Radiological Design Summary Report

For

TRU Vent and Purge Process

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LIST OF ACRONYMS

Acronym / Abbreviation	Definition
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
CA	Contamination Area
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
DAC	Derived Air Concentration
DBA	Design Basis Accident
DOE	Department of Energy
HDBK	Handbook
HEPA	High-Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
NUREG	Nuclear Regulatory Commission-produced guide
PCM	Personnel Contamination Monitor
PSAR	Preliminary Safety Analysis Report
RadCon	Radiological Control
RBA	Radiological Buffer Area
RCO	Radiological Control Organization
RPS	Radiological Protection Section
RT	Radiological Technology
SRS	Savannah River Site
SW	Solid Waste
TEDE	Total Effective Dose Equivalent
TSD	Treatment, Storage, and Disposal
TRU	Transuranic Waste
WSRC	Westinghouse Savannah River Company

1.0 INTRODUCTION

Manual WSRC-TM-95-1, Engineering Standard Number 01064, presents the radiological design criteria and requirements, which must be satisfied for all SRS facility designs. The radiological design criteria and requirements specified in the standard are based on 10CFR835, DOE Order 420.1, the WSRC Manual 5Q, other applicable standards, and various DOE guides and handbooks.

This report contains top-level requirements for the various areas of radiological protection for workers. Detailed quotations of the requirements for applicable regulatory documents can be found in the accompanying Implementation Guide. For the purposes of demonstrating compliance with these requirements, per Engineering Standard 01064, *shall consider* / *shall evaluate* indicates that the designer must examine the requirement for the design and either incorporate or provide a technical justification as to why the requirement is not incorporated.

The Transuranic Vent and Purge process is not a project, but is considered a process change. This process has been performed successfully by Solid Waste on lower activity TRU drums. This summary report applies a graded approach and describes how the Transuranic Vent and Purge process meets each of the applicable radiological design criteria and requirements specified in Manual WSRC-TM-95-1, Engineering Standard Number 01064.

1.1 Process Description

Many high activity TRU waste drums require venting and purging to maintain their atmosphere in compliance with the WIPP Waste Acceptance Criteria. This process is carried out with the vent and purge equipment on TRU Pads.

The Vent and Purge system is a drum-intrusive process that purges the gas space in a TRU waste drum and installs a filter to maintain the internal atmosphere below the WIPP Waste Acceptance Criteria. Since the potential for an explosive atmosphere inside an unvented or undervented drum exists, the process is performed remotely inside a HEPA-filtered glovebox and drum chamber that has been designed to withstand a hydrogen/air deflagration. The drums will be placed one at a time in the chamber of the vent and purge machine on a drum cart for processing. The chamber is closed and sealed and the operator inserts a drill bit/vent into the drilling head. The drum is lifted to seal the drum lid against the sampling dome. A nitrogen blanket is applied to eliminate the possibility of ignition. A hole is drilled to a specified depth and the drum headspace gas is sampled. If the sample results are below the flammability criteria, a filter is installed and drum is removed from the chamber and staged for additional characterization. If the flammability criteria are not met the drum is purged with nitrogen and sampled again until the satisfactory results are achieved. High curie drums will require the installation of multiple vents/filters. The chamber is opened, a RadCon survey performed, and the drum is removed from the chamber.

1.2 Facility Description

The Vent and Purge processing of high activity TRU waste drums will be performed in E-Area, inside the RUBB (fabric weather cover) on a TRU pad. Drums to be processed will be staged in the vicinity of the Vent and Purge machine.

1.3 Facility Conditions

1.3.1 Normal Operations

Operation of the V&P process is a day operation. Initially, V&P will operate four days per week, ten hours per day (a 4-10 shift) through the end of September 2003. Beginning in October 2003, the V&P will operate seven days per week, twelve hours per day (X3 and X4 shifts) through the remainder of the inventory processing. During the 4-10 shift operations, V&P is targeted to process 40 drums per week. When V&P moves to twelve hour shifts, the throughput is expected to increase to 70 drums per week. Based on these processing goals, the 4650 drum inventory should be complete by mid-November 2004. Initial staffing will consist of three operations personnel and one RCO inspector. The RCO inspector will be dedicated to covering V&P operations only. When V&P transitions to twelve-hour shifts in October 2003, staffing per shift will remain the same, but there will be two shifts operating V&P.

