ANALYSIS OF OFFSITE EMERGENCY PLANNING ZONES FOR THE ROCKY FLATS PLANT

OVERVIEW

EG&G ROCKY FLATS

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PREFACE

This Project Plan was developed jointly by an interdisciplinary team involving representatives from the U. S. Department of Energy - Rocky Flats Office (DOE-RFO), EG&G Rocky Flats, Inc. and its subcontractors. This report details our design of a project to complete analysis of offsite emergency planning zones for the Rocky Flats Plant.

The following personnel contributed to the development of this project plan:

- C. Armstrong, Clean Air Monitoring & Environmental Reporting, EG&G Rocky Flats, Inc., served as a resource for assessment of impacts from nonradiological hazardous substances;

- B. L. Crist, Safeguards and Security Division, the U. S. Department of Energy, Rocky Flats Office, served as resource in the areas of maximum credible accident review, source characterization, and protective action guide development;

- N. M. Daugherty, Clean Air Monitoring & Environmental Reporting, EG&G Rocky Flats, Inc., represented the areas of dose assessment and protective action guide analysis;

- T. L. Foppe, Safety Analysis Engineering, EG&G Rocky Flats, Inc., represented analysis of the maximum credible accident for the Rocky Flats Plant and radiological source characterization;

- A. Hazle, Radiation Protection Division, Colorado Department of Health, served as resource in the areas of maximum credible accident analysis, source characterization, protection action guide development, dose assessment, and dispersion modeling;

- C. R. Hodgin, Manager of Emergency Assessment Systems, EG&G Rocky Flats, Inc., served as project manager and as resource for atmospheric dispersion modeling;

- A. J. Petrocchi, Emergency Preparedness, EG&G Rocky Flats, Inc., served as resource for assessment of impacts from nonradiological hazardous substances; and

- B. Southward, Safety Analysis Engineering, EG&G Rocky Flats, Inc., served as resource for review of the Rocky Flats Plant maximum credible accident and radiological source characterization;

This report was prepared within the Emergency Assessment Systems Branch of the Safeguards and Security Directorate, EG&G Rocky Flats. The following personnel contributed to this report:

- C. R. Hodgin, Manager of Emergency Assessment Systems, EG&G Rocky Flats, Inc., authored this report;

- C. Bennett, Terry Personnel Services, Inc., transcribed the text of this report and provided administrative support for its publication.

- M. A. Brown-Strattan, CBIS Federal, Inc., acted as technical editor and publisher of this report; and

- J. K. Hooker, Express Personnel Service, acted as desktop publishing and administrative support for this report.

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EXECUTIVE SUMMARY

This Project Plan Overview summarizes the design of a project to complete analysis of offsite Emergency Planning Zones (EPZs) for the Rocky Flats Plant. An interdepartmental team of EG&G Rocky Flats, Inc. and contractor personnel are conducting the project at the request of the State of Colorado.

Federal, state, and local governments develop emergency plans for facilities that may affect the public in the event of an accidental release of nuclear or hazardous materials. One of the purposes of these plans is to identify EPZs where actions could be necessary to protect public health. Public protective actions include sheltering, evacuation, and relocation. Agencies use EPZs to develop response plans and to determine needed resources.

The State of Colorado, with support from the U.S. Department of Energy (DOE) and Rocky Flats contractors, has developed emergency plans and EPZs for the Rocky Flats Plant periodically beginning in 1980. In the Fall of 1988, Governor Romer requested a review and revision of the Rocky Flats EPZs. Subsequently, the Colorado Department of Health (CDH), DOE, and Rockwell International (the Rocky Flats contractor at the time), began a joint review in December 1988.

The "Analysis of Offsite Emergency Planning Zones (EPZs) for the Rocky Flats Plant - Overview" summarizes a project plan that, in four phases, continues, refines, and enlarges the technical EPZ analysis that began in 1988. Phase I, "Maximum Credible Accident (MCA) Review," evaluated and verified the MCA as a bounding radiological release scenario for the Rocky Flats Plant. The project considered the current MCA, reviewed the history of MCA development, identified and evaluated materials at risk, calculated interim release fractions for all forms of Rocky Flats plutonium, and prepared for a major review of plutonium release fractions.

