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ENVIRONMENTAL COMPLIANCE AT THE WEST VALLEY
DEMONSTRATION PROJECT: THE VITRIFICATION PERMITTING PROGRAM

TOPICAL REPORT
BY

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May 28, 1996

WORK PERFORMED UNDER CONTRACT NO. DE-AC24-81NE44139

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ABSTRACT

The major environmental laws that apply to the West Valley Demonstration Project (WVDP) are the: Resource Conservation and Recovery Act (RCRA), Clean Air Act (CAA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Toxic Substances Control Act (TSCA), National Environmental Policy Act (NEPA), and Emergency Planning and Community Right-To-Know Act (EPCRA). Regulations developed in accordance with these laws are administered by the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (EPA) through state and federal programs, and regulatory requirements such as permitting. The Environmental Permits & Reports (EP&R) Group of the Environmental Affairs (EA) Department has the primary responsibility for developing a site-wide permitting program for the WVDP and obtaining the necessary permits. This report discusses the permits and the permitting process associated with the Vitrification Facility (VF).

EXECUTIVE SUMMARY

The West Valley Demonstration Project (WVDP) was chartered under the West Valley Demonstration Project Act to solidify high-level radioactive waste (HLW) into a durable, solid form that is suitable for shipment to an approved federal repository. An element of that mission is the successful development and operation of the Vitrification Project. An essential ingredient in the planning, design, construction, and pre-operational testing preparatory to vitrification operations is the ongoing environmental permitting activities which support that effort.

Environmental permitting for both construction and operation of the Vitrification Facility and associated facilities was included in and is an essential part of overall Vitrification Project planning and design. This was accomplished by including permitting steps and milestones within the Vitrification Project Integrated Schedule. In addition, representation of the environmental engineers from the Environmental Permitting and Reports (EP&R) and Regulatory Compliance (RC) Departments was included in "plan-of-the-day" and "plan-of-the-week" status meetings and in the review of design engineering and standard operating procedures documentation. Each step of the permitting process required a detailed understanding of each associated activity, the requirements which governed that activity, and the best compliance strategy for ensuring that the requirements were fully met for both the overall Facility and each of its major sub-components. Essential to the permitting process was the need to ensure that not only were the regulatory requirements met completely and satisfactorily to both the regulators and the U.S. Department of Energy (DOE), but that the Facility needed to be fully functional and efficient in its intended operations.

The interdisciplinary integration of Project personnel began with early planning and design of the Project. Facilities permitting began with that integrated involvement. Project personnel, including Environmental Permitting and Regulatory Compliance professionals, benefitted from sharing information early in the process. The involvement began with a National Environmental Policy Act (NEPA) review under the WVDP's NEPA compliance process. Potential environmental effects were explored and regulatory requirements were outlined. The need for specific air and wastewater permits was identified at this juncture. Environmental Engineering specialists were included in the reviews of design documentation and in the development of system specifications for the minimization and processing of operational waste streams. This resulted in the early identification of requirements.

The primary permitting activities pursued in support of both the WVDP and the Vitrification Project include: the State Pollutant Discharge Elimination System (SPDES) permit under the Clean Water Act (CWA); Permits to Construct (PC) and Certificates to Operate (COs) per the National Emission Standard for Hazardous Air Pollutants (NESHAP) under the Clean Air Act (CAA); and the Resource Conservation and Recovery Act (RCRA), Part A Permit Application for the treatment and storage of hazardous and mixed waste.

The involvement of Regulatory Compliance professionals early in the planning process and the use of an integrated interdisciplinary environmental permitting approach led to the development of the air capping plan. The WVDP entered into a capping plan with federally enforceable permit conditions to limit Facility-wide nitrogen oxide (NO_x) and sulfur dioxide (SO₂) emissions to below 90.7 tonnes per year (tpy metric), (100 tpy English). By entering into the plan, the WVDP gained operational flexibility for vitrification and avoided having to modify the existing plant boilers. Another very important benefit resulting from the integrated process was that each permit and certificate was in place at the proper time to support each of the planned and scheduled activities. The environmental permitting process fully supported meeting the critical Vitrification Project milestones.

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1.0 HISTORICAL BACKGROUND

The West Valley Demonstration Project (WVDP) occupies approximately 80 hectares (80 ha.), (200 acres), within the 1,352-ha. (3,340-acre) Western New York Nuclear Service Center (WNYNSC) located 48 kilometers (km), (30 mi.), southeast of Buffalo, NY (Figure 1). The New York State Energy Research and Development Authority (NYSERDA) holds title to and manages the WNYNSC on behalf of the people of New York State. From 1966 to 1972, Nuclear Fuel Services, Company, Inc. (NFS) operated a commercial nuclear fuel reprocessing facility on the site that produced approximately 2.3 million liters (L) (600,000 gallons [gal.]) of liquid high-level radioactive waste (HLW). This waste was accumulated and stored in underground carbon steel tanks. NFS ceased operations in 1972 and notified NYSERDA in 1976 that it would terminate its lease and leave the HLW in place.

In 1980, Congress enacted the West Valley Demonstration Project Act (Public Law 96-368) that directs the U.S. Department of Energy (DOE) to:

- Solidify the HLW into a durable, solid form suitable for shipment to an approved federal repository
- Decontaminate and decommission (D&D) the tanks and facilities used to perform the WVDP
- Dispose of low-level and transuranic wastes that result from the WVDP's operations
- Develop containers suitable for the permanent disposal of the solidified HLW
- Transport the solidified HLW to a federal repository for permanent disposal as soon as feasible.

Under a cooperative agreement with NYSERDA, DOE assumed operational control of the 80-ha. (200-acre) portion of the WNYNSC. This portion is referred to as the Project premises. The Project premises eventually will be turned back to NYSERDA along with the responsibility for site closure. Decontamination and decommissioning activities, along with site closure, are covered in an Environmental Impact Statement (EIS) that was released by DOE for public comment on March 19, 1996 (DOE/EIS-0226-D).

