

# **Radioactive Air Emissions Notice of Construction for the T Plant Complex Fuel Removal Project**

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the  
U.S. Department of Energy under Contract DE-AC06-96RL13200



**United States  
Department of Energy**  
P.O. Box 550  
Richland, Washington 99352

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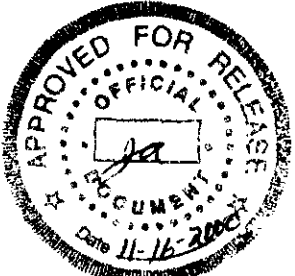
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A-6001-401 (02/98)

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Date Published  
November 2000

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**United States  
Department of Energy**  
P.O. Box 550  
Richland, Washington 99352

*James A. Arata*  
Release Approval

*11-16-2000*  
Date

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## TERMS

1		
2		
3		
4	ALARACT	as low as reasonably achievable control technology
5	ANSI	American National Standards Institute
6	ASME	American Society of Mechanical Engineers
7		
8	BARCT	best available radionuclide control technology
9		
10	Ci	curie
11	CSB	Canister Storage Building
12		
13	DOE-RL	U.S. Department of Energy, Richland Operations Office
14		
15	HEPA	high-efficiency particulate air
16		
17	LIGO	Laser Interferometer Gravitational Wave Observatory
18		
19	MEI	maximally exposed individual
20	mrem	millirem
21		
22	NOC	notice of construction
23		
24	PWR-2	Pressurized Water Reactor Core 2
25		
26	SEPA	<i>State Environmental Policy Act</i>
27	SNF	spent nuclear fuel
28	SSFC	Shippingport Spent Fuel Container
29		
30	TEDE	total effective dose equivalent
31		
32	WAC	Washington Administrative Code
33	WDOH	Washington State Department of Health

## METRIC CONVERSION CHART

Into metric units

Out of metric units

If you know	Multiply by	To get	If you know	Multiply by	To get
<b>Length</b>			<b>Length</b>		
inches	25.40	millimeters	millimeters	0.0393	inches
inches	2.54	centimeters	centimeters	0.393	inches
feet	0.3048	meters	meters	3.2808	feet
yards	0.914	meters	meters	1.09	yards
miles	1.609	kilometers	kilometers	0.62	miles
<b>Area</b>			<b>Area</b>		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
acres	0.404	hectares	hectares	2.471	acres
<b>Mass (weight)</b>			<b>Mass (weight)</b>		
ounces	28.35	grams	grams	0.0352	ounces
pounds	0.453	kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
<b>Volume</b>			<b>Volume</b>		
fluid ounces	29.57	milliliters	milliliters	0.03	fluid ounces
quarts	0.95	liters	liters	1.057	quarts
gallons	3.79	liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76456	cubic meters	cubic meters	1.308	cubic yards
<b>Temperature</b>			<b>Temperature</b>		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
<b>Energy</b>			<b>Energy</b>		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.948	British thermal unit per second	British thermal unit per second	1.055	kilowatt
<b>Force/Pressure</b>			<b>Force/Pressure</b>		
pounds per square inch	6.895	kilopascals	kilopascals	0.14504	pounds per square inch

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.



## **NOC HISTORY**

The current mission of the T Plant Complex is for treatment and storage of liquid mixed waste, storage of contaminated process equipment, decontamination of equipment and materials, and storage, treatment, and repackaging of containerized waste. This mission has been ongoing since before issuance of Washington Administrative Code (WAC) 246-247. A Notice of Construction (NOC) has not been required previously for the T Plant Complex, with the exception of the NOC submitted for the upgrades to the 2706-T Building (Project W-259).

1  
2  
3  
4  
5

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**RADIOACTIVE AIR EMISSIONS  
NOTICE OF CONSTRUCTION FOR  
THE T PLANT COMPLEX  
FUEL REMOVAL PROJECT**

This NOC describes the activities to remove all spent nuclear fuel (SNF) assemblies from the spent fuel pool in the T Plant Complex 221-T canyon for interim storage in the Canister Storage Building (CSB). The unabated total effective dose equivalent (TEDE) estimated for the public hypothetical maximally exposed individual (MEI) is 5.7 E-6 millirem (mrem) per year for this fuel removal NOC. The abated TEDE conservatively is estimated to account for 2.9 E-9 mrem per year to the MEI.

The following text provides information addressing the requirements of Appendix A of WAC 246-247 (requirements 1 through 18), and of the 40 Code of Federal Regulations (CFR) 61.07.

**1.0 LOCATION**

*Name and address of the facility, and location (latitude and longitude) of the emission unit:*

U.S. Department of Energy, Richland Operations Office  
Hanford Site,  
Richland, Washington

221-T Building, 200 West Area  
Latitude: 46° 33' 40.7" N  
Longitude: 119° 37' 2.2" W

Figure 1 shows the location of the T Plant Complex within the 200 West Area. The exhaust stack is identified as the 291-T-1 Stack.

**2.0 RESPONSIBLE MANAGER**

*Name, title, address and phone number of the responsible manager:*

Mr. G. H. Sanders, Director,  
Waste Management Division  
U.S. Department of Energy, Richland Operations Office  
P.O. Box 550  
Richland, Washington 99352  
509-372-1786

### 3.0 PROPOSED ACTIONS

*Identify the type and proposed action for which this application is submitted.*

The proposed action is considered an insignificant modification to an emission unit (291-T-1).

### 3.1 FUEL ASSEMBLIES AT THE T PLANT COMPLEX

The 221-T canyon cell 2R contains Pressurized Water Reactor Core 2 (PWR-2) fuel assemblies that were irradiated in an experimental reactor in Shippingport, PA from 1965 to 1974. These blanket fuel assemblies absorbed the neutron flux from the seed assemblies and bred plutonium. Although these blanket fuel assemblies could not sustain a criticality on their own, these fuel assemblies were located within the reactor with highly enriched seed fuel assemblies. The blanket fuel assemblies were transferred to the spent fuel pool in the 221-T canyon at the T Plant Complex in 1977 and 1978 for reprocessing to recover produced plutonium. The reprocessing operations never were initiated and the fuel assemblies have remained in storage in the 221-T cell 2R, spent fuel pool.

There are 72 PWR-2 fuel assemblies in the 221-T spent fuel pool. Each fuel assembly is 3.6 meters long and has a square cross-section of 19 centimeters as shown in Figure 2. The fuel in the assemblies is natural uranium oxide (UO<sub>2</sub>), with Zircaloy-4 cladding. The cladding confines the radionuclides (fission products, activation products, and actinides) present in the fuel assemblies, and prevents potential emissions from being released. External surface contamination on the assemblies, known as crud, is the material with a potential for radioactive air emissions.

A detailed description of the fuel is provided in the *Shippingport PWR Core 2 Blanket Assemblies Source Term Calculations Using ORIGEN2* (HNF-SD-SNF-TI-061).

### 3.2 SCOPE OF FUEL REMOVAL PROJECT

The scope of the T Plant Complex Fuel Removal Project includes all activities required to prepare for, and perform fuel handling, canister loading, canister drying and inerting, and cask loading within the 221-T canyon, and subsequent cask transportation to the CSB. The physical work activities required for fuel removal include the following:

- Retrieval of PWR-2 fuel assemblies (Figure 3) from their current pool storage racks in the 221-T Building
- Insertion of PWR-2 fuel assemblies into Shippingport Spent Fuel Containers (SSFCs) (Figures 4) and closure with shield plugs (Figure 5)
- Fuel conditioning (i.e., drying and inerting) within the SSFCs
- Transfer of the SSFCs to the CSB.

#### 4.0 STATE ENVIRONMENTAL POLICY ACT

*If the project is subject to the requirements of the State Environmental Policy Act (SEPA) contained in chapter 197-11 WAC, provide the name of the lead agency, lead agency contact person, and their phone number.*

The proposed action categorically is exempt from the requirements of SEPA under WAC 197-11-845.

#### 5.0 CHEMICAL AND PHYSICAL PROCESSES

*Describe the chemical and physical processes upstream of the emission unit.*

The chemical and physical processes associated with the T Plant Complex Fuel Removal Project will consist of the following.

- Because the spent fuel pool water has remained relatively clean and there has been no indication of fuel cladding failure (verified by monthly sampling of the pool water), the pool filtration system has not been used for years. The pool filtration system will be reactivated and placed in service before removal of the fuel assemblies to increase water clarity.
- The SSFCs (with inserts installed), shield plugs, shield plug seals, and required tools will be staged at the T Plant Complex. The skid-mounted fuel conditioning system will be placed in the 221-T tunnel.
- The SSFC/cask/transporter will be moved into the 221-T tunnel and the loading guide will be installed into the SSFC.
- The hoist will be moved to the spent fuel pool using the canyon bridge crane to position. The fuel assembly will be grappled remotely, raised from the pool, and the fuel assembly identification number will be recorded (Figures 6 and 7).
- The fuel assembly will be transferred over the cell partition and lowered into the SSFC. After four fuel assemblies are placed into an SSFC, the shield plug will be installed and the SSFC will be sealed mechanically. The SSFC identification number associated with the fuel assembly identification numbers will be recorded.
- The SSFC will remain on the transporter trailer during loading and conditioning operations within the fuel transport cask, and will be connected to the fuel conditioning system (Figure 8) via the process port on the shield plug (Figure 5). The SSFC will be conditioned by pulling a vacuum to dry the fuel, backfilling with helium, pulling a vacuum again, and refilling the SSFC with helium to inert the fuel. The SSFC will be leak tested to verify closure and the process port cover plate will be closed.
- The cask lid will be placed on the cask and bolted in place (airtight) and the cask will be transported to the CSB. After off-loading the SSFC at the CSB, the cask and transporter will be returned to the 221-T tunnel. It will take 18 trips to transfer the 72 fuel assemblies. The fuel transport cask (same type used to transport K Basin Fuel multicannister overpacks) is designed to preclude the potential release of radioactive emissions.

- The fuel conditioning system skid will be dismantled and removed from the 221-T canyon.
- The pool water will be pumped out and transferred (e.g., tanker trucks or hard piping) to a permitted liquid waste treatment/disposal facility.
- Decontamination of the spent fuel pool will not be part of the scope of this NOC.

## 6.0 PROPOSED CONTROLS

*Describe the existing and proposed abatement technology. Describe the basis for the use of the proposed system. Include expected efficiency of each control device, and the annual average volumetric flow rate in cubic meters/second for the emission unit.*

The existing 221-T ventilation system will be used (291-T-1 Stack). Two stages of high-efficiency particulate air (HEPA) filters are tested in place annually at a minimum control efficiency of 99.95 percent. Currently, the annual average flow for the 291-T-1 Stack is 15 cubic meters per second.

## 7.0 DRAWINGS OF CONTROLS

*Provide conceptual drawings showing all applicable control technology components from the point of entry of radionuclides into the vapor space to release to the environment.*

Figure 9 shows the existing ventilation system for the 291-T-1 Stack.

## 8.0 RADIONUCLIDES OF CONCERN

*Identify each radionuclide that could contribute greater than ten percent of the potential to emit TEDE to the MEI, or greater than 0.1 mrem/yr potential to emit TEDE to the MEI.*

Any radionuclide might be present in the T Plant Complex from historical operations. The 291-T-1 Stack is designated as a minor stack that currently requires periodic confirmatory measurements for total alpha and total beta/gamma. Although the fuel assemblies have a total inventory of  $1.9 \text{ E}+6 \text{ Ci}$  (actinides, fission products, and activation products, decayed to 2001), the radionuclides in the spent fuel are confined by the cladding and are not subject to potential release. The radionuclides of concern for this fuel removal project NOC are iron-55, cobalt-60, nickel 63, strontium-90, and plutonium-238 from the crud (external surface contamination on the fuel assemblies) and cobalt-60 and cesium-137 in the pool water.

## 9.0 MONITORING

*Describe the effluent monitoring system for the proposed control system. Describe each piece of monitoring equipment and its monitoring capability, including detection limits, for each radionuclide that could contribute greater than ten percent of the potential to emit TEDE to the MEI, or greater than 0.1 mrem/yr potential to emit TEDE to the MEI, or greater than twenty-five percent of the TEDE to the MEI, after controls. Describe the method for monitoring or calculating those radionuclide emissions. Describe the method with sufficient detail to demonstrate compliance with the applicable requirements.*

The proposed operations will be subject to periodic confirmatory measurement requirements specified in 40 CFR 61.93 and WAC 246-247. In accordance with these requirements, periodic confirmatory measurements will be performed to verify low emissions and to support an estimate of the quantity of those emissions for annual reporting purposes. The record sampler for the 291-T-1 Stack typically is operated continuously, and particulate sample air filters are collected biweekly. At a minimum, four samples are selected (minimum of one sample per calendar quarter) and analyzed for gross alpha/beta activity to provide periodic confirmatory measurements to verify low emissions. The emissions during the proposed activity will be represented by these samples.

Water quality of the spent fuel pool currently is being monitored monthly for cobalt-60 and cesium-137. This practice will continue until all of the fuel assemblies have been removed from the pool.

## 10.0 ANNUAL POSSESSION QUANTITY

*Indicate the annual possession quantity for each radionuclide.*

Table 1 summarizes the inventory at the T Plant Complex addressed by this fuel removal project NOC.

## 10.1 FUEL ASSEMBLIES

The 1.9 E+6 Ci inventory (decayed to 2001) of the 72 fuel assemblies is confined by the cladding, which has demonstrated good integrity. There is no credible scenario to release this inventory (i.e., less than 1 percent probability). The fuel assemblies have been in the T Plant Complex since 1978, and there will be no change in potential emissions resulting from removal of the fuel assemblies.

## 10.2 CRUD ACTIVITY

The crud on the blanket assemblies was formed during the reactor operations and is firmly attached, i.e., the blanket assemblies arrived at the T Plant Complex with the crud that is still present. The quantity of crud on the blanket assemblies was estimated based on an analysis of a seed assembly from the 1969 refueling of the Shippingport reactor (WAPD-MT[CRCT]-45). Crud activity (decay corrected to 2001) was estimated at 1.33 E-7 microcuries per square decimeter ( $\mu\text{Ci}/\text{dm}^2$ ) for iron-55, 4.03 E-7  $\mu\text{Ci}/\text{dm}^2$  for cobalt-60, 6.73 E-6  $\mu\text{Ci}/\text{dm}^2$  for nickel-63, 2.60 E-7  $\mu\text{Ci}/\text{dm}^2$  for strontium-90, and 3.24 E-7  $\mu\text{Ci}/\text{dm}^2$  for plutonium-238. The estimate was based on a total blanket surface of 1,870  $\text{dm}^2$  for 76 blanket assemblies. Because there are 72 blanket assemblies stored at the T Plant Complex, the total crud activity for each radionuclide is the concentration multiplied by the surface area (1,870  $\text{dm}^2 \times 72/76$ ). Results of those calculations are shown in Table 1.

