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HUNTERS POINT
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7 Oct 1998

From: Commanding Officer, Engineering Field Activity, West, Naval Facilities Engineering Command
To: Distribution

Subj: RESPONSE TO COMMENTS, ENGINEERING FIELD ACTIVITY, WEST, NAVAL FACILITIES ENGINEERING COMMAND, HUNTERS POINT SHIPYARD, SAN FRANCISCO, CALIFORNIA

Ref: (a) EFA West ltr 5090, Ser 62210LT/L8028 of 27 Oct 97

Encl: (1) Response to Agency Comments on the draft Final Parcel E Remediation Investigation, Hunters Point Shipyard

1. Reference (a) forwarded a copy of the draft Final Parcel E Remediation Investigation (RI) for Hunters Point Shipyard. Enclosure (1) is forwarded as the Navy's response to Agency comments on the draft Final RI.

2. If you have any questions regarding these enclosures, please contact Luann Tetirick, Code 62210, at (650) 244-2655, FAX (650) 244-2654.

Original signed by:
RICHARD E. POWELL
By direction

Distribution:
U.S. Environmental Protection Agency (Attn: Ms. Claire Trombadore)
U.S. Environmental Protection Agency (Attn: Ms. Sheryl Lauth)
U.S. Environmental Protection Agency (Attn: Mr. Clarence Callahan)
California Department of Toxic Substances Control (Attn: Ms. Valerie Heusinkveld)
California Regional Water Quality Control Board (Attn: Mr. David Leland)
California Department of Toxic Substances Control, Health & Ecological Risk Division (Attn: Dr. Jim Polisini)

Copies to:
Roy F. Weston, Inc. (Attn: Ms. Karla Brasaemle)
San Francisco City Attorney (Attn: Ms. Rona Sandler)
Department of Public Works. Site Assessment and Remediation Division (Attn: Mr. John Chester)
Department of Public Works, Bureau of Construction Management (Attn: Mr. Steve Mullinnix)
San Francisco Department of Public Health (Attn: Ms. Amy Brownell)
City and County of San Francisco, Public Utilities Commission, Bureau of Environmental Regulation and Management (Attn: John Mundy)
National Oceanic & Atmospheric Administration (Attn: Ms. Laurie Sullivan)
U.S. Department of the Interior (Attn: Mr. David Thornton)
U.S. Fish & Wildlife (Attn: Mr. Jim Haas)
Agency for Toxic Substances & Disease Registry (ATSDR) (Attn: Ms. Diane Jackson)

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California Department of Fish & Game (Attn: Ms. Susan Ellis)
California Office of Environmental Health (Attn: Ms. Margy Gassel)
California Department of Health Services (Emeryville) (Attn: Ms. Alyce Ujihara)
California Department of Health Services (Sacramento) (Attn: Ms. Dierdre Dement)
Bay Area Air Quality Management District (Attn: Ms. Catherine Fortney)
Port of San Francisco (Attn: Ms. Roberta Jones)
NAVSEA DET RASO (Attn: LCDR Vinny Deinnocentiis)
San Francisco Department of Public Health (Attn: Mr. Ed Ochi)
Kern Mediation Group (Attn: Mr. Douglas Kern)
RAB Member: ARC Ecology (Attn: Ms. Christine Shirley)
Tetra Tech EM Inc. (Attn: Mr. Jim Sickles) (w/o encl)

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ATTACHMENT S1

RESPONSE TO AGENCY COMMENTS ON THE DRAFT FINAL PARCEL E REMEDIAL INVESTIGATION, HUNTERS POINT SHIPYARD

(44 Pages)

RESPONSE TO AGENCY COMMENTS ON THE DRAFT FINAL PARCEL E REMEDIAL INVESTIGATION HUNTERS POINT SHIPYARD

This document presents the U.S. Department of the Navy's (Navy) responses to comments from the regulatory agencies on the draft final Parcel E remedial investigation (RI) report for Hunters Point Shipyard (HPS), dated October 27, 1997. The comments addressed below were received from the U.S. Environmental Protection Agency (EPA); the California Department of Toxic Substances Control (DTSC); the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB); the California Department of Health Services (DHS); and the San Francisco Redevelopment Agency (SFRA). This document also addresses comments submitted by DTSC from its Human and Ecological Risk Division (HERD) related to the human health risk assessment (HHRA) and ecological risk assessment (ERA).

Agency comments are presented in boldface type, and Navy responses are presented in normal type.

RESPONSE TO COMMENTS FROM EPA

General Comments

1. **Comment:** **Table of Contents. The titles of Figures 1.3-3 and 3.7-4 do not match the Table of Contents.**

   Response: The Table of Contents should have identified Figure 1.3-3 as "Station Locations and Extended Site Boundaries" rather than "Parcel E Map." Figure 3.7-4 was correctly identified.

2. **Comment:** **Figure 4.1-30. The TPH-d in groundwater contour lines do not match the contour lines in the new Figure 4.27-4. Please update Figure 4.1-30 to match Figure 4.27-4.**

   Response: Figure 4.27-4 was based on Hydropunch and monitoring well total petroleum hydrocarbons as diesel (TPH-d) in groundwater data while Figure 4.1-30 was based solely on monitoring well data. All of the Section 4.1 groundwater figures were based solely on monitoring well data because they are the most reliable data. Figure 4.27-4 was a special case where the Hydropunch data helped clarify the TPH-d trends in an area with relatively scarce monitoring well data. The two figures cannot be made to match due to the different data sets.

3. **Comment:** **Figure 4.27-5. The TPH-mo groundwater contour lines along the south-western side of the site do not appear to be based on sampling data. These contour lines should be dashed. The contour lines more likely extend into IR-01/21 as seen in Figure 4.27-4. The contour lines also do not match the contour lines on the parcel wide figure (4.1-32). Please revise Figure 4.1-32 to match Figure 4.27-5.**

Response: The reviewer is correct that the contour lines along the southern edge of IR-76 were not based on sampling data and should have been dashed to indicate the lack of control points along the boundary with IR-01/21 (the Industrial Landfill). The Navy assumes that total petroleum hydrocarbons as motor oil (TPH-mo) are present in the IR-01/21 area south of IR-76, but only contoured existing data on Figure 4.27-5. The Navy understands the reviewers concern but believes that the benefit gained by revising this figure to indicate areas that lack data control points would not justify making these changes. The Section 4.1 chemical distribution maps also do not use dashed lines (or any other convention) due to the large areal coverage to indicate areas where data control points are lacking. It should be remembered that these figures are highly interpretive by their nature and that extent of contamination will be verified as necessary during the remedial action.

Figures 4.1-32 and 4.27-5 show different affected areas of TPH-mo for the same reason discussed under comment number 2 for TPH-d.

4. **Comment:** **Appendix R, Section 4.12.3.2, p. 4-521. The table located on this page incorrectly lists the concentration units as μg/L instead of μg/kg.**

Response: This section was included in Appendix R for informational purposes, and is exactly as it appeared in the draft final Parcel D RI report. The text has not been revised. The reviewer is correct that units for the maximum detected concentration (MDC) and preliminary remediation goal (PRG) value should have been micrograms per kilogram (μg/kg).

5. **Comment:** **Appendix R, Section 4.12.4.1, p. 4-531. Concentrations of copper, lead, and zinc were detected at concentrations exceeding HPALs at the 2.25 foot sample at PA36B006 and at the 3.75 foot sample at PA36MW03A suggesting that sandblast grit may have been disposed of in these areas. Please update the text accordingly.**

Response: This section was included in Appendix R for informational purposes, and is exactly as it appeared in the draft final Parcel D RI report. For the sake of consistency with the original source material the text has not been revised. The reviewer is correct that these metals may be indicative of sandblast waste disposal.

6. **Comment:** **Appendix R, Section 4.13.4.1, p. 4-585. Copper, lead, mercury, and zinc concentrations exceeding soil HPALs had similar distributions, indicating that sandblast grit is a potential source of metals contamination. Please update the text to indicate the areas where sandblast grit is a potential contaminant source.**

Response: This section was included in Appendix R for informational purposes, and is exactly as it appeared in the draft final Parcel D RI report. For the sake of consistency with the original source material the text has not been revised. The reviewer is correct that these metals may be indicative of sandblast waste disposal.

7. **Comment:** **Appendix R, Section 4.14.4.1, p. 4-649. A discussion of product saturated soil was to be added to this page in the Parcel D Draft Final Report (See p. 14 of Response to EPA Comments on the Parcel D Remedial Investigation Draft Final Report). Please include the information on product saturated soil.**

Copper, lead, mercury, and zinc concentrations exceeding soil HPALs had similar distributions, indicating that sandblast grit is a potential source of metals contamination. Please update the text to indicate the areas where sandblast grit is a potential contaminant source.

Response: Section 4.14 was included in Appendix R for informational purposes and is exactly as it appeared in the draft final Parcel D RI report. For the sake of consistency with the original source material the text has not been revised. The reviewer is correct that these metals may be indicative of sandblast waste disposal. The reviewer is also correct in noting that text about product saturated soil was not incorporated into this section as was originally proposed. Although supplemental text was provided in the draft final Parcel D RI report response to comments, additional review of the boring logs and analytical data for IR-36 West was performed while addressing the response to comments on the draft final Parcel E RI report which would modify that response. The remainder of this response details supplemental text for Section 4.14 regarding product-saturated soil at IR-36 West.

Evidence of residual product in the saturated zone was detected in two distinct areas at IR-36 West. Evidence of residual product in soil above the water table was detected in three distinct areas in the central portion of IR-36 West. The presence of residual product at IR-36 West is discussed in the following paragraphs.

RESIDUAL PRODUCT IN THE SATURATED ZONE

Evidence of residual product in the saturated zone was detected in two distinct areas at IR-36 West, the Wagner Construction Company (Wagner) storage yard in the central portion of the site and the former service station area east of Building 709. The vertical and horizontal extent of residual product in these areas is discussed in the following paragraphs.

Wagner Storage Yard

The borings listed in the following table contain evidence of residual product at depths at or below the groundwater table but above Bay Mud Deposits. These borings comprise an area approximately 130 by 230 feet in size in the central portion of the site. Residual product was observed in the saturated zone at these locations at depths ranging from 14 to 45.5 feet below ground surface (bgs). No residual product was detected in the saturated zone at the following borings: IR36B043, IR36B049, IR36B051, IR36B058, IR36B059, IR36B063A, IR36B064, IR36MW11A, PA36B026, and PA36MW06A. The maximum lateral extent of residual product in this area is defined by these locations.

Boring	Total Depth (feet)	Depth to Bay Mud (feet)	Depth to Groundwater (feet)	Product Description and Depth	Type of Material in which Product was Observed
IR36B040	36.5	29.0	14.0	Saturated soil at 14 feet	Very dark grayish brown, poorly graded sand
IR36B042	31.5	23.0	12.0	Oily sand at 20 feet	Very dark gray, well-graded sand
IR36B044	56.5	47.5	25.0	Water with free product observed 40.5 to 41.5 feet	Black poorly graded sand
IR36B052	26.5	14.5	10.0	Odor/staining at 10.5 feet; free product at 14 feet	Brown silty gravel
IR36B054	41.5	34.0	7.0	Product staining at 31.5 feet	Very dark gray clayey gravel
IR36B056	56.5	49.5	15.0	Product sheen at 39 feet; odor at 45 feet	Dark olive-gray, gravelly fat clay; gray well-graded sand
IR36B061	31.5	19.5	10.5	Oily sheen at 16 feet	Black well-graded sand with gravel
IR36B065	51.5	44.5	19.5	Product-stained brick debris at 42 feet	Black silty gravel with sand
IR36B105	34.5	25.5	10.5	Black free product 25.5 feet	Black sandy fat clay
IR36B108	56.5	49	11.5	Free product at 14 feet; product-saturated material at 45.5 feet	Greenish gray, well-graded gravel with sand; very dark gray, poorly graded sand
IR36B109	45.5	43.5	13.0	Product-saturated material at 42.5 feet	Dark reddish gray, poorly graded sand
IR36MW12A	22.5	--	10	Product sheen/staining at 10.5 feet	Black well-graded gravel with sand

Boring	Total Depth (feet)	Depth to Bay Mud (feet)	Depth to Groundwater (feet)	Product Description and Depth	Type of Material in which Product was Observed
PA36B022	22	20	6	Odor/sheen on gravel at 9 feet; hydrocarbon sheen at 12 feet; sheen on sand lens at 20 feet	Dark gray, well-graded gravel with sand; very dark, well-graded sand; dark greenish gray, fat clay
PA36MW08A	27	--	6.5	Black product sheen at 15 feet; sheen at 20.5 feet (just above clay layer)	Black well-graded gravel with sand; very dark grayish brown, poorly graded sand

Motor oil range petroleum hydrocarbons were detected in soil and groundwater throughout the area at the Wagner storage yard where residual product was observed in the saturated zone soils. The source of residual product in the saturated zone and petroleum hydrocarbons in soil and groundwater in this area is likely due to releases of fuels and oils at Building 704 and the Wagner storage yard. The source may also be related to petroleum hydrocarbon-affected fill materials used in the area. The extent of petroleum hydrocarbons in soil and groundwater at the Wagner storage yard is discussed in detail in Section 4.14 of the draft final Parcel D RI report.

Area East of Building 709

The borings listed in the following table contain evidence of residual product at depths at or below the groundwater table but above Bay Mud Deposits. These borings comprise an area approximately 30 by 150 feet in size east of Building 709. Residual product was observed in the saturated zone at these locations at depths ranging from 5.5 to 17 feet bgs. No residual product was detected in the saturated zone at the following borings: IR36B057, IR39B011, IR39B014, IR39B017, IR39B023, IR39MW21A and IR39MW36A, as well as borings PA36B017 and PA36B018A at adjacent site IR-36 South. The maximum lateral extent of residual product in this area is defined by these locations.

Boring	Total Depth (feet)	Depth to Bay Mud (feet)	Depth to Groundwater (feet)	Product Description and Depth	Type of Material in which Product was Observed
IR39B012	21.5	--	6.5	Sheen on water at 6.5 feet; product sheen/odor at 10 feet; product sheen/odor at 17 feet	Very dusky red, gravelly fat clay; dark greenish gray, clayey sand with gravel; dark greenish gray, well-graded sand
IR39B012A	10	--	6.5	Product sheen/odor at 6.5 feet	Dark greenish gray, sandy fat clay
IR39B013	16.5	14.5	3.5	Product sheen/odor at 6 feet	Black clayey sand

Boring	Total Depth (feet)	Depth to Bay Mud (feet)	Depth to Groundwater (feet)	Product Description and Depth	Type of Material in which Product was Observed
IR39B029	14	10.5	9.5	Product-saturated material at 5.5 feet; product- and water-saturated material at 9.5 feet	Greenish black, well-graded gravel; greenish black, silty gravel
IR39MW24A	21.5	14	10.5	Visible product at 11.5 feet	Well-graded gravel with sand

Motor oil range petroleum hydrocarbons were detected in soil and groundwater throughout the area east of Building 709 where residual product was observed in the saturated zone soils. The source of residual product in the saturated zone and petroleum hydrocarbons in soil and groundwater in this area is likely due to releases of fuels and oils at the former service station at Building 709. The extent of petroleum hydrocarbons in soil and groundwater at the former service station is discussed in detail in Section 4.14 of the draft final Parcel D RI report.