Figure 1.
The Western New York Nuclear Service Center, the West Valley Demonstration Project
Premises, and the State-licensed Disposal Area

2.0 ENVIRONMENTAL COMPLIANCE

The major environmental laws that apply to the WVDP are the: Resource Conservation and Recovery Act (RCRA), Clean Air Act (CAA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Toxic Substances Control Act (TSCA), National Environmental Policy Act (NEPA), and Emergency Planning and Community Right-to-Know Act (EPCRA). Regulations developed in accordance with these laws are administered by the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (EPA).

The responsibility for compliance with environmental regulations is assigned to the Environmental Affairs (EA) Department of West Valley Nuclear Services Co., Inc. (WVNS). EA is comprised of three groups: Environmental Permits and Reports (EP&R), Regulatory Compliance (RC), and Environmental Monitoring. EA, and thus EP&R, takes its charter from DOE Order 5400.1, General Environmental Protection Program, which requires an environmental protection program be established for assuring compliance with applicable federal, state, and local environmental regulations; Executive Orders; and DOE internal policies, procedures, and legal agreements. In addition, DOE Order 5480.1B, Environment, Safety, and Health Program for Department of Energy Operations, directs contractors to develop and implement environmental compliance programs, and maintain liaison and a cooperative relationship with federal, state, and local regulators. Contractors shall take appropriate measures to ensure DOE that adequate resources will be in place, with assigned responsibilities to comply with environmental regulations.

2.1 Management of the Permitting Program

Regulations developed in accordance with state and federal environmental laws are administered by NYSDEC and the EPA through state and federal programs, and regulations requirements such as permitting. EP&R has the primary responsibility for developing a site-wide permitting program for the WVDP and obtaining any necessary permits. The Environmental Engineering staff was charged with preparing permit applications, working with the regulatory agencies, and fulfilling other requirements dictated by permit applications. The EP&R manager's role and responsibility was to interface with the Vitrification Project Design, Construction, and Operations groups to facilitate the review of Project documentation and to ensure the scheduling of resources to support the development of construction and operating permits and licenses. This was vital to ensuring that all necessary documentation met the necessary requirements, was agreed upon, and in place before it was needed.

2.2 Overview of the Environmental Permit Requirements for the Vitrification Facility

The environmental permits in effect at the WVDP in 1995 are listed in Figure 2. Chemical bulk storage and petroleum bulk storage registrations have also been obtained (Figure 2). The WVDP holds an asbestos license as well.

NOTE: The RCRA Part A, Permit Application, air permits, and State Pollutant Discharge Elimination System (SPDES) permit will be discussed in detail in Sections 3.0, 4.0, and 5.0 as they relate to the Vitrification Facility (VF).

2.2.1 RCRA Part A Permit Application

In addition to the permits listed in Figure 2, the WVDP filed a RCRA Part A Permit Application with NYSDEC in June 1990. The WVDP has been operating under interim status (Title 6 State of New York Codes, Rules and Regulations [NYCRR] Part 373).

2.2.2 Air Permits

The permitting program has resulted in 39 air permits (Figure 2). The site operates under state-issued (NYSDEC) air discharge permits for nonradiological air emissions. These include oxides of nitrogen (NO_x), sulfur dioxide (SO₂), and anhydrous ammonia (NH₃). Radiological emissions are permitted by the EPA and comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAP).

2.2.3 SPDES Permit

The WVDP holds a SPDES permit as required by NYSDEC. NYSDEC regulates liquid effluent discharges containing nonradiological pollutants. The SPDES permit identifies the outfalls where liquid effluents are released to site drainage and specifies the sampling and analytical requirements for each outfall.

Figure 2.
West Valley Demonstration Project Environmental Permits
(Sheet 1 of 3)

Permit Name and Number	Agency/Permit Type	Description
Boilers (042200-0114-00002 and 042200-0114-00003)	NYSDEC/Certificates to Operate (CO) an Air Emission Source	Boilers located in the Utility Room
Cement storage silo ventilation system (042200-0114-CSS01)	NYSDEC/CO	Exhaust from the cement storage silo baghouse
Analytical & Process Chemistry Laboratory (042200-0114-15F-1)	NYSDEC/CO	Analytical & Process Chemistry Laboratory equipment from various laboratories in the Main Plant
Tank #35157 vent (042200-0114-35157)	NYSDEC/CO	Vent from 3,000-gallon sulfuric acid Tank 35157
Source-capture welding system (042200-0114-MS001)	NYSDEC/CO	Maintenance Shop welding ventilation using "elephant trunk" ducts to vent welding fumes at the source of generation
Blueprint machine (042200-0114-00012)	NYSDEC/CO	Blueprint machine vent for ammonia emissions
Blower exhaust, welding only (042200-0114-00013) Welding/painting (042200-0114-00014) Painting only (042200-0114-00015)	NYSDEC/CO	Portable blowers (some with and some without filters) for venting emissions from typical painting and welding operations occurring at the site
Analytical cell mock-up unit (042200-0114-00027)	NYSDEC/CO	Analytical cell mock-up unit (located in the Vitrification Test Facility) emissions from use of laboratory chemicals
Scale Vitrification System (SVS) solids transfer system (042200-0114-SVS01) SVS vessel vent system (042200-0114-SVS02) SVS mini-melter off-gas system (042200-0114-SVS04)	NYSDEC/CO	Scale Vitrification System vac-u-max solids transfer system vent, feed mix tank vent, and melter off-gas treatment system emissions
SVS ammonia vent system- emission point system SVS07 (04220-0114-SVS07)	NYSDEC/CO	Scale Vitrification System ammonia vent system for relieving pressure before cylinder change-outs
Environmental Analytical Annex laboratory hoods (042200-0114-00016 through 042200-0114-00026)	NYSDEC/CO	Eleven separate blowers for laboratory hoods and analytical equipment in the Environmental Analytical Annex (EAA) [i.e., Vitrification Cold Operations Laboratory]

