

① DCF Originator: Donelle Welk *D. Welk* 9/4/02
Print Sign Date

Organization: MS/T&T

Phone/Pager/Location: 2233/212-3003/B460

② (Authorizes processing of request.)

Responsible Manager: J. A. Geis *J. A. Geis* 9/4/02
Print Sign Date

Organization: SE&QP

Phone/Pager/Location: 7088/212-1999

③ Assigned SME: B. Swenson
Print Name

Organization: MS/T&T

Phone/Pager/Location: 5794/212-3450/B460

④ Site Safety Analysis Report, Volume I
Document Title

PADC-1998-00662, Revision 2
Existing Document Number and Revision

N/A
New Document Number and Revision (if Applicable)

⑤ Type of Document
 Policy Procedure (indicate type) Instruction
 Mgt Directive Technical Alarm Job Aid
 Manual Administrative Other Other
If "Other" is checked, please specify type: AB

⑥ Type of Modification
 New One Time Use Only Change
 Revision Minor Major Cancellation

⑧ Proposed Modification	⑨ Justification
LOEP - Updated	Updated to show changed pages and addition of approval letter SP:NRD:DEF:02-00922 - Approval of B460 FDSA
Page 7-8 under SEC 1 Applicability Added Building 460 to the applicability statement	SP:NRD:DEF:02-00922 - Approval of B460 FDSA
Page 7-9 under SEC 2 Applicability Added Building 460 to the applicability statement	SP:NRD:DEF:02-00922 - Approval of B460 FDSA
Page 7-10 under SEC 3 & 4 Applicability Added Building 460 to the applicability statement	SP:NRD:DEF:02-00922 - Approval of B460 FDSA
Add Approval letter to Volume 1	SP:NRD:DEF:02-00922 - Approval of B460 FDSA

External (Technical) Review:

⑩ Reviewing Organization	⑪ Signature or Name of Reviewer	⑫ Date	⑩ Reviewing Organization	⑪ Signature or Name of Reviewer	⑫ Date
Subject-Matter Expert	<i>B. Swenson</i>	<u>9/4/02</u>			

⑬ Special Reviews: (NOTE: Other Special Reviews may be required. See PRO-815-DM-01 for more information.)

ISR (Number or "Not Required"): N/A

Ti Alignment (signature or N/A): N/A Sign Date

Reviewed for Classification (If Required, "N/A" if not)
By: N/A
Date: _____

⑭ Approval (Completed to approve changes and cancellations only. New documents and revisions are approved by signature on the document cover page.)

Approval Authority: J. A. Geis *J. A. Geis* 9/4/02 Effective Date: 9/9/02
6/1/2001 Print Name Sign Date

① DCF Originator: Donelle Welk
 Print Sign Date 7/30/02
 Organization: MS/T&T
 Phone/Pager/Location: 2233/212-3003/B460

② (Authorizes processing of request.)
 Responsible Manager: J. A. Geis
 Print Sign Date 7/30/02
 Organization: SE&QP
 Phone/Pager/Location: 7088/212-1999

③ Assigned SME: B. Swenson
 Print Name
 Organization: MS/T&T
 Phone/Pager/Location: 5794/212-3450/B460

④ Site Safety Analysis Report, Volume I
 Document Title
 FADC-1998-00662, Revision 2
 Existing Document Number and Revision
 N/A
 New Document Number and Revision (if Applicable)

⑤ Type of Document
 Policy Procedure (indicate type) Instruction
 Mgt Directive Technical Alarm Job Aid
 Manual Administrative Other Other
 If "Other" is checked, please specify type: AB

⑥ Type of Modification
 New One Time Use Only Change
 Revision Minor Major
 Cancellation

⑦ Proposed Modification
 LOEP - Updated
 Updated
 Volume I - Table of Contents
 Added Appendix J.
 Appendix J - Outdoor Waste Management
 Added to Document

⑧ Justification
 SDRM Requirement
 Appendix Approved by DOE on July 9, 2002
 Appendix Approved by DOE on July 9, 2002

External (Technical) Review:

⑩ Reviewing Organization	⑪ Signature or Name of Reviewer	⑫ Date	⑬ Reviewing Organization	⑭ Signature or Name of Reviewer	⑮ Date
Subject-Matter Expert	<u>[Signature]</u>	<u>7/30/02</u>			

⑯ Special Reviews: (NOTE: Other Special Reviews may be required. See PRO-815-DM-01 for more information.)

ISR (Number or "Not Required"): SISRC 02-03

TI Alignment (signature or N/A): N/A
 Sign Date

Reviewed for Classification
 (If Required, "N/A" if not)
 By: J. N. Conyers u/nu
 Date: 2/12/02

⑰ Approval (Completed to approve changes and cancellations only. New documents and revisions are approved by signature on the document cover page.)

Approval Authority: J. A. Geis
 Print Name Sign Date 7/30/02
 Effective Date: July 31, 2002

① DCF Originator: Donelle Welk
 Print Sign Date

Organization: Traffic & Transportation/MS

Phone/Pager/Location: 2233/212-3003/B460

④ Safety Analysis Building 881 and Related Facilities
 Document Title

Site Safety Analysis Report, Volume II, Revision 1
 Existing Document Number and Revision

Site Safety Analysis Report, Vol. I, App. H, Revision 2
 New Document Number and Revision (if Applicable)

② (Authorizes processing of request.)
 Responsible Manager: Fran Ito
 Print Sign Date 6/17/02

Organization: Traffic & Transportation/MS

Phone/Pager/Location: X2700/B116

⑤ Type of Document

Policy Instruction

Mgt Directive Procedure (indicate type) Alarm Job Aid

Manual Administrative Other Other

If "Other" is checked, please specify type: AB Document

③ Assigned SME: Kyle H. Turner
 Print Name

Organization: RISS Nuclear Safety

Phone/Pager/Location: x2794/B116

⑥ Type of Modification

New Change

One Time Use Only Minor

Revision Major

Cancellation

⑧ Proposed Modification	⑨ Justification
Removed FSA from Volume II and placed within Appendix H, Volume I	
Added discussion of Reactive Chemical Treatment Units in Room 267.	
Incorporated DOE RFFO Technical Direction contained in Letter AME:NRD:MER:00-01790, dated March 22, 2000.	Revision 2 incorporates DOE RFFO Technical Direction provided in Mazurowski-to-Parker Letter SP:NRD:RB:02-00850, dated June 3, 2002.
Revised Accident Analysis to reflect collocated worker at 100 meters and dose conversion factor based on ICRP-68.	
Added discussion of Safety Management Programs applicability and reformatted Credited Controls in the form of Administrative Controls Template.	
Incorporated DOE RFFO Technical Direction provided in Mazurowski-to-Parker Letter SP:NRD:RB:02-00850, dated June 3, 2002.	

External (Technical) Review:

⑩ Reviewing Organization	⑪ Signature or Name of Reviewer	⑫ Date	⑬ Reviewing Organization	⑭ Signature or Name of Reviewer	⑮ Date
Subject-Matter Expert	K. H. Turner /s/	6/13/02			
A. R. Hohl, RISS NS	A. R. Hohl /s/	6/13/02			
T. J. Humiston, RISS	T. J. Humiston /s/	6/13/02			
D. W. Clark	D. W. Clark /s/	6/13/02			

⑬ Special Reviews: (NOTE: Other Special Reviews may be required. See PRO-815-DM-01 for more information.)

ISR (Number or "Not Required"): SISRC-02-08

TI Alignment (signature or N/A): N/A
 Sign Date

Reviewed for Classification (If Required, "N/A" if not)
 By: C. J. Freiboth (u/nu)
 Date: 6/13/02

⑭ Approval (Completed to approve changes and cancellations only. New documents and revisions are approved by signature on the document cover page.)

Approval Authority: F. M. Ito
 Print Name Sign Date 6/17/02 Effective Date: 6/17/02

① DCF Originator: B. A. Swenson 5/2/02
Print Sign Date

Organization: Traffic & Transportation MS

Phone/Pager/Location: 5794/212-3450/T893A

② (Authorizes processing of request.)
Responsible Manager: F. M. Ito 5/2/02
Print Sign Date

Organization: Traffic & Transportation MS

Phone/Pager/Location: 6839/212-3577/T-893A

③ Assigned SME: B. A. Swenson
Print Name

Organization: Traffic & Transportation MS

Phone/Pager/Location: 5794/212-3450/ T-893A

④ Site Safety Analysis Report
Document Title

PADC-1998-00662, Revision 2
Existing Document Number and Revision

NA
New Document Number and Revision (if Applicable)

⑤ Type of Document
 Policy Procedure (indicate type) Instruction
 Mgt Directive Technical Alarm Job Aid
 Manual Administrative Other Other
If "Other" is checked, please specify type: Safety Analysis Report

⑥ Type of Modification
 New Change Minor
 One Time Use Only Major
 Revision Cancellation

⑧ Proposed Modification	⑨ Justification
Page 7-20 under Applicability: Added container types with gram limits Added specific controls/restrictions for use of powered industrial trucks for material Transfers between facilities - provides explanation of "areas"	Per DOE approved page change for STC 5 two box transfer Per DOE approved page change
Page 7-21 Table 7-8.b Increases LLW boxes to two per move for on-site transfer by PIT Prohibits the use of fossil fuels PITs and cranes to transfer TRU waste drums Provides gram limits when transferring TRU SWBs, requires palletizing SWBs, Requires securing SWBs to PIT, prohibits the use of lifting lugs/pin-lifters, requires combustible load inspections along transfer route	Per DOE Technical Direction Per DOE Technical Direction Per DOE Technical Direction
Page 7-39 under Specific Controls or Restrictions for use of PITs for material transfers Changed to read: the bases for the specific controls and restrictions are included with the bases for the programmatic controls in the next section.	Clarification for changes in controls per DOE Technical Direction
Page 7-40 Programmatic Controls Bases 1-4 Provides new bases for controls in Table 7-8.b	Revised bases for new controls per DOE Technical Direction

External (Technical) Review:

⑩	⑪	⑫	⑩	⑪	⑫
Reviewing Organization	Signature or Name of Reviewer	Date	Reviewing Organization	Signature or Name of Reviewer	Date
Subject-Matter Expert	<u>B.A. Swenson</u>	<u>5/2/02</u>			

⑬ Special Reviews: (NOTE: Other Special Reviews may be required, See PRO-815-DM-01 for more information.)
ISR (Number or "Not Required"): Not Required
TI Alignment (signature or NA): NA
Sign Date
Reviewed for Classification (If Required, "N/A" if not)
By: NA
Date: _____

⑭ Approval (Completed to approve changes and cancellations only. New documents and revisions are approved by signature on the document cover page.)
Approval Authority: F. M. Ito 5/2/02 Effective Date: 5/9/02
Print Name Sign Date

① DCF Originator: Mitch Waller *Mitch Waller* 8/28/01
Print Sign Date

Organization: Nuclear Safety

Phone/Pager/Location: 3544/800-431-7308/B130

② (Authorizes processing of request.)
Responsible Jack Hanson *Jack Hanson* 8/29/01
Manager: Print Sign Date

Organization: Technical Programs

Phone/Pager/Location: 5520/212-1194/B130

③ Assigned SME: Roberta Underwood 8/28/01
Print Date

Organization: Nuclear Safety

Phone/Pager/Location: 7542/B130

⑮ ISR Number: SISRC 01-15

④ Site Safety Analysis Report, Chapter 6
Document Title

Revision 2
Existing Document Number and Revision

Revision 2, PGC-RFP-01.0120-BMM
New Document Number and Revision (if Applicable)

⑤ Type of Document
 Policy Mgt. Directive Manual Procedure
 Tech. Standard Instruction Job Aid Other

⑥ Type of Modification
 New Change
 One Time Use Only Minor
 Revision Major
 Cancellation

⑧ Effective Date: 9/19/01 Expiration Date: N/A

⑨ Proposed Modification

Section rewrite to address safety important attributes of RFETS Safety Management Programs (SMPs). DOE approved page change PGC-RFP-01.0120-BMM. This includes revision to Chapter 6 and Section 7.5.6.1.

⑩ Justification

Streamlining initiative to address facility issues with site program where appropriate.

⑪ Reviewing Organization	⑫ Signature or Name of Reviewer	⑬ Date	⑪ Reviewing Organization	⑫ Signature or Name of Reviewer	⑬ Date
Building 371	M.S. Spears	4/20/01			
Building 707	D.P. Snyder	4/17/01			
Building 771/774	H.E. Gilpin	4/16/01			
Building 776/777	T.L. Vaughn	4/16/01			
Material Stewardship	S.K. Crowe	4/16/01			
RISS	K.W. Daniels	4/19/01			
Subject Matter Expert		<u>8/28/01</u>	<u>Nuclear Safety</u>	<u>Roberta Underwood</u>	<u>8/28/01</u>

⑭ (Completed to approve changes and cancellations only. New Documents and revisions are approved by signature on the document cover page.)

Approval Authority: Jack Hanson
Print Name

Jack Hanson
Sign

8/29/01
Date

① DCF Originator: B. Swenson B. Swenson 4/17/01
Print Sign Date

Organization: Traffic & Transportation/MS

Phone/Pager/Location: 5794/212-3450/T893A

② (Authorizes processing of request.)
Responsible Manager: F. M. Ito [Signature] 4/17/01
Print Sign Date

Organization: Traffic & Transportation/MS

Phone/Pager/Location: 6839/212-3577/T893A

③ Assigned SME: N/A N/A
Print Date

Organization: N/A

Phone/Pager/Location: N/A

④ ISR Number: N/A

④ Site Safety Analysis Report
Document Title

PADC 1998-00662
Existing Document Number and Revision

N/A
New Document Number and Revision (if Applicable)

⑤ Type of Document
 Policy Mgt. Directive Manual Procedure
 Tech. Standard Instruction Job Aid Other

⑥ Type of Modification
 New One Time Use Only Revision
 Change Minor Major Cancellation

⑧ Effective Date: 4/18/01 Expiration Date: N/A

⑨ Proposed Modification

Replace page 7-21

⑩ Justification

Administrative Correction

⑪ Reviewing Organization	⑫ Signature or Name of Reviewer	⑬ Date	⑪ Reviewing Organization	⑫ Signature or Name of Reviewer	⑬ Date
N/A	N/A				

⑭ (Completed to approve changes and cancellations only. New Documents and revisions are approved by signature on the document cover page.)

Approval Authority: F.M. Ito
Print Name

[Signature] 4/17/01
Sign Date

CONTROLLED COPY

① DCF Originator: B. Swenson B. Swenson 4/4/01
Print Sign Date

Organization: Traffic & Transportation/MS

Phone/Pager/Location: 5794/212-3450/T893A

② (Authorizes processing of request.)
Responsible Manager: F. M. Ito [Signature] 4/4/01
Print Sign Date

Organization: Traffic & Transportation/MS

Phone/Pager/Location: 6839/212-3577/T893A

③ Assigned SME: N/A
Print Date

Organization: N/A

Phone/Pager/Location: N/A

④ ISR Number: N/A

④ Site Safety Analysis Report
Document Title

PADC 1998-00662
Existing Document Number and Revision

N/A
New Document Number and Revision (if Applicable)

⑤ Type of Document
 Policy Mgt. Directive Manual Procedure
 Tech. Standard Instruction Job Aid Other

⑥ Type of Modification
 New One Time Use Only Change
 Revision Minor
 Major Cancellation

⑦ Effective Date: 4/4/01 5 BAS Expiration Date: N/A

⑨ Proposed Modification

Replace page Page 7-9

Replace page Page 7-16

Remove JCO RFP-99.344 from Volume 2

Add the following three (3) Review Reports at the end of Volume I.
November 28, 2000 (AME:NRD:RGB:00-03674)
May 4, 1999 (AME:ABD:RGB:02961)
November 30, 1998 (AME:ABD:MER:03196)

⑩ Justification

Administrative Correction

Administrative Correction

DOE Direction

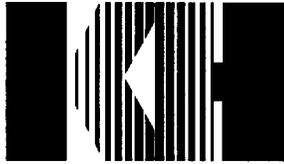
DOE Direction

⑪ Reviewing Organization	⑫ Signature or Name of Reviewer	⑬ Date	⑪ Reviewing Organization	⑫ Signature or Name of Reviewer	⑬ Date
N/A	N/A				

⑭ (Completed to approve changes and cancellations only. New Documents and revisions are approved by signature on the document cover page.)

Approval Authority: F.M. Ito [Signature] 4/4/01
Print Name Date

CONTROLLED COPY



KAISER•HILL
COMPANY

**ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
SAFETY ANALYSIS REPORT**

Volume I

Site Description and Characteristics

ISR: Site ORC: #SORC-00-007

REVIEWED FOR CLASSIFICATION/UCNI
By JAC J. N. CONYERS (initials)
Date 2/7/01

APPROVALS

Prepared by: J.A. Geis 2/6/01
Date
J.A. Geis, Manager of Authorization Basis
Material Stewardship
Kaiser-Hill Company, L.L.C.

F. M. Ito 2/6/01
Date
F. M. Ito, Site SAR Program Owner
Material Stewardship
Kaiser-Hill Company, L.L.C.

H. E. Gilpin 2/6/2001
Date
H. E. Gilpin, Manager of Engineering and Nuclear Licensing
Engineering, Environmental, Safety, and Quality Programs
Kaiser-Hill Company, L.L.C.

Approved by: M. D. Brailsford 2/7/01
Date
M. D. Brailsford, V.P., Project Manager
Material Stewardship
Kaiser-Hill Company, L.L.C.

Concurrence: G. M. Voorheis 2/7/01
Date
G. M. Voorheis, Deputy Director of
Engineering, Environmental, Safety,
and Quality Program and Site Chief Engineer
Kaiser-Hill Company, L.L.C.

LIST OF EFFECTIVE PAGES

Page 1 of 4

Volume I

Section	Pages	Effective Date
Title Page		11/1/00
Approval Page		11/1/01
LOEP	LOEP-1 – LOEP-4	7/31/02
Executive Summary	E-1 – E-18	11/1/00
Table of Contents	i – ix	7/31/02
Chapter 1	1-i – 1-ii	11/1/01
	1-1 – 1-12	11/1/01
Chapter 2	2-i – 2-ii	11/1/01
	2-1 – 2-36	11/1/01
Chapter 3	3-i – 3-ii	11/1/01
	3-1 – 3-58	11/1/01
Chapter 4	4-i – 4-iv	11/1/01
	4-1 – 4-44	11/1/01
Chapter 5	5-i – 5-iv	11/1/01
	5-1 – 5-64	11/1/01
Chapter 6	6-i – 6-iv	9/19/01
	6-1 – 6-153	9/19/01
Chapter 7	7-i – 7-ii	7/1/01
	7-1 – 7-7	11/1/01
	7-8 – 7-10	9/3/02
	7-11 – 7-15	11/1/01
	7-16	7/1/01
	7-17	11/1/01
	7-18 – 7-19	7/1/01
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Volume I (continued)

Section	Pages	Effective Date
Chapter 7 (continued)		
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	7-39 – 7-40	5/9/02
	7-41 – 7-44	7/1/01
Chapter 8	8-i – 8-iv	11/1/01
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Appendix A	A-1 – A-10	11/1/01
Appendix B	B-1 – B-18	11/1/01
Appendix C	C-1 – C20	11/1/01
Appendix D	D-1 – D18	11/1/01
Appendix E	E-1 – E-12	11/1/01
Appendix F	F-1 – F14	11/1/01
Appendix G	G-i – G-x	11/1/01
	G-1 – G-34	11/1/01
Appendix H	H-i – H-viii	6/17/02
	H-1 – H-B-6	6/17/02
Appendix I	I-i – I-ix	11/1/01
	I-1 – I-46	11/1/01
	I-A-1 – I-A-7	11/1/01
Appendix J	J-i – J-viii	7/1/02
	J-1 – J-92	7/1/02
DOE Letters – Volume I	AME:ABD:MER:03196	11/20/98
	AME:ABD:RGB:02961	5/4/99
	AME:NRD:RGB:00-03674	11/28/00
	FPA:NRD:EJW:01-01163	6/15/01
	FPA:NRD:EJW:01-01292	7/3/01
	SP:NRD:DEF:02-00532	4/9/02
	SP:NRD:RB:02-00974	7/9/02
	SP:NRD:DEF:02-00922	6/13/02

LIST OF EFFECTIVE PAGES

Page 3 of 4

Volume II

Section	Description	Effective Date
1 – Building 125	Standards Laboratory	5/99
2 – Building 126	Source Storage Building	5/99
3 – Building 444 Cluster	Depleted Uranium and Beryllium Manufacturing Facility	5/22/01
4 – Building 790	Radiation Calibration Laboratory	5/99
5 – Removed and placed in Volume I, Appendix H	_____	_____
6 – Building 886	(Includes B886, 875, 828, and 880). Hard copy distribution limited to those designated as needing it. Electronic version available on the intranet.	6/00
7 – Buildings 891, T900A & B	Consolidated Water Treatment Facilities	5/99
8 – Facilities 903A/903B & 966	Decontamination Facilities (Main and Protected Area)	5/99
9 – Aqueous Process Waste Transfer Project	B231, storage tanks 231A & B, valve vaults, B428 and tanker trucks	4/22/02
10 – Environmental Restoration Projects	Includes 903 pad	5/99
11 – Industrial Facilities	All facilities not included in other FSAs, FSARs, BIOs, or BFOs	5/99
DOE Letters – Volume II	SP:NRD:RB:02-00850	6/3/02

The following changes are active for this document

- CHG-01
- CHG-02
- CHG-03
- CHG-04
- CHG-05
- CHG-06
- CHG-07
- CHG-08
- CHG-09
- CHG-10

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EXECUTIVE SUMMARY

The Rocky Flats Environmental Technology Site Safety Analysis Report (Site SAR) establishes the authorization basis for facilities at the Rocky Flats Environmental Technology Site (RFETS) which do not have approved, in process, or planned Final Safety Analysis Report (FSAR), Basis for Interim Operation (BIO), or Basis for Operation (BFO) documentation. The Site SAR documents general information regarding the site, including geography, demography, meteorology, hydrology, and geology. The Site SAR also contains descriptions of site safety management programs, support systems, and utilities including administrative controls focused on notifications required due to unavailability of site systems or utilities.

