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Department of Ecology
NWP - Richland

Waste Site Reclassification Form

Date Submitted: 9/07/06 **Originator:** L. M. Dittmer **Phone:** 372-9664	**Operable Unit(s):** 100-HR-1 **Waste Site ID:** 132-H-1 **Type of Reclassification Action:** Rejected ☐ Closed Out ☐ Interim Closed Out ☒ No Action ☐	**Control Number:** 2006-053 **Lead Agency:** Ecology

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, interim closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List (NPL) of no action, interim closed-out, or closed-out sites will occur at a future date.

Description of current waste site condition:

The 132-H-1 waste site includes the 116-H exhaust stack burial trench and the buried stack foundation (which contains an embedded vertical 15-cm (6-in) condensate drain line). The 116-H reactor exhaust stack and foundation were decommissioned and demolished using explosives in 1983, with the rubble buried in situ beneath clean fill at least 1 m (3.3 ft) thick. The drain line connecting the stack base to the 1608-H effluent pumping station was removed incidentally during previous remedial actions around the 105-H Reactor Building (CVP-2000-00029, CVP-2006-00003) and does not require further remedial action. Radiological characterization was performed prior to final decommissioning, including the collection of concrete core samples from the stack at five different elevations. Sample results were used to support dose assessment calculations prepared in accordance with *Allowable Residual Contamination Levels for Decommissioning Facilities in the 100 Areas of the Hanford Site* (Kennedy and Napier 1983). The ARCL calculations indicated that the potential dose to the maximally exposed individual in 1983 would be 4.8 mrem/yr and as such the stack could be buried in situ. A RESidual RADioactivity (RESRAD) evaluation was performed in 2006 using the 1983 sampling results (after accounting for radioactive decay) to support the interim closed out decision. The evaluation accounts for radioactive decay from 1983 to 2006 and predicts the maximum dose rate is 0.0752 mrem/yr above background over 1,000 years. RESRAD also showed that of the contaminants detected only tritium is predicted to reach groundwater within 1,000 years. The maximum tritium concentration in groundwater is predicted to be less than the remedial action goal (20,000 pCi/L). Therefore, the dose limits for the rural-residential (15 mrem/yr) and groundwater (4 mrem/yr) pathways will not be exceeded.

Basis for reclassification:

The site achieves the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. Residual concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario and pose no threat to groundwater or the Columbia River based on RESRAD modeling. This site does not have a deep zone; therefore, no deep zone institutional controls are required. The basis for reclassification to interim closed out is described in detail in the *Remaining Site Verification Package for 132-H-1, 116-H Reactor Stack Burial Site* (attached). The data used for this evaluation were not obtained from environmental media and are not intended to be incorporated into the River Corridor Baseline Risk Assessment. Waste site-specific evaluations will be performed to determine which data are appropriate for an ecological risk assessment and/or to assess the risk these sites present to ecological receptors.

K. Bazzell DOE-RL Project Manager	Signature	6/8/2007 Date
J. Price Ecology Project Manager	Signature	6/26/2007 Date
NA EPA Project Manager	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR 132-H-1, 116-H REACTOR STACK BURIAL SITE

Attachment to Waste Site Reclassification Form 2006-053

January 2007

REMAINING SITES VERIFICATION PACKAGE FOR 132-H-1, 116-H REACTOR STACK BURIAL SITE

EXECUTIVE SUMMARY

The 116-H Reactor Exhaust Stack began operation in 1949 and was operational until the 105-H Reactor and its associated facilities were shut down in 1965. The stack, located in the southwest corner of the former 105-H Reactor Building, was originally built as part of the reactor's ventilation system to disperse unfiltered exhaust air from the reactor to the atmosphere. In 1960, the 117-H Filter Building was installed to filter the air through particulate (high-efficiency particulate air) and halogen (activated charcoal) filters prior to its atmospheric release through the exhaust stack. The stack stood approximately 61 m (200 ft) high with a base diameter of 5.1 m (16.6 ft). The 116-H exhaust stack and foundation were decommissioned and demolished in 1983 and the site was graded to match the surrounding terrain. The 116-H exhaust stack burial trench and buried concrete stack foundation, which includes an embedded condensate drain line, are identified as the 132-H-1 site in the Waste Information Data System (Appendix A). The drain line connecting the stack base to the 1608-H lift station was removed during previous remedial actions (BHI 2000, WCH 2006) and does not require further remedial action.

As part of decommissioning activities, extensive radiological surveying and sampling activities were performed to characterize residual radiological contamination of the 116-H exhaust stack. Samples of the concrete were collected by coring the stack at five elevations. Characterization results indicated that the contamination was confined to a 0.01-m (0.4-in.) surface layer of concrete on the interior wall of the stack.

The 116-H exhaust stack was released for unrestricted use based on the allowable residual contaminant level methodology (UNI 1986a, 1987). The allowable residual contaminant level calculation indicated that the demolished facility would contribute a 4.8 mrem/yr dose to a hypothetical, maximally exposed site resident if the site was released for unrestricted use after the demolition and in situ burial of the stack. Consequently, the stack and its foundation were demolished by explosives in 1983 and buried in situ. The rubble was buried under at least 1 m (3.3 ft) of clean fill, and the site was graded to blend with the natural terrain.

Using the maximum radiological activities from the pre-demolition characterization data to represent residual contamination levels over the entire mass of concrete of the former stack, RESidual RADioactivity (RESRAD) modeling was performed in 2006 to support the previous decision to demolish and bury the stack in place. The RESRAD modeling was performed only for the contaminated rubble which was buried in the shallow zone. An evaluation of the concrete foundation that extends greater than 4.5 m (15 ft) was not required because the foundation was not contaminated. The condensate drain embedded in the stack foundation is located in the shallow zone. The RESRAD modeling accounts for radioactive decay from 1983 (year of sampling) to 2006 and predicts that the site achieves the dose limits and risk objectives for rural-residential land use, groundwater protection, and river protection. Results of the RESRAD evaluation are summarized in Table ES-1.

Table ES-1. Summary of Remedial Action Goals for the 132-H-1 Site.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15 mrem/yr dose rate above background over 1,000 years.	0.0752 mrem/yr is the highest dose rate above background predicted over 1,000 years.	Yes
Groundwater/River Protection – Radionuclides	Attain single COC groundwater and river protection RAGs.	Tritium is the only radionuclide that is predicted to reach groundwater, but its maximum concentration will not exceed the remedial action goal based on RESRAD modeling.	Yes
	Attain national primary drinking water standards:[a] 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5.[b]		

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[b] *Radiation Protection of the Public and the Environment* (DOE Order 5400.5).
COC = contaminant of concern
MCL = maximum contaminant level
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the 1983 sampling results support a reclassification of the 132-H-1 site to interim closed out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (ROD) (EPA 1999). These results show that the site and contaminant levels remaining in the soil will be protective of direct exposure, groundwater, and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

Soil cleanup levels were established in the interim action ROD based on a limited ecological risk assessment. A baseline risk assessment for the river corridor portion of the Hanford Site began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used as part of the final ROD for this site.

REMAINING SITES VERIFICATION PACKAGE FOR 132-H-1, 116-H REACTOR STACK BURIAL SITE

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 132-H-1 site meets the objectives for interim closed out as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (EPA 1999). These results show that the site and contaminant levels remaining in the soil will be protective of direct exposure, groundwater, and the Columbia River.

GENERAL SITE INFORMATION

The 132-H-1 waste site (116-H Reactor Stack Burial Site) is located in the 100-HR-1 Operable Unit of the Hanford Site. The 116-H Reactor Exhaust Stack began operation in 1949 and was operational until the 105-H Reactor and its associated facilities were shut down in 1965. The 116-H exhaust stack dispersed unfiltered exhaust air from the 105-H Reactor Building to the atmosphere until 1960 when the 117-H Filter Building was installed to filter the exhaust air prior to its release.

The 116-H exhaust stack was located in the southwest corner of the former 105-H Reactor Building adjacent to the ventilation wing (Figure 1). The stack stood approximately 61 m (200 ft) high with a base diameter of 5.1 m (16.6 ft). The stack was constructed of reinforced concrete with a maximum wall thickness of 0.5 m (1.5 ft) at the stack base. The stack rested on a double octagon-shaped base that extended 5.3 m (17.5 ft) below grade. The upper octagon measured 5.6 m (18.5 ft) wide and was 3.5 m (11.5 ft) thick; the lower octagon measured 8.3 m (27 ft) wide and was 1.8 m (6 ft) thick. A 15-cm (6-in.) vertical condensate drain line was embedded in the monolithic concrete stack foundation (UNI 1986a) and exited the stack below grade. The drain line carried condensate from the 116-H stack to the 105-H Reactor Building, before it was pumped to the 1608-H Lift Station. Figure 2 shows a schematic of the 116-H exhaust stack and 117-H Filter Building. A historical drawing is provided in Appendix D which details the design of the stack foundation with the embedded stack drain.

