The Boeing Company v. Movassaghi

Case NO. 09-CV-03165-GEB-KJN

Civil Action

APPENDIX OF AUTHORITIES PER LOCAL RULE 133(i)(3)

TABLE OF CONTENTS

TAB 1

DOE/EA-1345

ENVIRONMENTAL ASSESSMENT FOR CLEANUP AND CLOSURE OF THE ENERGY TECHNOLOGY ENGINEERING CENTER

FINAL

March 2003

U.S. Department of Energy
NNSA Service Center
Oakland, CA

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Oakland Operations Office is responsible for the operation of the Energy Technology Engineering Center (ETEC), a government-owned complex of buildings located within Area IV (approximately 1.2 square kilometers [290 acres]) of the Santa Susana Field Laboratory (SSFL) (*see* Figure 1-1). The 11-square-kilometer (2,850-acre) SSFL is located atop a range of hills between the Simi and San Fernando Valleys in southeastern Ventura County, California. ETEC is operated by Rocketdyne Propulsion & Power, a division of The Boeing Company. ETEC does not have specific site boundaries, but rather is a group of facilities owned by DOE or where DOE-sponsored operations took place.

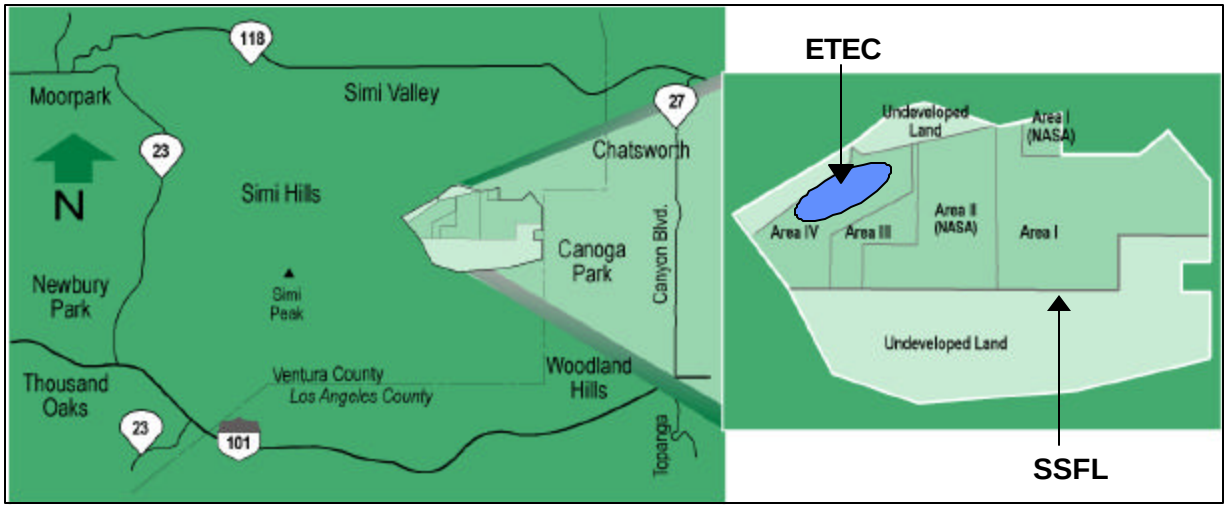

Figure 1-1. Location of SSFL, Area IV, and ETEC

From the mid-1950s until the mid-1990s, DOE and its predecessor agencies conducted nuclear research and energy development projects at ETEC. Activities in Area IV of the SSFL sponsored by DOE included nuclear operations (development, fabrication, disassembly, and examination of nuclear reactors, reactor fuel, and other radioactive materials) and large-scale liquid sodium metal experiments for testing liquid metal fast breeder reactor components. The use of radioactive materials at the SSFL was restricted to Area IV only. As a result of these and other activities, various facilities and locations on the site contain radioactive and chemical contamination. Hazardous materials such as asbestos insulation and lead-based paint may also be present in some buildings. The remainder of Area IV and the SSFL are not owned or controlled by DOE.

All nuclear research at ETEC terminated in 1988. Since then, many of the previously used nuclear facilities and associated site areas have been decontaminated and decommissioned. Decontamination and decommissioning activities at the sodium test facilities began in 1996.

As public concern over cleanup activities at ETEC increased, DOE decided to conduct an environmental assessment (EA) under the National Environmental Policy Act (NEPA) of its remaining cleanup activities. (Previous closure activities at the site were performed under NEPA through categorical exclusions). DOE has prepared this EA to evaluate the potential impacts of implementing additional

Subdivisions			
Owner	**Jurisdiction**	**Acres**	**Subtotals**
Rocketdyne	Rocketdyne-Area IV	289.9	
	Rocketdyne	784.8	
	Rocketdyne (Undeveloped land)	1,324.6	2,399.3
Government	NASA (former AFP 57)	409.5	
	NASA (former AFP 64)	41.7	451.2
Total Acres			2,850.5

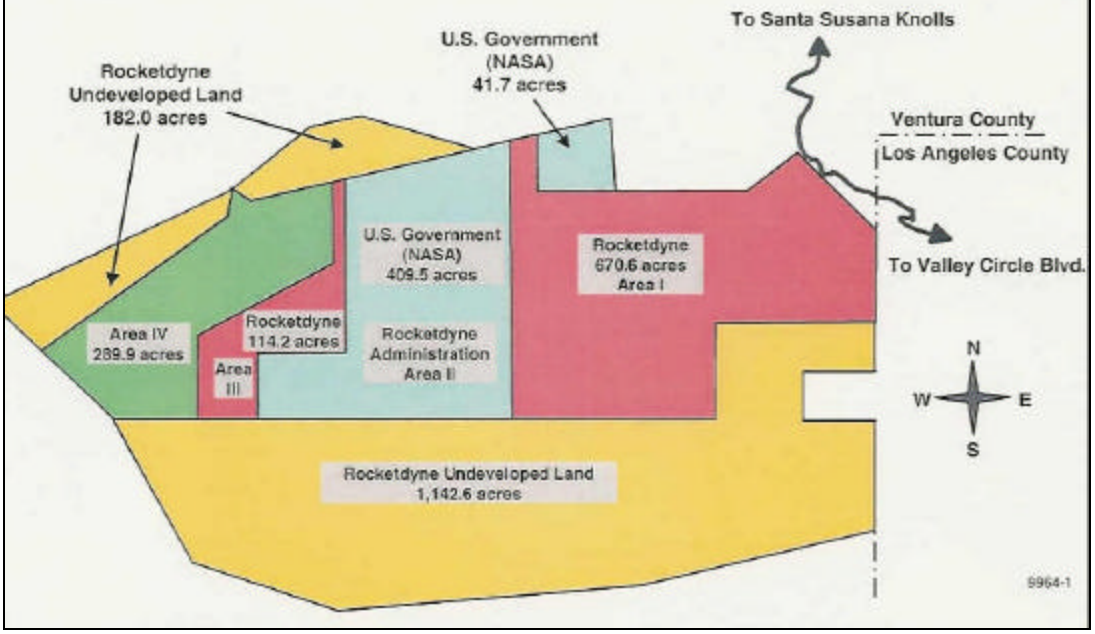

Figure 4-1. SSFL Arrangement

Table I-3. Status of All Radiological Facilities at ETEC

Facility Number	Facility Title	Rocketdyne Operations	Verification Surveys	Owner	Released By	Release Date	Building Demolition Date
OCY	Old Conservation Yard	D&D and survey complete	ORISE, DHS	Rocketdyne	DHS	1995	Land Only
RMHF	Radioactive Materials Handling Facility	Operational	-	DOE	-	ECD 2006	ECD 2006
003	Engineering Test Building	D&D and survey complete	ANL	Rocketdyne	DOE	1985	1999
005	Uranium Carbide Fuel Facility	D&D and survey complete	ORISE, DHS	Rocketdyne	DHS	1995	1996
009	Organic Moderated Reactor, Sodium Graphite Reactor	D&D and survey complete	DHS	Rocketdyne	DHS	1999	Not Planned
011	Radiation Instrument Calibration Laboratory	Survey complete	DHS	Rocketdyne	DHS	1998	Not Planned
010	SNAP-8 Experimental Reactor	D&D and survey complete	ANL	DOE	DOE	1982	1983
012	SNAP Critical Facility	D&D and survey complete	ORISE, DHS	DOE	DOE, DHS	1997	ECD 2004
17th St.	17th St. Drainage Area	D&D and survey complete	ORISE, DHS	Rocketdyne	Pending	ECD 2002	Land Only
019	Flight System Critical Assembly	D&D and survey complete	ORISE, DHS	DOE	Pending	ECD 2002	Not Planned
020	Hot Lab Bldg.	D&D and survey complete	DHS	DOE	DHS (concrete)	1997-99	1997-99

Table I-3. Status of All Radiological Facilities at ETEC (cont)

Facility Number	Facility Title	Rocketdyne Operations	Verification Surveys	Owner	Released By	Release Date	Building Demolition Date
020	Hot Lab Land	Survey complete	ORISE, DHS	DOE	Pending	ECD 2002	Land Only
023	Corrosion Test Loop	D&D and survey complete	ORISE, DHS	DOE	DOE, DHS	1997	1999
024	SNAP Environmental Test Facility	Operational (offices)	-	DOE	-	ECD 2005	ECD 2005
028	Shield Test Iradiation Reactor	D&D and survey complete	ORISE, DHS	DOE	DOE, DHS	1997	1998
029	Radiation Measurement Facility	D&D and survey complete	ORISE, DHS	DOE	DOE, DHS	1997	ECD 2003
030	van de Graaf Accelerator	D&D and survey complete	ORISE, DHS	DOE	DOE, DHS	1997	1999
055	Nuclear Materials Development Facility	D&D and survey complete	ORAU	Rocketdyne	NRC	1987	Not Planned
059	SNAP Ground Prototype Test Building	Phase I D&D and survey complete	ORISE, DHS	DOE	Phase I pending	ECD 2002	ECD 2003
059	059 Land	Phase II D&D and survey complete	ORISE, DHS	DOE	-	ECD 2004	Land Only
064	Fuel Storage Facility	D&D and survey complete	ORISE, DHS	DOE	DOE, DHS	1996	1997
064SY	064 Side Yard and land	D&D and survey complete	ORISE, DHS	DOE	Pending	ECD 2002	Land Only
073	Kinetic Experiment Water Boiler	D&D and survey complete	ANL	ERDA	ERDA	1976	1976

Table I-3. Status of All Radiological Facilities at ETEC (cont)

Facility Number	Facility Title	Rocketdyne Operations	Verification Surveys	Owner	Released By	Release Date	Building Demolition Date
093	L-85 Reactor	D&D and survey complete	ORAU	Rocketdyne	NRC	1987	1995
100	Fast Critical Experiment Laboratory	D&D and survey complete	NRC	Rocketdyne	NRC	1980	Not Planned
143	Sodium Reactor Experiment	D&D and survey complete	ANL	Rocketdyne	DOE	1985	1999
363	R&D Laboratory	D&D and survey complete	ORISE, DHS	Rocketdyne	DHS	1998	2001
373	SNAP Critical Facility	D&D and survey complete	DHS (document review only)	Rocketdyne	DHS	1995	1996-99
654	Interim Storage Facility	D&D and survey complete	ORISE, DHS	DOE	Pending	ECD 2002	Land Only
886	Sodium Disposal Facility	Rad. D&D and survey complete	DHS	Rocketdyne	DHS	1998 (Land)	1991(Bldg)

D&D: decontamination and decommissioning
ECD: estimated completion date

TAB 2

Rocketdyne Division
Rockwell International Corporation
6633 Canoga Avenue
Canoga Park, California 91304

Telex: 698478
ROCKETDYN CNPK

Rockwell International

April 25, 1986

In reply refer to 86RC05802

Mr. James T. Davis, Director
Environment, Safety, and Quality
Assurance
U.S. Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, CA 94612

Subject: Phase I of CERCLA Program

Dear Mr. Davis:

DOE Order 5480.14, "Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Program," provides instructions for implementing the DOE CERCLA Program, which is to be accomplished in five phases. Phase I - Installation Assessment requires a survey to locate and identify any inactive hazardous waste disposal sites in DOE facilities. This survey has been performed on those facilities which are DOE-owned and contained on the DOE-optioned land at the Rockwell International Santa Susana Field Laboratory in Ventura County, California. The results of the survey are reported in Document NOO1TI000262, "CERCLA Program Phase I Installation Assessment for DOE Facilities at SSFL." Three copies of the document are enclosed for your information and use.

Please note that the enclosed document is the final form of the report originally sent as a draft to your office with my letter of March 21, 1986.

Sincerely yours,

M. E. Remley, Director
Nuclear Safety and Licensing

7080A/reg

Enclosure: Document NOO1TI000262 (3 copies)

Rockwell International
Rocketdyne Division

SUPPORTING DOCUMENT

GO NO.	S/A NO.	PAGE 1 OF	TOTAL PAGES	REV LTR/CHG NO. SEE SUMMARY OF CHG	NUMBER
		42	42	NC	N001TI000262

PROGRAM TITLE

DOCUMENT TITLE

CERCLA Program Phase I Installation Assessment for DOE Facilities at SSFL

DOCUMENT TYPE

Technical Information

KEY NOUNS
CERCLA, Hazardous Waste,
Site Survey

ORIGINAL ISSUE DATE

REL. DATE
4-25-86 SW

APPROVALS
M. E. Remley

DATE
25 April 1986

PREPARED BY/DATE DEPT MAIL ADDR
K. L. Adler/P. S. Olson
M. E. Remley
R. D. Schmued

IR&D PROGRAM? YES ☐ NO ☒
IF YES, ENTER TPA NO.

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ABSTRACT

A survey has been conducted to determine if there are any potential disposal sites on the DOE-optioned land at the SSFL of RCRA-type hazardous waste which would fall under the purview of the Comprehensive Environmental Responses, Compensation and Liability Act (CERCLA) requirements. One area which had been used as a temporary storage facility was identified as a candidate for further investigation. There is no indication of any hazard, but a prudent course of action requires sampling and analysis of the area.

