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Environment, Safety and Health
Office of Environmental Audit

Environmental Survey
Preliminary Report

Rocky Flats Plant
Golden, Colorado

June 1987

MASTER

EB

PREFACE TO
THE DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
ENVIRONMENTAL SURVEY PRELIMINARY REPORT

This report contains the preliminary findings based on the first phase of an Environmental Survey at the Department of Energy (DOE) Rocky Flats Plant (RFP), located at Golden, Colorado. The Survey is being conducted by DOE's Office of Environment, Safety and Health.

The Rocky Flats Plant Survey is a portion of the larger, comprehensive, DOE Environmental Survey encompassing all major operating facilities of DOE. The DOE Environmental Survey Program is one of a series of initiatives announced on September 18, 1985, by Secretary of Energy John S. Herrington, to strengthen the environmental, safety, and health programs and activities within DOE. The purpose of the Environmental Survey is to identify, via a "no fault" baseline survey of all the Department's major operating facilities, environmental problems and areas of environmental risk. The identified problem areas will be prioritized on a Department-wide basis in order of importance in 1988.

The findings in this report are subject to modification based on the results from the sampling and analysis phase of the Survey. The findings are also subject to modification, based on comments from Albuquerque Operations Office concerning the technical accuracy of the findings. The modified preliminary findings and any other appropriate changes will be incorporated into an Interim Report. The Interim Report will serve as the site-specific source for environmental information generated by the Survey, and ultimately as the primary source of information for the DOE-wide prioritization of environmental problems in the final Survey report.

June 1987

Washington, D.C.

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EXECUTIVE SUMMARY

Introduction

This report presents the preliminary findings of the Environmental Survey of the United States Department of Energy (DOE), Rocky Flats Plant (RFP), conducted August 11 through 22, 1986.

The Survey is being conducted by an multidisciplinary team of environmental specialists, led and managed by the Office of Environment, Safety and Health's Office of Environmental Audit. Individual team members are outside experts supplied by a private contractor. The objective of the Survey is to identify environmental problems and areas of environmental risk associated with the RFP. The Survey covers all environmental media and all areas of environmental regulation. It is being performed in accordance with the DOE Environmental Survey Manual. The on-site phase of the Survey involves the review of existing site environmental data, observations of the operations carried on at RFP, and interviews with site personnel.

The Survey team developed a Sampling and Analysis Plan to assist in further assessing certain environmental problems identified during its on-site activities. The Sampling and Analysis Plan is being executed by DOE's Oak Ridge National Laboratory. When completed, the results will be incorporated into the RFP Environmental Survey Interim Report. The Interim Report will reflect the final determinations of the RFP Survey.

Site Descriptions

The RFP is located on a 6,550-acre site in northern Jefferson County, Colorado. The plant structures are centrally located within the site inside a security-fenced area of approximately 384 acres. Downtown Denver is about 16 miles to the southeast of the RFP, and the cities of Boulder and Golden are each about 8 miles north and south of the plant, respectively. The RFP is operated by Rockwell International Corporation, North American Space Operations Group, under contract with DOE.

The primary mission of the RFP is the production of component parts for nuclear weapons which are shipped to other DOE sites for final assembly. Key production activities involve the fabrication of parts from plutonium, uranium, and nonradioactive metals, principally beryllium, stainless steel, and aluminum. Components from obsolete nuclear weapons are also processed at the RFP to recover plutonium and americium. The RFP has been in continuous use since 1952.

Summary of Findings

The major preliminary findings of the Environmental Survey of RFP are as follows:

- On-site groundwater is contaminated with nitrates and volatile organic compounds, and potential migration of contaminants off-site could degrade community drinking water supplies located downgradient; levels of nitrates and several of the volatile organic compounds found in on-site groundwater exceed limits or recommended limits established under the Safety Drinking Water Act.
- Mixed (radioactive and hazardous) wastes previously sent to the Nevada Test Site for disposal as low-level radioactive wastes are now accumulating on-site, and the potential exists for hazardous and radioactive constituents to be released to the environment when the plant's capacity to adequately store the wastes is exceeded.
- Ten on-site areas, believed to contain radioactive and/or hazardous substances from past waste disposal practices and plant operations, are considered to be potentially prominent sources of soil and/or water contamination. The Solar Evaporation Ponds collectively represent a potential source for off-site contamination; degraded groundwater can discharge to surface water drainages and potentially effect public drinking water reservoirs off-site.
- Improper asbestos handling and disposal practices at the active landfill make it possible for friable asbestos to contaminate the surrounding area and be dispersed in the atmosphere.
- Inadequate storage of bulk pesticide and herbicide stocks appears to have resulted in localized soil contamination.
- Drums and crates of wastes stored at several locations known to generate radioactive and/or hazardous wastes were not labeled as to their contents and, as such, may be handled and disposed of incorrectly.

- Deviations from accepted practices and deficiencies uncovered in the air monitoring and quality assurance programs potentially affect the accuracy and reliability of the air quality data being reported.

Overall Conclusions

The Survey found no environmental problems at the RFP that represent an immediate threat to human life. The environmental problems identified at the RFP by the Survey do confirm that the site is confronted by a number of current environmental concerns which are, by and large, a legacy from past practices when environmental implications and consequences were not as well understood. These problems vary in terms of their magnitude and risk, as described in this report. Although the sampling and analysis performed by the RFP Survey will assist in further identifying environmental problems at the site, a complete understanding of the significance of some of the environmental problems identified requires a level of study and characterization that is beyond the scope of the Survey. Actions currently under way or planned at the site, particularly those in response to the Compliance Agreement with EPA Region VIII and the State of Colorado, as well as the Phase II activities of the Comprehensive Environmental Analysis and Response Program (CEARP), will contribute toward meeting this requirement.

Transmittal of Results

The findings of the Environmental Survey of RFP were shared with the DOE Office of Military Applications, the Albuquerque Operations Office, the DOE Area Office for RFP, and the site contractor at the Survey closeout briefing held August 22, 1986. Since that time, informal coordination with the site and with representatives of the Albuquerque Operations Office has been ongoing in an effort to gather additional environmental information and data that have recently become available. Those problems that involve extended studies and multi-year budget commitments will be the subject of the Environmental Survey Summary Report and the DOE-wide prioritization.

Within the Office of Environment, Safety and Health, the Office of Environmental Guidance and Compliance has immediate responsibility for monitoring environmental compliance and the status of the RFP Survey findings. The Office of Environmental Audit will continue to assess the environmental problems through the program of systematic environmental audits that will be initiated toward the conclusion of the DOE Environmental Survey in 1988.

1.0 INTRODUCTION

The purpose of this report is to present the preliminary findings made during the Environmental Survey, August 11 through 22, 1986, of the Department of Energy's (DOE) Rocky Flats Plant (RFP) at Golden, Colorado (Figure 2-1) and a site visit on August 25 and 26, 1986, to the support facility at Oxnard, California (Figure 2-3). As a Preliminary Report, the contents are subject to revisions, in the Interim Report, based on the Albuquerque Operations Office review and comments on technical accuracy, the results of sampling and analyses, and other information that may come to the Survey team's attention prior to issuance of the Interim Report. The RFP is operated for DOE by the North American Space Operations Group of Rockwell International Corporation.

The RFP Survey is part of the larger DOE-wide Environmental Survey effort announced by Secretary John S. Herrington on September 18, 1985. The purpose of this effort is to identify, via "no-fault" baseline Surveys, existing environmental problems and areas of environmental risk at DOE facilities, and to rank them on a DOE-wide basis. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and to allocate the resources necessary to correct these problems. Because the Survey is "no-fault" and is not an "audit," it is not designed to identify specific isolated incidents of noncompliance, or to analyze environmental management practices. Such incidents and/or management practices will, however, be used in the Survey as a means of identifying existing and potential environmental problems.

The RFP Environmental Survey was conducted by a multidisciplinary team of technical specialists headed and managed by a Team Leader and Assistant Team Leader from DOE's Office of Environmental Audit. A complete list of the RFP Survey participants and their affiliations is provided in Appendix A.

The Survey team focused on all environmental media, using Federal, state, and local environmental statutes and regulations, accepted industry practices, and professional judgment to make the preliminary findings included in this report. The team carried out its activities in accordance with the guidance and protocols of the Environmental Survey Manual (May 1986). Substantial use of existing information and of interviews with knowledgeable field office and site-contractor personnel accounted for a large part of the on-site effort. A summary of the site-specific Survey activities is presented in Appendix B, and the Survey Plan is presented in Appendix C.

The preliminary Survey findings, in the form of existing and potential environmental problems, are presented in Sections 3.0 and 4.0. Section 3.0 includes those findings that pertain to a specific

environmental medium (e.g., air or soil), whereas Section 4.0 includes those that are non-media specific (e.g., waste management, direct radiation, and quality assurance). Because the findings are highly varied in terms of magnitude, risk, and characterization, and consequently require different levels of management attention and response, they are further subdivided into four categories within Sections 3.0 and 4.0.

The criteria for placing a finding into one or more of the four categories are as follows:

- Category I includes only those findings which, based upon the information available to the Team Leader, involve immediate threat to human life. Findings of this type shall be immediately conveyed to the responsible Environmental Safety and Health personnel at the scene or in control of the facility or location in question for action. Category I findings are those environmental problems where the potential risk is highest, the confidence in the finding, based on the information available, is the strongest, and the appropriate response to the finding is the most restrictive in terms of alternatives.
- Category II findings encompass one or more of the following situations:
 - Multiple or continuing exceedances, past or present, of a health-based environmental standard where there is immediate potential for human population exposure, or a one-time exceedance where residual impacts pose an immediate potential for human population exposure.
 - Evidence that a health-based environmental standard may be exceeded, as discussed in the preceding situation, within the timeframe of the DOE-wide Survey.
 - Evidence that the likelihood is high for an unplanned release due to, for example, the condition or design of pollution abatement or monitoring equipment or other environmental management practices.
 - Noncompliance with significant regulatory procedures; i.e., those substantive technical regulatory procedures designed to directly or indirectly minimize or prevent risks, such as inadequate monitoring or failure to obtain required permits.

Category II findings include those environmental problems where the risk is high but where the definition of risk is broader than in Category I. The information available to the

Team Leader is adequate to identify the problem but may be insufficient to fully characterize it. Finally, in this category, most discretion is available to the Operations Offices and Program Offices as to the appropriate response; however, the need for that response is such that management should not wait for the completion of the entire DOE-wide Survey to respond. Unlike Category I findings, a sufficient near-term response by the Operations Office may include further characterization prior to any action taken to rectify the situation.

- Category III findings encompass one or both of the following criteria:

- The existence of pollutants or hazardous materials in the air, water, groundwater, or soil resulting from DOE operations that pose or may pose a hazard to human health or the environment.
- The existence of conditions at a DOE facility that pose or may pose a hazard to human health or the environment.

Category III findings are those environmental problems for which the broadest definition of risk is used. As in Category II, the information available to the Team Leader may not be sufficient to fully characterize the problem. Under this category, the range of alternatives available for response, and the corresponding timeframes for response, are the greatest. Environmental problems included within this category will typically require lengthy investigation and remediation phases, as well as multi-year budget commitments. These problems will be included in the DOE-wide prioritization effort to ensure that DOE's limited resources are used effectively.

In general, the levels of pollutants or materials that constitute a hazard or potential for hazard are those that exceed some Federal, state, or local regulations for release of, contamination by, or exposure to such pollutants or materials. However, in some cases, the Survey may determine that the presence of some nonregulated material is in a concentration that presents a concern for local populations or the environment that is sufficient to be included as an environmental problem. Likewise, the presence of regulated materials in concentrations, even though below those established by regulatory authorities, that nevertheless present a potential for hazard or concern may be classified as an environmental problem. In general, however, conditions that meet regulatory or

other requirements, where such exist, should not present a potential hazard and will not be identified as an environmental problem.

Conditions that pose or may pose a hazard are generally those which are violations of regulations or requirements (e.g., improper storage of hazardous chemicals in unsafe tanks). Such conditions present a potential hazardous threat to human health and the environment and should be identified as an environmental problem. Additionally, potentially hazardous conditions are those where the likelihood of the occurrence of release is high.

The definition of the term environmental problem is broad and flexible to allow for the wide differences among the DOE sites and operations. Therefore, a good deal of professional judgment must be applied to the identification of environmental problems.

- Category IV findings include instances of administrative noncompliance and management practices that are indirectly related to environmental risk but are not appropriate for inclusion in Categories I-III. Such findings can be based upon any level of information available to the Team Leader, including direct observations by the team members. Findings in this category are generally expected to lend themselves to relatively simple, straightforward resolution without further evaluation or analysis. These findings, although not part of the DOE-wide prioritization effort, will be passed along to the Operations Offices and appropriate Program Office for appropriate action.

Based on the professional judgment of the Team Leader, the findings within the categories are arranged in order of relative significance. Comparing the relative significance of one finding to another, either between categories within a section or within categories between sections, is neither appropriate nor valid. The categorization and listing of findings in order of significance within this report constitute only the first step in a multi-step, iterative process to prioritize DOE's problems.

The next phase of the RFP Survey is sampling and analysis (S&A). Oak Ridge National Laboratory (ORNL), the S&A team for the RFP, began taking samples over a 2-week period starting September 22, 1986. Prior to sampling, an S&A Plan was prepared by DOE and ORNL in accordance with the protocols in the Environmental Survey Manual. The S&A Plan was designed to fill existing data gaps or weaknesses. The results generated by the S&A effort will be used to assist the Survey team in further defining the existence and extent of potential environmental problems identified during the Survey.

An Interim Report will be prepared 6 to 8 weeks after the completion of the S&A effort. The Interim Report will incorporate the results of the S&A effort as well as any changes or comments resulting from the review of the Preliminary Report. Based on the S&A results, the preliminary findings and observations made during the on-site Survey may be modified, deleted, or moved within or between categories. The Interim Report will serve both as the site-specific repository for information generated by the Survey, and ultimately as the site-specific source of information for the DOE-wide prioritization of environmental problems.

It is clear that certain of the findings and observations contained in this report, especially those in Category II, can and should be addressed in the near-term, i.e., prior to the DOE-wide prioritization effort. It is also clear that the findings and observations in this report vary greatly in terms of magnitude, risk, and characterization. Consequently, the priority, magnitude, and timeliness of near-term responses will require careful planning to ensure appropriate and effective application. The information in this Preliminary Report, albeit provisional, will assist the Albuquerque Operations Office (ALO) in the planning of these near-term responses.

PRELIMINARY

2.0 GENERAL SITE INFORMATION

This section contains a general discussion of the site setting, operations, and concerns of Federal, state, and local environmental agencies for the Rocky Flats Plant and the Oxnard Support Facility.

2.1 Site Setting

The Rocky Flats Plant (RFP) is located in northern Jefferson County, Colorado. The plant site consists of 6,550 acres of Federal land, bounded approximately by Colorado Highways 93 and 128 on the west and north, respectively; Indiana Street on the east; and Colorado Highway 72 on the south (Figure 2-1). The plant structures are centrally located within the site inside a security-fenced area of about 384 acres.

Downtown Denver is about 16 miles to the southeast of the plant and the cities of Boulder, Golden, and Arvada are each about 8 miles away. The population of the area within a 50-mile radius of the plant was estimated at about 1.8 million in 1977 (RI, 1986). Based on the 1980 census, about 2 million people were distributed over the same area, as shown in Figure 2-2. By the year 2000, the population has been projected to be about 3.5 million people.

Although the RFP is located in a basically rural area, there are no prime agricultures as determined by the U.S. Department of Agriculture (USDA) Soil Conservation Service. Several ranches are located within 10 miles of the plant, primarily in Jefferson and Boulder Counties; these are operated to produce crops, raise beef cattle, supply milk, and breed and train horses. According to the 1977 Colorado Agricultural Statistics, 14,200 acres of crops were planted in 1976 in Jefferson County (total land area approximately 475,000 acres). In addition, Boulder County had 56,200 acres planted out of a total land area of 405,760 acres. These crops consisted of winter wheat, corn, barley, dry beans, sugar beets, hay, and oats. Livestock statistics for the two counties included 9,500 head of cattle, 200 pigs, and 400 sheep being raised in Jefferson County; and 34,000 head of cattle, 2,300 pigs, and 6,500 sheep in Boulder County. A comparison of these figures with those acquired two years prior shows an increase of acreage for agricultural production, whereas the total land area has declined somewhat because of annexation by cities. In addition, livestock increases are noted in Jefferson County, whereas in Boulder County the numbers of cattle, pigs, and sheep have decreased from 1975 figures. Small areas along Colorado Route 72 to the south of the plant, along Colorado Route 93 to the west, and the Jefferson County Airport are zoned for industrial use. The area is projected to remain essentially rural, although residential developments in Westminster and Arvada are expanding (DOE, 1980).

FIGURE 2-1

ROCKY FLATS PLANT LOCATION MAP, NORTH CENTRAL COLORADO
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986

FIGURE 2-2

DEMOGRAPHIC ESTIMATES - 1980^a
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986

Five streams occur near the Rocky Flats Plant site. Of these, North Walnut Creek, South Walnut Creek, and Woman Creek drain the production areas of the Rocky Flats Plant site; all of these are ephemeral. The other two streams in the area are Coal Creek and Rock Creek. North Walnut Creek and South Walnut Creek originate west of the Plant and flow eastward into Great Western Reservoir. Great Western Reservoir supplies water to the City of Broomfield. Woman Creek also originates west of the Plant, drains the south portion of the Rocky Flats Plant site, and flows eastward into Standley Lake. Standley Lake provides irrigation storage and the municipal water supply for the City of Westminster. Some of the water in Woman Creek, downstream of the C-2 holding pond, flows into Mower Reservoir. This reservoir is used by area ranchers as a supply of water for cattle and irrigation. Excess water discharges back into Woman Creek, further downstream, and flows into Standley Lake. Coal Creek has its headwater in the Front Range and is the largest stream near the Plant. Coal Creek and Rock Creek drain the area north of the Plant. Streams are discussed in Section 3.3, Surface Water, and their locations shown in Figure 3-7.

Six ditches convey water through the area. The South Boulder Diversion Canal carries water southward from South Boulder Creek (north of the Plant site) to Raiston Reservoir, which supplies water to the City of Denver. The water supply for the Rocky Flats Plant is obtained from South Boulder Diversion Canal and Raiston Reservoir. The Last Chance, Church, McKay, and Kinnear Ditch and Reservoir Company ditches divert water from Coal Creek. The Last Chance Ditch delivers water to Rocky Flats Lake and Twin Lakes. Outflow from Rocky Flats Lake is transported out of the area by Smart Ditch. The Church Ditch supplies water to Upper Church Lake and Great Western Reservoir; McKay Ditch supplies water to Great Western Reservoir; and Kinnear Ditch and Reservoir Company Ditch supplies water to Standley Lake.

The South Platte River flows north-northeastward through Denver to Greeley, Colorado, where it turns toward the east.

The climate at Rocky Flats is characterized by dry, cool winters with some snow cover, and warm, somewhat moist summers. There is considerable clear-sky sunshine, and the average precipitation and relative humidity are low.

Annual average precipitation is slightly over 38.5 centimeters (15.16 inches). The maximum annual precipitation recorded over a 24-year period was 63.17 centimeters (24.87 inches) in 1969. Typically, more than 80 percent of the precipitation falls as rain between April and September. Most of the remaining precipitation is in the form of snow.

The Rocky Flats Plant is located in the sharp transition zone between the rugged Rocky Mountain Front Range to the west and the Great Plains to the east. Thus, complex airflow patterns occur that change continuously with location and with time.

Historical analyses have shown that airflow patterns near RFP consist of a few major types. The primary patterns are those that are influenced by the major terrain features and uneven heating of mountains and valleys. During daytime hours, the mountains to the west receive more sunlight and heating than the valleys and plains below. The result is a general flow of air toward the higher elevations (from northeast and east to west).

Nighttime conditions are characterized by a rapid loss of heat from the earth's surface, beginning after sunset. This results in a general movement of air toward lower elevations. The air flows down the mountain canyons (west to east) all along the Front Range and then out onto the plains below. These paths merge with the overall flow down the South Platte River Valley, moving generally toward the north-northeast.

Wind observations at RFP indicate that the dominant daytime and nighttime flow patterns (along with twice-daily transition periods) occur more than 90 percent of the time.

Unusual airflow patterns occur when large-scale weather systems overcome the local mountain-valley effects. These are known as regional up-slope, Chinook windstorm, and modified up-valley patterns.

Regional up-slope flow results when a high-pressure center to the northeast of Colorado or a low-pressure center near the Oklahoma panhandle produces a lifting of moist air all along the Front Range. Most often experienced in late winter or spring, this pattern results in several hours to a few days of steady precipitation. Based on Rocky Flats wind observations, regional up-slope flow occurs about 3 percent of the time.

Another late winter and spring phenomenon along the Front Range is the Chinook windstorm. The Chinook is a warm, dry wind that descends the eastern slopes of the Rocky Mountains, with wind speeds that often exceed 70 miles per hour (MPH) and can reach 120 mph or more at Rocky Flats. The Chinook winds generally flow across RFP toward the Denver metropolitan area. Based on Rocky Flats observations, Chinook windstorm conditions exist with a frequency of less than one percent.

Two unusual daytime flows also exist, in which the normal daytime up-slope pattern is modified but not entirely replaced. Strong southerly or northerly winds can prevent up-valley flow from entering the canyons. Based on Rocky Flats observations, these trajectories occur less than 2.5 percent of the time (Hodgin, 1986).

The Oxnard Support Facility (Figure 2-3) is situated in an industrial area within the city limits of Oxnard, California. The site, located at 1235 East Wooley Road, is bounded on the East by the City of Oxnard's Garage, on the North by an agricultural crop-processing facility, on the west by a Department of Defense subcontractor (explosive dye bomb) and across Wooley Road on the South by farm cropland. The entire 14 acres is fenced and a security guard is on duty. The City of Oxnard is located on the Pacific coast, in a primarily agricultural area of Ventura County.

2.2 Overview of Major Site Operations

The RFP is a government-owned facility with a primary mission of producing component parts for nuclear weapons. Key production activities involve the fabrication of parts from plutonium, uranium, and nonradioactive metals, principally beryllium, stainless steel, and aluminum. Components made at the RFP are shipped elsewhere for final assembly. This site began operation in 1952 in 20 buildings and has grown continuously since then; more than 100 buildings are now used in accomplishing its mission (Figure 2-4).

Components from obsolete nuclear weapons are disassembled and processed to recover plutonium and americium. Enriched uranium components are separated and shipped to Oak Ridge, Tennessee for recycle. Plutonium scrap generated in metallurgical and machining operations is degreased and recycled through the foundry. Chemical processing is used to recover plutonium from contaminated scrap materials.

2.2.1 Plutonium Fabrication and Assembly

Plutonium ingots of the required shape and alloy content are prepared by melting selected scrap, buttons, and briquettes in a tantalum crucible in a vacuum induction-heated furnace and pouring the molten metal into a coated graphite mold. The plutonium ingots are subjected to metallurgical operations such as reduction rolling, blanking, forming, and heat treating. Various machining operations are used to produce the finished component parts, which are then cleaned with trichloroethane and inspected. Following inspection, the parts are assembled with other components using specialized welding and brazing techniques.

FIGURE 2-3

OXNARD SUPPORT FACILITY LOCATION MAP, SOUTHERN CALIFORNIA
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986

ROCKY FLATS PLANT PLOT
DOE SURVEY - ROCKY FLATS
AUGUST 1986

FIGURE 2-4

PLAN
PLANT

2.2.2 Uranium Fabrication

Depleted uranium, enriched uranium, and (intermittently) uranium-233 have all been handled at the RFP. Currently, work is only performed on depleted uranium. Depleted uranium alloys are fabricated by arc-melting a depleted uranium tube filled with the required alloying material. Ingots formed in this first-melt are remelted to form larger ingots, which are sawed into billets for further processing. These alloys can be rolled, formed, extruded, shearspun, swaged, and machined into required shapes.

Depleted-uranium-alloy scrap is recycled at one of the RFP's foundries. Large ingots for extrusion, rolling, and forging are cast. Occasionally, shaped castings are made that require only finish machining. After inspection, finished parts are assembled into a component or packaged and stored.

2.2.3 Beryllium Fabrication

In the past, clean, solid-metal, beryllium scrap from commercial sources and from other DOE facilities was combined with RFP-generated scrap and melted in a vacuum furnace. The molten metal was then cast into a beryllium oxide (BeO) coated graphite mold to form an ingot, which was sawed into slabs, called billets. The billets were machined by a milling operation. To protect the billet from the atmosphere during subsequent operations, a steel "can" was welded around the billet and vacuum sealed. The canned billet was then heated, rolled to reduce thickness, and annealed. After removal of the steel can, the beryllium was etched, reduced in thickness (rolled), annealed, and cut into desired shapes. Following acid cleaning, the blanks were heated and formed into desired shapes. Finished parts were produced by machining in a dedicated machine shop.

Currently, all beryllium is brought on-site in preformed shapes. These shapes are finish machined for specific purposes in a special machine shop designed for beryllium work.

2.2.4 Fabrication of Other Metals

The RFP is also capable of fabricating items from many kinds of nonradioactive metals with equipment for rolling, conventional forming, hydroforming, high-energy-rate forming, extruding, heat treating, shearing, machining, electroplating, and inspection. Stainless steel and aluminum are

the principal metals fabricated, although materials such as tantalum, titanium, tungsten, copper, cadmium, gold, silver, lead, and nickel are used at times for special-order work.

2.2.5 Plutonium and Americium Recovery

The primary objective of the plutonium recovery process is the recovery of plutonium from all residues generated during plutonium-related fabrication, assembly, and research operations. Residues normally are solid materials varying in plutonium content from a few percent to almost pure plutonium metal suitable for use in foundry operations.

Plutonium recovery processes are divided into two categories. Some relatively pure plutonium residues require only a minimum of processing to produce a plutonium nitrate solution from which the pure plutonium metal can be extracted. On the other hand, some residues have high plutonium content but require extensive purification. These residues, plus residues having a low concentration of plutonium, require multiple operations to concentrate and purify the plutonium into a suitable nitrate solution. Both streams are then combined and converted into plutonium metal.

The side streams of waste liquids generated during the recovery operations and having plutonium content below approximately 10^{-3} g/l are treated in the process waste treatment plant.

A secondary objective of recovery processes is the recovery of americium, a transuranium element that appears in plutonium materials as the result of the beta decay of plutonium-241. The only americium isotope of significant concentration found in plutonium materials processed at the RFP is americium-241.

Americium is separated from plutonium metal residues by contacting the molten plutonium with a halide salt mixture in an inert atmosphere. The americium is recovered from the resulting salt residue and is sold to the radioisotope pool at Oak Ridge National Laboratory, Oak Ridge, Tennessee.

A quantitative separation of americium from liquid process streams containing plutonium is done by a plutonium peroxide precipitation process. The americium fraction from this process goes to a waste treatment facility, where it is prepared for off-site burial as a solid waste.

2.2.6 Support Activities

Operations that support the major production activities are those dealing with the control of quality, safety, and maintenance; utilities such as electricity, fuel, inert gas, water, and steam; and the transfer or shipping of materials to and from the plant (DOE, 1980).

2.2.7 Oxnard Support Facility

The primary activity at the Oxnard Support Facility is the forging of unclassified shapes and materials to specification for further processing at RFP and other DOE facilities. Other operations at Oxnard are those required to support this primary activity. These include sawing, grinding, machining, and testing operations.

2.3 State/Federal Concerns

As part of the pre-Survey site visit at Rocky Flats, meetings were held with the U.S. Environmental Protection Agency (EPA), Region VIII, on July 9, 1986, and the Colorado Department of Health (CDH) on July 10, 1986, to discuss the objective and scope of the Environmental Survey. At these meetings, the Survey team representative asked the Federal and state representatives to identify and discuss their environmental concerns about the RFP so that these could be reviewed during the DOE Survey.

Members of the CDH staff expressed several concerns regarding the RFP. No attempt has been made to prioritize these concerns in any manner, or to judge whether these are legitimate concerns or just statements by the staff as reminders of past items of discussion with RFP. These concerns are

- The long-standing commitment made by RFP to remove the plutonium-contaminated material under the 903 Area asphalt pad when there is an appropriate place to put it. They are concerned that it is taking so long to find an acceptable disposal site.
- The consequences of cleaning up the B-series Ponds and whether the plutonium in the sediments would be resuspended and transported further downstream.
- Whether there would be a long-term commitment of funding for groundwater sampling and remedial action projects.

- The question of radioactively contaminated PCB oils stored on-site. There are none at present. All of these oils have been transported to Los Alamos for disposition by incineration.
- The length of time that scrap material had to be stored at the plant prior to being reprocessed.

The regional EPA expressed an interest in the Survey effort and in receiving a copy of the Interim Report; no site-specific concerns were expressed during the meeting.