RESIDUAL PRODUCT IN SOIL ABOVE THE SATURATED ZONE

Evidence of residual product in soil above the saturated zone was detected in three distinct areas in the central portion of IR-36 West: (1) four borings in the western portion of the Wagner storage yard, (2) five borings in the eastern portion of the Wagner storage yard, and (3) one sampling location in the southern portion of the Wagner storage yard. All of these borings are within or at the perimeter of the area of residual product observed in the saturated zone at the Wagner storage yard. The vertical and horizontal extent of residual product in soil in these areas is discussed in the following paragraphs.

Western Portion of the Wagner Storage Yard

The four borings listed in the following table contain evidence of residual product in surface soil. These borings comprise an area approximately 40 by 50 feet in size in the western portion of the Wagner storage yard. Residual product was observed in soil at these locations at depths ranging from the ground surface to 1.5 feet bgs. No residual product was detected in soil above the saturated zone in the following borings: IR36B054, IR36B088, IR36B091, IR36B092, IR36B094, and IR36B109. The maximum lateral extent of residual product in surface soil in this area is defined by these locations.

Boring	Total Depth (feet)	Depth to Bay Mud (feet)	Depth to Groundwater (feet)	Product Description and Depth	Type of Material in which Product was Observed
IR36B086	11.5	--	--	Trace product at 1.5 feet	Very dark gray and darkish reddish brown, poorly graded gravel with sand
IR36B087	11.5	--	--	Product staining at 1 foot	Very dark gray and dark reddish brown, silty sand with gravel

Boring	Total Depth (feet)	Depth to Bay Mud (feet)	Depth to Groundwater (feet)	Product Description and Depth	Type of Material in which Product was Observed
IR36B090	11.5	--	--	Product staining at surface	Brown to dark greenish gray silty sand with gravel
IR36B093	11.5	--	--	Heavy product staining at 1 foot	Grayish brown, sandy silt with gravel

Concentrations of motor oil range petroleum hydrocarbons above the RI screening criteria were detected at a depth of 1.25 feet bgs in each of these borings; these concentrations decrease significantly with depth. The source of residual product and petroleum hydrocarbons in surface soil in this area is likely due to releases of fuels and oils in the Wagner storage yard. As noted in the draft final Parcel D RI report, puddled surface water with a petroleum-hydrocarbon sheen and several stained soil areas were observed in the Wagner storage yard. The extent of petroleum hydrocarbons in soil and groundwater at the Wagner storage yard is discussed in detail in Section 4.14 of the draft final Parcel D RI report.

Eastern Portion of the Wagner Storage Yard

The five borings listed in the following table contain evidence of residual product in soil above the saturated zone. These borings comprise an area approximately 100 by 110 feet in size in the eastern portion of the Wagner storage yard. Residual product was observed in soil at these locations at depths ranging from 3 to 9 feet bgs. No residual product was detected in soil above the saturated zone in the following borings: IR36B041, IR36B055, IR36B057, IR36B059, IR36B063, and PA36B019. The maximum lateral extent of residual product in soil in this area is defined by these locations.

Boring	Total Depth (feet)	Depth to Bay Mud (feet)	Depth to Groundwater (feet)	Product Description and Depth	Type of Material in which Product was Observed
IR36B013A	11	10	--	Product sheen at 8 feet	Very dark gray, sandy fat clay
IR36B049	36.5	22	9.5	Oily substance at 6.5 feet	Dark greenish gray, silty sand with gravel
IR36B060	26.5	10.5	8	Product sheen at 6.5 feet	Greenish gray, sandy silt with gravel
IR36B063A	13	--	--	Petroleum staining at 3 feet	Very dark gray to dark greenish gray clayey gravel
IR36B106	31.5	25	11	Free product at 9 feet	Dark bluish gray, clayey sand with gravel

Motor oil range petroleum hydrocarbons were detected at concentrations exceeding the RI screening criteria in soil collected at depths ranging from 1.25 to 21.75 feet bgs from these borings. The source of residual product and petroleum hydrocarbons in soil in this area is likely due to releases of fuels and oils at the Wagner storage yard. The extent of petroleum hydrocarbons in soil and groundwater at the Wagner storage yard is discussed in detail in Section 4.14 of the draft final Parcel D RI report.

Southern Portion of the Wagner Storage Yard

The soil boring listed in the following table contained evidence of residual product in surface soil. This boring is in the southern portion of the Wagner storage yard. Residual product was observed in the uppermost 4 inches of soil at this location. No residual product was detected in soil above the saturated zone in the following borings: IR36B065, PA36B021, PA36B023, and PA36B024. The maximum lateral extent of residual product in surface soil in this area is defined by these locations.

Boring	Total Depth (feet)	Depth to Bay Mud (feet)	Depth to Groundwater (feet)	Product Description and Depth	Type of Material in which Product was Observed
IR36B107	56.5	49	9.5	Free product and sheen in upper 4 inches	Very dark grayish brown, silty sand with gravel

Motor oil range petroleum hydrocarbons were detected at a concentration exceeding the RI screening criteria in soil collected at a depth of 1.25 feet bgs from boring IR36B107; concentrations decrease significantly with depth in this boring. The source of residual product and petroleum hydrocarbons in surface soil in this area is likely due to releases of fuels and oils in the Wagner storage yard. As noted in the draft final Parcel D RI report, puddled surface water with a petroleum-hydrocarbon sheen and several stained soil areas were observed in the Wagner storage yard. The extent of petroleum hydrocarbons in soil and groundwater at the Wagner storage yard is discussed in detail in Section 4.14 of the draft final Parcel D RI report.

Section 3.8 (Hydrogeology) Comments

1. **Comment:** **Comments 9 and 17. The anomalous nature of the high TDS value needs to be discussed in the text to avoid future confusion.**

   Response: The Navy agrees that discussion of the anomalous total dissolved solids (TDS) value in the text might avoid some confusion; however, the Navy does not expect to revise the draft final report. The few numerical changes would not significantly change the conclusions of the affected sections.

2. **Comment:** **Comment 18. A note needs to be added to Figure 3.8-8 stating that the TDS values are maximum concentrations (except for the IR01MW43A anomaly).**

Response: The Navy agrees that a note clarifying that Figure 3.8-8 includes maximum TDS concentrations "except at IR01MW43A" might have avoided some confusion; however, the Navy does not believe that the benefit of reissuing the figure would be justifiable. The note would have read, "All TDS values are maximum concentrations measured at the monitoring wells, except at IR01MW43A, where a maximum value of 77,000 milligrams per liter (mg/L) TDS was determined to be anomalous and was eliminated."

Section 4.1 Comments

1. **Comment:** **Comment 11. This change was not made to the text as discussed in the response.**

Response: The text was changed as indicated in the response to comments and should be the last complete sentence at the bottom of page 4-45.

2. **Comment:** **Comment 14. It is unclear why the additional data analysis presented in the comment response was not integrated into Section 4.1.2. This information should be included in the main text, not just in the comment responses where it may not be seen by most readers. The extent of total Aroclor contamination must be carried forwarded to the FS.**

Response: Chemicals were carried forward to the feasibility study (FS) based on the HHRA results, not just on the chemical distribution maps. Although the discussion of total polychlorinated biphenyls (PCB) would have been more visible in Section 4.1, the Navy regarded this presentation as supplementary to the original analysis and, therefore, chose not to integrate it into Section 4.1.

3. **Comment:** **Comment 17. It is unclear why the discussion of TPH-mo horizontal concentration trends at IR-13, IR-39, and IR-56 were removed from the text.**

Response: Upon reexamination of the data, concentration trends appeared to exist most clearly at IR-72 and IR-73. Concentration trends may exist at IR-13, IR-39, and IR-56, but the relative scarcity of TPH-mo data in Parcel E makes actual trends difficult to distinguish. The Navy had dropped these areas from the text because they did not seem to meet the criteria of a horizontal concentration trend as set forth in this section.

Section 4.2 (IR-01/21) Comments

1. **Comment:** **Comment 8. The text was not changed as indicated in the last sentence of the response. Also, if sandblast waste was disposed of outside the debris zone, then there is a correlation between hazardous waste disposal and the extent of copper and lead detected in soil, even though this sandblast waste disposal occurred outside the debris zone.**

   Response: A discussion of the nature and extent of copper and lead in soil at IR-01/21 is provided on pages 4-141 and 4-142. The discussion contains text to support possible sources of the presence of these metals. The Navy does not dispute that sandblast waste that might have been classified as hazardous waste was disposed of at IR-01/21. The Navy only maintains that the disposal of sandblast waste probably occurred within and outside the extent of the Industrial Landfill as shown on Figure 4.2-5.

2. **Comment:** **Comment 17. Text describing the distribution of samples that contained arsenic or nickel at concentrations exceeding the HPAL was not found (see the last sentence of the comment response). Please add the additional text or indicate where it was inserted.**

   Response: The text describing numbers and locations of samples with concentrations of arsenic and nickel exceeding the Hunters Point ambient level (HPAL) may be found on pages 4-139 and 4-140.

Section 4.3 (IR-02 Northwest) Comments

1. **Comment:** **Comment 8. The text was not revised as stated in the comment response. Please provide the revised text.**

   Response: The following sentence should have been added to the paragraph at the top of page 4-266, "Chlorinated aliphatic compounds primarily degrade under anaerobic conditions."

Section 4.6 (IR-03) Comments

1. **Comment:** **Comment 1. The text was not revised as stated in the comment response. It is important to cite the correct capacity of the ponds. Please revise the text.**

   Response: The third sentence in the fifth paragraph on page 4-464 should read, "One pond was 50 by 60 feet and 5 feet deep with a capacity of 112,000 gallons, and the other pond was 55 by 100 feet and 5 feet deep with a capacity of 205,700 gallons." The fifth sentence of the fourth paragraph on page 4-545 should have been similarly changed.

2. **Comment:** **Comment 2. Accordingly to the text on p. 4-475 (paragraph 31), Triple A "allegedly transported mixtures of waste oil, solvents, bilge water...". Solvents should be added to the list of potential sources.**

Response: Solvents were not added to the list of potential sources for reasons explained in the response to the original comment. The Navy understands that EPA believes that solvents should have been added to the list.

Section 4.7 (IR-04) Comments

1. **Comment:** **Comment 7. The extent of PCBs in the vicinity of test pit IR04TA07B was drawn based solely on the detected level of PCBs in that test pit and in test pit IR01TA07A, located west-northwest of IR04TA07B. No samples were collected south of these two locations, so the extent of PCBs extending southwest from IR04TA07B into IR-01/21 is speculation. It should also be noted that the detected concentration of total PCBs is 370,000 µg/kg, more than twice the detected concentration of Aroclor-1260. It will likely be necessary to collect more samples to define the extent of PCBs in this area during remedial design.**

Response: The Navy concurs that it may be necessary to collect additional samples during the remedial design phase to define further the distribution of PCBs in the area between IR-01/21 and IR-04.

Section 4.8 (IR-05) Comments

1. **Comment:** **Comment 2. The text was not revised as stated in the comment response. Please provide the revised text.**

Response: The text on page 4-684 was revised to include a sentence stating, "The presence of lead in these samples is possibly due to the presence of lead in motor oil released in the area." This same sentence should replace the fourth and fifth sentences in the third paragraph on page 4-658. The seventh sentence in this paragraph should also be deleted.

Section 4.11 (IR-13) Comments

1. **Comment:** **Comment 6. The presence of floating product on the groundwater table is a significant feature of this site and as such needs to be discussed in the conclusions section (4.11.7). Add a discussion of the floating product to Section 4.11.7.**

Response: Please see response to EPA general comment 7.

Section 4.20 (IR-52) Comments

1. **Comment:** **Comment 3. The real issue is whether there is sufficient data to define the extent of contamination for the FS (i.e., how much soil would have to be excavated to clean up this site). EPA does not believe that the data is sufficient to accurately estimate the volume of soil that might require remediation, however, this information could be gathered during design (or during remediation, if the Navy is prepared for the possibility that the volume of soil to be remediation might be much greater than estimates based on single point samples, spaced 200 to 300 feet apart.**

   Response: The Navy is prepared for the possibility that the current data may underestimate the volume of soil that will require remediation and expects to gather additional data, as required, during the remedial design and remediation.

Section 4.24 (IR-73) Comments

1. **Comment:** **Comment 1. The EPA disagrees with the comment response. The scale of Figure 3.1-1 is too small to be useful in locating the fuel and storm drain lines on Figure 4.24-1.**

   Response: To avoid confusion through presenting too much information, Figure 4.24-1 did not include the fuel and storm drain lines. If necessary, Figures 4.15-1, 4.16-1, 4.17-1, and 4.18-1 can be used to derive a more detailed picture of the utilities in the vicinity of IR-73.

Section 4.26 (IR-75) Comments

1. **Comment:** **Comment 6. Figures 4.27-4 and 4.27-5 do not support this response. These figures show a single plume. Also, the part of the original comment about the pattern of the plume being biased because no samples were collected along the western edge of the site was not addressed.**

   Response: This comment appears to refer to EPA's Section 4.27 (IR-76) comment number 6, not Section 4.26 (IR-75) comment number 6. The point of the original response was that surface soil contamination east of Building 830 cannot be related to contaminants moving with the groundwater (subsurface), and therefore must be due to a second source. The original comment stated, "The pattern [of TPH-mo in subsurface soil] is somewhat biased because no samples were collected along the western site boundary." In fact, Hydropunch borings IR75B001, IR75B002, and IR75B003 were collected immediately adjacent to the IR-76 property boundary (see Figure 4.27-1). Sampling further west to address this lack of closure will have to await the negotiation of access

with the current property owner at IR-75 (Building 820). This lack of data was identified as a data gap for IR-75.

2. **Comment:** **Comment 7. The new figures (4.27-4 and 4.27-5) and p. 4-1344 contradict the last sentence of paragraph 5, p. 4-1330. Please revise p. 4-1330, paragraph 5, so that it is consistent with the rest of the section.**

Response: The last sentence of paragraph 5 on page 4-1,330 should have read, "The source may be related to the presence of TPH-mo in soil and groundwater at adjacent site IR-76 (see Figures 4.27-4 and 4.27-5)."

Section 5.0 Comments

1. **Comment:** **Comment 11. A discussion of the soil and groundwater data gap that was due to the detection of PCE in IR12B001 (Section 4.10, Comment 4) has not been added to Section 5.1.9. This data gap was also identified in Section 5.6. The site summary should discuss the data in enough detail so that a reader has some idea why the data gap was identified.**

Response: Data gaps were not typically discussed in the site summary section (Section 5.1) but were presented, as noted, in Section 5.6. Although it might have been helpful to have more discussion in Section 5.6 for IR-12, a full discussion may be found in Section 4.10.

2. **Comment:** **Comment 12. It is unclear why the presence of vanadium is attributed to sandblast waste. Vanadium is frequently found in petroleum products, so the presence of this metal is more likely associated with petroleum releases from the former service station.**

Response: The fourth sentence of paragraph 3 on page 5-27 should be replaced with the following: "The presence of chromium and mercury is likely due to Triple A's management of sandblast waste in the area. The presence of vanadium is likely related to petroleum product releases from the former service station."

3. **Comment:** **Comment 36. IR-04. See Comment 1. Under Section 4.7.**

IR-40. Please clarify whether there is any soil in the vicinity of the former transformers.

IR-52. See comment 1. Section 4.20.

Response: IR-40 consists of Building 527 located on Pier 2 which is constructed of steel-reinforced concrete. No soil is in the vicinity of the former transformers. Sediments under Pier 2 will be assessed as part of Parcel F. See EPA Section 4.20 comment number 1 regarding IR-52.

Appendix C Specific Comments

1. **Comment:** **Comment 1. This change was not made; the text still states that barometric pressure was measured.**

   Response: The first sentence of the first paragraph on page C-2 should have read, "Water levels in the monitoring wells and at the tidal monitoring station were measured using pressure transducers and recorded by automatic data loggers."

