ADDENDUM C
PROCESS INFORMATION

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ADDENDUM C

PROCESS INFORMATION

Contents

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C. PROCESS INFORMATION

C.1 PUREX Description

The Plutonium-Uranium Extraction (PUREX) Complex, constructed in 1956, is located in the southeast portion of the 200 East Area of the Hanford Facility. PUREX consists of the 202-A Building, the two PUREX Storage Tunnels, and various support structures. The 202-A Building is a reinforced concrete structure approximately 306 meters long, 36 meters wide (at its maximum) and 30 meters high with approximately 12 meters of the height below grade. The 202-A Building consists of three main structural components: (1) a thick-walled, concrete canyon containing remotely operated process equipment (in cells mostly below grade); (2) the pipe and operating, sample, and storage galleries; and (3) an annex that included offices, process control rooms, laboratories, and building services. PUREX contains tank, containment building, and miscellaneous unit dangerous waste management units, as described in this Addendum.

C.2 Production Process Information

The PUREX process was an advanced solvent extraction process that replaced the Reduction-Oxidation (REDOX) process. The PUREX process used a recyclable salting agent, nitric acid (which greatly lessened costs and the amount of waste generated), and tri-butyl phosphate (TBP) in a normal paraffin hydrocarbon (NPH) solution as a solvent. TBP/NPH proved to be a much safer and more effective solvent than methyl isobutyl ketone (REDOX's solvent) for recovering uranium and plutonium from nitric acid solutions of irradiated uranium.

The main purpose of PUREX was to extract, purify, and concentrate plutonium, uranium, and neptunium contained in irradiated uranium fuel rods discharged from Hanford Site reactors. The chemical separation processes were based on dissolving fuel rods in nitric acid and conducting multiple purification operations on the resulting aqueous nitrate solution. The driving forces for the separations consisted of chemically changing the valence of specific radionuclides so they could selectively be extracted or stripped from the organic phase.

C.3 PUREX Dangerous Waste Management Units

The following sections briefly describe the tanks, containment building, and miscellaneous unit dangerous waste management units in PUREX. Table B-1 in Addendum B summarizes the regulatory status of each group of PUREX dangerous waste management units with respect to permit authorization to manage existing waste as of the effective date of this permit, and to accept additional waste.

C.3.1 Tank Systems

There are a total of 45 tanks in the PUREX complex that are regulated as dangerous waste management units, all of which were historically used for storage and/or treatment activities. All of these tanks have been drained and flushed, and are considered empty with respect to dangerous waste regulatory requirements. However, draining and flushing of these tanks did not occur within 90 days of shut-down of PUREX, subjecting the tanks to dangerous waste closure requirements. PUREX tanks subject to closure requirements in the Hanford dangerous waste permit are documented in Table 4-2 below. The scope of these closure requirements includes all corresponding ancillary equipment physically within the 202-A Building.

C.3.2 Containment Building

Some mixed waste debris remains in storage in the PUREX, 202-A Building, managed in a containment building. The wastes in the containment building consist of a steel open-top skid containing concrete chips from the floor or E-Cell (stored in F-Cell), and various pieces of discarded canyon process equipment, jumpers (or isolated components thereof) and other discarded equipment from other on-site sources. All such debris have been drained to the extent practicable of free liquids, and isolated as necessary to ensure any residual liquids cannot be released. None of these pieces of debris are considered to contain free liquids.

C.3.3 Miscellaneous Units

PUREX includes two miscellaneous units used for the storage of waste and debris from PUREX and other onsite sources. These storage tunnels were designed and constructed to provide a means of protecting personnel and the environment from exposure to mixed waste associated with stored material, preventing spills or releases of dangerous waste or dangerous constituents, and to provide quick and easy storage of failed equipment. This design also serves to protect personnel and the environment from the dangerous waste component of the mixed waste stored inside the tunnels. Both mixed waste and radioactive waste without a dangerous component (non-mixed radioactive waste) is stored in the tunnels on railcars. Tunnel 1, designated 218-E-14, is 5.8 meters wide by 6.7 meters high by 109 meters long and provides storage for eight railcars. Storage Tunnel 1 was filled in 1965 and was sealed. Storage Tunnel 2, designated 218-E-15, is 5.8 meters wide by 6.7 meters high by 514 meters long and provides storage space for 40 railcars. Presently, 28 railcars reside in Storage Tunnel 2.