### 10.3 SPENT FUEL POOL WATER ACTIVITY

The 221-T spent fuel pool has a capacity of 190,000 liters. The pool water chemistry and depth have been maintained and monitored while the PWR-2 fuel has been in storage. There has been no significant increase in radionuclide concentration in the pool water, evidencing that the integrity of the fuel cladding is intact. The cobalt-60 concentration of the pool water in 1996 was  $9.79 \text{ E-6 } \mu\text{Ci/ml}$  and the 2000 concentration of cobalt-60 was  $6.78 \text{ E-6 } \mu\text{Ci/ml}$ , which is essentially the same. The concentration of cesium-137 in 2000 was less than  $3.6 \text{ E-7 } \mu\text{Ci/ml}$ . This inventory, based on concentrations in 2000, is included in Table 1.

### 11.0 PHYSICAL FORM

*Indicate the physical form of each radionuclide in inventory: Solid, particulate solids, liquid, or gas.*

The physical form of each radionuclide of concern in the inventory is listed in Table 1.

### 12.0 RELEASE FORM

*Indicate the release form of each radionuclide in inventory: Particulate solids, vapor or gas. Give the chemical form and ICRP 30 solubility class, if known.*

All emissions from the radionuclides in the inventory presented in Table 1 are assumed released as particulate solids.

### 13.0 RELEASE RATES

*Give the predicted release rates without any emissions control equipment (potential to emit) and with the proposed control equipment using the efficiencies described in subsection (6) of this section. Indicate whether the emission unit is operating in a batch or continuous mode.*

The predicted release rates for each radionuclide, without any emissions control equipment (unabated), are presented in Table 1 using the appropriate WAC 246-247-030 (21)(a) release fractions ( $1.0 \text{ E-3}$ ). The total potential release rates for the radionuclides of concern (unabated) are summarized in Table 2. The predicted release rates using the control equipment efficiencies in Section 6.0 (abated) also are presented in Table 2.

Actual emissions for 1999 from the 291-T-1 Stack were  $3.7\text{E-5 Ci}$  of total alpha and  $1.3 \text{ E-4 Ci}$  of total beta/gamma. The 291-T-1 Stack will operate in continuous mode; however, the proposed activities in this NOC are not expected to result in a measurable change of actual emissions from the 291-T-1 Stack.

### 14.0 LOCATION OF MAXIMALLY EXPOSED INDIVIDUAL

*Identify the MEI by distance and direction from the emission unit.*

The MEI from the T Plant Complex is located at the Laser Interferometer Gravitational Wave Observatory (LIGO), approximately 18.3 kilometers east southeast of the Reduction Oxidation Facility



(S Plant), conservatively chosen to represent 200 West Area. Dose estimates for unit Ci releases of selected radionuclides were calculated for emissions from the 200 West Area of the Hanford Site. These estimates were provided by e-mail (PNNL 2000a and PNNL 2000b), where the doses were calculated for an onsite member of the public working at LIGO. The dose calculations, Hanford defaults, and unit dose factors are provided in Attachment 1. A representative synopsis report (for the worker data set 1 file, out of 44 files) is provided in Attachment 2.

## **15.0 TOTAL EFFECTIVE DOSE EQUIVALENT TO THE MAXIMALLY EXPOSED INDIVIDUAL**

*Calculate the TEDE to the MEI using an approved procedure. For each radionuclide identified in subsection (8) of this section, determine the TEDE to the MEI for existing and proposed emission controls, and without any existing controls using the release rates from subsection 13 of this section. Provide all input data used in the calculations.*

The calculations are summarized in Table 2. The total unabated dose for this NOC conservatively is estimated to be 5.7 E-6 mrem per year to the MEI, with a total abated dose estimate of 2.9 E-9 mrem per year to the MEI.

## **16.0 COST FACTOR IF NO ANALYSIS**

*Provide cost factors for construction, operation and maintenance of the proposed control technology components and the system, if a BARCT or ALARACT demonstration is not submitted with the NOC.*

Pursuant to WAC 246-247-110, App. A (16), cost factors for construction, operation, and maintenance of proposed technology requirements are not required, as the following discussion is provided as an as low as reasonably achievable (ALARACT) demonstration.

The Washington State Department of Health (WDOH) has provided guidance that HEPA filters are generally considered best available radionuclide control technology (BARCT) for particulate emissions (Letter, AIR 92-107, A. W. Conklin, Washington State Department of Health, to J. D. Bauer, U.S. Department of Energy, Richland Operations Office, no subject, October 5, 1992). Control technology that meets BARCT requirements also meets ALARACT requirements. Because the radionuclides of concern are particulates, it is proposed that the controls described in Section 6.0 for the 291-T-1 Stack be accepted as ALARACT.

## **17.0 DURATION OR LIFETIME**

*Provide an estimate of the lifetime for the facility process with the emission rates provided in this application.*

The removal of the fuel assemblies is scheduled to start in November 2001, and all of the assemblies will be removed before 2004.

## 18.0 STANDARDS

Indicate which of the following control technology standards have been considered and will be complied with in the design and operation of the emission unit described in this application:

ASME/ANSI AG-1, ASME/ANSI N509, ASME/ANSI N510, ANSI/ASME NQA-1, 40 CFR 60, Appendix A Methods 1, 1A, 2, 2A, 2C, 2D, 4, 5, and 17, and ANSI N13.1

For each standard not so indicated, give reasons to support adequacy of the design and operation of the emission unit as proposed.

Cited documents will be provided to WDOH on request.

- ASME/ANSI AG-1:

The 291-T-1 Stack and ventilation system were built before the standard was issued. The HEPA filters used in the ventilation system for the 291-T-1 Stack meet all but two criteria dealing with filter qualification testing. Justification for this exception was discussed with and approved by WDOH at the December 1998 Routine Technical Assistance Meeting. A WDOH approved temporary deviation currently is in place to satisfy this issue (WDOH AIR 99-507).

- ASME/ANSI N509:

The 291-T-1 ventilation system was built with the consideration of design guidance contained in ASME/ANSI N509. Full compliance has not been verified. The existing system has operated in its current configuration since 1995. Adequacy of the filtration system has been demonstrated by testing in accordance with requirements in ASME/ANSI N510.

- ASME/ANSI N510:

Systems that do not conform to ANSI/ASME N509 by definition do not conform to ANSI/ASME N510. However, to demonstrate the adequacy of the system design and operation, both stages of HEPA filters will be tested individually in-place annually to meet the intent of ANSI/ASME N510.

- ANSI/ASME NQA-1:

Quality assurance is addressed in HNF-0528-3, *NESHAP Quality Assurance Project Plan for Radioactive Airborne Emissions* (all of Sections 2.0, 3.0 and 5.0) as a compatible alternative to NQA-1.

- ANSI/ASME NQA-2:

The standard is no longer an active National Standard and has been incorporated into NQA-1. Compliance compatible with NQA-1 was described previously.

- 40 CFR 60, Appendix A

Stack flow will be tested using Methods 1 and 2. Methods 1A, 2A, 2C, and 2D are not applicable to the stack dimensions/design. Methods 4, 5, and 17 are not applicable to radioactive airborne effluent stacks.

1 • ANSI N13.1:

2  
3 The sampling system may not fully comply with ANSI N13.1 (1969) criteria. The stack probe, a  
4 rake design with 10 nozzles, was installed in the mid-1980's. The nozzles do measure equal annular area  
5 as described in the standard. Although the probe was designed to provide near isokinetic sampling at a  
6 given stack flow, variability in stack flow could affect the ability to achieve near isokinetic sampling.  
7 Currently the sample system is operated to provide periodic confirmatory measurements only, as  
8 described in Section 9.0.  
9

10  
11 **19.0 REFERENCES**

12  
13 AIR 92-107, Letter, WDOH to DOE-RL, "Surveillance Report Generated by the DOH of KE &  
14 KW Basin on 09/16/1992", October 05, 1992  
15

16 AIR 99-507, Letter, WDOH to DOE-RL, "Technical Justification for Temporary Deviation to American  
17 Society of Mechanical Engineers (ASME) AG-1, Section FC 5100 High Efficiency Particulate  
18 Air (HEPA) Filter Qualification Test Requirements", May 19, 1999.  
19

20 ANSI N13.1, *Guide to Sampling Airborne Radioactive Materials in a Nuclear Facility*, 1969, American  
21 National Standards Institute, New York, New York.  
22

23 ANSI/ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*, 1994,  
24 American National Standards Institute and American Society of Mechanical Engineers,  
25 New York, New York.  
26

27 ANSI/ASME NQA-2, *Quality Assurance Requirements for Nuclear Power Plants*, 1989, American  
28 National Standards Institute and American Society of Mechanical Engineers, New York,  
29 New York.  
30

31 ASME/ANSI AG-1, *Code on Nuclear Air and Gas Treatment*, 1991, American Society of Mechanical  
32 Engineers and American National Standards Institute, New York, New York.  
33

34 ASME/ANSI-N509, *Nuclear Power Plant Air-Cleaning Units and Components*, 1989, American Society  
35 of Mechanical Engineers and American National Standards Institute, New York, New York.  
36

37 ASME/ANSI N510, *Testing of Nuclear Air Treatment Systems*, 1989, American Society of Mechanical  
38 Engineers and American National Standards Institute, New York, New York.  
39

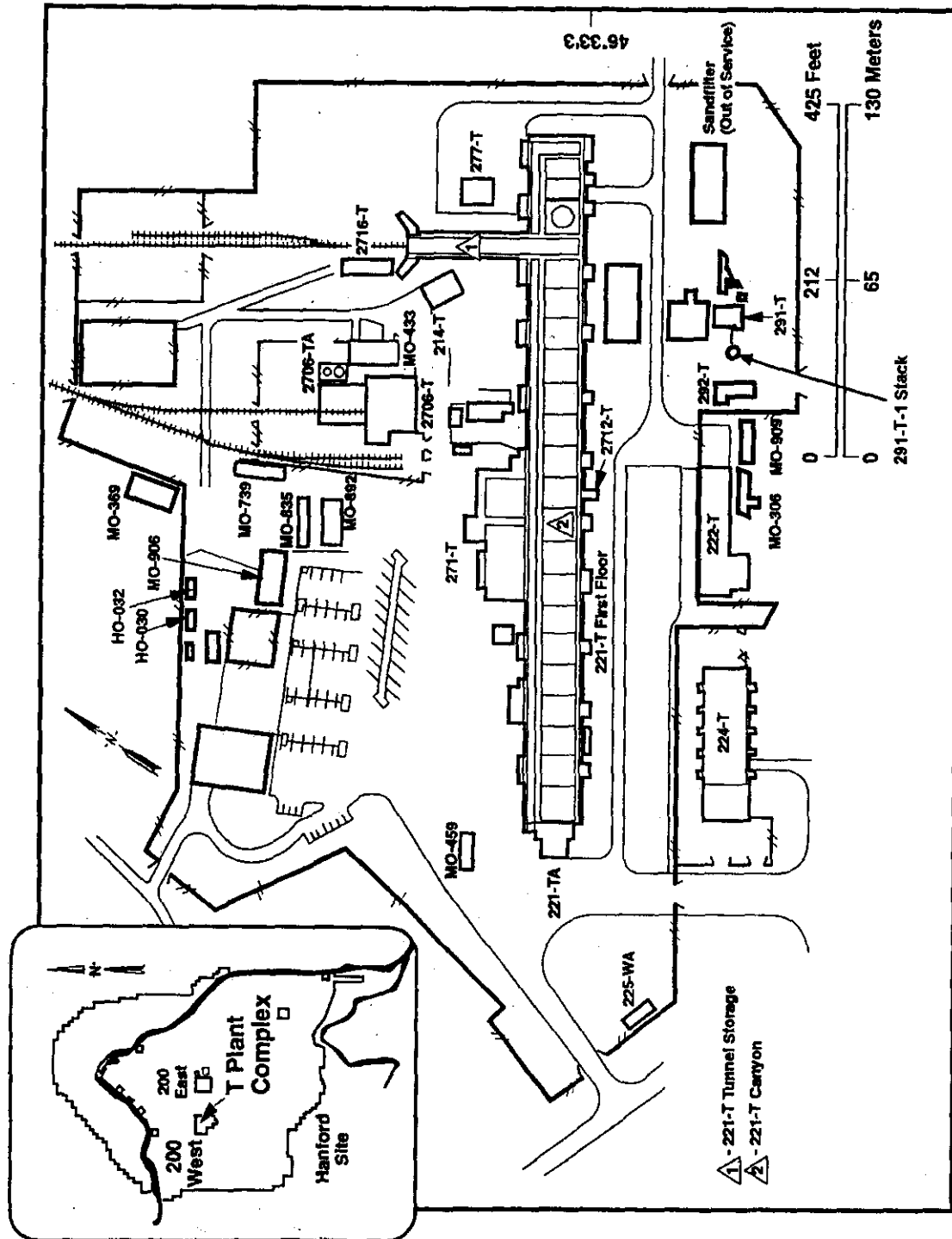
40 HNF-SD-SNF-TI-061, Rev. 1, *Shippingport Pressurized Water Reactor Core 2 Blanket Assemblies*  
41 *Source Term Calculations Using ORIGEN2*, July 1999, Fluor Hanford, Richland, Washington  
42

43 HNF-0528-3, *NESHAP Quality Assurance Project Plan for Radioactive Air Emissions*, September 1998,  
44 Fluor Hanford, Richland, Washington.  
45

46 HNF-3553, Annex A, Rev. 0-A, Addendum A, *Spent Nuclear Fuel Project Canister Storage Building*  
47 *Final Safety Analysis Report*, May 2000, Fluor Hanford, Richland, Washington.  
48