Phase I of the program is complete. We are now beginning efforts for Phase II of the overall program, "Interim EPZs Analysis." In this phase we will utilize the Rocky Flats MCA, existing dispersion methodologies, and upgraded dosimetry methodologies to update the radiological EPZs for nonradiological hazardous materials releases and evaluate potential surface water releases from the facility. We plan to complete these objectives by July 31, 1990.

Phase III, "Final Emergency Planning Zone Analysis, MCA," will upgrade our interim EPZ analyses, adding an advanced determination of plutonium release fractions in a more comprehensive review of nonradiological hazardous material scenarios. We will gain approval for and utilize the Terrain-Responsive Atmospheric Code (TRAC) for the consequence analysis. We will complete our initial plan for this phase that identifies completion by January 31, 1991.

Phase IV of the overall project, "Comprehensive Hazards Analysis," will evaluate in detail the full spectrum of emergencies that could occur at Rocky Flats. Using a zero-based approach, we will identify all potential accidents, radiological and hazardous, at the facility. The data base will include low-, mid-, and high-probability events and will evaluate severe accidents (those beyond credible levels). We will screen these accidents which could produce offsite releases of hazardous or toxic materials, focusing our offsite emergency planning efforts on this subset. We plan to complete this multiperson year effort by the end of Fiscal Year 1993.

This Project Plan will allow EG&G Rocky Flats, Inc. to meet current commitments to the State of Colorado and make steady, tangible improvements in our understanding of risk to offsite populations during potential emergencies at the Rocky Flats Plant.

OBJECTIVE

DOE and EG&G Rocky Flats, Inc., will develop recommended offsite EPZs for the Rocky Flats Plant (RFP). We will develop recommended sheltering and evacuation EPZs for accidental release of radionuclides to the atmosphere from the facility. We will also develop recommended EPZs for accidental releases of major nonradiological hazardous substances to the atmosphere, and will analyze the impacts of an unplanned surface water release from the facility. DOE and EG&G Rocky Flats will submit these recommendations to the CDH for potential use in the State's offsite emergency planning for the Rocky Flats Plant.

INTRODUCTION

Federal, state, and local governments require emergency planning for facilities that may affect the public in the event of an accidental release of nuclear or hazardous materials. Governments develop emergency plans for nuclear plants, chemical plants, and nuclear weapons facilities, among others. One of the purposes of these plans is to identify EPZs where actions could be necessary to protect public health. These zones usually focus on atmospheric releases where impacts are less controllable than with pathways such as water or soil.

Public protective actions include **sheltering** (in homes or other structures), **evacuation** (short-term removal of population to avoid immediate impacts), and **relocation** (long-term removal of population to allow cleanup). States, local governments, and other cognizant agencies use EPZs to develop response plans and to determine needed resources.

EPZs are developed in a two-step process. Potential accidents are first identified and scenarios devised. This produces expected source characteristics (such as duration) and amount of material released. The second step calculates impacts from the hypothetical accident on the public and environment. Finally, the resulting health effects are determined and compared against criteria to establish zones where protective action (evacuation or sheltering) may be needed.

The State of Colorado is responsible for offsite emergency planning for radiological incidents at the Rocky Flats Plant. Jefferson

and Boulder counties have joint responsibility for offsite emergency planning for nonradioactive hazardous materials incidents at the facility.

DOE and the State of Colorado have historically established the Maximum Credible Accident (MCA) as the basis for developing EPZs around the Rocky Flats Plant. The MCA for Rocky Flats is defined as the greatest release of plutonium with a probability of 1×10^{-7} per year (once in every 10 million years) or greater.

The Rocky Flats Plant first published its MCA in the *Final Environmental Impact Statement (Final Statement to ERDA 1545-D), Rocky Flats Plant Site, Golden, Jefferson County, Colorado*[1] (1980). The MCA is defined as an aircraft crashing into a plutonium processing building, releasing 100 grams of plutonium to the atmosphere. The State of Colorado adopted this accident scenario, and through consequence assessments (dispersion modeling), established EPZs at about four miles (evacuation) and ten miles (sheltering) from Rocky Flats. CDH, DOE, and Rockwell International reviewed and updated the MCA and consequence analysis in 1983 and in 1985.

In the fall of 1988, Governor Romer requested a review of the MCA for the Rocky Flats Plant. Subsequently, CDH, DOE, and Rockwell International, the Rocky Flats contractor to DOE at the time, began a joint MCA review in December 1988.