The PUREX Storage Tunnels are permitted as a miscellaneous unit under WAC 173-303-680. WAC 173-303-680 requires that miscellaneous unit permit conditions include those regulatory requirements of other types of dangerous waste management units that are appropriate for the miscellaneous units being permitted. Because the construction and operation of the PUREX Storage Tunnels most closely resemble those of a container storage unit, regulatory requirements applicable to the PUREX Storage Tunnels are largely drawn from container storage unit requirements.

Table C.1. PUREX Plant Tanks

Vessel ID	Location	Capacity
TK-D5	D Cell	19,851
TK-E5	E Cell	19,873
TK-E6	E Cell	19,813
TK-F3	F-Cell	19,964
TK-F4	F-Cell	19,592
T-F5	F-Cell	1,132
E-F11	F-Cell	9,804
TK-F15	F-Cell	19,419
TK-F16	F-Cell	19,870
TK-F18	F-Cell	19,798
TK-G1	G-Cell	18,662
TK-G2	G-Cell	7,064
T-G2	G-Cell	8,248
TK-G5	G-Cel	55,403
TK-G7	G-Cell	50,827
TK-G8	G-Cell	19,881
TK-H1	H-Cell	19,593
T-H2	H-Cell	7,003
E-H4	H-Cell	10,137
TK-J1	J-Cell	19,926
TK-J3	J-Cell	19,911
T-J6	J-Cell	6,057
T-J7	J-Cell	6,730
TK-J21	J-Cell	1,162
T-J22	J-Cell	568
T-J23	J-Cell	393
TK-K1	K-Cell	19,828
T-K2	K-Cell	5,194
T-K3	K-Cell	6,507
T-K6	K-Cell	19,593
T-L2	L-Cell	447
TK-L3	L-Cell	488
T-L4	L-Cell	139
TK-M2	M-Cell	6,852
TK-Q21	Q-Cell AMU	81
TK-Q22	Q-Cell AMU	968
TK-R1	R-Cell	18,121
TK-R2	Q-Cell AMU	6,746
T-R2	Q-Cell AMU	8,282
TK-R7	Q-Cell AMU	35,174
TK-U3	U-Cell	31,124
TK-U4	U-Cell	31,184
TK-P4	203-A	402,930
TK-40	211-A	247,360
TK-156	AMU	1,533

C.4 PUREX Storage Tunnels Operations

This section describes the selection, characterization, preparation, placement, and removal activities associated with storage of mixed waste in the PUREX Storage Tunnels.

C.4.1 Preparation for Tunnel Activities

Management, with the concurrence of an appropriate cognizant engineer, determines when material is to be removed and transported to the PUREX Storage Tunnels. A job specific work plan describing the overall transfer activities is prepared.

C.4.2 Storage/Removal Equipment Preparation

A remotely controlled, battery-powered locomotive normally was used to move railcars into and out of the PUREX Storage Tunnels. Other mechanical means such as a standard locomotive or a winch also can be used independently or in combination with the remote locomotive should the need arise. Use of the remote locomotive is described in this Addendum, as this represents the normal placement and removal of railcars at the PUREX Storage Tunnels. Should storage activities require the use of a mechanical means other than the remote locomotive to place or withdraw a railcar, methods for that application will be developed, and submitted to Ecology for approval.

Any activities other than those identified here will require a Class 1 prime modification. Preparations associated with use of the remote-controlled locomotive include the following:

- Reverse actions taken to deactivate the PUREX Storage Tunnels
- Charging the batteries for both the locomotive and the radio transmitter
- Performing operational checks
- Installing a plastic shroud over the locomotive to facilitate decontamination
- Installing an anticoupling device on the south coupler of the locomotive (storage only)
- Performing physical inspections of the railroad track within the railroad tunnel to ensure that the track switches are positioned properly and the track is clear of obstructions

C.4.3 Water-Fillable Door Preparation

Each PUREX Storage Tunnel has a water-fillable door that isolates the storage area from the PUREX railroad tunnel. Currently, the water-fillable door to Tunnel 2 is empty and is not expected to be filled. Operational checks are performed on the door hoists. Before performing operational checks on the water-fillable door, the operator confirms with a dispatcher that the railroad tunnel area is clear of personnel.