1.3.2 Shutdown Operations

This operation is expected be a day operation with the V&P process operating one shift per day. The V&P machine will be empty at the end of each shift. V&P ventilation will remain in operation 24 hours a day, 365 days per year unless the system must be secured for maintenance.

1.3.3 Maintenance Operations

Maintenance activities will be conducted as necessary and with the proper RadCon requirements in force. Some expected maintenance items, which may require ventilation shutdown, would include main HEPA change out, fan repairs, or damper repairs. Prior to ventilation system shutdown, the glovebox and drum enclosure will be decontaminated if necessary. This will minimize the possibility of contamination spread. The main exhaust HEPA filters are bag-in / bag-out type filters.

1.3.4 Transient Operations

If contamination is detected outside the drum after V&P processing is completed, the drum will be decontaminated prior to its removal from the drum enclosure. Based on previous operating experience with venting low activity drums, this condition is expected to occur on a low frequency basis. Some drums will require special handling after installation of the vent due to H_2 bounce-back. These drums will be staged in a separate area from the V&P process until it is safe to move them.

1.3.5 Postulated Events and Accident Conditions

The bounding radiological design basis accident is a deflagration inside the drum while in the containment enclosure. Any accident that could occur during V&P processing is bounded by design basis accidents documented in the SW Safety Analysis Report.

2.0 DESIGN REQUIREMENTS

This section presents the technical basis for how the design ensures compliance with applicable requirements for each process condition, including normal, shutdown, maintenance, transient, and postulated events and accidents.

2.1 Radiation Exposure Limits

Per SRS Engineering Standard 01064:

Design features shall ensure that individual worker total effective dose equivalent (TEDE) is As Low As Reasonably Achievable (ALARA) and less than 1000 mrem per year. The remaining radiation exposure design limits shall be ALARA and shall not exceed 20 percent of the regulatory limits in 10CFR835. A total of 2000 hours shall be used as worker stay times for areas of continuous occupancy. Table 2-1 summarizes the design basis radiation exposure limits.

Table 2-1 - Design Basis Annual Radiation Exposure Limits

Type of Exposure	Limit (rem)
Whole Body TEDE (internal + external)	1.0
Internal CEDE	0.1
Lens of Eye	3
Extremity	10
Organ (other than eye) or Tissue	10

The dose to any member of the public or a minor exposed to radiation at a DOE facility shall not exceed 0.1 rem total effective dose equivalent in a year.

Due to the wide variety of isotopes and range of radioactivity contained in the drum inventory, dose rates among the drums will vary significantly. More than half of the drums to be processed are expected to have whole body dose rates less than 5 mrem/hr @ 30cms (lower limit for posting a Radiation Area). The inventory also indicates that there will also be drums that are radiating greater than 100 mrem/hr @ 30cms (lower limit for posting a High Radiation Area). RadCon and Operations will manage the fluctuating dose rates in the work area and drum staging area on a daily basis to ensure proper access control and posting of the areas are maintained. From a contamination controls perspective, the operating area is expected to be maintained at Radiological Buffer Area (RBA) contamination levels.

2.2 Facility and Equipment Layout

Per SRS Engineering Standard 01064:

Facility layout shall be based on segregation of facility functional areas.

The glovebox operating area will be segregated from the drum staging area in order to maintain personnel doses ALARA.

2.3 Access Control

Per SRS Engineering Standard 01064:

Minimizing the number of entry points into a Radiological Buffer Area (RBA) shall be considered such that appropriate qualifications can be checked and access controlled. Within the RBA, appropriate entry control features shall be established for each radiological area per [10CFR835]. The degree of control shall be commensurate with

existing and potential radiological hazards within the area. All radiological access control features shall be consistent with the site radiological access control program.

Control of access to Vent & Purge where radioactive materials are present is achieved through existing Solid Waste operating procedures, Site Radiological Work Permit and radiological posting programs, and access control for E-Area facilities.