2. **Comment:** **Comment 3. The text in Section 1.2.2 was not modified as indicated in the comment response.**

   Response: The third paragraph on page C-3, which starts "TDS and salinity concentrations can be used...," should be deleted.

3. **Comment:** **Comment 7. The response does not address the original comment. Please address why and when the Bouwer and Rice method can be used for a confined aquifer, and define the type and magnitude of error(s) associated with using this method for confined aquifer. This information should both be discussed in the response and incorporated into the Appendix C text.**

   Response: As noted, the Bouwer and Rice method is appropriate for analyzing slug tests performed on wells with well screens partially or fully penetrating an unconfined aquifer (such as the A-aquifer wells). The Cooper method is generally suitable for analyzing slug tests on wells with screens fully penetrating a confined aquifer (such as the B-aquifer). The Navy has used both the Bouwer and Rice and Cooper methods to analyze slug tests on B-aquifer wells. Although the Cooper method is preferred for estimating the hydraulic conductivity of a confined aquifer, both methods generally produce similar results, or results within an order of magnitude.

   In Parcel B, the range of B-aquifer hydraulic conductivities calculated from four slug tests was 0.5 to 15 feet per day by the Cooper method and 0.15 to 4.5 feet per day by the Bouwer and Rice method (PRC Environmental Management, Inc. 1994). Since the Cooper method is preferred for evaluating slug tests of the confined B-aquifer, the Bouwer and Rice method appears to underestimate the hydraulic conductivity by a factor of three.

4. **Comment:** **Comment 8. The response did not address the original comment. Please discuss conditions under which methods designed for analysis of pumping tests in confined aquifers can be used for unconfined aquifers. Also discuss errors that will result when these methods are used for unconfined aquifers. This information should be included in the response and incorporated into the Appendix C text.**

Response: Analytical methods designed for analysis of pumping tests in confined aquifers (for example, the Theis nonequilibrium method) are routinely used for unconfined aquifers, especially at hazardous waste sites. The long-term pumping requirements of more accurate unconfined aquifer tests (such as the Boulton delayed drainage model) conflict with the desire to (1) minimize the volume of contaminated groundwater collected and requiring disposal, and (2) minimize the potential of induced movement of contaminated groundwater plumes.

Methods designed for analysis of pumping tests in unconfined aquifers require the following to be recorded: (1) the very early groundwater-level responses, typically 10 or more readings in the first minute of pumping, to capture the aquifer response that is "ideal" and prior to the start of delayed drainage or storage; (2) the intermediate groundwater-level responses that represent the curve for delayed yield; and (3) the later stage groundwater-level responses within several days or tens of days or more to capture the aquifer responses when an equilibrium is established between the rate of gravity drainage and the rate of decline of the water table. These responses in unconfined aquifers are used to estimate delayed drainage factors to refine the hydraulic functions used by the Theis non-equilibrium method, which models the "ideal aquifer."

The "ideal aquifer" (confined aquifer) yields instantaneous groundwater-level response to a pumping well and has no delayed drainage; water is instantaneously released from storage when the hydraulic head is reduced at the pumping well. Delayed drainage from an unconfined aquifer produces a slow release of groundwater from storage during a pumping test. If uncorrected time-drawdown data are used for pumping test analysis of an unconfined aquifer, the observed time-drawdown data is flatter, and the change in drawdown is smaller. This smaller drawdown produces higher estimates of transmissivity and hydraulic conductivity and much lower estimates of storativity. Distortions from unadjusted time-drawdown data have been observed to be in error by a factor of 2 or 3 or more (Powers 1992).

5. **Comment:** **Comment 10. Unless this information has been presented in another document, it should be supplied in the Parcel E RI Report. If the information has been published, cite the document in which it was published.**

Response: Background water levels and step drawdown tests for several of the constant rate discharge tests have been included in Attachment S1-A. Barometric pressure was apparently not recorded during these tests.

6. **Comment:** **Comment 13. The response did not address the original comment. The response and text in Appendix C should address the following questions: Are the lithologic logs correct for these wells? Were the slug tests and analyses performed correctly for these wells?**

Response: The lithologic logs record what the field geologist noted at the time that the well borings were completed. The Navy has reviewed the documentation to affirm that these are the lithologic logs for these wells. The slug test results were previously rechecked and were found to have been performed correctly. Monitoring wells IR01MWI-3 and IR01MWI-7 were installed in 1986, while monitoring well IR02MW101A2 was installed in 1990. Since the slug tests were performed relatively recently and since the wells were not redeveloped before testing, it is possible that the low values observed at IR01MWI-3 and IR02MW101A2 reflect fouling of these wells. The high values observed at IR01MWI-7 are not consistent with the data recorded on the boring log and likely indicate an error in the lithologic log or the slug test. Retesting of this well would be required to determine the source of the error. The Navy believes that the results of these three questionable slug test results should be disregarded since the other slug tests provide an adequate amount of data to evaluate Parcel E.

Appendix F General Comments

1. **Comment:** **Comment 1. It will be important for EPA and the Navy to agree as to what a validation study would entail. In addition, data collection and evaluation should lead to cleanup numbers that could be used for these areas of the site, rather than a determination of the potential for health risks (as the Navy has noted, the ecological risk assessment has already established that risks to terrestrial receptors exist).**

These discussion should focus on decision-making for the areas of the site that will not be excavated or capped. This seems appropriate, given that the screening assessment suggests that risks to terrestrial receptors may possibly occur. Major revisions to the screening assessment approach are unlikely to change this outcome, therefore effort to this end does not seem warranted.

Response: The Navy concurs with these comments and is working with the agencies to develop an acceptable validation study. The draft work plan and field sampling plan for the Parcel E validation study was submitted to the agencies on July 22, 1998. The agencies verbally approved the work plan, with modifications, on August 4, 1998.

2. **Comment:** **The Navy should review the appendix one more time to ensure that the stated text changes were actually made. As an example, the Navy stated it would remove aluminum from the list of COPCs that were dropped from the assessment because they were essential nutrients. However, review of**

page F-12 (Section 4.2) shows that aluminum is still included in the essential nutrient list.

Response: The reviewer is correct and the Navy understands their concern.

Appendix O Specific Comments

1. **Comment:** **Comment 9. Page O-46, paragraph 4, of the Draft Final report is not complete. Please provide the completed text.**

   Response: Paragraph 4 on page O-46 should have read, "The 3-ring aromatics tend to more strongly adsorb the 2-ring aromatics as indicated by the much higher K_{oc} values measured for these compounds. The K_{oc} is 2.3×10^{-4} milliliters per gram (mL/g) for phenanthrene."

2. **Comment:** **Comment 10. Full citations were not provided as indicated in the comment response. Please provide an updated References section.**

   Response: All values in Table O-2 were taken from "Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemical," Volumes I (1992), II (1992), III (1983), and IV (1995) by D. Mackay, W.Y. Shin, and K.C. Ma (Lewis Publishers, Boca Raton, Florida). The Navy proposes to delete Table O-3 since it does not add much to the presentation of the fate and transport discussion for inorganic compounds.

Appendix Q Specific Comments

1. **Comment:** **Comment 3. This correction was apparently not made to the text, because updates for Appendix Q were not supplied to EPA.**

   Response: Although responses were provided to all comments received on the Mass Loading Technical Memorandum (Appendix Q), the appendix itself was not revised. The response to the comment noted, "The text should read...." No change was actually made to the text.

Dr. Stralka - Appendix N Comments

1. **Comment:** **The use of the default value for Cr^{+6} of 0.99% is not substantiated. We have previously set up a clear way of incorporating the speciation results into the RI, as in parcel B, the highest proportion of Cr^{+6}/Cr_{total} will be used as a health protective determination for all those samples where speciation was not done. For those samples where speciation was done, the analytical results are to be used. This process had been agreed to by the Navy and regulators during Parcel B and should be carried through to all the parcels.**

Response: The Navy believes that the calculation of hexavalent chromium for Parcel E was as conservative (health protective) as the approach used in Parcel B, followed appropriate EPA guidance, and likely resulted in significant overestimation of hexavalent chromium concentrations.

2. **Comment:** **Several of the comments refer to a previous agreement that the screening values used, Region 9 PRG's, are frozen in time to the 1994 tables. We must use the most current toxicity evaluations at the time of the report, anything less is unacceptable.**

Response: The Navy believes that it was appropriate to use the same toxicity data for all HPS HHRAs. In an August 18, 1995 letter to the agencies, the Navy suggested for consistency using the February 1995 EPA Region IX preliminary remediation goals (PRG) as screening criteria for data in the Parcel B through E RI reports (Navy 1995). The Navy also proposed that the HHRAs use the toxicity factors from the same February 1995 PRG document (Note: 1995 PRGs were reissued in 1996 with minor revisions). The Navy has reviewed the differences resulting from the revised PRGs and found the differences did not provide sufficient benefit to justify the recalculation of the risks in the HHRA and the revision of the associated text in the RI and FS. A memorandum presenting this analysis is included with this response to comments.

Dr. Callahan - Appendix F Comments

1. **Comment:** **Generally, the Navy seems to agree with the Agencies that further risk assessment work is needed and EPA would certainly agree with that position.**

Response: The Navy understands the agency's position on this matter.

1a. **Comment:** **The "10 percent" rule. We have read the response to DTSC, HERD that was referenced in the Navy's response. Please elaborate/explain what is meant by the first complete sentence on S-146, "The spatial distribution of the chemical was factored into the reevaluation although that was not explicitly stated." Please clarify this statement with reference to the "10 percent criterion."**

Response: During the evaluation of chemicals of potential concern (COPC), the Navy looked at the spatial distribution and concentrations of chemicals that fell below the 10 percent cutoff to ensure that significant releases were not missed as a result of the screening process. Although this full process was not stated or documented in the report, the Navy found that the 10 percent criteria only eliminated relatively low (near detection limit) concentrations of chemicals (mainly pesticides) that did not demonstrate a discernible pattern.

1b. **Comment:** **PCB analysis. Please cite the volume and page number for the analytical results of the Aroclor-1254 and 1260. We would like to see the laboratory results for the levels of these two Aroclor concentrations. We want to view the analytical peaks from the sample and the peaks got the standards to understand how the two Aroclors were identified and separated from other contaminants.**

Response: The Navy followed the standard EPA Contract Laboratory Program (CLP) statement of work (SOW) for analysis of PCBs. Updates to the CLP SOW were implemented as appropriate. Much of the recent sample analyses would have followed the 1993 revision, "Statement of Work for Organics Analysis Multi-Media Multi-Concentration" (Document No. OLM02.1). The analytical results may be found in Appendix M (Volumes XVI through XVIII) and various tables in Volumes III through V. A specific page number cannot be referenced since the PCB results are not presented separately from the other analytical data. The Navy will provide copies of specific analytical reports upon request.

1c. **Comment:** **Herbicides. The comment does not address the possibility that the contaminants may have been above a significant risk level, even at frequencies of detection less than 10 percent. Please provide contaminant concentrations where these contaminants were detected above detection limits.**

Response: The Navy is working with the agencies to develop an appropriate list of COPCs for the purposes of the validation study. Please also see response to comment 1a.

2a. **Comment:** **Invertebrates as receptors. EPA is in support of the Navy positions as expressed on p S-94, "The Navy however, ...the basic conclusion of the study, that all Parcel E sites evaluated have concentrations of COPECs in soil that represent a potential terrestrial ecological risk." Having made this statement, the Navy must recognize that the RI/FS process now requires that a cleanup concentration must be determined. EPA accepts the Navy offer as expressed in the first sentence, second paragraph on pS-94 "...to identify an appropriate strategy for addressing this potential risk and expects to include any additional field work in the data gap sampling and analysis activities for Parcel E." We would suggest that discussions for validation studies be initiated immediately for Parcel E so as to avoid any further delay in cleanup of this Parcel.**

Response: As a result of discussions held between the Navy and the regulatory agencies a work plan for the validation study was submitted on July 22, 1998. The agencies verbally approved the work plan, with modifications, on August 4, 1998. The validation study report will be issued in late 1998 and will be incorporated into the draft final Parcel E FS.

2b. **Comment:** **Exposure. The response is not sufficient as it only refers the reader to a discussion of uncertainties when EPA is suggesting (perhaps not as directly required) that validation studies be planned to reduce the great amount of possible range in the uncertainties (either from data variance or from unknown levels) produced by the approach described by the Navy.**

Response: The Navy has included direct measurements of appropriate exposure parameters as part of the ecological validation study. The specific parameters to be determined are discussed in the validation study work plan submitted on July 22, 1998 and verbally approved by the agencies on August 4, 1998.

2c. **Comment:** **Bio-transfer factors. This is another area where EPA strongly suggests that validation samples would eliminate the great amount if uncertainty in the data resulting in an inability to produce definitive results in the ERA.**

Response: Please see response to comment 2b.

2d. **Comment:** **Trophic transfer factors. The use of literature values for estimating trophic transfer factors is not reasonable given the potential range of results possible due to site specific characteristics (i.e., edaphic and species specific conditions) compared to the definitive results that are not possible from sampling the material at Hunters Point to obtain the most relevant data. EPA strongly suggests that the trophic transfer factor data be validated.**

Response: Please see response to comment 2b.

3a. **Comment:** **Interpretation of TRVs. The response provided is inadequate as it does not address the EPA comment. The TRV document was not raised as an issue of being a completed document (i.e., reviewed), but is cited here as an issue of interpretation of the values especially on the low end of the values. The risk derived using the low TRV is a "low risk" estimate, not a "no risk" estimate. If a "no risk" level is desired, EPA suggests that the Navy follow the DTSC document (as well as the EPA Superfund guidance and the Risk Forum guidelines) to develop an exposure-response relationship, The Navy must be able to discuss the points listed in the risk characterization phase of the EPA Risk Forum document as listed below (see comment 4a).**

Response: The Navy acknowledges that "the risk derived using the low TRV is a 'low risk' estimate, not a 'no risk' estimate." In keeping with the use of the TRV methodology, development of a "no risk" level is not desired. Analysis of tissue concentration data from the planned ERA validation study will permit a more comprehensive response to the points listed in the risk characterization phase of the EPA Risk Forum document as in comment 4a.

3b. **Comment:** **Use of hazard quotients. What is the Navy suggesting as a solution to the problem that the Navy has shown as a likely significant ecological risk? What is the next step in the Navy's opinion? EPA is suggesting that validation studies be performed for Parcel E.**

Response: The results of the screening ERA showed a potential ecological risk, not a "likely significant ecological risk." The Navy, nevertheless, concurs that a validation study is the appropriate next step and has started the preliminary work on the study.

4a. **Comment:** **Risk Characterization. Although the Navy states that this "...ERA primarily incorporated guidance from the Framework" (see page S-95, response to EPA general comment no.3), the Navy contradicts itself when stating that, "...risk management decisions may be made without full knowledge of all of these parameters." "These parameters" as referred to here are the components of risk characterization as defined not only in the Tri-services document but also in the Framework document. Knowledge of these four items are necessary rather than just helpful. For instance, the Forum document provides explicit definitions of what is needed, "Managers should clearly describe the sources and causes of risks and the potential adversity of the risks (e.g., nature and intensity, spatial and temporal scale, and recovery potential.)" Further, from p113, Text Box 6-1, Questions Regarding Risk Assessment Results (Adapted From U.S. EPA, 1993d);**

Questions principally for risk assessors to ask risk managers:

- **Are the risks sufficiently well defined (and data gaps small enough) to support a risk management decision?**
- **Was the right problem analyzed?**
- **Was the problem adequately characterized?**

Questions principally for risk managers to ask risk assessors?