C.4.4 Other Preparation Tasks

Before material storage, the storage tunnel exhaust fan is verified to be operating. Labels will be attached to the railcar in accordance with WAC 173-303-395(6) and WAC 173-303-630(3) if the material contains dangerous waste components.

C.4.5 Tunnel Storage Activities

This section describes the placement of material within the PUREX Storage Tunnels.

C.4.5.1 Physical Characterization of Material to be Stored

Physical characterization includes an evaluation of the following physical properties:

- Length, width, and height
- Gross weight and volume
- Preferred orientation for transport and storage
- Presence of mixed waste

Information sources used in physical characterization include equipment fabrication and installation drawings, operational records, and process knowledge. Physical characterization provides information necessary to appropriately describe the mixed waste materials. Such information also is used to design and fabricate, if required, supports on the railcar.

Specific material known to contain constituents that would cause the equipment to be designated as mixed waste is discussed in the waste analysis plan in Addendum B. The material includes but is not limited to dissolvers that contain elemental mercury; silver reactors that contain silver salts; jumpers and other equipment that have elemental lead counterweights; a concentrator that contains chromium; neutron absorbing equipment containing cadmium. Characteristics of these materials when stored as mixed waste are described in Addendum B. Waste transferred to the PUREX Storage Tunnels from other than PUREX also would be physically characterized.

C.4.5.2 Material Flushing

Before removal from service, the material from PUREX was flushed to minimize loss of products, to reduce contamination, and to minimize the quantity of mobile or water-soluble dangerous waste constituents present in any residual heel.

C.4.5.3 Railcar Preparation

Railcars are modified to serve as dedicated storage platforms and transporters for material placed in the PUREX Storage Tunnels. The wooden decking on the railcars is removed to minimize the amount of combustible material placed in the PUREX Storage Tunnels. The south coupler is disabled or removed to prevent the railcar from coupling to the railcar stored ahead. Brakes are disabled to ensure freewheeling of the railcar. Steel decking, catch pans filled with absorbent, and equipment cradles are provided as needed to modify the railcar for its specific task.

C.4.5.4 Placement of Material into Storage Position

With all preparations complete and with management approval, the transfer of material to the PUREX Storage Tunnels proceeds as follows.

- The water-fillable door to the storage tunnel is opened
- The railcar is loaded as specified in the storage tunnel checklist
- An inventory of items loaded on the railcar and a record of their location on the railcar are recorded in the storage tunnel checklist
- A survey is obtained of the loaded railcar at a distance commensurate with ALARA practices
- The railcar is pushed into the storage tunnel to its storage position

Once the railcar is in position, the water-fillable door is closed

C.4.5.5 Removal of Stored Material

Removal of material stored within the PUREX Storage Tunnels is not conducted routinely. It is planned that the material will remain in storage until a means to accommodate processing and repackaging of the material for disposal or further storage or until another final disposition option becomes available. Removal of material from storage within the PUREX Storage Tunnels would proceed after the preparation activities identified in Section C.2.1.

With all preparations complete and approval of management, removal of material from the storage area of the PUREX Storage Tunnels would proceed as follows.

- The equipment that will be used to remove material is positioned in the PUREX railroad tunnel.
- Verification is made that the PUREX railroad tunnel is configured properly to proceed with entrance into the PUREX Storage Tunnels (i.e., tunnel ventilation system is operating, the overhead door is closed and a survey of the area is performed for ALARA concerns).
- The water-fillable door is opened.
- The equipment that will be used to remove material is moved into the storage tunnel and connected to the railcar.

- Verification is made that the railcar is connected to the removal equipment and the railcar is extracted from the storage tunnel and positioned within the PUREX railroad tunnel.
- The water-fillable door is closed.