The V&P operating and staging areas will be clearly demarcated and posted as a radiological area, for which entry is controlled by Radiological Work Permit. During off-hours, i.e. not during normal daytime work hours, entry into the Solid Waste Management Facility (SWMF) is controlled by a physical barrier. The entire SWMF is surrounded by fencing with locked gates. If personnel are working during off-hours, they must notify the EDO, giving their name, work location, and purpose for entry in the SWMF. Additionally, to gain access to the SWMF, they must obtain a gate key or access code from the Shift Manager prior to the end of the normal day shift.

2.4 External Radiation Exposure

This section deals with external radiation exposures and addresses whether engineered design features are required to limit worker exposures to ALARA below the Table 2-1 external exposure limits.

2.4.1 Area Radiation Levels

Per SRS Engineering Standard 01064:

Compliance with the ALARA principle and the regulatory dose limits is accomplished in part by designing radiological portions of the facility to meet predetermined maximum area radiation dose rate levels. The radiation zoning criteria for the facility is given in Table 2-2.

Table 2-2 Radiation Zoning Criteria

Radiation Zone	Design Basis Maximum Area Radiation Dose Rate (mrem/hr)	Description
1	D≤0.05 (@30cm)	Non-Rad Continuous Occupancy
2	0.05<D≤ 0.5 (@30cm)	Rad-Worker Continuous Occupancy
3	0.5<D≤ 5 (@30cm)	Intermittent Occupancy RBA
4	5<D≤ 100 (@30cm)	Radiation Area
5	100<D@30cm and D≤500,000 mrad/hr@100cm	High Radiation Area
6	D> 500,000 mrad/hr (@100cm)	Very High Radiation Area

Since a “facility” was not being constructed and the drums are shielded by the 1-in. thick steel walls (for deflagration/explosion protection) of the V&P machine, specific area target design dose rates were not utilized. Operating and staging areas will be barricaded to prevent inadvertent access by non-radiological workers. There will be a mixture of drums with dose

rates ranging from no detectable to High Radiation Area when the drums are outside the glovebox.

2.4.2 Radiation Shielding

Per SRS Engineering Standard 01064:

Radiation shielding may be designed using any applicable method. The selection of material properties of all shielding materials, as used in the analysis, shall be made such that the calculation results are conservative.

For glovebox designs, shielding for radiation sources inside the glovebox shall be considered in addition to glovebox structural shielding. In addition, shield covers or plugs shall be supplied for each gloveport with shielding equivalent to the glovebox if the potential exists that material in the glovebox will cause dose to personnel other than those directly handling the sources during processing operations.

Based on the TRU Vent and Purge Operations Dose Assessment Baseline [25] calculations, operator and RadCon inspector doses will be less than the design limit of 1000 mrem/yr. Therefore, no additional shielding is required to meet design whole body dose limits or eye exposure dose limits. Conservatively assuming hands-on-the-drum working time of 10 minutes per drum, and an average contact dose rate of 44 mrem/hr, the maximum extremity dose to the hands is estimated to be 2.29 rem for CY03 and 3.98 rem for CY04. These values are less than the design limit of 10 rem.

In order to control area dose rates to facilitate unrestricted movement around the staging area, lead blankets may be hung on racks around the storage if drum dose rates require it. Additional shielding of the glovebox / drum enclosure is judged to not be Safe Mission Essential or cost effective for the small dose savings it would achieve beyond the existing steel blast shield. Higher dose rate drums can be shielded with wrap-around blankets composed of lead during manual drum handling steps if extended handling tools are not available.

2.4.3 Penetrations

Per SRS Engineering Standard 01064:

Straight-line penetrations of shield walls shall be avoided to the extent necessary to prevent radiation streaming. All penetration configurations in radiation shield walls shall be evaluated to ensure compliance with the radiation zone criteria. Higher, localized dose rates will require a case-by-case approval by the Radiological Technology Group of RPS.

The design shall consider guidance from [HDBK-1132-99] Part II Section 1.4.3 on radiation shielding penetration seals and shall incorporate requirements from [Engineering Standard 07270, Installation and Inspection of Penetration Seals [1]].

[1] Engineering Standard 07270 provides the requirements for materials, installation, repair, inspection, and documentation of penetration seals. This standard does not address seals for exterior walls, roofs or glove box penetrations.

This requirement is not applicable to V&P since there are no shield wall penetrations.