The 116-H exhaust stack was part of the reactor building ventilation system, which was designed to provide clean air to the various work sites within the reactor building. The clean air entered the noncontaminated portions of the reactor building and then moved through zones with increasing levels of contamination before its discharge into the atmosphere. After the 1960 installation of the 117-H Filter Building, the air passed through particulate (high-efficiency particulate air) and halogen (activated charcoal) filters prior to its atmospheric release. In 1983, the 116-H exhaust stack was demolished using explosives and the concrete rubble was buried under at least 1 m (3.3 ft) of clean fill. The stack base was removed to a minimum of 0.9 m (3 ft) below grade before it was buried in situ. The monolithic concrete base attached to the 116-H exhaust stack extends into

the deep zone, however, the concrete base was for structural support and did not come into contact with contaminated exhaust. Therefore, no deep zone evaluation is necessary for this site. After demolition activities were completed, the 116-H site was graded to conform with the surrounding terrain.

A portion of the vertical 15-cm (6-in) condensate drain pipe remains embedded in the center of the buried stack base (see Appendix D). The embedded condensate drain does not extend into the deep zone and, therefore, no deep zone evaluation is necessary. The pipe was a free draining condensate line that fed into the 1608-H Effluent Lifting Station. The potential contamination remaining within the drain is considered to pose little risk to human health and the environment, such that further sampling activities are not required. Residual contamination that could remain in the floor drain pipe would be analogous to residual contamination in the buried 105-D (132-D-4; BHI 2005) and 105-F (132-F-4:2; WCH 2005) embedded stack condensate drain lines. The condensate drain lines were not sampled; however, these sites were reclassified as "interim closed out" and "no action," respectively (BHI 2005, WCH 2005).

The horizontal condensate drain line running from the stack base to the 1608-H effluent pumping station has been removed. Most of the stack base drain line was removed during previous remedial actions to remediate and close the 100-H-21 Reactor Effluent Pipelines (BHI 2000). Based on excavation boundaries of the demolition activities required to place the 105-H Reactor into interim safe storage (WCH 2006), the remaining portion of the horizontal condensate drain line external to the 105-H Reactor Safe Storage Enclosure has been removed. The horizontal condensate drain line and underlying soils were not sampled; however, it is believed that contamination related to this drain line, as well as to the embedded drain remaining in the stack, is bounded by the waste profile for the 100-H-21 Reactor Effluent Pipelines.

DECONTAMINATION AND DECOMMISSIONING BACKGROUND

The 116-H exhaust stack and foundation were decommissioned in situ in 1983. The exhaust stack decommissioning involved drilling and felling the stack; drilling, blasting, and excavating the stack base; and excavating, backfilling, and contouring the burial trench to match the surrounding terrain (UNI 1986a). Prior to demolition and site grading, radiation surveys and isotopic analyses of the stack's concrete were performed (UNI 1986a).

Concrete core samples were collected from the 116-H exhaust stack for the purpose of establishing an isotopic inventory of radionuclides and depth of radionuclide penetration into the stack interior surface. Core samples were drilled from the outside surface of the stack inward. A total of five core samples were obtained from the following elevations: 4.6 m (15 ft), 5.8 m (19 ft) 9 m (30 ft), 17 m (56 ft), and 24 m (80 ft) (UNI 1987). The depth of contaminant penetration in the concrete was then determined by removing three successive layers from each core. The core layer from the interior of the stack had the highest radiological readings with levels of radiation greater than 200 cpm per probe size (2.5 cm^2 [2 in^2]). Sampling of the core layers showed that the contamination was confined to a 0.01-m (0.4-in) surface layer of the concrete wall of the inner surface of the stack.

Prior to demolition, the exhaust ventilation ductwork, which was attached approximately 6 m (20 ft) above the stack base, was disconnected from the stack and disposed of in the 200 Area burial grounds. The opening of the stack was closed and sealed to prevent entry by humans or animals (UNI 1986a). The stack burial trench was excavated in a south-by-southwesterly direction from the base of the stack, between the 117-H Filter Building and the 1608-H Lift Station Building. The stack burial trench was approximately 3.7 m (12 ft) deep, 9 m (30 ft) wide, and 61 m (200 ft) long (UNI 1987).

The stack and foundation were demolished using explosives in September 1983. Demolition charges caused the stack to fall into the excavated trench. After felling the stack, it was broken into pieces no larger than 0.9 m (3 ft) in diameter. The stack base, which was excavated to a minimum of 0.9 m (3 ft), was also broken into pieces no larger than 0.9 m (3 ft) in order to allow for adequate drainage. After demolition of the foundation, about one-third of the rubble was removed and placed in the stack burial trench. The remainder of the foundation was buried in place. Demolition rubble for both the stack and foundation was buried under at least 1 m (3.3 ft) of clean fill. The trench was subsequently backfilled and the entire site was graded to match the surrounding terrain.

The sample results were used to support calculation of the residual dose contribution for the demolished 116-H exhaust stack in accordance with U.S. Department of Energy guidelines and *Allowable Residual Contamination Levels for Decommissioning Facilities in the 100 Areas of the Hanford Site* (Kennedy and Napier 1983). The allowable residual contaminant level (ARCL) calculation indicated that the demolished facility would contribute a dose of 4.8 mrem/yr to a hypothetical, maximally exposed site resident, if the site was released for unrestricted use after

Figure 1. 132-H-1 Site Location Map.

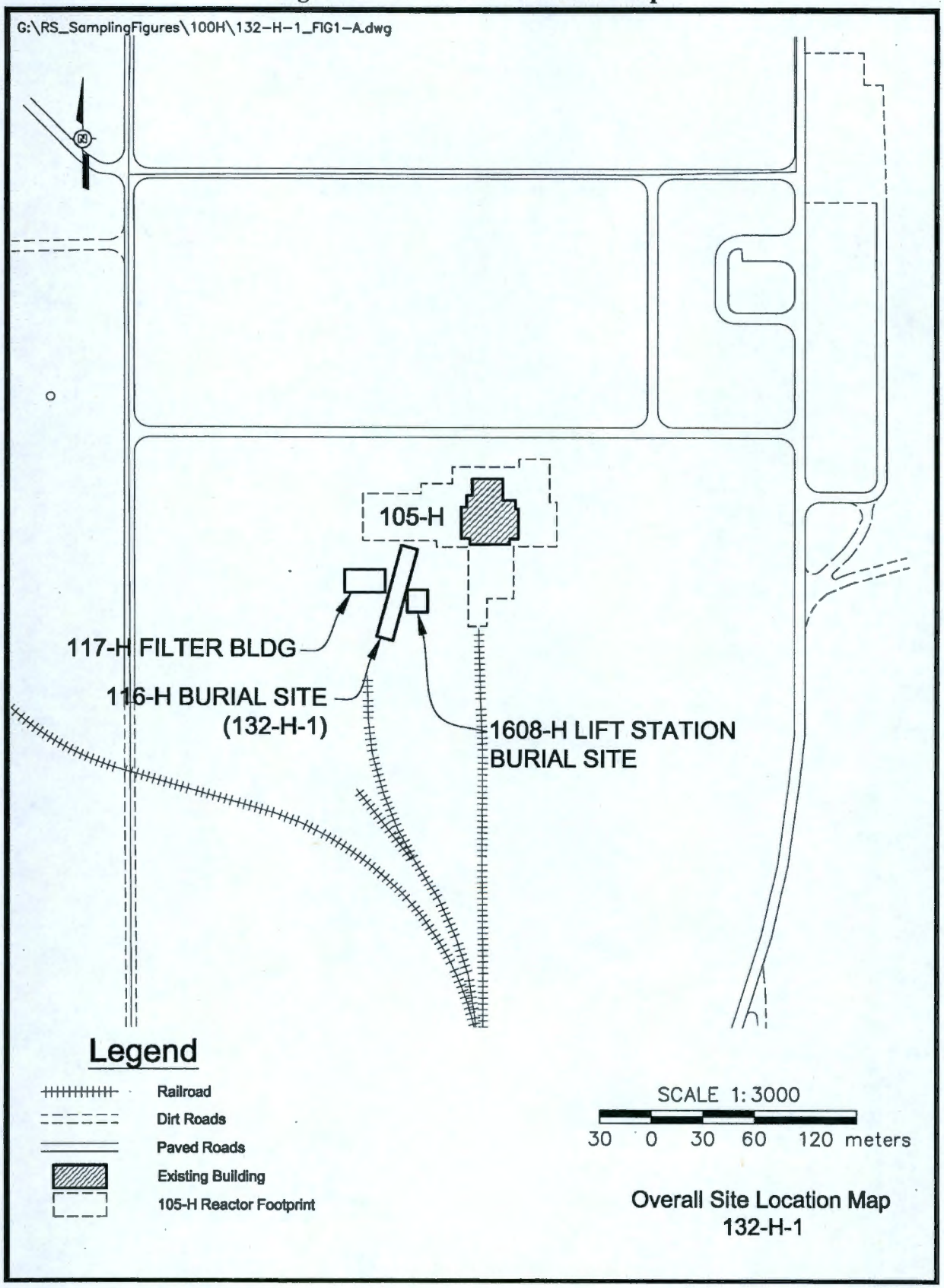
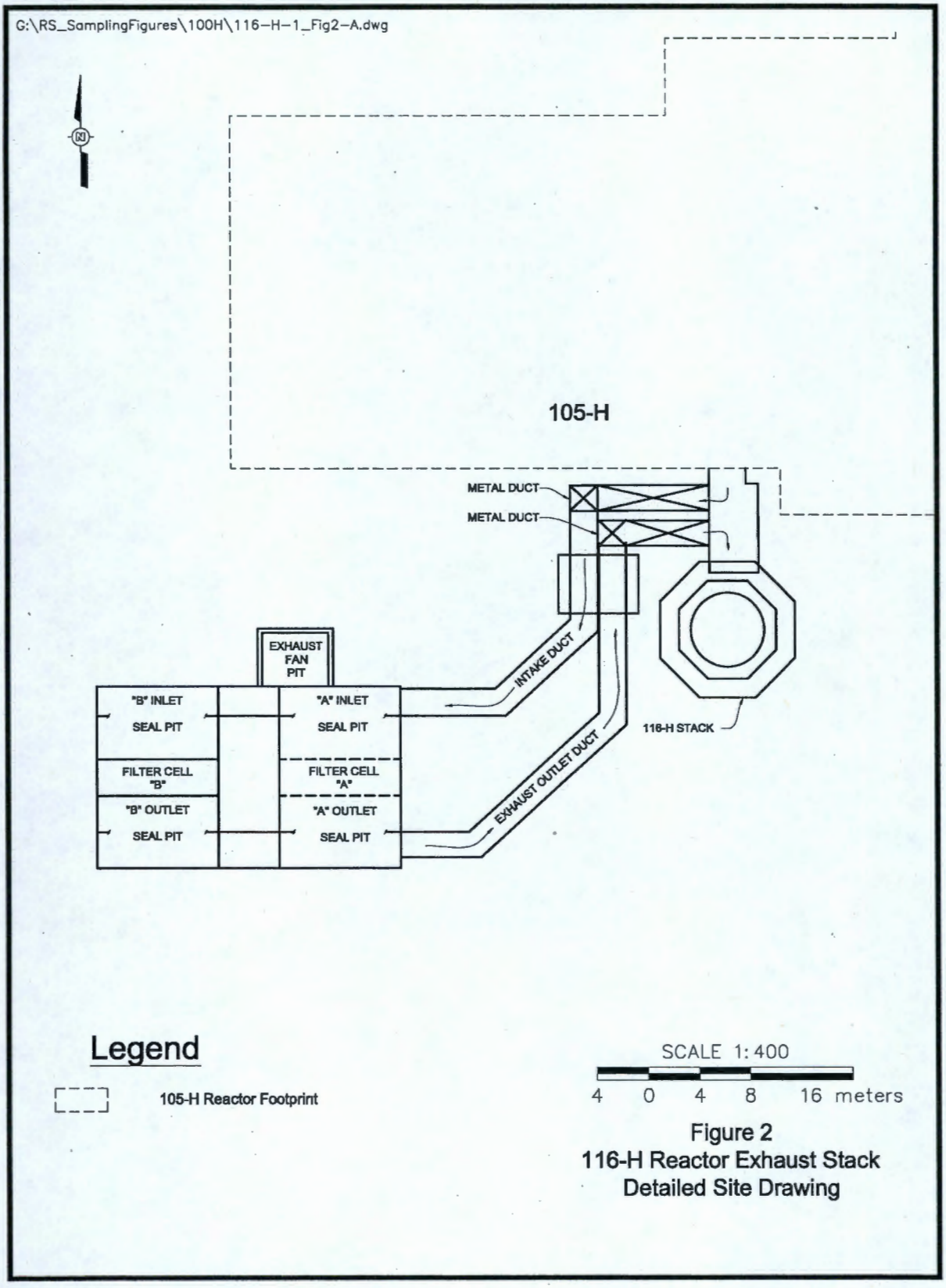


