow the alternate encapsulation mass classification guidelines in Reference 4.2.27, if encapsulated to provide stability, with an approved Topical Report.

Typical dose-to-activity models may be used to convert radiation survey data into total radioactivity. The hard-to-detect radionuclides may be scaled via the predominant gamma emitters identified by onsite spectroscopy with the use of sample analyses results from offsite laboratories. Direct sampling results from representative homogenous waste media may also be used to determine gamma radioactivity concentrations.

Direct sampling shall be representative of each waste form.

When package waste characterization is performed using sample analysis results from homogeneous wastes, scaling factors used for hard-to-detect radionuclides should be based on the following criteria:

- Activation products and C-14 should be scaled from Co-60 measured activities
- Fission products should be scaled from Cs-137 measured activities

- Transuranics should be scaled from Ce-144 measured activities
- In the absence of Ce-144, Cs-137 may be substituted
- In the absence of Cs-137, Co-60 may be substituted
- Default to the reactor coolant concentration if H-3 is scaled higher than that value

When package waste characterization is performed using dose-to-activity models, the radionuclide distribution is typically a constant.

The hard-to-detect radionuclide distribution shall be verified for each waste stream (unique radionuclide distribution) when changes in facility equilibrium are suspected or at a minimum frequency of (Ref. 4.2.28):

- Every two years for typical Class A wastes such as DAW
- Each fuel cycle for typical Class B and C wastes such as aqueous filter media and liquid concentrates

Typical radionuclides used in classification for disposal and transportation are based on the following minimum criteria:

- Listed radionuclides greater than or equal to 1% of the Class A limits in 10 CFR 61.55 Tables 1 and 2
- Radionuclides greater than or equal to 1% of the total radionuclide inventory
- Radionuclides greater than or equal to 1% of the Reportable Quantity limits listed in 49 CFR 172.101
- Real or lower limit of detection (LLD) values for H-3, C-14, Tc-99, and I-129

Suspected mixed waste shall further be characterized for hazardous substances by process knowledge (such as in Material Safety Data Sheets) or direct sampling and analyses.

Non-routine generated waste will be sampled individually. Based on the gamma emitter distributions and/or concentrations, a determination is made whether to send the sample for further hard-to-detect analysis or use appropriate existing waste stream analysis results. The determination will use the guidance criteria in References 4.2.27 and 4.2.28.

## 8.3 Disposal and Processing Facility WACs

The Barnwell site criteria also require that Class A waste be divided into and labeled Class A-unstable (AU) waste or Class A-stable (AS) waste. Class AU waste has a concentration of greater than 5-year half-life radionuclides of less than 1.0 μCi/cc and Class AS waste has a concentration of greater than 5-year half-life radionuclides of greater than or equal to 1.0 μCi/cc. Class AS waste requires the additional package stability requirements of 10 CFR 61.56(b). Based on the classification driven packaging requirements, drum dried waste and DAW may require HIC over-packing to provide additional stability.

The Clive waste acceptance criteria also require that all waste is pre-approved prior to disposal.

Applicable disposal site or processor facility waste acceptance criteria shall be met prior to shipment. Each facility has specific requirements for waste form, characterization, packaging, waste/shipment notifications/approvals and documentation. A copy of the facilities current license and WAC shall be on file and used to ensure compliance.

## 8.4 Transportation Characterization and Packaging

Transportation category, packaging, and shipment record requirements are defined in 10 CFR 71 and 49 CFR 171 through 178. Personnel who package waste must satisfy the training requirements of 49 CFR 172 Subpart H and NRC IEB 79-19 (Ref. 4.2.26).

Waste characterization is based on the radionuclide inventory and waste mass consistent with the waste classification results. Waste characterized for transport must meet the following additional criteria:

- In a form acceptable for receipt license
- Type determination in accordance with 10 CFR 71 or 49 CFR 173
- If applicable, sub-type determination in accordance with 49 CFR 173
- Reportable quantity determination in accordance with 49 CFR 172
- If applicable, special nuclear material (SNM) determination in accordance with 10 CFR 71

Each package shall be properly marked and labeled according to the characterization results.

Packaging requirements are prescribed by transportation Type, Sub-type, and radiological profile for the following packages:

- HIC: conforms to Certificate of Compliance
- Strong-tight package: meets definition prescribed in 49 CFR 173.410
- Industrial Package (IP): meets the definition for IP-1, IP-2, IP-3 prescribed in 49 CFR 173.411
- Type A package: meets the definition prescribed in 49 CFR 173.412
- Type B package:
    - meets the definition prescribed in 10 CFR 71
    - Conforms to Certificate of Compliance
- Specification package: mixed waste has additional container specifications based on hazard class

## 8.5 Shipping and Manifest Requirements

Waste offered for shipment shall comply with the following regulations:

- 10 CFR 20.2006, 2007, & Appendix G
- 49 CFR 171 through 178
- 40 CFR 263

Shippers must satisfy the training requirements of 49 CFR 172 Subpart H and NRC IEB 79-19 (Ref. 4.2.26). Training shall be recorded at a minimum frequency of every three years.