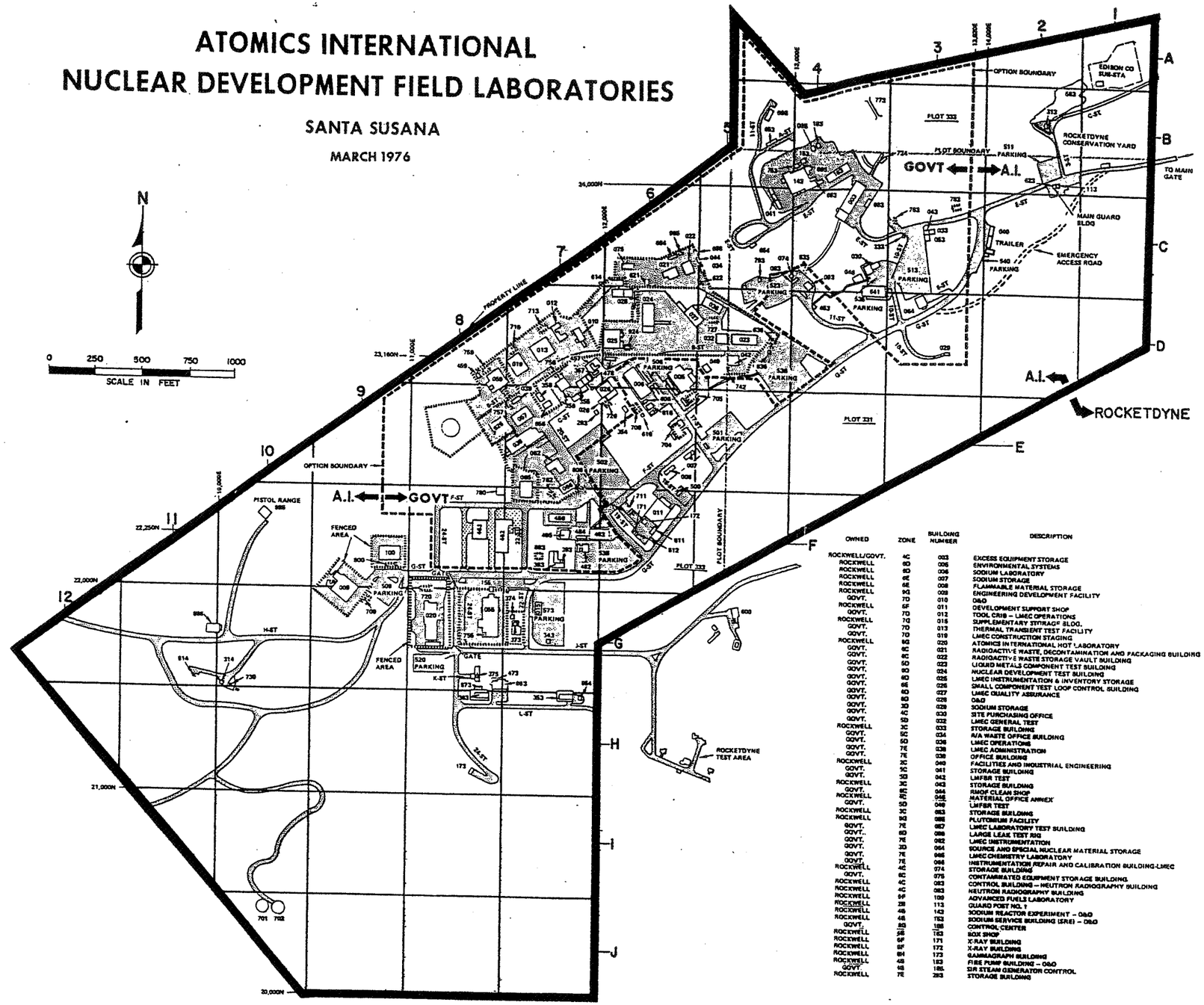
RESERVED FOR PROPRIETARY/LEGAL NOTICES

FORM 724-C REV. 10-84

ATOMICS INTERNATIONAL
NUCLEAR DEVELOPMENT FIELD LABORATORIES

SANTA SUSANA

MARCH 1976



OWNED	ZONE	BUILDING NUMBER	DESCRIPTION
ROCKWELL/GOVT.	4C	003	EXCESS EQUIPMENT STORAGE
ROCKWELL	6D	005	ENVIRONMENTAL SYSTEMS
ROCKWELL	6D	006	SODIUM LABORATORY
ROCKWELL	6E	007	SODIUM STORAGE
ROCKWELL	6E	008	FLAMMABLE MATERIAL STORAGE
ROCKWELL	6D	009	ENGINEERING DEVELOPMENT FACILITY
GOVT.	7D	010	O&D
ROCKWELL	6F	011	DEVELOPMENT SUPPORT SHOP
GOVT.	7D	012	TOOL CRIB – LMEC OPERATIONS
ROCKWELL	7D	013	SUPPLEMENTARY STORAGE BLDG.
GOVT.	7D	013	THERMAL TRANSIENT TEST FACILITY
GOVT.	7D	013	LMEC CONSTRUCTION STAGING
ROCKWELL	6D	020	ATOMICS INTERNATIONAL HOT LABORATORY
GOVT.	6C	021	RADIOACTIVE WASTE, DECONTAMINATION AND PACKAGING BUILDING
GOVT.	6C	022	RADIOACTIVE WASTE STORAGE VAULT BUILDING
GOVT.	6D	023	LIQUID METALS COMPONENT TEST BUILDING
GOVT.	6D	024	NUCLEAR DEVELOPMENT TEST BUILDING
GOVT.	6D	025	LMEC INSTRUMENTATION & INVENTORY STORAGE
GOVT.	6E	026	SMALL COMPONENT TEST LOOP CONTROL BUILDING
GOVT.	6D	027	LMEC QUALITY ASSURANCE
GOVT.	6D	028	O&D
GOVT.	7D	029	SODIUM STORAGE
GOVT.	6C	030	SITE PURCHASING OFFICE
GOVT.	7D	032	LMEC GENERAL TEST
ROCKWELL	7C	033	STORAGE BUILDING
GOVT.	6C	034	A/A WASTE OFFICE BUILDING
GOVT.	7D	036	LMEC OPERATIONS
GOVT.	7E	038	LMEC ADMINISTRATION
GOVT.	7E	039	OFFICE BUILDING
ROCKWELL	7K	040	FACILITIES AND INDUSTRIAL ENGINEERING
GOVT.	7C	041	STORAGE BUILDING
GOVT.	7D	042	LMFBR TEST
ROCKWELL	7K	043	STORAGE BUILDING
GOVT.	6E	044	RMDF CLEAN SHOP
ROCKWELL	7K	045	MATERIAL OFFICE ANNEX
GOVT.	7D	046	LMFBR TEST
ROCKWELL	7C	053	STORAGE BUILDING
ROCKWELL	8D	055	PLUTONIUM FACILITY
GOVT.	7K	057	LMEC LABORATORY TEST BUILDING
GOVT.	6D	058	LARGE LEAK TEST RIG
GOVT.	7E	062	LMEC INSTRUMENTATION
GOVT.	7D	064	SOURCE AND SPECIAL NUCLEAR MATERIAL STORAGE
GOVT.	7E	065	LMEC CHEMISTRY LABORATORY
GOVT.	7E	066	INSTRUMENTATION REPAIR AND CALIBRATION BUILDING-LMEC
ROCKWELL	6E	074	STORAGE BUILDING
GOVT.	6E	075	CONTAMINATED EQUIPMENT STORAGE BUILDING
ROCKWELL	6C	083	CONTROL BUILDING – NEUTRON RADIOGRAPHY BUILDING
ROCKWELL	6C	083	NEUTRON RADIOGRAPHY BUILDING
ROCKWELL	6F	108	ADVANCED FUELS LABORATORY
ROCKWELL	8E	113	GUARD POST NO. 7
ROCKWELL	6B	142	SODIUM REACTOR EXPERIMENT – O&D
ROCKWELL	6B	153	SODIUM SERVICE BUILDING (SRE) – O&D
GOVT.	8D	158	CONTROL CENTER
ROCKWELL	8E	163	SOX SHOP
ROCKWELL	6F	171	X-RAY BUILDING
ROCKWELL	6F	172	X-RAY BUILDING
ROCKWELL	6F	173	GAMMAGRAPH BUILDING
ROCKWELL	6B	183	FIRE PUMP BUILDING – O&D
GOVT.	6B	185	SIR STEAM GENERATOR CONTROL
ROCKWELL	7E	283	STORAGE BUILDING
ROCKWELL	2B	213	CONSERVATION BUILDING
ROCKWELL	10G	214	LARGE LEAK INJECTOR DEVICE (LLID) TEST CONTROL BUILDING
ROCKWELL	3C	215	TIME CLOCK BUILDING
ROCKWELL	7G	215	TIME CLOCK BUILDING
ROCKWELL	7H	223	RESEARCH AND DEVELOPMENT LABORATORY BUILDING
GOVT.	6E	226	CONTROL ELEMENT TEST STRUCTURE
GOVT.	7D	228	SCTI CONTROL BUILDING
GOVT.	7D	229	SODIUM COMPONENT TEST INSTALLATION
GOVT.	7D	237	LMEC PUMP BEARING TEST FACILITY CONTROL BUILDING
ROCKWELL	8H	238	CHEMICAL STORAGE BUILDING
ROCKWELL	7G	273	RESEARCH AND DEVELOPMENT LABORATORY BUILDING
GOVT.	7D	273	DEVELOPMENT TEST BUILDING
ROCKWELL	6G	276	TEST LOOP ENCLOSURE
GOVT.	7F	283	CONTROL SHELTER BUILDING
ROCKWELL	4D	283	LMEC CONSTRUCTION STAGING
GOVT.	7D	285	STG. NEUTRON RADIOGRAPHY STORAGE
GOVT.	8D	457	PUMP BEARING TEST STRUCTURE
GOVT.	8D	468	UNINTERRUPTABLE POWER SUPPLY
GOVT.	8F	468	SODIUM PUMP TEST FACILITY
ROCKWELL	8E	468	SODIUM CLEANING AND HANDLING FACILITY
GOVT.	6D	473	HYDRAULIC TEST INSTRUMENTATION BUILDING
GOVT.	7F	479	SUPPORT TRAILER (LMEC)
GOVT.	7F	482	GOVERNMENT PROJECT OFFICES
GOVT.	7F	484	LMEC OFFICE COMPLEX
GOVT.	7F	484	REST ROOM – TRAILER
GOVT.	7F	486	LMEC OFFICE COMPLEX
GOVT.	7F	486	LMEC OFFICE COMPLEX
ROCKWELL	8F	488	COMPRESSED GAS BOTTLE STORAGE DOCK
ROCKWELL	8E	501	PARKING LOT
ROCKWELL	7E	502	PARKING LOT
ROCKWELL	8D	503	PARKING LOT
ROCKWELL	8D	504	PARKING LOT
ROCKWELL	8E	505	PARKING LOT
ROCKWELL	8E	517	PARKING LOT
GOVT.	8H	517	PARKING LOT
ROCKWELL	8G	520	PARKING LOT
ROCKWELL	8E	525	PARKING LOT
GOVT.	8E	525	PARKING LOT
ROCKWELL	8D	528	PARKING LOT
GOVT.	8E	528	PARKING LOT
ROCKWELL	7H	528	PARKING LOT
ROCKWELL	7E	532	PARKING LOT
ROCKWELL	8E	532	CONSERVATION STORAGE YARD
ROCKWELL	8E	533	SEWAGE TREATMENT PLANT
ROCKWELL	8E	534	HYDROGEN RECOMBINER TEST
ROCKWELL	8E	534	PAINT SPRAY BOOTH
ROCKWELL	8E	534	STORAGE BUILDING
GOVT.	8E	534	DRAINAGE SUMP
ROCKWELL	8E	534	COOLING TOWER
GOVT.	8E	534	RADIOACTIVE ACCOUNTABLE WASTE STORAGE BUILDING
GOVT.	8E	534	RADIOACTIVE WASTE COUNTING BUILDING
ROCKWELL	8E	534	GUARD POST NO. 1
GOVT.	8E	534	LMEC INVENTORY STORAGE
ROCKWELL	8E	534	REACTOR COOLING WATER PAD
GOVT.	8E	534	GUARD POST
GOVT.	8E	534	RECEIVING & STORAGE BUILDING
GOVT.	8E	534	LIQUID RADIOACTIVE WASTE VAULT – O&D
GOVT.	8E	534	INTERIM RADIOACTIVE WASTE – O&D
GOVT.	8E	534	SCTI COOLING TOWER
GOVT.	8E	534	LOW LEVEL RADIOACTIVE WASTE PROCESSING
GOVT.	8E	534	RMDF OXIDATION FACILITY
GOVT.	8E	534	ELECTRICAL SUB-STATION
GOVT.	8E	534	TEMPORARY HOT WASTE STORAGE – O&D
GOVT.	8E	534	AUXILIARY SKID BUILDING
GOVT.	8E	534	ELECTRICAL SUB-STATION NO. 1
ROCKWELL	10Z	701	COLD TRAP VAULT (SRE) – O&D
ROCKWELL	10Z	701	WATER TANK (DEER FLATS)
GOVT.	10Z	702	WATER TANK (DEER FLATS)
ROCKWELL	8E	704	ELECTRICAL SUB-STATION
ROCKWELL	8E	705	ELECTRICAL SUB-STATION
ROCKWELL	8E	706	ELECTRICAL SUB-STATION
ROCKWELL	8E	708	ELECTRICAL SUB-STATION
ROCKWELL	8E	711	ELECTRICAL SUB-STATION
GOVT.	7D	713	ELECTRICAL SUB-STATION
GOVT.	7D	718	ELECTRICAL SUB-STATION
ROCKWELL	8E	720	ELECTRICAL SUB-STATION
GOVT.	4B	724	CONTAMINATED SODIUM CLEANING BUILDING
GOVT.	7D	725	ELECTRICAL SUB-STATION
GOVT.	8D	727	ELECTRICAL SUB-STATION
ROCKWELL	10Z	732	STORAGE SHED
GOVT.	8D	742	ELECTRICAL SUB-STATION
GOVT.	6E	753	PRIMARY FILL TANK VAULT – O&D
ROCKWELL	8D	754	ELECTRICAL SUB-STATION
GOVT.	7D	756	ELECTRICAL SUB-STATION
GOVT.	8E	757	ELECTRICAL SUB-STATION
GOVT.	8D	758	ELECTRICAL SUB-STATION
GOVT.	7F	762	ELECTRICAL SUB-STATION
GOVT.	7K	763	ELECTRICAL SUB-STATION
GOVT.	6E	773	DRAINAGE CONTROL DAM
GOVT.	8E	780	ELECTRICAL SUB-STATION
SCE	7K	783	ELECTRICAL SUB-STATION
GOVT.	5K	783	ELECTRICAL CONTROL BUILDING
ROCKWELL	9F	800	ELECTRICAL SUB-STATION
ROCKWELL	7E	806	TIME CLOCK BUILDING
ROCKWELL	11G	814	LARGE LEAK INJECTOR DEVICE
ROCKWELL	6E	814	RECOMBINER CANOPY
ROCKWELL	8D	836	TIME CLOCK BUILDING
GOVT.	7H	836	TEST STRUCTURE
ROCKWELL	7H	863	HYDRAULIC TEST LOOP
ROCKWELL	8G	873	HYDRAULIC TEST LABORATORY
ROCKWELL	7E	883	ELECTRICAL SUB-STATION
ROCKWELL	10E	885	PISTOL RANGE
ROCKWELL	11G	886	SODIUM DISPOSAL FACILITY
GOVT.	8D	934	ELECTRICAL SUB-STATION

Figure 3.
NDFL Site - Building Arrangement

TAB 3

Published in 27 Federal Register, 3864, April 21, 1962

NOTICE OF AGREEMENT WITH THE STATE OF CALIFORNIA

Notice is hereby given that the Chairman of the Atomic Energy Commission and the Governor of the State of California have signed the attached Agreement for the discontinuance of certain commission regulatory authority. The Agreement is published in accordance with the requirements of Public Law 86-373 (section 274 of the Atomic Energy Act of 1954, as amended). The exemptions from the licensing requirements of Chapters 6, 7, and 8 of the Atomic Energy Act are contained in Part 150 of the Commission's regulations (10 CFR Part 150), which was published in the February 14, 1962, issue of the FEDERAL REGISTER, (27 F.R. 1351).

Dated at Washington, D.C., this 18th day of April 1962.

For the Atomic Energy Commission.
WOODFORD B. McCOOL, Secretary.

AGREEMENT BETWEEN THE UNITED STATES ATOMIC ENERGY COMMISSION AND THE STATE OF CALIFORNIA FOR DISCONTINUANCE OF CERTAIN COMMISSION REGULATORY AUTHORITY AND RESPONSIBILITY WITHIN THE STATE PURSUANT TO SECTION 274 OF THE ATOMIC ENERGY ACT OF 1954, AS AMENDED

WHEREAS the United States Atomic Energy Commission (hereinafter referred to as the Commission) is authorized under section 274 of the Atomic Energy Act of 1954, as amended, (hereinafter referred to as the Act), to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission within the State under Chapters 6, 7, and 8, and section 161 of the Act with respect to byproduct materials, source materials, and special nuclear materials in quantities not sufficient to form a critical mass; and

WHEREAS the Governor of the State of California is authorized under section 25830, Chapter 7.6, Division 20 of the California Health and Safety Code to enter into this Agreement with the Commission, subject to its ratification by the State Legislature; and

WHEREAS the Governor of the State of California certified on December 15, 1961, that the State of California (hereinafter referred to as the State) has a program for the control of radiation hazards adequate to protect the public health and safety with respect to the materials within the State covered by this Agreement, and that the State desires to assume regulatory responsibility for such materials; and

WHEREAS the Commission found on February 26, 1962, that the program of the State for the regulation of the materials covered by this Agreement is compatible with the Commission's program for the regulation of such materials and is adequate to protect the public health and safety; and

WHEREAS the State recognizes the desirability and importance of maintaining continuing compatibility between its program and the program of the Commission for the control of radiation hazards in the interest of public health and safety; and

WHEREAS the Commission and the State recognize the desirability of reciprocal recognition of licenses and exemption from licensing of those materials subject to this Agreement; and

WHEREAS this Agreement is entered into pursuant to the provisions of the Atomic Energy Act of 1954, as amended;

NOW, THEREFORE, it is hereby agreed between the Commission and the Governor of the State, acting in behalf of the State, as follows:

ARTICLE I

Subject to the exceptions provided in Articles II, III, and IV, the Commission shall discontinue, as of the effective date of this Agreement, the regulatory authority of the Commission in the State under Chapters 6, 7, and 8, and section 161 of the Act with respect to the following materials:

A. Byproduct materials;

B. Source materials; and

C. Special nuclear materials in quantities not sufficient to form a critical mass.

ARTICLE II

This Agreement does not provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of:

A. The construction and operation of any production or utilization facility;

B. The export from or import into the United States of byproduct, source, or special nuclear material, or of any production or utilization facility;

C. The disposal into the ocean or sea of byproduct, source, or special nuclear waste materials as defined in regulations or orders of the Commission;

D. The disposal of such other byproduct, source, or special nuclear material as the Commission from time to time determines by regulation or order should, because of the hazards or potential hazards thereof, not be so disposed of without a license from the Commission.

ARTICLE III

Notwithstanding this Agreement, the Commission may from time to time by rule, regulation, or order, require that the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing source, byproduct, or special nuclear material shall not transfer possession or control of such product except pursuant to a license or an exemption from licensing issued by the Commission.

ARTICLE IV

This Agreement shall not affect the authority of the Commission under subsection 161 b or i of the Act to issue rules, regulations, or orders to protect the common defense and security, to protect restricted data or to guard against the loss or diversion of special nuclear material.

ARTICLE V

The State will use its best efforts to maintain continuing compatibility between its program and the program of the Commission for the regulation of like materials. To this end the State will use, its best efforts to keep the Commission informed of proposed changes in its rules and regulations, and licensing, inspection, and enforcement policies and criteria, and of proposed requirements for the design and distribution of products containing source, byproduct, or special nuclear material, and to obtain the comments and assistance of the Commission thereon.

ARTICLE VI

The Commission will use its best efforts to keep the State informed of proposed changes in its rules and regulations, and licensing, inspection, and enforcement policies and criteria and to obtain the comments and assistance of the State thereon.

ARTICLE VII

The Commission and the State agree that it is desirable to provide for reciprocal recognition of licenses for the materials listed in Article I licensed by the other party or by any agreement State. Accordingly, the Commission and the State agree to use their best efforts to develop appropriate rules, regulations, and procedures by which such reciprocity will be accorded.

ARTICLE VIII

The Commission, upon its own initiative after reasonable notice and opportunity for hearing to the State, or upon request of the Governor of the State, may terminate or suspend this Agreement and reassert the licensing and regulatory authority vested in it under the Act if the Commission finds that such termination or suspension is required to protect the public health and safety.

ARTICLE IX

This Agreement, upon ratification by law of the State, shall become effective on the ninety-first day after the adjournment of the First Extraordinary Session of the 1962 California Legislature or on September 1, 1962, whichever is later, and shall remain in effect unless, and until such time as it is terminated pursuant to Article VIII.

Done at Washington, District of Columbia, in triplicate, this 9th day of March 1962.

FOR THE UNITED STATES ATOMIC ENERGY COMMISSION.

GLENN T. SEABORG, Chairman.

Done at Sacramento, State of California, in triplicate, this 12th day of March 1962.

FOR THE STATE OF CALIFORNIA.

EDMUND G. BROWN, Governor.

[F.R. Doc. 62-3926; Filed, Apr. 20, 1962; 8:49 a.m.]

TAB 4

Rockwell International
Rocketdyne Division

SUPPORTING DOCUMENT

GO NO.	S/A NO.	PAGE 1 OF	TOTAL PAGES	REV LTR/CHG NO SEE SUMMARY OF CHG	NUMBER
Burden	Burden	1	95	Rev. C	N001ER000017

PROGRAM TITLE

DOCUMENT TITLE

Nuclear Operations at Rockwell's Santa Susana Field Laboratory - A Factual Perspective

DOCUMENT TYPE

Facility Report

KEY NOUNS

Nuclear operations, nuclear power, nuclear reactor, Santa Susana Field Laboratory

ORIGINAL ISSUE DATE

December 20, 1989

REL. DATE

9-6-91 SC

PREPARED BY/DATE	DEPT	MAIL ADDR
R. D. Oldenkamp 1/10/90	638	T006
D. C. Mills 1/16/90	638	HB19

IR&D PROGRAM? YES ☐ NO ☒

IF YES, ENTER TPA NO.

APPROVALS	DATE
L. J. Auge	1/16/90
G. G. Gaylord	1/16/90
D. C. Gibbs	1/16/90
R. T. Lancet	1/16/90
W. R. McCurnin	1/17/90
R. J. Tuttle	1/17/90

DISTRIBUTION

*	NAME	MAIL ADDR
*	E. B. Baumeister	HB15
*	J. Charney	AB57
*	L. Circle	AB57
*	M. Davis	AA47
*	R. L. Gay	T006
*	G. G. Gaylord	T038
*	D. C. Gibbs	T038
*	P. H. Horton	HB09
*	R. A. Johnson	HB13
*	S. R. Lafflam	JA16
*	P. E. McCourt	AA21
*	R. D. Meyer	T038
*	J. C. Mills	HB19
*	T. A. Moss	HA02
*	R. M. Mucica	HA02
*	J. T. Nagamatsu	AA24
*	R. D. Paster	AA49
*	B. S. Pilling	T038
*	R. Reisenweber	SG05
*	C. J. Rozas	CB01
*	P. D. Rutherford	HB07
*	W. Vetter	B28
*	H. Wieseneck	SS46

ABSTRACT

This report describes the radioactivity at Rocketdyne's Santa Susana Field Laboratory (SSFL), and puts the information into perspective to permit readers to make an informed evaluation of the SSFL situation for themselves. Emphasis has been placed on the presentation of facts which clarify and/or quantify: (1) the history of nuclear operations at the SSFL; (2) the regulation of those operations; (3) the amount of radioactivity that has been removed from the site; (4) the amount of radioactivity remaining; and (5) Rocketdyne's plans for both ongoing cleanup and operations.

RESERVED FOR PROPRIETARY/LEGAL NOTICES

N001ER000017/ETEC-WPC

* COMPLETE DOCUMENT

NO ASTERISK. TITLE PAGE/SUMMARY OF CHANGE PAGE ONLY

FORM 734-C REV 12-84

REV	SUMMARY OF CHANGE	APPROVALS AND DATE
A	Extensive minor revisions to clarify various sections. Total revision of Section 4.0. Revisions marked in left margin. Release Date	E. B. Baumeister 2/12/90 G. G. Gaylord 2/2/90 D. C. Gibbs 2/13/90 W. R. McCurnin 2/12/90 R. J. Tuttle 2/12/90 P. D. Rutherford 2/13/90 2/16/90 LC
B	Addition of Section 4.4 Radiological Surveys of the SSFL, plus cross references. Many minor revisions for corrections or clarity. Integration of tables into the body of the report. Additional references for Section 4.4. Revisions marked in left margin. Release Date 10-2-90 CV	E. B. Baumeister G. G. Gaylord 8/1/90 D. C. Gibbs W. R. McCurnin 7/30/90 R. J. Tuttle 8/1/90 P. D. Rutherford 8/7/90
C	Many minor revisions for clarity and to provide additional information. Added Sections 4.5, Environmental Monitoring, and 4.5, Radioactive Waste. Extensive revision to Section 6.0 to emphasize DOE guidance of the clean up activities. Added Appendix E to describe change of DOE priorities in 1989. Added Appendix F to provide a list of acronyms. Release date 11 RC	G. Gaylord 6-7-91 D. C. Gibbs P. H. Horton B. S. Pilling 7/11/91 R. D. Rutherford

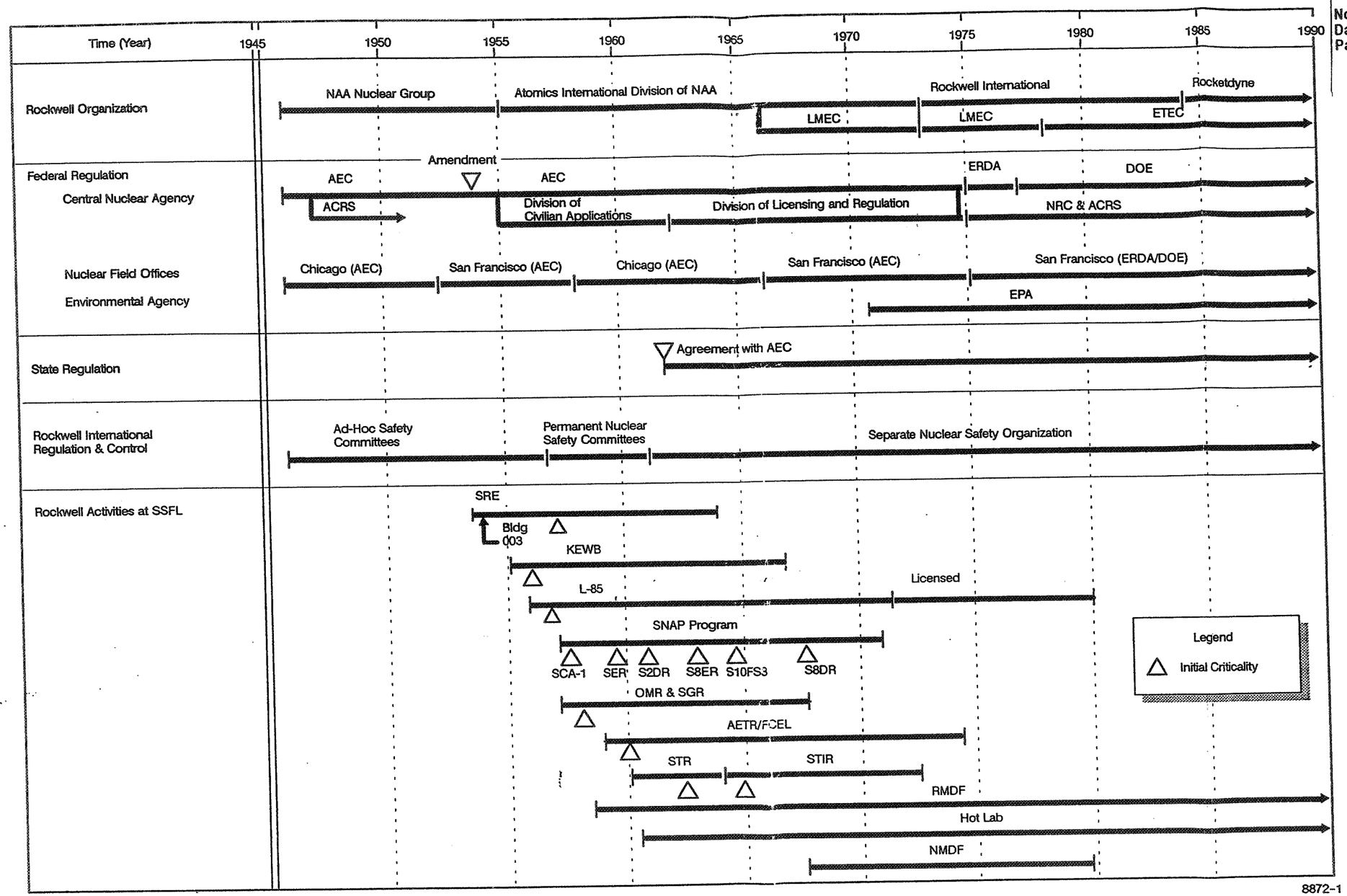


Figure 3. SSFL Timeline

TAB 5

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH

RADIOACTIVE MATERIAL LICENSE

Pursuant to the California Administrative Code, Title 17, Chapter 5, Subchapter 4, Group 2, Licensing of Radioactive Material, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, use, possess, transfer or dispose of radioactive material listed below; and to use such radioactive material for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations and orders of the Department of Public Health now or hereafter in effect and to any conditions specified in this license.

1. Licensee: Atomics International A Division of North American Rockwell Corp. 2. Address: P.O. Box 309 Canoga Park, California 91304 Attn: M. E. Remley, Manager; Health, Safety and Radiation Services Department	3. License no. 0015-59 is hereby amended in its entirety. Amendment no. 39 4. Expiration date: September 11, 1974 5. Inspection agency: Division of Industrial Safety

6. Nuclide	7. Form	8. Possession limit
A. Any radionuclide with atomic number 3 thru 83	A. Any	A. Not to exceed 25 curies for any one radionuclide.
B. Hydrogen 3	B. Any	B. 10,000 curies
C. Cobalt 60	C. Sealed sources (AECL dwg CP 36-C-142)	C. 10 sources not to exceed 400 curies each.
D. Krypton 85	D. Any	D. 100 curies
E. Antimony 124 (cont'd)	E. Any (cont'd)	E. 100 curies (cont'd)

9. Authorized use

A-K. Calibration of instruments and research and development as defined in 17 CAC 30175(j), except production of neutrons.

L & M. In AI designed projectors for industrial radiography.

N. As a component of the North American Rockwell Corporation Gamma Facility. (cont'd)

10. Radioactive material may be used only at the following locations:

(a) 8900 De Soto Avenue, Canoga Park, California (All Subitems except X and Y)

(b) Nuclear Development Field Laboratory, Chatsworth, California (All Subitems except N)

11. This license is subject to an annual fee of five hundred (500) dollars due and payable on the anniversary of the date of issue of this license, September 11, 1963.