Figure 2. Schematic of the 116-H Exhaust Stack and 117-H Filter Building.



the demolition and burial in situ of the facility. Additional information regarding the stack demolition and ARCL calculations is provided in the associated characterization and closeout reports (UNI 1986a, 1987).

BASIS FOR INTERIM CLOSED OUT

Allowable Residual Contamination Level Methodology

The ARCL calculation methodology was used to determine if further decontamination or remedial action was needed prior to demolition and in situ burial (UNI 1986a, 1987). The calculation scenario was designed to represent unrestricted use conditions for a hypothetical, maximally exposed individual to receipt of a dose not exceeding 25 mrem/yr to the whole body or any organ. Application of the ARCL methodology to the 116-H exhaust stack was straightforward because the structure contained only one contaminated surface, i.e. the interior surface area of the stack. The radionuclide inventories for the facility were determined from the sampling results and using the following general criteria:

- The residential/construction exposure scenario was used.
- The site would be available for unrestricted use at the time of release based on an annual dose rate of less than 25 mrem/yr.
- The contamination condition of confined soil is 1 to 4 m (3.3 to 13 ft) deep (i.e., contamination in the stack trench is buried under at least 1 m (3.3 ft) of clean soil and all contamination is confined to a layer 1 to 4 m (3.3 to 13 ft) deep).
- The average radiological activity is assumed to be distributed over 100% of the inside surface of the stack (UNI 1987).

The ARCL calculations were prepared in accordance with *Allowable Residual Contamination Levels for Decommissioning Facilities in the 100 Areas of the Hanford Site* (Kennedy and Napier 1983). At the time of decommissioning the 116-H exhaust stack, the ARCL calculation determined that the site would contribute 4.8 mrem/yr under the residential/construction exposure scenario, and therefore no further decontamination to reduce the source term was necessary and the stack could be buried in situ. Additional information is provided in the characterization and closeout reports (UNI 1986a, 1987).

RESidual RADioactivity Modeling Methodology

In 2006, RESidual RADioactivity (RESRAD) modeling was performed in accordance with the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005) to support the interim closed-out decision (Appendix C). Only the contaminated stack rubble, which was collapsed into a 3.7 m (12 ft) deep burial trench, was evaluated in the RESRAD calculations (Appendix C). The stack base, which extends into the deep zone, was not exposed to contamination and, therefore, no further evaluation was required for the deep zone. The

maximum concentrations of radionuclides, determined from the concrete core samples, were used to model the residual concentrations present in the buried concrete, assuming that the entire mass of concrete was contaminated. The weighted average radionuclide contaminant levels cited in UNI 1987 (Table 2) were not used in the RESRAD calculations because they were incorrectly based on ratios using cesium-137 as the reference isotope. The only radionuclides in reactor waste sites that can be correctly referenced to cesium-137 are strontium-90, plutonium isotopes, and europium-152. As such, the maximum radionuclide concentrations cited in UNI 1987 were used instead.

The waste site was modeled considering the entire thickness of the concrete stack as contaminated materials and all pathways (direct exposure to gamma radiation; dust inhalation; soil ingestion; and ingestion of plants, meat, milk, aquatic foods, and drinking water) in the RESRAD evaluation. Contaminated concrete was buried at least 1 m (3.3 ft) below grade. The RESRAD evaluation used the 1983 sampling data adjusted for decay from 1983 to 2006. For each radionuclide identified in the samples that were collected, the highest value reported was conservatively used in the RESRAD modeling.

Table 1 provides a summary of the maximum radionuclide results from the samples collected in 1983 with the associated correction for decay. The corrected results for the maximum activities were used to represent uniform residual radiological contaminant concentrations over 100% of the rubble layer. Although the contamination was present in the concrete on the inner surface of the stack, soil distribution coefficients (K_d values) were used in the modeling as conservative inputs to predict future potential groundwater impacts. The RESRAD input parameters are presented in Appendix B.

Table 1. Radionuclide Activity.

Radionuclides	Maximum Activities from September 1983 [a] (pCi/g)	Activities Decayed to June 2006 (pCi/g)
Carbon-14	249	248
Cesium-137	69.4	41.2
Cobalt-60	4.07	0.20
Europium-152	5.77	1.77
Tritium (H-3)	22.4	6.25
Plutonium-239	27.2	27.1
Strontium-90	9.49	5.52

[a] *ARCL Calculations for Decommissioning the 116-H Stack* (UNI 1987).

