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Chemical Process Technology

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HAZARDOUS WASTE/MIXED WASTE
TREATMENT BUILDING
SAFETY INFORMATION DOCUMENT (SID) (U)

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PROJECT: Safety Information Document
DOCUMENT: WSRC-TR-93-251
TITLE: Hazardous Waste/Mixed Waste Treatment Building
Safety Information Document (SID) (U)

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Hazardous Waste/Mixed Waste Safety Information Document

Section 1. Introduction and Summary of Sections

1.1 Introduction and Summary

This Safety Information Document (SID) provides a description and analysis of operations for the Hazardous Waste/Mixed Waste Disposal Facility Treatment Building (the Treatment Building). The Treatment Building has been classified as a moderate hazard facility (Ref. 1), and the level of analysis performed and the methodology used are based on that classification. Preliminary design of the Treatment Building has identified the need for two separate buildings for waste treatment processes (Ref. 4). One building is classified as a Moderate Hazard building because of the potential release of tritium from the facility during certain repackaging and waste treatment operations. The other building contains Low Hazard processes and General Use areas. The term Treatment Building applies to all these facilities.

The evaluation of safety for the Treatment Building is accomplished in part by the identification of hazards associated with the facility and the analysis of the facility's response to postulated events involving those hazards. The events are analyzed in terms of the facility features that minimize the causes of such events, the quantitative determination of the consequences, and the ability of the facility to cope with each event should it occur.

The SID presents the methodology, assumptions, and results of the systematic evaluation of hazards associated with operation of the Treatment Building. The SID also addresses the spectrum of postulated credible events, involving those hazards, that could occur.

Facility features important to safety are identified and discussed in the SID. The SID identifies hazards and reports the analysis of the spectrum of credible postulated events that can result in the following consequences:

- Personnel exposure to radiation
- Radioactive material release to the environment
- Personnel exposure to hazardous chemicals
- Hazardous chemical release to the environment
- Events leading to an onsite/offsite fatality
- Significant damage to government property

The SID addresses the consequences to the onsite and offsite populations resulting from postulated credible events and the safety features in place to control and mitigate the consequences. A postulated event is considered credible if the frequency of occurrence is 1.00×10^{-6} per year or greater, according to the

definition found in LA-10294-MS, A Guide to Radiological Accident Considerations for Siting and Design of DOE Nonreactor Nuclear Facilities (Ref. 2).

If the inputs to this chapter (e.g., frequency of occurrence) are derived from other sources, reference is usually made to them. The use of these references does not totally replace addressing a topic within the SID.

SID Format

The SID is formatted to identify hazards and the associated facility features for preventing, controlling, and mitigating the consequences of accidents hazards. It is also formatted to address the three major classifications of postulated events as described below:

- Impact of Normal Operations - Includes the negative impacts of normal operation on the three domains: adjacent work areas, general population, and the environment;
- Abnormal Operational Events (AOEs) - Includes the spectrum of events that do not have a significant effect outside of the facility;
- Accidents - Includes the spectrum of events that could have significant effects within and/or beyond the site boundary.

This format organizes the normal and abnormal operational events and the accidents considered in a manner that achieves the following results:

- Demonstrates that all operational hazards have been identified;
- Documents the features established to eliminate, control, or mitigate the hazards;
- Demonstrates that a sufficiently broad spectrum of initiating occurrences has been considered and categorizes the events by type (i.e., normal operational event, AOE, or accident);
- Provides an analysis of the consequences of facility operation and categorizes these by type (i.e., radiological or nonradiological);
- Promotes the consistent application of specific criteria for each postulated event.

Each major section contains subsections that address the event (such as an explosion), including information about the initiators; the sequence of occurrences leading to the event; and the detection, frequency, and (for those

events determined credible) the effects or consequences of the event for employees, the public, the environment, and government property.

Summaries of Section Information

Section 2 identifies the hazards associated with operation of the Treatment Building and the administrative and engineered features established to eliminate, control, or mitigate the hazards. Table 1-1 provides the generic hazard categories considered for the Treatment Building and applied to all aspects of facility operations.

Section 2 documents the impact of the hazards associated with normal operations for the Treatment Building. The annual facility doses were estimated at 12 person-rem for the facility population and 0.6 rem for the average worker. The only notable releases of radioactive materials for normal Treatment Building operations are HEPA-filtered and occur at 50 feet above ground level. It is anticipated that some releases from the Treatment Building will occur during normal operations. The radiological consequences for such releases during normal operations are presented in Table 1-2 in terms of Effective Dose Equivalents (EDEs).

Section 3 provides the analyses for the spectrum of events that are classified as AOE's. An AOE is defined as a safety, process, or support system failure with the worst case resulting in a facility shutdown or in increased operator exposure. Section 3 lists the system failures considered as AOE's.

Section 4 provides the qualitative analyses for the spectrum of events identified as accidents for the Treatment Building.

The consequences for all accidents described in Section 4 are bounded by the worst unmitigated accident scenario presented in Section 5.

Risk Considerations

The initiating events postulated for the worst unmitigated accident scenario are extremely unlikely (as discussed in Section 4). Risk numbers were determined for this Moderate Hazard facility for all events that approach or exceed the risk acceptance levels for unmitigated event consequences. (Ref. 1). Acceptance levels were concluded from applicable limits established by 10CFR61, DOE Order 5480.11, WSRC Manual 9Q, other state and federal regulations, as well as other industry and WSRC standards.

TABLE 1-1 Generic Hazard Categories applied to Treatment Building Operations with Potential Consequences Not Routinely Encountered in Nonradiological Industrial Operations

Hazards
Fires
Explosions
Nuclear Criticality *
Natural Phenomena
External Events
Radioactive Material and Chemical Releases
Direct Radiation Exposure

* The nuclear criticality category was applied to the Treatment Building. However, nuclear criticality was determined early in this safety analysis to be incredible as a result of the insignificant fissile material inventories.

TABLE 1-2 Radiological Consequences of Exposure to Onsite and Offsite Persons Due to Normal Operations Hazards

Source Term	Exposure Dose to Max. Onsite Individual (Rem)	Exposure Dose to Max. Offsite Individual (Rem)
2.0 Ci of Tritium	3.0E-04	6.0E-06

**TABLE 1-3 Safety and Support Systems Analyzed under Abnormal
Operational Events**

Systems
Ventilation System
Electrical Power System
Compressed Air System
Steam Supply System
Water Supply System
Offgas System
Safety Communication and Alarm Systems
Fire Protection Systems
Health Monitoring System
Bulk Material Handling System

1.2 References

1. Ebra-Lima, O. M. "Hazardous Waste/Mixed Waste Disposal Facility Treatment Building Hazards Assessment," Inter-Office Memorandum SRL-NPS-910041, Westinghouse Savannah River Company, Aiken, SC, August 15, 1991.
2. Elder, J. C., et al. A Guide to Radiological Accident Considerations for Siting and Design of DOE Nonreactor Nuclear Facilities. Report LA-10294-MS, Los Alamos National Laboratory, Los Alamos, NM, 1986.
3. SRS Methodology Manual for Nonreactor Safety Analysis. WSRC-TM-90-13, Westinghouse Savannah River Company, Aiken, SC, February 22, 1991.
4. Title 1 Design Summary Report. Hazardous Waste Mixed Waste Disposal Facility Treatment Building. Document Number SDSRE-0001, Project S2944, Ebasco Services, Augusta, Georgia, April 24, 1992.

Section 2. Identification of Hazards

This section defines the hazards encountered in the operation of the Hazardous Waste/Mixed Waste Disposal Facility Treatment Building (the Treatment Building). Hazard scenarios, control features, and risks analyzed in other sections are summarized.

2.1 Methodology

The methodology used to identify the hazards associated with operation of the Treatment Building and to quantify the significance of those hazards to safety is presented in WSRC-TM-90-13, SRS Methodology Manual for Nonreactor Safety Analysis, (the Methodology Manual) (Ref. 1).

2.1.1 Organization of the Safety Analysis Effort

This Safety Information Document (SID) for the Treatment Building was written by the Savannah River Technology Center (SRTC)

2.1.2 Hazard Identification Methodology

This section identifies hazards associated with operation of the Treatment Building and describes the methodology used to identify hazards. Table 2-1 lists the hazard categories considered. The hazards summary tables in Section 2.9 list the hazards identified and the locations in the facility that have a potential for each event occurring. The hazards are analyzed for normal operational events, Abnormal Operational Events (AOEs), and accidents in Sections 2, 3, and 4, respectively. The worst unmitigated accident scenario is addressed in Section 5.

Identification of hazards is a multistage process based on experience, analysis, and review. Hazards for the Treatment Building were identified by studying Process Hazards Reviews (PHRs) for the facility (Ref. 2), and by comparing operations to the operations of other SRS facilities for which recent safety studies have been conducted. Comparisons were also made between Treatment Building operations and similar operations in the commercial industry.

TABLE 2-1. Generic Hazard Categories Applied to Treatment Building Operations with Potential Consequences Not Routinely Encountered in Nonradiological Industrial Operations

Hazards
Fires
Explosions
Nuclear Criticality *
Natural Phenomena
External Events
Radioactive Material and Chemical Releases
Direct Radiation Exposure

- * The nuclear criticality category was applied to the Treatment Building. However, nuclear criticality was determined early in this safety analysis to be incredible as a result of the insignificant fissile material inventories.

The primary sources of information for hazards encountered at SRS are extensive data banks compiled by SRTC for identification and quantification of accident initiators and enablers.

The Generic Incidents Data Bank contains a listing of generic safety-related incidents to which unit operations and/or support systems can be subjected. In addition to listing incidents with associated causes and consequences, the data bank includes the safety features present to detect the event and to prevent and mitigate the consequences of the event.

The primary internal sources of data for hazard identification for 200-Area facilities are SRS internal documents, audits, log books, and incident reports. Failure and operator-error information from these sources has been stored in the computer by a program written especially to store and retrieve information in a form compatible with risk assessment. Currently, the 200-Area Fault Tree Data Bank contains more than 200,000 entries. Capabilities of the data bank are described in detail in the SRS Methodology Manual (Ref. 1).

In addition to the data banks, technical memoranda and research and development reports were reviewed for potential incidents. These reports were written in support of technical standards, process development, and incident investigations.

2.1.3 Frequency Methodology

Frequencies of events are determined in a variety of ways depending on the amount of data available and the significance of the event being analyzed. The

following sections summarize the information in the SRS Methodology Manual (Ref. 1).

2.1.4 Process-Related Events

Waste acceptance criteria (WAC) are the controls that prevent unacceptable materials from being disposed in the Solid Waste Disposal Facility (SWDF). Data concerning errors in using the WAC from 1977 to 1992 were analyzed. The frequency data for the SWDF were averaged, and this average was taken to be the SRS facility frequency for WAC errors. There were 14 recorded incidents of mis-administration of the WAC system in those years. The resulting average facility frequency of incident occurrence is about 1 per year. Procedural errors and violations should be at least 100 times less frequent in the Treatment Building due to the smaller numbers of procedures used and the smaller number of persons working per shift, compared to the SWDF. The frequency of errors resulting in exceedance of the waste acceptance criteria in the Treatment Building is taken as $1.0\text{E-}02$ per year in the Treatment Building. Not all exceedances will lead to an accident or AOE. However, the SWDF data bank indicates that approximately half of the reported incidents were significant in terms of potential exposures and releases. Therefore, $5.0\text{E-}03$ is taken as the annual frequency of errors leading to high inventory-conditions in the Treatment Building. Exceeding the inventory allowed can not, in itself, cause excessive releases of radioactive material except in the case of excessive amounts of fissionable materials. Inventory control prevents excessive release in the event of other accidents.

2.1.5 Natural Phenomena

Natural events of interest to SRS/SRTC safety analysts generally include high-velocity straight winds, tornadoes, and earthquakes. Probabilities for these events occurring at SRS have been independently studied by several investigators. (Ref.19) As a result of a thorough review of these studies, a standard set of probability models and/or curves for these natural events was selected for use by all SRS/SRTC safety analysts. These selected probability models have been adopted as a guide for all safety studies conducted for SRS operations and for facility studies. These models are presented in the SRS Methodology Manual (Ref. 1).

Temperature, relative humidity, wind, and precipitation data are constantly measured at SRS. The SRS Methodology Manual provides descriptions of natural phenomena and a list of references elaborating on the particular phenomena. (Ref. 1)

2.2 Consequence Methodology

For the Treatment Building, the consequences of an accident will depend on the inventory of waste to be treated in the building, the nature of the waste being treated and/or stored, and the events involved in the accident.

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The inventories considered are presented in the Appendix. This table of inventories now stored in the two mixed waste storage buildings is divided into five groups. Each group may be expected to be present in the entirety in the Treatment Building at one time. Grouping the inventory this way provides a conservative estimate of the inventory in support of treatment operations. The term "campaign" is used in this SID to describe either the inventory of waste in one of these groups, or the treatment operation involved. The grouping of inventory in the Appendix defines the "campaign". Regardless of the actual inventories in the storage buildings when operations start, the Treatment Building inventories will be kept at lower or equal hazardous/radioactive levels than the campaign inventories in the Appendix.

In case of accidental dispersal of radioactive materials, the dispersed materials are assumed to stay airborne in worst case meteorology for a period of two hours, and the release will be at the level at which vented air exits the exhaust system. If this scenario is not applicable, a discussion of the variation is presented where it is used in the analysis.

The following sections address the resulting radiological consequences, highlighting information covered in greater detail in the SRS Methodology Manual (Ref. 1).

Masses and Curies Involved in an Accident at the Treatment Building

The Treatment Building is a moderate hazard facility, (Ref. 4). Several accident scenarios (Ref. 2) were analyzed to prove that all credible consequences would be extremely low. The release considered for the maximum event was based on the maximum inventories that are allowed to be stored and processed in the Treatment Building. Table 2-2 presents the bounding quantities analyzed.

Waste acceptance will be by administrative controls. An analysis was performed to determine the probability that these limits would be exceeded by system failure or human error. No failure of an engineered system could result in limit exceedance, since no engineered controls are relied upon to protect against exposures. Human failures might allow excessive inventories of radioactive or hazardous materials. As noted above, it was determined that the chance for the Treatment Building to accidentally accept waste exceeding the WAC standards is about $5.0E-03/\text{yr}$.

The source reduction factors used to determine source terms are taken from Reference 4.

TABLE 2-2. Maximum Permissible Source Terms for Individual Hazardous and Radioactive Materials in the Treatment Building at one time (with no other Hazardous and Radioactive materials present).

<u>Material</u>	<u>Moderate Hazard Segment</u>	<u>Low Hazard Segment</u>
Tritium	4.8E+05 Ci	2.4E+04 Ci
Gamma emitters as Cs137*	1.5E+03 Ci	7.2E+01 Ci
Alpha emitters as Pu238	1.0E+00 Ci	5.0E-02 Ci
Other beta/gamma emitters (as Sr90)**	3.7E+01 Ci	1.8E+00 Ci
Asbestos	In consolidated form only.	
Cr+6	27 lbs.	27 lbs.
Hg	276 lbs.	276 lbs.

*This limit applies strictly to Cs137. Other gamma emitters may have different limits based on known assays and biological dose conversion factors. These limits will be spelled out in procedures. The quantity shown in this table is the limit in the absence of other information when the emission characteristics are known.

**This limit applies strictly to Sr90. Other beta/gamma emitters may have different limits based on known assays and biological dose conversion factors. These limits will be spelled out in procedures. The quantity shown in this table is the limit in the absence of other information, when the emission characteristics are known.

To prevent acceptance of combinations of materials that might cause the facility to exceed the dose limits in case of accidents, algorithms that define allowed maximum inventories will be defined in procedures. Additional limitations will be imposed on receipts by the regulatory permit.

2.3 Radiological Dose Methodology

2.3.1. General

The highlights and conclusions of standard environmental transport/dosimetry methodology and codes for radiological exposure used at SRS are provided in the SRS Methodology Manual (Ref. 1). The SRS Methodology Manual provides the data sources and assumptions concerning meteorology, demography, topography, agriculture, and the surrounding population. Standard assumptions concerning normal operations versus accidents are presented. The manual describes the models and codes used at SRS for determining the radiological effects for people onsite and offsite. The models and codes are summarized in the following sections.

2.3.1.1 Transport and Dose Methodology for Routine Releases

Offsite doses resulting from routine releases are calculated based on models developed for the nuclear industry to assess the effects of the operation of licensed commercial nuclear facilities. At SRS, the radioactive transport and dose models are implemented in the following computer programs:

- MAXIGASP - A computer program to calculate maximum and average doses to offsite individuals from routine atmospheric releases.
- POPGASP - A computer program to calculate offsite population doses from routine atmospheric releases.
- LADTAP II - A computer program to calculate maximum and average doses to offsite individuals and the population from routine liquid releases.

MAXIGASP and POPGASP are SRTC-modified versions of the GASP code with input from the XOQDOQ code. Both GASP and XOQDOQ are Nuclear Regulatory Commission (NRC) computer programs. The modifications meet the requirements for input of specific SRS physical and biological data and expand the amount of printed output data. The basic calculation methods used in the XOQDOQ and GASP programs are not modified.

LADTAP II is a site-specific version of the NRC program of the same name.

The NRC codes are currently accepted for licensing applications of commercial nuclear power vendors. Details concerning the various codes are presented in the SRS Methodology Manual (Ref. 1) and are summarized in the following sections.

2.3.1.2 Routine Airborne Releases

Background Information

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Radioactive materials released to the environment generally enter into a complex series of physical, chemical, and biological processes. Some of these processes involve dilution, while others involve physical and/or biological reconcentration followed by transfer through various pathways to man.

Calculation of the transport of radioactive materials from SRS by the atmosphere is based on meteorological conditions measured continuously at seven onsite meteorological towers and a 1000-foot television transmitting tower 30 kilometers (18.8 miles) northwest of the geometric center of SRS. For assessing environmental effects, meteorological dispersion is calculated with measurements collected over a 5-year period (1975 through 1979) at the onsite meteorological towers (Ref. 1).

The calculations of radiological doses to members of the public from various exposure pathways are based on methods recommended by the NRC for licensing nuclear power reactors. Dose estimates are based on detailed analyses of the sources and rates of radioactive releases and on the pathways by which dispersed radioactive materials can result in exposure to people. Radiation doses are calculated for the maximally exposed offsite individual and for the regional offsite population within 80 km of the release location.

Transport Methodology

The XOQDOQ code (Ref. 1), developed by the NRC, is used to calculate dispersion and deposition calculations for routine or anticipated intermittent atmospheric releases. Relative atmospheric dispersion and deposition factors are computed for 11 specific distances, out to 50 miles from the release location, for each of 16 compass sectors. Site-specific meteorological data are used to generate joint frequency distributions of windspeed, stability, and direction for input to the code.

The XOQDOQ code is based on a straight-line trajectory Gaussian plume model. At the analyst's option, the plume concentration can be depleted by dry deposition and radioactive decay. The computed ground level concentration can be modified to account for plume recirculation or stagnation. This code computes an effective plume height that accounts for physical release height, aerodynamic downwash, plume rise, and terrain features.

The calculations for relative concentrations (X/Q) are described in the SRS Methodology Manual (Ref. 1) and are based on the assumption that the release is continuous and that resulting effluent concentrations are distributed evenly across a 22.5-degree compass sector.

For both ground level and elevated releases, a plume rise is determined and the effective plume height is calculated for each wind-direction sector as a function of distance from the release location. If topography data are input, the effective plume height is reduced.

The XOQDOQ code computes concentrations for 22 downwind distances between 0.25 and 50 miles for each of the 16 directional sectors. Therefore, normalized effluent concentrations are predicted at 352 downwind locations. Using the predicted downwind concentrations, 10 downwind segment concentrations are calculated for each of the 16 directional sectors. The calculated value represents an average concentration for the downwind directional sector bounded by the range of the segment.

Calculated concentrations can include the effect of plume depletion from dry deposition using certain NRC data (Ref. 1). The depletion factor is adjusted for changes in topography. Curves are also available for deposition and depletion of plumes 100, 60, 30, and 0 meters above the ground.

The XOQDOQ code assumes that after full plume rise is achieved, the plume cannot rise any higher from the ground. The derivation of the depletion and deposition curves assumes no change in terrain height with downwind distance. Because topography does change with distance, and likewise the vertical distance between the plume centerline and the ground changes, it is usually necessary to read from more than one depletion or deposition curve as the plume travels.

The SRS Methodology Manual (Ref. 1) addresses other factors affecting the actual depletion that the plume experiences and the resulting adjustments that must be made.

Dose Assessment

The meteorological dispersion parameters obtained from the XOQDOQ code are used as input to the NRC GASPARD code. The GASPARD code implements certain NRC radiological exposure models to estimate doses from the following atmospheric exposure pathways (Ref. 1):

- Plume - External dose from radioactive materials transported by the atmosphere.
- Ground - External dose from radioactive materials deposited on the ground.
- Inhalation - Internal dose from inhalation of radioactive materials transported by the atmosphere.
- Vegetation - Internal dose from consumption of vegetable food crops that are contaminated by radioactive materials deposited from the atmosphere.
- Milk - Internal dose from consumption of milk that is contaminated by radioactive materials deposited from the atmosphere on vegetation.

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- Meat - Internal dose from consumption of meat products that are contaminated by radioactive materials deposited from the atmosphere on vegetation.

The various analytical models used in the GASP code for calculating doses from exposure to noble gases, radioiodines, and other radionuclides routinely discharged to the atmosphere are described in the SRS Methodology Manual (Ref. 1). Separate models are given for air and tissue doses due to gamma and beta rays. All plume shine models assume immersion in a semi-infinite cloud.

Computer Codes

There are two sets of computer codes for the assessment of radiological consequences resulting from routine SRS atmospheric releases of radionuclides. The MAXIGASP code can be used to calculate maximum radiation doses to offsite individuals. The POPGASP code can be used to calculate offsite population doses within a 50-mile region.

Each of these two code packages is an SRTC-modified version of the GASP code with input from the XOQDOQ code. Comparisons of relative air concentrations and relative deposition indicate that measured values show agreement with the calculated values from the transport portion of the MAXIGASP and POPGASP codes (Ref. 1).

Because the 50-year Dose Conversion Factors (DCFs) are used in both codes, the radiation doses obtained are the 50-year committed doses resulting from 1 year of operating releases. In addition, the residual effects on the affected population from the deposition, over an additional 100 years, have been considered in the POPGASP code; therefore, the calculated 50-year committed doses to the population can be regarded as a 100-year Committed Effective Dose Equivalent (CEDE) per year of operation.

MAXIGASP - Individual Doses

The MAXIGASP code calculates annual average air and ground deposition

concentrations per unit release (X/Q and D/Q , respectively) for the site boundaries in 16 compass sectors. Site-specific meteorological data are used to generate joint-frequency distributions of windspeed, stability, and direction for input to the MAXIGASP code. Flat terrain is assumed; no credit is taken for plume rise induced by momentum or thermal effects. The meteorological dispersion parameters obtained and the user-specified source term are used to estimate radiation doses from atmospheric exposure pathways.

The main outputs from the MAXIGASP code are the doses at the location of the maximum Effective Dose Equivalent (EDE) to the age-specific individuals along the SRS buffer-zone boundary (i.e., the nearest possible approach of the residential population). The maximally exposed individual is assumed to reside continuously at

the location of highest potential exposure. Parameters used in calculating doses to maximally exposed individuals are described in the SRS Methodology Manual (Ref. 1).

POPGASP - Population Doses

The POPGASP code calculates annual average air and ground deposition concentrations per unit release (X/Q and D/Q, respectively) for each of the 160 segments (i.e., 16 wind direction sectors at 10 distances within an 80-km [50-mile] radius of the release location). Besides the meteorological dispersion parameters, the user-specified source terms, population density, and milk, meat, and vegetable production distribution data for the 16 sectors are inputs to the POPGASP code to estimate population doses from atmospheric exposure pathways. Flat terrain is assumed; no credit is taken for plume rise induced by momentum or thermal effects.

The main outputs from the POPGASP code are the doses to population residing within 80 km (50 miles) of the release location. Parameters used in calculating population doses are described in the SRS Methodology Manual (Ref. 1).

2.3.1.3 Routine Surface Water Releases

SRS routinely releases radioactive materials to the Savannah River. These materials (mainly ^3H , ^{60}Co , ^{89}Sr , ^{90}Sr , ^{129}I , ^{137}Cs , ^{238}U , and ^{239}Pu) include releases made directly to surface streams at SRS and releases entering surface streams via groundwater transport from earthen seepage basins. The models and codes used to analyze the resulting consequences are described in the SRS Methodology Manual (Ref. 1).

No radioactive materials are released to the environment in liquid effluents during disposal operations at the Treatment Building. As a result, no methodologies for routine surface water releases were utilized in the SID.

2.3.2 Transport and Dose Methodology for Accidents

2.3.2.1 Airborne Releases Resulting from an Accident

Background Information

AXAIR89Q (Ref. 5) is the quality-assured, configuration-controlled version of the accident dose code AXAIR89 (Ref. 6, 7, 8, 9) developed by SRTC, which calculates 50-year EDEs to individuals and populations based on the inhalation and plume gamma-shine exposure pathways. AXAIR89Q is the version presently in use by SRS and can be used to perform both environmental transport and radiological

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dosimetry calculations for postulated process accidents involving airborne releases.