12. Radioactive material may be used by, or under the supervision of, individuals designated by the Isotopes Committee.

13. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 7 and 8 of this license in accordance with statements, representations and procedures contained in the following documents:

(a) the application dated September 5, 1969 as amended by the letter dated October 31, 1969 all signed by L. W. Wheeler.

14. (a) The radiation safety officer in this program shall be W. F. Heine.

(b) The chairman of the Isotopes Committee shall be L. Baumash, Chairman.

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH

Page 2 of 3 Pages

RADIOACTIVE MATERIAL LICENSE

License Number 0015-59

Amendment Number 39

Supplementary Sheet

continued

6. Nuclide (cont'd)	7. Form (cont'd)	8. Possession limit (cont'd)
F. Iridium 192	F. Any	F. 100 curies
G. Polonium 210	G. Any	G. 150 curies
H. Radium 226	H. Any except as neutron sources	H. 5 grams
I. Thorium, natural	I. Any	I. 1000 pounds
J. Uranium, natural or depleted	J. Any	J. 20,000 pounds
K. Neptunium 237	K. Any	K. 100 microcuries
L. Cobalt 60	L. Sealed source (U.S. Nuclear Corp., Model 338)	L. 1 source not to exceed 5 curies.
M. Cobalt 60	M. Sealed source (Isotopes Specialties Co., Model 338)	M. 1 source not to exceed 5 curies.
N. Cobalt 60	N. Sealed source (Lockheed Nuclear Products, dwg 442-1001)	N. 25,000 $\pm$ 2500 curies in 12 sources.
O. Iridium 192	O. Sealed source (Technical Operations, Inc., Model A424-1)	O. 4 sources not to exceed 100 curies each
P. Radium 226	P. Sealed sources (NRC Equipment Corp.)	P. 7 sources not to exceed 0.4 milligram each.
Q. Radium 226	Q. Sealed neutron sources	Q. Total not to exceed 500 milligrams.
R. Californium 252	R. Sealed source (Oak Ridge)	R. 2 sources not to exceed 550 microcuries each.
S. Any radionuclide with atomic number 3 thru 83	S. Any	S. Not to exceed 100 curies for any one radionuclide
T. Promethium 147	T. Promethium-Oxide	T. 150,000 curies
U. Tantalum 182	U. Metal	U. 500 curies
V. Uranium, natural or depleted	V. Any	V. 50,000 pounds
W. Americium 241	W. Any	W. 10 curies
X. Mixed fission products	X. Any	X. 10^7 curies

(cont'd)

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH

RADIOACTIVE MATERIAL LICENSE

Supplementary Sheet

License Number 0015-59
Amendment Number 39

continued

6. Nuclide (cont'd)	7. Form (cont'd)	8. Possession limit (cont'd)
Y. Any radionuclide with atomic number 3 thru 83.	Y. Any	Y. Not to exceed 10^5 curies for any one radionuclide.

9. Authorized use (cont'd)

O. In Technical Operations, Inc. projectors for industrial radiography.

P. As components of NRC Equipment alphatron gages.

Q and R. Calibration of instruments and research and development as defined in 17 CAC 30175(j).

S-U, and W. Fabrication of sealed sources and transfer to authorized recipients.

V. Fabrication and transfer of fuel assemblies to authorized recipients; fabrication of radiation shielding, counterweights, and system components; distribution of counterweights to persons exempt under provisions of 17 CAC 30180(c) (12).

X and Y. Irradiated fuel examinations at the Atomics International Hot Laboratory; for the repair, examination, and storage of irradiated or radioactive assemblies in the Atomics International Hot Laboratory; transfer to authorized recipients.

15. All uses of radioactive material under this license shall be conducted in accordance with the user's application to and modifying requirements of the Isotopes Committee. The review of intramural applications shall include findings with respect to matters specified in 17 CAC 30194. Documentation of these findings shall be maintained for review by the Department or its authorized representatives.

16. The licensee is hereby authorized to demonstrate sealed sources specified below at temporary job sites of the licensee throughout the State of California, except areas under exclusive Federal jurisdiction.

Sealed source Model number	Nuclides contained	Activity per source
(a) EX 6090-25001	Ta 182	0.5 curie
(b) EX 6090-25002	Ta 182	0.5 curie
(c) EX 6090-25003	Ta 182	0.5 curie
(d) EX 6090-15020	Pm 147	15 KCi
(e) EX 6104-25007	Pm 147	30 KCi
(f) EX 6104-1500	Pm 147	25 KCi

For the State Department of Public Health

Date December 5, 1969

by C. J. [signature]
for [illegible], Ph.D., Chief
Bureau of [illegible] Health
[illegible]

TAB 6

Radiological Release Process

Process for the Release of Land and Facilities for (Radiologically) Unrestricted Use

Phil Rutherford
Manager, Health, Safety & Radiation Services
Environment, Health & Safety

September 17, 2007

Radiological Release Process

Facilities that have been utilized for radiological operations and/or research, are required to be remediated prior to being released for unrestricted use. This release process is implemented to ensure that the facility is restored to a safe, clean status in order to prevent exposing future users to hazards or risks from radiation or radioactivity. Such a process is described in a NRC NUREG report entitled "NMSS Decommissioning Standard Review Plan" (Reference 1). Department of Energy (DOE) facilities generally follow a similar process, and the California Department of Public Health (DPH) generally follow NRC guidance, since California is an Agreement State. This process is outlined below.

- **Radiation Cleanup Standards.** DOE Order 5400.5 (Reference 2) requires DOE contractors to submit for DOE-EM approval, cleanup standards that will be implemented during D&D activities. These cleanup standards cover surface contamination limits for building surfaces, soil radioisotope concentrations and groundwater.

    - Surface contamination limits have been promulgated by NRC (Reference 3), DOE (Reference 2) and DPH (Reference 4). Surface contamination limits for each agency are consistent and Boeing has adopted these limits.

    - In 1994 between EPA and NRC had reached consensus that 15 mrem/y was fully protective of public health. Rockwell developed soil radioisotope concentration limits using the DOE developed RESRAD code, based on a suburban residential scenario and a dose limit of 15 mrem/y. Subsequently, NRC has promulgated a final license termination rule, 10CFR20 Appendix E 20.1402, specifying 25 mrem/y plus ALARA as an appropriate cleanup standard.

    - Boeing adopted, as its groundwater limits, the EPA drinking water MCLs (where they existed) and RESRAD derived limits based on 4 mrem/y (where MCLs did not exist).

    Rockwell (Boeing's predecessor) submitted these cleanup criteria to DOE and DHS for approval in June 1996 by Reference 5. DHS approved the limits in August 1996 with Reference 6 and DOE-EM approved this document in September 1996 with Reference 7. In February 1999 Boeing published its "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL" (Reference 8). This document was transmitted to the various agencies and stakeholders involved with SSFL and was placed in three public library repositories in the neighboring community.

- **ALARA and Cost Benefit Analysis.** The NRC has established a mathematical framework to determine if it is cost effective to remediate below the established 10 CFR 20.1402 goal of 25 mrem/y or Reg. Guide 1.86 limits. (Reference 1, Appendix D). This process is used to establish an ALARA goal, that is to say, at what point should one remediate below the established 25 mrem/y goal to achieve ALARA.

  Remedial costs, including excavation, sampling, waste disposal, industrial accidents, worker exposure, traffic accidents and public exposure from waste shipping, are balanced against the benefits of person-rem averted by going to lower residual contamination levels. Generic analyses have been performed for soil excavation at SSFL, which confirm the NRC generic conclusion below (Reference 1, Appendix D, page D12).

  > "Meeting the [25 mrem/y] dose limit would be limiting by a considerable margin. Based on these results, it would rarely be necessary to ship soil to a waste disposal facility to meet the ALARA requirement."
  >
  > "In certain circumstances, the results of an ALARA analysis are known on a generic basis and an analysis is not necessary. For residual radioactivity in soil at sites that will have unrestricted release, generic analyses (See NUREG 1496, the examples in this appendix, and other similar examples) show that shipping soil to a low level waste disposal facility is unlikely to be cost effective for unrestricted release, largely because of the high costs of waste disposal. Therefore shipping soil to a low level waste disposal facility generally does not have to be evaluated for unrestricted release."

- **Soil Cleanup Standards based on Risk Models.** Although much of the NRC, DOE and State regulated radiological cleanups are based on dose-based cleanup standards similar to those described above, the EPA Superfund process requires a risk-based approach whereby preliminary soil remediation goals are based on achieving a residual risk in the range of 10^{-6} to 10^{-4} using 10^{-6} as the point of departure. DOE remediation at SSFL will use the risk framework to establish soil cleanup standards after December 2006.

- **Characterization Survey.** A characterization survey determines the extent and type of contamination. This also includes a review of operating history to determine the likely contaminants of concern and to identify if any spills occurred. Frequently sufficient characterization data exists from routine radiation and contamination surveys performed during the operational phase, to circumvent the requirement for a new stand-alone characterization survey. Data from this phase facilitates planning of the cleanup phase in the next step.

- **Decommissioning Plans.** As its name suggests, the written decommissioning plan lays out the technical requirements, schedule, resources, and goals of cleanup. Depending on the size, scope, complexity and hazards associated with the project, other separate plans may be generated at this time. These may or may not be folded

into the decommissioning plan. These include ...

- **Program Management Plan**
- **Health & Safety Plan**
- **Quality Assurance Plan**

- **Decommissioning & Decontamination (D&D)**. This is the step where all contamination is removed from the facility. Depending on the situation this could involve removal of all fuel and equipment, cleaning of surfaces with surface contamination, removal of material with volumetric neutron activation (e.g. concrete and rebar), removal of tanks and drainlines and removal of contaminated soil. This phase is variously known as D&D, restoration, remediation or simply cleanup.

- **Remedial Action Support Surveys.** During D&D, routine surveys of facility surfaces for surface contamination are performed to determine if indeed, a cleanup operation has been effective. If not, then additional remediation is performed. This process is also performed during soil excavation operations. This step in the process ensures that regulatory cleanup goals are not only met, but are exceeded. This is central to the **"as low as reasonably achievable" (ALARA)** process.

- **Radioactive Waste Disposal.** This is the process of characterizing, packaging, shipping and ultimate disposal and burying of waste generated in the D&D step. Disposal of radioactive waste from SSFL occurs at a variety of DOE-approved or NRC-licensed disposal sites including the Hanford Disposal Site in Washington State, and the Nevada Test Site in Nevada. Two main objectives are key to this process.

    - Compliance with DOT shipping regulations for shipment of radioactive materials on public highways

    - Compliance with disposal site waste acceptance criteria (WAC) which mandates documentation to verifiy the characterization (or pedigree) of the waste

- **Final D&D Report.** Upon completion of D&D, a final report is prepared documenting the D&D process, costs, waste volumes generated, and worker exposure incurred.

- **Final Radiological Status Survey.** This step is the process of surveying a facility to ensure that all contamination has been removed to below limits specified by federal and state regulations. These measurements can include measurements for fixed and removable surface contamination, sampling for volumetric activation, sampling for soil contamination and measurements of radiation exposure rates. Guidance for performing such surveys is provided in the **Multi-Agency Radiation Survey and Site Investigation Manual, MARSSIM** (Reference 9). MARSSIM provides a structured and statistical framework by which to demonstrate compliance with appropriate cleanup standards. MARSSIM defines survey designs using the **Data**

Quality Objectives (DQO) process and utilizes **Data Quality Assessment (DQA)** that includes the Wilcoxon Rank Sum (WRS) test to determine if a sampled area meets established cleanup standards. The MARSSIM manual demonstrates the commonality between the MARSSIM process and the RCRA and CERCLA processes. MARSSIM applies to surface contamination of buildings and facilities and to surface soil contamination. It does not apply to construction debris, subsurface soil contamination, surface or sub-surface water, biota, air or volumetric contamination.

The facility owner or contractor, in this case Boeing, usually performs this survey. Key reports prepared to document these surveys are,

- **Final Status Survey Procedure** (Sampling and Analysis Plan)
- **Final Status Survey Report** (Results)

Procedures and results of these surveys are sent to the appropriate regulatory agencies, namely the Department of Energy and the California Department of Public Health Radiologic Health Branch.

- **Independent Verification Surveys**. Independent verification surveys (IVS) are performed by a third party to confirm or verify the prior Boeing final status survey. The DOE contracts with the Oak Ridge Institute of Science and Education (ORISE) to perform an IVS. ORISE reviews the final status survey procedures and results and provide comments and/or questions to DOE and Boeing. Boeing provides written answers to ORISE and DOE. ORISE utilize information in these reports to prepare a work plan for their IVS which it submits to DOE. ORISE then visits the site in order to perform their IVS.

  A similar process is undertaken with the DHS who visit the site to perform a second IVS at approximately the same time period as ORISE.

  ORISE then prepare a final IVS report and submit to DOE who in turn forwards a copy to Boeing. Boeing then forwards a copy of the ORISE IVS report to the DHS and requests either, that DHS release the facility for unrestricted use (Boeing-owned buildings), or that DHS concur with the release for unrestricted use (DOE-owned buildings).

- **Dose and Risk Analysis.** Although not required by established MARSSIM protocols, it is frequently instructive to perform post-remedial pathways dose assessments and risk analyses. This step in the process can demonstrate the effectiveness of the ALARA process in achieving post-remedial levels far below the established regulatory dose goals. It can also be demonstrated that the ALARA process achieves risk levels within the lower end of the 10^{-6} to 10^{-4} CERCLA target risk range, and in many cases achieves risk levels below 10^{-6}.

  For example building surface contamination limits were developed in a 1974 Atomic

Energy Commission Regulatory Guide (Reference 3). It is natural to wonder how these surface contamination limits (in units of disintegrations per minute per 100 cm^2) translate into dose and risk. Such calculations can be performed using RESRAD-Build; a DOE developed computer code. Calculations using post-remedial survey data have shown that facilities released for unrestricted use pose an insignificant dose to an occupant. Similar calculations, using RESRAD-Recycle and IMPACTS, have been performed for building debris shipped to landfills (prior to 2002) and scrap metal sent for recycling (prior to 2000). Again, doses are insignificant.

The recent ANSI/HPS N13.12-1999, Surface and Volume Radioactivity Standards for Clearance (Reference 10) has proposed new isotope specific standards for surface and volumetric contamination based on a 1 mrem/y standards. Comparing the Regulatory Guide 1.86 limits with these new proposed limits shows that RG 1.86 limits are equal or less than 1 mrem/y, thus confirming the Boeing analyses.

- **Certification Docket.** At the completion of the D&D and survey process for a DOE building, a Certification Docket is prepared by Boeing, which includes all key documentation. This includes the approved site release criteria (Reference 8), the DOE approval of these criteria (Reference 7), the final D&D report, the final status survey report, the ORISE IVS report, and the release concurrence letter from DHS (if available). This Docket is submitted to DOE for approval.

- **Federal Register Publication.** For DOE-owned buildings, DOE publishes in the Federal Register, its intent to release the building for unrestricted use. DOE then transmits a letter to Boeing releasing the building for unrestricted use.

- **Removal of Facility from Radioactive Materials License 0015-19.** For Boeing-owned buildings, the DHS transmits a letter to Boeing releasing the building for unrestricted use and issues an amendment to Radioactive Materials License 0015-19, removing the facility from the license.

- **Release for Unrestricted Use.** The legal and regulatory process of "releasing a building for unrestricted use" means that,

    - Approved cleanup standards have been met.
    - DOE and DHS impose no further radiological controls or regulatory oversight for the building or land.
    - DHS removes the building from the Radioactive Material License.
    - The building can be safely used for any other purposes without any further radiological controls.
    - Prior to September 2002, the building could be safely demolished and disposed of at municipal landfills without any further radiological controls. Subsequent to California Executive Order D-62-02 of September 2002 (a.k.a.

Governor's Moratorium) all such decommissioned material is required to be sent instead to a Class 1 hazardous waste landfill.

- Prior to July 2000, any other material from the building, including metal, can be safely reused or recycled without any further radiological controls. Subsequent to July 2000, there is a suspension on recycling of metal from DOE radiological facilities.

References

1. US Nuclear Regulatory Commission, NUREG-1727, "NMSS Decommissioning Standard Review Plan". September 2000.

2. DOE Order 5400.5, "Radiation Protection of the Public and Environment", Chapter 4. January 7, 1993

3. US Nuclear Regulatory Commission, Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." June 1974.

4. California Department of Health Services, DECON-1, "State of California Guidelines for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use." June 1977.

5. Rocketdyne Document, N001SRR140127, "Proposed Site-wide Release Criteria for Remediation of Facilities at the SSFL." March 11, 1996.

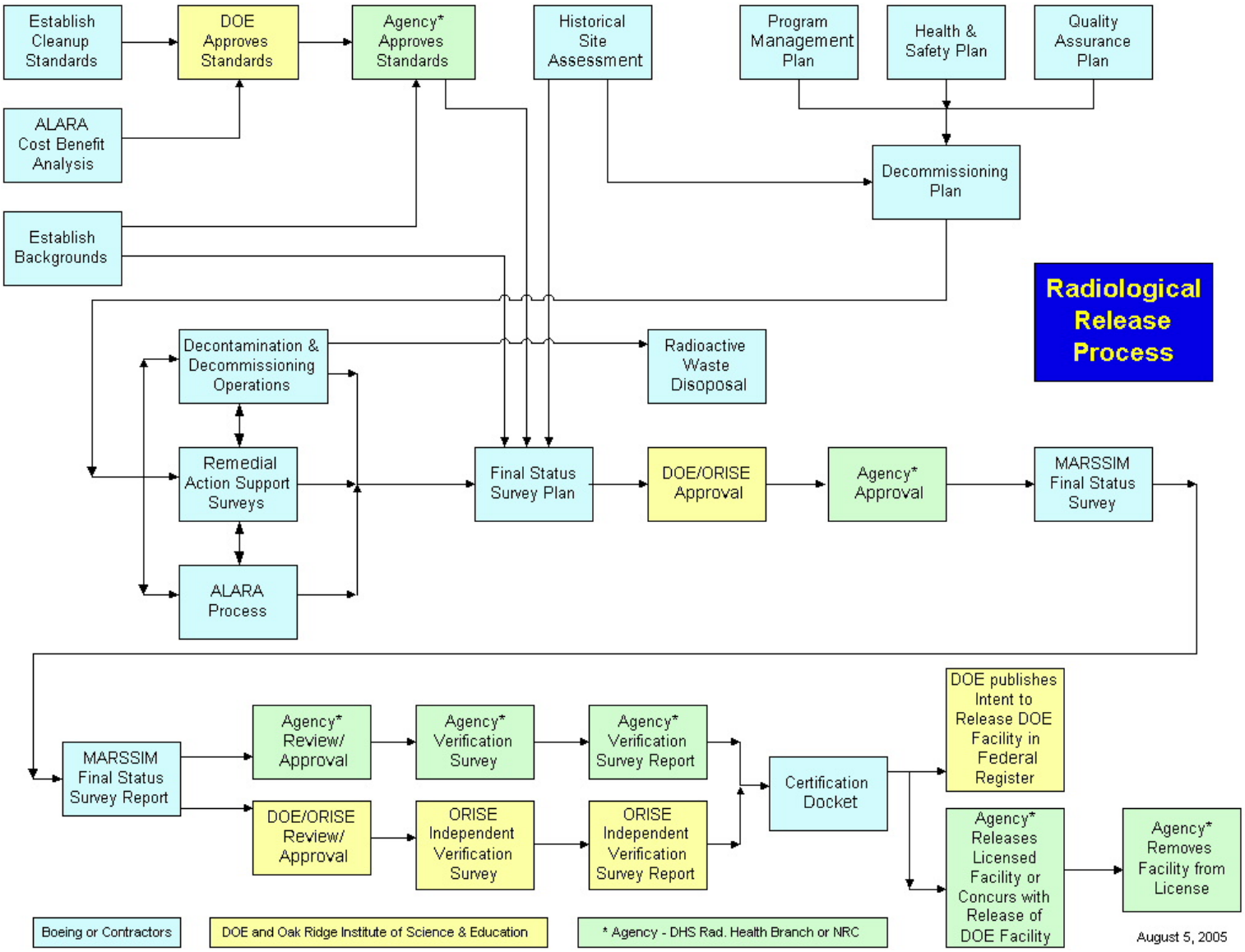
6. Department of Health Services, Letter from Gerard Wong (DHS) to Majelle Lee, "Authorized Statewide radiological Guidelines for Release for Unrestricted Use." August 9, 1996.

7. Department of Energy, Sally Robison (DOE-EM-44) to Roger Liddle (DOE-OAK), "Site-wide Limits for Release of Facilities without Radiological Restriction." September 17, 1996.

8. Rocketdyne Document. N001SRR140131, "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL." February 18, 1999.

9. Nuclear Regulatory Commission NUREG-1575. Environmental Protection Agency EPA 402-R97-016. "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)." December 1997.

10. American National Standards Institute, ANSI/HPS 13.12-1999, "Surface and Volume Radioactivity Standards for Clearance." August 31, 1999.


Establish Cleanup Standards
DOE Approves Standards
Agency* Approves Standards
Historical Site Assessment
Program Management Plan
Health & Safety Plan
Quality Assurance Plan
ALARA Cost Benefit Analysis
Decommissioning Plan
Establish Backgrounds
Radiological Release Process
Decontamination & Decommissioning Operations
Radioactive Waste Disoposal
Remedial Action Support Surveys
Final Status Survey Plan
DOE/ORISE Approval
Agency* Approval
MARSSIM Final Status Survey
ALARA Process
MARSSIM Final Status Survey Report
Agency* Review/ Approval
Agency* Verification Survey
Agency* Verification Survey Report
DOE/ORISE Review/ Approval
ORISE Independent Verification Survey
ORISE Independent Verification Survey Report
Certification Docket
DOE publishes Intent to Release DOE Facility in Federal Register
Agency* Releases Licensed Facility or Concurs with Release of DOE Facility
Agency* Removes Facility from License
Boeing or Contractors
DOE and Oak Ridge Institute of Science & Education
* Agency - DHS Rad. Health Branch or NRC
August 5, 2005

TAB 7

Scoping Comment Responses

for the

Environmental Impact Statement for Remediation of Area IV of the Santa Susana Field Laboratory (SSFL Area IV EIS)

Prepared for

U.S. Department of Energy
Energy Technology Engineering Center

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LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
Boeing	The Boeing Company
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
COI	constituent of interest
CPEC	chemical of potential ecological concern
CSM	conceptual site model
DCGL	derived concentration guideline level
DOE	U.S. Department of Energy
DTSC	State of California Department of Toxic Substances Control
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
ESL	Ecological Screening Level
ETEC	Energy Technology Engineering Center
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information Systems
HEPA	high-efficiency particulate air
HERD	Human and Ecological Risk Division
H.R. 2764	House Resolution 2764
HSA	Historical Site Assessment
IAG	Interagency Agreement
LARWQCB	Los Angeles Regional Water Quality Control Board
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	maximum contaminant level
MCV	most conservative value
MDL	Method Detection Limit
NAHC	Native American Heritage Commission
NASA	U.S. National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NIOSH	National Institute of Occupational Safety and Health
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List

OCY	Old Conservation Yard
OHP	State of California Office of Historic Preservation
PRG	preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SB	Senate Bill
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
SSFL Area IV EIS	Environmental Impact Statement for Remediation of Area IV of the Santa Susana Field Laboratory
TCE	trichloroethylene
VOC	volatile organic compound

1.0 INTRODUCTION

In May 2008, the U.S. Department of Energy (DOE) issued a Notice of Intent (NOI) to prepare an *Environmental Impact Statement for Remediation of Area IV of the Santa Susana Field Laboratory* (*SSFL Area IV EIS*) and conduct scoping meetings. Scoping meetings were held on July 22, 2008 in Simi Valley, California; July 23, 2008 in Northridge, California; and July 24, 2008 in Sacramento, California.

