1217773

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2009-030

Waste Site Code(s)/Subsite Code(s): 100-H-28:7

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☐ No Action ☒ Rejected ☐
RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-H-28:7 subsite encompasses the filtered/treated water pipelines originating at the 183-H Filter Plant. The pipelines were designed to supply water treated at the 183-H Filter Plant to 100-H Area facilities, including the 184-H Boiler House, 190-H Pumphouse, 105-H Reactor Building, and the elevated water tanks adjacent to the 105-H Reactor Building. The 183-H Filter Plant has been demolished and the pipelines remain in place, consisting of various sizes of cast iron and steel pipelines.

Confirmatory sampling of the pipelines was performed between September 3, 2008 and March 3, 2009. Three test pits were excavated and samples of the pipeline contents and underlying soil were collected. The results of confirmatory sampling were used to determine if the waste site meets remedial action objectives and remedial action goals established by 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* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999). The selected action involved (1) evaluating the site using available process information, (2) demonstrating through confirmatory sampling that cleanup goals have been achieved, and (3) proposing the site for reclassification to No Action.

Basis for reclassification:

Evaluation of the confirmatory sampling results for 100-H-28:7, 183-H Process Water Lines support a reclassification of this subsite to No Action. The 183-H Filter Plant was used for the physical and chemical treatment of river water for use in reactor cooling and other 100-H Area operations. Physical treatment (settling basins and filtration) removed debris and sediment from raw river water. Chemical treatment included pH modification (with sulfuric acid), chlorination for algae control, and the addition of coagulants (primarily alum prepared at the facility by reacting bauxite with sulfuric acid) and a commercial organic polymer flocculation/filtration aid to remove coagulated material. The site achieves the remedial action objectives established in 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. The site will support future unrestricted land uses that can be represented (or bounded) by a rural-residential scenario. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-H-28:7, 183-H Process Water Lines* (attached).

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WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2009-030

Waste Site Code(s)/Subsite Code(s): 100-H-28:7

Regulator comments:

Approval of this WSRF documents regulator agreement that the 100-H-28:7, 183-H Process Water Lines waste site qualifies for "No Action" under this Interim Action ROD. In addition, Ecology has evaluated the data for this waste site against WAC 173-340 (2007) cleanup levels for direct contact, groundwater protection, and river protection. This evaluation is documented in the letter transmitting Ecology's approval of the waste site's interim reclassification to "No Action."

Waste Site Controls:

Engineered Controls: ☐ Yes ☒ No Institutional Controls: ☐ Yes ☒ No O&M Requirements: ☐ Yes ☒ No

If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents:

J. P. Neath	J P Neath	10/16/12
DOE Federal Project Director (printed)	Signature	Date
N. Menard		
Ecology Project Manager (printed)	Signature	Date
EPA Project Manager (printed)	Signature	Date

Draft A

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-28:7, 183-H PROCESS WATER LINES

Attachment to Waste Site Reclassification Form 2009-030

June 2012

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-28:7, 183-H PROCESS WATER LINES

EXECUTIVE SUMMARY

The 100-H-28, 100-H Water Treatment Facilities Underground Pipelines waste site is part of the 100-HR-1 Operable Unit. The 100-H-28 waste site encompasses pre-reactor underground pipelines, including supply lines between water treatment facilities and the 105-H Reactor Building, process sewers, and sanitary sewers. The site has been divided into eight subsites based on process knowledge, contaminants of potential concern (COPCs), and grouping for field remediation. The primary operational period for these pipelines coincides with the 105-H Reactor and its support facilities, from 1949 to 1965. The 100-H-28:7 subsite consists of pipelines located between the former 183-H Filter Plant Pumphouse and the 182-H Reservoir, 184-H Boiler House, 190-H Pumphouse, and the 105-H Reactor facilities. The 100-H-28:7 pipelines were used to supply treated and filtered water to these facilities.

Confirmatory sampling of the 100-H-28:7 pipelines occurred over the period beginning September 3, 2008 and concluding on March 3, 2009. The pipelines were accessed and sampled via three test pits. Based on evaluation of the analytical results, it was determined that the risk associated with the small volume of pipe scale found within the pipelines of the 100-H-28:7 subsite is minimal and does not require remedial action. Access to these materials is prevented because they are encased within the pipelines. Furthermore, many of the metals and other inorganic constituents are at concentrations consistent with sediments and deposits contained within public water distribution pipelines (EPA 2006). Therefore, evaluation of the waste site is based on analytical results from soil samples associated with the site. The evaluation determined that the 100-H-28:7 subsite achieves the remedial action objectives (RAOs) and the corresponding remedial action goals (RAGs) established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) 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* (Remaining Sites ROD) (EPA 1999).

In accordance with this evaluation, a reclassification status of no action has been determined for the 100-H-28:7 subsite. In addition to meeting the RAGs and RAOs for the Remaining Sites ROD (EPA 1999), the site will support future unrestricted land uses that can be represented (or bounded) by a rural-residential scenario with no requirement for institutional controls. A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table ES-1. The results of the confirmatory sampling are used to make reclassification decisions for the 100-H-28:7 subsite in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2007).

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison of ecological risk screening levels to the 100-H-28:7 subsite contaminants of concern, contaminants of potential concern, and other constituents that exceed ecological screening levels

Table ES-1. Summary of Confirmatory Soil Sample Results for the 100-H-28:7, 183-H Process Water Lines. (2 Pages)

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.	RESRAD evaluation of the predicted direct exposure dose due to radionuclides in the pipe scale finds the maximum dose to be 2.65 mrem/yr, thus meeting the 15 mrem/yr above background dose limitation [a].	Yes
Direct Exposure – Nonradionuclides	Attain individual COC RAGs.	All individual COPC soil concentrations are below the direct exposure RAGs. There is no creditable pathway for exposure to contamination inside pipelines.	Yes
Meet Nonradionuclide Risk Requirements	Hazard quotient of less than 1 for noncarcinogens.	All individual soil concentrations hazard quotients are less than 1.	Yes
	Cumulative hazard quotient of less than 1 for noncarcinogens.	The cumulative soil concentrations hazard quotient is less than 1 at 1.4E-03	
	Excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	All individual soil concentrations carcinogen risk values are less than 1.0E-06.	
	Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk quotient for soil concentrations is less than 1.0E-05 at 1.8E-07.	
Groundwater/River Protection – Radionuclides	Attain single COC groundwater and river RAGs.	RESRAD modeling predicts that all groundwater and river protection RAGS are attained [a].	Yes
	Attain National Primary Drinking Water Regulations 4-mrem/yr (beta/gamma) dose standard to target receptor/organ [b].	RESRAD modeling predicts that all groundwater and river protection RAGS are attained [a].	
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [c].	No alpha-emitting radionuclide COCs were quantified above groundwater/river protection lookup values.	Yes
	Meet total uranium standard of 21.2 pCi/L [d].	RESRAD modeling predicts that the maximum uranium groundwater concentration will be 2.39 pCi/L [a].	Yes

Table ES-1. Summary of Confirmatory Soil Sample Results for the 100-H-28:7, 183-H Process Water Lines. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Four nonradionuclide COPCs (total chromium, lead, benzo(a)pyrene, and benzo(k)fluoranthene) were quantitated in soil above the groundwater and/or river soil RAGs. However, based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b) and the constituent with the lowest K_d value (30 mL/g for lead) it is predicted that these COPCs will not reach groundwater (or the river) within 1,000 years [e].	Yes

[a] RESRAD modeling evaluation of radionuclide dose and radionuclide groundwater and drinking water protection is documented in the *100-H-28:7 RESRAD Calculation Brief* (Appendix C).

[b] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).

[c] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).

[d] Based on the isotopic distribution of uranium in the 100 Area, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).

[e] Total chromium, lead, benzo(a)pyrene, and benzo(k)fluoranthene results from soil samples exceed groundwater and/or river protection RAGs. Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b) and evaluation of the constituent with the lowest K_d value (lead at K_d = 30 mL/g), none of these constituents are predicted to migrate more than 2.2 m (7 ft) vertically in 1,000 years. The vadose zone underlying the waste site is approximately 9.5 m (31 ft) thick. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

COC = contaminant of concern
COPC = contaminant of potential concern
DOE = U.S. Department of Energy
K_d = distribution coefficient
MCL = maximum contaminant level
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)

is presented in Appendix A. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, lead, manganese, vanadium, and zinc. Ecological screening levels from *Washington Administrative Code* 173-340 were exceeded for boron and vanadium. Because concentrations of antimony, manganese, vanadium, and zinc are below Hanford Site (DOE-RL 2001) or Washington State (Ecology 1994) background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents does not pose a risk to ecological receptors. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-28:7, 183-H PROCESS WATER LINES

STATEMENT OF PROTECTIVENESS

The 100-H-28:7 subsite evaluation and supporting documentation demonstrate that the pipeline subsite meets the remedial action objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) 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* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow-zone soil (i.e., surface to 4.6 m [15 ft]), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The 100-H-28:7 subsite did not extend into the deep zone. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison of ecological risk screening levels to the 100-H-28:7 subsite contaminants of concern, contaminants of potential concern, and other constituents that exceed ecological screening levels is presented in Appendix A. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, lead, manganese, vanadium, and zinc. Ecological screening levels from *Washington Administrative Code* 173-340 were exceeded for boron and vanadium. Because concentrations of antimony, manganese, vanadium, and zinc are below Hanford Site (DOE-RL 2001) or Washington State (Ecology 1994) background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents does not pose a risk to ecological receptors. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

GENERAL SITE INFORMATION AND BACKGROUND

The primary operational period of the 100-H-28:7 pipelines coincides with the operation of the 105-H Reactor and its support facilities, from 1949 to 1965. The pipelines were designed to supply water treated at the 183-H Filter Plant to 100-H Area facilities, including the 184-H Boiler House, 190-H Pumphouse, 105-H Reactor Building, and the elevated water tanks adjacent to the 105-H Reactor Building.

The 183-H Filter Plant was used for the physical and chemical treatment of river water. Treated water was used in reactor cooling and other 100-H Area operations. Chemical treatment at the

183-H Filter Plant included pH modification (with sulfuric acid), chlorination for algae control, and the addition of coagulants (primarily alum prepared at the facility by reacting bauxite with sulfuric acid) and a commercial organic polymer flocculation/filtration aid (DOE-RL 1992).

These 100-H-28:7 pipelines are located between the former 183-H Filter Plant Pumphouse and the 182-H Reservoir, 184-H Boiler House, 190-H Pumphouse, and 105-H Reactor facilities (Figure 1). The 100-H-28:7 pipelines are approximately 1.8 to 3 m (6 to 10 ft) below existing grade. These steel pipelines consist of 0.15-m (6-in.), 0.20-m (8-in.), 0.25-m (10-in.), 0.61 m (24-in.), 0.76-m (30-in.), and 0.91-m (36-in.) pipes. These pipelines were used to transfer treated water from the 183-H Filter Plant Pumphouse to the 182-H Reservoir Pumphouse, 184-H Boiler House, 190-H Pumphouse, and 105-H Reactor facilities (including the 187-H Emergency Cooling Water Tanks).

The 183-H Filter Plant was used for the physical and chemical treatment of river water for use in reactor cooling and other 100-H Area operations. In 1973, portions of the former flocculation and settling basins were converted to solar evaporation basins to be used to reduce the volume of chemical and mixed wastes from 300 Area fuel fabrication facilities. These basins (116-H-6 Solar Evaporation Basins) were used until 1988, but were not associated with any of the 100-H-28:7 pipelines. The majority of the facility, except the clearwells and converted settling basins, was demolished and backfilled to grade in 1974 (WHC 1991).

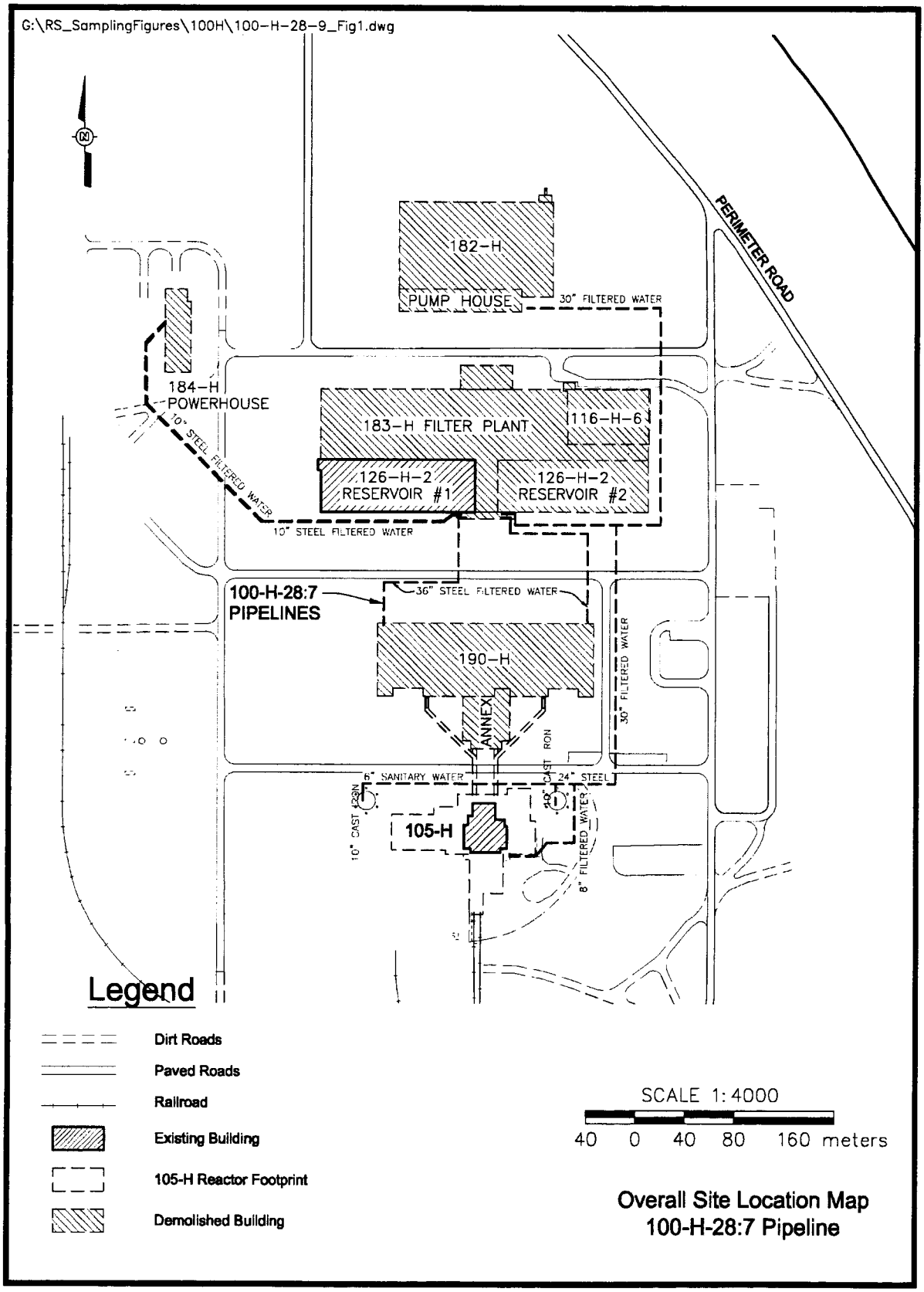
CONFIRMATORY SAMPLING DESIGN

Contaminants of Potential Concern

Contaminants of potential concern (COPCs) identified in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009a) for the 100-H-28 waste site include cobalt-60, cesium-137, europium-152, europium-154, strontium-90, lead, hexavalent chromium, and metals, where "metals" is taken to mean any remaining *Resource Conservation and Recovery Act of 1976* (RCRA)-listed metals not already included (arsenic, barium, cadmium, total chromium, mercury, selenium, and silver). For strontium-90, isotope specific analysis was required only for samples in which gross beta activity above background was detected (WCH, 2007). Additional COPCs for the 100-H-28:7 pipeline subsite were identified based on historical information and possible use of the pipelines.

Radionuclides were identified as COPCs for the 100-H-28:7 pipelines due to possible crossover of contamination from the process sewers at the 105-H Reactor Building and possible intake of radionuclide-contaminated effluents from upstream reactor areas. Due to the potential presence of rubber gaskets within the 183-H Filter Plant, polychlorinated biphenyls (PCBs) were included as COPCs. Lead, metals, and hexavalent chromium were identified as COPCs for the 100-H-28:7 subsite due to potential addition of these chemicals at the water treatment facilities that may have been discharged to the subject process sewers. Although not considered COPCs, analysis for additional metals (antimony, beryllium, boron, cobalt, copper, manganese, molybdenum, nickel, vanadium, and zinc) and anions were identified. Kinetic phosphorescence

Figure 1. 100-H-28:7 Subsite Pipeline Location Map.



analysis (KPA) for uranium was also performed. Suspect asbestos-containing materials (ACM) (mastic on pipelines) were identified during field sampling and were subsequently sampled and analyzed. No other anomalous debris or media were identified or sampled during confirmatory sampling activities of the 100-H-28:7 pipelines.

Analysis for anions was identified in the work instruction, but was inadvertently excluded from requested analyses for several samples. However, anions are not considered site COPCs and this omission does not significantly impact the data set. The omission is discussed further in the data quality assessment (DQA).

Confirmatory Sampling

The 100-H-28:7 pipelines were all pressurized pipelines without known sediment accumulation points. The *Work Instruction for Confirmatory Sampling of the 100-H-28:7, 183-H Process Water Lines* (WCH 2007) designated three locations for the collection of confirmatory samples (Figure 2). Samples identified in the work instruction included soil beneath the pipelines, sediment or scale within the pipelines, and any potentially hazardous materials encountered during sampling. A summary of samples collected at the 100-H-28:7 subsite is presented in Table 1.

Excavation and sampling of the 100-H-28:7 pipelines occurred between September 2008 and March 2009 (WCH 2008a, 2009). In accordance with the 100-H-28:7 work instruction (WCH 2007), the subject pipeline(s) were located at each of the prescribed test pits and cut open to obtain a sample of available pipe scale/rust. A soil sample from beneath each pipe was also collected.

At test pit 1, two 25-cm (10-in.)-diameter pipelines were excavated (Figure 3). Both of the 100-H-28:7 pipelines at test pit 1 contained a significant volume of water. Water within each pipe, as well as the soil underlying each pipe, were sampled on September 30 and October 1, 2008 (Table 2). The water contained slightly elevated concentrations of lead and manganese, but at levels which would allow this water to be used for dust suppression. With concurrence from the Washington State Department of Ecology, the water was removed from the pipeline and used for dust suppression.

After the water was removed from the pipes, a second sampling of the pipe material at test pit 1 occurred on March 19, 2009. Limited scale material was available for collection; therefore, scale from the north and south pipe sections was collected and combined into a single sample. Due to low mass, only gross alpha, gross beta, gamma energy, and total uranium analyses were able to be performed on this scale sample.

Figure 2. Confirmatory Sampling Pits for the 100-H-28:7 Pipelines.