- **What effects might occur?**
- **How adverse are the effects?**
- **How likely is it that the effects will occur?**
- **When and where do the effects occur?**
- **How confident are you in the conclusions of the risk assessment?**
- **What are the critical data gaps, and will information be available in the near future to fill these gaps?**
- **Are more ecological risk assessment iterations required?**
- **How could monitoring help evaluate the results of the risk management decision?**

The Navy has stopped the ERA process at a screening level for Hunters Point. Management decisions are best made with all the required information obtained in the completed ERA process, rather than trying to

defend a management decision arrived at by guessing based on incomplete data and assumptions that cannot be supported.

The Agencies have not agreed that Category 2 is a rational interpretation of the data. The Agencies do not recognize that any site with risk determined to be above risk derived from the low TRV and below the high TRV need to be further evaluated.

Response: The intent of performing a validation study is to address the concerns expressed above. When appropriately designed, the validation study should ensure that the risk will be relatively well-defined at the completion of the study.

4b. **Comment:** **Limited receptors for risk characterization. With respect to the response cited by the Navy (reference to EPA Appendix G specific response number 7), the question of the kestrel and small mammals being adequate is a moot point. The Navy acknowledged that, "...the basic conclusion of the study, that all Parcel E sites evaluated have concentrations of COPECs in soil that represent a potential terrestrial ecological risk." EPA suggests that the next step is to validate these conclusions.**

Response: The Navy concurs and is working with EPA to develop an appropriate validation study.

4c. **Comment:** **Classification of sites and cleanup levels. EPA agrees with the Navy that the next step in the process is the need for cleanup numbers based on site specific validation studies.**

Response: The Navy understands the agency's position on this matter.

4d. **Comment:** **Category 2 sites and cleanup values. What was the purpose of the work presented if not to complete the ecological risk assessment?**

Response: The validation study will include a discussion of how the results will be used to derive cleanup values.

RESPONSE TO COMMENTS FROM DTSC

General Comments

1. **Comment:** **The Report must be signed by a Geologist or Engineer licensed and registered in the State of California.**

Response: The report actually was signed by a registered geologist although the report did not indicate that was the case. In the future, reports requiring the sign-off of a registered geologist or professional engineer will be signed with his or her registration or license number.

2. **Comment:** **Most if not all, of the Contaminant Fate and Transport sections of the site reports include brief statements regarding degradation of many different contaminants, including pentachlorophenol, polychlorinated biphenyls (PCBs) and chlorinated solvents. The text infers that degradation is or will be occurring but there is no Hunters Point Shipyard (HPS) site-specific data presented to support the statement. For example, the Report's reference to 1,2-dichloroethylene (1,2-DCE) as a degradation product of trichloroethylene (TCE), while true, is not accurate. A significant body of literature exists that identifies the cis-1,2-DCE isomer as the preferential breakdown product of TCE. Unless speciation of cis-1,2-DCE and trans-1,2-DCE is performed and presented along with other degradation indicators (e.g., dissolved oxygen (D.O.), reduction-oxidation potential (Eh), etc.), DTSC would not agree with statements suggesting degradation is occurring. Likewise, statements identifying aerobic or anaerobic zones not supported by field data, are simply a hypothesis. It is unclear how a remedy evaluation can be performed in the Feasibility Study (FS) if data does not exist to support the presumption of degradation. DTSC will not support remedial decisions regarding degradation of contaminants unless site specific data is collected and presented for review by the regulatory agencies.**

Response: The Navy attempted to refer to any degradation as potentially occurring and avoided statements about actual anaerobic or aerobic conditions. As noted previously, the Navy will obtain site-specific data if required to support remedial decisions.

3. **Comment:** **Summary of Potential Data Gaps, ES-89 Pgph 3. DTSC has concerns regarding the discussion on addressing data gaps and accelerated schedules. Previous experience, not only at HPS but at other sites, has shown that if the nature and extent of contamination is not defined in the Remedial Investigation (RI), proper remedy selection is difficult and in fact may not be suitable or appropriate for the site. Costs associated with uncertainties carried forward from the RI are magnified when proceeding through the FS, Remedial Design (RD) and Remedial Action (RA). Determining nature and extent of contamination and understanding hydrogeologic characteristics early is best for all parties involved.**

Response: Comment acknowledged; however, the Navy does not believe any of the data gaps are such that they will present a problem for the FS report. The data gaps will need to be addressed before completion of the remedial design.

Specific Comments

1. **Comment:** **IR-01/21, Pgs. ES-16 & 4-208: DTSC recommends that data gaps at IR-01/21 be filled prior to developing the Final FS. Use of limited data from RI activities can lead the remedial decision process to a decision that is not appropriate.**

Response: The pages noted do not discuss specific data gaps; however, characterization of contamination at the southwest corner of IR-01/21 from an apparent off-site source was identified as a data gap. The Navy does not believe that this off-site area would be likely to significantly alter remedy selection within Parcel E. Regardless, the FS report can address this question of uncertainty.

2. **Comment:** **IR-01/21, Pg. 4-136: Soil sampling at IR01B021A identified several Semi-volatile Organic Compound (SVOCs) in the shallow soil, but there is no discussion of SVOCs in the ground water section. Specify if ground water sampling at IR01B021 (since IR01B021A had refusal at ~6.75 feet) was performed and if the ground water results showed SVOC contaminates.**

Response: Pages 4-155 and 4-156 discuss the presence of semivolatile organic compounds (SVOC) in groundwater at IR-01/21, and specifically discuss the results of a grab groundwater sample collected at boring IR01B021.

3. **Comment:** **IR-02 Central, Pgs. ES-23 & 4-373:**

   a. **The extent of dioxin contamination is not currently defined. Uncertainties in the extent of contamination could likely impact remedy selection (e.g. cost of excavation and removal versus capping and long term monitoring). Costs associated with uncertainties carried forward from the RI are magnified when proceeding through the FS, RD, and into the RA. The earlier the extent of contamination is defined, the better it is for all parties involved.**

   b. **Figures 4.1-19A & B, S-1A & B. The extent of PCB contamination in the area of IR02TA57A is not defined. The text (4.4.4.1) should include a discussion of the elevated detection limits (1,900) influence on data interpretation. DTSC recommends additional sampling in the area.**

Response:

a. The Navy believes the source area and maximum concentrations of dioxins in soil have been identified; therefore, this data gap is not expected to impact alternatives evaluated in the FS. The extent of dioxin contamination will be defined before completion of the remedial design.

b. The Navy agrees that, because of elevated PCB detection limits in the area of IR02TA57A, additional soil sampling should be conducted to better characterize the extent of PCB contamination. This sampling will be conducted during the remedial design phase. The reviewer should note that the impact on the FS is expected to be minimal because during the HHRA, PCBs were assumed to be present at concentrations equal to half their elevated detection limits. Therefore, risk to human health associated with elevated levels of PCBs in this area was in fact evaluated using this approach.

4. **Comment:** **IR-02 Central, Pgs. 4-374 & 375. The Report identifies elevated lead being found in the area of the former firing range but never suggests that the firing range could be just as likely a source of lead as the dumping of liquid wastes from Tank S-505, dumping of wastes at Triple A site 19, etc. Characterization of the waste source (firing range versus liquid waste disposal) is important for remedy selection. For example, if the lead results were based in part on lead shot being present in the soils, physical separation processes may be appropriate. If the lead is from microscopic metal shavings, paint chips, etc., different treatment processes (solidification in place, capping, etc.) may be more appropriate.**

Response: The first sentence on page 4-375 states that, "The source of lead in these samples may be related to the reported dumping of liquid waste from Tank S-505 along the Parcel E shoreline or activities conducted at the former firing range." No changes to the report appear to be required.

5. **Comment:** **IR-04, Pgs. ES-30 & 4-557: Pgph 1. IR-04 is in the northeast corner of Parcel E.**

Response: The Navy refers to the area in the vicinity of IR-38 as the northeast corner of Parcel E.

6. **Comment:** **IR-04, Pg. 4-591: The discussion on soil chemistry should include pH of soil and groundwater since potential sources included a battery disposal area. Soil pH will affect the leachability of metals to ground water and may need to be considered during remedy selection.**

Response: The Navy concurs that the disposal of batteries at IR-04 could have affected soil pH and the leachability of metals to groundwater. The Navy will consider this during remedy selection.

7. **Comment:** **IR-05, Pg. 4-659 & Figures 4.1-19A & B. PCB contours depicted to show the 66 μg/kg (PRG) are located inside sample locations were the detection limits on the sample consistently exceed the 66 μg/kg level. DTSC had previously made this same comment on the draft document in regards to PCBs and Benzo(A)pyrene. The Navy's response does not adequately address the comment or issue, and contrary to the response provided by the Navy, the contours do not respect the data as presented. At a minimum, section 4.8.4.1,** Nature and Extent of Contaminants in the Soil, **should include a discussion on why the contouring is appropriate and how the analytical detection limits are used to contour data. DTSC will hold the Navy responsible for ensuring that the FS properly depicts contaminant concentration contours relative to "clean-up" levels.**

Response: Consistent with EPA guidance, the risk assessment considered a nondetected concentration as detected at a concentration equal to half the detection limit. The FS uses the results of the risk assessment to estimate the areas and depths required for soil remediation. The most likely remediation alternative that will be employed for soil containing PCBs at IR-05 is soil excavation. As part of this alternative, the Navy will perform confirmation sampling. The Navy feels that this method will responsibly remediate soil containing PCBs at IR-05.

8. **Comment:** **IR-40, Pgs. ES-51 & 4-1024. Including the recommendation to remove Pier 2 does not appear to be relevant or appropriate for the RI. The purpose of the RI is to characterize contamination to aid in selecting an appropriate remedy. Removal of the pier is not needed from an environmental clean-up stand-point. DTSC recommends removing the text discussing removal of Pier 2.**

Response: The Navy agrees that a discussion of the removal of Pier 2 may not be within the scope of the RI. However, this information was included to address the issue of the possible presence of PCBs in concrete at IR-40. This text was requested by EPA (see page S-54, EPA Specific Comments on Section 4.14).

9. **Comment:** **IR-76, Pg. 4-1385, The text states that anaerobic conditions exist at IR-76. Evidence (at a minimum D.O. data) showing anaerobic conditions exist at IR-76 could not be found in the Report by DTSC staff. The Report should reference or include the data that supports the statement that anaerobic conditions exist.**

Response: The text states, "Pentachlorophenol will be degraded in the anaerobic conditions at IR-76." The text should have qualified this statement to indicate that if anaerobic conditions exist at IR-76, pentachlorophenol would be expected to degrade. This text referred to the first paragraph of this section which stated, "Conditions at IR-76 are expected to be primarily oxidizing in the soil above the water table and reducing in the soil and debris below the water table and in the groundwater."

10. **Comment:** **Appendices R&S, Pages S-133 through 136**

    a. **DTSC would like to further discuss the Navy's Response to DTSC's General Comments 2, 3, 4 and 5 and DTSC Specific Comments 1, 2, 3 and 5.**

    b. **Figure S-2. DTSC's copy of the figure does not include the dashed blue line found in IR-01/21 and IR-02C. The legend should clarify the significance of the dashed blue line.**

Response: The noted responses to DTSC comments generally relate to consistency issues between the RI reports for Parcels B through E and earlier agreements between the Navy and the agencies. The Navy is eager to discuss ongoing DTSC concerns so that these issues may be resolved.

The dashed blue lines at IR-01/21 and IR-02 Central depict the portions of the parcel that the Navy expects to cap.

RESPONSE TO COMMENTS FROM DTSC HERD

1. **Comment:** **We have several concerns regarding some of the Navy's responses to HERD comments of the Draft Final RI Report.**

   We accept the Navy's response to HERD general comment number one that the incremental cancer risk and non-cancer hazard associated with ingestion of fish and/or shellfish will be addressed in the Parcel F Remedial Investigation (RI) report.

   Response: To clarify for the reviewer, please note that the question of risk from ingestion of fish and/or shellfish will be addressed in the draft final Parcel F FS rather than the RI report since that document's equivalent (the Phase 1A and 1B ERA) is complete.

2. **Comment:** **The intent of the human health risk assessment (HHRA) specific comment number one was that the California-specific ambient concentrations (Bradford, et al., 1996) should be used in place of, not in addition to, the ambient concentrations for the entire United States. We will not insist that this change be made at this late date.**

   Response: The Navy understands the agency's position in regards to the use of ambient concentrations.

3. **Comment:** **Despite the Navy's response we still believe that a more appropriate hexavalent chromium concentration would be 2.2 percent rather than the 0.99 percent used in the HHRA. The response to the HERD HHRA specific comment number 3 refers to a lengthy discussion of statistics contained in the response to a similar U.S. EPA comment. Regardless of the statistical basis for one value or the other, the use of differing hexavalent chromium ratios in different parcels at HPA will make the base-wide HHRA extremely difficult to perform. We continue to recommend a more uniform hexavalent chromium value more similar to that used in other HPA parcels but will not insist that the hexavalent chromium value be changed at this late date. The Navy should be aware of difficulty this will cause in performing the base-wide HHRA.**

   Response: The Navy understands the position of HERD in regards to the appropriate hexavalent chromium ratio calculation approach.

4. **Comment:** **The DTSC risk manager should bear in mind that the Navy admits the low dose hazard calculated in the ecological risk assessment was performed incorrectly by using trophic transfer factors but declines to change the calculation. This position is contained in the response to ecological risk assessment (ERA) general comment number 1. Removing the trophic transfer factors would increase the low dose hazard quotient (HQ_1) by a factor of ten for some representative species.**

Response: The Navy evaluated the effect of the elimination of the trophic transfer coefficients and found that this modification did not change the individual site categorizations. The Navy has elected to perform a validation study rather than refine the dose model.

5. **Comment:** **The response to ERA general comment 2 addresses the method for estimating deer mouse tissue concentrations as part of the kestrel intake calculation. The method used to estimate the maximum deer mouse tissue concentration is unacceptable to HERD. It has not been used in any DTSC ERA in California of which we are aware. DO NOT USE THIS METHOD OF ESTIMATING MAXIMUM PREY TISSUE CONCENTRATIONS IN ANY FUTURE ECOLOGICAL RISK ASSESSMENTS.**

Response: The Navy will refrain from using the noted method for estimating the maximum tissue concentrations in future ERAs.

6. **Comment:** **We continue to recommend sites IR-02 Northwest and IR-04 for validation studies to decrease the uncertainty in the Parcel E Predictive Assessment for terrestrial receptors as stated in HERD Conclusion comment number 2. These two sites are the most heavily contaminated of those evaluated in Parcel E. If validation studies at these two sites do not indicate a potential problem the other sites in Parcel E are unlikely to pose a threat.**

Response: The Navy is working with EPA and the state to develop an acceptable validation study for Parcel E.

RESPONSE TO COMMENTS FROM RWQCB

General Comments

1. **Comment:** **The city reuse plan for Parcel E, as presented in Figure 4.0-3, shows several possible wetland creation sites in the parcel. In addition to the evaluation of the existing wetland added to the Draft Final document, the Navy needs to look at the concentrations and distribution of chemicals in the wetland creation areas designated in the reuse plan from the perspective of the suitability of these areas for wetland creation. The wetland cover and non-cover values used in the analysis of the existing**

wetland seem appropriate for use as screening values for these other areas as well.

Response: The Navy has agreed to conduct an analysis of the feasibility of wetlands creation in Parcel E as a part of the draft final Parcel E FS. The study will be submitted for agency review in November 1998.