Prior to the scoping meetings, a comprehensive review of all previous Area IV sampling activity was conducted. The *Draft Gap Analysis Report* presented this evaluatation of the existing chemical and radiological site characterization data to determine what additional data would be needed to prepare both a human health risk assessment and an ecological risk assessment. These assessments would be used as part of the evaluation of alternatives in the *SSFL Area IV EIS*. Additionally, two public meetings concerning the *Draft Gap Analysis Report* were conducted in Simi Valley, California, on June 10 and 26, 2008.

Because comments submitted in response to DOE's announced efforts to scope the environmental impact statement (EIS) and comments submitted on the *Draft Gap Analysis Report* were received during overlapping timeframes, many of the comments dealt with both. DOE decided to combine the comments from both efforts and respond to all comments in this comprehensive comment response document. The National Environmental Policy Act (NEPA) does not require federal agencies, nor do the Council on Environmental Quality nor DOE implementing regulations, to respond individually to scoping comments; however, DOE wanted to go beyond what was required and provide individual responses to commentors.

This comment response document is divided into four sections and two appendices, as outlined below:

Section 1.0 – Introduction. This section includes information on public meetings, project and schedule changes, and changes as a result of the scoping process.

Section 2.0 – Summary of Comments Received. This section includes a summary of the nine broad categories of comments received.

Section 3.0 – Stakeholder Concerns. This section contains 11 comments that were frequently repeated by commentors that DOE felt should be brought forward either because of the level of interest expressed by commentors or the length and complexity of the response.

Section 4.0 – Individual Comments and Responses. This section includes all comments and the corresponding individual responses.

Appendix A – Radionuclides Related to Historical Operations at the Santa Susana Field Laboratory Area IV. This white paper was written in response to a request from the State of California to provide a list of all the radionuclides from reactor operations and to reduce the list using industry accepted standards.

Appendix B – Advertising for Scoping Meetings. In response to questions about advertising, a list of all advertising done for the scoping meetings was compiled and attached to this comment response document.

Since the *SSFL Area IV EIS* scoping meetings occurred in July 2008, there have been many changes to the project. The most significant of these changes are summarized below:

- Based on provisions of the 2008 Consolidated Appropriations Act, 2008 (H.R. 2764, Public Law 110-161), DOE and the Environmental Protection Agency (EPA) signed, on July 24, 2008, an Interagency Agreement (IAG) that provides for EPA to conduct a radiological background study. At that time, DOE transferred $1.5 million in funding to EPA to conduct this work. EPA is near completion of its efforts to develop and design the background study. In December 2008, EPA provided a draft scope of work for EPA to conduct a radiological characterization study for Area IV and the adjoining northern undeveloped land. The DOE/EPA IAG was amended on February 17, 2009 to reflect the transfer of an additional $1.7 million to EPA to begin the radiological characterization study of Area IV and the Northern Undeveloped Land. On April 23, 2009 the IAG was again amended to provide to EPA the full funding ($38.3 million) that they requested for the radiological characterization study using funding provided by the 2009 American Recovery and Reinvestment Act. Initial work for planning and implementing the Area IV radiological characterization survey has begun with an expected completion date of September 2011.
- The State of California Department of Toxic Substances Control (DTSC) has the lead for determining the chemical background levels. A chemical background group has been formed and DTSC expects to complete this work by summer 2010.
- An Amended Consent Order is under negotiation between DTSC, DOE, the U.S. National Aeronautics and Space Administration (NASA), and The Boeing Company (Boeing), for cleanup of SSFL. The Revised Consent Order will further refine how remediation efforts at SSFL Area IV will be conducted.
- EPA reevaluated the entire SSFL site and, based on that evaluation, recommended that the entire site be listed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL), also called the Superfund List. The State of California did not agree, and concluded that it would be in the State's best interest to conduct cleanup under the direction of DTSC as the lead regulator. DTSC has oversight responsibility of the Resource Conservation and Recovery Act (RCRA) Facility Investigation that is being conducted for the entire SSFL site. DOE will conduct CERCLA-based human health and ecological risk assessments for evaluating the alternatives.

These changes have resulted in significant modifications to the schedule and to the project. As a result, DOE will conduct another round of scoping to further refine what will be addressed in the *SSFL Area IV EIS* as EPA nears the end of the radiological characterization. This rescoping will include an amended NOI, new scoping meetings, and an additional opportunity to comment on the scope of the *SSFL Area IV EIS*, the alternatives, and any issues pertinent to the EIS. Additional information on the changes noted above are discussed in the concerns and responses listed below.

As a result of the scoping process, DOE has added two alternatives, one specifically addressing the clean up to agriculatural future land use levels and another in which SSFL Area IV would be cleaned up and future land use would be classified as restricted open space (open to wildlife, but fenced and secured to preclude human use). In the amended NOI, all of the alternatives will be refined and better defined (including options for groundwater remediation) as part of the new scoping effort. Other changes resulting from the initial scoping process include commitment by DOE to additional methods of notifying and communicating with the public (email, newsletters, and community member help), interviewing former workers about historical operations, and developing a more comprehensive understanding of historical operations and impacts.

DOE intends to revise and finalize the Gap Analysis Report, after EPA completes the radiological background study and the Area IV radiological characterization study. Any sampling that was identified as necessary in the Draft Gap Analysis Report not conducted by EPA or DTSC will be completed by DOE prior to development of the ecological and human health risk assessments and the analysis of the alternatives for the Area IV EIS.

For the *Draft Gap Analysis Report*, many comments were received concerning sampling methodology, exposure units, contaminants of concern, sampling density, and other characterization-related topics. Because EPA now has the responsibility for the radiological characterization of Area IV and the Northern Undeveloped Area, those comments are being provided to EPA for their consideration during the development of EPA's sampling and analysis plan.

2.0 SUMMARY OF COMMENTS RECEIVED

As a result of the *Draft Gap Analysis Report* comment period and public EIS scoping process, DOE received input from 74 commentors, including individuals; elected officials; special interest groups; and local, state, and federal agencies. Written comments were received via U.S. mail, e-mail, and at public meetings. Oral comments were obtained at public meetings and documented by court reporters. Approximately 750 individual comments were received, of which approximately 40 percent were concerned with the *SSFL Area IV EIS* and 60 percent with the *Draft Gap Analysis Report*.

All comments were generally grouped into the following nine broad categories:

- **Scope of Studies (*SSFL Area IV EIS* and *Draft Gap Analysis Report*)** – These comments related to suggestions for modifying the scope of the remediation, specifically to address all of SSFL and adjacent lands.
- **Nature and Extent of Contamination** – This category included suggestions that DOE develop a full understanding of the nature and extent of the contamination to be addressed in the cleanup program, including the types of contamination (radiological or chemical), how those contaminants resulted from historical operations, the level of contamination that is attributable to background and site characteristics, and movement of contaminants in the surrounding environment.
- **Cleanup Criteria and Standards** – These comments discussed screening levels for cleanup actions and cleanup standards.
- ***Draft Gap Analysis Report* Sampling** – These comments concerned the sampling methodologies and sample density.
- **Policy Issues** – This category included a range of DOE policy issues such as process transparency, contracting issues, regulatory compliance, and listing on the CERCLA NPL.
- **EIS Process and Alternatives** – These comments were concerned with the process DOE will use to develop the EIS (such as the method of selection for the preferred alternative), the schedule, and the alternatives to be analyzed.
- **Public Involvement** – These comments concerned meeting logistics, meeting format, meeting notifications, and advertising budget.
- **Health Impacts of Previous Operations (Cumulative Health Impacts) and Proposed Alternatives** – Comments in this category related to the health effects resulting from human exposure to SSFL contamination from both the proposed alternatives and historical operations and accidents (cumulative health impacts).
- **EIS Resource Evaluations** – This category included environmental resource areas and activities that would be analyzed in the *SSFL Area IV EIS*, such as cultural resources, biological resources, water resources, and waste management.

Additional information on the comments received within these categories is presented in Table 2–1. DOE's responses to general issues raised in these comment categories are provided in Section 3. Responses to individual comments are included in Section 4.

Table 2–1. Summary of Scoping Comments by Category

Scope of Studies (SSFL Area IV EIS and Draft Gap Analysis Report) – These comments related to modifying the scope of the remediation effort, specifically to address all of SSFL and adjacent lands. Many comments requested sampling and analysis of the entire SSFL site, and provided information on DOE activities that either impacted areas beyond Area IV or took place outside of Area IV; such as gas releases from the Sodium Reactor Experiment (SRE) accident, holding ponds, or the Area I Burn Pit. Specific locations such as the Brandeis-Bardin campus and Sage Ranch Park were mentioned as areas of potential contamination.
Nature and Extent of Contamination – Most of the comments in this category were specific to the *Draft Gap Analysis Report*. The comments requested the identity of all contaminants present, their concentrations, their locations, and the potential remediation effort. Commentors also stated that, to understand the contamination issues, DOE must first understand the full history of operations and activities at the site to locate and characterize contaminants. Commentors requested a review of records, such as accident reports, log books, previous gamma walkover surveys, radionuclide monitoring, tracer studies, and air filters in buildings. Access to records was also requested. Interviews with former employees were suggested. Some comments requested information on a specific event or piece of equipment, such as the SRE accident and the Van de Graaff accelerator. Several comments noted distrust of the Historical Site Assessment document, and asked for DOE to redo the assessment. Comments on conducting the background and site characterization studies accompanied the comments addressing the nature and extent of contamination. Commentors noted a need for a site-specific background study and a site-wide gamma walkover survey. Appropriate sampling locations for background samples were also discussed. Furthermore, commentors discussed the list of radiological constituents of interest (COIs) and the processes and operations that took place. Commentors were concerned that the list presented in the *Draft Gap Analysis Report* may not be appropriate or comprehensive and asked for details on the development of the COI list. The commentors also requested information on radionuclides and their characteristics, such as half-lives, exposure scenarios, health risks, radionuclide reactions in different media, and remediation methods. Other commentors asked for the specific locations of radionuclides on the site. They also asked for information on the potential movement of radionuclides, including the effects of wind patterns on radionuclide dispersion and the effects of soil erosion and migration on radionuclide levels.
Cleanup Criteria and Standards – This category of comments discussed screening levels for cleanup actions and cleanup standards. Several comments asked for a description of the development of a screening level, such as a preliminary remediation goal (PRG) or derived concentration guideline level (DCGL), and how the levels were used. Other comments requested clarification of the relationship between different screening levels, as well as the screening criteria for chemicals and radionuclides. Comments noted the confusion over the development of PRGs in the *Draft Gap Analysis Report* and their relationship to SB 990. Several comments concerned development of the cleanup standards to be employed in the remediation. A few commentors asked that DTSC certify that SSFL is cleaned up to the highest standards. Questions were raised addressing various aspects of cleanup standards, such as achievable cleanup levels, the development and selection of cleanup levels, and the differences in cleanup standards between federal agencies.
Draft Gap Analysis Report Sampling – Sampling comment topics ranged from satisfying Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) requirements to conducting statistical evaluations of data. Comments concerned the sample density compliance with CERCLA and MARSSIM, justification of sample numbers presented in the *Draft Gap Analysis Report*, and definitions of terms used in the report. Other comments expressed concern over perceived averaging and segmenting analytical results, and the need to use appropriate research methodology. Several commentors asked for assurance that adequate and appropriate sampling and analysis will be done.
Policy Issues – These comments concerned DOE policies for site cleanup or preparing the *SSFL Area IV EIS*, such as process transparency, contracting issues, regulatory compliance, and listing SSFL on the CERCLA NPL. Additionally, commentors asked DOE to describe how it will comply with RCRA, CERCLA, and NEPA, especially in regards to remediation selection. A few comments questioned compliance with State of California regulations, discussed the problems with accelerated cleanup programs, and suggested the completion of an environmental impact report. Some commentors asked for a

clarification of the roles of the different agencies involved at SSFL, or requested that more regulatory enforcement take place at SSFL. Several comments communicated distrust in DOE and requested that EPA take the lead on site characterization, remedy selection, and all cleanup activities. A frequent comment was the request that DOE comply with SB 990. A few commentors asked for specific information related to SB 990, such as the actual cost of compliance and the effects of SB 990 on Boeing's proposed land transfer. Commentors requested that the site be placed on the CERCLA NPL, asked about the consequences of listing the site, and indicated a preference for using the Superfund process to evaluate and select cleanup actions.

EIS Process and Alternatives – These comments were concerned with EIS processes (such as how the preferred alternative would be selected), schedule, and alternatives to be analyzed, and preferences for specific alternatives. Several comments asked for a clearly defined scope, while others asked for the scope to be redetermined. A few commentors asked for a description of the EIS process, specifically the relationship between public comments, the EIS document and the ultimate cleanup decision. Also, several comments suggested revising the *SSFL Area IV EIS* schedule. Many commentors said the list of proposed alternatives was inadequate, and DOE should consider other alternatives not proposed in the NOI. Some commentors requested a more detailed description of each alternative. A number of comments conveyed a preference for Alternative 4, Offsite Disposal of SSFL Area IV Materials. Two additional alternatives were proposed—one that complied with SB 990 and one where Area IV is cleaned up, designated as restricted open space, and fenced and secured to preclude human access. Future land uses mentioned for SSFL included general public use, an equestrian center, parkland, open space, restricted open space, agricultural, agricultural/rural residential, and rural. Also, commentors said that future land use should be considered within the context of current land uses of adjacent properties, namely agricultural and residential developments.

Public Involvement – These comments concerned meeting logistics, meeting format, meeting notifications, and the advertising budget. A few comments related to the actual logistics of the scoping process, such as the location and timing of meetings. A couple of commentors offered suggestions on the scoping meeting format. Some comments related to notification of the public of *SSFL Area IV EIS* activities. Commentors asked for details on how the public was contacted and the advertising budget. Many comments addressed a perceived lack of public awareness of the scoping meetings. Comments on the lack of participation by government representatives were also submitted.

Health Impacts of Previous Operations (Cumulative Health Impacts) and Proposed Alternatives – These comments concerned human exposure to SSFL contamination from both the proposed alternatives and historical operations and accidents (cumulative health impacts). Several commentors asked DOE to perform risk assessments and epidemiologic studies of former and current workers. Some commentors requested biomonitoring of former and current workers as well as of local residents, including an update of the cancer registry and the Agency for Toxic Substances and Disease Registry study (ATSDR). Concerns were raised over short-term health risks, particularly related to removing structures or leaving structures in place, transporting materials, and soil disturbing and cleanup activities. Commentors were also concerned with the health risks associated with each alternative. A few commentors asked about the disclosure of health risks to communities and the potential for relocation of residents at greater risk of adverse health effects.

EIS Resource Evaluations – This category included commentor concerns on environmental resource areas and issues that would be analyzed in the *SSFL Area IV EIS*, including cultural resources, biological resources, water resources, air, geology, soils, transportation of radioactive materials, and waste management.

3.0 STAKEHOLDER CONCERNS

At the public meetings, there were some specific concerns that were expressed by a number of commentors:

- Cleanup of the entire SSFL site, not just Area IV;
- Preference for Alternative 4 (i.e., off-site disposal of SSFL Area IV materials; demolition of buildings, etc.);
- Alternatives to be analyzed and DOE's method of selecting a preferred alternative;
- Request to meet the requirements of SB 990;
- Listing SSFL on the NPL;
- Health impacts of previous operations (cumulative health impacts);
- Historical operations/accidents and interviews with former employees;
- Background measurements of radiological and chemical constituents;
- Proper use of EPA PRGs;
- List of radiological COIs in the *Draft Gap Analysis Report;* and
- Notification process for meetings

These concerns and a response by DOE are detailed below.

Cleanup of the entire SSFL site, not just Area IV

A number of comments were received requesting that DOE not restrict the *Draft Gap Analysis Report* and the *SSFL Area IV EIS* to Area IV. The focus on Area IV is based on the following considerations.

- SSFL is divided into four administrative units and two undeveloped areas with DOE, NASA, and Boeing being responsible for different parts of investigations and the cleanup. Boeing owns most of the land, except for 42 acres of Area I and all of Area II, which are owned by NASA. DOE does not own any of the land; DOE's predecessors used 90 acres of Boeing's Area IV land for a number of facilities called the Energy Technology Engineering Center (ETEC). The Atomic Energy Commission (AEC) and the Energy Research and Development Administration (ERDA) contracted with Boeing and its predecessors to conduct research and related support activities at ETEC. All of these contracted activities were restricted to Area IV.

- The U.S. District Court for the Northern District of California ordered DOE to prepare the EIS for Area IV of the SSFL.

- H.R. 2764 mandates a radiological survey of Area IV and tasks DOE and EPA with developing a joint survey and an Interagency Agreement. EPA is the lead agency for this effort, and will conduct the radiological background study, the gamma walkover survey, and all associated soil sampling.

- Significant work on SSFL cleanup is underway beyond Area IV, and will include other areas that stakeholders have identified as concerns, such as the Area I Burn Pit. The various cleanup efforts are subject to applicable federal and state requirements, including the RCRA authority of DTSC for the entire SSFL site. Under DTSC orders, DOE, Boeing, and NASA are actively investigating chemical use and contamination throughout SSFL.

- Under California Environmental Quality Act (CEQA) requirements, DTSC will also be responsible for the preparation of an environmental impact report addressing cleanup for all of SSFL. This document will be prepared at the completion of the RCRA investigations.
- Stormwater runoff at SSFL is being addressed through the National Pollutant Discharge Elimination System (NPDES) permit process under the authority of the Los Angeles Regional Water Quality Control Board. NPDES controls water pollution at SSFL by regulating discharges of pollutants in stormwater. All of SSFL is subject to NPDES requirements, including the requirement to collect and treat stormwater.
- DOE is committed to identifying the extent of contamination from DOE activities at ETEC.

Preference for Alternative 4

A number of commentors indicated a preference for Alternative 4, Offsite Disposal of SSFL Area IV Materials as it was described in the NOI. DOE acknowledges this expressed preference. DOE is preparing the *SSFL Area IV EIS* in compliance with NEPA, which requires consideration of a range of alternatives. No preferred alternative will be identified until all of the alternatives have been analyzed and evaluated.

As a result of rescoping, the alternatives that are actually evaluated in the EIS will likely differ from those originally listed in the NOI. In addition, Alternative 4 as originally described in the NOI may be reworded.

Alternatives to be analyzed and DOE's method of selecting a preferred alternative

A number of commentors addressed the alternatives to be evaluated in the *SSFL Area IV EIS* questioning how DOE will select a preferred alternative. However, it is too early in the process for DOE to designate a preferred alternative, or to fully determine what might be technically or economically feasible. Under NEPA, federal agencies must prepare EISs when proposed actions may have a significant impact on the environment. The EIS must evaluate the environmental and related social and economic effects of the proposed action and a range of reasonable alternatives. NEPA requires that DOE look at "no action" as a basis of comparison among alternatives, regardless of whether the site must be cleaned up. Two no action alternatives were identified to meet the requirements for no action under both NEPA and CERCLA. For each of the three action alternatives identified in the NOI, it is DOE's intent to analyze each separately for the agricultural, residential, and open space scenarios. This analysis will be fully described in the *Draft SSFL Area IV EIS*. NEPA requires DOE decisionmakers to make informed decisions. NEPA does not require the decisionmaker to select the most environmentally benign alternative or the alternative that is preferred by the local community. However, DOE will use the nine EPA CERCLA evaluation criteria to select a preferred alternative. These include: 1) overall protection of human health and the environment; 2) compliance with applicable or relevant and appropriate requirements; 3) long-term effectiveness and performance; 4) reduction of toxicity, mobility, or volume through treatment; 5) short-term effectiveness; 6) implementability; 7) cost; 8) State acceptance; and 9) community acceptance. In an amended NOI, the range of reasonable alternatives will be further clarified and additional scoping of the *SSFL Area IV EIS* will occur. One purpose of scoping is to solicit public input on alternatives to ensure all reasonable alternatives are evaluated.

Based on the results of the EPA background study, DTSC's chemical analysis and background study, and EPA's radiological characterization survey of Area IV, the alternatives in the EIS may be revised, refined, and changed. Once EPA and DTSC complete their studies, DOE will evaluate all alternatives to assure that a full range of reasonable alternatives, including those suggested as part of the July 2008 scoping, are considered in the EIS. The two alternatives suggested during scoping (future agricultural land use and restricted open space land use) will be considered for the EIS, and other alternatives may change based upon results of these studies. DOE will conduct another round of scoping meetings when EPA is nearing completion of the radiological characterization of Area IV. When additional scoping meetings are conducted, proper public notifications including *Federal Register* notices, via the local media, and email distribution lists will be made. As part of DOE's on-going stakeholder involvement activities, discussions will be held with interested stakeholders and regulators to determine the need for additional scoping meetings.

Request to meet the requirements of Senate Bill (SB) 990

Commentors recommended that DOE pursue a cleanup program that would allow compliance with SB 990. SB 990 requires a cleanup standard for an agricultural future use scenario. As previously explained, DOE will evaluate a full range of reasonable land use alternatives as part of the *SSFL Area IV EIS*. DOE will consider future use scenarios during the EIS process to determine how to clean up SSFL Area IV. One of these future use scenarios is an agricultural scenario. DOE will also consider residential and open space scenarios. As a result of the scoping comments, DOE has added an additional alternative that is specifically designed to meet the requirements of SB 990. The additional alternative will allow the decisionmakers to compare the SB 990 alternative to other alternatives.

Listing SSFL on the National Priorities List

Some commentors requested that SSFL be included on the CERCLA NPL to assure that all of SSFL is cleaned up, not just Area IV. DOE had similarly concluded that inclusion of SSFL on the NPL would have resulted in a comprehensive, coordinated cleanup. The State of California did not agree, and concluded that it would be in the State's best interest to conduct cleanup under the auspices of DTSC as the lead regulator. Therefore, EPA has decided against including the SSFL on the NPL. Instead, DTSC will direct the cleanup of SSFL under an Amended Consent Order and DOE will conduct the cleanup of Area IV accordingly.