The airborne release of radioactivity must be specified as either a stack release or a building-vent release. The environmental transport models are essentially based on the NRC Regulatory Guide 1.145 (Ref. 10). The exposure pathways considered in the AXAIR89Q code include inhalation of radionuclides and immersion in the radioactive plume. The AXAIR89Q code offers numerous improvements relative to the previously developed NRC145 (Ref. 10) and NRC145-2 codes (Ref. 12).

The SRS Methodology Manual (Ref. 1) describes the models and equations utilized in the AXAIR code; however, the manual's descriptions are in terms of an older version of the code.

Methodology

To evaluate the radiological consequences of an airborne release, it is necessary to consider the dispersion of radionuclides in the environment and the pathways through which humans receive the doses. The exposure pathways considered in the AXAIR89Q code include inhalation of radionuclides and direct irradiation from plume shine.

Radiation doses resulting from inhalation of radionuclides in air depend on the amount of radionuclides released; the gaseous dispersion factor (X/Q); the physical, chemical, and radiological nature of the radionuclides; and biological parameters, such as breathing rate.

Radiation doses from gamma shine result from radiation emanating from the traveling plume and are affected by the spatial distribution of the radionuclides, the energy of the radiation, and the extent of shielding. In the AXAIR89Q code, no shielding is assumed for the individual receiving the maximum dose, and 50% shielding is assumed for the 50-mile population. The gamma-shine doses are calculated using a nonuniform Gaussian plume model because of its more realistic modeling as compared to the conventional uniform semi-infinite plume model. In addition to the use of the worst-case, worst-sector meteorology, and conservative breathing rates and shielding factors, the AXAIR89Q code also takes no credit for the probable plume rise of stack releases. Therefore, the doses calculated by the AXAIR89Q code are considered an upper bound of radiological consequences for the postulated atmospheric releases.

Dose Conversion Factors

Inhalation and ingestion doses to certain designated adult individuals and population groups are normally calculated for SRS airborne releases, either from a routine operation or from a postulated accident. To ensure reasonable and consistent calculations, a set of DCFs for inhalation and ingestion dose calculations has been selected and should be used by all safety analysts.

The DCFs used with the SRTC consequence analysis codes are calculated with International Commission on Radiological Protection (ICRP) Publication 30 methodology (Ref. 13, 14). In both the inhalation and ingestion models, radioactivity is fractioned between various organs immediately after inhalation or ingestion and allowed to be eliminated using effective biological clearance half-times.

The newer ICRP-30 methodology assumes that everyone is in the adult age group. The older ICRP-2 methodology uses assumptions that attempt to account for the fact that radiation dose commitment per unit intake of a given radionuclide usually varies as a function of age, as well as inhalation and ingestion. DCFs from the older methodology have been retained for optional use in AXAIR89Q and may still be selected by the analyst.

Transport/Dispersion Modeling

The transport/dispersion modeling in the AXAIR89Q code (Ref. 5) follows the methodology in the NRC Regulatory Guide 1.145 (Ref. 10). Five equations, adapted from the Gaussian plume model, are used to assess the accidental releases. Two of the equations are used to calculate relative concentrations from stack releases. The remaining equations are used to calculate relative concentrations from releases through vents or through building penetration. The equations are described in the SRS Methodology Manual (Ref. 1).

Dosimetry Modeling

The exposure pathways considered in the AXAIR89Q code (Ref. 5) include inhalation of radionuclides and exposure to plume gamma radiation. For calculating doses to the maximally exposed offsite individual, the "two-hour" integral air concentration is used. For calculating doses to onsite and offsite populations in the downwind compass sector, the 2-hour average integral air concentration is used.

The annual-average integral air concentrations, required when the release duration (T) is longer than 2 hours, require a logarithmic interpolation between the "two-hour" integral air concentration and the annual-average integral concentrations.

Assumptions made concerning the maximally exposed offsite individual and the various recipient populations are discussed in the SRS Methodology Manual (Ref. 1).

Plume Gamma-shine doses

The AXAIR89Q code (Ref. 5) offers three methods of calculating plume gamma-shine doses (in decreasing order of realistic dose determination and required computer Central Processing Unit [CPU] time): nonuniform plume method, nonuniform upper-bound plume approximation, and uniform plume

approximation. The uniform plume approximation is not recommended for SRTC/SRS use because of its unrealistic assumptions. The nonuniform upper-bound approximation, a special case of the nonuniform plume method, is recommended for use when the anticipated shine dose results are insignificant when compared to regulating guidelines. For those accidents that may cause significant shine doses to the general public, the nonuniform plume method should be used to provide more accurate calculated values.

In the uniform plume approximation, it is assumed that there is a uniform integral air concentration of the exposure nuclides throughout the infinite hemisphere above ground level, in which the integral air concentration is identical to that at the receptor location. Accordingly, the gamma-shine dose to an individual is directly proportional to the integral air concentration.

In both the nonuniform plume method and nonuniform upper-bound plume approximation, the Gaussian nature of the atmospheric plume in the hemisphere above ground level is accounted for. It is assumed that the integral air concentration of exposure radionuclide in the yz-plane through the receptor location is uniform in the x direction.

In the AXAIR89Q code (Ref. 5), an identical probability analysis of the plume-exposure doses is performed for determining the worst-case, worst-sector doses to both populations and the maximally exposed individuals. The frequency of occurrence for such an organ dose is the same as that for the meteorological condition on which the dose calculation is based. Because the total body is the most important factor for most dose-consequence evaluations, the probability analysis is carried out with respect to the possible total-body doses and their frequencies of occurrence. The total-body dose determined by the AXAIR89Q code is that which would only be exceeded 0.5% of the time based on worst-case, worst-sector meteorological probability analysis.

The procedure used in the worst-case probability analysis is briefly described as follows:

1. For a given compass sector k , calculate the total-body dose for each of the 42 possible meteorological conditions of windspeed class i ($i=6$) and stability category j ($j=7$).
2. List these 42 total-body doses in descending order, together with their frequencies of occurrence.
3. Determine the cumulative frequencies down the ordered list and then obtain, by linear interpolation, the worst-case total-body dose that would occur at the 0.5% cumulative-frequency level.
4. Determine the associated worst-case doses to the other body organs by linear interpolation.

The worst-case probability analysis is carried out for each of the 16 compass sectors. The worst sector is the sector that has the highest worst-case total-body dose.

Computer Code - AXAIR89Q

The AXAIR89Q code (Ref. 5) is a highly automated site-specific version of the NRC145-2 code for radiological consequence analysis. Given minimal input to characterize a release, the AXAIR89Q code estimates the doses via inhalation (including ingestion) and plume gamma radiation pathways to the area maximally exposed individual, area population, onsite population, offsite population within 50 miles, and maximally exposed offsite individual. The total-body doses evaluated are those that would be exceeded only 0.5% of the time based on worst-case, worst-sector meteorological probability analysis. Associated doses to other organs are provided in dose breakdowns by radionuclide, organ, and pathway.

2.3.2.2 Dose to the Worker Resulting from an Accident

Dose from Inhalation of Sources

The dose (D), in rem, to the worker breathing contaminated air is the product of the dose commitment factor (F), the volume breathed (V), and the radioactivity concentration (C) as shown below:

$$D(\text{rem}) = F(\text{rem/lCi}) \times V(\text{m}^3) \times C(\text{lCi/m}^3)$$

Where:

F is the dose commitment factor. The dose commitment factor converts assimilated radioactive isotopes into radiation dose. These factors are dependent upon the type and energy of decay and radiation, the radiological and biological half-life, other biological factors that allow the material to distribute itself in the body, and the mode of assimilation. A different F is used for each radionuclide and each organ.

V is the volume of air breathed. Adults are assumed to breathe air at the rate of 350 cm³/sec. After an accident, it is assumed that the operator breathes the respirable air activity for 5 minutes.

C is the concentration of radioactivity in the air. The airborne activity concentration in the area immediately following the accident is computed by dividing the number of curies released into the air in the room by the volume of the room.

Dose from Immersion in Radioactive Cloud

The dose (D), in mrem, to the worker immersed in a cloud of contaminated air is the product of the DCF, the radioactivity concentration (C), and the exposure time (T) as shown below:

$$D(\text{mrem}) = \text{DCF}(\text{mrem/yr per lCi/m}^3) \times C(\text{lCi/m}^3) \times T(\text{yr})$$

Where:

DCF is the dose conversion factor. The DCF converts immersion in a radioactive cloud to a dose rate; inhalation effects are not included. A different DCF is used for each radionuclide and each organ.

C is the concentration of radioactivity in the air. The airborne activity concentration in the area immediately following the accident is computed by dividing the number of curies released into the air in the room by the volume of the room.

T is the total time of immersion in the radioactive cloud.

2.3.2.3 Surface Water Releases Resulting from an Accident

Certain SRS facilities have the potential, in the event of an accident, of releasing radioactive materials in their liquid effluents to the Savannah River. The models and codes used to analyze the resulting consequences are described in the SRS Methodology Manual (Ref. 1).

No accidents were postulated for which the Treatment Building released radioactive materials to the environment in its liquid effluents. As a result, no methodologies were utilized in the SID for accidental releases of radioactive material to surface water.

2.3.2.4 Chemical Hazard Assessment

Evaluation of the hazards associated with the accidental release of chemicals at SRS involves assessing the impact of airborne exposures resulting from liquid releases of chemicals (in the form of spills/leaks) or gaseous or vapor releases (usually from process equipment). The SRS Methodology Manual (Ref. 1) describes the methods used to evaluate these types of chemical releases and to determine what hazards are generated as a result of the release.

Exposures are evaluated for personnel inside buildings, for personnel outside and adjacent to buildings, and for the offsite general population. Facility-specific methodology not described in the SRS Methodology Manual (Ref. 1) is described in this section.

To calculate the concentrations of chemicals downwind for the worst unmitigated accident scenario (Ref. 3), relative concentrations from the XOQDOQ code were used. These relative concentrations represent dose per unit source term.

2.3.3 Mitigator Reliability

The reliability of the various systems available to mitigate the consequence of accidents in the Treatment Building is discussed in the applicable portions of Sections 3 and 4.

2.4 Risk Methodology

Risk (Ref. 15) is a term used to express the relative safety of a facility for a given incident. Risk is the continuum of the products of the frequency (1/[mean time between occurrence]) of the incident and the associated consequence as a result of the incident.

The purpose for calculating risk is to provide an indication of the actual hazard associated with an event. For the Treatment Building, a worst unmitigated accident scenario was analyzed, and the results are presented in Section 5.

2.5 Hazard Listing

Use of a generic hazards outline results in a systematic analysis of operations and thus ensures that all significant hazards have been identified. The following generic hazards outline is applied to each unit operation defined in this section for the Treatment Building:

- Fires
- Explosions
- Nuclear Criticality
- Natural Phenomena
- External Events
- Radioactive Material and Chemical Releases
- Direct Radiation Exposure

Combustible materials will be handled either in repackaging or treatment operations in the Treatment Building. Fires can result in personal injuries, damage to property and dispersion of hazardous and radioactive materials.

An explosion, one form of uncontrolled reaction, is a high-energy event that can potentially result in primary containment damage or destruction.

Radioactive material and chemical releases can exist as isolated hazards or as the consequences of any of the first five hazard categories. Release of materials may

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occur due to accidents in transit at the Treatment Building, spills from containers deliberately or inadvertently open, overheating in accidental fires, overheating during process operations, and other accidents that breach containment, misoperation that allows material to migrate as divided solids, liquids, or gasses. The only pathway analyzed in detail was airborne dispersion.

Support system failures were considered for a hazard category. However, a support system failure represents, at most, a reduction in the margin of safety for operations, sometimes with the potential for operator injury or increased operator exposure. Loss-of-function for various safety and support systems is addressed in Section 3 as an Abnormal Operational Event (AOE).

Residual release events were considered for a hazard category. Malfunction by pluggage, reverse-operation, and unexpected shutdown of the of the forced ventilation system may occur. Failure of the ventilation system to perform as intended can lead to dispersion of hazardous and radioactive materials from the Treatment Building.

The Treatment Building, as analyzed in this SID, comprise the following unit operations.

- **Waste receiving.** Containers of mixed radioactive/hazardous waste received from one of the Mixed Waste Storage Buildings (643-29E, 709-2G, 634-43E, or other designated mixed waste storage building) is checked for compliance with WAC requirements, removed from the delivery vehicle, and transported into the main structure of the Treatment Building.
- **Sorting Waste for Treatment.** Received containers will be are categorized for treatment. Typically, the available inventory of one type of waste will be collected at one time in the Treatment Building for treatment. Then the entire inventory of that waste will be processed through either treatment or repackaging for treatment elsewhere. The types of waste so far identified for treatment are:
 - * **Tritiated Oils;**
 - * **Waste containing both tritium and mercury; (Liquid mercury may be present)**
 - * **Lead contaminated with radioactive materials on its surface;**
 - * **Filter media, made of Tyvek, contaminated with uranium;**

- * HEPA Filters mounted in cadmium coated metal frames with particulate radioactivity in the filter paper;
- * Chromium-contaminated wipes;
- * Soils contaminated with pesticides;
- * Waste water may also be treated

The Process Hazard Review for the Treatment Building (Ref. 2) was reviewed using the generic hazards outline. Peer reviews and reviews of other Treatment Building documents also contributed to the hazards summary tables. The hazards summary tables indicate which hazards are present in each unit operation and provide the following information for each specific hazard identified:

- Cause
- Prevention
- Detection
- Mitigation
- Consequences (qualitative)

Further details concerning the locations of hazards within the Treatment Building and the methods and features that prevent, control, and mitigate the hazards are presented in Section 3. The following sections summarize, in general terms, the hazards associated with the Treatment Building operations.

2.6 Identification and Assessment of Radiological Hazards

2.6.1 Facility Population

Treatment Building personnel can be exposed to various radiological hazards. Radiological hazards encountered during normal operations are covered in this section. Situations in which an operator could be exposed to abnormal radiological hazards are addressed in Section 3. Accident situations involving an operator are discussed in Section 4.

2.6.2 Onsite and Offsite Populations

The radiological exposures for people outside the Treatment Building resulting from normal (i.e., stack) releases are covered in Section 2. All events that could potentially increase onsite or offsite radiological exposures above the amounts for normal operations are addressed as accidents in Section 4 and are bounded by the worst unmitigated accident scenario (Ref. 2) postulated in Section 5.

2.7 Identification and Assessment of Nonradiological Hazards

2.7.1 Chemical Hazards

Chemical exposure for Treatment Building personnel is one type of industrial hygiene hazard discussed in Section 4. Chemical exposure for people outside the Treatment Building resulting from potential ground level releases is covered under Section 4. All events that could potentially increase onsite or offsite chemical exposures above the amounts for normal operations are addressed as accidents in Section 4 and are bounded by the worst unmitigated accident scenario. (See also Table 2-2)

2.7.2 Industrial Hazards in the Workplace

Attention to the safety of personnel includes the recognition of industrial hazards and the avoidance of events resulting in injury. Highlights of the SRS Safety program that apply specifically to industrial safety and industrial hygiene are summarized below:

- Overall direction of the safety program is provided through a Central Safety Committee. Subcommittees are defined and chartered to provide specialized and detailed support to both specific facility/area operations and higher level committees. The committee's structure helps to establish and enforce safety policy and compliance.
- Health Protection (HP) responsibilities encompass the administration of all SRS policies with regard to occupational health, establishing and maintaining an HP and industrial hygiene training program, and auditing site operations to determine the degree of compliance with appropriate policies and procedures.
- Fire protection responsibilities include building inspections, annual surveys, fire training programs, and fire safety awareness of all personnel.
- Audit activities include ongoing Treatment Building operations staff assessments that focus on specific items such as work practices or equipment compliance to imposed standards and procedures. External audits, conducted by staff not involved with the Treatment Building, occur less frequently, and serve as a topical "overview" of applicable standards and procedures. Appraisals are also conducted by DOE to address specific functional safety and health issues. All information gathered from the assessments, audits, or appraisals is presented to facility management for correction of deficiencies, when applicable.

- Administrative operating and maintenance procedures require comprehensive and independent reviews of hazard control and personnel safety before approval and use.

The ultimate responsibility for safety lies with line management. Industrial safety and hygiene practices that emphasize the prevention of workplace injuries and the protection of personnel health are part of this responsibility.

The Treatment Building places no demands on personnel or equipment that would subject the operating and support staff to the adverse effects of unique or significant nonradiological hazards (beyond those of a type or magnitude routinely encountered or accepted by the general public) during the conduct of normal operations. Administrative barriers are defined and in place to protect Treatment Building staff from adverse effects of all nonradiological hazards. The barriers must fail or somehow be compromised before any ill effects are experienced by the staff. These barriers include the following items:

- Approved operating procedures
- Approved administrative procedures
- Approved maintenance procedures
- Approved training programs, including certification and qualification requirements
- Formal safety programs, including specialized training for operating and support staff and reviews and inspections by safety staff
- Engineered safety features such as shields, guards, interlocks, and insulation
- Operating features such as equipment redundancy and functional testing
- Facility features such as ventilation, fire detection/suppression, and illumination

Adequate reviews, inspections, and controls exist to ensure the suitability and effectiveness of the required barriers.

2.7.3 Industrial Safety Hazards

To quantify industrial safety hazards similar to those at the Treatment Building, the operating history for an existing facility located near the Treatment Building (e.g., the Solid Waste Disposal facilities, SWDF) was considered. The Treatment Building

has nonradiological hazards, other than chemical exposure, of a magnitude approaching that in those facilities.

Based on information from the 200-Area Fault Tree Data Bank (Ref. 16), all events involving SWDF resulting in minor personnel injury during the period from 1976 through 1992, were reviewed. Ten minor events related to industrial safety hazards occurred that required first aid or medical treatment. These events at SWDF resulted from the following general hazard sources that are also present at the Treatment Building:

Kinetic Energy (Motion) - Items in motion (linear and rotational) pose hazards to personnel whenever the interaction between people and equipment occurs. Using tools and portable equipment, manually positioning equipment and supplies, and moving in and around congested areas provide the potential for personnel injury.

Potential Energy (Mass-Gravity-Height) - Situations requiring lifting, climbing, and carrying pose hazards to personnel. Drops, spills, and falls can result in events causing personnel injury.

Thermal Energy (Heat) - Heat sources include motive systems, operating electrical and mechanical equipment, and welding activities. Contact with thermally hot surfaces can result in personnel injury.

Although no Electrical Energy incidents are recorded as causing injury in the SWDF, the safety program includes training and instruction in electrical safety.

The event consequences for SWDF are grouped into injury categories in Table 2-3 to illustrate the types of injuries that have occurred. Postulated industrial safety incidents obtained from the PHRs (Ref. 2) for the systems or unit operations making up the Treatment Building are listed in Table 2-4 for each unit operation.

Maintenance and repair activities conducted by personnel using manual tools and equipment are major contributors to minor industrial injuries in the workplace. This is true for all facilities. The categories of scratch/cut, broken skin, abrasion/bruise, broken bone, and skin puncture consist largely of minor injuries occurring when personnel use tools and equipment for maintenance and repair activities. These injuries occur sitewide and are not representative of any specific operation or proceduralized activity. Skilled craftsmen, doing work for which they are trained and qualified, occasionally experience these minor injuries.

Those employee groups within SWDF considered to have maximum exposure to industrial safety hazards resulting in injury are Operations, Maintenance, Electrical and Instrumentation, and HP craftsmen and technicians. Placement of

waste containers and wasteforms in the SWDF has traditionally been assigned to Waste Management Works Engineering personnel because of the rigging and lifting requirements involved in these operations. These groups consist of approximately 30 people per shift. Assuming that the 26 craftsmen and technicians experienced all 11 of the minor industrial injuries reported during the 17-year period results in a frequency of $2.4E-02$ injuries/person-year.

2.7.4 Industrial Hygiene Hazards

To quantify industrial hygiene hazards similar to those at the Treatment Building, the operating history for an existing facility located near the Treatment Building (e.g., SWDF) was considered. The Treatment Building has no nonradiological hazards as significant as those in the existing facilities.

Based on information from the 200-Area Fault Tree Data Bank (Ref. 16), all events involving SWDF, resulting in personnel exposure to industrial hygiene hazards over the 5-year period from 1975 through 1992, were reviewed. Ten minor events related to industrial hygiene hazards occurred that required first aid or medical treatment. These statistics for SWDF, applied to the 78 craftsmen considered for the industrial safety events, result in a frequency of occurrence for industrial hygiene events (requiring first aid or medical treatment) of $8.0E-03$ events/person-year.

TABLE 2-3 Injury Categories for Industrial Hazard Events in SWDF (1975-1992)

Injury Category	Number of Injuries	Causes
Scratch/Cut/Wound	6	Contact with Equipment
Abrasion/Bruise	1	Broken part thrown against operators hip.
	1	Falling Equipment
Miscellaneous	1	Falling/Slipping
	1	Insect bite
Total	10	

TABLE 2-4. Postulated Industrial Safety Incidents for the Treatment Building

Personnel might be injured due to exposure to the following hazards during these unit operations in the Treatment Building.

Cadmium Stabilization

Dropped objects normally supported by a crane.

Splash or spill of acid leach bath from process basket or vessel.

Splash or spill during makeup and transfer of acid leach bath.

Exposure of eyes and skin of employees to lime

Exposure of eyes and skin of employees to portland cement.

Exposure of eyes and skin of employees to residues and effluents of leaching process.

Repackaging Chromium Wipes for Incineration

Dropped objects normally supported by a crane.

Exposure of employees to carcinogenic and toxic compounds of chromium.

Macroencapsulation of Lead

Exposure to lead compounds

Contact with hot equipment

Exposure to corrosives and irritants in the resin ingredients

Soil Washing

Exposure of employees to pesticides in soils.

Exposure of eyes and skin of employees to portland cement.

TABLE 2-4. Postulated Industrial Safety Incidents for the Treatment Building (Continued)

Reducing the size of the Filter takeup rolls for incineration

Exposure of employees to uranium

Malfunction of size reduction equipment

Amalgamation of Mercury

Exposure of employees to mercury vapors and liquid

Mercury Waste Cleanup

Exposure to mercury vapors and liquid

Exposure to hot surfaces during separation of mercury from other wastes

Cleanup of Mercury Contaminated Soils

Exposure to mercury vapor and liquid

Exposure to mechanical equipment for solid washing

Exposure to hot surfaces during separation of mercury from other wastes.

Cleanup of mercury contaminated process beds and discarded equipment

Exposure to mercury vapor and liquid

Exposure to mechanical equipment for solid washing

Exposure to hot surfaces during separation of mercury from other wastes.

Repackaging tritiated oil contaminated with mercury

Exposure to mercury vapor and liquid

Contact with mechanical equipment used to repackage the oil

Accidents during transport of the original or destination containers.

The following general industrial hygiene hazards exist within many SRS facilities, including the Treatment Building:

- **Acoustic Radiation** - Exposure to excessive noise can be harmful to personnel. Sources of noise >85 db include the diesel powered crane.
- **Oxygen Deficiency** - Breathing-air quality is a concern in every industrial facility. Inert gases are not present in occupied areas during normal operations. Occasional welding using acetylene gas may occur during maintenance or repair activities. Special procedures govern entry into vaults for repair and maintenance work. Respiratory requirements are defined for all activities, both new and old.
- **Organics** - Inhalation or ingestion of, or excessive contact with, certain organics can result in adverse health effects. Organics are not of concern at the Treatment Building provided the characterized waste is representative of the inventory.
- **Chemical Reactions** - Spurious reactions from combining or contacting chemicals can result in undesirable effects to personnel. Decontamination solutions may contain solvents or small quantities of caustics. Cleaning agents and solvents are available for maintenance.
- **Minerals/Metals** - Inhalation, ingestion, or contact with certain minerals/metals poses a health concern. Lead is used as radiation shielding within certain equipment, and structures and portable lead shielding (e.g., bricks, plates) may be installed when necessary.
- **Public Health** - The prevention of personnel health problems is a constant concern at SRS. Pathogens (e.g., bacteria, viruses, and spores) can appear in work areas when people gather and work together; sanitary conditions are maintained throughout the Treatment Building. Temperature and air circulation are controlled in all areas of personnel occupancy in order to prevent heat stress.

Postulated industrial hygiene incidents obtained from the SWDF PHRs for the systems or unit operations making up the Treatment Building are listed in Table 2-5 for each unit operation.

2.8 Comparison with DOE and Industrial Statistics

SRS production facilities are ranked first among DOE production contractors with regard to injury statistics (Ref.17). DOE and contractor facility rates average 3.2 per 100,000 worker-years.

TABLE 2-5. Postulated Industrial Hygiene Incidents for The Treatment Building

Personnel may be adversely affected in ways other than overt injury by exposure to certain materials used in Treatment Building Processes.

Mixed Waste Receiving and Placement

Containers contaminated on the surface with radioactive or hazardous materials.

Personnel exposure to materials released from dropped and damaged containers.

Mixed Waste Rearrangement

Personnel exposure to materials released from dropped and damaged containers.

Exposure to Chemicals used in Waste Treatment.

Personnel exposure to materials used during normal operations.

Personnel exposure to materials used during waste disposition.

Personnel exposure to process materials during mis-operation.