The evaluation predicts that the dose limits will not be exceeded for either the rural-residential scenario (15 mrem/yr) or the groundwater pathway (4 mrem/yr) (Appendix C). The maximum potential dose to a receptor in the rural-residential scenario is predicted to be 0.0752 mrem/yr, which is less than the guideline of 15 mrem/yr above background. This dose rate occurs 14.35 years after June 2006. RESRAD showed that of the contaminants detected, only tritium is

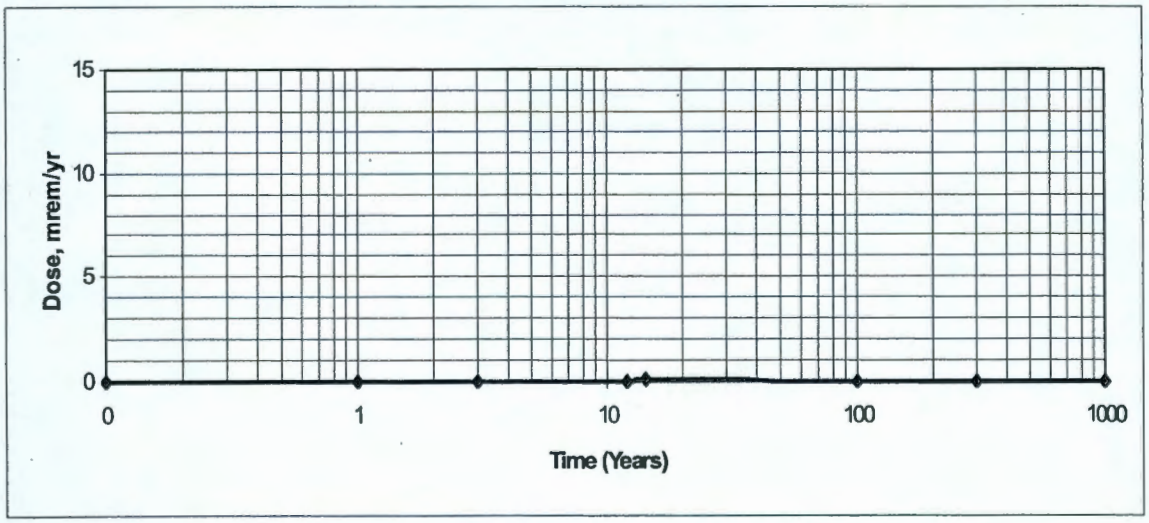
predicted to reach groundwater within 1,000 years. The maximum tritium concentration in groundwater is predicted to be less than the remedial action goal (20,000 pCi/L) at 1,070 pCi/L. Results are summarized in Table 2 and Figure 3.

Table 2. Summary of Attainment of Dose Limits for Radiological Contaminants of Concern for the 116-H Exhaust Stack Using Soil Distribution Coefficient Values.

Scenario	Dose Limit (mrem/yr)	Dose Predicted by RESRAD (mrem/yr)	Is Dose > Dose Limit?
Rural-residential	15	0.0752	No
Groundwater protection	4	0.0752	No
	MCL [a] (pCi/L)	**Concentration Predicted by RESRAD (pCi/L)**	**Is Concentration > Maximum Contaminant Level?**
Carbon-14 in groundwater	2,000	0	No
Cesium-137 in groundwater	60	0	No
Cobalt-60 in groundwater	100	0	No
Europium-152 in groundwater	200	0	No
Tritium (H-3) in groundwater	20,000	1,070	No
Plutonium-239	1.2	0	No
Strontium-90 in groundwater	8	0	No

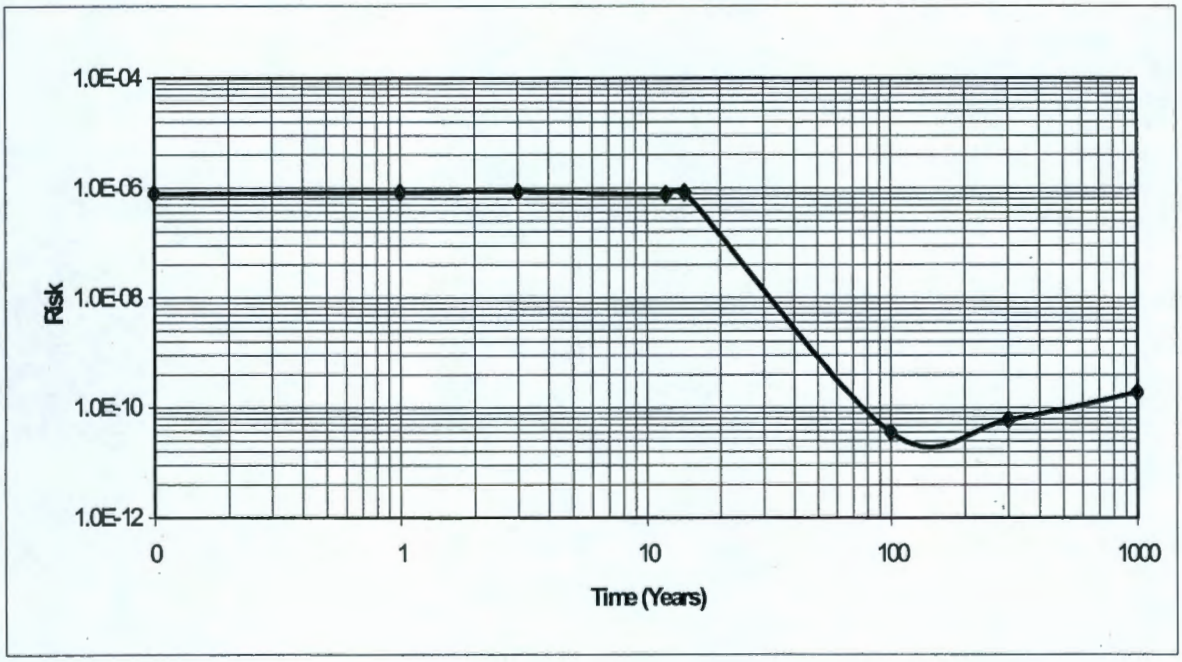
[a] Maximum contaminant levels from Table 2-3 of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005).
MCL = maximum contaminant level
RESRAD = RESidual RADioactivity (dose model)

Figure 3. Radionuclide Dose Rate – All Pathways for the 132-H-1 Site.



The RESRAD model also estimates the excess lifetime cancer risk associated with the radiation dose rates using the U.S. Environmental Protection Agency's Health Effects Assessment Summary Tables. The "National Oil and Hazardous Substances Pollution Contingency Plan" (40 *Code of Federal Regulations* 300) presents a target range for residual risk of 10^{-4} to 10^{-6}. The radionuclide excess lifetime cancer risk results are shown in Figure 4. The maximum excess lifetime cancer risk is 8.59×10^{-7} and occurs 3 years after June 2006. Additional information for the RESRAD modeling is presented in Appendices B and C.

Figure 4. Estimated Radionuclide Cancer Risk for the 132-H-1 Site.



Nonradionuclides

The 116-H Exhaust Stack would not have received nonradiological contaminants as it was used solely to discharge exhaust air from the 105-H Reactor Building. After 1960, the stack received filtered air from the 117-H Filter Building. Although no detailed analysis was performed for nonradionuclides at the 117-H Filter Building, the *117-H Filter Building Decommissioning Individual Facility Report* (UNI 1986b) states that no asbestos, mercury, or any other non-radioactive hazardous materials were found in the 117-H building.

SUMMARY FOR INTERIM CLOSED OUT

The 132-H-1 site residual contaminant levels are protective of direct exposure, groundwater, and the Columbia River. This decision is supported based on reviews of the historical data and RESRAD modeling results. Using conservative inputs (e.g., highest activity sample results and assuming uniform contamination levels on the entire mass of residual concrete), the RESRAD outputs indicate that residual contamination levels do not present an unacceptable risk to the

maximally exposed individual. The RESRAD evaluation and historical data support a reclassification of the 132-H-1 site to interim closed out. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

REFERENCES

40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*, as amended.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*, as amended.

BHI, 2000, *Cleanup Verification Package for the 100-H-21 Reactor Effluent Pipelines, 100-H-22 Effluent Pipeline Leakage, and 100-H-1 Rod Cave*, CVP-2000-00029, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2005, *Cleanup Verification Package for the 118-D-6:2, 105-D Reactor Ancillary Support Areas, Below-Grade Structure, and Underlying Soils: the 118-D-6:3, 105-D Reactor Fuel Storage Basin and Underlying Soils; and the 132-D-4, 105-D Reactor Exhaust Stack Foundation,* CVP-2005-00003, Bechtel Hanford, Inc., Richland, Washington.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, as amended, U.S. Department of Energy, Washington, D.C.

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EPA, 1999, *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

Kennedy, W. E., Jr. and B. A. Napier, 1983, *Allowable Residual Contamination Levels for Decommissioning Facilities in the 100 Areas of the Hanford Site*, PNL-4722/UNI-2522, Pacific Northwest Laboratory, Richland, Washington.

UNI, 1986a, *116-C, 116-F, 116-H Reactor Exhaust Ventilation Stack Demolition Hanford Site Individual Facility Report*, UNI-3855, UNC Nuclear Industries, Richland, Washington.

UNI, 1986b, *117-H Filter Building Decommissioning Individual Facility Report*, UNI-2752, UNC Nuclear Industries, Richland, Washington.

UNI, 1987, *ARCL Calculations for Decommissioning the 116-H Stack*, UNI-3827, UNC Nuclear Industries, Richland, Washington.

WCH, 2005, *Waste Site Reclassification Form 2005-043 for the 132-F-4:2, (116-F) Reactor Stack Base,* Washington Closure Hanford, Richland, Washington.

WCH, 2006, *Cleanup Verification Package for the 118-H-6:2, 105-H Reactor Ancillary Support Areas, Below-Grade Structures, and Underlying Soils; the 118-H-6:3, 105-H Reactor Fuel Storage Basin and Underlying Soils; the 118-H-6:6 Fuel Storage Basin Deep Zone Side-Slope Soils; the 100-H-9, 100-H-10, and 100-H-13 French Drains; the 100-H-11 and 100-H-12 Expansion Box French Drains; and the 100-H-14 and 100-H-31 Surface Contamination Zones*, CVP-2005-00003, Washington Closure Hanford, Richland, Washington.

