Response to
PSR-LA Petition & Complaint
Superior Court of California
Case No. 34-2013-80001589

Phil Rutherford

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GLOSSARY

AF	Area Factor
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
AOC	Administrative Order on Consent
APTF	Advanced Power Test Facility
BEIR	Biological Effects of Ionizing Radiation
BPRG	Building Preliminary Remediation Goal
BRC	Below Regulatory Control
BTV	Background Threshold Value
CBG	Committee to Bridge the Gap
CDM	Camp, Dresser & McKee
CFR	Code of Federal Regulations
cm	Centimeter
CoC	Contaminant of Concern
cpm	Counts per minute
CRPE	Center for Race, Poverty, and the Environment
CTL	Component Test Laboratory
DCGL	Derived Concentration Guideline
D&D	Decontamination and Decommissioning
DECON	(RHB) Decontamination Guide
DHS	(California) Department of Health Services
DOE	(US) Department of Energy
DPH	(California) Department of Public Health
dpm	Disintegrations per minute
DQO	Data Quality Objectives
DTSC	(California) Department of Toxic Substances Control
ECL	Engineering Chemical Laboratory
ELCR	Excess Lifetime Cancer Risk
EPA	(US) Environmental Protection Agency
ESADA	Empire State Atomic Development Authority
ETEC	Energy Technology Engineering Center
FC	Fuel Cycle (NRC Division of Fuel Cycle and Material Safety Guidance Documents)
FRC	Federal Radiation Council (Defunct)
GM	Geiger-Mueller (detector)
HPS	Health Physics Society

H&S	Health and Safety
HWMF	Hazardous Waste Management Facility
IPM	(RHB) Internal Policy Memorandum
K	Efficiency
L_C	Critical level (decision level)
L_D	Detection level
LET	Linear Energy Transfer
LLD	Lower Limit of Detection
LOD	Limit of Detection
LLRW	Low-level radioactive waste
MARSSIM	Multi-agency Radiation Survey and Site Investigation Manual
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
mrem/y	millirem per year
NaI	Sodium Iodide (detector)
NASA	(US) National Aeronautics and Space Administration
NORM	Naturally Occurring Radioactive Material
NRC	(US) Nuclear Regulatory Commission
NRDC	Natural Resources Defense Council
NUREG	NRC Guidance Document Series
OSWER	(EPA) Office of Solid Waste and Emergency Response
OV	Oversight Verification
pCi/g	Picocuries per gram
PRG	Preliminary Remediation Goal
R.G.	Regulatory Guide
RHB	Radiologic Health Branch
RMHF	Radioactive Materials Handling Facility
RRC	Radiological Reference Concentration
RTL	Radiological Trigger Level
SA	Surface Activity
SB	Senate Bill
SNAP	Systems for Nuclear Auxiliary Power
SSFL	Santa Susana Field Laboratory
SPTF	Sodium Pump Test Facility
STP	Sewage Treatment Plant

TEDE	Total Effective Dose Equivalent
UCLA	University of California, Los Angeles
U	Flag used by radiochemistry laboratories to indicate not detected above MDA
US	United States
ZnS	Zinc Sulphide (scintillation detector)

REVISION STATUS

This white paper was originally prepared in November 2013. Since then, several situations have developed that required updates to the original paper. These updates are itemized below.

1. DOE, DTSC and EPA periodically reorganize their websites. As a result, some of the original URL links to content on these websites cited in the footnotes become inactive. These have been updated.

2. New URLs have also been added to some existing footnote citations that did not previously have a linked URL.

3. On August 12, 2016, the NRC withdrew Regulatory Guide 1.86. The consequence of this regulatory action is discussed in a new Appendix A.

4. ANSI/HPS N13.12-1999 was revised in May 2013, becoming ANSI/HPS N13.12-2013. The changes in the standard are discussed in a new Appendix B.

5. Testimony by a CDPH/RHB official during legal proceedings stated that several internal RHB policies had been withdrawn. These withdrawals are discussed in a new Appendix C.

6. A new Appendix D addresses statements made in two 2018 declarations by Plaintiff's expert witness, Dr. Bemnet Alemayehu.

7. The original Table 1 provided gross surface activity levels (in counts per minute) measured in Area I, III, IV and an off-site West Hills residence. This data has been shown graphically in a new Figure 1.

8. In April 2002 DOE issued DOE G 441.1-XX (Draft), "Control and Release of Property with Residual Radioactive Material." In March 2023, DOE issued a final version as a DOE technical standard, DOE-STD-1241-2023, "Implementing Release and Clearance of Property Requirements." Appendix E discusses the release and clearance limits adopted in this standard.

9. The radiation survey of an off-site West Hills residence is provided in Appendix F.

The original response (dated November 20, 2013), the added Appendices A, B, C and D (dated March 15, 2021), Appendix E (dated May 20, 2023) and Appendix F (dated September 4, 2013) of the revised response (dated May 20, 2023) represent the views and opinions of the author, and do not necessarily reflect the views and opinions of The Boeing Company.

EXECUTIVE SUMMARY

This paper represents the views and opinions of the author and does not necessarily reflect the views and opinions of The Boeing Company.

This document responds to the "Verified Petition for Writ of Mandate and Complaint for injunctive and Declaratory Relief" ("Complaint")[1] and the associated report entitled, "Demolition of Radioactive Structures and the Disposal and Recycling of the Debris from the Santa Susana Field Laboratory Nuclear Area and the Role Played by the California Department of Toxic Substances Control and The California Department of Public Health" ("Hirsch Report").[2]

Much of the Complaint and Hirsch Report focuses on "background", with the implication that anything "above background", is contaminated, unsafe, and is, by definition, low-level radioactive waste, that should be disposed of at licensed low-level radioactive waste facilities. All assertions are incorrect. The Complaint and Hirsch Report answer the question of "how safe is safe?" and "how clean is clean?", with the answer "only zero is acceptable." This answer is at variance with federal and state regulatory practice. No federal or state regulation or guidance that is designed to protect the public and environment is based on a zero threshold. All are based on meeting low risk, low dose, acceptably safe levels. This applies to both chemicals and radioactive materials.

The Complaint is also at variance with California's Executive Order D-62-02. In 2002, one of the petitioners (Committee to Bridge the Gap) attempted to pass Senate Bill SB 1970 (Romero) that would have redefined radioactive waste in the same way that this Complaint attempts to do. Governor Davis vetoed the Bill and enacted D-62-02, allowing decommissioned material to be sent to Class 1 or 2 landfills. D-62-02 states, *"the Federal Nuclear Regulatory Commission has determined that residual radioactive material below twenty-five millirems poses no significant*

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[1] "Verified Petition for Writ of Mandate and Complaint for Injunctive and Declaratory Relief", Petitioners, Physicians for Social Responsibility - Los Angeles, Southern California Federation of Scientists, Committee to Bridge the Gap and Consumer Watchdog. Respondents, Department of Toxic Substances Control and Department of Public Health. Real Party In Interest, The Boeing Company. Superior Court of California - County of Sacramento. August 6, 2013.
https://www.philrutherford.com/SSFL/boeing_building_demolition/Consumer_Watchdog_Complaint_8-6-13.pdf

[2] Hirsch & Miska, CBG, "Demolition of Radioactive Structures and the Disposal and Recycling of the Debris from the Santa Susana Field Laboratory Nuclear Area and the Role Played by the California Department of Toxic Substances Control and The California Department of Public Health", August 5, 2013.
https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/2694828867/CBG%20Report%20%26%20Documents_Part1%20of%202.pdf (Part 1 of 2)
https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/7229904651/CBG%20Report%20%26%20Documents%20Part%202%20of%202.pdf (Part 2 of 2)

risk to public health" and *"no other state or the federal government monitors the disposal of residual radioactive materials once a site is decommissioned and released for unrestricted use."* The DTSC has imposed strict requirements on Boeing's demolition program. It reviews voluminous data associated with each demolition, it consults with the CDPH and USEPA, it then issues letters describing its review and assessment, thereby concurring with Boeing's proposal to proceed with demolition and disposal. DTSC oversees this process every step of the way. Boeing does not proceed with demolition until this process is completed.

Typical statements from DTSC in its concurrence letters include the following (extracted from the Water Tank concurrence letter).[3]

> *"Based on a review by DTSC staff qualified in nuclear health physics (see the attached memorandum), it was determined that the radiological screening of accessible portions of the Water Tanks, as reported, was performed to accepted regulatory and industry standards. It was also determined that the resulting data is adequate to conclude that fixed and removable radionuclide contaminants are not present above background activity levels in structures or demolition materials that have been identified for disposal and recycling. Consequently, the portions of the tanks and supporting structures which have been screened are deemed appropriate for release and recycling."*

> *"DTSC's consultation with California Department of Public Health confirmed that the Tanks are classified as Non-Radiological structures under the Multi-Agency Radiation Survey and Site Investigation Manual. DTSC also discussed the radiological screening methods used at the sites with US EPA staff, in order to evaluate their adequacy and applicability."*

> *"The documents indicate that the survey instruments used-Ludlum 2224 survey meter plus Ludlum 43-89 plastic scintillator probe for alpha and beta/gamma total surface activity, Bicron microRem meter for gamma exposure rate, and Tennelec alpha/beta counter in laboratory-were in calibration and appropriate for use with adequate sensitivity to accurately measure values below US NRC Regulatory Guide 1.86/DOE Order 5400.5 action levels. The majority of instrument surface activity measurements and wipe tests were below the detection limit, the level at which there is a 5% probability of incorrectly concluding that no activity is present when it is indeed present. The majority of surface activity measurements met the most restrictive regulatory surface activity limits for release/clearance of equipment and materials for unrestricted use from former*

[3] Letter from Paul Carpenter (DTSC) to Arthur Lenox (Boeing), "DTSC Review of Notification Package for Planned Demolition of Abandoned Water Tanks 812 and 851, Boeing, Santa Susana Field Laboratory, Ventura County, California", November 6, 2012. Memorandum from Valerie Chenoweth-Brown (DTSC) to Paul Carpenter (DTSC), "Comments on Notification of Planned Demolition for Water Storage Tanks, No. 812 and No. 851, Area IV, Boeing Santa Susana Field Laboratory, Ventura County, California. November 1, 2012. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/66197_WATER-TANK-COMMENTS.pdf

radiological facilities. All surface activity measurements were below US NRC Regulatory Guide 1.86, USDOE Order 5400.5 and CDPH guidance DECON-1 and IPM-88-2 action levels."

"The Water Tanks, Area IV Radiological Release Survey and Waste Certification Preliminary Data indicates the post-demolition debris is certified to be radiologically acceptable for off-site disposal and/or recycling and the waste from the demolition project meets the requirements of disposal facility permits and complies with the California Health & Safety Code. Survey results support this conclusion."

1.0 RESPONSE TO PETITION AND COMPLAINT

On August 6, 2013, Petitioners filed a Complaint[4] against the California Department of Toxic Substances Control (DTSC) and the California Department of Public Health (DPH) challenging defendants' authorizations to The Boeing Company (Boeing) to demolish and dispose of structures in Area IV of the Santa Susana Field Laboratory. The following responds to key allegations in the Complaint.

1.1 Complaint, Paragraph 4. Health Based Risk Standards

Petitioners allege that *"there is no existing legally valid health-based risk standard that permits the disposal of any level of radioactively contaminated material to a facility that is not licensed to receive radioactive waste."*

In 1996, the Department of Energy (DOE) and the CDPH/RHB approved release criteria for radiological facilities at SSFL. These were published in N001SRR140131, "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL."[5] Release criteria for building structures were based on then current DOE Order 5400.5[6], which were identical to those used by the USNRC in Regulatory Guide 1.86[7] and the CDPH/RHB in DECON-1.[8] N001SRR140131 was referenced as license condition 13(o) of the then current Amendment 112 of Boeing's Radioactive Materials License 0015-19 for SSFL.[9] DOE 5400.5 has since been superseded by DOE Order 458.1 which allows for prior existing approved limits such as surface

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[4] "Verified Petition for Writ of Mandate and Complaint for Injunctive and Declaratory Relief", Petitioners, Physicians for Social Responsibility - Los Angeles, Southern California Federation of Scientists, Committee to Bridge the Gap and Consumer Watchdog. Respondents, Department of Toxic Substances Control and Department of Public Health. Real Party In Interest, The Boeing Company. Superior Court of California - County of Sacramento. August 6, 2013.
https://www.philrutherford.com/SSFL/boeing_building_demolition/Consumer_Watchdog_Complaint_8-6-13.pdf

[5] N001SRR140131, "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL", Page 14, Section 4, Table 5. February 18, 1999. https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf

[6] DOE Order 5400.5, "Radiation Protection of the Public and the Environment", Chapter IV, Figure IV-1. January 7, 1993. https://www.directives.doe.gov/directives-documents/5400-series/5400.05-BOrder-c2

[7] US Nuclear Regulatory Commission, Regulatory Guide 1.86, "Termination of Operation Licenses for Nuclear Reactors", June 1974. https://pbadupws.nrc.gov/docs/ML0037/ML003740243.pdf

[8] CDPH Radiologic Health Branch, DECON-1, "Guidelines for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use", https://www.philrutherford.com/SSFL/boeing_building_demolition/DECON-1.pdf

[9] Amendment 112, Radioactive Materials License 0015-19, License Condition 13(o), July 9, 2013.
https://www.philrutherford.com/SSFL/boeing_building_demolition/0015-19_Amendment_112.pdf

contamination limits … *"Previously approved guidelines and limits (such as the surface activity guidelines) may continue to be applied and used as Pre-Approved Authorized Limits until they are replaced or revised by Pre-Approved Authorized Limits issued under this Order."* (Section 2.k.(6).(f).1.b of the Contractor requirements Document).[10]

More recent industry guides (e.g., ANSI and USNRC), that have assessed the effective dose rate from potentially surface contaminated materials, have shown that release criteria based on Regulatory Guide 1.86 limits ensure low doses, at or below 1 mrem per year. The majority of historical and current instrument surface activity measurements and wipe tests are non-detect (i.e., less than the minimum detectable activity (MDA)) and are therefore indistinguishable from background. The dose from any resulting post-demolition solid debris would therefore be zero mrem per year. A small percentage of measurements exceed detection levels. However, this is not an indication of "contamination", but merely reflects the fact that detection levels are established at the 95% level (so one should expect a small number of detects above MDA) and it is not always possible to accommodate the wide variability of natural background in the numerous different types of building materials. If it were conservatively assumed that all building structural debris was actually contaminated at the MDA levels, then the effective dose would be much less than 1 mrem per year since MDAs are always much less than the more limiting dose-based criteria of the cited guidelines.[11,12]

Current surveys for both non-radiological and radiological facilities continue to use current surface activity limits based on USNRC, DOE and CDPH/RHB guidance for release/clearance of equipment and material for unrestricted use from former radiological facilities.[13,14,15]

[10] DOE Order 458.1. Change 3. "Radiation Protection of the Public and the Environment", January 15, 2013. https://www.directives.doe.gov/directives-documents/400-series/0458.1-BOrder-chg3-admchg/@@images/file

[11] ANSI/HPS N13.12-1999. "Surface and Volume Radioactivity Standards for Clearance." American National Standards Institute/Health Physics Society, 1999. The most limiting beta/gamma screening value is 6,000 dpm/100 cm^2 corresponding to a dose of 1 mrem per year. The most limiting alpha screening value is 600 dpm/100 cm^2 corresponding to a dose of 1 mrem per year. A subsequent revision of this standard in 2013 has revised screening values for some radionuclides. Appendix B summarizes and compares screening values for all both versions of this standard to Reg. Guide 1.86.

[12] NUREG-1640. "Radiological Assessments for Clearance of Materials from Nuclear Facilities." Nuclear Regulatory Commission, June 2003. The most restrictive beta/gamma dose conversion from Volume 1, Table 2.1 is 0.16 µrem/y per dpm/100 cm^2. This corresponds to 0.8 mrem/y per 5,000 dpm/100 cm^2. https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1640/

[13] (a) U.S. Nuclear Regulatory Commission Regulatory Guide 1.86. "Termination of Operating Licenses for Nuclear Reactors." June 1974. https://pbadupws.nrc.gov/docs/ML0037/ML003740243.pdf
(b) U.S. NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," April 1993. https://www.nrc.gov/docs/ML1036/ML103620647.pdf

USEPA utilized Regulatory Guide 1.86 limits for its release of equipment and material during its Area IV Radiological Survey.[16] CDM Smith's radiological survey plan[17] for the remaining DOE-owned building in Area IV likewise utilizes release criteria based on Regulatory Guide 1.86.

In a recent confirmation survey conducted for building 4100, the CDPH compared their own measurements to the generic limits (total 5,000 dpm/100 cm^2 and 1,000 dpm/100 cm^2 removable) of Reg. Guide 1.86 limits to determine that the facility could be released for unrestricted use.[18]

1.2 Complaint, Paragraph 4. Release Criteria

Petitioners allege *"Standards were developed 40 years ago to facilitate the reuse of former radiological facilities, not their demolition and disposal."*

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[14] (a) U.S. Department of Energy Order 458.1, "Radiation Protection of the Public and Environment", Attachment 1, Section 2.k.(6).(f).1.b, Change 3, January 15, 2013.
https://www.philrutherford.com/Radiation_Cleanup_Standards/DOE_O_458.1_Change_3_2013-01-15.pdf#page=65
(b) U.S. Department of Energy Memorandum from Sally Robison to Roger Liddle, "Site-wide Limits for Release of Facilities without Radiological Restriction", September 17, 1996.
https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf#page=28
(c) U.S. Department of Energy Draft Guide DOE G 441.1-XX. "Control and Release of Property with Residual Radioactive Material." Table 2. April 4, 2002. https://www.energy.gov/sites/prod/files/2014/03/f13/doe441.1-xx_0.pdf#page=32

[15] (a) California Department of Public Health. DECON-1. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use."
https://www.philrutherford.com/Radiation_Cleanup_Standards/DECON-1.pdf
(b) California Department of Public Health Letter from Gerard Wong to Majelle Lee, "Authorized Site-wide Radiological Guidelines for Release for Unrestricted Use", August 9, 1996.
https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf#page=27
(c) California Department of Public Health, IPM-88-2. "Clearance Inspection and Survey." December 1, 1997.
https://www.philrutherford.com/Radiation_Cleanup_Standards/IPM-88-2.pdf

[16] Hydrogeologic Inc., "SSFL Field Operating Procedure 3.09 - Release of Potentially Radioactive Equipment", Section 1.7.3 and Appendix A - Contamination Release limits. December 2010.
https://www.philrutherford.com/SSFL/boeing_building_demolition/HGL_SSFL_FOP_3.09.pdf

[17] CDM Smith, "Radiological Survey Plan for Buildings and Consolidated Materials within Area IV of SSFL", Health Physics Procedure HP-03 - Radiological Limits, Section 6.3.2 - Surficial Contamination Limits, and Attachment 1. Regulatory Guide 1.86 Surface Contamination Limits. September 2011.
https://www.philrutherford.com/SSFL/boeing_building_demolition/SSFL_Building_Rad_Survey_Plan_Sept_2011_Draft.pdf

[18] CDPH, "Radiological Assessment Unit, Confirmation Survey, Santa Susana Field Laboratory, Area IV, Building 4100, Rooms 112, 113, 114 and Annex", Appendix A, Release Criteria, July 27, 2013. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/DTSC_demo_workplan_B4100.pdf#page=295-346.

Far from being "underground regulations', these standards have been, and are being, used industry-wide to decommission and release for unrestricted use former radiological facilities and remove them from federal and state licenses. Demonstration that these surface contamination limits are met assures that dose from waste disposal is less than 1 mrem/ y. This is less than the NRC 25 mrem/y limit for license termination for building re-use. Removing regulatory controls from a former radiological facility means that there are no further radiological controls irrespective of future use or demolition or disposal. It is obvious that any potential exposure pathways from residual radioactivity from human re-use scenarios will exceed any potential exposure pathways from disposal to a landfill.

1.3 Complaint, Paragraph 12. Reasonable Efforts

Petitioners correctly state that *CDPH "is not to approve cleanup unless a reasonable effort has been made to eliminate contamination."*

Boeing (and previously Rockwell International) has made "reasonable efforts" to decontaminate and decommission (D&D) radiological facilities in Area IV, as documented in final D&D reports, final status survey reports, and the numerous multi-agency confirmation surveys.[19]

1.4 Complaint, Paragraph 29. Low Level Radioactive Waste

Petitioners state, *"State law defines low-level radioactive waste as all regulated radioactive material that is not high-level radioactive waste or subject to other exceptions not applicable here; there is no floor beneath which radioactive material is not subject to regulation as low-level radioactive waste."*

When state or federal agencies release a facility for unrestricted use, that means that the agency has determined that no residual contamination remains that would result in an unacceptable hazard or risk to the public. It means that the facility is removed from a state or federal license. It means that the building is no longer subject to any further regulatory radiological controls. It means that the building can be used for any other non-radiological purpose. And it means that the building could be demolished, and waste debris is subject to no further radiological controls. A potential residual contamination that may be present is no longer "regulated radioactive material" and is therefore NOT low-level radioactive waste.

The reference to "no floor" is preposterous. No federal or state regulation that is designed to protect the public and environment is based on a zero threshold. All are based on meeting low risk, acceptably safe, levels. This applies to both chemicals and radioactive materials. For radioactive materials, this includes, the USEPA drinking water maximum contaminant levels

[19] DOE ETEC Web Site, "Clean-up at the Santa Susana Field Laboratory. DOE's Responsibility at Area IV." Major Radiological Operations Timeline. https://www.etec.energy.gov/Operations/Rad_Timeline.php

(MCL)[20] based on 4 mrem/y, the USEPA airborne release limits[21] based on 10 mrem/y, the USNRC license termination dose[22] of 25 mrem/y, the USNRC public dose limit from operating nuclear facilities[23] of 100 mrem/y, USNRC regulations specifying air, water and sewerage effluent limits[24], based on 50 mrem/y, USNRC license-exempt articles,[25] USNRC license-exempt quantities,[26] USNRC license-exempt concentrations,[27] USNRC unimportant quantities of source material,[28] and USEPA preliminary remediation goals[29] based on an acceptable risk[30] range of 10^{-6} to 10^{-4}.

The California Health & Safety Code does not impose a zero threshold for disposal but instead states *"No person shall bury, throw away, or in any manner dispose of radioactive wastes within*

[20] USEPA National Primary Drinking Water Regulations (Radionuclides).
https://www.epa.gov/dwreginfo/radionuclides-rule

[21] USEPA, 40 CFR 61.92, National Emission Standards for Hazardous Air Pollutants (Radionuclides).
https://www.govinfo.gov/content/pkg/CFR-2011-title40-vol8/xml/CFR-2011-title40-vol8-part61.xml#seqnum61.92

[22] USNRC, 10 CFR 20.1402, Radiological Criteria for Unrestricted Use.
https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1402.html

[23] USNRC, 10 CFR 20.1301, Radiation Dose Limits for Individual Members of the Public,
https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1301.html

[24] USNRC, 10 CFR 20 Appendix B, Appendix B to Part 20—Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage, https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-appb.html

[25] USNRC, 10 CFR 30.15, Certain [Exempt] Items Containing By-product Material, https://www.nrc.gov/reading-rm/doc-collections/cfr/part030/part030-0015.html

[26] USNRC, 10 CFR 30.18 and 30.71 Schedule B, Exempt Quantities.
https://www.nrc.gov/reading-rm/doc-collections/cfr/part030/part030-0018.html
https://www.nrc.gov/reading-rm/doc-collections/cfr/part030/part030-0071.html

[27] USNRC, 10 CFR 30.14 and 30.70 Schedule A, Exempt Concentrations, https://www.nrc.gov/reading-rm/doc-collections/cfr/part030/part030-0070.html

[28] USNRC, 10 CFR 40.13, Unimportant Quantities of Source Material, https://www.nrc.gov/reading-rm/doc-collections/cfr/part040/part040-0013.html

[29] USEPA, Preliminary Remediation Goals for Radionuclides. https://epa-prgs.ornl.gov/radionuclides/

[30] Acceptable risk is defined in EPA's OSWER 9355.0-30, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions", April 22, 1991. https://semspub.epa.gov/work/02/114039.pdf

the state except in a manner and at locations as will result in no significant radioactive contamination of the environment."[31]

1.5 Complaint, Paragraph 30. Below Regulatory Control

Notwithstanding Petitioners statements about the NRC's failed "below regulatory control (BRC)" policy, all environmental, and specifically radiation regulations, are based on acceptably low dose or risk levels. See previous response to Complaint Paragraph 29.

1.6 Complaint, Paragraph 33. Executive Order D-62-02

Petitioners' reference to Executive Order D-62-02 is relevant and supports Boeing's practice.

In 2002, then Governor Gray Davis issued Executive Order D-62-02[32] which *"impose[d] a moratorium on the disposal of decommissioned materials into Class III landfills and unclassified waste management units."* This essentially required decommissioned material to be disposed of to either a Class 1 or 2 landfill if disposed of in the state of California. Boeing has complied with this order for released former radiological facilities. All debris from former radiological buildings has been (since 2002) and will be disposed of to Class 1 landfills.

Governor Davis issued D-62-02 in response to Senate Bill SB 1970 (Romero) which he vetoed. One of the Complaint's Petitioners helped author SB 1970. In vetoing SB 1970, Governor Davis issued a press release[33] and letter to the California Senate[34] in which he stated,

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[31] Health & Safety Code, Division 104, Part 9, Chapter 5, Article 1, Section 114715, states, "No person shall bury, throw away, or in any manner dispose of radioactive wastes within the state except in a manner and at locations as will result in no significant radioactive contamination of the environment." For the purposes of this requirement, "significant" is defined in Section 114710 as amounts of radioactive materials that are likely to expose persons to ionizing radiation greater than the guide levels published by the Federal Radiation Council (FRC). The FRC no longer exists, but the applicable guide level last published by the FRC was 500 mrem per year to a member of the public. The regulatory basic dose limit to members of the public has since been lowered to 100 mrem per year. CDPH/RHB conservatively utilizes a lower dose of 1 mrem per year for purposes of defining "significant radioactive contamination."
https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=114715.&lawCode=HSC
https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=114710.&lawCode=HSC

[32] California Executive Order D-62.02. September 2002.
https://www.emcbc.doe.gov/SEB/ETEC/Browsing/Historical%20Facility%20Crosswalk/Historical%20Facility%20Crosswalk%20Documents/HWMF/HWMF/1/HWMF%20Closure%20Plan/Agency%20Correspondence/Ca%20State%20Exec%20Order%20D-62-02.pdf

[33] SB 1970 Veto Press Release. September 30, 2002.
https://www.philrutherford.com/SSFL/boeing_building_demolition/9-30-02_SB_1970_Press_Release.pdf

[34] SB 1970 Veto Letter to the California Senate. September 30, 2002.
https://www.philrutherford.com/SSFL/boeing_building_demolition/9-30-02_SB_1970_Veto_Message.pdf

> *"This bill [SB 1970] redefines the term 'radioactive waste' to include any discarded decommissioned material with the slightest trace of detectable radioactivity not attributable to background sources, and prohibits all such material from being disposed of at all existing hazardous or solid waste disposal facilities in the State of California. As written, this bill is overly broad, unworkable and would do little to significantly enhance protection of the public health."*

Governor Davis vetoed SB 1970, but as a compromise, enacted Executive Order D-62-02. Petitioners' complaint attempts to re-impose the vetoed SB 1970 on SSFL and negate Executive Order D-62-02.

Executive Order D-62-02 defines decommissioned material *as "materials with low residual levels of radioactivity that, upon decommissioning of a licensed site, may presently be released with no restrictions upon their use."*

The Order further stated*, "the Federal Nuclear Regulatory Commission has determined that residual radioactive material below twenty-five millirems poses no significant risk to public health"* and *"no other state or the federal government monitors the disposal of residual radioactive materials once a site is decommissioned and released for unrestricted use."*

Demolition debris from released former radiological facilities at SSFL is decommissioned material, and all debris from the proposed demolition of former radiological facilities, has been, and will be disposed of to Class 1 disposal sites in full compliance with D-62-02. Although D-62-02 is silent on recycling, no debris from released former radiological facilities, has been, since 2002, or will be, recycled.

Notwithstanding the baseless reasoning behind SB 1970 and the current Complaint, it is illogical to expect that licensees would expend considerable resources decommissioning a facility, getting it released for unrestricted use, getting it removed from a license and any further radiological controls, only to have activist groups say that the remaining building debris should be managed and disposed of as regulated low-level radioactive waste. What is the point in decommissioning? The Complaint, in effect, is dismissing the whole regulatory basis for decommissioning. Perhaps the Petitioners should file a complaint against the US Nuclear Regulatory Commission.

1.7 Complaint, Paragraph 34. Buttonwillow

Petitioners cite two cases where to CDPH said that the Buttonwillow Class 1 facility was not permitted to accept low-level radioactive waste.

For the reasons outlined in responses to Complaint Paragraphs 29 and 33, neither decommissioned material from released former radiological facilities nor building debris from non-radiological buildings that meets state and federal release criteria, is regulated radioactive material or low-level radioactive waste.

1.8 Complaint, Paragraph 38. USEPA Area IV Survey

Petitioners juxtapose separate and unrelated statements by EPA in a blatant attempt to misinform the court.

No statement in any EPA Area IV survey reports documenting levels of contamination above background stated that *"exposure to these radioactive substances <u>at the site</u> can cause cancer."* (Underline added). There is undoubtedly, general radiological information on EPA's website site that exposure to radionuclides can cause cancer with no reference to SSFL. Indeed, regarding the radiation levels and soil contamination encountered in the Area IV Survey, EPA stated,

> *"This survey resulted in the discovery of several areas of elevated radiation levels, but none of the levels recorded posed a health and safety danger to personnel."*[35]

> *"Over the course of the project no incidences of radioactive contamination above established contamination limits were detected on any equipment."*[36]

1.9 Complaint, Paragraph 38. Health Studies

Petitioners refer to the 1997 UCLA Worker Health Study that claimed alleged higher cancer rates, however they fail to mention a larger, more comprehensive, IEI Follow-on Worker Health Study, released in 2004 that concluded that *"There is no evidence that working conditions caused increased mortality in the Rocketdyne workforce*."[37]

Petitioners make non-specific references to increases of various cancers in the community, with the implication that radiation is the cause. On the contrary, numerous studies by the

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[35] EPA, "Final Gamma Radiation Scanning Report, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County, California", Section 6.1.1. October 17, 2012.
https://www.etec.energy.gov/Library/Cleanup_and_Characterization/Soil/Co-Located/2_Final%20Gamma%20Radiation%20Scanning%20Report%20101712.pdf#page=70

[36] EPA, "Final Gamma Radiation Scanning Report, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County, California", Section 7.5.5. October 17, 2012.
https://www.etec.energy.gov/Library/Cleanup_and_Characterization/Soil/Co-Located/2_Final%20Gamma%20Radiation%20Scanning%20Report%20101712.pdf#page=83

[37] Rocketdyne Worker Health Study. 2004.
https://www.etec.energy.gov/Environmental_and_Health/Documents/WorkerHealthFiles/Rocketdyne_Worker_Health_Study_Executive_Summary_July_2005.pdf

State agencies and academia have concluded unambiguously that radiation has not caused cancer in the community.[38]

California Department of Health Services[39,40]

Two studies were performed by the Environmental Epidemiology Unit of the California Department of Health Services (DHS), now renamed the Department of Public Health (DPH).