E.1 SITE BACKGROUND AND MISSION

The RFETS is a U. S. Department of Energy (DOE) owned, contractor-operated, former nuclear weapons component production facility. Formerly known as the Rocky Flats Plant, the site was established, and facilities constructed, in the early 1950s to produce uranium and plutonium containing assemblies and parts for nuclear weapons. Principal production activities involved fabrication and assembly of parts made of plutonium and uranium, as well as non-radioactive materials such as aluminum, beryllium, and stainless steel. Recovery operations included the chemical recovery and refining of plutonium from various forms of plutonium-bearing scrap and residues. Other support activities included metallurgical analysis, chemical analysis, and nondestructive testing and assay. Research activities, in support of nuclear weapons production, included development of welding, coatings, metal alloys, and processes for the recovery of plutonium from scrap and residues.

The current mission at the RFETS is to provide safe storage and management of wastes and special nuclear material (SNM) with the goal of reducing existing hazards and decommissioning existing facilities. These activities include the consolidation and stabilization of nuclear materials, removal of hazardous materials, decontamination, decommissioning, and environmental restoration. The vision for the future of RFETS is outlined in the Final Rocky Flats Cleanup Agreement (RFCA) (CDPHE, 1996). The current vision for RFETS, as contained in the RFCA signed on July 19, 1996, is to:

- To achieve accelerated cleanup and closure of RFETS in a safe, environmentally protective manner and in compliance with applicable state and federal environmental laws;
- To ensure that RFETS does not pose an unacceptable risk to the citizens of Colorado or to the site's workers from either contamination or an accident; and
- To work toward the disposition of contamination, wastes, buildings, facilities and infrastructure from RFETS, consistent with community preferences and national goals.

The key activities that will support reaching the vision and goals contained in the RFCA over the next ten years include special nuclear material stabilization and consolidation for on-site long

term storage or for off-site shipment, shipment of low-level and transuranic waste including mixed waste offsite at the earliest possible date, cleanup and demolition or conversion of all facilities onsite, and environmental cleanup. The Site SAR supports this vision and these goals and activities by:

- providing a hazard assessment for site facilities/systems/activities that have not been previously documented, such as transportation activities, and
- providing site-wide administrative controls for transportation activities and for systems credited in facility authorization basis (AB) documents.

E.2 SITE OVERVIEW

The RFETS is located in central Colorado, approximately 16 miles northwest of downtown Denver and 10 miles south-southeast of Boulder. The area in the immediate vicinity of the site is a mixture of agriculture, open space, light industry, and low density residential housing. The site consists of approximately 6,265 acres, most of which is a buffer zone around the central industrial area.

The industrial area contains the majority of the facilities and operations with identified and numbered facilities, including the major buildings, appurtenances to major buildings, office trailers, designated pads and storage areas, tank farms, and other features such as roadways and fencing. In addition, there are numerous storage units and modules, predominately cargo containers, associated with various facility areas, some of which are numerically designated. The various structures are occupied, for the most part, and active with respect to supporting current missions. Within the industrial area is the Protected Area (PA) which is surrounded by an extensive security system. All plutonium handling and storage facilities (with the exception of waste storage) are within the PA. Activities involving nuclear materials outside the PA are limited to storage and handling of contaminated wastes, activities involving depleted uranium, and environmental restoration.

Several facilities are authorized to perform nuclear activities in support of the current RFETS mission and objectives. Principal activities in these nuclear facilities include:

- Nuclear analytical operations (Building 559),
- Material stabilization operations (Building 707),
- Tank draining and material removal in preparation for D&D (Building 771),
- Residue and liquid processing, residue and special nuclear material storage, and drum repackaging (Building 371),
- Liquid/solid waste processing (Buildings 374 and 774),

- Waste assay (Building 569),
- Waste storage and/or shipping (Buildings 440, 664, 750/904 Pads, 776/777, 906, and 991), and
- Deactivation (Building 886).

Most site facilities are in the process of removing hazardous materials and chemicals that are no longer needed to support the operations or processes within the facility. Environmental restoration activities are concentrating on the remediation of contaminated soils. Waste management activities continue and include treatment, storage, shipment, and minimization of transuranic (TRU) waste, TRU-mixed waste, low-level radioactive waste, low-level mixed waste, hazardous waste, mixed residues, sanitary, solid, and medical waste.

The buffer zone, which surrounds the Industrial Area, is a protected environmental “preserve” for plant and animal life providing refuge for a large number of bird and mammal species, some of which are endangered. The protection and isolation of the buffer zone has provided habitat for rare species, including the Preble’s meadow jumping mouse. Over 180 bird species, 37 mammal species, eight reptile and seven amphibian species have been identified. The buffer zone contains a large unit of relic Xeric Tallgrass Prairie, and is a potential habitat for endangered plants. Also common to the buffer zone is a number of wetlands.

Air emissions from site operations are monitored to ensure compliance with the federal and state regulatory limits pursuant to the Clean Air Act and its amendments. In addition to monitoring emissions from facilities, the site has a system of ambient air monitoring stations. The ambient air monitoring program consists of a network of samplers on site and at the borders of the buffer zone, and community sampling stations. Water sampling and monitoring stations are also provided pursuant to the Clean Water Act. Both surface water and underground water are monitored.

E.3 FACILITY HAZARD CLASSIFICATION

DOE standard DOE-EM-STD-5502-94, *Hazard Baseline Documentation* (DOE, 1994b), defines four facility classification categories based on inventories of radiological and hazardous materials present in a facility. These classifications are nuclear, non-nuclear, radiological, and industrial. On an individual basis, all site facilities fall into one of these four categories. Nuclear facilities are further classified according to DOE Order 5480.23, *Nuclear Safety Analysis Reports*, and DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, into Hazard Categories 1, 2, and 3, and non-nuclear facilities are further classified according to DOE Order 5481.1B, *Safety Analysis and Review System*, into high, moderate, and low hazard.

RFETS has several nuclear Hazard Category 2 and 3 facilities, radiological facilities, and non-nuclear moderate and low hazard facilities, but no nuclear Hazard Category 1 or non-nuclear high hazard facilities. The nuclear Hazard Category 1 classification is reserved for Category A

reactors or for facilities specifically designated by a Program Secretarial Officer at the Department of Energy (DOE) Headquarters. Non-nuclear high hazard facilities are those with hazards that present a potential for considerable on-site and off-site impacts on people or the environment. Table EX-1 provides a compilation of nuclear, non-nuclear, and radiological facilities at RFETS according to their respective hazard classifications. Table EX-2 provides a summary of RFETS facility hazards. These tables are located at the end of this section.

E.4 SAFETY ANALYSIS OVERVIEW

The facilities identified in Tables EX-1 and EX-2 have stand-alone authorization bases, safety analyses in an appendix to Volume I of the Site SAR, or have Facility Safety Analyses (FSAs) in Volume II of the Site SAR. Facilities with stand-alone authorization bases have significant radiological inventories and include all nuclear Hazard Category 2 and one nuclear Hazard Category 3 facility. Authorization bases for these facilities include FSARs, BIOs, BFOs, and FSAs depending on when the document was developed. A facility is covered in the Site SAR if it is (1) a nuclear Hazard Category 3 facility (with the exception of the 904 Pad), (2) a radiological facility, (3) a non-nuclear facility, or (4) an industrial facility. The 904 Pad authorization basis is combined with the 750 Pad which is a Category 2 facility.

The facilities listed in Table EX-1 and EX-2 are sorted based on their facility hazard classification. Table EX-1 identifies the basis for the facility classification. Table EX-2 provides a brief description of the facility activities, identifies most significant hazard associated with the activities in that facility, and provides information on the associated authorization basis document. Unless otherwise noted, the title of the FSA for the facility corresponds with the facility number. Table EX-3 provides a list of facilities whose classification has changed since the original issue of the Site SAR and the basis for the classification change.

The following thresholds of hazardous materials are used to determine the hazard classification of each facility:

- Nuclear Hazard Category 2: The quantity of radioactive materials in the facility is greater than the threshold quantity for Hazard Category 2 given in DOE-STD-1027-92.
- Nuclear Hazard Category 3: The quantity of radioactive materials in the facility lies between the Hazard Category 2 and 3 threshold quantities identified in DOE-STD-1027-92.
- Radiological: The total quantity of radioactive material in the facility is less than the Hazard Category 3 threshold quantities from DOE-STD-1027-92, but greater than the reportable quantity from 40 CFR 302, Table 302.4, Appendix B.
- Non-nuclear: Radioactive material in these facilities is less than the reportable quantities in 40 CFR 302, Table 302.4, Appendix B, or the material is in the form of a certified sealed source or it is in a DOT Type B shipping container. Non-nuclear facilities are further qualitatively classified, based on the quantities of hazardous chemicals, as high, medium, or

low. The specific materials and thresholds of interest were determined using regulatory thresholds contained in 40 CFR 302, 40 CFR 355, 40 CFR 68, and 29 CFR 1910.119 as guidelines.

As hazardous materials are removed from facilities as part of the cleanup mission of the site, the hazard classification will be reduced to a lower classification and the current authorization basis will be changed to reflect the new classification. Authorization bases will be incorporated into the Site SAR as FSAs as the facilities meet the criteria for inclusion or a FSA will be removed as the facility hazards are reduced to industrial levels or the facility removed.

The Site SAR applies the graded approach to derive authorization bases for facilities that do not have a stand-alone safety document. Documentation of hazards in all facilities is necessary to support the determination of which facilities are affected by the impending 10 CFR 830 Nuclear Safety Rules, e.g., 10 CFR 830.110. The FSAs contain safety analyses which document the current activities, facility descriptions, and hazards present in the facility with the goal of identifying potential scenarios for hazardous material releases and controls necessary to prevent or mitigate these releases. Accident consequence analyses were performed, as needed, based on the amount of material determined to be available for release. These analyses were performed in a graded manner determined by both the hazards and quantity of hazardous materials present in the facility. Acute exposure resulting from accidental releases is evaluated as risk to workers, the public or the environment. An implementation plan(s) will ensure that all assumptions and controls credited in the Site SAR are applied site-wide as appropriate. Chronic risk from exposure to low levels of hazardous and toxic chemical materials is not evaluated, and is addressed by the site's industrial health and safety program. Standard industrial hazards identified are controlled by site safety management programs and are not evaluated if they do not potentially result in hazardous material releases to the public.

Facilities not identified on Tables EX-1 and EX-2 are considered to be industrial facilities based on the lack of significant radioactive or chemical inventories. Inventory controls are placed on these facilities to ensure the hazard classification of the facility will not change without the proper review and revision of safety documentation.

E.5 SAFETY ANALYSIS SUMMARY

Radiological, hazardous material, and occupational hazards are present in various degrees at RFETS. The radiological hazards present in nuclear Hazard Category 2 and 3 facilities have the potential to expose the public and workers to radioactive material. Non-nuclear moderate and low hazard facilities have the potential for chemical releases. In addition to the chemicals present in individual facilities, past practices have resulted in asbestos and beryllium contamination being present in many facilities on site.

Natural Phenomena and External Events Summary

The natural phenomena and external events identified as potentially impacting RFETS include earthquake, high wind and tornado, heavy rain, heavy snow, and lightning, aircraft crash, and range fires and are summarized in Chapter 5. Information in Chapter 5 reflects the latest DOE guidance.

The natural phenomena/external event most likely to result in a breach of confinement and a release of hazardous materials are earthquakes and aircraft crashes. The severity of these events on a specific facility is determined in individual facility safety documents. Historically, the site has not experienced heavy rains, snows, lightning or range fires that have resulted in a release of hazardous materials. Also, based on the location and geography common to RFETS, some natural phenomena events are not considered credible for this location. These include landslides, avalanches, hurricanes, tsunamis, volcanic eruptions, and extreme cold or heat. These events are not considered in hazard assessments at RFETS.

Facility Hazard Classification Summary

There are currently fourteen facilities at RFETS classified as nuclear Hazard Category 2 (Buildings 371, 374, 440, 559, 569, 664, 707, 750 Pad, 771, 774, 776/777, 886, 906, and 991). These facilities were associated with weapons production in the past and still contain significant quantities of radioactive material, or are currently storage and/or handling facilities for transuranic wastes.

Facilities are identified as nuclear Hazard Category 3, based on the radioactive material inventory present in the stored wastes and/or building or equipment hold-up (Buildings 666, 881, 904 Pad, and the RCRA Storage Units).

The radiological facilities at RFETS cover a wide range of activities, from source and waste storage to facilities with activities potentially involving radioactively contaminated materials. One facility, Building 444 (along with Buildings 447 and 448), contains large quantities of depleted uranium; however, the form of the material is not dispersible, and poses only minimal risks to the immediate worker in the event of an accident. This classification of radiological follows the guidance of DOE-STD-1027-92 which allows for adjusting the threshold quantity based on accident specific release fractions for the material involved. The 903 Pad is classified as radiological in its undisturbed state due to the contaminated soil present under the pad. This classification may change in the event of remediation/removal of the soils.

Non-nuclear facilities do not have radiological inventories, but do contain quantities of hazardous chemicals. The two propane tank farms are the only facilities on the site that contain quantities of hazardous materials (propane) in excess of a threshold quantity. All other hazardous chemicals and toxic gases have been removed from the site or are now used in quantities less than the threshold quantities. Low hazard facilities have chemicals in quantities that only present minor on-site impacts and negligible off-site impacts.

Fuel Gas Summary

A 12-inch KN Energy Company natural gas pipeline crosses the site from north to south and passes about 2,000 feet east of the Industrial Area fence. This gas line is buried underground, and does not enter the site Industrial Area. Natural gas is supplied to the site by Public Service Company of Colorado (PSCO) primarily for heating buildings. An underground pipeline passes south of the Industrial Area, entering the site at the junction of the East Access Road with Indiana Street and leaving the site outside the south Industrial fence to Coal Creek Canyon. On-site gas distribution pressure is reduced to approximately 50 psi. Nuclear Hazard Category 2 and 3 facilities no longer use natural gas within the building structures, however, gas mains still run up to facility boundaries or in the vicinity of nuclear facilities. An accidental release of natural gas, such as from a gas line leak or break, will disperse very quickly because of its low specific density. Weak ignition of an unconfined cloud in an unobstructed environment generally will not result in a damaging explosion. Natural gas is not anticipated to pose a significant health and safety impact on the workers or cause uncontrolled radioactive release from a potential explosion. Buildings with attached natural gas distribution piping were evaluated for the overpressure condition that results from a breach in the piping. This evaluation is discussed in Chapter 3.

Propane systems supply fuel gas to heat waste storage tents and trailers. Liquid propane is supplied by an off-site vendor and stored in two main tank farms, P750 and P904. Each tank farm includes eight 1,000-gallon water capacity horizontal steel tanks mounted on a common concrete pad, self-supported, and tied down to the concrete foundations with wire rope. Each tank is equipped with isolation and pressure relief devices, and is filled separately. In addition to the propane tank farms, propane is stored in individual tanks located throughout the site to support individual facility requirements. Postulated vapor cloud explosions (VCEs), explosions involving a propane jet from a stuck open relief valve, and boiling liquid, expanding vapor explosions (BLEVEs) have been conservatively analyzed. Results showed that the worst-case overpressure condition from the postulated explosions which results from a BLEVE and did not exceed 1 psi beyond 130 feet for a 1,000-gallon tank.

Facility Interactions and Nearby Facility Accidents Summary

Potential facility interactions involving radioactive spills, fires, explosion, and nuclear criticalities were evaluated. It was concluded that postulated propane VCEs could result in significant overpressure conditions if the propane tank is located near a parking lot with the potential to contain a large number of parked vehicles, or in the vicinity of stored boxes and 55-gallon drums. Release of hazardous materials is possible if a VCE results from a leak of propane tank 771B or any tank at the 904 Tank Farm.

The potential for an accident at a nearby facility that could adversely affect operations in the industrial area of the site and lead to a release of hazardous materials was also evaluated. General operations at nearby facilities include a cement plant, a drilling and blasting operation, an explosives storage area, a natural gas storage area, an airport and industrial parks. Only explosions and/or fires at nearby facilities were identified as having the potential to affect on-site operations. It was

concluded that there is no risk to site industrial facility operations from an accident involving explosive substances at nearby facilities. Fires initiated at nearby facilities were considered to be bounded by range fires which were evaluated under natural phenomena and external events.

Transportation Analysis Summary

The nuclear materials evaluated in this chapter are plutonium oxide, plutonium containing residues, plutonium solutions (including solutions with high concentrations of fissile material), and materials with high levels of americium (residues, wastes, etc.). All accident scenarios involving nuclear materials and radioactive wastes fall into the *extremely unlikely* (10^{-4} to 10^{-6}) and *incredible* ($<10^{-6}$) frequency bins with the exception Scenarios 6 and 10. Scenario 6, partial load fire, is *unlikely* for wastes because no credit can be taken for the truck floor to prevent the spread of the fire to the cargo. Scenario 10, the transfer of material using a forklift, is considered to be *anticipated* for spills of LLW/LLMW in boxes or drums, *unlikely* for spills of TRU/TRM in boxes or drums, and *extremely unlikely* for high Am TRU waste. Forklift accidents resulting in fire are *extremely unlikely* for all materials except high Am TRU waste, which is considered *incredible*.

The highest consequences from any of the accident scenarios is 52 rem to the MOI and 5,091 rem to the collocated worker for a hydrogen overpressurization accident involving one drum of high americium residues. This scenario is considered *incredible*. Of the credible scenarios, the highest consequences are from accidents involving average residues in a hydrogen overpressurization. This scenario is considered *extremely unlikely*.

The highest risk is due to the spill of TRU box during transfer by forklift at $5.0E-05$ rem/year to the MOI and $4.9E-03$ rem/year to the collocated worker. The highest consequences do not present the highest risk due to the difference in the frequencies between the scenarios, e.g., the hydrogen overpressurization of high americium residues is considered *incredible* while forklift spills are considered *unlikely*.

The highest consequences, due to a release due to a fire, is from Scenario 5, a fire involving the entire contents (as oxide) of the transfer vehicle. This scenario has 14 rem to the MOI and 490 rem to the collocated worker. The highest risk due to a fire is one involving three drums of TRU waste with $6.0E-06$ rem/year to the MOI and $2.1E-04$ rem/year to the collocated worker. The frequency of a fire involving the entire contents of the transfer vehicle is considered *incredible* and the fire involving three drums of TRU waste is considered *unlikely*.

The frequency for all scenarios postulated for the transportation of non-radioactive substances (not including fuels), except the beryllium spill, are *incredible* ($<10^{-6}$ /year). The beryllium spill is considered *extremely unlikely*. All of the accident scenarios result in *high* consequences and Risk Class II for the MOI. The risk to the collocated worker is also Risk Class II for all scenarios except for spills of anhydrous ammonia gas and beryllium which are Risk Class IV. The risk class for incredible scenarios is based on the extremely unlikely frequency bin in risk matrix given in DOE-STD-3011-94 (DOE, 1994b). Toxic gases (e.g., chlorine, sulfur dioxide, and anhydrous ammonia) are no longer ordered for use on the site; however, there could be instances

where the gas is present on the vendor delivery vehicle or discovered in a facility during deactivation.

Several fuels are used throughout the site for various purposes. These include propane for heating and laboratory use, diesel fuel for standby/emergency generators, gasoline for vehicles, and fuel oil for boiler operation. A spill of fuel on the site will not impact the public, but may present health hazards to the plant population. Fuel spills also present an environmental hazard. The probability that an accident will occur involving the propane tanker or the 2,000-gallon diesel tanker that will result in a fire in the vicinity of a nuclear facility are considered to be *incredible* for the propane tanker and *extremely unlikely* for the diesel tanker. Similar accidents involving the small tanker truck, either hauling diesel fuel or gasoline, are more probable because this delivery vehicle travels many more miles per year than the larger tankers. Including the probability that the ensuing fire from the 2,000-gallon diesel tanker will not be contained by the Fire Department before it breaches a facility, the final frequency is *incredible*. The consequences of a facility breach are dependent on the location of the breach and the location of radioactive materials in the facility. For illustration, it is assumed the breach due to a diesel fuel fire releases 10,000 grams WG Pu. The consequences of such an accident are 0.96 rem to the MOI and 34 rem to the collocated worker. This relates to a *moderate* consequence with a Risk Class III for the MOI and *high* consequences and Risk Class II for the collocated worker for the estimated frequency. The impact of a fire on a facility or other vehicle is based on the pool size and depth.

Transportation accidents on public highways and railways in the vicinity of RFETS have the potential to affect personnel on the site due to the toxic vapors produced in the event of a spill or fire involving hazardous materials. Because of the distance from these transportation routes to the industrial area of the site, no accident is considered to have the potential to cause a release of fissile and hazardous materials.

Safety Management Programs Summary

The risk and consequences determined through the hazard assessments are based on releases due to accidents or unusual occurrences resulting in a breach of confinement. Chronic exposures to low levels of hazardous materials or the effects of carcinogens were not evaluated because these issues are addressed by other site programs. Routine occupational hazards are regulated by DOE-prescribed occupational safety and health (OSH) standards, as implemented through industrial health and safety programs.

The hazards at RFETS are controlled through engineered features, limiting conditions of operations, surveillances, good management practices, and the site infrastructure as appropriate for the level of hazard in the facility. For instance, nuclear Hazard Category 2 facilities will have more stringent controls than a non-nuclear low hazard facility. Major controls for the prevention and/or mitigation of nuclear accidents include fire protection and criticality safety. Many of the controls in place within the infrastructure of RFETS are necessary regardless of the mission of the site. As hazards are reduced in facilities, the number of controls required will be reduced accordingly.

E.6 ORGANIZATION

The RFETS is currently being operated using a projectized approach. Kaiser-Hill Company, L.L.C. provides the upper management structure for the projects and contracts support service contractors depending on their expertise and Kaiser-Hill's needs.