Although not discussed during the meetings, the Environmental Protection Agency (EPA) and the Colorado Department of Health (CDH) have several concerns regarding current and past waste management operations. The RCRA Part B permit applications submitted by the RFP in November, 1985, were found deficient, especially in the areas of waste stream characterization and groundwater monitoring activities. The agencies are concerned that nonradioactive hazardous wastes may be mixed with radioactive wastes and not properly managed, and that active and inactive waste management units may be adversely affecting groundwater. In addition, several inactive waste disposal sites and spill areas have been identified as potential problems that may require remedial action. A compliance agreement with EPA Region VIII and the State of Colorado was entered into on July 31, 1986, to resolve compliance issues related to RCRA and CERCLA. The agreement contains an aggressive schedule to prepare revisions to RCRA permit applications and closure plans, prepare lists of waste management units, plan and conduct a site-wide remedial investigation/feasibility study (RIFS), develop waste analysis plans, and install groundwater monitoring wells. At the time of this writing, all required deliverables have been made on or before the date required (Appendix D). The RFP expects to continue to meet the compliance agreement schedule (Sections 4.1 and 4.5).

A complaint was issued against the RFP operating contractor by EPA for alleged Toxic Substances Control Act (TSCA) violations on August 4, 1986. Six violations concerning the handling of polychlorinated biphenyls (PCBs) were cited, and a fine of \$111,000 was assessed against Rockwell International. Negotiations with EPA Region VIII are currently underway to eliminate the fine and violations. Because of recent changes at the Regional Administrator level in Region VIII, completion of negotiations may be delayed.

The Oxnard Support Facility lies within EPA Region IX. However, EPA has delegated authority to the State of California, which has in turn delegated authority to Ventura County. No contact was made

with these authorities to elicit their concerns. However, pertinent correspondence between the site and local regulatory agencies was reviewed as part of the visit. No unresolved concerns were evident from this review.

PRELIMINARY

3.0 MEDIA-SPECIFIC SURVEY FINDINGS

The discussions in this section pertain to existing or potential environmental problems in the air, soil, water, and groundwater media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

3.1 Air

The air portion of the RFP Environmental Survey is designed to address existing and potential environmental impacts associated with releases of contaminants to the atmosphere, and includes a critical evaluation of air pollution sources and controls, and compliance with air pollution regulations and DOE orders. Adherence to established environmental procedures is evaluated from the standpoint of environmental problems or risks. Principal regulations and DOE orders relating to air emissions used as guidance during the Survey include:

- The Clean Air Act (CAA) and amendments
- Federal regulations including
 - National Ambient Air Quality Standards (NAAQS) (40 CFR 50)
 - National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR 61
- Colorado Ambient Air Quality Standards (Code of Colorado Regulations, Vol. 5, Part 14)

The release of radionuclides to the environment from a DOE facility is regulated by DOE Order 5400.1A. In 1985, the Department of Energy (DOE) adopted, as an amendment to this order, an interim radiation protection standard to be implemented in calendar year 1985 (DOE, 1985). This interim standard incorporates guidance from the National Council on Radiation Protection and Measurement (NCRP), as well as the air emission standards of 40 CFR 61, Subpart H. Included in the interim standard is a revision of the dose limits for members of the public and tables of radiation dose conversion factors to be used for calculating dose from intakes of radioactive materials. The dose factors are based on International Commission on Radiological Protection (ICRP) Publication 30 methodology for radiation dosimetry. Effluent air derived concentration guides (DCG) were provided in a memorandum from Robert J. Stern dated February 28, 1986 (DOE, 1986). The DCGs apply to inhalation of air by members of the general public.

The assessment of the environmental impacts of airborne radiological emissions considered the DOE interim standards referenced above; National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR 61, Subpart H, and NRC limits for concentrations of radionuclides in air above natural background, 10 CFR 20, Appendix B. Although the NRC standards do not directly apply to DOE facilities, they provide a health-based reference for comparisons with site radionuclide releases.

3.1.1 Background Environmental Information

Meteorological data summarized in Section 2.1 provides details on atmospheric conditions in the Rocky Flats vicinity.

A wind rose (Figure 3-1) shows the 1985 annual summary of the percent frequency of wind directions (16 compass points) divided into four speed categories. The wind rose vectors also represent the direction from which the wind is blowing (i.e., wind along each vector blows toward the center). The low frequency of winds greater than 7 meters per second (15.7 mph) with westerly components is also normal. Winds, although variable, originate predominately in the northwesterly quadrant, with stronger winds occurring during the winter months.

In the Code of Federal Regulations (40 CFR 50), the Environmental Protection Agency has designated ambient air quality standards for six air pollutant materials (criteria pollutants). The list of pollutants includes sulfur dioxide (SO_2), total suspended particulate matter (TSP), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and lead (Pb) (Table 3-1). Also presented in the table are Colorado ambient air quality standards, which for SO_2 and O_3 are more stringent.

Additionally, National Emission Standards for Hazardous Air Pollutants (NESHAPs) at 40 CFR 61 list eight substances that have been designated as hazardous air pollutants, and an additional twenty substances for which a Federal Register notice has been published that included consideration of serious health effects. Those substances are listed in Table 3-2. The regulations provide for delegation to a state for the authority to implement and enforce NESHAPs; such delegation has been made to the State of Colorado.

3.1.1.1 Nonradioactive Air Contaminants

The RFP is in Jefferson County, which is part of the Metropolitan Denver Intrastate Air Quality Control Region. The area surrounding the plant has been designated by the Environmental Protection Agency as attainment for total suspended particulates, sulfur dioxide, carbon monoxide,

FIGURE 3-1

1985 ANNUAL WIND ROSE FOR ROCKY FLATS PLANT
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986

TABLE 3-1

**SUMMARY OF AMBIENT AIR QUALITY STANDARDS
(CRITERIA POLLUTANTS - NONRADIOACTIVE)**

Parameter	Averaging Time	NAAQS	Colorado AAQS
TSP	Annual Geometric Mean		
	Primary ^a	75 $\mu\text{g}/\text{m}^3$	75 $\mu\text{g}/\text{m}^3$
	Secondary ^b	60 $\mu\text{g}/\text{m}^3$	60 $\mu\text{g}/\text{m}^3$
	24-Hour		
	Primary ^{a,c}	260 $\mu\text{g}/\text{m}^3$	260 $\mu\text{g}/\text{m}^3$
SO ₂	Secondary ^{b,c}	150 $\mu\text{g}/\text{m}^3$	150 $\mu\text{g}/\text{m}^3$
	Annual Arithmetic Mean		
	Primary ^a	0.030 ppm	—
	24-Hour		
CO	Primary ^{a,c}	0.140 ppm	—
	1-Hour		
	Secondary ^{b,c}	0.500 ppm	0.267 ppm
NO ₂	1-Hour		
	Primary ^{a,c}	35 ppm	35 ppm
	8-Hour		
NO ₂	Primary ^{a,c}	9 ppm	9 ppm
NO ₂	Annual Arithmetic Mean		
	Primary ^a	0.05 ppm	0.05 ppm

TABLE 3-1
SUMMARY OF AMBIENT AIR QUALITY STANDARDS
(CRITERIA POLLUTANTS - NONRADIOACTIVE)
PAGE TWO

Parameter	Averaging Time	NAAQS	Colorado AAQS
Ozone	1-Hour		
	Primary ^{a,d}	0.12 ppm	0.082 ppm
Lead	Calendar Quarter		
	Primary ^a	1.5 $\mu\text{g}/\text{m}^3$	

Notes:

- a. Primary National Ambient Air Quality Standards (NAAQS) are intended to protect public health.
- b. Secondary NAAQS are intended to protect public welfare.
- c. Not to be exceeded more than once per year.
- d. Statistically estimated number of days with concentrations in excess of the standard is not to be more than 1.0 per year.

Sources:

NAAQS - 40 CFR 50

Colorado AAQS - Code of Colorado Regulations, Volume 5, Part 14.

TABLE 3-2

**SUBSTANCES DESIGNATED OR UNDER CONSIDERATION AS
HAZARDOUS AIR POLLUTANTS**

Designated Hazardous Air Pollutants	Health Effects Under Consideration
Asbestos	Acrylonitrile
Benzene	1,3-Butadiene
Beryllium	Cadmium
Coke Oven Emissions	Carbon Tetrachloride
Inorganic Arsenic	Chlorinated Benzenes
Mercury	Chlorofluorocarbon-12
Radionuclides	Chloroform
Vinyl Chloride	Chloroprene
	Chromium
	Epichlorohydrin
	Ethylene Dichloride
	Ethylene Oxide
	Hexachlorocyclopentadiene
	Manganese
	Methyl Chloroform
	Methylene Chloride
	Perchloroethylene
	Polycyclic Organic Matter
	Toluene
	Trichloroethylene
	Vinylidene Chloride

Source: 40 CFR 61 as amended in 51 FR 23419, June 27, 1986.

and nitrogen dioxide. However, the entire Denver-Boulder metropolitan area, including the RFP site, has been designated as nonattainment for ozone (FR, 1984). Site-specific air quality data are presented in Section 3.1.3.3, Nonradioactive Ambient Air Monitoring.

National Ambient Air Quality Standards (NAAQS) are designed to protect the health and welfare of the general public. The nonattainment status of the Metropolitan Denver Intrastate Air Quality Control Region with respect to the primary NAAQS for ozone requires special attention to the emissions of hydrocarbons from RFP. The formation of ozone in the lower atmosphere occurs through a complex air chemistry that involves photochemical reactions with atmospheric hydrocarbons. Thus, the emissions of photochemically reactive hydrocarbons are considered precursors to the ambient levels of ozone in the atmosphere, and implementation plans for attainment and maintenance of the ozone NAAQS involve the control of hydrocarbons.

3.1.1.2 Radioactive Air Contaminants

The background radioactivity in the vicinity of the RFP is attributable to both natural and manmade sources. Natural background radiation in the area is typically higher than average values in the United States because of the elevation of the region and the geological deposits of relatively high concentrations of uranium and thorium. Both of these result in an increased external dose, while the latter may also yield elevated levels of uranium, thorium, and their decay products in air, surficial soils, surface waters, and groundwater.

The RFP is a source of airborne radioactivity through routine and accidental releases and fugitive emissions from areas contaminated as a consequence of past spills and releases of radioactive materials. RFP production activities involving radioactive materials include machining, cleaning, and assembly of metallic uranium and plutonium components; plutonium recovery and purification; and research and development. The isotopes plutonium-239 and plutonium-240 constitute more than 97 percent of the alpha radioactivity in the plutonium handled at the RFP (RI, 1986). The RFP handles both enriched and depleted uranium. Enriched and depleted uranium will contain different percentages of uranium-234, -235 and -238. Uranium-235 is the major isotope by weight (93 percent) in the enriched uranium, although the uranium-234 accounts for approximately 97 percent of the alpha activity. This results from the much higher specific activity of the uranium-234. In depleted uranium, greater than 99 percent (by weight) of the material is uranium-238. The combined uranium-238 and -234 activities account for approximately 99 percent of the alpha activity in depleted uranium. Tritium contamination may be present in materials handled at the RFP and may be released during processing.

Non-RFP man-made sources of airborne radioactivity include fallout from past nuclear weapons detonations, and very small quantities of activity released from nuclear power plants, industrial processes utilizing radioactive materials, and various research and medical applications. World-wide nuclear weapons detonations and the re-entry burn-up of nuclear-powered satellites have resulted in background plutonium concentrations throughout the world. These levels will vary with time and location because of local meteorological conditions. Environmental radiation data are collected in various cities throughout the United States by the U.S. Environmental Protection Agency. These data are tabulated and reported quarterly. Because of the wide variability of plutonium-in-air data, it is difficult to select any single value as representative of background. Table 3-3 shows average plutonium-239 activities observed in several cities during the period October-December 1984 (EPA, 1985) and January-June 1985 (EPA, 1986). The extreme variability of the data is exemplified by the data from Pierre, South Dakota; the plutonium activity for the October-December 1984 period was 0.3×10^{-18} $\mu\text{Ci}/\text{ml}$, whereas the January-June 1985 level was 1.9×10^{-18} $\mu\text{Ci}/\text{ml}$. The data for Denver, Colorado, during both periods agree with levels found in most cities within the United States, within the uncertainty of the data. The background levels at the RFP site would be expected to be comparable to those of Denver, Colorado. Observed plutonium concentrations outside the range of values tabulated may be indicative of a local contribution of plutonium particulates to the atmosphere.

Airborne uranium particulates are also monitored by the EPA on a quarterly basis. Measured concentrations of uranium isotopes in air for eight United States cities are tabulated in Table 3-4. The uranium activities in the United States background are primarily a consequence of natural radioactive materials in the environment. As with the plutonium concentrations, the uranium data varies widely. This variation is related to different levels of natural uranium in geological deposits. Background levels at the RFP site would be expected to be comparable to those of Denver, Colorado.

Tritium is present in the environment from both natural and man-made sources. The predominant natural source is through cosmic-ray interactions (cosmogenic) with the atmosphere and materials at or near the earth's surface. Spontaneous fissioning of heavy nuclides will also contribute tritium to the environment during ternary fissioning, a phenomenon that occurs in approximately 1 of every 12,000 fissions. The USEPA monitors for environmental levels of tritium in precipitation throughout the United States; this is an indicator of the concentration of tritium found in the air, as tritiated water vapor. During the period July 1985 through March 1986, the precipitation tritium concentration, neglecting areas near nuclear power plants and facilities that release large quantities

TABLE 3-3
CONCENTRATIONS OF PLUTONIUM-239 IN AIR
 ($\times 10^{-10}$ $\mu\text{Ci}/\text{ml} \pm 2s$)

City	October-December 1984 Plutonium-239	January-June 1985 Plutonium-239
Denver, CO	0.3 ± 0.4	0.2 ± 0.5
Boise, ID	0.6 ± 0.5	0.8 ± 0.7
Jefferson City, MO	0.4 ± 0.4	0.2 ± 0.3
Bismark, ND	0.6 ± 0.5	0.4 ± 0.3
Santa Fe, NM	0.4 ± 0.5	0.6 ± 0.4
New York City, NY	0.2 ± 0.8	0.4 ± 0.4
Pierre, SD	-0.3 ± 0.4	0.9 ± 0.4
El Paso, TX	1.0 ± 2.4	0.7 ± 0.5

s = Sample Standard Deviation

Source:

1. Environmental Radiation Data, Report 43, July-September 1985, United States Environmental Protection Agency, EPA 520/5-86-007, December 1985.
2. Environmental Radiation Data, Report 44-45, October 1985 - March 1986, United States Environmental Protection Agency, EPA 520/5-86-031, June 1986.

TABLE 3-4

CONCENTRATIONS OF URANIUM ISOTOPES IN AIR
(x 10⁻¹⁸ μ Cl/ml $\pm$ 2s)

City	October-December 1984			January-June 1985		
	U-234	U-235	U-238	U-234	U-235	U-238
Denver, CO	22.3 $\pm$ 3.7	1.3 $\pm$ 0.7	22.3 $\pm$ 3.7	47.4 $\pm$ 5.8	1.6 $\pm$ 0.7	44.2 $\pm$ 5.5
Boise, ID	20.5 $\pm$ 3.7	0.1 $\pm$ 0.2	15.8 $\pm$ 3.1	22.9 $\pm$ 2.8	1.1 $\pm$ 0.5	22.0 $\pm$ 2.7
Jefferson City, MO	16.6 $\pm$ 3.1	0.5 $\pm$ 0.5	16.2 $\pm$ 3.1	15.2 $\pm$ 2.0	0.3 $\pm$ 0.2	15.3 $\pm$ 2.1
Bismark, ND	33.2 $\pm$ 5.0	0.8 $\pm$ 0.6	27.0 $\pm$ 4.3	19.1 $\pm$ 2.5	0.9 $\pm$ 0.4	19.0 $\pm$ 2.5
Santa Fe, NM	16.4 $\pm$ 3.3	0.5 $\pm$ 0.6	15.5 $\pm$ 3.1	27.1 $\pm$ 3.6	0.5 $\pm$ 0.4	26.8 $\pm$ 3.5
New York City, NY	18.9 $\pm$ 3.1	0.9 $\pm$ 0.6	15.7 $\pm$ 2.8	23.0 $\pm$ 3.2	0.8 $\pm$ 0.5	24.0 $\pm$ 3.6
Pierre, SD	18.7 $\pm$ 4.4	0.1 $\pm$ 0.6	14.5 $\pm$ 3.7	29.3 $\pm$ 4.6	1.2 $\pm$ 0.6	24.3 $\pm$ 3.4
El Paso, TX	48.0 $\pm$ 8.0	0.2 $\pm$ 0.4	44.0 $\pm$ 7.5	37.6 $\pm$ 5.1	1.1 $\pm$ 0.6	28.5 $\pm$ 4.2

s = Sample Standard Deviation

Source:

1. Environmental Radiation Data, Report 43, July-September 1985, United States Environmental Protection Agency, EPA 520/5-86-007, December 1985.
2. Environmental Radiation Data, Report 44-45, October 1985-March 1986, United States Environmental Protection Agency, EPA 520/5-86-031, June 1986.

of tritium, ranged from 1×10^{-7} to 2×10^{-7} $\mu\text{Ci/ml}$, with an assigned uncertainty for both values of $\pm 2 \times 10^{-7}$ $\mu\text{Ci/ml}$ (EPA, 1985; 1986).

3.1.2 General Description of Pollution Sources/Controls

The discussion of air emissions, controls and problems at the RFP is presented in terms of radioactive and nonradioactive materials. The radioactive emissions, including plutonium, uranium, tritium, and possibly others, are generated by present operations and potentially by the resuspension of contaminated soils. The nonradioactive emissions include a wide range of substances generated by the burning of fuel and by the research, development, and production processes conducted at the facility.

Activities at RFP that result in or have a potential for release of pollutants to the atmosphere involve fabrication, cleaning, and assembly of plutonium, beryllium, uranium, and other metals, such as stainless steel and aluminum; plutonium recovery; americium separation; and research and development. Supportive activities that result in emissions to the air include steam generation, disposal of sensitive documents, disposal of waste asbestos, and painting.

In the following sections, potential sources of pollutants listed in EPA Regulations on National Emission Standards for Hazardous Air Pollutants (NESHAP) are discussed, as are Criteria Pollutants, with established ambient air quality standards.

3.1.2.1 Radioactive Pollutant Sources and Controls

The presence and handling of radioactive materials at the RFP create a potential for the airborne release of radioactive materials. RFP handles plutonium, enriched uranium, and depleted uranium. The principal plutonium isotopes in the RFP material are plutonium-239 and -240; however, it also contains a small amount (less than 0.5 percent by weight) of plutonium-241 which decays to americium-241. Typically, the RFP plutonium is about 10 years old (DOE, 1980) and will have an americium-to-plutonium ratio ranging from 0.1 to 0.2. Consequently, emissions from plutonium processes can be expected to contain small amounts of americium-241. It is also possible for some of the plutonium received at the RFP to be contaminated with tritium. When this contaminated material is processed, tritium is released to the atmosphere. Both depleted and enriched uranium contain the isotopes uranium-234, -235 and -238, although, by weight, the depleted material is predominantly uranium-238 and the enriched is uranium-235. The uranium will also contain small but measurable activity from the uranium decay products thorium-231 and -234, and

protoactinium-234. Radionuclides can be released during normal processing activities such as machining.

Radionuclides can become airborne when ventilation air or nitrogen gas (the latter used to provide an inert atmosphere in plutonium gloveboxes) comes in contact with fine particles of radioactive materials. Fine particles, capable of being entrained in these gases, come from handling oxide powder formed during machining of metallic materials, incinerating scrap and waste materials, and from chemical recovery processes. These ventilation exhaust gases, containing radioactive particles of plutonium and uranium (with small amounts of tritium gas, and the uranium and plutonium decay products), are passed through filtration systems to remove the radioactive particles prior to release to the atmosphere.

In addition to routine process-related releases, radionuclides may be released to the atmosphere through accidents such as fires or spills of radioactive materials and the resuspension of materials released in the past. The RFP has had several fires throughout its history that have released plutonium to the atmosphere. The major non-routine release of plutonium and uranium to the environment was through the leakage of contaminated cutting oil from drums stored in the 903 Area. The oil leakage contaminated soils, which have resulted in fugitive air emissions through wind resuspension.

Containment of process radioactive materials at the RFP is achieved by ventilation systems designed to maintain pressure differentials between zones and thus control the airflow pattern. Pressure differentials exist not only between the various controlled areas within a process building, but also between any one of the areas and the outside. For example, the desired pressure in the utilities and office spaces typically is negative by 0.15-inch water column (wc) with respect to outside air; the corridors surrounding the operating areas should be 0.25-inch wc less than the outside. The operating areas themselves should be 0.3-inch wc less than outside, and the glovebox atmosphere within the operating areas should be 1.0-inch wc less than outside. Figure 3-2 illustrates these differentials. Should any zone be breached, the flow of air would be inward. Thus, any contaminated air would be prevented from bypassing the ventilation filters and reaching the outside atmosphere.

Supply air is filtered, dehumidified, and heated or cooled to meet the requirements of a given area. The air is then transported by ducts to that area in a carefully controlled manner. Some non-inerted gloveboxes draw air from the room into the box through a high-efficiency particulate air (HEPA)

FIGURE 3-2

**VENTILATION PRESSURE DIFFERENTIALS
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filter. The systems are designed for once-through airflow or for various percentages of air recycle, depending on operating conditions.

HEPA filters, used exclusively for final air filtration at Rocky Flats, consist of 15-to-20-mil continuous-fiberglass sheet-filter media enclosed in fire-retardant frames. Filters are fabricated to meet rigid RFP standards for materials of construction, physical characteristics, and efficiency. New HEPA filters are individually tested in the Filter Certification Test Facility. In addition to laboratory tests of filter components, the assembled filters are tested with a thermally generated aerosol of dioctylphthalate, which has an average particle size of $0.3\text{ }\mu\text{m}$. This test reveals possible filter media or bypass leakage, which might result from improper fabrication. Filters are also tested for total pressure drop and squareness and are inspected for excessive looseness of packing and for damaged gaskets. All newly installed filter systems are field tested for overall system efficiency or, in the case of large systems, are leak tested to assure an overall-system efficiency of 99.95 percent.

At 17 RFP buildings, a total of 43 separate exhaust ventilation systems utilizing HEPA filters are provided for room air, glovebox enclosures containing dry air, and glovebox enclosures having an inert atmosphere of nitrogen (Table 3-5). The RFP uses a minimum of two stages of HEPA filtration for general building air in buildings where plutonium is handled and four stages of filters for air and nitrogen from gloveboxes used for plutonium handling. The filtration systems for the plutonium gloveboxes are designed and maintained to assure that effluents will have a plutonium concentration less than the administrative guide of 0.06 pCi/m^3 . This level can be achieved with only three stages of HEPA filtration; the fourth is added to assure the required containment even if one stage is damaged.

Small amounts of tritium handled at the RFP result in the discharge of this isotope. Tritium is not removed by the HEPA filter systems. The principal control of tritium releases is a strict limit of the total amount of tritium that can be contained in materials processed by RFP, based on specific isotopic analyses of incoming materials. All nonroutine, incoming shipments of special nuclear materials are tested for tritium to prevent inadvertent processing of unknown amounts of that element. For the 5-year period 1981-1985, a total of 1.15 Ci of tritium was released from RFP operations (see Section 3.1.3.1).

The use of multiple stages of HEPA-filtration for both building ventilation and process area exhausts would be expected to contain releases of radionuclides to the environment to levels well below applicable health-based release limits. For the 5-year period 1981-1985, the total release of plutonium was measured to be approximately $128\text{ }\mu\text{Ci}$ (see Section 3.1.3.1).

TABLE 3-5

POLLUTANT SOURCES, CONTROLS, AND MONITORING

Building	No. of Vents	Emission Control*	Major Material Processed	No. of Vents Monitored Per Pollutant					
				TLL α	Pu	Am	U	³ H	Be
371	3	A	Pu	3	3	3	3	3	3
374	2	A	Pu	2	2	2	2	2	2
444	2	B	Be	2			2		
447	1	B	Be	1			1		1
559	1			1	1	1	1	1	1
707	6	A	Pu	6	6	6	6	6	6
771	3	A	Pu	3	3	3	3	2	3
774	1	A	Pu	1	1	1	1	1	1
776	9	A	Pu	9	9	9	9	7	9
778	1			1	1	1	1		1
779	2	A	Pu	2	2	2	2	2	2
865	2	B	Be	2			2		2
881	3	C	U	3	3	3	3	1	3
883	3	B	U	3			3		3
886	1		U	1	1	1	1		1
889	1	B	U	1			1		1
991	2			2	2	2	2		2
Total	43			43	34	34	43	25	43

- *A - Four stages of High Efficiency Particulate Air filters for glovebox vents, two stages for room air.
 B - Two stages of High Efficiency Particulate Air filters.
 C - One stage of High Efficiency Particulate Air filter.
 TLL α - Total Long-lived Alpha Activity.

Source: G. S. Setlock and M. L. Paricio, "Catalog of Monitoring Activities at Rocky Flats," Rockwell International, EAC-421-86-2, July 1986.

Since production began in 1953 at RFP, several accidental fires involving plutonium, a pyrophoric metal (ignites spontaneously), have occurred. Two fires have caused significant damage to production buildings (DOE, 1980). These occurred in Building 771 in 1957 and Buildings 776-777 in 1969, and resulted in estimated (DOE, 1980) airborne releases of 25,618 μCi and 856 μCi , respectively. In addition, there were three isolated fires that resulted in detectable airborne releases of plutonium to the environment. These fires occurred in 1965, 1969, and 1972 with releases of 1,170; 20; and less than 2 μCi of plutonium, respectively. Other minor releases occurred in 1964, 1971, and 1972 as a result of other incidents. These historical releases are summarized in Table 3-6. Recent improvements in fire prevention and fire control systems have minimized the potential for releases to the atmosphere.

In addition to releases of plutonium to the atmosphere from the production facilities, a potential fugitive source of airborne activity is the resuspension from the soil of plutonium released during past incidents. The only location where the plutonium-in-soil concentration is sufficiently high that resuspension could result in a significant quantity of airborne activity is in the 903 Area. This area became contaminated during the period between 1957 and 1967 when cutting oil contaminated with plutonium leaked from drums being stored at an outdoor drum storage field. This contamination is described in more detail in Section 3.2.3. It has been estimated that 8.6 Ci of plutonium contamination remain on the RFP Site (Krey, 1972; 1976). The original storage area has been covered with an asphalt pad to contain the plutonium that remains in the soil at that location, estimated at 1.7 Ci. The remaining activity is believed to be dispersed to the east of the 903 Area with the activity concentration decreasing with increasing distance from that location. The contaminated land is covered with vegetation and has, since the initial release, "weathered in," (i.e., has undergone limited vertical migration so that the activity is not highly concentrated in the top 1 centimeter (cm) of the soil and cannot be readily resuspended). The consequence of these factors is that the contaminated soils are effectively stabilized and do not present a significant risk of airborne plutonium release to off-site locations. On-site air samplers near the 903 Area do exhibit plutonium activities above background, but there is no evidence that this activity is being released off-site; perimeter monitors do not show significant levels of plutonium activity. Ambient air monitoring data are discussed in Section 3.1.3.2. In addition, studies by Langer (Langer, 1986; 1983) indicate that plutonium-contaminated material of respirable size is comparable to background levels of plutonium. Since plutonium is primarily an inhalation hazard, this indicates that resuspension of the contaminated soils does not present an airborne health or environmental hazard.

TABLE 3-6

ACCIDENTAL RELEASES OF PLUTONIUM FROM RFP

Year	Type of Incident	Estimated Release (μ Cl)*
1957	Plutonium fire in production building	25,618
1964	Chemical explosion in glovebox	10
1965	Glovebox drain plug fire	1,170
1969	Plutonium fire in glovebox and production building	856
1969	Plutonium fire in tunnel between buildings	20
1970	Spill during cleaning of plugged drain line	25
1971	Reduction furnace explosion	4
1971	Plutonium can explosion and spill through hole in barrel liner	4
1972	Incinerator fire and incinerator glovebox explosion	<2
1974	Control valve failure	934
Total		28,643

* Data prior to 1973 were based on total long-lived alpha measurements. In subsequent years, the data represent actual plutonium releases.

Source: "Final Environmental Impact Statement: Rocky Flats Plant Site, Golden, Jefferson County, Colorado," Vol. 1, U.S. Department of Energy, DOE/EIS-0064 (DOE, 1980).