2.4.4 Extremity And Eye Protection

Per SRS Engineering Standard 01064:

> Specialized tools and remote handling equipment, such as remote manipulators, shall be considered where it is anticipated that exposures to extremities and eyes would otherwise approach the dose limits in Table 2-1 or where contaminated puncture wounds could occur.

Per the Consolidated Hazards Analysis Report for the V&P process [26], event VP-16 addresses the hazard of the drilling head damaging the glovebox gloves resulting in laceration to the glove and/or the worker's hands. This event is caused by the drill inadvertently being turned on while an operator is installing a bit or maintenance is being performed. Mitigation of this hazard is through administrative control which requires the same operator installing a bit also be the same operator controlling operation of the drill. During maintenance, the drill operation would be locked out to prevent inadvertent operation of the drill. Additionally, operators working through the gloves will be required to frisk for contamination upon removing their hands from the gloves.

2.5 Internal Radiation Exposure

Per SRS Engineering Standard 01064:

> The design shall ensure that respiratory personnel protective equipment is not required to meet the dose limits for operations including normal, shutdown, maintenance, transient, and postulated events and accidents. Engineered controls and features shall be provided to minimize potential inhalation of radioactive and other hazardous material under all operating conditions.

Internal dose potential to workers was assessed and documented in S-CLC-E-00153 [28]. This calculation showed that under normal and upset operating conditions, V&P could process the entire drum inventory without respiratory protection, containing up to 727 Plutonium Equivalent Curies (PECs) of activity without reaching the 100 mrem CEDE limit. The expected CEDE (for a process upset [28]) would be 5 mrem and 70 mrem for processing the average 52 PEC drum and the maximum 727 PEC drum, respectively.

2.6 Radiological Monitoring Systems

Per SRS Engineering Standard 01064:

> Radiological warning and alarm systems shall be designed, installed, and tested to ensure that they can be heard in the ambient condition of the area they are intended to cover. All radiological alarm systems required for personnel protection shall annunciate inside and outside the affected area to identify hazardous condition to anyone inside or outside in the vicinity of the affected area. All radiological alarms shall be provided with both audible and visual signaling systems. The audible alarm shall have the capability to be acknowledged while the visual alarm remains.

In addition to a local station alarm, radiation monitoring system signals in new facilities shall have central (e.g. control room or radiation monitoring office) read-out and alarm panels that are accessible after anticipated events to evaluate internal conditions. For modified facilities, the use of central read-out and alarm panels shall be considered.

For glovebox design, the use of an audible and visual alarm that can be manually activated (e.g. foot pedal, within glovebox trouble button, etc.) to signal radiological problems without removing one's arms from the glovebox shall be evaulated. The alarm shall occur in continuously occupied areas, identify the room of concern, and be uniquely identifiable versus other alarm signals.

There are no installed radiological or ventilation alarms. There are differential pressure (DP) gauges on the three HEPA filters in the exhaust train, the glovebox, and drum containment cabinet. Operators are procedurally required to verify appropriate DPs exist prior to the loading and unloading of a drum at the containment cabinet. The need for a manually activated glovebox trouble alarm was evaluated and determined to not be necessary since operators will not be alone at any time while they are working in the glovebox.

2.6.1 Airborne Sampling and Monitoring

Per SRS Engineering Standard 01064:

Air sampling shall be performed in occupied areas where an individual is likely to be exposed to 40 DAC-hrs over a one year period of airborne radioactive material. Guidance on placement of samplers, in order to comply with the SRS program, is given in *The Savannah River Site Workplace Air Monitoring Technical Basis Manual.* The design shall also evaluate particulate line loss as necessary between the sampling location and sample collection media.

Continuous air monitoring equipment shall be installed in occupied areas as necessary to detect and warn personnel of airborne radioactive material concentrations which could result in exceeding Section 2.1 dose limits prior to detection by sampling. Guidance on placement of monitors, in order to comply with the SRS program, is given in *The Savannah River Site Workplace Air Monitoring Technical Basis Manual*. The design shall also evaluate particulate line loss as necessary between the monitoring location and sample collection media.