E.7 SITE SAR ORGANIZATION

The Site SAR consists of two volumes. Volume I contains the general information concerning the site, such as description and characteristics that are germane to the site as a whole. Volume I contains a summary of facility hazards, and non-facility hazards and accidents (e.g., transportation accidents) and identifies site controls for systems which support systems in individual facilities. It also contains information about natural phenomena and external events that can affect the site and the safety analyses for nuclear Hazard Category 3 facilities (with the exception of the 904 Pad). Information is provided for use in FSAs and other authorization basis documents. Volume II is used to house the individual facility safety analyses for facilities, systems, or operations identified to be radiological, non-nuclear low, or industrial. Operational controls identified in the FSAs are to ensure safe operation of the facility. These analyses reference Volume I where appropriate to eliminate duplication of information.

Updates and maintenance of the Hazard Category 3 Safety Analysis documents found in the appendices for Volume I and the Facility Safety Analysis documents in Volume II are the responsibility of the cognizant project managers.

Volume I - Site Description and Characteristics

Chapter 1, *Introduction*, presents the purpose and scope of the Site SAR. It discusses the need for a Site SAR, the site administration, the site mission, past authorization bases, open issues, and the conversion to the decommissioning phase.

Chapter 2, *Site Description and Characteristics*, provides a description of the site, identifies the site boundaries, the geography and demography of the area, and the meteorology, hydrology and seismology/geology affecting the site. It also includes a description of the ecology of the site and surrounding area.

Chapter 3, *Site Configuration, Support Systems and Utilities*, provides an overview of the current site facilities and operations, descriptions of the utility systems and supporting facilities.

Chapter 4, *Site Hazard Analysis*, identifies of the hazards common to the site, provides summaries of the hazards and risks associated with nuclear Hazard Category 2, Hazard Category 3, radiological, and non-nuclear moderate and low hazard facilities, and discusses facility interactions. Also included is an assessment of the effects activities and/or accidents in nearby facilities may have on the site.

Chapter 5, *Natural Phenomena and External Events*, provides information, such as occurrence probabilities and hazard curves, used to evaluate natural phenomena and external events in site authorization basis documents.

Chapter 6, *Safety Management Programs*, discusses and references the site programmatic approach to safety management programs for protection of workers, the general public, and the environmental.

Chapter 7, *Site Controls*, contains the controls associated with site-wide systems, activities, or processes.

Chapter 8, *Transportation Safety Analysis*, contains an evaluation of the transport of nuclear materials, radioactive wastes, non-radiological hazardous substances, and fuels within the industrial area of the site. Also included is an assessment of the effects to the site from possible accidents occurring off site.

Appendices - Appendices A and B contain a list of acronyms and a glossary, respectively, of terms used in the Site SAR. Appendix C contains a list of all numbered entities on the site and identifies the current hazard classification and the current authorization basis. Appendices D, E, and F contain the hazard assessment for site systems, fuel, steam, and domestic water, respectively. Appendices G, H, and I contain the safety evaluation for Building 666, Building 881 and related facilities, and the RCRA Units, respectively. These appendices replace the FSAs which evaluated these hazards and facilities in previous versions of the Site SAR.

Table EX-1. Hazard Classification of Facilities at RFETS

Facility	Facility Description	Basis for Classification (Based on the quantities of hazardous materials.)
Nuclear Hazard Category 2 Facilities		
Building 371	Plutonium Recovery Building	Radioactive material inventory present in quantities greater than the Category 2 threshold.
Building 374	Liquid Waste Treatment	Potential for radioactive material inventory to be present in quantities greater than the Category 2 threshold.
Building 440	Waste Storage/Shipping and LLW Repackaging Facility	Radioactive material inventory present in quantities greater than the Category 2 threshold.
Building 559	Plutonium Analytical Laboratory	Maximum radioactive material inventory allowed is greater than the Category 2 threshold.
Building 569	Crate Counter Facility	Radioactive material inventory present in quantities greater than the Category 2 threshold.
Building 664	Waste Storage and Shipping	Radioactive material inventory present in quantities greater than the Category 2 threshold.
Building 707	Plutonium Manufacturing	Radioactive material inventory present in quantities greater than the Category 2 threshold.
750 Pad	Waste Storage Facility	Total radioactive material inventory greater than Category 2 threshold due to storage of TRU waste in

Table EX-1. Hazard Classification of Facilities at RFETS (Continued)

Facility	Facility Description	Basis for Classification (Based on the quantities of hazardous materials.)
		POCs.
Building 771	Plutonium Recovery Facility	Radioactive material inventory present in quantities greater than the Category 2 threshold.
Building 774	Liquid Waste Treatment	Radioactive material inventory present in quantities greater than the Category 2 threshold.
Building 776/777	Manufacturing Buildings	Radioactive material inventory present in quantities greater than the Category 2 threshold.
Building 886	Criticality Laboratory	Although most fissile material has been removed from the facility, holdup has the potential to be above the Category 2 threshold quantity.
Building 906	Centralized Waste Storage	Radioactive material inventory present in quantities greater than the Category 2 threshold.
Building 991	Product Warehouse	Fissile material present in quantities greater than the Category 2 threshold.
Nuclear Hazard Category 3 Facilities		
Building 666	Toxic Substance Control Act (TSCA) Waste Storage	Radioactive material inventory present in quantities greater than the Category 3 threshold and less than the Category 2 threshold.
Building 881 and 881F	Manufacturing and General Support and associated filter plenum	Conservatively classified based on the unknown radiological activity in ductwork and an abandoned scrubber.
904 Pad (RCRA Unit 15B)	Waste Storage Facility (Includes Tent 7, 902 Pad)	Radioactive material inventory present in quantities greater than the Category 3 threshold and less than the Category 2 threshold.
RCRA Storage Units	Units 1, 10, 13 (Bldg 884), 15A (on 904 Pad), 18.03 (Area west of Bldg 551), 18.04, 24 (Bldg 964)	Radioactive material inventory present in quantities greater than the Category 3 threshold and less than the Category 2 threshold.
Radiological Facilities		
Building 126	Source Storage Building	Certification of the sources can not be documented and in combination exceed the RQ of 40 CFR 302.
Building 231, Tanks 231A and B	Process Waste Collection Tanks Included in the Process Waste Collection and Transfer FSA	Based on the volume of each tank, the inventory of fissile material is greater than the 40 CFR 302 RQ and less than the nuclear Hazard Category 3 limit.
Building 444 Cluster	Depleted Uranium Operations Includes Buildings 444, 447, 448 with filter plenums 450, 451, and 455.	Inventory and non-dispersible form of depleted uranium. Filter plenums integral with the facilities are given the same classification. See Note 4.
Building 447	Included in Building 444 Cluster	
Building 448	Included in Building 444 Cluster	
Building 790	Radiation Calibration Laboratory	Form of materials and radiation levels in facility.
Building T886D	Modular Analytical Laboratory	Analyzes radioactive samples.
Building 887	Process Waste Collection and Transfer	Permitted to receive mixed waste streams. Included in Building 881 authorization basis.
Buildings 903A&B	Main Decontamination Facility and support facility	Conservatively classified based on potential to have contaminated materials.

Table EX-1. Hazard Classification of Facilities at RFETS (Continued)

Facility	Facility Description	Basis for Classification (Based on the quantities of hazardous materials.)
903 Pad	Radiological Pad	Classified based on presence of contaminated soil. Classification is based on the undisturbed condition of the environmental remediation site.
Building 966	Protected Area Decontamination Facility	Conservatively classified based on potential to have contaminated materials.
Non-Nuclear Moderate Hazard Facilities		
P750	Propane Tank Farm	Inventory of propane (60,000 lb) exceeds the 10,000 lb TQ.
P904	Propane Tank Farm	Inventory of propane (60,000 lb) exceeds the 10,000 lb TQ.
Non-Nuclear Low Hazard Facilities		
Building 125	Standards Laboratory	Mercury inventory is greater than the RQ.
Building 129	Water Treatment Plant	Maximum quantity of calcium hypochlorite exceeds the RQ.
Building 443	Heating Plant	Maximum quantity of sodium hydroxide can equal RQ.
Building 891	Consolidated Water Treatment Facility	Inventory of acids in excess of RQs. Includes T900A & B.
Building 928	Fire Water Pump House	Calcium hypochlorite exceeds RQ.

Table EX-2. RFETS Facilities Hazard Summary

Facility	Activity Description	Hazard Summary/Bounding Accident	Authorization Basis Document
Nuclear Hazard Category 2 Facilities			
Building 371 Plutonium Recovery Building	Storage of SNM, residues and waste. Thermal stabilization and repackaging operations, caustic waste treatment.	Hazards: radioactive contamination, radioactive materials, and inadvertent criticality. Bounding accident: Fire on dock	See ABDL for appropriate authorization basis documents.
Building 374 Liquid Waste Treatment	Treatment of liquid wastes from Bldg 371 and the process waste system.	Hazards: radioactive contamination, radioactive materials, and inadvertent criticality. Bounding accident: Fire on dock	See ABDL for appropriate authorization basis documents.
Building 440 Waste Storage/Shipping and LLW Repackaging Facility	Storage, staging and repackaging for low-level and transuranic wastes.	Hazards: radioactive contamination, radioactive materials Bounding accident: Aircraft crash followed by fire	See ABDL for appropriate authorization basis documents.
Building 559 Plutonium Analytical Laboratory	Analytical analysis of nuclear samples from on-site activities.	Hazards: Radioactive materials Bounding accident: Fires followed by spills. Explosions	See ABDL for appropriate authorization basis documents.

Table EX-2. RFETS Facilities Hazard Summary (Continued)

Facility	Activity Description	Hazard Summary/Bounding Accident	Authorization Basis Document
		less frequent.	
Building 569 Crate Counter Facility	Drum counting, crate counting, and real-time radiography for the determination of radionuclide quantities in wastes and residues.	Hazards: Radioactive materials Bounding accident: Large lofted fire, earthquake caused spill	See ABDL for appropriate authorization basis documents.
Building 664 Waste Storage and Shipping	Storage and shipping of LLW, LLM, TRU, TRM wastes, TRUPACT II loading and real-time radiography.	Hazards: Radioactive materials Bounding accident: Fires	See ABDL for appropriate authorization basis documents.
Building 707 Plutonium Manufacturing	Residue stabilization and repackaging.	Hazards: Radioactive material Bounding accident: Fires	See ABDL for appropriate authorization basis documents.
750 Pad Waste Storage Facility	Storage of LLW/LLMW and TRU/TRM wastes.	Hazards: Radioactive wastes Bounding accident: Fire	See ABDL for appropriate authorization basis documents.
Building 771 Plutonium Recovery Facility	Waste and SNM management associated with deactivation of the facility.	Hazards: Radioactive material Bounding accident: Earthquake with a nuclear criticality	See ABDL for appropriate authorization basis documents.
Building 774 Liquid Waste Treatment	Treatment of low-level and some transuranic wastes.	Hazards: Radioactive material Bounding accident: Large room fire in Room 210.	See ABDL for appropriate authorization basis documents.
Building 776/777 Manufacturing Buildings	Waste management, stabilization, or decontamination.	Hazards: Radioactive wastes Bounding accident: Fires	See ABDL for appropriate authorization basis documents.
Building 886 Criticality Laboratory	Formerly the critical mass laboratory. All fissile has been removed except holdup.	Hazards: Fissile holdup Bounding accident: Earthquake (spill)	See ABDL for appropriate authorization basis documents.
Building 906 Centralized Waste Storage	Storage of low-level and low-level mixed wastes.	Hazard: Radioactive wastes Bounding accident: Fires	See ABDL for appropriate authorization basis documents.
Building 991 Product Warehouse	Transuranic waste storage, SNM shipping	Hazards: Radioactive materials Bounding accident: Earthquake, container puncture	See ABDL for appropriate authorization basis documents.
Nuclear Hazard Category 3 Facilities			
Building 666 Toxic Substance Control Act (TSCA) Waste	Storage of TSCA wastes prior to ultimate disposal.	Hazard: Asbestos and PCBs. Low-level radioactive contamination.	Site SAR, Volume I, Appendix G

Table EX-2. RFETS Facilities Hazard Summary (Continued)

Facility	Activity Description	Hazard Summary/Bounding Accident	Authorization Basis Document
Storage		Bounding accident: Vehicle impact with fire	
Building 881 and 881F Manufacturing and General Support and associated filter plenum	Activities range from laboratory services and development support to administrative support (such as offices and computer center).	Hazards: Radioactive materials Bounding accident: Breach of ventilation system	Site SAR, Volume I, Appendix H
904 Pad Waste Storage Facility (Includes Tent 7, 902 Pad)	Storage of low-level and low-level mixed wastes.	Hazards: Radioactive wastes Bounding accident: Earthquake with propane fire	See ABDL for appropriate authorization basis documents.
RCRA Storage Units [1, 10, 13 (Bldg 884), 15A (on 904 Pad), 18.03 (Area west of Bldg 551), 18.04, 24 (Bldg 964)]	Storage and management of low-level, low-level mixed and hazardous wastes.	Hazard: Radioactive and hazardous wastes. Bounding accident: Aircraft crash with fire	Site SAR, Volume I, Appendix I
Radiological Facilities			
Building 126 Source Storage Building	Storage of radioactive sources, most of which are inactive and awaiting disposal.	Hazard: Radiation exposure to the immediate workers.	Building 126 FSA
Building 231, Tanks 231A and B Process Waste System	Storage of low level process waste for processing in the waste treatment facility.	Hazard: Fissile solutions in the tanks. Can not exceed 2.0E-07 g/liter fissile material.	Process Waste Transfer System FSA
Building 444 Cluster Includes Buildings 444, 447, 448 with filter plenums 450, 451, and 455.	Storage of scrap and components of depleted uranium and beryllium, graphite stock and molds, and management of low-level radioactive, hazardous wastes.	Hazard: Depleted uranium, uranium contamination, and beryllium contamination.	Building 444 Cluster FSA
Building 447	Included as part of the 444 cluster		
Building 448	Included as part of the 444 cluster		
Building 790 Radiation Calibration Laboratory	Radiometric calibration and characterization of radiation detection devices.	Hazard: High radiation exposure to immediate workers.	Building 790 FSA
Building 887 Waste Collection and Transfer Station	Collects and stores process waste for shipment to Bldg. 374.	Hazard: Potentially contaminated process wastes.	See Building 881 authorization basis
Building T886D Modular Analytical	Analysis of radioactive samples.	Hazard: Radioactive samples	Safety Analysis for Modular Analytical

Table EX-2. RFETS Facilities Hazard Summary (Continued)

Facility	Activity Description	Hazard Summary/Bounding Accident	Authorization Basis Document
Laboratory			Laboratory, July 1997
Buildings 903A&B Main Decontamination Facility and support facility	Decontamination of equipment used in environmental remediation work.	Hazard: Potential radioactive contamination.	Buildings 903A/B, 966 FSA
903 Pad	Contamination containment pad	Hazard: Potential radioactive contamination.	Environmental Projects FSA
Building 966 Protected Area Decontamination Facility	Decontamination of equipment used in environmental remediation work.	Hazard: Potential radioactive contamination.	Buildings 903A/B, 966 FSA
Non-Nuclear Moderate Hazard Facilities			
P750 Propane Tank Farm	Propane supply for operations at the 750 pad.	Hazard: Propane Bounding accident: Explosion	Site SAR, Volume I, Chapter 3 and Appendix D
P904 Propane Tank Farm	Propane supply for operations at the 904 pad.	Hazard: Propane Bounding accident: Explosion	Site SAR, Volume I, Chapter 3 and Appendix D
Non-Nuclear Low Hazard Facilities			
Building 125 Standards Laboratory	Provides standards and technology for calibration of equipment and standards for calibration of physical processes.	Hazard: Mercury. Potential to result in minor on-site consequences.	Building 125 FSA
Building 129 Water Treatment Plant	Treatment of domestic water.	Hazard: Calcium hypochlorite	Site SAR, Volume I, Chapter 3 and Appendix F
Building 443 Heating Plant	Generation of steam for use on site.	Hazard: Sodium hydroxide	Site SAR, Volume I, Chapter 3 and Appendix E
Building 891, T900 A&B Consolidated Water Treatment Facility	Treatment of ground and surface water from environmental sites.	Hazard: Hydrochloric acid, sulfuric acid, and hydrogen peroxide	Building 891, T900A&B FSA
Building 928 Fire Water Pump House	Contains the fire water pumps. Calcium hypochlorite used to maintain chlorine concentration.	Hazard: Calcium hypochlorite	Site SAR, Volume I, Chapter 3 and Appendix F

Table EX-3. Facility Hazard Classification Changes

Bldg No.	Classification in Site SAR June 1998	Current Classification	Basis for Classification Change
124	Non-nuclear moderate	Industrial Non-nuclear low	04/00 - Storage of calcium hypochlorite in Bldg. 129, not Bldg 124 05/99 - Removal of chlorine gas from the process
129	Industrial	Non-nuclear low	04/00 - Storage of the calcium hypochlorite currently used in the water treatment process
231	Industrial	Radiological	04/00 - Potential inventory allowed in the associated process waste tanks
462	Non-nuclear low	Industrial	05/99-Removal of the calcium hypochlorite from the facility
551	Non-nuclear low	Industrial	05/99 - Removal of hazardous material from facility
552	Non-nuclear moderate	Industrial	05/99 - Removal of chlorine, sulfur dioxide, and anhydrous ammonia from the facility and the site
666	Radiological	Nuclear Category 3	04/00 - Total inventory has potential to exceed Category 3 threshold quantities
750 Pad	Nuclear Category 3	Nuclear Category 2	05/99 - Addition of TRU waste in POCs to the inventory
779 Cluster	Nuclear Category 2	NA	05/99 - Building removed
788 (RCRA Unit 21)	Radiological	NA	04/00 - Building removed
865	Non-nuclear low	Industrial	05/99 - Reduction of the chemical inventory
883	Radiological	Industrial	05/99 - Reduction of the radiological inventory
891 T900A&B	Non-nuclear moderate	Non-nuclear low	05/99 - Quantity of hydrochloric acid in the facility is less than the TPQ values due to a change in these values
906	Nuclear Category 3	Nuclear Category 2	04/00 - Addition of TRU wastes to the inventory
RCRA Units (Units 1, 10, 15A, 18.03, 18.04, 24)	Radiological	Nuclear Category 3	04/00 - Classification based on total inventory of worst case facility which has the potential to exceed Category 3 threshold quantities.

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CHAPTER 1

INTRODUCTION

The Rocky Flats Environmental Technology Site (RFETS), formerly known as the Rocky Flats Plant, was established and constructed in the early 1950s to produce plutonium-containing assemblies and parts for nuclear weapons. The weapons mission was discontinued in 1992 and the site was transitioned from nuclear defense to a deactivation and environment restoration mission. The Final Rocky Flats Cleanup Agreement (RFCA) (CDPHE, 1996) describes the vision for the future of RFETS. This vision is:

- To achieve accelerated cleanup and closure of Rocky Flats in a safe, environmentally protective manner and in compliance with applicable state and federal environmental laws;
- To ensure that Rocky Flats does not pose an unacceptable risk to the citizens of Colorado or to the site's workers from either contamination or an accident; and
- To work toward the disposition of contamination, wastes, buildings, facilities and infrastructure from Rocky flats consistent with community preferences and national goals. (CDPHE, 1996)

As a result of the change in mission, the existing safety documentation required updating. As a part of the overall plan to provide current authorization basis documents for activities at the site, the Rocky Flats Environmental Technology Site Safety Analysis Report (Site SAR) was proposed as a mechanism to provide the appropriate documentation for site wide activities and systems, and for facilities classified as nuclear Hazard Category 3, non-nuclear, radiological and industrial.

1.1 NEED FOR SITE SAR

The Site SAR supports the current mission of the site, as outlined in the Rocky Flats 2006 Closure Project Baseline (RFETS, 1999a), by providing baseline safety documentation on hazards not covered by stand-alone safety analyses. The baseline documentation identifies hazards and controls to mitigate the consequences of possible accidents to protect the worker and the public from potential harm. Many facilities at RFETS contain hazardous materials, and DOE orders require these hazards be analyzed and appropriate controls identified to prevent or mitigate adverse consequences to workers, the public or the environment. The Site SAR provides the safety documentation for facilities that do not have approved, or planned, safety analyses. DOE standards and orders allow a graded approach to be utilized for safety analysis documentation based on the magnitude of the hazards involved and the complexity of the facility.

DOE-EM-STD-5502-94, *Hazard Baseline Documentation* (DOE, 1994b), defines four facility classification categories based on inventories of radiological and hazardous materials present in a facility. These classifications are nuclear, non-nuclear, radiological, and industrial. On an individual

basis, all site facilities fall into one of these categories. Nuclear facilities are further classified according to DOE-STD-1027-92 into hazard Categories 1, 2, and 3. Non-nuclear facilities may be categorized as high, moderate, and low hazard corresponding to the guidance provided in DOE Order 5481.1B (DOE, 1987), which has been superseded for nuclear facilities but still applies to non-nuclear facilities.^a

RFETS has several nuclear hazard Category 2 and 3, radiological, and non-nuclear moderate and low hazard facilities, but no nuclear hazard Category 1 or non-nuclear high hazard facilities. The nuclear hazard Category 1 classification is reserved for Category A reactors or for facilities specifically designated by the Program Secretarial Officer. Nuclear facilities are required to have a safety analysis report, radiological facilities an auditable safety analysis, and non-nuclear facilities are required to have a safety analysis or an auditable safety analysis depending on the quantities of hazardous materials involved. The Site SAR concept is utilized to provide safety documentation for nuclear Hazard Category 3, non-nuclear, radiological and industrial facilities to reduce the duplication of information, which would be needed if all these facilities had a stand alone safety document. With the changing mission of the site, and as a result, the changing mission of individual facilities, an authorization basis is needed to ensure the safe operation of individual facilities and the site as a whole.