The loaded railcar retrieved from the tunnel would be remotely viewed and measurements may be obtained to determine the possibility of mixed waste containment failure during storage in the PUREX Storage Tunnels. If evidence of containment failure is detected, the specific details (i.e., material, location on railcar, storage position) would be documented and attached to the waste tracking form. This information would be maintained in the files and would be used to establish sampling locations within the tunnels at closure. After remote viewing and surveying, the railcar and associated material may be prepared as required for transfer to an appropriate onsite dangerous waste management unit for treatment or further storage.

C.4.5.6 Filling the Water-Fillable Door (Tunnel 2)

If shielding beyond that provided by the empty water-fillable door becomes necessary, the door can be filled with water. In the past, this was accomplished by connecting a fire hose from the water hydrant to the wall stub on the exterior of the door housing (Figure C.1). Once the fire hose was in place, the hydrant valve was opened and the door was filled with water.

The hydrant was closed by personnel when a high-level indicator light illuminated. Although attendance by an operator is required at all times during filling operations, should the door overfill, excess water is channeled through a vent/spill pipe to the door sump. A 15.2-centimeter drain is provided in each door sump. Water accumulated in the door sump was pumped out to the Double-Shell Tank System, and the sump and drain were made inoperable during PUREX deactivation activities. The drain was sealed during PUREX deactivation. In the future, a temporary source of water could be provided for filling the water-fillable door, and any overflow will be hand pumped from the sump.

C.4.6 Post-storage Activities

Decontamination activities, if required, are performed following completion of the tunnel storage activities documented in Section C.1.5.5. Management is notified of any unusual conditions observed during the storage/retrieval activities.

C.4.7 Operation of the Tunnel Ventilation System

The ventilation systems for Tunnel 1 and Tunnel 2 were designed to ventilate air from within the tunnels so the airborne contamination is vented through a HEPA filtered exhaust system.

C.4.7.1 Tunnel 1 Ventilation

Active ventilation of Tunnel 1 presently is not provided. After placement of the last railcar into Tunnel 1, the tunnel was sealed. As part of the sealing activities, the ventilation fan was deactivated electrically and the exhaust stack and filter were isolated from the system by installing blanks upstream and downstream of both the exhaust fan and filter and the stack was removed. In the event railcar removal activities are initiated, it is planned that the ventilation system would be reactivated. Operation of the ventilation system would be similar to that for Tunnel 2.

C.4.7.2 Tunnel 2 Ventilation

The Tunnel 2 ventilation system presently is inactive. As part of PUREX deactivation, the water-fillable door and outer PUREX railroad tunnel door were sealed. The seal may be temporary or permanent depending on the future need for storing waste in the tunnel. The ventilation system may be operated continuously, or de-energized and reactivated during waste placement activities. During deactivation, a blank was installed on the downstream side of the filter and the stack was capped. While the Tunnel 2 ventilation system is operating and the water-fillable door is closed, the exhaust system, which discharges approximately 100 cubic meters per minute, maintains a slightly negative pressure in the tunnel. The exhaust air is replaced by infiltration around the water-fillable door and through the porosity of the tunnel structure (e.g., the rail-bed ballast). When the water-fillable door is open (during transfer activities), inward airflow is maintained through the open doorway. This inward airflow channels airborne radioactive contamination away from both the railroad tunnel and personnel following railcars (if allowed) into the storage tunnel. A HEPA filter provides filtration of all exhaust air before release to the atmosphere. When the ventilation system is operating, the HEPA filter is tested in place at least annually to ensure radioactive particulate removal efficiency. Exhausted air is sampled periodically and analyzed for airborne radionuclides.

C.4.8 PUREX Storage Tunnel Containers

This section describes the various types of containment used to isolate mixed waste stored in the PUREX Storage Tunnels. The PUREX Storage Tunnels are considered to be a miscellaneous unit most closely resembling that of a container storage unit. The mixed waste stored in the PUREX Storage Tunnels is managed in containers in a manner protective of human health and the environment.