PHASED APPROACH

In this Project Plan, EG&G Rocky Flats defines a continuation, refinement, and enlargement of the technical EPZ analysis begun in December 1988. The project includes four phases, allowing us to make recommendations to the State within the committed schedule, respond effectively to new expectations, and incorporate new technology and approaches as they become available.

Table 1 lists the phases and associated due dates for the overall program. Figure 1 establishes the relationship among these major phases in a network diagram. Figure 2 presents a time/task analysis for the overall program.

Phase	Title	Completion Date
I	MCA Review	May 8, 1990
II	Interim EPZ Analysis - MCA	July 31, 1990
III	Final EPZ Analysis	January 31, 1991
IV	Comprehensive Hazards Analysis	September 30, 1993

Table 1. Four Phases and Due Dates for EPZ Analysis Project

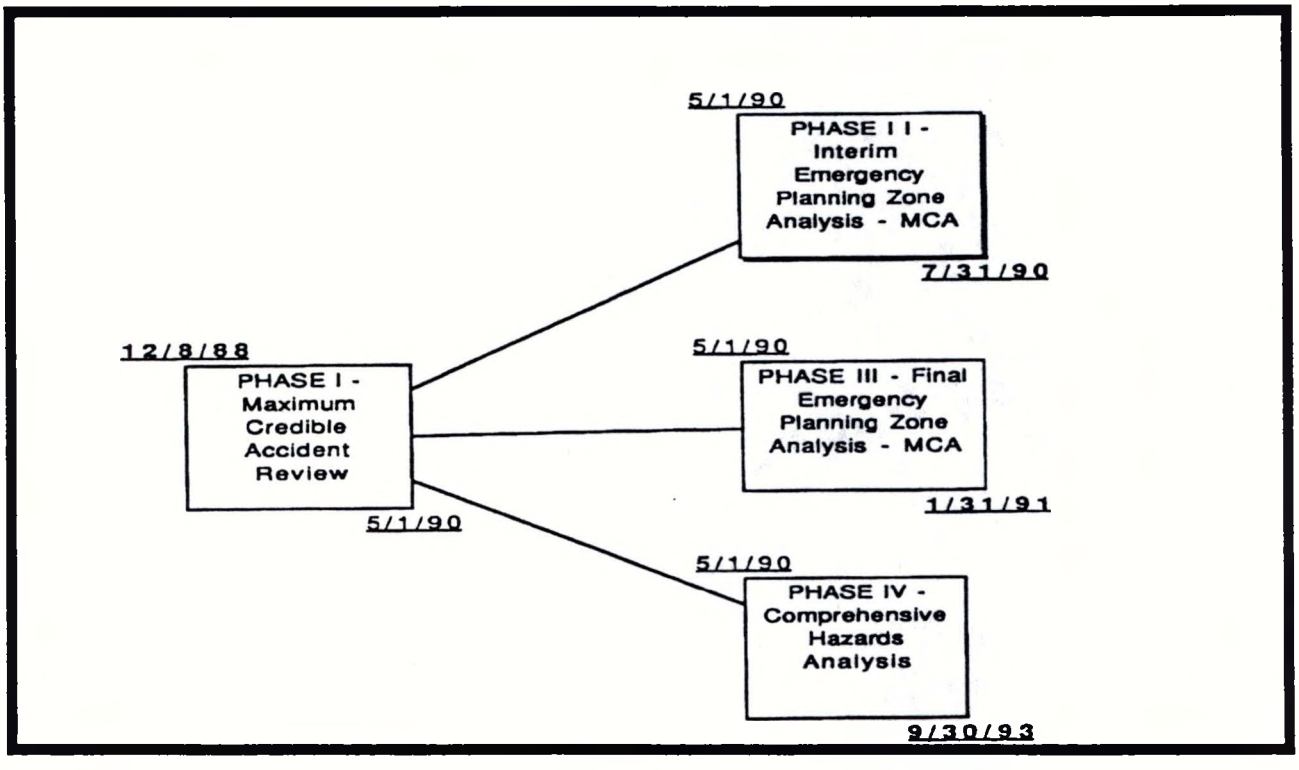

Figure 1. Network Diagram in Four Phases of EPZ Analysis Project

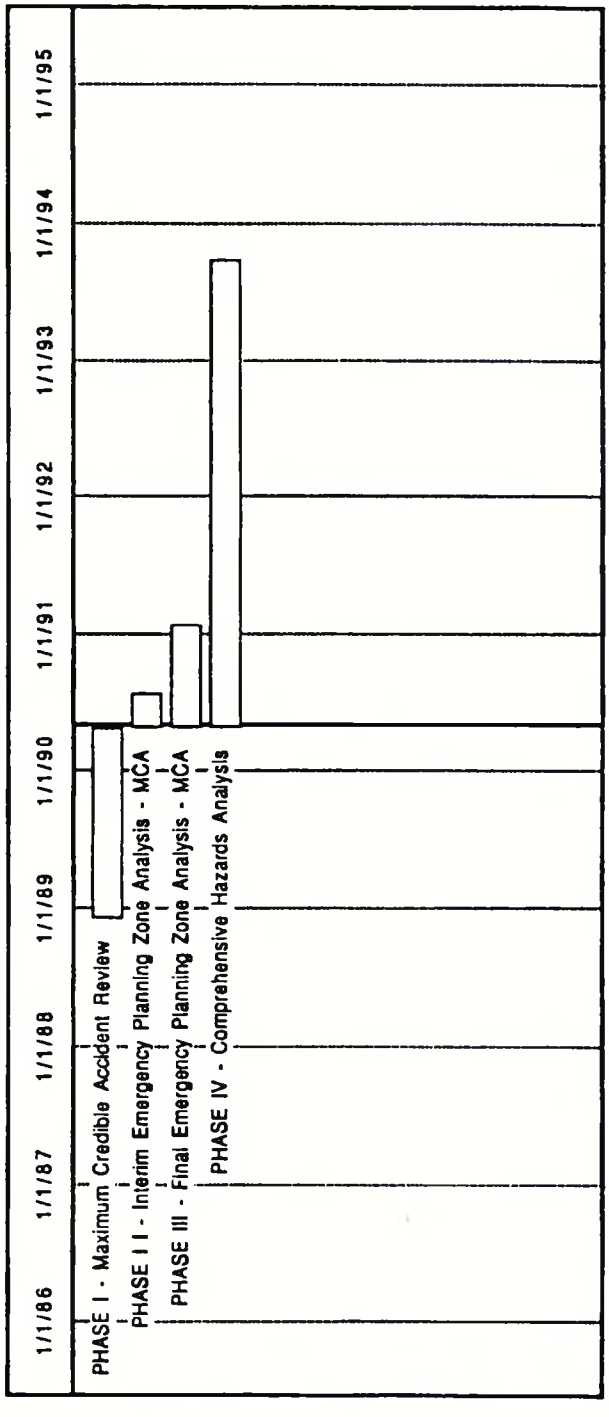

Figure 2. Time/Task Diagram for EPZ Analysis Project

PHASE I - MCA REVIEW

In Phase I of the program, we reviewed and verified the MCA as the bounding radiological release scenario for the Rocky Flats Plant. This process has been underway since December 1988 and is now complete. The project considered the current MCA, reviewed the history of MCA development and review process, identified and evaluated materials at risk (including areas with less than 100 gram inventories of plutonium), identified interim release fractions for all forms of Rocky Flats plutonium, and prepared for a major review of plutonium release fractions.

The joint project team accomplished a number of objectives during Phase I of the program. The team defined "maximum credible" as a worst-case event (largest release) that has an occurrence probability of 1×10^{-7} per year as identified in the *Final Environmental Impact Statement (Final Statement to ERDA 1545-D), Rocky Flats Plant Site, Golden, Jefferson County, Colorado*[1]. The State of Colorado confirmed that a large-bodied, fully loaded aircraft penetrating a Rocky Flats Plant plutonium processing building will be maintained as the MCA source scenario on an interim basis.

The joint team also confirmed in Phase I that the MCA, as listed in the *Final Environmental Impact Statement (Final Statement to ERDA 1545-D), Rocky Flats Plant Site, Golden, Jefferson County, Colorado*[1], involves the release of 100 grams of Rocky Flats plutonium. Additionally, the team determined that radiant heat from the MCA scenario would affect a 10,000 square-foot area within the building.

Representatives from DOE-RFO, EG&G Rocky Flats, and officials of the State of Colorado toured Rocky Flats Plant plutonium operation buildings (including Buildings 707, 776/777, 771, 371, 779, 374, 559, 991, 664, and 569) to evaluate plutonium inventories, hazardous materials inventories, building construction, and building appurtenances.