2.9 Hazard Control

This section describes the administrative safety features established to either prevent, control, or mitigate the hazards identified for the Treatment Building. The details were taken from the compilation of data resulting from a review of

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Nuclear Processes Safety Research
Savannah River Technical Center

SWDF operation and design PHRs for the Treatment Building unit operations. (Ref.2) Hazard controls are summarized in this section for each of the hazard categories defined.

The following information is presented for each hazard category:

- Locations (i.e., unit operations) within the facility where the hazard has the potential to exist
- Safety systems and features and special controls that prevent, control, or mitigate the hazard
- Administrative controls that prevent, control, or mitigate the hazard
- Safety programs used to control the hazard
- Events that can initiate loss of control for the hazard
- Accident scenarios associated with the hazard

"Safety systems" must not be confused with "safety class items." The Treatment Building has no safety class items. A safety system simply refers to any system (mechanical, electrical, procedural, or administrative) that contributes to the facility's operational margin of safety.

Locations within the facility are for the following unit operations:

<u>Process</u>	<u>Location</u>
• Acid (cadmium) leaching	Low Hazard Bldg
• Repackaging Chromium Wipes	Low Hazard Bldg
• Soil Washing	Low Hazard Bldg
• Lead macroencapsulation	Low Hazard Bldg
• Filter Roll Size Reduction	Low Hazard Bldg
• Mercury Liquid Amalgamation	ModerateHaz. Bldg.
• Mercury Waste Cleanup	ModerateHaz. Bldg.
• Mercury Soil Washing	Low Hazard Bldg
• Mercury Process Bed Cleanup	ModerateHaz. Bldg.
• Mercury-Tritium contaminated equipment cleanup	ModerateHaz. Bldg.
• Repackaging tritiated oil	ModerateHaz. Bldg.
• Process Waste Water Treatment	Low Hazard Bldg

Table 2-6 Potential locations of Hazards in the facility

• Fires	Moderate Hazard, Low Hazard, and General Use
• Explosions	None
• Nuclear Criticality	None
• Natural Phenomena	Moderate Hazard, Low Hazard, and General Use
• External Events	Moderate Hazard, Low Hazard, and General Use
• Radioactive Material and Chemical Releases	Moderate Hazard and Low Hazard
• Direct Radiation Exposure	Moderate Hazard, and Low Hazard

2.9.1 Fires

2.9.1.1 Location

The locations for potential fires within the Treatment Building are shown in Table 2-6.

2.9.1.2 Safety Systems

Safety systems and actions available to control or mitigate the consequences of fires are shown in Section 3.0. The tables indicate any administrative and special controls.

2.9.1.3 Administrative Controls

Administrative controls are used to prevent exceeding the inventories limited for safe operation. Other administrative controls are imposed site-wide to prevent or mitigate the effects of fires.

2.9.1.4 Facility Safety Programs

Facility safety programs available to control or mitigate hazards from fires are described in Section 4 of this SID.

2.9.1.5 Initiating Events

Based on the hazards summary table, initiating events that can lead to fires are shown in Table 2-1.

2.9.1.6 Accident Scenarios

The accident scenarios that are associated with fires are described in Section 4.

2.9.2 Explosions and Uncontrolled Reactions

The only explosions postulated for the Treatment Building (i.e., battery explosion, fuel oil explosion, radiolysis product explosion, etc.) have no potential for direct consequences different from those accepted in industry. The one exception is an explosive vapor explosion; however, this type of explosion is not considered credible because explosive chemicals are not allowed in the Treatment Building.

Process-related chemical reactions must be considered because reactive materials will be used to encapsulated lead objects, and to dissolve cadmium from filter frames, and in the Treatment Building. Other potential reactions might occur from the presence of oxidizing materials and tritiated oils in the Treatment Building. After treatment is completed, and materials are stored pending deposition in vaults, no hazardous material will be associated with the waste. Still, certain materials regularly or periodically used may be stored in the building. These may include toxic, combustible, and corrosive substances.

Diesel fuel, paper and textile fabrics are also combustible materials allowed in the Treatment Building.

Since there are no unique consequences involved, the industrial hazard explosions are not considered further as explosions, but only as initiating events for fires with the potential for direct consequences unique to the facility process. Fires are addressed in Section 2.9.

2.9.3 Nuclear Criticality

Fissile material is not received or processed at the Treatment Building in quantities that make nuclear criticality a hazard for any of the unit operations. Waste Acceptance Criteria will prohibit receipt of fissionable materials above 15 grams per container into the Treatment Building. (Ref. 4)

2.9.4 Natural Phenomena

2.9.4.1 Location

Natural phenomena can impact all the Treatment Building unit operations.

2.9.4.2 Safety Systems

Natural phenomena cannot be prevented. Safety systems and actions available to control or mitigate the consequences of natural phenomena are the systems available to control or mitigate the consequences of any accident conditions, such as fires or radioactive material releases, resulting from the natural phenomena.

2.9.4.3 Administrative Controls

Administrative controls available to control or mitigate the hazards that could result from natural phenomena are described under the individual hazard categories, such as fires or radioactive material and chemical releases.

2.9.4.4 Facility Safety Programs

Facility safety programs available to control or mitigate the hazards that could result from natural phenomena are described in Section 4 of this SID.

2.9.4.5 Initiating Events

Natural phenomena that can lead to hazards within the Treatment Building unit operations include earthquakes, tornadoes, hurricanes (or high-velocity straight winds), rains, floods, snow, and meteors.

2.9.4.6 Accident Scenarios

The accident scenarios associated with natural phenomena are described in Section 4.

2.10 External Events

The external events that could result in significant hazards within the Treatment Building unit operations include natural phenomena and impacts by aircraft, truck, or train. External events can impact all the Treatment Building operations.

2.10.1 Safety Systems

By definition, external events are independent of the Treatment Building operations; no safety systems or actions are available within the facility to prevent external events. Based on the hazards summary table, safety systems and actions available to control or mitigate the consequences of external events are the systems available to control or mitigate the consequences of any accident conditions, such as fires or radioactive material releases, resulting from the external events.

2.10.2 Administrative Controls

Administrative controls available to control or mitigate the hazards that could result from external events are described under the individual hazard categories, such as fires or radioactive material and chemical releases.

2.10.3 Facility Safety Programs

Facility safety programs to control or mitigate hazards from external events are described in Section 4 of this SID.

2.10.4 Initiating Events

External events that can lead to hazards in the Treatment Building include natural phenomena and impacts by aircraft, truck, or train. Natural phenomena are addressed separately in Section 4.

2.10.5 Accident Scenarios

The accident scenarios associated with external events are described in Section 4.

2.11 Radioactive Material and Chemical Releases

2.11.1 Location

The locations within the Treatment Building for potential radioactive material and chemical releases are shown in Table 2-6.

2.11.2 Systems important to Safety

Based on the hazards summary tables, safety systems available to prevent radioactive material and chemical releases are listed in Table 1-3.

2.11.3 Administrative Controls

Administrative controls available to prevent, control, or mitigate hazards from radioactive material and chemical releases are described in Section 4 of this SID.

2.11.4 Facility Safety Programs

Facility safety programs available to control or mitigate hazards from radioactive material and chemical releases and the SRS radiological control programs are described in WSRC Manual 5Q (Ref. 18).

2.11.5 Initiating Events

Based on the hazards summary table, initiating events that can lead to radioactive material and chemical releases are shown in Table 2-7.

Table 2-7 Initiating Events that Could Lead to release of Hazardous and Radioactive materials from the Treatment Building.

Fires

- Ignition of combustible or flammable waste
- Ignition of process materials
- Rapid oxidation by chemical used in process

Explosions

No mechanism for an explosion has been defined for processes in the Treatment Building.

Nuclear Criticality *

Masses of fissile material sufficient to cause nuclear criticality are excluded from the Treatment Building

Natural Phenomena

- Earthquakes
- High winds
- Floods

External Events

- Aircraft crash

2.11.6 Accident Scenarios

The accident scenarios associated with radioactive material and chemical releases are described in Section 4.

2.12 Direct Radiation Exposure

2.12.1 Location

The locations within the Treatment Building having the potential for direct radiation exposure are shown in Table 2-6.

2.12.2 Safety Systems

Direct radiation exposure cannot be completely eliminated. Direct radiation exposure is minimized, controlled, or mitigated using various combinations of distance, shielding, and administrative and procedural controls.

2.12.3 Administrative Controls

Administrative controls limit material accumulation and occupancy times. SRS radiological control programs are described in WSRC Manual 5Q (Ref. 18).

2.12.4 Facility Safety Programs

Facility safety programs available to control hazards from direct radiation exposure are described in Section 4 of this SID. SRS radiological control programs are described in WSRC Manual 5Q (Ref. 18).

2.12.5 Initiating Events

Events resulting in increased direct radiation exposure for the Treatment Building unit operations are shown in Table 1-1.

2.12.6 Accident Scenarios

The accident scenarios that result in increased direct radiation exposure are described in Section 4.

2.13 References

1. SRS Methodology Manual for Nonreactor Safety Analysis. WSRC-TM-90-13, Westinghouse Savannah River Company, Aiken, SC, February 22, 1991.
2. Title 1 Design Summary Report, Hazardous Waste Mixed Waste Disposal Facility Treatment Building, Document Number SDSRE-0001, Project S2944, Ebasco Services, Augusta, Georgia, April 24, 1992.
3. Fault Tree Handbook. Report NUREG-0492, Systems and Reliability Research, Office of Nuclear Regulatory Research, U. S. Nuclear Regulatory Commission, Washington, DC, January 1981.
4. Ebra-Lima, O. M., "Hazardous Waste/Mixed Waste Disposal Facility Treatment Building Hazards Assessment," Inter-Office Memorandum SRL-NPS-910041, Westinghouse Savannah River Company, Aiken, SC, August 15, 1991.
5. Huang, J. C. Use of the AXAIR890 Code (U). WSRC-TR-90-569, Westinghouse Savannah River Company, Aiken, SC, December 5, 1990.
6. Huang, J. C., and Lux, C. R. AXAIR89: An Improved Version of the AXAIR Code. WSRC-RP-89-1197, Westinghouse Savannah River Company, Aiken, SC, November 1990.
7. Pillinger, W. L., and Huang, J. C. AXAIR: A Computer Code for SAR Assessment of Plume-Exposure Doses from Potential Process-Accident Releases to Atmosphere. Internal Report DPST-85-304, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC, June 1986.
8. Laurinat, J. E. Modification to AXAIR Atmospheric Dose Code. Internal Report DPST-87-573, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC, July 1987.
9. Huang, J. C. Technical Manual on Environmental Risk Assessment. DPSTM-86-700-1, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC, April 1986.
10. Regulatory Guide 1.145: Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants. U. S. Nuclear Regulatory Commission, Washington, DC, 1979.
11. Pendergast, M. M., and Huang, J. C. A Computer Code to Assess Accidental Pollutant Release. U. S. Department of Energy Report DP-1552, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC, July 1980.

2.13 References (Continued)

12. Pendergast, M. M. NRC145-2. A Computer Code to Assess Dose from Accidental Pollutant-Releases. U. S. Department of Energy Report DP-1646, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC, May 1983.
13. ICRP Publication 30 Part 1. "Limits for Intake of Radionuclides by Workers." International Commission on Radiological Protection, 1979.
14. ICRP Publication 30 Part 2. "Limits on Intakes by Workers." International Commission on Radiological Protection, 1980.
15. Yeung, J. Y. H., and Durant, W. S. Risk Definition for Safety Analysis Reports. Internal Report, DPST-88-805, E. I. du Pont de Nemours & Co., Aiken, SC, August 25, 1988.
16. Durant, W. S. and Galloway, W. D. 200-Area Fault Tree Data Bank - 1985 Status Report. Internal Report DPST-86-233, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC, February 3, 1986.
17. "Injury and Property Damage Summary, January - December 1986." U. S. Department of Energy, prepared by EG&G Idaho, Inc., Idaho Falls, ID.
18. SRS Radiological Controls Manual. WSRC Manual 5Q, Rev. 0 (interim), Westinghouse Savannah River Company, Aiken, SC, January 18, 1991.
19. Kennedy, R. P., et al., Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards. UCRL-15910, Lawrence Livermore National Laboratory, Livermore, CA, October 1989.

SECTION 3 ABNORMAL OPERATIONAL EVENTS

An Abnormal Operational Event (AOE) is defined as any loss of function of a safety or support system with the worst case resulting in a shutdown of the facility or in limited personnel contamination.

The objective of this section is to present the methodology, assumptions, and results of the systematic evaluation of the hazards associated with the operation of the Hazardous Waste/Mixed Waste Disposal Facility Treatment Building (The Treatment Building) at the Savannah River Site (SRS), and the spectrum of postulated credible events involving those hazards that could occur.

This section of the Safety Information Document (SID) identifies hazards that can exist as AOE's and addresses the associated controls involved. AOE's include the spectrum of unplanned events that will not have a significant effect within or beyond the site boundary (e.g., malfunctions of systems, abnormal operating conditions, and operator error); any significant effect occurs within the facility.

The following is a summary of the safety systems with respect to failure frequencies and faults discussed in this section:

- Failure Frequencies for the Ventilation System
- Faults in the Electrical Power System
- Failure Frequencies for the Compressed Air System
- Faults in the Steam Supply System
- Failure Frequencies for the Water Supply System
- Failure of the Safety Communication and Alarm System
- Failure of the Fire Protection System
- Failure Frequencies for the Health Monitoring Systems
- Failure Frequencies for the Offgas System
- Failure Frequencies for the Bulk Material Handling System
- Failure Frequencies for the Macroencapsulation Process

3.1 Failure of the Ventilation System

The function of the Ventilation System in the regulated areas is to protect the public, the environment, and the onsite personnel by confining radioactive and other hazardous airborne material within the building Ventilation System. The Ventilation System is designed to maintain pressure differences so that air flow is from clean areas to regulated areas.

A detailed description of the Ventilation System is provided in Ref. 1.

3.1.1 Causes

Causes of disruption in ventilation include failures of the following items:

- Local Air Monitoring
- Manual Control Damper
- Centrifugal Fan
- Filter (plugging)
- Motor Operator
- Exhaust Fan

The events considered for Ventilation System AOE's are listed in Table 3-1.

3.1.2 Detection

Abnormal conditions of the Ventilation System will be detected by the following Instrumentation and Control (I&C) system features:

- Differential pressure gages to indicate filter condition
- Thermostats to control the temperature within the areas
- Flow indicators for the proper indication of flow
- Alarms to provide local and remote system trouble warning
- Interlocks to shut down processes on loss of ventilation.

3.1.3 Frequency

The Treatment Building has both a Low Hazard and a Moderate Hazard segment. Both buildings have similar ventilation systems and based on the analysis of similar systems designed for other Department of Energy (DOE) waste disposal facilities, the frequency of AOE's in the Treatment Building Ventilation System is estimated to be 6×10^{-2} /yr. The failure frequencies for various components considered for Ventilation System AOE's are listed in Table 3-1.

3.1.4 Consequences

3.1.4.1 Radiological Consequences

Loss of ventilation capability has no significant radiological consequences.

3.1.4.2 Nonradiological Consequences

Loss of ventilation capability has no significant nonradiological consequences except for the possible impact on facility operation. Air flow reversals resulting from a system failure can require a temporary shutdown.

**TABLE 3-1. Failure Frequencies for the Ventilation System
(Common Cause Failures are Excluded)**

Event	Frequency (per hour)	Reference
Local Air Monitoring Failure	3.5×10^{-6}	4
Manual Control Damper	1.5×10^{-5}	4
Centrifugal Fan Failure	4.1×10^{-6}	4
Filter Plugging	1.0×10^{-6}	4
Damper Fails Closed	6.0×10^{-7}	4
High-Efficiency Particulate Air Filters	1.0×10^{-6}	4
Motor-Operated Damper Fails Closed	6.2×10^{-7}	4
Exhaust Fan Failure	4.1×10^{-6}	4
Pressure Sensors	3.5×10^{-6}	4
Pressure Transmitters	3.0×10^{-6}	4
Alarm/Pressure	6.0×10^{-6}	4

3.1.5 Corrective Actions

Corrective actions following AOE in the Ventilation System include repair of system components and return of the facility to an operational status, as required.

3.2 Failure of the Electrical Power System

The Electrical Power System within the Treatment Building is required to provide normal electrical power and standby power requirements for the operation of the facility.

The following major electrical components provide electrical service to the Treatment Buildings:

- Electrical Substation Load Center
- Standby Power Diesel Generator
- Uninterruptible Power Supply (UPS)

A detailed description of the Electrical Power System is provided in Ref.1.

3.2.1 Causes

AOEs for the Electrical Power System include components in the supply site loop, the secondary feeder, the standby diesel system, the Motor Control Centers (MCCs), and the Uninterruptible Power Supply (UPS). Faults considered for Electrical Power System AOEs are presented in Table 3-2.

3.2.2 Detection

The loss of the Electrical Power System will be detected by all personnel in the Treatment Building.

3.2.3 Frequency

3.2.3.1 Low Hazard Building

Based on the analysis of similar systems designed for other DOE waste disposal facilities with a Low Hazard Classification, the following frequencies of AOEs in the Treatment Building Electrical Power System are estimated. The frequency for losing offsite power is $3.4 \times 10^{-1}/\text{yr}$. The frequency for losing offsite power and losing standby MCC is $1.7 \times 10^{-2}/\text{yr}$. The frequency for losing offsite power, standby MCC, instrumentation distribution, or the UPS is less than $1.0 \times 10^{-6}/\text{yr}$ and is not a credible event.

3.2.3.2 Moderate Hazard Building

Since the Moderate Hazard building has essentially the same electrical system as the Low Hazard building, the frequencies described above will be used.

3.2.4 Consequences

3.2.4.1 Radiological Consequences

Loss of electrical power has no direct radiological consequences.

3.2.4.2 Nonradiological Consequences

Loss of electrical power has no significant nonradiological consequences except for the possible impact on facility operation (i.e., a required shutdown).

3.2.5 Risk

Risk was not calculated since no significant consequences exist.

3.2.6 Corrective Actions

Corrective actions following AOE in the Electrical Power System include repair of system components and return of the facility to an operational status, as required.

3.3 Failure of the Compressed Air System

The functions, design considerations and descriptions of the compressed air systems for the Low Hazard and Moderate Hazard Buildings have similar descriptions. For this reason, both buildings have been combined in this section.

The function of the Station and Instrument Air System is to support operation of pneumatic power tools, air operated instrumentation and process equipment for the Treatment Building.

The Breathing Air System supplies Grade D air from the air receiving tank to the local manifold supply systems. The systems are capable of supplying breathing air continuously to six (6) plant operators in the Low Hazard building and Moderate Hazard building. (Note: The Breathing Air System consists of two independent breathing air systems: one system for the Low Hazard building and one for the Moderate Hazard building. The design philosophy for both systems are the same) (Ref. 1).

TABLE 3-2. Faults in the Electrical Power System

SUBSYSTEM	EVENT
Supply to Site Loop	Insulator damage Defective coil Surges in Georgia Power System Power line from SCE&G failure Power line sagging onto line beneath Static line breaking and falling across hot line Faulty power meter Helicopter hitting line Bird shorting line Acid spraying onto transformer
Site Loop	High wind breaking insulator Tree limb across line during tornado Fire fighters pushing tree onto line Poles broken/deteriorated due to termites, woodborers, or woodpeckers Pole decayed Ice storm breaking line Broken calsun bronze static wire Defective sleeve on supervisory control cable Supervisory control cable severed during excavation Pole switch left open (operator error) Raised boom on crane contacting wire when brakes failed Circuit breaker failure Lightning arrestor failure
Secondary Feeder	Lightning striking transformer power supply Pole switch failure Transformer damaged due to overcurrent

TABLE 3-2. Faults in the Electrical Power System (Continued)

SUBSYSTEM	EVENT
Standby Diesel	Automatic Transfer Switch (ATS) failure System (mechanical faults and lightning) Voltage regulator failure Undervoltage relay failure Damage to diesel cylinder heads Rheostat failure Breaker not resetting Water pump failure Battery failure Electrical short in diesel control panel Exciter failure Improperly set rheostat Powerstat failure Damage to diesel cylinder block Damaged insulation on electrical contact Acid leak to diesel Generator tripped off-line by differential Relay when generator in parallel with SCE&G Damaged teeth on starting drive pinions Fuse failure Circuit breaker failure
Motor Control Center	Lightning Deteriorated control wiring Accidental de-energizing Defective insulation
Uninterruptible Power Supply	Shorted Disconnected Damaged

3.3.1 Causes

AOEs for the Compressed Air System exist as disruptions that affect air supply or air distribution. These disruptions include failures of the following items:

- Air Compressor
- Air Receivers
- Prefilters
- Aftercoolers
- Afterfilters
- Inlet Filter
- Air purifiers
- Dual-Tower Desiccant Dryer
- Catalyst/Charcoal Cartridge
- Breathing Air Headers
- Instrumentation

3.3.2 Detection

Faults in the Compressed Air System will be detected by the following I&C features:

- Pressure Indicators
- Pressure Switches
- Pressure Control Valves
- Pressure Indicating Controllers
- Temperature Indicators
- Temperature Switches
- Electric Switches

3.3.3 Frequency

3.3.3.1 Low Hazard Building

Based on the analysis of similar systems designed for other DOE waste disposal facilities with a Low Hazard Classification (Ref. 2), the following frequencies of AOEs in the Treatment Building Compressed Air System are presented in Table 3.3.

3.3.3.2 Moderate Hazard Building

The Compressed Air System for the Moderate Hazard building is the same in design philosophy, but independent of the Compressed Air System in the Low

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Hazard Building (Ref. 1). Therefore, the frequencies of the Low Hazard Building are used.

3.3.4 Consequences

3.3.4.1 Radiological Consequences

Loss of compressed air has no significant radiological consequences except where breathing air is concerned. A breathing air disruption could result in an uptake of radioactive material by an operator. In the event of the loss of breathing air compressor airflow, a minimum of five (5) minutes of breathing air is provided for each user (maximum six (6) users) from high pressure breathing air cylinders permanently connected to the breathing air systems via piping and valving arrangement (Ref. 1).

Uptakes of radioactive material by operators are handled by Health Protection (HP) personnel. Actions to be taken are specified in the Westinghouse Savannah River Company (WSRC) Procedure Manual 5Q (Ref. 5).

3.3.4.2 Nonradiological Consequences

Loss of the compressed air can require a temporary shutdown. A breathing air disruption could possibly result in an uptake of radioactive material by an operator.

3.3.5 Risk

Risk was not calculated since no significant consequences exist.

3.3.6 Corrective Actions

Corrective actions following AOE in the Compressed Air System include repair of system components and return of the facility to an operational status, as required.

3.4 Failure of the Steam Supply System

The steam system for the Treatment Building is supplied from the existing high pressure (325psig) steam line located within 100 feet of the Treatment Building. The system is used to furnish the required quantity of steam for process, HVAC equipment and maintenance needs.

The steam system consists of a two-stage pressure reducing station and a steam distribution network.

A detailed description of the Steam Supply System is provided in Ref. 1.

3.4.1 Causes

Causes of disruption in the Steam Supply System include failures of the following items:

- Valves
- Strainer
- Instrumentation
- Steam Lines (i.e., leaks, breaks, plugging, etc.)

3.4.2 Detection

Faults in the Steam Supply System will be detected by the following I & C features:

- Pressure Relief Valves
- Pressure Regulators
- Flow Control Valves
- Visual detection of leaks
- By-Pass lines
- Low pressure on demand

3.4.3 Frequency

Because limited historical data exist for the Treatment Building Steam Supply System it is necessary to estimate failure frequencies using generic equipment failure rate data and historical data for similar equipment, as appropriate.

3.4.4 Consequences

3.4.4.1 Radiological Consequences

Loss of steam has no direct radiological consequences.

TABLE 3-3. Failure Frequencies for the Compressed Air System

Event	Frequency (per hour)	Reference
Plugged or Cut Hose	4.0×10^{-5}	4
Local Cartridge Filter Plugged	3.0×10^{-7}	4
Header Isolation Valve Fails Closed	6.0×10^{-7}	4
Header Rupture	1.0×10^{-9}	4
Regulator Fails Closed	2.14×10^{-6}	4
Air Supply Failure/Compressor	5.5×10^{-6}	4
Main Regulator Failure	2.14×10^{-6}	4

3.4.4.2 Nonradiological Consequences

Loss of steam capability has no significant nonradiological consequences except for the possible impact on facility operation. System failure could result in a temporary shutdown.

3.4.5 Risk

Risk was not calculated since no significant consequences exist.

3.4.6 Corrective Actions

Corrective actions following AOE's in the Treatment Building Steam Supply System include repair of system components and return of the facility to an operational status, as required.

3.5 Failure of the Water Supply Systems

The functions, design considerations and descriptions of the water supply system for the Low Hazard and Moderate Hazard Buildings have similar descriptions. For this reason, both buildings have been combined in this section.

The water systems consist of a Closed Cooling Water System, Cooling Water System, Well Water System, Service Water System, and Domestic Water System.

Water systems are provided for use in chemical make-up, process flush, heat sink, washdown water and domestic uses.

The Closed Cooling Water system provides circulating cooling water required for Service Air and Instrument Air compressors and the Breathing Air compressor.

The Cooling Water system provides removal of waste heat energy from service equipment.

The Well Water system indirectly supplies water for the Service Water system which supplies water for the fire suppression system.