Health impacts of previous operations (cumulative health impacts)

A number of commentors requested that DOE analyze the health impacts of previous operations on the surrounding population. NEPA requires the analysis of cumulative impacts of past, present, and reasonably foreseeable actions. The Council on Environmental Quality's 2005 Memorandum, "Guidance on the Consideration of Past Actions in Cumulative Effects Analysis," states: "[t]he environmental analysis required under NEPA is forward-looking, in that it focuses on the potential impacts of the proposed action that an agency is considering. Thus, review of past actions is required to the extent that this review informs agency decision making regarding the proposed action." It also states: "[i]n determining what information is necessary for a cumulative effects analysis, agencies should use scoping to focus on the extent to which information is "relevant to reasonably foreseeable significant adverse impacts," is "essential to a reasoned choice among alternatives," and "can be obtained without exorbitant cost." All resource areas will be analyzed for cumulative impacts. Impacts on workers, the public, and the environment of all alternatives (including no action or containment in place) will be analyzed for comparison among alternatives.

Historical operations/accidents and interviews with former employees

A number of commentors suggested that DOE add to and clarify its understanding of the history of SSFL, including accidents, and operational practices. Many suggested conducting interviews with former employees. There are several ongoing efforts to assure that new information is included in the historical record. In addition, DOE is searching through all records in its possession or those in the possession of its contractors to assure that all relevant information is provided to DTSC as required in the RCRA Consent Order. A part of this effort will be discussions with former employees. DOE will share information about these efforts with interested stakeholders.

Background measurements and characterization of radiological and chemical constituents

Commentors requested that EPA, and specifically Mr. Gregg Dempsey, conduct the background studies and characterization of radiological and chemical constituents for the *SSFL Area IV EIS*. Background levels reflect concentrations in the bedrock and soil resulting from the geological processes that created the Santa Susana Mountains. Additionally, background levels include concentrations of radionuclides and chemicals at the site that stem from other unrelated sources. These include radionuclides from global nuclear testing and lead from automobile exhaust. These background levels are needed for comparison with concentrations found at Area IV.

DOE understands that the community holds EPA and Mr. Gregg Dempsey from EPA's Las Vegas Lab in high regard. As a result, EPA has appointed Mr. Dempsey to serve as the technical lead for both studies, and he is already taking a very active role in the work of the background study. EPA has also appointed two project managers, one to conduct the radiological background study (Nicole Moutoux) and another to conduct the Area IV radiological characterization study (Craig Cooper). DTSC is directing similar work to determine the background levels of chemical contaminants and is directing the chemical contaminant characterization of all of SSFL, including Area IV. DOE has and will continue to work closely with DTSC to ensure that efforts under the Consent Order and work on the *SSFL Area IV EIS* are coordinated. DOE will prepare CERCLA-based human health and ecological risk assessments. Input values for the risk assessments will be obtained from both the EPA radiological sampling efforts and the DTSC-led chemical survey. In addition, DOE will continue to actively engage all stakeholders in the development of the scenarios and assumptions that will be incorporated in the risk assessment process.

Commentors may provide suggestions directly to those parties involved in the determination of background or site characterization. Contact information is provided below:

EPA Background Study:
Nicole Moutoux
Project Manager
Superfund Division
U.S. Environmental Protection Agency, Region 9
75 Hawthorne Street, SFD-8-1
San Francisco, CA 94105
Phone: (415) 972-3012
Email: Moutoux.Nicole@epa.gov

EPA Survey of Area IV:

Mr. Craig Cooper
Project Manager
U.S. Environmental Protection Agency, Region 9
75 Hawthorne Street, SFD-3
San Francisco, CA 94105
Phone: 415-947-4148
Email: cooper.craig@epa.gov

RCRA Investigation of SSFL and Chemical Background Study:

Mr. Rick Brausch
Project Director
California Department of Toxic Substances Control
P.O. Box 806
Sacramento, CA 95812-0806
E-mail: rbrausch@dtsc.ca.gov

Proper use of EPA Preliminary Remediation Goals (PRGs)

Some commentors questioned the PRG values used by DOE's contractors in the *Draft Gap Analysis Report*. One reason that DOE contracted the preparation of the *Data Gap Analysis Report* was to evaluate the existing information about Area IV contamination and determine how much additional sampling would be needed in order to prepare the risk assessment and the EIS. Part of this evaluation is the comparison of existing soil concentrations and the EPA PRGs. PRGs are a tool used by EPA in the evaluation of CERCLA sites to determine whether further study is warranted. PRGs are calculated acceptable soil concentrations based on probable future land use scenarios.

The EPA PRGs were used in this study in accordance with EPA guidance as one measure to screen the usability of the existing data for future risk assessment purposes. One objective of this screening was to determine what additional data would be needed from Area IV to complete the CERCLA risk assessment. Within the *Draft Gap Analysis Report* the PRGs were not used for remedy evaluation or remedy selection. EPA's guidance related to the establishment of PRGs is presented in Part B of the *Risk Assessment Guidance for Superfund*, which can be viewed at http://www.epa.gov/oswer/riskassessment/ragsb/pdf/chapt2.pdf.

DOE intends to look at the data again once EPA and DTSC have completed their background and characterization studies and determine if any additional "gaps" remain that will necessitate additional sampling.

The List of Radiological COIs in the Draft Gap Analysis Report

In comments submitted by the State of California on the *Draft Gap Analysis Report*, the State requested that the authors of the report "[p]rovide listing of all radionuclides generated during reactor operation and reduce the list using industry acceptable methods (i.e. radiological half-life)." As a response to this request, a white paper was developed including all potential radionuclides produced as a result of Area IV nuclear activities and explaining the rationale for determining whether each radionuclide remains a COI based on its half-life and other factors. This white paper is entitled *Radionuclides Related to Historical Operations at the Santa Susana Field Laboratory Area IV*. This white paper is included as Appendix A to this document. Any new radiological COIs identified as a result of EPA's background and radiological characterization studies will be included in the revised *Draft Gap Analysis Report*.

Notification process for meetings

Concern was expressed that more people were not present at the scoping meetings and information was requested on the extent of community notifications in advance of the scoping meetings, including amount of funding devoted to the advertising budget. The extent and types of outreach to the community for the scoping meetings are outlined in Appendix B. Advertising costs for the scoping meetings (newspaper ads, postage, and mailing) totaled approximately $26,000.

DOE appreciates input from commentors and will consider other means to notify the community about SSFL Area IV events, activities, reports, and opportunities for involvement in decisionmaking related to the cleanup. Some commentors suggested that DOE place members of certain neighborhoods on the DOE mailing list. DOE will place members of the public on the mailing list at their request. However, DOE welcomes help from members of the public to notify their neighbors or others in the community of important meetings held by DOE. Some commentors suggested that DOE use email to contact community members. DOE has accepted the suggestion and has begun an email notification contact list. Additionally, DOE has created a newsletter called the *Santa Susana Clean Update* that is now being sent out via email and traditional mail service with information on cleanup topics and future meetings.

TAB 8

Role of Background in the CERCLA Cleanup Program

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Office of Emergency and Remedial Response
April 26, 2002
OSWER 9285.6-07P

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Purpose

This document clarifies the U.S. Environmental Protection Agency (EPA) preferred approach for the consideration of background constituent concentrations of hazardous substances, pollutants, and contaminants in certain steps of the remedy selection process, such as risk assessment and risk management, at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund") sites. To the extent practicable, this document may also be applicable to sites addressed under removal actions and time-critical actions. In general, the presence of high background concentrations of hazardous substances, pollutants, and contaminants found at a site is a factor that should be considered in risk assessment and risk management.

The primary goal of the CERCLA program is to protect human health and the environment from current and potential threats posed by uncontrolled releases of hazardous substances, pollutants, and contaminants. Contamination at a CERCLA site may originate from releases attributable to the CERCLA site in question, as well as contamination that originated from other sources, including natural and/or anthropogenic sources not attributable to the specific site releases under investigation (EPA, 1995a). In some cases, the same hazardous substance, pollutant, and contaminant associated with a release is also a background constituent. These constituents should be included in the risk assessment, particularly when their concentrations exceed risk-based concentrations. In cases where background levels are high or present health risks, this information may be important to the public. Background information is important to risk managers because the CERCLA program, generally, does not clean up to concentrations below natural or anthropogenic background levels.

A comprehensive investigation of all background substances found in the environment usually will not be necessary at a CERCLA site. For example, radon background samples normally would not be collected at a chemically contaminated site unless radon, or its precursor (radium, Ra-226) was part of the CERCLA release. Also, EPA normally would not analyze background samples for Ra-226 at a cesium (Cs-137) site, or dioxin at a lead site where dioxin was not the subject of a CERCLA release into the environment.

This document provides guidance to EPA Regions concerning how the Agency intends to exercise its discretion in implementing one aspect of the CERCLA remedy selection process. The guidance is designed to implement national policy on these issues.

Some of the statutory provisions described in this document contain legally binding requirements. However, this document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the

circumstances. Any decisions regarding a particular remedy selection decision will be made based on the statute and regulations, and EPA decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. EPA may change this guidance in the future.

History

Background issues are discussed in a number of EPA documents[1]. A need for CERCLA-specific guidance was identified during risk assessment reform discussions with stakeholders in 1997. An issue that is often raised at CERCLA sites is whether a reliable representation of background is established (EPA, 1989). To assist Regions with this issue, EPA developed a peer-reviewed practical guide to sampling and statistical analysis of background concentrations in soil at CERCLA sites (EPA, 2001b).

EPA has developed this policy to respond to questions about the general application of background concentration during the CERCLA remedial investigation process.[2] This policy encourages national consistency and responds to the Agency's goals for risk characterization and communication of risks to the public as expressed in other EPA policy and guidance, including:

- *Policy for Risk Characterization* which provides principles for fully, openly, and clearly characterizing risks (EPA, 1995b); and,

- *Cumulative Risk Assessment Guidance* which encourages programs to better advise citizens about the environmental and public health risks they face (EPA, 1997c).

Definitions of Terms

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[1] *Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual* [RAGS] (EPA, 1989).
Preamble to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 1990a).
Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions (EPA, 1991).
Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites (EPA, 1995a).
Soil Screening Guidance: User's Guide (EPA, 1996).
Ecological Risk Assessment Guidance for Superfund (EPA, 1997a).
Rules of Thumb for Superfund Remedy Selection (EPA, 1997b).
Soil Screening Guidance for Radionuclides: User's Guide (EPA, 2000).
ECO Update. The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments (EPA, 2001a).

[2]The process of determining when risks warrant remedial actions and the degree of cleanup for specific hazardous substances, pollutants, and contaminants involves many factors that are not addressed in this document. Additional guidance is provided in the EPA (1991) *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*.

For the purposes of this policy, the following definitions are used.

Background refers to constituents or locations that are not influenced by the releases from a site, and is usually described as naturally occurring or anthropogenic (EPA, 1989; EPA, 1995a):

> 1) *Anthropogenic* – natural and human-made substances present in the environment as a result of human activities (not specifically related to the CERCLA release in question); and,
>
> 2) *Naturally occurring* – substances present in the environment in forms that have not been influenced by human activity.

Chemicals (or constituents) of concern (COCs) are the hazardous substances, pollutants, and contaminants that, at the end of the risk assessment, are found to be the *risk drivers* or those that may actually pose unacceptable human or ecological risks.[3] The COCs typically drive the need for a remedial action (EPA, 1999a).

Chemicals (or constituents) of potential concern (COPCs) generally comprise the hazardous substances, pollutants, and contaminants that are investigated during the baseline risk assessment. The list of COPCs may include all of the constituents whose data are of sufficient quality for use in the quantitative risk assessment, or a subset thereof (EPA, 1989).

Screening is a common approach used by risk assessors to refine the list of COPCs to those hazardous substances, pollutants, and contaminants that may pose substantial risks to health and the environment. Screening involves a comparison of site media concentrations with site-specific risk-based values.[4]

Consideration of Background in Risk Assessment

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[3]Guidance for determining if site risks are unacceptable is discussed in the EPA (1991) *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*. As stated in the EPA (1991) memorandum, "EPA uses the general 10^{-4} to 10^{-6} risk range as a "target range" within which the Agency strives to manage risks as part of a Superfund cleanup." The risk used in this decision generally is the "cumulative site risk" to an individual using reasonable maximum exposure (RME) assumptions for either current or future land use and includes all exposure pathways which the same person may consistently face. See also EPA (1989) RAGS, Section 8.3.

[4]Risk-based values or concentrations are generally based on a cancer risk of one-in-a-million ($1x10^{-6}$) or a hazard quotient of 1.0 for noncarcinogens (EPA, 1996) or screening-level ecological risk values (EPA, 1997a; EPA, 2001a). COPCs with concentrations below the screening levels might be excluded from the risk assessment unless there are other pathways or conditions that are not addressed by the screening values (EPA, 1996).

A baseline risk assessment generally is conducted to characterize the current and potential threats to human health and the environment that may be posed by hazardous substances, pollutants, and contaminants at a site. EPA's 1989 *Risk Assessment Guidance for Superfund* (RAGS) provides general guidance for selecting COPCs, and considering background concentrations. In RAGS, EPA cautioned that eliminating COPCs based on background (either because concentrations are below background levels or attributable to background sources) could result in the loss of important risk information for those potentially exposed, even though cleanup may or may not eliminate a source of risks caused by background levels. In light of more recent guidance for risk-based screening (EPA, 1996; EPA, 2000) and risk characterization (EPA, 1995c), this policy recommends a baseline risk assessment approach that retains constituents that exceed risk-based screening concentrations. This approach involves addressing site-specific background issues at the end of the risk assessment, in the risk characterization. Specifically, the COPCs with high background concentrations should be discussed in the risk characterization, and if data are available, the contribution of background to site concentrations should be distinguished.[5] COPCs that have both release-related and background-related sources should be included in the risk assessment. When concentrations of naturally occurring elements at a site exceed risk-based screening levels, that information should be discussed qualitatively in the risk characterization. To summarize:

- The COPCs retained in the quantitative risk assessment should include those hazardous substances, pollutants, and contaminants with concentrations that exceed risk-based screening levels.

- The Risk Characterization should include a discussion of elevated background concentrations of COPCs and their contribution to site risks.

- Naturally occurring elements that are not CERCLA hazardous substances, pollutants, and contaminants, but exceed risk-based screening levels should be discussed in the risk characterization.

This general approach is preferred in order to:

- Encourage national consistency in this area;

- Present a more thorough picture of risks associated with hazardous substances, pollutants, and contaminants at a site; and,

- Prevent the inadvertent omission of potentially release-related hazardous

[5]Technical guidance should be consulted for sampling and analysis of background concentration data (EPA, 2001b).

substances, pollutants, and contaminants from the risk assessment.

This approach is consistent with the *Policy for Risk Characterization* which provides principles for fully, openly, and clearly characterizing risks (EPA, 1995b). Risks identified during the baseline risk assessment should be clearly presented and communicated for risk managers and for the public. Risk characterization is one of many factors in determining appropriate CERCLA risk management actions (EPA, 1991; EPA, 1995b).

Consideration of Background in Risk Management

Where background concentrations are high relative to the concentrations of released hazardous substances, pollutants, and contaminants, a comparison of site and background concentrations may help risk managers make decisions concerning appropriate remedial actions. The contribution of background concentrations to risks associated with CERCLA releases may be important for refining specific cleanup levels for COCs that warrant remedial action[6].

Generally, under CERCLA, cleanup levels are not set at concentrations below natural background levels. Similarly, for anthropogenic contaminant concentrations, the CERCLA program normally does not set cleanup levels below anthropogenic background concentrations (EPA, 1996; EPA, 1997b; EPA, 2000). The reasons for this approach include cost-effectiveness, technical practicability, and the potential for recontamination of remediated areas by surrounding areas with elevated background concentrations. In cases where area-wide contamination may pose risks, but is beyond the authority provided under CERCLA, EPA may be able to help identify other programs or regulatory authorities that are able to address the sources of area-wide contamination, particularly anthropogenic (EPA, 1996; EPA, 1997b; EPA, 2000). In some cases, as part of a response to address CERCLA releases of hazardous substances, pollutants, and contaminants, EPA may also address some of the background contamination that is present on a site due to area-wide contamination.

The determination of appropriate CERCLA response actions and chemical-specific cleanup levels includes the consideration of nine criteria as provided in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 1990b). In cases where applicable or relevant and appropriate requirements (ARARs) regarding cleanup to background levels apply to a CERCLA action, the response action generally should be carried out in the manner prescribed by the ARAR. In the case where a law or regulation is determined to be an ARAR and it requires cleanup to background levels, the ARAR will normally apply and be incorporated into the Record of Decision, unless the ARAR is waived.

Consideration of Background in Risk Communication

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[6]For example, in cases where a risk-based cleanup goal for a COC is below background concentrations, the cleanup level may be established based on background.

EPA strives for transparency in decision-making (EPA, 1995c) and encourages programs to better advise citizens about the environmental and public health risks they face (EPA, 1997c). The presence of high background concentrations of COPCs may pose challenges for risk communication. For example, the discussion of background may raise the expectation that EPA will address those risks under CERCLA. The knowledge that background substances may pose health or environmental risks could compound public concerns in some situations.

On the other hand, knowledge of background risks could help some community members place CERCLA risks in perspective. Also, the information about site and background risks can be helpful for both risk managers who make an appropriate CERCLA decision, and for members of the public who should know about environmental risk factors that come to light during the remedial investigation process.

As a general policy matter, EPA strives for early and frequent outreach to communities in order to share information and encourage involvement (EPA, 2001c). EPA has made a clear commitment to fully, openly, and clearly characterize and communicate risks (EPA, 1995b; EPA, 1995c). There is no one-size-fits-all technique that can help explain risks associated with CERCLA releases or with background levels, or the basis of risk management decisions. Approaches will depend on the site, the issues, and the level of community interest. Early on in the process, Regions should clarify their understanding of stakeholder expectations and clearly explain the relevant constraints and limitations of the CERCLA remedial process (EPA, 1999b; EPA, 2001c).

In some cases where area-wide contamination may pose a risk, but is beyond the authority of the CERCLA program, communication of potential risks to the public may be most effective when coordinated with public health agencies. Examples of situations where Regions might coordinate risk communication with local, state or federal health officials are sites where widespread lead contamination or high levels of naturally occurring radiation have been found, but are not the subject of a CERCLA release into the environment. Public health agency officials may combine education and outreach efforts to inform residents about ways to reduce exposures and risks.

Hypothetical Case Examples

Three general hypothetical case examples are given to show how background may be considered in risk assessment and risk management at CERCLA sites:

Case 1 presents an example of a chemical site with widespread background contamination.

Case 2 presents an example of a radiation site with both natural- and release-related sources.

Case 3 presents an example of a site with hazardous substances, pollutants, and contaminants from both natural- and release-related sources.

In these examples, it is presumed that adequate samples are collected from appropriate background reference locations and evaluated using appropriate statistical methods. It is presumed that background is not used to screen out substances from the risk assessment. For simplicity, only one pathway[7] is used for hypothetical human health risk assessments.[8]

Based on the presumptions above, the basic concepts these examples are designed to highlight are:

- Background issues should be discussed in the risk characterization portion of the baseline risk assessment in order to inform risk management decisions;
- Information about unacceptable risks should be communicated to public; and,
- Other factors, such as the nine criteria provided in the NCP, should be considered by the risk manager in making final decisions.

Hypothetical Case 1

The ABC Industrial Site risk assessment included all COPCs that exceed site-specific risk-based concentrations for soil pathways. The results of the risk assessment identified the following COPCs with risks above or at the high end of the 10^{-4} to 10^{-6} risk range: arsenic, dieldrin, and 4,4-DDT. The hazard quotients were below 1.0.

Arsenic is a potential background substance – it is a common naturally occurring element – but is also a hazardous substance that was released at this site. The available site characterization data indicate that soil arsenic concentrations may be naturally occurring or consistent with background concentrations. Dieldrin and DDT are present at high concentrations that contribute to an unacceptable site risk. However, only dieldrin is known to be associated

[7] At most CERCLA sites, risks for the reasonably maximum exposed individual typically are combined across several exposure pathways to estimate the total risks at a CERCLA site. This is done only for the pathways which the same individual would be likely to face consistently (EPA, 1989). Depending on the particular CERCLA site, risks could be calculated for the entire area of the site or for separate units (see Section 4.5 of RAGS (EPA, 1989)). More technical guidance for characterizing background concentrations and comparing data sets is provided in EPA (2001b) and other technical references cited previously in this document.

[8] Guidance on the consideration of background concentrations during screening level ecological risk assessments is provided in EPA (2001a).

with the CERCLA site activities and releases. Since there are no known historical uses of DDT at this CERCLA site, the RPM suspects that the DDT in soil originated from area-wide agricultural pesticide applications in this part of the state. Based on this information, the RPM requests additional sampling of background locations for arsenic and DDT analysis. A statistical comparison of sampling data for arsenic and 4,4-DDT in on-site samples and background samples indicates that site concentrations for DDT are consistent with background concentrations. Local and regional data support the conclusion that DDT is an area-wide contaminant. The additional data indicate that arsenic concentrations on the site are above background concentrations. Therefore, the arsenic risks cannot be attributed solely to background.

In this example, arsenic and dieldrin are the soil COCs for which cleanup goals should be derived. The risk characterization should present information about DDT as an area-wide background contaminant that is unrelated to releases at this site, and the Agency should explain whether or not it will be addressed. The RPM should consider whether other regulatory programs or authorities are able to address the area-wide DDT contamination in a coordinated response effort. If available, the location(s) of additional information on pesticide use in this part of the state should be provided for concerned citizens.

Hypothetical Case 2

At ABC Radium Production Site, site characterization data indicate that radium (Ra-226) and inorganics are present in soil. Arsenic concentrations exceed screening levels but are assumed to be within naturally occurring levels. To confirm this assumption, the RPM evaluates site-specific background samples for comparison to site concentrations. The site-specific background analysis confirms that arsenic concentrations collected on the site are consistent with background concentrations in soils. There are no known regional anthropogenic sources of arsenic (such as smelters or pesticide manufacturers). Arsenic, in this case, is considered to be a naturally occurring substance and is excluded from further consideration in the quantification of site risks. However, the finding of natural background arsenic at concentrations that may pose health risks should be discussed in the text of the risk characterization.

The risk assessment indicates that Ra-226 exceeds the high end of the acceptable risk range of 10^{-4} to 10^{-6}. It is commonly known that Ra-226 occurs naturally in the environment. Samples collected in an appropriate background location near this site indicate that Ra-226 levels from natural sources are lower than the site levels, but are associated with a risk at the upper end of the risk range (10^{-4}).