The group also determined that Rocky Flats Plant plutonium release fractions, listed in the *Final Environmental Impact Statement (Final Statement to ERDA 1545-D), Rocky Flats Plant Site, Golden, Jefferson County, Colorado*[1], significantly overestimated

materials release during an accident. CDH, DOE, and Rockwell International jointly established interim release fractions using Nuclear Regulatory Commission (NRC) recommended values. Finally, CDH, DOE-RFO, Rockwell International, and the U. S. Environmental Protection Agency (EPA) selected a contractor to review release fraction literature. EG&G Rocky Flats awarded a contract to conduct the review.

PHASE II - INTERIM EPZs ANALYSIS

In Phase II we will utilize the Rocky Flats Plant MCA, existing dispersion methodologies, and upgraded dosimetry methodologies to identify radiological EPZs for Rocky Flats as recommendations to the State of Colorado. We will also identify recommended screening-level EPZs for nonradiological hazardous materials releases and evaluate potential surface water releases from the facility. These interim analyses will be conducted in support of a revised State Radiological Emergency Response Plan for the Rocky Flats Plant, now being developed by the State Division of Disaster Emergency Services (DODES).

EG&G Rocky Flats will apply currently approved dispersion approaches to the MCA in order to establish interim EPZs for the Rocky Flats Plant. We will base our consequence assessment on dosimetry methodologies recommended in *Recommendations of the International Commission on Radiological Protection*[2] and *Limits for Intakes of Radionuclides by Workers*[3]. Phase II of the project will meet the original goals set in December 1988 within schedule which will support revision of the Colorado Radiological Emergency Response Plan for Rocky Flats Plant. EG&G Rocky Flats will complete Phase II by July 31, 1990.

Table 2 presents a breakdown of the 15 major tasks involved in Phase II of the project. The project team has completed a detailed analysis of the Phase II Project Plan. This analysis includes detailed subtasking, scheduling, resource allocation, and milestone development. A separate report, now in production, will fully document the detailed Project Plan for Phase II.

II.1	Administer Project
II.2	Confirm and Quantify Interim Release Fractions - Radiological
II.3	Confirm and Quantify MCA Using Interim Release Fractions - Radiological
II.4	Establish Dosimetry Approach
II.5	Develop Consequence Modeling Approach - Radiological
II.6	Establish Protective Action Guides (PAGs) - Radiological
II.7	Develop Screening Level EPZs for Hazardous Materials
II.8	Develop Final Contingency Plan for Water Releases
II.9	Ensure Quality of Project
II.10	Ongoing Documentation
II.11	Conduct Consequence Modeling - Radiological
II.12	Establish Emergency Planning Zones
II.13	Prepare Final Report
II.14	Review and Accept the Report
II.15	Issue Final Report to State

Table 2. Task-by-Task Breakdown for Phase II

PHASE III - FINAL
EPZ ANALYSIS - MCA

In Phase III of the program we will upgrade our interim analyses, incorporating an advanced determination of plutonium release fractions and a more comprehensive review of nonradiological hazardous material scenarios. We will gain approval for and utilize the Terrain-Responsive Atmospheric Code (TRAC), a site-specific complex-terrain dispersion model being developed at the Rocky Flats Plant. We will also incorporate new protective action criteria to be established by the State of Colorado. The release fraction upgrade, originally scheduled for Phase II of the project, has been moved to Phase III of the project in response to difficulties in obtaining critical contracted services. All other tasks in Phase III represent an extension and scope beyond the original objectives of the program.

Fifteen major tasks comprise the plan for Phase III, as shown in Table 3. EG&G Rocky Flats has established a completion date of January 31, 1991 for these tasks.