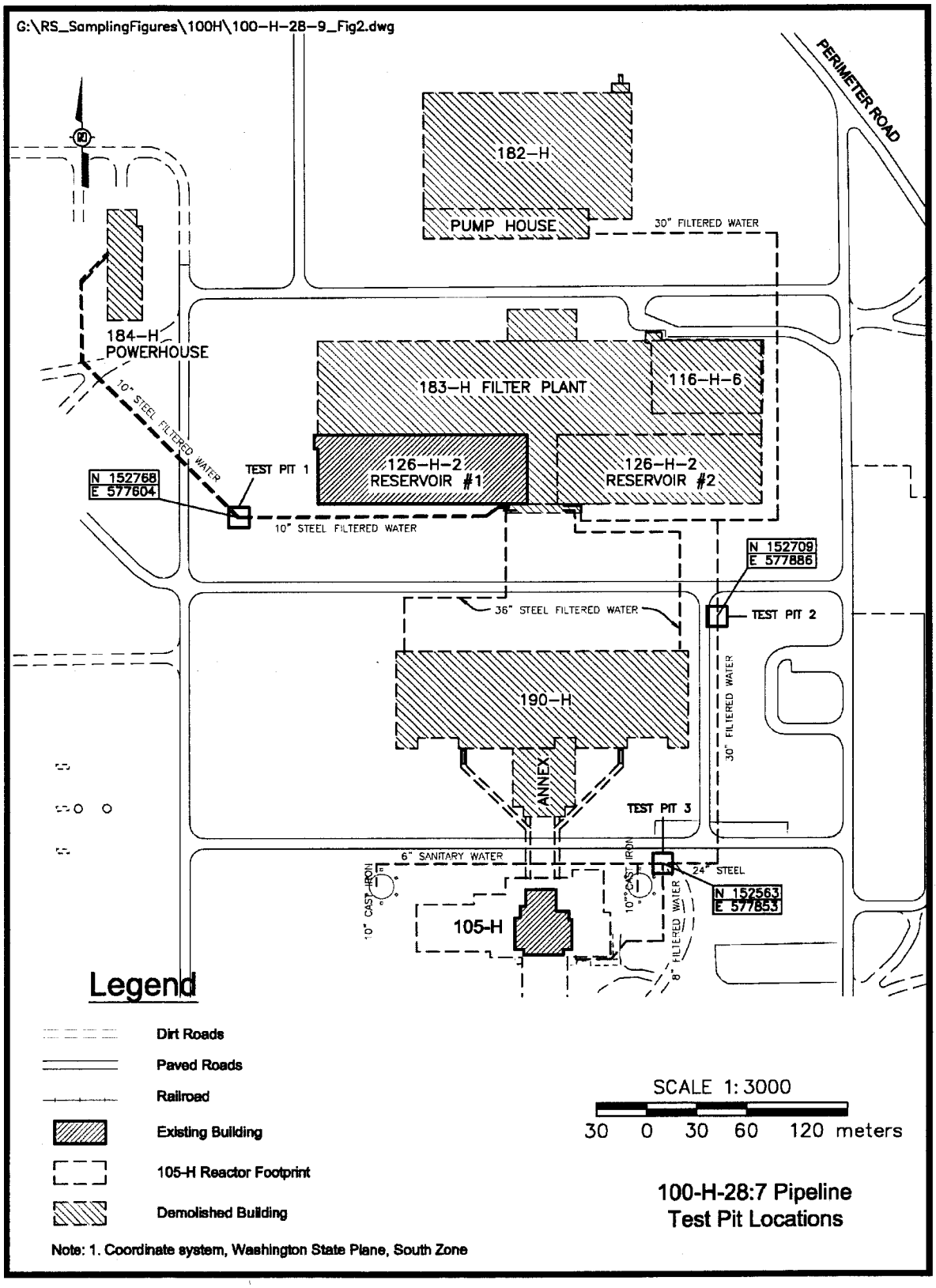


Table 1. Confirmatory Sample Summary for the 100-H-28:7 Subsite.

Sample Location	Sample Media	Sample Number	Sample Collection Date	WSP Coordinate Locations	Sample Analysis
Test pit 1	Pipe scale	J18KV3	3/19/2009	N 152768, E 577604	GEA, gross alpha, gross beta, KPA [a]
		J18KW4	3/19/2009		Hexavalent chromium
	Soil under southern pipe	J17HJ1	10/1/2008		ICP metals, mercury, GEA, gross alpha, gross beta, KPA, PCB, hexavalent chromium
	Soil under northern pipe	J17HJ2	10/1/2008		
Test pit 2	Soil under 30-in.-diameter pipe	J17HJ5	10/13/2008	N 152709, E 577886	ICP metals, mercury, GEA, gross alpha, gross beta, KPA, PCB, anions, hexavalent chromium [b]
	30-in.-diameter pipe scale	J17HK8	10/15/2008		ICP metals, mercury, GEA, gross alpha, gross beta, KPA, PCB
		J17HL3	10/15/2008		Hexavalent chromium
	Mastic on 30-in.-diameter pipe	J17FP8	10/1/2008		Asbestos
Test pit 3	Soil under pipe	J18KV0	3/23/2009	N 152563, E 577853	ICP metals, mercury, GEA, gross alpha, gross beta, KPA, PCB, hexavalent chromium [c]
	Pipe scale	J18KV5	3/23/2009		ICP metals, mercury, GEA, gross alpha, gross beta, KPA, PCB [c]
		J18KW5	3/23/2009		Hexavalent chromium
NA	Equipment blank	J17HJ3	10/13/2008	NA	ICP metals and mercury

[a] Due to limited sample mass, not all analyses were performed on pipe scale sample J18KV3.
[b] Additional analyses (Ni-63, Sr-90, Tc-99, isotopic uranium, and isotopic plutonium) were requested for this sample due to an elevated gross alpha result. Results of these analyses are included with the sample data in Appendix B.
[c] Analyses for polycyclic aromatic hydrocarbons were inadvertently requested for this sample. Results of this analysis are included with the sample data in Appendix B.

GEA = gamma energy analysis
ICP = inductively coupled plasma
KPA = kinetic phosphorescence analysis
NA = not available
PCB = polychlorinated biphenyl
WSP = Washington State Plane

Figure 4. 100-H-28:7 Test Pit 2 View to the South.

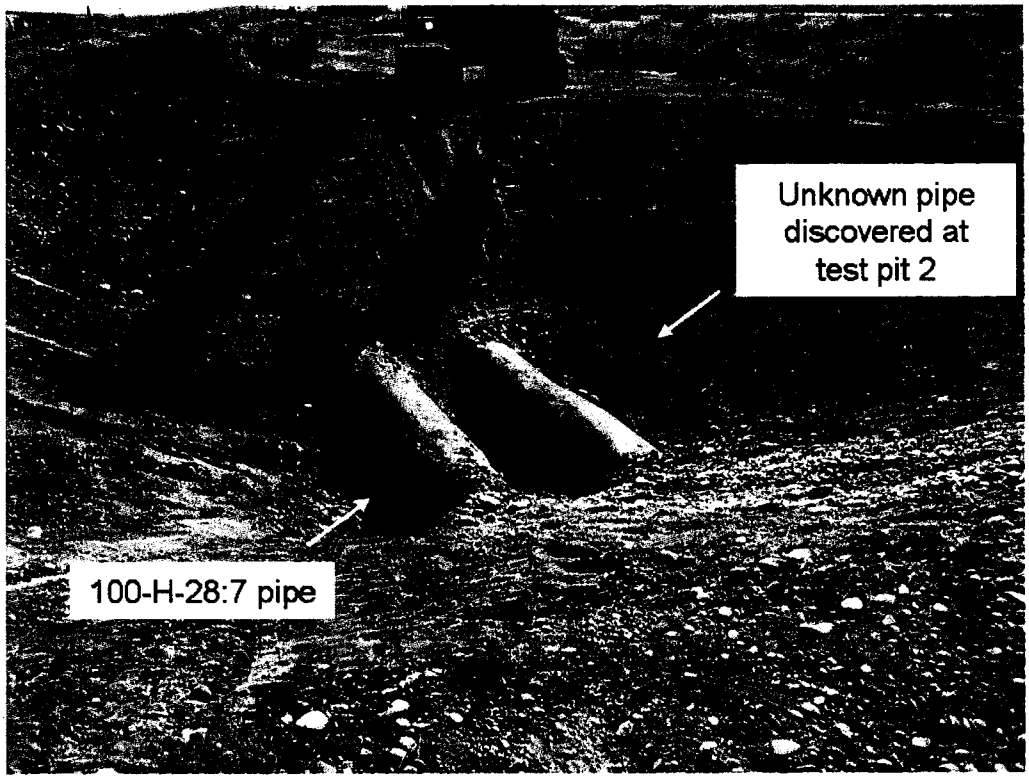


Figure 5. Rust and Scale in the 76-cm (30-in.) Pipeline at 100-H-28:7 Test Pit 2.

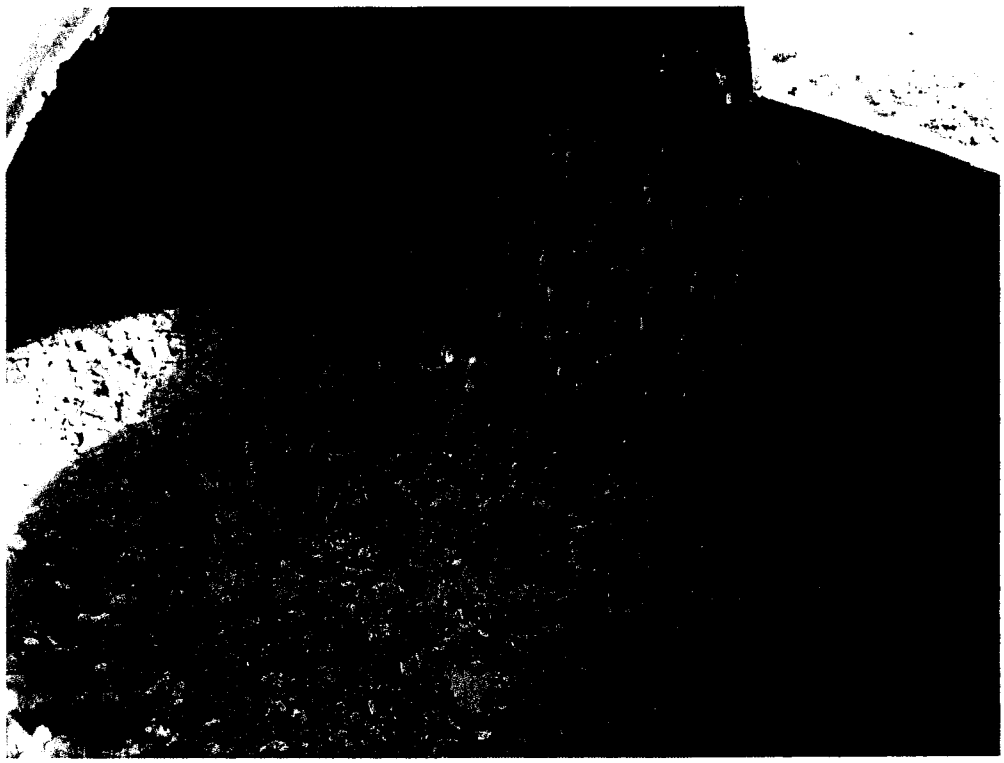


Figure 3. 100-H-28:7 Pipelines Exposed at Test Pit 1.

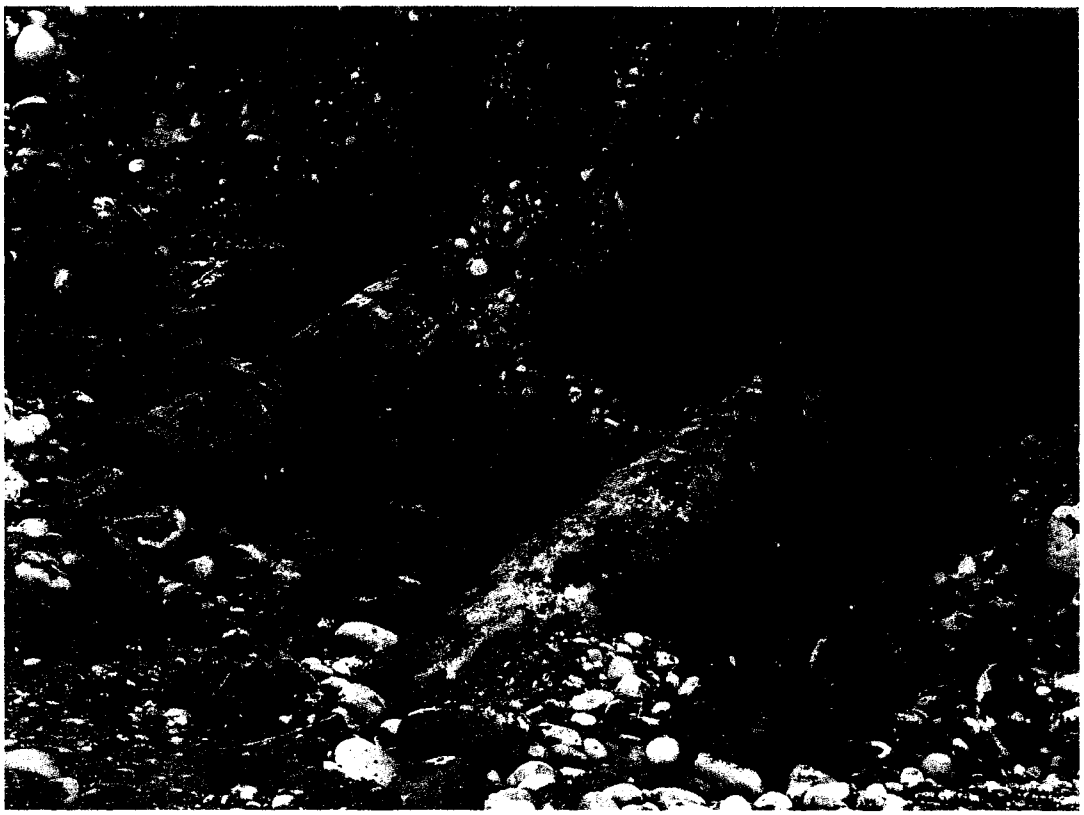


Table 2. Water Samples Collected from 100-H-28:7 Test Pit 1 Pipelines.

Sample Media	Sample Number	Sample Collection Date	WSP Coordinate Locations	Sample Analysis
Liquid in southern pipe	J17JX8	9/30/2008	N 152768, E 577604	ICP metals, mercury, GEA, gross alpha, gross beta, KPA, PAH, pesticides
	J17JY2	9/30/2008		Hexavalent chromium
Liquid in northern pipe	J17JX9	10/1/2008		ICP metals, mercury, GEA, gross alpha, gross beta, KPA
	J17K37	10/1/2008		Hexavalent chromium

GEA = gamma energy analysis
ICP = inductively coupled plasma
KPA = kinetic phosphorescence analysis
PAH = polycyclic aromatic hydrocarbons
WSP = Washington State Plane

Test pit 2 excavation began September 3, 2008 and two pipes were located at approximately 2.1 to 2.4 m (7 to 8 ft) below ground surface (bgs) (Figure 4). The west pipe was 61 cm (24 in.) in diameter and the east pipe was 76 cm (30 in.) in diameter. The 61 cm (24 in.) diameter pipe was an unknown pipeline not related to the 100-H-28:7 pipelines and has since been included as part of 100-H-35, 100-H Service Water Pipelines. Scale inside the 100-H-28:7 pipe (Figure 5) at test pit 2 and the underlying soil were sampled on October 13 and 15, 2008. Additionally, a sample of suspect ACM from each pipe was sampled on October 1, 2008.

During excavation at test pit 3 on March 23, 2009, a french drain was discovered. Samples were taken both within and below the structure. This french drain is not related to the 100-H-28:7 pipelines and has since been included as part of the 100-H-49:1, 184-H Boiler House and 1717-H Hot Shop French Drains subsite. The 100-H-28:7 test pit 3 pipeline was also excavated and scale from inside the pipe and the soil underlying the pipe was sampled on March 23, 2009. The pipe contained no water and the scale inside had a similar appearance to that seen in the test pit 2 pipe.

A section of the 100-H-28:7 pipeline was removed near the location of 100-H-28:7 test pit 2 to facilitate confirmatory sampling of the 100-H-28:2 pipeline at test pit 1. The 100-H-28:2 pipeline is located approximately 9 m (30 ft) bgs at test pit 1. The 100-H-28:7 pipeline runs parallel to the 100-H-28:2 pipeline at this location, but it is significantly shallower at approximately 2 m (6 ft) bgs. Therefore, a section of the 100-H-28:7 pipeline was cut and removed at the 100-H-28:2 test pit 1 location. The ends of the 100-H-28:7 pipe were wrapped in plastic after its removal. Field screening of the section of 100-H-28:7 pipeline was initially within the acceptable range for radiological activity. However, after moisture in the pipeline dried, a second field screen of this section of pipe identified radiological activity above background. It is believed that water within the pipe shielded this radiological activity from the initial field screening. The section of the 100-H-28:7 pipeline was placed back into the excavation and backfilled with concurrence from the Washington State Department of Ecology (WCH 2008b). The entire 100-H-28:2 pipeline subsite has been recommended for remediation. The 100-H-28:7 pipe section that was reburied shall be removed and disposed as part of the 100-H-28:2 remediation.

CONFIRMATORY SAMPLE RESULTS

Confirmatory sampling data for the 100-H-28:7 waste subsite is presented in Appendix B. The laboratory-reported confirmatory data results for all samples and constituents associated with the 100-H-28:7 subsite are stored in the Environmental Restoration (ENRE) project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are presented as Appendix B of this document.

Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2009) under *Washington Administrative Code* (WAC) 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site contaminants of concern (COCs)/COPCs. Potassium-40, radium-226, radium-228, thorium-228, thorium-232, and uranium-233/234 may have been detected in samples collected at the site, but are not considered within the calculations or following tables. These isotopes are excluded from consideration as COCs/COPCs because they are unrelated to the operational history of the Hanford Site and were detected below background levels. Based on an assumption of secular equilibrium, the background activities for radium-228 and thorium-228 are equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in *Hanford Site Background: Part 2, Soil Background for Radioactive Analytes* (DOE-RL 1996).

The results from soil samples obtained beneath the pipelines at three test pits show levels of chromium (total), lead, benzo(a)pyrene, and benzo(k)fluoranthene exceeding groundwater and/or river protection RAGs. Samples of rust/scale collected from inside the pipelines showed concentrations of cesium-137, uranium-238, arsenic, cobalt, and benzo(a)pyrene above the direct exposure RAGs for soil. Additional metals (antimony, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel silver, and zinc) were quantified in pipe scale at levels above groundwater and/or river protection RAGs for soil. Cobalt-60 and europium-152 were detected in the scale samples below the individual radionuclide lookup values. Comparison of the maximum results for the pipeline contents (i.e., rust/scale) and the underlying soil to the cleanup criteria is provided in Table 3. Results of suspect asbestos containing material samples collected from the pipes at test pit 2 did not identify any ACM.

The samples with constituents quantified above direct exposure RAGs originated from inside the pipelines at test pits 2 and 3 and represent a limited volume (mass) of rusty pipe scale (Table 4). A site-specific RESidual RADioactivity (RESRAD) evaluation of the predicted direct exposure dose due to all detected radionuclides in the pipe scale (cesium-137, uranium-238, cobalt-60, and europium-152) finds the maximum dose to be 2.65 mrem/yr, which is less than the 15 mrem/yr above background dose limitation (Appendix C). This RESRAD evaluation also predicts that there will be no impact to groundwater or the river from cesium-137, cobalt-60, and europium-152 in the pipe scale within 1,000 years. Uranium-238 is predicted to reach groundwater and peak at year 270 with a maximum activity of 2.39 pCi/L. This peak activity is well below the RAG of 21.2 pCi/L (BHI 2001). Further restriction to the mobility of the radionuclides, resulting from encasement inside of a steel pipe, was not accounted for in the RESRAD evaluation, making this a conservative evaluation.

The soil sample collected underneath test pit 2 (J17HJ5) had a gross alpha analysis of 18.2 pCi/g. Therefore, the sample was further evaluated by analysis of nickel-63, strontium-89/90, technetium-99, isotopic plutonium, and isotopic uranium. Constituents in all additional analyses were not detected, except for uranium-233/234 and uranium-235 which were detected at levels below background.

The results of soil samples collected below the pipelines indicate that although multiple metals were detected above the groundwater and river protection RAGs or (in the case of arsenic and cobalt) direct exposure RAGs in the pipeline rust/scale, these constituents have no pathway to migrate from the pipeline into the underlying soil. Of the elevated constituents in the pipe scale, only chromium, lead, benzo(a)pyrene, and benzo(k)fluoranthene were quantified above RAGs in soil samples. Although arsenic, cobalt, and benzo(a)pyrene concentrations present in rust/scale inside the pipeline exceed the direct exposure RAGs for soil, these constituents are contained within pipelines. Therefore, credible pathways do not exist for these constituents to affect human health or the environment.