The plant wide fire protection system is a second source supplier for the fire suppression system.

The Domestic Water system provides water for the safety showers, drinking, toilets, and nonregulated areas.

A detailed description of the Water Supply Systems is provided in (Ref. 1).

3.5.1 Causes

Causes of disruption in the Water Supply Systems include failures of the following items:

- Pumps
- Headers
- Water Lines (i.e., breaks, leaks, plugging, etc.)
- Condensers
- Valves

3.5.2 Detection

AOEs in the various water supply systems will be detected by the following items:

- Tank level switches
- Flow switches
- Standby pump status alarms
- Automatic check-recirculation valves
- Visual detection of leaks
- Low flow or low pressure on demand

3.5.3 Frequency

Because limited historical data exist for the Treatment Building Water Supply Systems, it is necessary to estimate failure frequencies using generic equipment failure rate data and historical data for similar equipment, as appropriate.

Historical failure rate data for domestic water system components in the Uranium Solidification Facility (USF) in H-Area are used to analyze the Treatment Building Water Supply Systems. The USF domestic water system is used because of its similarity to the types of equipment and functions of the Treatment Building Domestic Water System. Table 3-4 presents the frequencies of failure of the Water Supply Systems. These frequencies were developed using data obtained from the 200-Area Fault Tree Data Bank for H-Area Outside Facilities for the years 1976 through 1987.

3.5.4 Consequences

3.5.4.1 Radiological Consequences

Loss of water supply has no direct radiological consequences.

3.5.4.2 Nonradiological Consequences

Loss of water supply has no significant nonradiological consequences except for the possible impact on facility operation. System failure could result in a temporary shutdown.

3.5.5 Risk

Risk was not calculated since no significant consequences exist.

3.5.6 Corrective Actions

Corrective actions following AOE's in the Treatment Building Water Supply Systems include repair of system components and return of the facility to an operational status, as required.

3.6 Failure of the Safety Communication and Alarm Systems

The functions, design considerations and descriptions of the Safety Communication and Alarm systems for the Low Hazard and Moderate Hazard Buildings have similar descriptions. For this reason, both buildings have been combined in this section.

The purpose of the Safety Communication and Alarm Systems is to provide an areawide communications network for the Treatment Building with interconnections to the site and public telephone systems. Area and local alarm systems are required to notify personnel of unusual and emergency events.

A detailed description of the Safety Communication and Alarm Systems is provided in Ref. 1.

3.6.1 Causes

Causes of disruptions in the Safety Communication and Alarm Systems include the following items:

- Amplifier problems
- Blown fuses
- Power failures
- Lines severed by construction

3.6.2 Detection

Failures of the Safety Communication and Alarm Systems will be detected when personnel find them inoperable on demand.

Alarms are tested periodically for functional operation. The Public Address (PA) system is signal-tested daily during the work week.

3.6.3 Frequency

Data from the 200-Area Fault Tree Data Bank for the years 1980 through 1987 indicate that the PA system can be expected to suffer a partial failure at a frequency of 22/yr. One hundred seventy-five instances of failure or maintenance activity were recorded for the 8-year interval. The Bell system was also reported to have failed six times in the interval, at a failure rate of 0.75/yr.

TABLE 3-4. Failure Frequencies for the Water Supply Systems

Event	Frequency (per hour)
Leak	4.3×10^{-4}
Header Failure	1.6×10^{-4}
Outage, Miscellaneous Causes	1.4×10^{-4}
Safety Shower Failure	1.1×10^{-4}
Valve Malfunction	3.8×10^{-5}
Pump Failure	5×10^{-6}
Eyewash Failure	5×10^{-6}
Pluggage	5×10^{-6}
Miscellaneous Failures	1.9×10^{-5}

3.6.4 Consequences

There are no direct consequences resulting from failures in the Safety Communication and Alarm Systems. The backup systems, including portable radios, ensure that, at a minimum, safe shutdown of the process may be accomplished.

The majority of the faults reported in the 200-Area Fault Tree Data Bank are for partial communication system failures that are more of a nuisance than a threat to personnel safety or to continued operations.

3.6.4.1 Radiological Consequences

There are no direct radiological consequences resulting from failures in the Safety Communication and Alarm Systems.

3.6.4.2 Nonradiological Consequences

There are no direct nonradiological consequences resulting from failures in the Safety Communication and Alarm Systems.

3.6.5 Risk

Risk was not calculated since no significant consequences exist.

3.6.6 Corrective Actions

Corrective actions following AOE in the Safety Communication and Alarm Systems include repair of system components and return of the facility to an operational status, as required.

3.7 Failure of the Fire Protection Systems

The functions, design considerations and descriptions of the fire protection systems for the Low Hazard and Moderate Hazard Buildings have similar descriptions. For this reason, both buildings have been combined in this section.

The purpose of the Fire Protection Systems is to detect fires quickly, to extinguish or suppress fires that occur, and to limit the resulting damage to the facility.

A detailed description of the Fire Protection Systems is provided in Ref. 1.

3.7.1 Causes

Abnormalities can reduce or disable the ability to detect a fire or to suppress the fire once it is detected. Possible causes of abnormalities for the fire detection systems and fire suppression systems are shown below. These lists are based on information obtained from the 200-Area Fault Tree Data Bank for H Canyon for the years 1977 through 1987.

Abnormalities in the Fire Detection Systems

- Alarm wire cut
- Transformer failure
- Lightning damage
- Indicator lights burned out
- Audible alarm failure
- Autoterm miswired
- Alarm box faulted
- Computer failure
- Heat detector failure
- Smoke detector failure
- Air compressor failure
- Electrical short
- Alarm reset failure

Possible Abnormalities in the Fire Suppression Systems

- Damage to underground fire pump control cable
- Buildup of material on inside surface of fire pump and line
- Fire header ruptured by excavation equipment
- Water system isolated by valving error
- Fire pump electrical breaker failure
- Header leak
- Header frozen
- Valve failure
- Sprinkler leak
- Pressure system leak

3.7.2 Detection

Faults in the fire detection and suppression systems will be detected by routine testing and inspection of the equipment and by pressure switches that activate system alarms and pumps, if required.

3.7.3 Frequency

Frequencies of faults in the Treatment Building fire detection and suppression systems are determined by analysis of similar systems in other facilities with longer operating histories.

Based on information for H-Canyon in the 200-Area Fault Tree Data Bank, it was determined that the H-Area fire water system was partially or totally disabled 41 times during the years 1977 through 1987 for a failure frequency of 3.8/yr. The mean repair time for this system was about 24 hours. Therefore, the unavailability of this system is 1.6×10^{-2} /yr (failure frequency x repair time = fraction of time system is unavailable).

Based on the 200-Area Fault Tree Data Bank, it was determined that the H-Canyon fire alarm system was partially or totally disabled 30 times for the years 1977 through 1987 for a failure frequency of 2.7/yr.

The repair time for this system was also estimated to be 24 hours. Therefore, the unavailability of this system is $7.4 \times 10^{-3}/\text{yr}$.

Based on the 200-Area Fault Tree Data Bank, there were 60 false alarms for the H-Canyon sprinkler systems for the years 1977 through 1987. The frequency of this event is 5.4/yr.

3.7.4 Consequences

The possible consequences of AOE's in the Fire Protection Systems are reduced capability to detect a fire and reduced capability to suppress one.

3.7.4.1 Radiological Consequences

There are no direct radiological consequences resulting from failures of the fire detection and suppression systems.

3.7.4.2 Nonradiological Consequences

There are no direct nonradiological consequences that result from abnormalities in the fire detection and suppression systems.

3.7.5 Risk

Risk was not calculated since no significant consequences exist.

3.7.6 Corrective Actions

Corrective actions following AOE's in the Fire Protection Systems include repair of system components.

3.8 Failure of the Health Monitoring System

The functions, design considerations and descriptions of the Health Monitoring system for the Low Hazard and Moderate Hazard Buildings have similar descriptions. For this reason, both buildings have been combined in this section, unless otherwise noted.

The function of the Health Monitoring System is to provide for the safety of site and visitor personnel. It provides the means for prompt detection of the unwanted movement of radioactive contamination and for the detection of contaminants that are to be excluded and/or minimized in site effluents. Health

Protection standards shall be incorporated to assure that As Low As Reasonably Achievable (ALARA) has been incorporated into facility design during normal operation, standby, and planned shutdown (Ref. 1, 3).

The Health Monitoring System contains the following major components:

- Stack Monitoring System
- Continuous Air Monitors (CAMs)
- Area Radiation Monitors (ARMs)
- Kanne Chamber Tritium Monitors (Moderate Hazard Building)
- HP Equipment (i.e., smear counters, whole body friskers, etc.)
- Gaseous Effluent Monitoring System
- Dual Isokinetic Samplers

3.8.1 Causes

The causes of failures for the Health Monitoring System are presented in Table 3-5.

3.8.2 Detection

The CAMs and associated blowers and piping are provided to monitor the radioactive content of the air in HW/MW DF. If the radiation level in the area exceeds the high-level setpoint, an alarm sounds notifying personnel of the condition. The on/off status of each blower is displayed in the control room. Alternating current (AC) power failure at either blower initiates an alarm in the control room.

3.8.3 Frequency

The frequencies of failures for the Health Monitoring System are presented in Table 3-5. The frequency for partial loss of system function is expected to be less than $5 \times 10^{-1}/\text{yr}$.

3.8.4 Consequences

3.8.4.1 Radiological Consequences

Loss of health monitoring capability has no direct radiological consequences. Portable monitoring equipment can be used on a temporary basis.

3.8.4.2 Nonradiological Consequences

Loss of health monitoring capability has no significant nonradiological consequences except for the possible impact on facility operation. System failure may require a temporary shutdown.

3.8.5 Risk

Risk was not calculated since no significant consequences exist.

3.8.6 Corrective Actions

Corrective actions following AOE's in the Health Monitoring System include repair of system components and return of the facility to an operational status, as required.

3.9 AOEs in the Offgas System

The Offgas System for the Treatment Building provides the capability of removing any remaining mercury, organics and tritium. Refer to Ref. 1 for a more detailed description of the Offgas System.

3.9.1 Causes

Causes of disruptions in the Offgas System include failures of the following items:

- Normal and backup AC power supply
- Pumps
- Vent blowers
- Preheater
- Zeolite beds
- Gas cooler
- Heated reactor vessel
- Valves
- Carbon filters
- High-Efficiency Particulate Air (HEPA) filters

TABLE 3-5. Failure Frequencies for the Health Monitoring Systems

Event	Frequency (per hour)	Result
Sample Line Leak (Partial or Total)	2.5×10^{-5}	Loss of Monitoring Function
Blower Failure (Single Failure)	8.3×10^{-6}	Switch to Standby
Detector Malfunction (Partial)	1.4×10^{-5}	Loss of Monitoring Function
Filter Blockage	2.0×10^{-6}	Switch to Standby
Pressure Relief Valve	2.5×10^{-6}	Switch to Standby
Loss of AC Power (With Loss of Backup AC)	3.3×10^{-8}	Loss of Monitoring Function
Blower System Failure (Dual Failure)	7.5×10^{-8}	Loss of Monitoring Function

3.9.2 Detection

AOEs in the Offgas System will be detected by the following controls and indications in the Central Control Room (CCR):

- Storage tank level indication, including HI-HI and LO-LO level alarms.
- Process water inlet isolation valve and demister spray isolation valve control and fully closed position indication.
- Storage tank recirculation pump control, power available indication including vent scrubber pump power high and low alarms, and discharge pressure indication including high- and low-pressure alarms.

- Vent scrubber recirculation valve control and fully closed position indication.
- Recirculation flow indication including low-flow alarm.
- Mixer vent tank agitator control and load (ammeter).

3.9.3 Frequency

The failure frequencies for several types of components in the Offgas System are presented in Table 3-6.

3.9.4 Consequences

3.9.4.1 Radiological Consequences

Failure of HEPA filters could allow the release of small quantities of radioactive material. The stack monitors would limit these consequences by providing alarms in the Moderate Hazard building and the central alarm/monitoring panel in the Low Hazard building.

3.9.4.2 Nonradiological Consequences

The failure of fans, pumps, and other components (excluding HEPA filters) would have no consequence except possible interruption of facility operations while repairs are made.

3.9.5 Risk

Risk was not calculated since no significant consequences exist.

3.9.6 Corrective Actions

Corrective actions following AOE's in the Offgas System include repair of system components and return of the facility to an operational status, as required.

3.10 Failure of the Bulk Material Handling System

The Bulk Material Handling Systems is used primarily in the Low Hazard Building (unless noted) in the following process areas: Waste Segregation & Size

Reduction, Soil Washing, Stabilization/Solidification, Macroencapsulation, Sorting/Shredding. The Bulk Material Handling System consists mainly of a series of conveyor systems (e.g. flat belts, screw type, roller, accumulator, or troughed belt), hoppers, and bucket elevators. The systems may be of the pneumatic, hydraulic and/or electric powered type. The Bulk Material Handling System only includes the method of transporting the "process material" from operation to operation (it does not include the operation itself).

At this time, detailed specifications are not available for the Bulk Material Handling Systems.

TABLE 3-6. Failure Frequencies for the Offgas System

Event	Frequency (per hour)	Reference
Centrifugal Fan Failure	4.1×10^{-6}	4
Filter Plugging	1.0×10^{-6}	4
HEPA Filters	1.0×10^{-6}	4
Exhaust Fan Failure	4.1×10^{-6}	4
Centrifugal Pump Failure	3.4×10^{-6}	4

3.10.1 Causes

The causes of disruptions in the Bulk Material Handling System include failures of the following items:

- Normal and backup AC power supply
- Load/Limit switches
- Belts
- Hydraulic lines
- Pneumatic lines
- Compressors
- Valves
- Regulators.

3.10.2 Detection

Faults in the Bulk Material Handling System will be detected by the following I & C features:

- Status alarms in the control room
- Visual detection
- Pressure indicators
- Pressure control valves
- Pressure switches

3.10.3 Frequency

Because limited historical data exist for the HW/MW Bulk Material Handling System, it is necessary to estimate failure frequencies using generic equipment failure rate data and historical data for similar equipment in other facilities with longer operation histories.

Based on information from the 200-Area Fault Tree Data Bank, it was determined that the conveyors systems was partially or totally disabled 43 times during the years 1981 through 1990 for a failure frequency of 4.3/yr. The mean repair time for this system was about 24 hours. Therefore, the unavailability of this system is $1.2 \times 10^{-2}/\text{yr}$.

3.10.4 Consequences

3.10.4.1 Radiological Consequences

Loss of the Bulk Material Handling System has no direct radiological consequences.

3.10.4.2 Nonradiological Consequences

Loss of the Bulk Material Handling System has no significant nonradiological consequences except for the possible impact on facility operation. The direct consequence of a loss of the Bulk Material Handling System in any of the process areas would be down time in that particular process area. This situation would require a shutdown in that process area until the condition was resolved.

3.10.5 Risk

Risk is not applicable for the Bulk Material Handling System, since consequences are negligible.

3.10.6 Corrective Actions

Corrective actions following AOE's in the Bulk Material Handling Systems include repair of system components.

3.11 AOEs of the Macroencapsulation Process

Macroencapsulation is the process of surface coating a solid material, (in this case radioactivity contaminated lead) with a protective substance such as polymeric organic or inert inorganic materials. This process is performed to reduce the solid's surface exposure to potential leaching media. After compacting the lead into a standard size shape (billet) using a compactor/baler, the billet is transferred to a series of heated tanks containing molten polymer. The billet is alternately dipped and cooled until the required coating thickness is achieved (Ref. 1).

3.11.1 Causes

Causes of disruptions for the Macroencapsulation Process include failures of the following items:

- Normal and backup AC power supply
- Hydraulic lines (i.e. breaks, leaks, etc.)
- Pneumatic lines (i.e. breaks, leaks, etc.)
- Valves
- Pumps
- Tank leak

3.11.2 Detection

Faults in the Macroencapsulation Process will be detected by the following I & C features:

- Visual detection of leaks
- Temperature regulators
- Pressure regulators
- Load/limit switches

3.11.3 Frequency

Because limited historical data exist for the Macroencapsulation Process, it is necessary to estimate failure frequencies using generic equipment failure rate

data and historical data for similar equipment, as appropriate. Table 3-7 presents the failure frequencies of the Macroencapsulation Process.

3.11. 4 Consequences

3.11. 4.1 Radiological Consequences

Failure of the Macroencapsulation Process would pose no direct radiological consequences, except where the heated tanks containing molten polymer are concerned. In the unlikely event of a reaction with the plastic polymer from the tank(s), Cs^{137} could be released as a result. The contaminated lead to be processed in the worst-case container contains $1.3\text{E}+01$ Ci of Cs^{137} . If the open container is the worst-case Cs^{137} container, the maximum onsite individual dose could be $7.7\text{E}-01$ rem (Ref. 2).

3.11. 4.2 Nonradiological Consequences

Failure of the Macroencapsulation Process has a potential consequence with regard to possible operator burns from the molten polymer in the tank(s). Since the process is automated, operator interaction with the heated tanks is minimal. As determined in the Design Process Hazards Review (Ref. 1) guards will be in place to prevent splashing of molten polymer.

3.11. 5 Risk

Controls imposed to reduce the frequency and intensity of the potential AOE described in Section 3.11.1.4.1 and Table 3-7 is described below. The worst-case container in question would be in the Treatment Building with the container open for a maximum of 24 hours. This includes the time required to encapsulate the material assuming the process takes an 8-hour work shift. Failure frequency estimates of the incident occurrence is 1/yr ($1.1\text{E}-04/\text{hr}$). The automated thermoplastic coating process limits the interaction of operators within proximity of the heated tanks. The potential release of hazardous material is minimal due to inventory control and the HEPA filtration/exhaust system.

3.11. 6 Corrective Actions

Corrective actions following AOE's for the Macroencapsulation Process include procedural review and repair of system components.

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Nuclear Processes Safety Research
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Event	Frequency (per hour)	Reference
Valve Actuator, Pneumatic	6.5×10^{-7}	4
Valve Operator, Hydraulic	3.7×10^{-5}	4
Tanks	1.5×10^{-7}	4
Pumps, Hydraulic	1.68×10^{-6}	4
Pumps, Electric Drive	1.35×10^{-5}	4
Thermocouple	1.0×10^{-5}	4
Pressure Measurements	1.61×10^{-4}	4
Crane, (Mobile and Bridge)	5.3×10^{-5}	*
Heaters, Electrical,	2.29×10^{-6}	4

* Frequency rate obtained from Waste Management Fault Tree Data Bank for the years 1964 through 1992.

3.11 References

1. Title I Design Summary Report, Hazardous Waste Mixed Waste Disposal Facility Treatment Building, Document Number SDSRE-0001, Project S2944, Ebasco Services, Augusta, Georgia, April 24, 1992
2. Ebra-Lima, O. M. "Hazard Waste/Mixed Waste Disposal Facility, Treatment Building Hazards Assessment", Inter-Office Memorandum SRL-NPS-910041, Westinghouse Savannah River Company, Aiken, SC, August 15, 1991.
3. Basic Data Report, Hazardous Waste/Mixed Waste Disposal Facility Phase II Treatment Building WSRC-TR-91-120, Westinghouse Savannah River Company, Aiken SC March 28, 1991.
4. "Component Failure-Rate Data with Potential Applicability to a Nuclear Fuel Reprocessing Plant," DP-1633, E. I. du Pont de Nemours & Co., Aiken, SC, July 1982.
5. Savannah River Site Radiological Controls, WSRC Manual 5Q, Westinghouse Savannah River Company, Aiken, SC, January 31, 1991.

SECTION 4 ACCIDENTS

This section presents analyses of events initiated by internal or external occurrences that have the potential to produce significant consequences at the Savannah River Site (SRS). In the case of the Treatment Building, these events are shown in Section 5 to be bounded in severity by the worst unmitigated accident scenario (Ref. 1). The consequences of each individual event are discussed in this section except for consequences less than those for Low Hazard segment of this facility (Ref. 1).

4.1 Transfer Errors

Transfer errors are defined as the intentional movement of materials to an unintended location, the premature movement of materials to an intended location, or the excessive movement of materials. For the Treatment Building, this error means mis-placement of treated waste after receipt, or receipt of unacceptable waste. Transfer errors are generally taken to include errors in transfers of liquid wastes.

4.1.1 Causes

Transfer errors can be attributed to procedural inaccuracies and human mistakes associated with placement instructions.

4.1.2 Detection

Transfer errors are detected in processes, by formal and informal inventory determination during otherwise normal operations, and by reviews of operations records.

4.1.3 Frequency

Data concerning hazardous waste/mixed waste transfer errors from 1990 through 1992 were analyzed for the SWDF. Since mixed liquid wastes are handled in discrete units instead, generally, of from tank to tank, these data are applicable. Sixteen incidents are recorded from the SWDF during this period. The average frequency of incident occurrence is 5/yr.

In the Treatment Building, the hazardous materials considered for transfer errors are materials represented by the inventory of mixed waste in buildings 643-29E and 709-2G. The Waste Acceptance Criteria (WAC) and the controls thereon are the controls that assure that only acceptable materials are received for processing in the Treatment Building. Therefore the failure frequency of WAC controls at SRS are used as the failure frequency for controls on waste handling at the Treatment Building. $5.0E-03$ incidents per person-year is considered a bounding frequency for the Treatment Building. The actual frequency will depend on the number of

persons operating the facility and the fraction of the year during which it is operated.

4.1.4 Consequences

The radiological and nonradiological consequences of transfer errors in the Treatment Building* are bounded by the consequences of the worst unmitigated accident scenario (Ref. 1) Transfer errors in the extreme case of the opening and evaporation of the tritium in the worst-case drums could lead to exposures listed in Table 4-1 for Transfer Errors.

4.1.5 Risk

The consequences of the various accidents listed in Table 4-1 are not greatly in excess of SRS guides for exposure of individuals to radioactivity. (The consequences shown are unmitigated, and result from multiple failures of safety controls. For instance, administrative controls will prevent there being multiple opened containers of higher concentration tritiated oil.) Controls imposed to reduce the frequency and intensity of these accidents will provide risks below the risk guides for SRS operations (Ref. 2 and 3) When accidents other than release of tritium are considered, the low activities offset the greater frequencies of misoperation in the risk calculations. (Table 4-2)

4.2 Chemical Addition Errors

Chemical addition in the Treatment Building may occur in the following operations:

- Chemical leaching of cadmium from HEPA filter frames;

- Preparation of resins for macroencapsulation of contaminated lead

- Amalgamation of mercury

- Soil Washing

4.2.1 Cadmium leaching

Addition of the wrong chemical, or of the correct chemicals in the wrong order can lead to improper operation and inadequate treatment of the wastes. However, the improper dilution technique with sulfuric acid can lead to eruption, vessel pressurization and rupture and exposure of personnel to corrosive materials. Loss of eyesight, destruction of tissue in other parts of the body surface are potential results. In radioactively contaminated systems, exposure to radioactivity along with chemical burns may occur if personnel contact the liquid. Operators at the site of the eruption would be exposed. Eruption due to overpressure would effect nearby plant personnel, but radioactivity levels would be low enough to

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prevent exceeding onsite exposure guides. The filter frames to be processed contain only $5.0\text{E-}06$ Ci of Cs137, the only radionuclide present. Release of the entire amount would only contribute $7.0\text{E-}06$ rem to the dose of the maximally exposed onsite individual.

4.2.2 Macroencapsulation

Molten polymer is used to immobilize the contamination on the surface of materials and equipment. The maximum consequence is burns from splashing of molten polymer. Shields to prevent splash burns reduce this hazard. Molten polymer will contain too little radioactivity to result in detectable releases from splashes.

4.2.3 Amalgamation of mercury

Mercury is a toxic substance. Use of the wrong materials in the amalgamation step could lead to exposure of personnel during non-routine cleanup operations. Mercury exposure can cause acute and chronic poisoning. Subsequent preparation of the mercury for disposal after amalgamation has not been defined.

4.2.4 Soil washing

Incorrect use of materials other than water in soil washing is prevented by the ready availability of the water and by administrative controls preventing the presence of hazardous materials in the facility used for soil washing.

4.3 Fires

Fires are credible events in the Treatment Building (i.e., expected frequency greater than 1.00×10^{-6} events per year). However, this is a normal industrial hazard and is not due to the nature of the waste material disposal process.

The most likely fire scenarios include ignition of the waste in a general fire, electrical fires, welding or other maintenance activities, and smoking. A fire could envelop open containers and vessels, rupture other vessels stored for processing in the facility, and lead to consequences as outlined in Table 4-1.

Although the Treatment Building is a moderate hazard facility, the potential release of hazardous material is minimal because of inventory control. In addition, release of the hazardous materials that will be present are shown to be of little consequence in the Hazards Analysis. (Ref. 1) A Fire Hazards Analysis has been performed for the Treatment Building. (Ref. 4)

Table 4-1 Incidents and Maximum Consequences in the Treatment Building

<u>Incident</u>	<u>(Max Exposed Onsite Person)</u>	<u>(Max Exposed Offsite Person)</u>
Transfer Errors (includes spills due to operational errors)		
Release of tritium.	6.5E+00 rem	1.6E-02 rem
Excessive inventory in the Treatment Building	1.2E+01rem	3.2E-02 rem
Excessive open containers in the Treatment Building (3)	1.9E+01 rem	5.2E-02 rem
Wrong material received	indeterminate	indeterminate
Damaged containers in the Treatment building (release)		
One container	3.0E+00 rem	6.2E-03 rem
Two to ten containers	3.0E+01 rem	6.2E-02 rem
Explosion		
Half of inventory of tritium released	2.5E+01 rem	5.1E-02 rem
Fire		
Half of inventory of tritium released	2.5E+01 rem	5.1E-02 rem
Nuclear Criticality	not credible due to inventory control	
Other releases of radioactive	None identified material	

Table 4-1, Continued

Fatalities

Potential based on Site experience with dropped objects, fires and explosions, other materials handling operations. Normal industrial hazard.