Per 10CFR835.403 (a) and (b):

(a) Monitoring of airborne radioactivity shall be performed: (1) Where an individual is likely to receive an exposure of 40 or more DAC-hours in a year; or (2) as necessary to characterize the airborne radioactivity hazard where respiratory protective devices for protection against airborne radionuclides have been prescribed.

(b) Real-time air monitoring shall be performed as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material.

Since the maximum postulated internal dose due to airborne radioactivity released from the drum enclosure is less than 100 mrem CEDE (40 DAC-hrs), continuous air monitors (CAM) are

not required. Portable retrospective air samplers will be positioned around the V&P work area to characterize any potential airborne radioactivity. Since there are no DP alarms, a retrospective air sampler will be appropriately positioned to monitor for any airborne radioactivity increases in the V&P exhaust in the event that any one of the three HEPA filters (in-series) breaks through.

2.6.2 Personnel Contamination Monitoring

Per SRS Engineering Standard 01064:

> The design shall provide for the monitoring of occupational workers in work areas where radioactive materials (other than tritium only) are stored and handled. Appropriate whole body personnel contamination monitoring equipment shall be provided at the exit from all Contamination and Radiological Buffer Areas where potential for contamination (other than tritium only) exists, to prevent the spread of contamination.

Since RCO will be providing continuous coverage of the V&P processing, RCO will frisk personnel out of the operating and staging areas as appropriate. Personnel will then proceed to the PCM-1B installed on the TRU Pad for whole body contamination monitoring.

2.6.3 Area Radiation Monitoring

Per SRS Engineering Standard 01064:

> Area radiation monitors shall be installed in occupied locations with the potential for an unexpected increase in dose rates and in locations where there is a need for local indication of dose rate prior to personnel entering remote locations.

RCO surveys the drums prior to them being delivered to the V&P staging area. RCO will be present to monitor dose rates at the staging area and in the V&P operating area. There is nothing in the V&P processing that could cause external dose rates to suddenly increase. Therefore, there is no need for Area Radiation Monitors.

2.7 Personnel Decontamination

Per SRS Engineering Standard 01064:

> The facility shall provide for a personnel decontamination facility close to the area that represents the source of potential contamination. The use of nearby, existing decontamination resources shall be considered.

There are no dedicated personnel decontamination facilities in E-Area. If personnel become contaminated, the action taken would depend on the extent of contamination. Limited decontamination capabilities are available in E-Area for minor contamination cases. In case of

significant contamination, E-Area has an MOU (SWI-03-001) with Liquid Waste Disposition to use the Effluent Treatment Facility (ETF) decontamination facility. This will require dressing the contaminated individual appropriately and transporting them to ETF. If an injury with contamination occurred, the individual would be transported to Eisenhower Medical Center for decontamination and treatment.

2.8 Facility Operations, Maintenance, Decontamination, and Decommissioning

Per SRS Engineering Standard 01064:

The design or modification of a facility and the selection of materials shall include features that facilitate operations, maintenance, decontamination, and decommissioning.

The facility design shall incorporate measures to simplify decontamination of areas that may become contaminated with radioactive or hazardous materials.

The V&P glovebox and drum enclosure are constructed of steel to facilitate ease of decontamination.

2.9 Locker Rooms / Change Areas

Per SRS Engineering Standard 01064:

Men's and women's change rooms shall be provided for changing into and out of modesty clothing if areas within the facility will require work in protective clothing on a routine basis. The use of nearby, existing change rooms shall be considered. Change areas for the removal of protective clothing shall be provided at the exit of areas that have the potential to become contaminated. These areas shall provide space for protective clothing removal and personnel monitoring. These areas shall ensure that storage of contaminated clothing will control contamination so that it does not spread beyond the storage container.

Modesty clothing is utilized underneath protective clothing. Therefore, full change facilities are not necessary at V&P. A dress out area will be provided at the entrance to the V&P work area. This area will provide appropriate storage containers for contaminated protective clothing. Upon exiting the V&P work area, a PCM-1B is located southeast of V&P on TRU Pad 6, is available for monitoring personnel for contamination. Shower facilities are also available in 724-7E.

2.10 Breathing Air Systems

Per SRS Engineering Standard 01064:

Operations and maintenance of special facilities may lead to situations (e.g., accidents, special maintenance, spill recovery) where air-supplied respiratory protection is required. For modifications, the use of existing breathing air manifolds shall be considered.