APPENDIX A

WASTE INFORMATION DATA SYSTEM GENERAL SUMMARY REPORT

(Note: The WIDS Summary Report is in the process of being updated and does reflect all current information presented within the 132-H-1 RSVP.)

Waste Information Data System
General Summary Report

4/17/2003

Site Code: 132-H-1 **Site Classification:** Accepted Page 1

Site Names: 132-H-1, 116-H Reactor Exhaust Stack Burial Site

Site Type: Burial Ground **Start Date:** 1945

Status: Inactive **End Date:** 1965

Operable Unit: 100-HR-1 **Coordinates:**

Hanford Area: 100H (E) 577721.25

(N) 152480.094

Washington State Plane

Site Description: The unit was part of the 105-H Reactor Gas and Exhaust Air system. It was constructed of reinforced concrete. Prior to demolition the stack was 61 meters (200 feet) tall and had a diameter of 5.1 meters (16.58 feet) at its base. The stack was toppled into a 60.96 meter (200 feet) long by 9.14 meter (30 feet) wide by 5.49 meters (18 feet) deep trench.

Location Description: The unit is located on the south side of 105-H.

Associated Structures: Following completion of the confinement project in 1960, the air was diverted via underground reinforced concrete ducts to the 117-H Filter Building. After flowing through the filters, the air went through below-grade and above-grade concrete ducts and into the exhaust stack.

Site Comment: In 1983, this site was demolished and buried between the 117-H Building and the 1608-H Building.

References:

1. K. M. Harmon, et al, 8/75, Resource Book - Decommissioning of Contaminated Facilities at Hanford (Waste Management Facilities) App. XI (Draft), PNL-MA-588.
2. Dorian and Richards, 5/26/78, Radiological Characterization of the Retired 100 Areas, UNI-946.
3. 2/89, Preliminary Operable Units Designation Project, WHC-EP-0216.
4. Scott Kitts to Nancy Homan, 4/17/90, 100N updates for WIDS, DSI.
5. D.H. Deford, M.W. Einan, Feb 1995, 100-H Area Technical Baseline Report, BHI-00127, Rev 00.
6. E. W. Powers and J. M. Steffes, 7/24/86, 116-C, -F, and -H REACTOR EXHAUST VENTILATION STACK DEMOLITION HANFORD SITE INDIVIDUAL FACILITY REPORT, UNI-3855.

Waste Information:

Type: Demolition and Inert Waste

Category: Radioactive

Physical State: Solid

Description: Air moving from the least contaminated zones through increasingly contaminated zones was discharged to the stack unfiltered. At the time of demolition low-level smearable alpha contamination was present measuring up to 30 disintegrations/minute per 100 square centimeters (190 disintegrations/minute per 100 square inches). Smearable beta contamination ranged from 100 to 5,000 disintegrations/minute per 100 square centimeters (650 to 32,000 disintegrations/minute per 100 square inches).

References:

1. K. M. Harmon, et al, 8/75, Resource Book - Decommissioning of Contaminated Facilities at Hanford (Waste Management Facilities) App. XI (Draft), PNL-MA-588.

Dimensions:

Length:	60.96 Meters	200.00 Feet
Width:	9.14 Meters	30.00 Feet
Depth / Height:	5.49 Meters	18.00 Feet

Comment: These values are approximate.

References:

1. E. W. Powers and J. M. Steffes, 7/24/86, 116-C, -F, and -H REACTOR EXHAUST VENTILATION STACK DEMOLITION HANFORD SITE INDIVIDUAL FACILITY REPORT, UNI-3855.

Site Code: 132-H-1 **Site Classification: Accepted**

Regulatory Information:

Programmatic Responsibility

DOE Program: EM-40 **Confirmed By Program:** Yes

DOE Division: ERD - Environmental Restoration Division

Responsible Contractor/Subcontractor: BHI. Bechtel Hanford, Inc.

Site Evaluation

Solid Waste Management Unit: Yes

TPA Waste Management Unit Type: Waste Disposal Unit

Permitting

RCRA Part A Permit:	No	**Closure Plan:**	No
RCRA Part B Permit:	No	**TSD Number:**	
RCRA Permit Status:			
Septic Permit:	No	**216/218 Permit:**	No
Inert Landfill:	No	**NPDES:**	No
Air Operating Permit:	No	**State Waste Discharge Permit:**	No

Air Operating Permit Number(s):

Tri-Party Agreement

Lead Regulatory Agency: Ecology

Unit Category: CERCLA Past Practice (CPP)

TPA Appendix: C

Remediation and Closure

Decision Document: Interim Action Record of Decision, 100 Area Remaining Sites (1999)

Decision Document Status: Final

Remediation Design Group: Group 5

Closure Document:

Closure Type:

Post Closure Requirements:

Residual Waste:

Images:

Date Taken: 5/27/1998

Pathname: \\apwids01\widsimg\100H\0241\0241_01.JPG

Description: Photo shows the south side of 105-H where the stack once stood. There are no markers for the trench where the stack is buried.

Date Taken: 5/27/1998

Pathname: \\apwids01\widsimg\100H\0241\0241_02.JPG

Photo shows the south side of 105-H where the stack once stood. The area is not marked.

APPENDIX B

116-H EXHAUST STACK
RESRAD INPUT PARAMETERS

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Summary : 132-H-1 / 116-H Reactor Stack RESRAD Evaluation of Concrete Rubble
File : 132-H-1_Shallow_Zone.RAD

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File : 132-H-1_Shallow_Zone.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	C-14	2.090E-06	2.090E-06	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(5)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(7)
B-1	H-3	6.400E-08	6.400E-08	DCF2(8)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(9)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(10)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(11)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(12)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	C-14	2.090E-06	2.090E-06	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(5)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(7)
D-1	H-3	6.400E-08	6.400E-08	DCF3(8)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(9)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(10)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(11)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(12)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(2,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(2,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(2,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(7,3)

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 Summary : 132-H-1 / 116-H Reactor Stack RESRAD Evaluation of Concrete Rubble
 File    : 132-H-1_Shallow_Zone.RAD
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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(8,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(8,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(8,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(9,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(9,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(10,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(11,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(11,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(11,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(12,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(2,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(2,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(7,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(7,2)
D-5				
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(8,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(8,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(9,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(11,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)

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Summary : 132-H-1 / 116-H Reactor Stack RESRAD Evaluation of Concrete Rubble
File : 132-H-1_Shallow_Zone.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)

1RESRAD, Version 6.30 T« Limit = 0.5 year 06/13/2006 12:15 Page 5
Summary : 132-H-1 / 116-H Reactor Stack RESRAD Evaluation of Concrete Rubble
File : 132-H-1_Shallow_Zone.RAD

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.100E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.700E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	2.100E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.200E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.435E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	2.480E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	2.000E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	4.120E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-152	1.770E+00	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): H-3	6.250E+00	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Pu-239	2.710E+01	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): Sr-90	5.520E+00	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	1.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.600E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	2.400E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.600E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	4.100E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	1.140E+01	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.610E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ

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 File    : 132-H-1_Shallow_Zone.RAD
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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.500E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	9.100E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	1.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.169E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.464E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.464E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.169E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)

1RESRAD, Version 6.30 T« Limit = 0.5 year 06/13/2006 12:15 Page 7
Summary : 132-H-1 / 116-H Reactor Stack RESRAD Evaluation of Concrete Rubble
File : 132-H-1_Shallow_Zone.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-01	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.169E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.918E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.142E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.496E-05	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.464E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.883E-03	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR

.1RESRAD, Version 6.30 T« Limit = 0.5 year 06/13/2006 12:15 Page 9
Summary : 132-H-1 / 116-H Reactor Stack RESRAD Evaluation of Concrete Rubble
File : 132-H-1_Shallow_Zone.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Contamination fraction of milk	-1	-1	0.305E-01	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)

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Summary : 132-H-1 / 116-H Reactor Stack RESRAD Evaluation of Concrete Rubble
File : 132-H-1_Shallow_Zone.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	5	---	---	LYMAX
TITL	Maximum number of integration points for risk	17	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

1RESRAD, Version 6.30 T« Limit = 0.5 year 06/13/2006 12:15 Page 11
Summary : 132-H-1 / 116-H Reactor Stack RESRAD Evaluation of Concrete Rubble
File : 132-H-1_Shallow_Zone.RAD

Contaminated Zone Dimensions

Area:	610.00 square meters
Thickness:	2.70 meters
Cover Depth:	1.00 meters

Initial Soil Concentrations, pCi/g

C-14	2.480E+02
Co-60	2.000E-01
Cs-137	4.120E+01
Eu-152	1.770E+00
H-3	6.250E+00
Pu-239	2.710E+01
Sr-90	5.520E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.200E+01	1.435E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.975E-05	3.784E-05	3.443E-05	2.384E-05	7.517E-02	2.198E-06	5.947E-06	2.550E-05
M(t):	2.650E-06	2.523E-06	2.296E-06	1.589E-06	5.012E-03	1.465E-07	3.965E-07	1.700E-06

0Maximum TDOSE(t): 7.517E-02 mrem/yr at t = 14.35 ñ 0.03 years
0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.435E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
C-14	5.385E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Co-60	1.044E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Cs-137	1.570E-05	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-152	5.160E-06	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-239	1.807E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Sr-90	2.678E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Total	2.190E-05	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000