Most of the uranium processing at the RFP is conducted in four buildings: 881, 883, 886, and 889 (see Table 3-5). However, since small quantities may be present in other facilities, air emissions are monitored for uranium at the 17 major production and waste processing facilities. With one exception, filter plenums in buildings in which only uranium is handled have been modified to use two HEPA-filtration stages. At one location in the uranium processing area, Building 881, one HEPA-filtration stage is used; this building is scheduled for the addition of a second stage of HEPA-filtration in 1987. Because of the efficiency of the two stages of HEPA-filtration, the releases of uranium from RFP have been small in comparison to the NRC concentration limit of 1×10^{-10} $\mu\text{Ci}/\text{ml}$ release of airborne uranium to an unrestricted area (10 CFR 20 Appendix B). For the period 1981 through 1985, the maximum concentration of uranium observed in RFP airborne emissions was 1.48×10^{-11} $\mu\text{Ci}/\text{ml}$ (see Section 3.1.3.1); this concentration is less than 15 percent of the NRC limit. The Environmental Survey team found no documentation to indicate that any releases of uranium in excess of any health-based standards have occurred during the operating history of RFP.

Incinerators installed in Buildings 771 and 776 are used to burn radioactively contaminated wastes. Descriptions of those incinerators, their operation limitations, and emission controls are given in the following sections.

- Building 771 Incinerator

The incinerator in Building 771 is a production unit consisting of a multiple chamber retort designed to burn plutonium-contaminated plastics, paper, rubber, and cloth for the dual purpose of disposing of the contaminated waste and for subsequent recovery of plutonium. The original Emission Permit (No. C-12932), issued on November 5, 1981, by the Colorado Department of Health, Air Pollution Control Division, limited operation to 550 hours per year. However, to reduce the backlog of waste materials and to dispose of wastes as generated, a Revised Air Pollution Emission Notice (RAPEN) was submitted by RFP for an increase in operating time. The RAPEN provided for 24-hour operation for backlog elimination, with 16-hour-per-day operation thereafter.

The incinerator is fueled only by combustible solid wastes. High-temperature combustion is achieved through oxygen addition. The RFP has established acceptance criteria for materials to be burned. These criteria restrict feed materials to combustible solids having economically recoverable levels of plutonium. Each drum has an identification number and a material description code. After opening a drum, two people verify the contents against the codes and both sign the run sheet.

Ash generated during the combustion process is removed from the firebox at least hourly and from the afterburning chamber at least twice per shift. The collected ash is subsequently processed for recovery of plutonium.

Particulate emissions from the incinerator are controlled by passing the effluent gases through a potassium hydroxide venturi scrubber and wet cyclone, followed by a filter plenum with four banks of HEPA filters. The effluent from this filter plenum is exhausted to the main building ventilation system, which is served by another stage of four banks of HEPA filters. Installation of a continuous monitor for NO_x emissions is planned; however, the operating permit states emission limits only for particulates.

• Demonstration and Pilot-Scale Incinerators - Building 776

Two incinerators are covered by a single Emission Permit (No. C-13022) issued by the Colorado Department of Health, Air Pollution Control Division, on March 25, 1982.

The first unit is a pilot-scale fluidized-bed incinerator capable of burning up to 20 pounds per hour of plutonium-contaminated solid waste and up to 2 gallons per hour of plutonium-contaminated liquid waste. The second unit is a demonstration-scale fluidized-bed incinerator burning up to 180 pounds per hour of plutonium-contaminated solid waste and up to 10 gallons per hour of plutonium-contaminated liquid waste. The use of these units is limited to materials containing quantities that are considered to be economically recoverable.

The effluent gases from both units are handled by a common exhaust system that consists of a cyclone, catalytic afterburner, sintered metal filters, and five stages of HEPA filters. The permit specifically prohibits simultaneous operation of the two incinerators.

Efforts are being made to obtain a Resource Conservation and Recovery Act (RCRA) permit for the demonstration-scale incinerator to burn plutonium-contaminated hazardous wastes.

3.1.2.2 Nonradioactive Pollutant Sources and Controls

The sources and emissions of nonradioactive air contaminants generated by the RFP are presented in this section. These contaminants include, in part, the criteria pollutants with established ambient air quality standards, and those air contaminants regulated under National Emission Standards for Hazardous Air Pollutants (NESHAP). However, the survey also considered the emissions of toxic air pollutants and unregulated air contaminants that might pose a future problem.

3.1.2.2.1 Beryllium

Beryllium is brought on-site in usable form, machined for specific purposes, and the scrap is shipped off-site for commercial recycling. Parts are machined in a special machine shop designed for beryllium work. All machines in this shop are equipped with high-speed downdraft systems to remove machine chips as they are generated and collect them in drums so that beryllium particulates are not released to the atmosphere. These chips are not exposed to machining oil; consequently, they are clean, dry, and can be sold as scrap to the beryllium industry. Exhausts from the ventilating system and room air are passed through HEPA filters before being vented to the atmosphere.

Air Contaminant Emission Notices, which serve as operating permits, were filed with the Colorado Department of Health, Division of Air Pollution Control, during May 1979, concerning the potential sources of beryllium emissions from the RFP.

3.1.2.2.2 Asbestos

See Section 4.2.2.2 for a discussion of asbestos as related to the Rocky Flats Plant.

3.1.2.2.3 Steam Plant

The steam plant (Building 443) consists of four boilers that are capable of producing, in total, 300,000 pounds of steam per hour at 300 pounds per square inch and 475°F. The steam is used largely in heating, ventilating, and air conditioning systems in the buildings, with about 30 percent being used for process heating. The boilers are capable of burning natural gas or No. 6 fuel oil. As shown in Figure 3-3, natural gas has been the usual fuel, providing generally more than 80 percent of the total heat input since 1973.

FIGURE 3-3

STEAM PLANT FUELS CONSUMPTION
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Air Contaminant Emission Notices, which serve as operating permits for the four boilers, were filed with the Colorado Department of Health (CDH) in 1979; CDH has incorporated those data into its computerized source inventory. The notices show no emission control equipment on any of the four stacks. Estimates of emissions made by RFP using emission factors from AP-42 (EPA, 1976) are shown in Table 3-7.

Colorado Air Regulations exempt SO₂ sources from process-based standards if the total SO₂ emissions from all sources are less than 5 tons per day, and all Federal and state ambient air quality standards are met (CDH, 1985). Calculation of the maximum potential to emit sulfur dioxide shows that the 5-ton-per-day limit could be exceeded if all four boilers were operated at 100 percent capacity, firing only No. 6 fuel oil containing 1 percent (or more) sulfur, for a continuous 24-hour period. Because the sulfur content of the fuel oil used at the RFP is typically near 0.7 percent, the exemption from the process-based emission standards is applicable.

3.1.2.2.4 Waste Paper Incinerator

An incinerator, located at Building 122, has been used in the past to dispose of waste paper considered to contain sensitive information. The incinerator was operated under an Emission Permit (No. C-12931) issued by the Colorado Department of Health, Air Pollution Control Division, on March 25, 1982. The permit prescribed specific operating limitations, including a maximum feed rate of 490 pounds per hour and a maximum operating schedule of 5 hours per day and 250 days per year. Hourly and annual particulate emissions could not exceed 0.45 pound per hour and 0.22 ton per year. Visible emissions could not exceed 20 percent opacity. The incinerator is not equipped with emission control devices.

Because the incinerator frequently emitted visible smoke, it has been placed on standby status with the operating permit still current, so it could be used in the event the waste paper shredder is inoperable.

3.1.2.2.5 Waste Paper Shredder

A paper shredder has been installed in Building 122 to dispose of sensitive waste paper. The shredded paper is transported by an air stream through a cyclone separator and is discharged to a bin outside Building 122. Finely divided paper particles not captured in the bin are released to the atmosphere. The shredded paper is disposed of at the on-site landfill.

TABLE 3-7

ESTIMATES OF EMISSIONS FROM ROCKY FLATS STEAM PLANT

	Boiler Identification			
	443-4	443-5	443-6	443-7
Design Heat Input, million Btu/hr	100	100	100	100
Fuel Consumption				
Natural Gas, million ft ³ /yr	66.5	35.2	199.2	219.0
No. 6 Oil, gal/yr	255,990	16,991	357,192	204,104
Pollutant Emitted*				
Particulates, t/y	1.5	0.3	2.5	2.0
Sulfur Dioxide, t/y	20.0	1.4	20.0	16.0
Nitrogen Oxides, t/y	13.5	3.4	28.0	25.3
Hydrocarbons, t/y	0.2	0.1	0.5	0.4
Carbon Monoxide, t/y	1.2	0.3	2.6	2.4

* Estimated based on AP-42 emission factors.

Source: Data from Air Contaminant Emission Notices dated June 28, 1979, prepared by Rockwell International.

3.1.2.2.6 Volatile Organic Compounds

Ozone and other photochemical oxidants are not emitted into the air as primary pollutants. Rather, they are formed as secondary pollutants in the atmosphere from primary organic and inorganic precursors emitted from a multiplicity of sources. The primary pollutants that serve as precursors are volatile nonmethane organic compounds and nitrogen oxides.

In several parts of the country, it has become increasingly apparent that the ozone national ambient air quality standard will not be attained in 1987. Thus, the EPA is developing a four-part strategy for attainment of the standard through (1) improvements in existing regulations and programs, (2) new control measures, (3) State Implementation Plan (SIP) revision recalls, and (4) a sustained progress program (ER, 1986). All these efforts would require tighter controls on emissions of volatile organic compounds.

Several activities at RFP involve the use of volatile organic compounds (VOC) and have the potential to emit these compounds into the atmosphere. Those activities include, but are not limited to, solvent degreasing operations, and painting. In some instances, large on-site storage tanks for gasoline and for carbon tetrachloride are indicative of substantial usage of these substances. A number of other VOCs are used in smaller drum-sized quantities.

An 18,000-gallon underground tank at Building 331 (garage) contains unleaded gasoline for use by on-site vehicles. The tank is equipped to return gasoline vapor to the delivery truck as gasoline is transferred from the truck to the tank. About 312,000 gallons of unleaded gasoline are used per year.

Carbon tetrachloride is stored in two tanks (5,000-gallon tank outside Building 707 and 3,500-gallon tank outside Building 776). The storage tanks are equipped with vapor return lines to vent vapors to the delivery truck during tank filling. The carbon tetrachloride is used to wash oil from parts, tools, gloves, and machines, and for degreasing plutonium turnings prior to briquetting. These operations are conducted in gloveboxes that are ventilated to the outside. These emissions are uncontrolled. It has been estimated (DOE, 1985) that the amount of carbon tetrachloride released to the outside atmosphere, based on the rate of consumption, is about 4.0 grams per second, which is equivalent to a rate of 72 liters per 8-hour day. This is substantially in excess of the 38 liter-per-day limit for VOC disposal by evaporation or spillage in an ozone nonattainment area as set by Colorado Air Regulation No. 7. However, in addition to its potential role as an ozone precursor, carbon tetrachloride is being considered by the USEPA for listing as a hazardous air pollutant (see Table 3-2).

Odors of paint and lacquer solvents were frequently detected outside Building 333 (paint shop) by the Survey team.

A vehicle-emission testing program provides for an annual inspection of all 1968 or newer plant vehicles with license plates. This program ensures minimal hydrocarbon emissions from about 140 on-site vehicles.

3.1.2.3 Oxnard Support Facility

Twenty-three gas fired furnaces are covered by Ventura County Air Pollution Control District (APCD) Permit No. 1203. A vapor degreaser in Building 3, which utilizes 1,1,1-trichloroethane, also has a permit from the APCD. A degreaser in the fabrication shop in Building 2 and the units having emissions control devices for particulates (baghouses on the four wheelabrators at Building 5, the sand blaster at Building 4, and the cyclone on the grinders at Building 4) are not required to have permits because of their size.

3.1.3 Environmental Monitoring Program

RFP conducts extensive monitoring programs to quantify releases of pollutants to the atmosphere and to evaluate the effects of these releases on ambient air quality. The information on radionuclides and selected data of current interest is submitted monthly to the DOE Rocky Flats Area Office, the Radiation Control Division of the Colorado Department of Health, Region VIII of the EPA, the health departments of Boulder and Jefferson Counties, and to interested city officials in communities near the plant. An annual environmental monitoring report (RI, 1986) is also prepared in compliance with DOE Order 5484.1, Chapter IV.

In the subsequent sections, the effluent monitoring activities and data are presented, followed by ambient monitoring efforts and data.

3.1.3.1 Effluent Monitoring

The effluent monitoring efforts are separated into two major categories: (1) radionuclides and beryllium, and (2) other pollutants.

3.1.3.1.1 Effluent Monitoring for Radionuclides and Beryllium

The ventilation exhaust systems for all of the production and research facilities are continuously sampled for residual particulates downstream of the HEPA filter banks (see Table 3-5). However, the sampling may not be representative for the following reasons:

- Because of physical constraints within the buildings, the ductwork was rarely configured in a manner that would allow conformance to isokinetic sampling guidelines regarding sampling probe placement.
- There is no documentary evidence that the condition of the sampling probes is adequate for representative sampling.
- Although sampler air-flow rates are calibrated monthly, flow rate changes between calibrations could occur. There is no evidence that flow rate checks are made between calibrations.

Thus, the accuracy of the reported emissions of particulate radionuclides and beryllium is considered questionable.

Exhaust systems that service plutonium-handling areas are also equipped with Selective Alpha Air Monitors (SAAM). The SAAMs are calibrated to selectively detect plutonium-239 and -240. The monitors are adjusted to automatically sound an alarm if the level of plutonium activity in the effluent significantly exceeds typical values. The alarm level is individually set for each monitor on the basis of the stack flow rate and historical data. The Environmental Survey team reviewed effluent monitoring data for the period 1981 through 1985. No records were observed that indicated any out-of-tolerance activity levels.

Filters from the exhaust particulate samplers are collected three times each week and analyzed for total long-lived alpha activity (TLL_α). There are 43 separate exhaust systems with samplers that service areas where radioactive materials are handled (see Table 3-5). Of these, 35 service plutonium-handling facilities. If the TLL_α concentration exceeds the plant action guide value of 2.0×10^{-14} $\mu\text{Ci/ml}$, an investigation is conducted to determine the cause and evaluate the need for corrective action. The Environmental Survey team reviewed monitoring records at the RFP and found no records to indicate failed control systems for the period 1981 through 1985.

At the end of each month, filters from each of the 43 exhaust systems are composited and analyzed for specific alpha-emitting radionuclides and beryllium. RFP environmental monitoring data were examined for the period 1981 through 1985 by the Environmental Survey team. During this period, the maximum plutonium concentration observed in the airborne effluent was 2.96×10^{-12} $\mu\text{Ci}/\text{ml}$; this occurred during one 3-day period in 1983. The total release of plutonium during the 5-year period was approximately 128 μCi or 1.75 mg. The largest release of plutonium for any single year was 78.10 μCi or 1.07 mg in 1983. The maximum observed uranium concentration of 14.83×10^{-12} $\mu\text{Ci}/\text{ml}$ occurred in 1982. For the 5-year period, the total uranium release was 184.70 μCi ; assuming this to be all depleted uranium, this corresponds to 486 grams. The NRC-established health-based concentration limits for the release of radioactive materials to restricted areas are 1×10^{-10} $\mu\text{Ci}/\text{ml}$ for insoluble uranium and 4×10^{-11} $\mu\text{Ci}/\text{ml}$ for insoluble plutonium -239 or -240 (10 CFR 20, Appendix B).

The total annual discharge of beryllium from the 43 ventilation exhaust systems for the period 1981 through 1985 was not significantly different from background associated with the analysis, with a maximum of 0.496 gram being reported for the entire year of 1983 (RI, 1986). This value is insignificant when compared with the EPA NESHAP emission limitation of 10 grams per 24-hour period.

Bubbler-type samplers are used to sample continuously for tritium in the 25 exhaust systems for areas where tritium-containing materials may be processed (see Table 3-5). The bubbler contents are collected three times each week and analyzed using a liquid scintillation spectrophotometer. For the period 1981 through 1985, a total of 1.15 Ci of tritium was released. The maximum concentration released during this period was approximately 3.1×10^{-7} $\mu\text{Ci}/\text{ml}$, a concentration level that occurred over a 2-day period in 1981. This maximum value is approximately 6 percent of the health-based NRC limit of 5×10^{-6} $\mu\text{Ci}/\text{ml}$ (10 CFR 20, Appendix B) for the release of tritium to a restricted area.

3.1.3.1.2 Effluent Monitoring for Other Pollutants

The Colorado General Smoke and Opacity Regulations limit visible emission opacity to 20 percent (6-minute average), but do not require continuous emission monitoring for boilers with design heat input less than 250 million Btu/hour (CDH, 1985). Although the four boilers at the steam plant are individually rated at 100 million Btu/hour, each stack is equipped with a continuous monitor for visible emission opacity. In addition, monitoring devices for carbon dioxide, sulfur dioxide, and nitrogen oxides are available in the steam plant. However, the monitors are not operational.

Stack testing for particulate emissions was conducted in 1976 at 3 of the 4 boiler stacks (Table 3-8). Those tests, which were made while firing No. 6 fuel oil, showed that particulate emission limitations were being met.

The waste paper incinerator at Building 122 is equipped with a continuous monitor for visible emission opacity, which has not operated properly in the past, and is not currently operating because the incinerator has been placed on standby status.

The exhaust duct serving the pilot- and demonstration-scale fluid-bed incinerators in Building 776 is monitored for oxygen, total hydrocarbons, carbon monoxide, and carbon dioxide. These data are used primarily for control of incinerator burn efficiency to thus minimize emissions of hydrocarbons and carbon monoxide.

An analyzer for nitrogen oxides is planned for installation in the exhaust duct serving the incinerator in Building 771.

A monitoring device for carbon tetrachloride has been used in ventilation exhaust 101 in Building 707, but is not currently operating (see Section 3.1.2.2, Nonradioactive Pollutant Sources and Controls, Sources and Controls for Volatile Organic Compounds).

3.1.3.2 Radioactive Ambient Air Monitoring

High-volume ambient air samplers are located on the Rocky Flats Plant site, at the plant perimeter, and in nearby communities. The samplers, of a Rocky Flats design, operate continuously at a volume flow rate of approximately 12 liters/sec collecting particulates on 20 x 25 cm filter media. The manufacturer's test specifications rate the filter media as 99.97 percent efficient for particle sizes pertinent to ambient air monitoring.

Ambient air samplers have been placed at 23 locations within and adjacent to the Rocky Flats exclusion area. The sampler locations are shown in Figure 3-4. Filters from the samplers are collected once every 2 weeks and analyzed for total long-lived alpha (TLL_α) activity. If the TLL_α activity exceeds the plant guide value of 1.0×10^{-14} μCi/ml, a specific plutonium analysis must be performed. The TLL_α analysis is primarily a gross screening technique. The plant guide value was set to insure that if measurements statistically different from typical background are observed, the samples are analyzed to determine if the increase may be a consequence of an accidental release of plutonium from RFP. During the 5-year period, 1981 through 1985, no TLL_α activities exceeded the plant guide.

TABLE 3-8

BOILER STACK PARTICULATE EMISSION TEST RESULTS

	Boiler Load Factor*			
	100%	75%	50%	25%
Boiler No. 4				
Gas Volume Flow, acfm	44,900	45,600	31,600	--
Grain Loading, gr/acf	0.028	0.016	0.010	--
Gas Temperature, °F	322	322	272	--
Particulate Emission Rate, lb/hr	10.8	6.3	2.8	--
Allowable Emission Rate, lb/hr	15.1	12.2	9.0	--
Boiler No. 6				
Gas Volume Flow, acfm	57,500	54,200	42,200	36,300
Grain Loading, gr/acf	0.010	0.016	0.008	0.015
Gas Temperature, °F	375	355	320	302
Particulate Emission Rate, lb/hr	5.1	4.6	2.5	4.5
Allowable Emission Rate, lb/hr	15.1	12.2	9.0	5.4
Boiler No. 7				
Gas Volume Flow, acfm	56,700	41,600		
Grain Loading, gr/acf	0.013	0.006		
Gas Temperature, °F	390	355		
Particulate Emission Rate, lb/hr	6.4	2.0		
Allowable Emission Rate, lb/hr	15.1	12.2		

* Fuel = No. 6 Fuel Oil

Source: "Emission Tests of Particulate of (3) Three Boilers at Rockwell International Rocky Flats Plant, Golden, Colorado," STW, March 9-12, 1976.

FIGURE 3-4

LOCATION OF ON-SITE AND PLANT PERIMETER AMBIENT AIR SAMPLES
 (Portions of figure are not to scale)
DOE SURVEY - ROCKY FLATS PLANT
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All of the radionuclide analyses for the ambient air samplers are performed by the Health, Safety and Environment Laboratory in Building 123.

Filters from five of the 23 samplers, S-5 through S-9 (Figure 3-4), are analyzed for plutonium once every 2 weeks. These samplers are in locations where elevated airborne plutonium concentrations are most likely to be expected, that is, near the 903 Area (see discussion in Section 3.1.2.1, of 903 Area contamination). The average plutonium-in-air concentrations for these samplers for 1985 ranged from 0.04×10^{-15} to 0.41×10^{-15} $\mu\text{Ci}/\text{ml}$. These data are tabulated in Table 3-9. These concentrations ranged from 0.21 to 2.03 percent of the interim standard calculated Derived Concentration Guide (DCG) for inhalation of Class W plutonium by members of the public, 20×10^{-15} $\mu\text{Ci}/\text{ml}$. The proposed EPA screening level guidance for transuranics in air (EPA, 1977) is 1×10^{-15} $\mu\text{Ci}/\text{ml}$.

Airborne particulate samples are collected at 14 locations near the plant perimeter. Unlike the 23 on-site monitors, these samplers are outside the RFP exclusion area and are located at distances of between 3 and 6 kilometers from the plant center. The locations are shown in Figure 3-4. In addition, 14 samplers are located in or near communities in the vicinity of the plant. These locations are shown in Figure 3-5. Filters are collected once every 2 weeks, composited by location, and analyzed for plutonium as plutonium-239, -240. Maximum average concentrations for the perimeter and community monitors were obtained by the Environmental Survey Team by reviewing RFP monitoring data. These values are presented in Table 3-10. For 1985, the maximum average activity concentrations for plutonium in air at the perimeter and community monitors, respectively, were 0.008×10^{-15} and 0.006×10^{-15} $\mu\text{Ci}/\text{ml}$. The perimeter level is 0.04 percent of the DCG for plutonium and 0.8 percent of the proposed EPA screening level. The community plutonium concentrations are 0.03 percent and 0.6 percent of the DCG and EPA screening levels, respectively.

Ambient air water vapor is monitored for tritium at three on-site locations: S-4, S-5, and S-16 (Figure 3-4). The sampling is accomplished by continuously drawing air through a silica-gel trap at 1 liter per minute. Samples are collected weekly and analyzed for tritium using a liquid scintillation counter. The data are reported as the tritium concentration ($\mu\text{Ci}/\text{ml}$) in the collected water vapor. RFP environmental tritium monitoring data were reviewed by the Environmental Survey team for the 5-year period 1981 to 1985; these data are summarized in Table 3-11. The highest concentration reported during 1985 was 630×10^{-9} $\mu\text{Ci}/\text{ml}$. This value is well below the EPA drinking water limit of $20,000 \times 10^{-9}$ $\mu\text{Ci}/\text{ml}$ and the DCG for tritium in water of $2,000,000 \times 10^{-9}$ $\mu\text{Ci}/\text{ml}$ (DOE, 1986). Within the uncertainty of the analyses, the tritium level in the water vapor cannot be differentiated from background levels in surface waters.

TABLE 3-9

AVERAGE OBSERVED ON-SITE PLUTONIUM CONCENTRATIONS IN AIR
MONITORS S-5 THROUGH S-9

Station	Concentration ($\times 10^{-15}$ $\mu\text{Ci}/\text{ml}$)				
	1981	1982	1983	1984	1985
S-5	0.104 ± 0.004	0.102 ± 0.004	0.036 ± 0.003	0.079 ± 0.015	0.041 ± 0.011
S-6	0.095 ± 0.004	0.117 ± 0.005	0.052 ± 0.002	0.051 ± 0.012	0.095 ± 0.018
S-7	0.289 ± 0.011	0.206 ± 0.006	0.292 ± 0.010	0.363 ± 0.049	0.245 ± 0.045
S-8	0.398 ± 0.012	0.316 ± 0.009	0.430 ± 0.013	0.550 ± 0.072	0.390 ± 0.062
S-9	0.549 ± 0.018	0.478 ± 0.016	0.318 ± 0.010	0.240 ± 0.037	0.445 ± 0.059

Source: Environmental Survey Team Review of RFP Monitoring Data.

FIGURE 3-5

**LOCATION OF COMMUNITY AMBIENT AIR SAMPLERS
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TABLE 3-10

**MAXIMUM AVERAGE PLUTONIUM CONCENTRATIONS IN AIR
PERIMETER AND COMMUNITY MONITORS**

Year	Plutonium -239, -240 ($\times 10^{-15}$ $\mu\text{Ci}/\text{ml}$)			
	Perimeter	Perimeter Station	Community	Community Location
1985	0.008 ± 0.005	S-37	0.006 ± 0.006	Westminster
1984	0.009 ± 0.003	S-37, S-39	0.008 ± 0.004	Westminster
1983	0.005 ± 0.001	S-37, S-38	0.038 ± 0.004	Superior
1982	0.009 ± 0.001	S-37	0.018 ± 0.001	Broomfield
1981	$0.023 \pm \text{ND}$	S-32	0.030 ± 0.002	Boulder

ND = Not determined

Source: Review of RFP Environmental Monitoring Data by Environmental Survey Team.

PRELIMINARY

TABLE 3-11

MAXIMUM TRITIUM CONCENTRATIONS OBSERVED IN WATER
VAPOR AT ON-SITE LOCATIONS

Year	Maximum Tritium Concentration ($\times 10^{-9}$ $\mu\text{Ci/ml}$)	Location
1985	630 $\pm$ 670	S-5
1984	650 $\pm$ 550	S-5
1983	600 $\pm$ 250	S-4
1982	950 $\pm$ 300	S-4
1981	600 $\pm$ 450	S-4

Source: Review of RFP Environmental Monitoring Data by
Environmental Survey Team

The Colorado Department of Health monitors for radioactive particulates in air. These data are reported in monthly reports titled, "Environmental Surveillance Report on The U.S. Department of Energy, Rocky Flats Plant." The Environmental Survey team reviewed the CDH reports for the period January - June 1986. The CDH documents reported total long-lived alpha activity (TLLa) in air samples collected at 23 locations: 4 on-site (within the RFP exclusion area); 4 along the RFP site perimeter; 10 within the metropolitan area influenced by RFP; and 5 at remote locations outside the area of RFP influence. The report format also includes space for tables of plutonium-in-air data; however, during the period reviewed, CDH did not report any plutonium-in-air data. Table 3-12 summarizes the January - June 1986 TLLa data for the off-site locations. There is no statistically significant difference between plutonium-in-air levels of the off-site (metro) and the off-site (remote) locations. Within the limits of the CDH data, airborne radioactivity from RFP does not have a detectable effect on the TLLa activity at off-site locations.

3.1.3.3 Nonradioactive Ambient Air Monitoring

Monitoring of ambient air includes the following parameters: total suspended particulates (TSP), inhalable particulates (PM-10), sulfur dioxide (SO₂), carbon monoxide (CO), ozone (O₃), nitrogen dioxide (NO₂), and lead (Pb). This monitoring is conducted at a site near the east entrance to RFP, in an open area that is generally downwind from plant buildings (Figure 3-4). All of the monitored parameters, except PM-10, are criteria pollutants regulated under National Ambient Air Quality Standards and Colorado Air Quality Control Commission Ambient Air Standards. A PM-10 standard is under development by the EPA.

Written procedures detailing methods for calibrating, operating, and maintaining equipment, and for data reduction and quality assurance have been developed. Independent quality assurance audits conducted annually have shown that the sampling program is well run (Delwiche 1984; Gemmill 1985, 1986).

The TSP and PM-10 samplers are operated on a one-day-in-six schedule, a lead analysis is conducted six to eight times per calendar quarter, and the remaining parameters are sampled continuously. The ambient air quality data for 1981 through 1985, summarized in Table 3-13 show attainment for all criteria pollutants except ozone, which did not meet the Colorado air-quality standard in any of the 4 years reported.