2. **Comment:** **It is the understanding of RWQCB staff that the significance of groundwater concentrations will be evaluation against NAWQC when considering potential use by fish and wildlife. Specifically, exceedances of NAWQC at the point of compliance or within the tidal influence zone will constitute a basis for action by the Navy.**

Response: That understanding is correct.

3. **Comment:** **The text of Section 5.4 notes the Navy's intent to perform an analysis of onshore to offshore migration as part of the Parcel F FS. This analysis will be essential in developing an understanding of migration pathways and in developing remedies for the onshore parcels (including Parcel E) that are protective of human health and the environment.**

Response: The Navy understands the agency's concern in this matter.

Specific Comments

1. **Comment:** **Section 4.0, Definitions. The first sentence mentions three ways to describing analytes detected, but only two are presented. Please revise.**

Response: This sentence should have read, "In this Parcel E RI report, analytes detected in the same sample are described in one of the following two ways: ..."

2. **Comment:** **Section 4.0, Aquatic Ecological Assessment, p 4-18, third para. Modeling of wind transport and surface water erosion are noted, with the possibility that results may be available in the draft final RI. What is the status of these efforts? Please update this section to reflect modeling results and status.**

Response: The Navy has not pursued this modeling approach further and has no plans to revisit this effort. Simple surface soil erosion and wind transport models do not appear to be sufficiently refined to produce meaningful results for this application. The third and fourth sentences of this paragraph should be deleted.

3. **Comment:** **Section 4.1.4, p. 4-62. The analysis of NAWQC exceedances in Section 4.1.10.4 and Table 4.1-48 indicates more exceedances of the NAWQC for zinc than any other metal. In addition, the relative magnitude of the highest measured zinc concentration relative to its NAWQC exceeds that of arsenic and nickel, both of which were plotted. Please add a plot showing the distribution of maximum of concentrations of zinc in groundwater.**

Response: The Navy evaluated which metals to plot based on all of the Parcel E monitoring wells, not just those shown in Table 4.1-48. Table 4.1-16 shows that copper, lead, mercury, nickel, and zinc had 113, 36, 33, 173, and 32 samples, respectively, that exceeded their National Ambient Water Quality Criteria (NAWQC) out of approximately 390 A-aquifer groundwater samples. Zinc exceeded its NAWQC the least frequently of these five metals. Groundwater contaminant distribution maps for arsenic and manganese were included in the RI report because greater than half of the samples exceeded their respective tap water PRGs.

Table 4.1-48 only included the nearshore A-aquifer monitoring wells at IR-01/21, IR-02 Northwest, IR-02 Central, IR-02 Southeast, and IR-03. The maximum observed concentrations of copper and nickel in the 46 monitoring wells in Table 4.1-48 actually exceeded their NAWQC more frequently than zinc (in 27 and 22 monitoring wells, respectively, versus 14 for zinc). Although the highest measured zinc concentration in Table 4.1-48 exceeded its NAWQC by a relatively greater proportion than nickel and arsenic exceeded their NAWQC, Table 4.1-16 shows that the maximum zinc concentration in A-aquifer groundwater exceeded the NAWQC by a factor of 380 while maximum concentrations of copper, lead, mercury, and nickel exceeded their NAWQC by factors of 7800, 1250, 1960, and 780.

Even though the concentrations and distribution of zinc in groundwater are relevant, the Navy does not believe that a figure showing this distribution is required. Zinc in groundwater at HPS is typically found in combination with copper, lead, and nickel, and a groundwater distribution map for zinc would mirror these other metals that were plotted (see Figures 4.1-25, 4.1-26, and 4.1-28). The Navy prepared a series of groundwater distribution maps for the entire HPS facility, which includes a map for zinc in A-aquifer groundwater (PRC Environmental Management, Inc. 1997).

4. **Comment:** **Section 4.1.8, p 4-76, line 6. The text states that molybdenum average concentration exceeds its ER-M and does not mention mercury, while Table 4.1-40A notes mercury but not molybdenum. Please review and correct this inconsistency.**

Response: The third complete sentence on page 4-76 should have read, "The parcel-wide average concentrations of these metals also exceeded their respective ER-Ls, although only copper, lead, mercury, and nickel exceeded their respective ER-Ms."

5. **Comment:** **Section 4.1.9, Table 4.1-41B. There are discrepancies between the NAWQC values cited in this table and those presented in Table 4.1-48. Please review and correct any inconsistencies.**

Response: The comment correctly observed that in Table 4.1-41B, the NAWQC do not match the NAWQC values in Table 4.1-48 for copper, lead, mercury, nickel, and zinc. The NAWQC for mercury in the two tables is substantively the same except that the value in Table 4.1-48 (0.03 micrograms per liter [μg/L]) has been rounded up from the actual NAWQC of 0.025 μg/L. Table 4.1-41B correctly listed the current chronic NAWQC for copper (2.9 μg/L), lead (8.5 μg/L), nickel (8.3 μg/L), and zinc (86 μg/L). The Table 4.1-48 values of 2.4, 8.1, 8.2, and 81 μg/L, respectively, are proposed guidelines for dissolved metals concentrations (filtered) that reflect an adjustment to the NAWQC (EPA 1996). The NAWQC represent total metals concentrations (unfiltered).

The values in Table 4.1-48 also appeared in Table 4.0-1 and were used to screen groundwater data throughout the RI report. Although these tables and associated text could be revised to use only the NAWQC, the use of these proposed guidelines was conservative (protective) and reasonable since most of the groundwater samples collected were filtered. As such, the Navy believes that revision of the text and tables is not necessary. The Navy will refrain from using the proposed guidelines in future HPS reports until they have been formally adopted by EPA. It also should be noted that the chronic and acute NAWQC for silver of 0.92 and 7.2 μg/L, respectively, are also proposed values (EPA 1987). The only available, approved NAWQC for silver is an acute value of 2.3 μg/L.

6. **Comment:** **Section 4.1.10, p. 4-79, second bullet. Please provide additional detail on the City policy and permit conditions regarding groundwater use. Does the Navy view these policies and permit conditions as adequate institutional controls on groundwater use or as mechanisms for implementing additional institutional controls? If there are additional actions that would be required to assure adequate controls, please identify them.**

Response: The City of San Francisco bases its groundwater policy on several factors, including recent technical and planning studies (CH2M Hill 1993; Phillips and Others 1993). The City does not currently consider the groundwater basins associated with HPS to be able to provide a potable water supply from on-site groundwater (San Francisco Water Department [SFWD]. 1995. "Preliminary Draft San Francisco Groundwater Master Plan." September 19. Pages 6 through 7). This conclusion is based on the limited thickness of aquifers, high potential for subsidence in artificial and non-engineered fill, limited groundwater development, limited water quality data, and possible basin-wide pollution (SFWD. 1994. "Draft Groundwater Master Plan." January 5. Pages 2 through 12).

The City also requires that water well permits be issued to approve potable water wells within the City. The RWQCB has identified groundwater east (Bay-ward) of Highway 101 as nonpotable (RWQCB 1996), consistent with the City of San Francisco's Mahler Ordinance (San Francisco Public Works Code, Article 20). The role City policies and permit conditions may have with respect to institutional controls has been discussed in the Parcel E FS.

7. **Comment:** **Section 4.1.10, p. 4-79, fourth para. It's not clear how the beneficial uses of Parcel E groundwater are supported by water quality criteria exceedances. The intent and reasoning of this paragraph need to be clarified.**

Response: Because saltwater aquatic life forms are assumed to exist offshore from Parcel E and because A-aquifer groundwater is inferred to discharge from Parcel E to the adjacent Bay based on water level contours, Parcel E groundwater has the beneficial use of recharge to the South Bay.

8. **Comment:** **Section 4.1.10.1, p. 4-80, first para. We strongly disagree with the suggestion that exceedances of MCLs constitute a basis for eliminating Parcel E groundwater from consideration as a potential drinking water source. On the contrary, exceedances of MCLs are a motivation for action to improve water quality for drinking water use. In addition, coincidence of MCL exceedances with HGAL exceedances indicates degradation of water quality as a result of Navy activities that must be addressed.**

Response: TDS, chloride, specific conductance, hardness (and associated detectable taste), and several other maximum contaminant level (MCL) parameters detected in Parcel E groundwater are not associated with Navy activities or releases, but rather are associated with water quality conditions at the adjacent San Francisco Bay, as modified by fill material and recharge conditions. The cited tables show MCLs and other standards for comparison purposes and do not imply that Parcel E groundwater is suitable as a drinking water source. Please note that currently discussion are ongoing between the Navy and EPA as to the appropriate criteria for drinking water classification the results of which may modify this approach.

Although this section does not discuss Hunters Point groundwater ambient levels (HGAL), only the average lead, mercury, nickel, silver, and zinc concentrations exceed 10 times (the default dilution factor) their HGALs in A-aquifer groundwater samples from Parcel E. The draft Parcel E FS includes a remedial action objective to address theses metals in groundwater.

9. **Comment:** **Section 4.1.10.1, p. 4-80, third and fourth paras. Technologies for desalinating seawater exist and are operative at many locations worldwide. Please review the use of the terms "theoretically possible" and "some future technologies" in these paragraphs.**

Response: It is currently unlikely to be feasible to apply desalination technologies economically to the groundwater at Parcel E because of the relatively high TDS concentrations found in the groundwater and the abundance of alternative, already supplied freshwater sources.

10. **Comment:** **Section 4.1.10.1, p. 4-81, second line. The 77,000 mg/L value seems anomalously high. The Navy addressed this issue in Appendix S (Response to Comments) but that discussion is not reflected here. It could be helpful to the reader to note in the text such anomalous values.**

Response: The 77,000 mg/L TDS value is anomalously high. The highest TDS for Parcel E A-aquifer groundwater should be 35,700 mg/L and the average should be 10,200 mg/L.

11. **Comment:** **Section 4.1.10.1, p. 4-82, second para. Please review the reference to Yosemite Falls. Isn't Yosemite Falls in Yosemite Valley (Merced River watershed), while the Hetch Hetchy reservoir is in the Tuolumne River watershed?**

Response: Runoff from the Sierra Nevada mountains within Yosemite National Park, as delivered by the Hetch-Hetchy aqueduct, provides the bulk of potable water to San Francisco. Runoff from several valleys or watersheds contributes to the flow; however, as the reviewer notes, Yosemite Falls would not be included.

12. **Comment:** **Section 4.1.10.1, p. 4-81. Please explain why settling and subsidence would be problems in this area proposed for use as parkland. Does the Navy have any estimates of the extent of settling that might be expected for potential groundwater extraction scenarios.**

Response: Settling and subsidence induced by large groundwater withdrawals may adversely affect roads, utilities, and other surface features. Groundwater withdrawals could also adversely affect the integrity of remedial measures such as gravity flow groundwater collection systems or the landfill grade and cap. No estimates have been made of the extent of settling that might be expected. Several feet of settling has been observed in the southern reaches of Parcel D, probably as a result of earthquake activity.

13. **Comment:** **Section 4.1.10.4, p. 4-83, second para and Table 4.1-48. A number of errors were identified in Table 4-1.48 regarding comparison of HGAL and NAWQC values to measured concentrations. Please review the table and revise the table and this section of text as appropriate. Also, please explain the significance of the 10 times value for evaluating HGAL exceedances.**

Response: HGAL and NAWQC values for Table 4-1.48 were taken from Table 3-3 in the HGAL report (see Appendix B). Table 4.1-48 reports the mercury NAWQC as 0.03 μg/L, as opposed to the Table 3-3 value of 0.025 μg/L. This difference has no impact on the text.

The 10-fold value is the minimum or default natural dilution factor for groundwater entering surface water bodies. The 10-fold dilution factor is consistent with the RWQCB practices for groundwater in fill material at the San Francisco Giants Stadium (China Basin) and University of California at San Francisco - Mission Bay sites. In addition, the 10-fold natural dilution factor is consistent with the average value observed for TPH-d and TPH-mo from nine pairs of A-aquifer monitoring wells in Parcel B, where the average factor was 12 for 200 feet of horizontal groundwater flow. The actual dilution factor for metals is likely to be higher because metals have relatively high soil-to-water partition functions (distribution coefficients).

14. **Comment:** **Section 4.4.10.4, p. 4-84, first para. Does the Navy have a hypothesis regarding the coincidence of maximum exceedances at IR02MW141A, all apparently from the same sample?**

Response: Groundwater samples collected before and after the sample with the "coincidence of maximum exceedances" contained much lower concentrations of metals and organics. Although it would be speculative to suggest a specific hypothesis for the anomalously high values in the one sample, it seems likely that the sample was not representative of the groundwater.

15. **Comment:** **Section 4.1.10.4, p. 4-84. The discussion of dilution of groundwater discharging to receiving waters does not address the potential for exposure of benthic organisms to groundwater discharging to the bay. In addition, the approach is not consistent with what we understand to be the Navy's intent to use NAWQC to evaluate groundwater concentrations at the point of compliance and within the tidal influence zone.**

Response: The discussion of dilution of groundwater discharging to receiving waters is presented for information and comparison purposes only, and not for ERA or point of compliance evaluation. The section was prepared in response to an RWQCB request.

16. **Comment:** **Section 5.7, p. 5-89. The text notes that a data gap technical memorandum will be prepared prior to the draft final FS. Please update the status of this memo. It's not clear why preparation of this memo would need to wait until the Draft Final FS. How does the Navy intend to complete analysis of remedial alternatives in those instances where significant data gaps remain after completion of the RI?**

Response: The most significant data gap that the Navy believes must be addressed before the FS is finalized is the question of terrestrial ecological risk and the related remedial action objectives. The Navy intends to fill other data gaps as well, if possible, in the draft final FS.

RESPONSE TO COMMENTS FROM DHS

General Comments

1. **Comment:** **DHS' 8/29/97 General Comment 1 is correct as stated. This comment stated the following:** ***DHS did not have access to all the documents referenced for justification of why additional surveys were not required or necessary. DHS only questioned the validity of the documentation when discrepancies occurred; additional clarification was needed; or the justification appeared questionable. Therefore, DHS' review scope was limited by the documentation available.***

   Response: The Navy will provide supplemental documentation necessary to support review by DHS upon request. However, previously approved documents will only be provided for informational use.

2. **Comment:** **Page S-160, Navy's Response to DHS' 8/29/97 General Comment 3. It is not clear how the Navy proposed to show that the subsurface areas, including the concrete pad at Building 707 (See Specific Comment 1), do not have subsurface contamination. This becomes more difficult to discern with the different types of media (i.e., asphalt, soil/grass, gravel, fill contaminated with radium devices, etc.). It appears that many of the "buildings"/areas that have been scanned for direct radiation are buried beneath fill material that potentially could contain radium devices. It is not clear that these radium devices would be discernable from anomalous readings.**

   Information should be provided regarding the depth of the fill material, the depth of compaction (e.g., it was noted in the Navy's response to DHS' Specific Comment 3 that some soil was compacted approximately 18 inches) and samples to verify with a 95% assurance that the outside areas that are open to the weathering effects of the external environment (NUREG/CR-5819 refers to these areas as "Open Laid Areas.") do not contain unacceptable levels of contamination.

   DHS would like to review all data pertinent to determining the "criteria for free release of all the remaining buildings and sites," (See the following General Comment 3 regarding the discrepancies in tables and figures showing data and the lack of an established release limit.)

Response: Numerous surface and subsurface surveys have been performed in Parcel E, and radium-containing devices have only been detected at the Industrial Landfill (IR-01/21) and Bay Fill Area (IR-02). The Navy has no evidence to support the supposition that radium dials were disposed in the vicinity of the concrete pad at Building 707. All residual contamination detected at the pad appeared to be surface contamination; this area is not suspected to have been used for subsurface waste disposal.