C.4.8.1 Containers with Free Liquids

The only mixed waste stored as a free liquid is elemental mercury. A small quantity, less than 1.7 liters, of mercury is contained in each of the two thermowells attached to and contained within each dissolver (Addendum B). Primary containment of the mercury is provided by the all-welded construction of the thermowell itself, which is fabricated from 7.6-centimeter, Schedule 80, 304L stainless steel pipe. The open upper end of the thermowell was plugged with a 304L stainless steel nozzle plug in preparation for storage. The dissolver rests on a cradle on its railcar in an inclined position. This ensures that the mercury remains in the lower portion of the thermowell and is not in contact with the mechanical closure on the nozzle end of the thermowell.

A secondary containment barrier for mercury, should it leak from the thermowell, is provided by the dissolver itself. The dissolver is a 304L stainless steel process vessel constructed from 1-centimeter-thick plate and is approximately 2.7 meters in diameter. The dissolver is of all-welded construction and contains no drains or nozzle outlets in the bottom several feet of its lower section, which contains both thermowells.

The 304L stainless steel used to contain the elemental mercury is both compatible with the waste itself and the storage environment. The potential for significant deterioration of either the primary or secondary containment barrier material before closure is considered to be negligible.

The dissolvers stored within the PUREX Storage Tunnels are not labeled as containing characteristic toxic mercury (D009) [WAC 173-303-090(8)(c)]. Procedures for labeling were not in place at the time of storage. Personnel access into the storage area for purposes such as labeling is not feasible and cannot be justified under ALARA guidelines. Based on ALARA, mixed waste presently within the PUREX Storage Tunnels will remain unlabeled. However, during future transfers of mixed waste into the PUREX Storage Tunnels the railcars will be labeled as specified by WAC 173-303-395(6) and WAC 173-303-630(3).

C.4.8.2 Containers without Free Liquids that do not Exhibit Ignitability or Reactivity

Most lead is fully contained in all-welded encasements of either carbon steel or 304L stainless steel (Addendum B, Table B.1). The encasement serves as support, protection against mechanical damage, and protection of the lead from exposure to the environment. Also, lead has been placed in burial boxes of appropriate size. The boxes provide secondary containment for the lead in the unlikely event the primary encasement should fail. Although boxes may be open on the top, the PUREX Storage Tunnels are enclosed; therefore, the containers are protected from the elements.

Both carbon steel and 304L stainless steel used to encase the lead are compatible with the waste and the storage environment. Significant deterioration of either the primary or secondary containment barrier materials before closure is not considered to be credible.

In the past, material that contains lead or that has encased lead attached was not labeled as containing characteristic toxic lead (D008) [WAC 173-303-090(8)], because the requirements were not yet on line.

As stated in Section 4.2.1, personnel entry into the tunnel storage area for purposes of labeling would be inconsistent with ALARA guidelines. However, during future storage of material containing lead the railcars will be labeled in accordance with WAC 173-303-395(6) and WAC 173-303-630(3).

C.4.9 PUREX Storage Tunnels Container Storage Activities

C.4.9.1 Protection of Extremely Hazardous Waste in Containers

Because the PUREX Storage Tunnels are enclosed totally, protective covering from the elements and from run-on is provided for the storage of extremely hazardous waste. Periodic inspection of the equipment stored in the PUREX Storage Tunnels is not feasible and cannot be justified under ALARA guidelines. Safe management of this waste is based on the following considerations.

The operation of the PUREX Storage Tunnels is passive, i.e., once a storage position is filled, the storage position remains undisturbed until closure.

Extremely hazardous waste in containers as of the effective date of this permit has already been documented to be compatible with its storage container and the storage environment. For any additional waste which may be placed in the PUREX Storage Tunnels, the waste acceptance process documented in Addendum B will ensure that such additional waste is also compatible with containers in which it is placed as well as other waste already in storage.

C.4.9.2 Prevention of Reaction of Ignitable, Reactive, and Incompatible Waste in Containers

There is no reactive or incompatible waste known to be stored in the PUREX Storage Tunnels. The only mixed waste stored in the PUREX Storage Tunnels considered an ignitable waste is the silver nitrate in Tunnel 2. The silver nitrate fraction of the silver salts, within the silver reactors, exhibits the characteristic of ignitability pursuant to WAC 173-303-090(5)(iv) Therefore, the silver salts are managed as an ignitable dangerous waste in accordance with WAC 173-303-395.