Figure 2. (Cont.)
West Valley Demonstration Project Environmental Permits
(Sheet 2 of 3)

Permit Name and Number	Agency/Permit Type	Description
Cold chemical solids transfer system (042200-0114-CTS02) Cold chemical vessel vent system (042200-0114-CTS03) Cold chemical vessel dust collection hood (042200-0114-CTS04)	NYSDEC/CO	Cold Chemical Facility. Dry or solid chemical emissions from solids transfer system, dust collection hood, and mix tank vent for vitrification operations
Vitrification Facility heating, ventilation, and air conditioning (HVAC) system (042200-0114-15F-2)	NYSDEC/CO	Canister-welding emissions vented through Vitrification Facility HVAC system. [i.e., canister welding ventilation]
Vitrification off-gas treatment system (042200-0114-15F-1)	NYSDEC/Permit to Construct (PC) an Air Emission Source	Vitrification Facility off-gas treatment system emissions
Slurry-fed ceramic melter (modification to WVDP-687-01)	EPA/Interim NESHAP	Slurry-fed ceramic melter radionuclide emissions
Vitrification Facility HVAC system	EPA/Interim NESHAP	Vitrification Facility HVAC system radionuclide emissions
01-14 Building ventilation system (WVDP-187-01)	EPA/NESHAP	Liquid waste treatment system ventilation of radionuclides in the 01-14 Building
Contact Size-reduction Facility (WVDP-287-01)	EPA/NESHAP	Contact Size-reduction and Decontamination Facility radionuclide emissions
Supernatant Treatment System (WVDP-387-01)	EPA/NESHAP	Supernatant Treatment System ventilation for radionuclide emissions
Low-level waste supercompactor (WVDP-487-01)	EPA/NESHAP	Low-level waste supercompactor ventilation system for radionuclide emissions
Outdoor ventilated enclosures (WVDP-587-01)	EPA/NESHAP	Ten portable ventilation units for removal of radionuclides
Process Building ventilation system (WVDP-687-01)	EPA/NESHAP	Original Main Plant ventilation of radionuclides
State Pollutant Discharge Elimination System (SPDES [NY-0000973])	NYSDEC/Water discharge	Covers discharges to surface waters from various sources on site

Figure 2. (Cont.)
West Valley Demonstration Project Environmental Permits
(Sheet 3 of 3)

Permit Name and Number	Agency/Permit Type	Description
Buffalo Pollutant Discharge Elimination System (95-05-TR096)	Buffalo Sewer Authority/Sanitary sewage and sludge	Permit issued to hauler of waste from the wastewater treatment facility
Chemical bulk storage	NYSDEC/Chemical bulk storage tank registration	Registration of bulk storage tanks used for listed hazardous chemicals
Petroleum bulk storage	NYSDEC/Petroleum bulk storage tank registration	Registration of bulk storage tanks used for petroleum

3.0 RCRA INTERIM STATUS TREATMENT PROCESSES

The WVDP interim status permitted processes that involve treatment of mixed waste (i.e., waste that contains a RCRA-hazardous component and a radioactive component subject to the Atomic Energy Act [AEA] of 1954 and, as further defined in DOE's interpretive rule for by-product material, 10 Code of Federal Regulations [CFR] 962 [52 FR 159]) include:

- High-level Radioactive Mixed Waste (HL-RMW) vitrification
- Low-level Radioactive Mixed Waste solidification.

Vitrification involves the treatment of HL-RMW (PUREX [Plutonium Uranium Extraction] and THOREX [Thorium Chemical Extraction]) in accordance with the Land Disposal Restrictions (LDR) technology-based treatment standard. Vitrification treatment involves a process that includes a series of chemical steps that separate the LLW fraction from the HL-RMW. The low-volume, high-level waste is vitrified into borosilicate glass. The high-volume, low-level fraction is stabilized with cement.

NFS' 1966 to 1972 on-site operations involved the reprocessing of spent commercial spent nuclear fuel rods. The reprocessing was designed to recover both uranium and plutonium from the spent nuclear fuel using the PUREX process. Thorium and uranium were recovered from a single core of thorium-enriched reactor fuel using the THOREX process. NFS-generated PUREX wastes were stored in an underground storage tank (Tank 8D-2). One campaign¹ of acidic, thorium-containing THOREX, in-process waste was stored in waste Tank 8D-4. The waste in 8D-2, the larger of the two tanks, had settled into two layers: a liquid layer (the supernatant) and a precipitate layer on the bottom of the tank (the sludge).

3.1 Integrated Radwaste Treatment System (IRTS)

A process of pretreatment and solidification was designed and developed to solidify the HLW. Pretreatment of the supernatant in Tank 8D-2 (PUREX) began in 1988. A four-part process, the Integrated Radwaste Treatment System (IRTS), reduced the volume of the HLW needing vitrification by separating the HLW into its HLW and low-level radioactive waste (LLW) fractions. The LLW was stabilized in cement. Each major steps is described below:

- The supernatant was passed through zeolite-filled, ion-exchange columns in the Supernatant Treatment System (STS) to remove more than 99.9% of the radioactive cesium.
- The resulting liquid was then concentrated by evaporation in the Liquid Waste Treatment System (LWTS).

¹A campaign is a resource-integrated set of activities planned together to arrive at a common product or result. For example, the production of 200 barrels of cemented waste product may involve sampling, characterization, reduction, mixing, sampling, solidification, verification, storage, and documentation. A number of integrated actions, performed by a number of closely coordinated groups, ensures that the final result meets the desired design specification.

- This low-level radioactive concentrate was blended with cement in the Cement Solidification System (CSS) and placed in 269-L (71-gal.) steel drums. This cement-stabilized waste form has been accepted by the U.S. Nuclear Regulatory Commission (NRC).
- Finally, the steel drums were stored in an on-site, aboveground vault, the Drum Cell.