In this example, only Ra-226 should be a COC for which a cleanup goal should be derived. The risk characterization, however, should include a discussion of natural background levels of both arsenic and Ra-226.

Hypothetical Case 3

XYZ Site contains buried chemical wastes, but some anecdotal accounts indicate that radium may have been used. Preliminary site characterization data show that arsenic, manganese, and Ra-226 concentrations exceed the site-specific, risk-based concentrations. A comparison of arsenic and manganese concentrations in groundwater samples collected from upgradient background locations indicates that only manganese site concentrations are consistent with background levels and considered to be naturally occurring. Naturally occurring manganese is not considered further in the quantification of risks, but is included in a qualitative discussion of risks in the risk characterization.

The RPM decides to analyze for Ra-226 both at the site and in background locations because it is commonly known that Ra-226 occurs naturally in the environment. Samples are collected in an appropriate background location near this site. The samples indicate that Ra-226 levels at this site are not different from naturally occurring levels. Therefore, Ra-226 is not a COPC for further consideration in the quantification of risks. Subsequent site investigation data confirms the use of chemicals, but not radionuclides.

In this example, only arsenic risks are quantified in the risk assessment. The baseline risk for groundwater indicates that arsenic poses an unacceptable risk. The risk characterization should include a discussion of the natural Ra-226 and manganese concentrations because the levels exceeded risk-based concentrations. Site characterization data indicate that site disposal activities caused naturally occurring arsenic in soil to be mobilized and leach to groundwater. Arsenic, therefore, is the subject of a CERCLA release into the environment and a cleanup goal for it should be derived.

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TAB 9

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 17 1999

MEMORANDUM

SUBJECT: Distribution of OSWER Radiation Risk Assessment Q & A's Final Guidance

FROM: Stephen D. Luftig, Director
Office of Emergency and Remedial Response (OERR)
Office of Solid Waste and Emergency Response

Stephen D. Page, Director
Office of Radiation and Indoor Air (ORIA)
Office of Air and Radiation

TO: Addressees

PURPOSE

The purpose of this memorandum is to transmit to you a final guidance document entitled: "Radiation Risk Assessment At CERCLA Sites: Q & A." The guidance provides answers to several common questions about radiation risk assessments at CERCLA sites. It should be especially useful to Remedial Project Managers (RPMs), On-Scene Coordinators (OSCs), and risk assessors.[1]

BACKGROUND

The U.S. Environmental Protection Agency (EPA) issued guidance entitled "Establishment of Cleanup Levels for CERCLA Levels for CERCLA Sites with Radioactive Contamination" (OSWER No. 9200.4-18, August 22, 1997). This 1997 guidance provided clarification for establishing protective cleanup levels for radioactive contamination at Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) sites. The 1997 guidance reiterated that cleanups of radionuclides are governed by the risk range for all carcinogens established in the NCP when ARARs are not available or are not sufficiently protective. Cleanup should generally achieve a cumulative risk within the 10^{-4} to 10^{-6} carcinogenic risk range based on the reasonable maximum exposure. The cleanup levels should consider exposures from all potential

[1]The attached document provides guidance on risk assessment issues involved at CERCLA sites and is consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). It does not alter the NCP expectations regarding treatment of principal threat waste and the use of containment and institutional controls for low level threat waste. Consistent with CERCLA and the NCP, response actions must attain or waive Applicable or relevant and appropriate requirements (ARARs). CERCLA response actions for contaminated ground water at radiation sites must attain (or waive as appropriate) the Maximum Contaminant Levels (MCLs) or non-zero Maximum Contaminant Level Goals (MCLGs) established under the Safe Drinking Water Act, where the MCLs or MCLGs are relevant and appropriate for the site.

pathways, and through all relevant media (e.g., soil, ground water, surface water, sediment, air, structures, etc.) The 1997 guidance also provides a listing of radiation standards that are likely to be used as ARARs to establish cleanup levels or to conduct remedial actions.

Since issuance of the 1997 guidance, regional staff have requested additional guidance on specific Superfund process and requirements related to radiation cleanups. Today's guidance responds to these requests.

The attached final Risk Q & A fact sheet is part of a continuing effort between the Office of Emergency and Remedial Response (OERR) and the Office of Radiation and Indoor Air (ORIA) to provide updated guidance for addressing radioactively contaminated sites that is consistent with our guidance for addressing chemically contaminated sites, except to account for the technical differences between radionuclides and chemicals. This effort is intended to facilitate compliance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at radioactively contaminated sites while incorporating the improvements to the Superfund program that have been implemented through Administrative Reforms.

Two issues addressed in this Risk Q & A should be noted here. First, the answer to question 32 in the Risk Q & A is intended to further clarify that 15 millirem per year is not a presumptive cleanup level under CERCLA, but rather site decision-makers should continue to use the risk range when ARARs are not used to set cleanup levels. There has been some confusion among stakeholders regarding this point because of language in the 1997 guidance. EPA is issuing further guidance today to site decision makers on this topic. This Risk Q&A clarifies that, in general, dose assessments should only be conducted under CERCLA where necessary to demonstrate ARAR compliance. Further, dose recommendations (e.g., guidance such as DOE Orders and NRC Regulatory Guides) should generally not be used as to-be-considered material (TBCs). Although in other statutes EPA has used dose as a surrogate for risk, the selection of cleanup levels for carcinogens for a CERCLA remedy is based on the risk range when ARARs are not available or are not sufficiently protective. Thus, in general, site decision-makers should not use dose-based guidance rather than the CERCLA risk range in developing cleanup levels. This is because for several reasons, using dose-based guidance would result in unnecessary inconsistency regarding how radiological and non-radiological (chemical) contaminants are addressed at CERCLA sites. These reasons include: (1) estimates of risk from a given dose estimate may vary by an order of magnitude or more for a particular radionuclide, and; (2) dose based guidance generally begins an analysis for determining a site-specific cleanup level at a minimally acceptable risk level rather than the 10^{-6} point of departure set out in the NCP.

Second, it is important that data that support remedial decisions be of known and acceptable quality. There are a number of EPA guidances available that may aid the decision maker in gathering data of acceptable quality. One such guidance is the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). The determination of what data are needed is a site-specific decision and it is the responsibility of the site decision-maker (e.g., RPM, OSC) to use the tools that are most appropriate for that situation.

IMPLEMENTATION

For questions regarding radiation site policy and guidance for CERCLA cleanup actions, readers are referred to the RCRA/Superfund Hotline at 1-800-424-9346. The subject matter specialists for this fact sheet are Stuart Walker of OERR and Dr. Kung-Wei Yeh of ORIA.

Attachments

Addressees:

National Superfund Policy Managers
Superfund Branch Chiefs (Regions I-X)
Superfund Branch Chiefs, Office of Regional Counsel (Regions I-X)
Radiation Program Managers (Regions I, IV, V, VI, VII, X)
Radiation Branch Chief (Region II)
Residential Domain Section Chief (Region III)
Radiation and Indoor Air Program Branch Chief (Region VIII)
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United States Environmental Protection Agency | Office of Emergency and Remedial Response | Office of Radiation and Indoor Air | Directive 9200.4-31P EPA 540/R/99/006 December 1999

Radiation Risk Assessment At CERCLA Sites: Q & A

INTRODUCTION

Some sites on the U.S. Environmental Protection Agency's National Priorities List (NPL) are radioactively contaminated. To assist in the evaluation and cleanup of these sites and surrounding areas under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), EPA's Office of Emergency and Remedial Response (OERR) and the Office of Radiation and Indoor Air (ORIA) have developed guidance for conducting radiation risk assessments during the remedial investigation/feasibility study (RI/FS) process. This guidance is provided primarily in the multi-part document, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual* (*RAGS*). Guidance specific to radiation risk includes:

- Chapter 10, "Radiation Risk Assessment Guidance," of *RAGS* Part A (U.S. EPA, 1989a) which covers data collection and evaluation, exposure and dose assessment, toxicity assessment, and risk characterization for sites contaminated with radioactive substances;

- Chapter4, "Risk-based PRGs for Radioactive Contaminants," of *RAGS* Part B (U.S. EPA, 1991a) which presents standardized exposure parameters and equations that should generally be used for calculating preliminary remediation goals (PRGs) for radionuclides under residential and commercial/industrial land use exposure scenarios [the equations for residential land use will be updated shortly with a new soil screening guidance for radionuclides (U.S. EPA, 1998d)];

- Appendix D, "Radiation Remediation Technologies," of *RAGS* Part C (U.S. EPA, 1991b) which provides guidance on using risk information to evaluate and select remediation technologies for sites with radioactive substances; and

- *RAGS* Part D, *Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (U.S. EPA, 1998a), which provides guidance on standardized risk assessment planning, reporting, and review throughout the CERCLA process (Radionuclides Worksheet to be developed).

In addition to *RAGS*, EPA has published several other guidance documents and OSWER Directives concerning risk assessment methods for radioactive and nonradioactive contaminants. Attachment 1 presents a bibliography of selected Agency guidance documents on risk assessment. OSWER Directives specific to radioactive contaminants include:

- OSWER No. 9200.4-18, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination* (U.S. EPA 1997a), which provides guidance for establishing protective cleanup levels for radioactive contamination at CERCLA sites; and

- OSWER No. 9200.4-25, *Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites* (U.S. EPA 1998c), which provides guidance regarding the circumstances under which the subsurface soil cleanup criteria in 40 CFR Part 192 should be considered an applicable or relevant and appropriate requirement (ARAR) for radium or thorium in developing a response action under CERCLA.

Overall, the process for assessing radionuclide exposures and radiation risks presented in *RAGS* and in supplemental guidance documents parallels the process for assessing risks from chemical exposures. Both types of assessments follow the same four-step evaluation process (exposure assessment, toxicity assessment, risk characterization, ecological assessments) , consider similar exposure scenarios and pathways (except the external "direct exposure" pathway which is unique to radiation), determine exposure point concentrations, and provide estimates of cancer risks to humans.

However, several aspects of risk assessment for radioactive contaminants do differ substantially from those considered for chemical contaminants. Occasionally these differences—in measurement units, exposure terms and concepts, field and laboratory procedures and detection limits, and toxicity criteria, among others—have led to questions concerning the Agency's recommended approach for addressing radionuclide contamination and risk and the cleanup of CERCLA radiation sites.

PURPOSE

OERR and ORIA have prepared this document to provide answers to several commonly asked questions regarding risk assessments at radioactively contaminated CERCLA sites raised by Remedial Project Managers (RPMs), On-Scene Coordinators (OSCs), risk assessors, Federal, State and local agencies, potentially responsible parties (PRPs), and contractors. Its purpose is to provide an overview of current EPA guidance for risk assessment and related topics for radioactively contaminated CERCLA sites. Guidance issued by other organizations (e.g., NRC, DOE, ICRP, NCRP) may provide technical assistance, however the reader should exercise caution since some of these documents utilize a framework for risk management (e.g., allowable dose limits of 25, 100, or 500 mrem/yr) that EPA has determined is not suitable for use at CERCLA sites.

The questions and answers (Q & A) that follow are presented in sections corresponding to the four basic steps in the CERCLA risk assessment process:

1. Data Collection and Evaluation
2. Exposure Assessment
3. Toxicity Assessment
4. Risk Characterization

In addition, a bibliography of selected reference materials related to radiation risk assessment is provided in Attachment 1.

Readers are strongly encouraged to direct all questions concerning site-specific evaluations involving radioactive contaminants to the EPA Regional Radiation Program Office or Regional Superfund Office in the EPA Region in which their site is located. EPA has found that early involvement of the Regional Radiation Program and Superfund staff in all phases of site characterization and cleanup improves and expedites the entire process.

For general questions on, or assistance with, radiation surveys or radioanalytical procedures, readers are directed to EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, AL, or Radiation and Indoor Environments National Laboratory (RIENL) in Las Vegas, NV. For questions regarding radiation site policy and guidance, readers are also referred to the RCRA/Superfund Hotline at 1-800-424-9346. The subject matter specialists for this fact sheet are Dr. Kung-Wei Yeh of ORIA and Stuart Walker of OERR.

I. DATA COLLECTION AND EVALUATION

Q1. What strategy and key information should be considered during the initial planning stage for radiological data collection?

A. The Data Quality Objectives (DQO) process is an important tool for project managers and planners to determine the types, quantity, and quality of data needed to support decisions. Detailed guidance on the DQO Process can be found in *Guidance for the Data Quality Objectives Process* (U.S. EPA, 1994a) and *Data Quality Objectives for Superfund* (U.S. EPA, 1993a). Additional guidance on the application of this process at radiation sites can be found in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (U.S. EPA et al. 1997). The DQO process outlined in these documents should be completed during the initial planning stage for data collection.

At a minimum, site characterization should include the following key information and considerations:

✔ Review of the site history and records collected during the preliminary assessment and site inspection (PA/SI), considering:

- past site operations
- types and quantities of radioactive material used or produced
- radioactive waste stream characteristics
- disposal practices and records
- previous radiological characterization data and/or environmental monitoring data
- physical site characteristics (hydrology, geology, meteorology, etc.)
- demography
- current and potential future land use

✔ Formulation of a conceptual site model to:

- identify radionuclides of concern
- identify the time period for assessment
- identify potentially contaminated environmental media
- identify likely release mechanisms and exposure pathways
- identify potential human and ecological receptors
- focus initial surveys and sampling and analysis plans

✔ Development of comprehensive sampling plans based on the conceptual site model and available historical information to

- confirm the identities of radionuclide contaminants
- confirm release mechanisms and exposure pathways
- measure or model exposure point concentrations and point exposure rate (as appropriate for the type of radioactive decay)
- confirm human and ecological receptors
- specify cleanup levels or develop preliminary remediation goals
- establish DQOs

The MARSSIM (U.S. EPA et al. 1997) provides guidance on planning, implementing, and evaluating radiological site surveys. This multi-agency consensus document was developed collaboratively by the four Federal Agencies having authority and control over radioactive materials: the Department of Defense (DoD), Department of Energy (DOE), EPA, and the Nuclear Regulatory

Commission (NRC). While the primary focus of MARSSIM is on final status surveys to demonstrate compliance with dose- or risk-based criteria, guidance is also provided for designing and conducting scoping and characterizing surveys, based on the DQO process.

Q2. How should a list of radionuclides of concern be constructed?

A. An initial list of radionuclides of potential concern should be based on a review of previous site operations that contributed to the current levels of contamination and the conceptual site model. As a first consideration, all radionuclides used or produced at the site should be included on the list. If appropriate, the list should also include all radioactive decay products that may have formed since disposal or termination of operations. Radionuclides with short half-lives and no parent radionuclide to support ingrowth may be considered for exclusion from the list. However, before a short-lived radionuclide is excluded from the list, careful consideration should be given to its initial and current activity inventories, its radioactive half-life, and the time elapsed since the contamination occurred to the present.

Site characterization efforts should be directed to confirming or refuting the presence of the radionuclides of concern in on-site sources and in environmental media contaminated by releases migrating off-site. The activity concentrations of radionuclides (and decay products, if appropriate) in each medium should then be compared with site-specific background concentrations of those radionuclides (i.e., radionuclide concentrations in environmental media not related to site operations or releases), PRGs, screening levels, or potential remediation criteria (see Q3). Caution should be exercised in making such comparisons, since radionuclide concentrations in environmental media may change over time due to radioactive decay and ingrowth; therefore, consideration should be given to the radioactive half-life of the radionuclides of concern and any decay products, and the time period over which risks will be evaluated.

Q3. What criteria should be used to determine areas of radioactive contamination or radioactivity releases?

A. Section 7 of EPA's revised Hazard Ranking System (HRS) (see Appendix A to 40 CFR Part 300) provides general criteria for comparing concentrations of radionuclides in sources and various environmental media against background levels for use in screening sites for inclusion on the NPL. Table 1 presents a summary of the HRS criteria for establishing observed radiological contamination or observed releases of radioactive materials; key considerations include the measurement of radionuclide concentrations significantly above site-specific background levels. General guidance is provided in the following Agency documents:

- *Methods for Evaluating the Attainment of Cleanup Standards—Volume 1: Soil and Soil Media* (U.S. EPA, 1989b)
- *Statistical Methods for Evaluating the Attainment of Cleanup Standards—Volume 2: Ground Water* (U.S. EPA, 1992a)
- *Statistical Methods for Evaluating the Attainment of Cleanup Standards—Volume 3: Reference-Based Standards for Soils and Solid Media* (U.S. EPA, 1992b)

Although these documents do not specifically address radionuclides, most of the evaluation methods and tests provided in these documents should be applicable to both radioactive and nonradioactive contaminants. More specific guidance for the measurement and evaluation of radiological contaminants is provided in the MARSSIM (U.S. EPA et al. 1997); MARSSIM also provides guidance on the determination of site-specific background levels for comparison to site measurements. Additional guidance regarding soil screening levels (SSLs) for radionuclides is currently under development (U.S. EPA 1998d). The SSLs are not cleanup standards, but may be used to identify areas that may require further investigation at NPL sites. The SSL equations should also be used to establish PRGs for residential land use where ARARs are not available or sufficiently protective. For additional guidance on this issue, readers should contact the appropriate EPA Regional Radiation Program Office or Regional Superfund Office, as appropriate, or ORIA-HQ.

Table 1. EPA's Hazard Ranking System Criteria for Establishing Radionuclide Contamination/Releases*

Based on:	Criteria for Establishing Observed Contamination or Observed Releases of Radionuclides
Direct Observation	**Applies to All Radionuclides**
	(I) For each migration pathway, a material that contains one or more radionuclides has been seen entering the atmosphere, surface water, or ground water, as appropriate, or is known to have entered ground water or surface water through direct deposition, or (ii) For the surface water migration pathway, a source area containing radioactive substances has been flooded at a time that radioactive substances were present and one or more radioactive substances were in contact with the flood waters.
Analysis of Radionuclide Concentrations in Samples (ground water, soil, air, surface water, benthic, or sediment samples)	**Applies to Naturally Occurring Radionuclides and Man-made Radionuclides With Ubiquitous Background Concentrations in the Environment**
	(I) Measured concentrations (in units of activity, for example pCi per kilogram [pCi/kg], pCi per liter [pCi/L], pCi per cubic meter [pCi/m^3]) of a given radionuclide in the sample are at a level that: (a) Equals or exceeds a value 2 standard deviations above the mean site-specific background concentration for that radionuclide in that type of sample, or (b) Exceeds the upper-limit value of the range of regional background concentration values for that specific radionuclide in that type of sample. (ii) Some portion of the increase must be attributed to the site to establish the observed release (or observed contamination). (iii) For the soil exposure pathway only, the radionuclide must also be present at the surface or covered by 2 feet or less of cover material (for example, soil) to establish observed contamination. **
	Applies to Man-made Radionuclides Without Ubiquitous Background Concentrations in the Environment:
	(I) Measured concentrations (in units of activity) of a given radionuclide in the sample equals or exceeds the sample quantitation limit for that specific radionuclide in that type of media and is attributable to the site. (a) However, if the radionuclide concentration equals or exceeds its sample quantitation limit, but its release can also be attributed to one or more neighboring sites, then the measured concentration of that radionuclide must also equal or exceed a value either 2 standard deviations above the mean concentration of that radionuclide contributed by the neighboring sites or 3 times its background concentration, whichever is lower. (ii) If the sample quantitation limit cannot be established: (a) use the EPA contract-required quantitation limit (CRQL) in place of the sample quantitation limit in establishing an observed release (or observed contamination) if the sample analysis was performed under the EPA Contract Laboratory Program, or (b) use the detection limit in place of the sample quantitation limit if the sample analysis is not performed under the EPA Contract Laboratory Program. (iii) For the soil exposure pathway only, the radionuclide must also be present at the surface or covered by 2 feet or less of cover material (for example, soil) to establish observed contamination.**
Gamma Radiation Exposure Rate Measurements	**Applies to Gamma-Emitting Radionuclides**
	(I) The gamma radiation exposure rate in microroentgens per hour (μR/hr) using a survey instrument held 1 meter away from the ground surface (or 1 meter away from an aboveground source), equals or exceeds 2 times the site-specific background gamma radiation exposure rate. (ii) Some portion of the increase must be attributable to the site to establish observed contamination. (iii) The gamma-emitting radionuclides do not have to be within 2 feet of the surface of the source.

* Source: *Hazard Ranking System; Final Rule*, Environmental Protection Agency, 55 FR 51532, December 14, 1990.

** Note: This criterion should not be interpreted to mean that radionuclides present in soils at depths greater than 2 feet below the surface would not warrant investigation and potential response action, but only that such materials may not be readily detected by surface measurements.

Q4. How should the areal extent and depth of radioactivity contamination be determined?

A. As noted in Q1, a conceptual site model should be developed to identify reasonable boundaries for investigating the nature and extent of contamination. General guidance for site characterization activities is provided in *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (U.S. EPA 1988a).

The choice of a specific method or methods to characterize sites contaminated with radioactive substances depends on several factors, including the decay characteristics of the radionuclides potentially present at the site, suspected contamination patterns, and activity concentrations. For gamma-emitting radionuclides in near-surface sources, walk-over radiation surveys are typically conducted to characterize the areal extent of contamination. For subsurface contamination, borehole logging for gamma emitters, core sampling programs for radionuclides that emit only alpha or beta particles, or a combination of both types of methods, may be advisable. In addition to measurements to determine volumetric contamination in environmental media, measurements of surface contamination on building and equipment surfaces may also be required. Additional discussion of measurement techniques and their limitations is provided in MARSSIM (U.S. EPA et al. 1997) For site-specific assessments, readers should consult the appropriate EPA Regional Radiation Program Office or Regional Superfund Office.

Q5. What field radiation survey instruments should be used and what are their lower limits of detection?

A. Selection of appropriate radiation detection instruments for site characterization depends on the decay characteristics of the radionuclides potentially present at the site, suspected contamination patterns, and activity concentrations, among other factors. Numerous documents have been written on this topic. For a general discussion on radiation survey instruments, readers are directed to MARSSIM (U.S. EPA 402-R-96-018) and Chapter 10 of RAGs Part A (U.S. EPA, 1989a). For supplemental information regarding the usability of analytical data for performing a baseline risk assessment at sites contaminated with radioactivity, readers should refer to "Guidance for Data Usability in Risk Assessment, Part B" (U.S. EPA, 1992d). For site-specific applications of field radiation survey instruments, readers should contact their appropriate Regional Radiation Program Office or Regional Superfund Office.

Q6. What sample measurement units for radiation risk assessment are typically used?