In the 1990 study, DHS concluded that, *"… these findings are consistent with random variation in cancer incidence rates."*

In the 1992 study DHS concluded that, *"These analyses suggest that people living near the SSFL are not at increased risk for developing cancers associated with radiation exposure."*

The 1992 report further observed that, *"We would expect that if community exposure to ionizing radiation were causing an elevation in cancers in this geographic area, we would see the greatest increase among those cancers known to be most strongly associated with radiation exposure. Not only is such a pattern not evident, but the very radiosensitive cancer group appears to be somewhat underrepresented in people living near the SSFL."*

[38] Boeing Factsheet. Community Cancer Studies. June 24, 2019. http://www.boeing.com/resources/boeingdotcom/principles/environment/pdf/Community_Cancer_Studies_2014.pdf

[39] Letter from William E Wright & Carin Perkins (Cancer Surveillance Section) to Robert L. Holtzer (Environmental Epidemiology and Toxicology Branch), "Cancer Incidence Rates in Five Los Angeles Census Tracts", October 10, 1990. https://www.etec.energy.gov/Environmental_and_Health/Documents/CancerStudies/DHS_Cancer_Study_1990.pdf

[40] Molly Coye and Lynn R Goldman (California Department of Health Services), "Cancer Incidence Near the Santa Susana Field laboratory", March 27, 1992. https://www.etec.energy.gov/Environmental_and_Health/Documents/CancerStudies/DHS_Cancer_Study_1992.pdf

California Department of Toxic Substances Control[41,42]

In August 1999, the Department of Toxic Substances Control (DTSC) released its report of an inquiry into the California Department of Health Services (DHS) Cancer Registry Studies. DTSC found no evidence of elevated cancer rates surrounding SSFL.

DTSC also hired an expert panel of epidemiologists to review the three previous state and county cancer studies. The expert panel concluded*, "Three studies of cancer incidence in the vicinity of SSFL were reviewed ... the combined evidence from all three does not indicate an increased rate of cancer in the regions examined. The results do not support the presence of any major environmental hazard."*

University of Michigan School of Public Health[43]

A 2007 study by the University of Michigan, School of Public Health, on cancer incidence in the community concluded that, *"The results from this study suggest little or no association between residential distance from SSFL and the incidence of all cancers or the group of (radiosensitive) malignancies thought to be affected by ionizing radiation."*

University of Southern California[44]

In 2011, Dr. Thomas Mack of the Keck School of Medicine at the University of Southern California (USC) reviewed previous community cancer incidence studies and performed a new assessment of cancer rates in census tracts surrounding SSFL. Dr. Mack presented his results and findings to the West Hills Neighborhood Council in 2011 and in a Department of Toxic Substances Control public meeting on April 9, 2014, in which he concluded,

- *"It is not possible to completely rule out any offsite carcinogenic effects from SSFL"*

[41] Department of Toxic Substances Control, "Rocketdyne Inquiry, Summary of Findings and Report", August 1999. https://www.etec.energy.gov/Environmental_and_Health/Documents/CancerStudies/Rocketdyne_Inquiry_Report.pdf

[42] Myrto Petreas, Hazardous Materials Laboratory, "Health Studies at Santa Susana Field Laboratory - Expert Panel Review", June 20, 1999.
https://www.etec.energy.gov/Environmental_and_Health/Documents/CancerStudies/ExpertPanelReport.pdf

[43] Hal Morgenstern et al (University of Michigan School of Public Health), "Cancer Incidence in the Community Surrounding the Rocketdyne Facility in Southern California", March 2007.
https://www.etec.energy.gov/Environmental_and_Health/Documents/CancerStudies/Final_Epi_Report.pdf

[44] Thomas Mack, University of Southern California, "Cancer Occurrence in Offsite Neighborhoods Near the Santa Susana Field Laboratory", April 9, 2014. https://www.dtsc-ssfl.com/files/lib_pub_involve/meeting_agendas/meeting_agendas_etc/66362_Santa_Susana_8.pdf

- *"No evidence of measurable offsite cancer causation occurring as a result of emissions from the SSFL was found"*

1.10 Compliant, Paragraph 41. USEPA Area IV Survey

Petitioners make the statement*, "In 2012, EPA released a soil study. The study revealed that radioactive contamination still pervades the site, with concentrations as much as a thousand times background levels.*"

This rhetoric does not tell the true picture. Out of 3,735 scheduled soil and sediment samples and over 128,000 separate analyses …

- 423 (11%) samples exceeded the EPA background levels for man-made radionuclides
- Only 8 (0.2%) samples exceeded the former DOE and CDPH approved dose-based cleanup standards for conservative residential land use (only cesium-137)
- No samples exceeded the EPA acceptable risk range for open space land use

The EPA survey demonstrated that alleged massive, widespread contamination does not exist, and that past remediation has been effective in eliminating the majority of contamination that did exist.

The single sample with cesium-137 "*one thousand times background levels"* is not a significant hazard. One would need to lie down on the ground at that location for 7 days, 24 hours per day to receive the same radiation dose that we all receive from elevated cosmic ray exposure when we make one round trip, coast-to-coast, airplane flight.

1.11 Complaint, Paragraphs 49 and 50. Public Notification

Petitioners allege that the public were not notified of Boeing's plans to commence building demolition in Area IV.

This is incorrect. On February 12, 2012, Boeing conducted a public meeting to describe its plans to commence demolition of both non-radiological buildings and released former radiological buildings in Area IV. The meeting was well attended by many engaged members of the public, including members from state agencies, including DTSC. The demolition process was described in detail. Following the meeting, attendees were taken on a tour of Area IV and shown all buildings that were planned for demolition. Attendees were taken into several buildings including 4006, 4009 and 4055.

For several years DTSC has sent monthly emails to a larger number of SSFL stakeholders describing all remedial activities at SSFL. These emails included building demolition activities during the previous 30 days and plans for the following 30 days. These monthly emails included current details on building demo activities and plans. In addition, DTSC has made several public presentations on the status of building demolition periodically during this period.

1.12 Complaint, Paragraph 54. Exceeding Background

Petitioners allege that *"Boeing's own measurements contained debris with level of radiologic activity that exceeds background levels."*

This is incorrect. The vast majority of instrument surface activity measurements and wipe tests are non-detect (i.e., less than the minimum detectable activity (MDA)) and are therefore indistinguishable from background. A small percentage of measurements exceed detection levels (~0.5%). However, this is not an indication of "contamination", but merely reflects the fact that detection levels are established at the 95% level (so one should expect a small number of detects) and it is not always possible to accommodate the wide variability of natural background in the numerous different types of building materials. See additional discussion in Section 2.22.

1.13 Complaint, Paragraph 54 and 55. Exceeding Release Criteria

Petitioners allege that *"Boeing's own data reveals that even facilities in which debris with activity levels exceeding these levels [release standards] have been disposed in facilities not licensed to receive low-level radioactive waste."*

This is incorrect. A small number of measurements exceeded the most limiting Regulatory Guide 1.86 total alpha surface activity limit of 100 dpm/100 cm^2. However, this limit applies to radium-226 and transuranic radionuclides such as plutonium-238 and plutonium-239. Other Regulatory Guide 1.86 total alpha surface activity limits are 1,000 dpm/100 cm^2 (for natural thorium and thorium-232) and 5,000 dpm/100 cm^2 (for uranium isotopes and associated decay products). These higher limits are the appropriate limits to use for total alpha surface activity.

EPA's contractor, Hydrogeologic, has stated *"For SSFL, transuranics are not expected to be present in large enough quantities to warrant usage of the transuranic release limits."*[45] This is confirmed by EPA's soil sampling data that demonstrated that plutonium-239 is not a widespread contaminant of concern in Area IV.[46] Only 16 of 3,735 or 0.4% of soil samples exhibited plutonium isotopes higher that background. However, none of these background

[45] Hydrogeologic Inc., "SSFL Field Operating Procedure 3.09 - Release of Potentially Radioactive Equipment", Section 1.7.3 and Appendix A - Contamination Release Limits. December 2010. https://www.philrutherford.com/SSFL/boeing_building_demolition/HGL_SSFL_FOP_3.09.pdf

[46] EPA Factsheet, "Radiological Characterization Study Results", November 2012. http://www.boeing.com/resources/boeingdotcom/principles/environment/pdf/EPA_November_2012_Factsheet.pdf

exceedances, which ranged from 0.0137 to 0.187 pCi/g, exceeded the EPA's plutonium 10^{-6} preliminary remediation goals (PRG) for residential land use[47] of 2.95 (Pu-238) and 2.58 (Pu-239) pCi/g.

Furthermore, more recent dose-based release criteria published by the American National Standards Institute,[48] state that the most limiting (restrictive) total alpha surface activity is 600 dpm/100 cm^2.

All total alpha measurements are less than both applicable limits of 1,000, and 5,000 dpm/100 cm^2 and even less than non-applicable limits of 600 dpm/100 cm^2. Therefore, established and approved federal and state release criteria have not been exceeded.

1.14 Complaint, Paragraph 56. Exceeding MDA

Petitioners discuss a small number of exceedances of minimum detectable activity (MDA).

See response to Compliant Paragraph 54 in Section 1.12 repeated here.

The vast majority of instrument surface activity measurements and wipe tests are non-detect (i.e., less than the minimum detectable activity (MDA)) and are therefore indistinguishable from background. A small percentage of measurements exceed detection levels (~0.5%). However, this is not an indication of "contamination", but merely reflects the fact that detection levels are established at the 95% level (so one should expect a small number of detects) and it is not always possible to accommodate the wide variability of natural background in the numerous different types of building materials.

1.15 Complaint, Paragraph 57. Radiation Measurements

Petitioners allege *"254 instances of radiation above the background levels established by Boeing."*

This is incorrect. We assume that "radiation" refers to the dose rate measurements and not surface activity measurements. All measured dose rate levels were within the daily range of background and therefore indistinguishable from background.

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[47] EPA, "Preliminary Remediation Goals (PRGs) for Radionuclides." http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

[48] ANSI/HPS N13.12-1999. "Surface and Volume Radioactivity Standards for Clearance." American National Standards Institute/Health Physics Society, 1999. The most limiting beta/gamma screening value is 6,000 dpm/100 cm^2 corresponding to a dose of 1 mrem per year. The most limiting alpha screening value is 600 dpm/100 cm^2 corresponding to a dose of 1 mrem per year. A subsequent revision of this standard in 2013 has revised screening values for some radionuclides. Appendix B summarizes and compares screening values for both versions of this standard to Reg. Guide 1.86.

If petitioners are actually referring to surface activity measurements, then "exceeding background" is not necessarily indicative of contamination. See other discussions of background and detection levels in Sections 1.12, 1.17, 2.22, 2.23 and 2.25.

1.16 Complaint, Paragraph 57. USEPA Background

Petitioners question background data. We are unaware of which EPA data Petitioners refer. Daily background surface activity and radiation dose rate measurements are taken for three characteristic materials (asphalt, concrete, and construction material) at non-impacted locations in Area I, over 2 miles from Area IV. These background locations have been surveyed and verified by CDPH.

1.17 Complaint, Paragraph 58 and 59. Detection Levels

Petitioners refer to the critical level, L_C. Boeing calculates the critical level. L_C, in units of counts per minute (cpm) and reports it in the various survey forms. However, the minimum detectable activity (MDA) in units of dpm/100 cm^2 is always calculated based on the detection level, L_D , in units of cpm. The L_D and MDA both account for 5% Type 1 errors (false positives) and 5% Type 2 errors (false negatives). MDAs (or MDCs, minimum detectable concentrations) are conventionally used as detection levels in radiological surveys and are reported together with measured values and +/- 2σ error bounds whenever measurements are compared to a regulatory limit. See additional discussion in Section 2.25 about background and detection levels.

1.18 Complaint, Paragraph 60. Fallout Radionuclides

Petitioners allege that *"materials contaminated with these isotopes [cesium-137 and strontium-90] could be contaminated, i.e., above background levels because these isotopes do not occur in nature."*

It is well known that, although cesium-137 and strontium-90 are not primordial, they both are found in background due to weapons test fallout. Indeed, EPA verified background levels of cesum-137 and strontium-90 during the recent Background Study, associated with the Area IV Radiological Characterization Study. Petitioners' statement that *"these isotopes do not occur in nature"* is therefore misleading.

Release criteria for both cesium-137 and strontium-90, published in Regulatory Guide 1.86, are both 5,000 dpm/100 cm^2 (identified as mixed beta-gamma emitters). Release criteria for both cesium-137 and strontium-90, published in ANSI/HPS N13.12-1999, are both 6,000 dpm/100 cm^2 (Group 2, high dose, beta-gamma). All total beta measurements are either non-detect or less than these values.

2.0 RESPONSE TO HIRSCH REPORT

Many of the allegations in the Hirsch Report have been addressed in the earlier section on Responses to the Complaint. Additional responses to the Hirsch Report[49] are provided below.

2.1 Hirsch Report, Pages 3 and 4. SRE

Reference is made to the SRE accident in 1959. Extensive material is provided on the DOE ETEC website.[50] DOE hosted a day-long seminar on the SRE accident in 2009 in which it invited three nationally renowned experts on reactor accident analysis to review the data and presented their findings to the public.[51] All three concluded that (1) the damage was much less extensive than at the Three Mile Island accident in 1980 and that (2) environmental releases were much less than at Three Mile Island. Recent EPA soil sampling data in and around SRE has not indicated massive, widespread contamination that Petitioner alleges occurred as a result of the SRE accident.

2.2 Hirsch Report, Page 6. UCLA Worker Health Study

See Section 1.9 Complaint Paragraph 38 Health Studies.

2.3 Hirsch Report, Pages 6 and 7. Pre-1990 Environmental Monitoring

Reference is made to a 1989 internal EPA memorandum critical of Rockwell's environmental monitoring program. An extensive response was prepared at the time which is documented on the DOE ETEC website.[52]

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[49] Hirsch & Miska, CBG, "Demolition of Radioactive Structures and the Disposal and Recycling of the Debris from the Santa Susana Field Laboratory Nuclear Area and the Role Played by the California Department of Toxic Substances Control and The California Department of Public Health", August 5, 2013.
https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/2694828867/CBG%20Report%20%26%20Documents_Part1%20of%202.pdf (Part 1 of 2)
https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/7229904651/CBG%20Report%20%26%20Documents%20Part%202%20of%202.pdf (Part 2 of 2)

[50] DOE ETEC Website, "SRE Accident."
https://www.etec.energy.gov/Operations/Major_Operations/SRE_Accident.php

[51] DOE ETEC Website, "SRE Workshop."
https://www.etec.energy.gov/Community_Involvement/Public%20Meetings/SRE_Workshop.php

[52] DOE ETEC Website, "Reviews of Radiological Environmental Programs (1988-1991)."
https://www.etec.energy.gov/Library/Rad_Operations_Review.php

2.4 Hirsch Report, Page 7. 1996 Area IV Radiological Survey

Reference is made to an EPA letter critical of Rockwell's 1996 Area IV Survey. An extensive response was prepared at the time which is documented on the DOE ETEC website.[53]

2.5 Hirsch Report, Page 9. EPA Building Survey

The Hirsch Report alleges that EPA *"expressed substantial displeasure"* at the demolition of several buildings before EPA could conduct confirmatory surveys. This is incorrect. EPA's preliminary planning for this project took over 3 years, in part because of the need to satisfy the demands of stakeholders, principally the author of the Hirsch Report. Boeing notified EPA that this delay would have a negative impact on Boeing's demolition schedule. EPA notified Boeing that it should <u>not</u> delay its demolition schedule, to accommodate the protracted EPA survey planning process.

2.6 Hirsch Report, Page 10. DOE Metals Suspension

The Hirsch report alleges that the 2000 DOE suspension of metals recycling from DOE nuclear facilities was due, in part, because of SSFL. This is incorrect. The suspension was due to previous recycling of volumetrically contaminated nickel from its facilities at Oak Ridge, Tennessee. No subsequent communications from DOE regarding the reason for this suspension mentioned SSFL as the cause. Boeing has not recycled any metals from DOE nuclear facilities at SSFL since the suspension.

2.7 Hirsch Report, page 11. Demolition Debris to Landfills

The Hirsch Report alleges that contaminated debris had been shipped from SSFL to the Bradley Landfill and Calabasas Landfill, prior to 2002. At the time, this led to State Water Board mandated sampling of California landfills and landfill leachates.

In a report issued by Waste Management Inc.,[54] that managed Kettleman Hills and the Bradley landfill, it stated, *"Landfill groundwater and leachate samples collected for this study do not appear to exhibit radioactivity levels of radiological significance, nor do they indicate the presence of the unauthorized disposal of regulated radioactive materials or waste in any of the six landfills examined."*

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[53] DOE ETEC Website, "Area IV Radiological Survey." https://www.etec.energy.gov/Library/1995_Rad-Survey.php

[54] DOE ETREC Website, "Results of Radiochemical Sampling at Six Waste Management Inc. California Landfills", Geochem Applications, January 2003.
https://www.etec.energy.gov/Library/Cleanup_and_Characterization/Waste_Mgmt/RadiochemistryFinal.pdf

A separate report,[55] prepared by the Los Angeles County Sanitation District, for the Calabasas Landfill concluded, *"The radioactivity data collected for the Calabasas Landfill indicate no evidence of radioactive waste disposal from the Rocketdyne facility. Levels of radioactivity in monitoring wells appear consistent with natural sources."*

Clearly, no evidence was found that Boeing debris had contaminated these landfills.

2.8 Hirsch Report, page 11. Soil from FSDF to Buttonwillow

The Hirsch report alleges that in January 2001, Boeing shipped soil, that was [radiologically] contaminated and was therefore low-level radioactive waste, to Buttonwillow. This is incorrect. DHS had issued numerous letters certifying that the facility had been released for unrestricted use, and that the soil could be disposed of at Buttonwillow in full compliance with the law and would not have an impact on the environment or public safety. In a final joint letter sent to Senator Boxer and Senator Kuehl, December 2000, DTSC and DHS stated, *"DHS has carefully reconsidered the issues presented, and has concluded, with confidence, that the soils at issue do not present a radiological health hazard. DHS and DTSC concur that the soils at issue may legally and safely be disposed of at a permitted Class 1 hazardous waste facility."*[56]

2.9 Hirsch Report, page 12. 17 CCR 30256(k)(1) and (2)[57]

The Hirsch Report refers to the subject CCR citation as *"the only cleanup regulation that remains on the books."*

The exact citation reads,

(1) Radioactive material has been properly disposed;

(2) Reasonable effort has been made to eliminate residual radioactive contamination, if present; and

(3) A radiation survey has been performed which demonstrates that the premises are suitable for release for unrestricted use; or other information submitted by the licensee is sufficient to demonstrate that the premises are suitable for release for unrestricted use.

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[55] DOE ETEC Website, "Radioactivity Sampling Report for Calabasas Landfill, Agoura, California", Geochem Applications and Todd Engineers, January 2003.
https://www.etec.energy.gov/Library/Cleanup_and_Characterization/Waste_Mgmt/Calabasas_Final_Report2.pdf

[56] Letter from Kevin Reilly (DHS) and Bob Borzelleri (DTSC) to Senator Barbara Boxer and State Senator Sheila Kuehl. Untiled, Undated.
https://www.philrutherford.com/SSFL/boeing_building_demolition/4886_DHS_DTSC_Letter_2000-12.pdf

[57] California Code of Regulations. 17 CCR 30256. Vacating Installations: Records and Notice.
https://govt.westlaw.com/calregs/Document/I71D75570F3B211DF9979F9727972A1D3?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)

"Reasonable effort has been made to eliminate residual radioactive contamination, if present" has its analogy with the ALARA process which requires that doses be kept *"as low as reasonably achievable."* A "reasonable effort" and the ALARA process do not require achieving zero as the Hirsch Report maintains.

A "reasonable effort" has been conducted by decommissioning, and releasing for unrestricted use, former licensed radiological facilities. A "reasonable effort" has been conducted by performing radiological surveys on even non-licensed, non-radiological facilities, and demonstrating that state and federal release criteria have been met.

2.10 Hirsch Report, page 12. Executive Order D-62-02

See Section 1.6, repeated here.

In 2002, then Governor Gray Davis issued Executive Order D-62-02[58] which *"impose[d] a moratorium on the disposal of decommissioned materials into Class III landfills and unclassified waste management units."* This essentially required decommissioned material to be disposed of to either a Class 1 or 2 landfill if disposed of in the state of California. Boeing has complied with this order for released former radiological facilities. All debris from former radiological buildings has been (since 2002) and will be disposed of to Class 1 landfills.

Governor Davis passed D-62-02 in response to Senate Bill SB 1970 (Romero) which he vetoed. One of the Complaint's Petitioners helped author SB 1970. In vetoing SB 1970, Governor Davis issued a press release[59] and letter to the California Senate[60] in which he stated,

> *"This bill [SB 1870] redefines the term 'radioactive waste' to include any discarded decommissioned material with the slightest trace of detectable radioactivity not attributable to background sources, and prohibits all such material from being disposed of at all existing hazardous or solid waste disposal facilities in the State of California. As written, this bill is overly broad, unworkable and would do little to significantly enhance protection of the public health."*

Governor Davis vetoed SB 1970, but as a compromise, enacted Executive Order D-62-02.

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[58] California Executive Order D-62.02. September 2002. https://www.emcbc.doe.gov/SEB/ETEC/Browsing/Historical%20Facility%20Crosswalk/Historical%20Facility%20Crosswalk%20Documents/HWMF/HWMF/1/HWMF%20Closure%20Plan/Agency%20Correspondence/Ca%20State%20Exec%20Order%20D-62-02.pdf

[59] SB 1970 Veto Press Release. September 30, 2002. https://www.philrutherford.com/SSFL/boeing_building_demolition/9-30-02_SB_1970_Press_Release.pdf

[60] SB 1970 Veto Letter to the California Senate. September 30, 2002. https://www.philrutherford.com/SSFL/boeing_building_demolition/9-30-02_SB_1970_Veto_Message.pdf

Petitioners' complaint attempts to re-impose the vetoed SB 1970 on SSFL and negate Executive Order D-62-02.

Executive Order D-62-02 defines decommissioned material *as "materials with low residual levels of radioactivity that, upon decommissioning of a licensed site, may presently be released with no restrictions upon their use."*

The Order further stated*, "the Federal Nuclear Regulatory Commission has determined that residual radioactive material below twenty-five millirems poses no significant risk to public health"* and *"no other state or the federal government monitors the disposal of residual radioactive materials once a site is decommissioned and released for unrestricted use."*

Demolition debris from released former radiological facilities at SSFL is decommissioned material, and all debris from the proposed demolition of former radiological facilities, has been, and will be disposed of to Class 1 disposal sites in full compliance with D-62-02. Although D-62-02 is silent on recycling, no debris from released former radiological facilities, has been since 2002, or will be, recycled.

Notwithstanding the baseless reasoning behind SB 1970 and the current Complaint, it is illogical to expect that licensees would expend considerable resources decommissioning a facility, getting it released for unrestricted use, getting it removed from a license and any further radiological controls, only to have activist groups say that the remaining building debris should be managed and disposed of as regulated low level radioactive waste. What is the point in decommissioning? The Hirsch Report, in effect, is dismissing the whole regulatory basis for decommissioning. Perhaps the Petitioners should file a complaint against the US Nuclear Regulatory Commission.

2.11 Hirsch Report, pages 13 and 14. Below Regulatory Concern

Notwithstanding the Hirsch Report statements about the NRC's failed "below regulatory control (BRC)" policy, all environmental, and specifically radiation regulations, are based on acceptably low dose or risk levels. No federal or state regulation that is designed to protect the public and environment is based on a zero threshold. All are based on meeting low risk, acceptably safe, levels. This applies to both chemicals and radioactive materials. For radioactive materials, this includes, the USEPA drinking water maximum contaminant levels (MCL)[61] based on 4 mrem/y, the USEPA airborne release limits[62] based on 10 mrem/y, the USNRC license termination dose[63]

[61] USEPA National Primary Drinking Water Regulations (Radionuclides).
https://www.epa.gov/dwreginfo/radionuclides-rule

[62] USEPA, 40 CFR 61.92, National Emission Standards for Hazardous Air Pollutants (Radionuclides), https://www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol8/xml/CFR-2011-title40-vol8-part61.xml#seqnum61.92

of 25 mrem/y, the USNRC public dose limit from operating nuclear facilities[64] of 100 mrem/y, USNRC regulations specifying air, water and sewerage effluent limits,[65] based on 50 mrem/y, USNRC license-exempt articles,[66] USNRC license-exempt quantities,[67] USNRC license-exempt concentrations,[68] USNRC unimportant quantities of source material,[69] and USEPA preliminary remediation goals[70] based on an acceptable risk[71] range of 10^{-6} to 10^{-4}.

2.12 Hirsch Report, page 14. Boeing's Site-wide Release Criteria

In the mid-1990s, both USEPA and USNRC issued proposed draft regulations and conducted public rule-making hearings, setting radiation cleanup standards. The USEPA draft regulation was 40 CFR 196, "Environmental Protection Agency Radiation Site Cleanup Regulation."[72] The USEPA cleanup standard was 15 mrem/y for soil and drinking water MCLs (based on 4 mrem/y)

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[63] USNRC, 10 CFR 20.1402, Radiological Criteria for Unrestricted Use, https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1402.html

[64] USNRC, 10 CFR 20.1301, Radiation Dose Limits for Individual Members of the Public, https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1301.html

[65] USNRC, 10 CFR 20 Appendix B, Appendix B to Part 20—Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage, https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-appb.html

[66] USNRC, 10 CFR 30.15, Certain [Exempt] Items Containing By-product Material, https://www.nrc.gov/reading-rm/doc-collections/cfr/part030/part030-0015.html

[67] USNRC, 10 CFR 30.18 and 30.71 Schedule B, Exempt Quantities, https://www.nrc.gov/reading-rm/doc-collections/cfr/part030/part030-0018.html

[68] USNRC, 10 CFR 30.14 and 30.70 Schedule A, Exempt Concentrations, https://www.nrc.gov/reading-rm/doc-collections/cfr/part030/part030-0070.html

[69] USNRC, 10 CFR 40.13, Unimportant Quantities of Source Material, https://www.nrc.gov/reading-rm/doc-collections/cfr/part040/part040-0013.html

[70] USEPA, Preliminary Remediation Goals for Radionuclides. https://epa-prgs.ornl.gov/radionuclides/

[71] Acceptable risk is defined in EPA's OSWER 9355.0-30, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions", April 22, 1991. https://www.epa.gov/sites/production/files/2015-11/documents/baseline.pdf

[72] USEPA, 40 CFR 196, "Environmental Protection Agency Radiation Site Cleanup Regulation", 1994. https://www.philrutherford.com/Radiation_Cleanup_Standards/Draft_40_CFR_196_NPRM.pdf

for groundwater. The USEPA issued a Technical Basis Document[73] supporting both the draft 40 CFR 196 and the adoption of the 15 mrem/y standard for soil.

The USNRC draft regulation (later to become 10 CFR 20 Subpart E) was initially also based on 15 mrem/year.

At the same time, Boeing was developing its SSFL Site-wide Release Criteria,[74] consistent with USEPA and USNRC criteria, of 15 mrem/y for soil, drinking water MCLs for groundwater and Regulatory Guide 1.86 limits for surface activity. Both the Department of Energy and California Department of Public Health approved these limits in 1996.

Subsequently, the USNRC decided to raise their release criteria to 25 mrem/y for all sources including soil and groundwater, and this is what was promulgated in 10 CFR 20 Subpart E, "Radiological Criteria for License Termination."[75]

This led to a protracted conflict between the USEPA and USNRC over what was the "safe" limit, 15 mrem/y or 25 mrem/y. In August 1997, the USEPA issued OSWER Memo 9200.4-18,[76] arguing that the 15 mrem/y was safe and protective of public health, but that 25 mrem/y was not. Since Boeing had a State and DOE approved lower limit of 15 mrem/y, it felt unconcerned over this inter-agency squabble.

OSWER 9200.4-18 which is still featured among the guidance documents on USEPA's Radiation at Superfund Sites website,[77] states,

> *"If a dose assessment is conducted at the site then 15 millirem per year (mrem/yr) effective dose equivalent (EDE) should generally be the maximum dose limit for humans."*

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[73] USEPA, EPA 402-R-96-011A, "Technical Support Document for the Development of Radionuclide Cleanup Levels in Soil", September 1994. https://www.epa.gov/sites/production/files/2015-05/documents/402-r-96-011a_intro.pdf
https://www.philrutherford.com/Radiation_Cleanup_Standards/402-R-96-011A.pdf

[74] Boeing, "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at SSFL", 2/18/1999. https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf

[75] USNRC, 10 CFR 20.1401, Radiological Criteria for License Termination", https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1401.html

[76] USEPA OSWER Memo 9200.4-18, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination", August 22, 1997. https://semspub.epa.gov/work/HQ/176331.pdf

[77] USEPA Radiation at Superfund Sites. https://www.epa.gov/superfund/radiation-superfund-sites

> *"This level equates to approximately 3 x 10^{-4} increased lifetime risk and is consistent with levels generally considered protective in other governmental actions, particularly regulations and guidance developed by EPA in other radiation control programs."*

> *"Protectiveness for carcinogens under CERCLA is generally determined with reference to a cancer risk range of 10^{-4} to 10^{-6} deemed acceptable by EPA. Consistent with this risk range, EPA has considered cancer risk from radiation in a number of different contexts and has consistently concluded that levels of 15 mrem/yr EDE (which equate to approximately a 3 x 10^{-4} cancer risk) or less are protective and achievable."*

Region IX of USEPA criticized the 2003 DOE Environmental Assessment,[78] because the EA did not follow the CERCLA process which requires an "a posteriori" selection of risk-based remedial alternatives following complete characterization of the nature and extent of radiological and chemical contamination. However, that does not invalidate the fact that 15 mrem/y is a safe and protective "a priori" dose-based radiological soil cleanup goal, that is confirmed by the USEPA in OSWER Memo 9200.4-18.

2.13 Hirsch Report, page 14. 2007 Conti Ruling

The Conti ruling requiring DOE to conduct an EIS has succeeded in delaying progress on cleanup, thus achieving the major objective of the CBG and NRDC. However, the ruling did not specify that building decommissioning and demolition should be halted (a view now shared by DTSC), and it did not apply to Boeing activities in Area IV. The Boeing demolition program therefore does not violate the Conti ruling.

2.14 Hirsch Report, page 15. 2010 DTSC/DOE AOC

Not only does the AOC attempt to re-define low level radioactive waste (in an attempt to legislate, by fiat, the failed objectives of SB 1970), but also attempts to re-define soil to include structures and debris.