If air-supplied respiratory protection were to be required for special maintenance or accident recovery, a portable breathing air compressor would be brought to the vicinity of the V&P operating area. Under normal operating conditions, no air-supplied respiratory protection equipment is required for processing.

2.11 Contamination Control

Per SRS Engineering Standard 01064:

This section addresses whether engineered design features are required for contamination control in order to limit worker exposures to ALARA below the Table 2-1 exposure limits.

Under normal operating conditions, contamination will be contained inside the waste drums. The drum enclosure beneath the glovebox is exhausted to ensure that if any contamination escapes from the drum, it is drawn out through the exhaust system, which passes through three HEPA filters prior to being exhausted to the RUBB. RCO will smear drums prior to their removal from the drum enclosure to ensure there is no spread of contamination. RCO will also be frisking operator gloves that have worked in the glovebox and their hands and feet prior to exiting the work area. A PCM-1B contamination monitor, located in the vicinity of V&P, will be used by personnel to perform whole body contamination monitoring.

2.11.1 Confinement

Per SRS Engineering Standard 01064:

The facility shall be provided with a confinement system to prevent the migration of radioactive materials from confinement enclosures, containment vessels, process equipment and their associated ventilation systems to occupied and unoccupied work areas. Design of confinement systems shall ensure compliance with both the internal and external radiation exposure limits contained in Section 2.1.

Per 10CFR835, 835.1002(c):

Regarding the control of airborne radioactive material, the design objective shall be under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used.

Per HDBK-1132-99, Part I, Section 1.1.2:

Confinement system features, including confinement barriers and associated ventilation systems, are used to maintain controlled, continuous airflow from the environment into the confinement building, and then from uncontaminated areas of the building to potentially contaminated areas, and then to normally contaminated areas.

The area of highest contamination potential will be at the top of a drum where the vent is being installed. The vent is loaded into the drum remotely by a drill bit from the glovebox to the drum below. The glovebox is exhausted, as well as the drum enclosure below the glovebox. The enclosure ventilation maintains a minimum of 100 linear feet per minute across the drum door opening during loading / unloading of the drums. The exhaust effluent passes through three HEPA filters that are 99.97% efficient and have differential pressure instrumentation to detect filter breakthrough. The V&P glovebox is equipped with an inlet blast shield to prevent release to the work area if pressurization of the glovebox were to occur. Both the glovebox and drum enclosure inlets have HEPA filtration to prevent the backflow of contamination to the work area.

2.11.2 Ventilation

Per SRS Engineering Standard 01064:

Confinement ventilation design requirements are located in SRS Engineering Standard 15889[2].

See Confinement section 2.11.1 above.

2.11.3 Access Ways

Per SRS Engineering Standard 01064:

Special features (e.g. air locks, enclosed vestibules) shall be provided for access through confinement barriers to minimize the impact of facility access requirements on the ventilation system and to prevent the release of radioactive airborne materials.

The ventilated drum enclosure provides an access way to the glovebox. Both the drum enclosure and the glovebox are under negative pressure to the surrounding area to prevent the release of radioactive airborne materials to the work area.

2.11.4 Transfer Pipes And Encasements

Per SRS Engineering Standard 01064:

When a pipe is used as the primary confinement barrier for materials (excluding ventilation systems), and the pipe exits the facility, a secondary confinement shall be provided by a double-walled pipe or other encasement/spill control. In areas within the facility, the use of double-walled pipe shall be considered.

Where double-walled piping or encasements are employed, leak detection shall be provided for the primary pipe, which may include liquid detection, airborne

[2] Engineering Standard 15889 provides the minimum design criteria for confinement ventilation systems/components where confinement ventilation is required. The standard provides for confinement of airborne radiological particulate material and does not address radioactive gases except for a reference to Tritium ventilation requirements.

contamination monitoring, or other means, in areas affecting personnel protection or the environment.

There shall be no interconnection among storm water systems, the sanitary waste systems, and the radioactive or other hazardous material handling systems or areas.

Chilled water systems shall be designed to minimize the volume of water that can be contaminated.