The risk of fire associated with the storage of silver nitrate in the PUREX Storage Tunnels is considered to be extremely low. This conclusion is based on the following considerations.

- The operation of the PUREX Storage Tunnels is passive; i.e., once a storage position is filled, the storage position remains undisturbed until closure.
- The silver nitrate is contained within large, heavy-walled stainless steel vessels that isolate the silver nitrate from contact with any combustibles that might be in the tunnels.
- The silver nitrate is dispersed over a large surface area on a ceramic packing substraight and is not conducive to build-up of heat that could lead to spontaneous combustion.
- Personnel access to the occupied areas of the tunnels is not permitted, thereby precluding activities that could present a fire hazard (e.g., smoking, flame cutting, welding, grinding, and other electrical activities).

Although ignitable waste storage units are required by WAC 173-303-395(1)(d) to have inspections conducted at least yearly by a fire marshall or professional fire inspector familiar with the requirements of the Uniform Fire Code, ALARA concerns within the PUREX Storage Tunnels make such inspections impractical. These inspections are not considered appropriate or necessary for the safe operation of the unit because of the nature of the ignitable waste, the means of storage, and ALARA concerns.

C.5 Special Procedural Requirements

The following sections describe special procedural requirements associated with waste in the PUREX Storage Tunnels.

C.5.1 Procedures for Ignitable, Reactive, and Incompatible Waste

Presently, the only ignitable, reactive, or incompatible dangerous waste stored in the PUREX Storage Tunnels is the silver nitrate coating on the ceramic packing inside the silver reactors. This material is confined to the interior of a large stainless steel vessel that separates this material from all other waste material stored in the tunnel. The requirements in WAC 173-303-395(1)(a) require 'No Smoking' signs be conspicuously placed wherever there is a hazard present from ignitable or dangerous waste. 'No Smoking' signs are not considered necessary at any of the Closure Unit Group 25 dangerous waste management units based on ALARA principles. Smoking is not allowed in any area with ALARA concerns and rules prohibiting smoking are strictly enforced. This policy serves to achieve the no smoking intent of WAC 173-303-395(1)(a).

Isolated areas within the PUREX Storage Tunnels make periodic inspections inconsistent with ALARA guidelines [e.g., an annual fire inspection as required by WAC 173-303-395(1)(d) for storage areas containing ignitable waste]. Therefore, such inspections are not performed.

Although some wastes managed in the PUREX Canyon Tank Systems originally designated as ignitable or reactive wastes, the removal of these wastes and flushing of the vessels and ancillary equipment during pre-closure activities has ensured that no waste residuals in these dangerous waste management units remain ignitable or reactive.

C.5.2 Provisions for Complying with Land Disposal Restriction (LDR) Requirements

Since no treatment is performed in Closure Unit Group 25 dangerous waste management units for purposes of satisfying LDR treatment standards, compliance with LDR requirements is achieved through Permit Condition V.25.D.2.

C.6 PUREX Storage Tunnel Engineering Drawings

As-built drawings for the PUREX Storage Tunnels include the following engineering drawings:

H-2-55587	218-E-14 Structural Floor Plan and Section
H-2-55588	Structural Sections and Details: Disposal Facility for Failed Equipment
H-2-55589	Structural Sections and Details: Disposal Facility for Failed Equipment
H-2-55590	Door and Hoist Details
H-2-55591	Door and Hoist Details
H-2-55592	Door and Hoist Details
H-2-55593	Electrical Details
H-2-55594	Shielding Door Fill and Drain Lines Arrangement: Disposal Facility for Failed Equipment
H-2-55599	Electrical Door Control Plan, Elementary Diagram and Miscellaneous Details: Disposal Facility for Failed PUREX Equipment
H-2-58134	Ventilation Details; Sheet 1, Sheet 2, Sheet 3, Sheet 4
H-2-58175	PUREX Tunnel
H-2-58193	Sump Details
H-2-58194	Sump Details
H-2-58195	Structural Sections and Details: Equipment Disposal - PUREX
H-2-58206	Sump Details
H-2-58208	Fan Details; Sheet 1, Sheet 2, Sheet 3
H-2-94756	Filter Details; Sheet 1, Sheet 2

