ATTACHMENT C
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West Valley Demonstration Project

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DESIGN CRITERIA

HIGH-LEVEL WASTE INTERIM STORAGE SYSTEM

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RECORD OF REVISION

PROCEDURE

If there are changes to the controlled document, the revision number increases by one. Depending on the document type (per WV-100) changes are indicated by:

- a heavy vertical black line located in the right-hand margin adjacent to the sentence or paragraph which was revised
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The vertical line in the margin indicates a change. |
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Rev. No.	Description of Changes	Revision On Page(s)	Dated
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RECORD OF REVISION (CONTINUATION SHEET)

Rev. No.	Description of Changes	Revision On Page(s)	Dated

HIGH-LEVEL WASTE INTERIM STORAGE SYSTEM

Rev. 2

1.0 SCOPE

This document presents the design criteria for the system to provide interim storage and handling of the canisters of vitrified high-level waste (HLW) on the WVDP site, and for storage of failed or used process equipment that is contaminated with radioactive material from the Vitrification Facility (VF). The facilities, equipment, operations, and the requirements associated with the storage of the waste are described herein.

1.1 Description

The High Level Waste Interim Storage (HLWIS) system shall be capable of receiving HLW canisters that were filled within and transferred from the VF Cell. In addition, provision shall be made for unloading, storing, and transferring the loaded canisters from the storage facility to the ship-out facility for shipment to another interim storage facility or a final Federal repository. The design of the ship-out facility is not included in the storage system design scope, but due consideration shall be given so that ship-out is not unduly complicated by the design of the storage system.

The HLWIS System consists of canister storage racks, radiation shielding, contamination containment, canister cooling, canister handling equipment, and canister monitoring equipment.

The HLWIS system shall be located in the Chemical Process Cell (CPC), an existing structure at the WVDP site.

1.2 Terms and Definitions

ADS - Air Displacement Slurry (pump)

CPC - An existing shielded cell which was previously used as a remotely operated Chemical Process Cell

CCR - The Chemical Crane Room of the existing process building. This room was used as a shielded crane repair room for the CPC.

CFMT - Concentrator Feed Make-up Tank

DBE - Design Basis Earthquake

EDR - The Equipment Decontamination Room of the existing process building. This room was used to decontaminate used equipment from the CPC prior to disposal.

HEV - The main plant Head End Ventilation system.

HLW - High Level Waste

HLWIS - All components which make-up the High Level Waste Interim Storage System

RACKS - Support structures used to hold canisters in fixed identifiable locations, protecting them from damage.

SHALL - Indicates mandatory requirements.

SHOULD - Indicates discretionary guidelines, where mandatory compliance may conflict with other requirements of this document.

TRU - Transuranic Waste - Waste with a long lived alpha emitting transuranic isotope content greater than 100 nanocuries/gm.

VF Cell - The remotely operated facility where HLW will be Vitrified.

WVDP - West Valley Demonstration Project

2.0 FUNCTIONAL REQUIREMENTS

The HLWIS system provides for the interim storage of canisters of vitrified HLW until the canisters are shipped to another interim storage facility or a final Federal repository.

The HLWIS system shall provide for the following functions:

2.1 Storage in racks for at least 372 HLW canisters generated during Phase I operations of the vitrification facility. This is based on the worst case credible production estimate (352 canisters) from Reference [1] with an additional twenty canisters associated with start-up, melter flush-out, upsets (partially filled canisters), and the Evacuation Canisters.

2.2 HLW canisters generated during any future phase II operations of the vitrification system are not included in the scope of this design criteria since it is unknown at this time whether any of the waste generated during phase II operations will be vitrified.

2.3 Additional storage capacity for failed or used VF equipment shall be provided. Based on experience to date and industry wide experience with similar equipment, the following items are likely to require storage until a size reduction and decontamination facility is available:

2.3.1 2 primary cell HEPA filter assemblies (3 filters each assembly) - drawing E&W 68E2-3

2.3.2 9 primary cell roughing filter assemblies (2 filters each assembly) - drawing E&W 68E2-4

2.3.3 2 off-gas filter housings - drawing PNL-276-01

2.3.4 2 melter off-gas jumpers - drawing PNL-642

2.3.5 1 set start-up heaters - drawing PNL-260

2.3.6 6 discharge heaters - drawing PNL-012-01

2.3.7 1 sample module - drawing PNL-402-01

2.3.8 1 sample flow control module - drawing PNL-402-01

2.3.9 1 concentrator feed make-up tank (CFMT) agitator - drawing PNL-255-01

2.3.10 1 concentrator feed tank agitator - drawing 900-E-977

2.3.11 1 air displacement slurry (ADS) pump - drawing 900D-2466

2.3.12 11 miscellaneous jumpers (Approx. 2-inch dia., 8-foot dog-leg)

2.4 The HLWIS System shall provide storage space for 12 remotely handled Transuranic Waste (TRU) containers which are presently stored in the CPC. The containers are 55.88 cm diameter x 106.68 cm tall carbon steel canisters. (Drawing 900-C-1059)

2.5 Interface with a transfer cart(s) capable of moving canisters and/or equipment into the storage area on existing rails. The design of the transfer cart is not in the storage system design scope.

> 2.6 Shielding to permit access as required by Section 4.4 of this document.

2.7 A canister closure, either permanent or temporary, must be attached by others prior to storage.

2.8 A means of dissipating the decay heat from the HLW canisters while stored in racks within the CPC to maintain the CPC air temperature below 38°C (100°F). This temperature limit is required to protect the concrete shielding and any in-cell equipment from damage. The total heat generation rate of the HLW based on decay heat in 1996 is 72000 watts.[3] Additional mechanical and electrical loads within the storage facility shall be included in the total heat load.

2.9 A means of dissipating the decay heat from each HLW canister while stored in racks within the CPC to maintain the canister centerline temperature below 400°C (752°F) as required by Reference [4]. The decay heat for each canister is dependent on the amount of HLW in the canisters. The decay heat ranges from 295 watts/canister for the minimum production of 244 canisters to 204 watts/canister for the maximum production of 352 canisters.[1][3] An analysis shall be performed to demonstrate that natural convection with the storage system configuration and ambient air in the CPC will provide sufficient cooling to meet this requirement.

2.10 Capability to monitor the CPC air temperature to ensure that the temperature requirements of this document are satisfied.

2.11 Capability of handling a single HLW canister in a normally vertical position and in accident condition intermediate or horizontal position.

2.12 Capability of maintaining the CPC at a negative pressure with respect to the cell external environment for contamination control purposes as described in Reference [5].

2.13 The HLWIS shall be designed to store HLW canisters for a 20 year interim period.

2.14 After 20 years of normal storage and any minor off-normal occurrences, all canisters shall meet the Federal repository acceptance requirements, as defined in Reference [4].

2.15 All equipment installed inside the CPC shall be designed to accommodate installation, maintenance, and removal after the canister storage period by remote handling methods. The existing CPC cranes shall be used for remote operations and the Chemical Crane Room will be used as a shielded maintenance area for the cranes. Design consideration shall be given to minimize the in-cell maintenance activities and to minimize the production of contaminated components.

2.16 The design shall provide redundancy for critical components that may require maintenance or replacement unless these components can be repaired or replaced in sufficient time to meet the design criteria requirements.

2.17 Viewing capability to monitor operations shall be provided.

3.0 OPERATIONAL REQUIREMENTS

3.1 The operational requirements of the HLWIS System shall include the following:

3.1.1 All canister handling shall be done remotely.

3.1.2 Operating personnel shall maintain visibility of the handling operations at all times using shield windows and/or video equipment.

> 3.1.3 The maximum radiation dose for a full-time occupancy area shall be 0.25 mRem/hour. A full-time occupancy area is one in which an individual(s) may be expected to spend all or most of his or her work day.

3.1.4 The maximum radiation dose for a full-time access area shall be 2.5/t Mrem/hr in which "t" is the maximum average time in hours per day that the area is expected to be occupied by any one individual. A full-time access area is one in which no physical or administrative control or entry exists. If compliance with full-time access area requirements would be economically not feasible, impractical or prohibitive, higher dose rates may be allowed. However, access to such fields shall be strictly controlled.

3.1.5 The handling equipment shall be remotely replaceable or repairable in a shielded area.

3.1.6 The storage racks shall accommodate loading and unloading one canister at a time.

3.1.7 The storage facility shall have sumps which are able to detect, collect, and remove any water inadvertently released into the CPC.

3.1.8 The storage racks shall have a storage location identification system which uniquely identifies each canister with its storage location.[6]

3.1.9 The existing plant air monitoring method will be utilized for monitoring ventilation discharge and operating aisle contamination levels.

3.1.10 The existing plant area radiation monitoring equipment will be utilized for monitoring operating aisle radiation levels.

3.1.11 Any portion of the cooling equipment located in the CPC will be maintained by remote replacement. Any cooling equipment located outside of the CPC will be maintained by contact maintenance.

3.1.12 The controls for the CPC cranes, the EDR/CPC shield door, the canister transfer cart, and the CPC/EDR video cameras shall be located at a common operating point near a CPC shielded viewing window.

3.2 Operations Outline

3.2.1 Canisters are filled within the VF Cell. The lids are welded onto the canisters. The canisters are decontaminated and then they are transferred to the CPC in a canister restraining rack mounted atop the canister transfer cart.

3.2.2 Canisters are then unloaded individually from the canister transfer cart in the CPC and are loaded into the storage racks.The transfer cart is returned to the EDR.

3.2.3 Empty canisters are loaded onto the canister transfer cart in the EDR which is transported back into the VF Cell where the empty canisters are unloaded and are replaced with the filled canisters. Only empty canisters are to be handled by the EDR crane due to inadequate back-up, recovery and repair capabilities in EDR.

4.0 DESIGN REQUIREMENTS

4.1 Location

The HLWIS System shall be located in the CPC located south of the VF cell. Reference Drawings 905-D-031, 032, 036.

4.2 Viewing

Canister handling shall be controlled from outside of the radiation shielding. Sufficient operator visibility, through shielded viewing windows and/or by remote TV, shall be provided to facilitate operator handling of canisters and contaminated equipment.

4.3 Lighting

Lighting shall be of the high pressure sodium bulb type. Design of the In-cell lighting fixtures shall be the same as the original design. i.e., The existing in-cell light housings shall be used with high pressure sodium type light bulbs. Crane lighting shall be upgraded to use standard commercial fixtures with HP sodium bulbs.

4.4 Shielding

The CPC walls shall provide sufficient shielding to meet the following radiation criteria with racks containing all of the vitrified HLW storage canisters (each having a maximum dose rate of 9500 rads/hr at contact).[2][7] A listing of the quantities of radioactive isotopes contained in the HLW canisters is given in Reference [4].

The maximum radiation dose for a full-time occupancy area shall be 0.25 Mrem/hour. A full-time occupancy area is one in which an individual(s) may be expected to spend all or most of his or her work day.

The maximum radiation dose for a full-time access area shall be 2.5/t Mrem/hr in which "t" is the maximum average time in hours per day that the area is expected to be occupied by any one individual. A full-time access area is one in which no physical or administrative control or entry exists. If compliance with full-time access area requirements would be economically not feasible, impractical or prohibitive, higher dose rates may be allowed. However, access to such fields shall be strictly controlled.

4.5 Structural Requirements

New structures that are not required to confine radioactive material shall be designed to the New York State "Code Manual for the State Building Construction Code" and the loadings specified in this section.

Structures and components that are required to confine radioactive material that could be hazardous to the public or site personnel shall be able to withstand the effects of the loadings in this section without loss of capability to perform safety function(s) and prevent the release of radioactivity.

Since the canister storage racks are not a confinement structure, they shall be designed using the New York State "Code Manual for the State Building Construction Code", the "Uniform Building Code (UBC) 1991 edition" and the "American Institute of Steel Construction" manual.

The CPC structure is an existing building at the WVDP site. Per DOE 6430.1A, General Design Criteria, "For existing facilities, original design criteria apply to the structure in general". The CPC structure was originally designed to the 1961 Uniform Building Code utilizing UBC-1961 Earthquake Loads and other loads from ANSI A58.1-1955. Modifications to the existing CPC structure shall be designed in accordance with the Uniform Building Code (UBC) 1991 edition.

4.5.1 Canister Storage Rack Loads

The filled HLW canisters (900-D-1092) shall always be supported so that they will not incur any damage that would prohibit them from meeting the Federal repository acceptance criteria [4]. The following accident scenarios shall be considered:

Accidental bumping with a crane suspended load or canister handling equipment.

The Uniform Building Code Earthquake.

A. Dead Loads shall be that of the completely loaded racks with 90 percent filled canisters (2240 kg/canister, 4928 pounds/canister [7]).