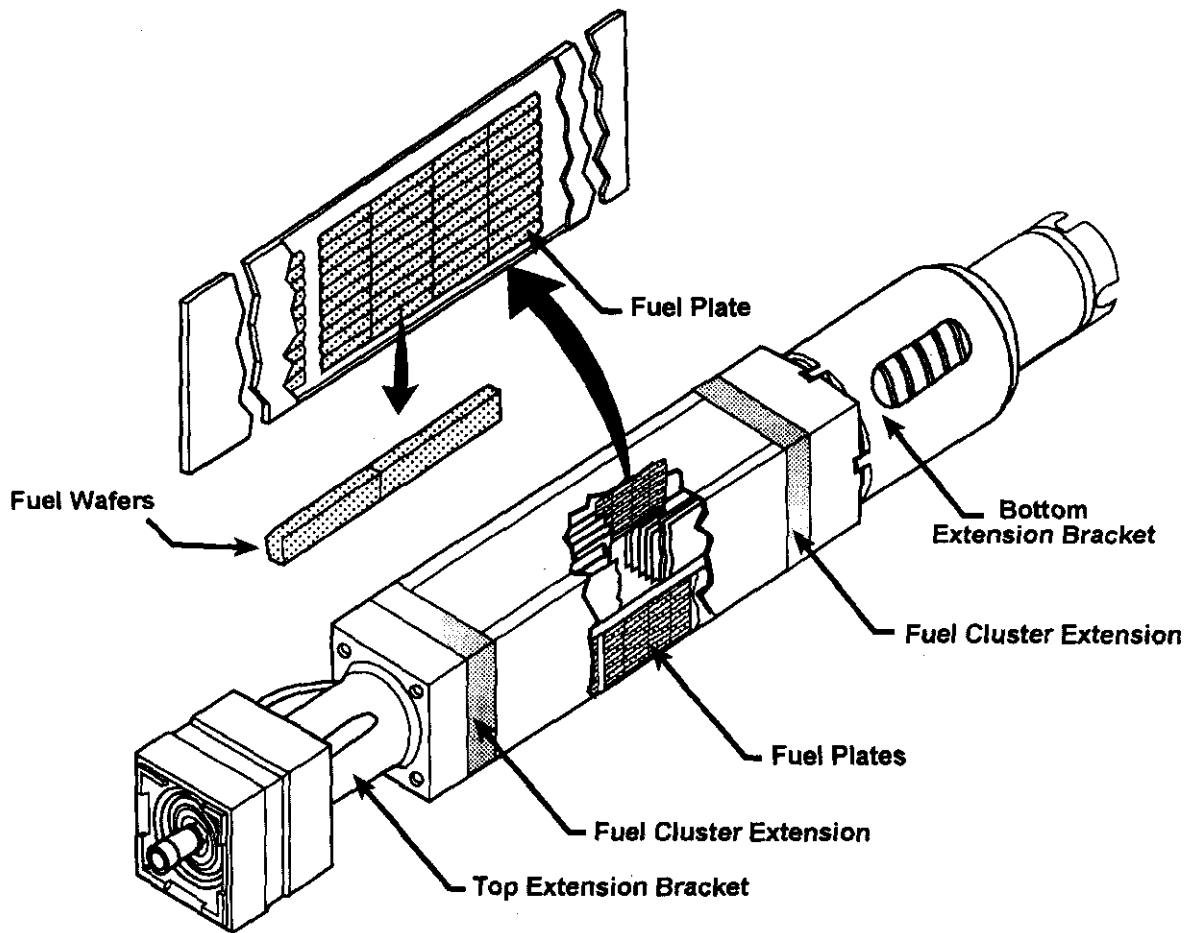
49 HNF-6456, Rev.0, *Solid Waste Treatment Facility Fuel Removal Project Execution Plan*,  
50 September 2000, Fluor Hanford, Richland, Washington.

- 1
- 2 PNNL 2000a, E-mail: L. H. Staven (PNNL) to R. E. Johnson (FH), *200w factors*, May 16, 2000.
- 3
- 4 PNNL 2000b, E-mail: L. H. Staven (PNNL) to R. E. Johnson (FH), *200w synopsis files for 10 and 40 m*
- 5 *release heights*, May 25, 2000.
- 6
- 7 WAPD-MT[CRCT]-45, Letter, E. F. Benz to F. L. Lau, "Crud Activity Estimate for PWR Core",
- 8 August 11, 1977
- 9



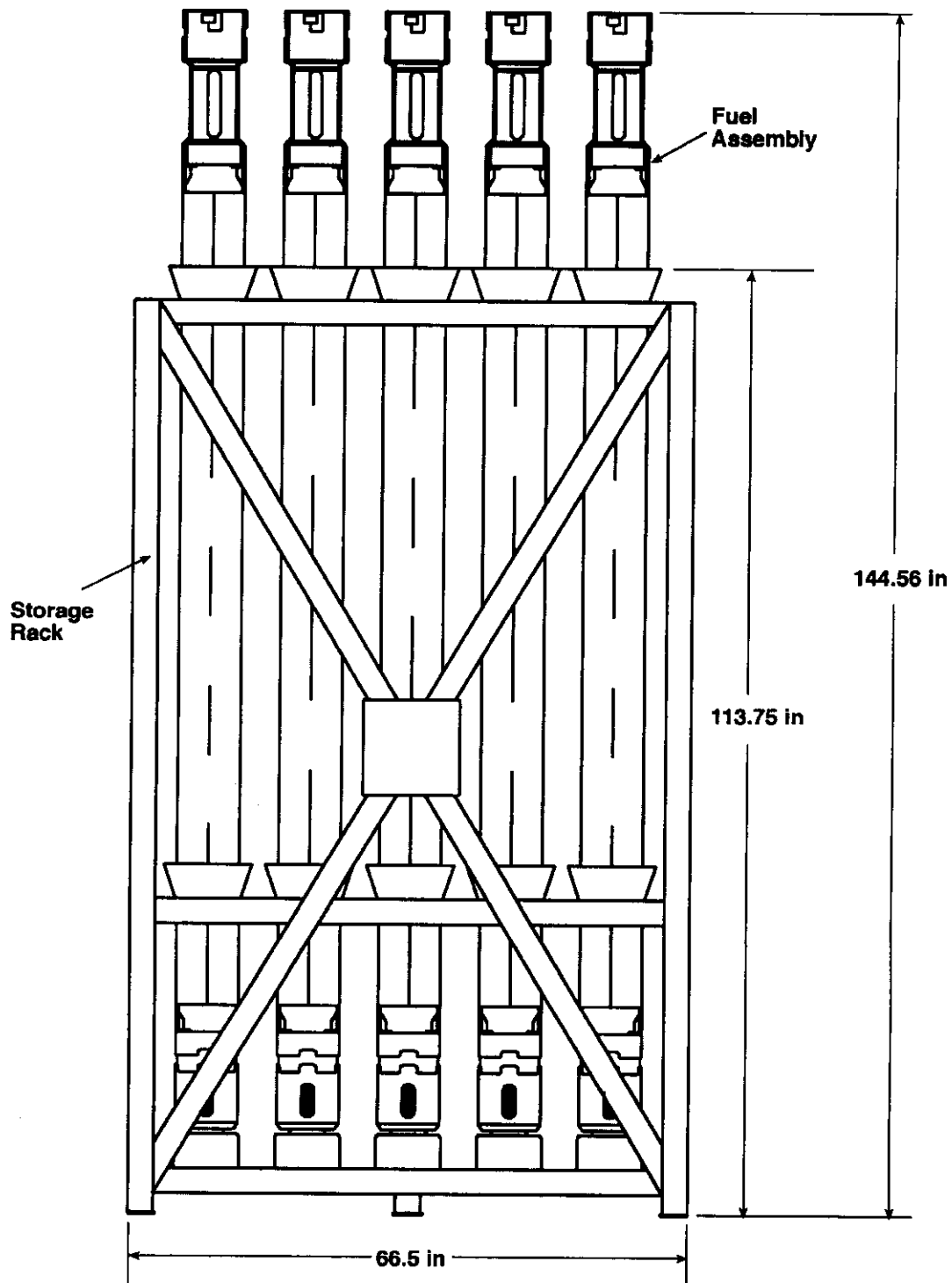
H00100072.50  
changed 111.43.46

Figure 1. Location of T Plant Complex and the 291-T-1 Stack in the 200 West Area.



G00090100.1

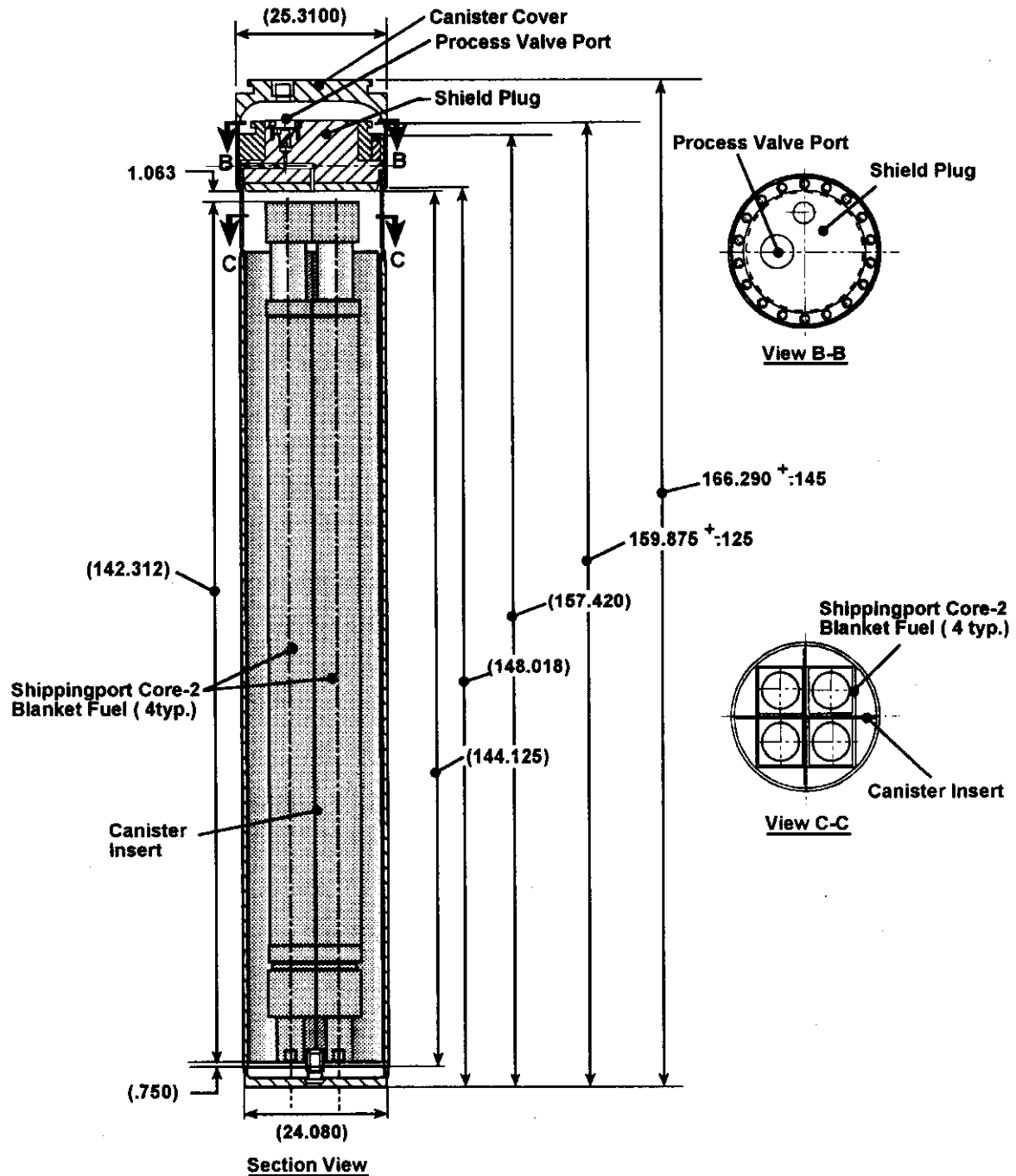
Figure 2. PWR Core 2 Blanket Fuel Assembly.



