SNS 102030000-TR0002-R02

Spallation Neutron Source Waste Management Plan

A U.S. Department of Energy Multilaboratory Project

SPALLATION NEUTRON SOURCE

Argonne National Laboratory • Brookhaven National Laboratory • Thomas Jefferson National Accelerator Facility • Lawrence Berkeley National Laboratory • Los Alamos National Laboratory • Oak Ridge National Laboratory

SNS

March 2006

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SPALLATION NEUTRON SOURCE WASTE MANAGEMENT PLAN

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Date Published: March 2006

Prepared by
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managed by
UT-Battelle, LLC
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-00OR22725

SNS 102030000-TR0002-R02

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WASTE MANAGEMENT PLAN

March 2006

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ACRONYMS

DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy-Headquarters
EPA	U.S. Environmental Protection Agency
H-	negative hydrogen
linac	linear accelerator
LLW	low-level waste
LLLWE	liquid low-level waste evaporator
MLLW	mixed low-level waste
NTS	Nevada Test Site
ORR	Oak Ridge Reservation
OTE	out-of-tank evaporator
RCRA	Resource Conservation and Recovery Act
RH	remote handled
SNS	Spallation Neutron Source
TBD	to be determined
TSCA	Toxic Substances Control Act

1. INTRODUCTION

1.1 WASTE MANAGEMENT PLANNING

The operation of the Spallation Neutron Source (SNS) will generate numerous types of waste from normal operations and maintenance activities. Per U.S. Department of Energy (DOE) Order 435.1, *Radioactive Waste Management*, and DOE Manual 435.1-1, *Radioactive Waste Management Manual*, planning shall be performed to address the entire life cycle for all waste streams before generation. The purpose of this SNS Waste Management Plan is to address the entire 40-year life cycle of all waste streams foreseen to be generated as the result of SNS operations and maintenance. Furthermore, all waste streams generated by SNS have identified paths to disposal. This Waste Management Plan may undergo review approximately every two years, or more frequently should significant process changes warrant reexamination of facility waste streams.

1.2 BACKGROUND

When completed in Fiscal Year 2006, SNS will be the world's foremost neutron-scattering facility. It will be an important scientific tool for basic research in many fields, including materials science, life sciences, chemistry, solid state and nuclear physics, earth and environmental sciences, and engineering sciences. The design calls for a beam of negatively charged hydrogen ions (H^-) to be generated and accelerated to an energy of one billion electron volts (1 GeV) using a linear accelerator (linac). The H^- beam will be transported to an accumulator ring where it will be injected by stripping away the electrons to leave the desired protons and bunching them into a short (under one microsecond) pulse 60 times per second. Finally, the proton beam will be directed onto a liquid mercury target, where pulses of neutrons will be created through spallation reaction of the protons with the mercury nuclei. Inside the Target Building, the emerging neutrons will be slowed or moderated and channeled through beam lines to instrumented experimental areas, where users will carry out research.

1.3 DISPOSITION MAPPING

To address the entire life cycle of SNS operational and maintenance waste streams, the SNS Waste Management Plan incorporates the use of disposition mapping. "Disposition" is an inclusive term that refers to "those activities that follow generation of a waste and which constitute completion of the life cycle of management of the waste, including, but not limited to, stabilization, deactivation, disposal, decommissioning, dismantlement, and/or reuse" (adapted from DOE O 430.1). Disposition maps have been constructed for low-level, mixed low-level, and hazardous wastes resulting from SNS operations and maintenance activities. In addition, a brief description of sanitary/industrial wastes is provided. The small amounts of wastes generated by experiments performed by visiting scientists and/or engineers are the responsibilities of the respective scientists and/or engineers and their respective sponsoring institutions.