It was recognized by all parties that removal of building structures in Area IV would be beneficial to soil characterization and achieving the "cleanup soil to background" objective of the AOC. Section 2.3.2. of the AOC states, *"DOE shall make every effort to gain The Boeing Company's cooperation and approval in removing the buildings at the Site that remain under the ownership and control of The Boeing Company."* During the numerous public meetings of the USEPA Radiological Characterization Survey, most public stakeholders expressed the wish that all building structures, DOE's, and Boeing's, were down, so that soil characterization of the below building footprints could be characterized.

[78] DOE, Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center", March 2003. https://www.etec.energy.gov/Library/About/ETECEA.pdf

The Hirsch Report claims that *"EPA is to determine what is background and what is above background."* USEPA has done that for soil only, the intent of the AOC, at a price-tag of $42 million over a period of 4 years. DOE, the signature to the AOC, only entered into an agreement with USEPA to characterize soils. USEPA did not determine what is background, or what is above background for buildings or structural materials during its survey, indeed the DOE has contracted with CDM Smith to conduct radiation surveys[79] of its remaining buildings, without mention of any participation by USEPA.

2.15 Hirsch Report, page 16. EPA Soil Survey

See Section 1.10 Complaint Paragraph 41, repeated here,

This rhetoric does not tell the true picture. Out of 3,735 scheduled soil samples and over 128,000 separate analyses …

- 423 (11%) samples exceeded the EPA background levels for man-made radionuclides
- Only 8 (0.2%) results exceeded the former DOE and CDPH approved cleanup standard for conservative residential land use (only cesum-137)
- No results exceeded the EPA acceptable risk range for open space land use

The EPA survey demonstrated that alleged massive, widespread contamination does not exist, and that past remediation has been effective in eliminating the majority of contamination that did exist.

The single sample with cesium-137 "*one thousand times background levels"* is not a significant hazard. One would need to lie down on the ground at that location for 7 days, 24 hours per day to get the same radiation dose that we all receive from elevated cosmic ray exposure when we make one round trip coast to coast airplane flight.

2.16 Hirsch Report, page 20. Applicability of Governor's Moratorium to Non-radiological Buildings

The Hirsch Report maintains that Executive Order D-62-02 applies to all facilities at SSFL. Quote, *"All of the waste in question here originated from SSFL, a decommissioned nuclear site with an extensive history of nuclear activity, and so is considered decommissioned material subject to the moratorium."*

[79] CDM Smith, "Radiological Survey Plan for Buildings and Consolidated Building Materials within Area IV of the Santa Susana Field Laboratory", September 2011.
https://www.etec.energy.gov/Library/Cleanup_and_Characterization/SSFL%20Building%20Rad%20Survey%20Plan%20-%20Sept%202011%20Draft.pdf

This is incorrect. The moratorium applies to decommissioned material from licensed sites. The moratorium defines decommissioned materials as*, "materials with [potentially] low residual levels of radioactivity that, upon decommissioning of a licensed site, may presently be released with no restrictions upon their use."*

Various facilities in Area IV have been licensed facilities which are subject to D-62-02. Demolition debris from these facilities is classified as decommissioned material and will go to a Class I disposal facility in compliance with D-62-02. These buildings are 4100 (USNRC license), 4055 (USNRC license), 4009 (CDPH license), 4005 (CDPH license), 4011 (CDPH license) and L-85 (USNRC license). All these facilities have been decommissioned and released for unrestricted use. Documented evidence has been provided to DTSC, CDPH and USEPA. The California Radioactive Materials license, 0015-19, applied to specific Boeing-owned buildings in Area IV, as opposed to the entire SSFL site. Indeed, as each building (4009, 4011, 4005, part of 4100) was release for unrestricted use, the CDPH removed that building from Boeing's Radioactive Materials License. Most recently, the last remaining radioactive materials use areas in Building 4100 were removed from the license by the CDPH. Those "calibration and counting laboratory" activities have been transferred to another SSFL building, 1319. Accordingly, building 1319 is now the last remaining building in SSFL, licensed and authorized to possess and use radioactive materials.

The other buildings/sites in Area IV that have been demolished and that are referred to as non-radiological buildings (i.e., non-licensed sites) have never been licensed by the CDPH or the USNRC. No radiological cleanup, remediation or decommissioning was required or conducted at these facilities. Therefore, demolition debris from these buildings is not "decommissioned material" as defined in D-62-02 and is therefore not subject to D-62-02. The buildings/sites are Building 4015, Building 4006, Building 4011 (high bay), Weather Station, Water Tanks and ESADA.

As concurred to by DTSC, the disposal options for debris from these buildings was determined based on the hazardous characterization of the waste. Hazardous waste went to Class I disposal sites. Non-hazardous waste was sent to Class II or III landfills or recycled.

2.17 Hirsch Report, page 20. Buttonwillow and Tanner Act

The Hirsch Report alleges that disposal of low-level radioactive waste from SSFL to Buttonwillow resulted in the Tanner Act. This is incorrect. Disposal of soil to Buttonwillow at the time was conducted with the full concurrence of DTSC and CDPH. See Section 2.8.

2.18 Hirsch Report, page 21. Metal Recycling

For those non-radiological, non-licensed buildings, not subject to D-62-02, and as concurred to by DTSC, the disposal options for debris from these buildings was determined based on the hazardous characterization of the waste. Hazardous waste went to Class I disposal sites. Non-hazardous waste was sent to Class II or III landfills or recycled. Asphalt, concrete, and metal may be recycled. Boeing's contractors and subcontractors (MPe and Kimco) signed a legally binding commitment that any metal recycling conducted would not include commercial level products.

2.19 Hirsch Report, pages 26 to 29. Underground Regulations

See Section 1.1, repeated here.

In 1996, the Department of Energy (DOE) and the CDPH/RHB approved release criteria for radiological facilities at SSFL. These were published in N001SRR140131 "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL."[80] Release criteria for building structures were based on then current DOE Order 5400.5,[81] which were identical to those used by the USNRC in Regulatory Guide 1.86[82] and the CDPH/RHB in DECON-1.[83] N001SRR140131 is still referenced as license condition 13(o) of the current Amendment 112 of Boeing's Radioactive Materials License 0015-19 for SSFL.[84] DOE 5400.5 has since been superseded by DOE Order 458.1 which allows for prior existing approved limits such as surface contamination limits … *"Previously approved guidelines and limits (such as the surface activity guidelines) may continue to be applied and used as Pre-Approved Authorized Limits until they are replaced or revised by Pre-Approved Authorized Limits issued under this Order."* (Section 2.k.(6).(f).1.b of the Contractor Requirements Document).[85]

More recent industry guides (e.g., ANSI and USNRC) that have assessed the effective dose rate from potentially surface contaminated materials have shown that release criteria based on Regulatory Guide 1.86 limits ensure low doses, at or below 1 mrem per year. The vast majority

[80] N001SRR140131, "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL", Page 14, Section 4, Table 5. February 18, 1999. https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf

[81] DOE Order 5400.5, "Radiation Protection of the Public and the Environment", Chapter IV, Figure IV-1. January 7, 1993. https://www.directives.doe.gov/directives-documents/5400-series/5400.05-BOrder-c2

[82] US Nuclear Regulatory Commission, Regulatory Guide 1.86, "Termination of Operation Licenses for Nuclear Reactors", June 1974. http://pbadupws.nrc.gov/docs/ML0037/ML003740243.pdf

[83] CDPH Radiologic Health Branch, DECON-1, "Guidelines for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use." https://www.philrutherford.com/SSFL/boeing_building_demolition/DECON-1.pdf

[84] CDPH/RHB, "Radioactive Materials License 0015-19, Amendment 112, License Condition 13(o)", July 9, 2013. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/DTSC_demo_workplan_B4100.pdf#page=350.

[85] DOE Order 458.1. Change 3. "Radiation Protection of the Public and the Environment", January 15, 2013. https://www.directives.doe.gov/directives-documents/400-series/0458.1-BOrder-chg3-admchg/@@images/file

of historical and current instrument surface activity measurements and wipe tests are non-detect (i.e., less than the minimum detectable activity (MDA)) and are therefore indistinguishable from background. The dose from any resulting post-demolition solid debris would therefore be zero mrem per year. A small percentage of measurements exceed detection levels. However, this is not an indication of "contamination", but merely reflects the fact that detection levels are established at the 95% level (so one should expect a small number of detects) and it is not always possible to accommodate the wide variability of natural background in the numerous different types of building materials. If it were conservatively assumed that all building structural debris was actually contaminated at the MDA levels, then the effective dose would be much less than 1 mrem per year since MDAs are always much less than the more limiting dose based criteria of the cited guidelines.[86,87]

Current surveys for both non-radiological and radiological facilities continue to use current surface activity limits based on USNRC, DOE and CDPH/RHB guidance for release/clearance of equipment and material for unrestricted use from former radiological facilities.[88,89,90]

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[86] ANSI/HPS N13.12-1999. "Surface and Volume Radioactivity Standards for Clearance." American National Standards Institute/Health Physics Society, 1999. The most limiting beta/gamma screening value is 6,000 dpm/100 cm^2 corresponding to a dose of 1 mrem per year. The most limiting alpha screening value is 600 dpm/100 cm^2 corresponding to a dose of 1 mrem per year. A subsequent revision of this standard in 2013 has revised screening values for some radionuclides. Appendix B summarizes and compares screening values for both versions of this standard to Reg. Guide 1.86.

[87] NUREG-1640. "Radiological Assessments for Clearance of Materials from Nuclear Facilities." Nuclear Regulatory Commission, June 2003. The most restrictive beta/gamma dose conversion from Table 2.1 is 0.16 μrem/y per dpm/100 cm^2. This corresponds to 0.8 mrem/y per 5,000 dpm/100 cm^2. http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1640/

[88] (a) U.S. Nuclear Regulatory Commission Regulatory Guide 1.86. "Termination of Operating Licenses for Nuclear Reactors." June 1974. https://pbadupws.nrc.gov/docs/ML0037/ML003740243.pdf
(b) U.S. NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," April 1993.
https://www.nrc.gov/docs/ML1036/ML103620647.pdf

[89] (a) U.S. Department of Energy Order 458.1, "Radiation Protection of the Public and Environment" Attachment 1, Section (7)1b, Change 3, January 15, 2013.
https://www.philrutherford.com/Radiation_Cleanup_Standards/DOE_O_458.1_Change_3_2013-01-15.pdf#page=65
(b) U.S. Department of Energy Memorandum from Sally Robison to Roger Liddle, "Site-wide Limits for Release of Facilities without Radiological Restriction", September 17, 1996.
https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf#page=28
(c) U.S. Department of Energy Draft Guide DOE G 441.1-XX. "Control and Release of Property with Residual Radioactive Material." Table 2. April 4, 2002. https://www.energy.gov/sites/prod/files/2014/03/f13/doe441.1-xx_0.pdf#page=32 .

USEPA utilized Regulatory Guide 1.86 limits for its release of equipment and material during its Area IV Radiological Survey.[91] CDM Smith's radiological survey plan[92] for the remaining DOE-owned building in Area IV likewise utilizes release criteria based on Regulatory Guide 1.86.

In a recent confirmation survey conducted for building 4100, the CDPH compared their own measurements to the generic limits (total 5,000 dpm/100 cm^2 and 1,000 dpm/100 cm^2 removable) of Reg. Guide 1.86 limits to determine that the facility could be released for unrestricted use.[93]

2.20 Hirsch Report, page 29. Boeing's Radioactive Materials License

The Hirsch Report asserts that Boeing's Radioactive Materials License authorizes use of radioactive materials in all buildings in Area IV. This is incorrect. See prior response in Section 2.16.

2.21 Hirsch Report pages 30 to 31, Figure 7. Buildings Demolished or to be Demolished

The Hirsch Report questions the use of the "non-radiological" classification for certain buildings, namely Building 4006, Building 4011 hi-bay, and ESADA). The rationale for these classifications is discussed below,

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[90] (a) California Department of Public Health. DECON-1. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use."
https://www.philrutherford.com/Radiation_Cleanup_Standards/DECON-1.pdf
(b) California Department of Public Health Letter from Gerard Wong to Majelle Lee, "Authorized Site-wide Radiological Guidelines for Release for Unrestricted Use", August 9, 1996.
https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf#page=27
(c) California Department of Public Health, IPM-88-2. "Clearance Inspection and Survey." December 1, 1997.
https://www.philrutherford.com/Radiation_Cleanup_Standards/IPM-88-2.pdf

[91] Hydrogeologic Inc., "SSFL Field Operating Procedure 3.09 - Release of Potentially Radioactive Equipment", Section 1.7.3 and Appendix A - Contamination Release limits. December 2010.
https://www.philrutherford.com/SSFL/boeing_building_demolition/HGL_SSFL_FOP_3.09.pdf

[92] CDM Smith, "Radiological Survey Plan for Buildings and Consolidated Materials within Area IV of SSFL", Health Physics Procedure HP-03 - Radiological Limits, Section 6.3.2 - Surficial Contamination Limits, and Attachment 1. Regulatory Guide 1.86 Surface Contamination Limits. September 2011.
https://www.philrutherford.com/SSFL/boeing_building_demolition/SSFL_Building_Rad_Survey_Plan_Sept_2011_Draft.pdf

[93] CDPH, "Radiological Assessment Unit, Confirmation Survey, Santa Susana Field Laboratory, Area IV, Building 4100, Rooms 112, 113, 114 and Annex", July 27, 2013. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/DTSC_demo_workplan_B4100.pdf#page=295-346.

4006 Liquid Sodium Laboratory. 4006 was never a licensed facility, and no radiological cleanup, remediation or decommissioning was required or conducted at this facility. However, it was recognized that small quantities of radioactive materials had been used at 4006 in the past. These uses were documented in DOE's Historical Site Assessment,[94] EPA's Historical Site Assessment[95], and also declared to DTSC in the 4006 Demolition Notification Package.[96]

As a consequence of these activities involving radioactive materials, a MARSSIM final status survey[97] was conducted in 2008. The survey concluded that …

> *"Measurements confirmed surface residual radioactivity to be below the levels given in the Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL (Rocketdyne, 1999). Based on the measured surface residual radioactivity levels, Building 4006 can be released for unrestricted use."*

On September 2, 2008, Boeing provided this survey report to the California Department of Public Health (CDPH) and requested that a verification survey be conducted by the State. On September 16, 2008, the CDPH declined to conduct a verification survey. Boeing has met its regulatory obligations in demonstrating that building 4006 was suitable for release for unrestricted use.

Building 4011 High Bay. The 4011 hi-bay was never a licensed facility, and no radiological cleanup, remediation or decommissioning was required or conducted at this facility. The "Building 4011, Area IV, Non-radiological High-Bay Document Review and Operations Certification"[98] states,

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[94] DOE, "Historical Site Assessment of Area IV, Santa Susana Field Laboratory", Sapere, May 2005. Page O-5, https://www.etec.energy.gov/Library/Main/Group_O.pdf)

[95] EPA, Historical Site Assessment of Area IV, Santa Susana Field Laboratory - Final Technical Memorandum for Subarea HSA-5B", Page 101, December 2011.

[96] Boeing, "Building 4006, Area IV, Document Review and Operations Certification", November 30, 2012. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65801_B4006-DEMO-SSFL-Pt__2.pdf#page=16

[97] Cabrera, "Radiological Final Status Survey of Building 4006, Santa Susana Field Laboratory, Ventura County, California." June 2008. https://www.etec.energy.gov/Library/Main/08-1011.00_Bldg_4006_Final_Report_with_Apps.pdf

[98] Boeing, "Building 4011, Area IV, Non-radiological High-Bay Document Review and Operations Certification", November 1, 2012, https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65774_112657-B4011_demo_notification.pdf#page=173

"No radioactive material use authorizations exist for the high-bay portion of building 4011. No radiological incident reports exist for the high-bay portion of building 4011. Neither the DOE nor the EPA Area IV Historical Site Assessment (HSA) teams found any evidence or documentation on the use or storage of radioactive materials in the non-radiological high-bay portions of building 4011."

The following was reported in the pre-demo survey report for 4011 hi-bay,[99]

"Three measurements on a sink, exhibited relatively high levels of total beta activity that exceeded the general release limits for uranium and mixed fission products of 5,000 dpm/100 cm^2. However, all other measurement were less that MDA and the gamma dose rate was indistinguishable from background. The sink is constructed of ceramic material. Certain ceramics are known to have slightly elevated naturally occurring uranium and thorium. The sink will not be removed during pre-demo activities and a sample of the sink has been taken and sent an off-site laboratory for radionuclide analysis. The sink will be segregated during future building demolition and its disposition will be based on the results of the radionuclide analysis."

Subsequently, laboratory analysis[100] did not identify any anthropogenic radionuclides that exceeded the EPA radiological trigger levels for soil.

Empire State Atomic Development Authority (ESADA). Although ESADA was use for principally non-nuclear purposes, USEPA Historical Tech Memo for Subarea 8 and, "4314, 4814 & 4730 Sites Document Review and Operations Certification"[101] identifies some minor uses of radioactive materials at the ESADA site. The building structures have long since been removed and all that remained was some concrete and asphalt pads and driveways. USEPA gamma radiation surveys of all ground, asphalt and concrete surfaces, and targeted soil sampling, have failed to identify any elevated radiation or

[99] Boeing, "Building 4011 (Telecom & Storage), Area IV Radiological Release Survey and Waste Certification", https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65774_112657-B4011_demo_notification.pdf#page=86

[100] Boeing, "4011 Sink, Area IV, Site ID 125657, Radiological Release Sampling Waste Certification", November 9, 2012.

[101] Boeing, "4314, 4814 & 4730 Sites Document Review and Operations Certification", October 16, 2012, https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65872_113127_ESADA_Demo_Notification.pdf#page=9

any contaminants of concern in soil. See "USEPA Data from the Surrounds of the 4314, 4814 & 4730 Sites",[102] dated October 16, 2012.

2.22 Hirsch Report, pages 32 et. seq. Assertions that Boeing's Own Measurements Exceed Background

The Hirsch report asserts that every net measurement, (i.e., gross measurement - background) that exceeds zero is evidence of contamination (see Hirsch Report page 36, Footnote xii). This is incorrect and ignores the fact that all radiological measurements have an associated statistical detection level. If the net measurement is below the detection level, then the measurement is considered a non-detect (see later discussion of detection levels). If the Hirsch Report logic was correct, then 50% of all measurements of uncontaminated material would exceed an average representative "background" level and 50% of all measurements would always be incorrectly identified as "contaminated."

The vast majority of instrument surface activity measurements and wipe tests conducted in Area IV are non-detect (i.e., less than the minimum detectable activity (MDA)) and are therefore indistinguishable from background. Approximately 0.5% of actual measurements exceeded the MDA.

A small percentage of measurements of clean material are theoretically expected to exceed detection levels (up to 5% of the total). However, this is not an indication of "contamination", but merely reflects the fact that detection levels are established at the 95% confidence level (so one should expect a small number or small percentage of detects above the MDA) and it is not always possible to accommodate the wide variability of natural background (and associated MDAs) in the numerous different types of building materials using just three representative materials.

All materials contain different levels of naturally occurring radioactivity. To complicate things even further, different forms of the same material (e.g., concrete) will contain different levels of naturally occurring radioactive materials depending on its age, weathering, existence of rust stains, manufacturer, geographical source of constituent materials, etc. As a result, all materials will give different instrument measurements (different backgrounds). It is not practical or feasible to establish separate backgrounds and associated MDAs for the numerous different kinds of materials encountered in building demolition. In the demolition program we establish separate representative daily backgrounds and associated MDAs for three materials, concrete, asphalt and generic construction material. The generic construction material could include

[102] Boeing, "USEPA Data from the Surrounds of the 4314, 4814 & 4730 Sites", October 16, 2012, https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65872_113127_ESADA_Demo_Notification.pdf#page=33

metal, wood, drywall, equipment, etc. The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) recognizes this variability of naturally occurring radioactive material in non-contaminated building structures and the problems that raises for establishing "background" and detection levels. Section 6.7, page 6-35 on Detection Sensitivity of MARSSIM makes the following statement,

> *"From a conservative point of view, it is better to overestimate the MDC for a measurement method. Therefore, when calculating MDC and L_C values, a measurement system background value should be selected that represents the high end of what is expected for a particular measurement method. For direct measurements, probes will be moved from point to point and, as a result, it is expected that the background will most likely vary significantly due to variations in background, source materials, and changes in geometry and shielding. Ideally, the MDC values should be calculated for each type of area, but it may be more economical to simply select a background value from the highest distribution expected and use this for all calculations."* [Underlines added][103]

In order to address questions over choice of background and detection limits, we can look at the original gross measurements (in counts per minute) before subtracting background, look at the range, and compare the range for different buildings, both in Area IV and in Area I, far distant from Area IV and in an off-site residence. If the ranges of measurements are comparable, then there is no evidence that Area IV non-radiological buildings are "above background." A similar range and variability of gross measurements in Area IV non-radiological buildings, has been observed in all Area I and Area III buildings. Data from all these facilities have also been reviewed and concurred by DTSC. These facilities include Buildings 1300,[104] Bowl,[105] Canyon,[106] CTL-III,[107] CTL-V,[108], ECL,[109] STP-3[110] and Hydrogen Lab.[111] Table 1 and

[103] NUREG-1575, Revision 1, "Multi-Agency Radiation Survey and Site Investigation Manual", Section 6.7 Detection Sensitivity, page 6-35. August 2000. https://www.epa.gov/sites/production/files/2017-09/documents/marssim_manual_rev1.pdf#page=255

[104] Boeing, "Demolition Notification for 1300. Radiological Release Survey and Waste Certification", June 2012. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65326_Notification_of_Planned_Demolition_Building_300_Area_1.pdf#page=63

[105] Boeing, "Demolition Notification for Bowl. Radiological Release Survey and Waste Certification", July 2010. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/64623_ALenox_to_RBrausch_re_BOWL_AREA_DEMO_Notification_Final_(w_analytical_reports)_7-8-10.pdf#page=67

[106] Boeing, "Demolition Notification for Canyon. Radiological Release Survey and Waste Certification", April 2011. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/64915_Canyon_demo_notification_to_DTSC,4-14-11.pdf#page=32

Figure 1 below compare the minimum and maximum (range) and average measurements (in cpm) for various Area I and III facilities with the measurements from recently surveyed Area IV buildings. It is apparent that ranges are comparable and consistent. In addition, the table below gives the range of measurements from an off-site West Hills residence (my home).[112] Again, the ranges are comparable and consistent. These directly measured data, uncomplicated by choice of background and detection limits, demonstrate that Area IV buildings are not contaminated above the directly measured data observed in other SSFL buildings and even an off-site residence.

Clearly, the range of gross measurements (in cpm) from Areas I, III and IV buildings are completely consistent with measurements taken at my home, demonstrating that measurements from SSFL buildings are typical of background. The ranges of all SSFL building measurements overlap with those taken at my home. The average alpha measurement taken at my home (9 cpm) is close to the highest average alpha measurement at SSFL (11 cpm) and exceeds the average, average alpha measurement at SSFL (5 cpm). The maximum beta taken at my home (805 cpm) exceeds the highest maximum beta at SSFL (773 cpm). The average beta at my home (527 cpm) is close to the highest average beta at SSFL (545 cpm), is close to the average maximum beta at SSFL (577 cpm) and exceeds the average, average beta at SSFL (397 cpm).

Using net (background subtracted) data and using Hirsch's twisted logic that any net measurement above zero is contamination, 11% of my concrete exceeds background and

[107] Boeing, "Demolition Notification for CTL-III. Radiological Release Survey and Waste Certification", June 2011. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65060_111239.pdf#page=859

[108] Boeing, "Demolition Notification for CTL-V. Radiological Release Survey and Waste Certification", March 2011. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/64863_CTL5_Demo_notification_to_DTSC,3-8-11.pdf#page=408

[109] Boeing, "Demolition Notification for ECL. Radiological Release Survey and Waste Certification", May 2010. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/SSFL-DEMO-ECL-21MAY2010.pdf#page=43

[110] Boeing, "Demolition Notification for STP-3. Radiological Release Survey and Waste Certification", April 2012. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65286_STP3_Demo_Notification_to_DTSC_4-6-12.pdf#page=47

[111] Boeing, "Demolition Notification for Hydrogen Laboratory. Radiological Release Survey and Waste Certification", October 2011. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65178_Final_H2_Lab_Demo_Notification_to_DTSC_10-27-11.pdf#page=122

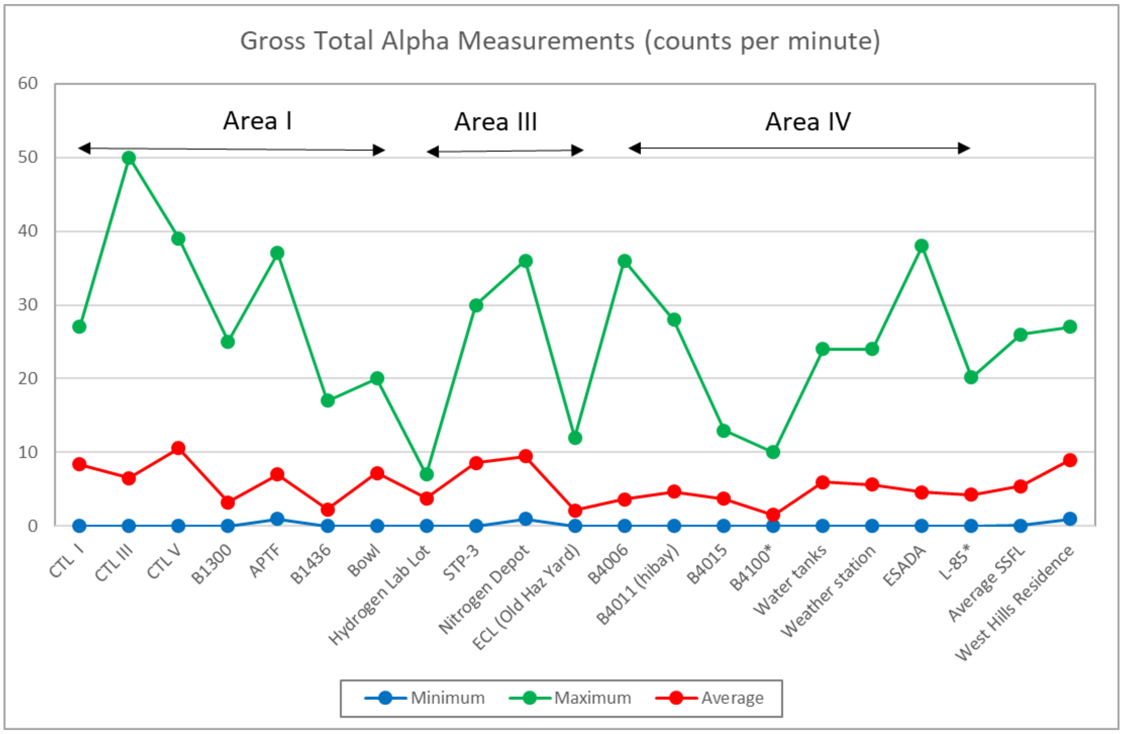
[112] Boeing, "Off-site West Hills Residence Radiological Survey", September 4, 2013. See Appendix F of this paper.

should be classified as LLRW. Likewise, 35% of the asphalt roadway in front of my house exceeds background and should be classified as LLRW, and 72% of the building materials inside my home exceeds background and should be classified as LLRW. Using a more relaxed Hirsch logic that any net activity exceeding the minimum detectable activity (MDA) is contamination, then only 67% of the building materials in my home should be classified as LLRW. In anticipation that Hirsch would then allege that my home is contaminated, similar results would occur if a survey were to be conducted at Hirsch's home, much further distant from SSFL.

Table 1. Range of Gross (Before Background Subtraction) Total Alpha and Beta Measurements for Buildings in Areas I, III, IV and an Off-Site Residence

Area	Building/Location	Alpha (gross cpm)			Beta (gross cpm)		
		Min	Max	Average	Min	Max	Average
I	CTL I	0	27	8	121	494	312
I	CTL III	0	50	7	133	664	435
I	CTL V	0	39	11	102	586	294
I	B1300	0	25	3	217	607	389
I	APTF	1	37	7	207	584	450
I	B1436	0	17	2	198	554	401
I	Bowl	0	20	7	272	662	545
III	Hydrogen Lab Lot	0	7	4	225	296	268
III	STP-3	0	30	9	172	586	389
III	Nitrogen Depot	1	36	9	185	591	465
III	ECL (Old Haz Yard)	0	12	2	266	617	367
IV	B4006	0	36	4	207	589	397
IV	B4011 (hibay)	0	28	5	204	773	435
IV	B4015	0	13	4	177	611	360
IV	B4100*	0	10	2	148	480	336
IV	Water tanks	0	24	6	139	565	336
IV	Weather station	0	24	6	210	530	388
IV	ESADA	0	38	5	289	609	509
IV	L-85*	0	20	4	237	569	461
SSFL	Average SSFL	0	26	5	195	577	397
Off-Site	West Hills Residence	1	27	9	226	805	527

*Former radiological buildings



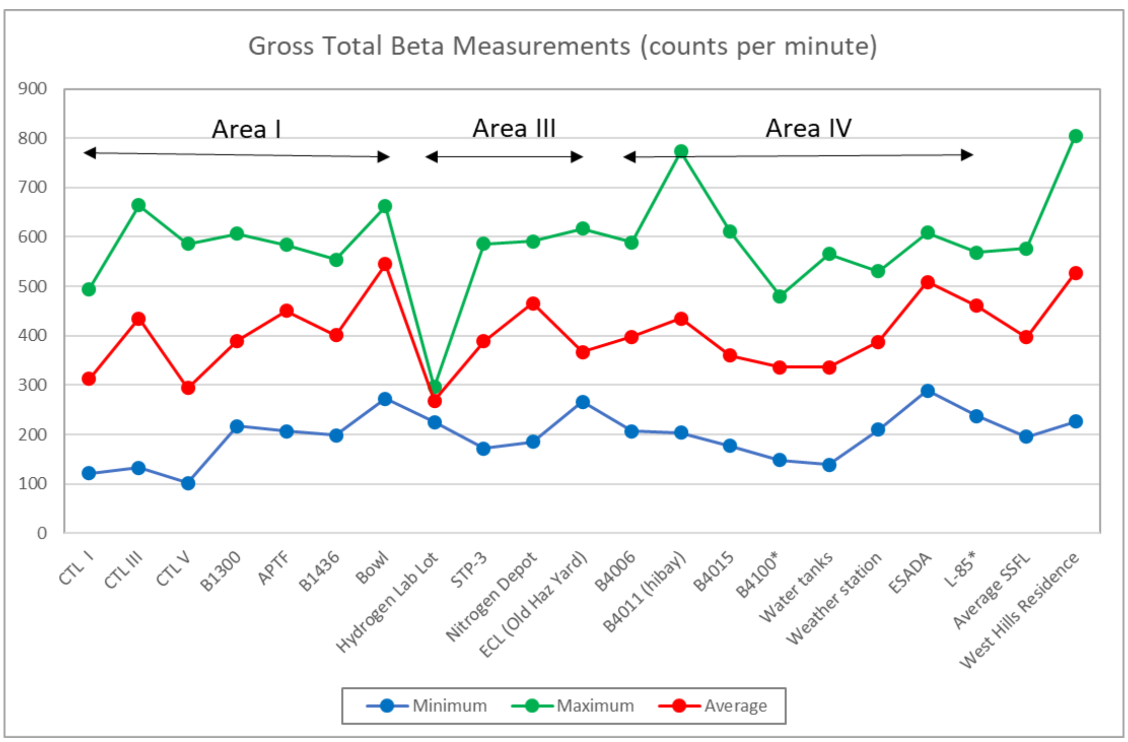


Figure 1. Gross Total Alpha and Beta Measurements for Buildings in Area I, III, IV and Off-Site

USEPA data from the surrounds of the Area IV facilities that are reported in the various "EPA Surrounds" reports submitted to DTSC with each building demolition notification, show that radiation levels are consistent with background and that occasional soil background exceedances are, in general, several hundred feet away from the facilities in question. This contradicts the Hirsch report assertion that any facility in Area IV would be contaminated as a result airborne release and subsequent fallout from past "accidents and releases."