The only potential point source detected outside the IR-01/21 and IR-02 areas was an anomaly near Building 529. In response to the original DHS specific comment 13, the Navy suggested that this anomaly might have been the result of earth-moving activities subsequent to demolition of the buildings in the area of Building 529. The Navy has no specific evidence to support this conclusion and was only speculating on the possible origin of the anomaly.

The fill material placed over the areas where the former Naval Radiological Defense Laboratory (NRDL) buildings were located (including Building 529) appears to have been placed as topsoil only and is less than 6 inches in depth. The fill was apparently not compacted. The Phase III radiation investigation team in many cases was able to dig down into the top soil a couple of inches and encountered intact floor tiles still imbedded in the original building foundations. Any radium dials potentially placed as fill on top of these old foundations would have been detected by the 2-inch by 2-inch sodium iodide detector used during the Phase III radiation investigation.

As previously stated, the work plan was approved by DHS as sufficient to meet data requirements for HPS. Therefore, with the exception of the noted anomalies, the data collected during the Phase III radiation investigation are suitable to support final determination procedures for the NRDL sites, including the concrete pad at Building 707.

3. **Comment:** **Pages S-161 and S-162, Navy's Response to DHS' 8/29/97 General Comments 4 and 6. The response from the Navy to use zero activity (i.e., zero picocuries per gram (pCi/g)) as background for sample media where no background samples were collected will be acceptable "provided the total activity meets the release criteria accepted for the site." It is not clear, however, that the accepted release criteria have been established or if it is being proposed that subsurface residual contamination be left in place.**

The statement on Page E1-19 stating, "All activity above 6,500 cpm was considered residual contamination.", was rewritten in the Draft Final Appendix E, Attachment E-1, Page E1-20 as, "All activity above 6,500 cpm was considered different from the background sample population." It does not appear from the new statement and previous values given for asphalt that 6,500 cpm is a significant number which was why DHS requested information regarding the surface covering and locations for values greater than 6,500 cpm.

The new tables listing the surface coverings of anomalous readings (i.e., those readings above 6500 cpm) contain many discrepancies between the cpm values shown on the figures, and also the locations of these anomalies. Rather than try to correct all these values on the figures, DHS would prefer to look at all the data if an action level is established for cpm values. There appears to be great variation in the cpm value for the different surface coverings (e.g., asphalt appears to have an average value approximately 1,000 cpm greater than soil) which may misrepresent those areas as being higher than background, but may also mask areas with subsurface contamination.

Response: The Navy concurs with DHS that 6,500 counts per minute (cpm) is not a significant number. It was used only to establish a background level. However, since an action level for gamma cpm measurements has not been established, the Navy needed a comparative number against which the gamma measurements collected in the Phase III radiation investigation could be evaluated. The 6,500-cpm criterion for soil and 7,600-cpm criterion for asphalt/concrete are considered extremely conservative background values.

The Navy acknowledges that the new tables submitted in the draft final Phase III radiation investigation report may not exactly correspond to the figures. The differences exist for the following reasons:

1. The individual survey locations did not always correspond with the nodes of the square grid established for the survey. Data points were plotted based on the position derived from the global positioning system; however, the "grid node" numbers assigned to survey locations as listed in the tables were based on the name of the nearest grid node.
2. If two values were obtained for any grid, only the highest value was listed in the revised table.
3. The data plot was edited to eliminate overlapping points that caused legibility problems.

Otherwise, all data are presented on the posting plots.

The Navy is submitting new proposed release criteria for radionuclide concentrations in asphalt or concrete based on state-approved guidance documentation. Please see Attachment S1-B for a discussion on the determination of acceptable concentrations of residual radioactivity at HPS.

4. **Comment:** **DHS would like to participate in confirmation or verification surveys, which may need to include subsurface sampling, after these areas are remediated or considered ready for release for unrestricted use.**

Response: DHS will be notified in advance of any additional field work. DHS is invited to take split samples during confirmation sampling and perform verification surveys after remediation has occurred at Building 707 (concrete pad), Building 364 (sump site), and Building 529 (buried point source).

Specific Comments

1. **Comment:** **Appendix E, Page E-25, Section 2.3.2.8. It is unclear what area of Building 707 Concrete Pad will be removed as part of the remedial action in Parcel E.**

   Response: The exact extent of the portion of the concrete pad to be removed at Building 707 has not yet been determined.

RESPONSE TO COMMENTS FROM SFRA

General Comments

1. **Comment:** **The San Francisco Redevelopment Plan (7/97) designates locations in Parcel E for future wetland construction. Has the Navy characterized the nature and extent of contamination in Parcel E to evaluate the level of remedial action necessary to sustain a viable wetland?**

   Response: The Navy believes that the nature and extent of contamination at Parcel E have been characterized, with the exception of the data gaps described in Section 5.6. This characterization is sufficient to evaluate the level of remedial action necessary for protection of human health and the environment, and would therefore likely be sufficient to evaluate the level of remedial action necessary to sustain a wetland, should that be necessary.

2. **Comment:** **Wetlands have been utilized as a remedial tool for groundwater and soil cleanup. Does this RI provide the level of information necessary for the Navy to evaluate wetlands as a viable remediation tool to be considered during the Feasibility Study?**

   Response: The Navy believes that the RI provides the level of information necessary to evaluate remedial alternatives during the FS.

3. **Comment:** **There may be many areas in Parcel E where activities associated with development and infrastructure improvements and repairs will encounter contaminated materials that were not identified through the RI process. What are the Navy's plans for handling (storage, transport, and disposal) contaminated materials which are identified during infrastructure improvements and redevelopment activities?**

   Hazardous and contaminated materials which are discovered during repair and improvement activities will place an undue fiscal burden on future development projects, and present future environmental liability issues.

Response: The purpose of the RI is to characterize the nature and extent of contamination in order to select an appropriate remedy. A description of the Navy's plans for handling contaminated materials identified during infrastructure improvements and redevelopment activities is not within the scope of this document. The Navy understands the SFRA's concern regarding cost and liability; however, these issues will be resolved in a more appropriate forum.

4. **Comment:** **The RI identifies Parcel E IR-1/21 as having been used as an industrial landfill. The HPS boundary in this area appears to cut an inconclusive, if not an arbitrary line across the northwest corner of the landfill in Parcel E. Has the Navy performed investigative sampling to determine to what extent the IR-1/21 landfill extends beyond the current HPS boundary? Does the Navy plan on performing additional characterization beyond the current HPS boundary adjacent to IR-1/21?**

Response: Based on soil boring, monitoring well boring, and test pit logs, the Navy defines the extent of the Industrial Landfill as the extent of the debris zone, shown as a solid line on Figure 4.2-5. The extent of the Industrial Landfill does not cross the HPS boundary. The dashed line surrounding the extent of the Industrial Landfill depicts the extent of trace debris in soil. Trace debris in soil is characterized on page 4-115 of the report. The Navy believes that the extent of trace debris in soil probably crosses the HPS boundary into the formerly used defense sites and expects to investigate this area further as part of the data gap sampling for IR-75.

5. **Comment:** **Page 4-1059, Storm Drain System**

   a. **What is the status of the 3 storm drain system discharge points to the bay at Parcel E, are they actively discharging? Are they permitted? Are the discharges in compliance? How often are the outfalls sampled?**

   b. **Are there any known dry wells in Parcel E, if so where are they located, what type of flow do they receive, how are they constructed, and have the dry well construction materials been sampled?**

Response: The three storm drain outfalls within Parcel E are still in use and are covered under the HPS storm sewer permit. Compliance status and sampling requirements are discussed in other HPS documents and are not within the scope of the RI report. Please see the 1996-1997 Annual Report for storm drain discharge requirements and status information (Radian International LLC 1997). No dry wells are known to exist in Parcel E.

6. **Comment:** **Page 4-1264, Section 4.17.1.2 RI Field Investigation**

   a. **The RI describes Drainage A as including 25,999 feet of drainage area, predominantly in Parcel E. How many linear feet of storm sewer is in Parcel E? How many linear feet of the storm sewer was video taped prior to any removal action? How many linear feet of storm sewer was video taped after the removal action?**

b. The RI Field Activities Summary table on page 4-1064 indicates that just three storm drain sediment samples were collected for all of Parcel E storm sewers during the RI. Are three sample a sufficient number to gain a representative understanding of the storm drain sediment? On page 4-1075, the RI states that storm drain sediment removal was completed in early 1997, were any confirmation samples collected after the cleaning? If so, how many and what were the results?

Response:

a. As described in the IT Corporation (IT) document "Draft Field Summary Report, Storm Drain Sediment Removal Action," dated December 1997, approximately 37,900 linear feet of storm drain line is present in Basin I (Drainage A), which is entirely in Parcel E, and about 400 linear feet of storm drain line is present in the Parcel E portion of Basin VII (Drainage G). All storm drain lines were planned to be videotaped prior to cleaning; however, due to excessive sediment and debris present in the lines, the video camera could not move through the lines in a timely manner. Therefore, only post-cleaning videotape exists. Many lines required second and third cleanings due to excessive sediment and debris; the lines were videotaped after each cleaning. The draft Field Summary Report cited above details this information.

b. The storm drain sediment was sampled on a facility-wide basis. Because the results of the sediment samples collected during the facility-wide investigation indicated that storm drain sediments contained hazardous substances, the Navy decided to remove sediment from the storm drains as a mitigative measure. Collection of additional storm drain sediment samples was considered unnecessary. During the storm drain sediment removal action conducted in 1997, sediments were removed from the storm drain lines, were stockpiled on site, and were sampled and analyzed before off-site disposal. These results may be found in the IT draft Field Summary Report. No sediments were available in the cleaned storm drains for collection and analysis following the removal action.

7. Comment: Page 4-1075, Section 4.17.5.1 Potential Migration Routes

a. Has all the storm drain pipe in IR-50 been cleaned? How does the Navy plan to clean drain pipe that is below the groundwater table?

b. In the Navy's judgment, has the storm drain system in IR-50 of Parcel E been cleaned, including verification sampling, such that in the future when City crews perform maintenance and repairs on the system, the likelihood of encountering residual hazardous and contaminated materials will be eliminated? If found, how will residual hazardous and contaminated materials be handled?

Response:

a. As described in the IT document "Draft Field Summary Report, Storm Drain Sediment Removal Action," dated December 1997, all storm drain lines were cleaned with the exception of the inaccessible laterals and about 9,000 linear feet of storm drain lines along the shoreline that were below the groundwater table. Storm drain lines below the groundwater table will be either repaired or replaced as a mitigative measure during the Parcel E remedial action based on evaluation of the infiltration of groundwater. Collars may be constructed around the storm drain pipes within the bedding material to abate the ability of groundwater to flow through bedding material to San Francisco Bay. An infiltration study will be conducted to determine which storm drain lines require rehabilitation.

b. The Navy believes that the completed storm drain sediment removal action combined with the mitigative measure to repair or line storm drain pipes below the groundwater table adequately addresses risks to human health and the environment from the storm drain system. The handling of contaminated materials by the City during maintenance and repairs on the storm drain system is not within the scope of this document. The Navy understands SFRA's concern regarding cost and liability; however, these issues will be resolved in a more appropriate forum.

8. **Comment:** **Page 4-1079, Section 4.17.7.1 Site Characteristics and Potential Sources**

a. The RI states that the storm drain lines leading toward IR-1/21 from Crisp Avenue are to be cleaned and permanently plugged. Has this work been initiated, and when is this work expected to be completed?

b. It seems possible that if a cracked storm sewer line is surrounded by contaminated soil, then groundwater originating as rain or surface water, moving vertically through the contaminated soil, could transport contaminants into the storm sewer line and eventually discharge into the bay. Has the Navy evaluated whether the cracks in the storm sewer lines allow contaminated groundwater and sediment to flow into the sewer line?

Response:

a. The IR-01/21 removal action is ongoing. During this removal action, the storm drain lines between the Industrial Landfill at IR-01/21 and Crisp Avenue were found to have been plugged at an earlier date. These lines were videotaped to document their condition.

b. The mitigative measure described in the response to general comment number 7 will address the issue of contaminant migration to the Bay through the storm drain lines.

9. **Comment:** **Page 4-1084, Section 4.18.1.2 RI Field Investigations**

a. It appears that only one Sanitary Sewer System Water Sample was collected in order to evaluate whether the entire Parcel E sanitary sewer was leaking to groundwater or whether groundwater was infiltrating the sanitary sewer. This does not appear to be an adequate sampling investigation. Please explain how one sample can be used to characterize the entire Parcel E sanitary sewer flow?

b. Have the sanitary sewer been video taped in the last year?

c. Page 4-1083, Section Previous Investigations, Technical Study, the RI states that a 1987 study concluded that the facility wide (including Parcel E) sanitary sewer system was in poor condition marked by corroded piping and manhole walls, leaking and broken joints and piping, and improperly disconnected flow diversion structures. On page 4-1098, Section Conclusions, Site Characteristics and Potential Sources, the RI states that the current physical condition of the sewer system in Parcel E is good based on observations performed during the Site Investigation. Please explain this disparity between the findings of these two investigations of the Parcel E sanitary sewer?

Response: a. The results of the single source water sample collected from the sanitary sewer were not used to characterize the entire Parcel E sanitary sewer flow. As described in the text of Section 4.18, the sanitary sewer system water sample collected from Drainage Reach 8 was only used to determine whether water from the system was exfiltrating in that specific location (see page 4-1093). The Navy assumes that groundwater infiltration may be occurring in areas where the sewer lines are below the groundwater table, and that exfiltration may be occurring in areas where the sewer lines are above the groundwater table.

b. The sanitary sewer lines were not videotaped in 1997.

c. As noted by the reviewer, the 1987 investigation of the sanitary sewer system indicated that the facility-wide system was in poor condition (see pages 4-1083 and 4-1084). The text of the RI report should have been expanded to include a more complete discussion of the 1987 investigation results for the Parcel E portion of the system. During the 1987 investigation, the Parcel E portions of the system (Reaches 6 and 8) were found to have some broken joints; however, corroded, broken, or leaking piping was not found in this portion of the system. The 1987 investigation report included recommendations for repair and upgrade of the sanitary sewer system; these repairs may have been made prior to the 1993 site investigation (SI). The results of the 1993 SI of the sanitary sewer system indicate that the system is in good condition.

10. **Comment:** **Storage Tanks. Are all the Parcel E underground storage tanks (USTs) and above ground storage tanks (ASTs) in regulatory compliance with Federal, State, and local regulations? It appears that the USTs are, but the RI is unclear about the compliance status of the ASTs. By December 1998 all USTs are to meet current state and federal regulations.**

Response: The compliance status of the USTs and ASTs at Parcel E is not within the scope of the RI report and, therefore, was not discussed in the document. All of the USTs at HPS under Navy control have been either removed or closed in-place and any soil or groundwater contamination will be addressed under the Installation Restoration Program. The Navy ASTs at HPS were resurveyed in 1997 and specific actions were recommended for each AST to bring it into regulatory compliance (IT 1997). The Navy plans to begin implementing these actions in 1998.

11. **Comment:** **Groundwater. Has the Navy sufficiently characterized groundwater to enable groundwater remediation design planning? If groundwater remediation will not be done because there is no current health risk or present beneficial use of groundwater, this may only be true for the current base use situation.**

Response: The nature and extent of hazardous substances in groundwater has been characterized. Groundwater remediation will be conducted to address the migration of contaminants to San Francisco Bay. Remedial alternatives for groundwater incorporating future reuse issues were evaluated in the draft Parcel E FS dated January 15, 1998. The Navy is re-evaluating groundwater beneficial use in light of EPA drinking water source criteria which has been proposed by the agencies to be applied to Parcel E, rather than RWQCB drinking water source criteria.