Processing of the supernatant was completed in 1990, with more than 10,000 drums of cemented waste produced.

The sludge that remained was composed mostly of iron hydroxide. Strontium-90 accounted for most of the radioactivity in the sludge.

Pretreatment of the sludge layer in high-level waste Tank 8D-2 began in 1991. Five specially designed 15 meter (m), (50-ft), long pumps were installed in the tank to mix the sludge layer with water in order to produce a uniform sludge blend and to dissolve the sodium salts and sulfates that would interfere with vitrification. After mixing and allowing the sludge to settle, processing the wash water through the IRTS began. Processing removed radioactive constituents for later solidification into glass. The wash water containing salts was then stabilized in cement.

Sludge washing was completed in 1994 after approximately 2,891,700 L (764,000 gal.) of wash water had been processed. About 8,000 drums of cement-stabilized wash water were produced. In January 1995, high-level waste liquid stored in Tank 8D-4 was transferred to Tank 8D-2. The resulting mixture was washed and the wash water was processed. IRTS processing of the combined wash waters was completed May 1995. In all, through the supernatant treatment process and the sludge wash process, more than 6,426,000 L (1.7 million gal.) of liquid had been processed by May 1995, producing a total of approximately 19,877 drums of cemented, low-level waste.

As one of the final steps, the ion-exchange material (zeolite) used in the IRTS to remove radioactivity will be blended with the washed sludge before being transferred to the VF for blending with the glass-formers. In 1995, approximately 91% of the spent zeolite was transferred to high-level waste Tank 8D-2 in preparation for vitrification. (See Figure 3 for the entire treatment system flow diagram.)

3.2 Vitrification

Since the early 1980s, the WVDP has been developing vitrification technology. Pre-start testing programs were conducted to identify process control variables, process design limitations and treatment process specifications, and ensure that the resultant borosilicate glass-form will effectively stabilize constituents of concern and meet NRC requirements.

The purpose of the Vitrification System is to solidify HL-RMW into borosilicate glass in order to immobilize the radioactive and hazardous constituents. The vitrification process converts hydroxides, nitrates, and sulfates in the waste into oxides in the resultant glass-form. The Vitrification System will be used to process the PUREX/THOREX HL-RMW washed sludge remaining in Tank 8D-2 and the high-level, RCRA-nonhazardous, cesium-loaded zeolite from the STS. The high-level washed sludge in Tank 8D-2, which is comprised mostly of iron hydroxide, resulted from pretreatment of both the PUREX and THOREX wastes (see Section 3, the IRTS). To facilitate the treatment of the RCRA-nonhazardous, cesium-loaded zeolite generated from the IRTS STS operations, approximately 61,700 L (16,300 gal.) of the spent zeolite (85-91% of the total zeolite) was transferred from Tank 8D-1 to Tank 8D-2 in accordance with standard operating procedures (SOPs) in late 1995 and early 1996. It is estimated that a heel of approximately 100 cubic meters (m³), (130 cubic yards [yd³]), of waste will remain in Tank 8D-2 at the completion of the vitrification campaign.

Figure 3.
Treatment System Flow Diagram

Vitrification of HL-RMW will take place in the WVDP VF, located between the Waste Tank Farm and the Main Plant Process Building (See Figures 4 & 5). The VF is the result of the shielded conversion of the Component Test Stand (CTS), originally constructed to test major components of the system prior to their use for actual vitrification. The VF contains the "Vitrification Cell" where the HLW vitrification operations will take place.

The major steps of the vitrification process are: HL-RMW transfer from the Waste Tank Farm to the VF; preparation of cold (i.e., nonradioactive) chemicals in the Cold Chemical Facility²; melter feed preparation in the Concentrator Feed Makeup Tank (CFMT); feed transfer from the CFMT to the Melter Feed Hold Tank (MFHT); transfer from the MFHT to the Slurry-fed Ceramic Melter (SFCM); SFCM operation and transfer of molten HLW glass to canisters; and, filled-canister, in-cell storage, welding, decontamination, and transfer to and temporary storage in the HL-RMW Interim Storage Facility. The VF functions take place in a closed-loop system and are performed remotely due to the inherent hazards associated with treating high-level radioactive wastes.

²An associated facility that supplies the glass formers needed to produce the borosilicate glass and is physically located adjacent to the Vitrification Facility.

Figure 4.
WVDP Vitrification Facilities

Figure 5.
Vitrification Facility

The PUREX/THOREX HL-RMW and spent zeolite in Tank 8D-2 will be transferred to the CFMT as an homogenized slurry via a double-walled containment pipe. The approximately 23,000-L (6,100 gal.) CFMT will receive all process constituents including: homogenized HLW from Tank 8D-2; glass-formers (principally: aluminum, calcium, iron, potassium, lithium, magnesium, manganese, titanium, zirconium, and the oxides/hydroxides of silicon, boron, and sodium); nitric acid to improve slurry rheology; and sucrose to prevent glass foaming. Glass-formers and other feed chemicals will be provided from the Cold Chemical Preparation and Feed System (Cold Chemical Facility). The CFMT operates on a batch cycle, with typical slurry transfers from Tank 8D-2 being approximately 14,000 L (3,700 gal.) (nominal) (15% solids). One CFMT slurry batch is expected to produce approximately three canisters of waste glass. The high-level waste is boiled/evaporated down to a maximum concentration (40-50%) before the addition of glass-formers (at a nominal 65% solids slurry). The glass-formers' weight fraction is approximately 70-80% of the total solids' weight. Approximately seven days are required to process one batch of slurry through the CFMT. The mixed homogeneous concentrated CFMT mixture is transferred as a batch to the MFHT where it is mixed with the tank heel; the heel can range up to 25-35% of the tank's volume. The mixture continues to be agitated prior to transfer to the SFCM. The 19,000-L (5,020-gal.) MFHT is capable of providing greater than 100 hours of feed to the SFCM.