Source: HNF-6456

H00080137.2

Figure 3. Fuel Assemblies in the Storage Racks

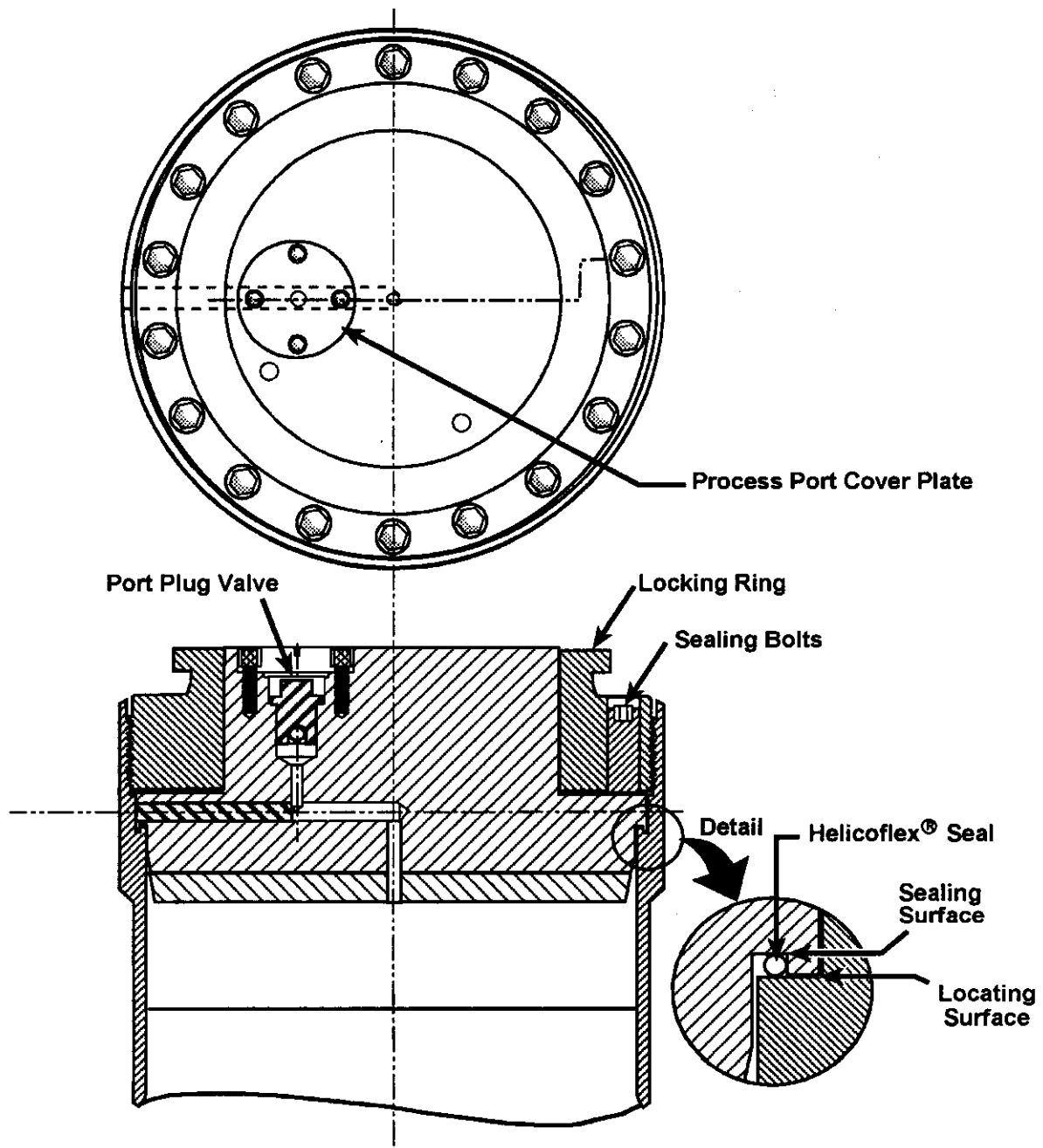


Source: HNF-3553 Rev. 0-A

G00090100.3R1

Figure 4. Shippingport Spent Fuel Canister

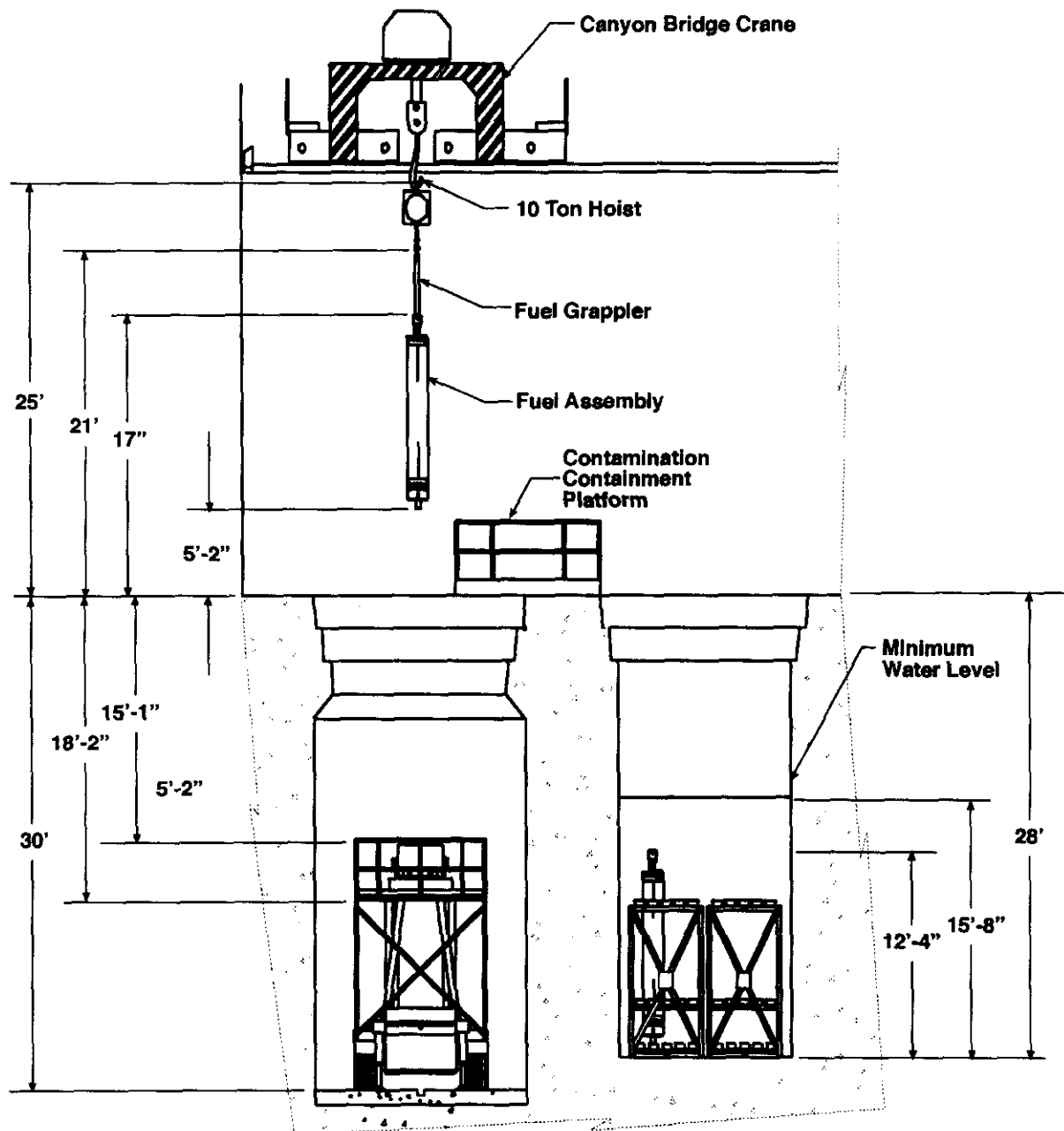




Helicoflex® is a registered trademark of Dennison, Meserole, Pollack and Scheiner, Arlington, VA.

G00090100.2R1

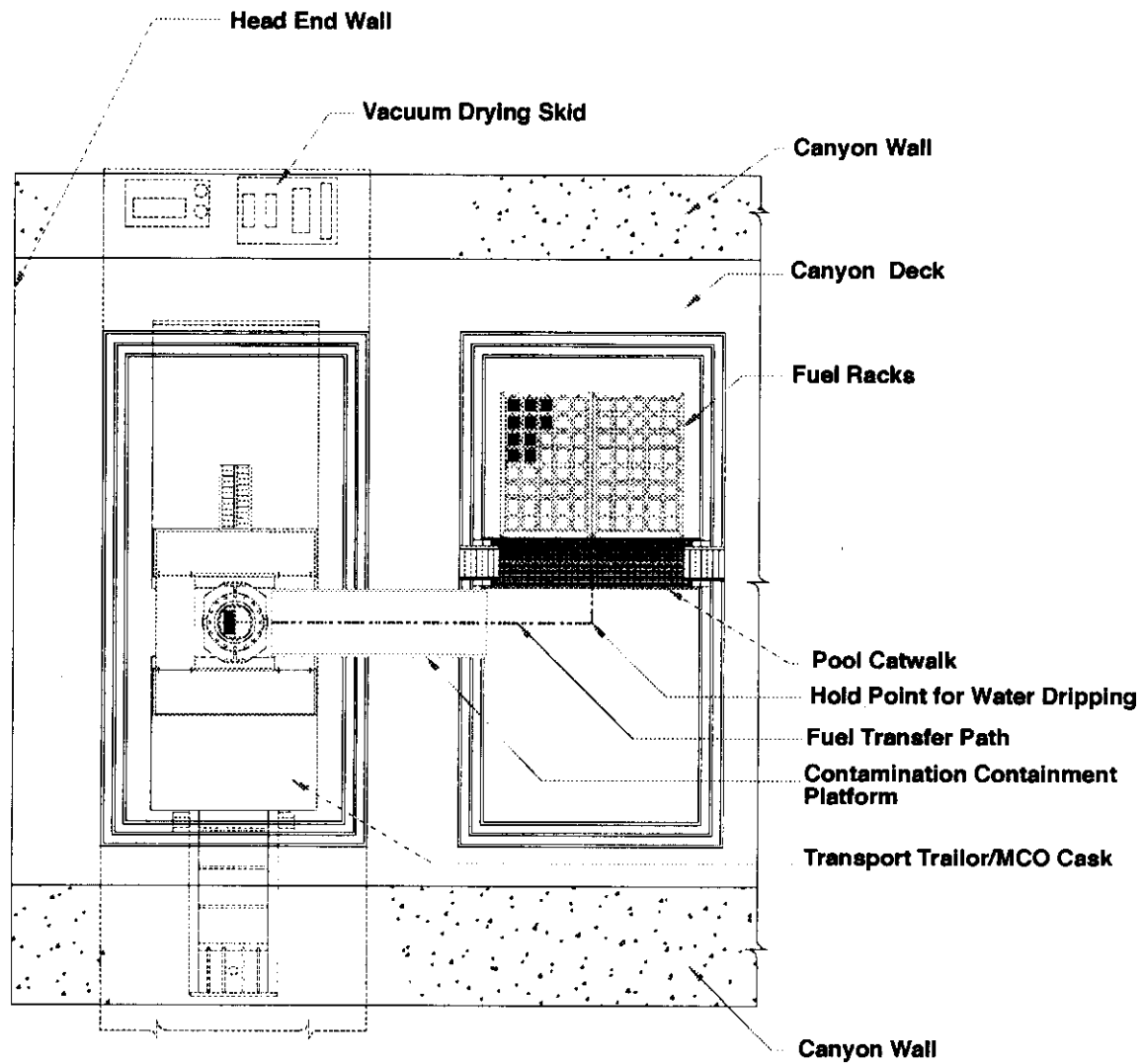
Figure 5. Shippingport Spent Fuel Canister Shield Plug



Source: HNF-6456

H00080137.3a

Figure 6. Vertical Cross-Section of Fuel Pool Cell and Tunnel



MCO = Multicanister Overpack

H00080137.4

Figure 7. Horizontal Cross-Section of Fuel Pool Cell and Tunnel

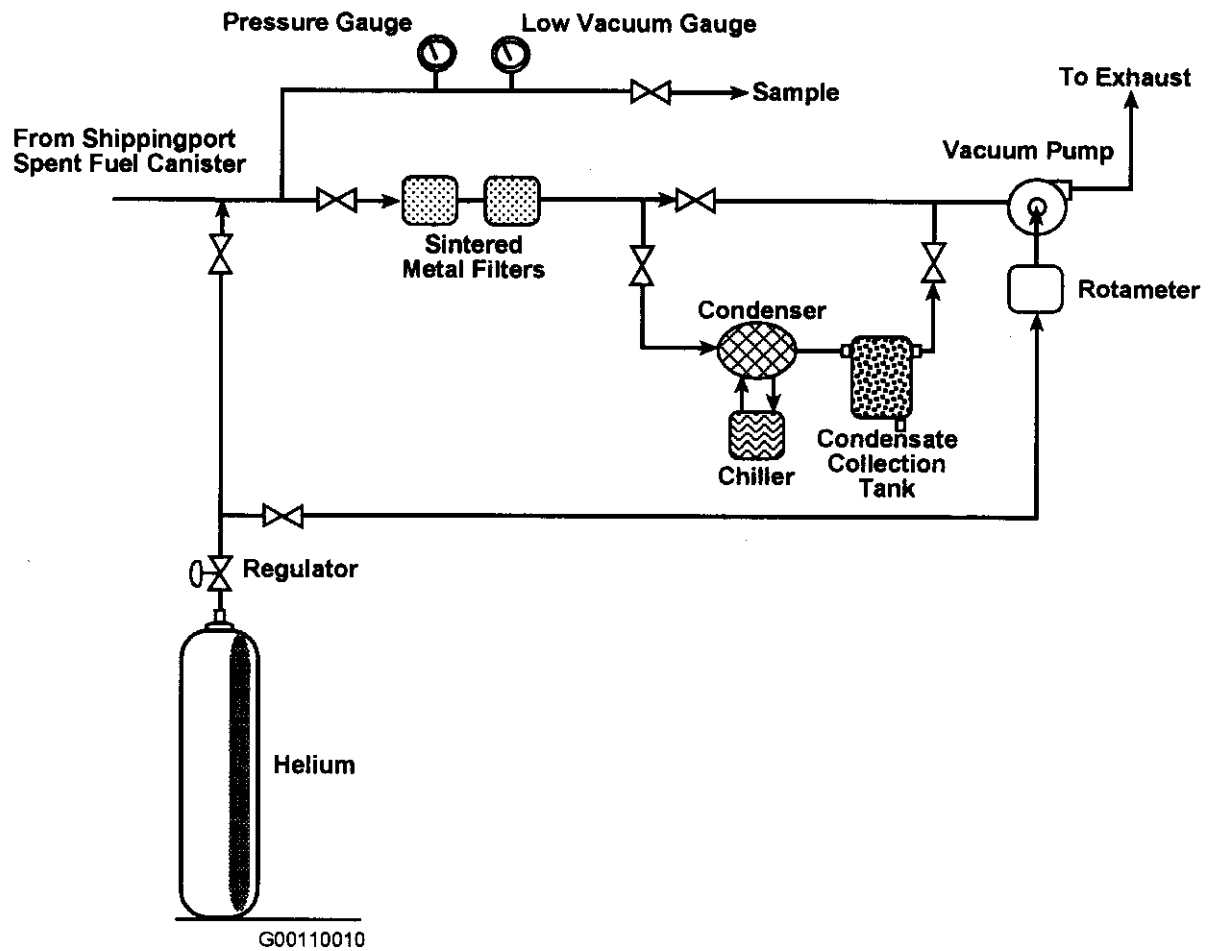


Figure 8. Fuel Conditioning Skid.

H00080137.5

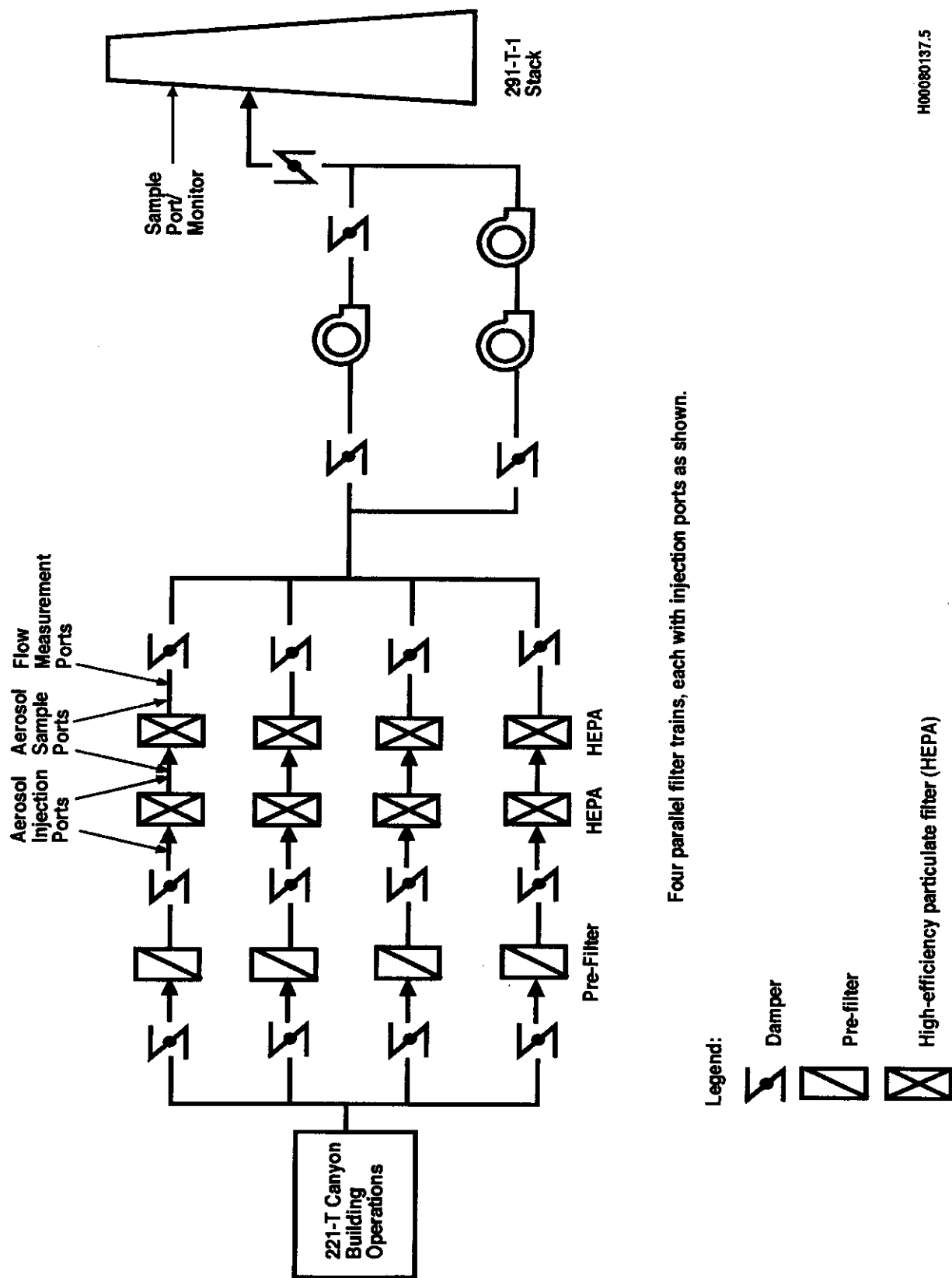


Figure 9. Ventilation Flow Diagram for the 291-T-1 Stack.