TABLE 3-12

**COLORADO DEPARTMENT OF HEALTH
ENVIRONMENTAL SURVEILLANCE DATA
JANUARY - JUNE 1986**

OFF-SITE METROPOLITAN

Month (1986)	Total Long-lived Alpha (x 10 ⁻¹² μ Cl/ml)			
	X	S.D.	Maximum	Minimum
January	<0.007	0.003	<0.014	<0.002
February	<0.005	0.002	<0.009	<0.001
March	<0.005	<0.001	0.007	<0.002
April	<0.005	0.001	<0.003	<0.002
May	<0.005	0.002	<0.003	<0.001
June	<0.005	0.001	0.007	<0.001

OFF-SITE REMOTE

January	<0.006	0.002	<0.011	<0.003
February	<0.006	0.002	<0.008	<0.003
March	<0.006	0.002	<0.014	<0.004
April	<0.005	<0.001	<0.006	<0.004
May	<0.006	<0.001	<0.007	<0.004
June	<0.006	<0.001	<0.007	<0.004

X = Monthly Average
S.D. = Standard Deviation

Source: Review of Colorado Department of Health Environmental
 Surveillance Data (CDH, 1986) by Environmental Survey Team

TABLE 3-13

**SUMMARY OF ON-SITE AIR QUALITY DATA
(CRITERIA POLLUTANTS - NONRADIOACTIVE)**

Parameter	Averaging Time	1981	1982	1983	1984	1985	NAAQS	Colorado AAQS
TSP	Annual Geometric Mean	33h	36	52	53	47		
	Primary ^a						75 $\mu\text{g}/\text{m}^3$	75 $\mu\text{g}/\text{m}^3$
	Secondary ^b						60 $\mu\text{g}/\text{m}^3$	60 $\mu\text{g}/\text{m}^3$
	24-Hour	104h	99	196 ^e	90	89		
	Primary ^{a,c}						260 $\mu\text{g}/\text{m}^3$	260 $\mu\text{g}/\text{m}^3$
	Secondary ^{b,c}						150 $\mu\text{g}/\text{m}^3$	150 $\mu\text{g}/\text{m}^3$
SO ₂	Annual Arithmetic Mean		0.004	0.002	0.004	0.003		
	Primary ^a						0.030 ppm	—
	24-Hour		0.019	0.016	0.010	0.012		
	Primary ^{a,c}						0.140 ppm	—
	8-Hour		0.20	0.025	0.015	0.026		
	Secondary ^{b,c}						0.500 ppm	0.267 ppm
CO	1-Hour			12.6 ^f	11.1	6.3		
	Primary ^{a,c}						35 ppm	35 ppm
	8-Hour			8.4 ^f	3.1	2.2		
	Primary ^{a,c}						9 ppm	9 ppm
NO ₂	Annual Arithmetic Mean			0.149	0.010	0.011		
	Primary ^a						0.05 ppm	0.05 ppm

TABLE 3-13
SUMMARY OF ON-SITE AIR QUALITY DATA
(CRITERIA POLLUTANTS - NONRADIOACTIVE)
PAGE TWO

Parameter	Averaging Time	1981	1982	1983	1984	1985	NAAQS	Colorado AAQS
Ozone	1-Hour	0.070 ^h	0.155	0.177	0.106	0.286		
	Primary ^d						0.12 ppm	0.082 ppm
Lead	Calendar Quarter		0.090 ^h	0.036	0.040	0.119		
	Primary ^a						1.5 $\mu\text{g}/\text{m}^3$	—

Notes:

- Primary National Ambient Air Quality Standards (NAAQS) are intended to protect public health.
- Secondary NAAQS are intended to protect public welfare.
- Not to be exceeded more than once per year.
- Statistically estimated number of days with concentrations in excess of the standard is not to be more than 1.0 per year.
- Second high of 112 $\mu\text{g}/\text{m}^3$ met secondary TSP NAAQS.
- Carbon monoxide sampling initiated in March, 1983.
- Nitrogen dioxide sampling initiated in November, 1983.
- Fourth quarter.

Source:

Annual Environmental Monitoring Reports, U.S. Department of Energy, Rocky Flats Plant, 1981-1985.

NAAQS - 40 CFR 80.

Colorado AAQS - Code of Colorado Regulations, Volume 5, Part 14.

3.1.3.4 Meteorological Monitoring

Meteorological data at the RFP is provided by two fixed towers and two portable towers. The data from the on-site towers, supplemented by real-time data from a network of 16 towers operated by the National Oceanic and Atmospheric Administration and upper-air data from Denver Stapleton Airport, are used in the preparation of daily upper-air analyses and, during emergencies, short-range forecasts. These data are used to predict the path of a plume or release to the atmosphere. Specialized forecasts and monitoring of severe weather conditions such as thunderstorms, heavy rain or snow storms, and windstorms are also made.

The main source of meteorological data is a 61-meter tower located in the plant buffer zone, north of the west access road (Figure 3-4). Meteorological instruments are mounted at four levels: surface, 10 meters, 25 meters, and 60 meters. Precipitation, atmospheric pressure, and solar radiation are measured near the ground. Ambient air temperature, dew-point temperature, horizontal wind speed and direction, and vertical wind speed are monitored at 10 meters. Temperature, horizontal wind speed and direction, and vertical wind speed are measured at 25 and 60 meters. Signals from each instrument are transmitted to the Environmental Assessment Facility, and are recorded at the tower both on magnetic tape and on strip-chart recorders.

A 40-meter tower (Woman Creek tower) is located in the southeast section of the plant buffer zone, south of the east access road and west of Indiana Street (Figure 3-4). Meteorological instruments are mounted at four levels: surface, 3 meters, 10 meters, and 40 meters. Precipitation and soil moisture are measured at ground level. Horizontal wind speed and direction, dew-point temperature, solar radiation, and ambient air temperature are measured at 3 meters. Sensors at 10 and 40 meters measure horizontal wind speed and direction, vertical wind speed, and temperature. Signals from each of the instruments are recorded at the base of the tower on strip-chart recorders and on magnetic tape.

An annual summary of wind conditions (direction and speed) is prepared and plotted as a wind rose to depict the frequency of occurrence of winds from 16 compass directions and for four wind-speed classes. These data can be used in atmospheric dispersion analyses for dose assessment; however, lacking a suitable EPA approved dispersion model, the RFP uses ambient monitored data for dose assessment (see Section 4.3.3).

3.1.3.5 Dispersion Analysis

Because of the strong influence of terrain features in the vicinity of the RFP, standard EPA gaussian-plume, steady-state, air-dispersion models such as the Industrial Source Complex and AIRDOS-EPA (as required in 40 CFR 61.93) cannot be used for meaningful estimation of ground-level concentrations of pollutants emitted from the RFP (Hodgin, 1985).

A site-specific dispersion model, known as the Terrain-Responsive Atmospheric Code (TRAC), is being developed at RFP that realistically simulates dispersion processes in complex terrain. The model uses available topographic, surface cover, and meteorological information to produce three-dimensional wind fields that vary with time and space. Emissions, simulated by puffs, are transported along nonlinear trajectories through these wind fields. The model output includes plume trajectory maps, regional isopleth maps for concentration, dose, and deposition; and tabular output for selected receptors.

At the present time, the TRAC model is being used in an emergency response function to predict plume path and plume height over varying terrain. A straight-line, gaussian-plume model is used to predict ground-level concentrations at receptors with corresponding distance and terrain height.

As a next step, plans are being made for a validation study to demonstrate the applicability of the TRAC model for use in regulatory analyses (Hodgin, 1986).

3.1.4 Findings

3.1.4.1 Category I

There are no air-related Category I findings.

3.1.4.2 Category II

There are no air-related Category II findings.

3.1.4.3 Category III

There are no air-related Category III findings.

3.1.4.4 Category IV

1. Air Effluent Sampling for Radionuclides. The reported emissions of particulate radionuclides from exhaust vents are questionable. Because of physical constraints within buildings, ductwork installations are configured in a manner that prohibits conformance to isokinetic sampling guidelines. Thus, sampling probes are generally located too close to disturbed flow regions to allow representative sampling. As a result, RFP is not in strict compliance with the NESHAP reporting regulation 40 CFR 61.94.

2. Air Effluent Sampling Quality Assurance. A review of current sampling for particulate radionuclides revealed practices that may adversely affect sampling quality and reported emissions data. The items of concern are:

- There is no evidence that the condition of the air effluent sample probes is adequate for effective sampling. No documentation is maintained to demonstrate that the air effluent sample probes are inspected or changed annually. If probes are not properly maintained or are allowed to deteriorate, samples will not be representative of the effluent stream.
- Flow rate changes between calibrations could invalidate any effluent release data collected since the most recent valid calibration. Effluent sampler flow rates are calibrated monthly, but there is no evidence that flow-rate checks are made between calibrations.

3. Effluent Sampling for Beryllium. Building and glovebox ventilation exhaust ducts that are potential sources of beryllium emissions have not been sampled in accordance with methodology specified in NESHAP regulation 40 CFR 61.33 (stack sampling). The regulation requires sampling according to Method 104 of Appendix B to 40 CFR 61 over a period or periods as necessary to accurately determine the maximum emissions for a 24-hour period for comparison with the emission standard (maximum allowable emission for a stationary source, 10 grams per 24-hour period.)

Although RFP's current continuous sampling of these ducts shows very low beryllium emission rates (0.496 gram for all of 1985 from all sources), the methodology does not comply with the NESHAP regulation nor does it provide emissions data for the required 24-hour period. However, the NESHAP methodology should only be used to supplement the current continuous sampling rather than as a replacement.

4. Dose Assessment Methodology. Dose assessments made for the area surrounding the Rocky Flats Plant, which are based on monitored ambient-air-quality data, do not meet NESHAP regulations (40 CFR 61.93) that require the use of AIRDOSE-EPA and RADRISK dispersion/ dose assessment models (or other methods with prior EPA approval).

Application has been made for EPA approval of the use of monitored data in demonstrating compliance with the NESHAP standard for radionuclide emissions. Efforts are also being made to validate a site-specific dispersion model, known as the Terrain-Responsive Atmospheric Code (TRAC), that was developed at the Rocky Flats Plant, and to subsequently obtain EPA approval to use TRAC in place of AIRDOSE-EPA for compliance demonstrations.

5. Volatile Organic Compound Emissions Inventory. A detailed inventory of sources of volatile organic compounds with estimates of emission rates to the atmosphere was not available at the time of the Survey. This leaves as an unknown the potential contribution of RFP sources to the local ozone problem.

6. Carbon Tetrachloride as a Degreasing Solvent. The evaporation of about 72 liters per day of carbon tetrachloride to the atmosphere from degreasing operations potentially contributes to the local ozone problem. In addition, carbon tetrachloride is being considered by the USEPA for listing as a hazardous air pollutant.

7. Ambient Monitoring for Criteria Pollutants. It is not known if the ambient-air monitoring station used for criteria pollutants is properly located to measure "hot-spot" concentrations. There is no documentation of the site-selection process.

8. Criteria Pollutant Background Levels. The contribution of sources at RFP to observed levels of criteria pollutants cannot be estimated. Only one monitoring station is used to characterize air quality for criteria pollutants and no information is available to define background levels.

9. Analytical Quality Assurance. Procedures for gravimetric analysis of total suspended particulates lack such quality assurance items as logbook records of balance checks against standard weights, room temperature and relative humidity, and second operator checks of filter weights (tare and exposed).

10. Steam Plant Visible Emissions. Exceedances of the Colorado visible emission opacity regulation have occurred at the steam plant stacks during operator training on fuel switching. The current

trend toward the use of more No. 6 fuel oil increases the potential for more frequent visible emissions.

11. Waste Paper Shredder. Paper dust is evident in the area surrounding the waste bins serving the paper shredder at Building 122. As a source of particulates emissions, the operation is not covered by an operating permit or Air Pollution Emission Notice.

12. Waste Paper Incinerator. A potential for violation of Colorado visible emission opacity regulation exists if the currently permitted incinerator at Building 122 is reactivated. The incinerator was shut down because of problems with visible emissions in the past.

3.2 Soil

This section discusses the general nature of soil contamination from radioactive and non-radioactive sources. Potential areas of soil contamination due to landfill erosion or to spray irrigation are likely to have both low-level radioactive and non-radioactive hazardous constituents.

3.2.1 Background Environmental Information

Soils are important both because of their role as a supporting medium and source of nutrition for plants, and because of their physical and chemical properties in retarding contaminant migration. Soils at the Rocky Flats Plant vary in properties such as grain size and permeability because they are developed on the Rocky Flats Alluvium, which is itself variable. This alluvium, which forms the surficial deposits over much of the site, consists of beds of clayey, sandy silt with interlayered gravel and cobbles.

Soil contamination generally results from airborne deposition, surface spills and releases, or leakage from underground tanks and piping. Burial sites produce soil contamination only if migration from the site occurs. Leaching of contaminated soil by precipitation may lead to groundwater pollution. Surface runoff may transport contaminated soil particles to streams and ponds. Some contaminants may be taken up by plants. The contaminated soil itself may be hazardous by direct contact, inhalation, or ingestion.

The primary concern, historically, with regard to soils at the RFP has been the deposition onto surface soil of airborne radionuclides. Radionuclides present in soil can be ingested by humans through consumption of food grown in that soil, since they can be incorporated metabolically into plants

through root uptake. Radionuclides or other contaminants deposited on leaf surfaces can be taken up by the plant, or can be transferred directly to animals that consume contaminated foliage. Deposition on leaf surfaces can occur through wind resuspension of contaminated soils, by splattering of soil on the plant during rains, and through direct contact between the soil surface and plant surfaces.

Plutonium contamination in the soils in the vicinity of RFP is a consequence of past releases of material from the plant and fallout from past worldwide detonations of nuclear weapons. Global fallout levels of plutonium contamination of soils are estimated to be about $1.5 \times 10^{-3} \mu\text{Ci}/\text{m}^2$. A study by Krey and Krajewski (Krey, 1972) reported in 1972, used plutonium isotopic ratios to differentiate between contamination of Rocky Flats origin and fallout. This study confirmed plutonium fallout levels in the Rocky Flats vicinity to be equivalent to the $1.5 \times 10^{-3} \mu\text{Ci}/\text{m}^2$ global fallout level, based on a 10 cm sampling depth. The Colorado Department of Health has established a value of 0.08 disintegrations per minute per gram (d/m/g) for background plutonium in soil measured to a depth of 0.3 cm (DOE, 1980). Assuming a uniform concentration of plutonium throughout the sample depth, and a soil density of $1.5 \text{ g}/\text{cm}^3$, this corresponds to a level of $1.6 \times 10^{-4} \mu\text{Ci}/\text{m}^2$. The CDH value is based on average for samples taken from sites more than 100 miles from the RFP. The difference between the two estimates is a consequence of the different sampling depths used.

There are no official Federal standards with which to compare indicated off-site plutonium levels in soil. In 1977, the EPA released a guidance document in draft form, "Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment" (EPA, 1977). The guidance provides a screening level for transuranics in soil ($0.2 \mu\text{Ci}/\text{m}^2$). These screening levels are values which indicate a need for further testing to determine whether dose limits are exceeded in areas having uncontrolled access. This is equivalent to a plutonium concentration in soils of 13.3 pCi/g, assuming a 1 cm sampling depth and a soil density of $1.5 \text{ g}/\text{cm}^3$.

The State of Colorado in 1973 adopted the following radiation control regulation:

RH4.21 Permissible Levels of Radioactive Material in Uncontrolled Areas

- 4.21.1 Plutonium. Contamination of the soil in excess of 2.0 disintegrations per minute of plutonium per gram of dry soil or square centimeter of surface area (0.01 microcurie plutonium per square meter) presents a sufficient hazard to the public health to require the utilization of special techniques of construction upon property so contaminated.

3.2.2 General Description of Pollution Sources/Controls

The RFP has contributed to the plutonium concentrations in soils through normal operational releases and releases from incidents such as glovebox fires. Prior to 1973, releases were reported as total long-lived alpha activity; subsequent to 1973, releases were reported as plutonium. If all the total alpha activity reported prior to 1973 is assumed to be plutonium, the normal operational releases over the plant's history (1953 through 1985) have totaled $2.7 \times 10^4 \mu\text{Ci}$ of plutonium (DOE, 1980). In addition to these releases, it has been estimated that 11.4 Ci of plutonium was released through leakage of plutonium-contaminated cutting oils from steel drums in an outside storage field (Krey, 1972; 1976).

During the period between 1958 and 1967, approximately 5,240 drums of plutonium- and uranium-contaminated machining oils were stored at an outside oil drum storage field in the 903 Area, also known as the asphalt pad. During the period of outdoor storage, corrosion of the drums resulted in oil leakage and contamination of soil in the vicinity. Leakage was first detected in 1959, prompting the addition of a rust inhibitor to all drums prior to storage. Despite the precautions, evidence of drum deterioration and further soil contamination was found in 1964. The drums were all removed to a processing facility during 1967 and 1968. In 1969, the drum storage area was covered with an asphalt pad to contain the soil and prevent migration off-site. During the period between initiation of the leakage and the placement of the asphalt pad over the storage area, the drum removal operations, construction activities, and natural forces such as wind erosion of the soil redistributed plutonium away from the drum storage area. Studies by Krey and others (Krey, 1972; 1976) estimated that approximately 11.4 Ci of plutonium was released from the drums. Of that quantity, 1.7 Ci was estimated to be contained under the asphalt pad, 3.4 Ci released beyond the site's 1972 boundaries, and the remainder dispersed on RFP property. In 1974, the buffer zone around RFP was enlarged and Krey was asked to revise his estimates of the off-site release (ERDA, 1975). The revised estimate indicated a release of 1.4 Ci off-site within an activity contour above $3 \times 10^{-3} \mu\text{Ci}/\text{m}^2$. Approximately 1.4 Ci is dispersed off-site beyond the $3 \times 10^{-3} \mu\text{Ci}/\text{m}^2$ level, much of which will be indistinguishable from background. Figure 3-6 illustrates the soil activity contours determined by Krey.

The activity released through the oil drum leakage represents greater than 99 percent of all the plutonium activity released from the RFP, since its inception. Krey estimates that 8.6 Ci of plutonium remain on-site. While some of the plutonium has clearly migrated off-site since its initial release, there is no evidence that significant migration is continuing. The soils in the area are currently stable

Figure From: Final Environmental Impact Statement, Rocky Flats Site, DOE/EIS-0064, April 1980.

FIGURE 3-6

PLUTONIUM-239 CONTOURS AROUND ROCKY FLATS ($\mu\text{Ci}/\text{m}^2$)
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and covered with vegetation. Unless the area is disturbed or the vegetation destroyed, the contamination should remain on-site.

Possible sources of non-radioactive soil contamination are discussed in the following section. These sources are the active and inactive landfills, to areas used for spray irrigation, and the solar evaporation ponds.

3.2.3 Environmental Monitoring Program

Soils in the vicinity of RFP have been the subject of numerous studies; the most comprehensive of these were those reported by Krey and others (Krey, 1972; 1976), discussed briefly in Section 3.1.2. The results of this study did not indicate that any soils beyond the site boundaries were contaminated in excess of the EPA screening guidelines for transuramics in soil (EPA, 1977) of $0.2 \mu\text{Ci}/\text{m}^2$. The data did indicate that some off-site lands might be contaminated in excess of the more stringent Colorado State Guideline of two disintegrations of plutonium per minute per gram of dry soil or $0.01 \mu\text{Ci}/\text{m}^2$.

Litigation proceedings were initiated against the RFP, claiming that deposition of plutonium from the plant on adjacent lands had caused them to be unfit for human habitation and use. In response to these claims, extensive soil and air sampling projects were conducted in 1976 and 1977. At the request of local landowners, a supplemental soil sampling program was initiated in 1978 to characterize plutonium concentrations in other lands adjacent to RFP property. These data have been summarized by Illsley and Horne (Illsley, 1979). No plutonium-in-soil contamination in excess of the Colorado State guideline or the EPA screening guideline was found on any lands located to the south or west of the site. Several samples from lands to the east of the site exhibited levels in excess of the Colorado State guideline, but none exceeded the EPA screening guideline. The highest plutonium contamination observed was in one of 14 samples collected on City of Broomfield land west of Great Western Reservoir. That sample contained $0.12 \mu\text{Ci}/\text{m}^2$, which is 59 percent of the EPA screening guideline. Adjacent samples in the area were also elevated but exhibited levels of less than 25 percent of the EPA guideline.

The data on plutonium concentrations in soil and air samples collected from the lands involved in litigation were evaluated by the Inhalation Toxicology Research Institute in Albuquerque, New Mexico. A report entitled "Defendant's Analysis of Health Risks" was submitted as an exhibit to U.S. District Court in Denver, Colorado. The conclusion of this report is as follows:

"Potential radiation doses to people having unrestricted use of lands near the Rocky Flats boundary line have been estimated using different exposure models and different sets of environmental measurements. All of the approaches described above yielded similar results in estimating the radiation doses and in projecting the probabilities for human health injury. The most important risks to people from exposures to plutonium and americium are potential increases in their incidences of lung-, bone-, and liver-related cancers. The probabilities for deaths due to cancers ranged between 1 and 3 per hundred million persons per year. This level of risk was shown to be small in comparison to the risks from exposures to naturally-occurring radionuclides and other natural background radiations."

In 1986, a settlement was reached with the land litigants, which resulted in a DOE-assisted purchase of the litigated lands for the City of Broomfield and Jefferson County. In addition, corrective action to reduce the plutonium levels on these properties to below the Colorado State guideline of 2 d/m/g was initiated during June 1986. The City of Broomfield had not decided (at the time of the on-site Survey) whether to request corrective action for one area of approximately 100 acres having plutonium levels above the 2 d/m/g guideline.

Soil sampling is conducted routinely as a part of the RFP environmental monitoring program. A program designed to detect any significant changes in plutonium concentrations in soils around RFP was initiated in 1984 and is expected to continue through at least 1990. In this program, 40 samples are collected at radial intervals of approximately 18 degrees and at approximate distances of 1.6 and 3.2 kilometers from the center of the plant. The geometry of the samples is controlled by driving a 10 x 10 cm cutting tool 5 cm into undisturbed soil. The soil within the tool is removed for analysis. Since data are currently available only for 1984 and 1985, no conclusions may be drawn concerning long-term migration of plutonium; however, the data do not indicate any clear changes in the horizontal distribution of plutonium in soils.

In addition to routine soil sampling for plutonium deposition, there are several sampling locations where non-routine soil investigations are being carried out. These locations include the active and inactive landfills and two areas used for spray irrigation.

Sampling of soil around the active landfill has been requested by the Survey to determine whether asbestos is entering the environment as a result of improper disposal practices at the landfill. These practices are described in Section 4.2.3.2.

Soil sampling is being done by the Survey near an outfall that discharges onto the face of the original landfill south of Building 460. Slumping and erosion, due in part to discharge from this outfall, has exposed waste materials. Surface runoff can transport contaminants from these wastes into surrounding areas. The problem is described in Section 4.5.3.2.

An area southeast of the east gate to the plant has been used for spray irrigation of water from runoff retention pond B-3. Pond B-3 receives waters from the sewage treatment plant, as described in Section 3.3.2.1. Samples of the soil in the irrigated area, also known as the East Spray Field, are being taken as part of the sampling and analysis effort of the Survey to determine if contaminants are building up in this area.

Water from Solar Pond 207 B-North (Section 3.4.2) has been spray irrigated in the past over an area on the west side of the plant. In this area, known as the West Spray Field, a water cannon with an application radius of 200 feet was used to spray water over a 2.8-acre circular zone. Soil samples from this high application area are being analyzed for comparison with background soil samples from the plant buffer zone to determine the presence or absence of contamination. Preliminary data (Weston, 1986) suggest that elevated concentrations of radionuclides and metals are not present in West Spray Field soil samples. Detectable concentrations of volatile organic compounds were found sporadically in both spray field and background samples, with no pattern of contamination apparent. This investigation is continuing.

Leakage of the solar evaporation ponds has contaminated underlying soils as well as groundwater in the vicinity of the ponds (Section 3.4.3). The major contaminant is probably nitrate, which is soluble in water and likely to be leached into surface water or groundwater. No standards exist for nitrate in soil, although a maximum contaminant level of nitrate as N has been set at 10 mg/l for drinking water. A plan for cleanup of this soil contamination will be included in the RFP closure plan for the solar ponds.

3.2.4 Findings

3.2.4.1 Category I

There are no soil-related Category I findings.

3.2.4.2 Category II

There are no soil-related Category II findings.

3.2.4.3 Category III

1. Plutonium Contamination In On-site Soils. Soils in the 903 Area and the on-site lands to the east are contaminated with an estimated 8.6 Ci of plutonium. A planimetric estimate from the activity isopleths produced by Krey and others (Krey, 1976) indicates that approximately 300 acres of exposed soils exceed the proposed EPA screening guideline ($0.2 \mu\text{Ci}/\text{m}^2$) for transuranics in soil in an uncontrolled area. Plutonium activity contours are shown in Figure 3-6. In addition, an estimated 1.7 Ci of activity remains underneath the asphalt pad.

The land in question is in a controlled-access area so the EPA guidelines do not directly apply. Further, the asphalt pad, vegetative cover, and so-called "weathering-in" have effectively stabilized the activity; there is no evidence that contaminated, on-site soils are currently being released to off-site properties. Administrative procedures are in place to control construction in the area of the contamination so that activity releases will be minimized. If the contaminated lands are protected from disturbances and they remain in a controlled-access area they do not present a significant risk of off-site release of activity or exposure to the general public. The existing ambient air and soil monitoring programs are designed to detect migration of activity beyond the site boundaries.

2. Off-site Plutonium Contamination In Soils. Lands to the east of the RFP have been found to contain some areas with plutonium-in-soil contamination in excess of the Colorado State guideline. This guideline establishes as its upper limit two disintegrations of plutonium per minute per gram of dry soil ($1 \text{ pCi}/\text{g}$) in the top one-eighth inch of soil or $0.01 \mu\text{Ci}/\text{m}^2$.

A soil sampling program was initiated in 1978 to characterize plutonium concentrations in lands adjacent to RFP property (Illsley, 1979). Several samples collected to the east of the site exhibited plutonium-in-soil levels in excess of the Colorado State guideline, but no samples were found with levels in excess of the EPA screening guideline of $0.2 \mu\text{Ci}/\text{m}^2$ ($13.3 \text{ pCi}/\text{g}$). Approximately 400 acres are considered to have plutonium-in-soil levels exceeding the Colorado State guidelines ($1 \text{ pCi}/\text{g}$), with maximum observed levels between approximately 4 and 8 pCi/g . With financial assistance from DOE, these lands were purchased for the city of Broomfield and Jefferson County. An additional 100 acres of land, owned by Broomfield, also has plutonium-in-soil levels above $1 \text{ pCi}/\text{g}$. Corrective action to reduce the contamination levels below the Colorado State guidelines was initiated in

June 1986 for the Jefferson County properties. Broomfield has not decided whether to request remediation for its property.

3.2.4.4 Category IV

There are no soil-related Category IV findings.

3.3 Surface Water

In addition to addressing surface water as a receptor and means of transport of pollution from RFP, this section also addresses the plant's water distribution system.

3.3.1 Background Environmental Information

Because of the slope of the Rocky Flats bench, surface water flow is from west to east (Figure 3-7). Runoff from the RFP area is carried by two major drainage basins that are tributary to Walnut Creek on the north, and by Woman Creek on the south. Both Walnut Creek and Woman Creek experience water flow only as a result of rainfall, snow melt, or the intentional introduction of water from sources west of the plant site to supplement the water supplies in Standley Lake and Great Western Reservoir, respectively.

South Walnut Creek, which runs inside the current plant area, converges with North Walnut Creek northeast of the security fence. North Walnut Creek originates outside the fenced area and passes through the plant just inside the northern security fence. An unnamed tributary north of North Walnut Creek joins the stream near its confluence with South Walnut Creek. These ephemeral streams flow toward the Great Western Reservoir, which supplies water to a part of the city of Broomfield.

Woman Creek originates west of the RFP site, drains the south portion of the Plant area, and flows eastward toward Standley Lake. Standley Lake provides storage of irrigation water and of municipal water for the City of Westminster and portions of the cities of Northglenn and Thornton.

Walnut Creek and Woman Creek are the only streams impacted by runoff or discharges from the processing area of the plant. Other streams flowing across the site are McKay Ditch, Upper Church Ditch and Rock Creek, north of Walnut Creek and Smart Ditch south of Woman Creek.

FIGURE 3-7

**ROCKY FLATS SITE DRAINAGE PATTERN
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986**

Prior to 1974 and 1980, RFP routinely discharged industrial and sanitary wastewater, respectively, into streams leading to Great Western Reservoir (GWR). These discharges resulted in plutonium concentrations in excess of baseline levels in GWR. Stormwater runoff may have contributed to elevated plutonium levels in GWR and Standley Lake, although to a lesser extent than the wastewater discharges.

The concentrations of plutonium in the sediments of the Great Western Reservoir and of Standley Lake were studied in four separate investigations: USEPA, two studies (USEPA, 1973 and 1975); Pacific Northwest Laboratories (PNL, 1974 and 1981); and Rockwell International (RI, 1985).

The earlier USEPA study concluded that almost the entire bed of Great Western Reservoir was covered with sediment that contained plutonium in excess of an estimated baseline concentration (≤ 0.1 pCi/g). These plutonium levels were attributable to fallout from atmospheric nuclear weapons testing. A follow-up study was conducted in 1975 in which dredge-type samples were collected at 20 locations and core samples at 15 locations. The maximum plutonium concentration observed in this study was 4.1 pCi/g. Eleven locations exhibited concentrations in excess of 1.0 pCi/g. The former study also indicated the possibility of contamination in Standley Lake; however, the latter study concluded that Standley Lake plutonium concentrations were at the baseline level.