B. Earthquake loads and evaluation shall be, as a minimum, in accordance with the Uniform Building Code (UBC) 1991 edition. More rigorous analysis techniques shall be used to confirm rack deflections and performance during a postulated seismic event.

4.5.2 CPC Structure Loads

A. Dead Loads shall be that of the existing facility plus the load of 90 percent filled canisters (2240 kg/canister, 4920 pounds/ canister [7]) in completely loaded storage racks.

B. Live Loads shall be that of the existing facility and a load of 7181 Pa (150 PSF) distributed on the portion of the floor not occupied by the storage racks.

C. Earthquake loads and evaluation shall be, as a minimum, in accordance with the Uniform Building Code (UBC) 1991 edition.

D. The CPC structure shall withstand operating and ambient temperatures in combination with other loadings without incurring total structural failure. The exterior ambient conditions are reflected in Reference [9].

Thermal load is the load induced by normal gradients across the walls and slabs between the building interior and the external environment. The conditions to be considered shall be:

SUMMER

CPC Interior	15°C - 38°C (60°F - 100°F)
Exterior Sustained Concrete Temperature	10°C - 29°C (50°F - 85°F)
Enclosure above El. 148.0' (Vent. Exh. Cell)	15°C - 49°C (60°F - 120°F)
Chemical Aisle El. 114.0' to El.131.0'	21°C - 41°C (70°F - 105°F)

WINTER

CPC Interior	15°C - 38°C (60°F - 100°F)
Exterior Sustained Concrete Temperature	-17°C - 10°C (2°F - 50°F)
Enclosure above El. 148.0' (Vent. Exh. Cell)	15°C - 27°C (60°F - 80°F)
Chemical Aisle El. 114.0' to El.131.0'	21°C - 27°C (70°F - 80°F)

Thermal loads for the foundation mat shall be based on a constant (summer and winter) temperature of 13°C (55°F) for material underlying the mat.

E. Negative pressure range with respect to the outside atmosphere of zero to negative 249 Pa (minus 1 inch of water column).

F. Wind forces on the building exterior as specified in the Uniform Building Code (UBC) 1991 edition.

G. Snow load as specified in the Uniform Building Code (UBC) 1991 edition.

H. No flood loads are required. [13]

4.5.3 Auxiliary Equipment

Auxiliary equipment required to satisfy the requirements of this document shall be designed such that they shall remain secured and intact when subjected to the Uniform Building Code (UBC) 1991 edition earthquake loads. The auxiliary equipment is not required to remain operational during an earthquake. However, the equipment must be repairable or replaceable in sufficient time to meet the design criteria requirements. An analysis or equivalent (testing,etc.) shall be performed to demonstrate that these requirements are met.

4.6 Materials

Materials of construction for the storage system shall be carbon steel and/or stainless steel. All contact points with the canisters throughout the storage facility shall have stainless steel surfaces to avoid contact between a carbon steel framework and the stainless steel canister to prevent corrosion or other contamination of the canisters. Protective coatings shall be used on carbon steel.

4.7 Seismic Requirement

The storage rack system shall be designed so that when subjected to the Uniform Building Code (UBC) 1991 edition earthquake loads, no damage shall result to the canister(s) that contain the vitrified HLW such that they do not meet the repository acceptance criteria.[4] After an earthquake has occurred, the canisters shall be capable of being removed by use of the normal canister handling equipment, i.e., no tipping shall be allowed. In addition, all auxiliary equipment shall be designed such that they shall remain secured to prevent possible damage to the canisters. An analysis or equivalent (testing,etc.) shall be performed to demonstrate that these requirements shall be met.

4.8 Radiation Resistance

Materials used in all components of the storage system shall accommodate the radiation field produced by vitrified HLW canisters which each emit a maximum of 9500 rads/hr at contact.[2][7]

4.9 Cooling

The storage system ambient air temperature shall be maintained between 15°C (60°F) and 38°C (100°F) to ensure that the CPC concrete structure and any in-cell equipment is not damaged. In addition, it shall be demonstrated by analysis that this will maintain the canister centerline temperature below 400°C (752°F) as required by [4].

The total estimated decay heat load for the stored vitrified glass is 72,000 watts.[3] with a maximum heat load of 295 watts per canister. The heat capacity of the vitrified HLW is given in Reference [7]. Additional mechanical and electrical heat loads within the storage facility shall be included in the total required cooling heat load. The in-cell lighting heat load (7kw estimated) and the heat load generated by any in-cell equipment is also to be included.

If required, provide additional in-cell air circulation and/or ducting to meet the aforementioned temperature and heat transfer requirements. The air distribution method should minimize the deposition of airborne sediment in the CPC containment area and should attempt to promote a uniform CPC temperature distribution. An analysis shall be performed to demonstrate that even without the benefit of forced air circulation, natural convection of ambient CPC air will maintain the canister centerline temperature below 400°C (752°F).

The cooling system design life shall be 20 years. All equipment installed inside the CPC cell shall accommodate installation, maintenance, and removal by remote handling methods. Design consideration shall be given to minimize the in-cell maintenance activities and to minimize the production of contaminated components. The in-cell equipment will be exposed to a temperature range between 15°C (60°F) and 38°C (100°F) as well as exposed to a radiation field produced by vitrified HLW canisters which each emit a maximum of 9500 rads/hr at contact.

All new cooling system equipment shall be designed such that it shall remain secured and intact when subjected to the Uniform Building Code (UBC) 1991 edition earthquake loads. The cooling system is not required to remain operational during an earthquake event. However, the equipment must be repairable or replaceable in sufficient time to meet the design criteria requirements. An analysis or equivalent (testing,etc.) shall be performed to demonstrate that these requirements are met.

The cooling system equipment shall not jeopardize either the CPC purge flow and negative pressure balance or the purge flows and pressure balances in the other cells served by the Head End Ventilation (HEV) system.

Calculations and equipment suppliers' specification data sheets shall be submitted to demonstrate that the design criteria are satisfied.

4.10 Ventilation for Contamination Control

The cell shall be maintained under a negative pressure with respect to the cell external environment to contain any possible loose contamination per the requirements for Zone II as described in Reference [5]. The existing plant Head End Ventilation (HEV) system will be used to provide this ventilation and negative pressure.

4.11 Design Life

The HLWIS System shall be designed to be maintainable for a useful life of 20 years with no personnel access permitted in the presence of unshielded canisters.

4.12 Sampling

There is no glass sampling requirement for canisters while in the storage system. It is intended that glass sampling shall be performed prior to transfer to storage in the CPC.[6]

4.13 Nuclear Criticality Control

The HLWIS System is assumed to be criticality safe due to low concentrations of fissile nuclides. Criticality safety of the system shall be demonstrated by analysis prior to storage of the HLW filled canisters in the CPC.

4.14 Material Handling

The existing CPC 16-ton/2-ton crane 3V-1 shall be used for material handling inside the HLWIS. The details of the crane are shown on drawings VP-4413-3-V-57-1-4 and VP-4413-3-V-57-6-2. Upgrades to the crane shall comply with CMAA-70. Provisions shall be made for recovery of a failed crane to the Chemical Crane Room including provisions for lowering suspended loads prior to recovery. Any below-the-hook lifting devices required should comply with ANSI/ASME B30.20.

4.15 Piping

Piping used in the HLWIS shall meet or exceed the requirements of ANSI B31.3.

4.16 Sumps

The storage facility shall have sumps which are able to detect, collect, and remove any water inadvertently released into the CPC.

5.0 INTERFACES

5.1 The ventilation system will discharge into the main plant Head End Ventilation system via existing flow paths. The existing plant ventilation system is described by drawings 15R-A-74 and 15R-A-75.

5.2 The canister transfer cart system shall be used to transport loaded canisters from the VF Cell to the HLWIS storage system and return to the VF Cell with empty canisters on existing rails. Design of the transfer cart system is not included in the HLWIS scope of work. (Drawings 900-D-4862 & 900-D-4869)

5.3 The HLWIS System shall interface with the HLW storage canisters. The canister is characterized by the dimensions given on Drawing 900-D-1092. Any changes to these dimensions will require a review of the storage system for adequacy.

5.4 The HLWIS System may make use of an individual canister lift fixture of the same design as that used in the Vitrification Cell. The design of this canister lift fixture is not in the HLWIS scope of work. (Drawing E-2034-1000)

5.5 Empty canisters shall be transferred into the EDR and loaded onto the canister transfer cart in the EDR using the EDR crane(15V-21). The EDR crane is shown on drawings 15A-M-26, 15A-M-27, and VP-4413-15-V-77-1-1.

5.6 The EDR crane(15V-21) shall not handle partially or completely filled HLW canisters due to the inadequate back-up, recovery, and repair capabilities in EDR.

5.7 The existing Head End Vent contamination control ventilation system may provide back-up cooling capacity in the event of a primary cooling system outage. This back-up system combined with the inherent thermal capacitance of the canister storage system may provide time to repair or replace the primary canister cooling system rather than having to provide redundant cooling equipment.

5.8 The main plant liquid waste handling system shall be used to discharge any liquids collected on the floor of the CPC. Details of the liquid waste handling system are shown on drawings 3R-A-1, 7R-A-1, 7R-A-2, and 15R-A-6.

5.9 Piping inside of the CPC shall interface with Purex nozzles as shown on drawings PNL-316-01, PNL-324-01, and PNL-334-01.

5.10 The HLWIS System shall interface with the HLW Evacuated Canister System. These canisters are filled with molten glass when the VF-cell Melter is emptied of molten glass. The canisters will be stored in the HLWIS storage racks. The proposed Evacuated Canister is anticipated to have the same configuration as the HLW Storage Canisters. Any changes to these dimensions will require a review of the storage design for adequacy.

6.0 QUALITY ASSURANCE REQUIREMENTS

All design, fabrication, and testing shall be in accordance with ASME NQA-1-1989, "Quality Assurance Program Requirements for Nuclear Facilities" and, as applicable, DOE RW-0214, "Quality Assurance Requirements Document for the Civilian Radioactive Waste Management Program".

7.0 APPLICABLE CODES AND STANDARDS

The following codes and standards are applicable to the design of the HLWIS where specifically referred to herein. Unless specified herein, the code or standard effective date is the contract or order placement date.

AISC Manual	Manual of Steel Construction
ACI 318	Building Code Requirements for Reinforced Concrete
ANSI A58.1	Minimum Design Loads for Buildings and Other Structures; NRC Adopted
ASME NQA-1	Quality Assurance Program Requirements for Nuclear Facilities
ANSI B30.2	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley)
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ANSI N101.6	Concrete Radiation Shields, 1972
ANSI N300	Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Plants
AWS D1.1	Structural Welding
DOE ORDER 5480.1	Environmental Protection, Safety and Health Protection Program for DOE Operations
DOE ID 12044	Operational Safety Design Criteria Manual
DOE 6430.1A	General Design Criteria
DOE RW 0214	Quality Assurance Requirements Document for the Civilian Radioactive Waste Management Program
C.M.A.A. No. 70	Crane Manufacturers Association of America Specification No. 70, Specifications for Electric Overhead Traveling Cranes

NYS Code	New York State "Code Manual for the State Building Construction Code"
UBC	Uniform Building Code, International Conference of Building Officials, 1991 edition

8.0 SYSTEM COMPONENTS, QUALITY LEVEL, AND SAFETY CLASS

Table 8.1 lists the Safety Class and the resulting Quality Level for significant new construction and modified existing construction components that may be included in the HLWIS design. These categories are defined in WVDP-QM-3, Design Control [8]. In accordance with DOE 6430.1A General Design Criteria, these Quality Levels do not imply that existing buildings or equipment need to be upgraded in Quality Level.

TABLE 8.1 SAFETY CLASS AND QUALITY LEVELS FOR HLWIS COMPONENTS

COMPONENT OR SYSTEM	SAFETY CLASS	NOTES	QUALITY LEVEL
Concrete Shielding	C	(2)	B
Shielded Viewing Windows	C	(2)	B
EDR/CPC Door	C	(2)	B
Jumpers	N	(1)	C
Penetrations, Pipes, and Isolation Valves	C	(1)	C
Cooling Tower	N	(2)	N
Canister Cooling Equipment (In-Cell)	N		B
Canister Handling Equipment	N		C
Overhead Cranes	N	(2)	B
Auxiliary Hoists and Cranes	N	(2)	B
Remote Manipulators	N	(1) (2)	C
Storage Racks	N		B
Area Radiation Monitors	C	(1) (2)	C
Airborne Particulate Monitors	C	(1) (2)	C
Closed Circuit Television System	N	(1)	C
In-Cell Lights	N	(1)	C
Communications Equipment	N	(2)	C
Electronics Instruments and Controls	N	(1)	C
Pneumatic Instruments and Controls	N	(1)	C
Main Plant Head End Ventilation System	C	(2)	B
Cell Penetrations	C		B
Ducting (In-Cell)	C		B

NOTES

(1) Spare or spare subcomponents are provided.