1.1.1 Purpose

The Site SAR serves several purposes. In addition to providing a single source document for reference by other ABs, it provides:

- Safety bases for on-site transportation activities and site systems for performing safety evaluations;
- Safety bases for nuclear Hazard Category 3 facilities (with the exception the 904 Pad);
- Site-wide controls for transportation activities and for systems credited in facility authorization basis (AB) documents;
- A description of the Safety Management Programs;
- Information on site characteristics, natural phenomena and external events, and site-wide hazards; and
- Facility safety analyses (FSAs) for facilities classified as radiological, non-nuclear, and industrial for performing safety evaluations and providing facility specific controls.

a The facility classification method described here is not to be confused with the method used for facility dispositioning and decommissioning.

1.1.2 Scope

The scope of the Site SAR is to provide an evaluation of the risks of site activities, systems, and facilities not specifically addressed in facility ABs and to provide site-wide information which can be referenced by other documents. The information contained in the Site SAR includes (a) a description of RFETS and description of site-wide utilities; (b) information on site-wide hazards marginally addressed by other authorization basis, such as probability/frequency information on natural phenomena events, external man-made threats, and threats from near-by facilities; (c) facility interactions; (d) descriptions of the RFETS Safety Management Programs; (e) site-wide operational controls that ensure safe operations of site facilities; (f) on-site transportation accident analysis; and (g) safety bases for nuclear Hazard Category 3 facilities (with the exception of the 904 Pad). This information is to be utilized and referenced by all other facility authorization basis documentation, including stand alone documents produced for nuclear hazard Category 2 facilities. In addition, Volume II of the Site SAR contains a collection of auditable safety analyses in the form of Facility Safety Analyses (FSAs) which cover facilities and activities involving less than nuclear hazard Category 3 quantities of material or which have non-nuclear hazards associated with them.

The following paragraphs describe the classifications of facilities at RFETS and identify the type of safety documentation for those classifications. Appendix C of the Site SAR provides a list of all facilities on the site and identifies the classification of each facility based on the presence of hazardous materials. These facilities (with the exception of industrial facilities) are summarized in the Site SAR, Chapter 4, but are evaluated in the individual authorization basis documents (FSARs, BIOs, or BFOs).

- Nuclear hazard Category 2 facilities contain quantities of nuclear material greater than the hazard Category 2 threshold in DOE-STD-1027-92. Safety documentation for nuclear hazard Category 2 facilities consists of Final Safety Analysis Report (FSAR), Basis for Interim Operations (BIO), or Basis for Operation (BFO) documents. The following facilities at RFETS are classified as nuclear hazard Category 2:

Building 371, Plutonium Storage and Handling Facility;
Building 374, Liquid Waste Treatment;
Building 440, Waste Storage/Shipping and LLW Repackaging Facility;
Building 559, Plutonium Analytical Laboratory;
Building 569, Crate Counter Facility;
Building 664, Waste Storage and Shipping;
Building 707, Plutonium Manufacturing;
750 Pad, Storage Pad;
Building 771, Plutonium Recovery Facility;
Building 774, Liquid Waste Treatment;
Building 776/777, Manufacturing Buildings;

Building 906, Centralized Waste Storage; and
Building 991, Product Warehouse.

- Nuclear hazard Category 3 facilities, as defined in DOE Order 5480.23 and DOE-STD-1027-92 (DOE, 1992a), contain quantities of nuclear material between the hazard Category 2 and 3 thresholds in DOE-STD-1027-92. Safety documentation for these facilities is included in the appendices of the Site SAR, Volume I, or in stand-alone documents. The following facilities at RFETS are classified as nuclear Hazard Category 3:

Building 881, Manufacturing and General Support;
904 Pad, LL Mixed Waste Storage Pad (Includes 902 Pad); and
RCRA Storage Units, Waste Storage.

- Radiological facilities, as defined in DOE-EM-STD-5502-94, contain levels of nuclear material in excess of the reportable quantities in 40 CFR 302, but less than the lower nuclear hazard Category 3 threshold in DOE-STD-1027-92. Radiological facilities at RFETS include Buildings 126, 790, T886D, 887, 903A&B, 966, the 444 Complex, and the Process Waste System, including Building 231 and Tanks 231A and B. Authorization bases for these facilities or activities in the form of FSAs, with the exception of Building T886D which has an auditable safety analysis. A collection of the FSAs is found in Volume II of the Site SAR.
- Non-nuclear moderate and low hazard facilities, as defined in DOE Order 5481.1B^a and DOE-EM-STD-5502-94, do not contain nuclear materials in excess of the reportable quantities in 40 CFR 302, but do contain chemicals in quantities that could pose a hazard to workers, the public, or the environment. Non-nuclear moderate hazard facilities include the propane tank farms P750 and P904. Non-nuclear low hazard facilities include Buildings 129, 125, 443, 891, T900A&B, and 928. The safety documentation for Buildings 125, 891, and T900A&B is provided in the form of FSAs found in Volume II. The safety analysis for facilities associated with a site system (e.g., Buildings 129, 443, and 928) and the propane tank farms are found in the appendices of Volume I of the Site SAR.
- Industrial facilities do not contain radiological or chemical hazardous materials. The Chemical Management Program and the Radiation Protection Program ensure hazardous materials are not introduced into the facility. The Industrial Facility FSA in Volume II reiterates these controls and identifies the industrial facilities on the site.

The Site SAR provides safety analyses of systems and activities that affect the site, or are located site-wide. This includes analysis of the site-wide systems, such as natural gas and propane systems, steam and condensate production and distribution, and domestic water treatment. Chapter 3 provides descriptions of the site-wide systems and utilities.

^a DOE Orders which have been canceled are still in effect for the site under terms of the contract between Kaiser-Hill and DOE, and will remain in use until the contract is modified.

1.2 SITE ADMINISTRATION

RFETS is a government-owned, contractor-operated facility. The site is currently operated by Kaiser-Hill (K-H) Company, L.L.C. (limited liability company). Support services are contracted depending on the expertise of the contractor and the needs of Kaiser-Hill. K-H assumed operation of the site on July 1, 1995 and is a joint venture between two environmental and engineering firms, ICF Kaiser and CH2M Hill.

The Dow Chemical Company operated RFETS, as the prime contractor, from its inception in 1951 to 1975. On July 1, 1975, the Atomics International Division of Rockwell International became the prime operating contractor. EG&G Rocky Flats, Inc. operated the site from January 1, 1990 until July 1, 1995.

1.3 AUTHORIZATION BASIS HISTORY

A safety analysis report, entitled the Interim Safety Analysis Report (RFETS, 1981), was prepared for the site in 1981. The Interim SAR was developed to present facts and analyses concerning safety aspects of the design, construction, and operation of the site. This Interim SAR gave a broad overview of the entire site, including a brief description of all buildings and structures present on the site at that time (1981). It also addressed in general the common support systems and facilities. No accident analysis was developed for any facility in the Interim SAR. The Site SAR replaces the Interim SAR.

Also in the 1980's, safety analysis reports (SARs) were written and approved for the weapon production buildings (Buildings 371, 374, 559, 707, 771, 774, 776/777, and 779) in accordance with DOE Order 5481.1B. In addition, individual draft safety analysis reports were prepared for the facilities (Buildings 444, 865, 881, 883, and 991) housing activities associated with the production of nuclear weapons. These draft SARs were compiled with the direction of DOE Order 5481.1B.

In the early 1990's, DOE began issuing new orders to provide more extensive requirements for safety analyses related to nuclear facilities. This effort resulted in issuance of orders addressing the processes for developing safety analysis reports, deriving technical safety requirements, and evaluating unreviewed safety questions. The SAR requirements for nuclear facilities are stated in DOE Order 5480.23, which supersedes DOE Order 5481.1B for nuclear facilities only. DOE also issued a standard, DOE-STD-3009-94, to provide more detailed guidance for developing SARs.

In the midst of DOE's issuance of new orders, the mission of RFETS changed from resuming nuclear weapon production to nuclear material storage and waste management with the ultimate goal of closing the site. This mission change and the implementation of DOE Order 5480.23, which introduced the concept of preparing a basis for interim operations (BIO) for facilities with only a couple of years remaining in their expected life cycle or activities with a short term mission, provided RFETS with a mechanism to expedite compliance with the new DOE orders. Therefore, BIOs, based upon the guidance in DOE-STD-3011-94, have been or are being developed for most of the nuclear facilities at RFETS. BIOs approved by DOE address Buildings 371/374, 569, 707,

776/777. These authorization basis documents, i.e., BIOs, may be converted to a FSAR or FSA in the event the mission and/or conditions of the facility change.

RFETS has also developed two Basis for Operations (BFO) documents, based upon the DOE Necessary and Sufficient Process (DOE, 1995) as described in "Authorization Basis Process Development Improvement Team Final Report" (Geis, 1995). One BFO addresses Buildings 771 and 774 and the other Building 440. Buildings 771 and 774 are currently in a closure phase and Building 440 is a radioactive waste management facility for the receiving, shipping, and storing of low-level (LLW), low-level mixed (LLM), transuranic (TRU), and transuranic mixed (TRM) waste. DOE, RFFO has declared that BFOs will no longer be developed.

FSARs have been written and approved that comply with DOE Order 5480.23. These include FSARs for Building 664, the 750/904 Pads, Building 906, Building 910 (inactive), and Building 991. Also, auditable safety analyses have been developed for specific closure activities and Activity Control Envelopes (ACEs) for specific processes. A risk analysis report was developed for the Live Fire Range and the Shoot House.

All of the various types of RFETS authorization basis documents provide the basis for identifying the operational controls on facility operations required to maintain risks below acceptable levels to facility personnel, collocated workers, the general public, and the environment. Operational controls apply to both nuclear and non-nuclear facilities. Historically, safety analyses have been prepared for nuclear facilities only, and operational controls were referred to as Operational Safety Requirements (OSRs) under DOE Order 5481.1B (DOE, 1987) and are currently referred to as Technical Safety Requirements (TSRs) under DOE Orders 5480.22 (DOE, 1992b) and 5480.23. Depending upon when a safety analysis was documented, both OSRs and TSRs exist for nuclear facilities at RFETS. Also, OSRs exist for non-nuclear facilities, such as the live-fire range, because separate and specific guidance for safety analyses and operational controls for non-nuclear facilities are not available within current DOE orders.

At RFETS, the typical convention for safety analyses, which are currently being prepared or will be prepared in the future, will be that TSRs apply to nuclear facilities and the term "operational controls" will be used in the authorization basis documents for radiological and non-nuclear facilities as defined by DOE-EM-STD-5502-94. The specific term, "OSR," is no longer used in the development of new RFETS safety analysis and authorization basis documentation.

1.4 SAFETY EVALUATIONS FOR RFETS FACILITIES AND ACTIVITIES

RFETS facilities and activities will be assessed through safety evaluations, as required and applicable, to determine impact on their respective safety and authorization bases. Safety evaluations for RFETS nuclear facilities (i.e., nuclear Hazard Category 2 and 3 facilities) shall comply with DOE Order 5480.21, "Unreviewed Safety Questions", which provides requirements for conducting safety evaluations and performing unreviewed safety question determinations (USQDs) at DOE facilities. Although DOE Order 5481.1B, "Safety Analysis and Review System" is now canceled, safety evaluations for non-nuclear facilities and activities meet the intent of that order.

Based on the Site Nuclear Safety Program definitions, non-nuclear facilities or activities refers to less than nuclear Hazard Category 3 facilities.

The safety evaluation process is applicable to changes in facility configuration, conduct of tests or experiments, and changes of operational procedures. The process also applies to evaluation of discovery issues that potentially challenge approved safety and authorization bases. As identified in DOE Order 5480.21, the consequences of both radiological and hazardous material events must be considered in the safety evaluation process. In general, safety evaluations will be prepared for the following types of conditions:

- Proposed work activities or facility modifications which deviate from the currently approved authorization bases.
- Discovery of unanticipated hazards or challenges to the safety bases for facility operations or for activities.

Nuclear facility Authorization Basis (AB) documents against which safety evaluations are performed consist of nuclear facility SARs, BIOs, BFOs, TSRs, JCOs and other documents (e.g., DOE Safety Evaluation Reports, BIO Review Reports) that comprise the AB for the respective nuclear facilities. Nuclear Hazard Category 2 and 3 facilities, including nuclear Hazard Category 3 facilities found in the Site SAR, would be subject to safety evaluation using approved, DOE Order 5480.21 compliant procedures.

USQDs for activities or changes that are wholly contained within the bounds of a nuclear facility as described in a DOE-approved AB document are not required to consider the Site SAR in the evaluation. Activities that potentially impact facilities or infrastructures (e.g., transportation) that are not completely contained within a separate DOE-approved AB or are unique to the Site SAR shall consider the Site SAR.

Non-nuclear facilities and activities have "authorization bases" that are developed and approved by the site contractor. These "authorization bases" are provided as auditable safety analyses (ASAs) and can be appended or incorporated into project, facility, or activity-specific Health and Safety Plans (HASPs) which can serve as the "authorization basis". ASAs are provided, for most (but not all) non-nuclear facilities, by the Facility Safety Analyses (FSAs). The FSAs provide administrative controls to ensure that facility categorizations are maintained (e.g., through inventory controls), and provides safety management infrastructure requirements for compliance with applicable safety management programs.

Safety evaluations for less than nuclear Hazard Category 3 facilities and activities may follow an "unreviewed safety question determination-like" process, functionally similar to the DOE Order 5480.21-compliant Safety Evaluation Screening/Unreviewed Safety Question Determination (SES/USQD) process used by K-H, SSOC, and RMRS for RFETS nuclear facility safety evaluations. These safety evaluations will assess the potential hazards or conditions identified for non-nuclear facilities and activities.

As is the case with nuclear facility safety evaluations, if operational controls for non-nuclear facilities and activities (e.g., administrative controls, procedures, or safety management programs) are not adequate to address the new condition, either a revised or new "authorization basis" may be required or, alternately, the increased risk may be accepted, as-is, for the non-nuclear facility or activity. A difference in handling of authorization bases approvals between nuclear and non-nuclear facilities is which organization approves the safety evaluation disposition (i.e., DOE approves for nuclear facilities AB and the Contractor approves for non-nuclear facilities "authorization bases").

Safety evaluations, for both nuclear and non-nuclear facilities and activities, supports the hazard assessment and work control requirements of the Site Integrated Safety Management System. Work planning and implementation, conducted under the Site Integrated Safety Management System and the Integrated Work Control Process, will use safety evaluations to assess the impact on required safety controls. It is incumbent on program, project, or facility management to recognize unreviewed safety issues and to request necessary safety evaluations against the applicable authorization basis, in order for work to proceed in a safe and compliant manner.

The specific processes and procedures for performing safety evaluations are conducted under the direction and responsibility of the K-H Nuclear Safety Program Manager. Assessment and disposition of issues which may have an impact on established safety and authorization basis is captured in these safety evaluations. Safety evaluation processes provided at the site, using DOE Order 5480.21-compliant procedures for nuclear facility safety evaluations can be used, in a graded approach, to perform appropriate safety evaluations for both nuclear and non-nuclear facilities and activities.

Activities with direct or indirect impact on nuclear safety Authorization Bases (e.g., changes or discovery issues within or near nuclear facilities, on-site transportation, aircraft flyovers) shall be explicitly evaluated using these DOE Order 5480.21-compliant procedures. Non-nuclear activities such as radiological operations, environmental restoration, facility demolition, site utility modifications, etc. should use a graded approach, applying the functional process of these procedures, to provide appropriate safety evaluations.

1.5 AUTHORIZATION TO PERFORM ACTIVITIES/WORK

The authorization for work/activities in nuclear facilities is contained in the authorization basis documents for that facility. These documents are identified on the Authorization Basis Document List (ABDL) which is a controlled list of all DOE approved documents that constitute the authorization bases for all site nuclear facilities (hazard Category 2 and 3) and nuclear activities, i.e., transportation. The ABDL contains document title, type, number and revision, and the approval and/or implementation date. The list is updated upon notification of document approval or status change of the document.

1.6 SITE MISSION

The mission of the Rocky Flats Closure Project is to safely close the site as described in Rocky

Flats Closure Project (RFCP) *Project Management Plan* (RFETS, 1999b). The RFCA provides specific supporting goals to achieve this mission in the shortest amount of time, in a cost efficient manner, and within a streamlined, flexible, and effective regulatory framework. It describes the following objectives:

1. The highest priority at Rocky Flats is to reduce the risks posed by plutonium, other special nuclear materials, and transuranic wastes. These materials will be collected, consolidated, safely stored (in a retrievable manner), and monitored. The fewest number of buildings will be used to store these materials while preparing for removal to offsite locations at the earliest possible date.
2. Other wastes presently stored onsite, generated during cleanup, and removed from buildings during cleanup and demolition will be collected, consolidated, and treated when necessary. Then they will be placed in safe, monitored, and retrievable storage to await disposition.
3. The quality of water supplies of the communities surrounding Rocky Flats will be protected. In addition, the water leaving the site will be of acceptable quality for nay use.
4. At a minimum, given current technology and resources, Rocky Flats will be cleaned up to allow open space uses in the Buffer zone, restricted open space or industrial use for most of the existing Industrial Area, and other appropriate uses.

1.7 SITE CLOSURE

The overall approach to site closure is defined in the RFCP *Project Management Plan* (RFETS, 1999b) and is to be executed in three primary phases:

1. Removing SNM including plutonium residues, metals, oxides and holdup from the site;
2. Disposition of all site facilities except those required for long term environmental monitoring; and
3. Environmental remediation and final site restoration with several engineered 'caps' followed by long term environmental monitoring under separate contract.

These three phases overlap in time and space. Site activities have been focused primarily on phases 1 and 2. In addition there are four overlapping focus areas and five operational elements. The four focus areas follow:

1. Risk reduction – this phase removes the hazardous materials, including the SNM, from the site.
2. Mortgage reduction – this phase reduces or eliminates operations, maintenance, and

security costs by deactivating facilities and reducing the need for protection. Elimination of SNM with the subsequent elimination of the Material Access Area (MAA) and the Protected Area (PA) will result in substantial reductions in the on-going safeguards and security effort, and thus are a significant focus of mortgage reduction.

3. Facility demolition – the facility demolition phase removes the facilities.
4. Environmental remediation – this phase restores the affected areas of the site to the conditions set forth in the RFCA.

These phases overlap since some of the building clusters are relatively independent of other clusters. Some of the demolition is scheduled early in the project to provide an experience base.

The five project operational elements are as follows:

1. Special Nuclear Materials
2. D&D Closure
3. Environmental Restoration
4. Waste Management
5. Site Support

The focus areas are used to identify the strategies, planning assumptions, and key activities. The key milestones that must be completed to accomplish site closure are depicted in Appendix H of the RFCP Project Management Plan (RFETS, 1999b).

Maintaining security of nuclear weapons information and materials is of utmost importance. Maintaining security while disposing of material and performing labor intensive activities, such as deactivation and decommissioning of facilities, is a difficult challenge never attempted on the scale of the closure of Rocky Flats.

Uncertainties exist in the knowledge of the extent of contamination that is contained in areas that are not accessible. K-H has elected to use an ‘observational approach’ (concurrent characterization and remediation) performing most of the deactivation, decontamination, decommissioning, and environmental restoration elements of the project. This method, used to expedite many environmental clean-ups, recognizes that the effort to measure and characterize the nature and extent of contamination to a high degree of accuracy delays actual clean-up work. Delay in performing the clean-up will substantially increase the cost at Rocky Flats because of the high cost of maintaining the nuclear buildings safety envelope, safeguarding the SNM, and the associated technical and administrative support for the facility. The basic strategy is to use all available information to understand and control risk and to perform adequate characterization to safely perform the work. While increasing the uncertainty of long-range cost estimates, this method ensures completing the job in the shortest possible time for the least possible cost.”

1.8 UPDATING THE SITE SAR

Because RFETS is in a closure process, the site is continually changing. For example, nuclear and non-nuclear hazard classifications are being reevaluated as hazards are being removed from facilities. Facility missions are being reassessed. Buildings are being demolished and/or removed. The Site SAR will need to reflect these changes in a timely manner. Therefore, periodic reviews and updates are expected to be performed as necessary, but at least annually as required by DOE orders for nuclear facilities or activities.

The cognizant project manager is responsible for maintaining the nuclear and non-nuclear hazard classifications for facilities, including the nuclear Hazard Category 3 facilities identified in the appendices of Volume I and in FSARs or BIOs, and for the facilities covered by Facility Safety Analysis documents found in Volume II.

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CHAPTER 2

SITE DESCRIPTION AND CHARACTERISTICS

2.1 INTRODUCTION

This chapter describes the characteristics of geography and demography associated with Rocky Flats Environmental Technology Site (RFETS) (Section 2.2). Environmental information for the Rocky Flats area such as meteorology, hydrology and geology associated with the site are presented in Section 2.3. Also included are descriptions of the programs that monitor the site's environment and the ecology of the site.

2.2 SITE DESCRIPTION

RFETS is located approximately 16 miles northwest of downtown Denver and 10 miles south-southeast of Boulder (see Figure 2-1). The area in the immediate vicinity of the site is a mixture of agriculture, open space, light industry, and low-density residential housing. The following sections describe geographic information about the central Colorado area and the site. Also included are present and projected permanent population data within 50 miles of the site as well as the site occupational population.

2.2.1 Geography

In this section, the geography, including topography, rivers, and transportation systems, is presented for the RFETS and the surrounding region.

2.2.1.1 Regional Geography

RFETS is located in high plains that extend to the north, south, and east. The Front Range of the Rocky Mountains lies a few miles west of the site running north and south, and the Continental Divide is about 26 mi west.

Numerous small lakes are distributed throughout the area. Standley Lake, located about 5 mi east of RFETS, is a park and recreational area where boating, picnicking, and limited overnight camping are permitted. Other surface water reservoirs within 10 mi of the site include Gross Reservoir, Baseline Reservoir, and Marshall Lake to the northwest; Ralston Reservoir to the southwest; and Louisville Reservoir, Great Western Reservoir, Harper Lake, and Wanaka Reservoir to the northeast. The region also is host to two alluvial aquifers: Laramie-Fox Hills and Arapahoe.