Water samples were collected from the liquid in both pipelines exposed in test pit 1 (Table 2). The laboratory results of these samples were evaluated against the drinking water maximum contaminant levels (MCLs). Levels of lead and manganese were slightly greater than MCLs. The minimum detectable activity for uranium by gamma energy analysis was higher than the MCL for uranium; however, since no other isotopes were detected in the water, it is believed that

Table 3. Comparison of Maximum Values to Remedial Action Goals for the 100-H-28:7 Subsite. (2 Pages)

Contaminant	Maximum Rust/Scale Result (pCi/g)	Maximum Soil Result (pCi/g)	Generic Site Lookup Values (pCi/g) [a]			Does the Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
			Shallow Zone	Groundwater Protection	River Protection		
Cesium-137	12.3	ND	6.2	1,465	2,930	Yes	Yes [b]
Cobalt-60	0.027	ND	1.4	13,900	27,800	No	--
Europium-152	0.154	ND	3.3	-- [c]	-- [c]	No	--
Uranium 233/234	ND	0.758 (<BG)	1.1	1.1	1.1	No	--
Uranium-238	3.58	0.494 (<BG)	1.1	1.1	1.1	Yes	Yes [b]
Contaminant	**Maximum Rust/Scale Result (mg/kg)**	**Maximum Soil Result (mg/kg)**	**Soil Cleanup Levels [a] (mg/kg)**			**Does the Maximum Result Exceed Lookup Values?**	**Does the Maximum Result Pass RESRAD Modeling?**
			Direct Exposure	**Groundwater Protection**	**River Protection**		
Antimony	15.0	0.75 (<BG)	32	5 [d]	5 [d]	Yes	Yes [e]
Arsenic	58.6	6.0 (<BG)	20 [d]	20 [d]	20 [d]	Yes	Yes [e]
Barium	62	86.3 (<BG)	5,600	200	400	No	--
Beryllium	0.61	0.77 (<BG)	10.4 [f]	1.51 [d]	1.51 [d]	No	--
Boron [g]	4.5	1.4	7,200	320	--	No	--
Cadmium	4.6	0.05 (<BG)	13.9 [f]	0.81 [d]	0.81 [d]	Yes	Yes [e]
Chromium (total)	374	20.9	80,000	18.5 [d]	18.5 [d]	Yes	Yes [e, h]
Chromium VI [g]	1.97	ND	2.1 [f]	4.8	2	No	--
Cobalt	75.4	7.1 (<BG)	24	15.7 [d]	--	Yes	Yes [e]
Copper	811	15.3 (<BG)	2,960	59.2	22.0 [d]	Yes	Yes [e]
Lead	26.7	13.8	353	10.2 [d]	10.2 [d]	Yes	Yes [e, h]
Manganese	1380	309 (<BG)	3,760	512 [d]	512 [d]	Yes	Yes [e]
Mercury	7.3	0.014 (<BG)	24	0.33 [d]	0.33 [d]	Yes	Yes [e]
Molybdenum [g]	30.6	0.36	400	8	--	Yes	Yes [e]
Nickel	305	18.6 (<BG)	1,600	19.1 [d]	27.4	Yes	Yes [e]
Silver	2.8	ND	400	8	0.73 [d]	Yes	Yes [e]
Uranium	3.05	1.28 (<BG)	240	3.21	3.21	No	--
Vanadium	42	40.3 (<BG)	560	85.1 [d]	--	No	--
Zinc	267	48.0 (<BG)	24,000	480	67.8 [d]	Yes	Yes [e]
Chloride	90	ND	NA	25,000	NA	No	--
Fluoride	12	ND	4,800	96	400	No	--
Nitrite (as nitrogen)	0.45	ND	8,000	100	200	No	--
Sulfate	680	5.5 (<BG)	--	25,000	--	No	--
Acenaphthene	0.049	ND	24,000	240	1,920	No	--
Benzo(a)pyrene	0.21	0.020	0.137	0.015 [i]	0.015 [i]	Yes	Yes [e, h]
Benzo(b)fluoranthene	ND	0.0075	1.37	0.015 [i]	0.015 [i]	No	--
Benzo(g,h,i)perylene [j]	0.044	ND	2,400	48	192	No	--
Benzo(k)fluoranthene	0.099	0.027	1.37	0.015 [i]	0.015 [i]	Yes	Yes [e, h]
Chrysene	ND	0.0063	13.7	0.12	0.1 [i]	No	--
Fluoranthene	ND	0.048	3,200	64	18.0	No	--

Table 3. Comparison of Maximum Values to Remedial Action Goals for the 100-H-28:7 Subsite. (2 Pages)

Contaminant	Maximum Rust/Scale Result (mg/kg)	Maximum Soil Result (mg/kg)	Soil Cleanup Levels [a] (mg/kg)			Does the Maximum Result Exceed Lookup Values?	Does the Maximum Result Pass RESRAD Modeling?
			Direct Exposure	Groundwater Protection	River Protection		
Fluorene	0.012	ND	3,200	64	260	No	--
Indeno(1,2,3-cd)pyrene	0.11	0.017	1.37	0.33 [i]	0.33 [i]	No	--
Naphthalene	0.031	ND	1,600	16.0	988	No	--
Phenanthrene [j]	0.21	0.038	24,000	240	1,920	No	--
Pyrene	0.097	0.051	2,400	48	192	No	--

[a] Lookup values and remedial action goals (RAGs) obtained from the RDR/RAWP (DOE-RL 2009a) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B (Ecology 1996), unless otherwise noted.

[b] Cesium-137 and uranium-238 are present in residual pipeline rust/ scale at concentrations exceeding direct exposure RAGs. A site-specific RESRAD evaluation (Appendix C) of the detected radiological results showed that the predicted radiological dose due to the concentrations in the pipes are less than the 15 mrem/yr above background RAG and are, therefore, protective of human health and the environment. No radionuclides were detected in the soil underlying the pipelines at concentrations exceeding RAGs.

[c] No value; because the K_d value for this contaminant is 200 mL/g, RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009) predicts that the contaminant will show no migration within the 100 Area vadose zone, and no impact on groundwater or the Columbia River.

[d] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.

[e] Multiple contaminants are present in residual pipeline rust/scale at concentrations exceeding groundwater and river protection soil RAGs. Arsenic, cobalt, and benzo(a)pyrene in the pipeline rust/scale exceed direct exposure soil RAGs. Many of the metals are inherently part of the corrosion byproduct of the piping material or deposits associated with constituents occurring naturally in the incoming water. For all rust/scale results, both metal and organic constituents are contained inside of the pipeline and credible pathways do not exist to affect human health and the environment. Therefore, concentrations of all constituents in the pipeline are predicted to be protective of human health and the environment.

[f] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3] [Ecology1996]) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

[g] No Hanford Site-specific background or Washington State background available.

[h] Total chromium, lead, benzo(a)pyrene, and benzo(k)fluoranthene results from soil samples exceed groundwater and/or river protection RAGs. Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009) and evaluation of the constituent with the lowest K_d value (lead at K_d = 30 mL/g), none of these constituents are predicted to migrate more than 2.2 m (7 ft) vertically in 1,000 years. The vadose zone underlying the waste site is approximately 9.5 m (31 ft) thick. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

[i] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996). The cited RDLs are based on analytical method numbers that may not be available for rapid turnaround analyses. Prior notification and concurrence with the laboratory may be necessary to analyze to meet this RDL. Actual detection limits may differ from any RDL.

[j] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals:
Contaminant: benzo(g,h,i)perylene; surrogate: pyrene
Contaminant: phenanthrene; surrogate: anthracene.

-- = not applicable
BG = background (obtained from DOE-RL [1996] and DOE-RL [2001], unless otherwise noted)
K_d = distribution coefficient
ND = not detected
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

Table 4. 100-H-28:7 Pipe Scale Samples Exceeding Direct Exposure RAGs.

Analyte	Test Pit 2 Pipe Scale, J17HK8	Test Pit 3 Pipe Scale, J18KV5	Direct Exposure RAG	Unit
Cesium-137	12.3	10.9	6.2	pCi/g
Uranium-238	3.58	NA	1.1	pCi/g
Arsenic	58.6	51	20	mg/kg
Cobalt	75.4	20[a]	24	mg/kg
Benzo(a)pyrene	0.21	NA	0.137	mg/kg

[a] Result does not exceed direct exposure but is included for comparison purposes.
NA = not analyzed
RAG = remedial action goal

uranium as an isolated radionuclide is not present as a contaminant. Additionally, KPA analysis did not detect total uranium above the MCL in the water samples. The water was removed from the pipeline and used for dust suppression with concurrence from the Washington State Department of Ecology. The results of these samples are presented in Appendix B. A comparison of maximum values from these samples to groundwater criteria and MCLs is presented in Table 5.

Table 5. Comparison of Maximum Values of Water Samples to Groundwater Criteria and MCLs for the Liquid Found in Test Pit 1 (J17JX8, J17JX9).

COPC	Maximum Water Result (ug/L)	Groundwater Action Levels (ug/L)			
		Method B	Primary MCL	Secondary MCL	State MCL/SMCL
Barium	108	3,200	2,000	--	2,000
Boron	49.5	3,200	--	--	--
Chromium (total)	2.0	24,000	100	--	100
Copper	115	640	1,300[c]	1,000	1,300[c]
Lead	104	--	15.0[c]	--	15.0[c]
Lithium	0.90	32	--	--	--
Magnesium	378	2,240	--	--	--
Manganese	174	752	--	50	50
Mercury	0.15	4.80	2.0	--	2.0
Nickel	9.3	320	--	--	100
Uranium	2.55	48	30	--	--
Vanadium	1.8	112	--	--	--
Zinc	113	4,800	--	5,000	5,000
Nitrate (as Nitrogen)	0.08	25,600	10,000	--	10,000

[a] Value reflects the primary drinking water standard action level.
-- = no criteria available
COPC = contaminant of potential concern
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level

Data Evaluation

Evaluation of the results provided in Table 3 from the confirmatory sampling event indicate that residual contamination concentrations associated with the 100-H-28:7 pipelines meet the applicable RAOs. Cesium-137, uranium-238, arsenic, cobalt, and benzo(a)pyrene were identified in pipeline scale and rust at values exceeding direct exposure RAGs for soil. Uranium-238, antimony, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, silver, zinc, benzo(a)pyrene, and benzo(k)fluoranthene were quantified in pipe scale at levels above groundwater and/or river protection RAGs for soil. Cobalt-60 and europium-152 were detected in pipe scale at levels below soil cleanup criteria.

Confirmatory sampling of the soil underlying these pipelines determined that constituents inside the pipeline have not had an impact on the underlying soil. Of the constituents with elevated results in the pipe scale, only chromium, lead, benzo(a)pyrene, and benzo(k)fluoranthene were quantified above groundwater and/or Columbia River protection RAGs in soil samples. Radionuclides above background levels were not detected in soil samples. Soil concentrations of chromium, (20.9 mg/kg), lead (13.8 mg/kg), benzo(a)pyrene (0.020 mg/kg), and benzo(k)fluoranthene (0.027 mg/kg) are predicted to be protective of groundwater and the Columbia River through RESRAD modeling. The RESRAD model was run using various distribution coefficient (K_d) values and unsaturated/uncontaminated vadose zone thicknesses to determine minimum K_d values necessary such that a contaminant will not migrate through the soil column to groundwater in 1,000 years (Appendix C of the RDR/RAWP [DOE/RL-2009b]). Of the four contaminants that exceed groundwater and/or river protection RAGs, lead has the lowest distribution coefficient at 30 mL/g. The RESRAD model shows that contaminants with a K_d of 30 mL/g will not migrate more than 2.2 m (7 ft) vertically in 1,000 years. The vadose zone thickness beneath the 100-H-28:7 subsite is approximately 9.5 m (31 ft) thick; therefore, none of the residual contaminants are predicted to migrate from the waste site to groundwater in 1,000 years.

The result of gross alpha analysis of the soil sample collected underneath the pipeline at test pit 2 (J17HJ5) was 18.2 pCi/g. Therefore the sample was further evaluated by analysis of nickel-63, strontium-89/90, technetium-99, isotopic plutonium, and isotopic uranium. Of these additional analytes, only uranium-233/234 and uranium-235 were detected. The detections of uranium-233/234 and uranium-235 were at concentrations below background levels. Gross beta results from all samples were below background (28 pCi/g) or not detected. Therefore, gross beta results did not trigger subsequent analysis for strontium-89/90.

The analytical results of soil samples collected from below the pipelines indicate that although multiple metals were detected above the groundwater and river protection RAGs or (in the case of arsenic and cobalt) direct exposure RAGS in the pipeline rust/scale, these constituents have not migrated and are not predicted to migrate from the pipeline into the underlying soil. Of the elevated constituents in the pipe scale, only chromium, lead, benzo(a)pyrene, and benzo(k)fluoranthene were quantified above RAGs in soil samples. Although arsenic, cobalt, and benzo(a)pyrene concentrations present in rust/scale inside the pipeline exceed the direct exposure RAGs for soil, these constituents are contained within pipelines and credible pathways do not exist for these constituents to affect human health or the environment.

Assessment of the risk requirements for the 100-H-28:7 subsite is determined by calculation of the hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. These calculations are located in Appendix C. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. These risk values were conservatively calculated using the maximum analytical values (Appendix B) from the soil samples collected at the 100-H-28:7 subsite.

Risk values are not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The calculations indicate that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-H-28:7 subsite is 1.4×10^{-3}. All individual cumulative carcinogenic risk values are less than 1×10^{-6}. The cumulative carcinogenic risk value is 1.8×10^{-7}. Therefore, nonradionuclide risk requirements are met.

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

An additional calculation of the hazard quotient and carcinogenic (excess cancer) risk values for the potential impact to groundwater was performed for nonradionuclides. The comparisons for the groundwater pathway include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. Risk values were not calculated for constituents that were not detected, were detected at concentrations below Hanford Site background values, or were not predicted to reach groundwater in 1,000 years according to fate and transport modeling. One individual constituent (boron) in soil met the criteria for calculation of a protection of groundwater hazard quotient for noncarcinogenic constituents. The maximum value of 1.40 mg/kg for boron was divided by the noncarcinogenic RAG value of 320 mg/kg to obtain the result of 4.4×10^{-3}. Therefore, the cumulative hazard quotient for the 100-H-28:7 subsite is less than 1.0. No carcinogenic constituents from groundwater met the criteria for evaluation at the 100-H-28:7 subsite; therefore, no calculations of excess carcinogenic risk were performed. Nonradionuclide risk requirements related to groundwater are met.

DATA QUALITY ASSESSMENT

A DQA was performed to compare the confirmatory sampling approach and analytical data with the sampling and data requirements specified in the confirmatory sampling work instruction (WCH 2007). The DQA for the 100-H-28:7 subsite established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. The data set was found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The confirmatory sample analytical data are stored in the ENRE project-specific database for data evaluation prior to its archival in HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR NO ACTION

The 100-H-28:7 subsite has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009b). Confirmatory sampling was performed, and the analytical results indicate that the residual concentrations of COCs/COPCs at this site meet the RAOs for direct exposure, groundwater protection, and river protection. Multiple analytes were identified in the pipelines' interior rust, scale, and concrete linings at concentrations exceeding soil RAGs. However, these analytes are contained inside of the pipelines and do not present a creditable risk to human health or the environment. Furthermore, metals and other inorganic constituents are at concentrations consistent with sediments and deposits commonly found in public water distribution pipelines (EPA 2006). Radionuclide COPCs were not detected in soil samples above background levels and those detected in scale inside of the pipelines are shown to meet the RAOs using a site-specific RESRAD evaluation (Appendix C). Furthermore, it is predicted that constituents in soil will not reach groundwater (and thus the Columbia River) within 1,000 years based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b). These results also indicate that residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation are not required. Accordingly, a reclassification to No Action is supported for the 100-H-28:7 subsite.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Exceedances of Ecological Screening Levels for the 100-H-28:7 Subsite [a, b].

Hazardous Substance		2007 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [c]				Site Analyses
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [d]	Mammalian [d]	
Metals (mg/kg):									
	Background								
Antimony	5	5	--	--	--	78	--	0.27	0.75
Boron	NA	0.5	--	--	--	--	--	--	1.4
Lead	10.2	50	500	118	120	1,700	11	56	13.8
Manganese	512	1,100	--	1,500	220	450	4,300	4,000	309
Vanadium	85.1	2	--	--	--	--	7.8	280	40.3
Zinc	67.8	86	200	360	160	120	46	79	48

NOTE: Shaded cells are exceeded by the maximum of the focused or statistical result.

[a] Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. All exceedances must be evaluated in the context of additional lines of evidence for ecological effects following a baseline risk assessment for the river corridor portion of the Hanford Site which will include a more complete quantitative ecological risk assessment.

[b] Based on an evaluation of analytical results of soil samples collected at the 100-H-28:7 subsite.

[c] Available on the internet at (www.epa.gov/ecotox/ecossl).

[d] Wildlife.

-- = values not available

COPC = contaminant of potential concern

EPA = U.S. Environmental Protection Agency

NA = not available

APPENDIX B

CONFIRMATORY SAMPLING DATA

Table B-1. 100-H-28:7 Sampling Results - Radionuclides. (3 Pages)

Sample Description	Sample Number	Sample Date	Americium-241			Americium-241 GEA			Antimony-125			Barium-133			Beryllium-7			Cesium-134		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP 1 scale (both pipes)	J18KV3	3/19/09				0.015	U	0.015												
TP 1 soil under south pipe	J17HJ1	10/1/08				0.042	U	0.042	0.055	U	0.055				0.163	U	0.163	0.033	U	0.033
TP 1 soil under north pipe	J17HJ2	10/1/08				0.136	U	0.136	0.045	U	0.045				0.147	U	0.147	0.029	U	0.029
TP 2 east pipe scale	J17HK8	10/15/08				0.021	U	0.021												
TP 2 soil under east pipe	J17HJ5	10/13/08	-0.030	U	0.336	0.123	U	0.123				0.026	U	0.026						
TP 3 pipe scale	J18KV5	3/23/09																		
TP 3 soil under pipe	J18KV0	3/23/09																		
Equipment blank	J17HJ3	10/13/08	-0.138	U	0.848	0.154	U	0.154				0.021	U	0.021						

Sample Description	Sample Number	Sample Date	Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155			Gross alpha		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP 1 scale (both pipes)	J18KV3	3/19/09	0.015	U	0.015	0.015	U	0.015	0.142	U	0.142	0.041	U	0.041	0.027	U	0.027	5.19	U	6.07
TP 1 soil under south pipe	J17HJ1	10/1/08	0.022	U	0.022	0.027	U	0.027	0.057	U	0.057	0.088	U	0.088	0.058	U	0.058	5.80	U	9.85
TP 1 soil under north pipe	J17HJ2	10/1/08	0.020	U	0.020	0.020	U	0.020	0.054	U	0.054	0.068	U	0.068	0.075	U	0.075	6.92	U	8.94
TP 2 east pipe scale	J17HK8	10/15/08	12.3		0.022	0.027		0.011	0.154		0.065	0.036	U	0.036	0.044	U	0.044	1.38	U	6.75
TP 2 soil under east pipe	J17HJ5	10/13/08	0.022	U	0.022	0.019	U	0.019	0.065	U	0.065	0.068	U	0.068	0.094	U	0.094	18.2		6.18
TP 3 pipe scale	J18KV5	3/23/09	10.9		0.0365	0.0237	U	0.0338	0.190	U	0.143	-0.00418	U	0.0916	0.0105	U	0.132	4.45	U	4.68
TP 3 soil under pipe	J18KV0	3/23/09	0.0108	U	0.0383	-0.00199	U	0.0353	0.0225	U	0.0893	-0.00328	U	0.113	0.0362	U	0.0980	3.01	U	3.49
Equipment blank	J17HJ3	10/13/08	0.018	U	0.018	0.020	U	0.020	0.049	U	0.049	0.074	U	0.074	0.060	U	0.060	2.42	U	4.44

Note: The following abbreviations apply to Tables 2 - 4.