(2) Existing structure or component.

9.0 REFERENCES

1. Letter OG:88:0400, S.M. Barnes to J.M. Pope, "Chronological Review of HLW Glass Production and Processing Time Requirements", dated November 28, 1988.

> 2. "Operational Safety Design Criteria Manual," ID 12044, dated April 1985. W. L. Williams, Operational Safety Division, Department of Energy.

3. Letter WD:86:0804, L.E. Rykken to W.W. Bixby, "Reference Radionuclide Content of High-Level Waste", dated November 10,1986.

4. "Waste Compliance Plan for the West Valley Demonstration Project High-Level Waste Form", WVNS-WCD-001.

5. ERDA 76-21 "Nuclear Air Cleaning Handbook".

6. Letter OB:88:0096, J. M. Pope to C.J. Winkler, "Design Criteria for SFCM Glass Sampling", dated November 10, 1988.

7. "Description of the West Valley Demonstration Project Reference High-Level Waste Form and Canister", R.L. Eisenstatt, July 28,1986, DOE/NE/44139-26

8. WVNS Quality Assurance Program Plan, WVDP-002.

9. FAX, G. Mazik to E. Picazo, "Dames & Moore - West Valley 1989 Meteorological Data", dated July 26, 1990.

9.1 REFERENCE DRAWINGS

E&W 68E2-3	Filter Handling Frame
E&W 68E2-4	Prefilter Handling Frame
PNL-276-01	Off-Gas Prefilter
PNL-642	Jumper Assembly
PNL-260	SFCM Start-up Heaters
PNL-012-01	Melter Discharge
PNL-402-01	Slurry Sample System
PNL-255-01	CFMT Agitator
900E-977	Concentrator Feed Tank Agitator
900D-2466	ADS Sample Pump

900C-1059	Hi-Vac Collection Containers
905D-031, 032, 036	CPC General Arrangement
VP-4413-3-V-57-1-4 VP-4413-3-V-57-6-2	CPC 16-Ton/2-Ton crane 3V-1
15R-A-74, 15R-A-75	Main Plant Ventilation system
900D-4862, 900D-4869	Canister Transfer Cart System
900D-1092	HLW Storage Canister
E-2034-1000	Canister Lift Fixture
15A-M-26, 15A-M-27, VP-4413-15-V-77-1-1	EDR Crane 15V-21
3R-A-1, 7R-A-1, 7R-A-2, 15R-A-6	Main Plant Liquid Waste Handling System
PNL-316-01, 324-01, 334-01	Purex piping nozzles inside of CPC

ATTACHMENT D
CC:93:0105

CN:93:0022

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	Job File	MS-Z-05
	CN Letter Log	MS-51

CDF0251:SEA-199

West Valley
Nuclear Services Company
Incorporated

P.O. Box 191
West Valley, New York 14171-0191

RESPONSE:
DW:5743

MS-B1E
WD:93:0868
July 15, 1993

Mr. T. J. Rowland, Director
West Valley Project Office
U.S. Department of Energy
MS-DOE
P.O. Box 191
10282 Rock Springs Road
West Valley, New York 14171-0191

Dear Mr. Rowland:

SUBJECT: Response to WVPO Comments on the Vitrification Non-Radiological Integrated Testing Hazard Assessment

REFERENCES:

1) Letter DW:93:0753 (Action:DW:5743) from B. A. Mazurowski to W. G. Poulson, "West Valley Project Office (WVPO) Comments and DOE Idaho Field Office (DOE-ID) Review of 'Hazard Assessment for the Vitrification Non-Radiological Integrated Testing'", dated June 4, 1993.

2) Letter TJJ:008:93 from E. J. Ziemianski to B. A. Mazurowski, "WVPO - DOE-ID Review of Hazard Assessment for the Vitrification Non-Radiological Integrated Testing", dated April 9, 1993.

3) Letter WD:93:0278 from R. E. Lawrence to T. J. Rowland, "Hazard Assessment for the Vitrification Non-Radiological Integrated Testing", dated March 1, 1993.

Responses to WVPO comments on the Vitrification Non-Radiological Integrated Testing Hazard Assessment (Reference 1) are summarized in Attachment A, and a copy of the revised document is included as Attachment B.

Your final approval of the Hazard Assessment is requested. If you have questions, please contact J. J. Prowse at extension 4270.

Very truly yours,

WEST VALLEY NUCLEAR SERVICES CO., INC.

J. A. Lazzaro

J. A. Lazzaro, Manager
Nuclear Engineering & Analysis

CN:93:0022

PJL:cdf

Attachment:

A: Response to WVPO Comments on the Vitrification Non-Radiological Integrated Testing Hazard Assessment

B: Hazard Assessment for the Vitrification Non-Radiological Integrated Testing

cc: T. J. Jackson, DOE-WV, MS-DOE
R. B. Provencher, DOE-WV, MS-DOE

CDF0251:SEA-199

A Subsidiary of
Westinghouse Electric Corporation

HAZARD ASSESSMENT FOR THE

VITRIFICATION NON-RADIOLOGICAL INTEGRATED TESTING

J. J. Prowse

July 1993

Response to WVPO Comments on the Vitrification Nonradiological Integrated Testing Hazard Assessment

Comment 1. Section 2.2, page 3.

Last sentence of the first paragraph - limiting values associated with the threshold quantities (TQs) listed in 29 CFR 1910.119 are missing. Also, the reference of OSHA 29 CFR 1910.199 should be OSHA 29 CFR 1910.119.

Response.

The recommended changes have been incorporated into the text.

Comment 2.

Add a table to the hazard assessment which shows the Emergency Response Protection Guide (ERPG) values for each hazard assessed with respect to the three ERPG levels.

Response.

Table 3, "Emergency Response Planning Guidelines", has been added.

Comment 3.

Acronyms are used throughout this document without definition. Examples: VF/EDR on page 1; TLV, ACGIH TVL (TWA), NIOSH-STEL on page 8; ERPG on page 11, etc.

Response.

This deficiency has been corrected in the text.

Comment 4.

Second paragraph of section 2.2, page 3 - Should DOE/RW-0214 be referenced here?

Response.

No. DOE/RW-0214 applies to glass qualification. It does not apply to quality of structures and components as they relate to safe operation of the facility during non-radiological integrated testing.

Comment 5.

Similar to comment 3 - this document is inconsistent about defining chemical compounds (i.e., at times it references Ammonium Nitrate, while other times it uses NH_4NO_3). It would be easier to read if the first time a compound was discussed the chemical properties were listed in parenthesis along side the name.

Response.

The recommended changes have been incorporated into the document.

Comment 6.

This drawing is illegible. It should be replaced.

Response.

The drawing has been replaced with a D drawing.

HAZARD ASSESSMENT FOR THE

VITRIFICATION NON-RADIOLOGICAL INTEGRATED TESTING

1 INTRODUCTION

1.1 Scope

This hazard assessment addresses the non-radiological hazards associated with the operation of the Vitrification Facility (VF) during non-radiological integrated testing. The Vitrification Non-Radiological Integrated Testing has been established as part of the West Valley Demonstration Project (WVDP) Vitrification program activities to provide focus and emphasis on the transition from construction to operations. There are a number of major structures associated with the Vitrification Non-Radiological Integrated Testing:

- Vitrification Facility (VF) Hot Cell
- Vitrification Facility/Equipment Decontamination Room (VF/EDR) Transfer Tunnel
- Crane Maintenance Room
- Sheet Metal Building Surrounding the VF Cell
- Underground Trench connecting the VF to the 01-14 Building
- 01-14 Building
- Portions of the existing Reprocessing Plant

Figure 1-1 presents the location of the major facilities associated with the West Valley Demonstration Project.

1.2 Hazard Classification of Vitrification Non-Radiological Integrated Testing

In accordance with the requirements of DOE Order 5481.1B and Supplemental Directive ID 5481.1B, a hazard classification must be established for non-nuclear facilities. Operations that involve hazards that are routinely encountered by members of the public do not require Safety Analysis Reports (SARs). This exclusion is explicitly defined by DOE in the introductory section of Order 5481.1B. It reads as follows:

> 4. EXCLUSIONS
>
> a. Operations having hazards only of a type and magnitude routinely encountered and/or accepted by the general public.

The hazards associated with operation of the Vitrification Non-Radiological Integrated Testing fall within this exclusion. Therefore, formal documentation in the form of a Safety Analysis Report is not required for this activity.

2 PURPOSE AND DESIGN OF THE FACILITY

2.1 Purpose

The Vitrification Non-Radiological Integrated Testing covers a phased turnover and testing of the VF and includes precommission, commission (first operation of equipment), system, and non-nuclear integrated testing of the systems associated with the vitrification process. The precommission, commission, system, and non-nuclear integrated testing of the vitrification systems involves all the testing necessary to prove that the facility is ready for turnover to Facilities (Operations) for radiological operation.

The checks, verifications, and performance tests will be done by various groups. Some will be done by suppliers and subcontractors under the supervision of the Construction Department. The remainder will be done by the Maintenance (Mechanical, Electrical and Instrumentation) personnel, and operators and engineers under the direction of the Vitrification Readiness Manager. The operators will be directed by plant operations when testing interfaces into existing operating facilities.

2.2 Design

The facility was designed according to the design criteria for Vitrification of High-Level Wastes (WVNS-DC-022). The design requirements in the industrial/occupational safety area are numerous. The facilities and functions will meet the requirements of DOE Order 5480.1, Chapter 1, "Environmental Protection, Safety, and Health Protection Standards;" Chapter VIII, "Occupational Medical Program;" Chapter IX, "Construction Safety and Health Programs;" Chapter X, "Industrial Hygiene Program," and OSHA Document 29 CFR 1910, "General Industrial Standards." Analysis of the inventory of materials to be used during Vitrification Facility Non-Radiological Integrated Testing identified only one substance, anhydrous ammonia (NH_3), that is listed in Appendix A to 29 OSHA 1910.119. However, since the on-site inventory of anhydrous ammonia (NH_3) does not exceed the threshold quantity (TQ) value of 10,000 lbs, a process safety analysis is not required under OSHA.

In addition, the facilities and structures have been assigned quality levels (WVNS-DC-022). The quality level identifies the implementation of the Quality Assurance program which will be based on the eighteen criteria of ASME NQA-1 and all supplements. The WVNS "Quality Management Manual" (QM) provides additional information on defining the quality level for the structures and components that will be used during Vitrification Non-Radiological Integrated Testing.

For this hazard assessment, a detailed design/process analysis is not necessary because the analysis is based on the "worst case" (most hazardous) accident or release from the system (e.g., a tank rupture, or pipe failure). Therefore, the maximum quantities present are of major importance and these are defined by the system capacities and flows. General failure scenarios together with the quantities of hazardous substances involved are developed in the following section.

3 HAZARD ANALYSIS

The hazards that will exist result from the handling of chemically hazardous materials, possible chemical incompatibilities and reactivity, and their potential release to the environment. Such releases could be gaseous or liquid and could affect both on-site personnel and off-site public.

Although hazardous substance releases represent the major facility hazard, and the only risk to which the off-site public is exposed, there are localized risks within the facility, which are typical of chemical handling operations and industrial activities in general. These operations could result in worker injury, but routine training, OSHA requirements, and other safety guidelines all reduce the probability of accidents and mitigate their consequences. If an industrial-type accident occurred, only one or two operators are likely to be affected. The more serious hazards involving the potential release of toxic substances are discussed later in this section.

The EPIcode program, version 5.0, was used to model chemical release scenarios. This model has been recommended by the USEPA and the DOE (EP division) for consequence assessment. The program uses a Gaussian Plume model which generally produces results in good agreement with experimental data. Stability class D and a wind speed of 4.5 m/sec was used consistently throughout the assessment, following the guidance of DOE-STD-1027-92. In addition, a 15 minute sample time has been used. For practical purposes, the peak 15 minute average concentration is treated as the instantaneous concentration. Use of the peak 15 minute average concentration introduces a measure of conservatism when comparing results against published standards. Additional reasons for using a 15 minute sampling time include the lack of toxic effects data to shorter time periods, physiological equilibration in relation to the breathing rate of humans, and better matching with centerline plume concentrations than would be the case over a longer time period.