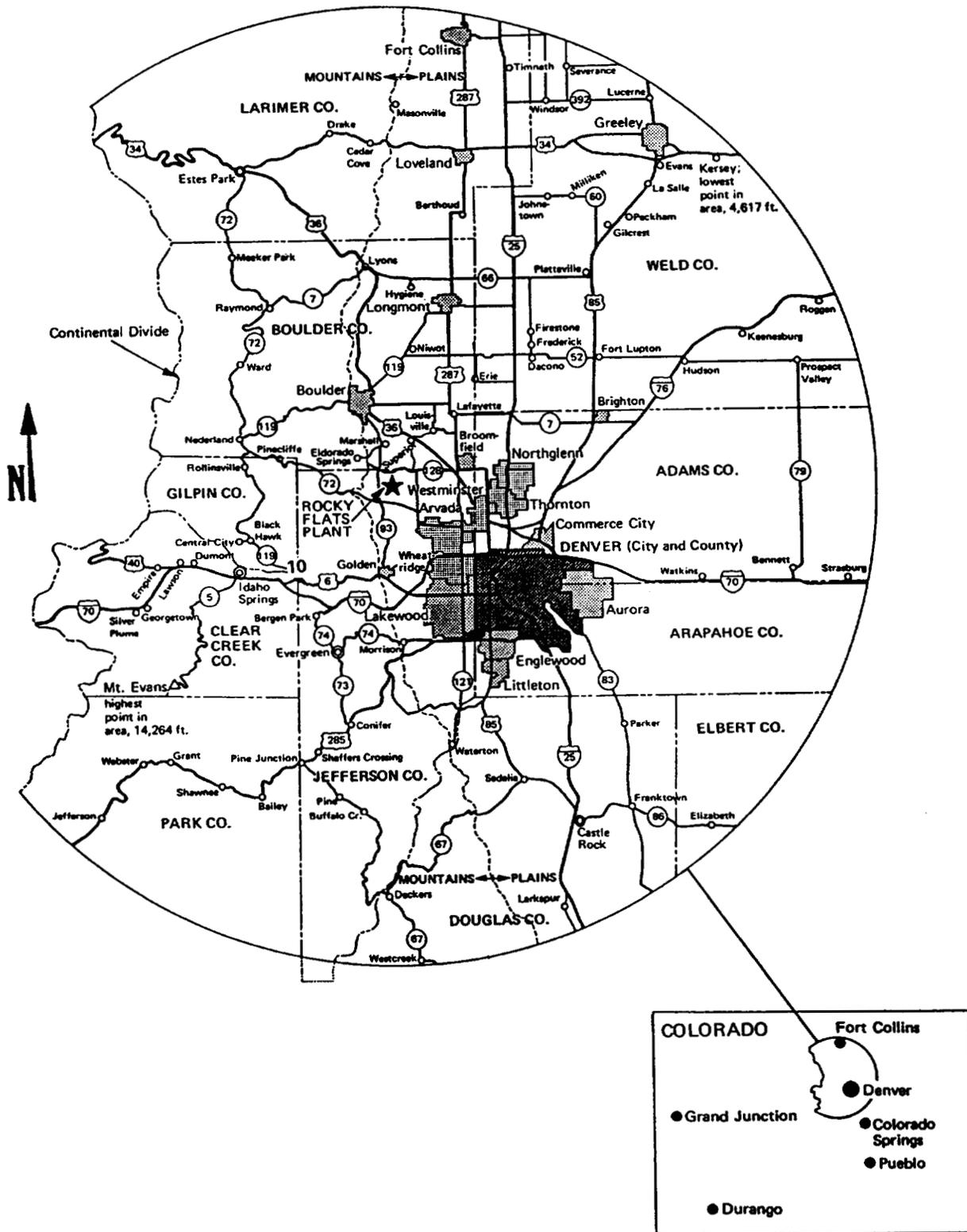


Figure 2-1. General Vicinity within a 50-mi Radius of RFETS

2.2.1.2 RFETS Geography

The site topography consists of a gentle west to east down-slope at an elevation of approximately 6,000 ft above mean sea level (MSL). At the northeast and southeast edges of the site, the topography drops relatively sharply to form natural drainage channels. The ground cover can be characterized as a prairie-type habitat with areas of marsh or stream bank vegetation. Predominant vegetation includes a variety of grasses, yucca, prickly pear cactus and occasional wild plum, hawthorn and cottonwood trees.

RFETS covers approximately 11 square miles, occupying Sections 1 through 4 and 9 through 15 of Township 2 South, Range 70 West, 6th Principal Meridian in Jefferson County, Colorado. RFETS is centered at 105° 11' 30" west longitude, 39° 53' 30" north latitude. This location is about 16 mi northwest of downtown Denver, and 9 to 12 miles from the communities of Boulder, Broomfield, Golden, Arvada, and Westminster. The area within 10 miles surrounding the site is located in three counties: Adams, Boulder, and Jefferson. RFETS and most of the area within 10 miles to the east, south, and west are located in Jefferson County. Adams County, east of the site, includes portions of the cities of Arvada, Broomfield, and Westminster. The area north of the site is in Boulder County.

RFETS, which consists of an industrial area and surrounding buffer zone, encompasses about 6,550 acres (including the Wind Site property) of Federally owned land (see Figure 2-2). The major facilities are all located in the Industrial Area. The Special Nuclear Material is located within the Protected Area, which is enclosed by a security fence. Two access roads, one from State Highway 93 to the west and one from County Highway 17 (Indiana Street) to the east, pass through the security fence. Land between the site boundary and the Industrial Area serves as a buffer zone between the hazards associated with the site and public.

The buffer zone is a protected environmental "preserve" for plant and animal life, some of which is endangered. Development in the buffer zone is limited to firebreaks, access roads, holding ponds and ditches, environmental sampling and monitoring stations, old and new sanitary landfills, a firing range, radio towers, a salvage yard, power lines, contaminated water holding tanks, a gravel pit, and a raw-water reservoir. The only permanent buildings in the buffer zone are unoccupied farm buildings of the Lindsay Ranch, which was operable before the site came into existence, and buildings associated with the new landfill. However, the Buffer Zone includes many permanent structures such as electric power poles, reservoirs, and dams.

Intermittent streams originating in the northern portion of RFETS (e.g., Rock Creek) flow generally northeast. The central and southern portions of the region are drained by tributaries of Big Dry Creek, which flows generally eastward from the foothills and uplands. A series of retention ponds on the site provide a mechanism for settling of sediments and monitoring for radioactive or chemical releases.

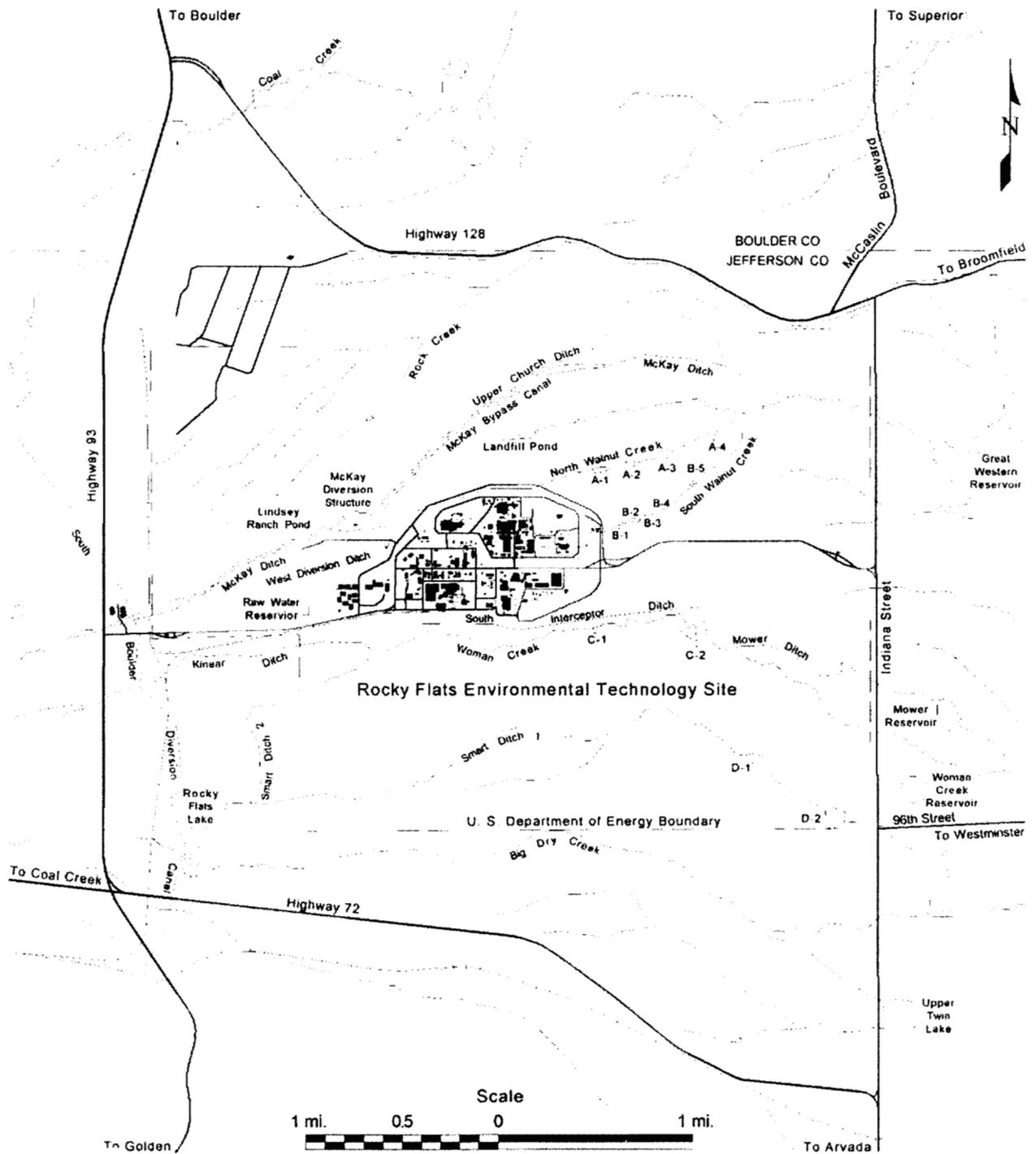


Figure 2-2. Rocky Flats Environmental Technology Site

2.2.1.3 Regional Transportation

RFETS is bounded by State Highway 128 on the north, State Highway 93 on the west, and Jefferson County Highway 17 (Indiana Street) on the east. State Highway 72 is located approximately two miles south of the southern edge of the site boundary. Other major roads that service the area are State Highway 121 (Wadsworth Ave.), 7 mi east of the site; State Highway 36 (Boulder Turnpike), 7 mi east-northeast of the site; and Interstate 25, 12 miles east of the site. The major transportation routes in the Denver area are shown in Figure 2-3.

Local traffic activities involving the site include both cargo-related and non-cargo-related travel. Non-cargo-related travel consists primarily of private vehicle traffic by employees and contractor personnel. No public transportation system provides service to the site, but a substantial van-pool system transports employees to and from communities in the greater Denver area and the Regional Transportation District provides service along State Highway 93 just west of RFETS.

Rail freight service to the site is provided by a spur from the main east-west rail line. One branch of this spur terminates within the site boundary (in the vicinity of Building 551) and does not serve any other facilities. The other branch continues north along the western boundary of RFETS to another industrial user, Western Aggregates. The main rail line from Denver west is located approximately 2.5 mi south of the site. Figure 2-2 shows the main rail line and the spur associated with the site. Other railways are located approximately 14 miles to the east of the site. Amtrak passenger trains currently operate daily on the main rail line south of the site.

Numerous civilian and military airports are in the general area. The greater Denver area is served by Denver International Airport (DIA) located 30 mi east of the site. There are several controlled (equipped with an operating control tower) general aviation airports in the area; the closest being Jefferson County (JeffCo) Airport, which is 5 mi east of the site. Most of the airports are uncontrolled general aviation fields.

2.2.2 Demography

Between its conception in the early 1950's and 1972, RFETS consisted of a 2,520 acre site which has developed into an industrial complex consisting of more than 425 facilities. In 1972, the surrounding 4,026 acres were acquired to function as a security and safety Buffer Zone to minimize problems arising from the growing proximity of residential communities to RFETS.

DOE is required to establish a plan to ensure that necessary public affairs actions are coordinated as an integral part of the total emergency response effort (DOE, 1992). DOE will provide (a) technical support and assistance to other government agencies or private organizations, and (b) accurate and timely information to the public in all situations involving DOE's response to any emergency that may affect on-site personnel, public health and safety, or the environment. This section addresses the population within 50 mi of the site.

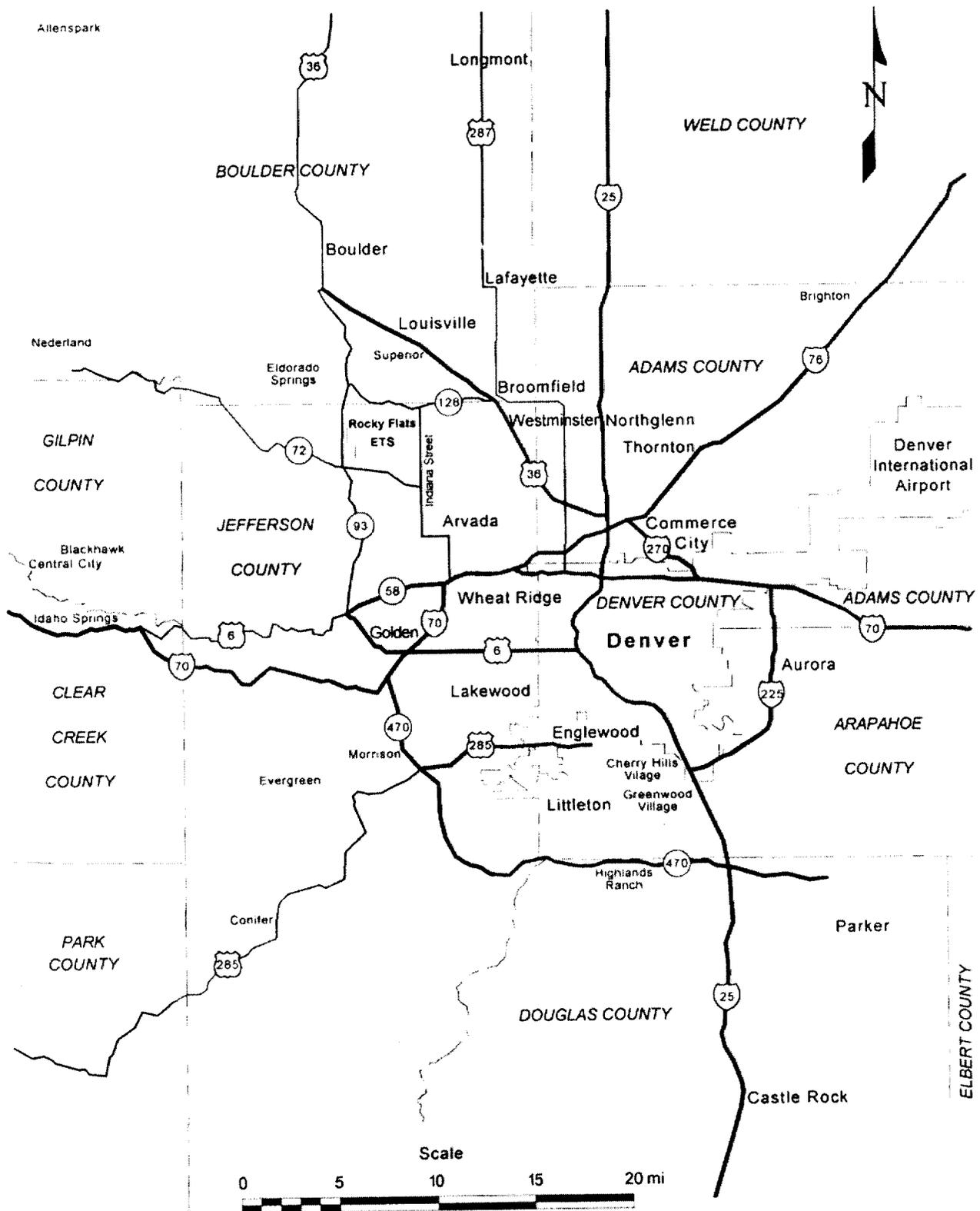


Figure 2-3. Major Transportation Routes in the Denver Region

2.2.2.1 Permanent Inhabitation

In the period since RFETS was constructed, surrounding multi-use development has steadily approached the site. Land immediately adjacent to the Buffer Zone is primarily used for agricultural and mining purposes. Within 5 mi of the site, there are a number of commercial and industrial facilities and relatively few residential properties. Most of this land is agricultural, industrial parks, or open range. The majority of residences within 5 mi are north and southeast of Standley Lake, and northeast in and around the town of Superior.

Within the 5- to 10-mi radius of RFETS, the number of residences increases significantly from the north to the southeast. This encompasses the communities of Lafayette, Louisville, Broomfield, Westminster, Wheat Ridge, and Arvada. The outer areas of this radius enter Boulder and Golden. Beyond 10 mi, east of the foothills and north to south, is the majority of the Denver metropolitan area and the Front Range communities. The population of the Denver metropolitan area has increased to over 2.2 million within a 50-mi radius of the site. In 1994, the majority of this population lived to the east and southeast (DOE, 1995). The total 1994 population for this region was 2,236,243. Table 2-1 presents the population distribution centered on the Industrial Area. Fifty-two miles is used in the Land Use Data Base (DOE, 1995) to account for the approximately 2-mi radius of the site.

The projected population distribution for 2005 is presented in Table 2-2 with a total projected population of 2,633,663 (DOE, 1995). This represents an expected overall growth rate of about 1.5% per year for the 1994 through 2005 period but this growth rate will not be the same for all areas, as some areas are already built-up and can expect little growth whereas others have much open space and great potential for growth. DOE (1995) also provides population projections for 2015, population densities, land use, socio-economic data, and the impact of RFETS on the local economy.

2.2.2.2 Occupational Inhabitation

The work force at RFETS is made up of approximately 5,000 persons, but varies with current activities and work shifts. The largest work force is on site during the day of the normal work week. However, some operations such as the fire, radiation protection, and security departments are staffed 24 hours a day throughout the whole year. This population is expected to decrease substantially as the site nears its closure date at the end of 2006.

2.3 ENVIRONMENTAL DESCRIPTION

This section contains descriptions of the meteorology, hydrology, and geology in the Rocky Flats region. Basic knowledge of this information is needed to understand the assumptions used in dispersion calculations for various release pathways and design basis accidents. Meteorology data are used in airborne release scenarios. Hydrology data apply to dispersion into ground and surface waters.

Table 2-1. Population Distribution within 52 Miles of RFETS for 1994.

Range Sector	0-1 miles	1-2 mile	2-3 miles	3-4 miles	4-5 miles	5-10 miles	10-20 miles	20-30 miles	30-40 miles	40-52 miles
N	0	0	8	43	276	7331	17998	16293	44874	103460
NNE	0	0	13	9	114	20177	19588	32531	7903	10736
NE	0	0	7	25	68	12906	2544	3416	2383	77050
ENE	0	0	5	24	3	24376	12456	21622	2865	1907
E	0	0	6	1306	5900	36142	92277	1666	1348	1439
ESE	0	0	22	77	37	63986	102644	120502	1797	1085
SE	0	0	10	269	2511	58330	308940	303742	26830	7176
SSE	0	0	20	403	1001	24543	206143	164628	9585	11929
S	0	0	9	215	255	9478	38430	15435	3347	2906
SSW	0	0	9	131	136	366	11788	8023	1997	1546
SW	0	0	22	51	49	380	3257	1108	915	1067
WSW	0	0	2	32	44	378	1379	2502	1704	7391
W	0	0	6	9	44	377	3816	1198	965	780
WNW	0	0	2	15	33	399	1459	1560	337	1591
NW	0	0	15	28	120	873	1461	3168	5	2315
NNW	0	0	26	46	166	57786	28275	3971	6822	4918
Total	0	0	182	2683	10757	317828	852455	701365	113677	237296

Table 2-2. Projected Population Distribution within 52 Miles of RFETS for 2005.

Range Sector	0-1 mile	1-2 mile	2-3 miles	3-4 miles	4-5 miles	5-10 miles	10-20 miles	20-30 miles	30-40 miles	40-52 miles
N	0	0	84	145	711	9083	25370	18152	55478	127888
NNE	0	0	141	277	1077	21944	25450	36458	9592	13017
NE	0	0	207	795	332	18588	5160	4129	2879	93130
ENE	0	0	5	177	19	32586	30479	30284	3646	2305
E	0	0	7	1325	6008	46272	104981	6981	5158	4624
ESE	0	0	20	369	348	66062	103617	154064	6272	1164
SE	0	0	10	731	4839	58612	307785	329187	79663	7557
SSE	0	0	322	1312	2484	26098	215906	193661	24731	21428
S	0	0	320	717	783	12077	44298	22449	5265	4183
SSW	0	0	320	486	323	510	13857	9832	3106	2345
SW	0	0	158	62	74	618	4108	1347	1193	1495
WSW	0	0	40	78	73	623	1867	3028	2077	9394
W	0	0	100	128	73	616	3980	1489	1259	1007
WNW	0	0	40	92	99	438	1536	1648	440	2076
NW	0	0	62	42	168	1057	1520	3477	5	2883
NNW	0	0	121	116	256	59970	31623	4446	8432	6172
Total	0	0	1957	6852	17667	355154	921537	820632	209196	300668

2.3.1 Meteorology

Weather conditions help define the dispersion characteristics of accidental airborne releases of radioactive materials and hazard chemicals. This section provides information for a basic understanding of the parameters used in these airborne dispersion calculations performed for safety analyses. In addition, certain weather conditions, such as high winds and heavy precipitation, can contribute directly to breach of buildings (see Chapter 5).