Chemicals detected above background do not automatically make soil hazardous. There are federal USEPA, non-zero thresholds for chemicals that must be exceeded before soil is classified, managed, and disposed of, as hazardous. In the same way radionuclides detected above background are not automatically classified as low-level radioactive waste.

2.23 Hirsch Report, pages 32 et. seq. Questions About Background Values and Locations

Daily background surface activity and radiation dose rate measurements are taken for three characteristic materials (asphalt, concrete, and construction material) at non-impacted locations in Area I, over 2 miles from Area IV. These background locations have been surveyed and verified by CDPH.

In a recent confirmation survey[113] conducted for building 4100, the CDPH used an average beta background of 450 cpm, very consistent with the beta backgrounds reported by Boeing (e.g., 4015 pre-demo range 238 - 500 cpm; 4015 post-demo range 382 - 624 cpm; water tanks pre-demo range 231 - 572 cpm, water tanks post-demo range 349 - 584 cpm).

2.24 Hirsch Report, pages 34. Assertions that Boeing's Measurements Exceed Boeing's Release Criteria

This is incorrect. A small number of measurements exceeded the <u>most limiting</u> Regulatory Guide 1.86 total alpha surface activity limit of 100 dpm/100 cm^2. However, this limit applies to radium-226 and transuranic radionuclides such as plutonium-238 and plutonium-239. Other Regulatory Guide 1.86 total alpha surface activity limits are 1,000 dpm/100 cm^2 (for natural thorium and thorium-232) and 5,000 dpm/100 cm^2 (for uranium isotopes and associated decay products). These higher limits are the appropriate limits to use for total alpha surface activity.

USEPA's contractor, Hydrogeologic, has stated *"For SSFL, transuranics are not expected to be present in large enough quantities to warrant usage of the transuranic release limits."*[114] This is

[113] CDPH, "Radiological Assessment Unit, Confirmation Survey, Santa Susana Field Laboratory, Area IV, Building 4100, Rooms 112, 113, 114 and Annex", July 27, 2013. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/DTSC_demo_workplan_B4100.pdf#page=295-346.

[114] Hydrogeologic Inc., "SSFL Field Operating Procedure 3.09 - Release of Potentially Radioactive Equipment", Section 1.7.3 and Appendix A - Contamination Release limits. December 2010.

confirmed by EPA's soil sampling data that demonstrated that plutonium-239 is not a widespread contaminant of concern in Area IV.[115] Only 16 of 3,735 or 0.4% of soil samples exhibited plutonium isotopes higher that background. However, none of these background exceedances, which ranged from 0.0137 to 0.187 pCi/g, exceeded the EPA's plutonium 10^{-6} preliminary remediation goals (PRG) for residential land use[116] of 2.95 (Pu-238) and 2.58 (Pu-239) pCi/g.

Furthermore, more recent dose-based release criteria published by the American National Standards Institute[117], state that the most limiting (restrictive) total alpha surface activity is 600 dpm/100 cm^2. All alpha measurements are less than this health dose-based limit.

If we hypothetically assumed that alpha background is zero (ultra conservative) and calculate surface activity based on gross counts per minute (cpm) rather than net cpm, then the resultant activity (in dpm/100 cm^2) would be less than the generic Reg. Guide 1.86 alpha limits of 5,000 dpm/100 cm^2 and even less that the most limiting alpha clearance limit of ANSI N13.12-1999 of 600 dpm/100 cm^2. For example, pre-demo gross alpha data from the Area IV Water Tanks,[118] discussed in the Hirsch report (pages 34 to 36) are shown in Table 2.

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https://www.philrutherford.com/boeing_building_demolition/HGL_SSFL_FOP_3.09.pdf

[115] EPA Factsheet, "Radiological Characterization Study Results", November 2012. https://www.boeing.com/resources/boeingdotcom/principles/environment/pdf/EPA_November_2012_Factsheet.pdf

[116] EPA, "Preliminary Remediation Goals (PRGs) for Radionuclides." http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

[117] ANSI/HPS N13.12-1999. "Surface and Volume Radioactivity Standards for Clearance." American National Standards Institute/Health Physics Society, 1999. The most limiting beta/gamma screening value is 6,000 dpm/100 cm^2 corresponding to a dose of 1 mrem per year. The most limiting alpha screening value is 600 dpm/100 cm^2 corresponding to a dose of 1 mrem per year. A subsequent revision of this standard in 2013 has revised screening values for some radionuclides. Appendix B summarizes and compares screening values for both versions of this standard to Reg. Guide 1.86.

[118] Boeing, "Water Tanks (Buildings 4701 and 4702), Area IV - Radiological Release Survey and Waste Certification", November 12, 2012. https://www.dtsc-ssfl.com/files/lib_rcra_soils/BuildingDemo/buildingdemolition/65796_Water_Tanks_Waste_Certification_Rev_1.pdf#page=1

Table 2. Gross Alpha/Beta Activity from Area IV Water Tanks without Background Subtraction

Area IV Water Tanks	Units	Gross Alpha			Gross Beta		
		Min	Max	Average	Min	Max	Average
Gross count per minute	cpm	2	24	9	139	536	351
Instrument Efficiency	cpm/emission	0.184	0.184	0.184	0.168	0.168	0.168
Surface Efficiency	emission/dpm	0.25	0.25	0.25	0.5	0.5	0.5
Probe Area	cm^2	100	100	100	100	100	100
Gross surface activity	dpm/100 cm^2	43	522	196	1,655	6,381	4,179

For the previously mentioned reasons, the typical range of total alpha MDAs of 250 - 400 dpm/100 cm^2, although higher than 100 dpm/100 cm^2, are acceptable to meet both the generic Reg. Guide 1.86 alpha limits of 5,000 dpm/100 cm^2 and even meet the most limiting alpha clearance limit of ANSI N13.12-1999 of 600 dpm/100 cm^2 (addresses the comment on page 46 the Hirsch Report).

2.25 Hirsch Report, pages 37. Questions About Detection Levels

The Hirsch Report questions the use of "minimum detectable activity" as a detection level.

There are two levels associated with radiological counting statistics. The first is L_C, called critical level or decision level. The second is L_D, known as the detection level (also sometimes referred to as the lower limit of detection (LLD) or the limit of detection (LOD)). Both L_C and L_D are usually expressed in units of counts or counts per minute (cpm). When L_D is converted to units of surface activity (disintegrations per minute per 100 cm^2 or dpm/100 cm^2) using various efficiencies and area factors it becomes known as the minimum detectable activity (MDA). The synonymous term for volumetric concentration is minimum detectable concentration (MDC).

The EPA/Tetra-tech survey report[119] for Buildings 4011, 4055 and 4100 explains the distinction between these two parameters. Underlines added.

> *"Detection limits (L_D) specify the capability of a measurement system to detect a signal in the presence of a background/noise signal. Because all low-level radioactivity measurements are associated with a physical error characteristic of the measurement process, statistical analysis is required for all measurements. Detection limits must be calculated at the field location where the survey is performed to account for background and to attain sufficient data quality of the intended purpose. Detection limits are based on counting statistics using the 95th percentile confidence interval for both Type I and II*

[119] USEPA, Tetra Tech EM inc., "Final Oversight Verification and confirmation Radiological Survey Report for Buildings, T-011, T-019, T-055 and T-100". Pages 18 through 20. December 20, 2002. http://www.etec.energy.gov/Library/Cleanup_and_Characterization/Rocketdyne_OV-Confirm_Bldgs_T-011_to_T-100.pdf

errors. Type I and II errors are detailed in MARSSIM. Adjustments of counting times allow required or specific L_Ds to be met.

Detection limits are [also] reported in terms of the critical level (L_C), the a posteriori statement of detection that protects from the false positive or Type I error. The L_C activity is the concentration at which the analyst has a 50 percent chance of determining that a measurement is part of background, when in fact it is not. That is, at the L_C, a measurement is equally likely to be from the background or not. All activity measurements less than L_C are reported as less-than values. The L_C is a statistical function of the sample and background counting times and the background count rate."

"The detection limit is the a priori limit that protects from the false negative or Type II error and represents the measurement system sensitivity. That is, a measurement with a true activity equal to L_D will be identified correctly as different from background for a predetermined percentage of the time. For the OV survey, the L_D was calculated to represent a 95 percent confidence level. Activities determined to be greater than L_D are reported with a ± error. The L_D is a statistical function of the sample and background counting times and the background count rate."

"The minimum detectable activity (MDA) is an a priori measure of the smallest quantity of activity that could be present and still be detected with a specified level of confidence. The MDA is equal to the L_D converted from raw data units (counts per minute) to activity units (disintegrations per minute).

"When reporting field survey results, levels of radioactivity will be reported to be "less than L_D" if the value in disintegrations per minute per 100 square centimeters is less than the limit of detection. If the value is greater than the calculated activity L_D, it is assigned an uncertainty estimate. The L_D is the smallest quantity of radioactivity that can be reliably distinguished from background 95 percent of the time, based on counting statistics (for a laboratory detection system, the L_D is equal to the laboratory MDA when the units are converted from counts to activity). The L_C is the level at which a 5 percent chance exists of calling a background sample value "greater than background" (that is, the probability of a false positive). Alternatively, the L_C is the smallest quantity of radioactivity that can be distinguished reliably from background 50 percent of the time, based on counting statistics and other matters. For the purpose of reporting individual measurement results, any response above the instrument L_C will be considered to be above background (or a net positive result)."

The underlined portions of the above discussion makes it clear that, at the L_C level, measurements are equally likely to be from the background or not. That is to say, the Type II false negative error is 50%. It is common practice to use both 5% for both Type I (false positive) and Type II (false negative) errors, which is accomplished by the use of L_D or MDA.

There are two schools of thought regarding the use of L_C and MDA as detection levels. A statistician may recommend the use of L_C, however the common practice is to use MDA. Numerous examples of the use of MDA (or MDC), not L_C are listed below.

- MARSSIM uses scan MDC (not scan L_C) to verify that instruments are able to see levels below the release criteria (or derived concentration guidelines (DCGL)).
- Laboratories report radionuclide concentration, +/- 2 sigma error ranges and the MDC. They do not report L_C. Radiochemistry laboratories will commonly define the U flag as *"Analyte was analyzed for, but not detected above the MDL, MDA, or LOD."*
- The AOC mandates the use of a background value or a MDC as a look-up table (LUT) value with which to make a remedial decision.
- The USEPA utilized either the maximum of a background threshold value (BTV) or an MDC (not an L_C) with which to calculate radiological trigger levels (RTL) to determine the need for Round 2 step-out sampling.
- The USEPA utilized either the maximum of a background threshold value (BTV) or an MDC (not an L_C) with which to calculate radiological reference concentrations (RRC)
- The USEPA utilized either the maximum of a background threshold value (BTV) or an MDC (not an L_C) in its recommended process to calculate look-up table (LUT) values.
- The DTSC utilized either the maximum of a background threshold value (BTV) or an MDC (not an L_C) in calculating look-up table (LUT) values.
- The DTSC approved the use of soil MDC (not L_C) in evaluating if NASA ISRA soil was non-detect.
- The CDPH utilized MDC (not L_C) in determining whether Boeing ISRA soil concentrations were detects or non-detects.
- CDPH calculated and utilized instrument scanning MDCs (not L_C) in the recent confirmation survey of building 4100.
- CDPH's laboratory wipe test counter calculates and utilizes MDA (not L_C) to report detection limits for wipes.
- The chemical analog for a radionuclide MDA (or MDC) is the method detection limit (MDL). A higher reporting limit (RL) is often used as a chemical detection limit. There is no chemical analog for a parameter, lower that the MDL which would be synonymous with an L_C.
- Comparison of the MDA (not L_C) to a regulatory limit is used to ensure that a measurement technique is capable of demonstrating compliance to that regulatory limit.

These statistical detection levels discussed above are based on counting statistics and assume that the material measured is identical in composition and content to the background material and <u>does not reflect inherent variability in different construction materials</u>.

2.26 Hirsch Report, page 47. Comments about Count Times

The Hirsch report asserts that Boeing used low count times and compares to the EPA Tetra-Tech survey of Building 4055, without reporting their count times. Boeing uses a 5-minute count time for background and a 1-minute count time for sample locations. Tetra-Tech used a 20-minute count time for background and a 2-minute count time for sampled locations. Using the same count times as Tetra-Tech would have reduced Boeing's MDAs by 33%. That is to say, a beta MDA of 900 dpm/100 cm^2 would reduce to 600 dpm/100 cm^2 and an alpha MDA of 450 dpm/100 cm^2 would reduce to 300 dpm/100 cm^2. Clearly that would still not be sufficient to achieve an alpha MDA of less than 100 dpm/100 cm^2.

However, inspection of the EPA Tetra-Tech report shows that Tetra-Tech, although it utilized an "instrument efficiency", apparently failed to use a "surface efficiency" in translating from counts per minute to dpm/100 cm^2. Boeing currently uses "surface efficiencies" of 0.25 for alpha and 0.5 for beta activity. By doing so, Boeing's dpm/100 cm^2 values for backgrounds, net measurements, and MDAs are all increased by a factor of 4 for alpha, and by a factor of 2 for beta. This is the main reason that Boeing has difficulty in achieving low alpha MDAs. If Boeing had not used "surface efficiencies" like Tetra-Tech, then Boeing's alpha MDAs would generally have been less than 100 dpm/100 cm^2.

APPENDIX A

(March 15, 2021)

Withdrawal of Regulatory Guide 1.86

There are several citations in this paper to the Nuclear Regulatory Commission's Regulatory Guide 1.86[120] which specifies surface contamination limits below which material and equipment can be released for unrestricted use, i.e., released from radiological regulatory control. The NRC withdrew R.G. 1.86 on August 12, 2016.[121]

Since the subject building demolition operations of 2010 through 2013, that were the subject of the complaint, pre-dated the withdrawal in 2016, the withdrawal obviously has no bearing on the building demolition operations, the legal proceedings following the complaint or the previous pages of this paper. Furthermore, the use of identical surface contamination limits as R.G. 1.86 in other cited documents, implemented by other federal and state agencies, and contractors has not been affected.

In withdrawing R.G. 1.86, NRC stated,

> *"Although R.G. 1.86 is withdrawn, current licensees may continue to use it, and withdrawal does not affect any existing licenses or agreements."*[122]

The surface contamination limits of R.G. 1.86 are still appropriate and enforceable NRC limits in current NRC decommissioning guidance. Section 15.11.1.1 of NUREG-1757[123] states,

> *"For materials licensees, NRC staff usually authorizes the release of solid material through specific license conditions. One set of criteria that is used to evaluate solid materials before they are released is contained in Regulatory Guide 1.86, entitled "Termination of Operating Licenses for Nuclear Reactors." A similar guidance document is Fuel Cycle Policy and Guidance Directive FC 83-23, entitled "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source or Special Nuclear Materials Licenses." Both documents contain a table of surface contamination criteria which may be applied by*

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[120] US Nuclear Regulatory Commission, Regulatory Guide 1.86, "Termination of Operation Licenses for Nuclear Reactors", June 1974. https://pbadupws.nrc.gov/docs/ML0037/ML003740243.pdf

[121] Federal Register, Volume 81, Number 156. https://www.govinfo.gov/content/pkg/FR-2016-08-12/html/2016-19195.htm

[122] Ibid.

[123] USNRC, NUREG 1757, "Consolidated Decommissioning Guidance", Section 15.11.1.1, Release of Solid Materials with Surface Residual Radioactivity. September 2006. https://www.nrc.gov/docs/ML0630/ML063000243.pdf

licensees for use in demonstrating that solid material with surface contamination can be safely released with no further regulatory control."

Fuel Cycle Policy and Guidance Directive FC 83-23[124] includes Table 1 of Enclosure 2 that gives acceptable surface contamination levels, identical to the withdrawn R.G. 1.86.

Finally, the USNRC has another existing guidance document called "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material."[125] This guidance contains identical acceptable surface contamination levels as R.G. 1.86.

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[124] USNRC, "Fuel Cycle Policy and Guidance Directive FC 83-23, "Termination of Byproduct, Source and Special Nuclear Material Licenses", Last Updated October 30, 2017, https://www.nrc.gov/about-nrc/radiation/protects-you/hppos/hppos266.html . Copy of actual document. https://www.nrc.gov/docs/ML0037/ML003745523.pdf

[125] USNRC. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material."
July 1982. https://www.nrc.gov/docs/ML1034/ML103430093.pdf
April 1993. https://www.nrc.gov/docs/ML1036/ML103620647.pdf

APPENDIX B

(March 15, 2021)

ANSI/HPS N13.12

Several references were made earlier in this paper to an American National Standards Institute (ANSI) standard, ANSI/HPS N13.12-1999, "Surface and Volume Radioactivity Standards for Clearance."[126] The following is some of the introductory material from the standard,

> *"This standard is intended to provide guidance for protecting the public and the environment from radiation exposure by specifying a primary radiation dose criterion and derived screening levels for the clearance of items that could contain radioactive materials."*
>
> *"This standard applies to the clearance of materials and equipment from controlled areas during operations. This standard establishes a primary radiation dose criterion and derived screening levels for surface and volume contamination for groups of radionuclides."*
>
> *"The primary criterion of this standard is to provide for public health and safety to an average member of a critical group such that the dose shall be limited to 10 µSv/y (1.0 mrem/y) Total Effective Dose Equivalent (TEDE), above background, for clearance of materials from regulatory control. When justified on a case-by-case basis, clearance shall be permitted at higher dose levels when it can be assured that exposures to multiple sources (including those that are beyond the scope of this standard) will be maintained ALARA and will provide an adequate margin of safety below the public dose limit of 1 mSv/y (100 mrem/y) TEDE."*
>
> *"ANSI/HPS N13.12-1999 provides screening levels, above background, for the clearance of solid materials or items that contain surface or volume activity concentrations of radioactive materials. The screening levels shall apply, irrespective of future use or application of the material after clearance."*

In May 2013, this standard was revised, becoming ANSI/HPS N13.12-2013.[127] Screening levels for some radionuclides were reduced, some increased, most stayed the same. Table B1 below

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[126] ANSI/HPS N13.12-1999. "Surface and Volume Radioactivity Standards for Clearance." American National Standards Institute/Health Physics Society, 1999. The obsolete version of this standard may not be reproduced in any electronic media without permission of the publisher.

[127] ANSI/HPS N13.12-2013. "Surface and Volume Radioactivity Standards for Clearance." American National Standards Institute/Health Physics Society, May 2013. This current version of the standard may not be reproduced in any electronic media but may be purchased at …
https://global.ihs.com/doc_detail.cfm?document_name=ANSI%2FHPS%20N13%2E12&item_s_key=00610089

summarizes and compares screening levels for both versions of the standard to the acceptable surface contamination levels of Regulatory Guide 1.86.

The radionuclides identified in Table B1 are those analyzed by USEPA and its contractor in the 2009-2012 Area IV Radiological Study. In the "Final Technical Memorandum – Lookup Table Recommendations",[128] EPA prioritized 57 radionuclides. Priority 1 radionuclides were those that were detected at concentrations exceeding the project radiological reference concentrations (RRC). There were seventeen Priority 1 radionuclides including 6 anthropogenic radionuclides (Cs-137, Co-60, Eu-152, Ni-63, Pu-239/240 and Sr-90) and 11 naturally occurring radioactive materials (NORM) including U-238 and progeny, Th-232 progeny and U-235. Of course, uranium, and to a lesser extent, are also potential nuclear fuel contaminants. EPA recommended focusing on the Priority 1 radionuclides in future remedial operations. Of the 478 anthropogenic background threshold value (BTV) exceedances, 291 (61%) were Cs-137 and 153 (32%) were Sr-90.[129]

Thirty-five Priority 2 radionuclides were not detected above RRC levels, and 5 radionuclides were not prioritized at all.

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[128] USEPA, ""Final Technical Memorandum - Lookup Table Recommendations, SSFL Area IV Radiological Study", November 27, 2012. https://www.dtsc-ssfl.com/files/lib_doe_area_iv/epaareaivsurvey/techdocs/65778_Final_Tech_Memo_Lookup_Table_Recommendations_112712.pdf

[129] USEPA, "EPA Radiological Characterization Study Results", November 2012. https://www.boeing.com/resources/boeingdotcom/principles/environment/pdf/EPA_November_2012_Factsheet.pdf

Table B1. Comparison of Regulatory Guide 1.86 Acceptable Surface Contamination Levels with ANSI/HPS N13.12 Screening Levels for Clearance

EPA Radionuclides of Concern for Area IV		Source	Decay Mode	EPA Area IV Priority	Total Surface Contamination Levels (dpm/100 cm^2)		
					Reg Guide 1.86[1]	ANSI N13.12 1999	ANSI N13.12 2013
A	B	C	D	E	F	G	H
Actinium-228[2]	Ac-228	NORM	βγ	1	5,000		
Bismuth-212[2]	Bi-212	NORM	βγ, α	1	5,000		
Bismuth-214[2]	Bi-214	NORM	βγ	1	5,000		
Cesium-137	Cs-137	Man-made	βγ	1	5,000	6,000	600
Cobalt-60	Co-60	Man-made	βγ	1	5,000	6,000	600
Europium-152	Eu-152	Man-made	EC, βγ	1	5,000	6,000	600
Lead-212[2]	Pb-212	NORM	βγ	1	5,000		
Lead-214[2]	Pb-214	NORM	βγ	1	5,000		
Nickel-59	Ni-59	Man-made	EC	1	5,000		600,000
Plutonium-239/240	Pu-239/240	Man-made	α	1	100	600	600
Strontium-90	Sr-90	Man-made	β	1	1,000	6,000	6,000
Thallium-208[2]	Tl-208	NORM	βγ	1	5,000		
Thorium-230[2]	Th-230	NORM	α	1	100	600	600
Thorium-234[2]	Th-234	NORM	βγ	1	5,000		
Uranium-234	U-233/234	NORM	α	1	5,000	6,000	6,000
Uranium-235	U-235/236	NORM	α	1	5,000	6,000	6,000
Uranium-238	U-238	NORM	α	1	5,000	6,000	6,000
Actinium-227[2]	Ac-227	NORM	βγ, α	2	100		
Americium-241	Am-241	Man-made	α	2	100	600	600
Americium-243	Am-243	Man-made	α	2	100		600
Antimony-125	Sb-125	Man-made	βγ	2	5,000		600
Cadmium-113m	Cd-113m	Man-made	βγ	2	5,000		
Carbon-14	C-14	MM and NORM	βγ	2	5,000	600,000	6,000
Cesium-134	Cs-134	Man-made	βγ	2	5,000	6,000	600
Curium-243/244	Cm-243/244	Man-made	α	2	100	600	6,000
Curium-245/246	Cm-245/246	Man-made	α	2	100		600
Curium-248	Cm-248	Man-made	α	2	100		600
Europium-154	Eu-154	Man-made	βγ	2	5,000	6,000	600
Europium-155	Eu-155	Man-made	βγ	2	5,000		6,000
Holmium-166m	Ho-166m	Man-made	βγ	2	5,000		
Iodine-129	I-129	Man-made	βγ	2	100	60,000	600
Neptunium-236	Np-236	Man-made	EC, βγ, α	2	100		
Neptunium-237	Np-237	Man-made	α	2	100	600	6,000
Neptunium-239	Np-239	Man-made	βγ	2	100		
Nickel-63	Ni-63	Man-made	βγ	2	5,000	600,000	600,000
Niobium-94	Nb-94	Man-made	βγ	2	5,000	6,000	600
Plutonium-236	Pu-236	Man-made	α	2	100		6,000
Plutonium-238	Pu-238	Man-made	α	2	100	600	600
Plutonium-241	Pu-241	Man-made	βγ	2	5,000	60,000	60,000
Plutonium-244	Pu-244	Man-made	α	2	100		600
Potassium-40	K-40	NORM	βγ	2	5,000		
Promethium-147	Pm-147	Man-made	βγ	2	5,000	600,000	600,000
Protactinium-231	Pa-231	NORM	α	2	100		
Radium-226	Ra-226	NORM	α	2	100	600	600
Sodium-22	Na-22	MM and NORM	EC	2	5,000	6,000	600
Technetium-99	Tc-99	Man-made	βγ	2	5,000	600,000	6,000
Thorium-228[2]	Th-228	NORM	α	2	100	600	600
Thorium-229	Th-229	Man-made	α	2	100		600
Thorium-232	Th-232	NORM	α	2	1,000	600	600
Thulium-171	Tm-171	Man-made	βγ	2	5,000		600,000
Tin-126	Sn-126	Man-made	βγ	2	5,000		
Tritium	H-3	MM and NORM	β	2	5,000	600,000	600,000
Iron-55[3]	Fe-55	Man-made	EC	-	5,000	600,000	600,000
Plutonium-242[3]	Pu-242	Man-made	α	-	100		600
Radium-228[3]	Ra-228	NORM	βγ	-	100	600	600
Tellurium-125m[3]	Te-125m	Man-made	IT	-	5,000		600,000
Uranium-232[3]	U-232	Man-made	α	-	5,000		600

[1] Average values taken from Regulatory Guide 1.86

[2] Progeny in decay chains are included in the total activity of the parent

[3] Radionuclides not included in final EPA Priority List

EPA Priority 1 radionuclides highlighted in yellow

Most limiting (restrictive) surface activity of Priority 1 radionuclides highlighted in green

Column F of Table B1 provides the Regulatory Guide 1.86 acceptable surface contamination levels. Columns G and H of Table B1 provides the ANSI/HPS N13.12-1999 and ANSI/HPS N13.12-2013 screening levels.

Table B1 highlights EPA Priority 1 radionuclides in yellow. Of those, the most limiting contamination level is highlighted in green.

Several conclusions can be drawn from comparison of these levels.

ANSI/HPS N13.12-1999

- The most restrictive alpha screening level is 600 dpm/100 cm^2 (e.g., transuranics). This exceeds the most restrictive R.G. 1.86 alpha level of 100 dpm/100 cm^2.
- The most restrictive general beta/gamma screening level is 6,000 dpm/100 cm^2. This is comparable with the R.G. 1.86 general beta/gamma level of 5,000 dpm/100 cm^2.
- The Sr-90 beta screening level of 6,000 dpm/100 cm^2. This exceeds the R.G. 1.86 beta level of 1,000 dpm/100 cm^2.

ANSI/HPS N13.12-2013

- The most restrictive alpha screening level is 600 dpm/100 cm^2 (e.g., transuranics). This is unchanged from ANSI/HPS N13.12-1999. This exceeds the most restrictive R.G. 1.86 alpha level of 100 dpm/100 cm^2.
- For the EPA Priority 1 radionuclides the ANSI/HPS N13.12-2013 are generally unchanged from ANSI/HPS N13.12-1999 with several notable exceptions.
    - Cs-137, Co-60 and Eu-152 beta/gamma screening levels have been reduced from 6,000 dpm/100 cm^2 to 600 dpm/100 cm^2. Co-60 and Eu-152 are neutron activation products and were only detected above the BTV in 4 and 6 samples respectively out of 3,735 soil and sediment samples in the EPA Area IV Radiological Study.[130] They are therefore not significant contamination risk drivers in soil. In contrast, Cs-137 is the most significant contamination risk driver in soil.

[130] Ibid.

- The Sr-90 beta screening level is 6,000 dpm/100 cm^2. This is unchanged from ANSI/HPS N13.12-1999. This exceeds the R.G. 1.86 Sr-90 beta level of 1,000 dpm/100 cm^2.

- Section 2.22 provided the range and average gross total alpha and beta cpm measurements in an off-site residence.[131] Using the instrument efficiencies and surface efficiencies, we can calculate the range and average gross total alpha and beta in units of dpm/100 cm^2. See Table B2.

Table B2. Gross Alpha/Beta Activity from Off-site Residence without Background Subtraction

Off-site Residence	Units	Gross Alpha			Gross Beta		
		Min	Max	Average	Min	Max	Average
Gross count per minute	cpm	1	27	9	226	805	527
Instrument Efficiency	cpm/emission	0.177	0.177	0.177	0.184	0.184	0.184
Surface Efficiency	emission/dpm	0.25	0.25	0.25	0.5	0.5	0.5
Probe Area	cm^2	100	100	100	100	100	100
Gross surface activity	dpm/100 cm^2	23	610	203	2,457	8,750	5,728

- Clearly, gross alpha and beta measurements in a non-impacted, non-contaminated location are due to potassium-40 and beta emitting progeny of naturally occurring uranium and thorium. In fact, the 73 gross measurements taken in the off-site residence could be regarded as a comprehensive set of reference, background data, including background data variability.

- The average background gross beta surface activity of 5,728 dpm/100 cm^2 is close to the 6,000 dpm/100 cm^2 ANSI/HPS N13.12-1999 general beta/gamma screening level. Furthermore, the range of background gross beta surface activity of 8,750 – 2,457 = 6,293 dpm/100 cm^2 is also similar to the 6,000 dpm/100 cm^2 ANSI/HPS N13.12-1999 general beta/gamma screening level. Distinguishing a net difference of 10% or 600 dpm/100 cm^2 for a hypothetical Cs-137 contaminant from ANSI/HPS N13.12-2013 without isotopic speciation is not practical.

[131] Boeing, "Off-site West Hills Residence Radiological Survey", September 4, 2013. See Appendix F of this paper.

APPENDIX C

(March 15, 2021)

Radiologic Health Branch Internal Documents, DECON-1 and IPM-88-2

In its "Radiological Release Survey and Waste Certification" documentation, Boeing references two Radiologic Health Branch (RHB) documents, DECON-1, and IPM-88-2[132] that utilize the same surface contamination limits as NRC Regulatory Guide 1.86. In the Declaration of Gonzalo Perez, Chief of the Radiologic Health Branch (RHB)[133] in the legal proceedings following the Complaint, it was stated that these two documents had previously been withdrawn in 2002. At the time of the declaration, Mr. Perez had been Chief for less than three years. Is important to note that these documents, even when they were still valid, were intended to guide RHB personnel in conducting its own verification surveys. They were never published on the RHB website, though they were freely provided to licensees upon request, which is how Boeing obtained copies before their withdrawal? However, RHB did not notify licensees, certainly not Boeing, that it had withdrawn DECON-1 and IPM-88-2 for internal use.