3.1 Hazardous Substances

Table 1 lists the chemicals needed for the production of 19,000 L (5000 gallons) of glass melter feed. These quantities are typical batch sizes for routine operation and represent the amounts available for a possible accidental release associated with a batch transfer. As an indication of relative hazard, Table 2 lists those chemicals used in the facility which are considered "hazardous" substances under existing Federal and NY State regulations (6 NYCRR 597.2; 40 CFR 302.4; 40 CFR 355; 29 CFR 1910.119). They are tabulated with applicable toxicity data and an indication of those for which the nominal on-site inventory exceeds the reportable quantity (RQ), or threshold planning quantity (TPQ). The volatile/gaseous chemicals which are easily transported off-site are potentially a greater risk. The most volatile substances to be used during the Vitrification Non-Radiological Integrated Testing are nitric acid (HNO_3), ammonia (NH_3), and formic acid (HCOOH).

Nitric acid (HNO_3) at 62 weight percent has a relatively low vapor pressure when compared to fuming nitric acid (HNO_3). The nitric acid (HNO_3) day tank has a maximum volume of 6,993 L (1,847 gals.). It has been assumed in the following analysis that this total quantity is accidentally released.

Anhydrous ammonia (NH_3) has a significant potential for release and off-site transport. Current design for the ammonia (NH_3) storage subsystem for the Ex-Cell Off-Gas System (System 64) consists of a tank which is 1 m (3.5 ft) in diameter and 5.2 m (17 ft) in height. The maximum inventory of NH_3 is 3,785 L (1000 gallons). The tank is located adjacent to the 01-14 Building.

A third, hazardous substance which has a significant vapor pressure is formic acid (HCOOH). The batch addition of 375 kg (827 pounds), would be added from multiple carboys. It has been assumed in the following analysis that this total quantity is accidentally released.

The other hazardous substances to be used during the Vitrification Non-Radiological Integrated Testing are non-volatile, or much less volatile than nitric acid (HNO_3), ammonia (NH_3), and formic acid (HCOOH). Therefore, the hazard represented by Vitrification Non-Radiological Integrated Testing is primarily related to the potential, accidental release of anhydrous ammonia (NH_3), nitric acid (HNO_3), or formic acid (HCOOH). It should be recognized that there is a risk from handling other materials. For example, nickel compounds if inhaled are particularly toxic. However, the consequences of a release of these other chemicals would be localized. The risk to the public would be negligible as compared to the risks posed by nitric acid (HNO_3), ammonia (NH_3) or formic acid (HCOOH).

Interactive effects of incompatible chemicals are a potential hazard when multiple chemicals are present in a facility. The basic Vitrification Non-Radiological Integrated Testing process mixes together those chemicals listed in Table 1. It has been demonstrated in previous test programs that under process conditions this mixing process will not result in toxic gas generation or disruptive energy release; hence there are no important chemical incompatibilities. The resultant mixture consists of a slurry of insoluble, or partially soluble, chemicals (e.g., SiO_2) and some other chemicals that are now soluble as a result of the mixture being acidified with nitric acid (HNO_3). As can be noted from the data in Table 1, many of the hazardous substances, such as nickel compounds, are initially in a nitrate form so that the mixing process does not produce a more hazardous product. Further such a mixture in normal process operations does not produce more volatile chemical forms, thereby increasing the consequences of a release. The higher and more probable risks are from the concentrated substances prior to their being mixed.

An accidental mixing scenario has been identified which could cause significant toxic substance releases, namely the chemical reaction of concentrated formic acid (HCOOH) with 62% nitric acid (HNO_3). The toxic products of this reaction are nitric oxide (NO) and nitrogen dioxide (NO_2). This mixing scenario is discussed in Section 3.4

Another scenario is the chemical combination of ammonia (NH_3) with oxides of nitrogen (NO_x) to form ammonium nitrate (NH_4NO_3) , a flammable and, under certain conditions, a potentially explosive compound. These two chemicals are brought together in the process off-gas treatment system. The possibility of this chemical reaction occurring is analyzed in Section 3.2.

3.2 Release of Process Gas

Oxides of Nitrogen (NO_x) Release

The maximum rate of release of NO_x during an excursion, if not treated for removal from the Vitrification Non-Radiological Integrated Testing process, is expected to be 11 g/sec. Normally this process gas is reacted with ammonia (NH_3) in a catalytic reactor located in the 01-14 Building to eliminate the NO_x, so that only innocuous nitrogen and water is released from the stack. If the removal system were not operating this release rate would result in a site boundary (1050 m) concentration (based on stability class D, and 4.5 m/sec wind speed) of 0.02 ppm. This concentration, assuming all of the oxides of nitrogen (NO_x) to be nitrogen dioxide (NO_2) [the most hazardous of the oxides of nitrogen (NO_x)] is approximately 0.07% of the interim ERPG-3 value. The Emergency Response Planning Guideline-3 (ERPG-3) which has been developed by DOE and submitted to the American Industrial Hygiene Association (AIHA) ERPG Committee for approval, for nitrogen dioxide (NO_2) is 30 ppm (see Table 3). Figure 3-1 presents the contour concentration for this release. Figure 3-2 presents the centerline concentration at downwind distances.

Ammonium Nitrate (NH_4NO_3) Formation

As indicated previously, under normal operating conditions the oxide of nitrogen (NO_x) released from the process is reacted with anhydrous ammonia (NH_3) in a catalytic reactor to form nitrogen (N_2) and water (H_2O) which are then discharged from the main plant stack. The key process parameters associated with the catalytic reactor are an entering off-gas temperature of 315°C (599°F) and a resulting discharge temperature from the reactor of 343°C (649°F).

Further, Battelle-PNL in 1990 completed a fundamental chemistry evaluation of this process (WVSP-90-043) in which it was concluded that 2 g of ammonium nitrate (NH_4NO_3) may collect in a year of full scale vitrification operation. Based on the fundamental chemical reactions, non-organic contaminated ammonium nitrate (NH_4NO_3) can explode only if "extreme confinement" is present so as to develop a pressure of 60-80 atmospheres. These pressures cannot be developed in the catalytic reactors.

Based on the quantities of ammonium nitrate (NH_4NO_3) which could be formed, the temperature conditions, the geometry of possible deposition points, and the absence of organics due to high melter temperatures, it is highly unlikely that a fire and/or an explosion could happen in the Ex-Cell Off-Gas System.

3.3 <u>Nitric Acid (HNO_3) Release</u>

It is planned to use tank 65-D-05, nitric acid (HNO_3) day tank, with 62% nitric acid (HNO_3) to make up the cold chemical feed. Tank 65-D-05 has a maximum capacity of 6,993 L (1,847 gals.).

The greatest hazard associated with a nitric acid (HNO_3) accident is the evaporation of nitric acid (HNO_3) fumes from an uncontained liquid spill. Therefore, the consequences of a nitric acid (HNO_3) accident are less dependent on the rate of liquid leakage than on the total quantity and "pool" area that is formed as a result of the leak. The partial pressure of 62% nitric acid (HNO_3) is approximately 3.17 mm mercury (Hg) pressure at 30°C (86°F) (Perry, 1950).

The procedure for finding the magnitude of a hazard is to assume that no mitigating actions are taken and that no engineered systems are effective in reducing the consequences of the assumed event/release. Only the inherent physical properties of the materials and the ambient environmental conditions are considered in calculating concentrations and dispersion. For nitric acid (HNO_3), a semi-volatile liquid, the estimate of pool size and the assumed environmental conditions are key parameters which determine the airborne release rate.

On a relatively impervious "flat" ground, a 1 cm of pool depth formed by 6,993 L (1,847 gals.) spill would cover an area of approximately 699 m^2. This is the assumed area for purposes of estimating nitric acid (HNO_3) vapor release. In reality the tank is bermed and the bermed area is approximately 9 m^2.

The evaporation rate from a liquid pool is a function of vapor pressure, molecular weight, temperature, wind (air) speed and direction relative to the pool dimensions. Given the pool size and vapor pressure described at a temperature of 29°C (84°F) and a stability class of D with a wind speed of 4.5 m/sec, the site boundary (1050 m) concentration is 0.3 ppm. The interim ERPG-3 value for nitric acid (HNO_3), which was developed by DOE is 30 ppm (see Table 3); therefore the calculated site boundary concentration is 1% of the ERPG-3 value. Figure 3-3 presents the contour concentration for this release scenario. Figure 3-4 presents the centerline concentration for downwind distances.

3.4 Formic Acid (HCOOH) Release

Formic acid (HCOOH) at 90 wt% may be utilized during Vitrification Non-Radiological Integrated Testing as an additive in the melter feed preparation. In accordance with Table 1, 375 kg (828 pounds) is the batch size, and this total quantity, even though added from multiple drums/carboys, is assumed to be released in a spill.

Utilizing the same meteorology and pool depth as described previously for the nitric acid (HNO_3) spill, this weight of formic acid (HCOOH) would form a pool of 31 m^2 and a site boundary (1050 m) concentration of 0.2 ppm. This is 0.7% of the alternative ERPG-3 value of 30 ppm (see Table 3). Figure 3-5 presents the contour concentrations for this release. Figure 3-6 presents the centerline concentration for downwind distances.

3.5 Anhydrous Ammonia (NH_3)

Anhydrous ammonia (NH_3) will be used during Vitrification Non-Radiological Integrated Testing to destroy oxides of nitrogen (NO_x) in the melter off gas. The anhydrous ammonia (NH_3) is fed, mixed together with the heated off-gas, to a catalytic reactor where the stoichiometric mixture of anhydrous ammonia (NH_3) and oxides of nitrogen (NO_x) are reduced to nitrogen (N_2) and water (H_2O) prior to discharge. During normal operation, the gaseous feed rate of ammonia (NH_3) is expected to be 5.2 kg/h (11.5 lbs/h) with a possible peak flow of 5 g/sec (0.01 lb/sec). This hazard assessment will deal with the possible release at the supply point where a significant inventory of anhydrous ammonia (NH_3) is located and higher release rates can be hypothesized.

As presently planned, the anhydrous ammonia (NH_3) is stored and utilized as a pressurized liquid in a tank 1 m (3.5 ft) in diameter and 5.2 m (17 ft) high. The tank is adjacent to the 01-14 Building where the Ex-Cell Off-Gas System is located. The tank will contain no more than 3,785 L (1,000 gals.) of anhydrous ammonia (NH_3) at any time. Anhydrous ammonia (NH_3) is an extremely volatile liquid, having a boiling point at atmospheric pressure of -28°F (-33°C) and a pressure of approximately 125 psi at room temperature of 68°F (20°C).

The tank failure analyzed assumes that a hole 2.54 cm (1 in) in diameter is made in the liquid space at the bottom of the tank. A 2.54 cm (1 in) diameter hole was used as it approximates the piping and penetration diameters of the tank (0.6 cm [0.25 in] to 5 cm [2 in]). In addition, a hole of this diameter would result in aerosolization of the ammonia (NH_3) with no pool formation, the most conservative assumption. Further, it is assumed that the tank will be completely evacuated in approximately 6 minutes. The meteorology used is stability class D and a wind speed of 4.5 m/sec.

The assumptions used result in a site boundary (1050 m) concentration of 440 ppm, which is 44% of the ERPG-3 value of 1,000 ppm. Figure 3-7 presents the contour concentrations for this release. Figure 3-8 presents the centerline concentration for downwind distances.

3.6 Nitric/Formic Acid (HCOOH) Mixing

Laboratory testing has shown that concentrated nitric acid (HNO_3) and formic acid (HCOOH) react to form oxides of nitrogen (NO_x), such as nitric oxide (NO) and nitrogen dioxide (NO_2), as well as, carbon dioxide (CO_2), and water (H_2O). The distribution between nitric oxide (NO) and nitrogen dioxide (NO_2) is dependent upon the nitric acid (HNO_3) concentration; high acid concentrations favoring nitrogen dioxide (NO_2) and lower concentrations favor the formation of nitric oxide (NO). These distributions have been quantitatively determined by Healy, 1958 as a function of nitric acid (HNO_3) concentration, and these distribution data have been utilized.

As briefly addressed in Section 3.1, when nitric acid (NHO_3) and formic acid (HCOOH) are mixed as dilute solutions under normal process conditions there are no significant interaction effects. However, it can be hypothesized that 6,993 L (9.1×10^4 mol) of 62% nitric acid (HNO_3) and 375 kg (8.2×10^3 mol) 90% formic acid (HCOOH) could be accidentally combined, resulting in the release of nitrogen oxides. The reaction would be terminated after the total quantity of formic acid (HCOOH) is consumed as there is an excess of nitric acid (HNO_3) available. Based upon information provided in Healy, the half-time for the reaction is approximately 40 minutes.