RFETS weather conditions are very similar to those of the city of Denver. Typical weather conditions in the greater Denver area have been summarized by the National Climatic Data Center (NCDC, 1991) as follows:

“Denver enjoys an invigorating climate that prevails over much of the central Rocky Mountain region, without the extremely cold mornings of the high elevations during winter, or the hot afternoons of summer at low altitudes. Extremely warm or cold weather in Denver is usually of short duration.

Situated a long distance from any moisture source, and separated from the Pacific Ocean by several high mountain barriers, Denver enjoys low relative humidity, light precipitation, and abundant sunshine.

Air masses from different sources influence Denver weather. These include arctic air from Canada and Alaska; warm, moist air from the Gulf of Mexico and the southwestern deserts; and the Pacific air modified by its passage over the mountains to the west.

In the winter, the high altitude and mountains to the west combine to moderate temperatures in Denver. Invasions of cold air from the north, intensified by the high altitude, can be abrupt and severe. However, many of the cold air masses that spread southward out of Canada never reach the altitude of Denver, but move off to the lower plains to the east. Surges of air from the west are moderated in the descent down the east face of the Rockies, and reach Denver in the form of Chinook winds that often raise temperatures into the 60's, even in midwinter.”

Meteorological data have been collected and archived at RFETS since late 1952. However, much of the wind and temperature data are not representative of the site because instruments were not installed in locations that could provide data typical of the overall site conditions. These early data were subjected to a quality assurance review and questionable data discarded. The results of this review are documented in AeroVironment (1995).

The gathering of consistent representative data began in February 1989 when weather instrumentation was installed on a 61-m (200 ft) tower, which is located west-northwest of the main-facilities area on a flat grassy mesa between the Rock Creek and Woman Creek Drainage areas. This is the primary source of meteorological data. The tower is instrumented at three different

heights, 10 m (33 ft), 25 m (82 ft), and 60 m (197 ft). Back-up meteorological data was provided by a similarly instrumented 10-m tower (erected in 1989) located about 135 m west of the 61-m tower. This 10-m tower was replaced in 1999 with another 10-m tower located next to Building 115.

Telemetry is used to transmit the data from the towers to the Regional Atmospheric Response Center (RARC) located in Westminster, Colorado. Information is then relayed from RARC to the Emergency Operations Center (EOC). A redundant system relays information directly to the EOC from the towers. Additional back-up is provided by data stations located around the perimeter of the site. Data from these back-up stations is independently relayed to the system by telemetry. The data collection software monitors the signal from the meteorological towers and automatically switches to the secondary source of data or to the back-up sources as needed.

The State of Colorado has five meteorological towers located around the perimeter of the site. These complement the site data and are made available to RFETS. Other State regulatory monitoring is done on these towers as well. A Doppler Acoustic Sodar, located in the southwest Buffer Zone, provides the detailed wind, turbulence, and stability data up to about 750 m above ground level, depending upon weather conditions. The Voltek Storm Tracker system provides real time lightning detection. Also, there are many other meteorological sensors within 50 miles of RFETS run by the National Center for Atmospheric Research (NCAR) in Boulder, the National Oceanic and Atmospheric Administration (NOAA) in Boulder, and the National Weather Service in Denver.

The weather statistics for RFETS provided in the following subsections are based in part on data from the 61-m tower, supplemented by data from the 10-m tower if the 61-m tower data were missing for an extended period; these data are from the period March 1989 through February 1996. Data from the earlier periods are also provided, based on the review in AeroVironment (1995). In the statistics presented, the 5th, 50th, and 95th percentile^a values are presented, where feasible. Also, mean and extreme values are provided where appropriate.

AeroVironment (1995) provides an exhaustive presentation of results for the weather parameters included in this section as well as other weather parameters not discussed below. The particular weather parameters are included in this section because of their importance to specific aspects of safety evaluations.

- Wind is important to atmospheric dispersion because the greater the wind speed the faster and more wide-spread the dispersion. Also, high winds may cause breaching of buildings by structural collapse or wind-generated missiles.
- Atmospheric stability is important to atmospheric dispersion because unstable conditions result in rapid dispersion and stable conditions slow dispersion.

^a Percentile is a value that indicates the percent of a distribution that is equal to or below it. The 50th percentile value is called the median.

- Atmospheric temperature is important in evaluating freezing of pipelines in liquid processes involving radioactive materials and hazardous chemicals or in fire protection systems. Also, temperature may be needed to evaluate the performance of Heating, Ventilating, and Air Conditioning (HVAC) systems to respond to an accidental release of radioactive materials or hazardous chemicals.
- Humidity is a calculation factor in the dispersion of hazardous chemicals. Humidity also contributes to accelerated degradation of equipment and is considered in very detailed quantitative evaluations of equipment reliability. It may also be needed to evaluate the performance of HVAC systems to respond to an accidental release of radioactive materials or hazardous chemicals.
- Atmospheric pressure and density are important to evaluating hazardous chemical releases. These parameters may also be needed to evaluate the performance of HVAC systems to respond to an accidental release of radioactive materials or hazardous chemicals.
- Precipitation may contribute to flooding and possible collapse of roofs under heavy rain or snow loads.

2.3.1.1 Wind

The wind statistics provided are based on data from a height of 10 m (33 ft), for data (from 1989 through 1996) taken from the meteorological tower, or from a height of 7.6 m (25 ft) in the case of the period from 1953 through 1975. The distribution of monthly-average wind speeds, and monthly-average peak gusts, for the periods 1964 through 1977 and 1984 through 1993, as taken from the AeroVironment (1995) report, are given in Table 2-3.

The mean annual wind from the above statistics is about 4.4 m/s (9.8 mph). Although mean wind speed is often considered “typical,” it is biased by the few high winds. A better measure for “typical” is the median (50th percentile); by definition, winds are less than the median 50% of the time and greater for the other 50%. The measure for “strong” wind speeds is the 95th percentile wind; only 5% of the time is the wind greater than this value. (See Section 5.3 for a discussion of extreme wind conditions at the site.) The AeroVironment (1995) report does not provide percentile wind speeds, so these statistics have been generated in Calculation 96-SAE-029 (SAE, 1996). These statistics are for the period March 1989 through February 1996 and are summarized in Table 2-4. Note that the median wind speed is 3.2 m/s, somewhat lower than the mean, 4.0 m/s, as expected. The mean for this period is a little smaller than for the longer period given in the AeroVironment (1995) report. The wind speed that corresponds to median atmospheric dispersion conditions is 4.5 m/s. This is higher than the median wind speed because atmospheric stability also plays a role in dispersion. Stable conditions are more common than unstable, which skews the wind speed upward for median dispersion conditions.

**Table 2-3. Monthly Average Wind Speeds at Rocky Flats
1964-1977 and 1984-1993.**

Month	Peak Gust (m/s)	Mean Wind (m/s)	Peak Gust (mph)	Mean Wind (mph)
January	20.4	5.5	45.7	12.3
February	26.6	5.1	59.6	11.5
March	28.9	4.8	64.7	10.7
April	26.6	4.7	59.4	10.5
May	23.6	4.3	52.7	9.6
June	24.0	3.9	53.7	8.7
July	20.2	3.8	45.2	8.4
August	18.8	3.6	42.0	8.1
September	21.9	3.7	49.0	8.2
October	22.6	3.8	50.5	8.4
November	30.0	4.6	67.0	10.3
December	31.2	4.9	69.9	10.9
Annual	24.6	4.4	55.0	9.8

**Table 2-4. Wind Speed Statistics for Rocky Flats
February 1989 - December 1992.**

Statistic	Speed (m/s)	Speed (mph)
5th percentile	1.3	2.9
50th percentile	3.2	7.1
Mean (average)	4.0	8.9
95th percentile	9.4	21.0

Wind speed and direction are often combined into a single plot, called a wind rose, in which wind direction is shown on the polar plot (the wind blows toward the center of the plot) and percent of the time for selected ranges of wind speed is shown by distance from the center of the plot. The annual-average wind roses for 1992 are shown in Figure 2-4 for daytime, Figure 2-5 for nighttime, and Figure 2-6 for combined day and night. As can be seen, daytime winds are infrequent from the southwestern sectors but are common from the southeastern sectors as well as the west-northwest and northern sectors. At night the winds are predominantly from one of the western sectors. The combined wind rose thus also shows a preponderance of winds from the west. This dominance of westerly winds is season-dependent, being more striking in the winter and spring and less striking in the summer and fall.

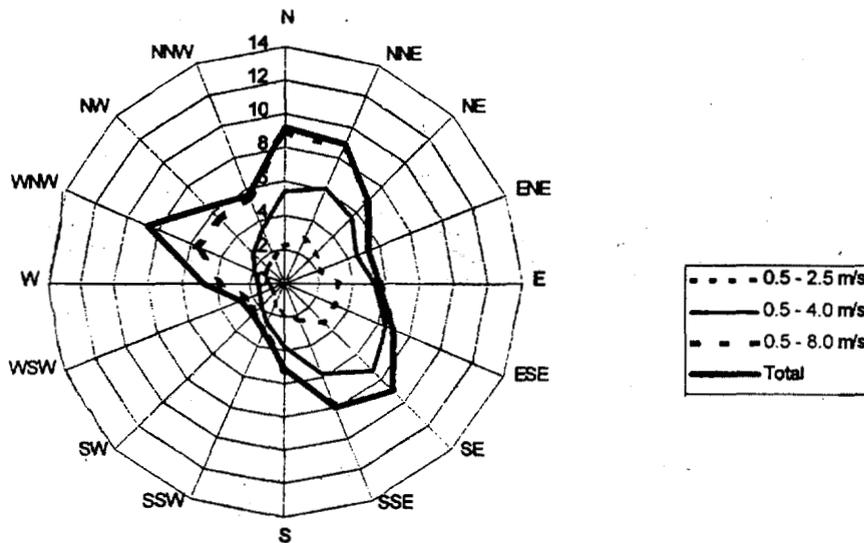


Figure 2-4. Annual Daytime Wind Rose for RFETS for 1992

2.3.1.2 Atmospheric Stability

The speed with which air turbulence disperses material depends upon the stability of the atmosphere. Seven stability classes have been defined for computations involving atmospheric conditions, as in straight-line Gaussian atmospheric dispersion calculations. The seven categories, called the Pasquill-Gifford stability classes, are: A - extremely unstable, B - moderately unstable, C - slightly unstable, D - neutral, E - slightly stable, F - moderately stable, and G - extremely stable. Unstable conditions result in rapid dispersion of pollutants whereas stable conditions result in slow dispersion. The final category, G, is seldom used in dispersion calculations. It corresponds to very slow dispersion and is fairly rare.

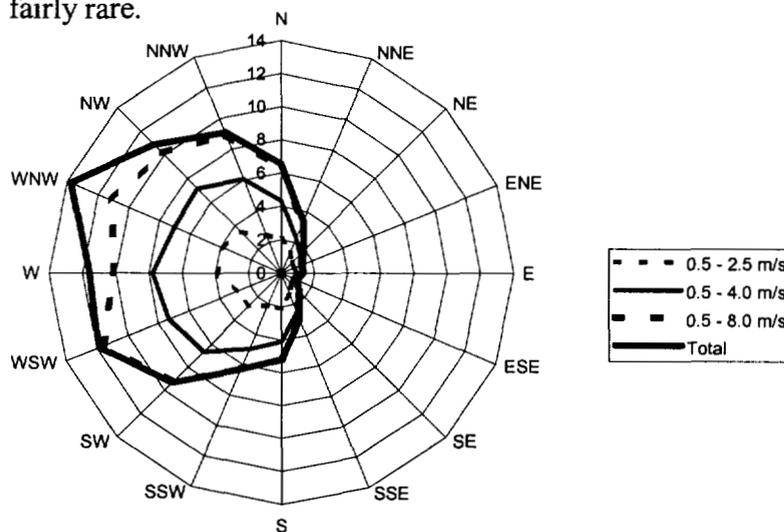


Figure 2-5. Annual Nighttime Wind Rose for RFETS for 1992

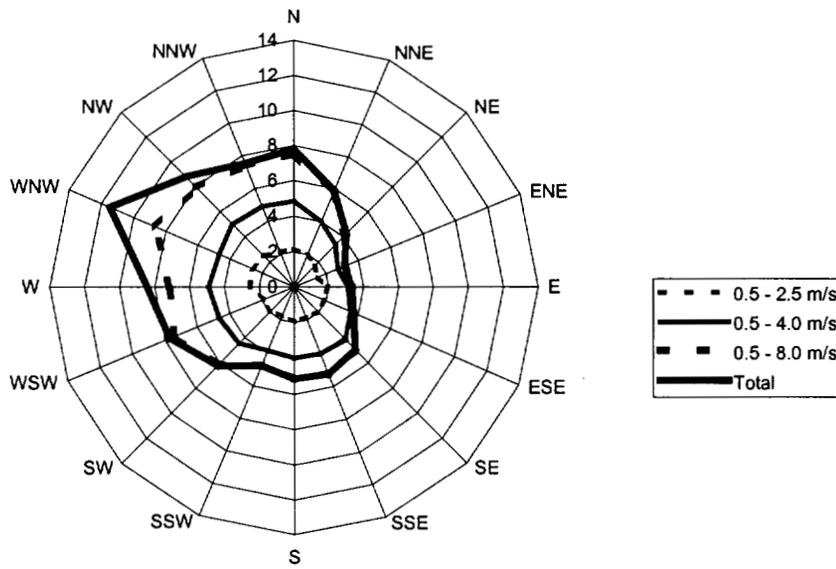


Figure 2-6. Total annual Wind Rose for RFETS for 1992, Combined Day and Night

Many schemes have been proposed and used for determining stability class from meteorological parameters. The one recommended by the Environmental Protection Agency (EPA, 1987) is considered best for the site (Peterson, 1993). In this EPA method, the stability class is calculated from the standard deviation of wind direction, wind speed, and whether it is day or night. The distribution of these classes for 1992 is shown in Figure 2-7, which breaks the distribution into day, night, and twilight. For this figure, twilight was defined as the period between one-half hour before to one-half hour after sunrise or sunset. Note that the most common stability class is D (neutral) for both day and night, as well as twilight. It is obvious from this figure that both the mean and the median stability class is D. Data for other years provide similar results.

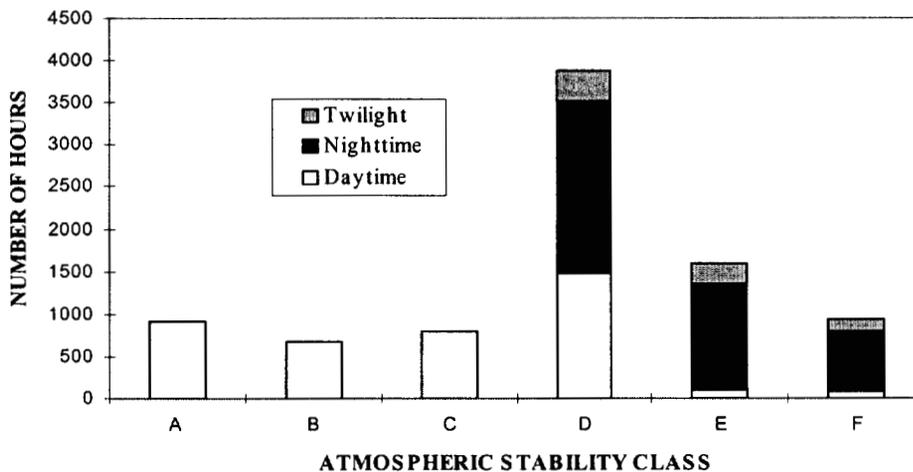


Figure 2-7. Data Distribution of Atmospheric Stability Class for 1992, Using EPA Method

2.3.1.3 Atmospheric Dispersion

The combined effects of atmospheric stability and wind speed influence the dispersion rate of an accidental release of hazardous materials into the atmosphere. The amount of dispersion is usually expressed in terms of χ/Q , where χ is the air concentration at some downwind location, either the instantaneous concentration [e.g., Bq/m³ (Becquerel per cubic meter), or g/m³ (grams per cubic meter)] or the time-integrated concentration (e.g., Bq-s/m³, Ci-s/m³, or g-s/m³), and Q is the source rate of release (e.g., Bq/s, Ci/s, or g/s) or total source strength (e.g., Bq, Ci, or g). The units of χ/Q are s/m³ for both instantaneous or time-integrated releases and for both radioactive or chemical releases. Various methods have been proposed for evaluating χ/Q . For this report, the Tadmor and Gur (1969) method of computing χ/Q is used for the purposes of determining the distribution of χ/Q . Figure 2-8 shows the distribution of plume centerline χ/Q at a distance of 1,900 m for a ground-based release, using weather data from 1992, a year with relatively few hours of missing data; 1,900 m is the distance to the nearest point on the site boundary from a location at the center of the Industrial Area. The distributions shown in this figure are separated into daytime, nighttime, and twilight (as defined above). As can be seen, χ/Q is typically larger during the night or twilight than during the day. It might be expected that the distribution of χ/Q would be more-or-less smooth, showing a single peak in mid-range and tailing off at the lower and higher values, as the wind speeds have such a distribution. However, this is not the case. The low frequency of occurrence of χ/Q for some ranges of χ/Q , such as for log₁₀ (χ/Q) values between -6.3 and -6.0, is an artifact of the method of determining stability class (EPA method). All the methods of determining stability class give similar drop-outs. The irregular distribution of χ/Q is a reflection of the discontinuous manner in which the stability classes are defined.

Values of χ/Q have also been calculated using the MELCOR Accident Consequence Code System (MACCS) code (Chanin, 1990), using both constant-weather conditions and 1992 weather. MACCS includes physical phenomena that can modify χ/Q and are not part of the Tadmor and Gur (1969) model. These include surface roughness, plume meander, and reflection of the plume from the top of the mixing layer and from the ground. The relevant statistical values of χ/Q from the use of MACCS at 100 m (the collocated worker) and 1,900 m (generic Maximum Offsite Individual, MOI), as taken from Peterson (1995), are given in Table 2-5.

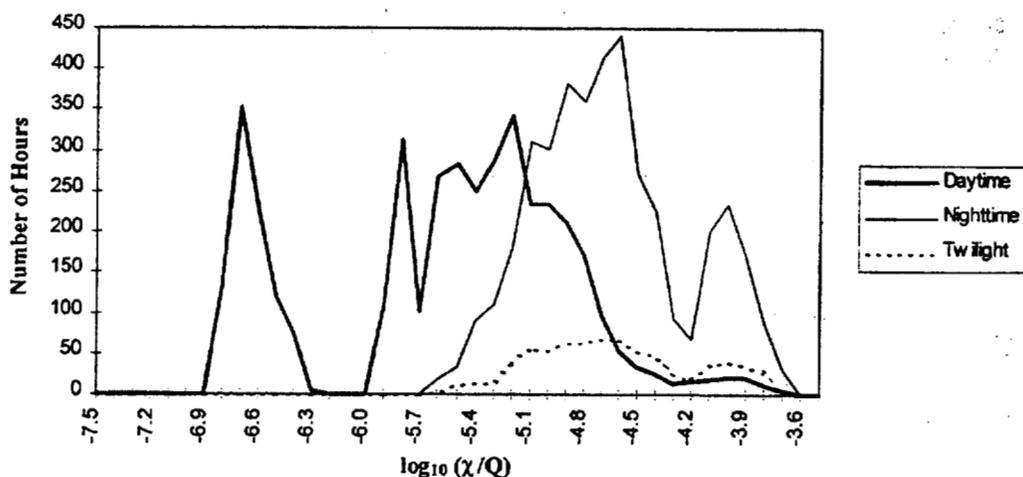


Figure 2-8. Distribution of χ/Q (s/m^3) at 1,900 meters, 1992 Weather Data, Using EPA Stability Class Method

It can be seen from Table 2-5 that the median χ/Q is nearly the same as that of the constant “Class D, 4.5 m/s” weather conditions and that the 95th Percentile χ/Q is about half that of the constant “Class F, 1 m/s” weather conditions; the “Class F, 2 m/s” conditions would give nearly the same χ/Q as the 95th Percentile. Note also that the collocated workers values are about 100 times larger than the MOI values. In the case of a large fire, the plume may be lofted and the above relationships are no longer valid.

Table 2-5. χ/Q (s/m^3) for Plume Centerline
10 Minute Plume, 10 cm Roughness Length, No Fire

WEATHER CONDITION Stability, Wind Speed or Statistic (1992 Weather)	Collocated Worker (100 meters)	Maximum Offsite Individual (1,900 meters)
Class F, 1 m/s	2.11×10^{-2}	2.21×10^{-4}
Class D, 4.5 m/s	1.24×10^{-3}	1.09×10^{-5}
Arithmetic Mean	2.60×10^{-3}	2.43×10^{-5}
Median	1.29×10^{-3}	1.12×10^{-5}
95th Percentile	1.05×10^{-2}	1.08×10^{-4}

2.3.1.4 Temperature

The temperature statistics for the periods 1964 through 1977 and 1984 through 1993 are provided in Table 2-6 (AeroVironment, 1995). The mean values are the arithmetic averages of all of the hourly readings for the month. The average high and low values are the averages of the daily highs or daily lows for the month. The maximum and minimum values are the extreme temperatures ever reached at RFETS for the month during this period. The 95th percentile values are of the daily

maxima and 5th percentile values are of the daily minima. The row labeled “annual” provides the average over all months for the mean, average high, and average low; yearly 95th and 5th percentile values; and the yearly extreme values for maximum and minimum. The annual median is not provided. The annual average temperature was 9.7°C (49.5 F), with July being the warmest month and January the coldest. The highest temperature recorded during this period was 38.9°C (102.0°F), on July 2, 1971, and the coldest was -30.9°C (-23.6°F), on December 21, 1990.