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Table 1. T Plant Complex Fuel Removal Project Inventory

Radionuclides	Physical Form	Inventory (Ci)	Release Factor	Potential Release (Ci)
<b>Crud Activity (decayed to 2001)</b>				
Fe-55	particulate	2.4 E-4	1.0 E-3	2.4 E-7
Co-60	particulate	7.3 E-3	1.0 E-3	7.3 E-6
Ni-63	particulate	1.2 E-2	1.0 E-3	1.2 E-5
Sr-90	particulate	4.6 E-4	1.0 E-3	4.6 E-7
Pu-238	particulate	5.7 E-4	1.0 E-3	5.7 E-7
<b>Spent Fuel Pool Water Activity</b>				
C0-60	liquid	1.3 E-3	1.0 E-3	1.3 E-6
Cs-137	liquid	6.8 E-5	1.0 E-3	6.8 E-8

Table 2. T Plant Complex Fuel Removal Project Potential-to-Emit.

Radionuclides	Potential Unabated Release (Ci/yr)	Potential Abated Release (Ci/yr)	Dose Factor CAP88-PC* (mrem/Ci)	Unabated Offsite Dose (mrem/yr)	Abated Offsite Dose (mrem/yr)
Fe-55	2.4 E-7	1.2 E-10	4.79 E-5	1.2 E-11	5.8 E-15
Co-60	8.6 E-6	4.3 E-09	2.33 E-1	2.0 E-06	1.0 E-09
Ni-63	1.2 E-5	6.0 E-09	5.30 E-5	6.4 E-10	3.2 E-13
Sr-90	4.6 E-7	2.3 E-10	8.71 E-3	4.0 E-09	2.0 E-12
Cs-137	6.8 E-8	3.4 E-11	2.09 E-3	1.4 E-10	7.1 E-14
Pu-238	5.7 E-7	2.9 E-10	6.53 E+0	3.7 E-06	1.9 E-09
Total				5.7 E-6	2.9 E-09

\* Attachment 1



**ATTACHMENT 1**

**CALCULATION OF DOSE FROM 200 WEST AREA TO  
ONSITE MEMBER OF THE PUBLIC**

1  
2  
3  
4  
5

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**Calculation of Dose from 200 W Area to Onsite Member of the Public**

L. H. Staven  
May 9, 2000

Pacific Northwest National Laboratory  
Richland, Washington

1  
2  
3  
4  
5  
6

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1 **Introduction**

2  
3 Dose estimates for unit Ci releases of selected radionuclides were calculated for emissions from the 200  
4 West Area of the Hanford Site. These estimates will be used as generic dose conversion factors to  
5 determine emission monitoring requirements for the 200 West facilities.

6  
7 **Methods for Calculating Radiation Dose**

8  
9 The desktop computer version of the Clean Air Act Compliance code (CAP88-PC, Parks 1992) was used  
10 to calculate the effective dose equivalent (EDE) to the receptors from routine chronic 10 and 40 m  
11 releases from 200 West Area.

12  
13 **Release and Atmospheric Transport Assumptions**

14  
15 Redox was selected as the most conservative facility to model 200 West Area emissions because it is the  
16 closest to the receptors. One Ci of each selected radionuclide was assumed to leave the facility at 10 and  
17 40 m heights with no plume rise.

18  
19 The 200 West meteorological data were used to model the direction and probability of dispersion. Data  
20 were collected at the 10 m height for calendar years 1983 through 1996 in 200 West Area.

21  
22 Locations around Hanford boundaries, and selected onsite non-DOE facilities were modeled to determine  
23 the locations with the highest  $\text{chi}/Q$ , or the probability to have the greatest integrated air concentration  
24 over the course of a year. Those sites with the highest  $\text{chi}/Q$  were selected to represent the location of  
25 the receptors.

26  
27 **Exposure and Dose Assumptions**

28  
29 The dose from the non-ingestion pathways ( i.e., inhalation and external) is proportional to the amount of  
30 time a receptor spends at the point of exposure. The reported doses for the onsite receptors  
31 conservatively assume that the individual is on site the entire year, for the full 8766 h/y.

32  
33 The onsite public worker was assumed to consume food grown regionally, that is, where the population  
34 is located in a 50 mile radius of the 200 Areas. The ingestion dose is added to the inhalation and external  
35 doses.

36  
37 Hanford specific parameters were used as documented in PNL-3777 (Schreckhise et al., 1990). The  
38 default file used for Hanford calculations is shown in Appendix A.

39  
40  
41 **Calculation Results**

42  
43 Doses were calculated for on onsite member of the public working at LIGO, and are shown in  
44 Table ATT-1-1. The location of the LIGO facility relative to 200 West Area is 18310 m to the east by  
45 southeast.

1 **References**

2

3 Parks, B. S. 1992. User's Guide for CAP88-PC. Version 1.0. 402-B-92-001. Office of Radiation  
4 Programs, U.S. Environmental Protection Agency, Las Vegas, Nevada.

5

6 Schreckhise, R. G., K. Rhoads, J. S. Davis, B. A. Napier, and J. V. Ramsdell. 1993. Recommended  
7 Environmental Dose Calculation Methods and Hanford-Specific Parameters. PNL-3777, Rev. 2. Pacific  
8 Northwest Laboratory, Richland Washington.

9

10

1 **Appendix A**

3 **A.1 Hanford Default Average Individual file for CAP88PC**

5 FILE: DEFAULTP.HAN Hanford Average Ind. Parameters Revised 3/29/00 KR

7 &METE TG = .0728, .1090, .1455 &END

8 &USAG BRTHRT = 9.7E+05, DD1 = 1.0, UF = 79.0, UL = 15.0, UM = 230.0,

9 UV = 140.0 &END

10 &POOL DILFAC = 1.0, USEFAC = 0.01 &END

11 &AGDT FSUBG = 0.25, FSUBL = 0.25, FSUBP = 0.75, FSUBS = 1.0,

12 LAMW = 3.0E-03, MSUBB = 200.0, P = 224.0, QSUBF = 15.6,

13 R1 = 0.25, R2 = 0.25, TAUBEF = .00381, TSUBE1 = 720.0,

14 TSUBE2 = 2160.0, TSUBF = 2.0, TSUBH1 = 0.0, TSUBH2 = 2400.0,

15 TSUBH3 = 336.0, TSUBH4 = 336.0, TSUBS = 34.0, VSUBM = 11.0,

16 YSUBV1 = 0.3, YSUBV2 = 2.0, TSUBB = 50.0 &END

17 &INPUT ILOC = 0, JLOC = 0, PLOC = 100.0, GSCFAC = 0.5 &END

18 &ORGAN NR\_ORGNS = 8, ORGN = 'GONADS ', 'BREAST ', 'R MAR ', 'LUNGS ',

19 'THYROID ', 'ENDOST ', 'RMNDR ', 'EFFEC ',

20 NR\_ORG\_WTS = 7, PATH = 5, 5, 5, 5, 5, 5, 5,

21 ORG\_WTS = 0.25, 0.15, 0.12, 0.12, 0.03, 0.03, 0.30 &END

22 &CANCER NR\_CANCERS = 11, CANC = 'LEUKEMIA', 'BONE ', 'THYROID ',

23 'BREAST ', 'LUNG ', 'STOMACH ', 'BOWEL ',

24 'LIVER ', 'PANCREAS', 'URINARY ', 'OTHER ',

25 &END

26 &GENTIC NR\_GENETICS = 3, GEN\_ORGNS = 'TESTES ', 'OVARIES ', 'AVERAGE ',

27 REPPER = 0.014113 &END

28 &LOCTBLP NTLOC = 4,

29 RNLOC = 'WLSUM ', 'WLSUM ', 'SUM ', 'SUM ',

30 OGLOC = 'SUM ', 'SUM ', 'SUM ', 'SUM ',

31 PTLOC = 7, 7, 7, 7,

32 FALOC = 2, 2, 1, 1,

33 LTABLE = 1, 3, 1, 3, &END

34 &LOCTBLI NTLOC = 2,

35 RNLOC = 'WLSUM ', 'SUM ',

36 OGLOC = 'SUM ', 'SUM ',

37 PTLOC = 7, 7,

38 FALOC = 2, 1,

39 LTABLE = 1, 1, &END

40

41

42

43 **NOTE: The NAMELISTS need to be in the order they are read**

44 **by the program. If a NAMELIST is not needed it will**

45 **simply be ignored. The system reads sequentially until**

46 **it finds a match.**

47

48

```

1  A.2 Hanford Default maximum individual file for CAP88PC
2  FILE: DEFAULTM.HAN Hanford Parameters Revised 6/5/97 KR
3
4  &METE TG = .0728, .1090, .1455 &END
5  &USAG BRTHRT = 9.7E+05, DD1 = 1.0, UF = 98.0, UL = 30.0, UM = 270.0,
6    UV = 220.0 &END
7  &POOL DILFAC = 1.0, USEFAC = 0.01 &END
8  &AGDT FSUBG = 1.0, FSUBL = 1.0, FSUBP = 0.75, FSUBS = 1.0,
9    LAMW = 3.0E-03, MSUBB = 200.0, P = 224.0, QSUBF = 15.6,
10   R1 = 0.25, R2 = 0.25, TAUBEF = .00381, TSUBE1 = 720.0,
11   TSUBE2 = 2160.0, TSUBF = 2.0, TSUBH1 = 0.0, TSUBH2 = 2400.0,
12   TSUBH3 = 24.0, TSUBH4 = 120.0, TSUBS = 15.0, VSUBM = 11.0,
13   YSUBV1 = 0.3, YSUBV2 = 2.0, TSUBB = 50.0 &END
14  &INPUT ILOC = 0, JLOC = 0, PLOC = 100.0, GSCFAC = 1.0 &END
15  &ORGAN NR_ORGNS = 8, ORGN = 'GONADS ', 'BREAST ', 'R MAR ', 'LUNGS ',
16    'THYROID ', 'ENDOST ', 'RMNDR ', 'EFFEC ',
17    NR_ORG_WTS = 7, PATH = 5, 5, 5, 5, 5, 5, 5,
18    ORG_WTS = 0.25, 0.15, 0.12, 0.12, 0.03, 0.03, 0.30 &END
19  &CANCER NR_CANCERS = 11, CANC = 'LEUKEMIA', 'BONE ', 'THYROID',
20    'BREAST ', 'LUNG ', 'STOMACH', 'BOWEL ',
21    'LIVER ', 'PANCREAS', 'URINARY', 'OTHER ',
22    &END
23  &GENTIC NR_GENETICS = 3, GEN_ORGNS = 'TESTES ', 'OVARIES ', 'AVERAGE ',
24    REPPER = 0.014113 &END
25  &LOCTBLP NTLOC = 4,
26    RNLOC = 'WLSUM ', 'WLSUM ', 'SUM ', 'SUM ',
27    OGLOC = 'SUM ', 'SUM ', 'SUM ', 'SUM ',
28    PTLOC = 7, 7, 7, 7,
29    FALOC = 2, 2, 1, 1,
30    LTABLE = 1, 3, 1, 3, &END
31  &LOCTBLI NTLOC = 2,
32    RNLOC = 'WLSUM ', 'SUM ',
33    OGLOC = 'SUM ', 'SUM ',
34    PTLOC = 7, 7,
35    FALOC = 2, 1,
36    LTABLE = 1, 1, &END
37
38
39
40    NOTE: The NAMELISTS need to be in the order they are read
41          by the program. If a NAMELIST is not needed it will
42          simply be ignored. The system reads sequentially until
43          it finds a match.
44

```



1

Table ATT-1-1. 200 West Area -- LIGO Worker (a) CAP88-PC Unit Dose Factors  
by Effective Release Height (40 m) with Regional Ingestion