It is instructive to review Mr. Perez discussion of DECON-1 and IPM-88-2.

> *"The Radiologic Health Branch's Policy No. IPM-88-2 was superseded by Policy No. RML-00-02, effective as of May 1, 2000. Therefore, since May 1, 2000, Policy No. IPM-88-2 has not been in effect as Branch policy. Additionally, Policy No. RML-00-02 has not been followed as Branch policy since issuance of the 2002 Amended Peremptory Writ of Mandate requiring that DPH set aside its regulatory adoption of dose-based radiological criteria for license termination. Policy No. RML-00-02 was formally rescinded on January 1, 2013."*
> *"DECON-1 is not Branch policy and has not been Branch policy since at least 2002."*
>
> *"Decommissioning and termination of radioactive material licenses issued by DPH is governed by California Code of Regulations, Title 17, section 30256, subdivision (k). DPH's Health Physicists are responsible for making the determinations required by that regulation, including determining whether radioactive material has been properly*

[132] (a) California Department of Public Health. DECON-1. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use."
https://www.philrutherford.com/Radiation_Cleanup_Standards/DECON-1.pdf
(b) California Department of Public Health, IPM-88-2. "Clearance Inspection and Survey." December 1, 1997.
https://www.philrutherford.com/Radiation_Cleanup_Standards/IPM-88-2.pdf

[133] Declaration of Gonzalo Perez, Chief of Radiologic Health Branch in Support of Respondent Department of Public Health's Opposition to Motion for Preliminary Injunction. October 25, 2013.
https://www.philrutherford.com/boeing_building_demolition/Dec_of_G_Perez_in_Support.pdf

disposed, determining whether the licensee has made a reasonable effort to eliminate any residual contamination, and determining whether the premises are suitable for release for unrestricted use. Those determinations are made on a case-by-case basis and are not governed by any set policy or required standard."

"Since 2002, DPH's Health Physicists and their supervisors have had complete discretion to exercise their professional judgment as to which standards and/or criteria to apply in making the determinations required by Section 30256. DPH's Health Physicists are never, under any circumstances, required to apply or follow, for example, IPM-88-2, DECON-1, Regulatory Guide 1.86, or U.S. Department of Energy Order 5400.5, nor are they required to apply or follow any other particular standard, criteria, or formula. DPH's Health Physicists are, likewise, not forbidden from applying whatever standards or criteria that they, in their professional judgment, conclude will assist them in making the determinations required by Section 30256. Similarly, DPH's Health Physicists have complete discretion to exercise their professional judgment as to which standards and/or criteria to apply in any other circumstance where they are called upon to evaluate the existence of radioactive contamination, or whether radioactive contamination constitutes a hazard to the public health."

"Since issuance of the 2002 Amended Peremptory Writ of Mandate, DPH has not adopted or re-adopted the radiological criteria for license termination set forth in 10 Code of Federal Regulations parts 20.1401-1406, or any similar provisions relating to the establishment of clean-up standards for license termination."

The 2002 Amended Peremptory Writ of Mandate refers to the lawsuit by the Committee to Bridge the Gap (CBG) following the RHB's adoption of the Nuclear Regulatory Commission's License Termination Rule, 10 CFR 20 Subpart E, Sections 1401-1406. As an Agreement State, California was obligated to adopt NRC regulations. CBG won its lawsuit.

It is unconscionable that a California court should find for the plaintiff. It is unconscionable that the California DPH has not adopted dose-based license termination regulations as required by the court. And it is even more unconscionable that RHB should openly admit to a garbled, vague, imprecise policy highlighted in yellow above. Mr. Perez's statement can be summarized as follows. RHB has withdrawn former numerical standards used to assist its own health physicists in determining if a facility can be released for unrestricted use. Our health physicists are not required to use any specific standards, but they can use their own professional judgement and use any standards that they wish. It appears that RHB lawyers are hanging its health physicists out to dry. Of course, RHB health physicists are smarter than their lawyers and continued to do what they have always done and used the DECON-1 / IPM-88-2 / R.G. 1.86

standards for radiological surveys. RHB health physicists did just that in the 2013 verification survey for building 4100.[134]
Notwithstanding the smoke and mirrors Mr. Perez (or his lawyers) played in his declaration, Boeing's Radioactive Materials License 0015-19 Amendment 112, License Condition 13(o) [135] referenced SSFL's Sitewide Release Criteria[136] which included the same surface contamination levels as DECON-1 and IPM-88-2 that were explicitly approved by the RHB.[137]

Mr. Perez had been preceded by Edgar Bailey as Chief of RHB from 1989 to 2006. Mr. Bailey also filed a declaration in the legal proceedings following the Complaint.[138] In his declaration, Mr. Bailey stated,

> *"Conclusions regarding the appropriateness of the evaluation of radiological issues associated with demolition debris from Area IV at the SSFL."*
> *"Based upon my review and evaluation of relevant documents, I conclude that NRC Regulatory Guide 1.86 is appropriate guidance to be used by regulatory agencies, along with other criteria, in evaluating surface contamination in buildings when making decisions regarding their release for unrestricted use and termination of regulatory control, and in evaluating whether buildings which never required a radioactive materials license may be safely reused or disposed."*
>
> *"I also conclude that NRC Regulatory Guide 1.86 (and corresponding California guidance) was properly used and implemented by the NRC and RHB as part of their overall decision-making process in releasing buildings at the SSFL for unrestricted use, and in their evaluations regarding whether buildings which never required a radioactive materials license may be safely reused or disposed."*

[134] CDPH, "Radiological Assessment Unit, Confirmation Survey, Santa Susana Field Laboratory, Area IV, Building 4100, Rooms 112, 113, 114 and Annex", July 27, 2013, Appendix A. Release Criteria, Table 9. USAEC Regulatory Guide 1.86 - Acceptable Surface Contamination Levels.
https://www.philrutherford.com/boeing_building_demolition/RHB_Confirmatory_Survey_of_SSFL_4100_112_113_114_An_(v1.02_scanned_reduced).pdf#page=26

[135] Radioactive Materials License 0015-19, Amendment 112, License Condition 13(o), July 9, 2013.
https://www.philrutherford.com/boeing_building_demolition/0015-19_Amendment_112.pdf#page=3

[136] N001SRR140131, "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL", Page 14, Section 4, Table 5. "Surface Contamination Guidelines for SSFL Facilities", February 18, 1999.
https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf#page=14

[137] Letter from Gerard Wong, Chief, Radioactive Materials Licensing, Radiologic Health Branch to Majelle Lee (Rocketdyne), "Authorized Sitewide Radiological Guidelines for Release of Unrestricted Use", August 9, 1996.
https://www.etec.energy.gov/Library/Main/N001SRR140131.pdf#page=27

[138] Declaration of Edgar D. Bailey in Support of Real Party in Interest The Boeing Company's Memorandum in Opposition to Petitioner's Motion for Preliminary Injunction", October 25, 2013.
https://www.philrutherford.com/boeing_building_demolition/Declaration_of_Edgar_Bailey.PDF

> *"Similarly, I have concluded that appropriate methods and procedures were used to consider whether or not materials were volumetrically contaminated with radioactive materials and to assess their potential radiological impacts."*
>
> *"In my opinion Boeing, the NRC, and RHB have correctly concluded that materials from buildings at SSFL Area IV which have been "released for unrestricted use," as well as materials from buildings at SSFL Area IV which never required a radioactive materials license, can be disposed of subject only to the requirements of DTSC."*
>
> *"Based on my review of the relevant information, and my experience in nuclear regulation and nuclear safety, it is my opinion that the standards, policies, and procedures presently being used with regard to the SSFL are protective of the public health and safety and the environment."*

Clearly, RHB still implements surface contamination standards of Regulatory Guide 1.86, DECON-1 and IPM-88-2 and believes those standards are protective of public health and the environment.

APPENDIX D

(March 15, 2021)

Declarations of Dr. Bemnet Alemayehu

In early 2018, Plaintiffs in the Complaint filed two declarations by Dr. Bemnet Alemayehu of the Natural Resources Defense Council (NRDC).[139,140] In these declarations, Dr. Alemayehu compared surface contamination limits from Regulatory guide 1.86 to Building Preliminary Remediation Goals (BPRG) that he derived using the USEPA's BPRG Calculator.[141] Dr. Alemayehu concludes that than the BPRGs based on a risk level of 10^{-6} excess lifetime cancer risk (ELCR) are, in general, orders of magnitude less than R.G. 1.86 surface contamination limits. The implication is that R.G. 1.86 limits are much less "safe" than a 10^{-6} risk point of departure. However, Dr. Alemayehu fails to acknowledge that the BPRGs are also orders of magnitude less than both the mean and variability of surface activity measurements from naturally occurring radioactive materials (NORM) in a wide variety of materials. The BPRGs are also significantly less than the minimum detectable concentrations (MDC) for field instrumentation used in radiological release surveys.

NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" was originally published in December 1997 coincident with the original publication date of NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM). NUREG-1507 is considered a supporting document to MARSSIM. Since then, both have been revised, NUREG-1507 in August 2020[142] and MARSSIM in August 2000.[143]

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[139] Superior Court of California, County of Sacramento, Case No.: 34-2013-80001589, "Declaration of Dr. Bemnet Alemayehu in Support of Petition for Writ of Mandate", Dated May 4, 2018. Filed February 22, 2018. https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/3460314691/180220%20Decl.%20of%20Bemnet%20Alemayehu%20iso%20Petition%20for%20Writ%20of%20Ma.pdf

[140] Superior Court of California, County of Sacramento, Case No.: 34-2013-80001589, "Reply Declaration of Dr. Bemnet Alemayehu in Support of Petition for Writ of Mandate", Dated May 4, 2018. Filed April 19, 2018. https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/8564452230/180419%20Reply%20Declaration%20Bemnet%20Alemayehu.pdf

[141] USEPA. "Building Preliminary Remediation Goals for Radionuclides." https://epa-bprg.ornl.gov/
https://epa-bprg.ornl.gov/cgi-bin/bprg_search

[142] USNRC, NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Revision 1, August 2020, https://www.nrc.gov/docs/ML2023/ML20233A507.pdf

[143] USNRC, NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual", Revision 1, August 2000. https://www.nrc.gov/docs/ML0037/ML003761445.pdf
MARSSIM Appendices. https://www.nrc.gov/docs/ML0037/ML003761454.pdf

Tables 5.1 and 5.2 from NUREG-1507, reproduced below as Tables D1 and D2, present typical backgrounds (in counts per minute (cpm)) for a variety of instruments and materials and MDCs (in dpm/100 cm^2) for a variety of materials. We will use as a representative example the ambient alpha and beta data for the gas proportional detector and convert the background count rate (in cpm) to surface activity (in dpm/100 cm^2).

Table D1. NUREG-1507, Table 5-1

Table 5-1 Background Count Rate for Various Materials

Surface Material	Background Count Rate (cpm)[a]					
	Gas Proportional			GM	ZnS	NaI
	α Only	ß Only	α + ß			
Ambient[b]	1.00 ± 0.45[c]	349 ± 12	331.6 ± 6.0	47.6 ± 2.6	1.00 ± 0.32	4,702 ± 16
Brick	6.00 ± 0.84	567.2 ± 7.0	573.2 ± 6.4	81.8 ± 2.3	1.80 ± 0.73	5,167 ± 23
Ceramic block	15.0 ± 1.1	792 ± 11	770.2 ± 6.4	107.6 ± 3.8	8.0 ± 1.1	5,657 ± 38
Ceramic tile	12.6 ± 0.24	647 ± 14	648 ± 16	100.8 ± 2.7	7.20 ± 0.66	4,649 ± 37
Concrete block	2.60 ± 0.81	344.0 ± 6.2	325.0 ± 6.0	52.0 ± 2.5	1.80 ± 0.49	4,733 ± 27
Drywall	2.60 ± 0.75	325.2 ± 8.0	301.8 ± 7.0	40.4 ± 3.0	2.40 ± 0.24	4,436 ± 38
Floor tile	4.00 ± 0.71	308.4 ± 6.2	296.6 ± 6.4	43.2 ± 3.6	2.20 ± 0.58	4,710 ± 13
Linoleum	2.60 ± 0.98	346.0 ± 8.3	335.4 ± 7.5	51.2 ± 2.8	1.00 ± 0.45	4,751 ± 27
Carbon steel	2.40 ± 0.68	322.6 ± 8.7	303.4 ± 3.4	47.2 ± 3.3	1.00 ± 0.54	4,248 ± 38
Treated wood	0.80 ± 0.37	319.4 ± 8.7	295.2 ± 7.9	37.6 ± 1.7	1.20 ± 0.20	4,714 ± 40
Untreated wood	1.20 ± 0.37	338.6 ± 9.4	279.0 ± 5.7	44.6 ± 2.9	1.40 ± 0.51	4,623 ± 34

[a]Background count rates determined from the mean of five 1-minute counts.
[b]Ambient background determined at the same location as for all measurements, but without the surface material present.
[c]Uncertainties represent the standard error in the mean count rate, based only on counting statistics.

Table D2. NUREG-1507, Table 5-2

Table 5-2 MDCs for Various Materials

Surface Material	MDC (dpm/100 cm^2)[a]	
	Gas Proportional	
	α Only	ß Only
Ambient	30	285
Brick	57	361
Ceramic block	83	425
Ceramic tile	78	385
Concrete block	41	283
Drywall	41	275
Floor tile	49	268
Linoleum	41	284
Steel	40	275
Treated wood	28	273
Untreated wood	32	281

[a]MDCs were calculated based on the background count rates presented in Table 5-1 for the gas proportional detector. The alpha-only and beta-only efficiencies were assumed to be 0.20 and 0.25 c/dis, respectively. Probe area corrections of 126 cm^2 were made for the gas proportional detectors. The following MDC equation was used for 1-minute counts:

$$MDC = \frac{3+4.65\sqrt{C_B}}{KT}$$

Table D3. Background and Minimum Detectable Concentration for Ambient Gas proportional Detector from NUREG-1507, Tables 5-1 and 5-2

Parameter	Symbol	Units	Equation	Alpha		Beta	
				Mean	+/- 1σ	Mean	+/- 1σ
Background Count Rate	C_B	cpm		1.0	0.45	349	12
Efficiency	K	cpm/dpm		0.20	-	0.25	-
Area factor	AF	-		1.26	-	1.26	-
Count Time	T	minute		1	-	1	-
Background Surface Activity	SA_B	dpm/100 cm^2	C_B / (K * AF)	4.0	1.8	1,108	38
Miinimum Detectable Concentration	MDC	dpm/100 cm^2	$\frac{3 + 4.65 * (C_B*T)^{0.5}}{K*AF*T}$	30	-	285	-

The following ambient measurements are considered conservative (low) background surface activities for non-contaminated materials. The minimum detectable concentrations (MDCs) are considered acceptable data quality objectives (DQOs) and meet (are less than) the derived concentration guidelines (DCGLs) typically used in MARSSIM release surveys.

- Alpha background surface activity 4.0 +/- 1.8 dpm/100 cm^2
- Beta background surface activity 1,108 +/- 38 dpm/100 cm^2
- Alpha Minimum Detectable Concentration 30 dpm/100 cm^2
- Beta Minimum Detectable Concentration 285 dpm/100 cm^2

Typical BPRGs in Dr. Alemayehu's declaration for common contaminants of concern (CoC) are shown in Table D4 compared to the range of MDCs for different materials from Table D2. Clearly the BPRGs derived by Dr. Alemayehu are significantly less than the detection capabilities of and backgrounds of typical radiation instrumentation used in MARSSIM surveys. Dr. Alemayehu should look at the results of his 10^{-6} BPRG calculations and ask himself.

- Do these numbers make sense?
- Can we measure down to these levels with state-of-the-art field instrumentation?
- Is a 10^{-6} risk BPRG meaningful in a world where naturally occurring radiation is at a risk level of approximately 10^{-2}?[144]

The answer to all these questions is no!!!

[144] Average background radiation in the U.S. is 300 mrem/y. The EPA BPRG calculator uses a 26-year exposure duration, so 26 x 300 = 7800 mrem = 7.8 rem. The BEIR VII radiation risk is 0.00114 per rem, which gives a background radiation risk of 7.8 x 0.00114 = 0.0089

Table D4. 10^{-6} BPRGs Compared to NUREG-1507 MDCs and Background

Total Alpha (dpm/100 cm^2)			Total Beta (dpm/100 cm^2)		
Dr. Alemayehu's BPRGs	U-238	2.664	**Dr. Alemayehu's BPRGs**	Cs-137	11.211
	Th-232	1.328		Co-60	1.274
	Ra-226	2.686		Eu-152	1.738
	Pu-239	7.171		Tl-208	0.835
	Am-241	5.883		Sr-90	3,085,800
NUREG-1507 MDC Range*		28 - 83	**NUREG-1507 MDC Range***		268 - 425
NUREG-1507 Background Range**		3.2 - 60	**NUREG-1507 Background Range****		979 - 2,514

* From Table D2

** From Table D1, converting cpm to dpm/100 cm^2 using K and AF from Table D3

Strontium-90

Dr. Alemayehu's BPRGs include a value for strontium-90 of 13,900 pCi/cm^2 or 3,085,800 dpm/100 cm^2. This is considerably in excess of the 1,000 dpm/100 cm^2 from R.G. 1.86 and 6,000 dpm/100 cm^2 from ANSI/HPS N13.12-2013. Is Dr. Alemayehu willing to eat at his (3 ft x 3 ft) breakfast table if it is contaminated with 0.1 millicurie of strontium-90?[145] Clearly the EPA BPRG calculator is not modelling the beta-emitting, non-gamma-emitting Sr-90 correctly.

Potassium-40

Using the same default inputs, one would derive a 10^{-6} BPRG value for potassium-40 of 1.56 pCi/cm^2 or 346 dpm/100 cm^2. Potassium-40 is in all the food we eat and therefore the human body contains approximately 1.5 pCi of potassium-40 per gram or cc of flesh. Therefore, a 1 cm thick slice of human flesh would equal the EPA's building preliminary remediation goals.

These are some of the unrealistic conclusions reached when one blindly uses the conservative, politically expedient and controversial LNT radiation risk model at 10^{-6} risk levels that are well below background, well below background variability, and well below limits of detectability.

Similar arguments can be made for the "dust" BPRPs that Dr. Alemayehu compares to R.G. 1.86 removable limits. Table D5 compares Dr. Alemayahu's dust BPRPs to typical backgrounds and MDCs for a low background laboratory alpha/beta Tennelec counting system used to count wipe test filters used to measure removable surface contamination. Again, the 10^{-6} dust BPRGs are significantly lower that the Tennelec backgrounds and MDCs, demonstrating that the 10^{-6} dust BPRGs are not detectable and impractical to enforce.

[145] 13,900 pCi/cm^2 x 10^{-12} x 3 x 3 x 12 x 12 x 2.54 x 2.54 = 0.116 millicuries

Table D5. 10^{-6} Dust BPRGs Compared to Tennelec MDCs and Background

Dust Alpha (dpm/100 cm^2)			Dust Beta (dpm/100 cm^2)		
Dr. Alemayehu's BPRGs	U-238	0.011	**Dr. Alemayehu's BPRGs**	Cs-137	1.492
	Th-232	0.024		Co-60	1.259
	Ra-226	0.013		Eu-152	1.015
	Pu-239	0.041		Tl-208	3.219
	Am-241	0.044		Sr-90	0.513
	Tennelec MDC	12		**Tennelec MDC**	24
	Tennelec Background	0.3		**Tennelec Background**	7.8

Potassium-40

The dominant naturally occurring beta/gamma emitting radionuclide in non-contaminated soil is potassium-40. The average mass concentration of potassium-40 is 20 pCi/g. The density of soil is 1.5 g/cc, therefore the volumetric concentration is 20 x 1.5 = 30 pCi/cc. A common measure of atmospheric dust is PM10, meaning concentration of particulate matter with a diameter of 10 microns or 10 micrometers. A layer of dust of thickness 10 microns (0.001 cm) with an area of 100 cm2 would have a volume of 0.001 x 100 = 0.1 cc. 0.1 cc of soil-generated atmospheric dust would contain 30 x 0.1 = 3 pCi of potassium-40. 3 pCi/100 cm^2 is 0.03 pCi/cm^2 or 3 x 60 x 3.7 x 10^{10} / 1 x 10^{12} = 6.66 dpm/100 cm^2. This number is close to the Tennelec beta background but considerably less that the Tennelec beta MDC. Guess what the dust BPRG for potassium-40 is using the same default assumptions used by Dr. Alemayehu? It is 5.25 x 10^{-3} pCi/cm^2 or 1.2 dpm/100 cm^2. This figure for potassium-40 is similar to the beta BPRGs for cesium-137, cobalt-60 and europium-152 suggesting that we should be as concerned about the radiological risk from a layer of non-contaminated, unregulated, PM10 dust as we should be from the radiological risk from cesium, cobalt or europium contamination.

Dr. Alemayehu's second declaration, filed April 19, 2018, responded to a declaration by real party of interest, The Boeing Company's expert witness, Dr. Whipple. I do not have access to Dr. Whipple's declaration (or his citations) so cannot directly respond to most of Dr. Alemayehu's rebuttal. However, a couple of Dr. Alemayahu's statements deserve responses.

Dr. Alemayehu's claims that BEIR VII[146] and the EPA's Blue Book[147] *"makes it clear that there is* *no safe level of radiation."* This is misleading, disingenuous, and deliberatively inflammatory. Nowhere in BEIR VII or the EPA Blue Book is this statement made. It is however a favorite statement of Daniel Hirsch, anti-nuclear founder of the Committee to Bridge the Gap. In reality,

[146] National Academies of Sciences, Engineering & Medicine, BEIR VII Phase 2, "Health Risks from Exposure to Low Levels of Ionizing Radiation", 2006. https://www.nap.edu/catalog/11340/health-risks-from-exposure-to-low-levels-of-ionizing-radiation

[147] USEPA, EPA 402-R-11-001, "EPA Radiogenic Cancer Risk Models and Projections for the US Population", April 2011. https://www.epa.gov/sites/production/files/2015-05/documents/bbfinalversion.pdf

both EPA and BEIR VII clearly say that low dose radiation results in low estimated, theoretical cancer risks.

The EPA Blue Book states,

- *"… there is inadequate statistical power to quantify risk below about 10,000 millirem.[148] This is about 100 times the annual whole-body, low-LET dose to an individual from natural background [radiation]."* [Executive Summary, pages 3-4]

- *"For uniform while-body exposures of low-dose gamma radiation to the entire population, the cancer incidence risk coefficient is 0.00116 per rem … For perspective, the average individual receives about 100 millirem each year from low-LET natural background radiation, or about 7,500 millirem [per a 75-year] lifetime. The average cancer incidence and mortality risks from natural background radiation are then estimated to be about 0.87% and 0.44% respectively."[149]* [Executive Summary, page 2]

BEIR VII states,

- *"For this report, the committee has defined low dose as doses in the range of near zero up to about 10,000 millirem of low-LET radiation … The annual worldwide background exposure from natural sources of low-LET radiation is about 100 millirem."* [Public Summary, page 2]

- *"Additional small amounts of exposure from background and man-made radiation come from activities such as travelling by jet aircraft (cosmic radiation – add 1 millirem for each 1,000 miles travelled)."* [Public Summary, page 3]

- *"At doses less than 40 times the average yearly background exposure (10,000 millirem),[150] statistical limitations make it difficult to evaluate cancer risk in humans."* [Public Summary, page7]

- *"The BEIR VII lifetime risk model predicts that approximately 1 person in 100 would be expected to develop cancer (solid cancer or leukemia) from a dose of 10,000 millirem*

[148] Doses and dose rates in SI (metric) units (sieverts, millisieverts) have been translated into CGS units (rem, millirem). 1 Sv = 100 rem.

[149] EPA uses a 100 millirem/y for average low-LET background radiation. EPA also uses a 300 millirem/y estimate for all U.S. background radiation, including 200 millirem/y from high-LET indoor radon. Using 300 millirem/y and the same risk coefficients, the average cancer incidence and mortality risks from natural background radiation are estimated to be about 2.6% and 1.3% respectively.

[150] BEIR VII refers in this instance to the global average radiation background of 240 millirem/y.

above background, while approximately 42 of the 100 individuals would be expected to develop solid cancer or leukemia from other causes. Lower doses would produce proportionally lower risks. For example, the committee predicts that approximately one individual per thousand would develop cancer from an exposure to 1,000 millirem. As another example, approximately one individual per hundred would be expected to develop cancer from a lifetime (70-year) exposure to low-LET, natural background radiation (excluding radon and other high-LET radiation)." [Public Summary, page 8]

- Similar statements can be found in the BEIR VII Factsheet.[151]

EPA and BEIR VII acknowledge that,

- Low dose radiation risks below 10,000 millirem are theoretical estimates at best.
- LNT derived risks from background radiation are 10,000 to 30,000 times EPA's arbitrary 10^{-6} point of departure.
- Inherent cancer risk is 400,000 times EPA's arbitrary 10^{-6} point of departure.

Given the statements of EPA and BEIR VII, Dr. Alemayehu's alarming allegation that a dose of 1 millirem/y is harmful, is strange.

- 1 millirem/y is 300 times less than natural background.
- 1 millirem/y is equal to one extra day of background radiation per year.
- 1 millirem/y is the difference in cosmic radiation in 500 feet elevation.
- A round trip NY to LA flight exposes passengers to 5 millirem (cancer risk = 5.8×10^{-6})
- A chest X-ray is 10 millirem, and equivalent to 10 days of background radiation (cancer risk = 1.2×10^{-5})
- 1 millirem/y for a 75-year lifetime would be 75 millirem or equivalent to 7.5 "unnecessary" chest X-rays (cancer risk = 8.7×10^{-5}).
- "Unnecessary chest X-rays" is yet another favorite phrase of Dan Hirsch. Dr. Alemayehu should acknowledge Dan Hirsch whenever he uses "Hirsch-isms", otherwise he could be accused of plagiarism.
- Background radiation of 300 millirem/year for a 75-year lifetime would be equivalent to 2,250 chest X-rays (cancer risk = 2.6×10^{-2}).

These numbers illustrate the fallacy of using the LNT radiation risk coefficient of 0.00116 ELCR per person-rem at low dose levels less than 10,000 millirem. All contributions to background radiation exceed by orders of magnitude the arbitrary EPA 10^{-6} point of departure.

[151] National Academies of Sciences, Engineering & Medicine, Report in Brief, "BEIR VII: Health Risks form Exposure to Low Levels of Ionizing radiation", June 2005. https://www.philrutherford.com/Radiation_Risk/11340rb.pdf

Perhaps the most foolish consequence of the LNT radiation risk model and EPA's arbitrary 10^{-6} "safe" limit is the theoretical risk from cosmic radiation that is a function of elevation.

- 2 millirem/y per 1,000 feet elevation change.[152]
- 0.002 rem x 75 years x 0.00116 = 0.000174 ELCR[153] per 1,000 feet elevation change.
- 0.000001 ELCR per 1,000 / 174 = 5.75 feet elevation change.
- Radiation risk increases by 10^{-6} from your feet to your head.

The next time the good Dr. considers moving homes, he should calculate his additional radiation risk to which he is exposing his family, due to the change in elevation.

Of course, Dr. Alemayehu knows the games one can play using LNT and 10^{-6}. He plays them well.

[152] USEPA, "Calculate Your Radiation Dose", Cosmic radiation increases by 2 millirem/y from sea level to 1,000 ft. ASL. At higher elevations, the increase is more than 2 millirem/y per 1,000 feet. https://www.epa.gov/radiation/calculate-your-radiation-dose

[153] ELCR = excess lifetime cancer risk

APPENDIX E

(May 20, 2023)

Implementing Release and Clearance of Property Requirements (DOE-STD-1241-2023)

In April 2002 DOE issued DOE G 441.1-XX (Draft), “Control and Release of Property with Residual Radioactive Material.”[154] DOE G 441.1-XX was an implementation guide for DOE 5400.5, “Radiation Protection of the Public and Environment.”

In March 2023, DOE issued a final version of DOE G 441.1-XX as a DOE technical standard, DOE-STD-1241-2023, “Implementing Release and Clearance of Property Requirements.”[155] DOE-STD-1241-2023 is designed to assist DOE and DOE contractors meet release and clearance of property requirements provided in DOE Order O 458.1, “Radiation Protection of the Public and the Environment”, Change 4 (2020).

DOE-STD-1241-2023 adopts …

- 25 mrem/y plus ALARA for **real property** based on NRC 10 CFR 20.1402 Subpart E (Section 3.3 and 4.7 of the standard).
- 1 mrem/y for **personal property** (Sections 4.4 and 4.5 of the standard).
- Total and removable **surface contamination** limits for **personal property** are identical to NRC Regulatory Guide 1.86 and NUREG 1556, Vol. 9, Rev. 3 (Section 4.4 and Table 1 of the standard).
- **Volumetric contamination** limits for **personal property** based on ANSI/HPS N13.12-2013 (Section 4.5 and Table 2 of the standard)
- 5 pCi/g of radium-226 in soil based on EPA UMTRCA regulations (Section 4.2 of the standard).

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[154] DOE Implementation Guide, DOE G 441.1-XX (Draft), “Control and Release of Property with Residual Radioactive Material.” April 4, 2002. https://www.energy.gov/sites/prod/files/2014/03/f13/doe441.1-xx_0.pdf.

[155] DOE Technical Standard, DOE-STD-1241-2023, “Implementing Release and Clearance of Property Requirements.” March 2023. https://www.standards.doe.gov/standards-documents/1200/1241-AStd-2023/@@images/file

***"Real property** is defined as **land** and anything permanently affixed to the land such as **buildings**, fences, and **those things attached to buildings** such as light fixtures, plumbing and heating fixtures, or other such items, that would be personal property if not attached."*

***"Personal property** is property of any kind, **except for real property.** For the purposes of DOE O 458.1 and this Standard, examples of personal property include consumable items (e.g., wood, containers, lab equipment and paper); personal items (e.g., clothing, brief cases, respirators and gloves); office items (e.g., computers, unused office supplies, and furniture); tools and equipment (e.g. hand tools, power tools, construction machinery, vehicles, tool boxes, ladders, and scales); and **debris** (e.g. **removed soil, rubble**, sludge, **wood**, tanks, **scrap metal**, **concrete**, wiring, doors, and windows)."*

APPENDIX F

(September 4, 2013)

Off-site West Hills Residence Radiological Survey

Off-site West Hills Residence
Radiological Survey

Introduction

This data package provides the radiation survey results of interior and exterior building materials in an off-site West Hills residence, approximately three miles east of SSFL. This survey complies with "Standard Operating Procedures: Building Demolition Debris Characterization and Management"[1] and with Boeing procedure RS-00012[2].

This survey was conducted to demonstrate the wide range of alpha and beta surface activity that is found in a variety of building materials.