The cited Healy data indicate that when 13N nitric acid (HNO_3) (62%) reacts with formic acid (HCOOH) the nitrogen products are 97% nitrogen dioxide (NO_2) and 2% nitric acid (HNO_3) by volume. This results in a release of 1.72E+06 g of (nitrogen dioxide (NO_2) within the first 40 minutes. This release rate results in a site boundary (1050 m) concentration of 8 ppm (15 mg/m^3), assuming the same meteorological conditions as in the previous analyses. This concentration is 16% of the IDLH of 50 ppm. DOE has issued interim ERPG values for oxides of nitrogen (NO_x). This concentration is 27% of the interim ERPG-3 of 30 ppm (see Table 3). The contour results for this release are shown in Figure 3-9. Figure 3-10 presents the centerline concentration for downwind distances.

4 HAZARD EVALUATION

Nitric acid (HNO_3), formic acid (HCOOH), and anhydrous ammonia (NH_3) associated with the Vitrification Non-Radiological Integrated Testing are routinely encountered by members of the general public; ammonia (NH_3) is the only chemical that has the potential for an off-site impact. Inquiries to local authorities revealed that five businesses in Cattaraugus County, New York, reported inventories of ammonia (NH_3) greater than the TPQ of 500 pounds. In addition, four facilities in the Village of Springville (Erie County) store hazardous materials in excess of TPQs. One of these was reported to maintain an inventory of approximately 38,000 pounds of ammonia (NH_3). The Ex-Cell Off-Gas System will have a maximum ammonia (NH_3) inventory of approximately 6,500 pounds, only 17% of the inventory associated with a single facility in the Village of Springville.

An assessment of the risk of prompt fatalities resulting from the accidental release of ammonia (NH_3) was analyzed (Lawrence, 1992). The assessment demonstrated that the system, as designed, meets the safety goal specified in DOE SEN-35-91.

Therefore, because the inventories of materials are encountered by the general public routinely and the system meets the safety goal specified in DOE SEN-35-91, this activity is excluded from further safety analysis, as indicated in DOE Order 5481.1B.

5 REFERENCES

ASME NQA-1 American Society of Mechanical Engineers, ASME NQA-1-1989, Quality Assurance Program Requirements for Nuclear Facilities. September 1989.

Baker, 1991 Baker, G. G. Transmittal of New York State DEC Air Permit Applications and Internal Certifications for Permanent Cold Chemical Emission Points (WD:91:0293). March, 1991.

DOE 5481.1B Department of Energy Order 5481.1B. Safety Analysis and Review System. September, 1986.

DOE SEN-35-91 DOE Secretary of Energy Notice-35-91. Nuclear Safety Policy. September, 1991.

DOE-STD-1027-92 Department of Energy. Draft DOE Standard. Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports. December, 1992.

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Healy, 1958 Healy, T. V. The Reaction of Nitric Acid (HNO_3) with Formaldehyde and with Formic Acid (HCOOH) and Its Application to the Removal of Nitric Acid (HNO_3) from Mixtures. Journal of Applied Chemistry, No. 8. September, 1958.

Lawrence, 1992 Lawrence, R. E. Vitrification Ex-Cell Off-Gas System, Ammonia (NH_3) Hazard Assessment (CN:93:0003). January, 1992.

Perry, 1950 Perry, J. H. (editor). Chemical Engineers' Handbook, 3rd ed. 1950.

QM West Valley Nuclear Services Co., Inc. Quality Management Manual (WVDP-022). November, 1992.

WVNS-DC-022 West Valley Nuclear Services Co., Inc., Design Criteria-022, Rev. 3. Vitrification of High-Level Wastes. January, 1992.

WVSP-90-043 Battelle-PNL. Off-Gas System Hazard assessment for SCR-Produced NH_4NO_3. February, 1990.

TABLE 1

TYPICAL VITRIFICATION NON-RADIOLOGICAL INTEGRATED TESTING BATCH CHEMICAL REQUIREMENTS

Chemicals Needed for Waste + Glass Formers
Total Feed Batch Volume-5000 Gallons*

COMPONENT	BATCH/NOMINAL (dry) (kg) (lb)	TQ value (lb)
Zeolite	521	N/A
$Mg(OH)_2$	93	N/A
$Na_2B_4O_7$ - 10 H_2O	1320	N/A
$Na_2B_4O_7$	77	N/A
or		
Boric Acid	950	N/A
$LiOH$ - H_2O	457	N/A
TiO_2	51	N/A
$Ba(OH)_2$ - $8H_2O$	2	N/A
$CaCO_3$	11	N/A
$Ce(OH)_4$	5	N/A
Cr_2O_3 - 1.5 H_2O	10	N/A
$Cs(OH)$ - H_2O	5	N/A
La_2O_3	2	N/A
$Ni(OH)_2$	21	N/A
NaH_2PO_4	231	N/A
Na_2SO_4	32	N/A
$Sr(OH)_2$	2	N/A
Nd_2O_3	7	N/A
Y_2O_3	1	N/A
Pr_6O_{11}	2	N/A
Sm_2O_3	2	N/A
KOH	222	N/A

TABLE 1
TYPICAL VITRIFICATION FACILITY NON-RADIOLOGICAL INTEGRATED TESTING BATCH CHEMICAL REQUIREMENTS
(Concluded)

COMPONENT	BATCH/NOMINAL (dry) (kg) (lb)	TQ value (lb)
MnO_2	71	N/A
NaOH	322	N/A
SiO_2	060	N/A
$Zr(OH)_4$	148	N/A
NaCl	1	N/A
NaF	8	N/A
NaCOOH or HCOOH (as 90 wt%) or H_2CO_4 or Na_2CO_4	555 375 TBD TBD	N/A N/A N/A N/A
$Al(OH)_3$	374	N/A
$Fe(OH)_3$	857	N/A
HNO_3 (as 62 wt%)	700	N/A
Sugar	900	N/A
Ammonia, anhydrous		10,000

*per Baker, 1991

TABLE 2

Vitrification Non-Radiological Integrated Testing Hazardous Chemicals

Chemical (CAS #)	TLV (TWA) (ppm)	STEL (ppm)	IDLH[b] (ppm)	ERPG-1 (ppm)	ERPG-2 (ppm)	ERPG-3 (ppm)
Anhydrous Ammonia* (7664-41-7)	25[a,b]	35[a,b]	500	25	200	1000
Barium Compounds (NA)	0.5[a,b,d]	--	1100[d]			
Chromium Compounds (II, III) (VI) (NA)	0.5[a,b,d] 0.05[a,d]	--	--			
Formic Acid* (64-18-6)	5[a,b]	10[b]	30			
Nickel Hydroxide (12054-48-7)	0.015[b,d] 0.05[a,d] 0.1[d] (OSHA)	--	--			
Nickel Nitrate (14216-75-2)	0.015[b,d] 0.05[a,d] 0.1[d] (OSHA)	--	--			
Nitric Acid* (76-97-37-2)	2[a,b]	4[a,b]	100	2[e]	15[e]	30[e]
Phosphoric Acid* (7664-38-2)	1[a,b,d]	3[a,b,d]	10,000[d]			
Potassium Hydroxide* (1310-58-3)	2[a,d]g	--	--			
Sodium Fluoride (7681-49-4)	--	--	--			
Sodium Hydroxide* (1310-73-2)	2[a,c,d]g	--	250[d]	2[d]	40[d]	1000[d]

Note: Definitions and references on next page.

TABLE 2

Vitrification Non-Radiological Integrated Testing Hazardous Chemicals
(Concluded)

Definitions:

CAS # -	Chemical Abstract Service Number
IDLH -	Immediately Dangerous to Life or Health
RQ -	Reportable Quantity (Based upon amount released to the environment)
STEL -	Short Term Exposure Limit (15 minutes)
TLV(TWA) -	Threshold Limit Value (8 Hour Time Weighted Average - 40 hours per week)
TPQ -	Threshold Planning Quantity

* The nominal inventory exceeds RQ or TPQ quantity as cited in 6 NYCRR 597.3, 40 CFR 302.4, 40 CFR 355.
# Ceiling Limit

Notes:

[a] 1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices (1991) American Conference of Governmental Industrial Hygienists (ACGIH).

[b] National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards (June 1990) U.S. Department of Health and Human Services (DHHS) Publication No. 90-117.

[c] Interim value proposed by DOE, not yet approved by AIHA.

[d] Concentration in mg/m^3

TABLE 3

EMERGENCY RESPONSE PLANNING GUIDELINES (ERPG) OR APPROPRIATE ALTERNATE GUIDELINES*

Chemical Name	Chemical Formula	ERPG-1 (ppm)	ERPG-2 (ppm)	ERPG-3 (ppm)
Oxides of Nitrogen**	NO_x	2**	15**	30**
Ammonium Nitrate*	NH_4NO_3	N/A	N/A	N/A
Nitric Acid	HNO_3	4* (PEL-STEL)	10* (5 X TLV-TWA)	100* (IDLH)
		2**	15**	30**
Formic Acid	HCOOH	10* (TLV-STEL)	25* (5 X TLV-TWA)	30* (IDLH)
Anhydrous Ammonia	NH_3	25	200	1000

*In order to evaluate chemicals for which AIHA-approved ERPG values are not currently available, a subcommittee of the Westinghouse M&O Nuclear Facility Safety Committee has developed a hierarchy of alternative concentration-limit parameters to be used as an approximation of ERPG values (Craig, et al., 1993; see also Table 4). The source for each of the alternate parameters listed above is included in parentheses next to the value.

**The values represented for these chemicals are interim ERPG values developed by DOE for nitric acid (HNO_3) <u>and</u> oxides of nitrogen (NO_x); the supporting draft document which has been prepared by DOE and submitted to the AIHA ERPG Committee for approval indicates that these values are based predominantly on the toxicology of nitrogen dioxide (NO_2).

Table 4

Recommended Hierarchy of Alternative Concentration-Limit Parameters

Primary Guideline	Hierarchy Group	Hierarchy of Alternative Guidelines	Source of Concentration Parameter
ERPG-3	1	EEGL (30-min) IDLH	AIHA 1991 NAS 1985 NIOSH 1990
ERPG-2	2	EEGL (60-min) LOC PEL-C TLV-C TLC-TWA x 5*	AIHA 1991 NAS 1985 EPA 1987 CFR 29:1910.1000 ACGIH 1992 ACGIH 1992
ERPG-1	3	PEL-STEL TLV-STEL TLVOTWA x 3*	AIHA 1991 CFR 29:1910.1000 ACGIH 1992 ACGIH 1992
PEL-TWA	4	TLV-TWA SPEGL (60-min) CEGL	CFR 29:1910.1000 ACGIH 1992 NAS 1985 NAS 1985

Notes: *Applicable only to chemicals whose effects are dose-dependent.

The protocol is to use the primary guidelines first and then the alternative guidelines in the order presented for each hazard level when the primary guideline does not exist.

If application of this hierarchy to a particular chemical gives rise to a value for a lower hazard class that is higher than the value for the next higher hazard class (e.g., ERPG-1-equivalent value greater than ERPG-2-equivalent value), then that value should be adjusted downwards to match that of the next higher hazard class (see Table 6 for examples).

Table from: Craig, D.K., J.S. Dans, L.G. Lee, P.J. Lein, and P. Hoffman. "Toxic Chemical Hazard Classification and Risk Acceptance Guidelines for use in DOE Facilities. (April 1993 Recommendations of the Westinghouse M&O Subcommittee on Nonradiological Risk Acceptance Guidelines Development).