B = estimated result; analyte was detected at a value less than requied detection limit (inorganics)
C = method blank contamination (inorganics)
D = diluted
ICP = inductively coupled plasma
GEA = gamma energy analysis
KPA = kinetic phosphorescence analysis
L = serial dilution in the analytical batch indicates that interferences are present
M = precision criteria not met in laboratory duplicate
MDA = minimum detectable activity
N = criteria not met in matrix spike and/or matrix spike duplicate recovery
N* = presumptive evidence of compound based on mass spectral library search
PQL = practical quantitation limit
Q = qualifier
TP = test pit
U = undetected
X = matrix interference evident; more than 40% difference between the primary and confirmation column results

Table B-1. 100-H-28:7 Sampling Results - Radionuclides. (3 Pages)

Sample Description	Sample Number	Sample Date	Gross beta			Nickel-63			Plutonium-238			Plutonium-239/240			Potassium-40			Radium-226		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP 1 scale (both pipes)	J18KV3	3/19/09	3.55	U	8.48										0.291	U	0.291	0.116	U	0.116
TP 1 soil under south pipe	J17HJ1	10/1/08	19.6		8.91										14.3		0.209	0.542		0.033
TP 1 soil under north pipe	J17HJ2	10/1/08	13.4		8.60										13.9		0.204	0.362		0.037
TP 2 east pipe scale	J17HK8	10/15/08	26.4		5.61										0.304	U	0.304	0.129		0.034
TP 2 soil under east pipe	J17HJ5	10/13/08	20.4		5.52	1.80	U	3.12	0.026	U	0.246	0.154	U	0.196	16.6		0.207	0.646		0.044
TP 3 pipe scale	J18KV5	3/23/09	51.8	U	4.66															
TP 3 soil under pipe	J18KV0	3/23/09	20.3		4.68															
Equipment blank	J17HJ3	10/13/08	5.91	U	8.60	1.77	U	2.95	-0.089	U	0.328	-0.030	U	0.227	4.71		0.232	0.191		0.041

Sample Description	Sample Number	Sample Date	Radium-228			Ruthenium-106			Silver-108 metastable			Technetium-99			Thorium-228			Thorium-232		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP 1 scale (both pipes)	J18KV3	3/19/09	0.063	U	0.063										0.024	U	0.024	0.063	U	0.063
TP 1 soil under south pipe	J17HJ1	10/1/08	0.791		0.101	0.179	U	0.179							0.734		0.032	0.791		0.101
TP 1 soil under north pipe	J17HJ2	10/1/08	0.578		0.086	0.158	U	0.158							0.527		0.027	0.578		0.086
TP 2 east pipe scale	J17HK8	10/15/08	0.053	U	0.053										0.029	U	0.029	0.053	U	0.053
TP 2 soil under east pipe	J17HJ5	10/13/08	1.08		0.092				0.02	U	0.017	0.175	U	0.400	1.04		0.034	1.08		0.092
TP 3 pipe scale	J18KV5	3/23/09																		
TP 3 soil under pipe	J18KV0	3/23/09																		
Equipment blank	J17HJ3	10/13/08	0.215		0.064				0.016	U	0.016	0.120	U	0.423	0.184		0.024	0.215		0.064

Sample Description	Sample Number	Sample Date	Total beta radiostronium			Uranium-233/234			Uranium-235			Uranium-235 GEA			Uranium-238			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP 1 scale (both pipes)	J18KV3	3/19/09										0.075	U	0.075				2.96	U	2.96
TP 1 soil under south pipe	J17HJ1	10/1/08										0.106	U	0.106				2.68	U	2.68
TP 1 soil under north pipe	J17HJ2	10/1/08										0.173	U	0.173				2.46	U	2.46
TP 2 east pipe scale	J17HK8	10/15/08										0.101	U	0.101				3.58		1.63
TP 2 soil under east pipe	J17HJ5	10/13/08	0.075	U	0.366	0.758		0.252	0.120	U	0.305	0.123	U	0.123	0.494		0.252	2.60	U	2.60
TP 3 pipe scale	J18KV5	3/23/09																		
TP 3 soil under pipe	J18KV0	3/23/09																		
Equipment blank	J17HJ3	10/13/08	-0.018	U	0.242	0.183	U	0.281	0.089	U	0.340	0.076	U	0.076	0.183	U	0.281	2.46	U	2.46

Table B-1. 100-H-28:7 Sampling Results - Radionuclides. (3 Pages)

Sample Description	Sample Number	Sample Date	Americium-241			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
TP 1 liquid in south pipe	J17JX8	9/30/08	6.82	U	6.82	5.18	U	5.18	5.71	U	5.71	12.8	U	12.8	15.0	U	15.0	11.0	U	11.0
TP 1 liquid in north pipe	J17JX9	10/1/08	17.8	U	17.8	4.34	U	4.34	4.04	U	4.04	12.9	U	12.9	12.9	U	12.9	16.5	U	16.5

Sample Description	Sample Number	Sample Date	Gross alpha			Gross beta			Potassium-40			Radium-226			Radium-228			Thorium-228		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
TP 1 liquid in south pipe	J17JX8	9/30/08	0.867	U	0.959	0.482	U	2.75	57.3	U	57.3	10.5	U	10.5	20.8	U	20.8	7.79	U	7.79
TP 1 liquid in north pipe	J17JX9	10/1/08	0.364	U	1.33	1.08	U	1.80	91.4	U	91.4	10.0	U	10.0	20.5	U	20.5	8.78	U	8.78

Sample Description	Sample Number	Sample Date	Thorium-232			Uranium-235			Uranium-238		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
TP 1 liquid in south pipe	J17JX8	9/30/08	20.8	U	20.8	18.7	U	18.7	611	U	611
TP 1 liquid in north pipe	J17JX9	10/1/08	20.5	U	20.5	22.4	U	22.40	498	U	498

Table B-2. 100-H-28:7 Sampling Results - Inorganics. (3 Pages)

Sample Description	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP 1 soil under south pipe	J17HJ1	10/1/08	7180	C	2.7	0.45		0.20	6.0		0.33	57.2	C	0.07	0.24		0.03	1.2		0.33
TP 1 soil under north pipe	J17HJ2	10/1/08	5560	C	2.5	0.75		0.19	2.9		0.31	60.0	C	0.06	0.17		0.03	1.1		0.31
TP 2 east pipe scale	J17HK8	10/15/08	1590		15.8	15.0		1.2	58.6		2.0	42.7		0.39	0.20	U	0.20	4.5		2.0
TP 2 soil under east pipe	J17HJ5	10/13/08	9820		2.8	0.21	U	0.21	4.6		0.34	86.3		0.07	0.33		0.03	1.4		0.34
TP 3 pipe scale	J18KV5	3/23/09	5100		1.6	0.65		0.40	51		0.70	62		0.080	0.61		0.035	1.0	U	1.0
TP 3 soil under pipe	J18KV0	3/23/09	5200		1.6	0.40	U	0.40	3.1		0.69	62		0.080	0.77		0.035	1.2	B	1.0
Equipment blank	J17HJ3	10/13/08	61.1		2.6	0.23		0.19	0.32	U	0.32	1.1		0.06	0.03	U	0.03	0.32	U	0.32

Sample Description	Sample Number	Sample Date	Cadmium			Calcium			Chromium (Total)			Hexavalent Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP 1 scale (both pipes)	J18WK4	3/19/09										0.155	U	0.155						
TP 1 soil under south pipe	J17HJ1	10/1/08	0.05		0.03	6660	C	2.7	14.7	C	0.13	0.21	U	0.21	6.4		0.13	13.4		0.13
TP 1 soil under north pipe	J17HJ2	10/1/08	0.03		0.03	6290	C	2.5	8.9	C	0.12	0.20	U	0.20	5.6		0.12	9.5		0.12
TP 2 east pipe scale	J17HK8	10/15/08	4.6		0.20	796	C	15.8	374		0.79				75.4		0.79	811	C	0.79
TP 2 east pipe scale	J17HL3	10/15/08										1.97		0.350						
TP 2 soil under east pipe	J17HJ5	10/13/08	0.03	U	0.03	8960	C	8.3	20.9	C	0.14	0.21	U	0.21	7.1		0.14	15.3	C	0.14
TP 3 pipe scale	J18KV5	3/23/09	0.64		0.043	4500		15	210		0.061				20		0.11	97		0.23
TP 3 pipe scale	J18KW5	3/23/09										0.671		0.148						
TP 3 soil under pipe	J18KV0	3/23/09	0.043	U	0.043	6100		15	8.0		0.061	0.155	U	0.155	5.0		0.10	13		0.23
Equipment blank	J17HJ3	10/13/08	0.03	U	0.03	17.5	C	2.6	0.13	U	0.13	0.20	U	0.20	0.13	U	0.13	0.22	C	0.13

Sample Description	Sample Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP 1 soil under south pipe	J17HJ1	10/1/08	17800	C	3.0	13.8		0.20	5210	C	1.7	276	C	0.03	0.01	U	0.01	0.32		0.20
TP 1 soil under north pipe	J17HJ2	10/1/08	15600	C	2.8	3.4		0.19	4370	C	1.5	275	C	0.03	0.009	U	0.009	0.24		0.19
TP 2 east pipe scale	J17HK8	10/15/08	484000	C	148	26.7		1.2	192		9.9	1380	C	0.16	7.3		0.17	30.6		1.2
TP 2 soil under east pipe	J17HJ5	10/13/08	19700		3.1	7.0		0.21	7060		1.7	309	C	0.03	0.009	U	0.009	0.36		0.21
TP 3 pipe scale	J18KV5	3/23/09	200000		20	14		0.28	2600		3.9	1000		0.53	6.2		0.058	6.2		0.27
TP 3 soil under pipe	J18KV0	3/23/09	14000		4.0	6.7		0.28	3400		3.9	220		0.10	0.014	BN	0.0058	0.27	U	0.27
Equipment blank	J17HJ3	10/13/08	151		2.9	0.34		0.19	8.4		1.6	3.6	C	0.03	0.008	U	0.008	0.19		0.19

Table B-2. 100-H-28:7 Sampling Results - Inorganics. (3 Pages)

Sample Description	Sample Number	Sample Date	Nickel			Potassium			Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP 1 soil under south pipe	J17HJ1	10/1/08	13.5		0.13	944		2.7	0.40	U	0.40	144	C	2.7	0.06	U	0.07	172	C	1.3
TP 1 soil under north pipe	J17HJ2	10/1/08	11.4		0.12	1050		2.5	0.37	U	0.37	321	C	2.5	0.06	U	0.06	130	C	1.2
TP 2 east pipe scale	J17HK8	10/15/08	305	C	0.79	57.4		15.8	2.4	U	2.4	831		15.8	2.8		0.39	7.9	U	7.9
TP 2 soil under east pipe	J17HJ5	10/13/08	18.6	C	0.14	1400		2.8	0.41	U	0.41	225		2.8	0.07	U	0.07	221	C	4.1
TP 3 pipe scale	J18KV5	3/23/09	36		0.13	490		43	4.5	U	4.5	490		2.2	1.1		0.17	160		62
TP 3 soil under pipe	J18KV0	3/23/09	8.2		0.13	660		43	0.9	U	0.9	190		2.2	0.17	U	0.17	220		62
Equipment blank	J17HJ3	10/13/08	0.13	U	0.13	18.1		2.6	0.39	U	0.39	47.5		2.6	0.06	U	0.06	6.7	C	1.3

Sample Description	Sample Number	Sample Date	Uranium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP 1 scale (both pipes)	J18KV3	3/19/09	3.05		0.102						
TP 1 soil under south pipe	J17HJ1	10/1/08	1.03		0.015	40.3		0.09	38.8		0.40
TP 1 soil under north pipe	J17HJ2	10/1/08	1.06		0.015	37.3		0.09	32.6		0.37
TP 2 east pipe scale	J17HK8	10/15/08	1.12		0.017	23.5		0.55	267		2.4
TP 2 soil under east pipe	J17HJ5	10/13/08	1.28		0.016	39.2		0.10	48		0.41
TP 3 pipe scale	J18KV5	3/23/09	2.48	U	3.30	42		0.099	130	L	0.42
TP 3 soil under pipe	J18KV0	3/23/09	0.568	U	3.40	39		0.098	30		0.42
Equipment blank	J17HJ3	10/13/08	0.516		0.016	0.12		0.09	0.39	U	0.39

Sample Description	Sample Number	Sample Date	Bromide			Chloride			Fluoride			Nitrate (as Nitrogen)			Nitrite (as Nitrogen)			Phosphate (as Phosphorous)		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP 3 pipe scale	J18KV5	3/23/09	0.61	B	0.41	90		2.1	12		0.87	0.45	B	0.33	0.35	UR	0.35	1.3	UR	1.3
TP 3 soil under pipe	J18KV0	3/23/09	0.41	U	0.41	2.1	U	2.1	0.86	U	0.86	0.33	UMR	0.33	0.35	UR	0.35	1.3	UR	1.3

Sample Description	Sample Number	Sample Date	Sulfate		
			mg/kg	Q	PQL
TP 3 pipe scale	J18KV5	3/23/09	680	D	9.1
TP 3 soil under pipe	J18KV0	3/23/09	5.5		1.8

Sample Description	Sample Number	Sample Date	Asbestos Result
TP 2 wrap on east pipe	J17FP8	10/1/08	None detected

Table B-2. 100-H-28:7 Sampling Results - Inorganics. (3 Pages)

Sample Description	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Bismuth		
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL
TP 1 liquid in south pipe	J17JX8	9/30/08	40	C	40	3.0	U	3.0	5.0	U	5.0	108		1.0	0.5	U	0.5	6.0	U	6.0
TP 1 liquid in north pipe	J17JX9	10/1/08	58.5		40	3.0	U	3.0	5.0	U	5.0	4.7	C	1.0	0.5	U	0.5	6.0	U	6.0

Sample Description	Sample Number	Sample Date	Boron			Cadmium			Calcium			Chromium (Total)			Hexavalent Chromium			Cobalt		
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL
TP 1 liquid in south pipe	J17JX8	9/30/08	7.0		5.0	0.5	U	0.5	1560		40	2.0	U	2.0				2.0	U	2.0
TP 1 liquid in south pipe	J17JY2	9/30/08													0.002	U	0.002			
TP 1 liquid in north pipe	J17JX9	10/1/08	49.5		5.0	0.5	U	0.5	4400	C	40	2.0		2.0				2.0	U	2.0
TP 1 liquid in north pipe	J17K37	10/1/08													0.002	U	0.002			

Sample Description	Sample Number	Sample Date	Copper			Iron			Lead			Lithium			Magnesium			Manganese		
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL
TP 1 liquid in south pipe	J17JX8	9/30/08	115		2.0	1630		45	104	C	3.0	0.55		0.4	378		25	174		0.4
TP 1 liquid in north pipe	J17JX9	10/1/08	13.3		2.0	3900	C	45	3.4		3.0	0.90	C	0.4	321	C	25	99.3	C	0.4

Sample Description	Sample Number	Sample Date	Mercury			Molybdenum			Nickel			Phosphorus			Potassium			Selenium		
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL
TP 1 liquid in south pipe	J17JX8	9/30/08	0.15		0.12	3.0	U	3.0	5.4		2.0	50	U	50	692		40	6.0	U	6.0
TP 1 liquid in north pipe	J17JX9	10/1/08	0.09		0.06	3.0	U	3.0	9.3		2.0	50	U	50	1720		40	6.0	U	6.0

Sample Description	Sample Number	Sample Date	Silicon			Silver			Sodium			Strontium			Thallium			Tin		
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL
TP 1 liquid in south pipe	J17JX8	9/30/08	248		40	1.0	U	1.0	1250		20	8.4	C	0.3	6.0	U	6.0	6.0	U	6.0
TP 1 liquid in north pipe	J17JX9	10/1/08	1190		40	1.0	U	1.0	3040	C	20	13.4	C	0.3	6.0	U	6.0	6.0	U	6.0

Sample Description	Sample Number	Sample Date	Uranium (by KPA)			Uranium (by ICP)			Vanadium			Zinc			Bromide			Chloride		
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL
TP 1 liquid in south pipe	J17JX8	9/30/08	2.55		0.038	20	U	20	1.4	U	1.4	113		6.0	0.25	U	0.25	3.8		0.25
TP 1 liquid in north pipe	J17JX9	10/1/08	0.092		0.038	20	U	20	1.8		1.4	6.0	U	6.0	0.25	U	0.25	0.25	U	0.25

Sample Description	Sample Number	Sample Date	Fluoride			Nitrate (as Nitrate)			Nitrite (as Nitrite)			Nitrate (as Nitrogen)			Nitrite (as Nitrogen)			Phosphate		
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL
TP 1 liquid in south pipe	J17JX8	9/30/08	0.25	U	0.25	0.51		0.25	0.25	U	0.25	0.08		0.02	0.02	U	0.02	0.25	U	0.25
TP 1 liquid in north pipe	J17JX9	10/1/08	0.25	U	0.25	0.25	U	0.25	0.25	U	0.25	0.02	U	0.02	0.02	U	0.02	0.25	U	0.25

Sample Description	Sample Number	Sample Date	Sulfate			Total Dissolved Solids			Total Suspended Solids			pH
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	Result
TP 1 liquid in south pipe	J17JX8	9/30/08	0.25	U	0.25							6.2
TP 1 liquid in north pipe	J17JX9	10/1/08	0.25	U	0.25	20.0		10.0	172		10.0	6.6

Table B-3. 100-H-28:7 Sampling Results - Organics. (2 Pages)

Constituents	J17HJ1 TP1 soil under south pipe 10/1/08			J17HJ2 TP1 soil under north pipe 10/1/08			J17HK8 TP 2 east pipe scale 10/15/08			J17HJ5 TP 2 soil under east pipe 10/13/08		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1221	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1232	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1242	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1248	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1254	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1260	14	U	14	14	U	14	13	U	13	14	U	14

Constituents	J17HJ3 Equipment blank 10/13/08		
	µg/kg	Q	PQL
Polychlorinated Biphenyls			
Aroclor-1016	13	U	13
Aroclor-1221	13	U	13
Aroclor-1232	13	U	13
Aroclor-1242	13	U	13
Aroclor-1248	13	U	13
Aroclor-1254	13	U	13
Aroclor-1260	13	U	13

Constituents	J18KV5 TP 3 pipe scale 3/23/09			J18KV0 TP 3 soil under pipe 3/23/09		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls						
Aroclor-1016	5.3	UN*	5.3	5.2	U	5.2
Aroclor-1221	16	U	16	16	U	16
Aroclor-1232	5.3	U	5.3	5.3	U	5.3
Aroclor-1242	9.5	U	9.5	9.4	U	9.4
Aroclor-1248	5.9	U	5.9	5.8	U	5.8
Aroclor-1254	5.8	U	5.8	5.7	U	5.7
Aroclor-1260	2.8	U	2.8	2.7	U	2.7
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	49	J	10	10	U	10
Acenaphthylene	9.4	U	9.4	9.0	U	9.0
Anthracene	3.2	U	3.2	3.1	U	3.1
Benzo(a)anthracene	3.3	U	3.3	3.2	U	3.2
Benzo(a)pyrene	210	X	6.7	20		6.4
Benzo(b)fluoranthene	4.4	U	4.4	7.5	JX	4.2
Benzo(ghi)perylene	44	X	7.5	7.2	U	7.2
Benzo(k)fluoranthene	99	X	4.1	27		4.0
Chrysene	5.0	U	5.0	6.3	JX	4.9
Dibenz[a,h]anthracene	11	U	11	11	U	11
Fluoranthene	14	U	14	48		13
Fluorene	12	J	5.5	5.3	U	5.3
Indeno(1,2,3-cd)pyrene	110		13	17	J	12
Naphthalene	31	JX	13	12	U	12
Phenanthrene	210		6.7	38	J	12
Pyrene	97	X	13	51		12

Table B-3. 100-H-28:7 Sampling Results - Organics. (2 Pages)

Constituents	J17JX8 TP 1 liquid in south pipe 9/30/08			J17JX9 TP 1 liquid in north pipe 10/1/08		
	µg/L	Q	PQL	µg/L	Q	PQL
Polychlorinated Biphenyls						
Aroclor-1016	0.40	U	0.40	0.41	U	0.41
Aroclor-1221	0.40	U	0.40	0.41	U	0.41
Aroclor-1232	0.40	U	0.40	0.41	U	0.41
Aroclor-1242	0.40	U	0.40	0.41	U	0.41
Aroclor-1248	0.40	U	0.40	0.41	U	0.41
Aroclor-1254	0.40	U	0.40	0.41	U	0.41
Aroclor-1260	0.40	U	0.40	0.41	U	0.41
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	1.0	U	1.0	1.05	U	1.05
Acenaphthylene	1.0	U	1.0	1.05	U	1.05
Anthracene	0.10	U	0.10	0.11	U	0.11
Benzo(a)anthracene	0.10	U	0.10	0.11	U	0.11
Benzo(a)pyrene	0.10	U	0.10	0.11	U	0.11
Benzo(b)fluoranthene	0.10	U	0.10	0.11	U	0.11
Benzo(ghi)perylene	0.10	U	0.10	0.11	U	0.11
Benzo(k)fluoranthene	0.10	U	0.10	0.11	U	0.11
Chrysene	0.10	U	0.10	0.11	U	0.11
Dibenz[a,h]anthracene	0.10	U	0.10	0.11	U	0.11
Fluoranthene	0.15		0.10	0.11	U	0.11
Fluorene	0.10	U	0.10	0.11	U	0.11
Indeno(1,2,3-cd)pyrene	0.10	U	0.10	0.11	U	0.11
Naphthalene	1.0	U	1.0	1.05	U	1.05
Phenanthrene	0.10		0.10	0.11	U	0.11
Pyrene	0.10	U	0.10	0.11	U	0.11
Pesticides						
Aldrin	0.050	U	0.050	0.051	U	0.051
alpha-BHC	0.050	U	0.050	0.051	U	0.051
alpha-Chlordane	0.050	U	0.050	0.051	U	0.051
beta-BHC	0.050	U	0.050	0.051	U	0.051
delta-BHC	0.050	U	0.050	0.051	U	0.051
Dichlorodiphenyldichloroethane	0.050	U	0.050	0.051	U	0.051
Dichlorodiphenyldichloroethylene	0.050	U	0.050	0.051	U	0.051
Dichlorodiphenyltrichloroethane	0.050	U	0.050	0.051	U	0.051
Dieldrin	0.050	U	0.050	0.051	U	0.051
Endosulfan I	0.050	U	0.050	0.051	U	0.051
Endosulfan II	0.050	U	0.050	0.051	U	0.051
Endosulfan sulfate	0.050	U	0.050	0.051	U	0.051
Endrin	0.050	U	0.050	0.051	U	0.051
Endrin aldehyde	0.050	U	0.050	0.051	U	0.051
Endrin ketone	0.050	U	0.050	0.051	U	0.051
gamma-BHC (Lindane)	0.050	U	0.050	0.051	U	0.051
gamma-Chlordane	0.050	U	0.050	0.051	U	0.051
Heptachlor	0.050	U	0.050	0.051	U	0.051
Heptachlor epoxide	0.050	U	0.050	0.051	U	0.051
Methoxychlor	0.050	U	0.050	0.051	U	0.051
Toxaphene	0.50	U	0.50	0.51	U	0.51

APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATIONS

The calculations in this appendix are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the file will be stored in a U.S. Department of Energy, Richland Operations Office, repository. These calculations have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculations," Washington Closure Hanford, Richland, Washington. The following calculations are provided in this appendix:

100-H-28:7 Process Water Lines Direct Contact Hazard Quotient and Carcinogenic Risk Calculation for Soil, Calculation No. 0100H-CA-V0113, Rev. 0.