CHI/q

8.982 E-08 s/m<sup>3</sup>

18310 m ESE

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
H-3	3.23E-06	2.42E-06	5.65E-06	4.28E-01
BE-7	1.72E-04	2.93E-07	1.72E-04	1.70E-03
BE-10 (b)	(Sr-90)	(Sr-90)	(Sr-90)	
C-11	5.41E-07	0.00E+00	5.41E-07	0.00E+00
C-14	2.96E-07	1.69E-04	1.69E-04	9.98E-01
C-15 (c)	0.00E+00	0.00E+00	0.00E+00	
N-13	6.69E-08	0.00E+00	6.69E-08	0.00E+00
O-15	6.37E-14	0.00E+00	6.37E-14	0.00E+00
F-18	7.06E-06	0.00E+00	7.06E-06	0.00E+00
NA-22	1.12E-01	1.04E-03	1.13E-01	9.18E-03
NA-24	1.90E-04	3.46E-07	1.90E-04	1.82E-03
P-32	1.24E-04	1.28E-04	2.52E-04	5.08E-01
S-35	6.10E-06	2.52E-05	3.13E-05	8.05E-01
AR-41	7.16E-06	0.00E+00	7.16E-06	0.00E+00
K-40	6.62E-02	2.82E-03	6.90E-02	4.08E-02
CA-41	9.98E-06	0.00E+00	9.98E-06	0.00E+00
SC-46	1.04E-02	4.52E-05	1.04E-02	4.33E-03
CR-51	6.35E-05	5.32E-07	6.40E-05	8.31E-03
MN-54	1.56E-02	1.06E-05	1.56E-02	6.81E-04
MN-56	2.13E-05	0.00E+00	2.13E-05	0.00E+00
FE-55	3.98E-05	8.11E-06	4.79E-05	1.69E-01
FE-59	3.21E-03	4.34E-05	3.25E-03	1.33E-02
CO-57	2.42E-03	1.68E-05	2.44E-03	6.88E-03
CO-58	4.41E-03	3.54E-05	4.45E-03	7.96E-03
CO-60	2.33E-01	4.26E-04	2.33E-01	1.82E-03
NI-59	2.20E-04	2.31E-06	2.22E-04	1.04E-02
NI-63	4.69E-05	6.06E-06	5.30E-05	1.14E-01
NI-65	8.38E-06	0.00E+00	8.38E-06	0.00E+00
CU-64	1.35E-05	2.66E-09	1.35E-05	1.97E-04
ZN-65	8.34E-03	1.07E-03	9.41E-03	1.13E-01
ZN-69	2.78E-07	0.00E+00	2.78E-07	0.00E+00
ZN-69M	3.56E-05	5.85E-08	3.57E-05	1.64E-03
GA-67	4.46E-05	2.66E-08	4.46E-05	5.96E-04
AS-76	1.17E-04	2.66E-08	1.17E-04	2.27E-04
SE-79 (b)	(Pu-241)	(Pu-241)	(Pu-241)	
BR-82	2.72E-04	2.07E-06	2.74E-04	7.57E-03
BR-83	6.30E-08	0.00E+00	6.30E-08	0.00E+00
BR-84	2.41E-06	0.00E+00	2.41E-06	0.00E+00
BR-85	6.45E-13	0.00E+00	6.45E-13	0.00E+00
KR-83M	1.29E-09	0.00E+00	1.29E-09	0.00E+00

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
KR-85	4.78E-08	0.00E+00	4.78E-08	0.00E+00
KR-85M	1.48E-06	0.00E+00	1.48E-06	0.00E+00
KR-87	3.49E-06	0.00E+00	3.49E-06	0.00E+00
KR-88	1.66E-05	0.00E+00	1.66E-05	0.00E+00
KR-89	6.83E-11	0.00E+00	6.83E-11	0.00E+00
KR-90 (c)	4.20E-37	0.00E+00	4.20E-37	
RB-86	2.71E-04	1.17E-04	3.88E-04	3.01E-01
RB-87	1.52E-04	5.25E-04	6.77E-04	7.75E-01
RB-88	3.27E-07	0.00E+00	3.27E-07	0.00E+00
RB-89	5.98E-07	0.00E+00	5.98E-07	0.00E+00
RB-90	7.36E-12	0.00E+00	7.36E-12	0.00E+00
RB-90M	2.09E-09	0.00E+00	2.09E-09	0.00E+00
SR-89	1.34E-04	3.63E-05	1.70E-04	2.13E-01
SR-90	4.56E-03	4.15E-03	8.71E-03	4.77E-01
SR-91	3.83E-05	2.66E-09	3.83E-05	6.94E-05
SR-92	1.94E-05	0.00E+00	1.94E-05	0.00E+00
Y-90	1.87E-04	2.13E-07	1.87E-04	1.14E-03
Y-90M	7.16E-06	0.00E+00	7.16E-06	0.00E+00
Y-91	1.02E-03	2.13E-05	1.04E-03	2.04E-02
Y-91M	1.44E-06	0.00E+00	1.44E-06	0.00E+00
Y-92	1.77E-05	0.00E+00	1.77E-05	0.00E+00
Y-93	5.03E-05	0.00E+00	5.03E-05	0.00E+00
ZR-93	9.86E-04	6.38E-06	9.92E-04	6.43E-03
ZR-95	3.17E-03	1.41E-05	3.18E-03	4.43E-03
NB-93M	8.24E-04	9.28E-05	9.17E-04	1.01E-01
NB-94	7.75E-01	1.60E-03	7.77E-01	2.05E-03
NB-95	1.77E-03	1.69E-04	1.94E-03	8.74E-02
NB-95M	6.49E-05	1.10E-05	7.59E-05	1.45E-01
NB-97	3.46E-06	0.00E+00	3.46E-06	0.00E+00
NB-97M	7.48E-22	0.00E+00	7.48E-22	0.00E+00
MO-93	2.76E-03	0.00E+00	2.76E-03	0.00E+00
MO-99	1.15E-04	7.98E-07	1.16E-04	6.89E-03
MO-99 +D	1.42E-04	7.98E-07	1.43E-04	5.60E-03
TC-97	3.08E-03	1.80E-04	3.26E-03	5.53E-02
TC-99	1.73E-04	1.54E-03	1.71E-03	8.99E-01
TC-101	6.93E-08	0.00E+00	6.93E-08	0.00E+00
RU-97	5.41E-05	2.66E-08	5.41E-05	4.91E-04
RU-103	1.37E-03	6.65E-06	1.38E-03	4.83E-03
RU-105	2.06E-05	0.00E+00	2.06E-05	0.00E+00
RU-106	9.81E-03	1.01E-04	9.91E-03	1.02E-02
RH-105	2.91E-05	8.88E-07	3.00E-05	2.96E-02
RH-105M	2.27E-28	0.00E+00	2.27E-28	0.00E+00
RH-106 (c)	0.00E+00	0.00E+00	0.00E+00	
PD-107	2.61E-04	5.40E-06	2.66E-04	2.03E-02
PD-109	2.90E-05	1.06E-07	2.91E-05	3.65E-03
AG-109M	4.61E-33	0.00E+00	4.61E-33	0.00E+00
AG-110 (c)	0.00E+00	0.00E+00	0.00E+00	

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
AG-110M	4.13E-02	3.75E-04	4.17E-02	9.00E-03
AG-111	1.46E-04	4.96E-05	1.96E-04	2.53E-01
CD-113 (b)	(Pu-241)	(Pu-241)	(Pu-241)	
CD-113M (b)	(Pu-241)	(Pu-241)	(Pu-241)	
CD-115	1.22E-04	7.45E-07	1.23E-04	6.07E-03
CD-115M	9.53E-04	5.13E-05	1.00E-03	5.11E-02
IN-113M	1.88E-06	0.00E+00	1.88E-06	0.00E+00
IN-115	2.11E-02	1.17E-03	2.23E-02	5.27E-02
IN-115M	4.78E-06	0.00E+00	4.78E-06	0.00E+00
SN-113	3.34E-04	1.06E-04	4.40E-04	2.42E-01
SN-123	5.05E-05	0.00E+00	5.05E-05	0.00E+00
SN-125	5.01E-04	3.24E-05	5.33E-04	6.08E-02
SN-126	3.08E-02	1.03E-03	3.18E-02	3.23E-02
SB-124	6.92E-03	2.39E-05	6.94E-03	3.45E-03
SB-125	2.51E-02	1.06E-05	2.51E-02	4.24E-04
SB-126	2.38E-03	8.51E-06	2.39E-03	3.56E-03
SB-126M	7.21E-07	0.00E+00	7.21E-07	0.00E+00
SB-127	2.91E-04	5.85E-07	2.92E-04	2.01E-03
TE-125M	2.25E-04	2.35E-05	2.49E-04	9.47E-02
TE-127	7.24E-06	0.00E+00	7.24E-06	0.00E+00
TE-127M	4.89E-04	6.81E-05	5.57E-04	1.22E-01
TE-129	9.14E-07	0.00E+00	9.14E-07	0.00E+00
TE-129M	5.68E-04	4.71E-05	6.15E-04	7.65E-02
TE-131	4.80E-07	0.00E+00	4.80E-07	0.00E+00
TE-131M	2.07E-04	5.32E-08	2.07E-04	2.57E-04
TE-132	2.11E-04	7.18E-07	2.12E-04	3.39E-03
TE-133	1.30E-07	0.00E+00	1.30E-07	0.00E+00
TE-133M	6.48E-06	0.00E+00	6.48E-06	0.00E+00
TE-134	1.66E-06	0.00E+00	1.66E-06	0.00E+00
I-122	1.57E-11	0.00E+00	1.57E-11	0.00E+00
I-123	9.89E-06	1.25E-08	9.90E-06	1.26E-03
I-125	2.09E-04	3.15E-04	5.24E-04	6.01E-01
I-129	1.91E-02	5.70E-03	2.48E-02	2.30E-01
I-130	1.10E-04	9.04E-08	1.10E-04	8.21E-04
I-131	4.18E-04	1.54E-04	5.72E-04	2.70E-01
I-132	1.24E-05	0.00E+00	1.24E-05	0.00E+00
I-133	6.46E-05	1.04E-06	6.56E-05	1.59E-02
I-134	2.59E-06	0.00E+00	2.59E-06	0.00E+00
I-135	3.56E-05	0.00E+00	3.56E-05	0.00E+00
XE-122	8.68E-07	0.00E+00	8.68E-07	0.00E+00
XE-123	3.86E-06	0.00E+00	3.86E-06	0.00E+00
XE-125	3.13E-06	0.00E+00	3.13E-06	0.00E+00
XE-127	3.71E-06	0.00E+00	3.71E-06	0.00E+00
XE-131M	1.35E-07	0.00E+00	1.35E-07	0.00E+00
XE-133	4.90E-07	0.00E+00	4.90E-07	0.00E+00
XE-133M	4.18E-07	0.00E+00	4.18E-07	0.00E+00
XE-135	2.82E-06	0.00E+00	2.82E-06	0.00E+00

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
XE-135M	1.19E-07	0.00E+00	1.19E-07	0.00E+00
XE-137	4.59E-11	0.00E+00	4.59E-11	0.00E+00
XE-138	2.77E-07	0.00E+00	2.77E-07	0.00E+00
CS-134	6.85E-02	1.68E-03	7.02E-02	2.39E-02
CS-134M	7.37E-07	0.00E+00	7.37E-07	0.00E+00
CS-135	9.60E-05	2.42E-04	3.38E-04	7.16E-01
CS-136	1.87E-03	6.76E-05	1.94E-03	3.49E-02
CS-137	6.36E-04	1.45E-03	2.09E-03	6.95E-01
CS-137 +D	2.10E-01	1.45E-03	2.11E-01	6.87E-03
CS-138	3.33E-06	0.00E+00	3.33E-06	0.00E+00
CS-139	1.69E-08	0.00E+00	1.69E-08	0.00E+00
BA-133	7.27E-02	0.00E+00	7.27E-02	0.00E+00
BA-133M	1.96E-05	5.32E-08	1.97E-05	2.71E-03
BA-137M	1.24E-12	0.00E+00	1.24E-12	0.00E+00
BA-139	1.37E-06	0.00E+00	1.37E-06	0.00E+00
BA-140	2.40E-04	9.47E-06	2.49E-04	3.80E-02
BA-140 +D	1.88E-03	9.47E-06	1.89E-03	5.01E-03
BA-141	3.55E-07	0.00E+00	3.55E-07	0.00E+00
BA-142	7.67E-08	0.00E+00	7.67E-08	0.00E+00
LA-140	3.39E-04	0.00E+00	3.39E-04	0.00E+00
LA-141	5.57E-07	0.00E+00	5.57E-07	0.00E+00
LA-142	1.62E-05	0.00E+00	1.62E-05	0.00E+00
CE-141	3.57E-04	5.05E-06	3.62E-04	1.40E-02
CE-143	9.66E-05	2.66E-08	9.66E-05	2.75E-04
CE-144	8.05E-03	6.38E-05	8.11E-03	7.87E-03
PR-143	1.74E-04	3.99E-06	1.78E-04	2.24E-02
PR-144	5.68E-08	0.00E+00	5.68E-08	0.00E+00
PR-144M	1.01E-09	0.00E+00	1.01E-09	0.00E+00
ND-147	2.40E-04	2.85E-06	2.43E-04	1.17E-02
PM-147	7.95E-04	5.85E-06	8.01E-04	7.31E-03
PM-148	4.15E-04	1.86E-06	4.17E-04	4.47E-03
PM-148M	6.11E-03	2.93E-05	6.14E-03	4.77E-03
PM-149	6.68E-05	5.32E-08	6.69E-05	7.96E-04
PM-151	2.73E-05	0.00E+00	2.73E-05	0.00E+00
SM-147	1.53E+00	1.06E-03	1.53E+00	6.95E-04
SM-151	6.18E-04	2.39E-06	6.20E-04	3.86E-03
SM-153	5.19E-05	2.66E-08	5.19E-05	5.12E-04
EU-152	2.35E-01	2.66E-05	2.35E-01	1.13E-04
EU-152M	9.04E-06	0.00E+00	9.04E-06	0.00E+00
EU-154	1.90E-01	5.32E-05	1.90E-01	2.80E-04
EU-155	7.42E-03	1.06E-05	7.43E-03	1.43E-03
EU-156	1.46E-03	1.12E-05	1.47E-03	7.59E-03
GD-152 (b)	(Pu-239)	(Pu-239)	(Pu-239)	
TB-160	5.08E-03	2.39E-05	5.10E-03	4.69E-03
HO-166	7.22E-05	0.00E+00	7.22E-05	0.00E+00
HO-166M	7.76E-01	0.00E+00	7.76E-01	0.00E+00
HF-181	1.72E-03	9.84E-06	1.73E-03	5.69E-03