APPENDIX C

SUMMARY OF 116-H EXHAUST STACK RESRAD EVALUATION

CALCULATION COVER SHEET

Project Title 100-H Area Field Remediation **Job No.** 14655
Area 100-H
Discipline Environmental ***Calc. No.** 0100H-CA-V0082
Subject 132-H-1 / 116-H Reactor Exhaust Stack Site RESRAD Evaluation
Computer Program RESRAD **Program No.** Version 6.30

The attached calculations have been generated to document compliance with established cleanup levels.
These calculations should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐ **Voided** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Summary – 5 pg Attm. 1 - 1 pg Attm. 2 - 24 pg Attm. 3 - 27 pg Attm. 4 - 17 pg Total – 75 pages	S. W. Clark S.W. Clark 6/13/06	M. W. Perrott MW Perrott 6/15/06	T. M. Blakley T.M. Blakley 6/19/06	R. A. Carlson RA Carlson	6/20/06

SUMMARY OF REVISION

WCH-DE-018 (4/14/06) *Obtain Calc. No. from R&DC and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	5/13/06	Calc. No.:	0100H-CA-V0082	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	6/15/06
Subject:	132-H-1 / 116-H Reactor Exhaust Stack Site RESRAD Evaluation					Sheet No.	1 of 5

PURPOSE:

Evaluate the potential dose and risk to a receptor in a rural residential scenario from contaminants in concrete rubble at 132-H-1, the former 116-H Reactor Exhaust Stack site, and determine if contamination is predicted to reach groundwater within 1,000 years. Use data available from samples taken in September of 1983 for an Allowable Residual Contamination Level (ARCL) method evaluation of the decommissioned stack site.

GIVEN/REFERENCES:

1) Decommissioning information, sample data, and dates from *ARCL Calculations for Decommissioning the 116-H Stack*, UNI-3827, June 30, 1987, UNC Nuclear Industries, Richland, Washington.
2) Facility description from *H Area Technical Baseline Report*, BHI-00127, Rev. 00, 1995, Bechtel Hanford Inc., Richland, Washington.
3) *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) For the purpose of these RESRAD calculations, there are no nonradionuclide contaminants of concern. Prior to demolition, all equipment, asbestos, water, sludge, sediment, and debris were removed from the facility.
5) RESidual RADioactivity (RESRAD) computer code, version 6.30, to calculate compliance with residual radioactivity guidelines, developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois.

BACKGROUND:

The 132-H-1 / 116-H Reactor Exhaust Stack operated from 1945 until the 105-H Reactor was shut down in 1965 to vent reactor building ventilation air to the atmosphere. It was demolished using explosives on September 16, 1983 and felled into a trench that was prepared for its burial. The burial site is approximately 67 m (220 ft) long, 9.1 m (30 ft) wide and 3.7 m (12 ft) deep and is located between the 132-H-2 and 132-H-3 waste sites. The original stack was 61 m (200 ft) tall, was 5 m (16.58 ft) in diameter at its base, and was constructed of reinforced concrete. After the stack was removed the foundation was also demolished and approximately one-third of the rubble was disposed of in the stack trench. The concrete rubble from the stack and its foundation were buried under at least 1 m (3.3 ft) of clean fill.

Samples of the interior of the stack were taken before the stack was demolished by coring at five elevations. Sampling showed the contamination was confined to a 0.01 m (0.4 inch) surface layer of the concrete wall of the stack. However, the RESRAD evaluation used the maximum concentrations of radionuclides from the concrete to conservatively model the residual concrete as if the entire mass of the concrete was contaminated. This was the conceptual model for evaluations of dose, risk, and groundwater protection.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark SWC	Date:	5/3/06	Calc. No.:	0100H-CA-V0082	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott MWP	Date:	6/6/06
Subject:	132-H-1 / 116-H Reactor Exhaust Stack Site RESRAD Evaluation					Sheet No.	2 of 5

SOLUTION:

1) Table 1 shows the waste site parameters used for RESRAD modeling. Because the rubble from the stack and its foundation were buried in a trench approximately 3.7 m (12 ft) deep all residual contamination is in the shallow zone (from zero to 4.6 m [15 ft] below ground surface).

2) A statistical sample design was not implemented because the maximum activities of the radionuclides were used for the RESRAD evaluations. Radionuclide activities were decayed from September 16, 1983 to the present date (June 13, 2006; 22.7 years) as shown in Table 2. Input factors for each RESRAD run are shown in the "Summary" section of the RESRAD "Mixture Sums and Single Radionuclide Guidelines," which are included as printouts in the Attachments to this Calculation Summary.

3) The year where the peak dose (or groundwater concentration) occurs from each individual radionuclide was determined by a preliminary run. For the direct exposure pathway (i.e. soil ingestion and inhalation and external radiation), the peak year occurred at year zero (year 2006) for all radionuclides. For the water pathways (i.e., drinking water and food ingestion) the peak year was year 14.35 for tritium. Only tritium was predicted to reach groundwater within 1,000 years. The 14.35-year time period was included in all of the RESRAD runs.

Table 1. Waste Site Dimensions for RESRAD Modeling

Parameter	Units	Value	Comments
Cover Depth	m	1	Minimum cover for conservative evaluation
Area of Contaminated Zone	m^2	610	Based on area of demolition trench [a]
Length Parallel to Aquifer Flow	m	21	Based on groundwater flow direction
Elevation: Surface	m	128.8	NAVD88
Elevation: Bottom of waste	m	125.1	NAVD88
Elevation: Groundwater	m	116.0	NAVD88
Thickness: Contaminated Zone	m	2.7	Based on trench depth and cover thickness [a]
Thickness: Unsaturated Zone	m	9.1	From trench bottom to groundwater

[a] *ARCL Calculations for Decommissioning the 116-H Stack*, UNI-3827, June 30, 1987, UNC Nuclear Industries, Richland, Washington.

METHODOLOGY:

1) Runs of RESRAD version 6.30 were completed for the shallow zone using the radionuclide concentrations decayed to June 2006 shown in Table 2. RESRAD numerical output reports for dose, risk, and concentration for the deep zone are presented in the Attachments to this calculation summary.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark SWC	Date:	6/13/06	Calc. No.:	0100H-CA-V0082	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott MWP	Date:	6/15/06
Subject:	132-H-1 / 116-H Reactor Exhaust Stack Site RESRAD Evaluation					Sheet No. 3 of 5	

Table 2. Radionuclide Activity.

Radionuclides	Maximum Activities from Sept. 1983[a] (pCi/g)	Activities Decayed to June 2006 (pCi/g)
Carbon-14	249	248
Cesium-137	69.4	41.2
Cobalt-60	4.07	0.20
Europium-152	5.77	1.77
Tritium (H-3)	22.4	6.25
Plutonium-239	27.2	27.1
Strontium-90	9.49	5.52

[a] *ARCL Calculations for Decommissioning the 116-H Stack*, UNI-3827, June 30, 1987, UNC Nuclear Industries, Richland, Washington.

RESULTS:

1) Radionuclide "All Pathways" Dose Rate: The "all pathways" dose rates are shown in Table 3. The maximum all-pathways dose rate is 0.0752 mrem/yr, which occurs 14.35 years after June 2006.

Table 3. All Pathway Dose Rate (mrem/yr)

Vadose Zone Horizon	"All Pathways" Dose Contributions in mrem/yr at each time slice (yr)							
	0	1	3	12	14.35	100	300	1000
Deep Zone Total Dose	3.98E-05	3.78E-05	3.44E-05	2.38E-05	7.52E-02	2.20E-06	5.95E-06	2.55E-05

2) Radionuclide Excess Cancer Risk: The radionuclide excess lifetime cancer risk results are shown in Table 4. The maximum excess lifetime cancer risk (8.59×10^{-7}) occurs 3 years after June 2006.

Table 4. Radionuclide Excess Lifetime Cancer Risk

Vadose Zone Horizon	Excess Cancer Risk at Each Time Slice (yr)							
	0	1	3	12	14.35	100	300	1000
Deep Zone Total Excess Cancer Risk	7.98E-07	8.33E-07	8.59E-07	7.72E-07	8.25E-07	3.55E-11	6.10E-11	1.95E-10

3) Figures 1 and 2 show the all pathways dose rate and radionuclide excess cancer risk for the rural residential scenario (with irrigation).

Washington Closure Hanford	CALCULATION SHEET						
Originator:	S. W. Clark	Date:	6/13/06	Calc. No.:	0100H-CA-V0082	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	6/15/06
Subject:	132-H-1 / 116-H Reactor Exhaust Stack Site RESRAD Evaluation					Sheet No.	4 of 5

Figure 1. RESRAD Analysis – Dose Rate, All Pathways.