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ATTACHMENT S1-B

DETERMINATION DISCUSSION OF ACCEPTABLE CONCENTRATIONS OF RESIDUAL RADIOACTIVITY CONTAMINATION AT HUNTERS POINT SHIPYARD

(3 Pages)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+00	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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): Cs-137	1.000E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
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)	1.500E+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 effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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)	1.000E+01	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

These residential values are based on soil contamination in larger areas than exist at Hunters Point Shipyard (HPS). Because the contamination at HPS is confined to a bound matrix (asphalt or concrete) that reduces radionuclide mobility, higher values than those for the residential soil scenario may be justified. The NRC in "A Summary of NRC's Interim Radiological Cleanup Criteria and Current Dose Basis," dated November 1992, uses a default input parameter RESRAD code analysis to provide an estimated dose basis for acceptable residual contamination criteria for surface and volumetric activity for selected radionuclides. For the radionuclides of concern at HPS, the Navy calculated the dose basis for 100 square meters (m^2) and 1 m^2 areas (by 1 meter in depth) for the proposed residual activities using default parameters available in RESRAD. The output of these RESRAD runs are attached (see Attachments S1-B1 through S1-B7).

For small hot spots, larger concentration values reflect both a reduced source term and other factors, All RESRAD runs assume a uniform depth of radioactive contamination from 0 to 1 meter with no surface shielding layer. The following free release criteria are suggested for specific radionuclides in asphalt or concrete at HPS:

1) For strontium-90 contamination in asphalt or concrete, 100 picoCuries per gram (pCi/g) was proposed. This value is supported by the RESRAD calculation. Any hot spots identified at HPS are less than 1 m^2 in surface area.

2) For cesium-137 contamination in asphalt or concrete, 100 pCi/g and 10 pCi/g were proposed for 1 m^2 and 100 m^2, respectively. These concentrations correspond to 20 and 16 mrem/yr as calculated by RESRAD.

3) For cobalt-60 contamination, the proposed values will exceed 15 mrem/yr; however, external exposure measurement criteria will apply and be limiting if contamination is on the surface.

4) For the thorium-232 decay series, NRC FC-83-23 identifies 10 pCi/g as an acceptable residual radioactivity criterion for soil. Calculated RESRAD values for 1 m^2 areas corresponding to 15 mrem/yr were 48 and 22 pCi/g for thorium-232 and thorium-228, respectively. The Navy proposes these as maximum values for residual activity in asphalt and concrete, subject to the 10 μrem/hr limitation on dose rate outdoors.

These values will be applied to final verification samples after hot spots identified using field survey techniques are removed. The residual dose determination asphalt and concrete concentration criteria are summarized in the following table:

Nuclide	Area (m^2)	Concentration (pCi/g)	Dose (mrem/yr)
Cesium-137	1	100	20[a]
	100	10	16[b]
Cobalt-60	1	100	96[c]
	100	1	77[d]
Strontium-90	1	100	0.6[e]
	100	30	12.6[f]
Thorium-232[g]	1	100	133[h]

Notes:

m^2	Square meter
mrem/yr	Millirem per year
pCi/g	Picocurie per gram
a	See Attachment S1-B1.
b	See Attachment S1-B2.
c	See Attachment S1-B3.
d	See Attachment S1-B4.
e	See Attachment S1-B6.
f	See Attachment S1-B5.
g	Thorium-232 is in secular equilibrium with radium-228 and thorium-228.
h	See Attachment S1-B7.

The Navy will remove asphalt and concrete based on one or more of the following: (1) where the external exposure rate exceeds 10 μrem/hr above background at 1 meter above the ground surface outdoors, (2) the volumetric concentrations exceed the release criteria proposed in the above discussion (removal will proceed such that the site will meet the 15 mrem/yr criterion), or (3) an alternative value acceptable to the State of California, based on 15 mrem/yr. The Navy considers the 2-inch by 2-inch scintillation detector data collected during the Phase III radiation investigation suitable for comparison to the 10 μrem/hr limit (10 μrem/hr is equivalent to approximately 9,000 counts per minute).

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ATTACHMENT 1

Cesium 137 (Cs-137)

Release Criteria: 100 picoCurie/gram
Area: 1 square meter
Maximum Dose Rate: 20 milliRem/year

See Page S1-B1-7 Summary

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+00	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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): Cs-137	1.000E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
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)	1.500E+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 effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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)	1.000E+01	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+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	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.333E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 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
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	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)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+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-03	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E-04	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E-04	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	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
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 annual wind speed (m/sec)	not used	2.000E+00	---	WIND
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)

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1.00 square meters	Cs-137	1.000E+02
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00
TDOSE(t):	2.090E+01	2.042E+01
M(t):	1.393E+00	1.361E+00

Maximum TDOSE(t): 2.090E+01 mrem/yr at t = 0.000E+00 years

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-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Cs-137	2.088E+01	0.9990	6.029E-04	0.0000	0.000E+00	0.0000	1.739E-02	0.0008	1.516E-03	0.0001	4.957E-04	0.0000	1.369E-04	0
Total	2.088E+01	0.9990	6.029E-04	0.0000	0.000E+00	0.0000	1.739E-02	0.0008	1.516E-03	0.0001	4.957E-04	0.0000	1.369E-04	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 = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
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	2.090E+01	1
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	2.090E+01	1

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Cs-137	2.040E+01	0.9990	5.889E-04	0.0000	0.000E+00	0.0000	1.698E-02	0.0008	1.481E-03	0.0001	4.842E-04	0.0000	1.337E-04	0
Total	2.040E+01	0.9990	5.889E-04	0.0000	0.000E+00	0.0000	1.698E-02	0.0008	1.481E-03	0.0001	4.842E-04	0.0000	1.337E-04	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

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
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	2.042E+01	1
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	2.042E+01	1

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Branch Fraction	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00
Cs-137	Cs-137	1.000E+00	2.090E-01	2.042E-01

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00
Cs-137	7.176E+01	7.346E+01

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

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.000E+02	0.000E+00	2.090E-01	7.176E+01	2.090E-01	7.176E+01

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00
Cs-137	Cs-137	1.000E+00	2.090E+01	2.042E+01

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00
Cs-137	Cs-137	1.000E+00	1.000E+02	9.768E+01

BRF(i) is the branch fraction of the parent nuclide.

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ATTACHMENT 2

Cesium 137 (Cs-137)

Release Criteria: 10 picoCurie/gram
Area: 100 square meters
Maximum Dose Rate: 16 milliRem/year
(98% from External Pathway)

See Page S1-B2-7 Summary

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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): Cs-137	1.000E+01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
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)	1.500E+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 effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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)	1.000E+01	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+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	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.333E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 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
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	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)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+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-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E-02	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	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
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 annual wind speed (m/sec)	not used	2.000E+00	---	WIND
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)

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	100.00 square meters	Cs-137	1.000E+01
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00
TDOSE(t):	1.628E+01	1.590E+01
M(t):	1.085E+00	1.060E+00

Maximum TDOSE(t): 1.628E+01 mrem/yr at t = 0.000E+00 years

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-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Cs-137	1.608E+01	0.9880	1.855E-04	0.0000	0.000E+00	0.0000	1.739E-01	0.0107	1.517E-02	0.0009	4.958E-03	0.0003	1.369E-03	0
Total	1.608E+01	0.9880	1.855E-04	0.0000	0.000E+00	0.0000	1.739E-01	0.0107	1.517E-02	0.0009	4.958E-03	0.0003	1.369E-03	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 = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
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	1.628E+01	1
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	1.628E+01	1

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Cs-137	1.571E+01	0.9880	1.812E-04	0.0000	0.000E+00	0.0000	1.699E-01	0.0107	1.481E-02	0.0009	4.844E-03	0.0003	1.337E-03	0
Total	1.571E+01	0.9880	1.812E-04	0.0000	0.000E+00	0.0000	1.699E-01	0.0107	1.481E-02	0.0009	4.844E-03	0.0003	1.337E-03	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

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
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	1.590E+01	1
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	1.590E+01	1

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Branch Fraction	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00
Cs-137	Cs-137	1.000E+00	1.628E+00	1.590E+00

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00
Cs-137	9.215E+00	9.434E+00

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

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.000E+01	0.000E+00	1.628E+00	9.215E+00	1.628E+00	9.215E+00

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00
Cs-137	Cs-137	1.000E+00	1.628E+01	1.590E+01

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00
Cs-137	Cs-137	1.000E+00	1.000E+01	9.768E+00

BRF(i) is the branch fraction of the parent nuclide.

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ATTACHMENT 3

Cobalt 60 (Co-60)

Release Criteria: 100 picoCurie/gram
Area: 1 square meter
Dose Rate: 96 milliRem/year
(99.98% from External Pathway)

See Page S1-B3-7 Summary

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-60	2.190E-04	2.190E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
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-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)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+00	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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	1.000E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
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)	1.500E+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 effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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)	1.000E+01	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+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	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.333E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 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
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	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)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+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-03	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E-04	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E-04	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	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
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 annual wind speed (m/sec)	not used	2.000E+00	---	WIND
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)

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1.00 square meters	Co-60	1.000E+02
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)		
t (years):	0.000E+00	1.000E+00
TDOSE(t):	9.631E+01	8.441E+01
M(t):	6.421E+00	5.628E+00

Maximum TDOSE(t): 9.631E+01 mrem/yr at t = 0.000E+00 years

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-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Co-60	9.628E+01	0.9998	4.139E-03	0.0000	0.000E+00	0.0000	1.864E-02	0.0002	9.848E-04	0.0000	1.195E-04	0.0000	7.364E-05	0
Total	9.628E+01	0.9998	4.139E-03	0.0000	0.000E+00	0.0000	1.864E-02	0.0002	9.848E-04	0.0000	1.195E-04	0.0000	7.364E-05	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 = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
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	9.631E+01	1
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	9.631E+01	1

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Co-60	8.439E+01	0.9998	3.628E-03	0.0000	0.000E+00	0.0000	1.633E-02	0.0002	8.632E-04	0.0000	1.047E-04	0.0000	6.454E-05	0
Total	8.439E+01	0.9998	3.628E-03	0.0000	0.000E+00	0.0000	1.633E-02	0.0002	8.632E-04	0.0000	1.047E-04	0.0000	6.454E-05	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

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
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	8.441E+01	1
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	8.441E+01	1

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Branch Fraction	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00
Co-60	Co-60	1.000E+00	9.631E-01	8.441E-01

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00
Co-60	1.558E+01	1.777E+01

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

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	1.000E+02	0.000E+00	9.631E-01	1.558E+01	9.631E-01	1.558E+01

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00
Co-60	Co-60	1.000E+00	9.631E+01	8.441E+01

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/q t= 0.000E+00	1.000E+00
Co-60	Co-60	1.000E+00	1.000E+02	8.765E+01

BRF(i) is the branch fraction of the parent nuclide.

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ATTACHMENT 4

Cobalt 60 (Co-60)

Release Criteria: 1 picoCurie/gram
Area: 100 square meters
Dose Rate: 77 milliRem/year
(99.7% from External Pathway)

See Page S1-B4-7 Summary

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-60	2.190E-04	2.190E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
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-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)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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	1.000E+01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
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)	1.500E+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 effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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)	1.000E+01	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+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	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.333E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 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
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	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)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+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-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E-02	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	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
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 annual wind speed (m/sec)	not used	2.000E+00	---	WIND
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)

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	100.00 square meters	Co-60	1.000E+01
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00
TDOSE(t):	7.679E+01	6.731E+01
M(t):	5.119E+00	4.487E+00

Maximum TDOSE(t): 7.679E+01 mrem/yr at t = 0.000E+00 years

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-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Co-60	7.659E+01	0.9974	1.274E-03	0.0000	0.000E+00	0.0000	1.864E-01	0.0024	9.850E-03	0.0001	1.195E-03	0.0000	7.364E-04	0
Total	7.659E+01	0.9974	1.274E-03	0.0000	0.000E+00	0.0000	1.864E-01	0.0024	9.850E-03	0.0001	1.195E-03	0.0000	7.364E-04	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 = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
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	7.679E+01	1
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	7.679E+01	1

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Co-60	6.713E+01	0.9974	1.116E-03	0.0000	0.000E+00	0.0000	1.633E-01	0.0024	8.633E-03	0.0001	1.047E-03	0.0000	6.454E-04	0
Total	6.713E+01	0.9974	1.116E-03	0.0000	0.000E+00	0.0000	1.633E-01	0.0024	8.633E-03	0.0001	1.047E-03	0.0000	6.454E-04	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

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
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	6.731E+01	1
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	6.731E+01	1

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Branch Fraction	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00
Co-60	Co-60	1.000E+00	7.679E+00	6.731E+00

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00
Co-60	1.953E+00	2.229E+00

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

Nuclide (i)	Initial pCi/q	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/q)	DSR(i,tmax)	G(i,tmax) (pCi/q)
Co-60	1.000E+01	0.000E+00	7.679E+00	1.953E+00	7.679E+00	1.953E+00

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00
Co-60	Co-60	1.000E+00	7.679E+01	6.731E+01

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00
Co-60	Co-60	1.000E+00	1.000E+01	8.765E+00

BRF(i) is the branch fraction of the parent nuclide.

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ATTACHMENT 5

Strontium 90 (Sr-90)

Soil Release/Guideline Criteria: 30 picoCurie/gram
Area: 100 square meters (Depth: 1 meter)
Dose Rate: 12.6 milliRem/year

RESRAD Run: 100 picoCurie/gram

Concentration: 35 picoCurie/gram
Dose Rate: 15 milliRem/year
(93% from Plant Pathway)

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(1)
D-34	Food transfer factors:			
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(1,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(1,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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): Sr-90	1.000E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(1)
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)	1.500E+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 effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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)	1.000E+01	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+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	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCU(1,1
R016	Saturated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.103E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 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(
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD SHAPE(
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD SHAPE(
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD SHAPE(1
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD SHAPE(1
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(1
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	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)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+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-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E-02	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	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
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 annual wind speed (m/sec)	not used	2.000E+00	---	WIND
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)

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/q	
Area:	100.00 square meters	Sr-90	1.000E+02
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00
TDOSE(t):	4.246E+01	4.101E+01
M(t):	2.831E+00	2.734E+00

Maximum TDOSE(t): 4.246E+01 mrem/yr at t = 0.000E+00 years

100 picoCurie/gram = 42.4 milliRem/year
1 picoCurie/gram = 0.42 milliRem/year
30 picoCurie/gram = 12.6 milliRem/year

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-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Sr-90	1.404E+00	0.0331	7.618E-02	0.0018	0.000E+00	0.0000	3.990E+01	0.9396	8.025E-01	0.0189	2.386E-01	0.0056	4.188E-02
Total	1.404E+00	0.0331	7.618E-02	0.0018	0.000E+00	0.0000	3.990E+01	0.9396	8.025E-01	0.0189	2.386E-01	0.0056	4.188E-02

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-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.246E+01
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	4.246E+01

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Sr-90	1.356E+00	0.0331	7.357E-02	0.0018	0.000E+00	0.0000	3.853E+01	0.9396	7.751E-01	0.0189	2.304E-01	0.0056	4.045E-02
Total	1.356E+00	0.0331	7.357E-02	0.0018	0.000E+00	0.0000	3.853E+01	0.9396	7.751E-01	0.0189	2.304E-01	0.0056	4.045E-02

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

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Path
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.101E+01
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	4.101E+01

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Branch Fraction	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00
Sr-90	Sr-90	1.000E+00	4.246E-01	4.101E-01

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00
Sr-90	3.532E+01	3.658E+01

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

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Sr-90	1.000E+02	0.000E+00	4.246E-01	3.532E+01	4.246E-01	3.532E+01

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00
Sr-90	Sr-90	1.000E+00	4.246E+01	4.101E+01

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00
Sr-90	Sr-90	1.000E+00	1.000E+02	9.658E+01

BRF(i) is the branch fraction of the parent nuclide.