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
W-181	3.27E-04	5.80E-06	3.33E-04	1.74E-02
W-185	1.59E-05	2.66E-05	4.25E-05	6.26E-01
W-187	4.48E-05	2.66E-08	4.48E-05	5.93E-04
RE-187	1.13E-06	6.95E-07	1.82E-06	3.81E-01
IR-192	4.42E-03	1.49E-05	4.43E-03	3.36E-03
HG-203	8.14E-04	1.42E-04	9.56E-04	1.49E-01
TL-207	2.09E-11	0.00E+00	2.09E-11	0.00E+00
TL-208	7.77E-11	0.00E+00	7.77E-11	0.00E+00
TL-209	4.94E-13	0.00E+00	4.94E-13	0.00E+00
PB-209	1.17E-06	0.00E+00	1.17E-06	0.00E+00
PB-210	2.86E-01	2.02E-02	3.06E-01	6.60E-02
PB-210 +D	2.86E-01	2.02E-02	3.06E-01	6.61E-02
PB-211	2.20E-05	0.00E+00	2.20E-05	0.00E+00
PB-212	2.89E-03	0.00E+00	2.89E-03	0.00E+00
PB-214	1.54E-06	0.00E+00	1.54E-06	0.00E+00
BI-210	3.96E-03	0.00E+00	3.96E-03	0.00E+00
BI-211	2.53E-13	0.00E+00	2.53E-13	0.00E+00
BI-212	1.54E-04	0.00E+00	1.54E-04	0.00E+00
BI-213	4.28E-06	0.00E+00	4.28E-06	0.00E+00
BI-214	1.08E-06	0.00E+00	1.08E-06	0.00E+00
PO-210	1.79E-01	5.80E-03	1.85E-01	3.14E-02
PO-212 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-213 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-214 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-215 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-216 (c)	0.00E+00	0.00E+00	0.00E+00	
PO-218	1.78E-12	0.00E+00	1.78E-12	0.00E+00
AT-217 (c)	0.00E+00	0.00E+00	0.00E+00	
RN-219 (e)	5.15E-04	3.64E-05	5.51E-04	6.61E-02
RN-220 (e)	4.05E-06	0.00E+00	4.05E-06	0.00E+00
RN-222	5.95E-05	0.00E+00	5.95E-05	0.00E+00
FR-221	1.00E-08	0.00E+00	1.00E-08	0.00E+00
FR-223	2.57E-06	0.00E+00	2.57E-06	0.00E+00
RA-223	1.70E-01	6.91E-04	1.71E-01	4.05E-03
RA-224	7.09E-02	5.32E-05	7.10E-02	7.50E-04
RA-225	8.59E-02	7.45E-04	8.66E-02	8.59E-03
RA-226	1.85E-01	5.11E-03	1.90E-01	2.69E-02
RA-228	5.00E-02	2.61E-03	5.26E-02	4.95E-02
AC-225	1.25E-01	5.32E-05	1.25E-01	4.25E-04
AC-227	1.31E+01	1.06E-02	1.31E+01	8.11E-04
AC-228	1.31E-03	0.00E+00	1.31E-03	0.00E+00
TH-227	2.41E-01	2.66E-05	2.41E-01	1.10E-04
TH-228	5.19E+00	0.00E+00	5.19E+00	0.00E+00
TH-229	1.44E+01	2.66E-03	1.44E+01	1.85E-04
TH-230	5.13E+00	2.66E-03	5.13E+00	5.18E-04
TH-231	1.98E-05	0.00E+00	1.98E-05	0.00E+00
TH-232	7.39E+00	0.00E+00	7.39E+00	0.00E+00

Nuclide	No Ingestion (mrem/yr)	Ingestion Only (mrem/yr)	Total With Ingestion (mrem/yr)	Percent Ingestion
TH-232 +D	8.62E+00	1.09E-04	8.62E+00	1.26E-05
TH-234	7.47E-04	1.89E-05	7.66E-04	2.47E-02
PA-231	9.89E+00	1.60E-02	9.91E+00	1.61E-03
PA-233	5.75E-04	5.32E-06	5.80E-04	9.17E-03
PA-234	5.93E-05	0.00E+00	5.93E-05	0.00E+00
PA-234M	3.02E-21	0.00E+00	3.02E-21	0.00E+00
U-232	9.87E+00	1.06E-02	9.88E+00	1.08E-03
U-233	2.75E+00	2.66E-03	2.75E+00	9.66E-04
U-234	2.71E+00	5.32E-03	2.72E+00	1.96E-03
U-235	2.59E+00	4.26E-03	2.59E+00	1.64E-03
U-236	2.57E+00	4.26E-03	2.57E+00	1.65E-03
U-237	1.41E-04	1.65E-06	1.43E-04	1.16E-02
U-238	2.41E+00	3.99E-03	2.41E+00	1.65E-03
U-240	4.46E-05	0.00E+00	4.46E-05	0.00E+00
NP-237	1.01E+01	1.33E-02	1.01E+01	1.31E-03
NP-238	7.07E-04	0.00E+00	7.07E-04	0.00E+00
NP-239	8.13E-05	2.66E-08	8.13E-05	3.27E-04
NP-240	4.74E-06	0.00E+00	4.74E-06	0.00E+00
NP-240M	6.64E-09	0.00E+00	6.64E-09	0.00E+00
PU-236	1.81E+00	1.33E-03	1.81E+00	7.34E-04
PU-238	6.52E+00	1.33E-02	6.53E+00	2.04E-03
PU-239	7.01E+00	1.06E-02	7.02E+00	1.52E-03
PU-240	7.01E+00	1.33E-02	7.02E+00	1.89E-03
PU-241	1.07E-01	2.39E-04	1.07E-01	2.23E-03
PU-242	6.67E+00	1.06E-02	6.68E+00	1.59E-03
PU-243	3.63E-06	0.00E+00	3.63E-06	0.00E+00
PU-244	6.62E+00	1.33E-02	6.63E+00	2.00E-03
AM-241	1.12E+01	1.33E-02	1.12E+01	1.19E-03
AM-242	1.09E-03	0.00E+00	1.09E-03	0.00E+00
AM-242M	1.07E+01	1.33E-02	1.07E+01	1.24E-03
AM-243	1.12E+01	1.33E-02	1.12E+01	1.19E-03
CM-242	3.68E-01	2.66E-04	3.68E-01	7.22E-04
CM-243	7.50E+00	7.98E-03	7.51E+00	1.06E-03
CM-244	5.89E+00	7.98E-03	5.90E+00	1.35E-03
CM-245	1.15E+01	1.33E-02	1.15E+01	1.16E-03
CM-246	1.14E+01	1.33E-02	1.14E+01	1.17E-03
CM-247	1.06E+01	1.33E-02	1.06E+01	1.25E-03
CM-248	4.19E+01	5.32E-02	4.20E+01	1.27E-03
CF-252	3.18E+00	2.66E-03	3.18E+00	8.36E-04

(a) Doses to workers conservatively assume that the worker is onsite 24 hours a day.

(b) Dose factors not included in the CAP88PC library. Suggest using DCF from radionuclide in parentheses.

(c) Very short-lived radionuclide. Dose is zero for onsite Public worker.

(d) "+D" designation indicates that the doses from grow-in progeny are included in the reported dose.

(e) Short-lived Rn isotopes were modeled based on the dose from their long-lived progeny. For each Ci of Rn-219 released, 0.0018 Ci of Pb-210 is generated. Each Ci of Rn-220 produces 0.0014 Ci of Pb-212. Dose is based on the Pb progeny times the appropriate equilibrium factor.

**ATTACHMENT 2**

**CAP88-PC SYNOPSIS REPORT (1 OF 10)**

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C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

SYNOPSIS REPORT

Non-Radon Individual Assessment  
May 9, 2000 10:36 am

Facility: 200W REDOX 40m eff DATASET1  
Address: BATTELLE PNL  
POB 999  
City: RICHLAND  
State: WA Zip: 99352

Effective Dose Equivalent  
(mrem/year)

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4.56E-01

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At This Location: 18310 Meters East Southeast

Source Category: 40.0 M STACK UNIT CI AIRBORNE RELEASE  
Source Type: Stack  
Emission Year:

Comments: worker set 1 (of 10) use defaultp.han

Dataset Name: w 2w 40m set1  
Dataset Date: May 9, 2000 10:26 am  
Wind File: WNDFILES\HS200W10.WND

C A U T I O N: Defaults Have Been Changed

(Changes Detailed on Next Page)

**CAUTION!**

The Following DEFAULT VALUES Have Been Changed By The User.

These changes CANNOT BE USED to demonstrate compliance  
per 40 CFR 61.93(a) unless specifically approved by EPA.

Inhalation Rate of Man

Changed From: 9.1670E+05  
To: 9.7000E+05

Fraction Radioactivity on Veg. & Prod. after Washing

Changed From: 0.5000  
To: 1.000

Ingestion Rate of Meat by Man

Changed From: 85.00  
To: 98.00

Ingestion Rate of Leafy Veg. by Man

Changed From: 18.00  
To: 30.00

Ingestion Rate of Milk by Man

Changed From: 112.0  
To: 270.0

Ingestion Rate of Produce by Man

Changed From: 176.0  
To: 220.0

Fraction Time Spent Swimming

Changed From: 0.0000  
To: 1.0000E-02

Fraction Year Animals Graze on Pasture

Changed From: 0.4000  
To: 0.7500

Fraction Year Animals Graze on Pasture

Changed From: 0.4300  
To: 1.0000

The Following DEFAULT VALUES Have Been Changed By The User  
(Continued):

Removal Rate Constant - Physical Loss by Weathering

Changed From: 2.9000E-03  
To: 3.0000E-03

Effec. Surface Density of Soil, Dry Weight

Changed From: 215.0  
To: 224.0

Fallout interception Fraction-Pasture

Changed From: 0.5700  
To: 0.2500

Fallout Interception Fraction-Vegetable

Changed From: 0.2000  
To: 0.2500

Period Exposure - Growing Season - Crops/Leafy Veg.

Changed From: 1440.  
To: 2160.

Time Delay - Ingestion Stored Feed

Changed From: 2160.  
To: 2400.

Time Delay - Ingestion Leafy Veg. - Man

Changed From: 336.0.  
To: 24.00

Time Delay - Ingestion Produce - Man

Changed From: 336.0.  
To: 120.0

Avg. Time - Slaughter to Consumption

Changed From: 20.00  
To: 34.00

The Following DEFAULT VALUES Have Been Changed By The User  
(Continued):

Agr. Productivity by Unit Area - Milk

Changed From: 0.2800  
To: 0.3000

Agr. Productivity by Unit Area - Prod/Leafy Veg.

Changed From: 0.7160  
To: 2.000

Period Long-term Buildup in Soil

Changed From: 100.0  
To: 50.00

Direction Single Location - Individual Calculation

Changed From: 0  
To: 12

Direction Single Location - Individual Calculation

Changed From: 0  
To: 1

Ground Surface Correction Factor

Changed From: 0.5000  
To: 1.000

May 9, 2000 10:36 am

SYNOPSIS

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(w 2w 40m set1)

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 18310 Meters East Southeast  
Lifetime Fatal Cancer Risk: 1.12E-05

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Dose Equivalent (mrem/y))
GONADS	5.28E-01
BREAST	4.80E-01
R MAR	4.07E-01
LUNGS	4.37E-01
THYROID	5.01E-01
ENDOST	4.36E-01
RMNDR	4.09E-01
EFFEC	4.56E-01

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## SYNOPSIS

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(w 2w 40m set1)

## RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source	Ci/y	Ci/y
		#1 TOTAL Size		
H-3	*	0.00	1.0E+00	1.0E+00
BE-7	Y	1.00	1.0E+00	1.0E+00
BE-10		0.00	1.0E+00	1.0E+00
C-11	D	1.00	1.0E+00	1.0E+00
C-14	*	0.00	1.0E+00	1.0E+00
C-15	D	1.00	1.0E+00	1.0E+00
N-13	D	1.00	1.0E+00	1.0E+00
O-15	D	1.00	1.0E+00	1.0E+00
F-18	D	1.00	1.0E+00	1.0E+00
NA-22	D	1.00	1.0E+00	1.0E+00
NA-24	D	1.00	1.0E+00	1.0E+00
P-32	D	1.00	1.0E+00	1.0E+00
S-35	D	1.00	1.0E+00	1.0E+00
AR-41	*	0.00	1.0E+00	1.0E+00
K-40	D	1.00	1.0E+00	1.0E+00
CA-41		0.00	1.0E+00	1.0E+00
SC-46	Y	1.00	1.0E+00	1.0E+00
CR-51	Y	1.00	1.0E+00	1.0E+00
MN-54	W	1.00	1.0E+00	1.0E+00
MN-56	W	1.00	1.0E+00	1.0E+00
FE-55	W	1.00	1.0E+00	1.0E+00
FE-59	W	1.00	1.0E+00	1.0E+00
CO-57	Y	1.00	1.0E+00	1.0E+00
CO-58	Y	1.00	1.0E+00	1.0E+00
CO-60	Y	1.00	1.0E+00	1.0E+00
NI-59	W	1.00	1.0E+00	1.0E+00
NI-63	W	1.00	1.0E+00	1.0E+00
NI-65	W	1.00	1.0E+00	1.0E+00
CU-64	Y	1.00	1.0E+00	1.0E+00
ZN-65	Y	1.00	1.0E+00	1.0E+00
ZN-69	Y	1.00	1.0E+00	1.0E+00
ZN-69M	Y	1.00	1.0E+00	1.0E+00

## SITE INFORMATION

Temperature: 12 degrees C

Precipitation: 16 cm/y

Mixing Height: 1000 m

May 9, 2000 10:36 am

SYNOPSIS

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(w 2w 40m set2)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source	Ci/y	Ci/y
		#1 TOTAL Size		
GA-67	W	1.00	1.0E+00	1.0E+00
AS-76	W	1.00	1.0E+00	1.0E+00
SE-79		0.00	1.0E+00	1.0E+00
BR-82	D	1.00	1.0E+00	1.0E+00
BR-83		0.00	1.0E+00	1.0E+00
BR-84		0.00	1.0E+00	1.0E+00
BR-85		0.00	1.0E+00	1.0E+00
KR-83M	*	0.00	1.0E+00	1.0E+00
KR-85	*	0.00	1.0E+00	1.0E+00
KR-87	*	0.00	1.0E+00	1.0E+00
KR-88	*	0.00	1.0E+00	1.0E+00
KR-89	*	0.00	1.0E+00	1.0E+00
Kr-90	*	0.00	1.0E+00	1.0E+00
RB-86	D	1.00	1.0E+00	1.0E+00
RB-87	D	1.00	1.0E+00	1.0E+00
RB-88	D	1.00	1.0E+00	1.0E+00
RB-89	D	1.00	1.0E+00	1.0E+00
RB-90		0.00	1.0E+00	1.0E+00
RB-90M		0.00	1.0E+00	1.0E+00
SR-89	D	1.00	1.0E+00	1.0E+00
SR-90	D	1.00	1.0E+00	1.0E+00
SR-91	D	1.00	1.0E+00	1.0E+00
SR-92	D	1.00	1.0E+00	1.0E+00
Y-90	Y	1.00	1.0E+00	1.0E+00
Y-90M		0.00	1.0E+00	1.0E+00
Y-91	Y	1.00	1.0E+00	1.0E+00
Y-91M	Y	1.00	1.0E+00	1.0E+00
Y-92	Y	1.00	1.0E+00	1.0E+00
Y-93	Y	1.00	1.0E+00	1.0E+00
ZR-93	W	1.00	1.0E+00	1.0E+00
ZR-95	W	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m