Per HDBK-1132-99, Part II, Section 1.3.8:

The routing of piping containing radioactive materials should consider the reduction of exposure levels to ALARA.

There is no potentially contaminated piping, other than ventilation ductwork, associated with the V&P process.

2.12 Material Radiation Tolerance and Compatibility

Per SRS Engineering Standard 01064:

Materials inside radiation areas shall be capable of withstanding the total absorbed dose over the lifetime of the system, structure, or component. The use of Teflon or organic materials in radiological areas should be avoided.

Using a 5-cm average drum dose rate of 44 mrem/hr, the V&P machine would receive an absorbed dose of 243 rad from penetrating radiation. This is orders of magnitude below known radiation damage thresholds. Surface alpha contamination can also impart an absorbed dose. Based on previous absorbed dose calculations [27] performed for SRS Pu^{238} and Pu^{239} materials and using an operating lifetime of 5520 hours, the absorbed dose (rad) to the V&P machine (in contact with any alpha contamination) would be equivalent to 0.063 * (dpm α / 100 cm^2). Using the lower threshold of radiation damage to Teflon (one of the least radiation resistant materials used in construction), 1.7E+04 rad, a surface contamination level of 2.7E+05 dpm α / 100 cm^2 would have to be maintained throughout the V&P operating lifetime. Since RCO smears the drums before they are removed from the enclosure, Operations will know when any contamination may have escaped the drum and can decontaminate as necessary.

2.13 Radioactive Waste

Per SRS Engineering Standard 01064:

The facility design shall meet the general and facility specific waste requirements of DOE Order 420.1 Section 4.1.1.2[3].

Per Manual 5Q, Article 441:

Radiological operations generating radioactive waste should be designed and developed to promote minimization and permit segregation, monitoring, treatment, storage and disposal.

[3] "Facility process systems shall be designed to minimize the production of wastes and minimize the mixing of radioactive and non radioactive wastes." [DOE Order 420.1, Section 4.1.1.2]

2.13.1 Waste Management

Per SRS Engineering Standard 01064:

The design requirements for storage, transfer, monitoring, surveillance, and leak detection of high-level and low-level radioactive wastes are stated in DOE Order 435.1[4].

The design shall provide for decontamination and decommissioning, and waste disposal of radioactive material. The design shall limit dispersion of radioactive materials and simplify decontamination and decommissioning.

Per Manual 5Q, Article 128:

Discharges of radioactive liquid to the environment are covered by the provisions of DOE 5400.5 and should not degrade the ground water.

Per Manual 5Q, Article 451:

DOE 5820.2A provides criteria for minimizing the generation of radioactive liquid waste. Minimization should include evaluating operational requirements to reduce liquid usage and maximize recycling activities. Activities that produce radioactive liquid waste shall be suspended unless sufficient processing, collection, and storage capacity is available to accommodate the waste. Radioactive liquid waste discharges should be controlled on a batch basis to enhance monitoring capability and to reduce the potential for inadvertent release.

The only radioactive waste that will be generated will be low-level job control waste. This would include RCO smears, rubber gloves, and plastic shoe covers. No radioactive liquid waste is anticipated in the drums entering V&P.

2.13.2 Mixed Waste Requirements

Per SRS Engineering Standard 01064:

Radioactive mixed wastes shall be avoided where practicable. Mixed waste that cannot be avoided shall be identified and considered in the design at the earliest possible time. Mixed waste shall be segregated and handled separately from the other types of wastes.

The V&P process will generate no radioactive mixed waste.

2.13.3 Waste Segregation

Per SRS Engineering Standard 01064:

The facility design shall provide for the segregation of waste into compatible groups for storage and disposal.

[4] DOE Order 435.1 states that waste shall be managed to protect the public, the environment, and workers. Specific requirements are put forth in DOE M 435.1-1, *Radioactive Waste Management Manual*.

Waste segregation practices at V&P will comply with WSRC Manual 1S[5] requirements.

2.14 Spill Prevention And Control

Per SRS Engineering Standard 01064:

Spill prevention and control shall be considered in the design stage of the facility to minimize the possibility of accidentally releasing radioactive material to the environment.

Per DOE-HDBK-1132-99, Part I, Section 2.1.2:

The piping system that collects contaminated liquids should be designed so that effluents from leaks in the system can be collected without releasing the liquids into the personnel access areas or to the environment.