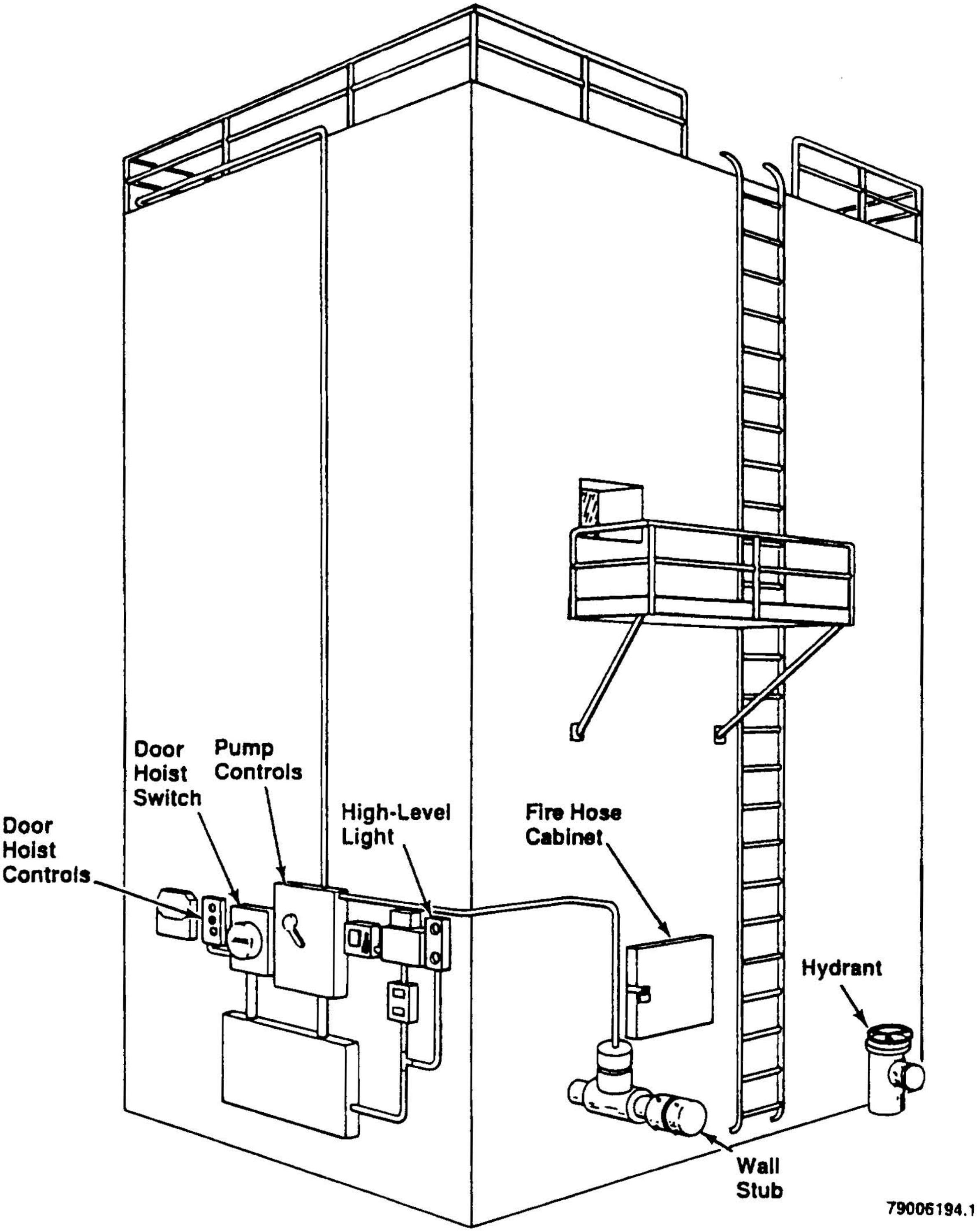

Figure C.1. Water Fillable Door Exterior (Tunnel 2)

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