Methodology

Instrument measurements (1 minute static counts) were made for alpha and beta/gamma total surface activity (Ludlum 2224 plus Ludlum 43-89 plastic scintillator probe) and gamma exposure rate (Bicron Microrem meter). Wipes were taken for removable alpha/beta activity and counted in a low-background Tennelec laboratory alpha/beta counter.

Instrument minimum detectable activities (MDA) for total activity measurements were 315 to 441 dpm/100 cm^2 alpha and 815 to 1,014 dpm/100 cm^2 beta (Ludlum 43-89 probe). Removable activity MDAs for the Tennelec were 12 dpm/100 cm^2 alpha and 24 dpm/100 cm^2 beta. These MDAs meet the generic regulatory limits for surface activity shown in Appendix 1. The Bicron MDA is ~4 μR/hr.

Results

Survey results are provided in Appendix 2. 284 surface activity measurements were taken, comprising 73 total alpha, 73 total beta, 73 removable alpha and 73 removable beta. 73 dose rate measurements were also taken.

Total Alpha Results

- The range of total alpha measurements was 1 to 27 cpm with an average of 9 cpm.
- 6 of 73 (8.2%) net total alpha measurements exceeded zero.
- 1 of 3 (33%) **asphalt** net total alpha measurements exceeded zero.
- 2 of 19 (10.5%) **concrete** net total alpha measurements exceeded zero.
- 0 of 73 (0.0%) net total alpha measurements exceeded the MDA.
- 1 of 73 (1.4%) net total alpha measurements exceeded the most restrictive regulatory limit of 100 dpm/100 cm^2.
- 1 of 19 (5.3%) **concrete** net total alpha measurements exceeded the most restrictive regulatory limit of 100 dpm/100 cm^2.
- 0 of 73 (0.0%) net total alpha measurements exceeded the generic regulatory limit of 5,000 dpm/100 cm^2.

[1] "Standard Operating Procedures: Building Demolition Debris Characterization and Management." Appendix A. "Radiation Screening Procedures for Non-radiological Buildings, Equipment and Debris." Letter from A. Lenox (Boeing) to R. Brausch (DTSC), February 24, 2010.

[2] Boeing, "Methods and Procedures for Radiological Monitoring." RS-00012, Revision B, August 6, 2006.

Total Beta Results

- The range of total beta measurements was 226 to 805 cpm with an average of 527 cpm.
- 37 of 73 (50.1%) net total beta measurements exceeded zero.
- 34 of 73 (46.6%) net total beta measurements exceeded the MDA.
- 31 of 73 (42.5%) net total beta measurements exceeded the most restrictive regulatory limit of 1,000 dpm/100 cm^2.
- 0 of 73 (0.0%) net total beta measurements exceeded the generic regulatory limit of 5,000 dpm/100 cm^2.

All data that exceeds zero, exceeds MDA, or exceeds the most restrictive regulatory release limit, would be declared by Hirsch to be contaminated above background and classified as low level radioactive waste.

A majority (257 of 292 or 88.0%) of all instrument surface activity measurements and wipe tests were non-detect (i.e. less than the MDA).

A majority (260 of 292 or 89.0%) of all instrument surface activity measurements and wipe tests meet the most restrictive regulatory surface activity limits for release/clearance of equipment and material for unrestricted use from former radiological facilities.

All instrument surface activity measurements and wipe tests meet the general surface activity limits for release/clearance of equipment and material for unrestricted use from former radiological facilities[3,4,5]. See Appendix 1 for regulatory limits for surface activity.

All dose rate measurements were within the range of background.

The above data summaries do not include four sets of measurements taken of an A/C filter and a kitchen stove exhaust fan filter, both of which had significantly elevated radon decay product activity. The A/C filter was 80,000 dpm/100 cm^2 total alpha and 146,000 dpm/100 cm^2 total beta. Radon decay product buildup is an expected phenomenon in all fluid (air and water) filtration systems. The levels significantly exceed the Regulatory Guide 1.86 limits.

[3] (a) U.S. Nuclear Regulatory Commission Regulatory Guide 1.86. "Termination of Operating Licenses for Nuclear Reactors." June 1974. (b) U.S. NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release to Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," August 1987.

[4] (a) U.S. Department of Energy Order 458.1, "Radiation Protection of the Public and Environment" Attachment 1, Section (f)1b, June 6, 2011. (b) U.S. Department of Energy Memorandum from Sally Robison to Roger Liddle, "Site-wide Limits for Release of Facilities without Radiological Restriction", September 17, 1996. (c) U.S. Department of Energy Draft Guide DOE G 441.1-XX. "Control and Release of Property with Residual Radioactive Material." April 4, 2002.

[5] (a) California Department of Public Health. DECON-1. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use." (b) California Department of Public Health Letter from Gerard Wong to Majelle Lee, "Authorized Site-wide Radiological Guidelines for Release for Unrestricted Use", August 9, 1996. (c) California Department of Public Health, IPM-88-2. "Clearance Inspection and Survey." December 1, 1997.

Conclusions

The range of total alpha and total beta measurement in counts per minute (cpm) (before background subtraction and before conversion to dpm/100cm^2) for building materials from the off-site West Hills residence is consistent with the ranges observed in recent surveys in Area I, III and IV buildings. This demonstrates that recent measurements in Area IV non-radiological buildings and two former radiological buildings are consistent with background measurements observed in Area I and III buildings and an off-site residence.

Table 1. Range of Gross (Before Background Subtraction) Total Alpha and Beta Measurements for Buildings in Area I, III, IV and Off-Site

Area	Building/Location	Alpha (cpm)			Beta (cpm)		
		Min	Max	Average	Min	Max	Average
I	CTL I	0	27	8	121	494	312
I	CTL III	0	50	7	133	664	435
I	CTL V	0	39	11	102	586	294
I	B1300	0	25	3	217	607	389
I	APTF	1	37	7	207	584	450
I	B1436	0	17	2	198	554	401
I	Bowl	0	20	7	272	662	545
III	Hydrogen Lab Lot	0	7	4	225	296	268
III	STP-3	0	30	9	172	586	389
III	Nitrogen Depot	1	36	9	185	591	465
III	ECL (Old Haz Yard)	0	12	2	266	617	367
IV	B4006	0	36	4	207	589	397
IV	B4011 (hibay)	0	28	5	204	773	435
IV	B4015	0	13	4	177	611	360
IV	B4100*	0	10	2	148	480	336
IV	Water tanks	0	24	6	139	565	336
IV	Weather station	0	24	6	210	530	388
IV	ESADA	0	38	5	289	609	509
IV	L-85*	0	20	4	237	569	461
Off-Site	West Hills Residence	1	27	9	226	805	527

*Former radiological buildings

Phil Rutherford
Manager, Health, Safety & Radiation Services

Appendix 1

Surface Activity Limits

Surface Activity Limits (dpm/100 cm^2)

	Alpha			Beta		
	Total		Removable[5]	Total		Removable[5]
	Average[4]	Maximum[5]		Average[4]	Maximum[5]	
Isotope-specific Regulatory Limits[1,2,3]						
Mixed beta/gamma emitters (Cs-137, Sr-90, Co-60, etc.)	-	-	-	5,000	15,000	1,000
Uranium, U-235, U-238 and decay products	5,000	15,000	1,000	5,000	15,000	1,000
Thorium, Th-232	1,000	3,000	200	-	-	-
Sr-90 (separated)				1,000	3,000	200
Transuranics, plutonium, radium-226	100	300	20	-	-	-
General Regulatory Limits	5,000	15,000	1,000	5,000	15,000	1,000
Most Restrictive Regulatory Limit	100	300	20	1,000	3,000	200
Preferred Boeing Limit	100		20	1,000		100
Typical Minimum Detectable Activities	250 - 400		<20	~1,000		<30

[1] (a) U.S. Nuclear Regulatory Commission Regulatory Guide 1.86. “Termination of Operating Licenses for Nuclear Reactors.” June 1974. (b) U.S. NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release to Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," August 1987.

[2] (a) U.S. Department of Energy Order 458.1, “Radiation Protection of the Public and Environment” Attachment 1, Section (f)1b, June 6, 2011. (b) U.S. Department of Energy Memorandum from Sally Robison to Roger Liddle, "Sitewide Limits for Release of Facilities without Radiological Restriction", September 17, 1996. (c) U.S. Department of Energy Guide DOE G 441.1-XX. “Control and Release of Property with Residual Radioactive Material.” April 4, 2002.

[3] (a) California Department of Public Health. DECON-1. “Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use.” (b) California Department of Public Health Letter from Gerard Wong to Majelle Lee, "Authorized Sitewide Radiological Guidelines for Release for Unrestricted Use", August 9, 1996. (c) California Department of Public Health, IPM-88-2. “Clearance Inspection and Survey.” December 1, 1997.

[4] Averaged over 1 m^2.

[5] Maximum measured over 100 cm^2.

Appendix 2

Field Survey Results

RADIATION SURVEY REPORT

FACILITY: Off-Site Residence (Internal)

LOCATION: West Hills, California

LOCATION NUMBER	DATE SAMPLED	DATE MONITORED	PURPOSE: Radiation Survey of Building Materials / LOCATION/OBJECT DESCRIPTION	UNITS / LIMITS	Alpha Removable (Net)	Beta Removable (Net)	Alpha Total (Net)	Beta Total (Net)	Gamma (Gross)
				UNITS	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	μR/h
				LIMITS	< 20	< 100	< 100 (< 5,000)	< 1,000 (< 5,000)	< MDA
1	8/31/2013	8/31/2013	Kitchen Granite Counter Top		< 20	< 100	0	1854	9
2	8/31/2013	8/31/2013	Kitchen Floor Tile		< 20	< 100	0	3028	10
3	8/31/2013	8/31/2013	Library Wood Laminate Floor		< 20	< 100	0	0	9
4	8/31/2013	8/31/2013	Drywall		< 20	< 100	0	0	9
5	8/31/2013	8/31/2013	Guest Bathroom Sink		< 20	< 100	0	2420	9
6	8/31/2013	8/31/2013	Guest Bathroom Granite Counter Top		< 20	< 100	0	4202	10
7	8/31/2013	8/31/2013	Guest Bathroom Floor Tile		< 20	< 100	0	2985	9
8	8/31/2013	8/31/2013	Guest Bathroom Wall Tile		< 20	< 100	0	2746	9
9	8/31/2013	8/31/2013	Guest Bathroom Toilet Tank		< 20	< 100	68	3376	9
10	8/31/2013	8/31/2013	Fireplace		< 20	< 100	0	0	7
11	8/31/2013	8/31/2013	Children's Bathroom Sink		< 20	< 100	0	2485	9
12	8/31/2013	8/31/2013	Children's Bathroom Granite Counter Top		< 20	< 100	0	2876	9
13	8/31/2013	8/31/2013	Children's Bathroom Bath Tub		< 20	< 100	0	1757	8
14	8/31/2013	8/31/2013	Children's Bathroom Toilet Pedestal		< 20	< 100	0	3213	9
15	8/31/2013	8/31/2013	Children's Bathroom Toilet Tank		< 20	< 100	0	2441	7
16	8/31/2013	8/31/2013	Master Bedroom Wood Door		< 20	< 100	0	0	7
17	8/31/2013	8/31/2013	Master Bathroom Shower Floor Tile		< 20	< 100	45	1572	8
18	8/31/2013	8/31/2013	Master Bathroom Sink		< 20	< 100	0	3593	7
19	8/31/2013	8/31/2013	Master Bathroom Granite Counter Top		< 20	< 100	0	2159	7
20	8/31/2013	8/31/2013	Master Bathroom Floor Tile		< 20	< 100	0	4420	8

COMMENTS: MDA = minimum detectable activity

[1]Tennelec (MDA = 12 dpm/100 cm^2 α and 24 dpm/100 cm^2 β)

[2]Ludlum 2224 with 43-89 dual alpha beta probe (MDA 441 dpm/100 cm^2 α and 815 dpm/100 cm^2 β)

[3]Bicron micro rem meter (MDA $\leq$ 4 μrem/h above background)

INSTRUMENT	Tennelec[1]		Ludlum 2224 & 43-89[2]		Bicron μrem[3]
IDENTIFICATION	Environmental Tennelec SN 37108		ZO257835		EX041002
CALIBRATION DUE	Daily		8/7/2014		8/7/2014
BACKGROUND (cpm)	0.1	3.0	21	398	7 to 10 μR/h
INSTR. EFFICIENCY	34.85%	38.26%	17.7%	18.4%	NA
COUNT TIME	1 min.		1 min		Scan

SAMPLED BY: Phil Rutherford [signature] DATE: 8/31/2013

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FORM 732-A REV 2012-01-31

BOEING

RADIATION SURVEY REPORT

FACILITY: Off-Site Residence (Internal)

LOCATION: West Hills, California

LOCATION NUMBER	DATE SAMPLED	DATE MONITORED	PURPOSE: Radiation Survey of Building Materials / LOCATION/OBJECT DESCRIPTION	UNITS / LIMITS	Alpha Removable (Net)	Beta Removable (Net)	Alpha Total (Net)	Beta Total (Net)	Gamma (Gross)
				UNITS	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	μR/h
				LIMITS	< 20	< 100	< 100 (< 5,000)	< 1,000 (< 5,000)	< MDA
21	8/31/2013	8/31/2013	Master Bathroom Wall Tile		< 20	< 100	0	2909	8
22	8/31/2013	8/31/2013	Master Bathroom Toilet Tank		< 20	< 100	90	3354	9
23	8/31/2013	8/31/2013	A/C Pre-Filter*		< 20	< 100	79932	140213	16
24	8/31/2013	8/31/2013	A/C Pre-Filter (re-count)*		< 20	< 100	80881	146050	16
25	8/31/2013	8/31/2013	Kitchen Stove Exhaust Filter*		< 20	< 100	4814	4648	7
26	8/31/2013	8/31/2013	Kitchen Stove Exhaust Filter*		< 20	< 100	1379	1463	7

* Filters contain high levels of radon decay products in collected dust

COMMENTS: MDA = minimum detectable activity

[1]Tennelec (MDA = 12 dpm/100 cm^2 α and 24 dpm/100 cm^2 β)

[2]Ludlum 2224 with 43-89 dual alpha beta probe

(MDA 441 dpm/100 cm^2 α and 815 dpm/100 cm^2 β)

[3]Bicron microrem meter (MDA $\leq$ 4 μrem/h above background)

INSTRUMENT	Tennelec[1]		Ludlum 2224 & 43-89[2]		Bicron μrem[3]
IDENTIFICATION	Environmental Tennelec SN 37108		ZO257835		EX041002
CALIBRATION DUE	Daily		8/7/2014		8/7/2014
BACKGROUND (cpm)	0.1	3.0	21	398	7 to 10 μR/h
INSTR. EFFICIENCY	34.85%	38.26%	17.7%	18.4%	NA
COUNT TIME	1 min.		1 min		Scan

SAMPLED BY: Phil Rutherford [signature] DATE: 8/31/2013

REVIEWED BY: Phil Rutherford [signature] DATE: 8/31/2013

FORM 732-A REV 2012-01-31

BOEING

RADIATION SURVEY REPORT

FACILITY: Off-Site Residence (External)

LOCATION: West Hills, California

LOCATION NUMBER	DATE SAMPLED	DATE MONITORED	PURPOSE: Radiation Survey of Building Materials / LOCATION/OBJECT DESCRIPTION	UNITS / LIMITS	Alpha Removable (Net)	Beta Removable (Net)	Alpha Total (Net)	Beta Total (Net)	Gamma (Gross)
				UNITS	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	μR/h
				LIMITS	< 20	< 100	< 100 (< 5,000)	< 1,000 (< 5,000)	< MDA
27	8/31/2013	8/31/2013	Road Outside Driveway		< 20	< 100	0	0	7
28	8/31/2013	8/31/2013	Road Outside Entrance		< 20	< 100	18	0	8
29	8/31/2013	8/31/2013	Road In Dip		< 20	< 100	0	0	8
30	8/31/2013	8/31/2013	Front Porch Floor Tile		< 20	< 100	0	3865	10
31	8/31/2013	8/31/2013	Front Yard Rock Wall		< 20	< 100	0	1757	8
32	8/31/2013	8/31/2013	Front Yard Stepping Stone		< 20	< 100	0	0	9
33	8/31/2013	8/31/2013	Front Yard Rock		< 20	< 100	0	2398	10
34	8/31/2013	8/31/2013	Front Yard Stepping Stone		< 20	< 100	0	0	9
35	8/31/2013	8/31/2013	Front Porch Flagstone		< 20	< 100	0	3354	9
36	8/31/2013	8/31/2013	Stucco		< 20	< 100	0	0	9
37	8/31/2013	8/31/2013	Driveway		< 20	< 100	0	0	8
38	8/31/2013	8/31/2013	Driveway - Stained		< 20	< 100	0	0	7
39	8/31/2013	8/31/2013	Driveway - Cinder Block Wall		< 20	< 100	0	1007	8
40	8/31/2013	8/31/2013	Transformer		< 20	< 100	0	0	7
41	8/31/2013	8/31/2013	Garage Floor - Rust Stain		< 20	< 100	0	0	6
42	8/31/2013	8/31/2013	Back Yard Patio - Brick		< 20	< 100	0	2811	9
43	8/31/2013	8/31/2013	Spa Heater		< 20	< 100	0	0	7
44	8/31/2013	8/31/2013	Spa Bag Filter		< 20	< 100	0	0	7
45	8/31/2013	8/31/2013	Spa Sand Filter		< 20	< 100	0	0	8
46	8/31/2013	8/31/2013	A/C Blower		< 20	< 100	0	0	8

COMMENTS: MDA = minimum detectable activity

[1]Tennelec (MDA = 12 dpm/100 cm^2 α and 24 dpm/100 cm^2 β)

[2]Ludlum 2224 with 43-89 dual alpha beta probe

(MDA 315 - 441 dpm/100 cm^2 α and 815 - 1014 dpm/100 cm^2 β)

[3]Bicron microrem meter (MDA ≤ 4 μrem/h above background)

INSTRUMENT	Tennelec[1]		Ludlum 2224 & 43-89[2]		Bicron μrem[3]
IDENTIFICATION	Environmental Tennelec SN 37108		ZO257835		EX041002
CALIBRATION DUE	Daily		8/7/2014		8/7/2014
BACKGROUND (cpm)	0.1	3.0	9 - 21	398 - 628	7 to 10 μR/h
INSTR. EFFICIENCY	34.85%	38.26%	17.7%	18.4%	NA
COUNT TIME	1 min.		1 min		Scan

SAMPLED BY: Phil Rutherford (signature) DATE: 8/31/2013

REVIEWED BY: Phil Rutherford (signature) DATE: 9/1/2013

FORM 732-A REV 2012-01-31

BOEING

RADIATION SURVEY REPORT

FACILITY: Off-Site Residence (External)

LOCATION: West Hills, California

LOCATION NUMBER	DATE SAMPLED	DATE MONITORED	PURPOSE: Radiation Survey of Building Materials / LOCATION/OBJECT DESCRIPTION	UNITS / LIMITS	Alpha Removable (Net)	Beta Removable (Net)	Alpha Total (Net)	Beta Total (Net)	Gamma (Gross)
				UNITS	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	μR/h
				LIMITS	< 20	< 100	< 100 (< 5,000)	< 1,000 (< 5,000)	< MDA
47	8/31/2013	8/31/2013	Cinder Block Wall		< 20	< 100	0	996	8
48	8/31/2013	8/31/2013	Concrete - Rust Stained		< 20	< 100	0	0	7
49	8/31/2013	8/31/2013	Concrete - Rust Stained		< 20	< 100	0	0	8
50	8/31/2013	8/31/2013	Brick Fire Pit		< 20	< 100	0	1876	8
51	8/31/2013	8/31/2013	Backyard Concrete		< 20	< 100	0	0	7
52	8/31/2013	8/31/2013	Backyard Brick Decoration		< 20	< 100	0	1604	8
53	8/31/2013	8/31/2013	Backyard Concrete - New		< 20	< 100	0	0	8
54	8/31/2013	8/31/2013	Pool Edge Tiles		< 20	< 100	0	528	7
55	8/31/2013	8/31/2013	Cinder Bricks		< 20	< 100	0	1257	9
56	8/31/2013	8/31/2013	Pool Heater		< 20	< 100	0	0	7
57	8/31/2013	8/31/2013	Pool Sand Filter		< 20	< 100	0	0	8
58	8/31/2013	8/31/2013	Concrete Drainage Channel		< 20	< 100	0	0	9

COMMENTS: MDA = minimum detectable activity

[1]Tennelec (MDA = 12 dpm/100 cm^2 α and 24 dpm/100 cm^2 β)

[2]Ludlum 2224 with 43-89 dual alpha beta probe

(MDA 423 - 441 dpm/100 cm^2 α and 815 - 1002 dpm/100 cm^2 β)

[3]Bicron microrem meter (MDA $\leq$ 4 μrem/h above background)

INSTRUMENT	Tennelec[1]		Ludlum 2224 & 43-89[2]		Bicron μrem[3]
IDENTIFICATION	Environmental Tennelec SN 37108		ZO257835		EX041002
CALIBRATION DUE	Daily		8/7/2014		8/7/2014
BACKGROUND (cpm)	0.1	3.0	19 - 21	398 - 612	7 to 10 μR/h
INSTR. EFFICIENCY	34.85%	38.26%	17.7%	18.4%	NA
COUNT TIME	1 min.		1 min		Scan

SAMPLED BY: Phil Rutherford (signature) DATE: 8/31/2013

REVIEWED BY: Phil Rutherford (signature) DATE: 9/1/2013

FORM 732-A REV 2012-01-31

BOEING

RADIATION SURVEY REPORT

FACILITY: Off-Site Residence (External)

LOCATION: West Hills, California

PURPOSE: Radiation Survey of Building Materials

LOCATION NUMBER	DATE SAMPLED	DATE MONITORED	LOCATION/OBJECT DESCRIPTION	UNITS / LIMITS	Alpha Removable (Net)	Beta Removable (Net)	Alpha Total (Net)	Beta Total (Net)	Gamma (Gross)
				UNITS	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	dpm/100 cm^2	μR/h
				LIMITS	< 20	< 100	< 100 (< 5,000)	< 1,000 (< 5,000)	< MDA
59	9/1/2013	9/1/2013	Stone Debris		< 20	< 100	0	126	9
60	9/1/2013	9/1/2013	Stone Debris		< 20	< 100	0	496	8
61	9/1/2013	9/1/2013	Metal Fence Post		< 20	< 100	0	0	8
62	9/1/2013	9/1/2013	Concrete Steps		< 20	< 100	0	0	8
63	9/1/2013	9/1/2013	Gs Line Rusty Metal		< 20	< 100	0	0	7
64	9/1/2013	9/1/2013	Concrete Drainline		< 20	< 100	0	0	8
65	9/1/2013	9/1/2013	Cinder Block Wall		< 20	< 100	0	996	8
66	9/1/2013	9/1/2013	Brick Floor		< 20	< 100	0	2061	8
67	9/1/2013	9/1/2013	Backyard Concrete - Stained		< 20	< 100	0	0	7
68	9/1/2013	9/1/2013	Garage Concrete Floor - Stained		< 20	< 100	0	0	8
69	9/1/2013	9/1/2013	Garage Concrete Floor - Stained		< 20	< 100	181	0	8
70	9/1/2013	9/1/2013	Garage Concrete Floor - Stained		< 20	< 100	45	0	8
71	9/1/2013	9/1/2013	Garage Concrete Floor - Stained		< 20	< 100	0	0	8
72	9/1/2013	9/1/2013	Garage Concrete Floor - Stained		< 20	< 100	0	0	8
73	9/1/2013	9/1/2013	Drainage Outside Garage		< 20	< 100	0	0	8
74	9/1/2013	9/1/2013	Porch Floor Tile		< 20	< 100	0	3485	9
75	9/1/2013	9/1/2013	Porch Floor Tile		< 20	< 100	0	4039	10
76	9/2/2013	9/2/2013	Roof Tile		< 20	< 100	0	1278	7
77	9/2/2013	9/2/2013	Roof Tile		< 20	< 100	0	876	7

COMMENTS: MDA = minimum detectable activity

[1]Tennelec (MDA = 12 dpm/100 cm^2 α and 24 dpm/100 cm^2 β)

[2]Ludlum 2224 with 43-89 dual alpha beta probe

(MDA 423 - 441 dpm/100 cm^2 α and 815 - 1002 dpm/100 cm^2 β)

[3]Bicron microrem meter (MDA ≤ 4 μrem/h above background)

INSTRUMENT	Tennelec[1]		Ludlum 2224 & 43-89[2]		Bicron μrem[3]
IDENTIFICATION	Environmental Tennelec SN 37108		ZO257835		EX041002
CALIBRATION DUE	Daily		8/7/2014		8/7/2014
BACKGROUND (cpm)	0.1	3.0	19 - 21	398 - 612	7 to 10 μR/h
INSTR. EFFICIENCY	34.85%	38.26%	17.7%	18.4%	NA
COUNT TIME	1 min.		1 min		Scan

SAMPLED BY: Phil Rutherford [signature] DATE: 9/1/2013

REVIEWED BY: Phil Rutherford [signature] DATE: 9/2/2013

FORM 732-A REV 2012-01-31

Surface Activity Calculation using Daily Background and MDA

Facility	Off-Site Residence (Internal)
Location	West Hills, Califirnia
Purpose	Survey of Building Materials

Instrument Type	2224-1/43-89	
Instument ID	ZO257835	
Calibration Due Date	8/7/2014	
Radiation	alpha	beta
Instrument Efficiency (cpm/emission)	0.177	0.184
Surface Efficiency (emission/dpm)	0.25	0.5
Probe Area (cm^2)	100	100

Input data in blue cells

Daily Background Measurements

Sample	Date	Description (Location, Object)	Material Type	Alpha Bkgd Count Time (min)	Alpha Sample Count Time (min)	Alpha Bkgd Gross Count	Alpha Bkgd Count Rate (cpm)	Alpha Bkgd Gross Activity (dpm/ 100 cm^2)	Alpha L_C (counts)	Alpha L_D (counts)	Alpha MDA (dpm/ 100 cm^2)	Beta Bkgd Count Time (min)	Beta Sample Count Time (min)	Beta Bkgd Gross Count	Beta Bkgd Count Rate (cpm)	Beta Bkgd Gross Activity (dpm/ 100 cm^2)	Beta L_C (counts)	Beta L_D (counts)	Beta MDA (dpm/ 100 cm^2)
1	8/30/2013	B1319 Reference Location - rusty	Concrete	5	1	95	19	429	8	19	423	5	1	3061	612	6654	45	92	1002
2	8/30/2013	B1319 Reference Location - rusty	Asphalt	5	1	46	9	208	5	14	315	5	1	3138	628	6822	45	93	1014
3	8/30/2013	B1319 Reference Location -metal	Construction	5	1	105	21	475	8	20	441	5	1	1992	398	4330	36	75	815
4																			
5																			
		Average	**Miscellaneous**	**5**	**1**	**82**	**16**	**371**	**7**	**17**	**393**	**5**	**1**	**2730**	**546**	**5936**	**42**	**87**	**943**

Sample Area Measurements

Sample	Date	Description (Location, Object)	Material Type	Alpha Sample Count Time (min)	Alpha Gross Sample Count	Alpha Gross Count Rate (cpm)	Alpha Bkgd Count Rate (cpm)	Alpha Net Count Rate (cpm)	Alpha Net Activity (dpm/ 100 cm^2)	Alpha MDA (dpm/ 100 cm^2)	Alpha > MDA or < MDA ?	Beta Sample Count Time (min)	Beta Gross Sample Count	Beta Gross Count Rate (cpm)	Beta Bkgd Count Rate (cpm)	Beta Net Count Rate (cpm)	Beta Net Activity (dpm/ 100 cm^2)	Beta MDA (dpm/ 100 cm^2)	Beta > MDA or < MDA ?
1	8/31/2013	Kitchen Granite Counter Top	Construction	1	7	7	21	-14	0	441	<MDA	1	569	569	398	171	1854	815	>MDA
2	8/31/2013	Kitchen Floor Tile	Construction	1	11	11	21	-10	0	441	<MDA	1	677	677	398	279	3028	815	>MDA
3	8/31/2013	Library Wood Laminate Floor	Construction	1	7	7	21	-14	0	441	<MDA	1	359	359	398	-39	0	815	<MDA
4	8/31/2013	Drywall	Construction	1	4	4	21	-17	0	441	<MDA	1	346	346	398	-52	0	815	<MDA
5	8/31/2013	Guest Bathroom Sink	Construction	1	6	6	21	-15	0	441	<MDA	1	621	621	398	223	2420	815	>MDA
6	8/31/2013	Guest Bathroom Granite Counter Top	Construction	1	5	5	21	-16	0	441	<MDA	1	785	785	398	387	4202	815	>MDA
7	8/31/2013	Guest Bathroom Floor Tile	Construction	1	6	6	21	-15	0	441	<MDA	1	673	673	398	275	2985	815	>MDA
8	8/31/2013	Guest Bathroom Wall Tile	Construction	1	9	9	21	-12	0	441	<MDA	1	651	651	398	253	2746	815	>MDA
9	8/31/2013	Guest Bathroom Toilet Tank	Construction	1	24	24	21	3	68	441	<MDA	1	709	709	398	311	3376	815	>MDA
10	8/31/2013	Fireplace	Construction	1	7	7	21	-14	0	441	<MDA	1	298	298	398	-100	0	815	<MDA
11	8/31/2013	Children's Bathroom Sink	Construction	1	9	9	21	-12	0	441	<MDA	1	627	627	398	229	2485	815	>MDA
12	8/31/2013	Children's Bathroom Granite Counter Top	Construction	1	19	19	21	-2	0	441	<MDA	1	663	663	398	265	2876	815	>MDA
13	8/31/2013	Children's Bathroom Bath Tub	Construction	1	9	9	21	-12	0	441	<MDA	1	560	560	398	162	1757	815	>MDA
14	8/31/2013	Children's Bathroom Toilet Pedestal	Construction	1	16	16	21	-5	0	441	<MDA	1	694	694	398	296	3213	815	>MDA
15	8/31/2013	Children's Bathroom Toilet Tank	Construction	1	15	15	21	-6	0	441	<MDA	1	623	623	398	225	2441	815	>MDA
16	8/31/2013	Master Bedroom Wood Door	Construction	1	7	7	21	-14	0	441	<MDA	1	318	318	398	-80	0	815	<MDA
17	8/31/2013	Master Bathroom Shower Floor Tile	Construction	1	23	23	21	2	45	441	<MDA	1	543	543	398	145	1572	815	>MDA
18	8/31/2013	Master Bathroom Sink	Construction	1	8	8	21	-13	0	441	<MDA	1	729	729	398	331	3593	815	>MDA
19	8/31/2013	Master Bathroom Granite Counter Top	Construction	1	8	8	21	-13	0	441	<MDA	1	597	597	398	199	2159	815	>MDA
20	8/31/2013	Master Bathroom Floor Tile	Construction	1	10	10	21	-11	0	441	<MDA	1	805	805	398	407	4420	815	>MDA

Surface Activity Calculation using Daily Background and MDA

Facility	Off-Site Residence (Internal)
Location	West Hills, Califirnia
Purpose	Survey of Building Materials