Natural Phenomena

Earthquakes	3.0E+01rem	6.2E-02 rem
Floods	6.5E+00rem	1.6E-02 rem
Windstorms and Tornadoes	3.0E+01rem	6.2E-02 rem
Aircraft Crashes	3.0E+01rem	6.2E-02 rem

Note: Dose consequences listed in this table are calculated from source terms derived from fractional releases of actual projected inventories. These are not to be confused with bounding maximum releases of isotopes shown in Table 2-2.

4.4 Explosions

Several explosion scenarios were postulated for the Treatment Building. The only scenario deemed credible (i.e., expected frequency greater than 1.00×10^{-6} events per year) is pressurized vessel explosion from H₂SO₄ makeup. This explosion could release small amounts of radioactive and non-radioactive hazardous materials. However the consequences could not exceed those outlined in Table 4-1. The amounts of radioactive material release could not exceed 1% of the inventory on the filter frames. (See the Appendix)

The emergency diesel generators and fuel oil storage tank are located away from the Treatment Building. Even if an explosion of the diesel fuel oil tank is assumed to affect the Treatment Building, the contents of the building except for volatile materials would be retained in a concrete-lined, diked area. This would not result in any significant radioactive material or chemical release except for tritium. The consequences are bounded by the values in Table 4-1

A bulk material handling dust explosion is also an industrial safety hazard and must be considered whenever large quantities of dry industrial chemicals (i.e., cement, slag, and flyash) are semicontinuously received and transferred. This type of explosion usually results in large-scale equipment damage and possible operator fatalities. The chemical release that would result represents an industrial hygiene hazard, and the distance between the bulk material handling area and the

process material represents no potential for a radioactive material release. A fire resulting from this type of explosion is not credible since all of the dust-chemicals will be in their maximum oxidation state.

The possibility exists that xylene vapors may be present in low concentrations in certain areas of the building. However, the vapors will only be present in amounts too low to make a gas explosion credible. The highest calculated liquid concentration of xylene is 5.1×10^{-3} g/l ($4.2 \times 10^{-4}\%$), which is approximately the calculated average concentration during repackaging for incineration, and is less than 1% of the LEL for xylene. It is therefore concluded that explosion or fire due to xylene buildup is not a credible event.

4.5 Criticality

Criticality is not a credible event for the Treatment Building and is not analyzed further. Only trace quantities of fissionable materials in highly diluted form will be processed. Because there is no concentrating process involved, criticality is considered impossible in the Treatment Building.

4.6 Externally Induced Events

Most safety-related occurrences are the result of failure within the system, or of some action intentionally directed toward the system. It is possible, however, for the damage to be inflicted on a system as a result of some occurrence in an apparently separate system. Two significant sources of externally induced failure mechanisms are identified as applicable to the Treatment Building operations. These sources are natural phenomena and impact.

4.6.1 Causes

The causes of externally induced failures include vehicle impact (e.g., airplane) and natural phenomena (e.g., tornado, earthquake). Impact by airplane was considered an externally induced event for the Treatment Building; impacts by other types of vehicles, such as trucks, generate consequences representative of industrial hazards. Natural phenomena are analyzed in this section.

4.6.2 Detection

Externally induced failures are detected by personnel in the area.

4.6.3 Frequency

A study of the probability of aircraft crashes into an SRS reactor building has been completed (Ref. 5), and the results are applied in this section to the Treatment Building. Studies related to power reactors, based on U. S. Civil Aviation accident data, indicate that, beyond 5 miles from a runway, the expected frequency of an

airplane crash approaches a constant value. For general aviation flights, this value is $7.00 \times 10^{-9}/\text{yr mile}^2$.

It is estimated that 4000 flights will occur within the SRS airspace each year (Ref. 5). Thus, the expected frequency of an airplane crash anywhere within the SRS site boundary is $2.80 \times 10^{-5}/\text{yr mile}^2$. The total target area for the Treatment Building that may contain hazardous material is $6 \times 10^{-3} \text{ mile}^2$ (200 feet x 100 feet). Thus, the expected frequency of an airplane crash in the Treatment Building is $1.6 \times 10^{-7}/\text{yr}$. This frequency makes an airplane crash in the Treatment Building an incredible event.

4.6.4 Consequences

Except for equipment and structural damage and operator injury, the consequences of externally induced events in the Treatment Building are bounded by the consequences of the worst unmitigated accident scenario (Ref. 1) defined for the Treatment Building and described in Table 4-1. An externally induced event can affect any given area of the Treatment Building, breaching containment in that area. For example, a direct airplane impact can breach containment provided by the culverts and the drums. Several types of event might breach all levels of waste containment at once. The consequences might be as high as the worst unmitigated accident consequences, shown in Table 4-1. Therefore, the scenario of maximum releases in that table are bounding, even when the entire building is involved.

4.6.4.1 Radiological Consequences

The radiological consequences of externally induced events in the Treatment Building are bounded by the consequences of the unmitigated accidents in Table 4-1.

4.6.4.2 Nonradiological Consequences

The chemical release consequences of externally induced events in the Treatment Building are bounded by the consequences of the worst unmitigated accident scenario (Ref. 1) and are below the levels of concern for the hazardous constituents.

Depending on the severity of the event, an externally induced event may cause significant equipment and structural damage and may also result in injury or death.

4.6.5 Risk

Risk resulting from release was calculated for the Treatment Building and the results are presented in Table 4-2 for each defined accident.

Table 4-2 Incidents and Associated Risk in the Treatment Building

<u>Incident</u>	<u>Max Exposed Onsite Person (Rem/yr)</u>	<u>Max Exposed Offsite Person) (Rem/yr)</u>
Transfer Errors (includes spills due to operational errors)		
Release of tritium.	3.0E-02	8.0E-05
Excessive inventory in the Treatment Building	6.0E-02	1.6E-04
Excessive open containers in the Treatment Building (3)	1.9E-01	5.2E-04
Wrong material received	indeterminate	indeterminate
Damaged containers in the Treatment building (release)		
One container	1.9E-02	4.8E-05
Two to ten containers	9.0E-02	1.0E-08
Explosion		
Half of inventory of tritium released	2.5E-05	5.1E-08
Fire		
Half of inventory of tritium released	2.5E-05	5.1E-08
Nuclear Criticality	not credible due to inventory control	
Other releases of radioactive material	None identified	

TABLE 4-2 CONTINUED

Incident	Max. Exposed Onsite Person (Rem/yr)	Max. Exposed Offsite Person (Rem/yr)
Fatalities	Potential based on Plant experience with dropped objects, fires and explosions, other materials handling operations	
Natural Phenomena		
Earthquakes	4.5E-02	9.3E-05
Floods	Treatment Building not located in 100 year floodplain (Ref. 4)	
Windstorms and Tornadoes	6.0E-01	1.2E-03

4.7 Leaks

In any mechanical system containing fluids, leaks will occur. The leaks may be from valves, expansion joints, tanks, process vessels, or piping.

4.7.1 Causes

Leaks are caused by a wide variety of equipment failures and inadequate maintenance. The most common causes of leaks are valve failure, seepage through expansion joints, seal failure, gasket failure, inadequate tightening of fittings, loose flange, corrosion, and inadequate welds. Leaks can also be caused by an overpressure situation.

Leaks of grout are not considered because this would not result in the release of any radiologically or chemically hazardous material.

4.7.2 Detection

A leak will usually be detected by personnel in the area. In the event a leak goes undetected by operating personnel, the leak will be detected by level detection in the associated sump or by radiation monitors.

4.7.3 Frequency

The frequency data of leaks from Waste Management Facilities at SRS were averaged, and this average was taken to be the SRS facility frequency for transfer errors.

The average frequency of incident occurrence is ca 32/yr (1.06×10^{-2} /hr) per facility. The Treatment Building is less complex than the systems used to establish the leak frequency. Therefore, 8/yr is considered bounding for the Treatment Building.

4.7.4 Consequences

The consequences of leaks in the Treatment Building are bounded by the consequences of the worst unmitigated accident scenario in Table 4-1.

4.7.5 Risk

Mitigation of escape of evaporated materials from leaks by ventilation and scrubbing of off-gas is relied upon to reduce the source term for leaks from the worst unmitigated release by a factor of 100 at least. Failure frequency for the mitigating safety systems is estimated at $3E-03$ /year, yielding a risk of release of $9.0E-02$ rem per year for the max exposed onsite individual and the $6E-05$ rem/yr for the max exposed onsite individual.

4.8 Natural Phenomena

Extremes in natural phenomena can adversely affect operations in the Treatment Building either by causing damage to equipment or by aggravating a deteriorated situation. Natural phenomena are discussed in detail in the SRS Methodology Manual (Ref. 4) and are summarized in this section since they can directly affect the Treatment Building. Temperature, earthquakes, meteorites, volcanoes, and winds were considered.

4.8.1 Causes

A discussion of the causes of natural phenomena is found in Reference 9.

4.8.2 Detection

4.8.2.1 Seismic Events

Seismic activity is recorded by the SRS seismograph network (SEISNET), which consists of four field seismometer sites. Each site has a vertical seismometer, one unit with two horizontal seismometers (SRAV, SRPN, SRPW, SRPD), and one central recording station. The seismic activity at each field site is detected by a

seismometer, which is a movable coil that induces a series of electrical impulses when vibrated. These electrical impulses are amplified and sent over telephone lines to a central recording site where the signals are again amplified and then recorded on digital tape in a seismic computer with four records visually displayed.

The signals from sites SRAV, SRPN, and SRPW are fed directly to telephone lines, but the signal for SRPD is first transmitted by radio to the D-Area Powerhouse and then fed into a telephone line for transmission to the recording station. The signals from seismometer site SRPN are recorded at two different gains (high and medium) to permit different resolutions for earthquakes of different magnitudes.

Timing accuracy is provided to within 0.050 seconds, and times are compared daily with the National Bureau of Standards time, which is broadcasted from Radio Station WMV in Fort Collins, Colorado. The time base for the network is Universal Time Coordinated, which is 5 hours later than Eastern Standard Time and 4 hours later than Eastern Daylight Savings Time.

The computer system to which the data are sent is capable of detecting real events from area noise and, if a regional earthquake occurs, will provide in real time a preliminary estimate of the magnitude, location, and depth of the earthquake.

4.8.2.2 Other natural events are detected by direct observation.

4.8.3 Frequency

Frequencies are considered for events involving temperature, snow, rain and flooding, lightning, earthquakes, meteorites, high-velocity straight winds, and tornadoes.

Temperature

Although cold weather has little direct effect on operations within the building confines, significant damage can occur to auxiliary services exposed to the environment. Experience has shown that winterizing procedures are effective down to about 18°F. Below this temperature, lines plug with ice, valves and pipes burst, alarm bell clappers freeze, instrumentation may become ineffective, and equipment with parts that occasionally move on demand may become immobilized. Thus, icing is a prime cause of common mode failure. Based on 18 occurrences in 10 years in which the minimum recorded temperature was less than 18°F, the frequency of significant ice damage is calculated as 1.84/yr (2.10×10^{-4} /hr).

Snow

Snow is not expected to damage the Treatment Building equipment directly but is a possible severe aggravation factor to normal operation and maintenance. Approximately 18 inches of snow, the most ever recorded in the Augusta, Georgia,

area, fell in February 1973. Some damage that resulted was attributed to the 14°F minimum temperature following the snowfall.

The average annual snowfall over the last 45 years has been about 0.9 inches. Trace amounts or greater can be expected 3 out of 4 years; snowfall of 0.1 inch or more occurs slightly less than every other year. One inch or more has fallen in 7 of the past 45 years (Ref. 7).

The expected frequency of sufficient snow to aggravate building operations is estimated to be $7.01 \times 10^{-2}/\text{yr}$ ($8.00 \times 10^{-6}/\text{hr}$).

Rain and Flooding

Rain can be both an aggravation to a deteriorated situation and a damage-inflicting condition in itself. The expected frequency of sufficient rain falling in a 24-hour period to aggravate a deteriorated situation is estimated to be $7.01/\text{yr}$ ($8.00 \times 10^{-3}/\text{hr}$), and to cause damage, $8.76 \times 10^{-1}/\text{yr}$ ($1.00 \times 10^{-4}/\text{hr}$).

Lightning

The principal adverse effect of lightning is the interruption of electrical power. Between 1973 and 1974, an improved multidisk ionization-type lightning arrester system was installed in the 13.8-kV distribution lines in place of the pellet-type arresters. These new arresters have reduced the frequency of power failure due to lightning to an estimated $1.75/\text{yr}$ ($2.0\text{E-}04/\text{hr}$), an improvement of approximately a factor of 10.

Earthquakes

The bases for the earthquake probabilities used at SRS are presented in the SRS Methodology Manual (Ref. 4). The manual lists frequencies for various earthquakes as a function of Peak Ground Acceleration (PGA).

Since it has been determined that the vital structures for the Treatment Building can withstand 0.11g (see Chapter 4.0 of this SAR) of lateral acceleration or PGA, the frequency for a 0.11g PGA is used for the frequency of an earthquake that could cause damage in the Treatment Building. This frequency is $1.50 \times 10^{-3}/\text{yr}$.

Meteorites

The bases for the expected frequency of a meteorite impacting at SRS are presented in the SRS Methodology Manual (Ref. 4). Resultant estimates of the frequency range from 1.00×10^{-14} to 1.00×10^{-9} impacts per year. The hazards associated with meteorites are not considered further due to the low probability of occurrence (i.e., less than $1.00 \times 10^{-6}/\text{yr}$).

High-Velocity Straight Winds

The bases for the probabilities of high-velocity straight winds occurring at SRS are presented in the SRS Methodology Manual (Ref. 4). It is not expected that a straight wind of less than 84 mph would cause significant damage to the vital structures in the Treatment Building; therefore, the associated frequency of occurrence used for high-velocity straight winds in the Treatment Building is $1.40 \times 10^{-2}/\text{yr}$.

4.8.4 Consequences

Except for equipment and structural damage and operator injury, the consequences of natural phenomena in the Treatment Building are bounded by the consequences of the worst unmitigated accident scenario defined for the Treatment Building and presented in Table 4-1. Certain natural phenomena such as earthquakes have the potential to affect all areas of the Treatment Building and to breach containment.

4.8.4.1 Radiological Consequences

The radiological consequences of natural phenomena in the Treatment Building are bounded by the consequences of the worst unmitigated accident scenario shown in Table 4-1.

4.8.4.2 Nonradiological Consequences

The chemical release consequences of externally induced events in the Treatment Building are bounded by the consequences of the worst unmitigated accident scenario (Ref. 1) and are below the levels of concern for the hazardous constituents.

Depending on the severity of the event, an externally induced event may cause significant equipment and structural damage and may also result in injury or death.

4.8.5 Risk

Maximum risks from naturally caused events are bounded by the same risks as the total breach of building containment from other causes. Table 4-2 sets forth those risks for the Treatment Building. None exceed acceptable risk as defined in References 2 and 3.

4.9 Spills

Spills result when material escapes primary containment by means other than those defined in other subsections of Section 4. This general category ensures

completeness of the mechanisms for loss of control of radioactive or toxic materials.

4.9.1 Causes

Liquid spills may be caused by operator error, seal or gasket rupture, or maintenance work. The contents of a tank can be spilled as a result of a mechanical failure or operator error. Spills can also be caused by an overpressure situation.

4.9.2 Detection

Spills are detected by level detectors or by operators in the area.

4.9.3 Frequency

Data concerning spills were obtained from the 200-Area Fault Tree Data bank (Ref. 8). The information allows an estimate of spill frequency for either waste handling-processing, or transfer of individual containers as addressed under Transfer Errors. The frequency of spills from a single process is estimated to occur at $5.0\text{E-}03/\text{yr}$ per tank.

The only operation involving liquid tanks in the treatment building is the cadmium leaching operation. Frequency of spills in this operation is estimated to occur at a frequency of $1.0\text{E-}02$ spills/yr.

4.9.4 Consequences

The radiological consequences of natural phenomena in the Treatment Building are bounded by the consequences of the worst unmitigated accident scenario shown in Table 4-1.

The chemical release consequences of externally induced events in the Treatment Building are bounded by the consequences of the worst unmitigated accident scenario (Ref. 1) and are below the levels of concern for the hazardous constituents.

Depending on the severity of the event, an externally induced event may cause significant equipment and structural damage and may also result in injury or death.

4.9.5 Risk

Risks from naturally caused events are bounded by the same risks as the total breach of building containment from other causes. Table 4-2 sets forth those risks for the Treatment Buildings. None exceed acceptable risk as defined in References 2 and 3.

4.10 References

1. Ebra-Lima, O. M. Hazardous Waste/Mixed Waste Disposal Facility, Treatment Building Hazards Assessment Inter-Office Memorandum SRL-NPS-910041, Westinghouse Savannah River Company, Aiken, SC, August 15, 1991.
2. Requirements for Radiation Protection of the Public and Environment, Department of Energy Order 5400.5, 2/8/90
3. Facility Safety Analysis Manual, 9Q, Westinghouse Savannah River Company, Aiken, SC, 1-15-91
4. Hazardous Waste/Mixed Waste Disposal Facility Treatment Building Title 1 Design Summary Report, Document S-DSR-E001, Project 2944, Volume II. (Rev. 0, 9-15-92) Westinghouse Savannah River Company, Aiken, SC,
5. Nomm, E. Probability of Aircraft Crash at SRP. Internal Report DPST-73-402, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC, 1973.
6. SRS Methodology Manual for Nonreactor Safety Analysis. WSRC-TM-90-13, Westinghouse Savannah River Company, Aiken, SC, February 22, 1991.
7. Local Climatological Data - Augusta, Georgia (1973). U. S. Department of Commerce.
8. Durant, W. S. and Galloway, W. D. 200-Area Fault Tree Data Bank - 1985 Status Report. Internal Report DPST-86-233, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC, February 3, 1986.
9. J. C. Huang and Y. S. Hsu. "Standardization of Natural Phenomena Risk Assessment Methodology at the Savannah River Plant." Proceedings of the DOE Natural Phenomena Hazard Mitigation Conference, Las Vegas, Nevada, October 7-11, 1985.

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SECTION 5: WORST UNMITIGATED ACCIDENT SCENARIO

The analysis of operations for the Treatment Building, a part of the Hazardous Waste/Mixed Waste Disposal Facility at the Savannah River Site (SRS), includes the analysis of an accident scenario - the worst unmitigated accident scenario - that bounds the consequences of any credible event that could occur in the Treatment Building. The Treatment Building is classified as a moderate hazard facility (Ref. 1). As a result of this classification and the nature of the low-level feed material, all consequences (excluding normal operations) are quantified with the single bounding event (Ref. 2).

Hazardous materials in the Treatment Building may include the inventory shown in the Appendix, and representative materials drawn from it. Selected inventories, chosen from this one, were composed to represent operational campaigns. These campaigns will be performed one at a time and will be devoted to one or two processes. That is, the treatment building will not be used to run multiple treatment processes simultaneously. Therefore the maximum credible inventory at any given time is the entire inventory of a given waste type, assembled at once in the Treatment Building in anticipation of preparing it for disposal. This is a conservative scenario that is used to define the maximum permissible inventory in the building. Although the Low Hazard part of the building is not qualified to accommodate opening, sorting, and sampling all of the waste now stored in the two mixed waste buildings, it is safe, because of the packaging, to hold the highest activity radwaste now stored inside the Treatment Building in closed containers.

The consequences of the several worst unmitigated accidents are shown in Table 4-1. The maximum exposures are seen to result from the unmitigated release due to rupture of up to ten containers (the worst possible ones present during a tritium packaging run). In order for the release to be unmitigated, a simultaneous failure of the ventilation system must occur, rendering the scrubber system useless. That condition infers a natural catastrophe or an external event that destroys the building.

The worst unmitigated accident scenario has credible initiating events. Due to the infrequent occurrence of the initiating events, $2.0\text{E-}04$ events/year, and the consequences of 30 rem to the maximum exposed onsite individual, the risk can be expressed without invoking fault tree or other complex analysis as a maximum of $6.0\text{E-}03$ rem/year. Risk to the maximum exposed offsite individual from the same worst accidents can be $1.2\text{E-}05$ rem/year. The conditions necessary for this release are two to ten open containers, and their contents evaporated or dispersed to the atmosphere during a two hour release. Obviously, general building destruction would have to occur along with a release of this intensity.

No release defined can cause exposure to onsite or offsite exposed individuals exceeding the EPRG or IDLH values for any of the hazardous substances in the inventory shown in the Appendix.

Concerning nonradiological consequences, the worst unmitigated accident scenario is bounding for radiological and chemical consequences only. The potential facility damage and operator injury from external events, such as earthquakes, are not bounded.

5.1 Cause

Only highly energetic natural or other external phenomena could simultaneously destroy the ventilation and scrubber system of the Treatment Building and cause the rupture of multiple containers of tritiated oil. These constitute the only credible causes of release beyond acceptable consequences, since multiple containers must be involved.

5.2 Detection

Detection will be by occupant observation.

5.3 Frequency

The threshold frequency of an initiator of this energy is that for a 0.15g earthquake or greater ($2.0\text{E-}04/\text{Yr}$)

5.4 Consequences

The consequences for this bounding accident, and for other somewhat less severe accidents, are presented in Table 4-1.

The consequences for the dispersion of radionuclides are calculated using the AXAIR89Q computer code and the associated methodology. The consequences for chemical toxins were calculated using the dispersion output from the AXAIR89Q code. The consequences at the point of the accident are based on a bounding evaporation rate and vapor concentration calculations coupled with the application of internal and external dose conversion factors.

5.4.1 Radiological Consequences

The source terms and resulting releases used for the various radionuclides considered in this analysis were obtained from the characteristics of the inventory of Hazardous and Mixed Waste now on hand at SRS. All accumulated mixed waste is now stored, awaiting disposition, in buildings 643-29E and 709-2G. Partition factor are taken as equivalent to the Source Reduction Factors in the Hazards Assessment Document for the Treatment Building. (Ref. 1)

5.4.2 Nonradiological Consequences

The source terms and resulting airborne concentrations used for the various toxic chemicals considered in this analysis are taken from the inventory characterization present in the Appendix. Maximum inventories are defined by the operation in progress and the materials stored in the Treatment Building for it. The release rates are based on the 2-hour release period.

The maximum nonradiological consequence of an accident for a person 100 meters from the accident is 1.4 mg of Hg per cubic meter. The IDLH value is 28mg per cubic meter.

5.5 Risk

Risks were calculated for the maximum credible consequence for an accident causing release of radioactive and other hazardous materials from the Treatment Building. The maximum risk is $6.0E-03$ rem/yr to the maximally exposed onsite individual resulting from release of tritium from the treatment building. This risk applies to accidents up to and including the Design Basis Earthquake.

5.6 Results and Conclusions

Conclusions are stated in terms of consequence and risk. Radiological and nonradiological (chemical only) consequences in this section are compared to appropriate standards cited where used or in Section 4.

5.7 References

1. Ebra-Lima, O. M. "Hazardous Waste/Mixed Waste Disposal Facility, Treatment Building Hazards Assessment" Inter-Office Memorandum SRL-NPS-910041, Westinghouse Savannah River Company, Aiken, SC, August 15, 1991.
2. Huang, J. C. Use of the AXAIR890 Code. Internal Manual WSRC-TR-90-569. Westinghouse Savannah River Company, Savannah River Laboratory, Aiken, SC, December 5, 1990.

Appendix: Hazardous Waste/Mixed Waste Treatment Building Safety Information Document.

This appendix is a listing of the inventory of materials now stored in Buildings 643-29E and 709-2G that will be processed in the Treatment Building. In planning the processing runs, or "campaigns" to accomplish necessary work on these inventories, the grouping of the inventory by the characteristics of the waste was the fundamental control. For example, all tritiated oils to be repackaged for incineration in the CIF was assumed to be assembled for processing at one time in the Treatment Building. This is a conservative approach, in that it maximizes inventory, but provides flexibility in operation by allowing lesser or equal amounts of radionuclides and hazardous materials, so long as the dose to the maximally exposed persons on and offsite is not exceeded in an unmitigated release.

Projected inventories are not available from the generators. The inventory now stored in the two buildings was collected over a five year period and is representative of the wastes expected over the next five years.

Transuranic waste, and high-activity waste will not be accepted in the Treatment Building.