The SFCM is the core of the VF and operates on the same principle as many electrical melters in the commercial glass industry. The function of the melter is to dry and melt the slurry that is fed to it, converting the slurry to glass. The nominal volume of glass in the melter is 860 L (227 gal.). The MFHT feed slurry is pumped into the SFCM at a rate of 20 to 150 L/hr (5.3 to 40 gal./hr). The bulk glass is heated and normally maintained in the SFCM melting cavity at between 1,100°C to 1,200°C. During intermittent transfer, the molten glass exits the SFCM at an average flow rate of 30 kilograms/hour (kg/hr), (66 lbs/hr), through the discharge duct into the receiving canister. The canisters are made of 304L^R stainless steel, have a minimum wall thickness of 0.34 centimeters (cm), (0.13 inch), an outside diameter of 0.61 m (2 ft), and an overall height of 3.0 m (9.8 ft). The canisters have been designed to contain approximately 1,900 kg (4,200 lbs) of glass at an 85% fill level. The four-canister turntable is used to position each empty canister precisely under the SFCM pour spout for filling and then, after filling, rotate the canister to a position for cooling to near ambient temperature. Canisters are removed from the turntable several days after filling and are then transferred to the VF lid-closure welding station. At this time, glass-fill height is measured, the material is sampled, and the lid welded on. After closure, the external surfaces of the filled canister are decontaminated. This radiation decontamination process involves immersion of the filled canister in a solution containing highly oxidizing cerium ions dissolved in a dilute nitric acid solution; the solution will chemically etch a thin metal layer from the canister surface. The decontaminated canister is then washed, first with dilute nitric acid and then with water.

After washing, the canister is air-dried and finally smear-surveyed for radioactivity. After being filled, sealed, and decontaminated, the canisters will be temporarily stored in the shielded Interim Waste Storage Facility (the former Chemical Process Cell [CPC]) on site pending shipment to a federal repository.

4.0 AIR PERMITS

The Clean Air Act (CAA), as amended, establishes a framework for the EPA to regulate air emissions from both stationary and mobile sources. NYSDEC is currently adopting regulations to implement the EPA CAA requirements. In New York State, permits for stationary sources emitting regulated pollutants, including hazardous air pollutants, are issued by either the EPA or NYSDEC. Sources requiring permits emit a regulated pollutant above a predetermined threshold from a particular source through a stack, duct, vent, or other similar opening. This type of air emission is considered a point source. Non-point sources of emissions, such as lagoons, do not require specific permits. Emissions from these sources are, however, quantified for reporting purposes to both the EPA and NYSDEC.

Emissions of radionuclides from the WVDP are regulated by the EPA under the National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61, Subpart H). Currently, the WVDP has permits for eight radionuclide sources. Less significant sources of radionuclide emissions, such as those from the on-site Laundry, do not require permits. The WVDP reports radionuclide emissions from its permitted and nonpermitted sources to the EPA annually in accordance with the NESHAP regulations.

Nonradiological sources of air emissions are regulated by NYSDEC. The WVDP has thirty permits-to-construct (PCs) and certificates-to-operate (COs) for nonradiological point sources. When NYSDEC issues a PC for a nonradiological source, it is generally valid for one year. If construction continues, a permit renewal is requested of the agency. When construction has been completed, NYSDEC will inspect the facility and convert the PC to a CO. The CO is valid for a five-year period. In 1995, four PCs were converted to COs that will expire in 1999. In addition, eight sources had their COs renewed in 1995; their renewals expire in 1999. One PC, the Vitrification Facility Off-gas System, was extended to July 1996 to allow for completion of construction and start-up testing.

Application for permits and responses to other requirements are administered by the NYSDEC local office, Region 9, Buffalo, or the Region II Office of the EPA in New York City.

4.1 Air Emissions

The Off-gas Treatment System (Figure 6) is designed to control the radioactive and hazardous air emissions from all vessels in the vitrification process. The Off-gas Treatment System is divided into the In-cell Off-gas Treatment System and the Ex-cell Off-gas Treatment System.³ The In-cell Off-gas Treatment System maintains the SFCM under a negative pressure with respect to the Vitrification Cell in which the SFCM is contained.

The In-cell Off-gas Treatment System collects the majority of the radioactive constituents. Process fluids are recycled back to the CFMT and the air emissions are sent to the Ex-cell Off-gas Treatment System, located in the 01-14 Building, for final filtration and NO_x destruction.

³"In-cell" and "Ex-cell" are terms relating to Vitrification Facility locations. The In-Cell area refers to that area of high radiation that is shielded and in which operations are remotely conducted. The Ex-cell area is that area where Operations personnel view and control the In-cell operations and where supporting equipment and instrumentation is housed.

Figure 6.
Off-gas Flow Diagram

4.1.1 In-cell Off-gas Treatment System

The In-cell Off-gas Treatment System includes the vessel vent header and condenser; the submerged bed scrubber (SBS); a mist eliminator (ME); a high efficiency mist eliminator (HEME) preheater; a HEME; a heater; and a process prefilter, consisting of two high efficiency particulate air (HEPA) filter elements. A redundant system consisting of a HEME, a heater, and prefilter units are available to allow for redundant operations, filter changing, or other maintenance.

The vessel vent header provides a mechanism to control steam and ventilation gases from the CFMT and an auxiliary vent for the SFCM. The vessel vent header vents all In-cell vessels except the SFCM during normal operations and the SFCM if there is a restriction in the off-gas line or other high pressure in the SFCM. The vessel vent header transports vessel gas to a condenser to remove water. The non-condensibles flow into the In-cell Off-gas Treatment System prior to the HEME preheater.

Normally, off-gas is directed from the SFCM to the SBS where the gas enters the bottom of a flooded, packed bed of ceramic spheres and is bubbled up through the bed. The gas is cooled from approximately 300°C to approximately 40°C. Large particulates and 99.4% of the radioactivity in the off-gas are removed. The SBS also removes about 3.0% of the NO_x.