DOE Headquarters (DOE-HQ) has addressed planning for low-level waste (LLW) and mixed low-level waste (MLLW). The *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site* was issued February 18, 2000. The decisions contained therein serve as the programmatic bases for the current master LLW and MLLW disposition maps maintained at DOE-HQ. There were four decisions addressing LLW treatment and disposal and MLLW treatment and disposal, respectively. First, DOE decided that each site will perform minimal treatment on its LLW, although each site may perform additional treatment as would be useful to decrease overall costs. However, it was noted that this decision does not preclude DOE's use of commercial treatment facilities, consistent with DOE regulations and policies. Second, DOE decided to establish regional LLW disposal at two DOE sites: the Hanford Site and the Nevada Test Site (NTS). In addition to disposing of

their own LLW, the Hanford Site and NTS will receive and dispose of LLW that is generated and shipped (by either truck or rail) by other sites that meets the waste acceptance criteria. Although the decision acknowledged that DOE will continue, to the extent practicable, on-site disposal at the Oak Ridge Reservation (ORR), current disposition maps show the majority of ORR-generated LLW going to NTS. Third, DOE decided to conduct regional MLLW treatment at numerous sites, inclusive of ORR, as would be consistent with current site treatment plans. This decision does not preclude DOE's use of commercial treatment facilities, consistent with DOE regulations and policies. Fourth, DOE decided to establish regional MLLW disposal operations at two DOE sites: the Hanford site and the NTS. In addition to managing their own MLLW, the Hanford site and NTS will receive and dispose of MLLW generated and shipped (by truck or rail) by other sites, consistent with permit conditions and other applicable requirements. Once again, this decision does not preclude DOE's use of commercial disposal facilities, consistent with current DOE regulations and policies.

Hazardous waste planning is also addressed by DOE-HQ. However, the treatment and/or disposal of hazardous waste is well understood, and numerous commercial treatment and/or disposal options are available. Therefore, in the *Record of Decision for the Department of Energy's Waste Management Program: Treatment of Non-wastewater Hazardous Waste*, issued July 30, 1998, DOE states its decision to continue use of off-site facilities for the treatment of major portions of the nonwastewater hazardous waste generated at DOE sites. Concurrently, DOE recognized that the ORR may treat some of its own nonwastewater hazardous waste on-site, where capacity is available in existing facilities and where treatment is economically favorable. This decision serves as the programmatic basis for the current master hazardous waste disposition map maintained at DOE-HQ.

Sanitary/industrial waste is typically not included in DOE-HQ planning initiatives because treatment and/or disposal of sanitary/industrial waste is well understood and occurs at all DOE facilities. Typically, the treatment and/or disposal of sanitary/industrial waste is regulated by state programs administered by the state of the respective DOE facility. Sanitary/industrial waste generated on the ORR consists of recyclable materials, such as metals, and nonrecyclable materials such as glass, paper, and wood. Nonrecyclable materials are disposed in state-permitted land disposal units (sanitary/industrial landfills).

Regardless of waste categorization, the SNS aggressively implements pollution prevention principles to prevent and/or reduce the amount of waste to be generated. As delineated in the *Pollution Prevention Act of 1990*, the SNS employs the following four principles with respect to all operations: 1) pollution should be prevented and reduced at the source whenever feasible; 2) pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible; 3) pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and 4) disposal or other release to the environment should be employed only as a last resort and should be conducted in an environmentally safe manner. Furthermore, SNS embraces the ORNL Pollution Prevention Policy whereby "we are committed to providing a safe and healthful working environment for all staff, guest scientists and engineers, and visitors; protecting the general public and the environment from unacceptable ES&H risks; operating in a manner that protects and restores the environment; and integrating pollution prevention into planning and decision-making." As such, SNS follows ORNL Pollution Prevention guidelines.

2. LOW-LEVEL WASTE

Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, by-product material [as defined in Section 11(e)2 of the *Atomic Energy Act of 1954* (42 U.S.C. 2011 et seq)], or naturally occurring radioactive material (adapted from: *Nuclear Waste Policy Act of 1982*, as amended). Furthermore, "[r]adioactive waste produced as a result of operations of DOE accelerators is low-level waste and shall be managed in accordance with DOE O 435.1, Radioactive Waste Management, and [DOE M 435.1-1], and all applicable Federal or State requirements" (DOE M 435.1-1, p. IV-1). Typical examples of SNS waste streams in this category include dry active waste (air filters, plastic cables, hoses and piping, floor sweepings, mops, wipes, etc.), radioactive scrap metal (metal filters, motors, pumps, and piping, etc.), resins and trapping materials (i.e., filters and ion-exchange resins), remote-handled (RH) miscellaneous solids (dry active waste, radioactive scrap metal, and resins/trapping material, etc.), wastewaters (condensate and cooling waters), and organic liquids (oils) generated during SNS maintenance and operations.