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ATTACHMENT 6

Strontium 90 (Sr-90)

Release Criteria: 100 picoCurie/gram
Area: 1 square meter (Depth: 1 meter)
Dose Rate: 0.6 milliRem/year
(57% from Plant Pathway)
(37% from External Pathway)

RESRAD Run: 10 picoCurie/gram

Soil Guideline Criteria: 2.164 picoCurie/gram

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(1)
D-34	Food transfer factors:			
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(1,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(1,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+00	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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): Sr-90	1.000E+01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(1)
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)	1.500E+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 effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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)	1.000E+01	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+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	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.103E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 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
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	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)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+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-03	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E-04	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E-04	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	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
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 annual wind speed (m/sec)	not used	2.000E+00	---	WIND
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)

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1.00 square meters	Sr-90	1.000E+01
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00
TDOSE(t):	6.931E-02	6.694E-02
M(t):	4.621E-03	4.463E-03

Maximum TDOSE(t): 6.931E-02 mrem/yr at t = 0.000E+00 years

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-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Sr-90	2.585E-02	0.3730	2.476E-03	0.0357	0.000E+00	0.0000	3.990E-02	0.5756	8.025E-04	0.0116	2.386E-04	0.0034	4.188E-05	0
Total	2.585E-02	0.3730	2.476E-03	0.0357	0.000E+00	0.0000	3.990E-02	0.5756	8.025E-04	0.0116	2.386E-04	0.0034	4.188E-05	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 = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.931E-02	1
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	6.931E-02	1

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Sr-90	2.497E-02	0.3730	2.391E-03	0.0357	0.000E+00	0.0000	3.853E-02	0.5756	7.750E-04	0.0116	2.304E-04	0.0034	4.045E-05	0
Total	2.497E-02	0.3730	2.391E-03	0.0357	0.000E+00	0.0000	3.853E-02	0.5756	7.750E-04	0.0116	2.304E-04	0.0034	4.045E-05	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

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.694E-02	1
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	6.694E-02	1

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Branch Fraction	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00
Sr-90	Sr-90	1.000E+00	6.931E-03	6.694E-03

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00
Sr-90	2.164E+03	2.241E+03

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

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Sr-90	1.000E+01	0.000E+00	6.931E-03	2.164E+03	6.931E-03	2.164E+03

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00
Sr-90	Sr-90	1.000E+00	6.931E-02	6.694E-02

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00
Sr-90	Sr-90	1.000E+00	1.000E+01	9.658E+00

BRF(i) is the branch fraction of the parent nuclide.

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ATTACHMENT 7

Thorium 232 (Th-232)
In Secular Equilibrium With
Thorium 228 (Th-228) and Radium 228 (Ra-228)

Release Criteria: 100 picoCurie/gram
Dose Rate: 133 milliRem/year

Dose Rate of 15 milliRem/year
Thorium 232: 48 picoCurie/gram
Thorium 228: 23 picoCurie/gram
Radium 228: 23 picoCurie/gram

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(1)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(2)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(3)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(1)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(2)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(3)
D-34	Food transfer factors:			
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(1,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(2,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(1,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(1,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(2,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(2,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(3,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(3,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+00	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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): Ra-228	1.000E+02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Th-228	1.000E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Th-232	1.000E+02	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(3)
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)	1.500E+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 effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+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)	1.000E+01	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+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	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.747E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.556E-06	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.556E-06	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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
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)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	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)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+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-03	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E-04	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E-04	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
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	---	FLOOR
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 annual wind speed (m/sec)	not used	2.000E+00	---	WIND
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)

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1.00 square meters	Ra-228	1.000E+02
Thickness:	1.00 meters	Th-228	1.000E+02
Cover Depth:	0.00 meters	Th-232	1.000E+02

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00
TDOSE(t):	1.333E+02	1.331E+02
M(t):	8.884E+00	8.870E+00

Maximum TDOSE(t): 1.333E+02 mrem/yr at t = 0.000E+00 years

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-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Ra-228	3.596E+01	0.2699	9.601E-02	0.0007	0.000E+00	0.0000	4.990E-01	0.0037	1.433E-03	0.0000	1.767E-03	0.0000	3.942E-03	0
Th-228	5.914E+01	0.4438	6.521E+00	0.0489	0.000E+00	0.0000	6.952E-03	0.0001	1.411E-05	0.0000	1.027E-06	0.0000	2.212E-03	0
Th-232	3.954E-03	0.0000	3.100E+01	0.2326	0.000E+00	0.0000	2.379E-02	0.0002	4.889E-05	0.0000	3.487E-06	0.0000	7.473E-03	0
Total	9.511E+01	0.7137	3.761E+01	0.2822	0.000E+00	0.0000	5.298E-01	0.0040	1.496E-03	0.0000	1.771E-03	0.0000	1.363E-02	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 = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.657E+01	0
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.567E+01	0
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.103E+01	0
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	1.333E+02	1

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Ra-228	4.856E+01	0.3649	1.940E+00	0.0146	0.000E+00	0.0000	4.454E-01	0.0033	1.285E-03	0.0000	1.560E-03	0.0000	4.107E-03	0
Th-228	4.116E+01	0.3094	4.539E+00	0.0341	0.000E+00	0.0000	4.839E-03	0.0000	9.822E-06	0.0000	7.146E-07	0.0000	1.540E-03	0
Th-232	5.179E+00	0.0389	3.113E+01	0.2339	0.000E+00	0.0000	8.092E-02	0.0006	2.140E-04	0.0000	2.043E-04	0.0000	7.961E-03	0
Total	9.490E+01	0.7132	3.761E+01	0.2826	0.000E+00	0.0000	5.311E-01	0.0040	1.509E-03	0.0000	1.765E-03	0.0000	1.361E-02	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

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathw	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	f
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.095E+01	0
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.571E+01	0
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.640E+01	0
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	1.331E+02	1

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Branch Fraction	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00
Ra-228	Ra-228	1.000E+00	3.657E-01	3.226E-01
Ra-228	Th-228	1.000E+00	0.000E+00	1.869E-01
Ra-228	∑DSR(j)		3.657E-01	5.095E-01
Th-228	Th-228	1.000E+00	6.567E-01	4.571E-01
Th-232	Th-232	1.000E+00	3.103E-01	3.103E-01
Th-232	Ra-228	1.000E+00	0.000E+00	4.143E-02
Th-232	Th-228	1.000E+00	0.000E+00	1.223E-02
Th-232	∑DSR(j)		3.103E-01	3.640E-01

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00
Ra-228	4.102E+01	2.944E+01
Th-228	2.284E+01	3.282E+01
Th-232	4.834E+01	4.121E+01

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

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ra-228	1.000E+02	1.000E+00	5.095E-01	2.944E+01	3.657E-01	4.102E+01
Th-228	1.000E+02	0.000E+00	6.567E-01	2.284E+01	6.567E-01	2.284E+01
Th-232	1.000E+02	1.000E+00	3.640E-01	4.121E+01	3.103E-01	4.834E+01

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00
Ra-228	Ra-228	1.000E+00	3.657E+01	3.226E+01
Ra-228	Th-232	1.000E+00	0.000E+00	4.143E+00
Ra-228	∑DOSE(j):		3.657E+01	3.640E+01
Th-228	Ra-228	1.000E+00	0.000E+00	1.869E+01
Th-228	Th-228	1.000E+00	6.567E+01	4.571E+01
Th-228	Th-232	1.000E+00	0.000E+00	1.223E+00
Th-228	∑DOSE(j):		6.567E+01	6.562E+01
Th-232	Th-232	1.000E+00	3.103E+01	3.103E+01

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00
Ra-228	Ra-228	1.000E+00	1.000E+02	8.822E+01
Ra-228	Th-232	1.000E+00	0.000E+00	1.133E+01
Ra-228	∑S(j):		1.000E+02	9.955E+01
Th-228	Ra-228	1.000E+00	0.000E+00	2.846E+01
Th-228	Th-228	1.000E+00	1.000E+02	6.961E+01
Th-228	Th-232	1.000E+00	0.000E+00	1.861E+00
Th-228	∑S(j):		1.000E+02	9.993E+01
Th-232	Th-232	1.000E+00	1.000E+02	1.000E+02

BRF(i) is the branch fraction of the parent nuclide.

ATTACHMENT S1-C

RESPONSE TO DEPARTMENT OF HEALTH SERVICES COMMENTS ON RESPONSE TO AGENCY COMMENTS ON THE DRAFT FINAL PARCEL E REMEDIAL INVESTIGATION, DATED MARCH 6, 1998, AND DETERMINATION DISCUSSION OF ACCEPTABLE CONCENTRATIONS OF RESIDUAL RADIOACTIVITY CONTAMINATION AT HUNTERS POINT SHIPYARD

(4 Pages)

RESPONSE T0 DEPARTMENT OF HEALTH SERVICES COMMENTS ON RESPONSE TO AGENCY COMMENTS ON THE DRAFT FINAL PARCEL E REMEDIAL INVESTIGATION, DATED MARCH 6, 1998, AND DETERMINATION DISCUSSION OF ACCEPTABLE CONCENTRATIONS OF RESIDUAL RADIOACTIVITY CONTAMINATION AT HUNTERS POINT SHIPYARD

This document presents the U.S. Department of the Navy's (Navy) responses to comments from the Department of Health Services (DHS) in conjunction with the Department of Toxic Substances Control (DTSC) on the following documents: March 6, 1998, draft of Appendix S1-1, response to agency comments on the draft final Parcel E remedial investigation Hunters Point Shipyard (HPS), pages S1-34 through S1-37, response to comments from DHS (DHS's comments from review of Appendix E with Attachments E1 and E1-1, and Appendix P with Attachments P1 through P5 of "Parcel E Remedial Investigation Draft Report, Hunters Point Shipyard, San Francisco, California", May 29, 1997), and review of Attachment S1-B, "Determination of Discussion of Acceptable Concentrations of Residual Radioactivity Contamination at Hunters Point Shipyard." These comments have been addressed with the input and approval from Naval Radiological Affairs Support Office (RASO).

RESPONSE TO COMMENTS FROM NAVY

General Comments

1. **Comment:** **The Navy's responses to DHS' comments appear adequate at this time. Additional review of and participation in the future remediation and confirmation sampling or verification surveys of Parcel E by DHS is anticipated and should be coordinated through DTSC.**

   Response: Comment noted. The Navy will keep DTSC informed so that they may participate in future remediation and confirmation sampling or verification surveys of radiation sites at Parcel E.

2. **Comment:** **The State of California, DHS' minimum requirements for release of site for unrestricted use are as follows**

   a. **that the site is suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20.1402, Subpart E; (This would allow release of a site for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent to an average member of a critical group that does not exceed 25 millirem per year (mrem/yr) and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)).**

   b. **that all discrete radioactive sources have been removed; and**

c. **that Ra-226 concentrations above background must not exceed 5 picocuries per gram (pCi/g) after remediation to ALARA levels.**

Response: The Navy understands that DHS requirements are based on Federal applicable or relevant and appropriate requirements (ARAR) and that there are no specific state ARARs (other than those promulgated for compatibility with U.S. Nuclear Regulatory Commission [NRC] requirements) related to residual radioactivity. It is the Navy's understanding that the use of U.S. Department of Energy's RESRAD program for modeling residual radioactivity is acceptable to the State.

a. The comment is noted by the Navy.

b. The comment is noted by the Navy.

c. The Navy will address the conflicting requirements of potential ARARs 10 Code of Federal Regulations (CFR) 20, "Standards For Protection Against Radiation," and 40 CFR 192, "Health And Environmental Protection Standard For Uranium And Thorium And Thorium Mill Tailings" (the basis for 5 picoCuries per gram [pCi/g] numerical goal) in the Comprehensive Environmental Response, Compensation, and Liability Act remedy selection process decision documents. This will be done on a case-by-case basis based upon the particular circumstances of the site. It is the Navy's understanding that for HPS Parcel E, DHS prefers to use 40 CFR 192 rather than 10 CFR 20 as the ARAR.

3. **Comment:** **Additional clarifications and explanations are needed before DHS can agree to the concentration limits contained in Attachment S1-B, Determination Discussion of Acceptable Concentration of Residual Radioactivity Contamination at Hunters Point Shipyard. The reviewer did not try to follow the RESRAD calculation data sheets included with this packet, as many of the sheets were illegible and to avoid wasting time reviewing this of the parameters of this model need to be readjusted. The following are some of the areas which require further clarification of explanations:**

a. **An assessment of how 10 microrem per hour (μrem/hr) above background outdoors and 5 μrem/hr indoors for cesium-137, cobalt-60 and europium-152 compare to the requirements listed in General Comment 2 above. The dose rates found in the table on Page S1-B-3 do not appear to meet the State's criteria for release for unrestricted use.**

b. **The draft NUREG-1500 has been replaced with U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide DG-4006 and NUREG 1549. The concentrations of radionuclides found in draft NUREG 1500 to correspond to a 15 mrem/yr dose are questionable as they have not been verified. As such, they would only show the maximum concentration allowable after ALARA for a particular radionuclide if it were found alone. If other radionuclides were present they would all contribute to the dose. An assessment of how the all the**

different radioisotopes present meet the requirements listed in General Comment 2 above would be necessary.

c. **This discussion should clearly demonstrate and justify the State's requirements, outlined in General Comment 2, for release for unrestricted use are met.**

Response: Tetra Tech EM Inc. has directly forwarded a legible copy of the report to Ms. Deirdre Dement at DHS. The model parameters used were the RESRAD default parameters, except those for the source area and the depth of source. The default parameters were used to be compatible with the NRC comparison study cited. The Navy welcomes any DHS suggestions as to alternative model parameters for this analysis.

a. It is the Navy's understanding that 5 microrems per hour (μrem/hr) is generally acceptable to the State for demonstrating that residual radioactivity requirements have been met at commercial sites licensed under DHS license. The criteria were proposed based on extant NRC guidelines as cited. As stated on page S1-B-3, the Navy proposed these hourly external dose rate values in addition to demonstration that volumetric concentrations (based on sampling) meet the numerical dose limit criteria. Therefore, they are only supplemental in nature and should not require rigorous justification. Secondly, the Navy proposed using an alternative value acceptable to DHS based on the numerical limit.

   With regard to the table in Attachment S1-B, the concentration values would be proportionately adjusted so that the concentrations corresponded to exactly 25 mrem/yr. The following table shows the new asphalt and concrete concentration criteria for nuclides of interest:

Nuclide	Area (m^2)	Concentration (pCi/g)	Dose (mrem/yr)
Cesium-137	1	125	25
	100	16	25
Cobalt-60	1	26	25
	100	0.3	25
Strontium-90	1	4,167	25
	100	60	25
Thorium-232	1	19	25

b. NUREG 1500 values were only provided for comparison. If multiple radionuclides were present, the Navy would evaluate their presence in accordance with the general methods outlined in Multi-Agency Radiation Survey and Site Investigation Manual and either evaluate using the sum of the fractions rule, or provide a specific dose calculation.

c. The Navy will meet 10 CFR 20 where unrestricted release is sought. The Navy would like to resolve any deficiencies in model parameters at DHS's earliest convenience. Final dose assessment calculations will be included in any removal action final reports.