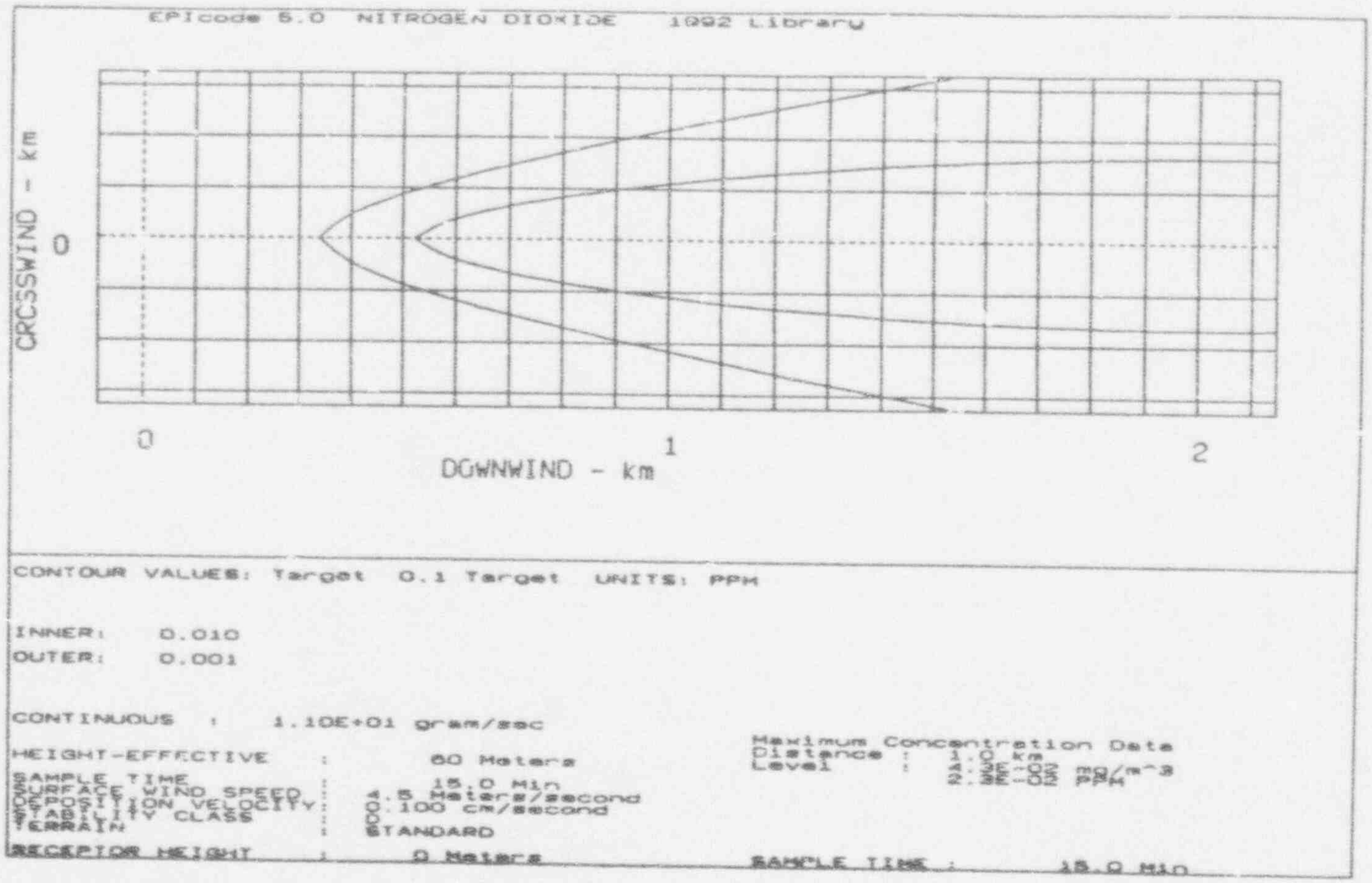

Figure 3-1 - NO_2 contour concentration from failure of Ex-Cell Off-Gas System catalytic reactor.

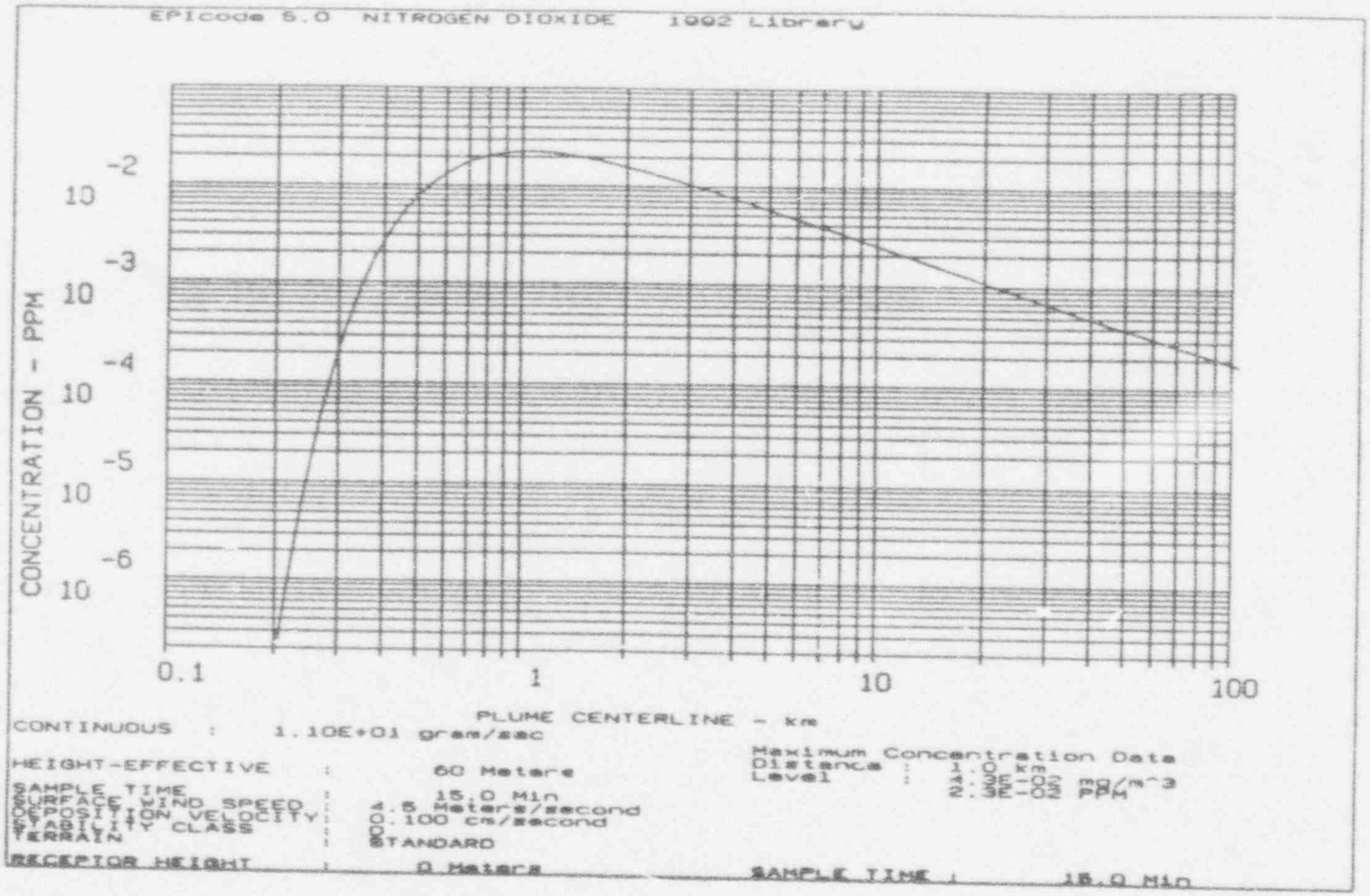

Figure 3-2 - NO_2 centerline concentration vs downwind distance from failure of Ex-Cell Off-Gas system catalytic reactor.

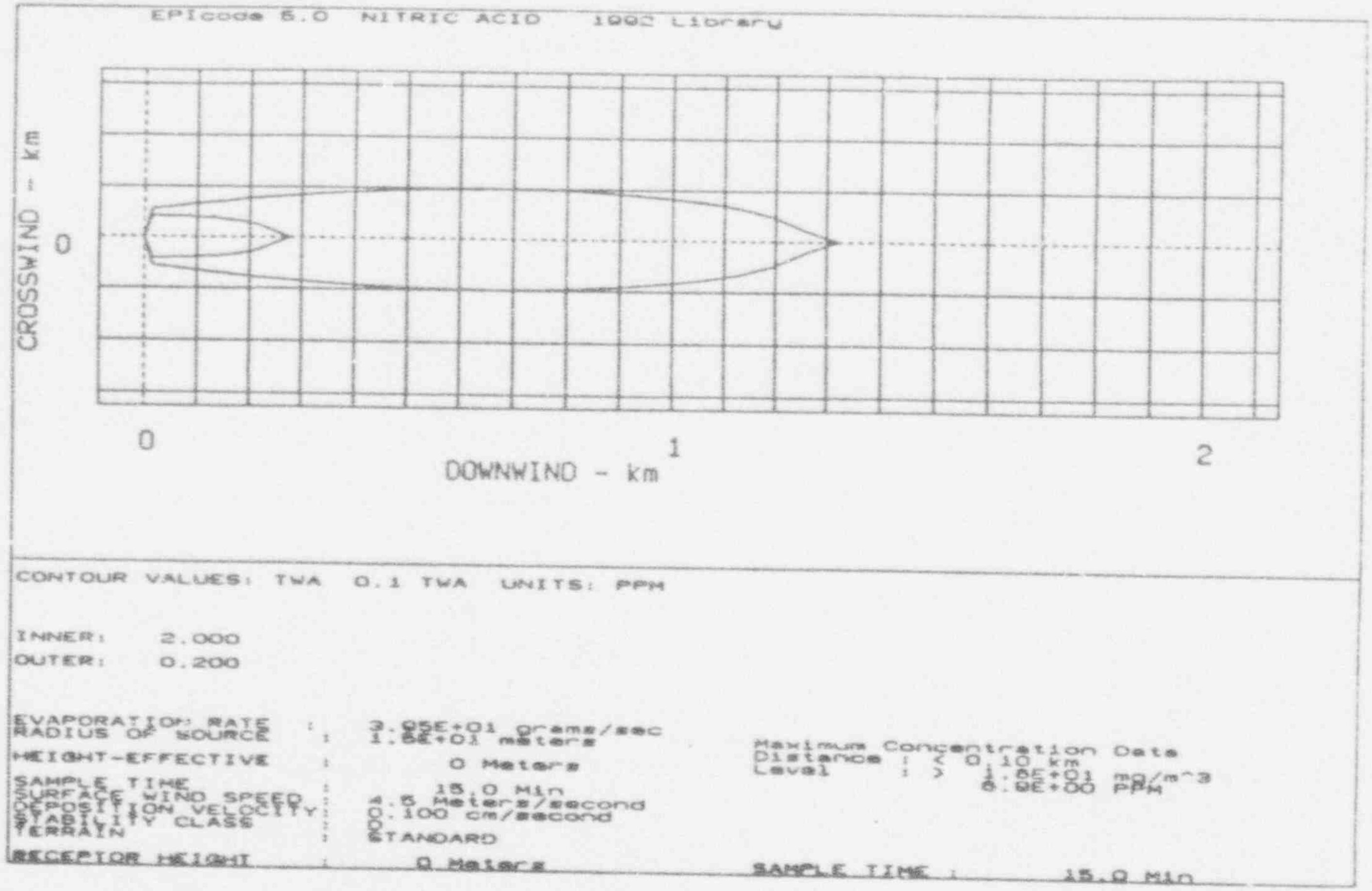

Figure 3-3 - HNO_3 contour concentration from failure of tank 65-D-05.

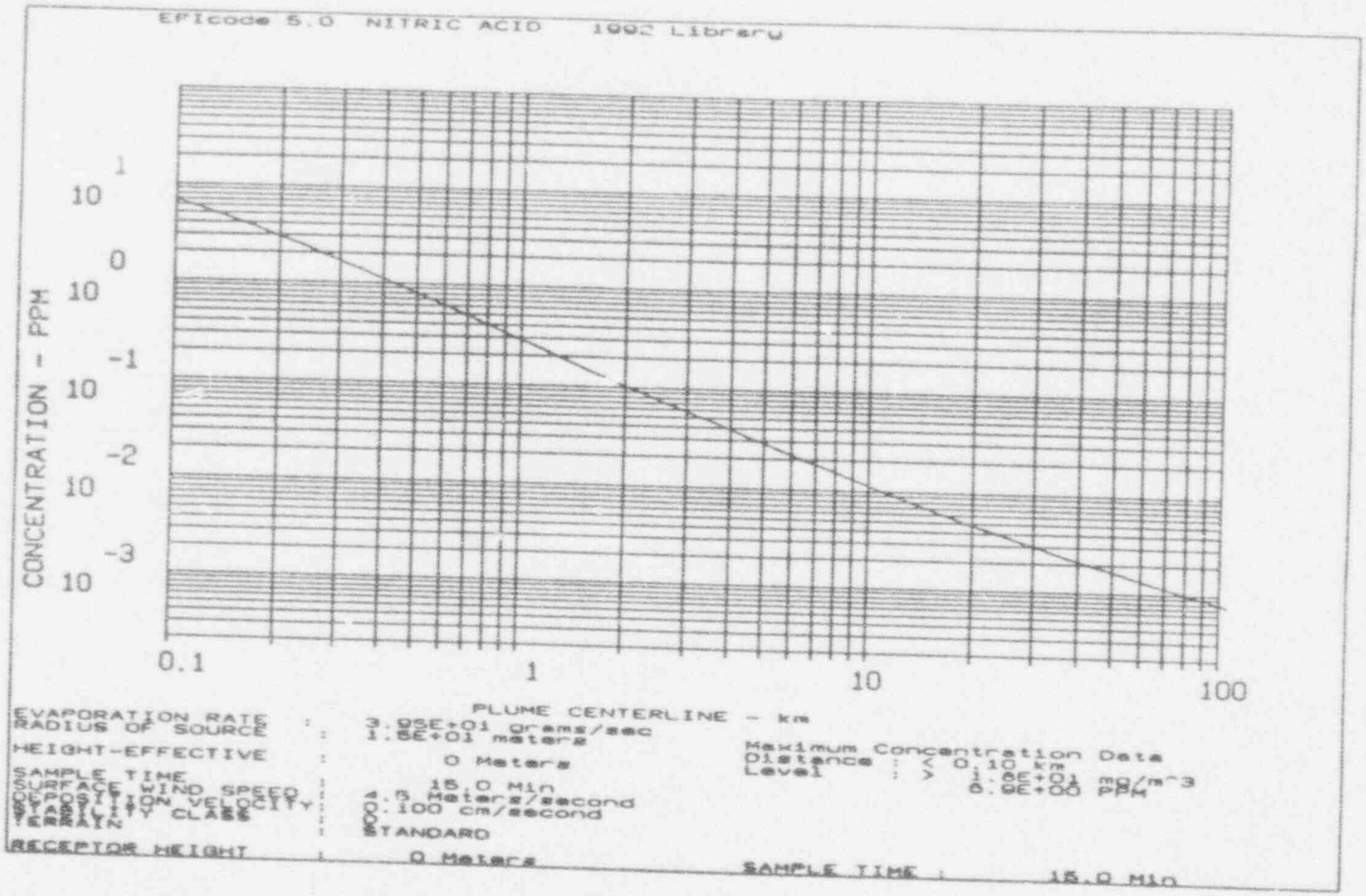

Figure 3-4 - HNO_3 centerline concentration vs downwind distance from failure of tank 65-D-05.