Gas exiting the SBS enters the ME, which removes liquid entrained in the gas as a result of the SBS treatment. This limits the water load on the HEME. The HEME is a glass-mesh filter device used in commercial applications and is capable of removal efficiencies above 95% for sub-micron and greater particulate size ranges. The HEME is equipped with a spray wash and a valve in its drain line so that the filter element can be washed for cleaning. The collected solution from the HEME is drained back to the SBS for recycling.

The gasses are then heated and prefiltered through a HEPA filter, which captures small radioactive particulates. The HEPA prefilter contains two filter elements, each of which removes greater than 99% of 0.3-micron particulates. Differential pressure across the HEPA filters is monitored. When the differential pressure reaches a point that indicates the prefilter elements are fully loaded, the alternate process filter is selected and placed into operation by remote means. The HEPA filter elements in each process prefilter are dioctyl phthalate (DOP) leak-tested after placement in a housing that can be remotely removed and replaced. Upon exiting the process prefilter, the vitrification off-gas consists primarily of air, water vapor, nitrogen oxides, sulfur dioxide, and a minimal amount of particulate.

4.1.2 Ex-cell Off-gas Treatment System

The Ex-cell Off-gas Treatment System receives off-gas from the In-cell Off-gas System. It provides further filtration of any radioactive particulates that were not captured by the In-cell Off-gas Treatment System and destruction of NO_x gases produced by the SCFM.

The Ex-cell processes include entrainment separation, preheating, HEPA filtration, and catalytic NO_x destruction. Off-gas from the VF passes through a pipe contained within an underground tunnel to the 01-14 Building. Heating the tunnel, insulation on the piping, and an entrainment separator within the pipe are used to minimize or eliminate condensate from the off-gas before it arrives at the 01-14 Building.

Subsequent to the entrainment separation, the gas will be preheated to ensure that it approaches the two in-line HEPA filters at a temperature above its dew point. HEPA filtration then removes more than 99.97% of all remaining particles.

The off-gas is then transported to the NO_x abatement system. Three blowers are installed in parallel. One will be in use while the other two are kept for backup. The blowers are used to maintain the vitrification system under a negative pressure for contamination control as well as to move the gas through the system. The NO_x abatement system consists of a heater, a catalytic convertor bed, and an ammonia injection subsystem. The ammonia is supplied from an anhydrous ammonia storage tank equipped with two vaporizers. Vaporized ammonia is delivered to the off-gas, upstream of the catalytic bed. NO_x destruction is accomplished by heating the off-gas and then causing it to react with ammonia in the presence of a catalyst. The catalyst is NC-300^R, a zeolite-base material proprietary to the Norton Company. The reaction produces water vapor, nitrogen, and oxygen. A number of related chemical reactions occur in the NO_x reactor. The dominant chemical reaction sequence is given below. This sequence is consistent with literature published by the catalyst vendor and with WVDP observations during pilot plant testing.

Since these reactions are all exothermic, the off-gas becomes hotter as it passes through the NO_x abatement system. Redundant preheaters and reactors are installed in parallel for backup.

The amount of NO_x and NO in the off-gas is continuously monitored by separate analyzers immediately prior to the silicon controlled rectifier (SCR). Ammonia and NO_x exiting the reactor will be continuously monitored at the SCR outlet. An additional NO_x analyzer serves as a backup and will be able to monitor NO_x prior to or after the SCR. This will enable the vitrification operators an opportunity to calibrate and/or service the other NO_x analyzers while providing continuous monitoring of the off-gas stream. The direct reading analyzers provide production operators with emission data on a real-time basis. Following the NO_x destruction, the treated off-gas will be directed into the existing Main Plant stack for discharge where, in conjunction with the other effluents, it will be monitored for radioactive constituents.

4.2 Vitrification Air Permits

A total of seven PCs were needed for vitrification operations. Five of these were for nonradiological sources and the other two were for radiological sources (Figure 7). The five PCs for nonradiological sources were issued by NYSDEC. Three of the five PCs were for Cold Chemical Facility operations. The other two PCs were for the Vitrification Facility HVAC system and vitrification off-gas treatment systems.

In 1995, four of these PCs were converted to COs for the Cold Chemical Facility and the vitrification HVAC system. Those COs will expire in 1999.

The fifth PC for nonradiological sources, the Vitrification Facility Off-gas System, was extended to July 1996 to allow for the completion of construction and start-up testing. A CO will be requested for that PC from NYSDEC after completion of a NO_x stack test. This test will be performed to verify emissions and the accuracy of the monitoring system. It is scheduled for completion during the second quarter of 1996.

Two NESHAP PCs required for vitrification operations provide for radiological emission from the melter and vitrification HVAC system. These permits were issued by the EPA as interim permits until monitoring data is received by the EPA for use in re-evaluating dose calculations. This data is due to the EPA six months after start-up of vitrification operations. Upon satisfactory review of the data by the EPA, it is expected that the EPA would then give final approval to the NESHAP permits. (See Figure 7 for description.)

Figure 7.
Vitrification Air Permits and
Certificates to Operate

Permit Name (Number)	Agency/Permit Type	Description	Status
Cold Chem. Solids Transfer System (042200-0114-CTS02) Cold Chem. Vessel Vent System (042200-0114-CTS03) Cold Chem. Vessel Dust Collection Hood (042200-0114-CTS04)	NYSDEC	Cold Chemical Facility. Dry or solid chemical emissions from a solids transfer system and dust collection hood; and from a mix tank vent for vitrification operations.	COs expire 08/01/99.
Vitrification Off-gas Treatment System (042200-0114-15F-1)	NYSDEC - PC	Vit. Facility off-gas treatment system emissions.	PC extended until 07/31/96. Will convert to a CO after NO _x stack testing, scheduled for 05/96.
Vitrification Facility HVAC System (042200-0114-15F-2)	NYSDEC - CO	Canister welding emissions vented through Vit. Facility HVAC system (aka, Canister Welding Ventilation).	CO expires 08/01/99.
SFCM (Modification to WVDP-687-01)	USEPA - Interim NESHAP	Slurry-fed Ceramic Melter radionuclide emissions.	Issued 05/08/95. No expiration date.
Vit. HVAC System	USEPA - Interim NESHAP	Vitrification Facility HVAC system radionuclide emissions.	Issued 05/08/95. No expiration date.