Pacific Northwest Laboratories (PNL) collected surficial sediment samples and core samples at GWR in 1974. The surface sediment (top 5 cm) concentrations of plutonium-239 and -240 ranged from 0.2 to 6.0 pCi/g and averaged 3.4 pCi/g. The depth distribution of the plutonium in age-dated sediment cores (based on cesium-137 distributions) showed two periods of plutonium deposition. The higher deposition corresponds to the period 1968 to 1969. The secondary maximum corresponds to the period between 1959 and 1964. Cores also show high cesium-137 concentrations for the 1959 to 1964 period. This is an indication that fallout from nuclear weapons testing has contributed in part to the elevated plutonium levels (PNL, 1974; 1981). The PNL study also collected surface grab samples and one core sample from Standley Lake. The plutonium concentrations in the Standley Lake samples averaged about 16 times lower than those in GWR.

PNL concluded the following (PNL, 1981):

The naturally occurring radium-226 in surface and domestic waters near the Rocky Flats area represents a much greater relative contribution to the public radiation exposure than do the traces of plutonium. The measured activity of radium-226 is 100 to 1,000 times that of Pu-239, 240, and its MPC (Maximum Permissible Concentration) as

soluble material is 167 times less than Pu-239. Also, radium-226 tends to be more soluble than plutonium and passes through the water treatment plants more efficiently than Pu-239, 240.

During the summer of 1983, Rockwell International conducted a sampling and analysis project at GWR. As part of that study, 48 surficial sediments and four core samples were collected. The maximum plutonium concentration observed in the surficial samples was 1 pCi/g. Activities of this level were observed in only two samples. Maximum values for core samples were 4.9 and 5.4 pCi/g, corresponding to depths of 7.5 and 17.0 inches, respectively. These values were observed for the same sampling location, but for different portions of a sample split between the city of Broomfield and Rocky Flats Plant. A review of the data reveals that maximum plutonium concentrations are observed at depth and approach background in surficial intervals. This is consistent with a constant sedimentation rate (approximately 1 inch per year) and changes in routine operations at RFP since 1973. In December of 1973, RFP discontinued discharge of industrial wastes into GWR, and in December of 1979, the routine discharge of sanitary liquid effluent was voluntarily discontinued. The core sample data indicate that the sediments are stable and not likely to release significant quantities of plutonium into the waters of the reservoir (RFP, 1984). Holding ponds and an interceptor ditch will prevent contamination from future stormwater runoff (see Section 3.3.2.3).

The concentrations of plutonium observed in the surficial sediments (≤ 1 pCi/g) are well below the proposed USEPA screening level of transuranics in soil, which corresponds to approximately 13 pCi/g.

Analyses of water in GWR and Standley Lake have exhibited plutonium concentrations well below the EPA drinking water limit of 15 pCi/l for gross alpha activity, exclusive of uranium and radon. In 1985, the average plutonium concentration in GWR water was 9.0×10^{-3} pCi/l. In Standley Lake, the average plutonium concentration in 1985 was 4×10^{-3} pCi/l. Within the limits of the analytical uncertainty, these are comparable to levels observed in water samples unaffected by RFP activities (see Section 3.3.3).

Background plutonium levels are expected to be observed in surface waters primarily as a consequence of past atmospheric detonations of nuclear devices. Tritium is contributed to the background by nuclear weapons detonation, the nuclear power industry, and industrial processes. Uranium in the environment is primarily from natural geological deposits; other sources (i.e., nuclear weapon testing and industrial processes) do not contribute significantly to the uranium in the background.

The USEPA publishes environmental radiation data for communities throughout the United States on a quarterly basis. Tritium concentrations are reported for surface water and drinking water. For the period January-March 1986 (EPA, 1986) the tritium concentration in water from the South Platte River at Greeley, Colorado exhibited a tritium concentration of $200 \times 10^{-9} \mu\text{Ci/ml}$. Excluding several locations where tritium levels are elevated because of proximity to nuclear power plant effluent release points, the observed tritium concentrations ranged from $100 \times 10^{-9} \mu\text{Ci/ml}$ to $1,200 \times 10^{-9} \mu\text{Ci/ml}$. For the same period, drinking water tritium concentrations ranged from $100 \times 10^{-9} \mu\text{Ci/ml}$, to $500 \times 10^{-9} \mu\text{Ci/ml}$, again excluding concentrations significantly higher than the average. Tritium levels in Denver, Colorado and Platteville, Colorado were $300 \times 10^{-9} \mu\text{Ci/ml}$ and $200 \times 10^{-9} \mu\text{Ci/ml}$, respectively. For all of these measurements, the assigned uncertainty is $\pm 200 \times 10^{-9} \mu\text{Ci/ml}$. Background levels of tritium near RFP (Exclusive of RFP contributions) would be in the range of concentrations observed throughout the United States).

In addition to the above, drinking water samples throughout the United States that exhibited gross alpha activity in excess of 2 pCi/l are composited and analyzed for plutonium-238 and -239 and uranium-234, -235 and -238 on an annual basis. For 1984, Platteville, Colorado and Denver, Colorado were analyzed for these specific nuclides; these data are listed in Table 3-14. Drinking water samples from Denver and Platteville, Colorado may be considered to be free of RFP contributions to the plutonium concentration levels and therefore indicative of fallout levels.

RFP samples three reservoirs (Ralston, Dillon, and Boulder) that do not receive runoff from RFP drainage systems and are at distances ranging from one to sixty miles from the plant. Waters from these locations are considered to be representative of regional background. The average radionuclide concentrations in these waters for the period 1981 through 1985 ranged between the following: uranium 0.2×10^{-9} and $33 \times 10^{-9} \mu\text{Ci/ml}$; plutonium 0.01×10^{-9} and $0.04 \times 10^{-9} \mu\text{Ci/ml}$; and americium 0.01×10^{-9} and $0.05 \times 10^{-9} \mu\text{Ci/ml}$.

The release of waterborne radionuclides to the environment from a DOE facility is regulated by DOE Order 5480.1A. In 1985, the Department of Energy (DOE) adopted, as an amendment to this order, an interim radiation protection standard to be implemented in calendar year 1985 (DOE, 1985). This interim standard incorporates guidance from the NCRP. Included in the interim standard is a revision of the dose limits for members of the public and tables of radiation dose conversion factors to be used for calculating dose from intakes of radioactive materials. The dose factors are based on ICRP Publication 30 methodology for radiation dosimetry. Effluent water derived concentration guides (DCG) were provided in a memorandum from Robert J. Stern, dated February 28, 1986 (DOE, 1986). The DCGs apply to ingestion of drinking water by members of the general public.

TABLE 3-14

PLUTONIUM AND URANIUM ANALYSES OF DRINKING WATER, 1984
($\times 10^{-9}$ $\mu\text{Ci}/\text{ml}$ $\pm 2s$)

City	U-234	U-235	U-238	Pu-238	Pu-239
Denver, CO	1.145 $\pm$ 0.132	0.012 $\pm$ 0.011	0.543 $\pm$ 0.075	0.008 $\pm$ 0.011	0.002 $\pm$ 0.003
Platteville, CO	7.158 $\pm$ 0.752	0.233 $\pm$ 0.075	5.479 $\pm$ 0.599	0.038 $\pm$ 0.049	0.012 $\pm$ 0.016

s = Sample Standard Deviation

Source: Environmental Radiation Data, Report 43, USEPA, EPA 520/5-86-007.

PRELIMINARY

The assessment of the environmental impacts of waterborne radiological releases considered the DOE interim standards referenced above; National Primary Drinking Water Standards, Radionuclides, 40 CFR 141, and NRC limits for concentration of radionuclides in water above natural background, 10 CFR 20, Appendix B. Although the NRC standards do not directly apply to DOE facilities, they provide a health-based reference for comparisons with site radionuclide releases.

3.3.2 General Description of Pollution Sources/Controls

Through its policy of zero discharge of liquid wastes, RFP has practically eliminated surface waters as a pathway for transporting pollution off-site. The discussion in this section addresses the plant systems that would have an impact on the surface water discharge and the methods used to control them. These are (1) aqueous process wastes, (2) sanitary wastes, and (3) stormwater runoff. The plant water distribution system and sediment contamination are also discussed in this section.

3.3.2.1 Aqueous Process Wastes

As discussed later in Section 4.1, aqueous process wastes are converted to dry solids for disposal off-site and to evaporator condensate for use as make-up by the RFP utilities department.

As discussed in Section 4.1.2.2, all liquid wastes containing recoverable plutonium are first processed at Building 774. Then the aqueous stream, with the recoverable plutonium removed, is sent to Building 374 for further treatment along with other liquid wastes from throughout the plant. Typical of the other aqueous wastes are those from the beryllium and depleted uranium fabrication facilities in Buildings 444 and 447 where machining, coating, and plating operations are carried out; the plutonium analytical laboratory in Building 559; the plutonium fabrication facilities in Buildings 707 and 777; the beryllium and uranium metal working R&D facilities in Building 865 and the production facilities in Building 883; and the non-plutonium analytical laboratories in Building 881. These wastes, containing nitrates, beryllium, uranium, and/or unrecoverable plutonium, as well as the blowdowns from the boilers and cooling towers and the plant laundry effluent, are transported to the Building 374 treatment facilities in individual containers or by the double walled, inspectable, waste collection system pipeline.

The solids precipitated during the treatment in Building 374 are processed for handling as mixed (radioactive and hazardous) wastes. The liquid effluent from the precipitation process is evaporated and the condensed steam is sent to the utilities department to be used as make-up to the boilers or

cooling towers. The concentrated evaporator brine is handled with the precipitate for disposal as a mixed waste. Because the boiler and cooling tower blowdowns are returned to the process waste system, there is no intentional aqueous process waste discharge from RFP.

3.3.2.2 Sanitary Wastes

Sanitary wastes from throughout the plant are collected by the sanitary sewer system for delivery to the sewage treatment plant. There are two main sewage trunk lines serving the plant. One is from the plutonium processing areas and the other from areas that do not handle plutonium. These trunk lines deliver the sewage to either one or both of two 60,000 gallon aerated surge basins. These basins are also used to catch any spills of materials into the sewage system. A flow control valve on the discharge from the surge basins is used to regulate the flow to the sewage treatment plant at a uniform rate. The recent repairs and replacement of sanitary sewer lines have done a good job of controlling inflow to the system. During this renovation, most of the vitrified clay, cast iron, and ductile iron pipes used in the original sewer system were either replaced or lined with polyvinyl chloride pipe. Normal flow is now 300,000 gallons per day (gpd), increasing to 350,000 gpd with rainfall. Prior to this, flows as high as 600,000 gpd were experienced. The flow entering the plant is split so that half of it goes to each of two secondary treatment systems that consist of a bar screen/comminutor, primary clarifier, activated sludge aeration basin, and a secondary clarifier. Since completion of sewage treatment plant modifications, each side of the plant is capable of handling 250,000 gpd for a total plant capacity of 500,000 gpd. The effluents from the secondary clarifiers discharge to a pit where alum and a polymer are added before the combined effluents are sent to a final clarifier. The effluent from the final clarifier is filtered through multimedia filters prior to being chlorinated and discharged to Pond B-3 (Section 3.3.2.3).

Sludges, skimmings, and filter backwashes generated at the sewage treatment plant are returned to the head end of the plant for reprocessing, except for the sludge from the primary clarifiers. This sludge is sent to digesters for solids reduction by the action of anerobic bacteria. Approximately once a week, solids are pumped from the digesters to sludge drying beds. The dried sludge is boxed for shipment off-site for disposal as low level radioactive waste (LLW).

Water in Pond B-3 is pumped to a flat area southeast of the east gate to the plant to be disposed of by spray irrigation. Although this water is tested and no discharge is allowed unless concentrations of radionuclides and other parameters are within established discharge criteria (Table 3-15), samples of the soil in this area are being taken as part of the sampling and analysis effort of the survey to determine if contaminants are building up in this area. If weather conditions are such that this area

TABLE 3-15

ANALYTICAL FREQUENCY AND CONTROL GUIDES FOR POND DISCHARGES

Parameter	Control Guide	Pond A-2	Pond A-3	Pond B-3	Ponds A-4, B-5, & C-2
Gross Alpha	0.1 pCi/l	S	B	S & B	B
Gross Beta	150 pCi/l	S	B	S & B	B
Gamma Emitting Isotopes	Above Background	—	B	S & B	B
Tritium	1,500 pCi/l	S	B & D	S, B & D	B & D
Plutonium	0.1 pCi/l	—	D(2)	—	D
Uranium	5.0 pCi/l	—	D	—	D
Americium	0.1 pCi/l	—	D(3)	—	D
pH	6.0 - 9.0 S.U.	S	B & D	S, B & D	B & D
BOD ₅	25 mg/l	—	—	D	—
Total Suspended Solids	30 mg/l	—	—	D	—
Non-volatile Suspended Solids	100 mg/l	—	—	—	B & D
Fecal Coliform	200/100 ml	—	—	D	—
Nitrate as N	10 mg/l	—	B & D	D	B & D
Total Phosphorus	8 mg/l	—	—	D	—
Total Residue Chlorine	0.5 mg/l	—	—	D	—
Oil and Grease	No visible sheen	—	—	D	—
Total Chromium	0.05 mg/l	—	—	D	—

S = Analyzed before spraying

B = Analyzed prior to discharge

D = Analyzed during discharge

(1) Control Guide is 20 mg/l

(2) Control Guide is 1.0 pCi/l

(3) Control Guide is 0.5 pCi/l

cannot accept all the water produced by the sewage treatment plant, the excess water is discharged to Pond B-5 (Section 3.3.2.3). No water has been discharged to B-5 in 1986; however, 10.6×10^6 , 0.6×10^6 and 2.6×10^6 gallons were discharged in 1985, 1984, and 1983, respectively.

The sewage treatment plant effluent is intended to go to the reverse osmosis (RO) plant. RO was installed to lower the dissolved solids in the sewage treatment effluent to a level that would allow the effluent to be used for make-up to either the boiler water or cooling water systems. However, this system has only operated for a total of two months since March 1985, for reasons described below.

Solar Ponds 207-B center and 207-B south were to hold feed and effluent, respectively, from the RO plant. However, due to problems resulting from algae growth in the center pond, the sewage treatment plant effluent is now pumped to a 500,000 gallon closed tank adjacent to the RO Building. Water from the tank is fed to the RO plant and is chlorinated to a free chlorine concentration of 0.5 mg/l. The water is then passed through a dual bed sand filter through an ion-exchange unit to remove the iron and the hardness that may be in solution, and through a precoat diatomaceous earth (DE) filter to remove any solids larger than 0.5 μ m. The temperature of the feed water is increased to 77°F, and acid is added to reduce the pH to 5.5. The water is then pumped to the primary reverse osmosis unit, which consists of hollow fine fiber membranes. The reject water is fed to the secondary reverse osmosis unit which consists of spiral wound membranes. This results in a total water recovery of 98 percent. There are three trains, each consisting of a primary and a secondary unit. Each train has a capacity of approximately 200,000 gpd. Both primary and secondary reverse osmosis product waters are sent to 207-B south holding pond until used as make-up water by the Utility Department. The reverse osmosis brine is sent directly to the process waste treatment plant in Building 474 for evaporation and spray drying or is stored in an emergency in Pond 207-C. The dried salts are packaged and sent to a DOE-approved storage site. Backwashes from the sand and DE filters are put into drying beds adjacent to the building. The dried sludge is taken to the landfill for disposal after it is tested and found to be free of radioactivity.

An engineering study for Rockwell has indicated that problems at the RO plant are attributable to carry over of fine materials from the DE filters causing problems with the membranes; the membranes in the first stage are the hollow fiber type and manufacturers now recommend that the spiral wound type be used in this application; the useful life of the membranes is approximately three years. The actual age of the membranes at RFP is seven years except for the membrane in the First Train Primary Unit which was replaced last year.

The guard posts at the east and west entrances to the plant are not served by the sanitary sewer system due to their distance from the main portion of the plant. Instead they have individual residential-type, aerobic digestion sewage disposal facilities that handle the 300 gallons per day flow from these sources (Illsley, 1987). A problem with high bacteria counts and suspended solids levels in the effluents from those units has been corrected by modifications that include the chlorination of the effluent. RFP is still working on this problem to adjust the dosage so that the chlorine residual meets normal discharge limits of 0.5mg/l. These discharges do not appear in the NPDES permit issued to RFP.

3.3.2.3 Storm Water Runoff

Pollution of off-site surface waters due to spills or potentially contaminated storm water runoff at RFP is controlled by a series of holding ponds constructed in the Walnut Creek and Woman Creek drainage channels (Figure 3-8).

At present, there is only one pond on the unnamed tributary to Walnut Creek north of the plant. It is at the base of the landfill. Another pond that was west of this one has been covered by the landfill operation. "Fog Nozzles" are used to spray water from the landfill pond into the air over the pond to evaporate the accumulated rainwater and any leachate collected from the landfill.

There are four ponds on North Walnut Creek. These are known as the A-Series Ponds. Ponds A-1 and A-2 are only used for standby containment to collect spills or potentially contaminated runoff. "Fog Nozzles" are also used to spray waters from Ponds A-1 and A-2 into the air over the ponds so that the accumulated rainwater evaporates and there is no discharge. North Walnut Creek is diverted around them to Pond A-3. Water that collects in A-3 is tested for the parameters shown in Table 3-15, prior to discharge to A-4. A-4 is designed to hold a 100-year storm event in emergencies. It is maintained at less than 10 percent of this capacity by periodic discharge to Great Western Reservoir, after testing for the parameters in Table 3-15.

The five ponds on South Walnut Creek are the B-Series ponds. Like the A-Series they are numbered west to east. Ponds B-1 and B-2 are not used except to collect spills and contaminated runoff. Pond B-3 receives treated effluent from the sewage treatment plant when the RO plant cannot take the entire flow. Most of this water is spray irrigated on a flat grassy area southeast of the east gate to the plant. When weather conditions are such that flow into the pond exceeds the irrigation capacity, the excess water is transferred to Pond B-5 for discharge. Pond B-4 is the recipient of the storm water drainage from the plant in the South Walnut Creek watershed. Pond B-5 is the final

Figure From: Final Environmental Impact Statement, Rocky Flats Site, DOE/EIS-0064, April 1980.

FIGURE 3-8

HOLDING PONDS DOE SURVEY - ROCKY FLATS PLANT AUGUST 1986

pond in this series and like A-4 is designed to hold a 100-year flood. It is also maintained at less than 10 percent of its design capacity.

Woman Creek is protected from discharge from the plant by an interceptor ditch that has been constructed between it and the plant. Pond C-1 has been built to contain any accidental spills into Woman Creek. The outlet of this pond is normally open and bypasses Pond C-2 which is located further downstream. The interceptor ditch flows into Pond C-2 which is also constructed to hold a 100-year storm event. The outlet from this pond is normally closed and is opened to maintain less than 10 percent of this capacity only after the accumulated waters have been tested and found to meet discharge criteria as shown in Table 3-15.

3.3.2.4 Plant Water Distribution System

Water used at Rocky Flats is purchased from the City of Denver and is supplied from either its Ralston Reservoir or the South Boulder Diversion Canal. A 1.5 x 10⁶ gallon raw water storage pond, located west of the plant, can be bypassed by the water being delivered to the plant.

Untreated raw water is supplied to the boiler house and cooling towers for use as make-up water. The rest of the water entering the plant is treated by flocculation and filtration using alum, lime and an inorganic polymer. There are two 60,000 gallon settling basins used to settle solids out of the filter backwash. The supernatant from these basins is pumped to the raw water system. The settled solids are put out onto drying beds and then taken to the landfill. The chlorinated treated water flows to a clear well from which it is pumped to a 500,000 gallon, ground level storage tank and then to a 300,000 gallon elevated storage tank or the distribution system. All process, potable, and fire protection water used in the plant comes from the treated water system. Firewater systems are completely independent once they are inside the buildings. Process water uses are supplied from the potable water system inside the buildings. Backflow preventers, of a type approved by the Colorado Department of Health (CDH), are used to prevent flow from the process water system into the potable water system.

3.3.2.5 Oxnard Support Facility

Water for domestic and process use is purchased from the city water system. A backflow preventer is installed to keep process water from entering the city water system. Sanitary wastes and the effluent from an oil/water separation system are discharged to the city sewer system. This oil/water separation system has been installed to remove dirt and water from the oil so that it can be reused in

the hydraulic system. A NPDES permit is not required since these wastes are accepted for treatment by a Publicly Owned Treatment Works (POTW).

3.3.3 Environmental Monitoring Program

Prior to being discharged, waters from Ponds A-3, A-4, B-3, B-5, and C-2 are sampled and analyzed for gross alpha, gross beta, tritium, gamma activity, pH, nitrate as N, and nonvolatile suspended solids. Plant control guides have been established for each of these parameters (Table 3-15). If the control guide is exceeded for any parameter, the water is not discharged. In addition, water is sampled continuously during discharge. The sample is then analyzed for plutonium, uranium, americium, tritium, pH, nitrate as N, and nonvolatile suspended solids. Water is also sampled continuously and collected daily from the outfall of Pond C-1 and from Walnut Creek at the Indiana Street sampling station (whenever there is flow). The daily samples are composited weekly and analyzed for plutonium, uranium, and americium. Once each week, individual grab samples from Pond C-1 and Walnut Creek are analyzed for tritium.

The 1985 DOE Interim Derived Concentration Guides (DCGs) for plutonium, uranium, americium, and tritium in water available to the general public are plutonium-239, -240, $300 \times 10^{-9} \mu\text{Ci/ml}$; uranium-233, -234, -238, $500 \times 10^{-9} \mu\text{Ci/ml}$; americium-241, $60 \times 10^{-9} \mu\text{Ci/ml}$; tritium $2,000,000 \times 10^{-9} \mu\text{Ci/ml}$. The EPA Drinking Water Limits for total alpha (excluding radon and uranium) and tritium are $15 \times 10^{-9} \mu\text{Ci/ml}$ and $20,000 \times 10^{-9} \mu\text{Ci/ml}$, respectively. A review of the plant's Annual Environmental Monitoring Reports for the 5-year period, 1981 through 1985, showed that the maximum observed concentrations of plutonium, uranium, americium, and tritium in samples from Ponds A-4, B-5, C-2, and C-1 and Walnut Creek were well below the DCGs for these nuclides. These maximum observed concentrations were also well below the EPA drinking water limits for total alpha (excluding radon and uranium) and tritium; EPA has not established drinking water limits for uranium.

Regional water monitoring includes sampling and analysis of public water supplies and tap water samples from nearby communities. Of the regional water supplies, only Great Western Reservoir and Standley Lake receive runoff from the RFP drainage system. Airborne emissions from RFP may contribute to the background in regional water supplies but this has been estimated to be insignificant with respect to contributions from fallout and natural background sources (DOE, 1980). Samples are collected weekly from Great Western Reservoir and Standley Lake, and from drinking water in Boulder, Broomfield, and Westminster. These samples are composited monthly and

analyzed for plutonium, americium, and uranium. The weekly samples are analyzed for tritium. The averages of these analyses for 1985 are given in Table 3-16.

In addition, three reservoirs (Ralston, Dillon, and Boulder) and one stream (South Boulder Diversion Canal) at distances ranging from 1 to 60 miles from the site boundary are sampled annually. These samples are analyzed for plutonium, uranium, americium, and tritium. These areas do not receive drainage from Rocky Flats Plant and are considered to provide a characterization of the regional background for radionuclides in water. On a quarterly basis, tap water samples are collected from nearby communities and analyzed for plutonium, uranium, americium, and tritium.

During the 5-year period from 1981 through 1985, the maximum observed concentrations of plutonium, uranium, americium, and tritium from regional water sources, including Great Western Reservoir and Standley Lake, were all well below applicable 1985 DCGs and EPA drinking water limits (RI, 1985). The plutonium and americium concentrations were less than 1 percent of both the DCGs and the EPA limit of 15 pCi/l total alpha activity. The two highest uranium concentrations observed were for the Ralston Reservoir in 1981 and 1982 (33×10^{-9} $\mu\text{Ci}/\text{ml}$ and 22×10^{-9} $\mu\text{Ci}/\text{ml}$, respectively). This reservoir does not receive runoff from the RFP drainage system and the elevated concentration cannot be attributed to the RFP. In fact, as discussed in Section 3.3.2.4, it is one of the sources of water for RFP. In 1984, the total uranium concentration in drinking water (U-234, U-235, and U-238) at Platteville, Colorado, was 12.9×10^{-9} $\mu\text{Ci}/\text{ml}$ (EPA, 1985). Because of its location and distance from RFP, the Platteville waters are not expected to have any activity contribution from the plant and the uranium may be assumed to be from fallout, natural background, or other sources. None of the uranium concentrations in the regional waters (other than Ralston Reservoir) exceeded the Platteville, Colorado, drinking water concentration. In addition, the maximum observed concentration was only about 7 percent of the DCG.

The maximum observed tritium concentration during this period in the regional waters including Standley Lake and the Great Western Reservoir was $(1,100 \pm 500) \times 10^{-9}$ $\mu\text{Ci}/\text{ml}$ in the Boulder Tap Water in 1981. This value is less than 0.1 percent of the DCG and 5.5 percent of the EPA drinking water limit.

3.3.4 Findings

3.3.4.1 Category I

There are no surface-water-related Category I findings.

TABLE 3-16

AVERAGE PLUTONIUM, URANIUM, AMERICIUM AND TRITIUM CONCENTRATIONS
IN PUBLIC DRINKING WATER SUPPLIES $(\times 10^{-9} \mu\text{Ci/ml} \pm 2s)$

	Plutonium	Uranium	Americium	Tritium
Great Western Reservoir	0.009 ± 0.002	2.35 ± 0.08	0.012 ± 0.004	100 ± 100
Standley Lake	0.004 ± 0.004	1.60 ± 0.06	0.006 ± 0.006	200 ± 100
Boulder Tap Water	0.006 ± 0.003	0.16 ± 0.02	0.015 ± 0.004	100 ± 100
Broomfield Tap Water	0.004 ± 0.003	1.45 ± 0.06	0.007 ± 0.003	200 ± 100
Westminster Tap Water	0.003 ± 0.002	0.65 ± 0.03	0.011 ± 0.004	100 ± 100

s = Sample Standard Deviation

Source: Rocky Flats Plant, Annual Environmental Monitoring Report, 1985

3.3.4.2 Category II

There are no surface-water-related Category II findings.

3.3.4.3 Category III

There are no surface-water-related Category III findings.

3.3.4.4 Category IV

1. Unpermitted Sewage Treatment Plant Discharges. Discharges from the packaged sewage treatment plants at the East and West Gates are not identified in the present NPDES permit. The guard posts at the east and west entrances to the plant are not served by the sanitary sewer system because of their distance from the main portion of the plant. Instead they have individual residential type aerobic digestion sewage disposal facilities. Previous problems with high coliform counts at these units have been overcome by additional chlorination. However, the chlorine concentration of $>3\text{mg/l}$ exceeds the normal permitted discharge limit of 0.5 mg/l . RFP is continuing to make adjustments to the chlorine dosage.
2. Inoperable Backflow Preventer. A backflow preventer at the sewage plant was found with a plug in the discharge line. This rendered the unit inoperable for preventing the flow of process water back into the potable water system in the event of a loss of pressure. Twenty samples (10 percent of the approximately 200 backflow preventers installed on-site) will be taken by the S&A Team to verify that there has been no backflow of process waters into the system.
3. Nonattainment of Zero Discharge. Rocky Flats goal of zero discharge of aqueous effluents may not be achievable because the RO plant is not operating.

Sanitary wastes from throughout the plant are collected by the sanitary sewer system for delivery to the sewage treatment plant where they are treated by an activated sludge process as discussed in Section 3.3.2.2. Effluent from the final clarifier is filtered through multimedia filters prior to being chlorinated and discharged to Pond B-3 or sent to the reverse osmosis plant. The sewage treatment plant effluent is intended to go to the reverse osmosis (RO) plant. RO was installed to lower the dissolved solids in the sewage treatment effluent to a level that would allow the effluent to be used for make-up to either the boiler water or cooling water systems. Sewage effluent in excess of the

amount of water needed for these make-ups can be disposed of by spray irrigation. An engineering study for Rockwell has indicated that problems at the RO plant are attributable to carry-over of fine materials from the DE filters, causing problems with the membranes; the membranes in the first stage are the hollow fiber type and manufacturers now recommend that the spiral wound type be used in this application. The useful life of the membranes is approximately three years; the actual age of the membranes at RFP is seven years, except for the membrane in the First Train Primary Unit which was replaced last year.

Water in Pond B-3 is pumped to a flat area southeast of the plant's east gate to be disposed of by spray irrigation. If weather conditions are such that this area cannot accept all the water produced by the sewage treatment plant, the excess water is discharged to Pond B-5 and from there to Walnut Creek (Section 3.3.2.3). For 1986, no water has been discharged to B-5, through August, however, 10.0×10^6 , 0.6×10^6 and 2.6×10^6 gallons were discharged in 1985, 1984, and 1983, respectively. Although this water is analyzed and no discharge is allowed unless concentrations of radionuclides and other parameters are within established discharge criteria (Table 3-15), samples of the soil in the irrigated area are being taken as part of the Sampling and Analysis effort of the Survey to determine if radionuclides are building up in this area.