100-H-28:7 RESRAD Calculation Brief, Calculation No. 0100H-CA-V0110, Rev. 1.

DISCLAIMER FOR CALCULATIONS

The calculations provided in this appendix have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents.

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CALCULATION COVER SHEET

Project Title: 100-H Field Remediation **Job No. 14655**

Area: 100-H

Discipline: Environmental Calculation No: 0100H-CA-V0113

Subject: 100-H-28:7 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2003

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 Number	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = ~~5~~ 3 Total = ~~55~~ 54 1-10-11	J. D. Skoglie	T. E. Queen	B. L. Vedder	D. F. Obenauer	1/6/11

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007)

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/20/2010	Calc. No.:	0100H-CA-V0113	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	12/20/2010
Subject:	100-H-28:7 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 3	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-H-28:7 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009a), the following criteria must be met:

1) An HQ of <1.0 for all individual noncarcinogens
2) A cumulative HQ of <1.0 for noncarcinogens
3) An excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

GIVEN/REFERENCES:

1) DOE-RL, 2009a, *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2009b, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

3) WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996.

4) WCH, 2011, *Remaining Sites Verification Package for the 100-H-28:7, 183-H Process Water Lines*, Attachment to Waste Site Reclassification Form 2009-030, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2009a).

2) Sum the HQs and compare this value to the cumulative HQ of <1.0.

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2009a).

4) Sum the excess cancer risk value(s) and compare it to the cumulative cancer risk of $<1 \times 10^{-5}$.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/20/2010	Calc. No.:	0100H-CA-V0113	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	12/20/2010
Subject:	100-H-28:7 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 3	

METHODOLOGY:

The 100-H-28:7 subsite is comprised of three test pits for confirmatory sampling. The direct contact hazard quotient and carcinogenic risk calculations for the 100-H-28:7 subsite were conservatively calculated for the entire waste site using the maximum soil sample results (WCH 2010). Of the contaminants of potential concern (COPCs) for this site total chromium requires an HQ and risk calculation because this analyte was detected above background values. Boron, molybdenum, and the detected PAHs require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Lead was detected above background; however, lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.4 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 1.9×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation. The sum of the HQ values is 1.4×10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, then multiplied by 1.0×10^{-6}. For example, the maximum value for chrysene is 0.0063 mg/kg, divided by 13.7 mg/kg, and multiplied as indicated, is 4.6×10^{-10}. Comparing this value, and all other individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values is 1.8×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None
2) List the cumulative noncarcinogenic HQ >1.0: None
3) List individual carcinogens and corresponding excess cancer risk $>1 \times 10^{-6}$: None
4) List the cumulative excess cancer risk for carcinogens $>1 \times 10^{-5}$: None

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/20/2010	Calc. No.:	0100H-CA-V0113	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	12/20/2010
Subject:	100-H-28:7 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 3	

Table 1 shows the results of the hazard quotient and excess cancer risk calculations.

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-H-28:7 Subsite.

Contaminants of Potential Concern	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.4	7,200	1.9E-04	--	--
Chromium, total	20.9	80,000	2.6E-04	--	--
Lead[c]	13.8	353	--	--	--
Molybdenum	0.36	400	9.0E-04	--	--
Polycyclic Aromatic Hydrocarbons					
Benzo(a)pyrene	0.020	--	--	0.137	1.5E-07
Benzo(b)fluoranthene	0.0075	--	--	1.37	5.5E-09
Benzo(k)fluoranthene	0.027	--	--	1.37	2.0E-08
Chrysene	0.0063	--	--	13.7	4.6E-10
Fluoranthene	0.048	3,200	1.5E-05	--	--
Indeno(1,2,3-cd) pyrene	0.017	--		1.37	1.2E-08
Phenanthrene[d]	0.038	24,000	1.6E-06	--	--
Pyrene	0.051	2,400	2.1E-05	--	--
Totals					
Cumulative Hazard Quotient:			**1.4E-03**		
Cumulative Excess Cancer Risk:					**1.8E-07**

[a] = From WCH (2011).

[b] = Value obtained from the RDR/RAWP (DOE-RL 2009a) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

[c] = Value for the noncarcinogenic RAG calculated using Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children, EPA/540/R 93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D.C.

[d] = Toxicity data for phenanthrene is not available. The cleanup level is based on use of surrogate chemicals. phenanthrene surrogate: anthracene

-- = not applicable RAG = remedial action goal

CONCLUSION:

The calculations in Table 1 demonstrates that the 100-H-28:7 subsite meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2009a) and SAP (DOE-RL 2009b). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

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CALCULATION COVER SHEET

Project Title: Field Remediation **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0110

Subject: 100-H-28:7 RESRAD Calculation Brief

Computer Program: RESRAD Program No: Version 6.5

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 – 3 pg Attm. 1 - 1 pg Attm. 2 - 18 pg Attm. 3 - 19 pg Attm. 4 - 9 pg Total – 51 pages	*Signed 09/09/09* S. W. Clark	*Signed 09/09/09* M. W. Perrott	N/A	*Signed 09/09/09* D. F. Obenauer	*Approved 09/09/09*
1	Cover – 1 pg Summary – 4 pg Attm. 1 - 1 pg Attm. 2 - 22 pg Attm. 3 - 28 pg Attm. 4 - 9 pg Total – 65 pages	S. W. Clark S. W. Clark	M. W. Perrott M. W. Perrott	N/A	D. F. Obenauer D. F. Obenauer	12/15/10

SUMMARY OF REVISION

1	Calculation brief was revised to include Uranium-238 activity and revisions to Cobalt-60 and Europium-152 activities. For convenience the entire calc brief was replaced.

WCH-DE-018 (05/08/2007) *Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/4/10	Calc. No.:	0100H-CA-V0110	Rev.:	1
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/4/10
Subject:	100-H-28:7 RESRAD Calculation Brief					Sheet No. 1 of 4	

PURPOSE:

Calculate the soil and groundwater concentrations, dose, and risk contributions over a period of 1,000 years from the activities of radionuclides for the 100-H-28:7 pipelines. Calculate the predicted groundwater concentrations of radionuclides over a period of 1,000 years.

GIVEN/REFERENCES:

1) For the purpose of performing RESRAD calculations for the contaminants of the 100-H-28:7 pipelines, the radionuclide maximum analyses of pipe scale are obtained from the *Remaining Sites Verification Package for the 100-H-28:7, 183-H Process Water Lines* (RSVP), Attachment to Waste Site Reclassification Form 2009-030. Analyses of Contaminants of Potential Concern (COPCs) to be evaluated further are summarized in Table 1, below.
2) *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.
3) RESidual RADioactivity (RESRAD) computer code, Version 6.5, 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.
4) Groundwater elevation from *Hanford Site Groundwater Monitoring for Fiscal Year 2008*, DOE/RL-2008-66, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.
5) Based on the isotopic distribution of uranium in the Hanford Site background, the 30 µg/L uranium MCL (40 *Code of Federal Regulations* 141.66) corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038 (BHI 2001).

SOLUTION:

1) RESRAD runs were performed for the 100-H-28:7 pipeline sediment and pipe scale analyses reported in the 100-H-28:7 RSVP. Table 1 summarizes the data for the RESRAD runs. Table 2 shows the elevations (NAVD88) and thickness of each soil horizon. The contaminated material (pipe scale) that exceeded cleanup criteria comparisons was conservatively represented for RESRAD evaluations by a one-fourth inch (0.00635 m) thick contaminated zone one meter wide and the full length of the pipelines. Attachment 1 shows representative dimensions of soil horizons and contaminant pathways considered for dose, risk, and groundwater protection. Input factors for each run are reported in the "Summary" section of the RESRAD "Mixture Sums and Single Radionuclide Guidelines" printouts in the Attachments to this Calculation Summary.

   Uranium isotopes background activities are subtracted from the uranium activities in all soils to determine the radionuclide dose above background. For all other radionuclides background is only subtracted from the radionuclide activity in overburden soils.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/14/10	Calc. No.:	0100H-CA-V0110	Rev.:	1
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/14/10
Subject:	100-H-28:7 RESRAD Calculation Brief					Sheet No. 2 of 4	

Table 1. Confirmatory Sampling Data Set

Radionuclide COPCs	Radionuclide Soil Activity (pCi/g)	Radionuclide Background Subtraction (pCi/g)	Radionuclide Soil Activity Above Background (pCi/g)
Cesium-137	12.3	--	12.3
Cobalt-60	0.027	--	0.027
Europium-152	0.154	--	0.154
Uranium-238	3.58	1.06	2.52

Table 2. Waste Site Dimensions for RESRAD Modeling

Parameter	Units	Dimensions (m)
Contaminated Zone Dimensions		
Cover Depth	m	0
Area of Contaminated Zone (CZ)	m^2	1,620
Length Parallel to Aquifer Flow	m	41
Elevations of Vadose Zone Horizons		
Elevation: Surface	m	128
Elevation: Pipeline Invert	m	125.5
Elevation: Groundwater	m	116
Thickness: Contaminated Zone	m	0.00635 m (1/4 in.)
Thickness: Unsaturated Zone	m	9.5

2) The year where the peak dose (or concentration) occurs from each individual radionuclide COC and layer is determined by a preliminary run. This year is then added for all horizons for the final RESRAD runs. For the direct exposure pathway (i.e. soil ingestion and inhalation and external radiation), the peak year occurred at year zero (year 2010) for all radionuclide COCs. For the water pathways (i.e. drinking water and food ingestion) only uranium-238 is predicted to reach groundwater within 1,000 years, at 270 years.

METHODOLOGY:

1) Runs of RESRAD version 6.5 were completed for the 100-H-28:7 pipelines using the radionuclide activities presented in Table 1. RESRAD numerical output reports for dose, risk, and concentration are presented in the Attachments to this calculation summary.

RESULTS:

1) Radionuclide "All Pathways" Dose Rate

The "all pathways" (maximum) dose rates are shown in Table 3. The maximum all pathways dose rate from the activities of radionuclides in Table 1 is 2.65 mrem/yr at year zero (2010).

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/14/10	Calc. No.:	0100H-CA-V0110	Rev.:	1
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/14/10
Subject:	100-H-28:7 RESRAD Calculation Brief					Sheet No. 3 of 4	

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

RESRAD Run	Vadose Zone Horizon	"All Pathways" Dose Contributions in mrem/yr at Each Time Slice (yr)							
		0	1	3	10	30	100	270	1000
Maximum Activities	Shallow Zone	2.65	1.87	0.783	0	0	0	0.523	9.4E-07

2) Radionuclide Excess Lifetime Cancer Risk

The radionuclide excess lifetime cancer risk (ELCR) results are shown in Table 4. The maximum ELCR for the activities of radionuclides in Table 1 is 5.45 x 10^{-6} at year zero (2010).

Table 4. Radionuclide Excess Lifetime Cancer Risk

RESRAD Run	Vadose Zone Horizon	Excess Cancer Risk at Each Time Slice (yr)							
		0	1	3	10	30	100	270	1000
Maximum Activities	Shallow Zone	5.45E-06	3.40E-06	9.29E-07	0	0	0	2.33E-07	7.35E-11

3) Radionuclide Groundwater Protection

The radionuclide activities in groundwater predicted by the RESRAD model are summarized in Table 5. Uranium-238 is the only radionuclide predicted to reach groundwater within the 1,000 years of the RESRAD model evaluation. The activity of uranium-238 in groundwater is predicted to peak at year 270 at a maximum activity of 2.39 pCi/L, which is below the remedial action goal [RAG] of 21.2 pCi/L (BHI 2001). Calculation of cumulative organ specific dose via the groundwater (and river) pathway is not necessary because uranium-238 is the only radionuclide predicted to reach groundwater and the drinking water RAG is predicted to be met at the maximum total uranium-238 concentration.

Table 5. Predicted Groundwater (Well Water/Drinking Water) Concentrations

Radionuclide	Groundwater Concentrations in pCi/L at Each Time Interval (yr)								RAG, pCi/L
	0	1	3	10	30	100	270	1000	
Cesium-137	0	0	0	0	0	0	0	0	60
Cobalt-60	0	0	0	0	0	0	0	0	100
Europium-152	0	0	0	0	0	0	0	0	200
Uranium-238	0	0	0	0	0	0	2.39	0	21.2[a]

[a] Based on the isotopic distribution of uranium in the Hanford Site background, the 30 µg/L uranium MCL (40 *Code of Federal Regulations* 141.66) corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038 (BHI 2001).

MCL = Maximum Contaminant Level

RAG = Remedial Action Goal

CONCLUSIONS:

- The "all pathways" (maximum) dose rates are shown in Table 3. The maximum all pathways dose rate from the activities of radionuclides in Table 1 is 2.65 mrem/yr at year zero (2010).

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/14/10	Calc. No.:	0100H-CA-V0110	Rev.:	1
Project:	100-H Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/14/10
Subject:	100-H-28:7 RESRAD Calculation Brief					Sheet No. 4 of 4	

- The radionuclide excess lifetime cancer risk (ELCR) results are shown in Table 4. The maximum ELCR for the activities of radionuclides in Table 1 is 5.45 x 10^{-6} at year zero (2010).

- The dominant pathway for the RESRAD evaluations dose rate for the 100-H-28:7 pipeline sediment and pipe scale analyses is direct exposure to radionuclides.

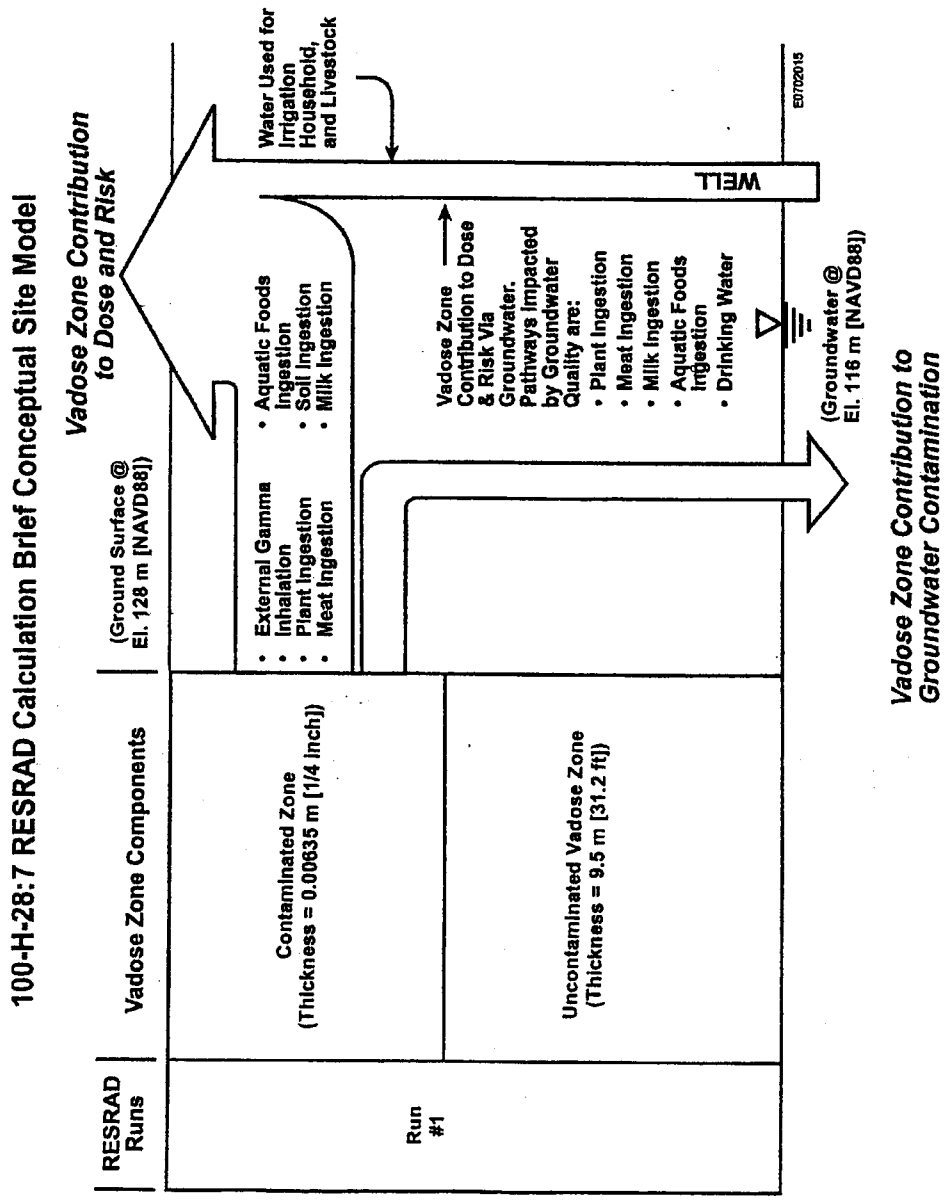
- Uranium-238 is predicted to reach groundwater within the 1,000 years of the RESRAD model evaluation. The uranium-238 concentration in groundwater is predicted to peak at year 270 at a maximum of 2.39 pCi/L, which is below the remedial action goal of 21.4 pCi/L (BHI 2001). Calculation of cumulative organ specific dose via the groundwater (and river) pathway was not necessary because uranium isotopes are the only COCs and the drinking water RAG is predicted to be met at the maximum total uranium concentration.

- None of the site contaminants are projected to exceed remedial action goals (RAGs).

ATTACHMENTS:

1. Graphic showing 100-H-28:7 Conceptual Site Model (1 page)
2. RESRAD Output: 100-H-28:7 Maximum Radionuclide Activities – Mixture Sums and Single Radionuclide Guidelines (22 pages)
3. RESRAD Output: 100-H-28:7 Maximum Radionuclide Activities – Intake Quantities and Health Risk Factors (28 pages)
4. RESRAD Output: 100-H-28:7 Maximum Radionuclide Activities – Concentration of Radionuclides, (9 pages)

ATTACHMENT 1



Attachment 1 Sheet No. 1 of 1
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
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ATTACHMENT 2

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 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(4)
A-1	Co-60 (Source: FGR 12)	1.622E+01	1.622E+01	DCF1(5)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(6)
A-1	Eu-152 (Source: FGR 12)	7.006E+00	7.006E+00	DCF1(7)
A-1	Gd-152 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(8)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(9)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(10)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(11)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(12)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(13)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(14)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(15)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(16)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(17)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(18)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(19)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(20)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(21)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(22)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-60	2.190E-04	2.190E-04	DCF2(1)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(2)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(3)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(5)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(6)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(7)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(8)
B-1	U-234	1.320E-01	1.320E-01	DCF2(9)
B-1	U-238	1.180E-01	1.180E-01	DCF2(10)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(11)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(2)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(3)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(5)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(6)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(7)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(8)
D-1	U-234	2.830E-04	2.830E-04	DCF3(9)
D-1	U-238	2.550E-04	2.550E-04	DCF3(10)
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(11)

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1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 3
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Food transfer factors:			
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(2,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(3,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(3,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(6,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(6,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(6,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(7,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RIF(9,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(11,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(2,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(3,2)

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ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days       12/13/2010  09:43  Page   4
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

                    Dose Conversion Factor (and Related) Parameter Summary (continued)
                                   Dose Library: FGR 12 & FGR 11
```

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(5,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(6,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(6,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(7,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Attachment 2 Sheet No. 4 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
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1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 5
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.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)	1.620E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	6.350E-03	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	4.100E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	2.700E+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): Co-60	2.700E-02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.230E+01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Eu-152	1.540E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): U-238	2.520E+00	0.000E+00	---	S1(10)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(10)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	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)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-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
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

Attachment 2 Sheet No. 5 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page   6
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	9.500E+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 Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.569E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	4.600E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	4.600E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	4.600E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.569E-01	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.931E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.709E+00	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.535E-03	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)

Attachment 2 Sheet No. 6 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 7
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.857E-02	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.122E-01	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.311E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter U-234				
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	1.569E-01	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	8.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.000E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Attachment 2 Sheet No. 7 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 8
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.100E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	2.700E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	1.000E+02	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	3.600E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	1.970E+01	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	7.300E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.810E-01	FMEAT
R018	Contamination fraction of milk	-1	-1	0.810E-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)

Attachment 2 Sheet No. 8 of 22
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 9
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
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)
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	64	---	---	NPTS

Attachment 2 Sheet No. 9 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  10
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	5	---	---	LYMAX
TITL	Maximum number of integration points for risk	9	---	---	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	active

Attachment 2 Sheet No 10 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev No 1

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  11
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

     Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g
     ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ            ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
       Area:   1620.00 square meters                Co-60       2.700E-02
  Thickness:      0.01 meters                       Cs-137      1.230E+01
 Cover Depth:     0.00 meters                       Eu-152      1.540E-01
                                                    U-238       2.520E+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)
             ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    t (years):  0.000E+00  1.000E+00  3.000E+00  1.000E+01  3.000E+01  1.000E+02  2.700E+02  1.000E+03
     TDOSE(t):  2.653E+00  1.874E+00  7.826E-01  0.000E+00  0.000E+00  0.000E+00  5.234E-01  9.475E-07
        M(t):  1.768E-01  1.249E-01  5.217E-02  0.000E+00  0.000E+00  0.000E+00  3.489E-02  6.316E-08
0Maximum TDOSE(t):  2.653E+00 mrem/yr   at t = 0.000E+00 years
```