The Clean Water Act (CWA), authorizes the EPA to regulate point source discharges of pollutants to waters of the United States through a National Pollutant Discharge Elimination System (NPDES) permit program. The EPA has delegated this authority to the State of New York, which issues State Pollutant Discharge Elimination System (SPDES) permits for point source discharges of pollutants to surface water and groundwater.

Section 404 of the CWA contains regulations for the development of areas in and adjacent to the waters of the United States. The section provides stringent controls for dredging activity and the disposal of dredged or fill material into these areas by granting the U. S. Army Corps of Engineers the authority to designate disposal areas and issue permits for these activities. Supreme Court interpretations of Section 404 have resulted in the regulatory definition of waters of the United States to include wetlands. In addition, New York State has promulgated regulations at 6 NYCRR Parts 662 through 665 for the protection of freshwater wetlands.

5.1 Point Source Outfalls

Point source effluent discharges to surface waters at the WVDP are permitted through the New York SPDES program. The WVDP has three SPDES permitted outfalls (001, 007, & 008), all of which discharge to Erdman Brook, a contribution to, or tributary of, Cattaraugus Creek, which flows to Lake Erie (Figure 8).

Outfall 001 (WNSP001) - The treated wastewater from the Low-level Waste Treatment Facility (LLWTF) is held in lagoon 3, sampled and analyzed, and periodically released upon notifying NYSDEC. The discharge is to Frank's Creek through outfall 001. In 1995, treated wastewater from the LLWTF was discharged in five batches that totaled 39.0 million L (10.3 million gal.) for the year. The annual average concentration of radioactivity at the point of release did not exceed the derived concentration guides established by the EPA.

Outfall 007 (WNSP007) - The effluent discharge from the site's sanitary and industrial wastewater treatment plant, which includes wastewater from sewage and various nonradioactive industrial and potable water treatment systems, is discharged through outfall 007. The average daily flow through this outfall in 1995 was approximately 70,700 L (18,700 gal.).

Outfall 008 (WNSP008) - Groundwater and storm water flow is directed from the northeast side of the site's LLWTF lagoon system through a french drain. The discharge is through outfall 008. The average daily flow for this outfall during 1995 was approximately 8,400 L (2,220 gal.).

The vitrification process will generate some condensate and non-contact cooling wastewater that will be treated at the LLWTF. These process wastewaters are covered by the SPDES permit for outfall 001. There is no direct discharge of wastewater and condensate from the VF.

Figure 8.
SPDES Monitoring Points

5.2 Storm Water Discharge Permit Application

Storm water runoff can become contaminated with pollutants from industrial process facilities, stored industrial materials, material handling areas, access roads, or vehicle parking areas. To protect the environment, aquatic resources, and public health, Section 402 (p) of the CWA requires the submission of a storm water discharge permit application that contains facility-specific information to the permitting authority. NYSDEC, the permitting authority in the State of New York, uses this information to ascertain the significance of releases of pollutants from storm water collection and discharge systems, and to determine appropriate permitting requirements.

The WVDP obtained storm water characterization data through sampling and analysis in 1991 and submitted a storm water discharge permit application to NYSDEC on September 30, 1992. In early 1994, NYSDEC indicated that future storm water monitoring requirements would be incorporated into the WVDP's existing SPDES permit. In response to NYSDEC comments on the permit application, the WVDP monitored eleven storm water outfalls in 1995. The WVDP prepared and submitted a new storm water discharge permit application that identified these outfalls in April 1996. As of this writing the application is undergoing NYSDEC review.

6.0 ADDITIONAL REGULATORY REQUIREMENTS

Two additional regulatory requirements pertain to the VF and are discussed briefly below:

6.1 NO_x and SO₂ Cap

When NYSDEC issued the PC for the VF melter in July 1992, it included under Section 174 of the permit, Special Conditions, additional requirements. The focus of these requirements centered on the NO_x test protocol, which was to be an annual test of the NO_x emissions as verification and for comparison to the NO_x process monitors. The test protocol method required by NYSDEC is EPA Method 7E, 40 CFR 60, Appendix A; a method applying chemical luminescence.

The protocol establishes the NO_x emission rate during normal Vitrification Facility operation and compares the results with those of the NO_x process monitors, thus confirming the validity of the NO_x process effluent monitoring system. The NO_x monitoring protocol, which contains a Quality Assurance Plan, has been approved by NYSDEC and the first annual test is currently scheduled for the second quarter of 1996. The protocol has been written into a standard operating procedure and Vitrification Systems Engineering is presently assigned the responsibility for its implementation.

In 1995 New York State adopted new air regulations. Specifically, 6 NYCRR Section 212.5 (f) allowed a facility to cap its site emissions, replacing the hourly emission rates generally listed on a permit. The new restrictions limited emissions of NO_x and SO₂ at the WVDP Facility to 90.7 tpy metric (100 tpy English) each. The Vitrification Facility is included under the cap along with other WVDP operations.

Environmental Affairs has established a WVDP Air Emissions Inventory (AEI) and NO_x/SO₂ monthly tracking procedure to ensure compliance with the 90.7 tpy metric (100 tpy English) cap for NO_x and SO₂. The NO_x/SO₂ monthly budget for the melter is approximately 1.68 tonnes (1.86 tons) which has been budgeted for normal operations. During an upset in the abatement system, Operations is allowed a "not to exceed" value of 4.5 tonnes (5.0 tons), 6.2 kg (13.7 lbs) NO_x/hour, for a 30-day period.