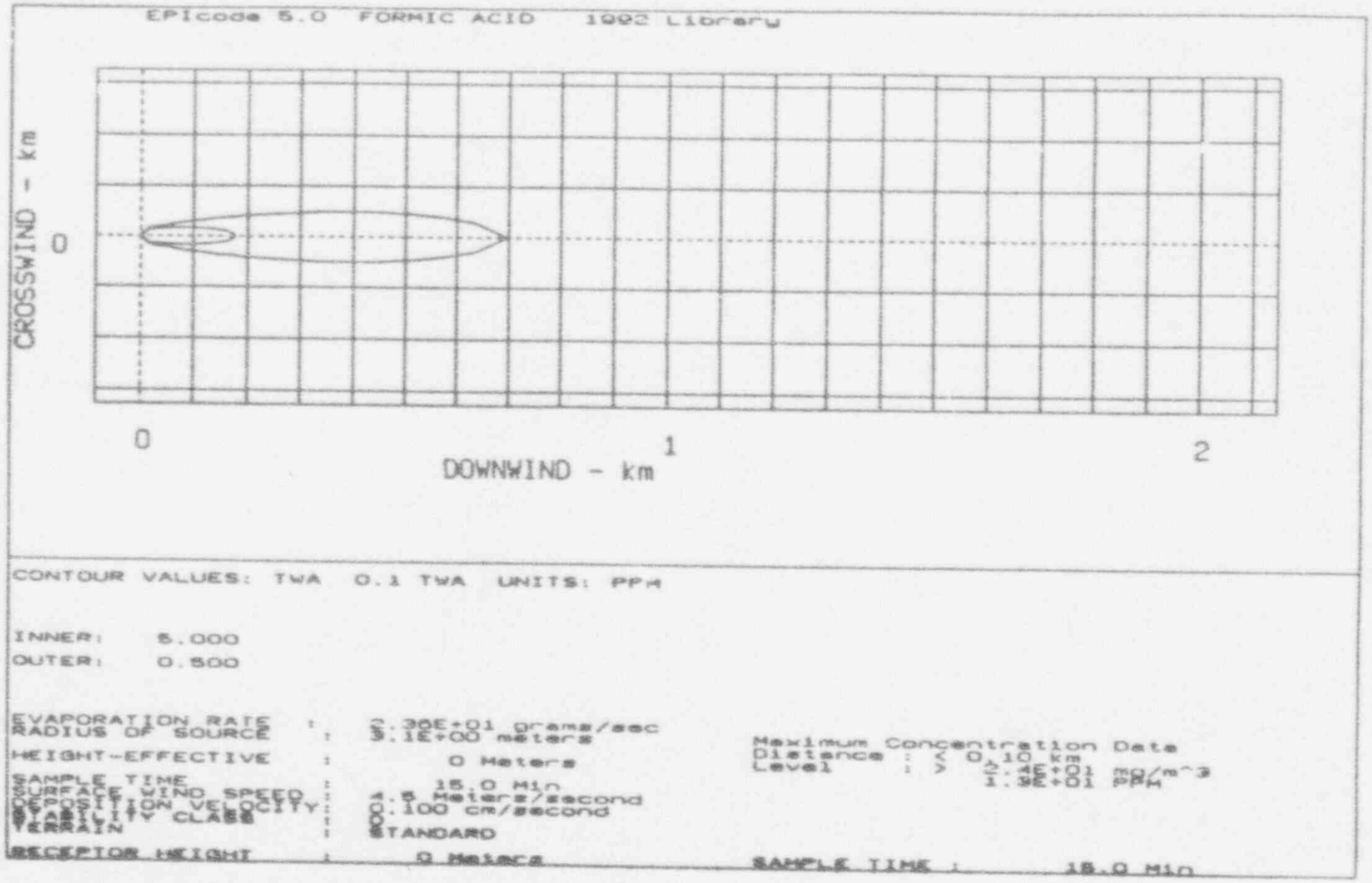

Figure 3-5 - HCOOH contour concentration from failure of multiple drums/carboys.

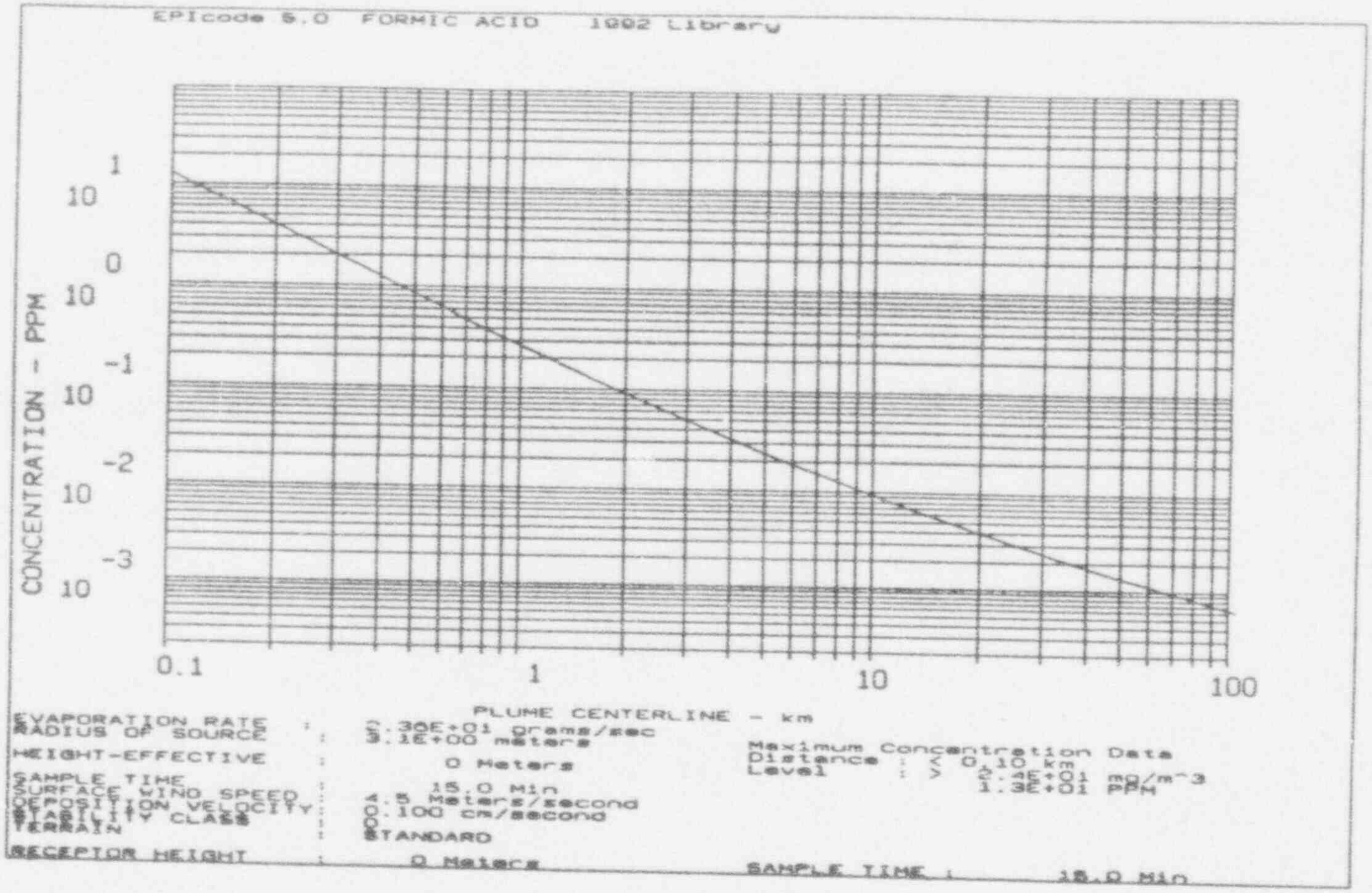

Figure 3-6 - HCOOH concentration vs downwind distance from failure of multiple drums/carboys.

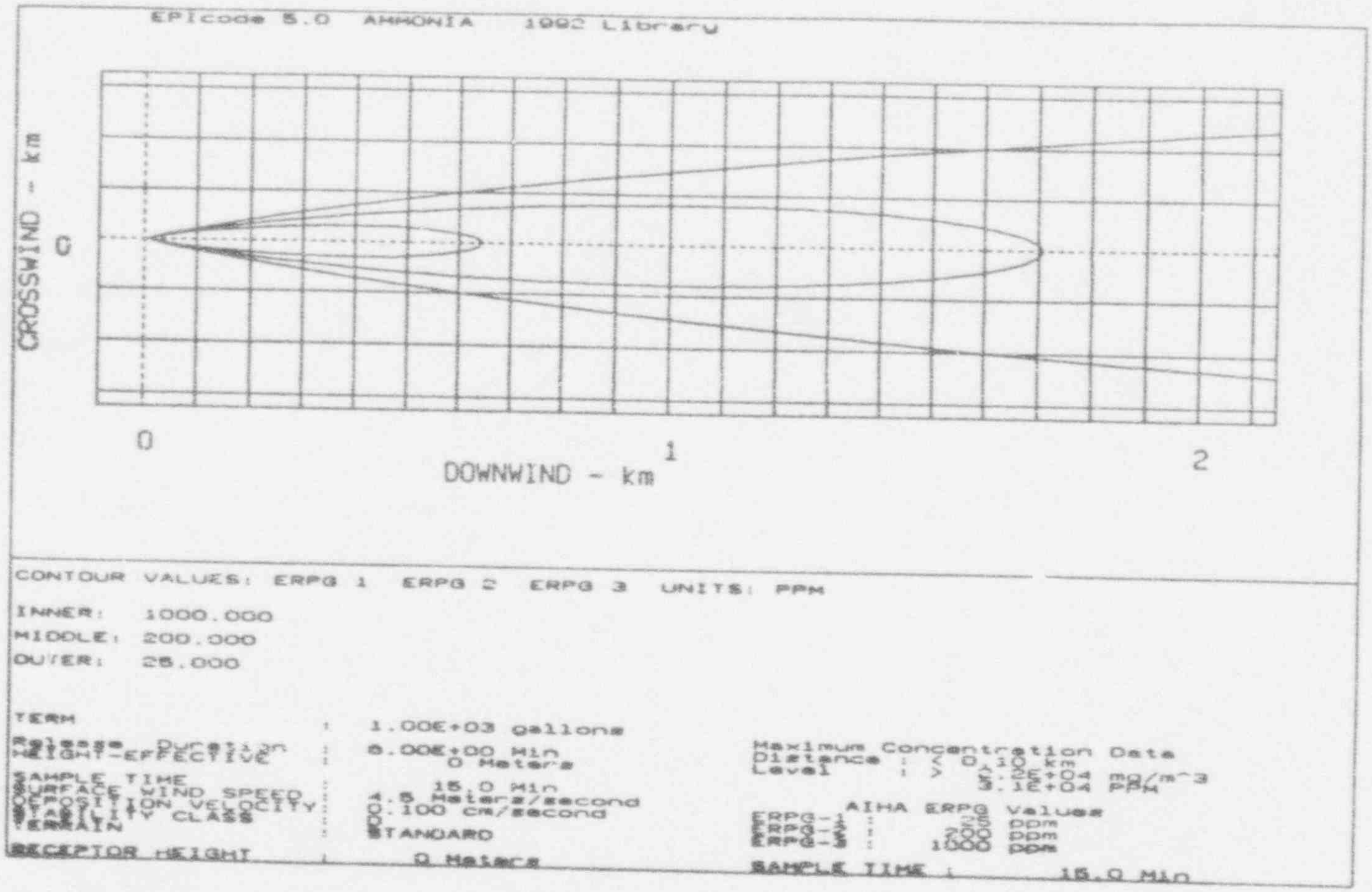

Figure 3-7 - NH_3 contour concentration from failure of the Ex-Cell Off-Gas System NH_3 storage tank.