In addition, waste offered for shipment shall meet applicable pre-requisites:

- HIC Certificate of Compliance documentation
- Cask User List member and handling procedures
- Destination site's radioactive material license and/or Treatment Storage or Disposal Facility (TSDF) permit is on file to ensure material can be received
- Processors used have a {CCNPP Unit 3} approved PCP
- Approval of any waste acceptance documentation
- Record of any shipment pre-notifications to applicable states and sites
- Packages and transport vehicle properly marked and labeled

Waste offered for shipment shall be manifested using properly prepared NRC Uniform Waste Manifests, Forms 540 – 542, or equivalent (Refs. 4.1.1, 4.2.3, and 4.1.15).

Special Nuclear Material (SNM) offered for transport shall also be accompanied by a properly prepared NRC 741 Form (Ref. 4.1.2).

Processed waste with the potential for combustible gas build up packaged in HICs with passive vents and shipped in secondary containers such as casks shall conform to the shipment duration requirements outlined in the HIC or Cask Certificate of Compliance.

Mixed waste offered for transport shall also be accompanied by a properly prepared EPA or State equivalent waste manifest in addition to the radioactive shipment record or manifest (Ref. 4.1.7).

Each destination facility may have specific requirements for the marking, labeling, and documentation to accompany the shipment.

## 8.6 Non-Compliance

Processed waste not meeting the acceptance criteria shall be reprocessed until the PCP acceptance criteria are met. Onsite or offsite vendor services may be procured for the purposes of processing to meet PCP acceptability criteria.

If waste cannot meet acceptance criteria, a variance request may be initiated to the applicable disposal facility. No waste shall be shipped for disposal until PCP acceptance criteria are met or an approved variance request is granted.

Mixed waste not meeting the acceptance criteria may be stored until future processes are identified. A conditional exemption should be filed in accordance with 40 CFR 266.

In accordance with Generic Letter 91-02 (Ref. 4.2.18), the NRC suggests that a voluntary submittal of information regarding waste-form mishaps be reported within 30 days of the incident to Director of the Division of Low-Level Waste Management and Decommissioning. Processed waste forms shipped for disposal found to be in non-compliance by the disposal facility or waste forms exhibiting the following mishaps will be reported:

- The failure of HICs used to ensure a stable waste form.  Container failure can be evidenced by changed container dimensions, cracking, or damage resulting from mishandling (e.g., dropping or impacting against another object).

- The misuse of HICs, evidenced by a quantity of free liquid greater than 1 percent of container volume, or by an excessive void space within the container.

# 9.0 ADMINISTRATIVE CONTROLS

In this section of the PCP, the administrative controls associated with the control and implementation of this document and the records produced from the operation of the solid waste treatment processes described in Section 6.0 are described. In addition, the principals of the operation of these processes are described in this section. These principals act as a placeholder for the listing of the implementing procedures which will be produced at a latter date. Finally, a description of the Radioactive Effluent Release Report is provided in this section showing how the solid wastes contribute to this report.

## 9.1 Responsibilities

The organization and responsibilities of site personnel at {CCNPP Unit 3} are as follows:

Radiation Protection and Chemistry Manager

- Overall responsibility for assuring low-level radioactive waste is packaged and prepared for disposal in accordance with applicable federal, state, and burial site requirements
- Ensure a training program is developed, implemented, and maintained for plant personnel involved in processing, packaging, and handling of radioactive waste (e.g., per 49 CFR 172.602)
- Owner and administrator of this PCP which includes reviewing and approving revisions (per Section 11.4) and supporting site compliance with this PCP

Chemistry Supervisor

- Preparation, review, and approval of implementing procedures for radioactive waste characterization and classification
- Ensuring radioactive waste is characterized and classified
- Maintaining records of onsite and offsite sample analyses of waste streams, waste processing (onsite and offsite), waste characterization, waste classification, and final waste disposal
- Assuring vendors processing low-level radioactive wastes maintain an approved QA program and procedures to perform the processing
- Ensuring only trained personnel are involved with processing, packaging, handling, characterizing, and classifying of radioactive wastes
- Ensuring training is provided upon initial employment or change in job responsibilities (within 90 days) and, at a minimum, every three years thereafter
- Ensuring mixed waste is appropriately collected, inspections are quarterly or more frequent
- Ensuring mixed waste is appropriately stored, inspections are quarterly or more frequent (per 40 CFR 266.230)
- Performs an annual inventory of the mixed waste (per 40 CFR 266.230)
- Ensuring proper personnel are trained in chemical waste management and hazardous materials incident response (per 40 CFR 266.230)