3.4 Groundwater (Hydrogeology)

This section presents information on aspects of the regional geologic framework which are pertinent to the RFP, site-specific geology and hydrogeology, known and potential sources of groundwater contamination, and the data which provide evidence for such contamination. It discusses the current site characterization studies which have replaced the historical groundwater monitoring program. As is true for many other DOE sites, the earlier program was primarily concerned with monitoring for radionuclides. Findings are presented on nitrate and VOC contamination, and on inadequacies in the historical program.

3.4.1 Background Environmental Information

RFP is located on the northwestern flank of the Denver Basin in a large downwarp in several thousand feet of sedimentary rocks. The ancient metamorphic rocks that form the core of the Colorado Front Range west of the basin are also present underneath this sedimentary sequence. The sedimentary rocks dip eastward toward the north-south trending axis of the basin, which passes through Denver. The dip of these rocks is nearly vertical west of the plant and more gentle beneath the plant area (Figure 3-9).

FIGURE 3-9

Figure From: Geological and Hydrogeological Data Summary, U.S. Department of Energy, Rocky Flats Plant, July 21, 1986

**GENERALIZED GEOLOGICAL CROSS SECTION
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986**

The bedrock formations of importance to the hydrogeology of RFP are of Cretaceous age and consist of rock units which overlie the Pierre Shale (Hurr, 1976). Surficial deposits of Pleistocene and younger ages rest on the eroded surface of the bedrock.

The lowermost unit of hydrologic importance is the Fox Hills Sandstone. This sandstone and a lower sandstone unit of the overlying Laramie Formation are collectively referred to as the Laramie-Fox Hills Aquifer. The lower sandstone unit of the Laramie Formation consists of interbedded sandstone and claystone. Kaolinite-rich clay is mined west of the plant in the steeply dipping claystone beds near the base of this unit. The upper part of the Laramie Formation consists of several hundred feet of relatively impermeable shale. This unit prevents vertical migration of groundwater between the Arapahoe Formation, which is the uppermost bedrock formation underlying the plant, and the Laramie-Fox Hills aquifer.

The Arapahoe Formation is a claystone with interbedded sandstone lenses near its base. Weathered claystone of the Arapahoe Formation tends to slump when wet and crack when dry, leading to slope stability problems. Groundwater movement occurs primarily in the sandstone lenses. Figure 3-10 shows the distribution of these lenses based on limited drill-hole data. The location of this cross-section is shown on Figure 3-11.

Surficial deposits overlying the Arapahoe Formation include the Rocky Flats Alluvium, slope wash or colluvium, and valley fill alluvium. The Rocky Flats Alluvium is an alluvial fan deposited at the foot of the Colorado Front range, downslope from the mouth of Coal Creek Canyon. The alluvium is a poorly sorted deposit of sand, gravel, and cobbles with occasional boulders. Its thickness ranges from 50 feet west of the plant to 0 feet east of the plant. Because it is considerably more permeable than the underlying Arapahoe claystone, springs and seeps are commonly found at the contact between the two units. These seeps are marked by the presence of cattails and other wetland vegetation.

Slope wash or colluvium is soil and rock material that has been moved downslope chiefly by gravity. Valley fill alluvium is material deposited in stream channels. Both types of surficial deposits are derived from both the Rocky Flats Alluvium and the Arapahoe Formation. They occur in the drainages of North Walnut, South Walnut, and Woman and Rock Creeks. The distribution of these materials is shown in Figure 3-11.

FIGURE 3-10

SANDSTONE LENSES IN THE ARAPAHOE FORMATION
 DOE SURVEY - ROCKY FLATS PLANT
 AUGUST 1986

FIGURE 3-11

**SURFICIAL GEOLOGY
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986**

The hydrogeology of the RFP area has been described by Hurr (Hurr, 1976), Hydro-Search, Inc. (Hydro-Search, 1985), and others referenced in these reports. Groundwater occurs in a shallow flow system in the Rocky Flats Alluvium, colluvium and valley fill alluvium, and in a deeper flow system in the claystones and sandstones of the Arapahoe Formation. The shallow system is recharged by infiltration of incident precipitation. Groundwater in the shallow system flows toward the east but also toward the drainages. These flow directions can be interpreted from the water table contours on Figure 3-12, because groundwater moves perpendicular to the contour lines. This figure is based on water level data from all wells less than 100 feet deep. Some of these wells may not be completed solely in the shallow system, so the water levels represent an approximation of the true water table. The horizontal groundwater velocity in the Rocky Flats Alluvium is estimated to be about 0.6 foot/day (2×10^{-4} cm/sec) where the horizontal gradient is 0.02 foot/foot. A steeper horizontal gradient of 0.05 foot/foot, as is seen near the drainages, would increase the horizontal groundwater velocity to 1.5 feet/day (5×10^{-4} cm/sec). Groundwater velocity in the valley fill material eastward along the drainages is estimated to be 0.1 foot/day (4×10^{-5} cm/sec).

Groundwater flow in the deeper system is primarily in the sandstones. The deeper system is recharged where the sandstones are in direct contact with alluvium, and also by leakage through the claystone. The horizontal groundwater velocity in the sandstones is estimated to be about 0.1 foot/day (4×10^{-5} cm/sec). The downward (vertical) velocity through the claystones is much slower, about 1×10^{-3} foot/day (3.5×10^{-7} cm/sec). The horizontal velocity in the claystones is approximately 9×10^{-4} foot/day (3×10^{-7} cm/sec). Flow in the Arapahoe Formation is also eastward, toward the regional discharge zone on the South Platte River which flows through Denver.

The relative groundwater velocities within the various units imply that groundwater will tend to move into the drainages through springs and seeps, or through direct contact between Rocky Flats Alluvium and valley fill material. Within the drainages, groundwater discharges to surface water. Recharge of the shallow groundwater system from surface water is also possible when surface water levels are high.

Downward movement of groundwater into the bedrock is not a preferred pathway except where sandstone lenses are in contact with the shallow system. Significant horizontal groundwater flow in bedrock will occur only where sandstone lenses or layers are interconnected. The distribution of these sandstone lenses under the RFP is under investigation in a current RFP drilling program.

Off-site well contamination has not been reported near the RFP. There are 222 wells registered with the Colorado State Engineer's office within two miles of the RFP. These wells are listed in

FIGURE 3-12

**APPARENT WATER TABLE CONFIGURATION IN THE ROCKY FLATS ALLUVIUM
DOE SURVEY - ROCKY FLATS PLANT
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Hydro-Search (1985). Another list of 65 wells within a three-mile radius of the solar ponds (see Section 3.2.4) is presented in the RFP RCRA Part B Application (1985). With the exception of a group of domestic wells near Standley Lake, most of the wells are near surface water drainages topographically separated from those potentially affected by the plant. The wells near Standley Lake and others southeast of the plant, near Leyden Junction, are away from the eastern direction of regional groundwater flow. None of the wells in the Laramie-Fox Hills aquifer are downgradient of the plant. Thus, off-site well contamination is unlikely.

Groundwater in both the shallow and deeper systems is subject to potential contamination by past and present activities at RFP. Existing and potential sources for groundwater pollution are described in Section 3.4.2. The environmental monitoring program for groundwater and the data resulting from this program are discussed in Section 3.4.3.

3.4.2 General Description of Pollution Sources/Controls

Evidence exists that groundwater at RFP is contaminated by both volatile organic compounds and ionic inorganic constituents. This evidence is discussed in Section 3.4.3. However, with the exception of high-nitrate contamination associated with leakage of the solar evaporation ponds, no link has yet been established between potential sources and the presence of contamination.

The solar ponds are described below. Other potential sources of groundwater contamination are

- The hillside south of Building 881, where five inactive waste disposal and spill sites are located (Section 4.5.2).
- Burial trenches T-1 to T-11 in the eastern part of the plant area, used for oils, solvents, and low-level radioactive waste (Section 4.5.2).
- The 903 pad and mound area, where four inactive storage or disposal sites are located (Section 4.5.2).
- The active and inactive landfills, north and south, respectively, of the plant area (Sections 4.1.1 and 4.5.2).

- The runoff retention ponds in North and South Walnut Creeks (Section 3.3.2).
- The sewage treatment plant or runoff routed through the treatment plant area (Section 3.3.2).

These potential sources are currently being investigated through the installation and sampling of new monitoring wells. The only clearly identified source of groundwater contamination is leakage from the solar ponds.

The 207-series solar evaporation ponds are located in the northeastern part of the 700 and 900 areas at the plant. They are situated near the top edge of a hill overlooking North Walnut Creek, between the North Walnut and South Walnut Creek drainages. There are three ponds that are designated as 207A, 207B, and 207C. Pond 207B is divided into three sections called North, Center, and South. An earlier unnumbered pond was located in the area now partially occupied by 207C.

Plant liquid waste streams are stored and treated by evaporation in these ponds. The waste streams are primarily treated effluents from the process waste treatment facility, as well as treated acid wastes containing aluminum hydroxide. These materials are low-level radioactive mixed wastes containing high nitrates. The limit for impounding wastes in these ponds was 100,000 pCi/l total long-lived alpha activity.

Cracking of the asphalt lining in these ponds has resulted in leakage of high-nitrate, low-radioactivity water. To prevent pond leakage from entering the North Walnut Creek drainage, a series of groundwater interceptor trenches was constructed from 1970 to 1974 along the north slope of the hillside. Intercepted groundwater is returned to Pond 207B North.

The three sections of Pond 207B were decommissioned in 1977 and now contain water from sources other than process wastes. Ponds 207B North and Center contain groundwater from the interceptor trenches. Elevated concentrations of alpha (100-300 pCi/l) and beta (50-100 pCi/l) radioactivity are present in samples of the groundwater stored in these ponds. It was formerly spray irrigated over an area west of the plant known as the West Spray Field, but this practice was discontinued in October 1985. The West Spray Field is described in Section 3.2.3.

Pond 207B South contains product or test water from the reverse osmosis facility. This water comes from the sewage treatment plant and is intended for reuse in the steam plant cooling towers and other plant systems after processing by reverse osmosis.

Ponds 207A and 207C are currently used on an emergency basis to store excess process waste water from Building 374, as described in Section 4.1.2.2. New process waste storage tanks will be installed and operational by April 1987, so that this emergency use will no longer be required (RI, 1986). Current activities at Pond 207A are the removal and solidification of pond sludge and the processing of pond liquid in Building 374. No activities were in progress at Pond 207C during August, 1986.

Water table contours and groundwater flow directions near the solar ponds are shown in Figure 3-13. The extent of the contaminant plume, based on nitrate concentrations, is shown in Figure 3-14. Installation and sampling of new wells in the vicinity of the solar ponds is in progress, and a closure plan for the ponds has been developed.

3.4.3 Environmental Monitoring Program

Current groundwater sampling and analysis at RFP is part of a site characterization project rather than a routine groundwater monitoring program. This sampling and analysis is being done by a subcontractor rather than plant personnel. After completion of current investigations, a revised groundwater monitoring program using plant personnel will be reinstituted at RFP.

Groundwater quality has been monitored at RFP since 1960. Wells were installed in 1960, 1966, 1971, 1974, 1981, and 1982. Well names include the year of installation, e.g., well 1-71 is the first well from the 1971 drilling program. Geologic logs are available only for the 1966 and 1974 wells, and well construction details are known only for the 1966 wells. Water quality sampling and measurement of water levels have been done routinely for the 56 wells listed in Table 3-17. Several other wells, some of which are described as holding tank monitoring wells, exist at RFP, but they are not part of the regular monitoring program and only sporadic data are available on their water quality. Geophysical logs were done for nine existing wells (Hydro-Search, 1985). From these logs and from comparison of well depth with expected thickness of rock units, it appears that many of the wells are completed in both the bedrock and the surficial deposits. Thus, water level and chemistry data are composites, and these wells are not providing data useful for tracing contaminants back to their sources. In addition, the construction of these wells does not meet current or proposed RCRA regulations. Polyvinyl chloride (PVC) is unsuitable where organic

FIGURE 3-14

**EXTENT OF GROUNDWATER CONTAMINANT PLUME
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986**

AUGUST 1986

TABLE 3-17

DETAILS OF EXISTING MONITOR WELLS AT THE ROCKY FLATS PLANT

Well	Location (Rocky Flats Coordinates)	Elevation of G.S. (feet)	Total Depth (feet)	Probable Completion Interval (feet)	Geologic Unit	Diameter (inches)	Material	Available Information
1-60	N38526.8 E22331.3	5905.9	25.6	0-25.6(?)	SW/KA	6	PVC	
2-60	N38204.6 E21898.4	5934.6	22.6	0-22.6(?)	SW/KA	6	Galv Steel	
3-60	N37901.7 E22388.0	5957.2	20.2	0-20.2(?)	RF/KA	6	Galv Steel	
4-60	N37593.4 E22404.9	5962.0	17.7	0-17.7(?)	RF/KA	6	Galv Steel	NG, N
5-60	N37320.8 E22299.4	5966.4	19.4	0-19.4(?)	RF/KA	6	Galv Steel	
6-60	N37138.1 E21815.2	5972.6	28.8	0-28.8(?)	SW/KA	6	Galv Steel	
1-66	N35992.2 E17437.2	6054.5	151.5	30.0-151.5	RF/KA	6	Galv Steel	CD, RT, NG, N, T, L
2-66	N38073.8 E22579.2	5949.4	139.7	30.0-139.7	KA	6	Galv Steel	CD, L
3-66	N37823.6 E23161.2	5957.1	144.9	30.0-144.9	KA	6	Galv Steel	CD, RT, L
1-68	N36253.7 E22472.5	5977.2	4.0	0-4.0	RF	6	Galv Steel	
2-68	N35899.1 E22469.2	5979.6	4.0	0-4.0	RF	6	Galv Steel	
3-68	N35897.9 E22847.8	5974.5	4.0	0-4.0	RF	6	Galv Steel	
4-68	N36252.1 E22848.6	5973.3	4.0	0-4.0	RF	6	Galv Steel	
1-71	N35823.9 E23205.5	5950.0	29.2	0-29.2(?)	SW/KA	6	Steel	
2-71	N35528.1 E22831.3	5936.2	28.6	0-28.6(?)	SW/KA	6	Steel	
3-71	N39030.4 E23936.4	5819.1	30.7	0-30.7(?)	VF/KA	6	Steel	
4-71	N34870.9 E23325.3	5818.6	22.3	0-22.3(?)	VF/KA	6	Steel	
5-71	N38264.6 E25353.0	5830.3	27.5	0-27.5(?)	VF/KA	6	Steel	
6-71	N38533.8 E21645.9	5906.0	60.9	0-60.9(?)	SW/KA	6	PVC	

TABLE 3-17
DETAILS OF EXISTING MONITOR WELLS AT THE ROCKY FLATS PLANT
PAGE TWO

Well	Location (Rocky Flats Coordinates)	Elevation of G.S. (feet)	Total Depth (feet)	Probable Completion Interval (feet)	Geologic Unit	Diameter (inches)	Material	Available Information
1-74	N36643.8 E23069.0	5968.0	24.2	0-24.2(?)	RF/KA	6	PVC	RT, L
3-74	N36944.9 E23884.5	5950.2	24.0	0-24.0(?)	RF/KA	6	PVC	L
4-74	N36925.8 E23787.5	5951.1	6.1	0-6.1(?)	RF/KA	6	PVC	L
5-74	N37011.1 E24223.3	5948.1	19.0	0-19.0(?)	RF/KA	6	PVC	L
6-74	N36988.0 E24122.2	5948.5	7.4	0-7.4(?)	RF/KA	6	PVC	L
7-74	N36427.9 E25071.9	5946.5	19.7	0-19.7(?)	RF/KA	6	PVC	L
8-74	N36416.7 E24982.8	5947.6	39.4	0-39.4(?)	RF	6	PVC	L
9-74	N35042.8 E21671.2	5925.1	19.0	0-19.0(?)	SW/KA	6	PVC	L
10-74	N35002.3 E21592.6	5925.8	9.9	0-9.9(?)	SW	6	PVC	L
13-74	N34142.4 E17054.0	5991.7	19.2	0-19.2(?)	VF/KA	6	PVC	L
14-74	N34142.2 E16969.0	5993.3	4.6	0-4.6(?)	VF	6	PVC	L
15-74	N34674.3 E25250.1	5765.7	19.3	0-19.3(?)	VF/KA	6	PVC	L
16-74	N34723.9 E25169.3	5767.4	4.3	0-4.3(?)	VF	6	PVC	L
17-74	N38173.0 E25413.5	5810.9	14.3	0-14.3(?)	VF/KA	6	PVC	L
18-74	N38133.0 E25401.6	5812.8	6.4	0-6.4(?)	VF/KA	6	PVC	L
21-74	N36011.6 E19526.4	6026.6	258.0	0-258.0(?)	VF/KA	3	PVC	RT, NG, N, T
22-74	N36542.5 E24002.4	5956.8	199.0	0-199.0(?)	VF/KA	3	PVC	RT, NG, N
1-81	N40306.7 E27080.5	5718.9	20.3	18.3-20.3(?)	VF/KA	6	PVC	RT
2-81	N40692.1 E26730.3	5722.9	20.1	18.1-20.1(?)	VF/KA	6	PVC	
3-81	N38272.7 E25479.0	5808.4	21.2	19.2-21.2(?)	VF/KA	6	PVC	
4-81	N34586.5 E18949.5	5944.3	4.3	2.3-4.3(?)	VF	6	PVC	

TABLE 3-17
DETAILS OF EXISTING MONITOR WELLS AT THE ROCKY FLATS PLANT
PAGE THREE

Well	Location (Rocky Flats Coordinates)	Elevation of G.S. (feet)	Total Depth (feet)	Probable Completion Interval (feet)	Geologic Unit	Diameter (inches)	Material	Available Information
5-81	N34595.7 E19044.5	5945.3	20.1	18.1-20.1(?)	VF/KA	6	PVC	
6-81	N37878.5 E19381.3	6004.4	30.6	27.6-30.6(?)	RF/KA	6	PVC	RT
7-81	N37878.7 E19414.7	6004.1	29.4	26.4-29.4(?)	RF/KA	6	PVC	
8-81	N36993.6 E16553.3	6064.5	109.1	92.1-100.1(?)	KA	6	PVC	RT, NG, N, T
9-81	N36991.2 E16615.1	6063.5	30.6	27.6-30.6(?)	RF	6	PVC	RT
10-81	N35885.7 E12975.3	6142.6	29.7	26.7-29.7(?)	RF	6	PVC	RT
1-82	N35052.6 E22004.2	5910.7	20.4	18.4-20.4(?)	SW/KA	6	PVC	
2-82	N35030.4 E21960.7	5911.0	10.2	8.2-10.2(?)	SW/KA	6	PVC	
3-82	N37038.1 E17447.2	6047.9	27.3	24.3-27.3(?)	RF	6	PVC	
4-82	N37006.6 E15940.8	6076.3	30.9	27.9-30.9(?)	RF	6	PVC	
5-82	N36486.0 E15017.1	6096.1	29.6	26.6-29.6(?)	RF	6	PVC	
6-82	N36436.7 E15020.6	6097.4	30.7	27.7-30.7(?)	RF	6	PVC	NG, N
7-82	N35835.9 E12985.7	6143.3	22.2	18.2-22.2(?)	RF	6	PVC	
WS-1	N39561.2 E19412.7	5993.5	24.6	0-24.6(?)	RF	4	PVC	
WS-2	N39599.9 E21100.8	5966.0	14.5	0-14.5(?)	RF	4	PVC	
WS-3	N39100.2 E20598.8	5976.9	11.8	0-11.9(?)	RF	-	None	

TABLE 3-17
DETAILS OF EXISTING MONITOR WELLS AT THE ROCKY FLATS PLANT
PAGE FOUR

Notes:

- (1) All depths reference ground surface
- (2) (?) Indicates Assumed Completion Interval

(3) Geologic Units:

RF - Rocky Flats Alluvium
 KA - Arapahoe Formation
 VF - Valley Fill
 SW - Slope Wash

(4) Available Information:

CD - Construction Details
 RT - Recovery Test
 NG - Natural Gamma Log
 N - Neutron Log
 T - Temperature Log
 L - Lithologic Log

Source: Hydro-Search, Inc., 1985

contamination is expected, galvanized steel is unsuitable for metals detection, and only stainless steel 316 or Teflon are recommended.

In 1981 the existing groundwater program, which had been focused on monitoring for radionuclides, was modified to provide a RCRA-equivalent program. Seventeen wells in the area of the solar ponds (see Section 3.4.2) were designated as RCRA Interim status monitoring wells. Five additional wells were used to characterize background water quality. These 22 wells are listed on Table 3-18.

Water quality samples have been collected quarterly from these wells since February 1982. The samples are analyzed for drinking water parameters (arsenic, barium, cadmium, chromium, fluoride, lead, mercury, nitrate as nitrogen, selenium, silver, coliform bacteria, gross alpha, gross beta, radium), groundwater quality parameters (chloride, iron, manganese, phenols, sodium, sulfate), and groundwater contamination indicator parameters (pH, specific conductance, total organic carbon, total organic halogen). It should be noted that an effort was made in April 1983 to sterilize the wells to eliminate bacterial contamination. This action inadvertently introduced sodium, calcium, and chloride into the wells, and should be considered when reviewing the data. Pesticide/herbicide data (endrin, lindane, methoxychlor, toxaphene, 2,4-D, 2,4,5-TP (Silvax)) are available for 1984. Data on all water quality parameters are presented in the November 1985 RCRA Part B Permit Application for Radioactive Mixed Waste, Appendix E-2, and only the significant aspects are discussed below. Data on plutonium, americium, uranium, and tritium from the regular (non-RCRA-equivalent) program appear in the RFP Annual Environmental Monitoring Reports. Additional unpublished analytical data are in the Environmental Master File at the plant. A summary of older radiological and non-radiological data for the 22 wells in the routine monitoring program from 1975 to 1980 may be found in Hoffman (1982). The non-radiological parameters tested during this period were nitrate as nitrogen, fluoride, chloride, pH, sulfate, and hardness.

The accuracy of these existing groundwater chemistry data was assessed through the use of cation-anion balances (Hydro-Search, 1985). This technique is applicable to any reasonably complete analysis of a water sample. When all the major anions (negative ions such as sulfate and chloride) and cations (positive ions such as sodium and calcium) have been determined, the sum of the cations in milliequivalents per liter should equal the sum of the anions expressed in the same units. The balance error in percent is defined as

$$\frac{(\text{sum of cations} - \text{sum of anions})}{(\text{sum of cations} + \text{sum of anions})} \times 100$$

TABLE 3-18

DETAILS OF INTERIM STATUS MONITORING WELLS

Well	Total Depth (feet)	Probable Screened Interval (feet)	Casing		Hydrogeologic Unit	Hydraulic Position
			Diameter (inches)	Material		
1-66	151.5	30.0-151.5	6	Galv. Steel	All	upgradient
9-81	30.6	27.6-30.6	6	PVC	All	upgradient
10-81	29.7	26.7-29.7	6	PVC	All	upgradient
6-82	30.7	27.7-30.7	6	PVC	All	upgradient
7-82	22.2	19.2-22.2	6	PVC	All	upgradient
8-81	100.1	92.1-100.1	6	PVC	CS	upgradient
3-60	20.2	0-20.2	6	Galv. Steel	All/CS	downgradient
4-60	17.7	0-17.7	6	Galv. Steel	All/CS	downgradient
5-60	19.8	0-19.8	6	Galv. Steel	CS	downgradient
2-66	139.7	30.0-139.7	6	Galv. Steel	CS	downgradient
3-66	144.9	30.0-144.9	6	Galv. Steel	CS	downgradient
1-60	25.6	0-25.6	6	PVC	Coll/CS	downgradient
2-60	22.6	0-22.6	6	Galv. Steel	Coll/CS	downgradient
6-71	62.7	0-63.7	4	PVC	Coll/CS	downgradient
3-71	30.7	0-30.7	6	Steel	VF/CS	downgradient
1-81	20.3	18.3-20.3	6	PVC	VF/CS	downgradient
2-81	20.1	18.1-20.1	6	PVC	VF/CS	downgradient
6-60	28.8	0-28.8	6	Galv. Steel	Coll/CS	downgradient
5-71	27.5	0-27.5	6	Steel	VF/CS	downgradient
17-74	14.3	0-14.3	6	PVC	VF/CS	downgradient
18-74	6.4	0-6.4	6	PVC	VF/CS	downgradient
3-81	21.2	19.2-21.2	6	PVC	VF/CS	downgradient

Notes:

- All - Rocky Flats Alluvium CS - Arapahoe Formation Claystone Coll - Colluvium
VF - Valley Fill
- Wells 9-81, 10-81, 6-82, 7-82, and 8-81 are not "RCRA" wells but were used in determining background water quality.

Source: RFP RCRA Part B Application, November, 1985.

For waters with total dissolved solids (TDS) between 250 and 1,000 milligrams per liter, the balance error should not exceed 1 or 2 percent (Hem, 1985). A larger error indicates problems with laboratory procedures, possible loss of constituents through poor sampling and preservation techniques, or the presence of additional constituents such as organic anions. Since the TDS of the groundwater at RFP is generally in the 250 to 1,000 milligram-per-liter range, the balance error should be less than five percent and certainly should not exceed ten percent. Data from the last quarter of 1983 and the first three quarters of 1984 were assessed, and many of the analyses were found to have unacceptable cation-anion balances. Caution in the use of these data for geochemical site characterization was therefore recommended by Hydro-Search, Inc. For purposes of the Survey, these data are considered Level II, defined in the DOE Environmental Survey Manual as data useful for screening for the existence of a potential environmental pollutant problem.

The analyses from May 1984 were the most accurate of those assessed by Hydro-Search, Inc., based on the number of analyses with less than 10% balance error. This quarter also had the largest total number of analyses. Data from this quarter were therefore used to differentiate the following six chemical types of groundwater (Hydro-Search, 1985).

<u>Type</u>	<u>TDS (mg/l)</u>	<u>Dominant Cation</u>	<u>Dominant Anion</u>
I	70 - 200	Calcium	Bicarbonate
II	200 - 400	Calcium	Bicarbonate
III	400 - 1100	Sodium	Bicarbonate
IV	400 - 1100	Sodium	Chloride
V	2400 - 5000	Calcium	Sulfate
VI	2400 - 5000	Calcium-Sodium	Nitrate

The distribution of these water types is shown on Figure 3-15, and potential source areas are indicated on Figure 3-16. The following interpretation is taken from the RI Geological and Hydrological Data Summary, July 21, 1986:

Type I water appears to be most representative of background conditions although the wells containing Type I water are located in or near the west spray field.

Type II is found downgradient of the plant in wells completed in both alluvium and bedrock. This water may be background water modified by chemical reactions with the subsurface materials along the length of the groundwater flow path or it may be produced by seepage from facilities immediately upgradient (west spray field, the present landfill, and/or the solar evaporation ponds).

FIGURE 3-15

SPATIAL DISTRIBUTION OF WATER TYPES
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986

FIGURE 3-16

**POTENTIAL CONTAMINANT SOURCE AREAS
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986**

Type III water occurs only in the drainages. The sodium in this water may be derived from natural ion-exchange processes or from plant operations.

Type IV water occurs downgradient of the evaporation ponds, the old waste disposal area near the east gate, and Building 881. These facilities are the likely sources of this water.

Type V water occurs in Woman Creek, downgradient of the original south landfill, downgradient of Building 881, and downstream of the holding ponds in the South Walnut Creek and North Walnut Creek drainages. These facilities are the likely sources of this water.

Type VI water occurs downgradient of the solar ponds, and the high concentration of nitrate, coupled with close proximity to the solar evaporation ponds indicate that pond water is the source.

The wells selected as ungradient wells for the RCRA Interim status program are 1-66, 9-81, 10-81, 6-82, 7-82, and 8-81. Well 1-66 is included because it was the only well west (ungradient) of the plant boundary when the Interim status program was designed in 1981. All have water of Type I or Type II. Type II has higher TDS (200 to 400 milligrams per liter) than Type I (70 to 200 milligrams per liter), but is otherwise similar in geochemical properties. Table 3-19 lists selected constituents which provide a characterization of background groundwater quality. TDS values for both wells 1-66 and 9-81 may exceed 200 milligrams per liter. The composition of the background groundwater is generally dominated by calcium, sodium, and bicarbonate with some chloride. Gross alpha and beta radioactivity values are generally less than about 20 pCi/l. Total organic carbon (TOC) is generally less than about 25 milligrams per liter. It should be noted that well 1-66 is listed on this table as a Rocky Flats Alluvium well but is actually a composite well. This well is 151.5 feet deep and the contact between alluvium and bedrock is at a depth of 35 feet, based on the neutron geophysical log run in this well. The probable completion interval for this well is 30.0 to 151.5 feet.