May 9, 2000 10:37 am

SYNOPSIS

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(w 2w 40m set3)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source	Ci/y	Ci/y
		#1 TOTAL Size		
NB-93M	Y	1.00	1.0E+00	1.0E+00
NB-94	Y	1.00	1.0E+00	1.0E+00
NB-95	Y	1.00	1.0E+00	1.0E+00
NB-95M	Y	1.00	1.0E+00	1.0E+00
NB-97	Y	1.00	1.0E+00	1.0E+00
NB-97M	Y	1.00	1.0E+00	1.0E+00
MO-93		0.00	1.0E+00	1.0E+00
MO-99	Y	1.00	1.0E+00	1.0E+00
TC-99M	W	1.00	1.0E+00	1.0E+00
TC-97	W	1.00	1.0E+00	1.0E+00
TC-99	W	1.00	1.0E+00	1.0E+00
TC-101		0.00	1.0E+00	1.0E+00
RU-97	Y	1.00	1.0E+00	1.0E+00
RU-103	Y	1.00	1.0E+00	1.0E+00
RU-105	Y	1.00	1.0E+00	1.0E+00
RU-106	Y	1.00	1.0E+00	1.0E+00
RH-105	Y	1.00	1.0E+00	1.0E+00
RH-105M	Y	1.00	1.0E+00	1.0E+00
RH-106	Y	1.00	1.0E+00	1.0E+00
PD-107	Y	1.00	1.0E+00	1.0E+00
PD-109	Y	1.00	1.0E+00	1.0E+00
AG-109M	Y	1.00	1.0E+00	1.0E+00
AG-110	Y	1.00	1.0E+00	1.0E+00
AG-110M	Y	1.00	1.0E+00	1.0E+00
AG-111	Y	1.00	1.0E+00	1.0E+00
CD-113		0.00	1.0E+00	1.0E+00
CD-113M		0.00	1.0E+00	1.0E+00
CD-115	Y	1.00	1.0E+00	1.0E+00
CD-115M	Y	1.00	1.0E+00	1.0E+00
IN-113M	W	1.00	1.0E+00	1.0E+00
IN-115	W	1.00	1.0E+00	1.0E+00
IN-115M	W	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m



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SYNOPSIS

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(w 2w 40m set4)

# RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source	Ci/y	Ci/y
		#1 TOTAL Size		
SN-113	W	1.00	1.0E+00	1.0E+00
SN-125		0.00	1.0E+00	1.0E+00
SN-126	W	1.00	1.0E+00	1.0E+00
SB-124	W	1.00	1.0E+00	1.0E+00
SB-125	W	1.00	1.0E+00	1.0E+00
SB-126	W	1.00	1.0E+00	1.0E+00
SB-126M	W	1.00	1.0E+00	1.0E+00
SB-127	W	1.00	1.0E+00	1.0E+00
TE-125M	W	1.00	1.0E+00	1.0E+00
TE-127	W	1.00	1.0E+00	1.0E+00
TE-127M	W	1.00	1.0E+00	1.0E+00
TE-129	W	1.00	1.0E+00	1.0E+00
TE-129M	W	1.00	1.0E+00	1.0E+00
TE-131	W	1.00	1.0E+00	1.0E+00
TE-131M	W	1.00	1.0E+00	1.0E+00
TE-132	W	1.00	1.0E+00	1.0E+00
TE-133		0.00	1.0E+00	1.0E+00
TE-133M		0.00	1.0E+00	1.0E+00
TE-134		0.00	1.0E+00	1.0E+00
I-122	D	1.00	1.0E+00	1.0E+00
I-123	D	1.00	1.0E+00	1.0E+00
I-125	D	1.00	1.0E+00	1.0E+00
I-129	D	1.00	1.0E+00	1.0E+00
I-130	D	1.00	1.0E+00	1.0E+00
I-131	D	1.00	1.0E+00	1.0E+00
I-132	D	1.00	1.0E+00	1.0E+00
I-133	D	1.00	1.0E+00	1.0E+00
I-134	D	1.00	1.0E+00	1.0E+00
I-135	D	1.00	1.0E+00	1.0E+00

## SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m

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SYNOPSIS

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(w 2w 40m set5)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source	Ci/y	Ci/y
		#1 TOTAL Size		
XE-122	*	0.00	1.0E+00	1.0E+00
XE-123	*	0.00	1.0E+00	1.0E+00
XE-125	*	0.00	1.0E+00	1.0E+00
XE-127	•	0.00	1.0E+00	1.0E+00
XE-131M	*	0.00	1.0E+00	1.0E+00
XE-133	*	0.00	1.0E+00	1.0E+00
XE-133M	*	0.00	1.0E+00	1.0E+00
XE-135	*	0.00	1.0E+00	1.0E+00
XE-135M	*	0.00	1.0E+00	1.0E+00
XE-137	*	0.00	1.0E+00	1.0E+00
XE-138	*	0.00	1.0E+00	1.0E+00
CS-134	D	1.00	1.0E+00	1.0E+00
CS-134M	D	1.00	1.0E+00	1.0E+00
CS-135	D	1.00	1.0E+00	1.0E+00
CS-136	D	1.00	1.0E+00	1.0E+00
CS-137	D	1.00	1.0E+00	1.0E+00
BA-137M	D	1.00	0.0E+00	0.0E+00
CS-138	D	1.00	1.0E+00	1.0E+00
CS-139		0.00	1.0E+00	1.0E+00
BA-133	D	1.00	1.0E+00	1.0E+00
BA-133M	D	1.00	1.0E+00	1.0E+00
BA-137M	D	1.00	1.0E+00	1.0E+00
BA-139	D	1.00	1.0E+00	1.0E+00
BA-140	D	1.00	1.0E+00	1.0E+00
LA-140	W	1.00	0.0E+00	0.0E+00
BA-141		0.00	1.0E+00	1.0E+00
BA-142		0.00	1.0E+00	1.0E+00
LA-140	W	1.00	1.0E+00	1.0E+00
LA-141		0.00	1.0E+00	1.0E+00
LA-142		0.00	1.0E+00	1.0E+00
CE-141	Y	1.00	1.0E+00	1.0E+00
CE-143	Y	1.00	1.0E+00	1.0E+00
CE-144	Y	1.00	1.0E+00	1.0E+00
PR-143	Y	1.00	1.0E+00	1.0E+00
PR-144	Y	1.00	1.0E+00	1.0E+00
PR-144M	Y	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m

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SYNOPSIS

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(w 2w 40m set6)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source		Ci/y	Ci/y
		#1	TOTAL Size		
ND-147	Y		1.00	1.0E+00	1.0E+00
PM-147	Y		1.00	1.0E+00	1.0E+00
PM-148	Y		1.00	1.0E+00	1.0E+00
PM-148M	Y		1.00	1.0E+00	1.0E+00
PM-149	Y		1.00	1.0E+00	1.0E+00
PM-151			0.00	1.0E+00	1.0E+00
SM-147	W		1.00	1.0E+00	1.0E+00
SM-151	W		1.00	1.0E+00	1.0E+00
SM-153	W		1.00	1.0E+00	1.0E+00
EU-152	W		1.00	1.0E+00	1.0E+00
EU-152M			0.00	1.0E+00	1.0E+00
EU-154	W		1.00	1.0E+00	1.0E+00
EU-155	W		1.00	1.0E+00	1.0E+00
EU-156	W		1.00	1.0E+00	1.0E+00
GD-152			0.00	1.0E+00	1.0E+00
TB-160	W		1.00	1.0E+00	1.0E+00
HO-166	W		1.00	1.0E+00	1.0E+00
HO-166M			0.00	1.0E+00	1.0E+00
HF-181	W		1.00	1.0E+00	1.0E+00
W-181	D		1.00	1.0E+00	1.0E+00
W-185	D		1.00	1.0E+00	1.0E+00
W-187	D		1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m

May 9, 2000 10:38 am

SYNOPSIS

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(w 2w 40m set7)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source	Ci/y	Ci/y
		#1 TOTAL Size		
RE-187	W	1.00	1.0E+00	1.0E+00
IR-192	Y	1.00	1.0E+00	1.0E+00
HG-203	W	1.00	1.0E+00	1.0E+00
TL-207	D	1.00	1.0E+00	1.0E+00
TL-208	D	1.00	1.0E+00	1.0E+00
TL-209	D	1.00	1.0E+00	1.0E+00
PB-209	D	1.00	1.0E+00	1.0E+00
PB-210	D	1.00	1.0E+00	1.0E+00
PB-210	W	1.00	0.0E+00	0.0E+00
PB-211	D	1.00	1.0E+00	1.0E+00
PB-212	D	1.00	1.0E+00	1.0E+00
PB-214	D	1.00	1.0E+00	1.0E+00
BI-210	W	1.00	1.0E+00	1.0E+00
BI-211	W	1.00	1.0E+00	1.0E+00
BI-212	W	1.00	1.0E+00	1.0E+00
BI-213	W	1.00	1.0E+00	1.0E+00
BI-214	W	1.00	1.0E+00	1.0E+00
PO-210	W	1.00	1.0E+00	1.0E+00
PO-212	W	1.00	1.0E+00	1.0E+00
PO-213	W	1.00	1.0E+00	1.0E+00
PO-214	W	1.00	1.0E+00	1.0E+00
PO-215	W	1.00	1.0E+00	1.0E+00
PO-216	W	1.00	1.0E+00	1.0E+00
PO-218	W	1.00	1.0E+00	1.0E+00
AT-217	D	1.00	1.0E+00	1.0E+00
RN-219	*	0.00	1.0E+00	1.0E+00
RN-220	*	0.00	1.0E+00	1.0E+00
RN-222	*	0.00	1.0E+00	1.0E+00
FR-221	D	1.00	1.0E+00	1.0E+00
FR-223	D	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m

May 9, 2000 10:38 am

## SYNOPSIS

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(w 2w 40m set8)

## RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source		Ci/y	Ci/y
		#1	TOTAL Size		
RA-223	W		1.00	1.0E+00	1.0E+00
RA-224	W		1.00	1.0E+00	1.0E+00
RA-225	W		1.00	1.0E+00	1.0E+00
RA-226	W		1.00	1.0E+00	1.0E+00
RA-228	W		1.00	1.0E+00	1.0E+00
AC-225	Y		1.00	1.0E+00	1.0E+00
AC-227	Y		1.00	1.0E+00	1.0E+00
AC-228	Y		1.00	1.0E+00	1.0E+00
TH-227	Y		1.00	0.0E+00	0.0E+00
TH-228	Y		1.00	1.0E+00	1.0E+00
TH-229	Y		1.00	1.0E+00	1.0E+00
TH-230	Y		1.00	1.0E+00	1.0E+00
TH-231	Y		1.00	1.0E+00	1.0E+00
TH-232	Y		1.00	1.0E+00	1.0E+00
RA-228	W		1.00	0.0E+00	0.0E+00
AC-228	Y		1.00	0.0E+00	0.0E+00
RA-224	W		1.00	0.0E+00	0.0E+00
RN-220	*		0.00	0.0E+00	0.0E+00
PO-216	W		1.00	0.0E+00	0.0E+00
PB-212	D		1.00	0.0E+00	0.0E+00
BI-212	W		1.00	0.0E+00	0.0E+00
TL-208	D		1.00	0.0E+00	0.0E+00
TH-234	Y		1.00	1.0E+00	1.0E+00
PO-218	W		1.00	1.0E+00	1.0E+00
PA-231	Y		1.00	1.0E+00	1.0E+00
PA-233	Y		1.00	1.0E+00	1.0E+00
PA-234	Y		1.00	1.0E+00	1.0E+00
PA-234M	Y		1.00	1.0E+00	1.0E+00

## SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m

May 9, 2000 10:38 am

SYNOPSIS

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(w 2w 40m set9)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source		Ci/y	Ci/y
		#1	TOTAL Size		
U-232	Y		1.00	1.0E+00	1.0E+00
U-233	Y		1.00	1.0E+00	1.0E+00
U-234	Y		1.00	1.0E+00	1.0E+00
U-235	Y		1.00	1.0E+00	1.0E+00
U-236	Y		1.00	1.0E+00	1.0E+00
U-237	Y		1.00	1.0E+00	1.0E+00
U-238	Y		1.00	1.0E+00	1.0E+00
TH-234	Y		1.00	0.0E+00	0.0E+00
PA-234	Y		1.00	0.0E+00	0.0E+00
U-234	Y		1.00	0.0E+00	0.0E+00
TH-230	Y		1.00	0.0E+00	0.0E+00
RA-226	W		1.00	0.0E+00	0.0E+00
RN-222	*		0.00	0.0E+00	0.0E+00
PO-218	W		1.00	0.0E+00	0.0E+00
PB-214	D		1.00	0.0E+00	0.0E+00
BI-214	W		1.00	0.0E+00	0.0E+00
PO-214	W		1.00	0.0E+00	0.0E+00
PB-210	D		1.00	0.0E+00	0.0E+00
BI-210	W		1.00	0.0E+00	0.0E+00
PO-210	W		1.00	0.0E+00	0.0E+00
U-240	Y		1.00	1.0E+00	1.0E+00
NP-237	W		1.00	1.0E+00	1.0E+00
NP-238	W		1.00	1.0E+00	1.0E+00
NP-239	W		1.00	1.0E+00	1.0E+00
NP-240	W		1.00	1.0E+00	1.0E+00
NP-240M	W		1.00	1.0E+00	1.0E+00
PU-236	Y		1.00	1.0E+00	1.0E+00
PU-238	Y		1.00	1.0E+00	1.0E+00
PU-239	Y		1.00	1.0E+00	1.0E+00
PU-240	Y		1.00	1.0E+00	1.0E+00
PU-241	Y		1.00	1.0E+00	1.0E+00
PU-242	Y		1.00	1.0E+00	1.0E+00
PU-243	Y		1.00	1.0E+00	1.0E+00
PU-244	Y		1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m

May 9, 2000 10:38 am

SYNOPSIS

Page 2  
(w 2w 40m set10)

RADIONUCLIDE EMISSIONS DURING THE YEAR

Nuclide	Class	Source	Ci/y	Ci/y
		#1 TOTAL Size		
AM-241	W	1.00	1.0E+00	1.0E+00
AM-242	W	1.00	1.0E+00	1.0E+00
AM-242M	W	1.00	1.0E+00	1.0E+00
AM-243	W	1.00	1.0E+00	1.0E+00
CM-242	W	1.00	1.0E+00	1.0E+00
CM-243	W	1.00	1.0E+00	1.0E+00
CM-244	W	1.00	1.0E+00	1.0E+00
CM-245	W	1.00	1.0E+00	1.0E+00
CM-246	W	1.00	1.0E+00	1.0E+00
CM-247	W	1.00	1.0E+00	1.0E+00
CM-248	W	1.00	1.0E+00	1.0E+00
CF-252	Y	1.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature: 12 degrees C  
Precipitation: 16 cm/y  
Mixing Height: 1000 m

May 9, 2000 10:36 am

SYNOPSIS

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(w 2w 40m set1)

### SOURCE INFORMATION

Source Number: 1

Stack Height (m): 40.00  
Diameter (m): 0.00

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Fixed (m): (Fixed Rise)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

### AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.000	0.000	0.000
Fraction From Assessment Area:	0.000	0.000	0.000
Fraction Imported:	1.000	1.000	1.000

Food Arrays were not generated for this run.  
Default Values were used

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