A. Concentrations of radionuclides in environmental media are typically expressed in terms of "activity" of the radionuclide per unit mass (for soil, sediment, and foodstuffs) or volume (for water and air) of the environmental medium. Two different systems of units for radioactivity are currently in common usage: the International System (SI) units and the "conventional" or "traditional" units which were used before the advent of the SI system. The principal unit of radioactivity in the SI system is the becquerel (1 Bq = 1 disintegration/second), while the basic conventional unit of activity is the Curie (1 Ci = 3.7×10^{10} Bq). Since most radiation standards in the U.S. are expressed in conventional units, this system is used for the purpose of this document. Concentrations of radionuclides in environmental media at contaminated sites are typically far below Curie quantities, and are commonly expressed in units of picocuries (1 pCi = 10^{-12} Ci = 3.7×10^{-2} Bq). Typical conventional units for reporting environmental measurements are pCi/g for soil (dry-weight), pCi/L for groundwater or surface water, and pCi/m^3 for air.

A special unit, the working level (WL), is used as a measure of the concentration of short-lived radon decay products in air. WL is any combination of short-lived radon decay products in one liter of air that will result in the ultimate emission of 1.3×10^5 million electron volts (MeV) of alpha energy. The Working Level Month (WLM) is the exposure to 1 WL for 170 hours (1 working month).

In addition to radionuclide concentrations in environmental media, the radiation "exposure" rate is often reported. Radiation exposure, in this context, refers to the transfer of energy from a gamma radiation field to a unit mass of air. The unit for radiation exposure is the roentgen (1 R = 2.58×10^{-4} coulombs of charge per kg of air). Exposure rates at contaminated sites are typically expressed in units of microroentgens/hour (μR/hr).

Radionuclide concentrations on building or equipment surfaces are specified in units of the activity concentrations of the radionuclide of concern in a specified surface area, typically dpm (disintegration per minute) per 100 cm^2 or pCi per 100 cm^2.

Q7. What sample measurement units for remedial action evaluation may be used?

For remedial action evaluations it is often useful to express radionuclide concentrations in terms of mass (mass concentration). The carcinogenic effects of a radionuclide are due to its disintegration rate that occurs during its decay process, **concentrations of radionuclides are generally measured in terms of activity for health evaluation purposes.** Mass units, however, provide insight and information into treatment selection, treatment compatibility, and treatment efficiency, particularly for remedial actions involving mixed waste. The practice of using activity concentration should continue for response actions at CERCLA sites. Mass concentration estimates contained in proposed and final site decision documents [e.g., proposed plans, Record of Decisions (RODs))] may

include, in addition to activity measurements, estimates of concentrations in terms of mass consistent with those used for non-radiological contaminants. Typically units for expressing mass in environmental media for soil and water are mg/kg for soil and mg/l for water. These mass units also can be expressed as parts per million (ppm) for soil and water, which is equivalent to mg/kg and mg/l. To estimate the radionuclide concentrations in ppm, the following equations are given below:

$$mg/kg_{soil} = (2.8 \times 10^{-12}) \times A \times T_{1/2} \times pCi/g$$

$$mg/l_{water} = (2.8 \times 10^{-15}) \times A \times T_{1/2} \times pCi/l$$

$$ppm_{soil} = (2.8 \times 10^{-12}) \times A \times T_{1/2} \times pCi/g$$

$$ppm_{water} = (2.8 \times 10^{-15}) \times A \times T_{1/2} \times pCi/l$$

where A is the radionuclide atomic weight and $T_{1/2}$ is the radionuclide half-life in years. Most radionuclides have half-lives ranging from a few years to 10,000 years, which means that for most radionuclides, an activity of 1 pCi/g would mean the concentration value of the radionuclide would be well under 1×10^{-6} ppm.

Q8. Are radionuclides included in EPA's Contract Laboratory Program (CLP)? If not, where should comparable radioanalytical services be obtained?

A. Radionuclides are not standard analytes in EPA's CLP program. However, EPA has published guidance for radionuclide methods in Chapter 10 of *RAGS* Part A (U.S. EPA, 1989a). In addition, EPA's *Radiochemistry Procedures Manual* (U.S. EPA, 1984) provides information for radionuclide-specific analytical techniques. For additional guidance on selection of radiological laboratories and analytical methods, readers should contact the appropriate Regional Radiation Program Office or Regional Superfund Office, NAREL, or RIENL.

Q9. How can I decide if the data collected are complete and of good quality?

A. EPA's *Guidance for Data Quality Assessment* (U.S. EPA, 1995), *Guidance for Data Useability in Risk Assessment, Part A* (U.S. EPA, 1992c) and *Part B* (U.S. EPA, 1992d), provide procedures and statistical tests that may be used to determine whether or not collected data are of the correct type, quality, and quantity to support their intended use. In addition, the MARSSIM (U.S. EPA et al. 1997) addresses quality assurance and quality control requirements for radiological data.

II. EXPOSURE ASSESSMENT

Q10. How does the exposure assessment for radionuclides differ from that for chemicals?

A. Exposure assessment for radionuclides is very similar to that for chemicals. Both nonradioactive chemical assessments and radionuclide assessments follow the same basic steps—i.e., characterizing the exposure setting, identifying exposure pathways and potential receptors, estimating exposure point concentrations, and estimating exposures/intakes. In addition to the exposure pathways considered for chemicals (e.g., ingestion of contaminated water, soil, or foodstuffs, and inhalation of contaminated air), external exposure to penetrating radiation (i.e., gamma radiation and x-rays) may be an important exposure pathway for certain radionuclides in near-surface soils. On the other hand, with the primary exception of tritium (H-3) as tritiated water or water vapor, dermal absorption is typically not a significant exposure pathway for radionuclides and generally need not be considered. (Other possible exceptions could include organic compounds containing radionuclides.) Figure 1 depicts typical exposure pathways for radionuclides; additional pathways that may be considered on a site-specific basis, where appropriate, are discussed in Q11. Additional discussion of radiation exposure pathways is provided in the Radiation Exposure and Risk Assessment Manual (RERAM), June 1996 (EPA 402-R-96-016).

Q11. Can exposure pathways be added or deleted based on site-specific conditions?

A. Yes. Inclusion or deletion of exposure pathways should be based upon site-specific conditions, including local hydrology, geology, potential receptors, and current and potential future land use, among other factors. Accordingly, some exposure pathways may not be appropriate for a given site and may be deleted, if justification is provided. In other cases, exposure pathways that are typically not significant may be important for the site-specific conditions (e.g., ingestion of contaminated fish for recreational scenarios, ingestion of contaminated meat or milk from livestock for agricultural scenarios) and should be included in the assessment.

Q12. How should radioactive decay products be addressed?

A. All radionuclides, by definition, undergo radioactive decay. In this process, one unstable nucleus of an element transforms (decays) spontaneously to a nucleus of another element. As the unstable nucleus decays, energy is released as particulate or photon radiation, or both, and the radionuclide is transformed in atomic number and/or atomic mass. The resulting decay products, or progeny, may also be radioactive and undergo further decay. Various decay products may have different physical and chemical characteristics that affect their fate and transport in the environment as well as their radiotoxicity. In cases where decay products have greater radiotoxicity than the original radionuclide, the potential radiation dose and health risk may increase over time; in such cases, the exposure assessment should consider the change in concentrations of

all decay products over time, to determine the time of maximum potential impact.

Consideration of all potential radioactive decay products is a key element of the exposure assessment for radionuclides. Many of the computerized mathematical models available for simulating the behavior of radionuclides in the environment (see Q15) incorporate the ingrowth and decay of radioactive decay products as a function of time; these models are very useful in pinpointing the time of maximum dose or risk. Similarly, slope factors (see Q20) and dose conversion factors (see Q21) for some radionuclides may include consideration of radioactive decay products, where appropriate, to facilitate these considerations in estimating potential radiation dose and risk. However, such values typically assume that all decay products are present at the same concentration as the primary radionuclide (i.e., secular equilibrium), which may not be appropriate for all situations. Readers should consult their Regional Radiation Program Office or Regional Superfund Office for additional information regarding such limitations. See also section "Modeling Assessment of Future Exposures" in OSWER Directive 9200.4-18 (U.S. EPA 1997a) for information modeling decay products.

Q13. To what extent should generic and site-specific factors and parameter values be used in exposure assessments?

A. For both radionuclide and chemical assessments, EPA recommends the use of empirically-derived, site-specific factors and parameter values, where such values can be justified and documented. For generic assessments, EPA recommends the use of the default parameter values provided in OSWER Directive 9285.6-03 *Standard Default Exposure Factors* (U.S. EPA, 1991c) and the *Exposure Factors Handbook* (U.S. EPA, 1990, 1997b).

Q14. How should exposure point concentrations be determined?

A. As for chemical contaminants, exposure point concentrations of radionuclides in environmental media and radiation exposure rates (e.g., alpha, beta, gamma) should be either measured, modeled, or both. To the extent possible, measurement data should be used to evaluate current exposures. When measurements at the exposure locations cannot be made, or when predicting potential concentrations and exposures at future times, modeling is required (see Q15).

Q15. What calculation methods or multimedia radionuclide transport and exposure models are recommended by EPA for Superfund risk assessments?

A. Currently, only the equations in *RAGS* Part B (U.S. EPA, 1991a) - which are used to develop risk-based preliminary remediation goals for hazardous chemicals and radionuclides - are recommended by EPA for Superfund radiation risk assessments. (Note: The *Soil Screening Guidance for Radionuclides* (U.S. EPA 1998d) is expected to supersede the RAGS Part B algorithms when finalized.) Numerous computerized mathematical models have been developed by EPA and other organizations to predict the fate and transport of radionuclides in the environment; these include single-media models (e.g., ground water transport) as well as multi-media models. These models have been designed for a variety of goals, objectives and applications, but no single model may be appropriate for all site-specific conditions. While the Agency has approved individual models for specific applications (e.g., CAP88 or COMPLY for atmospheric transport calculations to demonstrate compliance with 40 CFR Part 61 requirements), no model has yet been formally endorsed for evaluating potential impacts from radionuclides in soil. For further information on selection of models appropriate to meet a specific-site characteristics and requirements, readers can refer to *Ground-Water Modeling Compendium* (U.S. EPA 1994c), and *A Technical Guide to Ground-Water Model Selection at Sites Contaminated with Radioactive Substances* (U.S. EPA 1994d). While these documents specifically address groundwater models, the model selection criteria and logic may be useful for other types of models as well.

Attachment 1 provides a bibliography of reference documents for numerous models currently available. Readers are strongly encouraged to consult with the appropriate EPA Regional Radiation Program Office or Regional Superfund Office in which the site is located for guidance on selection and use of radionuclide fate and transport models for site-specific applications.

Q16. How should Radon-222 (radon) and Radon-220 (thoron) exposures and risks be evaluated?

A. Radon-222 (Rn-222) and Radon-220 (Rn-220) are radioactive gases that are isotopes of the element radon (Rn). Each is produced by the radioactive decay of an isotope of radium (Ra). For Rn-222 (also called radon), the parent radium isotope is Ra-226 and for Rn-220 (also called thoron), the parent radium isotope is Ra-224. (Although thoron is produced from the radioactive decay of Ra-224, it is often referred to as a decay product of Ra-228, which is a longer-lived precursor typically measured in environmental samples.) Each radon isotope gives rise to a series or chain of short-lived radioactive decay products that emit alpha particles which can damage lung tissues if inhaled. Of the two decay chains, the radon series is longer lived and more hazardous than the thoron series. Consequently, most (but not all) radon exposure and risk assessments deal with radon (Rn-222) arising from radium (Ra-226) contamination.

Structures built on radium-contaminated soil or constructed with radium-bearing materials can accumulate elevated concentrations of radon in indoor air. Some radiation protection standards which may be potential ARARs at a site, explicitly exclude dose or risk from radon and its decay products from consideration. Other potential ARARs and to-be-considered (TBC) information directly address radon and its decay products (e.g., allowable concentrations of radon decay products in indoor air under 40 CFR 192(b)(1) of a standard of 0.003 working level (WL) and a goal of 0.002 WL, as well as the U.S. EPA Guideline of 4 pCi radon-222 per liter of indoor air).

Several EPA-approved methods are available for measuring radon and progeny concentrations in indoor air (EPA et al, 1997). Computer codes have been developed to predict radon concentrations in indoor air and potential human exposure, based on simplified equations and assumptions; these models may yield results that are meaningful on average (e.g., for a geographical region) but highly imprecise for an individual house or structure. Despite their widespread use, these codes should be used with caution and their estimates interpreted carefully.

Readers are encouraged to consult with the EPA Regional Radiation Program Office or Regional Superfund Office for specific guidance and recommendations concerning measurement of radon concentrations in indoor air, evaluation of potential exposures, and applicable mitigation measures. Also, some states have their own radon testing and mitigation requirement or recommendations. Readers should also determine if any of the standards for radon are potential ARARs at their site (see Q 34).

Q17. How long a time period should be considered for possible future exposures?

A. Section "Modeling Assessment of Future Exposures" in OSWER Directive 9200.4-18 (U.S. EPA 1997a) provides guidance for estimating future threats. Also, in some cases, Federal or State ARARs may include specific time-frame requirements for a given purpose, such as disposal of radioactive materials in an approved waste repository.

Q18. How should the results of the exposure assessment for radionuclides be presented?

A. Results of the exposure assessment for radionuclides should be presented in two stages: (1) intake and external exposure estimates for use in risk characterization; and (2) estimates of radiation dose (see Q22 for discussion of specific dosimetric quantities that may be appropriate) for comparison with dose-based standards. Note that intake estimates for radionuclides should not be divided by body weight or averaging time as is done for chemical contaminants. Intake estimates for inhalation or ingestion pathways should include the total activity of each

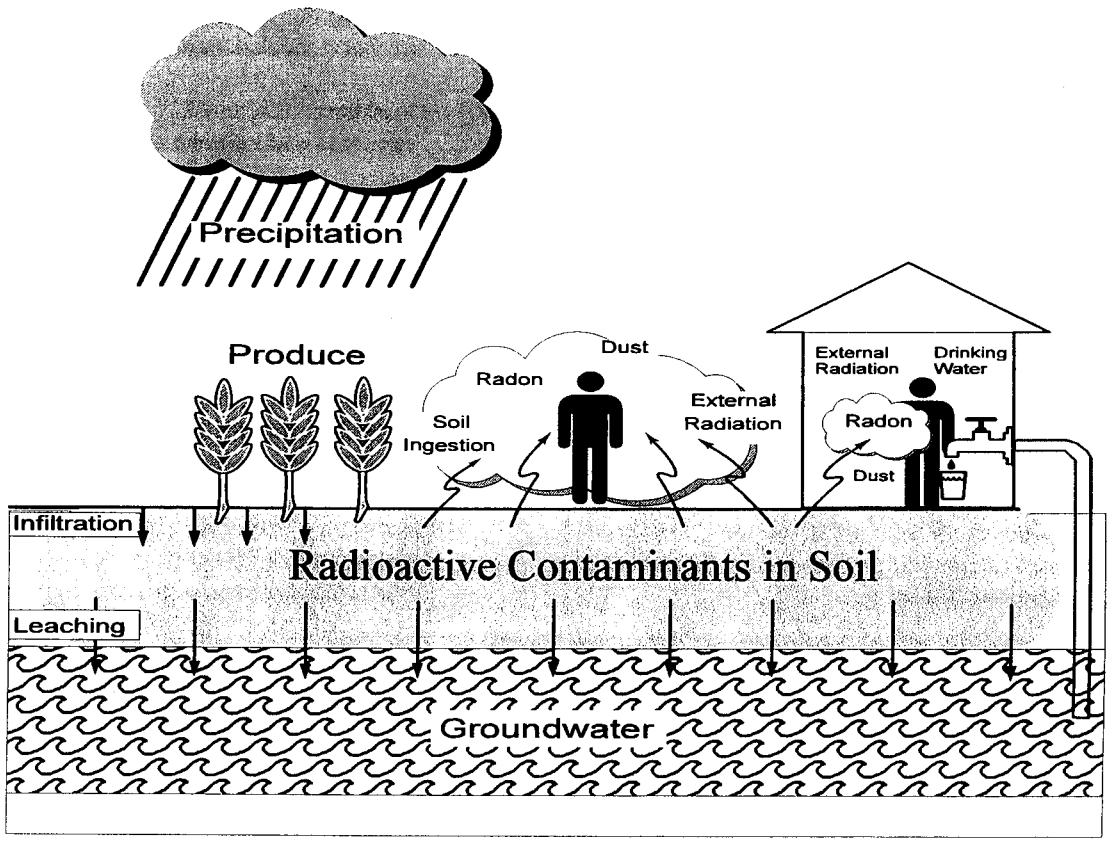

Figure 1. Typical Radionuclide Exposure Pathways

radionuclide inhaled or ingested via each pertinent route of exposure (e.g., ingestion of contaminated drinking water, direct ingestion of contaminated soil, ingestion of contaminated produce/milk/meat). Measured or predicted external exposure rates should be presented, along with the exposure time, frequency, and duration. In the absence of measured exposure rates, the concentration of each radionuclide in soil is needed to estimate the risk from the external pathway using slope factors. When present, estimates of radiation surface contamination also should be presented by radiation type (alpha, beta, gamma).

III. TOXICITY ASSESSMENT

Q19. What is the mechanism of radiation damage?

A. Radiation emitted by radioactive substances can transfer sufficient localized energy to atoms to remove electrons from the electric field of their nucleus (ionization). In living tissue, this energy transfer can produce chemically reactive ions or free radicals, destroy cellular constituents, and damage DNA. Irreparable DNA damage is thought to be a major factor in carcinogenesis. [While ionizing radiation may also cause other detrimental health impacts, only radiogenic cancer risk is normally considered in CERCLA risk assessments (see Q24).]

The type of ionizing radiation emitted by a particular radionuclide depends upon the exact nature of the nuclear transformation, and may include emission of alpha particles, beta particles (electrons or positrons), and neutrons; each of these transformations may be accompanied by emission of photons (gamma radiation or x-rays). Each type of radiation differs in its physical characteristics and in its ability to inflict damage to biological tissue. For purposes of radiation risk estimates, the various types of radiation are often categorized as low linear energy transfer (LET) radiation (photons and electrons) and high-LET radiations (alpha particles and neutrons).

Ionizing radiation can cause deleterious effects on biological tissues only when the energy released during radioactive decay is absorbed in tissue. The average energy imparted by ionizing radiation per unit mass of tissue is called the "absorbed dose". The SI unit of absorbed dose is the joule per kilogram, also assigned the special name the Gray (1 Gy = 1 joule/kg); the conventional unit of absorbed dose is the rad (1 rad = 100 ergs/g = 0.01 Gy).

Q20. What are radionuclide slope factors?

A. EPA has developed slope factors for estimating incremental cancer risks resulting from exposure to radionuclides via inhalation, ingestion, and external exposure pathways. Slope factors for radionuclides represent the probability of cancer incidence as a result of a unit exposure to a given radionuclide averaged over a lifetime. It is the age-averaged lifetime excess cancer incident rate per unit intake (or unit exposure for external exposure pathway) of a radionuclide (U.S. EPA 1989a).

Current radionuclide slope factors incorporate the age- and gender-specific radiogenic cancer risk models from *Estimating Radiogenic Cancer Risks* (U.S. EPA, 1994b). Age-specific estimates of absorbed dose rate are used, where available, for internal exposure pathways, whereas dose estimates for external exposure are taken directly from *Federal Guidance Report No. 12* (U.S. EPA 1993b). Population mortality statistics and baseline cancer rates reflect the U.S. population of 1989-1991 (1979-1981 for slope factors derived prior to 1998). Detailed information on the derivation and application of risk coefficients and radionuclide slope factors is presented in *Radiation Exposure and Risk Assessment Manual (RERAM)* (U.S. EPA, 1996, 1998h). Agency-recommended slope factors for radionuclides (as well as nonradioactive carcinogens) are published in EPA's *Health Effects Assessment Summary Tables* (HEAST) (U.S. EPA, 1998e). EPA plans to revise the HEAST tables based on information in *Federal Guidance Report No. 13: Health Risks from Low-Level Environmental Exposure to Radionuclides* (U.S. EPA 1998g).

Q21. What are radionuclide dose conversion factors?

A. Dose conversion factors (DCFs), or "dose coefficients", for a given radionuclide represent the dose equivalent per unit intake (i.e., ingestion or inhalation) or external exposure of that radionuclide. These DCFs are used to convert a radionuclide concentration in soil, air, water, or foodstuffs to a radiation dose. DCFs may be specified for specific body organs or tissues of interest, or as a weighted sum of individual organ dose, termed the effective dose equivalent (these quantities are discussed further in Q21). These DCFs may be multiplied by the total activity of each radionuclide inhaled or ingested per year, or the external exposure concentration to which a receptor may be exposed, to estimate the dose equivalent to the receptor.

EPA-approved DCFs for inhalation and ingestion exposure are published in *Federal Guidance Report No. 11* (U.S. EPA, 1988b). EPA-approved DCFs for external exposure are published in *Federal Guidance Report No. 12* (U.S. EPA, 1993b). Both compilations provide DCF values for a reference adult only, but it is anticipated that future revisions will include values for other age groups.

Q22. What is dose equivalent, effective dose equivalent, and related quantities?

As discussed in Q18, different types of radiation have differing effectiveness in transferring their energy to living tissue. Since it is often desirable to compare doses from different types of radiation, the quantity "dose equivalent"

has been defined as a measure of the energy absorbed by living tissues, adjusted for the relative biological effectiveness of the type of radiation present. The SI unit for dose equivalent is the sievert (Sv) and the conventional unit is the rem (1 rem = 0.01 Sv). For computation of dose equivalent, the absorbed dose is multiplied by Quality Factor (Q) or radiation weighting factor (w_R); these values range from 1 for photons and electrons to 10 for neutrons to 20 for alpha particles (i.e., for an equal amount of energy absorbed, an alpha particle will inflict approximately 20 times more damage to biological tissue than that inflicted by a beta particle or gamma ray). Internally deposited (i.e., inhaled or ingested) radionuclides may be deposited in various organs and tissues long after initial deposition. The "committed dose equivalent" is defined as the integrated dose equivalent that will be received by an individual during a 50-year period (based on occupational exposure) following the intake. By contrast, external radiation exposure contribute to dose only as long as the receptor is present within the external radiation field.

When exposed to equal doses of radiation, different organs and tissues in the human body will exhibit different cancer induction rates. The quantity "effective dose equivalent" was developed by the International Commission on Radiological Protection (ICRP) to account for these differences and to normalize radiation doses and effects on a whole body basis for regulation of occupational exposure. The effective dose equivalent is computed as a weighted sum of organ-specific dose equivalent values, with weighting factors specified by the ICRP (ICRP 1977, 1979). The effective dose equivalent is equal to that dose equivalent, delivered at a uniform whole-body rate, that corresponds to the same number (but possibly dissimilar distribution) of fatal stochastic health effects as the particular combination of organ dose equivalents.

Q23. What is the critical organ approach to dose limitation?