At present, dry active waste and radioactive scrap metal generated by SNS will be transported directly to commercial facilities and/or NTS for ultimate disposition. Radioactive scrap metal may undergo recycle and reuse when feasible (see Fig. 1). Resins/trapping material and RH-LLW may be temporarily stored for decay and/or transported directly to commercial and/or NTS for storage for decay and/or disposal. SNS process wastewaters will undergo on-site treatment at either the ORNL Wastewater Treatment Complex or the LLW Evaporator Facility. LLW organic liquids will be managed as MLLW.

The SNS LLW disposition map is consistent with the February 18, 2000, *Record of Decision for DOE's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site* and is in agreement with the current master LLW disposition maps maintained at DOE-HQ.

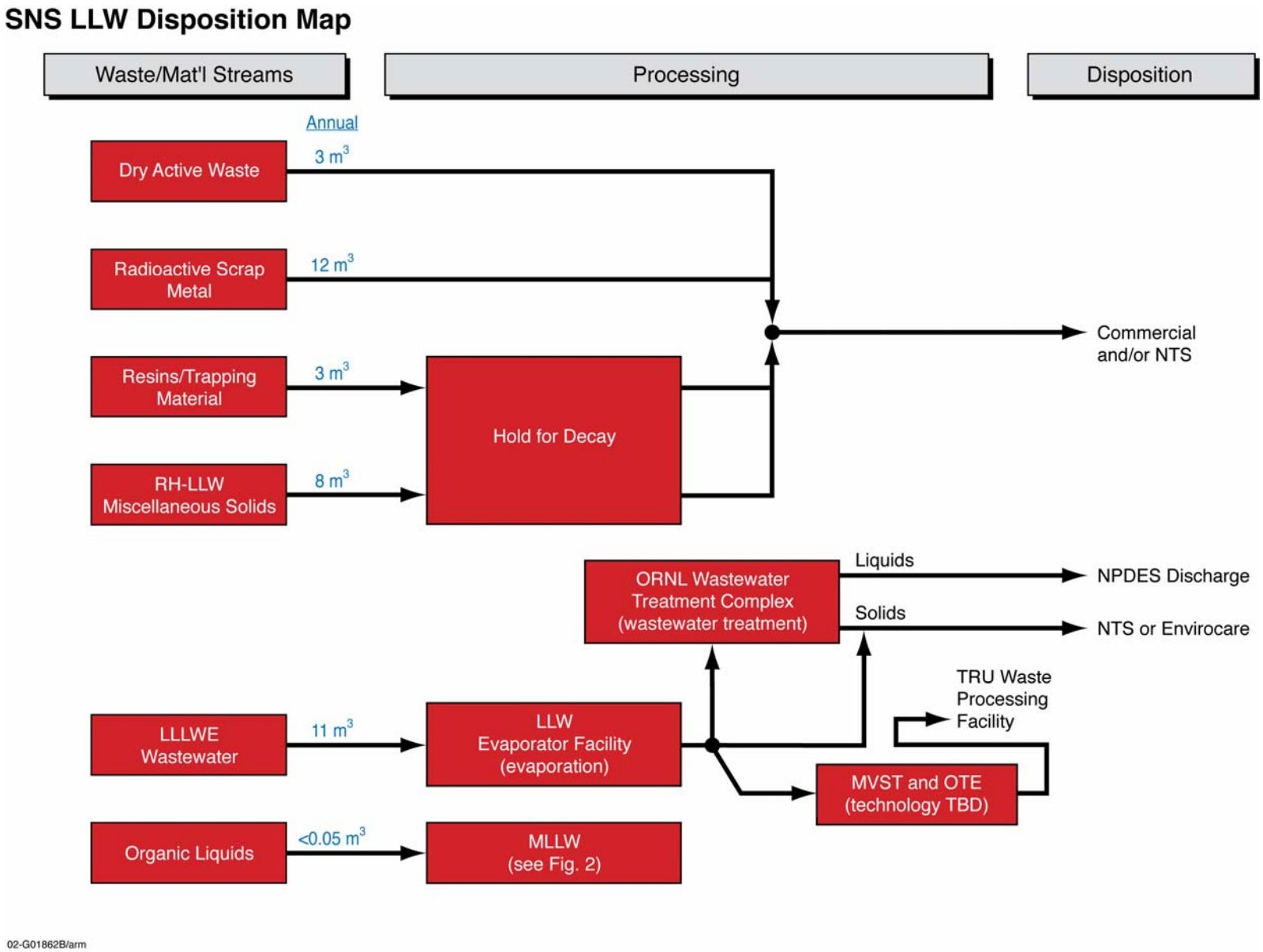

Fig. 1. SNS LLW disposition map.

3. MIXED LOW-LEVEL WASTE

MLLW comprises both hazardous and low-level radioactive waste. It is managed according to requirements established under the Resource Conservation and Recovery Act (RCRA) for hazardous waste and the Atomic Energy Act of 1954 for its radioactive components. The hazardous component of MLLW is subject either to U.S. Environmental Protection Agency (EPA) or state hazardous waste regulations promulgated under RCRA. SNS will not generate any hazardous and low-level radioactive waste for which the hazardous component is regulated under the Toxic Substances Control Act (TSCA).

SNS operations and maintenance will typically generate four MLLW waste streams: (1) miscellaneous solids, (2) organic liquids, (3) RH-miscellaneous solids, and (4) RH-organic liquids (see Fig. 2). At present, both miscellaneous solids and organic liquids will be transported to commercial facilities and/or NTS for treatment and/or disposal. At present, the NTS has a Mixed Waste Disposal Unit located within the Radioactive Waste Management Complex in Area 5 of the NTS. The Nevada Division of Environmental Protection is considering issue of a permit that would allow for the disposal of 20,000 m^3 of off-site generated MLLW for an operating time of five years, whichever comes first. At present, RH-miscellaneous solids and RH-organic liquids may be temporarily stored for decay and/or transported directly to commercial and/or NTS for storage for decay and/or treatment and/or disposal.

The SNS MLLW disposition map is consistent with the February 18, 2000, *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site* and is in agreement with the current master MLLW disposition maps maintained at DOE-HQ.