III.1	Administer Project
III.2	Final Release Fractions for Aircraft MCA - Radiological
III.3	Confirm and Quantify MCA Using Final Release Fractions -Radiological
III.4	Confirm or Revise Colorado PAGs
III.5	Complete TRAC Model Development for Radionuclides and Hazardous Materials
III.6	Gain Approval for Use of TRAC Model from DOE and State of Colorado
III.7	Develop Interim-level Sources and Scenarios for HAZMAT
III.8	Review and Confirm/Revise Contingency Plan for Water Releases
III.9	Ensure Quality of Project
III.10	Ongoing Documentation
III.11	Conduct Consequence Modeling - Radiological
III.12	Establish EPZs
III.13	Prepare Final Report

Table 3. Task-by-Task Breakdown for Phase III

PHASE IV - COMPREHENSIVE HAZARDS ANALYSIS

The Rocky Flats Plant will undertake a comprehensive hazards analysis for the facility. This program will allow Rocky Flats to develop fully detailed emergency plans for the full spectrum of emergencies that could occur at Rocky Flats. Using a zero-based approach, we will identify all potential accidents, radiological and hazardous, at the facility. The database will include a wide range, from high-probability, low-consequence events through low-probability, high-consequence events, and will evaluate severe accidents (those beyond credible levels). We will screen these accidents for those which could produce offsite releases of hazardous or toxic materials, focusing our offsite emergency planning efforts on this subset.

Phase IV of the project represents a major extension of the original objectives, based on an internal Rocky Flats evaluation of emergency planning needs.

Table 4 presents a breakdown of the nine major tasks involved in Phase IV of the project. EG&G Rocky Flats, Inc. has established a tentative completion date of September 30, 1993 for this major, long-term phase. The completion date will be revised and finalized based on the results of Task IV.2. The project team has completed a detailed analysis of the Phase IV Project Plan. This analysis includes detailed subtasking, scheduling, resource allocation, and milestone development. A separate report, now in production, will fully document the detailed Project Plan for Phase IV.

IV.1	Administer Project
IV.2	Develop Project Plan for Hazards Analysis
IV.3	Ensure Quality of Project
IV.4	Ongoing Documentation
IV.5	Conduct Hazards Analysis
IV.6	Conduct Consequence Modeling
IV.7	Establish EPZs
IV.8	Prepare Final Report
IV.9	Review and Accept the Report

Table 4. Task-by-task Breakdown for Phase IV

PROGRAM ORGANIZATION

The analysis of offsite EPZs for Rocky Flats Plant will be conducted by an interagency team of professionals and administrative personnel. EG&G Rocky Flats will perform the bulk of the technical effort, supported by experts contracted specifically for this project. DOE-RFO and CDH will also participate directly in the program.

Completion of the project within required schedules will require a substantial level of effort in several technical areas. A multidisciplinary technical team will be assembled and dedicated to the program. Figure 3 represents the organization of the project team for the offsite EPZ analysis. The structure shown has been specifically designed to meet the ambitious goals of this project.