Table 2-6. Temperature Statistics (°F) for RFETS, 1964 - 1977 and 1984 - 1993

Month	Maximum	95 th Percentile	Average High	Mean	Average Low	5 th Percentile	Minimum
January	69.0	59.0	41.0	32.3	23.5	-1.0	-12.0
February	71.0	59.3	42.9	34.0	25.3	5.0	-8.7
March	82.0	67.0	47.4	38.3	29.3	7.1	-5.0
April	80.7	73.0	55.3	46.1	36.7	23.6	5.0
May	89.0	81.4	64.5	55.1	45.8	32.8	26.0
June	99.0	90.0	74.5	64.4	54.5	43.0	34.8
July	102.0	92.0	80.7	70.5	60.2	50.9	37.6
August	97.0	89.0	78.8	68.9	59.0	50.0	45.6
September	91.0	84.0	69.7	60.3	50.8	37.0	24.0
October	82.1	77.0	60.1	50.8	41.2	25.0	4.0
November	72.0	66.8	48.2	39.9	31.4	13.0	-3.3
December	72.0	60.7	42.1	33.4	24.5	4.0	-23.6
Annual	102.0	87.0	58.8	49.5	40.2	2.0	-23.6
* The 95th and 5th percentile values are from 1984 through 1993 only							

2.3.1.5 Humidity

The statistics for both relative and absolute humidity, for the period 1984-1993, are provided in Table 2-7 (AeroVironment, 1995). Hourly values of humidity are not available prior to 1984. The values given in this table are the arithmetic averages of the hourly readings for each month during this ten-year period. Relative humidity is the amount of moisture in the air compared to what the air can hold for the existing temperature; the air can hold more moisture at higher temperatures. Absolute humidity is the amount of water (as vapor) per unit volume of air. Although both relative and absolute humidity can vary considerably as a storm front passes through the area, the hourly averages of absolute humidity for any given month vary only slightly during the day whereas the hourly averages of relative humidity normally reach a maximum just before sunrise, when the air is the coolest, and drop to a minimum value during mid-afternoon, when the air is the warmest. Absolute humidity is higher in the summer than the winter because the higher temperatures during summer allows the air to hold more moisture. The monthly average of relative humidity varies only

slightly during the year, peaking during February through April, and showing a minimum during the fall; it is noteworthy that these maximum and minimum values do not coincide with the wet and dry seasons of the year (see Section 2.3.1.8 on precipitation, which shows May is the wettest month and December/January the driest).

Table 2-7. Monthly Humidity Averages for RFETS, 1984 - 1993

Month	Relative Humidity (%)	Absolute Humidity (g/m³)
January	43.3	2.0
February	47.5	2.4
March	47.2	2.9
April	47.1	3.6
May	44.5	4.8
June	43.0	6.3
July	42.2	7.2
August	41.7	6.9
September	40.7	5.3
October	38.6	3.5
November	40.6	2.6
December	44.1	2.0
Annual	43.4	4.1

2.3.1.6 Atmospheric Pressure

Due to the elevation of RFETS, which is about 1,830 m (6,000 feet) above sea level, the atmospheric pressure is about 20% lower than at sea level. At RFETS, average atmospheric pressure is about 81.59 kPa (815.9 mb or 612 mm Hg).^a The pressure rarely drops below 80 kPa or rises higher than 83 kPa. Table 2-8 shows the monthly variation of atmospheric pressure averaged over a 24-yr period, 1964 through 1977 and 1984 through 1993 (AeroVironment, 1995). The 95th and 5th percentile values are computed as mean \pm 1.645 standard deviations. The average pressure is lowest in spring and highest in late summer.

2.3.1.7 Atmospheric Density

The atmospheric density is directly proportional to atmospheric pressure and inversely proportional to temperature. It is also somewhat dependent upon humidity. At RFETS, the annual average air density is 0.88 kg/m³, or 32% lower than at sea level (where the annual average is 1.29 kg/m³). The maximum value, 0.93 kg/m³, occurs in winter and the minimum, 0.83 kg/m³,

^a Atmospheric pressure units are kiloPascals (kPa), millibars (mb), and millimeters of mercury (mmHg).

occurs in summer. These variations are the result primarily of temperature variations; the pressure variations, by themselves, would have caused the peak density to be in summer, not winter.

Table 2-8. Pressure Statistics (mb) for Rocky Flats, 1964-1977 and 1984-1993

Month	95th Percentile	Mean	5th Percentile	Standard Deviation
January	824.9	813.5	802.1	6.9
February	825.0	813.2	801.4	7.2
March	822.5	812.5	802.5	6.1
April	822.9	812.9	802.9	6.1
May	825.5	815.6	805.7	6.0
June	827.7	817.3	806.9	6.3
July	827.4	820.3	813.2	4.3
August	826.4	820.3	814.2	3.7
September	827.2	819.0	810.8	5.0
October	827.4	818.0	808.6	5.7
November	826.1	815.1	804.1	6.7
December	824.5	813.3	802.1	6.8
Annual	825.6	815.9	806.2	5.9

2.3.1.8 Precipitation

The precipitation statistics for the period 1953 through 1977 and 1987 through 1993 are provided in Table 2-9 (AeroVironment, 1995). These include all forms of precipitation, converted to liquid water if in a form other than liquid (e.g., snow). The values shown in Table 2-9 are the monthly and or annual totals. The high and low values are the extreme precipitation amounts ever reached at the site for the month during this period. The mean annual precipitation during this period was 14.46 inches and the median was 13.43 inches. Typically, May has the most precipitation (2.07 inches, median) and January has the least (0.31 inches, median). Note that the annual values are not the sums of the values for the months (except for the mean) but are the appropriate percentile values for this period or are the highest or lowest annual precipitation for this period. The wettest year at RFETS was 1969 (pre 1998), with 25.72 inches of precipitation.

2.3.1.9 Air Quality Monitoring Program

In addition to the above parameters that are important for accident analyses, RFETS also monitors emissions from normal operations to comply with the federal and state regulatory limits pursuant to the Clean Air Act and its amendments. Radioactive emissions from approximately 53

building process vents are monitored in accordance with both DOE requirements and National Emission Standards for Hazardous Air Pollutants (NESHAP) reporting requirements radionuclide monitoring and reporting requirements. These effluents samples are taken from stacks or ducts in radioactive buildings and are analyzed weekly. Major effluent samples are analyzed weekly and non-major monthly. Major and non-major effluent samples are defined in 40 CFR 61, Subpart H.

Table 2-9. Precipitation Statistics (inches) for Rocky Flats, 1953-1977 and 1987-1993.

Month	High	95th Percentile	Mean	50th Percentile	5th Percentile	Low
January	1.73	1.09	0.46	0.31	0.06	0.03
February	1.81	1.28	0.57	0.53	0.04	0.00
March	4.20	3.36	1.27	0.94	0.14	0.13
April	4.73	3.78	1.56	1.25	0.15	0.10
May	9.70	5.97	2.68	2.07	0.55	0.08
June	4.79	3.41	1.56	1.17	0.22	0.12
July	5.10	2.60	1.46	1.26	0.43	0.30
August	3.69	2.90	1.30	1.22	0.20	0.10
September	4.53	3.17	1.50	1.26	0.00	0.00
October	4.83	1.91	0.90	0.53	0.05	0.03
November	2.00	1.70	0.83	0.81	0.15	0.12
December	1.50	1.45	0.47	0.35	0.09	0.02
Annual	25.72	22.60	14.46	13.43	8.06	7.76

Data from ambient monitoring of radionuclides at locations on the site, at the perimeter of the site, and in the communities immediately adjacent to the site are obtained to satisfy DOE requirements. Some of these Radioactive Ambient Air Monitoring Program (RAAMP) samples are analyzed monthly. Meteorological monitoring supports both the radionuclide NESHAP reporting requirements and emergency response requirements under DOE orders.

Effluent monitoring also supports the as low as reasonably achievable (ALARA) principles, which encourage radiation protection practices that exceed those of any prescribed standard. This concept acknowledges that low exposure dose-effect relationships may exist that cannot be measured or demonstrated scientifically. Effluent monitoring is used to verify the efficacy of radiation control mechanisms in areas containing and handling significant quantities of radionuclide materials. Level of emission that cause no concern from a regulatory perspective, are sufficient to trigger a proactive investigative response under the ALARA concept.

2.3.2 Hydrology

This section provides site hydrological information. Also, discussed are RFETS-specific programs for monitoring and managing groundwater and surface water.

2.3.2.1 Hydrogeology

Groundwater is present in the shallow, unconsolidated sediments and subcropping bedrock throughout the site. Shallow groundwater flows through two distinct layers, each exhibiting specific hydrologic and geochemical characteristics, which allow for grouping into two hydrostratigraphic units. These units are generally referred to as the upper hydrostratigraphic unit and the lower hydrostratigraphic unit.

The upper hydrostratigraphic unit is the predominant water-bearing unit of concern at RFETS. It consists of unconsolidated, sandy, and gravelly materials mixed with clay (i.e., alluvium, colluvium, and artificial fill), weathered bedrock claystones and minor bedrock sandstones hydraulically connected to the alluvium. The site experiences significant seasonal fluctuations of ground water levels in the upper hydrostratigraphic unit. The lower hydrostratigraphic unit consists of unweathered claystone, with some interbedded siltstones and sandstones. There is a significant difference in hydrologic conductivity of each unit.

Groundwater at the site has both horizontal and vertical components of flow. Groundwater in the upper hydrostratigraphic unit preferentially flows along preexisting channels cut into the bedrock. These channels are known to occur in the Industrial Area, Solar Ponds, 881 Hillside, 903 Pad, East Trenches Areas, and possibly in the West Spray Field. In addition, groundwater in the Industrial Area may preferentially flow along buried sewer lines and process-waste lines (RFETS, 1996). Other hydrogeologic controls for groundwater flow and contaminant transport are hydraulic gradient, distribution of subcropping sandstones and claystones, and topography. Groundwater in the surficial deposits of the upper hydrostratigraphic unit generally flows to the east, following bedrock and surface topography, and discharges to the surface water drainages.

Groundwater from the upper hydrostratigraphic unit discharges at springs, seeps, and associated wetlands on the hillsides of the Industrial Area at the contact between the alluvium and bedrock and where shallow sandstones crop out in the drainages. Water at seeps is either consumed by evapotranspiration or flows downslope as surface water or through colluvial deposits to south Walnut Creek or Woman Creek. A conceptual diagram of groundwater flow in the Industrial Area and adjacent drainage is shown in Figure 2-9 (RFETS, 1996 and RFETS, 1995a).

Both downward and upward vertical hydraulic gradients have been documented at RFETS. Vertical hydraulic gradient values, on the order of 0.79 to 1.05 feet per foot, have been estimated between the colluvium and bedrock sandstones at Operable Unit 1. Regional water-level elevations indicate that a strong downward vertical gradient also exists between the upper hydrostratigraphic unit and the Laramie-Fox Hills aquifer. At RFETS, the potentiometric surface in the Laramie-Fox Hills aquifer is 50 to 100 feet lower than the water level in the overlying alluvium. Upward

hydraulic gradients were identified in well clusters located in topographically low areas near the bottoms of drainages, suggesting that groundwater in the bedrock may recharge unconsolidated surficial deposits in stream drainages.

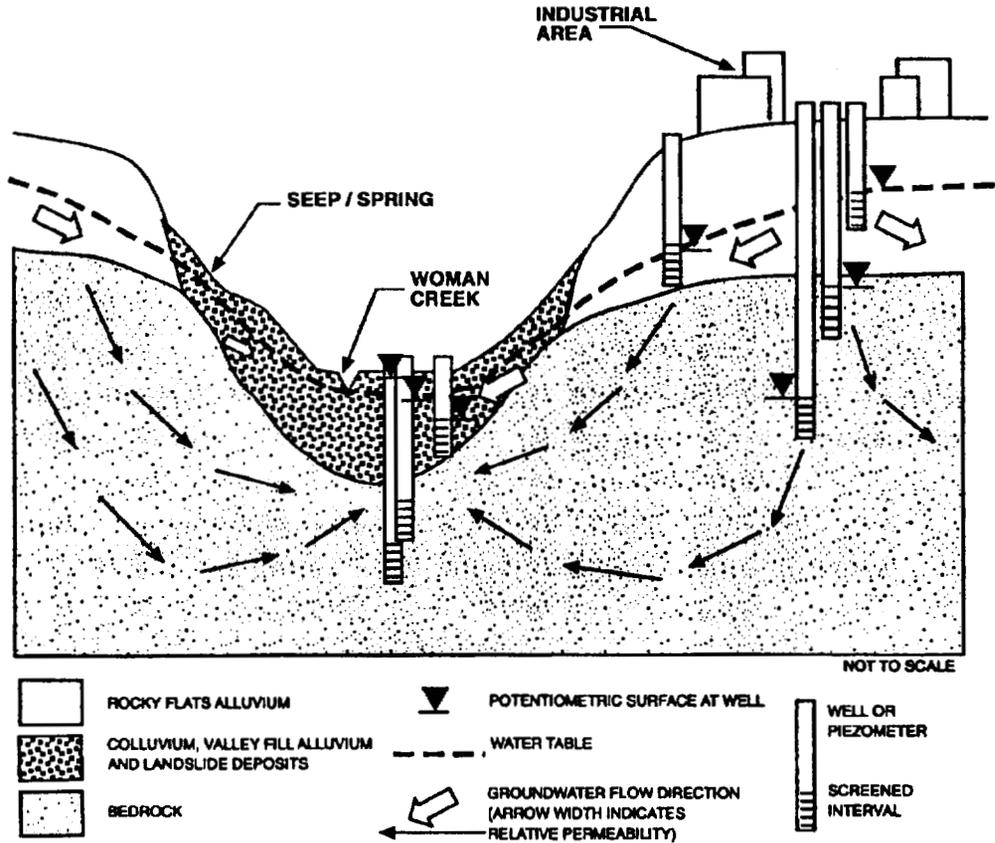


Figure 2-9. Conceptual Diagram of Groundwater Flow in the Industrial Area and Adjacent Drainage

2.3.2.3 Surface Water Management

Surface water flows from RFETS via five ephemeral streams that flow through or are adjacent to the site: North Walnut Creek, South Walnut Creek, Rock Creek, Smart Ditch, and Woman Creek. These drainages generally traverse the site from west to east. North and South Walnut Creek combine to form Walnut Creek on site and the combined stream flows off-site where it is diverted by the Broomfield Diversion Ditch just east of Indiana Street. The Broomfield Diversion Ditch routes Walnut Creek around Great Western Reservoir to Walnut Creek below the reservoir. Walnut Creek eventually discharges to Big Dry Creek. Rock Creek headwaters just west of RFETS and flows through the northeast section of the site. Rock Creek is not impacted by site operations. Smart Ditch flows from Rocky Flats Lake just west of the site, across the southernmost quarter of the Buffer Zone, and into two detention ponds. In addition to the natural drainages, there are several ditches that route surface water through or around RFETS. The site drawing in Figure 2-2 shows the surface water and drainages on the site.

In the history of the site, water detention ponds with earthen dams have been constructed to serve various purposes. The major ponds are shown in Figure 2-2. The ponds serve several functions including containment of surface water runoff, groundwater interception, containment of wastewater treatment plant effluent to allow for sample collection and analysis, and emergency spill containment.

However, most well cluster hydrographs show poor hydraulic connection between the bedrock and unconsolidated surficial deposits. The *Well Evaluation Report* (RFETS, 1993a) concluded that the deeper hydrostratigraphic units at the site, typically greater than 100 feet deep, are generally not in direct hydraulic connection with the upper hydrostratigraphic unit. This limited hydraulic connection indicates that groundwater from the upper hydrostratigraphic unit will not quickly nor easily migrate downward to the lower hydrostratigraphic unit, despite vertical gradients. Further, the low vertical hydraulic conductivities and the adsorptive properties of clay materials are expected to retard the downward movement of chemical constituents. The low-permeability claystones of the lower hydrostratigraphic unit form a barrier at least 500 feet in thickness to diminish contaminated groundwater from migrating vertically downward to the Laramie/Fox Hills aquifer. By comparison, (RFETS, 1996) indicates that the average Resource Conservation and Recovery Act (RCRA) landfill is lined with at least 3 feet of similar material.

Available hydrogeologic and isotopic data suggest that faults are not significant conduits for downward vertical groundwater flow to deep aquifers (RFETS, 1994). Evidence of limited hydraulic communication between groundwater from the upper hydrostratigraphic unit to the lower hydrostratigraphic unit was found to exist in some wells, but these occurrences do not present a pattern consistent with known fault locations. Isolated fractures in unfaulted bedrock, as opposed to fault-zone fractures, are the most likely mode of transport for the upper hydrostratigraphic unit groundwater to reach unweathered bedrock. However, the thick Laramie Formation claystone and siltstone prevent direct connection between surficial groundwater and the Laramie/Fox Hills aquifer.

2.3.2.2 RFETS Groundwater Program

The objectives of the RFETS Groundwater Program are (a) monitoring existing conditions, (b) ensuring compliance with regulations, (c) preventing further degradation of the upper hydrostratigraphic unit and (d) cleaning up existing contamination. To gather data to accomplish these objectives, wells are maintained to measure hydrologic parameters of the aquifers and concentrations of hazardous constituents (Singer, 1996). The analyses derived from the groundwater monitoring program are used to evaluate the impacts of past and present facility operations on groundwater and to ensure appropriate protective measures for activities that may have adverse effects on the quality of groundwater. It is believed that there is no direct exposure pathway to humans from contaminated groundwater, because there is no known hydraulic connection between domestic wells located off-site and impacted groundwater at the site. The following references provide more information concerning the RFETS Groundwater Program and its monitoring results: *Groundwater Geochemistry Report for the Rocky Flats Environmental Technology Site* (RFETS, 1995b); *Background Geochemical Characterization Report* (RFETS, 1992); and *Groundwater Conceptual Plan for the Rocky Flats Environmental Technology Site* (RFETS, 1996).

2.3.2.4 Surface Water Monitoring

Surface waters at RFETS are extensively monitored to (a) ensure that water quality standards are met, (b) characterize background water quality, and (c) evaluate potential contaminant releases from specific locations. Samples are routinely collected and analyzed from the drainages, seeps, and surface impoundments within the site. This section provides a description of the various aspects of the surface water monitoring program.

Detention Ponds Monitoring

The release of pollutants into any waters of the United States is controlled by the NPDES Program, which requires routine monitoring of point source discharges and reporting of results. An updated renewal application has been submitted to replace the current permit, which expired in 1988 (EPA, 1984) and was extended administratively until renewal.

However, the permit terms were modified by the NPDES Federal Facilities Compliance Act (FFCA) that was signed by DOE and EPA in 1991. The FFCA established an additional monitoring point at the waste water treatment plant and added certain monitoring requirements. Prior to discharging Ponds A-1, B-5, and C-2, samples are taken and analyzed by the Colorado Department of Public Health and Environment (CDPHE) to compare with Colorado Water Quality Control Commission stream standards for Segment 4 of Big Dry Creek. Water is released with concurrence from CDPHE.

During discharge, Ponds A-4, B-5, and C-2 are monitored for plutonium, americium, uranium, and tritium by CDPHE. Total chromium samples are analyzed monthly at discharge while whole effluent toxicity samples are analyzed quarterly when discharge occurs at Ponds A-4, B-5, and C-2. Pond B-5 is sampled monthly for total chromium during transfers to Pond A-4.

Remote Monitoring and Control Network

Twenty-five surface water remote monitoring stations have been installed since the summer of 1992. The remote monitoring program uses Supervisory Control and Data Acquisition Systems (SCADA). The remote surface water monitoring system consists of three major components: (a) field sensors, including flow equipment, dam safety monitoring systems, and water-quality probes, (b) remote bidirectional radio telemetry hardware; and (c) computer-based network monitoring station for automatic logging of data and network monitoring.

Hydrological Characterization and Storm Water Monitoring

Hydrological and stormwater quality characterization of RFETS is accomplished using 24 stream gaging stations dispersed sitewide. The stream gages are equipped with continuously recording flow meters and automatic water samplers that are programmed to sample storm events and pond discharge event flows when specified water flow levels are reached. The stream gages are

part of the fixed-station monitoring network for evaluating contaminant fate and transport across the site.

2.3.3 Geology

This section provides geological and seismology information. The geological information (Sections 2.3.3.1 through 2.3.3.3) addresses soil structures in the Rocky Flats region and at the site. Most of this information was summarized from the *Geologic Characterization Report* (EG&G, 1995), which presents the results of a Sitewide geoscience characterization. The geological information is beneficial to understanding the seismic phenomena addressed in safety analyses. General seismic information is provided in Section 2.3.3.4 and analytical data are discussed in Chapter 5.

2.3.3.1 RFETS Landforms

RFETS is located at an elevation of approximately 6,000 feet above mean sea level (MSL) on the western margin of the Colorado Piedmont section of the Great Plains Physiographic Province on a broad, mountain front pediment (erosional plain) named the Rocky Flats pediment. The surface is broadly rolling and slopes gently to the east with a drop of about 450 ft and a slope of approximately 1.5 degrees from the west to east edges of the buffer zone. Major stream valleys originating in the mountains of the Front Range cross the pediment generally from west to east. Small tributaries to these major streams have developed locally. Moderately steep hillsides are commonly adjacent to the streams.

West of RFETS, the Rocky Flats pediment terminates abruptly on the west by the Front Range section of the Southern Rocky Mountain Province, giving way to the eastern margin of the Front Range, which is characterized by a narrow belt of ridges and upthrusts formed by steeply east-dipping sedimentary rock. East of RFETS, the Rocky Flats pediment merges with the High Plains section of the Great Plains Physiographic Province.

Geologic units at RFETS include unconsolidated deposits on the surface (surficial) and the deep solid rock (bedrock). Surficial deposits range in thickness from 0 to 100 ft and include artificial fill, colluvial (gravity), landslide, and alluvial (stream) deposits. The characteristics of the surficial deposits are briefly described below and more thoroughly discussed in EG&G (1995) and USGS (1994).

2.3.3.2 Regional Features and Landforms

The natural surface features of the Colorado Piedmont reflect bedrock distorted into wavelike form (folding) and fracturing and displacement (faulting) along the edge of the Front Range uplift, subsequent pediment erosion, and burial by fluvial (rivers or streams) processes. More recent processes have incised drainages and removed portions of the alluvial cover. The Rocky Flats pediment is the most extensive pediment in the area (EG&G, 1995). RFETS occupies the eastern edge of this pediment, which extends approximately 5 mi northeast from the mouth of Coal Creek

Canyon. In eastern portions of the Rocky Flats pediment, the nearly flat surface gives way to lower, gently rolling terrain of the High Plains section of the Great Plains Physiographic Province.