Attachment	2	Sheet No.	11 of 22
Originator	S. W. Clark	Date	12/14/09
Chk'd By	M. W. Perrott	Date	12/14/09
Calc. No.	0100H-CA-V0110	Rev. No.	1

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  12
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	2.242E-02	0.0085	6.716E-09	0.0000	0.000E+00	0.0000	1.877E-05	0.0000	2.109E-06	0.0000	5.049E-07	0.0000	1.443E-06	0.0000
Cs-137	2.542E+00	0.9581	4.688E-07	0.0000	0.000E+00	0.0000	8.360E-03	0.0032	1.898E-03	0.0007	1.256E-03	0.0005	1.285E-03	0.0005
Eu-152	6.684E-02	0.0252	4.241E-08	0.0000	0.000E+00	0.0000	8.820E-07	0.0000	1.162E-07	0.0000	7.902E-09	0.0000	2.175E-06	0.0000
U-238	8.228E-03	0.0031	1.068E-04	0.0000	0.000E+00	0.0000	1.895E-04	0.0001	4.527E-06	0.0000	1.899E-05	0.0000	4.252E-04	0.0002
Total	2.639E+00	0.9949	1.073E-04	0.0000	0.000E+00	0.0000	8.569E-03	0.0032	1.905E-03	0.0007	1.276E-03	0.0005	1.714E-03	0.0006

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	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	2.244E-02	0.0085
Cs-137	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	2.554E+00	0.9630
Eu-152	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	6.685E-02	0.0252
U-238	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	8.973E-03	0.0034
Total	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	2.653E+00	1.0000

*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 12 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 13
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Co-60	1.426E-02	0.0076	4.177E-09	0.0000	0.000E+00	0.0000	1.170E-05	0.0000	1.323E-06	0.0000	3.156E-07	0.0000	8.973E-07	0.0000
Cs-137	1.799E+00	0.9599	3.248E-07	0.0000	0.000E+00	0.0000	5.806E-03	0.0031	1.325E-03	0.0007	8.737E-04	0.0005	8.904E-04	0.0005
Eu-152	5.171E-02	0.0276	3.210E-08	0.0000	0.000E+00	0.0000	6.690E-07	0.0000	8.821E-08	0.0000	5.984E-09	0.0000	1.646E-06	0.0000
U-238	1.738E-04	0.0001	2.190E-06	0.0000	0.000E+00	0.0000	4.071E-06	0.0000	1.001E-07	0.0000	3.943E-07	0.0000	8.718E-06	0.0000
Total	1.865E+00	0.9952	2.551E-06	0.0000	0.000E+00	0.0000	5.823E-03	0.0031	1.326E-03	0.0007	8.744E-04	0.0005	9.016E-04	0.0005

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 = 1.000E+00 years
0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Co-60	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	1.427E-02	0.0076
Cs-137	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	1.807E+00	0.9647
Eu-152	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	5.171E-02	0.0276
U-238	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	1.893E-04	0.0001
Total	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	1.874E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No 13 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev No 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 14
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 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.
Co-60	4.805E-03	0.0061	1.383E-09	0.0000	0.000E+00	0.0000	3.896E-06	0.0000	4.464E-07	0.0000	1.056E-07	0.0000	2.972E-07	0.0000
Cs-137	7.484E-01	0.9563	1.334E-07	0.0000	0.000E+00	0.0000	2.398E-03	0.0031	5.530E-04	0.0007	3.618E-04	0.0005	3.658E-04	0.0005
Eu-152	2.572E-02	0.0329	1.573E-08	0.0000	0.000E+00	0.0000	3.296E-07	0.0000	4.361E-08	0.0000	2.936E-09	0.0000	8.068E-07	0.0000
U-238	6.487E-08	0.0000	8.984E-10	0.0000	0.000E+00	0.0000	1.646E-09	0.0000	4.030E-11	0.0000	1.604E-10	0.0000	3.554E-09	0.0000
Total	7.789E-01	0.9953	1.514E-07	0.0000	0.000E+00	0.0000	2.402E-03	0.0031	5.535E-04	0.0007	3.619E-04	0.0005	3.669E-04	0.0005

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	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	4.810E-03	0.0061
Cs-137	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	7.521E-01	0.9610
Eu-152	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	2.572E-02	0.0329
U-238	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	7.117E-08	0.0000
Total	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	7.826E-01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No 14 of 72
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No 1

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  15
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 15 of 22
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 16
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 16 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 17
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 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.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 17 of 22
Originator: S. W. Clark Date: 12/14/09
Chk'd By M. W. Perrotti Date: 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 18
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.700E+02 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.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.700E+02 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	4.683E-01	0.8948	1.266E-03	0.0024	0.000E+00	0.0000	5.177E-02	0.0989	3.299E-04	0.0006	1.681E-03	0.0032	5.234E-01	1.0000
Total	4.683E-01	0.8948	1.266E-03	0.0024	0.000E+00	0.0000	5.177E-02	0.0989	3.299E-04	0.0006	1.681E-03	0.0032	5.234E-01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 18 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No.

ATTACHMENT 2

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  19
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	8.468E-07	0.8937	3.432E-09	0.0036	0.000E+00	0.0000	9.362E-08	0.0988	6.201E-10	0.0007	3.019E-09	0.0032	9.475E-07	1.0000
Total	8.468E-07	0.8937	3.432E-09	0.0036	0.000E+00	0.0000	9.362E-08	0.0988	6.201E-10	0.0007	3.019E-09	0.0032	9.475E-07	1.0000

*Sum of all water independent and dependent pathways.

Attachment	2	Sheet No. 19 of 22
Originator	S. W. Clark	Date 12/14/09
Chk'd By	M. V. Perrott	Date 12/14/09
Calc. No.	0100H-CA-V0110	Rev. No. 1

ATTACHMENT 2

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  20
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	2.700E+02	1.000E+03
Co-60	Co-60	1.000E+00	8.312E-01	5.286E-01	1.781E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Cs-137+D	Cs-137+D	1.000E+00	2.077E-01	1.469E-01	6.114E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-152	Eu-152	7.208E-01	3.129E-01	2.420E-01	1.204E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-152	Eu-152	2.792E-01	1.212E-01	9.375E-02	4.663E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Gd-152	2.792E-01	7.175E-19	1.738E-18	2.175E-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	äDSR(j)		1.212E-01	9.375E-02	4.663E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	5.400E-05	1.599E-08	3.342E-10	1.255E-13	0.000E+00	0.000E+00	0.000E+00	1.064E-05	0.000E+00
0U-238+D	U-238+D	9.999E-01	3.561E-03	7.512E-05	2.795E-08	0.000E+00	0.000E+00	0.000E+00	2.077E-01	0.000E+00
U-238+D	U-234	9.999E-01	6.294E-10	6.354E-10	2.859E-10	0.000E+00	0.000E+00	0.000E+00	3.071E-07	3.655E-07
U-238+D	Th-230	9.999E-01	4.011E-15	1.306E-14	1.778E-14	0.000E+00	0.000E+00	0.000E+00	3.056E-13	4.387E-12
U-238+D	Ra-226+D	9.999E-01	1.615E-16	1.272E-15	4.107E-15	0.000E+00	0.000E+00	0.000E+00	5.243E-10	2.152E-09
U-238+D	Pb-210+D	9.999E-01	8.812E-20	1.335E-18	9.204E-18	0.000E+00	0.000E+00	0.000E+00	2.121E-09	8.271E-09
U-238+D	äDSR(j)		3.561E-03	7.512E-05	2.824E-08	0.000E+00	0.000E+00	0.000E+00	2.077E-01	3.760E-07

The DSR includes contributions from associated (half-life ó 180 days) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	2.700E+02	1.000E+03
Co-60	1.805E+01	2.838E+01	8.420E+01	*1.132E+15	*1.132E+15	*1.132E+15	*1.132E+15	*1.132E+15
Cs-137	7.223E+01	1.021E+02	2.453E+02	*8.704E+13	*8.704E+13	*8.704E+13	*8.704E+13	*8.704E+13
Eu-152	3.456E+01	4.467E+01	8.982E+01	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14
U-238	4.213E+03	1.997E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	7.222E+01	*3.361E+05

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	2.700E-02	0.000E+00	8.312E-01	1.805E+01	8.312E-01	1.805E+01
Cs-137	1.230E+01	0.000E+00	2.077E-01	7.223E+01	2.077E-01	7.223E+01
Eu-152	1.540E-01	0.000E+00	4.341E-01	3.456E+01	4.341E-01	3.456E+01
U-238	2.520E+00	271.2 ñ 0.5	2.077E-01	7.222E+01	3.561E-03	4.213E+03

Attachment	2	Sheet No.	20 of 22
Originator:	S. W. Clark	Date	12/14/09
Chk'd By	M. W. Perrott	Date	12/14/09
Calc. No.	0100H-CA-V0110	Rev. No.	1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 21
Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

ONuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	2.700E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Co-60	Co-60	1.000E+00	2.244E-02	1.427E-02	4.810E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
OCs-137	Cs-137	1.000E+00	2.554E+00	1.807E+00	7.521E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
OEu-152	Eu-152	7.208E-01	4.818E-02	3.727E-02	1.854E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Eu-152	2.792E-01	1.866E-02	1.444E-02	7.181E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	äDOSE(j)		6.685E-02	5.171E-02	2.572E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
OGd-152	Eu-152	2.792E-01	1.105E-19	2.677E-19	3.349E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
OU-238	U-238	5.400E-05	4.029E-08	8.422E-10	3.162E-13	0.000E+00	0.000E+00	0.000E+00	2.682E-05	0.000E+00
U-238	U-238	9.999E-01	8.973E-03	1.893E-04	7.045E-08	0.000E+00	0.000E+00	0.000E+00	5.233E-01	0.000E+00
U-238	äDOSE(j)		8.973E-03	1.893E-04	7.045E-08	0.000E+00	0.000E+00	0.000E+00	5.234E-01	0.000E+00
OU-234	U-238	9.999E-01	1.586E-09	1.601E-09	7.204E-10	0.000E+00	0.000E+00	0.000E+00	7.740E-07	9.212E-07
OTh-230	U-238	9.999E-01	1.011E-14	3.291E-14	4.481E-14	0.000E+00	0.000E+00	0.000E+00	7.700E-13	1.106E-11
ORa-226	U-238	9.999E-01	4.069E-16	3.206E-15	1.035E-14	0.000E+00	0.000E+00	0.000E+00	1.321E-09	5.423E-09
OPb-210	U-238	9.999E-01	2.221E-19	3.364E-18	2.319E-17	0.000E+00	0.000E+00	0.000E+00	5.344E-09	2.084E-08
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

THF(i) is the thread fraction of the parent nuclide.

Attachment 2 Sheet No. 21 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V011(Rev. No. 1

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  22
 Summary : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

ONuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	2.700E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Co-60	Co-60	1.000E+00	2.700E-02	2.023E-02	1.136E-02	1.509E-03	4.713E-06	8.024E-15	4.059E-36	0.000E+00
OCs-137	Cs-137	1.000E+00	1.230E+01	1.027E+01	7.167E+00	2.032E+00	5.547E-02	1.864E-07	9.497E-21	0.000E+00
OEu-152	Eu-152	7.208E-01	1.110E-01	1.013E-01	8.441E-02	4.454E-02	7.173E-03	1.202E-05	2.182E-12	2.464E-41
Eu-152	Eu-152	2.792E-01	4.300E-02	3.924E-02	3.269E-02	1.725E-02	2.779E-03	4.657E-06	8.452E-13	9.544E-42
Eu-152	äS(j):		1.540E-01	1.406E-01	1.171E-01	6.180E-02	9.952E-03	1.668E-05	3.027E-12	3.419E-41
OGd-152	Eu-152	2.792E-01	0.000E+00	2.625E-16	7.134E-16	1.714E-15	2.317E-15	1.300E-15	2.571E-16	2.439E-19
OU-238	U-238	5.400E-05	1.361E-04	3.336E-06	2.004E-09	1.066E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-238	9.999E-01	2.520E+00	6.177E-02	3.711E-05	1.974E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	äS(j):		2.520E+00	6.177E-02	3.712E-05	1.974E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00
OU-234	U-238	9.999E-01	0.000E+00	1.670E-06	1.256E-06	4.187E-07	1.814E-08	3.072E-13	7.946E-25	0.000E+00
OTh-230	U-238	9.999E-01	0.000E+00	1.199E-11	3.843E-11	8.640E-11	1.091E-10	1.090E-10	1.065E-10	9.613E-11
ORa-226	U-238	9.999E-01	0.000E+00	2.098E-15	2.212E-14	1.564E-13	3.814E-13	4.200E-13	4.101E-13	3.703E-13
OPb-210	U-238	9.999E-01	0.000E+00	1.837E-17	6.260E-16	1.474E-14	8.517E-14	1.192E-13	1.164E-13	1.051E-13
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

THF(i) is the thread fraction of the parent nuclide.
ORESCALC.EXE execution time = 12.89 seconds

Attachment 2 Sheet No. 22 of 22
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

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1RESRAD, Version 6.5      T* Limit = 180 days       12/13/2010  09:43  Page   1
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Table of Contents

Part III: Intake Quantities and Health Risk Factors

Cancer Risk Slope Factors 2
Risk Slope and ETFG for the Ground Pathway 4
Amount of Intake Quantities and Excess Cancer Risks
Time= 0.000E+00 5
Time= 1.000E+00 8
Time= 3.000E+00 11
Time= 1.000E+01 14
Time= 3.000E+01 17
Time= 1.000E+02 20
Time= 2.700E+02 23
Time= 1.000E+03 26

Attachment 3 Sheet No. 1 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

BEST AVAILABLE COPY

ATTACHMENT 3

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page   2
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Cancer Risk Slope Factors Summary Table
Risk Library: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Co-60	1.24E-05	1.24E-05	SLPF(1,1)
Sf-1	Cs-137+D	2.55E-06	5.32E-10	SLPF(2,1)
Sf-1	Eu-152	5.30E-06	5.30E-06	SLPF(3,1)
Sf-1	Gd-152	0.00E+00	0.00E+00	SLPF(5,1)
Sf-1	Pb-210+D	4.21E-09	1.41E-09	SLPF(6,1)
Sf-1	Ra-226+D	8.49E-06	2.29E-08	SLPF(7,1)
Sf-1	Th-230	8.19E-10	8.19E-10	SLPF(8,1)
Sf-1	U-234	2.52E-10	2.52E-10	SLPF(9,1)
Sf-1	U-238	4.99E-11	4.99E-11	SLPF(10,1)
Sf-1	U-238+D	1.14E-07	4.99E-11	SLPF(11,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Co-60	3.58E-11	3.58E-11	SLPF(1,2)
Sf-2	Cs-137+D	1.19E-11	1.19E-11	SLPF(2,2)
Sf-2	Eu-152	9.10E-11	9.10E-11	SLPF(3,2)
Sf-2	Gd-152	9.10E-09	9.10E-09	SLPF(5,2)
Sf-2	Pb-210+D	1.39E-08	2.77E-09	SLPF(6,2)
Sf-2	Ra-226+D	1.16E-08	1.15E-08	SLPF(7,2)
Sf-2	Th-230	2.85E-08	2.85E-08	SLPF(8,2)
Sf-2	U-234	1.14E-08	1.14E-08	SLPF(9,2)
Sf-2	U-238	9.32E-09	9.32E-09	SLPF(10,2)
Sf-2	U-238+D	9.35E-09	9.32E-09	SLPF(11,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	Co-60	2.23E-11	2.23E-11	SLPF(1,3)
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(2,3)
Sf-3	Eu-152	8.70E-12	8.70E-12	SLPF(3,3)
Sf-3	Gd-152	3.85E-11	3.85E-11	SLPF(5,3)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(6,3)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(7,3)
Sf-3	Th-230	1.19E-10	1.19E-10	SLPF(8,3)
Sf-3	U-234	9.55E-11	9.55E-11	SLPF(9,3)
Sf-3	U-238	8.66E-11	8.66E-11	SLPF(10,3)
Sf-3	U-238+D	1.21E-10	8.66E-11	SLPF(11,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	Co-60	1.57E-11	1.57E-11	SLPF(1,4)
Sf-3	Cs-137+D	3.04E-11	3.04E-11	SLPF(2,4)
Sf-3	Eu-152	6.07E-12	6.07E-12	SLPF(3,4)
Sf-3	Gd-152	2.97E-11	2.97E-11	SLPF(5,4)
Sf-3	Pb-210+D	1.27E-09	8.81E-10	SLPF(6,4)
Sf-3	Ra-226+D	3.86E-10	3.85E-10	SLPF(7,4)
Sf-3	Th-230	9.10E-11	9.10E-11	SLPF(8,4)
Sf-3	U-234	7.07E-11	7.07E-11	SLPF(9,4)
Sf-3	U-238	6.40E-11	6.40E-11	SLPF(10,4)
Sf-3	U-238+D	8.71E-11	6.40E-11	SLPF(11,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	Co-60	4.03E-11	4.03E-11	SLPF(1,5)

Attachment _____ Sheet No. 2 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-C[illegible]10 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 3
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Cancer Risk Slope Factors Summary Table (continued)
Risk Library: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-3	Cs-137+D	4.33E-11	4.33E-11	SLPF(2,5)
Sf-3	Eu-152	1.62E-11	1.62E-11	SLPF(3,5)
Sf-3	Gd-152	6.29E-11	6.29E-11	SLPF(5,5)
Sf-3	Pb-210+D	2.66E-09	1.84E-09	SLPF(6,5)
Sf-3	Ra-226+D	7.30E-10	7.29E-10	SLPF(7,5)
Sf-3	Th-230	2.02E-10	2.02E-10	SLPF(8,5)
Sf-3	U-234	1.58E-10	1.58E-10	SLPF(9,5)
Sf-3	U-238	1.43E-10	1.43E-10	SLPF(10,5)
Sf-3	U-238+D	2.10E-10	1.43E-10	SLPF(11,5)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02	KFACTR(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Attachment 3 Sheet No 3 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev No 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 4
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Risk Slope and Environmental Transport Factors for the Ground Pathway

ONuclide (i)	Slope(i)*	t= 0.000E+00	1.000E+00	ETFG(i,t) At Time in Years (dimensionless) 3.000E+00	1.000E+01	3.000E+01	1.000E+02	2.700E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
At-218	3.570E-09	2.667E-01	2.407E-01	1.666E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ba-137m	2.690E-06	7.083E-02	6.115E-02	3.896E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Bi-210	2.760E-09	1.110E-01	9.737E-02	6.408E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Bi-214	7.480E-06	6.312E-02	5.449E-02	3.473E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	1.240E-05	6.298E-02	5.442E-02	3.483E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	5.320E-10	1.309E-01	1.157E-01	7.685E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	5.300E-06	6.945E-02	6.000E-02	3.830E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-234	8.710E-06	7.034E-02	6.073E-02	3.865E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-234m	6.870E-08	7.302E-02	6.328E-02	4.071E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	1.410E-09	3.301E-01	3.016E-01	2.221E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-214	9.820E-07	8.127E-02	7.008E-02	4.425E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Po-210	3.950E-11	6.865E-02	5.932E-02	3.794E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Po-214	3.860E-10	6.982E-02	6.023E-02	3.823E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Po-218	4.260E-11	6.939E-02	5.990E-02	3.818E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	2.290E-08	8.900E-02	7.653E-02	4.747E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Rn-222	1.740E-09	7.388E-02	6.374E-02	4.051E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	8.190E-10	1.603E-01	1.454E-01	1.046E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-234	1.630E-08	1.453E-01	1.272E-01	8.076E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tl-210	0.000E+00	6.800E-01	6.800E-01	6.800E-01	6.800E-01	6.800E-01	6.800E-01	6.800E-01	6.800E-01
U-234	2.520E-10	2.421E-01	2.297E-01	1.946E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	4.990E-11	4.937E-01	4.809E-01	4.409E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Attachment 3 Sheet No. 4 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 5
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Co-60	3.816E-05	8.588E-01	9.378E-02	2.284E-02	6.675E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.042E+00
Cs-137	1.739E-02	1.956E+02	4.343E+01	2.925E+01	3.041E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.987E+02
Eu-152	2.177E-04	1.533E-01	2.010E-02	1.381E-03	3.807E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.555E-01
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	3.562E-03	2.508E+00	5.590E-02	2.712E-01	6.230E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.066E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	4.181E-08	0.0077	2.656E-15	0.0000	3.750E-11	0.0000	4.173E-12	0.0000	1.005E-12	0.0000	5.230E-12	0.0000
Cs-137	5.196E-06	0.9528	4.742E-13	0.0000	1.693E-08	0.0031	3.830E-09	0.0007	2.542E-09	0.0005	3.018E-09	0.0006
Eu-152	1.576E-07	0.0289	5.356E-14	0.0000	3.637E-12	0.0000	4.793E-13	0.0000	3.255E-14	0.0000	1.668E-11	0.0000
Gd-152	0.000E+00	0.0000	2.264E-26	0.0000	6.846E-26	0.0000	9.055E-27	0.0000	2.441E-28	0.0000	2.738E-25	0.0000
Pb-210	2.419E-24	0.0000	4.818E-26	0.0000	3.746E-23	0.0000	5.818E-25	0.0000	5.494E-25	0.0000	1.615E-23	0.0000
Ra-226	3.987E-20	0.0000	1.124E-24	0.0000	5.611E-22	0.0000	4.120E-24	0.0000	1.046E-23	0.0000	1.242E-22	0.0000
Th-230	1.657E-20	0.0000	3.829E-21	0.0000	4.635E-21	0.0000	7.528E-23	0.0000	1.062E-23	0.0000	4.747E-20	0.0000
U-234	2.508E-16	0.0000	3.684E-17	0.0000	2.217E-16	0.0000	5.005E-18	0.0000	2.360E-17	0.0000	8.929E-16	0.0000
U-238	2.967E-08	0.0054	4.163E-11	0.0000	3.782E-10	0.0001	8.428E-12	0.0000	4.089E-11	0.0000	1.636E-09	0.0003
Total	5.425E-06	0.9948	4.216E-11	0.0000	1.735E-08	0.0032	3.843E-09	0.0007	2.584E-09	0.0005	4.676E-09	0.0009