	A	B	C	D	E	F	G	H	I	J
1	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
2										
3	B-5-1 #1	232-H	6.5 gallons	200	1.2	0	0	0	0	0
4	B-5-1 #2	232-H	6.5 gallons	200	1.2	0	0	0	0	0
5	B-5-1 #3	232-H	6.5 gallons	200	1.2	0	0	0	0	0
6	B-5-1 #4	232-H	6.5 gallons	200	1.2	0	0	0	0	0
7	B-5-1 #5	232-H	6.5 gallons	200	1.2	0	0	0	0	0
8	B-5-1 #6	232-H	6.5 gallons	200	1.2	0	0	0	0	0
9	B-5-1 #7	232-H	6.5 gallons	200	1.2	0	0	0	0	0
10	B-5-1 #8	232-H	6.5 gallons	200	1.2	0	0	0	0	0
11	B-5-1 #9	232-H	6.5 gallons	200	1.2	0	0	0	0	0
12	B-16-1	232-H	(15 cubic feet)	430	5	0	0	0	0	0
13	B-17 -1	232-H	1 CONTAINER	430	5	0	0	0	0	0
14	D-5-1	724-7G	55 gal	430	1.8	0	0	0	0	0
15	D-6-1	724-7G	55 gal	430	1.8	0	0	0	0	0
16	D-7-1	724-7G	55 gal	430	1.8	0	0	0	0	0
17	D-8-1	724-7G	55 gal	430	1.8	0	0	0	0	0
18	D-9-1	724-7G	55 gal	430	1.8	0	0	0	0	0
19	D-10-1	724-7G	55 gal	430	1.8	0	0	0	0	0
20	D-11-1	724-7G	55 gal	430	1.8	0	0	0	0	0
21	D-12-1	724-7G	55 gal	430	1.8	0	0	0	0	0
22	D-15 -1	773-A	55 gal	500	1E-09	0	0	0	1E-11	1.38 gm U235
23	T-1-1 #1	234-H	55 gal	unknown	10400	0	0	0	0	0
24	T-1-1 #2	234-H	55 gal	unknown	10400	0	0	0	0	0
25	T-1-1 #3	234-H	55 gal	unknown	10400	0	0	0	0	0
26	T-1-1 #4	234-H	55 gal	unknown	10400	0	0	0	0	0
27	T-1-1 #5	234-H	55 gal	unknown	10400	0	0	0	0	0
28	T-1-1 #6	234-H	55 gal	unknown	10400	0	0	0	0	0
29	T-1-1 #7	234-H	55 gal	unknown	10400	0	0	0	0	0
30	T-1-1 #8	234-H	55 gal	unknown	10400	0	0	0	0	0
31	T-1-1 #9	234-H	55 gal	unknown	10400	0	0	0	0	0
32	T-1-1 #10	234-H	55 gal	unknown	10400	0	0	0	0	0
33	T-1-1 #11	234-H	55 gal	unknown	10400	0	0	0	0	0
34	T-1-2 #1	234-H	55 gal in overpack	unknown	12025	0	0	0	0	0
35	T-2-1 #1	234-H	55 gal in overpack	unknown	10	0	0	0	0	0
36	T-2-1 #2	234-H	55 gal in overpack	unknown	10	0	0	0	0	0
37	T-2-1 #3	234-H	55 gal in overpack	unknown	10	0	0	0	0	0
38	T-2-1 #4	234-H	55 gal in overpack	unknown	10	0	0	0	0	0
39	T-2-1 #5	234-H	55 gal in overpack	unknown	10	0	0	0	0	0
40	T-2-1 #6	234-H	55 gal in overpack	unknown	10	0	0	0	0	0
41	T-2-1 #7	234-H	55 gal in overpack	unknown	10	0	0	0	0	0
42	T-2-2 #1	234-H	55 gal in overpack	unknown	20000	0	0	0	0	0
43	T-2-2 #2	234-H	55 gal in overpack	unknown	20000	0	0	0	0	0
44	T-2-2 #3	234-H	55 gal in overpack	unknown	13000	0	0	0	0	0
45	T-4-1 #1	234-H	30 gal in 85 gal ovpk	150	11819	0	0	0	0	0
46	T-4-1 #2	234-H	30 gal in 85 gal ovpk	150	11819	0	0	0	0	0
47	T-4-1 #3	234-H	30 gal in 85 gal ovpk	150	11819	0	0	0	0	0
48	T-4-1 #4	234-H	30 gal in 85 gal ovpk	150	11819	0	0	0	0	0
49										
50										
51										
52										
53										

1	K	L		M	N	O	P	Q
	Gamma field at 1 in. mR/hr	Hazardous Constituents				Physical State	Description	CAMPAIGN NUMBER
2		Name or EPA code	Mass (lbs)	Type of analysis				
3		0 none		0 pk	I		Tritiated Oil	1
4		0 none		0 pk	I		Tritiated Oil	1
5		0 none		0 pk	I		Tritiated Oil	1
6		0 none		0 pk	I		Tritiated Oil	1
7		0 none		0 pk	I		Tritiated Oil	1
8		0 none		0 pk	I		Tritiated Oil	1
9		0 none		0 pk	I		Tritiated Oil	1
10		0 none		0 pk	I		Tritiated Oil	1
11		0 none		0 pk	I		Tritiated Oil	1
12		0 none		0 pk	I		Tritiated Oil	1
13	unknown	0 none		0 pk	I		Tritiated Oil	1
14		0 none		0 pk	I		Tritiated Oil	1
15		0 none		0 pk	I		Tritiated Oil	1
16		0 none		0 pk	I		Tritiated Oil	1
17		0 none		0 pk	I		Tritiated Oil	1
18		0 none		0 pk	I		Tritiated Oil	1
19		0 none		0 pk	I		Tritiated Oil	1
20		0 none		0 pk	I		Tritiated Oil	1
21		0 none		0 pk	I		Tritiated Oil	1
22		0 none		0 pk	I		Contaminated oil	1
23		0 none		0 pk	I		Tritiated Oil	1
24		0 none		0 pk	I		Tritiated Oil	1
25		0 none		0 pk	I		Tritiated Oil	1
26		0 none		0 pk	I		Tritiated Oil	1
27		0 none		0 pk	I		Tritiated Oil	1
28		0 none		0 pk	I		Tritiated Oil	1
29		0 none		0 pk	I		Tritiated Oil	1
30		0 none		0 pk	I		Tritiated Oil	1
31		0 none		0 pk	I		Tritiated Oil	1
32		0 none		0 pk	I		Tritiated Oil	1
33		0 none		0 pk	I		Tritiated Oil	1
34		0 none		0 pk	I		Tritiated Oil	1
35		0 none		0 pk	I		Tritiated Oil	1
36		0 none		0 pk	I		Tritiated Oil	1
37		0 none		0 pk	I		Tritiated Oil	1
38		0 none		0 pk	I		Tritiated Oil	1
39		0 none		0 pk	I		Tritiated Oil	1
40		0 none		0 pk	I		Tritiated Oil	1
41		0 none		0 pk	I		Tritiated Oil	1
42		0 none		0 pk	I		Tritiated Oil	1
43		0 none		0 pk	I		Tritiated Oil	1
44		0 none		0 pk	I		Tritiated Oil	1
45		0 none		0 pk	I		Tritiated Oil	1
46		0 none		0 pk	I		Tritiated Oil	1
47		0 none		0 pk	I		Tritiated Oil	1
48		0 none		0 pk	I		Tritiated Oil	1
49								
50								
51								
52								
53								

Tritiated Oils (Cmpgn. 1)

WSRC-TR-93-251

	A	B	C	D	E	F	G	H	I	J
54	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
55										
56										
57										
58	T-7-1 #1	232-H	55 gal	unknown	0.24	0	0	0	0	
59	T-7-1 #2	232-H	55 gal	unknown	0.24	0	0	0	0	
60	T-7-1 #3	232-H	55 gal	unknown	0.24	0	0	0	0	
61	T-7-1 #4	232-H	55 gal	unknown	0.24	0	0	0	0	
62	T-7-1 #5	232-H	55 gal	unknown	0.24	0	0	0	0	
63	T-7-1 #6	232-H	55 gal	unknown	0.24	0	0	0	0	
64	T-7-1 #7	232-H	55 gal	unknown	0.24	0	0	0	0	
65	T-7-1 #8	232-H	55 gal	unknown	0.24	0	0	0	0	
66	T-8-1 #1	234-H	55 gal	unknown	2900	0	0	0	0	
67	T-8-1 #2	234-H	55 gal	unknown	2900	0	0	0	0	
68	T-8-1 #3	234-H	55 gal	unknown	2900	0	0	0	0	
69	T-8-1 #4	234-H	55 gal	unknown	2900	0	0	0	0	
70	T-8-1 #5	234-H	55 gal	unknown	2900	0	0	0	0	
71	T-8-1 #6	234-H	55 gal	unknown	2900	0	0	0	0	
72	T-8-1 #7	234-H	55 gal	unknown	2900	0	0	0	0	
73	T-8-2 #1	234-H	55 gal	400	1500	0	0	0	0	
74	T-8-2 #2	234-H	55 gal	400	1500	0	0	0	0	
75	T-9-1 #1	232-H	55 gal	200	2.5	0	0	0	0	
76	T-9-1 #2	232-H	55 gal	200	2.5	0	0	0	0	
77	T-9-1 #3	232-H	55 gal	200	2.5	0	0	0	0	
78	T-9-1 #4	232-H	55 gal	200	2.5	0	0	0	0	
79	T-9-1 #5	232-H	55 gal	200	2.5	0	0	0	0	
80	T-9-1 #6	232-H	55 gal	200	2.5	0	0	0	0	
81	T-9-1 #7	232-H	55 gal	200	2.5	0	0	0	0	
82	T-9-1 #8	232-H	55 gal	200	2.5	0	0	0	0	
83	T-9-3	105-L	55 gal	300	0.001	0	0	0	0	
84	6-002	Tritium	90 cubic feet	420	0.143	0	0	0	0	
85	6-004 #1	Reactors	55 gal	440	24	0	0	0	0	
86	6-004 #2	Reactors	55 gal	440	24	0	0	0	0	
87	6-004 #3	Reactors	55 gal	440	7.5	0	0	0	0	
88	6-004 #4	Reactors	55 gal	440	0.2	0	0	0	0	
89	6-005 #1	Reactors	55 gal	500	0.0012	0	0	0	0	
90	6-005 #2	Reactors	55 gal	500	0.0012	0	0	0	0	
91	6-005 #3	Reactors	55 gal	500	0.0012	0	0	0	0	
92	6-005 #4	Reactors	55 gal	500	0.042	0	0	0	0	
93	6-005 #5	Reactors	55 gal	500	0.00042	0	0	0	0	
94	6-005 #6	Reactors	55 gal	500	0.247	0	0	0	0	
95	6-006 #1	Reactors	55 gal	365	0.0119	0	0	0	0	
96	6-006 #2	Reactors	55 gal	365	0.0119	0	0	0	0	
97	6-006 #3	Reactors	55 gal	365	0.0119	0	0	0	0	
98	6-006 #4	Reactors	55 gal	365	0.0119	0	0	0	0	
99	6-006 #5	Reactors	55 gal	365	0.0119	0	0	0	0	
100	6-006 #6	Reactors	55 gal	365	0.0119	0	0	0	0	
101										
102										
103										
104										
105										
106										

	K	L	M	N	O	P	Q
54							
55	Gamma field at 1 in. mR/hr	Hazardous Constituents		Physical State		Description	CAMPAIGN NUMBER
56		Name or EPA code	Mass (lbs)	Type of analysis			
57							
58		0 none	0 pk	I		Tritiated Oil	1
59		0 none	0 pk	I		Tritiated Oil	1
60		0 none	0 pk	I		Tritiated Oil	1
61		0 none	0 pk	I		Tritiated Oil	1
62		0 none	0 pk	I		Tritiated Oil	1
63		0 none	0 pk	I		Tritiated Oil	1
64		0 none	0 pk	I		Tritiated Oil	1
65		0 none	0 pk	I		Tritiated Oil	1
66		0 none	0 pk	I		Tritiated Oil	1
67		0 none	0 pk	I		Tritiated Oil	1
68		0 none	0 pk	I		Tritiated Oil	1
69		0 none	0 pk	I		Tritiated Oil	1
70		0 none	0 pk	I		Tritiated Oil	1
71		0 none	0 pk	I		Tritiated Oil	1
72		0 none	0 pk	I		Tritiated Oil	1
73		0 none	0 pk	I		Tritiated Oil	1
74		0 none	0 pk	I		Tritiated Oil	1
75		0 none	0 pk	I		Tritiated Oil	1
76		0 none	0 pk	I		Tritiated Oil	1
77		0 none	0 pk	I		Tritiated Oil	1
78		0 none	0 pk	I		Tritiated Oil	1
79		0 none	0 pk	I		Tritiated Oil	1
80		0 none	0 pk	I		Tritiated Oil	1
81		0 none	0 pk	I		Tritiated Oil	1
82		0 none	0 pk	I		Tritiated Oil	1
83		0 none	0 pk	I		Tritiated Oil	1
84		0 None	0 pk	I		Petroleum oil	1
85		0 None	0 pk	I		Tritiated waste lube oil	1
86		0 None	0 pk	I		Tritiated waste lube oil	1
87		0 None	0 pk	I		Tritiated waste lube oil	1
88		0 None	0 pk	I		Tritiated waste lube oil	1
89		0 None	0 pk	I		Tritiated waste lube oil	1
90		0 None	0 pk	I		Tritiated waste lube oil	1
91		0 None	0 pk	I		Tritiated waste lube oil	1
92		0 None	0 pk	I		Tritiated waste lube oil	1
93		0 None	0 pk	I		Tritiated waste lube oil	1
94		0 None	0 pk	I		Tritiated waste lube oil	1
95		0 none	0 pk	I		Tritiated waste lube oil	1
96		0 none	0 pk	I		Tritiated waste lube oil	1
97		0 none	0 pk	I		Tritiated waste lube oil	1
98		0 none	0 pk	I		Tritiated waste lube oil	1
99		0 none	0 pk	I		Tritiated waste lube oil	1
100		0 none	0 pk	I		Tritiated waste lube oil	1
101							
102							
103							
104							
105							
106							

Tritiated Oils (Cmpgn. 1)

WSRC-TR-93-251

	A	B	C	D	E	F	G	H	I	J
107	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
108										
109	6-006 #7	Reactors	55 gal	365	0.0119	0	0	0	0	0
110	6-006 #8	Reactors	55 gal	365	0.0119	0	0	0	0	0
111	6-006 #9	Reactors	55 gal	365	0.0119	0	0	0	0	0
112	6-006 #10	Reactors	55 gal	365	0.0119	0	0	0	0	0
113	6-006 #11	Reactors	55 gal	365	0.0119	0	0	0	0	0
114	6-006 #12	Reactors	55 gal	365	0.0119	0	0	0	0	0
115	6-006 #13	Reactors	55 gal	365	0.0119	0	0	0	0	0
116	6-006 #14	Reactors	55 gal	365	0.0119	0	0	0	0	0
117	6-006 #15	Reactors	55 gal	365	0.0119	0	0	0	0	0
118	6-006 #16	Reactors	55 gal	365	0.0119	0	0	0	0	0
119	6-006 #17	Reactors	55 gal	365	0.0119	0	0	0	0	0
120	6-006 #18	Reactors	55 gal	365	0.0119	0	0	0	0	0
121	6-006 #19	Reactors	55 gal	365	0.0119	0	0	0	0	0
122	6-013	Tritium	55 gal	450	0.3	0	0	0	0	0
123	6-014 #1	Reactors	55 gal	400	0.4	0	0	0	0	0
124	6-014 #2	Reactors	55 gal	400	0.4	0	0	0	0	0
125	6-014 #3	Reactors	55 gal	400	0.4	0	0	0	0	0
126	6-014 #4	Reactors	55 gal	400	0.4	0	0	0	0	0
127	6-014 #5	Reactors	55 gal	400	0.4	0	0	0	0	0
128	6-014 #6	Reactors	55 gal	400	0.4	0	0	0	0	0
129	6-014 #7	Reactors	55 gal	400	0.4	0	0	0	0	0
130	6-014 #8	Reactors	55 gal	400	0.4	0	0	0	0	0
131	6-014 #9	Reactors	55 gal	400	0.4	0	0	0	0	0
132	6-014 #1	Reactors	55 gal	400	0.4	0	0	0	0	0
133	6-014 #11	Reactors	55 gal	400	0.4	0	0	0	0	0
134	6-014 #12	Reactors	55 gal	400	0.4	0	0	0	0	0
135	6-014 #13	Reactors	55 gal	400	0.4	0	0	0	0	0
136	6-014 #14	Reactors	55 gal	400	0.4	0	0	0	0	0
137	6-014 #15	Reactors	55 gal	400	0.4	0	0	0	0	0
138	6-014 #16	Reactors	55 gal	400	0.4	0	0	0	0	0
139	6-014 #17	Reactors	55 gal	400	0.4	0	0	0	0	0
140	6-014 #18	Reactors	55 gal	400	0.4	0	0	0	0	0
141	6-014 #19	Reactors	55 gal	400	0.4	0	0	0	0	0
142	6-014 #20	Reactors	55 gal	400	0.4	0	0	0	0	0
143	6-014 #19	Reactors	55 gal	500	0.044	0	unknown	unknown	0	unknown
144	6-015 #1	Reactors	55 gal	400	1.8	0	0	0	0	0
145	6-015 #2	Reactors	55 gal	400	1.8	0	0	0	0	0
146	6-015 #3	Reactors	55 gal	400	1.8	0	0	0	0	0
147	6-015 #4	Reactors	55 gal	400	1.8	0	0	0	0	0
148	6-015 #5	Reactors	55 gal	400	1.8	0	0	0	0	0
149	6-015 #6	Reactors	55 gal	400	1.8	0	0	0	0	0
150	6-015 #7	Reactors	55 gal	400	1.8	0	0	0	0	0
151	6-015 #8	Reactors	55 gal	400	1.8	0	0	0	0	0
152	6-015 #9	Reactors	55 gal	400	1.8	0	0	0	0	0

	K	L	M	N	O	P	Q
107	Gamma field at 1 in. mPA/hr	Hazardous Constituents			Physical State	Description	CAMPAIGN NUMBER
108							
109		0 none	0 pk			Tritiated waste lube oil	1
110		0 none	0 pk			Tritiated waste lube oil	1
111		0 none	0 pk			Tritiated waste lube oil	1
112		0 none	0 pk			Tritiated waste lube oil	1
113		0 none	0 pk			Tritiated waste lube oil	1
114		0 none	0 pk			Tritiated waste lube oil	1
115		0 none	0 pk			Tritiated waste lube oil	1
116		0 none	0 pk			Tritiated waste lube oil	1
117		0 none	0 pk			Tritiated waste lube oil	1
118		0 none	0 pk			Tritiated waste lube oil	1
119		0 none	0 pk			Tritiated waste lube oil	1
120		0 none	0 pk			Tritiated waste lube oil	1
121		0 none	0 pk			Tritiated waste lube oil	1
122	unknown	none	0 pk			Cutting oil with some b, g.	1
123		0 none	0 pk			Tritiated Lube Oils	1
124		0 none	0 pk			Tritiated Lube Oils	1
125		0 none	0 pk			Tritiated Lube Oils	1
126		0 none	0 pk			Tritiated Lube Oils	1
127		0 none	0 pk			Tritiated Lube Oils	1
128		0 none	0 pk			Tritiated Lube Oils	1
129		0 none	0 pk			Tritiated Lube Oils	1
130		0 none	0 pk			Tritiated Lube Oils	1
131		0 none	0 pk			Tritiated Lube Oils	1
132		0 none	0 pk			Tritiated Lube Oils	1
133		0 none	0 pk			Tritiated Lube Oils	1
134		0 none	0 pk			Tritiated Lube Oils	1
135		0 none	0 pk			Tritiated Lube Oils	1
136		0 none	0 pk			Tritiated Lube Oils	1
137		0 none	0 pk			Tritiated Lube Oils	1
138		0 none	0 pk			Tritiated Lube Oils	1
139		0 none	0 pk			Tritiated Lube Oils	1
140		0 none	0 pk			Tritiated Lube Oils	1
141		0 none	0 pk			Tritiated Lube Oils	1
142		0 none	0 pk			Tritiated Lube Oils	1
143	unknown	unknown	500 pk			Tritiated Lube Oils	1
144		0 none	0 pk			Tritiated Lube Oils	1
145		0 none	0 pk			Tritiated Lube Oils	1
146		0 none	0 pk			Tritiated Lube Oils	1
147		0 none	0 pk			Tritiated Lube Oils	1
148		0 none	0 pk			Tritiated Lube Oils	1
149		0 none	0 pk			Tritiated Lube Oils	1
150		0 none	0 pk			Tritiated Lube Oils	1
151		0 none	0 pk			Tritiated Lube Oils	1
152		0 none	0 pk			Tritiated Lube Oils	1
153		0 none	0 pk			Tritiated Lube Oils	1
154		0 none	0 pk			Tritiated Lube Oils	1
155		0 none	0 pk			Tritiated Lube Oils	1
156		0 none	0 pk			Tritiated Lube Oils	1
157		0 none	0 pk			Tritiated Lube Oils	1
158							
159							

Tritlated Oils (Cmpgn. 1)

WSRC-TR-93-251

	A	B	C	D	E	F	G	H	I	J
160										
161	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
162										
163	6-015 #15	Reactors	55 gal	400	1.8	0	0	0	0	0
164	6-015 #16	Reactors	55 gal	400	1.8	0	0	0	0	0
165	6-015 #17	Reactors	55 gal	400	1.8	0	0	0	0	0
166	6-015 #18	Reactors	55 gal	400	1.8	0	0	0	0	0
167	6-018	Tritium	55 gal	450	0.0001	0	0	0	0.000002	1 g U235
168	6-024 #1	Reactors	55 gal	550	0.0174	0	0	0	0	0
169	6-024 #2	Reactors	55 gal	550	0.0185	0	0	0	0	0
170	6-024 #3	Reactors	55 gal	550	0.0224	0	0	0	0	0
171	6-024 #4	Reactors	55 gal	550	0.0224	0	0	0	0	0
172	6-024 #5	Reactors	55 gal	550	0.0224	0	0	0	0	0
173	6-024 #6	Reactors	55 gal	550	0.0224	0	0	0	0	0
174	6-024 #7	Reactors	55 gal	550	0.0224	0	0	0	0	0
175	6-024 #8	Reactors	55 gal	550	0.0224	0	0	0	0	0
176	6-024 #9	Reactors	55 gal	550	0.0224	0	0	0	0	0
177	6-025 #1	Reactors	55 gal	550	0.0487	0	0	0	0	0
178	6-025 #2	Reactors	55 gal	550	0.0487	0	0	0	0	0
179	6-025 #3	Reactors	55 gal	550	0.0487	0	0	0	0	0
180	6-025 #4	Reactors	55 gal	500	0.015	0	0	0	0	0
181	6-025 #5	Reactors	55 gal	500	0.005	0	0	0	0	0
182	6-026 #1	Reactors	55 gal	400	0.018	0	0	0	0	0
183	6-026 #2	Reactors	55 gal	400	0.018	0	0	0	0	0
184	6-027 #1	Reactors	55 gal	350	0.0086	0	0	0	0	0
185	6-027 #2	Reactors	55 gal	350	0.0086	0	0	0	0	0
186	6-028 #1	Reactors	55 gal	550	0.0149	0	0	0	0	0
187	6-028 #2	Reactors	55 gal	550	0.0149	0	0	0	0	0
188	6-028 #3	Reactors	55 gal	550	0.0149	0	0	0	0	0
189	6-028 #4	Reactors	55 gal	550	0.0149	0	0	0	0	0
190	6-028 #5	Reactors	55 gal	550	0.0149	0	0	0	0	0
191	6-028 #6	Reactors	55 gal	550	0.0149	0	0	0	0	0
192	6-029 #1	Reactors	55 gal	400	0.119	0	0	0	0	0
193	6-029 #2	Reactors	55 gal	400	0.119	0	0	0	0	0
194	6-029 #3	Reactors	55 gal	400	0.119	0	0	0	0	0
195	6-029 #4	Reactors	55 gal	400	0.119	0	0	0	0	0
196	6-029 #5	Reactors	55 gal	400	0.119	0	0	0	0	0
197	6-029 #6	Reactors	55 gal	400	0.119	0	0	0	0	0
198	6-029 #7	Reactors	55 gal	400	0.119	0	0	0	0	0
199	6-029 #8	Reactors	55 gal	400	0.119	0	0	0	0	0
200	6-029 #9	Reactors	55 gal	400	0.119	0	0	0	0	0
201	6-029 #10	Reactors	55 gal	400	0.119	0	0	0	0	0
202	6-029 #11	Reactors	55 gal	400	0.119	0	0	0	0	0
203	6-029 #12	Reactors	55 gal	400	0.119	0	0	0	0	0
204	6-029 #13	Reactors	55 gal	400	0.119	0	0	0	0	0
205	6-029 #14	Reactors	55 gal	400	0.119	0	0	0	0	0
206	6-030 #1	Reactors	55 gal	550	0.148	0	0	0	0	0
207	6-030 #2	Reactors	55 gal	550	0.148	0	0	0	0	0
208	6-030 #3	Reactors	55 gal	550	0.148	0	0	0	0	0
209	6-030 #4	Reactors	55 gal	550	0.148	0	0	0	0	0
210	6-030 #5	Reactors	55 gal	550	0.148	0	0	0	0	0
211										
212										