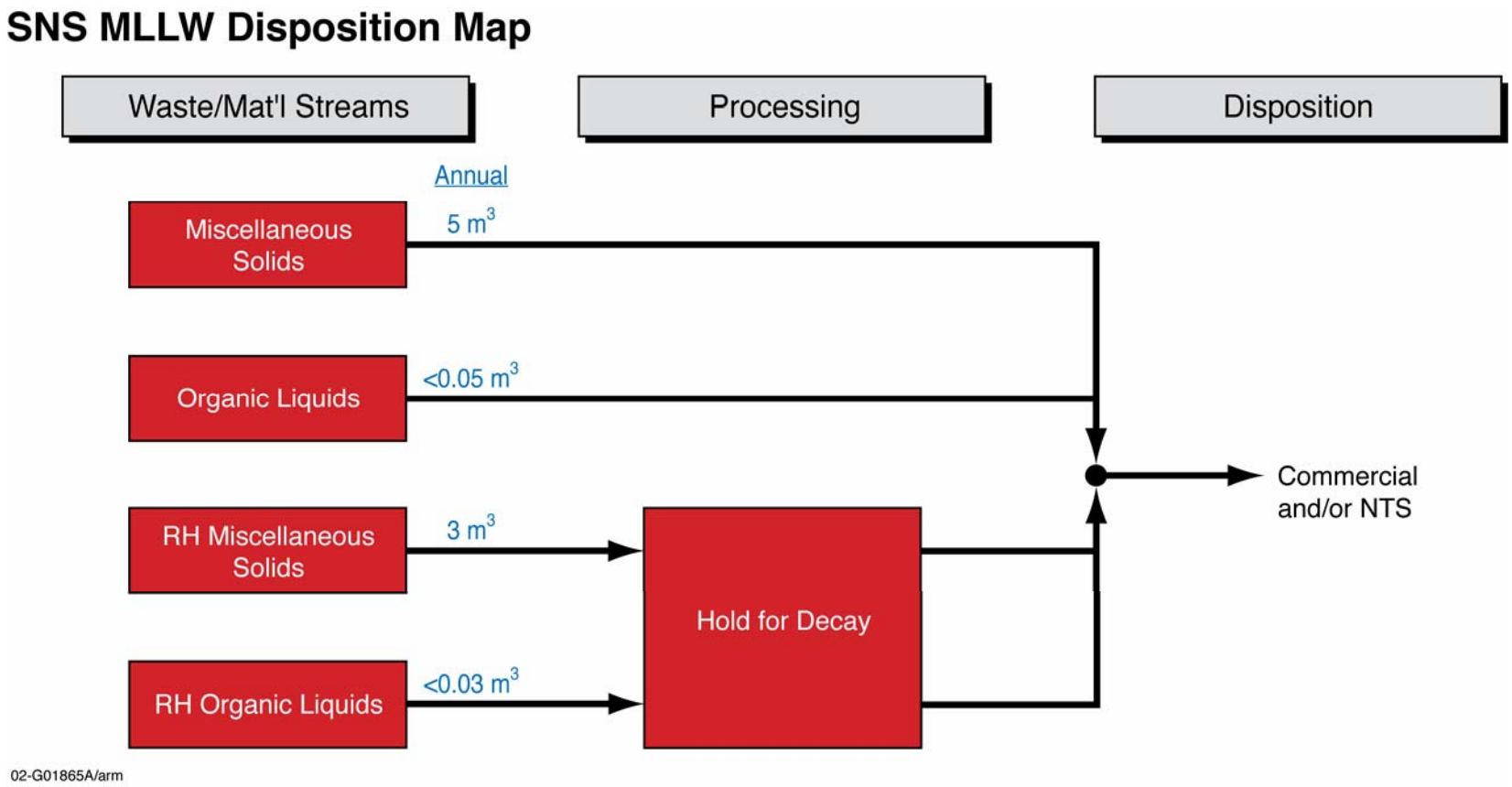

Fig. 2. SNS MLLW disposition map.

4. HAZARDOUS WASTE

Hazardous waste comprises nonradioactive waste exhibiting the characteristics of ignitability, corrosivity, reactivity, or toxicity, as defined by the EPA's regulations implementing RCRA, or waste that the EPA has listed under RCRA as hazardous waste. In addition, DOE manages some state-regulated hazardous wastes and hazardous wastes regulated under TSCA as hazardous wastes. SNS maintenance and operations should not generate TSCA waste; therefore, the management of TSCA-hazardous waste is not addressed in this plan. Conversely, SNS maintenance and operations will generate RCRA-hazardous waste. Typical examples of waste streams in this category include miscellaneous solids (i.e., lamps and wipes) and miscellaneous liquids (i.e., oils, plating solutions, and solvents). SNS hazardous waste disposition will focus on use of commercial treatment and/or disposal (see Fig. 3).

The commercial treatment and/or disposal of hazardous waste is consistent with DOE's July 30, 1998, *Record of Decision for the Department of Energy's Waste Management Program: Treatment of Non-wastewater Hazardous Waste* to continue use of off-site facilities for treatment of major portions of nonwastewater hazardous waste generated at DOE sites. However, DOE does acknowledge that ORR may treat some of their own nonwastewater hazardous waste on-site, where capacity is available in existing facilities and where such treatment is economically favorable. Thus, the SNS hazardous waste disposition map is consistent with DOE's decision and the current master hazardous waste disposition maps maintained at DOE-HQ.