Input data in blue cells

Instrument Type	2224-1/43-89	
Instument ID	ZO257835	
Calibration Due Date	8/7/2014	
Radiation	alpha	beta
Instrument Efficiency (cpm/emission)	0.177	0.184
Surface Efficiency (emission/dpm)	0.25	0.5
Probe Area (cm^2)	100	100

Daily Background Measurements

				Alpha								Beta							
				Bkgd Count Time	Sample Count Time	Bkgd Gross Count	Bkgd Count Rate	Bkgd Gross Activity	L_C	L_D	MDA	Bkgd Count Time	Sample Count Time	Bkgd Gross Count	Bkgd Count Rate	Bkgd Gross Activity	L_C	L_D	MDA
Sample	Date	Description (Location, Object)	Material Type	(min)	(min)		(cpm)	(dpm/ 100 cm^2)	(counts)	(counts)	(dpm/ 100 cm^2)	(min)	(min)		(cpm)	(dpm/ 100 cm^2)	(counts)	(counts)	(dpm/ 100 cm^2)
1	8/30/2013	B1319 Reference Location - rusty	Concrete	5	1	95	19	429	8	19	423	5	1	3061	612	6654	45	92	1002
2	8/30/2013	B1319 Reference Location - rusty	Asphalt	5	1	46	9	208	5	14	315	5	1	3138	628	6822	45	93	1014
3	8/30/2013	B1319 Reference Location -metal	Construction	5	1	105	21	475	8	20	441	5	1	1992	398	4330	36	75	815
4																			
5																			
		Average	**Miscellaneous**	**5**	**1**	**82**	**16**	**371**	**7**	**17**	**393**	**5**	**1**	**2730**	**546**	**5936**	**42**	**87**	**943**

Sample Area Measurements

				Alpha								Beta							
				Sample Count Time	Gross Sample Count	Gross Count Rate	Bkgd Count Rate	Net Count Rate	Net Activity	MDA	> MDA or < MDA ?	Sample Count Time	Gross Sample Count	Gross Count Rate	Bkgd Count Rate	Net Count Rate	Net Activity	MDA	> MDA or < MDA ?
Sample	Date	Description (Location, Object)	Material Type	(min)		(cpm)	(cpm)	(cpm)	(dpm/ 100 cm^2)	(dpm/ 100 cm^2)		(min)		(cpm)	(cpm)	(cpm)	(dpm/ 100 cm^2)	(dpm/ 100 cm^2)	
21	8/31/2013	Master Bathroom Wall Tile	Construction	1	14	14	21	-7	0	441	<MDA	1	666	666	398	268	2909	815	>MDA
22	8/31/2013	Master Bathroom Toilet Tank	Construction	1	25	25	21	4	90	441	<MDA	1	707	707	398	309	3354	815	>MDA
23	8/31/2013	A/C Pre-Filter	Construction	1	3558	3558	21	3537	79932	441	>MDA	1	13298	13298	398	12900	140213	815	>MDA
24	8/31/2013	A/C Pre-Filter (re-count)	Construction	1	3600	3600	21	3579	80881	441	>MDA	1	13835	13835	398	13437	146050	815	>MDA
25	8/31/2013	Kitchen Stove Exhaust Filter	Construction	1	234	234	21	213	4814	441	>MDA	1	826	826	398	428	4648	815	>MDA
26	8/31/2013	Kitchen Stove Exhaust Filter	Construction	1	82	82	21	61	1379	441	>MDA	1	533	533	398	135	1463	815	>MDA

Surface Activity Calculation using Daily Background and MDA

Facility	Off-Site Residence (External)
Location	West Hills, Califirnia
Purpose	Survey of Building Materials

Instrument Type	2224-1/43-89	
Instument ID	ZO257835	
Calibration Due Date	8/7/2014	
Radiation	alpha	beta
Instrument Efficiency (cpm/emission)	0.177	0.184
Surface Efficiency (emission/dpm)	0.25	0.5
Probe Area (cm^2)	100	100

Input data in blue cells

Daily Background Measurements

				Alpha								Beta							
				Bkgd Count Time	Sample Count Time	Bkgd Gross Count	Bkgd Count Rate	Bkgd Gross Activity	L_C	L_D	MDA	Bkgd Count Time	Sample Count Time	Bkgd Gross Count	Bkgd Count Rate	Bkgd Gross Activity	L_C	L_D	MDA
Sample	Date	Description (Location, Object)	Material Type	(min)	(min)		(cpm)	(dpm/ 100 cm^2)	(counts)	(counts)	(dpm/ 100 cm^2)	(min)	(min)		(cpm)	(dpm/ 100 cm^2)	(counts)	(counts)	(dpm/ 100 cm^2)
1	8/30/2013	B1319 Reference Location - rusty	Concrete	5	1	95	19	429	8	19	423	5	1	3061	612	6654	45	92	1002
2	8/30/2013	B1319 Reference Location - rusty	Asphalt	5	1	46	9	208	5	14	315	5	1	3138	628	6822	45	93	1014
3	8/30/2013	B1319 Reference Location -metal	Construction	5	1	105	21	475	8	20	441	5	1	1992	398	4330	36	75	815
4																			
5																			
		Average	**Miscellaneous**	**5**	**1**	**82**	**16**	**371**	**7**	**17**	**393**	**5**	**1**	**2730**	**546**	**5936**	**42**	**87**	**943**

Sample Area Measurements

				Alpha								Beta							
				Sample Count Time	Gross Sample Count	Gross Count Rate	Bkgd Count Rate	Net Count Rate	Net Activity	MDA	> MDA or < MDA ?	Sample Count Time	Gross Sample Count	Gross Count Rate	Bkgd Count Rate	Net Count Rate	Net Activity	MDA	> MDA or < MDA ?
Sample	Date	Description (Location, Object)	Material Type	(min)		(cpm)	(cpm)	(cpm)	(dpm/ 100 cm^2)	(dpm/ 100 cm^2)		(min)		(cpm)	(cpm)	(cpm)	(dpm/ 100 cm^2)	(dpm/ 100 cm^2)	
27	8/31/2013	Road Outside Driveway	Asphalt	1	4	4	9	-5	0	315	<MDA	1	558	558	628	-70	0	1014	<MDA
28	8/31/2013	Road Outside Entrance	Asphalt	1	10	10	9	1	18	315	<MDA	1	573	573	628	-55	0	1014	<MDA
29	8/31/2013	Road In Dip	Asphalt	1	2	2	9	-7	0	315	<MDA	1	554	554	628	-74	0	1014	<MDA
30	8/31/2013	Front Porch Floor Tile	Construction	1	4	4	21	-17	0	441	<MDA	1	754	754	398	356	3865	815	>MDA
31	8/31/2013	Front Yard Rock Wall	Construction	1	8	8	21	-13	0	441	<MDA	1	560	560	398	162	1757	815	>MDA
32	8/31/2013	Front Yard Stepping Stone	Concrete	1	7	7	19	-12	0	423	<MDA	1	557	557	612	-55	0	1002	<MDA
33	8/31/2013	Front Yard Rock	Construction	1	7	7	21	-14	0	441	<MDA	1	619	619	398	221	2398	815	>MDA
34	8/31/2013	Front Yard Stepping Stone	Concrete	1	4	4	19	-15	0	423	<MDA	1	536	536	612	-76	0	1002	<MDA
35	8/31/2013	Front Porch Flagstone	Construction	1	7	7	21	-14	0	441	<MDA	1	707	707	398	309	3354	815	>MDA
36	8/31/2013	Stucco	Construction	1	5	5	21	-16	0	441	<MDA	1	396	396	398	-2	0	815	<MDA
37	8/31/2013	Driveway	Concrete	1	16	16	19	-3	0	423	<MDA	1	505	505	612	-107	0	1002	<MDA
38	8/31/2013	Driveway - Stained	Concrete	1	4	4	19	-15	0	423	<MDA	1	519	519	612	-93	0	1002	<MDA
39	8/31/2013	Driveway - Cinder Block Wall	Construction	1	9	9	21	-12	0	441	<MDA	1	491	491	398	93	1007	815	>MDA
40	8/31/2013	Transformer	Construction	1	15	15	21	-6	0	441	<MDA	1	226	226	398	-172	0	815	<MDA
41	8/31/2013	Garage Floor - Rust Stain	Concrete	1	11	11	19	-8	0	423	<MDA	1	490	490	612	-122	0	1002	<MDA
42	8/31/2013	Back Yard Patio - Brick	Construction	1	16	16	21	-5	0	441	<MDA	1	657	657	398	259	2811	815	>MDA
43	8/31/2013	Spa Heater	Construction	1	1	1	21	-20	0	441	<MDA	1	277	277	398	-121	0	815	<MDA
44	8/31/2013	Spa Bag Filter	Construction	1	6	6	21	-15	0	441	<MDA	1	273	273	398	-125	0	815	<MDA
45	8/31/2013	Spa Sand Filter	Construction	1	2	2	21	-19	0	441	<MDA	1	296	296	398	-102	0	815	<MDA
46	8/31/2013	A/C Blower	Construction	1	1	1	21	-20	0	441	<MDA	1	288	288	398	-110	0	815	<MDA

Surface Activity Calculation using Daily Background and MDA

Facility	Off-Site Residence (External)
Location	West Hills, Califirnia
Purpose	Survey of Building Materials

Instrument Type	2224-1/43-89	
Instument ID	ZO257835	
Calibration Due Date	8/7/2014	
Radiation	alpha	beta
Instrument Efficiency (cpm/emission)	0.177	0.184
Surface Efficiency (emission/dpm)	0.25	0.5
Probe Area (cm^2)	100	100

Input data in blue cells

Daily Background Measurements

				Alpha								**Beta**							
				Bkgd Count Time	**Sample Count Time**	**Bkgd Gross Count**	**Bkgd Count Rate**	**Bkgd Gross Activity**	**L_C**	**L_D**	**MDA**	**Bkgd Count Time**	**Sample Count Time**	**Bkgd Gross Count**	**Bkgd Count Rate**	**Bkgd Gross Activity**	**L_C**	**L_D**	**MDA**
Sample	**Date**	**Description (Location, Object)**	**Material Type**	**(min)**	**(min)**		**(cpm)**	**(dpm/ 100 cm^2)**	**(counts)**	**(counts)**	**(dpm/ 100 cm^2)**	**(min)**	**(min)**		**(cpm)**	**(dpm/ 100 cm^2)**	**(counts)**	**(counts)**	**(dpm/ 100 cm^2)**
1	8/30/2013	B1319 Reference Location - rusty	Concrete	5	1	95	19	429	8	19	423	5	1	3061	612	6654	45	92	1002
2	8/30/2013	B1319 Reference Location - rusty	Asphalt	5	1	46	9	208	5	14	315	5	1	3138	628	6822	45	93	1014
3	8/30/2013	B1319 Reference Location -metal	Construction	5	1	105	21	475	8	20	441	5	1	1992	398	4330	36	75	815
4																			
5																			
		Average	**Miscellaneous**	**5**	**1**	**82**	**16**	**371**	**7**	**17**	**393**	**5**	**1**	**2730**	**546**	**5936**	**42**	**87**	**943**

Sample Area Measurements

				Alpha								**Beta**							
				Sample Count Time	**Gross Sample Count**	**Gross Count Rate**	**Bkgd Count Rate**	**Net Count Rate**	**Net Activity**	**MDA**	**> MDA or < MDA ?**	**Sample Count Time**	**Gross Sample Count**	**Gross Count Rate**	**Bkgd Count Rate**	**Net Count Rate**	**Net Activity**	**MDA**	**> MDA or < MDA ?**
Sample	**Date**	**Description (Location, Object)**	**Material Type**	**(min)**		**(cpm)**	**(cpm)**	**(cpm)**	**(dpm/ 100 cm^2)**	**(dpm/ 100 cm^2)**		**(min)**		**(cpm)**	**(cpm)**	**(cpm)**	**(dpm/ 100 cm^2)**	**(dpm/ 100 cm^2)**	
47	8/31/2013	Cinder Block Wall	Construction	1	13	13	21	-8	0	441	<MDA	1	490	490	398	92	996	815	>MDA
48	8/31/2013	Concrete - Rust Stained	Concrete	1	13	13	19	-6	0	423	<MDA	1	571	571	612	-41	0	1002	<MDA
49	8/31/2013	Concrete - Rust Stained	Concrete	1	15	15	19	-4	0	423	<MDA	1	463	463	612	-149	0	1002	<MDA
50	8/31/2013	Brick Fire Pit	Construction	1	19	19	21	-2	0	441	<MDA	1	571	571	398	173	1876	815	>MDA
51	8/31/2013	Backyard Concrete	Concrete	1	2	2	19	-17	0	423	<MDA	1	493	493	612	-119	0	1002	<MDA
52	8/31/2013	Backyard Brick Decoration	Construction	1	9	9	21	-12	0	441	<MDA	1	546	546	398	148	1604	815	>MDA
53	8/31/2013	Backyard Concrete - New	Concrete	1	2	2	19	-17	0	423	<MDA	1	481	481	612	-131	0	1002	<MDA
54	8/31/2013	Pool Edge Tiles	Construction	1	2	2	21	-19	0	441	<MDA	1	447	447	398	49	528	815	<MDA
55	8/31/2013	Cinder Bricks	Construction	1	10	10	21	-11	0	441	<MDA	1	514	514	398	116	1257	815	>MDA
56	8/31/2013	Pool Heater	Construction	1	7	7	21	-14	0	441	<MDA	1	308	308	398	-90	0	815	<MDA
57	8/31/2013	Pool Sand Filter	Construction	1	6	6	21	-15	0	441	<MDA	1	268	268	398	-130	0	815	<MDA
58	8/31/2013	Concrete Drainage Channel	Concrete	1	4	4	19	-15	0	423	<MDA	1	517	517	612	-95	0	1002	<MDA

Surface Activity Calculation using Daily Background and MDA

Facility	Off-Site Residence (External)
Location	West Hills, Califirnia
Purpose	Survey of Building Materials

Instrument Type	2224-1/43-89	
Instument ID	ZO257835	
Calibration Due Date	8/7/2014	
Radiation	alpha	beta
Instrument Efficiency (cpm/emission)	0.177	0.184
Surface Efficiency (emission/dpm)	0.25	0.5
Probe Area (cm^2)	100	100

Input data in blue cells

Daily Background Measurements

				Alpha								Beta							
				Bkgd Count Time	Sample Count Time	Bkgd Gross Count	Bkgd Count Rate	Bkgd Gross Activity	L_C	L_D	MDA	Bkgd Count Time	Sample Count Time	Bkgd Gross Count	Bkgd Count Rate	Bkgd Gross Activity	L_C	L_D	MDA
Sample	Date	Description (Location, Object)	Material Type	(min)	(min)		(cpm)	(dpm/ 100 cm^2)	(counts)	(counts)	(dpm/ 100 cm^2)	(min)	(min)		(cpm)	(dpm/ 100 cm^2)	(counts)	(counts)	(dpm/ 100 cm^2)
1	8/30/2013	B1319 Reference Location - rusty	Concrete	5	1	95	19	429	8	19	423	5	1	3061	612	6654	45	92	1002
2	8/30/2013	B1319 Reference Location - rusty	Asphalt	5	1	46	9	208	5	14	315	5	1	3138	628	6822	45	93	1014
3	8/30/2013	B1319 Reference Location -metal	Construction	5	1	105	21	475	8	20	441	5	1	1992	398	4330	36	75	815
4																			
5																			
		Average	**Miscellaneous**	**5**	**1**	**82**	**16**	**371**	**7**	**17**	**393**	**5**	**1**	**2730**	**546**	**5936**	**42**	**87**	**943**

Sample Area Measurements

				Alpha								Beta							
				Sample Count Time	Gross Sample Count	Gross Count Rate	Bkgd Count Rate	Net Count Rate	Net Activity	MDA	> MDA or < MDA ?	Sample Count Time	Gross Sample Count	Gross Count Rate	Bkgd Count Rate	Net Count Rate	Net Activity	MDA	> MDA or < MDA ?
Sample	Date	Description (Location, Object)	Material Type	(min)		(cpm)	(cpm)	(cpm)	(dpm/ 100 cm^2)	(dpm/ 100 cm^2)		(min)		(cpm)	(cpm)	(cpm)	(dpm/ 100 cm^2)	(dpm/ 100 cm^2)	
59	9/1/2013	Stone Debris	Construction	1	5	5	21	-16	0	441	<MDA	1	410	410	398	12	126	815	<MDA
60	9/1/2013	Stone Debris	Construction	1	4	4	21	-17	0	441	<MDA	1	444	444	398	46	496	815	<MDA
61	9/1/2013	Metal Fence Post	Construction	1	7	7	21	-14	0	441	<MDA	1	358	358	398	-40	0	815	<MDA
62	9/1/2013	Concrete Steps	Concrete	1	4	4	19	-15	0	423	<MDA	1	532	532	612	-80	0	1002	<MDA
63	9/1/2013	Gs Line Rusty Metal	Construction	1	3	3	21	-18	0	441	<MDA	1	303	303	398	-95	0	815	<MDA
64	9/1/2013	Concrete Drainline	Concrete	1	3	3	19	-16	0	423	<MDA	1	543	543	612	-69	0	1002	<MDA
65	9/1/2013	Cinder Block Wall	Construction	1	7	7	21	-14	0	441	<MDA	1	490	490	398	92	996	815	>MDA
66	9/1/2013	Brick Floor	Construction	1	6	6	21	-15	0	441	<MDA	1	588	588	398	190	2061	815	>MDA
67	9/1/2013	Backyard Concrete - Stained	Concrete	1	6	6	19	-13	0	423	<MDA	1	496	496	612	-116	0	1002	<MDA
68	9/1/2013	Garage Concrete Floor - Stained	Concrete	1	16	16	19	-3	0	423	<MDA	1	511	511	612	-101	0	1002	<MDA
69	9/1/2013	Garage Concrete Floor - Stained	Concrete	1	27	27	19	8	181	423	<MDA	1	530	530	612	-82	0	1002	<MDA
70	9/1/2013	Garage Concrete Floor - Stained	Concrete	1	21	21	19	2	45	423	<MDA	1	531	531	612	-81	0	1002	<MDA
71	9/1/2013	Garage Concrete Floor - Stained	Concrete	1	16	16	19	-3	0	423	<MDA	1	523	523	612	-89	0	1002	<MDA
72	9/1/2013	Garage Concrete Floor - Stained	Concrete	1	19	19	19	0	0	423	<MDA	1	530	530	612	-82	0	1002	<MDA
73	9/1/2013	Drainage Outside Garage	Concrete	1	9	9	19	-10	0	423	<MDA	1	491	491	612	-121	0	1002	<MDA
74	9/1/2013	Porch Floor Tile	Construction	1	1	1	21	-20	0	441	<MDA	1	719	719	398	321	3485	815	>MDA
75	9/1/2013	Porch Floor Tile	Construction	1	5	5	21	-16	0	441	<MDA	1	770	770	398	372	4039	815	>MDA
76	9/2/2013	Roof Tile	Construction	1	14	14	21	-7	0	441	<MDA	1	516	516	398	118	1278	815	>MDA
77	9/2/2013	Roof Tile	Construction	1	2	2	21	-19	0	441	<MDA	1	479	479	398	81	876	815	>MDA

Sample Report

Batch ID:	Smears 1 Minute Count - 201309031427	**Count Date:**	9/3/2013 2:27:30PM
Group:	D	**Count Minutes:**	1.00
Device:	Environ Tennelec SN 37108	**Count Mode:**	Simultaneous
Batch Key:	2503	**Operating Volts:**	1410
Selected	Swipe/Smear	**Comments:**	Off-site example survey smear

Background (cpm)		**Efficiency (%)**	
Alpha Rate:	0.10 ± 0.10	**Alpha:**	34.85 ± 0.60
Beta Rate:	3.00 ± 0.55	**Beta:**	38.26 ± 0.73

Sample ID		Sample Type	Alpha (dpm)	Unc	Alpha MDA (dpm)	Beta (dpm)	Unc	Beta MDA (dpm)
1		Unknown	2.58	2.88	12.00	15.68	7.98	24.00
2		Unknown	2.58	2.88	12.00	18.30	8.40	24.00
3		Unknown	-0.29	0.29	12.00	5.23	6.02	24.00
4		Unknown	-0.29	0.29	12.00	0.00	4.75	24.00
5		Unknown	2.58	2.88	12.00	10.46	7.06	24.00
6		Unknown	5.45	4.07	12.00	7.84	6.56	24.00
7		Unknown	11.19	5.75	12.00	13.07	7.53	24.00
8		Unknown	2.58	2.88	12.00	10.46	7.06	24.00
9		Unknown	-0.29	0.29	12.00	5.23	6.02	24.00
10		Unknown	2.58	2.88	12.00	5.23	6.02	24.00
11		Unknown	2.58	2.88	12.00	5.23	6.02	24.00
12		Unknown	5.45	4.07	12.00	7.84	6.56	24.00
13		Unknown	2.58	2.88	12.00	10.46	7.06	24.00
14		Unknown	-0.29	0.29	12.00	7.84	6.56	24.00
15		Unknown	14.06	6.43	12.00	7.84	6.56	24.00
16		Unknown	2.58	2.88	12.00	2.61	5.42	24.00
17		Unknown	8.32	4.98	12.00	5.23	6.02	24.00
18		Unknown	2.58	2.88	12.00	15.68	7.98	24.00
19		Unknown	2.58	2.88	12.00	20.91	8.80	24.00
20		Unknown	5.45	4.07	12.00	5.23	6.02	24.00
21		Unknown	-0.29	0.29	12.00	-2.61	3.96	24.00
22		Unknown	8.32	4.98	12.00	15.68	7.98	24.00
23	A/C Filter	Unknown	2.58	2.88	12.00	36.59	10.89	24.00
24	A/C Filter	Unknown	14.06	6.43	12.00	47.05	12.10	24.00
25	Stove Exhaust Filter	Unknown	8.32	4.98	12.00	18.30	8.40	24.00
26	Stove Exhaust Filter	Unknown	2.58	2.88	12.00	2.61	5.42	24.00
27		Unknown	-0.29	0.29	12.00	7.84	6.56	24.00
28		Unknown	2.58	2.88	12.00	5.23	6.02	24.00
29		Unknown	2.58	2.88	12.00	10.46	7.06	24.00
30		Unknown	-0.29	0.29	12.00	5.23	6.02	24.00
31		Unknown	2.58	2.88	12.00	10.46	7.06	24.00
32		Unknown	2.58	2.88	12.00	-2.61	3.96	24.00
33		Unknown	2.58	2.88	12.00	13.07	7.53	24.00
34		Unknown	2.58	2.88	12.00	10.46	7.06	24.00
35		Unknown	-0.29	0.29	12.00	0.00	4.75	24.00
36		Unknown	-0.29	0.29	12.00	5.23	6.02	24.00
37		Unknown	5.45	4.07	12.00	18.30	8.40	24.00
38		Unknown	8.32	4.98	12.00	18.30	8.40	24.00
39		Unknown	-0.29	0.29	12.00	5.23	6.02	24.00
40		Unknown	2.58	2.88	12.00	7.84	6.56	24.00
41		Unknown	2.58	2.88	12.00	2.61	5.42	24.00
42		Unknown	5.45	4.07	12.00	15.68	7.98	24.00
43		Unknown	2.58	2.88	12.00	0.00	4.75	24.00
44		Unknown	2.58	2.88	12.00	15.68	7.98	24.00
45		Unknown	2.58	2.88	12.00	7.84	6.56	24.00
46		Unknown	2.58	2.88	12.00	10.46	7.06	24.00
47		Unknown	2.58	2.88	12.00	15.68	7.98	24.00

Batch ID:	Smears 1 Minute Count - 201309031427	**Count Date:**	9/3/2013 2:27:30PM
Group:	D	**Count Minutes:**	1.00
Device:	Environ Tennelec SN 37108	**Count Mode:**	Simultaneous
Batch Key:	2503	**Operating Volts:**	1410
Selected	Swipe/Smear	**Comments:**	Off-site example survey smear

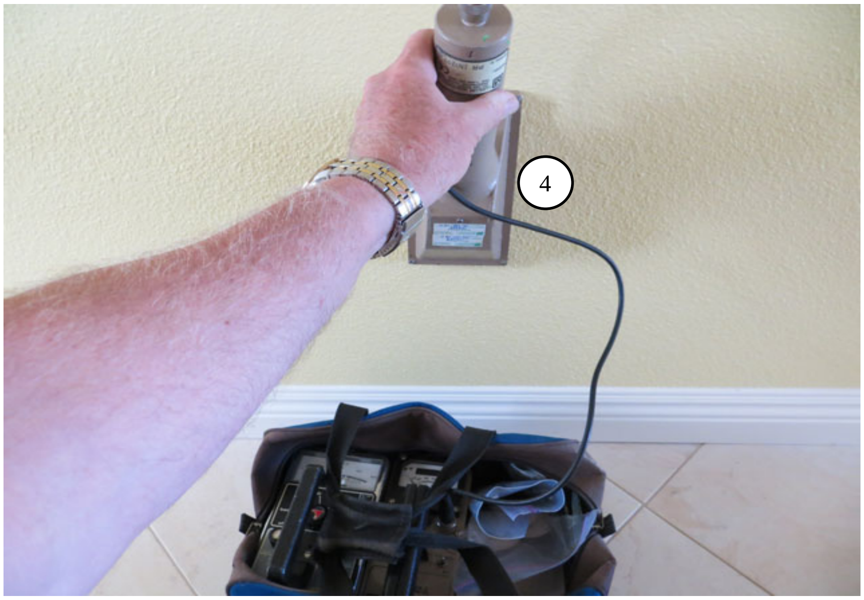
Background (cpm)				**Efficiency (%)**			
Alpha Rate:	0.10	±	0.10	**Alpha:**	34.85	±	0.60
Beta Rate:	3.00	±	0.55	**Beta:**	38.26	±	0.73

Sample ID	Sample Type	Alpha (dpm)	Unc	Alpha MDA (dpm)	Beta (dpm)	Unc	Beta MDA (dpm)
48	Unknown	5.45	4.07	12.00	5.23	6.02	24.00
49	Unknown	-0.29	0.29	12.00	0.00	4.75	24.00
50	Unknown	2.58	2.88	12.00	5.23	6.02	24.00
51	Unknown	2.58	2.88	12.00	5.23	6.02	24.00
52	Unknown	2.58	2.88	12.00	0.00	4.75	24.00
53	Unknown	-0.29	0.29	12.00	2.61	5.42	24.00
54	Unknown	-0.29	0.29	12.00	5.23	6.02	24.00
55	Unknown	-0.29	0.29	12.00	-7.84	1.44	24.00
56	Unknown	-0.29	0.29	12.00	7.84	6.56	24.00
57	Unknown	8.32	4.98	12.00	18.30	8.40	24.00
58	Unknown	-0.29	0.29	12.00	5.23	6.02	24.00
59	Unknown	2.58	2.88	12.00	7.84	6.56	24.00
60	Unknown	2.58	2.88	12.00	7.84	6.56	24.00
61	Unknown	-0.29	0.29	12.00	0.00	4.75	24.00
62	Unknown	-0.29	0.29	12.00	-5.23	2.98	24.00
63	Unknown	-0.29	0.29	12.00	2.61	5.42	24.00
64	Unknown	2.58	2.88	12.00	0.00	4.75	24.00
65	Unknown	2.58	2.88	12.00	2.61	5.42	24.00
66	Unknown	-0.29	0.29	12.00	5.23	6.02	24.00
67	Unknown	5.45	4.07	12.00	0.00	4.75	24.00
68	Unknown	-0.29	0.29	12.00	10.46	7.06	24.00
69	Unknown	-0.29	0.29	12.00	0.00	4.75	24.00
70	Unknown	-0.29	0.29	12.00	0.00	4.75	24.00
71	Unknown	2.58	2.88	12.00	0.00	4.75	24.00
72	Unknown	5.45	4.07	12.00	7.84	6.56	24.00
73	Unknown	2.58	2.88	12.00	7.84	6.56	24.00
74	Unknown	-0.29	0.29	12.00	-2.61	3.96	24.00
75	Unknown	-0.29	0.29	12.00	7.84	6.56	24.00
76	Unknown	-0.29	0.29	12.00	2.61	5.42	24.00
77	Unknown	-0.29	0.29	12.00	5.23	6.02	24.00