- Maintains an emergency plan (per 40 CFR 266.230)

Radiation Protection Supervisor

- Directs performance of waste stream sampling
- Evaluates sample results
- Maintains the records of the waste stream sample results
- Evaluates and directs sampling for unusual waste streams
- Assures the most up to date sample data is used to classify waste

## 9.2 Principles of Operation

The solid waste system program provides guidance as to the classification and characterization of the various radioactive waste forms associated with {CCNPP Unit 3} and the treatment and processing of these radioactive wastes. The solid waste system procedures provide directions for processing, packaging, storage, and radiological assessment of the various wastes in advance of transport for disposal or transfer to a licensed radioactive waste processor.

The solid waste system procedures for waste collection, processing, packaging, sampling, radiation survey, and storage are for the most part performed by automated systems and require minimal direct handling of radioactive waste material by site personnel.

Implementing procedures shall be developed, approved, and maintained for performing the activities in support of the PCP. Examples of functions included in site specific implementation procedures are:

- Sampling of Radioactive Waste for Determination of Waste Classification and Characterization
- Scaling of Difficult to Measure Radionuclides
- Operation of the Radioactive Liquid Waste Storage System, KPK
- Operation of the Radioactive Liquid Waste Processing System, KPF
- Operation of the Automated Filter Change-Out System, KPD
- Operation of the Automated Resin Flushing System, KBE
- Collection, Handling, Packaging, Transfer, and Temporary Storage of Solid Waste
- Segregation of Solid Wastes Prior to Processing
- Formulation of Radioactive Waste Batches for Processing
- Chemical Treatment of Wastes Prior to Processing
- Operation of the Drum Transport System
- Operation of the Concentrates Processing System
- Operation of the Drum Dryer for Drying Wet Solid Waste

- Operation of the Automated Drum Radiation Measuring System
- Operation of the Drum Sampling System
- Waste Package Assessment and/or Verification of Waste Packages Prior to Storage, Transfer for Offsite Processing, or Transport for Disposal
- Operation of the Solid Waste Storage System (e.g., drum storage crane)
- Operation of the Radioactive Liquid Waste Filter and Demineralizer System
- Filter Media Change-Out of Radioactive Liquid Waste Filter and Demineralizer System
- Resin Change-Out of Radioactive Liquid Waste Filter and Demineralizer System
- Processing (e.g., dewatering and filling) of vendor supplied HIC (vendor specific)
- Preparation of Radioactive Material for Shipment Including Preparation of Radioactive Waste Manifests, Shipping Papers, Notifications, Shipment Security, Container Specifications and Inspections, Vehicle Inspections, Proper Loading and Shoring of Shipments, and Radiation Surveys

## 9.3 Radioactive Effluent Release Reports

In accordance with 10 CFR 50.36a, the Radioactive Effluent Release Report covering the operation of the unit shall be submitted by May 1$^{st}$ of each year. The Radioactive Effluent Release Report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21 (Ref. 4.2.4) with liquid and gaseous data summarized on a quarterly basis following the format of Appendix B thereof. For solid wastes, the format for Table 3 of Appendix B of Regulatory Guide 1.21 (Ref. 4.2.4) shall be supplemented with three additional categories: class of solid waste (as defined by 10 CFR Part 61), type of container (e.g., LSA, Type A, Type B, Large Quantity), and solidification agent or absorbent, if any. The annual Radioactive Effluent Release Report shall also include any changes made during the reporting period to the PCP and the ODCM (pursuant to Technical Specification 5.5.1 of the US EPR FSAR), as well as any major change to Liquid, Gaseous, or Solid Radwaste Treatment Systems pursuant to ODCM Section 4.4.

## 9.4 Records

Records documenting the information necessary to demonstrate compliance with the regulatory guidance and requirements addressed by the PCP are the product of its implementing procedures. Records produced are as follows:

- Training of individuals performing work activities associated with the PCP and implementing procedures.
- Records demonstrating procurement of qualified goods and services used to support the PCP.
- Records pertaining to waste form, classification, and characterization including results of analysis on which hard to detect radionuclide scaling factor ratios are based.
- Waste volume generated by form and type.
- Mixed waste composition and volume (e.g., per 40 CFR 266.250).