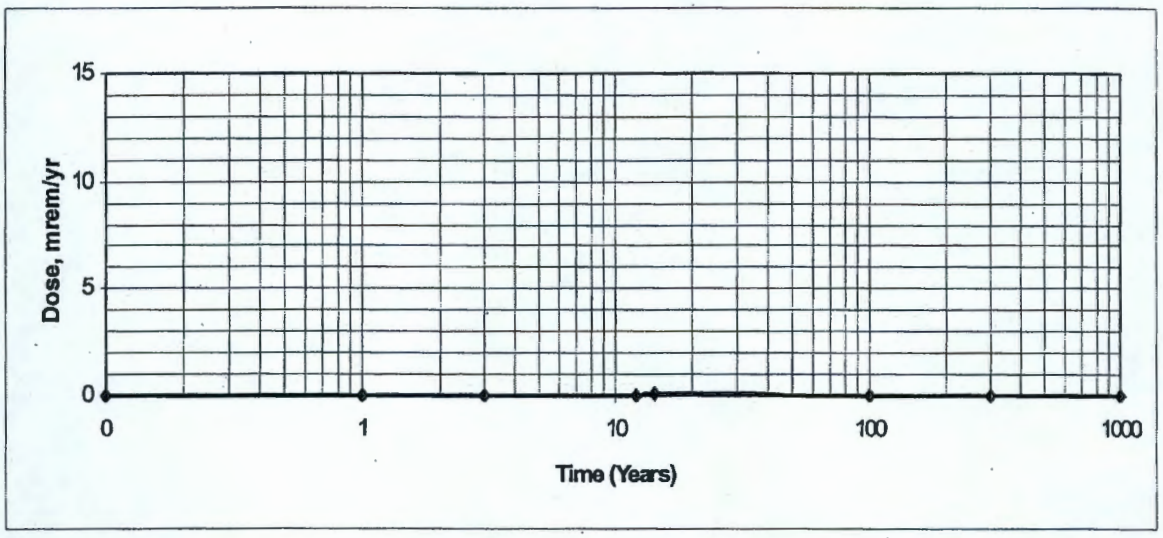
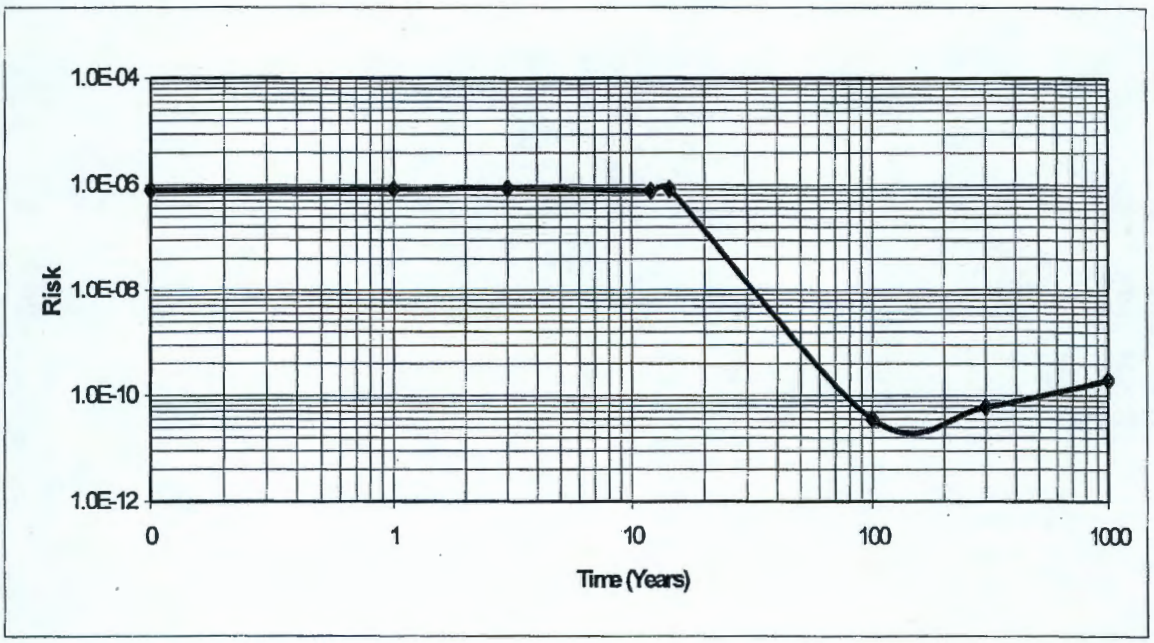


Figure 2. RESRAD Analysis – Radionuclide Risk, All Pathways.



Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	6/13/06	Calc. No.:	0100H-CA-V0082	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott MWP	Date:	6/15/06
Subject:	132-H-1 / 116-H Reactor Exhaust Stack Site RESRAD Evaluation					Sheet No. 5 of 5	

4) Radionuclide Groundwater Protection: The radionuclide concentrations in groundwater calculated by the RESRAD model are summarized in Table 5. Of the radionuclides only tritium (H-3) was predicted to reach groundwater within 1,000 years at a maximum concentration of 1,070 pCi/L, which is below the applicable RAG (20,000 pCi/L).

Table 5. RESRAD Predicted Radionuclide Groundwater (Well Water) Concentrations

Radio-nuclides	Vadose Zone Horizon	Groundwater Concentrations in pCi/L at Each Time Slice (yr)								RAGs From RDR, (pCi/L)
		0	1	3	12	14.35	100	300	1000	
C-14	Total	0	0	0	0	0	0	0	0	2,000
Cs-137	Total	0	0	0	0	0	0	0	0	60
Co-60	Total	0	0	0	0	0	0	0	0	100
Eu-152	Total	0	0	0	0	0	0	0	0	200
H-3	Total	0	0	0	0	1,070	2.55E-04	4.17E-20	0	20,000
Pu-239	Total	0	0	0	0	0	0	0	0	15
Sr-90	Total	0	0	0	0	0	0	0	0	8

CONCLUSIONS:

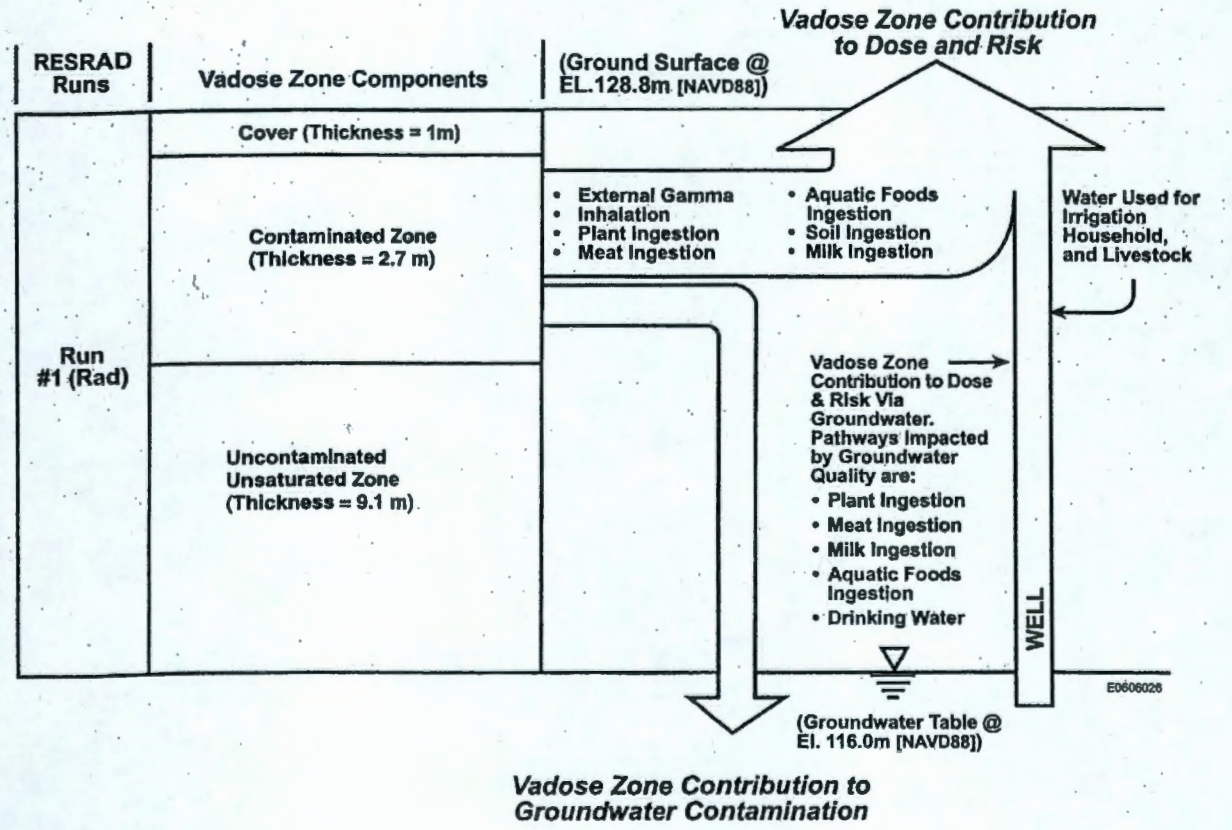
- The maximum all-pathways dose rate is 0.0752 mrem/yr which occurs 14.35 years after June 2006.
- The dominant pathway for the dose rate is drinking water.
- The primary radionuclide contributing to the drinking water pathway is tritium (H-3).
- None of the site radionuclides are projected to exceed remedial action goals (RAGs).
- The maximum excess lifetime cancer risk (8.59×10^{-7}) occurs 3 years after June 2006.
- Of the radionuclides, only tritium (H-3) was predicted to reach groundwater within 1,000 years, at a maximum concentration of 1,070 pCi/L, which is below the applicable RAG (20,000 pCi/L).