Attachment 3 Sheet No. 5 of 28
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

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1RESRAD, Version 6.5      T« Limit = 180 days       12/13/2010  09:43  Page   6
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	4.186E-08	0.0077
Cs-137	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	5.223E-06	0.9576
Eu-152	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	1.576E-07	0.0289
Gd-152	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	3.742E-25	0.0000
Pb-210	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	5.720E-23	0.0000
Ra-226	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	4.057E-20	0.0000
Th-230	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	7.258E-20	0.0000
U-234	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	1.431E-15	0.0000
U-238	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	3.177E-08	0.0058
Total	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	5.454E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	4.181E-08	0.0077	2.656E-15	0.0000	0.000E+00	0.0000	3.750E-11	0.0000	4.173E-12	0.0000	1.005E-12	0.0000	5.230E-12	0.0000
Cs-137	5.196E-06	0.9528	4.742E-13	0.0000	0.000E+00	0.0000	1.693E-08	0.0031	3.830E-09	0.0007	2.542E-09	0.0005	3.018E-09	0.0006
Eu-152	1.576E-07	0.0289	5.356E-14	0.0000	0.000E+00	0.0000	3.637E-12	0.0000	4.793E-13	0.0000	3.255E-14	0.0000	1.668E-11	0.0000
U-238	2.967E-08	0.0054	4.163E-11	0.0000	0.000E+00	0.0000	3.782E-10	0.0001	8.428E-12	0.0000	4.089E-11	0.0000	1.636E-09	0.0003
Total	5.425E-06	0.9948	4.216E-11	0.0000	0.000E+00	0.0000	1.735E-08	0.0032	3.843E-09	0.0007	2.584E-09	0.0005	4.676E-09	0.0009

Attachment 3 Sheet No. 6 of 28
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 7
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	4.186E-08	0.0077
Cs-137	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	5.223E-06	0.9576
Eu-152	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	1.576E-07	0.0289
U-238	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	3.177E-08	0.0058
Total	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	5.454E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 7 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 8
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Co-60	2.410E-05	5.493E-01	6.200E-02	1.480E-02	4.215E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.682E-01
Cs-137	1.223E-02	1.394E+02	3.178E+01	2.098E+01	2.140E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.136E+02
Eu-152	1.674E-04	1.189E-01	1.567E-02	1.064E-03	2.928E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.284E-01
Gd-152	3.126E-19	2.217E-16	2.920E-17	7.976E-19	5.467E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.984E-16
Pb-210	2.188E-20	8.442E-17	1.196E-18	1.113E-18	3.826E-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.250E-16
Ra-226	2.498E-18	2.593E-14	1.626E-16	4.680E-16	4.369E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.093E-14
Th-230	1.428E-14	4.347E-12	7.608E-14	1.258E-14	2.498E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.942E-11
U-234	1.989E-09	1.419E-06	3.191E-08	1.519E-07	3.478E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.081E-06
U-238	7.356E-05	6.007E-02	1.477E-03	5.818E-03	1.287E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.960E-01

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	2.428E-08	0.0071	1.516E-15	0.0000	2.162E-11	0.0000	2.470E-12	0.0000	5.856E-13	0.0000	2.984E-12	0.0000
Cs-137	3.257E-06	0.9569	2.928E-13	0.0000	1.055E-08	0.0031	2.435E-09	0.0007	1.592E-09	0.0005	1.864E-09	0.0005
Eu-152	1.052E-07	0.0309	3.522E-14	0.0000	2.409E-12	0.0000	3.190E-13	0.0000	2.144E-14	0.0000	1.096E-11	0.0000
Gd-152	0.000E+00	0.0000	2.038E-26	0.0000	6.198E-26	0.0000	8.229E-27	0.0000	2.200E-28	0.0000	2.464E-25	0.0000
Pb-210	3.174E-24	0.0000	5.774E-26	0.0000	4.453E-23	0.0000	6.993E-25	0.0000	6.558E-25	0.0000	1.936E-23	0.0000
Ra-226	3.879E-20	0.0000	1.087E-24	0.0000	5.483E-22	0.0000	4.112E-24	0.0000	1.027E-23	0.0000	1.201E-22	0.0000
Th-230	1.560E-20	0.0000	3.337E-21	0.0000	4.088E-21	0.0000	6.718E-23	0.0000	9.573E-24	0.0000	4.137E-20	0.0000
U-234	2.975E-16	0.0000	4.771E-17	0.0000	2.871E-16	0.0000	6.480E-18	0.0000	3.057E-17	0.0000	1.157E-15	0.0000
U-238	6.316E-10	0.0002	8.598E-13	0.0000	9.056E-12	0.0000	2.226E-13	0.0000	8.772E-13	0.0000	3.378E-11	0.0000
Total	3.387E-06	0.9951	1.189E-12	0.0000	1.059E-08	0.0031	2.438E-09	0.0007	1.594E-09	0.0005	1.911E-09	0.0006

Attachment 3 Sheet No. 8 of 28
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 9
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	2.431E-08	0.0071
Cs-137	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	3.274E-06	0.9618
Eu-152	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	1.052E-07	0.0309
Gd-152	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	3.372E-25	0.0000
Pb-210	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	6.847E-23	0.0000
Ra-226	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	3.947E-20	0.0000
Th-230	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	6.447E-20	0.0000
U-234	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	1.826E-15	0.0000
U-238	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	6.764E-10	0.0002
Total	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	3.404E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

0 Radionuclides

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	2.428E-08	0.0071	1.516E-15	0.0000	0.000E+00	0.0000	2.162E-11	0.0000	2.470E-12	0.0000	5.856E-13	0.0000	2.984E-12	0.0000
Cs-137	3.257E-06	0.9569	2.928E-13	0.0000	0.000E+00	0.0000	1.055E-08	0.0031	2.435E-09	0.0007	1.592E-09	0.0005	1.864E-09	0.0005
Eu-152	1.052E-07	0.0309	3.522E-14	0.0000	0.000E+00	0.0000	2.409E-12	0.0000	3.190E-13	0.0000	2.144E-14	0.0000	1.096E-11	0.0000
U-238	6.316E-10	0.0002	8.599E-13	0.0000	0.000E+00	0.0000	9.056E-12	0.0000	2.227E-13	0.0000	8.772E-13	0.0000	3.378E-11	0.0000
Total	3.387E-06	0.9951	1.189E-12	0.0000	0.000E+00	0.0000	1.059E-08	0.0031	2.438E-09	0.0007	1.594E-09	0.0005	1.911E-09	0.0006

Attachment 3 Sheet No. 9 of 28
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 10
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	2.431E-08	0.0071
Cs-137	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	3.274E-06	0.9618
Eu-152	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	1.052E-07	0.0309
U-238	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	6.764E-10	0.0002
Total	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	3.404E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 10 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V001 Rev. No. 1

ATTACHMENT 3

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  11
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Co-60	8.475E-06	1.940E-01	2.212E-02	5.250E-03	1.482E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.362E-01
Cs-137	5.344E-03	6.117E+01	1.405E+01	9.219E+00	9.347E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.379E+01
Eu-152	8.732E-05	6.228E-02	8.229E-03	5.556E-04	1.527E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.238E-01
Gd-152	5.320E-19	3.790E-16	5.004E-17	1.355E-18	9.305E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.361E-15
Pb-210	4.668E-19	1.491E-15	2.301E-17	2.169E-17	8.165E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.353E-15
Ra-226	1.650E-17	1.834E-13	1.323E-15	3.405E-15	2.886E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.169E-13
Th-230	2.866E-14	8.317E-12	1.357E-13	1.950E-14	5.013E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.860E-11
U-234	9.366E-10	6.709E-07	1.511E-08	7.158E-08	1.638E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.396E-06
U-238	2.768E-08	2.270E-05	5.596E-07	2.192E-06	4.841E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.386E-05

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	6.135E-09	0.0066	3.792E-16	0.0000	5.407E-12	0.0000	6.167E-13	0.0000	1.463E-13	0.0000	7.467E-13	0.0000
Cs-137	8.886E-07	0.9566	7.950E-14	0.0000	2.860E-09	0.0031	6.570E-10	0.0007	4.310E-10	0.0005	5.059E-10	0.0005
Eu-152	2.971E-08	0.0320	9.933E-15	0.0000	6.772E-13	0.0000	8.949E-14	0.0000	6.042E-15	0.0000	3.093E-12	0.0000
Gd-152	0.000E+00	0.0000	6.052E-27	0.0000	1.824E-26	0.0000	2.407E-27	0.0000	6.520E-29	0.0000	7.316E-26	0.0000
Pb-210	3.846E-25	0.0000	8.104E-27	0.0000	6.419E-24	0.0000	9.904E-26	0.0000	9.336E-26	0.0000	2.717E-24	0.0000
Ra-226	8.419E-21	0.0000	2.385E-25	0.0000	1.180E-22	0.0000	8.511E-25	0.0000	2.191E-24	0.0000	2.634E-23	0.0000
Th-230	4.115E-21	0.0000	1.021E-21	0.0000	1.237E-21	0.0000	2.019E-23	0.0000	2.901E-24	0.0000	1.266E-20	0.0000
U-234	7.699E-17	0.0000	1.335E-17	0.0000	8.009E-17	0.0000	1.804E-18	0.0000	8.545E-18	0.0000	3.235E-16	0.0000
U-238	2.431E-13	0.0000	3.235E-16	0.0000	3.422E-15	0.0000	8.437E-17	0.0000	3.305E-16	0.0000	1.271E-14	0.0000
Total	9.244E-07	0.9952	9.015E-14	0.0000	2.866E-09	0.0031	6.577E-10	0.0007	4.311E-10	0.0005	5.098E-10	0.0005

Attachment 3 Sheet No. 11 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 12
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	6.142E-09	0.0066
Cs-137	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	8.930E-07	0.9614
Eu-152	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	2.972E-08	0.0320
Gd-152	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	9.992E-26	0.0000
Pb-210	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	9.721E-24	0.0000
Ra-226	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	8.567E-21	0.0000
Th-230	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	1.905E-20	0.0000
U-234	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	5.043E-16	0.0000
U-238	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	2.599E-13	0.0000
Total	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	9.289E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	6.135E-09	0.0066	3.792E-16	0.0000	0.000E+00	0.0000	5.407E-12	0.0000	6.167E-13	0.0000	1.463E-13	0.0000	7.467E-13	0.0000
Cs-137	8.886E-07	0.9566	7.950E-14	0.0000	0.000E+00	0.0000	2.860E-09	0.0031	6.570E-10	0.0007	4.310E-10	0.0005	5.059E-10	0.0005
Eu-152	2.971E-08	0.0320	9.933E-15	0.0000	0.000E+00	0.0000	6.772E-13	0.0000	8.949E-14	0.0000	6.042E-15	0.0000	3.093E-12	0.0000
U-238	2.432E-13	0.0000	3.369E-16	0.0000	0.000E+00	0.0000	3.502E-15	0.0000	8.618E-17	0.0000	3.390E-16	0.0000	1.303E-14	0.0000
Total	9.244E-07	0.9952	9.015E-14	0.0000	0.000E+00	0.0000	2.866E-09	0.0031	6.577E-10	0.0007	4.311E-10	0.0005	5.098E-10	0.0005

Attachment 3 Sheet No. 12 of 28
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 13
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	6.142E-09	0.0066
Cs-137	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	8.930E-07	0.9614
Eu-152	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	2.972E-08	0.0320
U-238	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	2.605E-13	0.0000
Total	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	9.289E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment ___ Sheet No. 13 of 28
Originator S. W. [illegible] ___ Date 12/14/09
Chk'd By M. W. [illegible] ___ Date 12/14/09
Calc No. [illegible]/0110 ___ Rev. No. 1

ATTACHMENT 3

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  14
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	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
Ra-226	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
Th-230	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
U-234	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
U-238	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	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

Attachment 3 Sheet No. 14 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 15
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
file : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	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
Ra-226	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
Th-230	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
U-234	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
U-238	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	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

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Attachment 3 Sheet No 15 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No 1

ATTACHMENT 3

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  16
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment	3	Sheet No.	16 of 28
Originator: S. W. Clark		Date	12/14/09
Chk'd By M. W. Perrott		Date	12/14/09
Calc. No.	0100H-CA-V0110	Rev. No.	1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 17
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

0

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
	Water Independent Pathways (Inhalation excludes radon)											
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	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
Ra-226	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
Th-230	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
U-234	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
U-238	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	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

Attachment 3 Sheet No. 17 of 28
Originator. S W Clark Date 12/14/09
Chk'd By M W Perrott Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 18
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	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
Ra-226	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
Th-230	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
U-234	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
U-238	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	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

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Attachment 3 Sheet No. 18 of 28
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No 1

ATTACHMENT 3

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  19
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 19 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  20
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	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
Ra-226	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
Th-230	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
U-234	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
U-238	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	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

Attachment	3	Sheet No.	20 of 28
Originator	S. W. Clark	Date	12/14/09
Checked by	M. W. Perrott	Date	12/14/09
Proj. No.	0100H-CA-V0110	Rev. No.	1