	K	L	M	N	O	P	Q
160							
161	Gamma field at 1 in. mR/Hr	Hazardous Constituents			Physical State	Description	CAMPAIGN NUMBER
162							
163	0 none		0 pk	I		Tritiated Lube Oils	1
164	0 none		0 pk	I		Tritiated Lube Oils	1
165	0 none		0 pk	I		Tritiated Lube Oils	1
166	0 none		0 pk	I		Tritiated Lube Oils	1
167	0 none		0 pk	I		Oils	1
168	0 none		0 pk	I		Tritiated waste lube oil	1
169	0 none		0 pk	I		Tritiated waste lube oil	1
170	0 none		0 pk	I		Tritiated waste lube oil	1
171	0 none		0 pk	I		Tritiated waste lube oil	1
172	0 none		0 pk	I		Tritiated waste lube oil	1
173	0 none		0 pk	I		Tritiated waste lube oil	1
174	0 none		0 pk	I		Tritiated waste lube oil	1
175	0 none		0 pk	I		Tritiated waste lube oil	1
176	0 none		0 pk	I		Tritiated waste lube oil	1
177	0 none		0 pk	I		Tritiated waste lube oil	1
178	0 none		0 pk	I		Tritiated waste lube oil	1
179	0 none		0 pk	I		Tritiated waste lube oil	1
180	0 none		0 pk	I		Tritiated waste lube oil	1
181	0 none		0 pk	I		Tritiated waste lube oil	1
182	0 none		0 pk	I		Tritiated waste lube oil	1
183	0 none		0 pk	I		Tritiated waste lube oil	1
184	0 none		0 pk	I		Tritiated waste lube oil	1
185	0 none		0 pk	I		Tritiated waste lube oil	1
186	0 none		0 pk	I		Tritiated waste lube oil	1
187	0 none		0 pk	I		Tritiated waste lube oil	1
188	0 none		0 pk	I		Tritiated waste lube oil	1
189	0 none		0 pk	I		Tritiated waste lube oil	1
190	0 none		0 pk	I		Tritiated waste lube oil	1
191	0 none		0 pk	I		Tritiated waste lube oil	1
192	0 none		0 pk	I		Tritiated waste lube oil	1
193	0 none		0 pk	I		Tritiated waste lube oil	1
194	0 none		0 pk	I		Tritiated waste lube oil	1
195	0 none		0 pk	I		Tritiated waste lube oil	1
196	0 none		0 pk	I		Tritiated waste lube oil	1
197	0 none		0 pk	I		Tritiated waste lube oil	1
198	0 none		0 pk	I		Tritiated waste lube oil	1
199	0 none		0 pk	I		Tritiated waste lube oil	1
200	0 none		0 pk	I		Tritiated waste lube oil	1
201	0 none		0 pk	I		Tritiated waste lube oil	1
202	0 none		0 pk	I		Tritiated waste lube oil	1
203	0 none		0 pk	I		Tritiated waste lube oil	1
204	0 none		0 pk	I		Tritiated waste lube oil	1
205	0 none		0 pk	I		Tritiated waste lube oil	1
206	0 none		0 pk	I		Tritiated waste lube oil	1
207	0 none		0 pk	I		Tritiated waste lube oil	1
208	0 none		0 pk	I		Tritiated waste lube oil	1
209	0 none		0 pk	I		Tritiated waste lube oil	1
210	0 none		0 pk	I		Tritiated waste lube oil	1
211							
212							

Tritiated Oils (Cmpgn. 1)

WSRC-TR-93-251

[illegible]

	K	L	M	N	O	P	Q
213							
214	Gamma field at 1 in. mFV/hr	Hazardous Constituents			Physical State	Description	CAMPAIGN NUMBER
215							
216	0	none	0	pk	I	Tritiated waste lube oil	1
217	0	none	0	pk	I	Tritiated waste lube oil	1
218	0	none	0	pk	I	Tritiated waste lube oil	1
219	0	none	0	pk	I	Tritiated waste lube oil	1
220	1	none	0	pk	I	Tritiated waste lube oil	1
221	1	none	0	pk	I	Tritiated waste lube oil	1
222	1	none	0	pk	I	Tritiated waste lube oil	1
223							
224							
225							
226	0	Methanol D006,001	300	pk	I	Methanol from Naval Fuel	1*
227	0.025	none	0	pk	I	Waste Cutting Oil, (GULFCUT)	1*
228	0	Xylene	300 lbs	pk	I	Scintillation Fluid	1*
229	0	Xylene	300 lbs	pk	I	Scintillation Fluid	1*
230	0	TCE	80	pk	I	Trichloroethane in original container	1*
231	0	None	0	pk	I	Waste Oil from 221-F blowers	1*
232	0	none	0	pk	I	Contaminated Hydraulic oil	1*
233	0	none	0	pk	I	Contaminated Hydraulic oil	1*
234	0.025	none	0	pk	I	Contaminated Hydraulic oil	1*
235	0.025	none	0	pk	I	Contaminated Hydraulic oil	1*
236	0.25	none	0	pk	I	Hydraulic oil, 313M	1*
237	0.0125	none	0	pk	I	Oils from 221-F	1*
238	0.0125	none	0	pk	I	Oils from 221-F	1*
239	0.0125	none	0	pk	I	Oils from 221-F	1*
240	0.0125	none	0	pk	I	Oils from 221-F	1*
241	0.0125	none	0	pk	I	Oils from 221-F	1*
242	0.0125	none	0	pk	I	Oils from 221-F	1*
243	0	none	0	pk	I	Tritiated Oil	1*
244	0	none	0	pk	I	Tritiated Oil	1*
245	0	none	0	pk	I	Tritiated Oil	1*
246	10	none	0	pk	I	Oils	1*
247	10	none	0	pk	I	Oils	1*
248	0	none	0	pk	I	Oils	1*
249	0	none	0	pk	I	Oils	1*
250	0	none	0	pk	I	Oils	1*
251	0	none	0	pk	I	Oils	1*
252	0	none	0	pk	I	Oils	1*
253	0	none	0	pk	I	Oils	1*
254							
255							
256							1* is tritium-free

	A	B	C	D	E	F	G	H	I	J
1	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
2										
3	B-9 -1	232-H	1 CONTAINER	2000	1000	0	0	0	0	0
4	B-10 -1	232-H	1 CONTAINER	2000	2000	0	0	0	0	0
5	B-11	232-H	[44 cubic feet]	1000	500	0	0	0	0	0
6	B-14 #1	232 H	[56 cubic feet]	2000	2000	0	0	0	0	0
7	B-14 #2	232 H	[56 cubic feet]	2000 lbs	2000	0	0	0	0	0
8	B-14 #3	232 H	[56 cubic feet]	2000 lbs	2000	0	0	0	0	0
9	B-1-1	232-H	1 CONTAINER	2000	3848	0	0	0	0	0
10	B-3 -1	232-H	1 CONTAINER	2000	5002	0	0	0	0	0
11	B-4 -1	232-H	1 CONTAINER	2000	5002	0	0	0	0	0
12	B-2 -1	232-H	1 CONTAINER	2000	0	0	0	0	0	0
13	B-12-1	241-F	394 gallons	1000	0	0.000001	0	0	0	0
14	B-20	221-H	166 gallons	4500	0	unknown	unknown	unknown		unknown
15	B-25	221-H	394 gallons	2000	0	0.000008	0	0.00008	0.000045	0
16	D-2 -1	772-F	55 gal	404	0	0.0001	0	0.0001	0.0000045	0
17	D-3 -1	772-F	55 gal	702	0	0.0001	0	0.0001	0.0000045	0
18	D-13 -1	772-F	55 gal	248	0	0.0001	0	0.0001	0.000009	.2 g Pu, .5 g U235
19	D-14 -1	772-F	55 gal	460	0	0.0001	0	0.0001	0.000009	unknown
20	D-16 -1	772-F	55 gal	380	0	0.0001	0	0.0001	0.000001	.2 g Pu, .5 g U235
21	D-17 -1	772-F	55 gal	580	0	0.0001	0	0.0001	0.000004	.2 g Pu, .5 g U235
22	T-10 #1	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
23	T-10 #2	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
24	T-10 #3	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
25	T-10 #4	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
26	T-10 #5	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
27	T-10 #6	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
28	T-10 #7	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
29	T-10 #8	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
30	T-10 #9	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
31	T-10 #10	221-F	55 gal	340	0	0	0	4.5E-10	2E-11	0
32	3-069	247-F	55 gal	1647	0	0	0	0	0.00000009	0.004 U235
33	3-057	Separations	360 gal	3200	0	0.0000018	0	0	0.00000002	0
34	3-058	Separations	55 gal	400	0	0.0000048	0	0	0.0000045	0
35	3-054	Separations	166 gal	2800	0	0	0	3.6E-11	4.5E-12	.0002 U235
36	3-055	Separations	166 gal	3000	0	0	0	3.6E-11	4.5E-12	.0002 U235
37	3-049 #2	221F	166 gal	2100	0	2.3E-09	0	2.3E-09	9E-10	0.001 U235, 1.0E-06 Pu
38	3-049 #3	221F	166 gal	2300	0	2.3E-09	0	2.3E-09	9E-10	0.001 U235, 1.0E-06 Pu
39	3-049 #4	221F	166 gal	1000	0	2.3E-09	0	2.3E-09	9E-10	0.001 U235, 1.0E-06 Pu
40	3-050	Separations	55 gal	100	0	0.00000009	0	0	0	0
41	3-051 #1	241-28F	360 gal	2000	0	0.0000004	0	0	2E-10	0
42	3-051 #2	241-28F	360 gal	2000	0	0.0000004	0	0	2E-10	0</

	K	L	M	N	O	P	Q
1	Gamma field at 1 in. mR/Hr	Hazardous Constituents			Physical State	Description and Treatment	CAMPAIGN NUMBER
2							
3	0 Pb (D008)		40 pk	s		4 MG Beds with Pb.	2
4	0 Pb (D008)		40 pk	s		4 MG Beds with Pb.	2
5	0 Pb (D008)		10 pk	s		1 MG Bed with Pb.	2
6	0 Pb (D008)		35 pk	s		3 Mg Beds and one catalyst Bed	2
7	0 Pb	unknown	unknown	s		3 Mg Beds and one catalyst Bed	2
8	0 Pb	unknown	unknown	s		3 Mg Beds and one catalyst Bed	2
9	0 Pb (D008)		40 pk	s		MG Bed	2
10	0 Pb (D008)		40 pk	s		MG Bed with Pb	2
11	0 Pb (D008)		40 pk	s		DE Bed with Pb	2
12	0 Pb (D008)		40 pk	s		DE Bed	2
13	70 Pb (D008)		750 pk	s		Lead-filled Riser Plugs	2
14	200 Pb (D008)		4500 pk	s		Lead Sheets	2
15	20 Pb (D008)		2000 pk	s		Lead Shielding	2
16	250 Pb (D008)		320 pk	s		Lead and Hypalon gloves and aprons	2
17	250 Pb (D008)		618 pk	s		Lead and Hypalon gloves and aprons	2
18	100 Pb (D008)		248 pk	s		Lead impregnated gloves	2
19	1.2 Pb (D008)		460 pk	s		Lead impregnated gloves	2
20	50 Pb (D008)		286 pk	s		Doorstop, aprons, gloves	2
21	25 Pb (D008)		486 pk	s		Lead Gloves and Aprons, (Asbestos?)	2
22	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
23	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
24	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
25	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
26	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
27	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
28	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
29	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
30	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
31	0.02 Pb (D008)		340 pk	s		Contaminated Lead	2
32	0 Pb (D008)		1647 pk	s		Lead bricks	2
33	2.5 Pb (D008)		3200 pk	s		Lead sheets, shot, aprons	2
34	0.25 Pb (D008)		400 pk	s		Lead sheets, shot, aprons	2
35	0.2 Pb (D008)		2800 pk	s		Lead shielding	2
36	0.2 Pb (D008)		3000 pk	s		Lead shielding	2
37	0 Pb (D008)		2100 pk	s		Lead Shielding	2
38	0 Pb (D008)		2300 pk	s		Lead Shielding	2
39	0 Pb (D008)		1000 pk	s		Lead Shielding	2
40	0 Pb (D008)		100 pk	s		Lead sheets, shot, aprons	2
41	2.5 Pb (D008)		2000 pk	s		Contaminated lead shielding	2
42	2.5 Pb (D008)		2000 pk	s		Contaminated lead shielding	2
43	2.5 Pb (D008)		4000 pk	s		Lead sheets, shot, aprons	2
44	0.25 Pb (D008)		1200 pk	s		Lead shielding	2
45	0 Pb (D008)		3000 pk	s		Lead Shielding	2
46	0.25 Pb (D008)		2067 pk	s		Lead Shielding	2
47	0.25 Pb (D008)		705 pk	s		Lead Shielding	2
48	10 Pb (D008)		2000 PK	s		Shielding from Waste Tank Repairs	2
49	10 Pb (D008)		2000 PK	s		Shielding from Waste Tank Repairs	2
50	10 Pb (D008)		2000 PK	s		Shielding from Waste Tank Repairs	2
51	10 Pb (D008)		2000 PK	s		Shielding from Waste Tank Repairs	2
52							
53							

	A	B	C	D	E	F	G	H	I	J
54										
55	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
56										
57	3-042 #5	241-28F	360 gal	2000	0	0.0000018	0	0	0	0
58	3-043 #1	299-H	360 gal	1000	0	0.0000018	0	0	2E-10	0
59	3-043 #2	299-H	360 gal	1000	0	0.0000002	0	0	2E-10	0
60	3-040	221H	55 gal	2214	0	0	0	0	0	0
61	3-035	Separations	360 gal	1000	0	0	0	0.00000001	0.000001	.002 U235
62	3-031	Reactors	673 gal	3500	0	12.6	0	0	0	0
63	3-032 #1	Reactors	166 gal	3000	0	0	0	0.000000014	1.4E-09	0
64	3-032 #2	Reactors	166 gal	3000	0	0	0	0.000000014	1.4E-09	0
65	3-032 #3	Reactors	360 gal	4500	0	0	0	0.000000014	1.4E-09	0
66	3-033 #1	241-F	360 gal	1900	0	4.5E-08	0	0	0	0
67	3-033 #2	241-F	360 gal	1900	0	4.5E-08	0	0	0	0
68	3-028	241-F	55 gal	80	0	4.5E-09	0	0	2E-10	0
69	3-027 #1	241-F	360 gal	1500	0	0.0000002	0	0	0	0
70	3-027 #2	241-F	360 gal	1500	0	0.0000002	0	0	0	0
71	3-022	Separations	360 gal	580	0	0	0	0.0000001	0.000001	.02 U235
72	3-024 #1	241-F	360 gal	1500	0	0.00000036	0	0	0	0
73	3-024 #2	241-F	360 gal	1500	0	0.00000036	0	0	0	0
74	3-025 #1	241-F	360 gal	1000	0	0.00000045	0	0	0	0
75	3-025 #2	241-F	360 gal	1000	0	0.00000045	0	0	0	0
76	3-025 #3	241-F	360 gal	1000	0	0.00000045	0	0	0	0
77	3-025 #4	241-F	360 gal	1000	0	0.00000045	0	0	0	0
78	3-025 #5	241-F	360 gal	1000	0	0.00000045	0	0	0	0
79	3-020	241-F	360 gal	2000	0	0.00000045	0	0	0	0
80	3-018	Separations	360 gal	800	0	0	0	0.0000001	0.000001	.002 U235
81	3-016 #1	Separations	360 gal	1000	0	0	0	4.5E-09	0.000000018	0.001 U235, 1.0E-06 Pu
82	3-016 #2	Separations	360 gal	1000	0	0	0	4.5E-09	0.000000018	0.001 U235, 1.0E-06 Pu
83	3-008 #1	221F	673 gal	2500	0	4.5E-09	0	4.5E-09	0.000000018	0.002 U235, 1.0E-06 Pu
84	3-008 #2	221F	673 gal	2500	0	4.5E-09	0	4.5E-09	0.000000018	0.002 U235, 1.0E-06 Pu
85	3-008 #3	221F	673 gal	2500	0	4.5E-09	0	4.5E-09	0.000000018	0.002 U235, 1.0E-06 Pu
86	3-008 #4	221F	673 gal	2500	0	4.5E-09	0	4.5E-09	0.000000018	0.002 U235, 1.0E-06 Pu
87	3-008 #5	221F	673 gal	2500	0	4.5E-09	0	4.5E-09	0.000000018	0.002 U235, 1.0E-06 Pu
88	3-009 #1	Separations	360 gal	2300	0	0	0	0.0000001	0.000001	.02 U235
89	3-009 #2	Separations	360 gal	2300	0	0	0	0.0000001	0.000001	.02 U235
90	3-009 #3	Separations	360 gal	2300	0	0	0	0.0000001	0.000001	.02 U235
91	3-010 #1	241-F	673 gal	5000	0	0.00000004	0	0	0	0
92	3-010 #2	241-F	166 gal	3000	0	0.00000004	0	0	0	0
93	3-011	241-F	166 gal	1000	0	0.0000003	0	0	2E-10	0
94	3-012 #1	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
95	3-012 #2	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
96	3-012 #3	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
97	3-012 #4	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
98	3-012 #5	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
99	3-012 #6	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
100	3-012 #7	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
101	3-012 #8	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
102	3-012 #9	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
103	3-012 #10	Reactors	55 gal	400	0.01	0	0	0.000000045	4.5E-09	0
104	3-006 #1	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
105										
106										

	K	L	M	N	O	P	Q
54							
55	Gamma field at 1 in. mR/hr	Hazardous Constituents					
56					Physical State	Description and Treatment	CAMPAIGN NUMBER
57		10 Pb (D008)	2000 PK	s		Shielding from Waste Tank Repairs	2
58		10 Pb (D008)	1000 pk	s		Contaminated lead shielding	2
59		5 Pb (D008)	1000 pk	s		Contaminated lead shielding	2
60		0 Pb (D008)	2214 pk	s		Lead shot	2
61		0.25 Pb (D008)	1000 pk	s		Lead shielding	2
62		0.25 Pb (D008)	3500 pk	s		CIC Chambers, Lead Lights	2
63		0.025 Pb (D008)	3000 pk	s		Lead sheathing and shot	2
64		0.025 Pb (D008)	3000 pk	s		Lead sheathing and shot	2
65		0.025 Pb (D008)	4500 pk	s		Lead sheathing from 105 bldgs.	2
66		0.25 Pb (D008)	1900 pk	s		Riser Plugs	2
67		0.25 Pb (D008)	1900 pk	s		Riser Plugs	2
68		0.25 Cr, Pb, Hg	0.5 pk	s		Filters	2
69		1 Pb (D008)	1500 pk	s		Contaminated lead shielding	2
70		5 Pb (D008)	1500 pk	s		Contaminated lead shielding	2
71		0.25 Pb (D008)	580 pk	s		Lead lined gloves	2
72		0.2 Pb (D008)	1500 pk	s		Contaminated lead shielding	2
73		0.2 Pb (D008)	1500 pk	s		Contaminated lead shielding	2
74		2.5 Pb (D008)	1000 pk	s		Riser Plugs	2
75		2.5 Pb (D008)	1000 pk	s		Riser Plugs	2
76		2.5 Pb (D008)	1000 pk	s		Riser Plugs	2
77		2.5 Pb (D008)	1000 pk	s		Riser Plugs	2
78		2.5 Pb (D008)	1000 pk	s		Riser Plugs	2
79		2.5 Pb (D008)	2000 pk	s		Riser Plugs	2
80		0.025 Pb (D008)	5500 pk	s		Lead shielding	2
81		0.25 Pb (D008)	2000 pk	s		Lead Shielding	2
82		0.25 Pb (D008)	2000 pk	s		Lead Shielding	2
83		0.25 Pb (D008)	2500 pk	s		Sampler Boxes	2
84		0.25 Pb (D008)	2500 pk	s		Sampler Boxes	2
85		0.25 Pb (D008)	2500 pk	s		Sampler Boxes	2
86		0.25 Pb (D008)	2500 pk	s		Sampler Boxes	2
87		0.25 Pb (D008)	2500 pk	s		Sampler Boxes	2
88		0.25 Pb (D008)	2300 pk	s		Lead and lead-bearing equipment	2
89		0.25 Pb (D008)	2300 pk	s		Lead and lead-bearing equipment	2
90		0.25 Pb (D008)	2300 pk	s		Lead and lead-bearing equipment	2
91		2.5 Pb (D008)	5000 pk	s		Contaminated lead shielding	2
92		2.5 Pb (D008)	3000 pk	s		Contaminated lead shielding	2
93		1.5 Pb (D008)	1000 pk	s		Contaminated lead shielding	2
94		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
95		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
96		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
97		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
98		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
99		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
100		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
101		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
102		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
103		0.025 Pb (D008)	400 pk	s		Lead sheathing	2
104		1.25 Pb (D008)	1700 pk	s		Lead Shielding	2
105							2
106							

	A	B	C	D	E	F	G	H	I	J
	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
107										
108										
109	3-006 #2	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
110	3-006 #3	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
111	3-006 #4	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
112	3-006 #5	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
113	3-006 #6	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
114	3-006 #7	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
115	3-006 #8	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
116	3-006 #9	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
117	3-006 #10	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
118	3-006 #11	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
119	3-006 #12	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
120	3-006 #13	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
121	3-006 #14	Separations	673 gal	1700	0	2.2E-08	0	0.000000022	0.00000009	0.003 U235, 1.5E-06 Pu
122	3-006 #15	Separations	673 gal	3000	0	0.00000045	0	0	0.00000045	0
123	3-003 #6	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
124	3-003 #7	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
125	3-003 #8	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
126	3-003 #9	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
127	3-003 #10	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
128	3-004 #1	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
129	3-004 #2	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
130	3-004 #3	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
131	3-004 #4	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
132	3-004 #5	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
133	3-004 #6	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
134	3-004 #7	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
135	3-004 #8	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
136	3-004 #9	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
137	3-004 #10	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
138	3-004 #11	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
139	3-004 #12	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
140	3-004 #13	Separations	360 gal	5000	0	0.00000014	0	0	0.00000068	0
141	3-004 #14	Separations	360 gal	5000	0	0.00000014	0	0	0.00000045	0
142	3-004 #15	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
143	3-003 #1	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
144	3-003 #2	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
145	3-003 #3	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
146	3-003 #4	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
147	3-003 #5	Separations	360 gal	3000	0	0.00000045	0	0	0.00000045	0
148										
149										
150										

	K	L	M	N	O	P	Q
107	Gamma field at 1 in. mPA/hr	Hazardous Constituents		Physical State		Description and Treatment	CAMPAIGN NUMBER
108		Name or EPA code	Mass (lbs)	Type of analysis			
109	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
110	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
111	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
112	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
113	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
114	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
115	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
116	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
117	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
118	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
119	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
120	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
121	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
122	1.25	Pb (D008)	1700	pk	s	Lead Shielding	2
123	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
124	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
125	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
126	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
127	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
128	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
129	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
130	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
131	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
132	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
133	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
134	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
135	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
136	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
137	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
138	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
139	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
140	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
141	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
142	0.25	Pb (D008)	5000	pk	s	Sampler Boxes	2
143	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
144	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
145	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
146	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
147	0.25	Pb (D008)	3000	pk	s	Sampler Boxes	2
148							
149							
150							

Repack Solids (Cmpgn. 3)

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	A	B	C	D	E	F	G	H	I	J
1	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
2										
3										
4	3-001 #1	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
5	3-001 #2	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
6	3-001 #3	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
7	3-001 #4	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
8	3-001 # 5	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
9	3-001 #6	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
10	3-001 #7	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
11	3-001 #8	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
12	3-001 #9	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
13	3-001 #10	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
14	3-001 #11	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
15	3-001 #12	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
16	3-001 #13	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
17	3-001 #14	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
18	3-001 #15	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
19	3-001 #16	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
20	3-001 #17	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
21	3-001 #18	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
22	3-001 #19	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
23	3-001 #20	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
24	3-001 #21	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
25	3-001 #22	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
26	3-001 #23	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
27	3-001 #24	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
28	3-001 #25	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
29	3-001 #26	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
30	3-001 #27	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
31	3-001 #28	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
32	3-001 #29	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
33	3-001 #30	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
34	3-001 #31	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
35	3-001 #32	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
36	3-001 #33	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
37	3-001 #34	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
38	3-001 #35	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
39	3-001 #36	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
40	3-001 #37	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
41	3-001 #38	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
42	3-001 #39	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
43	3-001 #40	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
44	3-001 #41	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
45	3-001 #42	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
46	3-001 #43	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
47	3-001 #44	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
48	3-001 #45	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
49	3-001 #46	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
50	3-001 #47	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
51	3-001 #48	Reactor Matls	673 gal	1500	0	0	0	0	0.000000015	
52										
53										

1	K		L		M	N	O	P	Q
	Gamma field at 1 in. mR/hr		Hazardous Constituents				Physical State	Description and Treatment	CAMPAIGN NUMBER
2			Name or EPA code	Mass (lbs)	Type of analysis				
3									
4	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
5	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
6	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
7	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
8	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
9	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
10	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
11	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
12	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
13	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
14	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
15	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
16	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
17	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
18	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
19	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
20	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
21	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
22	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
23	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
24	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
25	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
26	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
27	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
28	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
29	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
30	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
31	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
32	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
33	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
34	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
35	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
36	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
37	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
38	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
39	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
40	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
41	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
42	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
43	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
44	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
45	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
46	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
47	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
48	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
49	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
50	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
51	0.1	F006 (listed)		1500	pk	s		Filter (Tyvek) on rolls.	3
52									
53									