Chemical analyses for selected groundwater quality parameters for the RCRA Interim status wells downgradient of the solar ponds are presented in Table 3-20. Chemical data on solar pond water and sludge may be found in the RFP RCRA Part B Application, November 1985, Appendix E-3. In general, water from ponds 207A and 207C is characterized by high TDS (on the order of 10,000 milligrams per liter), high nitrate (greater than 1,000 milligrams per liter), high pH (greater

TABLE 3-19

BACKGROUND GROUNDWATER QUALITY

Well	Date	pH	TDS	Ca	Mg	Na	K	Cl	HCO ₃	SO ₄	NO ₃	Gross Alpha	Gross Beta	TOC
1-66	Sept 1983	8.1	110	20	4.8	9.7	.8		236.0		2.6	-12.2	-1.3	9.9
	Dec 1983	7.9	135	25	4.9	8.7	1.0	3.6	157.0	15.0	<1	12.9	5.2	14
	May 1984	7.7	211	44	10.1	8.9	1.2	10.0	172.0	36.5	<1	-19.8	0	23.5
	June 1984	8.3	178	35	10.0	25	1.2	5.6	166.0	12.9	<1	4.6	4.8	10.5
	Sept 1984	8.4	183	41	11.0	11	1.6	7.7	202.0	2.1	<1	27	16	18
	Mar 1985	8.0	248	60	14.0	14	1.3	60.5	201.0	8.1	<1	12	42	5
9-81	Sept 1983	8.0	180	30	2	25	3.4		186.0		<1	-7	-2.7	6.5
	Dec 1983	8.2	205	35	3	70	3.5	63.0	56.4	70.0	<1	-4.1	3.2	9
	Mar 1984	7.5	215	40	2	20	3.7	5.0	290.0	49.0	2.4	19.3	5	<1
	May 1984	7.3	209	44	2	24	2.9	8.4	62.2	47.7	1.8	8	-1	<1
	Sept 1984	7.9	189	66	7	49	7.2	23.0	59.5	43.0	<1	-2	14	10
	Mar 1985	7.5	202	43	6	25	2.5	25.7	63.7	52.2	1.8	-5	24	6
10-81	Sept 1983	7.8	108	20	3.3	15	.8		168.0		7	4.1	-5.5	4
	Dec 1983	7.7	148	20	2.6	15	.7	5.8	59.0	14.0	31	14.2	1.6	3
	Mar 1984	7.2	128	20	2.8	10	.6	6.1	54.0	12.3	7.6	18.3	2.2	1
	May 1984	7.5	114	13	3.0	8.9	1.0	6.7	31.7	15.3	8.1	6	0	<1
	Sept 1984	7.5	134	31	6.6	25	2.1	5.3	32.8	13.0	7.6	18	12	6
	Mar 1985	7.2	115	17	2.8	14	.8	1.1	32.4	16.3	3.4	7	47	10

TABLE 3-19
BACKGROUND GROUNDWATER QUALITY
PAGE TWO

Rocky Flats Alluvium Wells

Well	Date	pH	TDS	Ca mg	Na	K	Cl	HCO ₃	SO ₄	NO ₃	Gross Alpha	Gross Beta	TOC
6-82	Sept 1983	8.0	83	30	5.5	1.0		110.0		<1	10.3	-9.9	8.9
	Dec 1983	7.7	69	15	5.3	1.0	2.7	36.7	15.0	1.5	7.8	2.9	5
	Mar 1984	6.9	81	20	3.4	9	10.6	16.0	19.1	<1	19.8	1.3	6
	May 1984	6.9	73	9.8	2.6	1.4	3.6	19.9	9.2	<1	9	6	5
	Sept 1984	7.6	65	23	1.9	2.7	2.7	26.7	11.0	<1	-7	7	9
	Mar 1985	7.0	88	10	1.7	1.3	4.4	15.6	17.0	<1	15	25	14
7-82	Sept 1983	8.2	139	40	5.1	2.1		147.0		<1	12.8	-7.6	9.8
	Dec 1983	8.1	170	35	4.7	1.3	9.5	111.0	31.0	4.9	11.5	2.4	14
	Mar 1984	7.3	148	30	40.0	1.2	16.7	46.0	27.9	3.3	22	1.3	4
	May 1984	7.4	141	24	4.2	1.2	17.2	54.3	21.6	2.1	10	7	<1
	Sept 1984	8.0	131	44	8.4	3.3	14.0	59.5	20.0	1.6	-7	5	10
	Mar 1985												

Arapahoe Claystone Well

8-81	Sept 1983	8.0	125	20	3.8	2.3		138.0		<1	-4.8	-5.6	6.2
	Dec 1983	8.1	140	25	3.4	2.3	10.0	30.2	33.0	<1	9.2	2	6
	Mar 1984	7.5	138	25	4.6	1.9	10.0	91.0	28.9	<1	15.3	2	<1
	May 1984	8.3	151	19	4.8	2.1	8.4	95.3	22.7	<1	14	0	<1
	Sept 1984	8.2	154	48	12.0	4.9	8.9	11.0	20.0	<1	5	1	2
	Mar 1985	8.0	164	33	8.9	2.0	8.8	138.0	16.3	<1	-7	10	6

Notes:

1. All units are mg/l except pH in standard units
2. TOC is total organic carbon
3. NO₃ reported as N
4. Blank means not analyzed
5. Negative radiometric values result from self-absorption or laboratory blank correction.

TABLE 3-20

DOWNGRAIENT GROUNDWATER QUALITY

ROCKY FLATS ALLUVIUM AND ARAPAHOE CLAYSTONE WELLS

Well	Date	pH	TDS	Ca	Mg	Na	K	Cl	HCO ₃	SO ₄	NO ₃	Gross Alpha	Gross Beta	TOC
3-60	Sept. 1983	8.4	475	95	25.0	60	3.6		240.0		3.3	-10.9	1.3	27.8
	Dec. 1983	8.2	557	50	20.0	65	1.4	256.0	289.0	102.0	18	19	7.1	21
	May 1984	8.3	240	52	6.9	16	1.5	7.4	214.0	14.9	4.8	-17.2	-1	17
	June 1984	8.4	420	55	15.0	50	1.3	21.5	339.0	50.0	6.1	7.7	4.5	15
	Sept. 1984	8.3	537	81	19.0	63	1.5	29.1	327.0	63.0	11.2	17.7	7	2
	Mar. 1985	8.3	405	62	20.0	56	1.2	15.1	345.0	50.8	4.2	12	32	<1
4-60	Sept. 1983	8.4	1020	120	30.0	170	30.0		280.0		66.7	34.5	6.9	18.8
	Dec. 1983	8.4	1123	75	30.0	160	20.0	30.0	356.0	65.0	12	27.5	11.7	21
	May 1984	8.1	229	34	5.7	17	9.9	8.2	17.8	14.2	7	-8.5	3.7	17.8
	June 1984	8.3	1242	120	50.0	130	32.0	15.0	485.0	82.0	125	14.4	6.5	16
	Sept. 1984	8.4	1386	120	52.0	180	46.0	58.0	396.0	69.6	126	84	15	17
	Mar. 1985	8.3	980	93	45.0	330	46.0	24.9	35.0	78.1	86.4	39	6	4

ARAPAHOE CLAYSTONE WELLS

2-66	Sept. 1983	7.9	392	55	15.0	30	2.1		294.0		22.6	-6.2	2.4	11.9
	Dec. 1983	8.1	419	50	15.0	35	2.3	85.0	317.0	30.0	14	24.1	2.1	20
	May 1984	8.2	418	60	19.0	47	3.4	102.0	244.0	43.8	13.3	-5.6	-3.6	4
	June 1984	8.2	454	56	20.0	50	2.7	78.0	254.0	25.0	8.6	6.4	3.8	15.5
	Sept. 1984	8.4	399	58	16.0	48	3.1	61.0	242.0	30.2	9.8	9	13	12
	Mar. 1985	8.3	372	56	20.0	61	3.9	67.4	355.0	33.9	7.4	18	17	8
3-66	Sept. 1983	8.4	542	55	20.0	100	3.3		175.0		2	-14.5	1.4	19.3
	Dec. 1983	8.3	533	55	15.0	90	3.4	138.0	219.0	59.0	3	15.6	4.4	28
	May 1984	8.4	525	52	20.0	89	3.8	182.0	290.0	67.7	1.9	-18	3.2	32.5
	June 1984	8.3	509	50	20.0	130	3.6	165.0	319.0	41.9	<1	7.9	6.3	13
	Sept. 1984	8.5	499	53	18.0	120	4.0	120.0	302.0	38.5	1.1	7	9	17
	Mar. 1985	8.4	423	39	17.0	95	4.7	131.0	210.0	58.6	1.2	21	46	8

TABLE 3-20
DOWNGRADIENT GROUNDWATER QUALITY
PAGE TWO
NORTH WALNUT CREEK

SLOPE WASH AND ARAPAHOE CLAYSTONE WELLS

Well	Date	pH	TDS	Ca	Mg	Na	K	Cl	HCO ₃	SO ₄	NO ₃	Gross Alpha	Gross Beta	TOC
1-60	Sept. 1983	7.9	2533	390	170.0	190	4.4		133.0		200	31.3	24	19.1
	Dec. 1983	7.8	5379	730	160.0	260	6.8	256.0	289.0	102.0	400	4.6	13.3	24
	May 1984	8.3	373	47	11.0	49	1.6	10.6	287.0	53.5	2.3	-21.9	3	29.5
	June 1984	8.0	654	440	25.0	95	2.1	33.0	288.0	79.9	30.7	8.4	4.7	16
	Sept. 1984	7.8	2698	310	74.0	160	3.9	105.0	180.0	131.0	381	35	8	21
	Mar. 1985	7.7	1615	190	70.0	200	4.0	77.1	191.0	176.0	20	32	6	8
2-60	Sept. 1983	8.0	7570	740	270.0	730	65.0		129.0		762	80	17	26.4
	Dec. 1983	7.7	9726	680	210.0	590	65.0	410.0	377.0	25.0	1075	78.5	22.2	33
	May 1984	8.1	5021	440	150.0	520	68.0	119.0	268.0	162.0	578	0	22.1	41.9
	June 1984													
	Sept. 1984	8.0	5033	730	210.0	730	73.0	549.0	781.0	320.0	1050	45	14	15
	Mar. 1985													
6-71	Sept. 1983	8.0	3058	410	85.0	180	6.1		174.0		344	45.9	-8.5	23.7
	Dec. 1983	8.0	3058	360	88.0	220	6.3	420.0	254.0	155.0	1090	63.9	10.3	33
	May 1984	8.3	1043	120	36.0	120	2.8	50.8	278.0	71.9	90.4	-3.8	-2.7	34.5
	June 1984	7.9	3034	240	75.0	220	5.7	107.0	228.0	148.0	304	6.7	5.7	15.5
	Sept. 1984	7.5	3226	350	88.0	380	8.7	160.0	261.0	33.6	450	14	9	26
	Mar. 1985													

TABLE 3-20
DOWNGRAIDENT GROUNDWATER QUALITY
PAGE THREE
NORTH WALNUT CREEK

VALLEY FILL AND ARAPAHOE CLAYSTONE WELLS

Well	Date	pH	TDS	Ca	Mg	Na	K	Cl	HCO ₃	SO ₄	NO ₃	Gross Alpha	Gross Beta	TOC
3-71	Sept. 1983	8.1	1340	95	40.0	250	4.5		166.0		<1	10.2	-9.4	17.8
	Dec. 1983	8.2	1372	100	35.0	200	4.9	277.0	171.0	483.0	<1	0	7	25
	May 1984	8.2	1751	180	81.0	250	7.2	376.0	233.0	719.0	<1	-38	-1.8	18.5
	June 1984	8.1	1701	140	60.0	260	5.4	260.0	261.0	640.0	<1	1.9	4.4	32.5
	Sept. 1984	8.1	1769	170	69.0	420	8.2	330.0	208.0	940.0	34	1.2	1.5	23
	Mar. 1985	8.0	1651	140	74.0	300	6.5	263.0	145.0	735.0	4.5	31	41	24
1-81	Sept. 1983	7.9	852	50	30.0	170	3.5		276.0		<1	3.9	27.6	
	Dec. 1983	8.2	619	45	15.0	130	5.9	400.0	250.0	1050.0	<1	4.6	7.4	25
	May 1984	8.3	707	52	22.0	100	3.2	57.0	290.0	158.0	<1	-14.3	-2.3	35.5
	June 1984	8.2	606	120	25.0	180	3.5	360.0	341.0	135.0	2.2	5.6	3.5	10
	Sept. 1984	8.0	605	110	41.0	330	4.2	30.0	323.0	136.0	<1	5	2	18
	Mar. 1985	8.1	605	61	0.0	300	4.6	37.5	352.0	192.0	<1	9	19	30
2-81	Sept. 1983	7.9	750	55	35.0	160	5.3		503.0		1.5	-5	-3.5	31.8
	Dec. 1983	7.9	654	45	25.0	120	5.1	270.0	476.0	350.0	<1	16.2	4	35
	May 1984	8.2	527	51	19.0	85	4.2	21.1	388.0	82.5	<1	-21.9	-2	39.5
	June 1984	8.1	530	95	25.0	140	4.3	30.0	437.0	84.5	2.3	5.8	5	31
	Sept. 1984	7.9	586	100	54.0	220	11.0	39.0	420.0	98.0	<1	9	6	25
	Mar. 1985	7.9	441	45	20.0	92	4.3	30.5	370.0	93.3	2.4	7	23	30

TABLE 3-20
DOWNGRAIDENT GROUNDWATER QUALITY
PAGE FOUR
SOUTH WALNUT CREEK

SLOPE WASH AND ARAPAHOE CLAYSTONE WELLS

Well	Date	pH	TDS	Ca	Mg	Na	K	Cl	HCO ₃	SO ₄	NO ₃	Gross Alpha	Gross Beta	TOC
6-60	Sept. 1983	7.9	321	80	25.0	25	.9		146.0		2.8	-25.3	-4.4	18.4
	Dec. 1983	8.4	352	40	25.0	30	1.1	10.0	407.0	30.0	4.6	2.2	1.9	20
	May 1984	8.2	480	66	30.0	31	1.3	26.1	359.0	40.6	17.1	2.8	3.2	20.5
	June 1984	8.3	425	35	30.0	25	1.1	17.8	338.0	32.3	11.8	2.4	3	17
	Sept. 1984	8.0	360	68	31.0	45	1.2	13.2	324.0	25.5	6.1	2.0	0	22
	Mar. 1985	8.4	348	58	21.0	40	1.2	15.9	302.0	31.3	7.7	24	6	5

VALLEY FILL AND ARAPAHOE CLAYSTONE WELLS

5-71	Sept. 1983	7.9	1350	200	35.0	130	5.7		385.0		<1	10.9	-16.3	13.7
	Dec. 1983													
	May 1984													
	June 1984													
	Sept. 1984													
	Mar. 1985													
17-74	Sept. 1983	7.9	3180	650	100.0	320	.5		378.0		<1	41.8	-13.9	29.8
	Dec. 1983	7.7	2543	430	105.0	360	4.1	443.0	518.0	1450.0	<1	0	9.2	55
	May 1984	8.1	2425	580	92.0	240	1.9	403.0	356.0	891.0	5.1	-27	0	52
	June 1984	8.0	2578	780	80.0	500	2.0	366.0	332.0	556.0	2.9	9.5	4.1	27
	Sept. 1984	7.8	2977	400	100.0	460	4.1	15.5	380.0	43.9	<1	72	13	33
	Mar. 1985	7.7	2768	300	100.0	350	3.9	395.0	309.0	1397.0	<1	12	35	35
18-74	Sept. 1983													
	Dec. 1983	7.7	1476	230	45.0	200	.7	227.0	369.0	682.0	10.5	32	9.8	40
	May 1984	8.1	1239	110	44.0	130	.9	100.0	299.0	296.0	<1	0	1.4	44
	June 1984													
	Sept. 1984													
	Mar. 1985													

TABLE 3-20
DOWNGRADIENT GROUNDWATER QUALITY
PAGE FIVE
SOUTH WALNUT CREEK

VALLEY FILL AND ARAPAHOE CLAYSTONE WELLS

Well	Date	pH	TDS	Ca	Mg	Na	K	Cl	HCO ₃	SO ₄	NO ₃	Gross Alpha	Gross Beta	TOC
3-81	Sept. 1983	7.8	2350	240	80.0	360	9.1		363.0		14.2	52.9	-2	35.8
	Dec. 1983	7.8	1954	190	55.0	270	8.0	620.0	335.0	1721.0	8	21	7.7	24
	May 1984													
	June 1984	7.8	1551	420	50.0	460	6.5	86.1	321.0	330.0	<1	18.8	5	19.5
	Sept. 1984	7.8	1587	300	110.0	550	23.0	106.0	382.0	650.0	1.2	21	14	23
	Mar. 1985	7.5	293	29	9.1	34	14.0	14.3	54.1	11.2	1.6	13	15	15

Notes:

1. All units are milligrams/liter except
pH in standard units
gross alpha and beta in PicoCuries/liter.
2. TOC is total organic carbon.
3. NO₃ reported as N.
4. Blank means not analyzed.
5. Negative radiometric values result from self-absorption or laboratory blank correction.

Source:

RFP RCRA Part B Application, November 1985

than 9), and high alpha and beta activities. Since Pond 207B is used for intercepted groundwater and water from the sewage treatment plant awaiting reverse osmosis, the water quality is better than in Ponds 207A and 207C, which still contain process waste water.

The plume immediately adjacent to the ponds (wells 1-60, 2-60, 4-60, and 6-71) consists of water of very similar composition to the pond waters. The groundwater in the vicinity of the ponds has higher than background TDS (in the 1,000 to 5,000 milligram-per-liter range) and high nitrate concentrations. Figure 3-14 shows the approximate limits of the plume, based on the logarithm of nitrate concentrations. The nitrate and TDS concentrations of samples from wells 3-60 and 6-60 (close to the ponds) are not as high as the ponds or other wells. This may be due to heterogeneities in subsurface materials or to a lack of saturation of the alluvium in this area. The wells nearest the ponds (wells 2-60 and 4-60) have high potassium concentrations and high alpha and beta activities. TOC is in the normal range or slightly elevated (less than 50 milligrams per liter). The solar pond plume is not related to the volatile organic contamination problem discussed below. Although some disposal of organic solvents into these ponds may have occurred, organic disposal was intentionally avoided to prevent formation of pond scum that would interfere with evaporation.

The eastern limit of the contamination plume along the ridge on which the ponds are located is defined by well 3-66. The water from this well has considerably lower TDS and nitrate concentrations than the water in wells closer to the ponds. Two types of non-background waters are present in the wells downgradient along North Walnut Creek (3-71, 1-81, and 2-81). Well 3-71 has high TDS (about 1,500 milligrams per liter), high sulfate, high chloride, and very low nitrate concentrations. This Type V water is different from both the plume and background water. Apparently the solar pond plume has not extended this far down North Walnut Creek. Wells 1-81 and 2-82 are of better quality than 3-71 with TDS in the range of 500 to 800 milligrams per liter and low to non-detectable nitrates. Samples from these wells have slightly higher than background TOC concentrations in the range of 24 to 40 milligrams per liter.

Data from wells downgradient along South Walnut Creek (5-71, 17-74, 18-74, and 3-81) indicate that the solar pond plume has not extended to them. These wells are very similar to 3-71 on North Walnut Creek (Type V water), having high TDS (1,000 to 3,000 milligrams per liter), high sulfate and chloride, and generally nondetectable nitrate concentrations. All these wells have slightly elevated TOC concentrations (30 to 50 milligrams per liter).

It should be remembered when comparing data from Table 3-20 with the groundwater type classifications shown on Figure 3-15 that the type classifications were based only on the May 1984

data. Data for this quarter were considered most accurate on the basis of cation-anion balance error. The analytical data in Tables 3-19 and 3-20 are considered Level II for purposes of the Survey but is clearly sufficient for the detection of a body of high TDS, nitrate-dominated groundwater near the solar ponds. Because of similarities in chemical characteristics between this plume and the pond water itself, the plume is considered to be the result of pond seepage.

Radionuclides in groundwater appear to be less of a problem at RFP than nonradioactive contaminants. Radium concentrations are very low, and plutonium and americium are at or near the detection limit. Uranium concentrations as high as 30 picoCuries per liter have been found in wells near the solar ponds. Elevated uranium concentrations have been found historically in wells elsewhere on-site. These elevated concentrations have been attributed to pockets of natural uranium in the soil, although some wells are near inactive disposal sites such as the Building 884 hillside and the burial trenches. Six of these wells will be sampled and analyzed for uranium isotopic composition by mass spectrometry as part of the Survey effort. This analysis should be able to distinguish natural uranium from the depleted uranium commonly processed at the plant.

Tritium may also be associated with the solar pond plume. Tritium was introduced into the solar ponds in 1973 when contaminated scrap was received and processed at RFP without knowledge of the contamination. Preliminary data (Weston, 1986) for solar pond 207A show tritium values of 610 ± 270 to 930 ± 260 picoCuries per liter for pond liquor and $2,400 \pm 600$ to $12,000 \pm 1,000$ pCi/g (dry weight) for pond sediments. The highest tritium value reported for groundwater in the 1985 Annual Environmental Monitoring Report was $1,480 \pm 750$ pCi/l in well 2-66, east of the solar ponds. Lower concentrations were observed in the same well in later sampling rounds. Counting errors for existing tritium data are large, and background concentrations range from 100 to 600 pCi/l. Thus the existence of elevated tritium levels in groundwater is not clearly established. More tritium data of high quality will be available from the well installation and sampling program currently being conducted by RFP.

The presence of high TDS groundwater in the drainages beyond the apparent limits of a nitrate-dominated solar pond plume has been confirmed by a geophysical study (terrain conductivity), which is discussed below. Analytical data for trace metals, which could be related to high TDS, show that concentrations of the following metals can exceed background levels in Type IV, V, and VI groundwater.

<u>Metal</u>	<u>Maximum Concentration (mg/l)</u>	<u>Highest Upgradient Concentration (mg/l)</u>
Cesium	0.24	<0.042
Manganese	0.49	0.13
Molybdenum	0.048	0.013
Selenium	2.9	<0.01
Strontium	4.9	0.84

Type I water west of the plant contains what appears to be relatively high concentrations of nickel (0.01 to 0.02 milligrams per liter).

In addition to the high-nitrate solar pond contaminant plume, a second type of groundwater contamination is present at the RFP. This type is characterized by the presence of volatile organic compounds (VOCs).

Organic contamination was suspected from the presence of total organic carbon/total organic halogen (TOC/TOX) anomalies in data collected since February 1982 from the 17 RCRA Interim status monitoring wells. TOC data are shown in Tables 3-19 and 3-20; TOX data are in Table 3-21.

In order to screen for VOCs and to determine whether the TOC/TOX data anomalies could be due to analytical problems, five wells (3-71, 1-74, 9-74, 7-81, and 5-82) were sampled in March 1985 for analysis by Accu-Labs Research, Inc. Well 5-82, a background well west of the plant, was clean, but trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1-dichloroethylene (DCE), 1,1,1-trichloroethane (TCA), and 1,2-dichloroethane (DCA) were found at varying levels in the other samples. In particular, well 9-74 in the Building 881 hillside area had 3.3 ppm TCE, 2.8 ppm PCE and 1.3 ppm DCE. Well 1-74 in the mound area had 0.97 ppm TCE, 6.7 ppm PCE, and 0.18 ppm TCA. These results and those from subsequent sampling rounds are shown in Table 3-22.

An expanded sampling program on 33 wells was conducted in April 1985. The results of this sampling round confirmed the presence of VOCs, especially TCE, PCE, DCE, and TCA. TCE was formerly used as the RFP general solvent, but its use was discontinued in 1975. PCE was discontinued as a plant degreasing solvent in 1976. TCA is the current RFP general solvent. It is far less toxic than TCE. DCE is a degradation product of TCA.

The recommended maximum contaminant levels (RMCLs) for TCE, PCE, and DCE are zero. RMCLs are proposed limits for the protection of human health. For comparison, the RMCL for TCA is 1030 ppm. Permissible limits for protecting aquatic life are 45 ppm for TCE, 18 ppm for TCA on an acute toxicity

TABLE 3-21

**TOTAL ORGANIC HALOGEN (TOX)
IN INTERIM STATUS MONITORING WELLS**

Well No.	2/82	5/82	8/82	12/82	7/83	11/83
1-66	7.3	16	31	11.5	28.0	10
1-60	35.0	33	30	135.0	30.0	105
2-60	83.0	115	79	78.0	175.0	360
3-60	36.0	34	25	22.0	38.0	51
4-60	54.0	68	48	21.0	49.0	55
5-60	Dry	Dry	Dry	Dry	22.0	Dry
6-60	15.0	13	17	8.2	17.0	15
2-66	21.0	22	43	19.5	115.0	47
3-66	19.0	23	33	21.0	7.0	62
3-71	32.0	41	28	21.0	265.0	46
5-71	Dry	Dry	Dry	Dry	130.0	Dry
6-71	36.0	55	75	51.5	1,625.0	633
17-74	17.0	20	27	31.5	3,225.0	563
18-74	18.0	Insufficient Sample	Dry	19.5	Dry	388
1-81	8.3	5.0	None Detected	9.0	1,350.0	313
2-81	6.8	8.0	8.1	7.8	1,100.0	370
3-81	3.7	None Detected	8.1	3.5	2,150.0	1,875

Values in micrograms of chloride per liter.

Source: RFP RCRA Part B Application, November 1985.

TABLE 3-22

VOLATILE ORGANIC ANALYTICAL RESULTS

Well	Date	TCE	PCE	DCE	TCA	DCA	CCl ₄	CHCl ₃
1-60	04/18/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4-60	12/23/85	.005	.016	.001	<0.002	.009	.005	.003
6-60	12/23/85	<0.001	.001	<0.001	<0.001	<0.001	<0.001	.003
2-66	04/18/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
3-66	04/18/85	<0.001	.003	.001	<0.001	<0.001	<0.001	<0.001
1-71	04/18/85	.550	.310	.360	1.300	<0.001	<0.001	<0.001
2-71	04/18/85	.211	.004	.014	.001	<0.001	<0.001	<0.001
3-71	04/18/85	.003	.003	.003	<0.001	<0.001	<0.001	<0.001
	12/23/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	03/20/85	.003	.004	.001	<0.001	<0.001	<0.001	<0.001
4-71	04/17/85	<0.001	<0.001	.003	<0.001	<0.001	<0.001	<0.001
5-71	04/18/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	.004
6-71	04/18/85	.006	.003	.003	.006	<0.001	<0.001	<0.001
	12/23/85	.033	.005	.001	<0.001	<0.001	.013	.042
1-74	12/ /85	.650	3.000	.005	.005	.005	.005	.160
	04/18/85	2.200	16.000	<0.001	<0.001	<0.001	<0.001	<0.001
	03/20/85	.970	6.700	<0.001	.180	<0.001	<0.001	<0.001
3-74	04/18/85	.014	.019	.005	.130	<0.001	<0.001	<0.001
7-74	04/18/85	.003	.012	.011	.002	<0.001	<0.001	<0.001
9-74	12/ /85	2.400	9.600	1.600	.520	.005		.005
	04/18/85	6.400	2.800	.130	.260	<0.001	<0.001	<0.001
	03/20/85	3.300	2.800	1.300	4.800	<0.001	<0.001	<0.001
10-74	04/18/85	.950	.041	.090	<0.001	4.500	.010	<0.001
13-74	04/17/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
14-74	04/17/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
15-74	04/17/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	12/ /85	<.005	<.005	<.005	<.005	<.005	<.005	<.005

TABLE 3-22
VOLATILE ORGANIC ANALYTICAL RESULTS
PAGE TWO

Well	Date	TCE	PCE	DCE	TCA	DCA	CCl ₄	CHCl ₃
17-74	04/18/85	.003	<0.001	.006	<0.001	<0.001	<0.001	<0.001
	12/23/85	<0.001	<0.001	<0.001	<0.001	.009	.002	.002
18-74	04/18/85	.002	.003	<0.001	<0.001	<0.001	<0.001	<0.001
21-74	04/18/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22-74	04/18/85	.004	.005	.009	.013	<0.001	<0.001	.014
1-81	04/17/85	<0.001	.003	<0.001	<0.001	<0.001	<0.001	<0.001
	12/23/85	<0.001	.012	<0.001	<0.001	<0.001	.001	.002
	01/30/86	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	01/31/86	.005	.007	.011	.007	.005	.007	.006
2-81	04/17/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	.001
	12/23/85	.010	<0.001	<0.001	<0.001	.008	.003	.005
	01/30/86	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	01/31/86	<0.001	.006	<0.001	<0.001	<0.001	<0.001	<0.001
3-81	04/18/85	.004	.005	.005	<0.001	<0.001	<0.001	<0.001
4-81	04/17/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
5-81	04/17/85	<0.001	<0.011	<0.001	<0.001	<0.001	<0.001	<0.001
7-81	03/20/85	.004	.019	.008	.021	.002	<0.001	.001
9-81	04/17/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
10-81	04/18/85	.002	.003	<0.001	<0.001	<0.001	<0.001	<0.001
1-82	04/17/85	.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
5-82	03/20/85	.001	.001	<0.001	<0.001	<0.001	<0.001	<0.001
TH-1-E	04/18/85	.003	.003	<0.001	<0.001	<0.001	<0.001	<0.001
WS-1	04/18/85	<0.001	<0.001	.002	<0.001	<0.001	<0.001	<0.001
WS-2	04/18/85	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
WS-3	04/18/85	.004	.003	<0.001	<0.001	<0.001	<0.001	<0.001

TABLE 3-22
VOLATILE ORGANIC ANALYTICAL RESULTS
PAGE THREE

Notes: All units are milligrams per liter

TCE	■ Trichloroethylene
PCE	■ Tetrachloroethylene
DCE	■ 1,1-Dichloroethylene
TCA	■ 1,1,1-Trichloroethane
DCA	■ 1,2-Dichloroethane
CCl ₄	■ Carbon Tetrachloride
CHCl ₃	■ Chloroform

Sources: Geological and Hydrological Data Summary, U.S. Department of Energy, July 21, 1986.
Greengard, T.C., Rocky Flats Groundwater Quality Studies: Recent Data/Actions
Summary, April, 1986.