- Waste batch identification, formulation, treatment/process, and packaging.
- Waste package inspection, sampling and testing to verify package preparation in compliance with disposal site or offsite processor acceptance criteria (e.g., per COMAR 26.12.01.01).
- Waste package preparation that fails to meeting acceptance criteria and corrective actions initiated to address this condition.
- Waste package radiological assessment (i.e., dose rates and surface contamination levels).
- Waste package inventory and tracking by storage location.
- Waste Shipping: uniform radioactive waste manifests (per NUREG/BR-0204), notifications, security, vehicle inspection, proper loading and shoring, and radiological surveys (e.g., per 10 CFR 20.2006, 10 CFR 71.91 and 71.97, 40 CFR 266.250, 49 CFR 172.201, and 49 CFR 173.433).
- Records pertaining to changes to this document (e.g., per Ref. 4.2.17)

All records will be retained until termination of the license in accordance with 10 CFR 20.2108.

## 10.0 RADIATION CONTROLS AND MONITORING

The Radioactive Waste Processing Building is equipped with a radiation monitoring system which provides local readouts as well as audible and visual alarms to alert operating personnel to exposure rates. The monitoring system is also designed to display data to the main control room and provide indication and alarms to the main control room and health physics office.

Waste processing activities are designed to minimize dose. For liquid wastes, dose is kept to a minimum by segregating liquid wastes by category and processing these wastes remotely. Dose is reduced in the gaseous waste processing system by placing the components into well-shielded separate cubicles and locating the controls for the system remotely from the gaseous sources. The solid radioactive waste storage area is designed with strategically placed concrete columns to prevent radiation streaming from the individual drums from becoming additive. Permanently installed equipment provides remote handling of radioactive material. Any processing using vendor-supplied equipment will be performed in a room with sufficient volume to contain a postulated spill with a floor drain routed to the liquid radioactive waste system.

All liquid and gaseous radioactive waste discharges are sampled and monitored prior to their release to the environment as prescribed in the ODCM. The ODCM also provides calculation of the gaseous and liquid effluent monitoring alarm and trip setpoints as well as details on the radiological environmental monitoring program (REMP).

# 11.0 ADMINISTRATION OF THE PCP

This section outlines the actions and responsibilities to prepare and process a revision to the PCP.

## 11.1 Responsibilities

**11.1.1** The Radiation Protection and Chemistry Manager is responsible for maintaining and revising the PCP.

**11.1.2** The Radiation Protection and Chemistry Manager is responsible for sending to the NRC, as part of the annual Radioactive Effluent Release Report, any changes made to the PCP. The discussion of each change shall contain:

- A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR Part 50.59;
- Sufficient detailed information to support the reason for the change without benefit of additional or supplemental information;
- A detailed description of the equipment, components, and processes involved and the interfaces with other plant systems;
- An evaluation of the change, which shows the quantity of solid waste that differs from those previously predicted in the license application and amendments thereto;
- A comparison of the predicted quantity of radioactive waste, to the actual quantities for the period prior to when the changes are to be made;
- An estimate of the exposure to plant operating personnel as a result of the change; and
- Documentation of the fact that the change was reviewed and found acceptable by the Plant Manager.

If no changes were made during the year, a statement to that effect is made.

**11.1.3** Records Management is responsible for maintaining the official records and complying with document retention requirements.

## 11.2 Preparer

**11.2.1** The preparer shall revise the PCP to be consistent with the requirements in the technical specifications, the documents listed in Sections 4.1 and 4.2, including SRP Sections 11.4 and 11.5, BTP 11-3, 10 CFR Parts 20, 61, and 71, 49 CFR Parts 171-180, state regulations, disposal and process facility waste acceptance criteria, and other requirements governing the disposal of solid radioactive waste.

**11.2.2** The preparer shall:

- Verify that all requirements reviewed in 11.2.1 are met.
- Update the revision history with changes, additions, or deletions and reason for the revision.

- Update the list of effective pages.
- Resolves all comments received from reviewers.

## 11.3 Reviewer

**11.3.1** The proposed revisions to the PCP shall be reviewed by the Radiation Protection and Chemistry organization.

**11.3.2** The reviewer(s) shall:

- Verify the accuracy and validity of the revision, using the requirements listed in 11.2.1.
- Identify changes needed to existing implementing procedures.
- Provide comments to the preparer.

## 11.4 Approval

The Radiation Protection and Chemistry Manager approves revisions to the PCP and forwards for further approvals. Changes to the PCP shall become effective upon approval by the Plant Manager.

## 12.0 REFERENCES

[1] UniStar Nuclear Topical Report No. UN-TR-06-001-A, “Quality Assurance Program Description,” Revision 0.