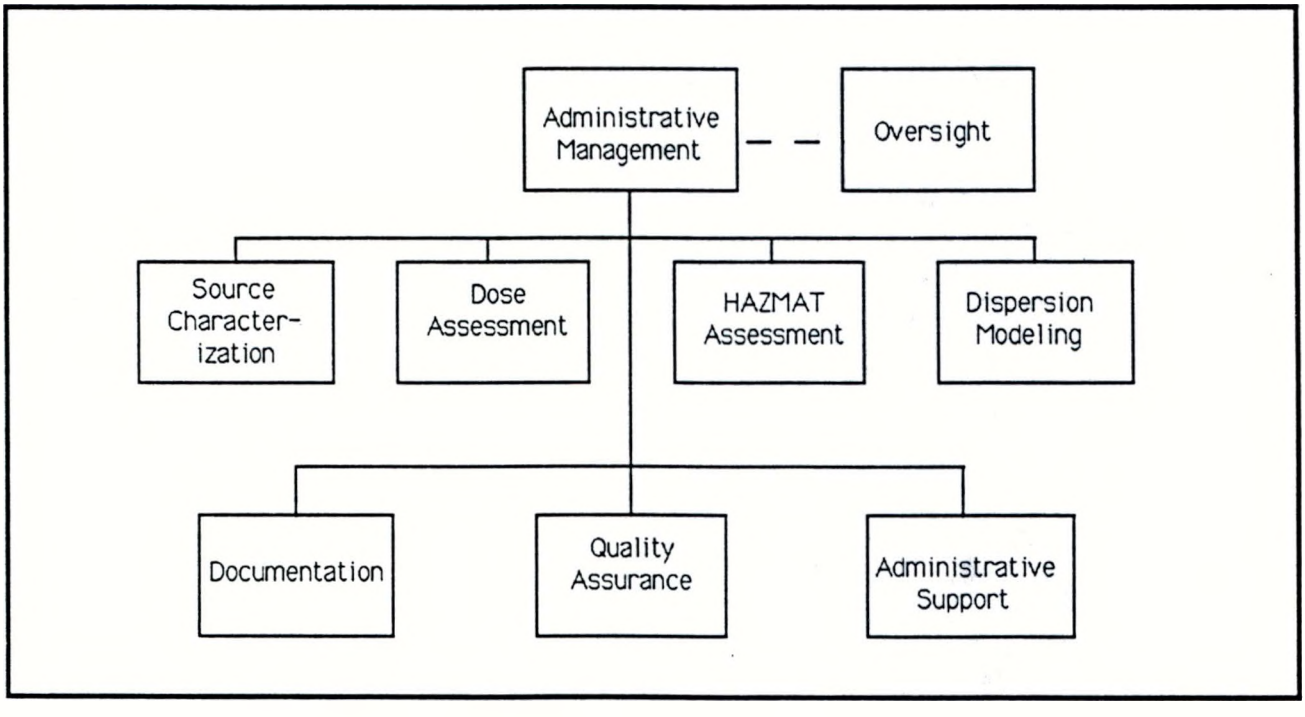

Figure 3. Organization of the Project Team

Administrative Management

The project manager function will have overall responsibility for financial, human resources, and logistical coordination of the project. The manager will coordinate all technical efforts. The manager will track project progress against the schedule identified in the project plan and adjust allocation of resources and staff efforts as necessary to ensure that the project objectives are met on schedule.

Oversight

An independent oversight committee will be established to track project performance and ensure that the goals are being met at levels of detail and quality which will satisfy client, regulatory, and public needs. The oversight committee will include representatives from:

- DOE
- CDH
- Colorado DODES
- EPA
- Rocky Flats Scientific Panel on Monitoring Systems
- Rocky Flats Environmental Monitoring Council

The oversight committee will meet periodically at the Rocky Flats Plant to evaluate project progress and to review and confirm policy-level technical decisions at the request of the State of Colorado. The oversight committee will meet from 0800-1200 MST at the Ramada Westminster on the following dates:

- May 31
- June 14
- June 28
- July 12
- July 26
- August 9
- August 23

Source Characterization	The source characterization function will identify and characterize potential accident scenarios and sources for Rocky Flats Plant. This function will conduct fault-tree analyses, release amount calculations, and source characterizations.
Dose Assessment	The dose assessment function will develop, implement, and apply methods for calculating impacts to offsite populations from simulated atmospheric releases. This function will develop dose conversion factors for direct use in atmospheric modeling capabilities.
HAZMAT Assessment	The Hazardous Materials Team (HAZMAT) assessment function will determine the nonradiological hazardous materials to be treated in offsite emergency planning. The function will identify potential sources, select accident scenarios for further analysis, and conduct screening analyses of consequences leading to initial EPZs. The function will conduct a series of more detailed hazardous materials assessments, leading to coordination with the full-scale Hazards Analysis for the plantsite.
Dispersion Modeling	The dispersion modeling function will develop, gain approval for, implement, and apply atmospheric dispersion modeling techniques for analysis of EPZs. This will include application of the TRAC model to this project.
Documentation	The documentation function will compile, produce, and publish a comprehensive set of documents for the analysis of offsite EPZs. This function will develop documentation formats and style guides, produce minutes for all overview meetings, and compile and publish a final report for each phase of the project.
Quality Assurance	The quality assurance function will ensure that the technical analysis of EPZs for Rocky Flats Plant is error-free. This function will conduct quality control and assurance efforts.
Administrative Support	The administrative support function will provide clerical and logistical support to the technical teams performing tasks on this project. Support will include word processing, data compilation, filing, research, and purchasing/contract administration.

REFERENCES

1. U. S. Department of Energy (USDOE). *Final Environmental Impact Statement (Final Statement to ERDA 1545-D), Rocky Flats Plant Site, Golden, Jefferson County, Colorado.* Washington, D. C.: April 1980. 3 volumes. (DOE/EIS-0064).

2. International Commission on Radiological Protection (ICRP). *Recommendations of the International Commission on Radiological Protection.* ICRP Publication 26. Oxford: Pergamon Press, 1977.

3. International Commission on Radiological Protection (ICRP). *Limits for Intakes of Radionuclides by Workers.* ICRP Publication 30. Oxford: Pergamon Press, 1978.