6.2 RCRA, Subpart D

Under RCRA, Subpart D, 40 CFR 2650.370, and implemented under 6 NYCRR 373-3.16 Thermal Treatment, the stack plume must be observed hourly for a normal appearance. If off-normal, appropriate steps must be taken to correct operations. Because the vitrification process is a thermal treatment process, this requirement is applicable and has been implemented at the WVDP. Personnel have been trained and certified to evaluate the opacity requirements versus performance for stack discharge. Standard operating procedures have been revised to contain provisions to respond to operating conditions where the stack plume appearance indicates a probable deviation exists.

7.0 CONCLUSION

An integral ingredient to the successful completion of any major project is the careful planning, scheduling, and coordination of necessary resources. The permitting and licensing process is an essential part of major project development activities. The vitrification of HLW into a canistered waste form is by its very nature complex and requires careful planning in relation to the environmental permitting and regulatory interface portions of the task. RCRA, CAA, and CWA require extensive interaction between the regulator and the regulated.

An approach to environmental regulation that involves early involvement by all parties, i.e., Engineering, Operations, Project Management, and Regulatory Permitting, provides for an avenue that results in the issuance of the necessary paperwork before critical need. The Vitrification Project was completed in accordance with milestone commitments; with all necessary environmental permitting issues resolved and permits to construct and operate in place on or before need. This was the result of careful project management, proactive regulatory permitting, good coordination between disciplines, and strict adherence to scheduling controls.

APPENDIX A
ABBREVIATIONS, ACRONYMS, AND GLOSSARY

NOTE: Standard units of measurement are not included in the following.

AEA:	Atomic Energy Act
AEI:	Air Emissions Inventory (requirement under the CAA)
AEC:	Atomic Energy Commission (now DOE and NRC)
AKA:	Also Known As
CAA:	Clean Air Act
CFMT:	Concentrator Feed Make-up Tank
CFR:	Code of Federal Regulations
CPC:	Chemical Process Cell
CSS:	Cement Solidification System
CTS:	Component Test Stand
CWA:	Clean Water Act
CO:	Certificates to Operate (requirement under the CAA)
DEC:	(AKA: NYSDEC)
D/D (D&D):	Decontamination and Decommissioning
DOE (USDOE):	U.S. Department of Energy (formally part of the AEC)
DOP:	Diethyl phthalate (used to test for ventilation leaks)
EA:	Environmental Affairs (department under ESH&QA at the WVDP)
EAA:	Environmental Analytical Annex

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NOTE: Standard units of measurement are not included in the following.

EIS:	Environmental Impact Statement (requirement under NEPA)
EPA (USEPA):	Environmental Protection Agency
EPCRA:	Emergency Planning and Community Right-to-Know Act
EP&R:	Environmental Permits & Reports (department under EA)
ESH&QA:	Environmental, Safety, Health, and Quality Assurance
HEME:	High Efficiency Mist Eliminator
HEPA:	High Efficiency Particulate Air [Filter]
HL-RMW:	High-level Radioactive Mixed Waste
HLW:	High-level Waste [Radioactive]
HVAC:	Heating, Ventilating, and Air Conditioning
IRTS:	Integrated Radwaste Treatment System
LDR:	Land Disposal Restrictions (requirements under RCRA)
LLW:	Low-level Waste [Radioactive]
LLWTF:	Low-level Waste Treatment Facility
LWTS:	Liquid Waste Treatment System
ME:	Mist Eliminator (see HEME)
MFHT:	Melter Feed Hold Tank
NEPA:	National Environmental Policy Act
NESHAP:	National Emission Standard for Hazardous Air Pollutants
NFS:	Nuclear Fuel Services Company, Inc.

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NOTE: Standard units of measurement are not included in the following.

NH ₃ :	Ammonia
NO _x :	Oxides of Nitrogen (primarily NO and NO ₂)
NPDES:	National Pollutant Discharge Elimination System
NRC (USNRC):	Nuclear Regulatory Commission (enforces parts of the AEA)
NYCRR:	Official Compilation of Codes, Rules & Regulations of the State of New York
NYSDEC:	New York State Department of Environmental Conservation
NYSERDA:	New York State Energy Research and Development Authority
PC:	Permits to Construct (requirement under the CAA)
PUREX:	Plutonium Uranium Extraction
RC:	Regulatory Compliance (department under EA)
RCRA:	Resource Conservation and Recovery Act
SBS:	Submerged Bed Scrubber
SCR:	Silicon-controlled Rectifier
SDWA:	Safe Drinking Water Act
SFCM:	Slurry-fed Ceramic Melter
SO ₂ :	Sulfur Dioxide
SO _x :	Oxides of Sulfur (primarily SO ₂ and SO ₃)
SOP:	Standard Operating Procedure
SPDES:	State Pollutant Discharge Elimination System (State equivalent to NPDES)

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ABBREVIATIONS, ACRONYMS, AND GLOSSARY

NOTE: Standard units of measurement are not included in the following.

STS:	Supernatant Treatment System
SVS:	Scaled Vitrification System
THOREX:	Thorium Chemical Extraction
tpy:	Tonnes per year
TSCA:	Toxic Substances Control Act
USDOE:	See DOE
USEPA:	See EPA
VF:	Vitrification Facility
WNYNSC:	Western New York Nuclear Service Center
WVDP:	West Valley Demonstration Project
WVNS:	West Valley Nuclear Services Company, Inc.
WVSP001:	West Valley [Nuclear Services] SPDES Permit [outfall number] 001
WVSP007:	West Valley [Nuclear Services] SPDES Permit [outfall number] 007
WVSP008:	West Valley [Nuclear Services] SPDES Permit [outfall number] 008
8D-1:	A waste tank at the WVDP
8D-2:	A waste tank at the WVDP
8D-4:	A waste tank at the WVDP