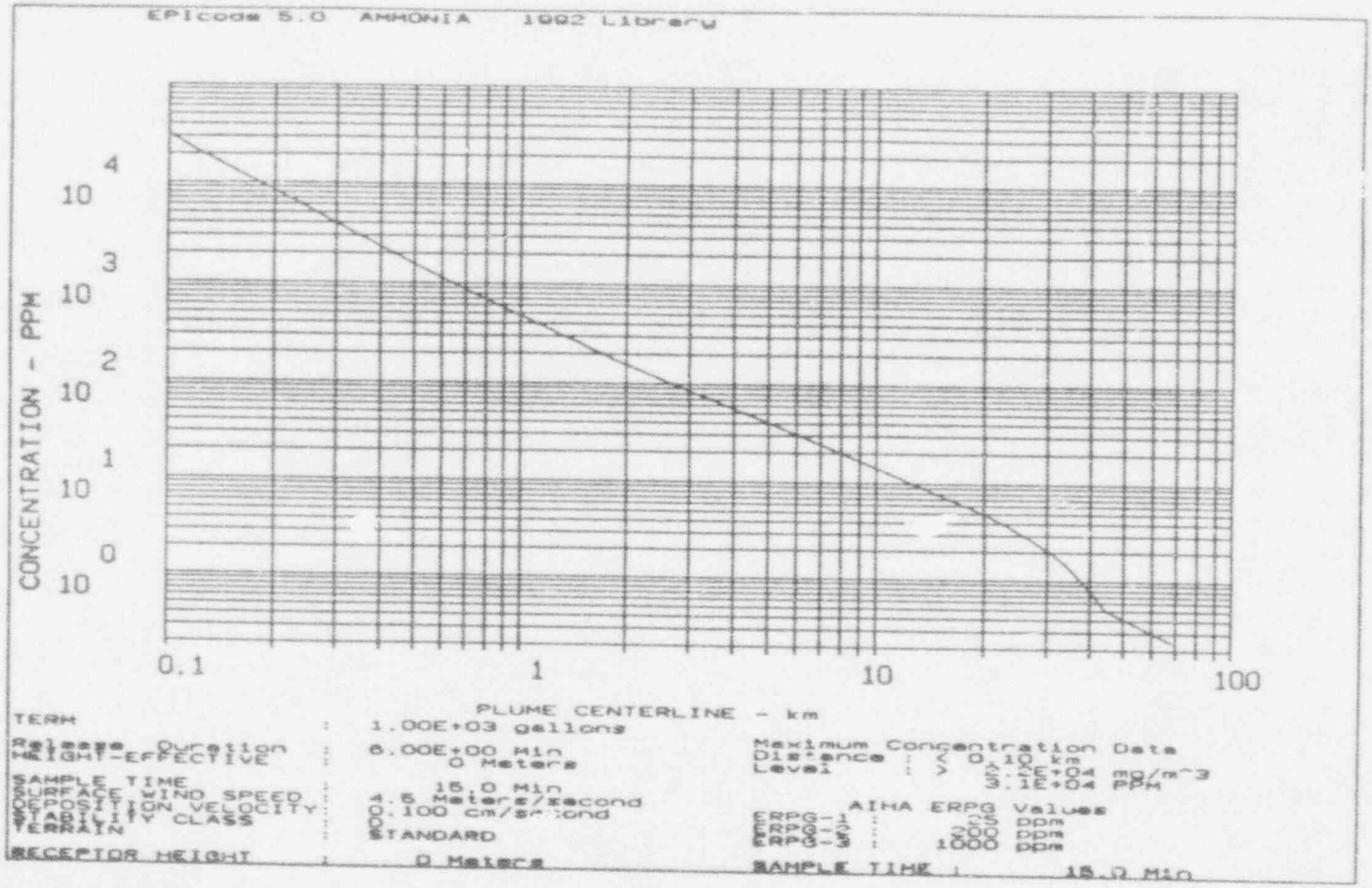

Figure 3-8 - NH_3 centerline concentration vs downwind distance from failure of the Ex-Cell Off-Gas System NH_3 tank.

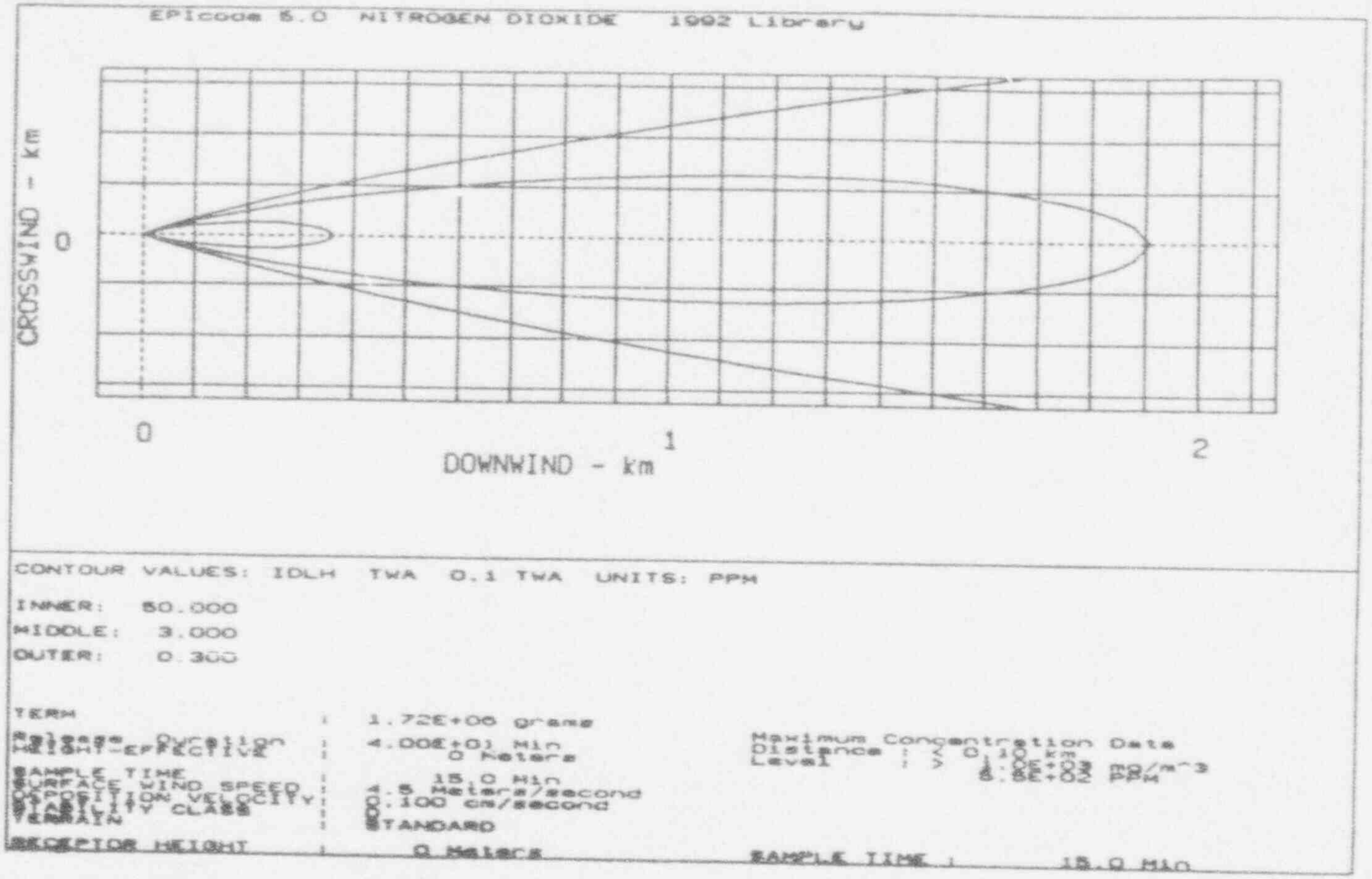

Figure 3-9 - NO_2 contour concentration from nitric/formic acid mixing.

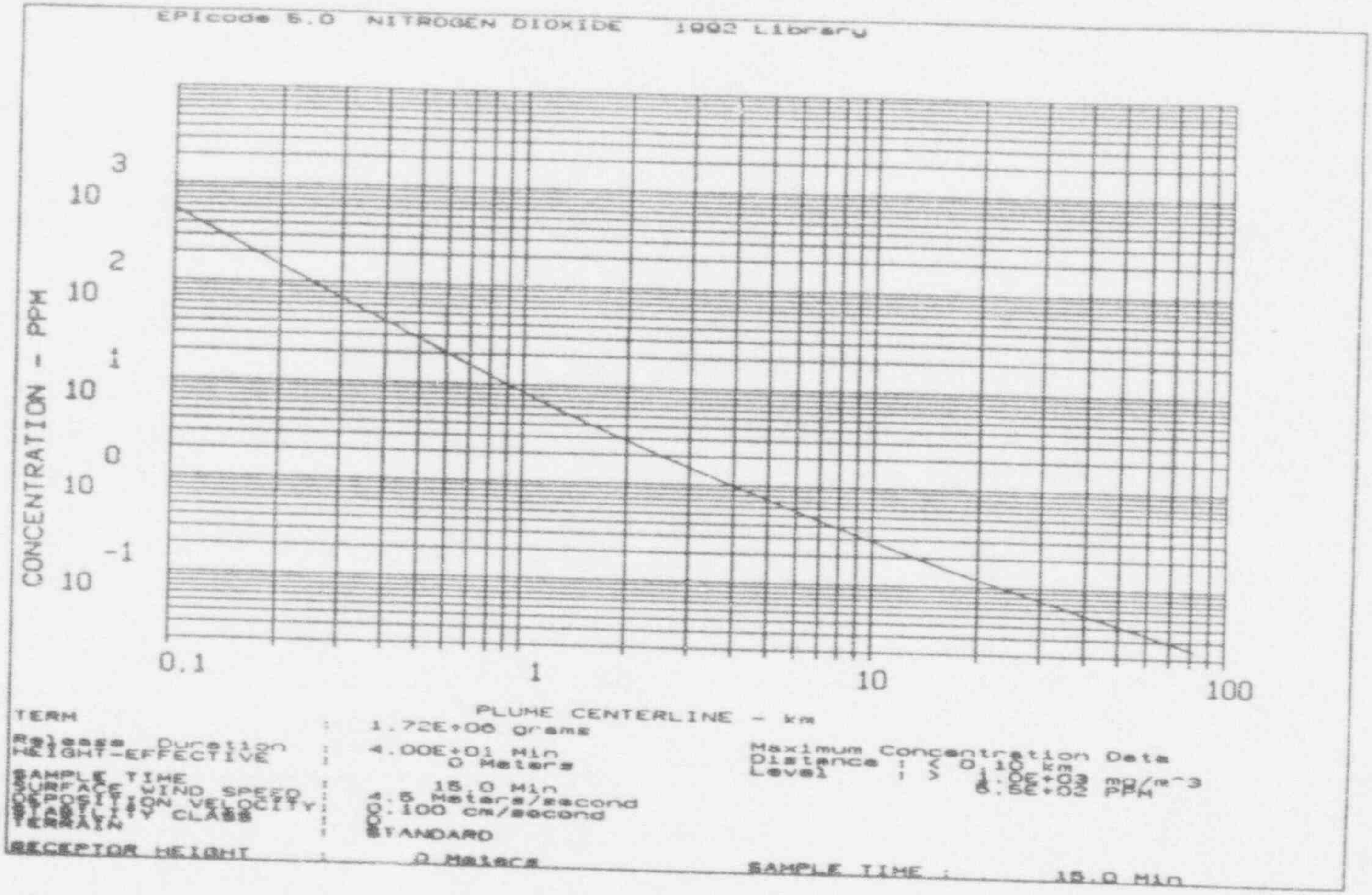

Figure 3-10 - NO_2 centerline concentration vs downwind distance from nitric/formic acid mixing.