ATTACHMENT 3

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  21
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
```

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	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
Ra-226	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
Th-230	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
U-234	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
U-238	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	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

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Attachment [illegible] Sheet No. 21 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-[illegible] Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 22
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 22 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 23
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 2.700E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.933E-07	2.061E-08	4.546E-08	5.615E-10	1.621E-10	2.601E-07
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.761E-07	5.936E-09	6.547E-08	9.999E-10	7.711E-10	3.492E-07
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.012E-10	1.596E-11	1.703E-10	1.701E-12	3.092E-13	5.895E-10
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.322E-03	6.486E-06	2.748E-04	2.189E-06	9.848E-06	2.616E-03
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.743E+03	4.710E+00	1.926E+02	1.228E+00	6.256E+00	1.948E+03

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 2.700E+02 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 2.700E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	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
Ra-226	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
Th-230	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
U-234	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
U-238	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	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

Attachment 3 Sheet No. 23 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page  24
 Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD
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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 2.700E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	4.026E-14	0.0000	7.106E-15	0.0000	1.225E-14	0.0000	1.829E-16	0.0000	1.959E-16	0.0000	5.999E-14	0.0000
Ra-226	1.750E-14	0.0000	3.063E-16	0.0000	2.639E-15	0.0000	4.874E-17	0.0000	1.394E-16	0.0000	2.064E-14	0.0000
Th-230	6.058E-18	0.0000	2.056E-19	0.0000	1.239E-18	0.0000	7.430E-21	0.0000	1.399E-21	0.0000	7.511E-18	0.0000
U-234	6.143E-12	0.0000	2.245E-14	0.0000	9.197E-13	0.0000	5.919E-15	0.0000	2.998E-14	0.0000	7.121E-12	0.0000
U-238	2.002E-07	0.8590	7.520E-10	0.0032	3.088E-08	0.1325	2.048E-10	0.0009	1.018E-09	0.0044	2.331E-07	1.0000
Total	2.002E-07	0.8590	7.520E-10	0.0032	3.088E-08	0.1325	2.048E-10	0.0009	1.019E-09	0.0044	2.331E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 2.700E+02 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 2.700E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Attachment 3 Sheet No. 24 of 28
Originator S. W. Clark Date 12/14/09
Checker M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 25
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 2.700E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	2.002E-07	0.8590	7.520E-10	0.0032	0.000E+00	0.0000	3.088E-08	0.1325	2.048E-10	0.0009	1.019E-09	0.0044	2.331E-07	1.0000
Total	2.002E-07	0.8590	7.520E-10	0.0032	0.000E+00	0.0000	3.088E-08	0.1325	2.048E-10	0.0009	1.019E-09	0.0044	2.331E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 25 of 28
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perron Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 26
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.428E-06	1.568E-07	2.692E-07	4.038E-09	4.365E-09	2.863E-06
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.621E-06	4.718E-08	4.048E-07	7.509E-09	2.168E-08	4.102E-06
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.765E-08	4.593E-10	2.050E-09	5.272E-12	8.534E-13	2.016E-08
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.913E-03	7.872E-06	3.220E-04	2.052E-06	1.045E-05	3.255E-03
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	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
Ra-226	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
Th-230	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
U-234	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
U-238	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	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

Attachment 3 Sheet No. 26 of 28
Originator: S. W. Clark Date 1-14-10
Chk'd By M. W. Perrott Date 1-14-10
Calc. No. 0100H-CA-V0110 Rev. 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 27
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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	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	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
Gd-152	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
Pb-210	9.429E-14	0.0128	1.655E-14	0.0023	2.841E-14	0.0039	4.261E-16	0.0001	4.606E-16	0.0001	1.401E-13	0.0191
Ra-226	4.278E-14	0.0058	7.442E-16	0.0001	6.386E-15	0.0009	1.185E-16	0.0000	3.419E-16	0.0000	5.038E-14	0.0069
Th-230	4.905E-17	0.0000	1.670E-18	0.0000	7.446E-18	0.0000	1.906E-20	0.0000	3.081E-21	0.0000	5.819E-17	0.0000
U-234	6.177E-12	0.8406	2.255E-14	0.0031	9.225E-13	0.1255	5.879E-15	0.0008	2.995E-14	0.0041	7.158E-12	0.9741
U-238	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	6.315E-12	0.8593	3.984E-14	0.0054	9.573E-13	0.1303	6.423E-15	0.0009	3.075E-14	0.0042	7.349E-12	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	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
Total	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

Attachment 3 Sheet No. 27 of 28
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No 1

ATTACHMENT 3

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 28
Intrisk : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Co-60	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
Cs-137	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
Eu-152	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
U-238	6.315E-12	0.8593	3.984E-14	0.0054	0.000E+00	0.0000	9.573E-13	0.1303	6.423E-15	0.0009	3.075E-14	0.0042	7.349E-12	1.0000
Total	6.315E-12	0.8593	3.984E-14	0.0054	0.000E+00	0.0000	9.573E-13	0.1303	6.423E-15	0.0009	3.075E-14	0.0042	7.349E-12	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 28 of 28
Originator S. W. Clark Date 12/14/09
Chk'd By M. V. Perrott Date 12/14/09
Calc. No. 100H-CA-V0110 Rev. No. 1

ATTACHMENT 4

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1RESRAD, Version 6.5      T« Limit = 180 days        12/13/2010  09:43  Page   1
 Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

                      Table of Contents
                      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
            Part IV: Concentration of Radionuclides
            ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ

 Concentration of radionuclides in different media
      Time= 0.000E+00 ..................................   2
      Time= 1.000E+00 ..................................   3
      Time= 3.000E+00 ..................................   4
      Time= 1.000E+01 ..................................   5
      Time= 3.000E+01 ..................................   6
      Time= 1.000E+02 ..................................   7
      Time= 2.700E+02 ..................................   8
      Time= 1.000E+03 ..................................   9
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Attachment 4 Sheet No. 1 of 9
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 4

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 2
Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Concentration of radionuclides in environmental media
at t = 0.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Co-60	2.700E-02	1.143E-03	1.188E-08	0.000E+00	0.000E+00
Cs-137	1.230E+01	5.207E-01	5.413E-06	0.000E+00	0.000E+00
Eu-152	1.540E-01	6.519E-03	6.777E-08	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	2.520E+00	1.067E-01	1.109E-06	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 0.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Co-60	0.000E+00	1.524E-02	1.524E-02	1.524E-02	1.524E-02	3.216E-02	2.820E-03	0.000E+00	0.000E+00
Cs-137	0.000E+00	3.472E+00	3.473E+00	3.473E+00	3.473E+00	1.490E+01	3.611E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	2.720E-03	2.734E-03	2.736E-03	2.736E-03	6.891E-03	1.705E-04	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	4.451E-02	4.474E-02	4.477E-02	4.477E-02	1.917E-02	3.348E-02	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 2 of 9
Originator: S. W. Clark Date 12-14-09
Chk'd By M. W. Perrott Date 12-14-09
Calc. No. 0100H-CA-V0110 Rev. No.

BEST AVAILABLE COPY

ATTACHMENT 4

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 3
Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Co-60	2.023E-02	7.217E-04	7.502E-09	0.000E+00	0.000E+00
Cs-137	1.027E+01	3.664E-01	3.809E-06	0.000E+00	0.000E+00
Eu-152	1.406E-01	5.013E-03	5.212E-08	0.000E+00	0.000E+00
Gd-152	2.625E-16	9.361E-18	9.731E-23	0.000E+00	0.000E+00
Pb-210	1.837E-17	6.552E-19	6.811E-24	0.000E+00	0.000E+00
Ra-226	2.098E-15	7.481E-17	7.777E-22	0.000E+00	0.000E+00
Th-230	1.199E-11	4.278E-13	4.447E-18	0.000E+00	0.000E+00
U-234	1.670E-06	5.956E-08	6.192E-13	0.000E+00	0.000E+00
U-238	6.177E-02	2.203E-03	2.290E-08	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Co-60	0.000E+00	9.751E-03	9.634E-03	1.030E-02	1.005E-02	2.126E-02	1.828E-03	0.000E+00	0.000E+00
Cs-137	0.000E+00	2.475E+00	2.446E+00	2.600E+00	2.551E+00	1.090E+01	2.590E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	2.110E-03	2.104E-03	2.195E-03	2.164E-03	5.373E-03	1.314E-04	0.000E+00	0.000E+00
Gd-152	0.000E+00	3.935E-18	3.928E-18	3.853E-18	4.016E-18	1.002E-17	9.847E-20	0.000E+00	0.000E+00
Pb-210	0.000E+00	1.507E-18	1.126E-18	1.808E-18	2.122E-18	4.102E-19	1.373E-19	0.000E+00	0.000E+00
Ra-226	0.000E+00	4.592E-16	4.961E-16	3.259E-16	3.743E-16	5.578E-17	5.778E-17	0.000E+00	0.000E+00
Th-230	0.000E+00	7.725E-14	7.286E-14	8.727E-14	9.128E-14	2.609E-14	1.553E-15	0.000E+00	0.000E+00
U-234	0.000E+00	2.519E-08	2.500E-08	2.651E-08	2.619E-08	1.094E-08	1.875E-08	0.000E+00	0.000E+00
U-238	0.000E+00	1.069E-03	9.345E-04	1.849E-03	1.510E-03	5.064E-04	7.183E-04	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No 3 of 9
Prepared by S. W. Clark Date 12/14/09
Reviewed By M. W. Perrott Date 12/14/09
Calc No 0100H-CA-V0110 Rev No 1

ATTACHMENT 4

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 4
Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Concentration of radionuclides in environmental media
at t = 3.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Co-60	1.136E-02	2.538E-04	2.638E-09	0.000E+00	0.000E+00
Cs-137	7.167E+00	1.601E-01	1.664E-06	0.000E+00	0.000E+00
Eu-152	1.171E-01	2.615E-03	2.719E-08	0.000E+00	0.000E+00
Gd-152	7.134E-16	1.593E-17	1.656E-22	0.000E+00	0.000E+00
Pb-210	6.260E-16	1.398E-17	1.453E-22	0.000E+00	0.000E+00
Ra-226	2.212E-14	4.941E-16	5.136E-21	0.000E+00	0.000E+00
Th-230	3.843E-11	8.583E-13	8.923E-18	0.000E+00	0.000E+00
U-234	1.256E-06	2.805E-08	2.916E-13	0.000E+00	0.000E+00
U-238	3.712E-05	8.289E-07	8.617E-12	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Co-60	0.000E+00	3.444E-03	3.389E-03	3.692E-03	3.584E-03	7.587E-03	6.482E-04	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.086E+00	1.069E+00	1.158E+00	1.130E+00	4.820E+00	1.138E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	1.105E-03	1.098E-03	1.167E-03	1.145E-03	2.822E-03	6.859E-05	0.000E+00	0.000E+00
Gd-152	0.000E+00	6.726E-18	6.688E-18	6.940E-18	6.941E-18	1.716E-17	1.673E-19	0.000E+00	0.000E+00
Pb-210	0.000E+00	2.654E-17	2.358E-17	3.221E-17	3.328E-17	7.892E-18	2.678E-18	0.000E+00	0.000E+00
Ra-226	0.000E+00	3.253E-15	3.292E-15	3.092E-15	3.156E-15	4.536E-16	4.204E-16	0.000E+00	0.000E+00
Th-230	0.000E+00	1.476E-13	1.457E-13	1.593E-13	1.593E-13	4.655E-14	2.407E-15	0.000E+00	0.000E+00
U-234	0.000E+00	1.191E-08	1.178E-08	1.275E-08	1.246E-08	5.183E-09	8.837E-09	0.000E+00	0.000E+00
U-238	0.000E+00	4.040E-07	3.517E-07	7.092E-07	5.758E-07	1.919E-07	2.706E-07	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 4 of 9
Originator W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No. 1

ATTACHMENT 4

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 5
Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Co-60	1.509E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	2.032E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	6.180E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	1.714E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	1.474E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	1.564E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	8.640E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	4.187E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	1.974E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+01 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 5 of 9
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc No. 0100H-CA-[illegible] Rev No 1

ATTACHMENT 4

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 6
Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Concentration of radionuclides in environmental media
at t = 3.000E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Co-60	4.713E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	5.547E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	9.952E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	2.317E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	8.517E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	3.814E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	1.091E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	1.814E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+01 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 6 of 9
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No. 0100H-CA-V0110 Rev. No

ATTACHMENT 4

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 7
Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Co-60	8.024E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.864E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	1.668E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	1.300E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	1.192E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	4.200E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	1.090E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	3.072E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+02 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No 7 of 9
Originator S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No 1

ATTACHMENT 4

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 8
Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Concentration of radionuclides in environmental media
at t = 2.700E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Co-60	4.059E-36	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	9.497E-21	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	3.027E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	2.571E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	1.164E-13	0.000E+00	0.000E+00	2.344E-10	3.685E-12
Ra-226	4.101E-13	0.000E+00	0.000E+00	3.347E-10	5.262E-12
Th-230	1.065E-10	0.000E+00	0.000E+00	4.166E-13	6.550E-15
U-234	7.946E-25	0.000E+00	0.000E+00	3.164E-06	4.973E-08
U-238	0.000E+00	0.000E+00	0.000E+00	2.388E+00	3.753E-02

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 2.700E+02 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	2.649E-10	7.809E-10	1.856E-09	3.089E-09	3.549E-10	1.926E-10	2.001E-11	2.061E-09	6.882E-10
Ra-226	3.782E-10	1.125E-09	2.658E-09	4.407E-09	5.064E-10	3.429E-10	9.519E-11	4.906E-10	2.453E-09
Th-230	5.496E-13	2.992E-12	4.291E-12	3.290E-11	2.836E-11	5.834E-13	3.817E-14	1.316E-12	6.668E-12
U-234	3.181E-06	4.501E-06	2.013E-05	2.731E-05	2.741E-05	7.505E-07	1.216E-06	5.168E-07	3.101E-06
U-238	2.388E+00	3.134E+00	1.502E+01	1.646E+01	1.646E+01	4.211E-01	7.723E-01	3.753E-01	2.252E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 8 of 9
Originator S. W. Clark Date 12/14/09
Chk'd By M. A. Pennett Date 12/14/09
Calc. No. 100-H-CA-V0110 Rev. No. 1

ATTACHMENT 4

1RESRAD, Version 6.5 T« Limit = 180 days 12/13/2010 09:43 Page 9
Concent : 100-H-28:7 Pipeline Scale Shallow Zone Radionuclides
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\100-H-28-7_183-H_PIPELINE.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+03 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	3.419E-41	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	2.439E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	1.051E-13	0.000E+00	0.000E+00	3.326E-09	5.229E-11
Ra-226	3.703E-13	0.000E+00	0.000E+00	4.961E-09	7.798E-11
Th-230	9.613E-11	0.000E+00	0.000E+00	2.408E-11	3.785E-13
U-234	0.000E+00	0.000E+00	0.000E+00	3.990E-06	6.272E-08
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+03 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	3.326E-09	4.380E-09	2.095E-08	2.297E-08	2.297E-08	1.385E-09	5.389E-10	1.568E-08	5.237E-09
Ra-226	4.961E-09	6.592E-09	3.133E-08	3.422E-08	3.422E-08	2.575E-09	2.676E-09	3.899E-09	1.950E-08
Th-230	2.417E-11	3.353E-11	1.527E-10	1.971E-10	1.971E-10	1.808E-12	1.054E-13	3.796E-11	1.899E-10
U-234	3.990E-06	5.238E-06	2.511E-05	2.750E-05	2.750E-05	7.037E-07	1.291E-06	6.272E-07	3.763E-06
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 9 of 9
Originator: S. W. Clark Date 12/14/09
Chk'd By M. W. Perrott Date 12/14/09
Calc. No 0100H-CA-V0110 Rev. No 1

APPENDIX D

DATA QUALITY ASSESSMENT

APPENDIX D

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2007). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample design (WCH 2007), the field logbooks (WCH 2010a and WCH 2010b), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design, with two exceptions. The ion chromatography (IC) anions analysis was not requested for the samples collected from test pits 1 and 2. In addition, because of limited pipe scale material from test pit one, the inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, and polychlorinated biphenyls (PCBs) analyses were not performed.

To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis and radiochemical analysis (BHI 2000a, BHI 2000b) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Confirmatory sample data collected at the 100-H-28:7 subsite were provided by the laboratories in 11 sample delivery groups (SDGs): SDG K1570, SDG J00411, SDG K1373, SDG K1392, SDG K1397, SDG J00208, SDG D8277004, SDG J00413, SDG J00416, SDG J00417, and SDG K1392. SDG K1373 was submitted for third-party validation.

Major deficiencies were identified in the analytical data set, and are discussed below.

MAJOR DEFICIENCIES

Due to the preparation holding time being exceeded by greater than twice the limit of 48 hours for nitrate, nitrite, and orthophosphate, the project flagged the undetected nitrite and orthophosphate values for samples J18KV5 in SDG J00417, and the undetected nitrate, nitrite, and orthophosphate results for sample J18KV0 in SDG J00416 as rejected, flagged with a "UR." The samples were collected on March 23, 2009, and they were analyzed on April 1, 2009. The laboratory reports nitrate, nitrite, and orthophosphate results when running the IC anion method. Anions were requested in the sample design (WCH 2010a) to obtain the bromide, chloride, fluoride, and sulfate data. The rejection of the undetected nitrate, nitrite, and orthophosphate data does not hinder the evaluation of the 100-H-28:7 subsite.

MINOR DEFICIENCIES

Minor deficiencies are discussed for the 100-H-28:7 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

SDG K1570

This SDG comprises a pipe scale sample (J18KV3) from test pit 1 of the 100-H-28:7 subsite. This sample was analyzed for gross alpha and gross beta by gas proportional counting, total uranium by kinetic phosphorescence analysis (KPA), and by gamma energy analysis (GEA). No major or minor deficiencies were noted.

SDG J00411

This SDG comprises a pipe scale sample (J18KW4) from test pit 1 of the 100-H-28:7 subsite. This sample was analyzed for hexavalent chromium. A minor deficiency was noted in the matrix spike (MS) recovery for the analysis. The MS recovery was below project acceptance criteria with a zero percent recovery. To confirm quantitation, a post digestion spike (PDS) was prepared, with a result of 63%. The laboratory control sample (LCS) recovery is 90%, indicating the methodology and equipment are effective. The MS recovery is attributed to a large reducing capacity in the sample matrix. The hexavalent chromium data for SDG J00411 may be considered estimated. Estimated data are useable for decision-making purposes.

SDG K1373

This SDG comprises two soil samples (J17HJ1 and J17HJ2) from test pit one of the 100-H-28:7 subsite. These samples were analyzed for ICP metals, mercury, hexavalent chromium, PCBs, gross alpha and gross beta by gas proportional counting, total uranium by KPA, and by GEA. This SDG was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for three analytes (aluminum, iron, and antimony). For aluminum and iron, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. Antimony did not have mismatched spike and native concentrations in the original MS. The original MS recovery for antimony was 40.6%. All antimony results were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, all silicon results were qualified as estimates and flagged "J" by third-party validation, due to a LCS below quality control (QC) limits at 2.5%. Estimated data are useable for decision-making purposes.

SDG K1392

This SDG includes a soil sample (J17HJ5) from test pit 2 of the 100-H-28:7 subsite and one equipment blank (J17HJ3). These samples were analyzed for ICP metals, mercury, hexavalent chromium, PCBs, gross alpha and gross beta by gas proportional counting, total uranium by KPA, americium-241, isotopic plutonium, and isotopic uranium by alpha spectroscopy, strontium-90 and technetium-99 by beta counting, nickel-63 by liquid scintillation counting, and by GEA. Minor deficiencies are as follows:

In the ICP metals analysis, the calcium, copper, iron, and sodium results for sample J17HJ3 (the equipment blank) are of similar magnitude as the method blank result. The result for calcium, copper, iron, and sodium in sample J17HJ3 may be considered estimated due to method blank contamination. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for three analytes (aluminum, iron, and antimony). For aluminum and iron, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. Antimony did not have mismatched spike and native concentrations in the original MS. The original MS recovery for antimony was 40.5%. The antimony results may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, all silicon results may be considered estimated due to an LCS below QC limits at 6.6%. Estimated data are useable for decision-making purposes.

SDG K1397

This SDG comprises a pipe scale sample (J17HK8) from test pit 2 of the 100-H-28:7 subsite. This sample was analyzed for ICP metals, mercury, PCBs, gross alpha and gross beta by gas proportional counting, total uranium by KPA, and by GEA. Minor deficiencies are as follows:

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for 11 analytes (aluminum, chromium, copper, iron, mercury, nickel, lead, silicon, silver, zinc, and antimony). For most of these constituents, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. Antimony, lead, and silver did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for antimony, lead, and silver were 48.5%, 55.9%, and 61.7%, respectively. The antimony, lead, and silver results may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, all boron and lead results may be considered estimated due to a laboratory duplicate relative percent difference (RPD) above the QC limit of 30%, at 36.4% and 50.7%, respectively. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the silicon result may be considered estimated due to a LCS below QC limits at 6.6%. Estimated data are useable for decision-making purposes.

SDG J00208

This SDG includes a pipe scale sample (J17HL3) from test pit 2 of the 100-H-28:7 subsite. This sample was analyzed for hexavalent chromium. A minor deficiency was noted in the MS recovery for the analysis. The MS recovery was below project acceptance criteria at 57%. To confirm quantitation, a PDS was prepared, with a result of 98%. The MS recovery is attributed to the reducing capacity in the sample matrix. The hexavalent chromium data for SDG J00208 may be considered estimated. Estimated data are useable for decision-making purposes.

SDG D8277004

This SDG includes a sample (J17FP8) from suspected asbestos-containing mastic on a pipe in test pit 2 of the 100-H-28:7 subsite. The sample was analyzed for bulk asbestos. No major or minor deficiencies were found in SDG D8277004. The data are useable for decision-making purposes.

SDG J00416

This SDG includes a soil sample (J18KV0) from test pit 3 of the 100-H-28:7 subsite. This sample was analyzed for ICP metals, mercury, IC anions, hexavalent chromium, PCBs, PAH, gross alpha and gross beta by gas proportional counting, total uranium by KPA, and by GEA. In addition, the sample was inadvertently analyzed for polycyclic aromatic hydrocarbons (PAH). Minor deficiencies are as follows:

In the radionuclide analysis, total uranium results may be considered estimated due to the MS recovery below the acceptance criteria at 63%. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for four analytes (aluminum, iron, manganese, and silicon). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. Silicon did not have mismatched spike and native concentrations in the original MS. The original MS recovery for silicon was 22%. The silicon data may be considered estimated. Estimated data are useable for decision-making purposes

In the ICP metals analysis, all silicon results may be considered estimated due to a LCS below QC limits at 29%. Estimated data are useable for decision-making purposes.

SDG J00417

This SDG includes a pipe scale sample (J18KV5) from test pit three of the 100-H-28:7 subsite. This sample was analyzed for ICP metals, mercury, IC anions, PCBs, gross alpha and gross beta by gas proportional counting, total uranium by KPA, and by GEA. In addition, the sample was inadvertently analyzed for PAH. Minor deficiencies are as follows:

In the radionuclide analysis, total uranium results may be considered estimated due to the MS recovery below the acceptance criteria at 58%. Estimated data are useable for decision-making purposes.

Due to the preparation holding time being exceeded by greater than twice the limit of 48 hours for nitrate, nitrite, and orthophosphate, the detected nitrate result for sample J18KV5 may be considered estimated. The sample was collected on March 23, 2009, and analyzed on April 1, 2009. The data are useable for decision-making purposes.

In the PCB analysis, a surrogate recovery was outside QC limits at 63% for sample J18KV5. In addition, an MS recovery and an MSD recovery are outside QC limits at 844% and 978%, respectively. The recoveries can be attributed to matrix interference. The PCB results for sample J18KV5 may be considered estimated. Estimated data are useable for decision-making purposes.

In the PAH analysis, the MS and MSD recoveries for benzo(a)pyrene (48% and 36%) and indeno(1,2,3-cd)pyrene (24% and 23%) are outside the QC limits. In addition, the MSD result for pyrene (45%) is outside the QC limit. The results for these analytes may be considered estimated. Estimated data are useable for decision-making purposes.

In the PAH analysis, the MS/MSD RPD for naphthalene is outside the QC limits at 40%. The result for naphthalene in sample J18KV5 may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for eight analytes (aluminum, chromium, copper, iron, lead, manganese, antimony, and silicon). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. Antimony, chromium, copper, lead, and silicon did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for antimony, chromium, copper, lead, and silicon were 62%, 59%, 0%, 30%, and 22%, respectively. The antimony, chromium, copper, lead, and silicon data may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the silicon result may be considered estimated due to an LCS recovery below QC limits at 27%. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, all antimony, cadmium, copper, iron, manganese, mercury, molybdenum, and zinc results may be considered estimated due to a laboratory duplicate RPD above the QC limit of 30%, at 63%, 61%, 68%, 83%, 34%, 42%, 107%, and 85%, respectively. Estimated data are useable for decision-making purposes.

SDG J00413

This SDG includes a pipe scale sample (J18KW5) from test pit 3 of the 100-H-28:7 subsite. This sample was analyzed for hexavalent chromium. A minor deficiency was noted in the MS recovery for the analysis. The MS recovery was below project acceptance criteria at 36%. To confirm quantitation, a PDS was prepared, with a result of 72%. The MS recovery is attributed to the reducing capacity in the sample matrix. The hexavalent chromium data for SDG J00413 may be considered estimated. Estimated data are useable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent difference evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratory. Any deficiencies in those calculations are reported by SDG in the previous sections.

Field QA/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2010b), are the primary and duplicate samples (J17HK6/J17HK7) that were taken of pipe scale material in test pit 2 for 100-H-28:7 and reported in SDG K1393, but were subsequently assigned to the 100-H-35 waste site.

Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the sample/duplicate pair(s) for each contaminant of potential concern (COPC). RPDs are not calculated for analytes that are not detected in both the main and duplicate sample at more than 5 times the target detection limit. RPDs of analytes detected at low concentrations (less than 5 times the detection limit) are not considered to be indicative of the analytical system performance.

The RPD calculated for copper in the test pit 2 pipe scale duplicate sample (J17HK7) is above the acceptance criteria of 30% at 46.7%. A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than 5 times the target detection limit (TDL), including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used to indicate that a visual check of the data is required by the reviewer. None of the data required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are useable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above, are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-H-28:7 subsite confirmatory sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling, with the exception of the IC analysis that was not performed for samples at test pits 1 and 2, and the inability to perform ICP metals, mercury, hexavalent chromium, and PCB analysis on sample J18KV3 from test pit 1. The DQA review for 100-H-28:7 subsite concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes. The confirmatory sample analytical data are stored in the Environmental Restoration (ENRE) project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System (HEIS) database. The confirmatory sample analytical data are also summarized in Appendix B.

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