Four miles west of RFETS, the eastern margin of the Front Range is characterized by a narrow zone of hogback ridges formed by steeply east-dipping Paleozoic and Mesozoic strata (the Fountain Formation and the Dakota Group, respectively). Fifteen miles west of the eastern margin of the Front Range, along the Continental Divide, the mountains reach elevations of 12,000 to nearly 14,000 ft above MSL. The core of the Front Range is composed of Precambrian basement (igneous and metamorphic assemblages).

2.3.3.3 Stratigraphy

The structural geology of RFETS and surrounding area is complex. The tectonic framework is dominated by structural features that formed during the uplift of the Rocky Mountains approximately 65 million years ago. These features include north-northwest trending mountain ranges that are bounded by low-angle thrust faults. The sediments underlying the site are flat-lying, and sediments to the west are east-dipping to vertical due to uplift tectonics. Figure 2-10 presents a generalized geologic cross-section that illustrates the structural setting in the region.

The region is dominated by colluvial, landslide, and alluvial deposits. Colluvial deposits (rock detritus and soil accumulated at the foot of a slope) cover the steep hillsides in the incised stream drainages. Landslide deposits are present along the steep hillsides in the incised drainages (Hurr, 1976). Alluvial deposits occur in flood plains, stream channels, and terraces along drainages across the site.

The shallower bedrock units beneath the surficial deposits include the Arapahoe Formation, Laramie Formation, and Fox Hills Sandstone. A generalized stratigraphic column illustrating the relationships and ages of these and other bedrock units is included in Figure 2-11. The total Paleozoic and Mesozoic stratigraphic section in RFETS area is estimated to be roughly 13,000 ft thick, assuming that the deeper formations are approximately as thick in the subsurface as in the Front Range outcrop. The characteristics and distribution of the bedrock units are discussed in detail in EG&G (1995).

2.3.3.4 Seismology

RFETS is located in an area of low historical seismicity. Although regional geologic structures in the vicinity of the site may be seismogenic and could generate large ground motions in a seismic event, the probability of recurrence of a large seismic event affecting the site is quite small (See Chapter 5). Table 2-10 lists earthquakes recorded since 1973 within 100 km of the site as published in the USGS earthquake data base.

There are seven faults in shallow bedrock within the boundary of RFETS that were inferred from stratigraphic correlations (EG&G, 1995). One of these faults is a northeast-trending reverse fault that extends across the western part of the Industrial Area and Landfill Pond. This fault is of

interest because it appears to lie near Building 371 in the Protected Area. The northerly extension of this fault was investigated for seismic capability. Detailed information about these faults is contained in EG&G (1995).

Figure 2-12 charts the historical seismic events in Colorado from 1870 to 1993. Events prior to the early 1960's were evaluated from damage accounts as part of the *Seismic Hazard Analysis* (REI, 1994). There has been one major earthquake in historical records that could have generated significant ground motion at RFETS. That event occurred in 1882 and caused damage from Boulder to Colorado Springs.

Table 2-10. Earthquakes within 100 km of the Site from 1973 to the Present
(Site Latitude 39.89, Longitude 105.19)

Year	Month	Day	Latitude	Longitude	Depth, km	Magnitude	Distance, km
1976	09	22	40.03	106.33	29	5.70 Ms GS	98
1985	01	15	39.38	104.36	33	4.20 mb GS	91
1988	06	09	39.91	105.76	10	3.50 MLBJI	49
1990	03	08	40.57	105.72	10	4.70 MLBJI	87
1990	03	09	39.84	106.29	33	3.60 MLBJI	93
1990	06	13	40.00	106.23	10	4.70 MLBJI	89
1991	01	13	40.56	105.79	16	5.60 Ms GS	90
1991	09	14	40.17	105.05	24	5.20 MLBJI	33
1991	09	28	39.98	106.34	33	3.80 MLBJI	98
1991	10	15	40.38	106.11	10	3.70 MLBJI	95
1992	01	28	40.09	104.79	33	4.40 mb GS	40

The area around Rocky Mountain Arsenal (RMA) is seismically active although not associated with a known fault. Deep well injection activities during the 1960's caused a swarm of felt seismic events in the Denver area; the three largest having magnitudes of 4.9, 5.2, and 5.3. The 201 earthquakes, which occurred between 1961 and 1972, were thought to be artificially induced by increased pore pressure caused by fluid injection and were removed from the catalog of historical events for the *Seismic Hazard Analysis* (REI, 1994). Note that there were earthquakes in that area both before and after the fluid injection, which ended in 1966. As a result, the RMA source is considered a significant contributor to seismic hazard at RFETS.

Studies on the structural geology of the Rocky Flats region have been conducted including general discussions of the structure of the Front Range, studies on Precambrian structure and other investigations on specific faults, structural mechanisms, or structural events. These studies are described in the EG&G (1995). The *Seismic Hazard Analysis* (REI, 1994) provides the most comprehensive assessment of seismic hazards at RFETS. Seismic sources, historical seismic events, ground motion attenuation, soil expansion, soil liquefaction potential, and geotechnical stability were evaluated to quantify the seismic hazards.

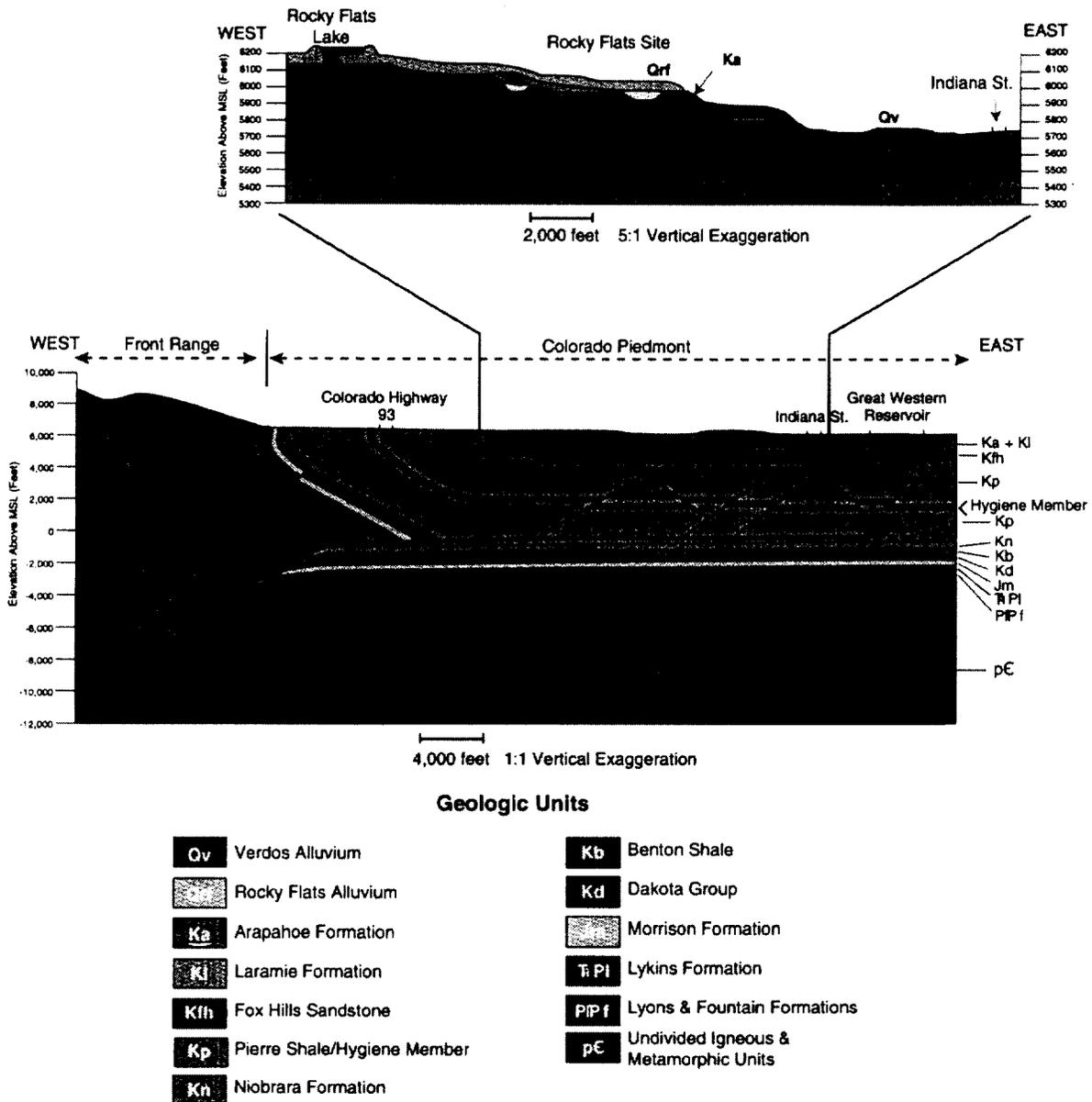


Figure 2-10. Generalized Geologic Cross-section Illustrating Structural Setting

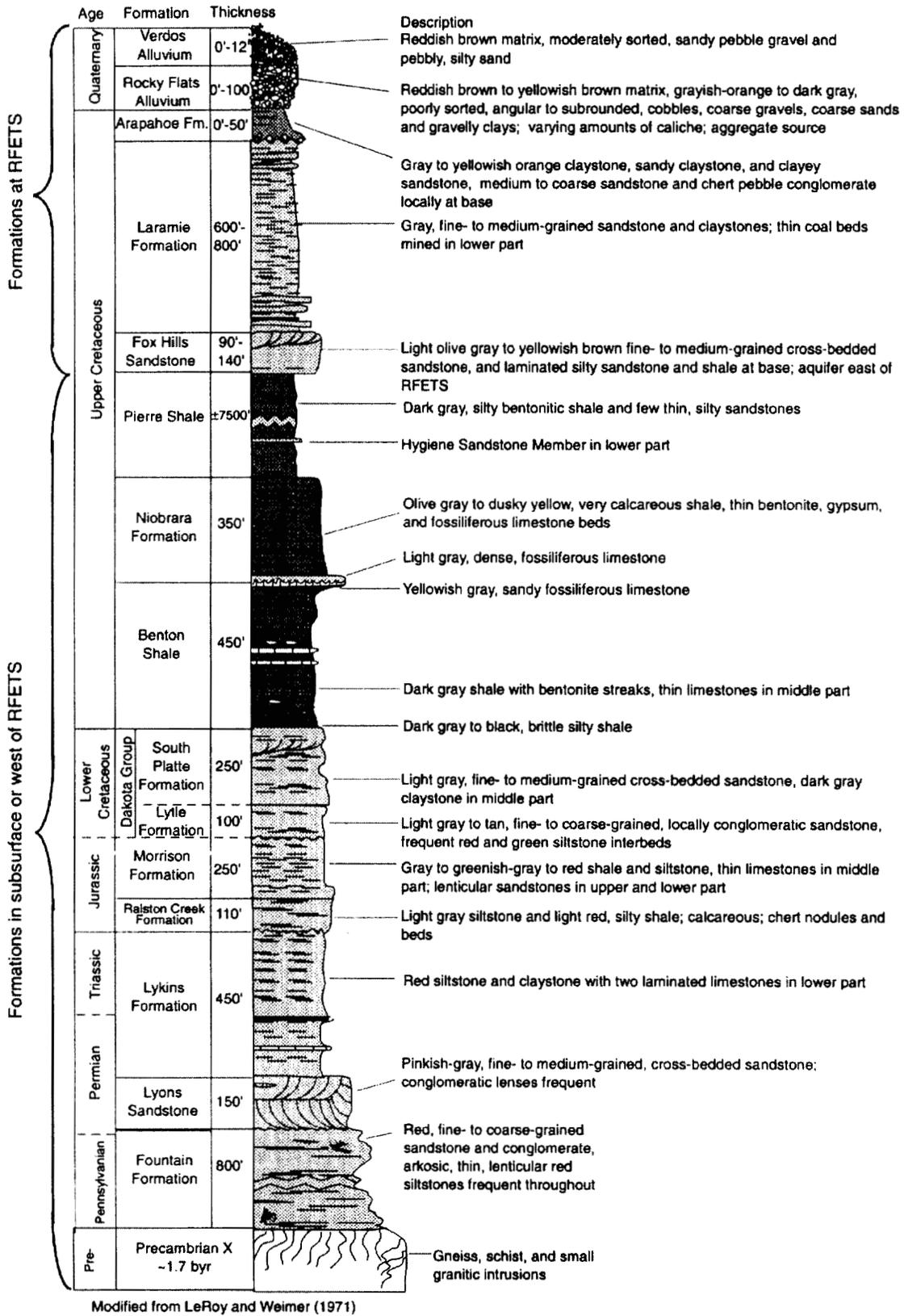


Figure 2-11. Generalized Stratigraphic Column

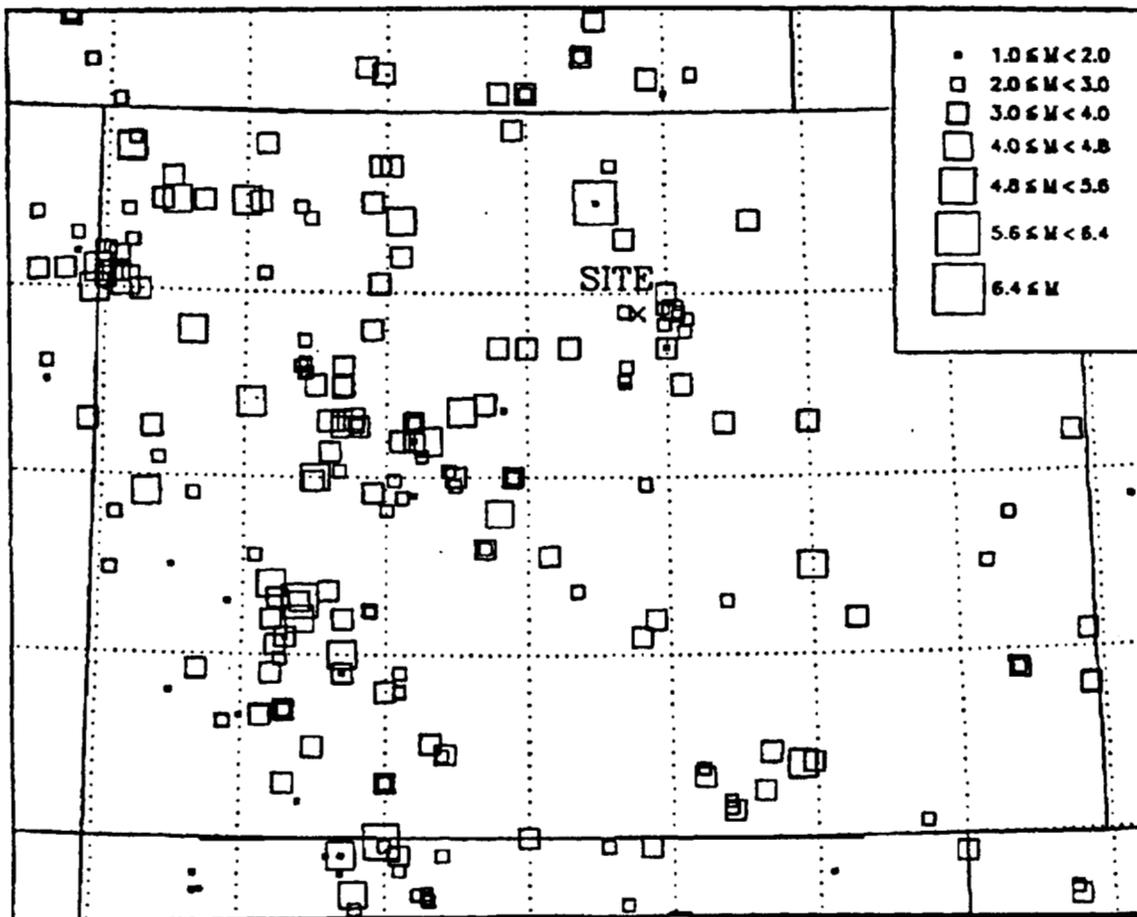


Figure 2-12. Historical Seismic Events in Colorado from 1870 to 1993

2.3.4 Ecology

RFETS is located in an area with some unique ecological factors. These factors are important to decisions made at the site that may impact safety evaluations, such as weed control for combustible loading reduction used in fire analyses. The following sections provide an overview of the unique ecological factors that impact the site.

2.3.4.1 Ecological Monitoring Program

Monitoring the ecological health of the Buffer Zone and Industrial Area is performed by RFETS personnel. Ecological surveys are performed as part of a long-term ecological monitoring program. This program is essential in identifying and describing fluctuations of wildlife populations, wildlife habitat use, and changes in species. Monitoring numbers, habitat affinities, and apparent health of the wildlife populations makes it possible to evaluate the overall ecological health of the site. Such data are an invaluable tool in predicting and avoiding impacts on the ecology of an area due to projected human activities. If species should dwindle in numbers or disappear, it would be

an indication of a serious environmental health problem. Monitoring and surveys can indicate trends of this sort, and act as an "early warning system" for impending ecological problems.

2.3.4.2 Ecological Resources

RFETS provides a unique refuge for a large number of bird and mammal species due in large part to more than two decades of protection from grazing, development, and other disturbances. The exclusion of grazing and development has allowed the native prairie/montane ecotonal system to rebound. Large-scale real estate development, mining, and water diversion on other large tracts of land have destroyed or degraded much of the native habitat once available.

Wildlife

Data from the past several years show an abundance and diversity of species that demonstrate the excellent ecological health of RFETS. The protection and isolation of the Buffer Zone has provided essential habitat for rare species such as the American peregrine falcons, bald eagles, eastern short horned lizards, burrowing owls, loggerhead shrikes, black swifts, Baird's sparrows, American white pelicans, grasshopper sparrows, water shrews, and Preble's meadow jumping mice. Many of these species are sensitive species or indicator organisms that by their presence or, more significantly, by their absence indicate the ecological health of an area.

RFETS supports a great diversity of bird species (over 180 species), including 19 avian predators. There are 37 mammal species (including 10 carnivores), eight reptiles, and seven amphibians, as well as numerous arthropods and other invertebrates (RMRS, 1996). This species diversity is another indicator of the high quality of the habitats provided by the site.

Wildlife Habitats and Plant Communities

A large unit of relic Xeric Tallgrass Prairie, a grassland classified by the Colorado Natural Heritage Program (CNHP, 1995a, 1995b) as rare and imperiled plant community, occupies the western third of RFETS. Xeric mixed grasslands are important fall breeding and winter foraging habitat for the resident mule deer herd. Additionally, xeric and mesic mixed grasslands are important breeding habitats for grasshopper sparrows (a declining prairie species) and other grassland bird species.

The Great Plains riparian community, a riparian (stream channel) woodland and shrubland plant community, is found along streams at RFETS. Cottonwood trees and willows predominate in this community. Another unusual shrub community, dominated by leadplant, is also often found in association with the Great Plains riparian community. This community provides important habitat for many bird and mammal species, including the Preble's meadow jumping mouse.

2.3.4.3 Regulatory Compliance Concerns for Ecological Resources

Several federal laws address preservation and protection of ecological resources. This section summarizes the regulatory compliance concerns that are important at RFETS.

Threatened and Endangered Species

At RFETS, special monitoring before, during, and after a project may be required by the U.S. Fish and Wildlife Service if the critical habitat for threatened and endangered species might be impacted. Threatened and endangered species are those plant or animal species listed in the Endangered Species Act (ESA) as threatened by extinction or in danger of immediate extinction, respectively. These species receive stringent protection from harm under the ESA and therefore any actions by DOE or its contractors that may affect threatened or endangered species are of concern. This regulation protects threatened and endangered fish, wildlife, and plants from injury, harassment, and death ("take"). The U. S. Fish and Wildlife Service also enforces the Fish and Wildlife Coordination Act of 1958, which requires consultation whenever the waters of any stream or other water body are altered by a federal agency. The Colorado Division of Wildlife administers the Colorado Nongame, Threatened, and Endangered Species Act, which protects State listed species in addition to all Federally listed species.

Migratory Birds

For RFETS projects, all work sites must be evaluated by a qualified ecologist for potential to impact migratory birds or their nests prior to the start of work. Also, the identities of all birds that are causing a nuisance must be confirmed by a qualified ecologist before any corrective or control action may be taken (e.g., nest removal). Migratory birds include songbirds, raptors (birds-of-prey), waterfowl, shorebirds, game birds, and others (magpies, crows, ravens, and jays) as listed in the federal Migratory Bird Treaty Act (MBTA). The U. S. Fish and Wildlife Service administers the Migratory Bird Treaty Act which is based on treaties with Canada, Mexico, Japan, and Russia.

Wetlands

The wetlands on RFETS have been surveyed and mapped by the U.S. Army Corps of Engineers (USACE, 1994). Wetlands are common on north-facing hillsides. One of the largest wetlands is Antelope Springs, which lies south of the Industrial Area. Although these wetlands are not unique, the role they serve in terms of retaining nutrients, sediments, and metals, water purification, and providing forage, cover, and nesting habitat for wildlife is very important.

Both the Environmental Protection Agency (EPA) and the U.S. Corps of Engineers have jurisdiction over activities that affect wetlands on the RFETS under the Clean Water Act. Generally, EPA has jurisdiction over CERCLA activities, and the Corps has jurisdiction over non-CERCLA activities. EPA reserves the right to make all jurisdictional determinations. Wetland protection requirements do not prohibit all activities in wetlands, but they do require avoiding wetlands where practicable, minimizing impacts to wetlands, and providing appropriate compensatory mitigation for

unavoidable impacts. Activities that have any potential to impact wetlands should be carefully evaluated by a qualified ecologist to ensure wetlands are not inadvertently impacted or contaminated.

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