ATTACHMENTS:

1. Graphic showing 132-H-1 RESRAD Calculation Conceptual Model (1 page)
2. RESRAD Output: 132-H-1 Shallow Zone Radionuclides, Mixture Sums and Single Radionuclide Guidelines (24 pages)
3. RESRAD Output: 132-H-1 Shallow Zone Radionuclides, Intake Quantities and Health Risk Factors (27 pages)
4. RESRAD Output: 132-H-1 Shallow Zone Radionuclides, Concentration of Radionuclides, (17 pages)

ATTACHMENT 1

132-H-1 RESRAD Calculation Conceptual Model



Attachment 1 Sheet No. 1 of 1
Originators: S. W. Clark Date 5/3/06
Chk'd By M. W. Perrott Date 5/15/06
Calc. No. 0100H-CA-V0082 Rev. No. 0

APPENDIX D

Historical Drawing of Analogous Stack Foundation

Figure D-1. Buildings No. 116-B, D, F - Concrete Stack Foundation (Historical Drawing W-72485, 1943).

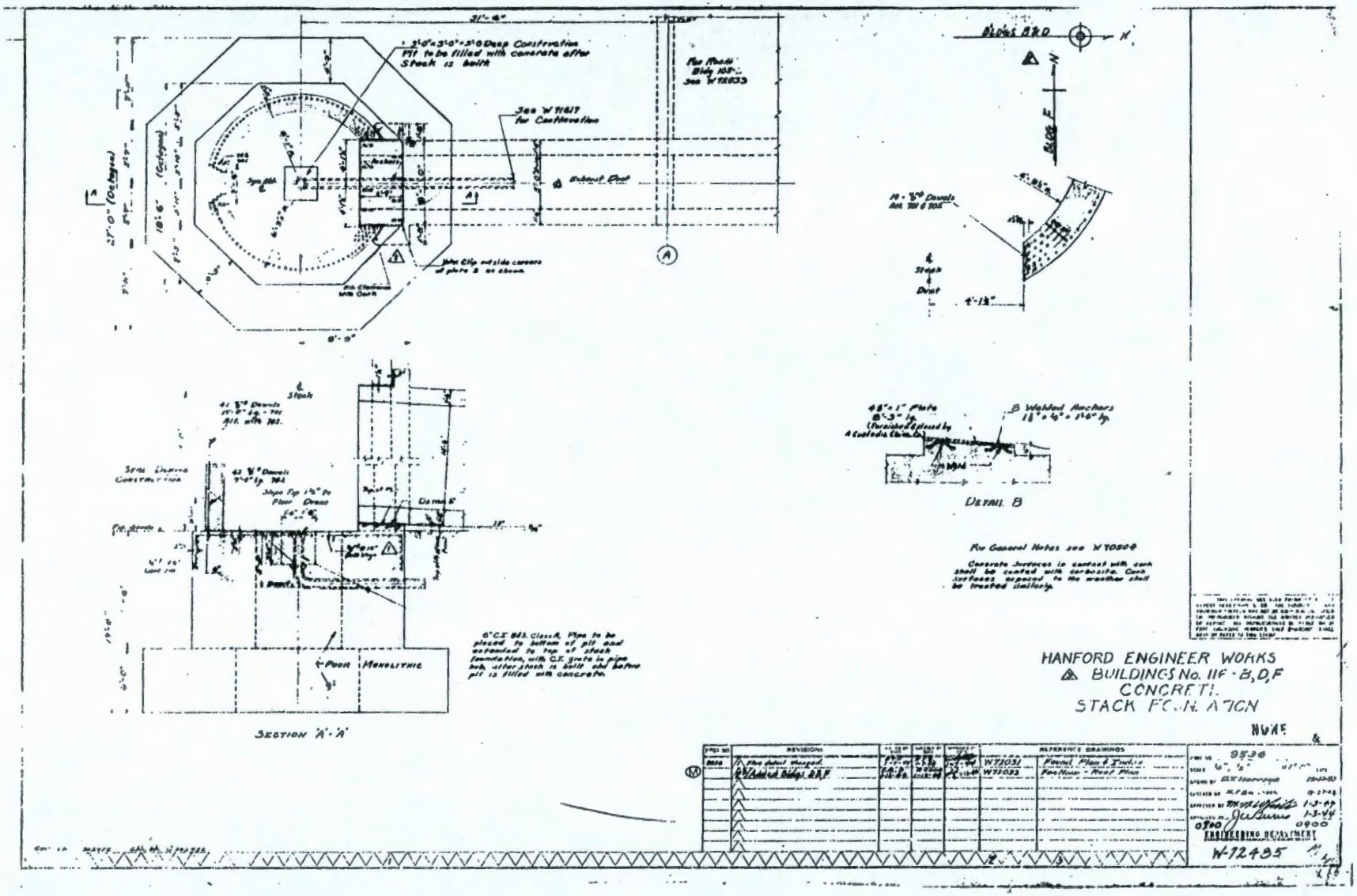
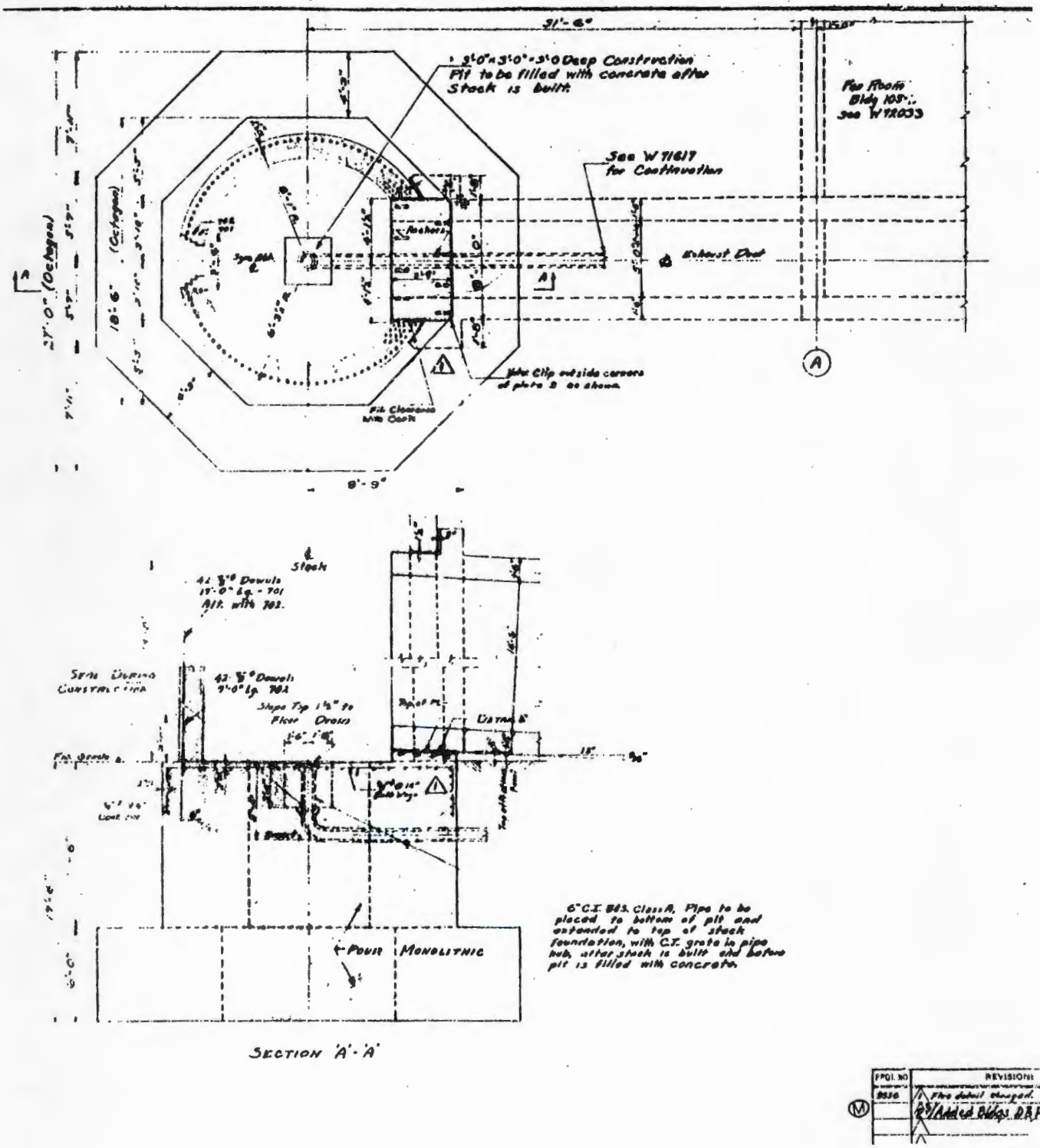



Figure D-2. Detail of Concrete Stack Foundation Showing Embedded Condensate Drain (Historical Drawing W-72485, 1943).