Repack Solids (Cmpgn. 3)

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	A	B	C	D	E	F	G	H	I	J
	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
54										
55										
56									0.000000015	0
57	3-001 #49	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
58	3-001 #50	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
59	3-001 #51	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
60	3-001 #52	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
61	3-001 #53	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
62	3-001 #54	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
63	3-001 #55	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
64	3-001 #56	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
65	3-001 #57	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
66	3-001 #58	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
67	3-001 #59	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
68	3-001 #60	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
69	3-001 #61	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
70	3-001 #62	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
71	3-001 #63	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
72	3-001 #64	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
73	3-001 #65	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
74	3-001 #66	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
75	3-001 #67	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
76	3-001 #68	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
77	3-001 #69	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
78	3-002 #1	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
79	3-002 #2	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
80	3-002 #3	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
81	3-002 #4	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
82	3-002 #5	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
83	3-014 #1	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
84	3-014 #2	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
85	3-015	Tank 42	55 gal	40	0	4.5E-09	0	0	0.000000015	0
86	3-019 #1	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
87	3-019 #2	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
88	3-019 #3	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
89	3-019 #4	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
90	3-029 #1	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
91	3-029 #2	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
92	3-029 #3	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
93	3-029 #4	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
94	3-034 #1	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
95	3-034 #2	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
96	3-036	Reactor Mats	673 gal	1500	0	0	0	0	0.000000015	0
97	3-059 #1	Separations	55 gal	70	0	0.00000023	0	0	0.000000015	0
98	3-059 #2	Separations	55 gal	70	0	0.00000023	0	0	0.000000015	0
99	3-059 #3	Separations	55 gal	70	0	0.00000023	0	0	0.000000015	0
100	3-059 #4	Separations	55 gal	70	0	0.00000023	0	0	0.000000015	0
101	3-059 #5	Separations	55 gal	60	0	0	0	0.00000001	0.000000001	.0001 U235
102	3-063 #1	Separations	55 gal	60	0	0	0	0.00000001	0.000000001	.0001 U235
103	3-063 #2	Separations	55 gal	130	0	0	0	0	0	0
104	3-064	Reactors	55 gal							
105										
106										

54	K	L		M	N	O	P	Q
	Gamma field at 1 in. mR/Hr	Hazardous Constituents				Physical State	Description and Treatment	CAMPAIGN NUMBER
55		Name or EPA code	Mass (lbs)	Type of analysis				
56								
57		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
58		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
59		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
60		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
61		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
62		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
63		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
64		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
65		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
66		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
67		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
68		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
69		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
70		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
71		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
72		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
73		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
74		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
75		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
76		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
77		0.1 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
78		0.25 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
79		0.25 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
80		0.25 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
81		0.25 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
82		0.25 F006 (listed)	1500	pk	s		Filter (Tyvek) on rolls.	3
83		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
84		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
85		0.25 Cr D007	0.1	pk	s		Atomic wipes from broken guage	3
86		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
87		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
88		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
89		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
90		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
91		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
92		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
93		0 F006	1500	pk	s		Filter (Tyvek) on rolls.	3
94		0 F0006	1500	pk	s		Spooled TYVEK on cardboard (filter medium)	3
95		0 F0006	1500	pk	s		Spooled TYVEK on cardboard (filter medium)	3
96		0 F0006	1500	pk	s		Spooled TYVEK on cardboard (filter medium)	3
97		0 Freon	7	pk	s		Solvent Rags and wipes	3
98		0 Freon	7	pk	s		Solvent Rags and wipes	3
99		0 Freon	7	pk	s		Solvent Rags and wipes	3
100		0 Freon	7	pk	s		Solvent Rags and wipes	3
101		0 Freon	7	pk	s		Solvent Rags and wipes	3
102		2.5 F001	60	pk	2%, 98% s		Rags containing F-listed solvents, tools, wipes	3
103		2.5 F001	60	pk	2%, 98% s		Rags containing F-listed solvents, tools, wipes	3
104		0.25 F001	130	pk	s		Wipes containing Methylene Chloride	3
105								
106								

	A	B	C	D	E	F	G	H	I	J
107	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
108										
109										
110	3-065 #1	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
111	3-065 #2	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
112	3-065 #3	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
113	3-065 #4	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
114	3-065 #5	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
115	3-065 #6	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
116	3-065 #7	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
117	3-065 #8	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
118	3-065 #9	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
119	3-065 #10	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
120	3-065 #11	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
121	3-065 #12	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
122	3-065 #13	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
123	3-065 #14	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
124	3-065 #15	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
125	3-065 #16	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
126	3-065 #17	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
127	3-065 #18	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
128	3-065 #19	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
129	3-065 #20	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
130	3-065 #21	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
131	3-065 #22	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
132	3-065 #23	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
133	3-065 #24	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
134	3-065 #25	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
135	3-065 #26	Separations	55 gal	200	0	0.000005	0	0	6E-10	0
136	3-065 #27	Separations	55 gal	200	0	0.000005	0	0	1.5E-06 U238	0
137	3-068	Reactor Mats	673 gal	2513	0	0	0	0	0.0000015	0
138	3-071	Reactor Mats	673 gal	3400	0	0	0	0		0

	K	L	M	N	O	P	Q
	Gamma field at 1 in. mR/Hr	Hazardous Constituents			Physical State	Description and Treatment	CAMPAIGN NUMBER
		Name or EPA code	Mass (lbs)	Type of analysis			
107							
108							
109			200	pk	s	Solvent Rags	3
110	0.02	F001	200	pk	s	Solvent Rags	3
111	0.02	F001	200	pk	s	Solvent Rags	3
112	0.02	F001	200	pk	s	Solvent Rags	3
113	0.02	F001	200	pk	s	Solvent Rags	3
114	0.02	F001	200	pk	s	Solvent Rags	3
115	0.02	F001	200	pk	s	Solvent Rags	3
116	0.02	F001	200	pk	s	Solvent Rags	3
117	0.02	F001	200	pk	s	Solvent Rags	3
118	0.02	F001	200	pk	s	Solvent Rags	3
119	0.02	F001	200	pk	s	Solvent Rags	3
120	0.02	F001	200	pk	s	Solvent Rags	3
121	0.02	F001	200	pk	s	Solvent Rags	3
122	0.02	F001	200	pk	s	Solvent Rags	3
123	0.02	F001	200	pk	s	Solvent Rags	3
124	0.02	F001	200	pk	s	Solvent Rags	3
125	0.02	F001	200	pk	s	Solvent Rags	3
126	0.02	F001	200	pk	s	Solvent Rags	3
127	0.02	F001	200	pk	s	Solvent Rags	3
128	0.02	F001	200	pk	s	Solvent Rags	3
129	0.02	F001	200	pk	s	Solvent Rags	3
130	0.02	F001	200	pk	s	Solvent Rags	3
131	0.02	F001	200	pk	s	Solvent Rags	3
132	0.02	F001	200	pk	s	Solvent Rags	3
133	0.02	F001	200	pk	s	Solvent Rags	3
134	0.02	F001	200	pk	s	Solvent Rags	3
135	0.02	F001	200	pk	s	Solvent Rags	3
136	0.02	F001	200	pk	s	Solvent Rags	3
137	0	F006	1500	pk	s	Filter (Tyvek) on rolls.	3
138	0	F006	2513	pk	s	Filter (Tyvek) on rolls.	3

Mercury Disposal (Cmpgn. 4)

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	A	B	C	D	E	F	G	H	I	J
1	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
2										
3										
4										
5	T-5 #1	234-H	55 gal	unknown	10000	0	0	0	0	
6	T-3-1 #1	234-H	55 gal	unknown	38500	0	0	0	0	
7	T-3-1 #2	234-H	55 gal	unknown	38500	0	0	0	0	
8	B-6-1	232-H	1 CONTAINER	600	200	0	0	0	0	
9	B-19	232-H	13 gallons	620	13200	0	0	0	0	
10	3-053 #1	Reactors	55 gal	544	338	0	0	0	0	
11	3-053 #2	Reactors	55 gal	508	125	0	0	0	0	
12	3-053 #4	Reactors	55 gal	548	95	0	0	0	0	
13	3-053 #5	Reactors	55 gal	521	74	0	0	0	0	
14	3-053 #6	Reactors	55 gal	529	97	0	0	0	0	
15	3-053 #7	Reactors	55 gal	509	155	0	0	0	0	
16	3-053 #8	Reactors	55 gal	525	98	0	0	0	0	
17	3-053 #9	Reactors	55 gal	379	38	0	0	0	0	
18	3-053 #10	Reactors	55 gal	509	83	0	0	0	0	
19	3-053 #11	Reactors	55 gal	527	145	0	0	0	0	
20	3-053 #12	Reactors	55 gal	510	21	0	0	0	0	
21	3-053 #13	Reactors	55 gal	548	154	0	0	0	0	
22	3-053 #14	Reactors	55 gal	529	129	0	0	0	0	
23	3-053 #15	Reactors	55 gal	509	228	0	0	0	0	
24	3-053 #16	Reactors	55 gal	559	112	0	0	0	0	
25	3-053 #17	Reactors	55 gal	534	113	0	0	0	0	
26	3-053 #18	Reactors	55 gal	488	135	0	0	0	0	
27	3-053 #19	Reactors	55 gal	531	26	0	0	0	0	
28	3-053 #20	Reactors	55 gal	376	58	0	0	0	0	
29	3-053 #21	Reactors	55 gal	529	87	0	0	0	0	
30	3-056 #1	Reactors	55 gal	514	139	0	0	0	0	
31	3-056 #2	Reactors	55 gal	529	95	0	0	0	0	
32	3-056 #3	Reactors	55 gal	522	189	0	0	0	0	
33	3-056 #4	Reactors	55 gal	464	177	0	0	0	0	
34	3-056 #5	Reactors	55 gal	558	102	0	0	0	0	
35	3-056 #6	Reactors	55 gal	534	131	0	0	0	0	
36	3-056 #7	Reactors	55 gal	540	133	0	0	0	0	
37	3-056 #8	Reactors	55 gal	545	148	0	0	0	0	
38	3-056 #9	Reactors	55 gal	526	131	0	0	0	0	
39	3-056 #10	Reactors	55 gal	236	143	0	0	0	0	
40	3-056 #11	Reactors	55 gal	544	174	0	0	0	0	
41	3-056 #12	Reactors	55 gal	520	36	0	0	0	0	
42	3-056 #13	Reactors	55 gal	520	74	0	0	0	0	
43	3-056 #14	Reactors	55 gal	485	94	0	0	0	0	
44	3-056 #15	Reactors	55 gal	536	150	0	0	0	0	
45	3-056 #16	Reactors	55 gal	487	86	0	0	0	0	
46	3-056 #17	Reactors	55 gal	527	61	0	0	0	0	
47	3-056 #18	Reactors	55 gal	529	87	0	0	0	0	
48	3-056 #19	Reactors	55 gal	529	209	0	0	0	0	
49	3-056 #20	Reactors	55 gal	531	55	0	0	0	0	
50	3-067	Reactors	55 gallons	524	97.6	0	0	0	0	
51	3-072 #1	Reactors	55 gallons	463	9.8	0	0	0	0	
52										
53										

	K	L	M	N	O	P	Q
1	Gamma field at 1 in. mR/hr	Hazardous Constituents		Physical State		Description and Treatment	CAMPAIGN NUMBER
2		Name or EPA code	Mass (lbs)	Type of analysis			
3							
4							
5		0 Hg (D008)	1	pk	s	Sprengel Pump	4
6		0 Hg (D008)	unknown	pk	s	Gold Traps	4
7		0 Hg (D008)	unknown	pk	s	Gold Traps	4
8		0 Hg (D009)	0.1	pk	s	4 FA Columns	4
9		0 Hg (D009)	0.05	pk	l	Tritiated water and Hg	4
10		0 Hg (D009)	0.008	la	l	Contaminated Heavy water	4
11		0 Hg (D009)	0.001	la	l	Contaminated Heavy water	4
12		0 Hg (D009)	0.008	la	l	Contaminated Heavy water	4
13		0 Hg (D009)	0.0024	la	l	Contaminated Heavy water	4
14		0 Hg (D009)	0.0008	la	l	Contaminated Heavy water	4
15		0 Hg (D009)	0.0001	la	l	Contaminated Heavy water	4
16		0 Hg (D009)	0.0008	la	l	Contaminated Heavy water	4
17		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
18		0 Hg (D009)	0.0003	la	l	Contaminated Heavy water	4
19		0 Hg (D009)	0.0001	la	l	Contaminated Heavy water	4
20		0 Hg (D009)	0.0001	la	l	Contaminated Heavy water	4
21		0 Hg (D009)	0.0024	la	l	Contaminated Heavy water	4
22		0 Hg (D009)	0.0008	la	l	Contaminated Heavy water	4
23		0 Hg (D009)	0.0008	la	l	Contaminated Heavy water	4
24		0 Hg (D009)	0.0008	la	l	Contaminated Heavy water	4
25		0 Hg (D009)	0.0008	la	l	Contaminated Heavy water	4
26		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
27		0 Hg (D009)	0.0002	la	l	Contaminated Heavy water	4
28		0 Hg (D009)	0.0003	la	l	Contaminated Heavy water	4
29		0 Hg (D009)	0.0008	la	l	Contaminated Heavy water	4
30		0 Hg (D009)	0.0001	la	l	Contaminated Heavy water	4
31		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
32		0 Hg (D009)	0.0004	la	l	Contaminated Heavy water	4
33		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
34		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
35		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
36		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
37		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
38		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
39		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
40		0 Hg (D009)	0.0001	la	l	Contaminated Heavy water	4
41		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
42		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
43		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
44		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
45		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
46		0 Hg (D009)	0.0005	la	l	Contaminated Heavy water	4
47		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
48		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
49		0 Hg (D009)	0.0006	la	l	Contaminated Heavy water	4
50		0 Hg (D009)	0.005	la	l	Contaminated Heavy water	4
51		0 Hg (D009)	0.0001	la	l	Contaminated Heavy water	4
52							
53							

Mercury Disposal (Cmpgn. 4)

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[illegible]

	K	L	M	N	O	P	Q
54	Gamma field at 1 in. mR/hr	Hazardous Constituents			Physical State	Description and Treatment	CAMPAIGN NUMBER
55		Name or EPA code	Mass (lbs)	Type of analysis			
56							
57		0 Hg (D009)	0.0001	la	l	Contaminated Heavy water	4
58		0 Hg (D009)	0.1	pk	s	3 Mercury Pumps	4
59		0 Hg (D009)	5	pk	s	Mercury Pump	4
60		0.25 Hg, As, Ba, Cd, Cr	0.08	la	s	Soil borings for TNX seepage basin	4
61		0 Hg (D009)	0.008	la	l	Contaminated Heavy water	4
62		1 Hg, As, Ba, Cd, Cr	0.66	la	s	Soil borings for TNX seepage basin	4
63		0.25 Hg (D009)	unknown	pk	s, 5%l	Soil from a spill	4
64		0.25 Hg (D009)	3	pk	s	Equipment contaminated with mercury	4
65		0.25 Hg (D009)	3	pk	s	Equipment contaminated with mercury	4
66		0.25 Hg (D009)	3	pk	s	Equipment contaminated with mercury	4
67		0.25 Hg (D009)	3	pk	s	Equipment contaminated with mercury	4
68		0.25 Hg (D009)	3	pk	s	Equipment contaminated with mercury	4
69		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
70		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
71		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
72		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
73		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
74		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
75		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
76		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
77		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
78		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
79		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
80		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
81		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
82		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
83		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
84		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
85		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
86		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
87		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
88		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
89		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
90		0 Hg (D009)	unknown	pk	s 5%l	Soil cleaned up from a spill	4
91	unknown	unknown	unknown	unknown	unknown	unknown	4
92		0 Hg (D009)	150	pk	s	mercury particles	4
93	unknown	Hg (D009)	1	pk	s	Sprengel Pump and drop tubes	4
94		0 Hg (D008)	unknown	pk	s	Gold Traps	4
95		0 Hg (D008)	unknown	pk	s	Gold Traps	4
96		0 Hg (D008)	unknown	pk	s	Gold Traps	4
97	unknown	Hg (D009)	0	pk	s	Wipes and plastic	4
98		0 Hg (D009)	1	pk	s	Mercury Pump	4
99		0 Hg (D009)	1	pk	s	Mercury Pump	4
100		0 Hg (D009)	unknown	Pk	s	Filter cartridges w/ depleted U	4
101		0 Hg (D009)	unknown	Pk	s	Filter cartridges w/ depleted U	4
102		0 Hg (D009)	unknown	Pk	s	Filter cartridges w/ depleted U	4
103		0 Hg (D009)	1	pk	s	Mercury Pump	4
104							4
105							
106							

Mercury Disposal (Cmpgn. 4)

WSRC-TR-93-231

	A	B	C	D	E	F	G	H	I	J
	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
107										
108										
109								0.000002	0.000028	0
110	3-061	SPL	55 gal	100	0	0	0	0	0.00000009	0
111	3-021 #1	SPL	55 gal	100	0	0	0	0	0.00000009	0
112	3-021 #2	SPL	55 gal	100	0	0	0	0	0.00000009	0
113	3-021 #3	SPL	55 gal	100	0	0	0	0	0.00000009	0

	K	L	M	N	O	P	Q
107	Gamma field at 1 in. mR/hr	Hazardous Constituents			Physical State	Description and Treatment	CAMPAIGN NUMBER
108		Name or EPA code	Mass (lbs)	Type of analysis			
109							
110	0.025	Hg (D009), Pb	30	la	l	Drum of bottles. 13 l of Hg cont with U238, Pb	4
111	0	Hg (D009)	unknown	Pk	s	Filter cartridges w/ depleted U	4
112	0	Hg (D009)	unknown	Pk	s	Filter cartridges w/ depleted U	4
113	0	Hg (D009)	unknown	Pk	s	Filter cartridges w/ depleted U	4

Miscellaneous (Cmpgn. 5)

	A	B	C	D	E	F	G	H	I	J
	CONTAINER LOG NUMBER	SOURCE	VOLUME	WEIGHT (lbs)	H3 (Ci)	Cs 137 (Ci)	Co 60 (Ci)	Other b/g as Sr 90 (Ci)	Alpha as Pu238 (Ci)	Fissile (Pu239, U235) gm
1										
2										
3										
4	1-004 #1	HP	55 gal	450	0	0	0	0.0000004	0.0000002	0
5	1-004 #2	HP	55 gal	450	0	0	0	0.0000004	0.0000002	0
6	1-006	299H	20 gal.	400 lbs	1E-09	0	0	0	0	0
7	3-013 #1	Reactors	673 gal	1200	0	2.7E-09	0	0	0	0
8	3-013 #2	Reactors	673 gal	1200	0	2.7E-09	0	0	0	0
9	3-013 #3	Reactors	673 gal	1200	0	2.7E-09	0	0	0	0
10	3-013 #4	Reactors	673 gal	1200	0	2.7E-09	0	0	0	0
11	3-013 #5	Reactors	673 gal	1200	0	2.7E-09	0	0	0	0
12	3-013 #6	Reactors	673 gal	1200	1	0.00000036	0	0	0	0
13	3-017 #1	Reactors	673 gal	1200	1	0.00000036	0	0	0	0
14	3-017 #2	Reactors	673 gal	1200	1	0.00000036	0	0	0	0
15	3-017 #3	Reactors	673 gal	1200	1	0.00000036	0	0	0	0
16	3-017 #4	Reactors	673 gal	1200	1	0.00000036	0	0	0	0
17	3-017 #5	Reactors	673 gal	1200	1	0.00000036	0	0	0	0
18	3-017 #6	Reactors	673 gal	1200	1	0.00000036	0	0	0	0
19	3-017 #7	Reactors	673 gal	1200	1	0.00000036	0	0	2E-10	2.3E-09
20	3-017 #8	Reactors	673 gal	300	0	4.5E-09	0	0	0.000000008	2.3E-09
21	3-030	WMETF	55 gal	110	0	0	0	0	0.000000008	0
22	3-037 #1	Reactor Matis	55 gal	110	0	0	0	0	0	0
23	3-037 #2	Reactor Matis	55 gal	700	0.000017	0	0	0	0	0
24	3-039 #1	232H	55 gal	700	0.000017	0	0	0	0	0
25	3-039 #2	232H	55 gal	700	0.000014	0	0	0	0	0
26	3-039 #3	232H	55 gal	700	0.000026	0	0	0	0	0
27	3-039 #4	232H	55 gal	700	0.000017	0	0	0	0	0
28	3-039 #1	232H	55 gal	700 lbs	0.000035	0	0	0	0	0
29	3-041#2	Reactors	360 gal	2500	0	2.6E-08	0	0	0	0
30	3-066 #1	Reactors	360 gal	2500	0	2.6E-08	0	0	0.0000045 U235	2.1 gm U235
31	3-066 #2	Reactors	360 gal	25 lbs	0	0	0	0	0	0
32	3-070	247-F	55 gal	1000	0	9E-09	0	0	2E-10	0
33	6-001	241-F	673 gal	250	0	5E-09	0	2.3E-10	4.5E-10	0
34	6-016	241-H	55 gal	500	0	2.3E-10	0	2.3E-10	4.5E-10	0
35	6-019 #1	Separations	55 gal	500	0	2.3E-10	0	2.3E-10	4.5E-10	0
36	6-019 #2	Separations	55 gal	500	0	2.3E-10	0	2.3E-10	4.5E-10	0
37	6-019 #3	Separations	55 gal	500	0	2.3E-10	0	2.3E-10	4.5E-10	0
38	6-019 #4	Separations	55 gal	500	0	2.3E-10	0	2.3E-10	4.5E-10	0
39	6-019 #5	Separations	55 gal	150	0	2.3E-10	0	2.3E-10	4.5E-10	0
40	6-021	Separations	55 gal	50	0	0.0000002	0	0	0	0
41	6-022	SWDF	55 gal							

	K	L	M	N	O	P	Q
1	Gamma field at 1 in. mR/Hr	Hazardous Constituents			Physical State	Description and Treatment	CAMPAIGN NUMBER
2		Name or EPA code	Mass (lbs)	Type of analysis			
3							
4	22	Xylene (F003)	450	pk	l	Atomlight, 10% urine	5
5	22	Xylene (F003)	450	pk	l	Atomlight, 10% urine	5
6	10	Cr	500 mg	la	l	95% water, 5% diesel fuel	5
7	0.025	Cd (D006)	1.2	pk	s	Cadmium plated filters from 105 bldgs.	5
8	0.025	Cd (D006)	1.2	pk	s	Cadmium plated filters from 105 bldgs.	5
9	0.025	Cd (D006)	1.2	pk	s	Cadmium plated filters from 105 bldgs.	5
10	0.025	Cd (D006)	1.2	pk	s	Cadmium plated filters from 105 bldgs.	5
11	0.025	Cd (D006)	1.2	pk	s	Cadmium plated filters from 105 bldgs.	5
12	0.025	Cd (D006)	1.2	pk	s	Cadmium plated filters from 105 bldgs.	5
13	2.5	Cd (D006)	1.2	pk	s	Cd plated filters from 105 bldgs	5
14	2.5	Cd (D006)	1.2	pk	s	Cd plated filters from 105 bldgs	5
15	2.5	Cd (D006)	1.2	pk	s	Cd plated filters from 105 bldgs	5
16	2.5	Cd (D006)	1.2	pk	s	Cd plated filters from 105 bldgs	5
17	2.5	Cd (D006)	1.2	pk	s	Cd plated filters from 105 bldgs	5
18	2.5	Cd (D006)	1.2	pk	s	Cd plated filters from 105 bldgs	5
19	2.5	Cd (D006)	1.2	pk	s	Cd plated filters from 105 bldgs	5
20	2.5	Cd (D006)	1.2	pk	s	Cd plated filters from 105 bldgs	5
21	0.25	none	0	pk	s	Core Samples from Seepage Basin in 145 Qt Jar	5
22	0.05	Cr (D007)	0.1	la	sludge	Sludge from plating line sump	5
23	0.05	Cr (D007)	0.1	la	sludge	Sludge from plating line sump	5
24	0.0125	Freon	700	pk	l	Freon	5
25	0.0125	Freon	700	pk	l	Freon	5
26	0.0125	Freon	700	pk	l	Freon	5
27	0.0125	Freon	700	pk	l	Freon	5
28	0.0125	Freon	700	pk	l	Freon	5
29	0.5	Freon	700	pk	l	Freon	5
30	0	Cd (D006)	2.5	pk	s	Cd plated filters from 105 bldgs.	5
31	0	Cd (D006)	2.5	pk	s	Cd plated filters from 105 bldgs.	5
32	0	Cr (D007)	0.06	pk	l	16 liters of U and Cr in solution	5
33	0.5	None	0	pk	s and l	Hydraulic oil on oil dry and tarp.s	5
34	0.25	none	0	pk	l	Oil and Oldry	5
35	0	none	0	pk	s	Oil and Oldry	5
36	0	none	0	pk	s	Oil and Oldry	5
37	0	none	0	pk	s	Oil and Oldry	5
38	0	none	0	pk	s	Oil and Oldry	5
39	0	none	0	pk	s	Oil and Oldry	5
40	0	none	0	pk	s	Oils and shavings	5
41	5	none	0	pk	s	Sources and Soil Samples	5

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