A. Critical organ standards developed by EPA and NRC usually consist of a combination of whole body and critical organ dose limits, such as 25 mrem/yr to the whole body, 75 mrem/yr to the thyroid, and 25 mrem/yr to any critical organ other than the thyroid. When these standards were adopted, dose was calculated and controlled for each organ in the body and uniform radiation of the "whole body." The "critical organ" was the organ that received the most dose for the radionuclide concerned. With the adoption of the dose equivalent concept, the dose to each organ is weighted according to the effect of the radiation on the overall system (person). The new system allows for one value of dose equivalent to be assigned as a limit, which is protective of the entire system. The critical organ approach required individual limits for each organ based on the effect of radiation on that organ.

It should be noted that although most critical organ standards include 25 mrem/yr or higher (75 mrem/yr) dose limits, these critical organ standards are not comparable to 25 mrem/yr effective dose equivalent standards or guidance. EPA's determination that the 25 mrem/yr dose level found in NRC's decommissioning standard and various guidance should not be used to establish cleanup levels at CERCLA sites does not apply to critical organ standards.

Q24. How should radionuclide slope factors and dose conversion factors be used?

A. **EPA recommends that radionuclide slope factors be used to estimate the excess cancer risk resulting from exposure to radionuclides at radiologically contaminated sites for comparison with EPA's target risk range (i.e., 10^{-4} to 10^{-6} lifetime excess cancer risk).** The incremental risk is calculated by multiplying estimates of the lifetime intake via inhalation and ingestion of each radionuclide of concern, and the duration and concentration in environmental media to which the receptor is exposed via the external exposure pathway, by the appropriate slope factor values for that exposure pathway and radionuclide. Additional information on the use of radionuclide slope factors and their underlying assumptions, which introduce significant uncertainties, is provided in the Radiation Exposure and Risk Assessment Manual (RERAM) (U.S. EPA 1996a, 1999b).

Estimates of cancer risk from radionuclide exposures may also be computed by multiplying the effective dose equivalent computed using the DCFs by a risk-per-dose factor. EPA recommends that this method **not** be used at CERCLA sites to estimate risks for PRGs or cleanup levels, and estimates computed using this method may tend to inaccurately estimate potential risks, with the magnitude of discrepancy dependent on the dominant radionuclides and exposure pathways for the site-specific conditions. These differences can be attributed to factors such as the consideration of competing mortality risks and age-dependent radiation risk models in the development of the slope factors, different distributions of relative weights assigned to individual organ risks in the two methods, and differences in dosimetric and toxicological assumptions. Some key differences in the two methods are summarized in Table 2.

Due to these factors, no simple and direct conversion between radiation dose and radiogenic cancer risk is available. Given the differing dosimetric and radio-toxicological characteristics of different radionuclides, as reflected in the DCFs and slope factors, respectively, a given dose from one radionuclide via a given exposure pathway may present a much greater cancer risk than the same dose from another radionuclide and/or exposure pathway. Therefore, any conversion between dose and risk now must be performed on a radionuclide- and pathway-specific basis.

The primary use of DCFs should generally be to compute doses resulting from site-related exposures for comparison with radiation protection standards and dose limits (see Q31-32) that are determined to be ARARs or TBCs. This is accomplished by multiplying the exposure estimates produced through the exposure assessment (i.e., the intake of each radionuclide of concern via inhalation and ingestion, and the duration of exposure and concentration of each radionuclide of concern in environmental media for external exposure) by the appropriate DCF values for that exposure pathway and radionuclide. Unlike excess cancer risk, which represents cumulative lifetime exposure, dose estimates are typically expressed in terms of annual exposure (e.g., the effective dose equivalent resulting from exposure during a one-year period, mrem/year).

Unless otherwise stated in the standard, DCFs from *Federal Guidance Report No. 11* (U.S. EPA, 1988b) and *Federal Guidance Report No. 12* (U.S. EPA, 1993b) should be used for complying with ARARs based on effective dose equivalent, while DCFs from ICRP 2 should be used when complying with ARARs based on the critical organ approach.

Q25. In addition to cancer, should the potential teratogenic and genetic effects of radiation exposures be considered?

A. Biological effects associated with exposure to ionizing radiation in the environment may include carcinogenicity (i.e., induction of cancer), mutagenicity (i.e., induction of mutations in somatic or reproductive cells, including genetic effects), and teratogenicity (i.e., effects on the growth and development of an embryo or fetus). Agency guidance (U.S. EPA, 1989a, 1994b) indicates that the radiogenic cancer risk is normally assumed to be limiting for risk assessments at Superfund sites, and evaluation of teratogenic and genetic effects is not required. Similarly, consideration of acute effects normally is not required, since these effects occur only at doses much higher than normally associated with environmental exposures.

Q26. Should chemical toxicity of radionuclides be considered?

A. At Superfund radiation sites, EPA generally evaluates potential human health risks based on the radiotoxicity (i.e., the adverse health effects caused by ionizing radiation), rather than on the chemical toxicity, of each radionuclide present. Uranium, in soluble form, is a kidney toxin at mass concentrations slightly above background levels, and is the only radionuclide for which the chemical toxicity has been identified to be comparable to or greater than the radiotoxicity, and for which a reference dose (RfD) has been established to evaluate chemical toxicity. For radioisotopes of uranium, both effects (radiogenic cancer risk and chemical toxicity) should be considered.

IV. RISK CHARACTERIZATION

Q27. How should radionuclide risks be estimated?

A. Risks from radionuclide exposures should be estimated in a manner analogous to that used for chemical contaminants. That is the estimates of intakes by inhalation and ingestion and the external exposure over the period of exposure estimated for the land use (e.g., 30 years residential, 25 years commercial/industrial) from the exposure assessment should be coupled with the appropriate slope factors for each radionuclide and exposure pathway. Only excess cancer risk should be considered for most radionuclides (except for uranium as discussed in Q25). The total incremental lifetime cancer risk attributed to radiation exposure is estimated as the sum of the risks from all radionuclides in all exposure pathways.

Q28. Should radionuclide and chemical risks be combined?

A. **Yes. Excess cancer risk from both radionuclides and chemical carcinogens should be summed to provide an estimate of the combined risk presented by all carcinogenic contaminants as specified in OSWER directive 9200.4-18 (U.S. EPA 1997a).** An exception would be cases in which a person reasonably can not be exposed to both chemical and radiological carcinogens. Similarly, the chemical toxicity from uranium should be combined with that of other site-related contaminants. As recommended in RAGS Part A (U.S. EPA 1989a), risk estimates for radionuclides and chemical contaminants also should be tabulated and presented separately in the risk characterization report.

There are generally several differences between slope factors for radionuclides and chemicals. However, similar differences also occur between different chemical slope factors. In the absence of additional information, it is reasonable to assume that excess cancer risks are additive for purposes of evaluating the total incremental cancer risk associated with a contaminated site.

Q29 How should risk characterization results for radionuclides be presented?

A. Results should be presented according to the standardized reporting format presented in *RAGS* Part D (U.S. EPA, 1998a). However, specific guidance for radionuclides (i.e., the Radionuclides Worksheet) is not yet available.

EPA guidance for risk characterization (U.S. EPA, 1992e) indicates that four descriptors of risk are generally needed for a full characterization of risk: (1) central tendency (e.g., median, mean) estimate of individual risk; (2) high-end estimate (e.g., 95th percentile) of individual risk; (3) risk to important subgroups (e.g., children) of the population, such as highly exposed or highly susceptible groups or individuals, if known; and (4) population risk. The reasonable maximum exposure (RME) estimate of individ-

ual risk typically presented in Superfund risk assessments represents a measure of the high-end individual exposure and risk. While the RME estimate remains the primary scenario for risk management decisions, additional risk descriptors may be included to describe site risks more fully.

Q30. Should the collective risk to populations be estimated along with that to individual receptors?

A. Risk to potential individual receptors is the primary measure of protectiveness under the CERCLA process (i.e., the target range of 10^{-6} to 10^{-4} lifetime excess cancer risk to the RME receptor). As noted in Q28, however, Agency guidance (U.S. EPA, 1992e) also indicates that the collective risk to the potentially exposed population and to important subgroups of the population also should be evaluated where possible. Consideration of population risk provides additional input to risk management decisions; such considerations may be either qualitative or quantitative depending on the availability of data and the magnitude of projected population risk.

Q31. How should uncertainty in estimates of radiation risk be addressed in the risk characterization report?

A. Consideration of uncertainty in estimates of risks from potential exposure to radioactive materials at CERCLA sites is essential for informed risk management decisions. *RAGS* and subsequent guidance (U.S. EPA, 1992e, 1995b) stress the importance of a thorough presentation of the uncertainties, limitations, and assumptions that underlay estimates of risk. Either qualitative or quantitative evaluation may be appropriate, depending on the availability of data and the magnitude of predicted risk. In either case, the evaluation should address both uncertainty (i.e., "the lack of knowledge about specific factors, parameters, or models") and variability (i.e., "observed differences attributable to true heterogeneity or diversity in a population or exposure parameter"). Estimates of potential risk should include both central tendency estimates (median, mean) and high-end estimates (e.g., RME or 95th percentile).

Table 2. Comparison of Radiation Risk Estimation Methodologies: Slope Factors vs Effective Dose Equivalent

Parameter	Slope Factor Approach	Effective Dose Equivalent x Risk Factor Approach
Competing Risks	• Persons dying from competing causes of death (e.g., disease, accidents) are not considered susceptible to radiogenic cancer. • Probability of dying at a particular age from competing risks is considered based on the mortality rate from all causes at that age in the 1989-1991 (previously 1979-1981) U.S. population.	• Competing risks not considered.
Risk Models	• Age-dependent and gender-dependent risk models for 14 cancer sites are considered individually and integrated into the slope factor estimate.	• Risk estimate averaged over all ages, sexes, and cancer sites.
Genetic Risk	• Genetic risk is not considered in the slope factor estimates; however, ovary is considered as a potential cancer site.	• Effective dose equivalent (EDE) value includes genetic risk component.
Dose Estimates	• Low-LET and high-LET dose estimates considered separately for each target organ.	• Dose-equivalent includes both low-LET and high-LET radiation, multiplied by appropriate Quality Factors.
RBE for high-LET (alpha) radiation	• 20 for most sites (8 prior to 1994) • 10 for breast (8 prior to 1994) • 1 for leukemia (1.117 prior to 1994)	• 20 (all sites)
Organs Considered	• Estimates of absorbed dose to 16 target organs/tissues considered for 13 specific cancer sites plus residual cancers.	• EDE (ICRP, 1979) considers dose estimates to 6 specific target organs plus remainder (weighted average of 5 other organs).
Lung Dose Definition	• Absorbed dose used to estimate lung cancer risk computed as weighted sum of dose to tracheobronchial region (80%) and pulmonary lung (20%).	• Average dose to total lung (mass weighted sum of doses to the tracheobronchial region, pulmonary region, and plumonary lymph nodes).
Integration Period	• Variable length (depending on organ-specific risk models and consideration of competing risks) not to exceed 110 years.	• Fixed integration period of 50 years typically considered.
Dosimetric / Metabolic Models	• Metabolic models and parameters for dose estimates follow recent recommendations of the ICRP series of documents on age-specific dosimetry (ICRP, 1989, 1993, 1995a, 1995b), where available; previous estimates based primarily on ICRP 30 (ICRP, 1979).	• Typically employ ICRP Publication 30 (ICRP, 1979) models and parameter for radionuclide uptake, distribution, and retention.

For both chemical carcinogens and radionuclides, extrapolation from high dose and dose rate exposure is generally required to estimate risks of low-level exposures. This extrapolation typically constitutes the greatest source of uncertainty. For chemical carcinogens, additional uncertainty may be introduced due to extrapolation of animal data to humans. Slope factors for both radionuclides and chemicals are used to estimate incremental cancer risk, which typically represents a small increment over a relatively high baseline incidence. Other sources of uncertainty may include that associated with instrumentation and measurements used to characterize the nature and extent of radionuclides of concern, and the parameters used to characterize potential exposures of current and future receptors (e.g., intake rates, frequency of exposure).

Probabilistic Risk Assessment (PRA) may be used to provide quantitative estimates of the uncertainties in the risk assessment. However, probabilistic estimates of risk should always be presented as a supplement to - not instead of - the deterministic (i.e., point estimate) methods outlined in *RAGS Part A*. A tiered approach is often useful, with the rigor of the analysis dependent on the magnitude of predicted risk. Factors to be considered in conducting a probabilistic analysis typically should include the sensitivity of parameters, the correlation or dependencies between parameters, and the distributions of parameter values and model estimates. Detailed guidance on this topic is provided in *Use of Probabilistic Techniques (Including Monte Carlo Analysis) in Risk Assessment* (U.S. EPA 1997c) and *Guiding Principles for Monte Carlo Analysis* (U.S. EPA 1997d).

Q32. When should a dose assessment be performed?

OSWER Directive 9200.4-18 (U.S. EPA 1997a) specifies that cleanup levels for radioactive contamination at CERCLA sites should be established as they would for any chemical that poses an unacceptable risk and the risks should be characterized in standard Agency risk language consistent with CERCLA guidance. **Cleanup levels not based on an ARAR should be based on the carcinogenic risk range (generally 10^{-4} to 10^{-6}, with 10^{-6} as the point of departure and 1 x 10^{-6} used for PRGs) and expressed in terms of risk (# x $10^{-\#}$).** While the upper end of the risk range is not a discrete line at 1 x 10^{-4}, EPA generally uses 1 x 10^{-4} in making risk management decisions. A specific risk estimate around 10^{-4} may be considered acceptable if based on site-specific circumstances. For further discussion of how EPA uses the risk range, see OSWER Directive 9355.0-30, Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions (U.S. EPA 1991d). In general, dose assessment used as a method to assess risk is not recommended at CERCLA sites.

Please note that the references to 15 mrem/yr in OSWER Directive 9200.4-18 are intended as guidance for the evaluation of potential ARARs and TBCs, and should not be used as a TBC for establishing 15 mrem/yr cleanup levels at CERCLA sites. **At CERCLA sites dose assessments should generally not be performed to assess risks or to establish cleanup levels** except to show compliance with an ARAR that requires a dose assessment (e.g., 40 CFR 61 Subparts H and I, and 10 CFR 61.41).

Q33 How and when should exposure rate be used to estimate radionuclide risks?

As discussed previously (see Q24 and Q27), EPA recommends that estimates of radiation risk should be derived using slope factors, in a manner analogous to that used for chemical contaminants. However, there may be circumstances where it is desirable to **also** consider estimates of risk based on direct exposure rate measurements of penetrating radiation. Instances where it may be beneficial to also use direct measurements for assessing risk from external exposure to penetrating radiation include:

- During early site assessment efforts when the site manager is attempting to communicate the relative risk posed by areas containing elevated levels of radiation,
- As a real-time method for indicating that remedial objectives are being met during the conduct of the response action. The use of exposure rate measurements during the conduct of the response actions may not decrease the need for a final status survey.
- When risk estimates developed during a risk assessment may underestimate the level of risk posed by radionuclides. An example of this situation would be where the source of the radiation is highly irregular (inside a contaminated structure) instead of being an infinite plane, which is the standard assumption used during risk assessments.

When developing risk estimates under any of these situations, risk factors from "Estimating Radiogenic Cancer Risks, EPA 402-R-93-076" or HEAST plus shape & area factor, should be used in conjunction with the measured dose rate to develop a risk estimate for external exposure to penetrating radiation.

Direct radiation exposure rate measurements may provide important indications of radiation risks at a site, particularly during early investigations, when these may be the first data available. However, such data may only reflect a subset of the radionuclides and exposure pathways of potential concern (e.g., only external exposure from gamma-emitting radionuclides in near-surface soil), and may present an incomplete picture of site risks (e.g., risk from internal exposures, or potential increased future risks from radionuclides in subsurface soils). In most cases, more accurate estimation of radiation risks will require additional

site characterization data, including concentrations of all radionuclides of concern in all pertinent environmental media. The principal benefits of exposure rate measurements is the speed and convenience of analysis, and the elimination of potential modeling uncertainties. However, these data should be used in conjunction with, rather than instead of, characterization data of radionuclides concentrations in environmental media to obtain a complete picture of potential site-related risks.

Q34. What radiation standards may be applicable or relevant and appropriate requirements (ARARs)?

A. In some cases, cleanup levels may be derived based on compliance with ARARs. Attachment A "Likely Federal Radiation Applicable or Relevant and Appropriate Requirements (ARARs)" of OSWER Directive 9200.4-18 (U.S. EPA 1997a) provides information regarding the circumstances in which federal standards that have often been selected as ARARs may be either applicable or relevant and appropriate for particular site-specific conditions. **It should be noted that the Agency has determined that the NRC decommissioning requirements (e.g., 25, 100 mrem/yr dose limits) under 10 CFR 20 Subpart E should generally not be used to establish cleanup levels under CERCLA**, even when these regulations are ARARs. OSWER Directive 9200.4-25, *Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites* (U.S. EPA 1998c), provides more detailed discussion on the use of the concentration limits for radium and/or thorium in subsurface soils.

V. ECOLOGICAL ASSESSMENTS

Q35. What guidance is available for conducting ecological risk assessments.

A. OSWER Directive 9285.7-25, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (U.S. EPA June 1997) is intended to facilitate defensible and appropriately-scaled site-specific ecological risk assessments at CERCLA sites. This guidance is not intended to dictate the scale, complexity, protocols, data needs, or investigation methods for such assessments. Professional judgement is required to apply the process outlined in this guidance to ecological risk assessments at specific sites.

VI. BACKGROUND CONTAMINATION

Q36. How should background levels of radiation be addressed?

A. Background radiation levels on a specific site will generally be determined as background levels are determined for other contaminants, on a radionuclide-specific basis when the same constituents are found in on-site samples as well as in background samples. The levels of each constituent in background are compared to that on site-related contaminant to determine its impact, if any. Background is generally measured only for those radionuclides that are contaminants of concern and is compared on a radionuclide specific basis to determine cleanup levels. For example, background levels for radium-226 and radon-222 would generally not be evaluated at a site if those radionuclides were not site-related contaminants.

In certain situations background levels of a site-related contaminant may equal or exceed PRGs established for a site. In these situations background and site-related levels of radiation will be addressed as they are for other contaminants at CERCLA sites. For further information regarding background, see section "Background Contamination" in OSWER Directive 9200.4-18 (U.S. EPA 1997a).

WHERE TO GO FOR FURTHER INFORMATION

Attachment 1 provides a bibliography of selected EPA documents related to radiation risk assessment. Readers should periodically consult the EPA Headquarters and Regional Superfund and Radiation Program Offices for updates on current guidances and for copies of new documents. Copies of many of the documents listed in Attachment 1 are available to the public for a fee from the National Technical Information Service (NTIS) at (703) 605-6000 or (800) 553-6847. Many documents are also available from EPA on the Internet.

Radiation and radioactive materials pose special hazards and require specialized detection instrumentation, techniques and safety precautions. EPA strongly encourages RPMs and risk assessors to consult with individuals trained and experienced in radiation measurements and protection. Such individuals include health physicists and radiochemists who can provide additional assistance in designing and executing radionuclide sampling and analysis plans and interpreting radioanalytical results.

The subject matter specialists for this fact sheet are Dr. Kung-Wei Yeh of ORIA and Stuart Walker of OERR. General questions about this fact sheet should be directed to 1-800-424-9346.

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TAB 10

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL 27 2000

Charles M. Hardin
Executive Director
Conference of Radiation Control
Program Directors, Inc.
205 Capital Avenue
Frankfort, KY 40601

Dear Mr. Hardin:

We appreciate the opportunity to review the current Conference of Radiation Control Program Directors, Inc. (CRCPD) draft model state regulation Part O - Decommissioning adopted by the Board of Directors on February 11, 2000. The U.S. Environmental Protection Agency (EPA) recognizes the difficulty in developing new rules for controversial topics such as decommissioning, and we applaud your efforts to develop this rule. However, we do not concur on the model state regulation Part O - Decommissioning for the reasons discussed below.

CRCPD's Part O - Decommissioning dose limits (e.g., allowable cleanup level of 25 millirem per year as the primary standard with exemptions allowing dose limits up to 100 millirem per year) and lack of a separate requirement for protecting ground waters that are potential or current sources of drinking water to the Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act are very similar to the limits established by the Nuclear Regulatory Commission (NRC) in 10 CFR Part 20 Subpart E, Radiological Criteria for License Termination. The EPA has and continues to express concerns with NRC's license termination rule, and because of this we have similar concerns with the CRCPD state regulation Part O.

We have provided comments to the NRC on a number of occasions including the enclosed letters from Administrator Browner to then Chairman Jackson, February 7, 1997, and from Tim Fields and Dick Wilson to Joe Callan, February 20, 1998. Because of the similarity between the NRC and CRCPD standards, we feel that our comments to NRC are also applicable to the CRCPD state regulation Part O and that these comments should be considered by CRCPD.

In addition, we recently provided comments to CRCPD on the Part N Draft Regulation for Technically Enhanced Naturally Occurring Radioactive Material. These comments to CRCPD identified a need to develop a separate standard for ground water protection and to develop a standard that is protective of human health and the environment. Letters from Tim Fields and Robert Perciasepe to Charles Hardin, April 19, 1999; Tim Fields to Ray Paris, July 25, 1997; and Frank Marcinowski to Ray Paris, July 21, 1997 discuss this issue in more detail, and are enclosed for your information. As these enclosures indicate, EPA is non-concurring with the release of the Part - O Decommissioning as a suggested state regulation because of concerns which include, but are not limited to, the failure of the regulation to recommend a separate standard or requirement for ground water protection and failure of the regulation to recommend a risk or dose based standard that the EPA considers protective of human health and the environment.

In addition, the draft model state regulation is also inconsistent with the majority of state ground water standards. Many states have established specific standards for radionuclides in ground water or have drinking water standards that address radionuclides that may be appropriate to be used as cleanup standards for ground waters which are current or potential sources of drinking water.

Because the NRC standard, Radiological Criteria for License Termination, is considered a Division 2 rule by NRC, it is our understanding that Agreement States would be allowed to adopt more stringent requirements. We would strongly encourage Agreement States to go further than the requirements in NRC's license termination rule and this draft model rule to develop decommissioning rules that require cleanups that are consistent with the protectiveness goals of CERCLA. EPA has previously developed guidance on how to cleanup radioactively contaminated sites in a protective and cost-effective manner and we feel that this guidance may be useful to CRCPD and Agreement States when developing rules. This guidance can be found in the following enclosed OSWER Directives: Radiation Risk Assessment at CERCLA Sites: Q & A, Directive 9200.4-31P, December 1999, and Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination, Directive 9200.4-18 August 22, 1997.

If you have questions regarding this information or the enclosed comments, please contact Bonnie Gitlin at (202) 564-9371 in the Office of Radiation and Indoor Air, or Stuart Walker at (703) 603-8748 in the Office of Solid Waste and Emergency Response.

Sincerely,

Robert Perciasepe
Assistant Administrator
for Air and Radiation

Timothy Fields, Jr.
Assistant Administrator
for Solid Waste and Emergency Response