1
2013/08/31 12:14


2
2013/08/31 12:19


3
2013/08/31 12:25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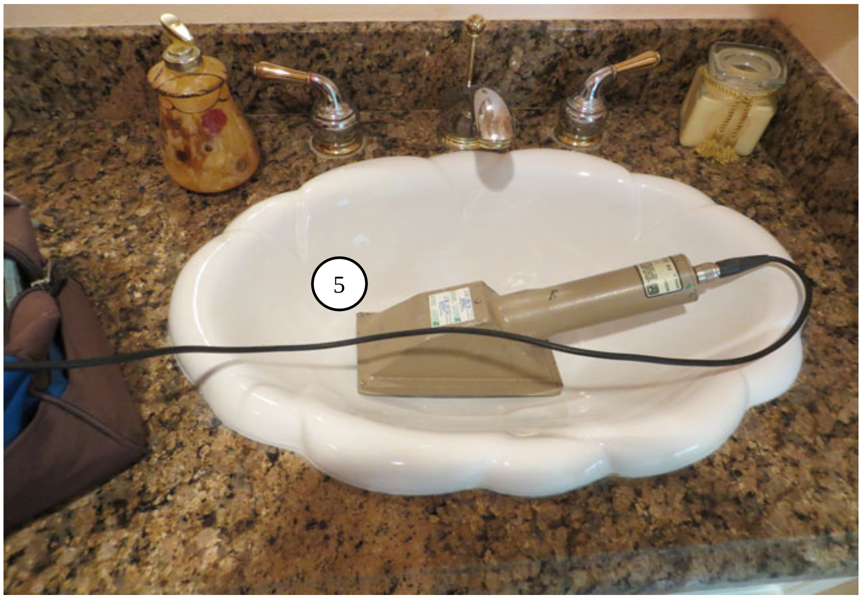
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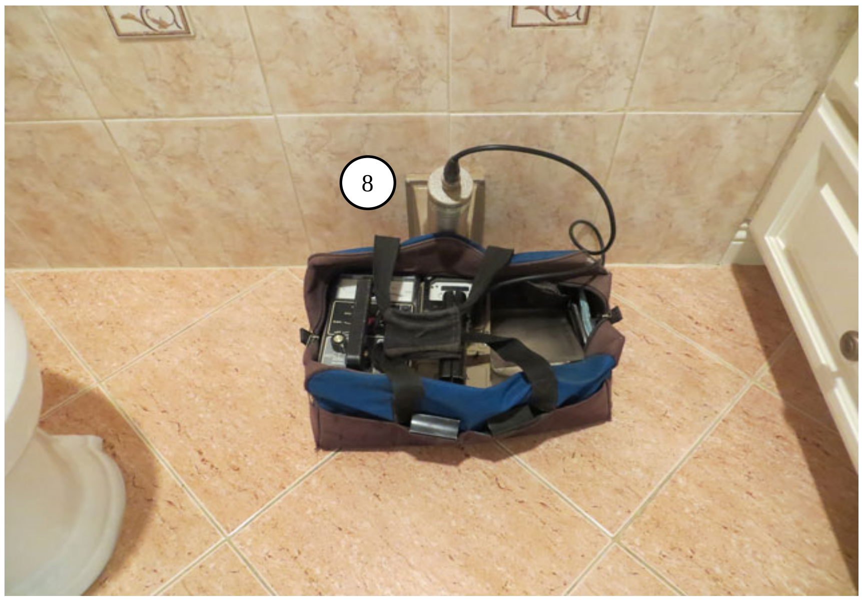
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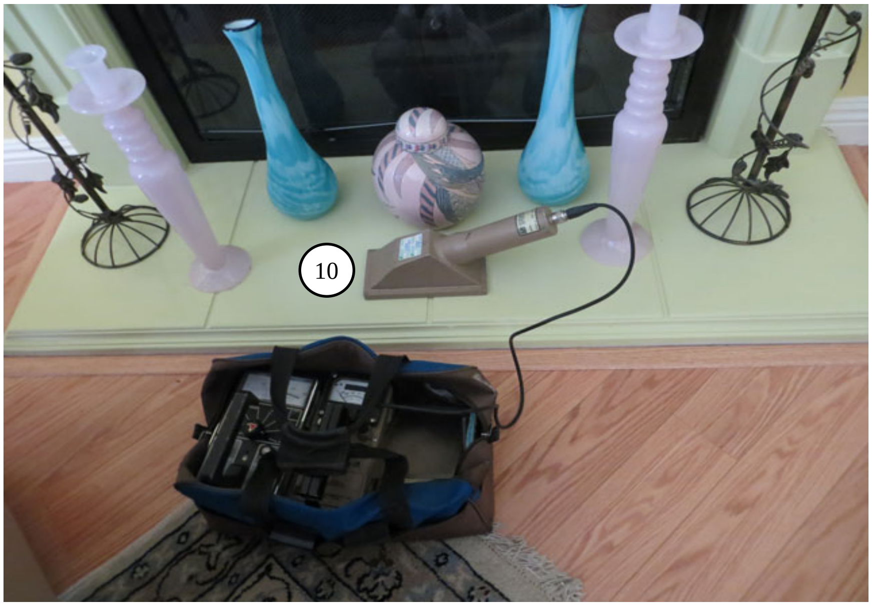
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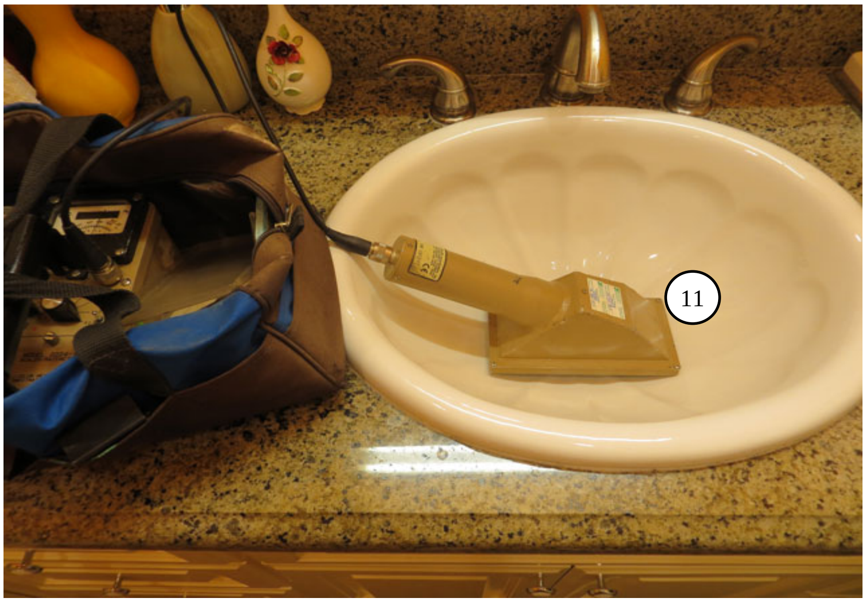
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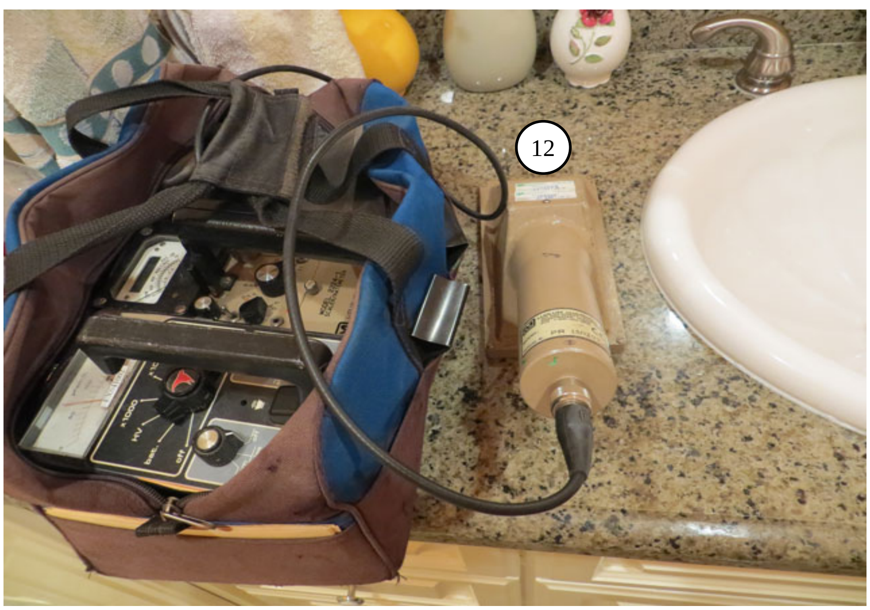
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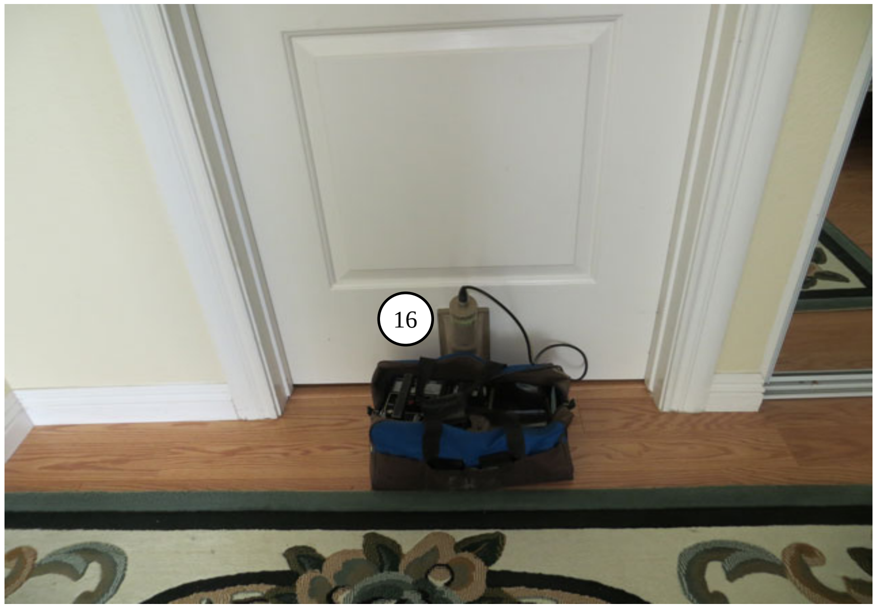
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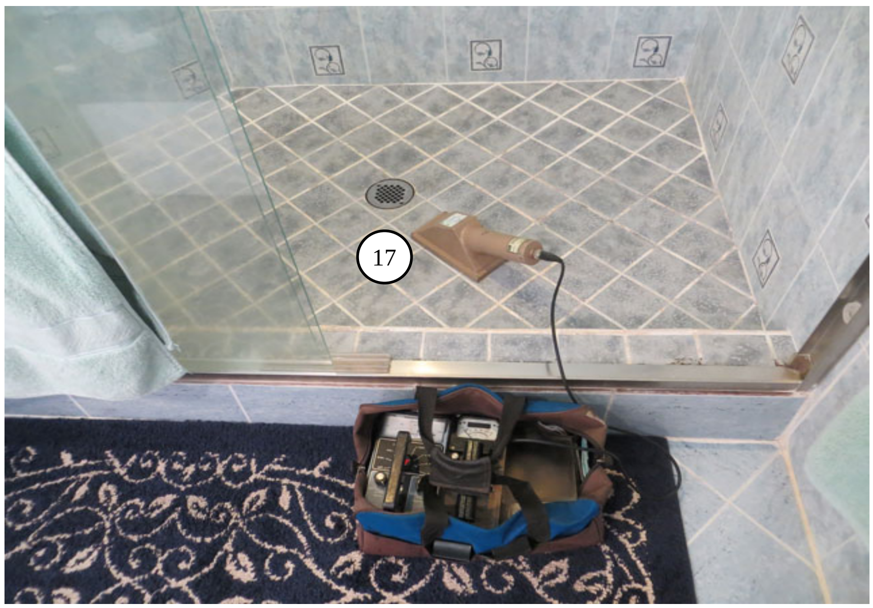
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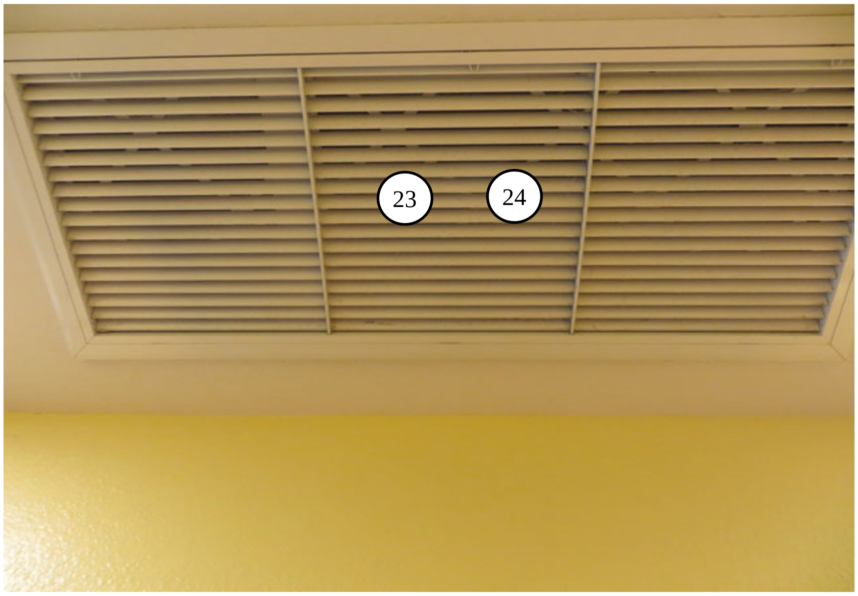
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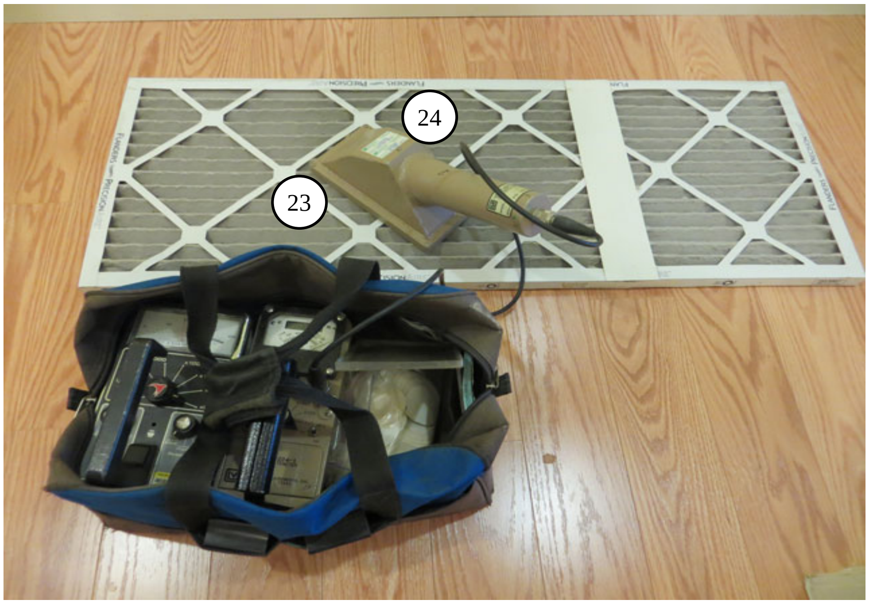
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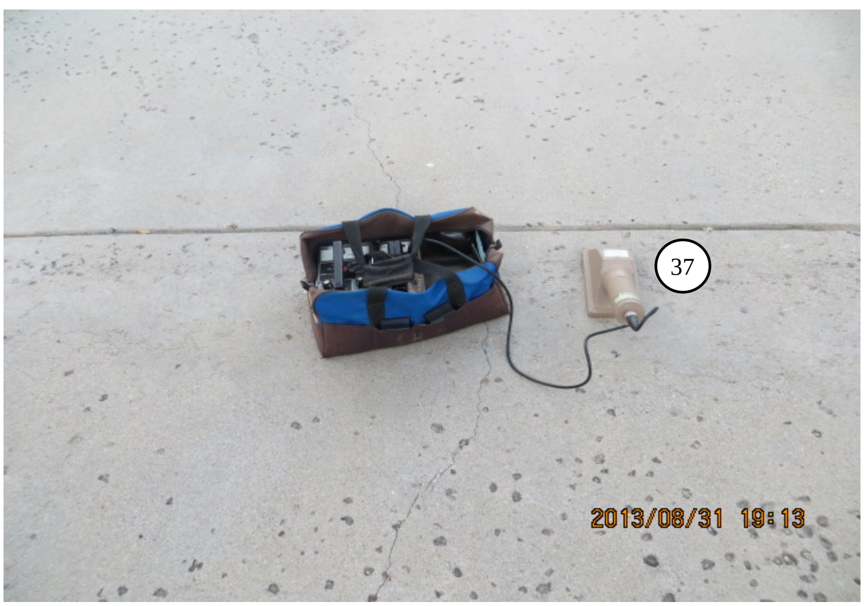
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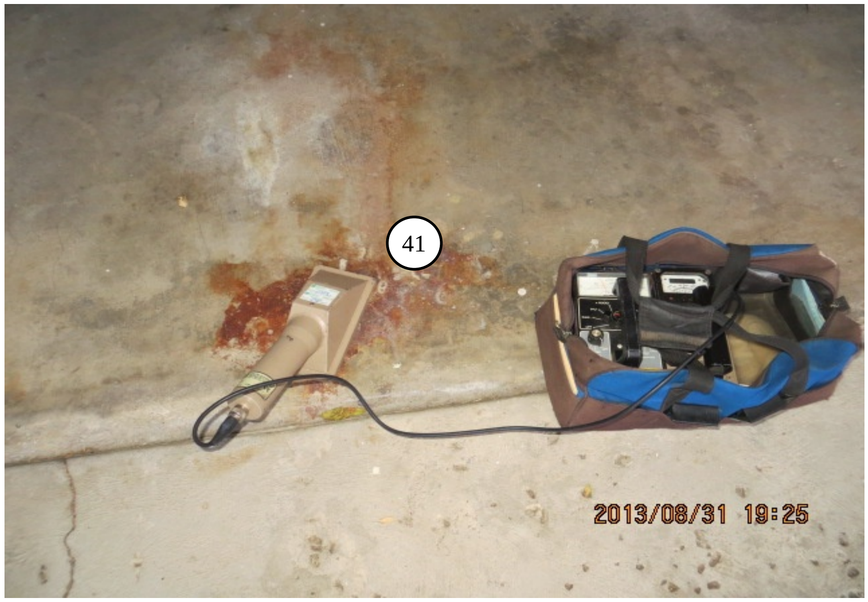
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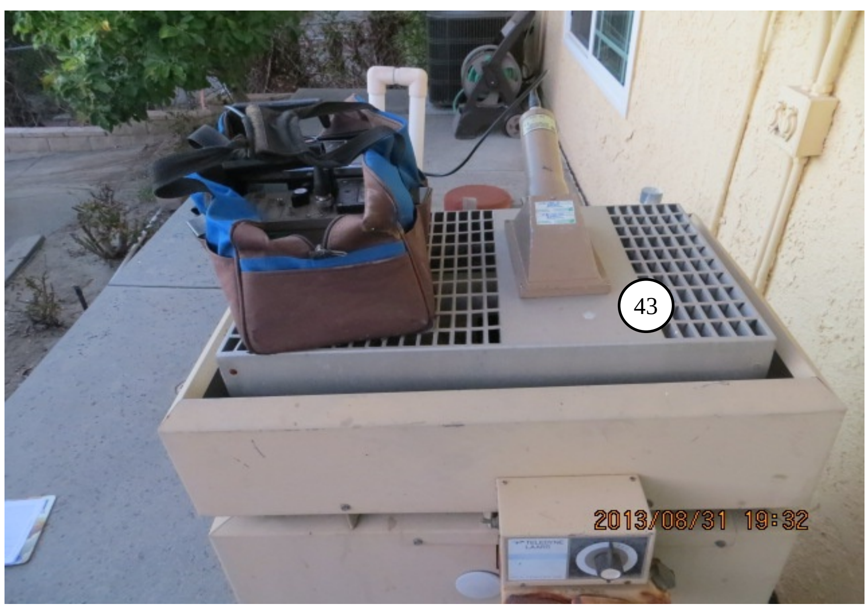
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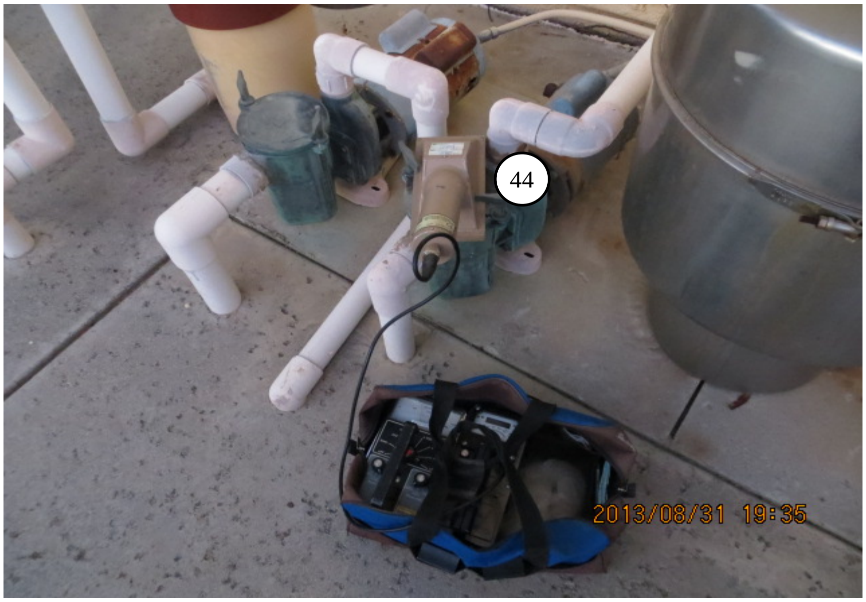
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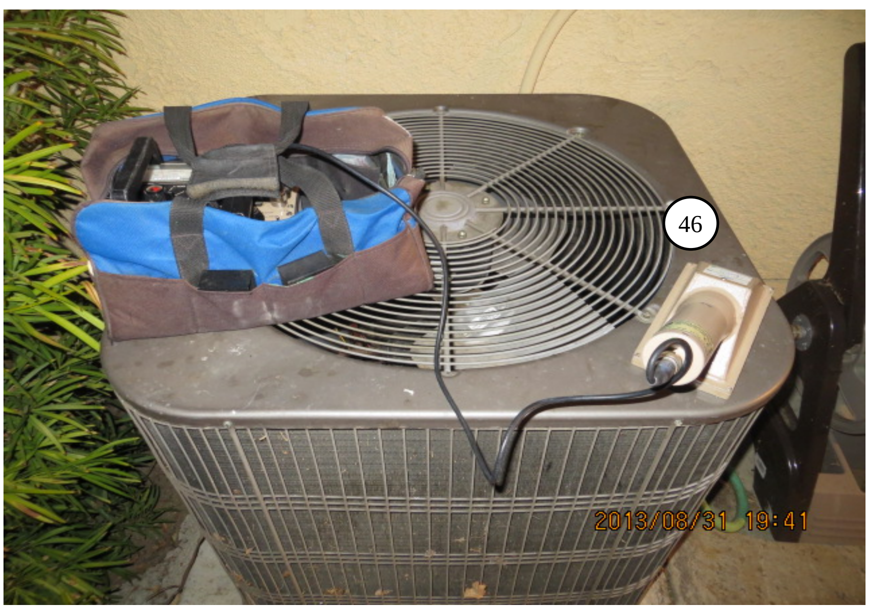
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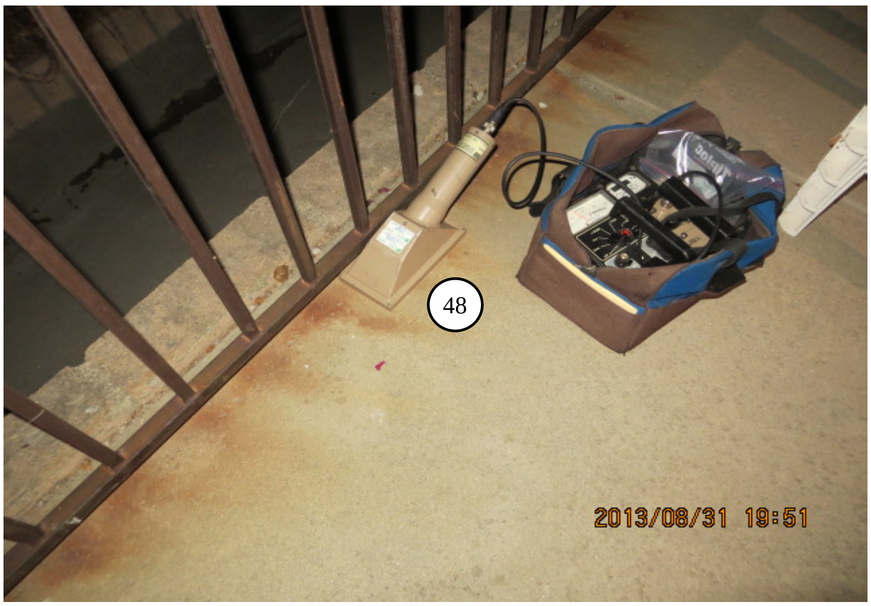
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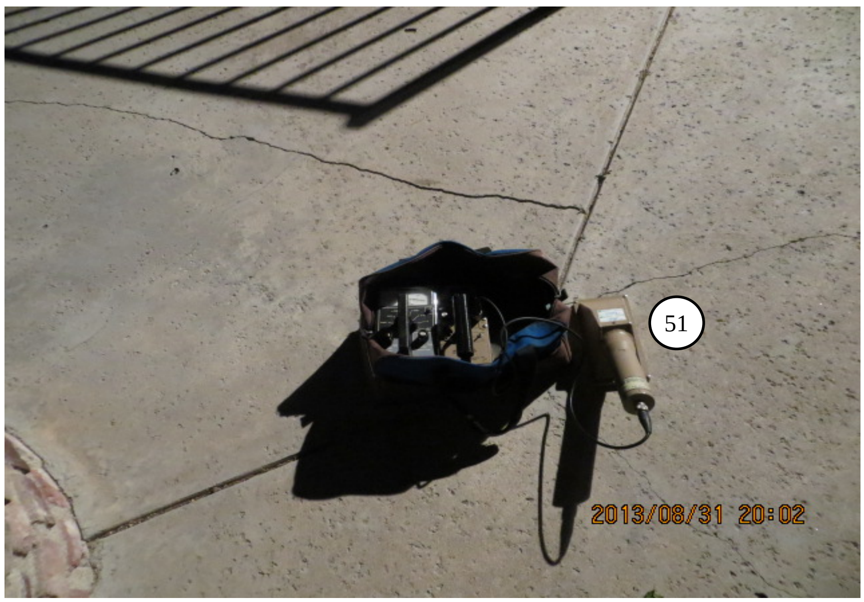
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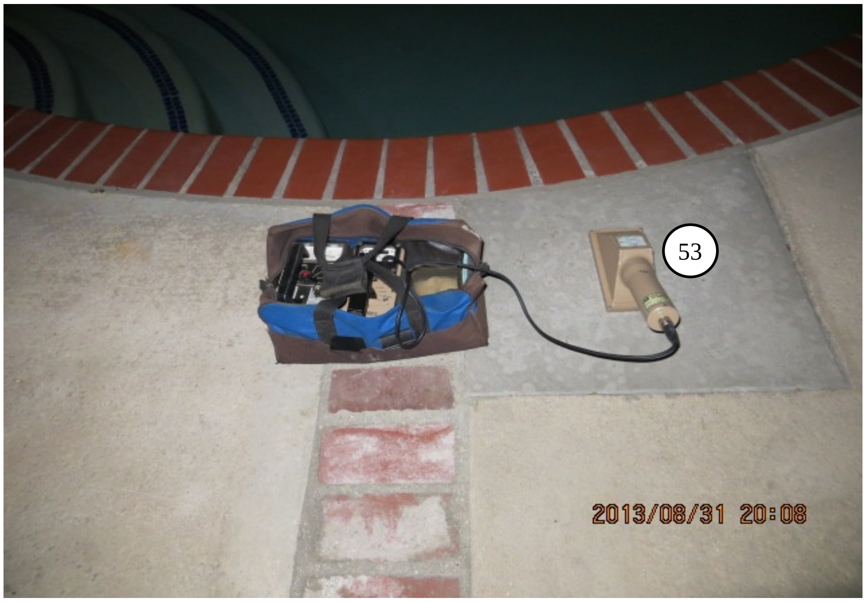
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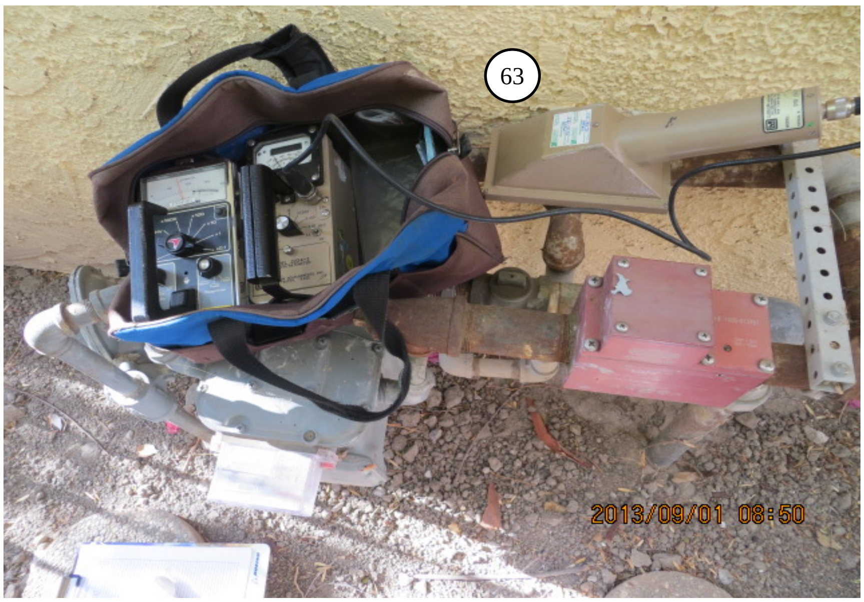
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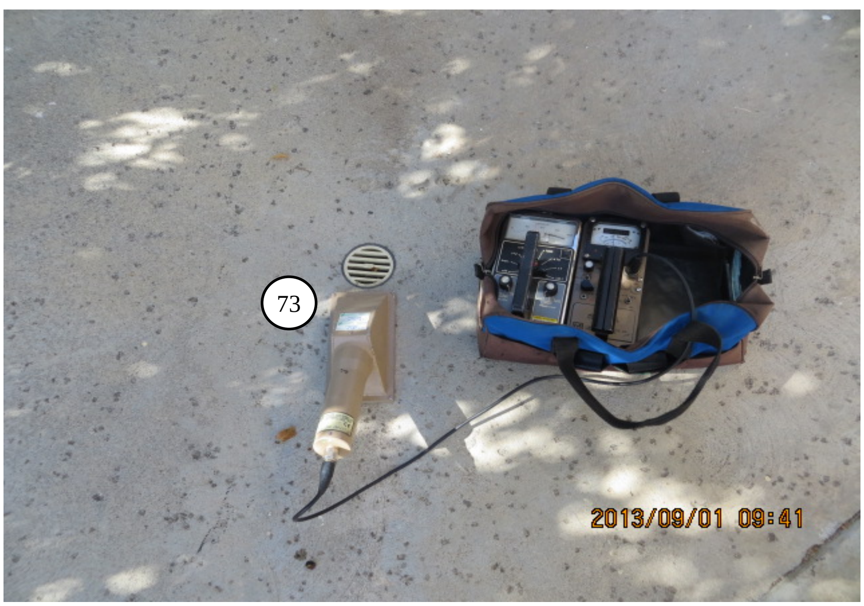
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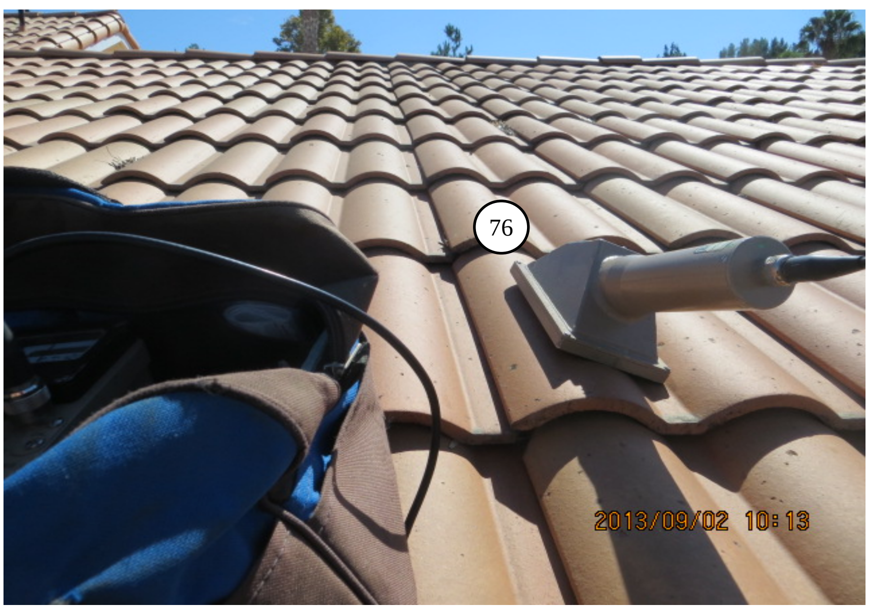
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