Per DOE-HDBK-1132-99, Part I, Section 2.8.2:

The use of multiple barriers should be emphasized when necessary to restrict the movement of radioactive liquid waste that has the potential for human contact or for reducing groundwater quality below requirements.

No radioactive liquid waste is anticipated in the drums entering V&P.

2.15 Radiological Control Space Requirements

Per SRS Engineering Standard 01064:

The facility shall contain designated areas for radiological support functions. Specifically, space is required for a Radiological Control (RadCon) Office, instrument storage and decontamination areas, RadCon supervisors office, desk space for RadCon inspectors, counting equipment, and records storage. The design shall evaluate the power supply and environmental needs of the counting equipment required to operate during routine and non-routine conditions.

Space for radiation monitoring equipment shall be available in shipping and receiving areas for surveying the contamination level on the surface of shipping containers and other radioactive material received from or to be shipped off-site and on-site.

Existing RadCon counting facilities and office space are provided by the Solid Waste Management Facility in E-Area and are sufficient to serve the purposes of the V&P process.

2.16 ALARA

Per SRS Engineering Standard 01064:

[5] The WSRC Manual 1S is the SRS Waste Acceptance Criteria Manual and applies "to all onsite and offsite generators processing waste for treatment, storage, and disposal (TSD) at Savannah River Site (SRS) facilities."

> Radiation exposure of the work force and public shall be controlled such that radiation exposures are well below regulatory limits and that there are no radiation exposures without commensurate benefit.
>
> Measures shall be taken to maintain radiation exposure ALARA through facility and equipment design and administrative control. The primary methods used shall be physical design features (e.g. confinement, ventilation, remote handling, and radiation shielding). Administrative control and procedural requirement shall be employed only as supplemental methods to control radiation exposure.
>
> Optimization principles shall be utilized in developing and justifying facility shield design as early as possible in the design effort. The design objective for personnel exposure from all sources of radiation is to reduce doses to ALARA and below the Table 2-1 design basis dose limits.

Based on the projected processing targets, the maximally exposed operator would be expected to receive a dose of 500 mrem during CY03 and 870 mrem during CY04. The maximally exposed RadCon inspector would be expected to receive a dose of 140 mrem during CY03 and 240 mrem during CY04. The collective dose for the entire V&P process is 8.77 person-rem. Per the V&P task analysis [25], 62% of the dose is received during manual loading and unloading of the drums (estimated using dose rates at a distance of 30cms). Simply moving the operator an additional 1ft. away from the drum during manual handling will reduce the collective dose by 2.90 person-rem. Using a design value of $6600 per person-rem, this equates to a value of $19,140. This reduces the collective dose by 33% and should be implemented if it can be achieved at a cost less than or equal to $19,140. Since the layout of the drum staging area has not been defined, no cost-benefit optimization of that process segment can be determined at this time. In order to control area dose rates and facilitate unrestricted movement around the staging area, lead blankets may be hung on racks around the storage if drum dose rates require it. Given the high dose rates of some of these drums, use of lead shielding blankets around the staging area should be evaluated. If the cost of the shielding blankets (~$90 ea. for 1ftx3ft w/ grommets and ~$170 ea. for 2ftx3ft w/ grommets) is less than or equal to the anticipated value of the dose savings. Use of lead-hydrogenous shield blankets that provide both photon and neutron shielding would reduce the collective neutron dose contribution by about 0.2 person-rem (~$1300 value). Since a single drum shield of this material costs $1600, this option does not meet the cost-benefit criterion and is not recommended.

3.0 SUMMARY AND CONCLUSIONS

The radiological design requirements specified in SRS Engineering Standard 01064, 10CFR835, DOE Order 420.1, WSRC Manual 5Q, and other applicable documents, have been addressed. The above sections present the technical basis for the radiological design for the V&P process meeting these radiological design requirements.

4.0 REFERENCES

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8. WSRC Manual 1S, *Waste Acceptance Criteria*.
9. WSRC Manual 5Q, *Radiological Control*.
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28. S-CLC-E-00153, *Internal Dose Assessment for TRU Vent and Purge Process*, Revision 1, July, 2003.