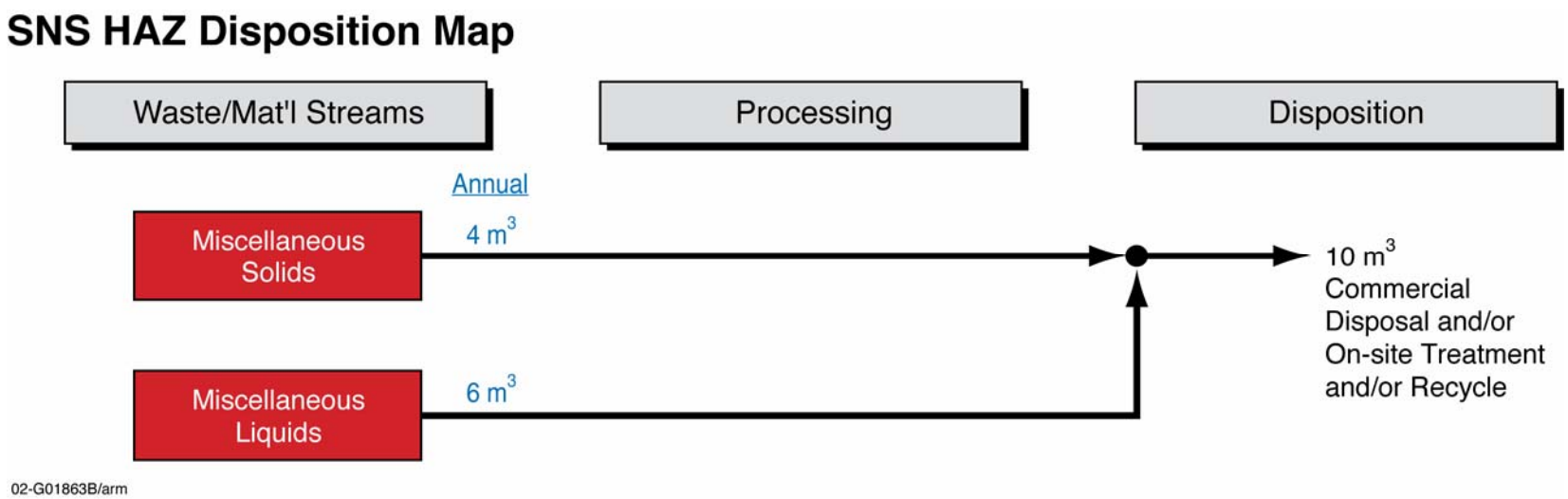

Fig. 3. SNS hazardous waste disposition map.

5. SANITARY/INDUSTRIAL WASTE

Sanitary/industrial waste comprises both liquid and solid wastes. Liquid wastes typically consist of industrial and/or sanitary wastewaters that are routed to the Oak Ridge National Laboratory sanitary sewer system. All such wastewaters comply with the respective waste acceptance criteria for the sewage treatment plant. SNS cooling tower waters are discharged to an on-site sediment/retention pond, which discharges to the headwaters of White Oak Creek. All liquid discharges, both those routed to the sewage treatment plant and those routed to the on-site sediment/retention pond, are permitted under existing National Pollutant Discharge Elimination System permit(s).

The solid wastes are nonhazardous, nonradioactive solid wastes from areas or systems free of potential activation or surface contamination. Typical examples of waste streams in this category include dry solids (air supply filters, plastic cables, hoses, and piping, floor sweepings, etc.), resins and trapping materials (ion-exchange resins), and nonrecyclable scrap metal (potentially aerosol cans) generated during SNS maintenance and operations. In addition to potentially nonrecyclable scrap metal, a significant quantity of recyclable scrap metal will result from maintenance and operations.

At present, the state of Tennessee regulates a subcategorization of sanitary/industrial waste known as “special wastes.” Special wastes include sludges, bulky wastes, pesticide wastes, medical wastes, industrial wastes, liquid wastes, exempted hazardous wastes, friable asbestos wastes, combustion wastes, and other solid wastes that are difficult or dangerous to manage. Presently, approved special waste streams that could be disposed of in the reservation landfill include empty hazardous material containers, empty aerosol cans, fiberglass, glass, and empty pesticide containers. Special waste streams requiring evaluation and approval include ion-exchange resins and filters from the Central Utilities Building’s de-ionized water supply, filters from the tunnel confinement or purge ventilation exhaust system, filters and ion-exchange resins from the target cooling loop de-ionized water supplies, and used oil filters from nonactivated systems. Miscellaneous maintenance materials that are not contaminated with oils or solvents from the front-end system, warm linac, or klystron gallery are also in this category. Process knowledge and/or sampling and analysis may be used for categorizing and characterizing solid waste.

6. REFERENCES

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