PRELIMINARY

basis, 11.6 ppm for DCE, and 5.28 ppm (5,280 ppb) for PCE. This limit for PCE was exceeded for well 1-74, which had 16 ppm PCE in the April sampling round.

Elevated levels (greater than 20 ppb) of VOCs were found in eight of the 33 wells sampled in April 1985. These eight were 9-74 and 10-74 at the Building 371 hillside; 1-71, 2-71, and 1-74 in the 903 pad and mound area; 3-74 in the burial trench area near the east gate; 6-71 north of the solar ponds; and 7-81 in the Buildings 371/374 area. Nineteen additional wells show trace levels (1 to 20 ppb) of the four major VOCs. Ten wells were sampled again in December 1985. Eight samples were analyzed off-site by Accu-Labs, and the samples from wells 9-74 and 1-74 were analyzed using the Brucker Mobile Laboratory during soil gas feasibility tests. Data for a given well from different sampling rounds illustrate the variability of VOC concentrations.

The highest VOC levels were detected in the following wells.

Constituent	Maximum Concentration (mg/l)	Well	Water Type
Trichloroethylene	6.400	9-74	II
Tetrachloroethylene	16.000	1-74	II
1,1-Dichloroethylene	1.300	9-74	II
1,1,1-Trichloroethane	4.800	9-74	II
1,2-Dichloroethane	4.500	10-74	V
Carbon Tetrachloride	0.013	6-71	VI
Chloroform	0.042	6-71	VI

These data indicate that the organics occur in both high TDS waters (Type V and VI waters with TDS in the range of 2,400 to 5,000 mg/l) and low TDS waters (Type II water with TDS less than 400 mg/l). Thus, TDS and organic contamination are not always related at the plant.

The extent of migration of contamination downgradient of the plant in the buffer zone outside the security area was investigated by two techniques. The first was an electromagnetic terrain conductivity survey, which was designed to detect high TDS in groundwater. The second was a soil gas survey, which studied volatile organic compounds migrating upward to the unsaturated zone above contaminated groundwater. The electromagnetic (EM) survey, a type of geophysical reconnaissance, was performed by Hydro-Search, Inc. (Hydro-Search, 1986). In this type of survey, the bulk electrical conductivity of subsurface materials is a function of the conductivity of the pore fluid, the porosity of the subsurface materials, and the nature of the solid materials themselves. Therefore, survey transects were made along lines of relatively constant geologic materials and

depths to groundwater so that the only variable was the conductivity of the groundwater, i.e., total dissolved solids (TDS) concentration.

The geophysical data are presented in a report by Hydro-Search, Inc. (Hydro-Search, 1986), which includes a map of the high-conductivity areas. These areas include several potential sources already identified from the groundwater monitoring program: the Building 881 hillside, the 903 pad area, the solar ponds and the area north of Building 371. The North Walnut and South Walnut Creek drainages are affected, including both the areas identified as part of the high-nitrate solar pond plume (Figure 3-14) and the areas farther downgradient where Type V water was identified (Figure 3-15). These downgradient areas may be associated with the A and B series runoff retention ponds. The sewage treatment plant or runoff routed through the treatment plant area are other potential sources for high TDS in the South Walnut Creek drainage. The Woman Creek drainage shows one high-TDS area south of the original landfill. Type V water was also identified in this part of the drainage (Figure 3-15). Another area farther east may be related to the 903 pad. Finally, high-TDS groundwater was detected in the unnamed tributary to North Walnut Creek which is the drainage for the present landfill. This is the clearest evidence available to date for possible contamination from this landfill, although well 2-81, which is downgradient along this drainage, has shown low but detectable VOC concentrations in some but not all sampling rounds. Because organic compounds are sometimes associated with high TDS, areas identified in the electromagnetic survey may also contain organics. All areas in which high TDS groundwater was identified are well within the land holdings of the plant, at least 3,500 feet west of the eastern property boundary (Indiana Street).

Shallow soil gas from depths of 5 feet (or less if cobbles prevented probes from reaching 5 feet) was analyzed for TCE, PCE, DCE, TCA, chloroform (CHCl_3), and carbon tetrachloride (CCl_4) (Tracer Research Corporation, 1986). The object of this initial soil gas investigation was to locate the downgradient extent of these chlorinated hydrocarbon VOCs. Only concentrations greater than 0.01 microgram per liter of soil gas were considered significant for evaluating possible contamination. TCE, DCE, PCE, and TCA were found along the southeast boundary of the plant security area, near Building 881 and the 903 pad. TCE and PCE were found north of Building 371. PCE was also detected near the present landfill. TCE was found in two previously unidentified areas 2,500 to 3,000 feet west of the Indiana Street boundary. PCE and CCl_4 were detected in the burial trench area near the east gate. Although large quantities of CCl_4 have been used at the RFP it had rarely been found in groundwater and only at levels of 13 ppb or less (Table 3-18). Thus the detection of CCl_4 in this soil gas survey is significant new information. The CCl_4 soil gas plume

appears unrelated to the Building 881 hillside area and may be associated only with the burial trenches.

These results were used to optimize the placement of new monitoring wells. A program of installation and sampling of 68 new RCRA-quality wells is currently in progress at the RFP. The locations of these wells were selected primarily to characterize the hydrogeologic systems, but many are in areas of potential groundwater contamination and may help to identify sources and extent of plumes. Some of these wells will be completed in the Arapahoe sandstone lenses, which will allow the detection of contamination in bedrock. The results of this well installation and sampling program will be available to the Survey within the next several months. Further work on plume and source characterization will be performed by RFP during 1987.

3.4.4 Findings

3.4.4.1 Category I

There are no groundwater-related Category I findings.

3.4.4.2 Category II

There are no groundwater-related Category II findings.

3.4.4.3 Category III

1. Groundwater Contamination. Groundwater is contaminated at the RFP. Although there is no evidence that contamination has moved off-site, such off-site migration could be a potential hazard to human health. This hazard is due to the proximity of drinking water reservoirs to RFP.

Two types of groundwater contamination are present. The first type is high-nitrate contamination associated with leakage of the solar evaporation ponds. The extent of this plume is shown on Figure 3-13. Groundwater in this plume has the following characteristics:

	<u>Solar Pond Plume</u>	<u>Background</u>
TDS	1,000-5,000 mg/l	<250 mg/l
Gross alpha	up to 84 pCi/l	<20 pCi/l
NO ₃ as N	up to 1,090 mg/l	<1 to 31 mg/l

The maximum contaminant level (MCL) for nitrate as N in drinking water is 10 mg/l.

The second type of groundwater contamination is characterized by the presence of volatile organic compounds (VOCs). The following maximum concentrations of VOCs have been detected:

<u>Constituent</u>	<u>mg/l</u>
Trichloroethylene (TCE)	6.400
Tetrachloroethylene (PCE)	16.000
1,1-Dichloroethylene (DCE)	1.300
1,1,1-Trichloroethane (TCA)	4.800

The recommended maximum contaminant levels (RMCLs) for TCE, PCE, and DCE are zero. The RMCL for TCA is 1,030 mg/l. RMCLs are proposed limits for the protection of human health.

Potential sources for this second type of contamination have been identified, but the link between these potential sources and the presence of certain VOCs has not been established. The potential sources include the Building 881 hillside, the 903 pad and mound area, and the burial trenches near the RFP east gate. These are shown on Figure 3-16.

Degraded groundwater can discharge to surface water drainages and potentially affect public drinking water reservoirs off-site. Two drinking water sources, Great Western Reservoir and Standley Lake, are immediately downstream of the RFP (see Figures 3-6 and 3-7).

It is possible that users of groundwater rather than surface water could also be affected. However, most of the wells in the vicinity of the plant are located in drainage basins other than those potentially affected by the plant.

Evidence exists that neither type of contamination has yet moved off-site. This evidence comes from a geophysical survey (terrain conductivity), an investigation of shallow soil gas contamination, and groundwater monitoring. Further details are presented in Section 3.4.3.

2. Data Quality Problems. Existing wells and existing data are inadequate to accurately define the horizontal and vertical extent of groundwater contamination.

These inadequacies include:

- a. Use of unsuitable construction materials such as galvanized steel or PVC in existing wells. Galvanized steel is unsuitable for accurate determination of metals in groundwater and PVC is unsuitable for organics.
- b. Screening of existing wells in more than one lithologic unit, thus making it impossible to determine vertical migration of contaminants and difficult to trace contamination back to possible sources.
- c. Questionable data on inorganic contaminants, as shown by cation/anion balance error.
- d. Questionable and undocumented well sampling.

Despite these inadequacies, the existing well network and existing data did identify the presence of groundwater contamination, the type of contamination, and the approximate concentration. Levels of nitrates from the solar ponds are so high that the existence of contamination is not in question. Levels of VOCs are also sufficiently high that well construction materials are irrelevant to the existence of contamination.

Work is in progress on the installation of 68 new wells that meet RCRA standards, and on sampling of groundwater from old and new wells. Selected existing wells are being sampled to provide continuity with historical data, but these existing wells are being phased out as they are replaced by new wells.

These new wells and the current sampling and analysis will alleviate the above problems because of the following aspects:

- a. The new wells are constructed of stainless steel 316.
- b. The new wells are completed in only one lithologic unit. Some are specifically designed to monitor sandstone units in the bedrock (Arapahoe Formation). Furthermore, the new wells are located in areas of suspected contamination and areas not previously monitored.

Many locations have multiple wells in both surficial and underlying units to detect vertical migration of contaminants.

- c. Inorganic analyses are currently being done by a subcontractor using an on-site mobile laboratory and operating under a detailed quality assurance/quality control program.
- d. Current groundwater sampling is being performed by subcontractor personnel under detailed and acceptable protocols which are carefully followed in the field. Further work on plume, source and site characterization is scheduled for 1987. When site characterization is complete, a revised groundwater monitoring program using plant personnel will be reinstituted at RFP.

3.4.4.4 Category IV

There are no groundwater-related Category IV findings.

PRELIMINARY

4.0 NON-MEDIA-SPECIFIC FINDINGS AND OBSERVATIONS

This section discusses findings for the RFP Site pertaining to waste management, toxic and chemical materials, direct radiation, quality assurance, and inactive waste sites and releases. The discussions provided in this section are not necessarily tied to one medium, as was the case with the discussions in Section 3.0. These discussions include an environmental monitoring program section, where appropriate, and in such instances where information was available and relevant.

4.1 Waste Management

This section deals with waste materials generated at RFP and the management of those wastes.

4.1.1 Background Information

RFP operations generate five major types of wastes: (1) hazardous wastes, (2) mixed (radioactive and hazardous) wastes, (3) transuranic wastes, (4) low-level radioactive wastes, and (5) nonradioactive/nonhazardous wastes. Brief definitions of these wastes follow.

- Hazardous wastes are materials that are either ignitable, reactive, toxic, corrosive, or contain materials listed in 40 CFR 261.
- Mixed (radioactive and hazardous) wastes are co-contaminated with hazardous and radioactive waste materials. Two categories of these wastes are generated at the RFP (i.e., low-level radioactive mixed wastes and transuranic mixed wastes).
- Transuranic (TRU) wastes contain more than 100 nanoCuries of alpha-emitting transuranic nuclides per gram of wastes (nCi/g). These nuclides have a half-life greater than 20 years and atomic numbers greater than 92. At the Rocky Flats Plant, transuranic nuclides of concern include plutonium and americium.
- Low-level wastes (LLW) at the Rocky Flats Plant contain naturally-occurring, non-transuranic radioactive elements, such as uranium and thorium. They may also contain transuranic nuclides at concentrations equal to or less than 100 nCi/g of waste material.
- Nonradioactive/nonhazardous wastes contain no radioactive or chemical contamination.

The management of these wastes and potential problems associated with waste management practices are discussed in this section.

Presently, DOE and Rockwell are working toward improving waste management practices and eliminating conditions that could lead to environmental problems. DOE, EPA, and the Colorado Department of Health (CDH) have developed and approved a RCRA/CERCLA compliance agreement for the plant (Appendix D). It includes aggressive schedules for the following:

- Preparation of a single RCRA Part B Permit application for hazardous and mixed (radioactive and hazardous) wastes.
- Active waste stream and unit identification and analyses.
- Solid waste management unit (SWMU) characterizations and corrective action.
- Preparation of closure and post-closure care plans for RCRA-regulated facilities.
- Closure and post-closure care of the solar evaporation surface impoundments.

In addition, Rockwell has developed a long-range waste management plan (Rockwell International, 1986). The plan emphasizes means to maximize waste minimization and waste segregation, and includes steps to correct RCRA permit deficiencies. Elements of both the compliance agreement and the waste management plan have been or are being implemented.

Two RCRA Part B permit applications were submitted for the RFP during November 1985. One is a permit application for hazardous waste submitted to the Colorado Department of Health. It does not include data on mixed waste. The other permit application was submitted to USEPA Region 8 and was for radioactive mixed waste. This application presents data on only low-level mixed waste (not transuranic mixed waste). During 1986 RFP consolidated and updated the permit applications into one submittal for the state. It includes data on both hazardous and low-level mixed wastes, since the State of Colorado now has authority for hazardous and mixed wastes. This RCRA Part B permit application was not available to the DOE Environmental Survey team. A site plan locating the RCRA regulated facilities, including those in the original Part B permit applications, will be provided in the Interim Report.

The Survey procedure to identify waste-related environmental problems incorporated four types of activities: (1) inspection of waste generating processes and waste management facilities; (2) interviews with waste management plant personnel; (3) review of relevant records and documents; and (4) comparison of on-site observations with RFP reports and procedures. Emphasis was placed on tracking through the plant waste streams that have been identified in RFP's Federal and State hazardous waste permit applications and RFP's Waste Management Plan. A significant amount of time was devoted to inspection of facilities and operations listed in the Waste Management Plan. Statutes used as guidance to identify problems include:

- The Resource Conservation and Recovery Act (RCRA) and its amendment (specifically 40 CFR 261, 262, and 265); and
- Colorado Hazardous Waste Regulations.

4.1.2 General Description of Pollution Sources/Controls

4.1.2.1 Hazardous Wastes

Hazardous wastes that are not radioactive are generated both routinely and on a one-time-only basis. The most common hazardous wastes include oils, solvents, radiographic solution, machine coolant, corrosive solutions, paints, and electrochemical milling sludge. Hazardous wastes generally are commercially disposed or commercially recycled. Reportedly, some hazardous wastes are also mixed with the radioactive waste stream and treated in the radioactive waste treatment facilities (DOE, 1986). Hazardous wastes cannot be disposed of at the plant. The RFP has not applied for a RCRA permit to dispose of such wastes on-site. It is possible for some hazardous wastes to be disposed of at the landfill as nonhazardous waste because of insufficient controls (refer to Section 4.1.2.4). Table 4-1 presents summary data on quantities of known hazardous wastes generated at the Rocky Flats Plant during fiscal year (FY) 1985.

Until recently, small amounts of nonradioactive hazardous chemical wastes were being detoxified on an as-needed basis in two chemical laboratories (i.e., the Health, Safety and Environmental Laboratory in Building 123 and the general laboratory in Building 881). Reaction products from the detoxification processes, presumably nonradioactive and nonhazardous, were disposed of along with the laboratories' radioactive wastes. Nonradioactive hazardous chemical wastes that have been treated and disposed of in this manner include pyrophoric metals, small cylinders of toxic gases, and reactive chemicals. Records for this treatment appear among the radioactive waste records because

TABLE 4-1
ESTIMATED HAZARDOUS WASTE GENERATION
(FY 1985)

Waste	Quantity		Source (Bldg. No.)	Disposition
	Kilogram	Liters		
Alcohol and Acetone		1,000	460	Storage/Off-site TSDF
Chlorinated Solvents		500	111, 123, 551, Waste Ops	Storage/Off-site TSDF
Cyanide Solution		1,200	444	Storage/Off-site TSDF
Machine Coolant		6,400	334, Lake Arbor Machine Shop	Storage/Off-site TSDF
Diethyl Phthalate		1,000	442	Storage/Off-site TSDF
Electrochemical Milling Sludge	2,400		460	Storage/Off-site TSDF
Fluorochemical-3M	7		125	Evaporation in Hood
Freon and Freon/Solvent Mixtures		5,500	125, 331, 551, 778, 881	Storage/Off-site TSDF
Gas Cylinders (68)	Wt. Unknown		551, 881, Waste Ops	Vented & Commercial Recycle
Heat Treating Salts	14		444	Storage/Off-site TSDF
Hydrogen Peroxide		200	551	Reuse within RFP
Lead Acid Batteries (217)	Wt. Unknown		331, 371, 549, 707, 750, S&W	Storage/Commercial Recycle
Liquid Organics		150	Waste Ops	Burned
Liquid Tar		200	778	Storage/Off-site TSDF
Magnesium Chips	550		444	Storage/Off-site TSDF
Magnesium Scrap	7		779	Landfill
Mercury Batteries	7		125	Storage/Commercial Recycle
Paint, Lacquer, Thinners, and Stripper		5,700	334, 778, S&W, 881, Waste Ops	Storage/Off-site TSDF
PCB Capacitors (107)	Wt. Unknown		444, 777	Storage/Off-site TSDF

TABLE 4-1
ESTIMATED HAZARDOUS WASTE GENERATION
(FY 1985)
PAGE TWO

Waste	Quantity		Source (Bldg. No.)	Disposition
	Kilogram	Liters		
PCB Wastes (e.g., Oils and Solis with PCBs)		10,600	125, 662, 779, 881	Storage/Off-site TSDF
Plating Acids		800	444	Storage/Off-site TSDF
Polyester Resin		400	551	Storage/Off-site TSDF
Sodium Hydroxide	200		551	Storage/Off-site TSDF
Toluene, Methyl Alcohol, and DDCP		65	123	Storage/Off-site TSDF
Radiographic Solution		14,560	122, 444, 664, 777, 881, 991	Bldg. 774 Silver Recovery
Waste Chemicals	90	340	124, 444, 779, 881, 991, S&W	Storage/Off-site TSDF Storage/Future On-site Incineration
Waste Oil & Solvents		46,800	334, 344, 460, 881, Lake Arbor Machine Shop, S&W, Waste Ops	Storage/Off-site TSDF
TOTAL	3,275	65,415		

TSDF = treatment, storage, disposal facility
Waste Ops = Waste Operations
S&W = Swinerton & Walberg, Co.; RFP construction contractor
DDCP = diethyl n,n-diethyl carbamyl phosphonate

Source: DOE Environmental Survey team, adapted from Rockwell International, Long Range Waste Management Plan for Rocky Flats Plant (RI, 1986).

the ultimate disposal was with the radioactive waste (DOE, 1986). Detoxification of laboratory hazardous wastes was ceased in the fall of 1986, because the RFP did not possess the required RCRA approvals. These wastes are now stored on-site temporarily and disposed of commercially.

Spent photographic solutions, which are generated in small photographic shops on-site (including Building 11), are reportedly disposed of in the sanitary sewer system (DOE, 1986). These solutions contain small quantities of silver, which is found in the sanitary sewage sludge. This sludge has been identified as a mixed waste (see Section 4.1.2.2), and silver is one of the toxic heavy metals regulated under RCRA. Information on the number of photographic shops discharging spent photographic solutions to the sanitary sewer system and on the quantities discharged was not obtained by the DOE Environmental Survey team.

Hazardous wastes are segregated by personnel from RFP's Environmental Analysis and Control (EA&C) and Waste Operations departments. The waste generator prepares a Waste Processing Request (WPR) form for each waste and attaches analytical data to verify the waste contents. EA&C personnel then decide on the disposal technique (i.e., disposal in the landfill, recycling off-site, or off-site disposal). The RFP procedure governing the disposal of non-process waste and excess chemicals (HSE 21.01, May 1986) establishes radioactivity concentration guidelines for their off-site disposal/recycle as nonradioactive materials. These guidelines are stated in terms of alpha or combined plutonium and americium activity concentrations. Gamma analyses are also required for all materials prior to release from the site. EA&C personnel also request any additional analytical data needed to meet requirements of the off-site disposal facilities. All WPR forms and analytical results are kept in permanent files maintained by Waste Operations. An operating log of WPR forms is also maintained. It records waste materials, and the generating process, hazard, volume, and deposition of those wastes.

After hazardous wastes have been assayed and can be certified as nonradioactive, they are packaged for off-site shipment per established, written procedures and in compliance with DOT regulations. Manifests are prepared for each shipment. The RFP also uses only appropriately permitted transporters and commercial disposal facilities. The commercial disposal firm routinely used by the RFP is the Osco Oil/Solvent Recovery Company. The facility is located in nearby Henderson, Colorado. The RFP also uses Rollins Environmental Services for the incineration of PCB wastes in Deer Park, Texas. The RFP has used in the past facilities of U.S. Pollution Control, located in Oklahoma and Utah, for the disposal of nonroutine wastes (i.e., cyanide salts and off-spec sulfuric acid). In addition, the RFP is prepared to use the GSX land burial facility in South Carolina.

Nonradioactive RCRA hazardous wastes held on-site awaiting off-site commercial disposal are generally kept in drums, which are stored in steel cargo containers designed to meet RCRA requirements. These containers are fitted with air vents and catch basins and are electrically grounded. The containers are located in a remote storage area near the active landfill. Waste drums are also stored by waste types (i.e., incompatible wastes are stored in different containers). A log tracking wastes being stored is kept in each cargo container. Excess chemicals are stored for off-site disposal in their original containers in Building 553. Gas cylinders to be disposed are stored in Building 952, a remote shed that is currently empty. Storage of PCB wastes is discussed in Section 4.2. A weekly inspection log is maintained for each storage area.

Construction of a storage facility for hazardous and mixed (radioactive and hazardous) wastes is planned for the site. This facility will centralize storage of hazardous materials currently being stored in cargo containers at various locations and will provide storage for mixed (radioactive and hazardous) wastes until a DOE-approved disposal site becomes available.

4.1.2.2 Mixed (Radioactive and Hazardous) Wastes

The RFP generates several mixed wastes, some of which are low-level radioactive mixed wastes and others are transuranic (TRU) mixed wastes. Table 4-2 presents summary data on the known mixed wastes generated at RFP. Other mixed wastes may have been identified by RFP personnel during waste characterization analyses that were mandated in the compliance agreement and conducted since the DOE Environmental Survey.

The TRU mixed wastes are managed as TRU wastes in accordance with current DOE policy and shipped to the Idaho National Engineering Laboratory (INEL) for interim, retrievable storage. RFP's RCRA Part B permit application to USEPA for the management of hazardous and mixed wastes does not include TRU mixed wastes. DOE and EPA are in the process of determining how TRU mixed wastes should be regulated in the future.

Until the fall of 1986, the low-level mixed wastes were being managed as LLW and sent to the Nevada Test Site (NTS) for shallow land burial. However, waste analyses have indicated that these wastes have hazardous characteristics or contain listed RCRA wastes. These low-level mixed wastes can no longer be sent to NTS and are now being stored on-site.

TRU mixed sludges and saltcrete (Table 4-2) are generated from the treatment of RFP's liquid process wastes, which are both hazardous and radioactive (i.e., mixed). The collection and treatment of

TABLE 4-2
ESTIMATED MIXED WASTE GENERATION
(FY 1985)

Waste	Quantity		Source (Bldg. No.)	Disposition
	Kilograms	Feet ³		
TRU Mixed Waste				
Building 374 Wet Sludge		8,500	374	INEL
Building 774 Sludges		6,800	774	INEL
Solidified Organics		2,220	774	INEL
Special Setups		1,370	774	INEL
SUBTOTAL		18,890		
Mixed LLW				
Saltcrete		8,000	374	NTS ¹
Pondcrete		8,100	Pond 207-A	NTS ¹
Uranium Metal Wastes		3,720	444	NTS ¹
Sewage Sludge		3,360	995	NTS ¹
Scrap Beryllium	1,260		444	NTS ¹
SUBTOTAL	1,260	21,180		
TOTAL	1,260	40,070		

¹ Currently being stored on-site.
INEL = Idaho National Engineering Laboratory
NTS = Nevada Test Site

Source: DOE Environmental Survey team, adapted from Rockwell International, Long Range Waste Management Plan for Rocky Flats Plant, (RI, 1986).

these mixed liquid process wastes are described below, as well as the management of low-level mixed wastes generated at RFP.

Mixed Liquid Process Wastes

RFP's basic strategy for management of mixed liquid process wastes is to convert the liquids to solids. Figure 4-1 gives a conceptual flow path for radioactive waste management at RFP. Solids resulting from liquid waste conversion fall into one of two categories: (1) low-level waste (LLW and mixed LLW) or (2) transuranic waste (TRU and TRU mixed waste). This strategy was selected because solids are more easily handled than liquids, disposal sites (i.e., Federal land-based repositories) will not accept free-standing liquids in wastes, and the resulting solids could be managed in the same manner as other solid radioactive wastes. However, low-level mixed solid wastes can no longer be managed in the same manner as low-level solid wastes. In addition, regulatory policies controlling the management of TRU solid wastes may change.

- Collection

Production, research, and support facilities in which radioactive materials are handled are tied into a process waste collection system. This system, which is isolated from the sanitary waste collection system, collects mixed liquid wastes from such sources as process drains, decontamination showers, laboratory sinks, janitors' sinks, and floor drains located in areas that might be radioactively contaminated. The process waste collection system also accepts any water used in fire-fighting in these areas. The collected mixed liquid wastes are held in appropriate tanks pending analysis of the contaminants and determination of treatment requirements. Depending on its origin, the waste may be analyzed for plutonium, americium, uranium, hexavalent chromium, beryllium, nitrates, pH, or other parameters as appropriate.

Most of the mixed liquid process wastes are piped to either Building 374 or Building 774 for treatment, as shown in Figure 4-2. Liquid process wastes (e.g., acid wastes and plating solutions) and liquid organic wastes (e.g., oils and solvents) are transferred via separate pipelines. All waste transfer lines and associated collection tanks are inspectable. The lines can be inspected via twenty valve vaults located throughout the system. The lines are also double-contained to prevent migration of contaminants leaking from the lines. Collection tanks are located in building basements or in separate housings; thus any leaks and spills would be contained. Small volumes of mixed liquid process wastes are also

DOE Environmental Survey team, Adapted from DOE, 1986

FIGURE 4-1
CONCEPTUAL FLOW PATH FOR RADIOACTIVE WASTES
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986

Drummed Liquid Waste

Trucked to 774 or to 374

Piped Liquid Waste

Liquid Waste

* Buildings 374 and 774 are liquid waste processing facilities.
DOE Environmental Survey team, Adapted from Rocky Flats Environmental, 1986

FIGURE 4-2

LIQUID PROCESS WASTE FLOW DIAGRAM

BY SOURCE/BUILDING NUMBER

DOE SURVEY - ROCKY FLATS PLANT

AUGUST 1986

transferred to the two processing buildings by truck in separate portable tanks or smaller, closed containers.

- Treatment

Mixed liquid wastes are treated in one or both of two processing facilities (i.e., Buildings 374 and 774; refer to Figure 4-2). Building 774 is used to treat liquid wastes that contain high levels of plutonium, whereas Building 374 is used to treat only those wastes with uranium or low amounts of plutonium. Wastes from plutonium fabrication and recovery operations, therefore, are treated in Building 774. The majority of the radioactive contamination is removed from the liquid in this building by a two-stage precipitation process, which generates a sludge that is managed as a TRU mixed solid waste. The liquid remaining after precipitation is transferred to Building 374 for additional treatment, but only if the radioactivity is sufficiently low. If not, the liquid is reprocessed in Building 774. In the 374 facility, liquid wastes from other plant operations are also collected and treated. All of these liquids are treated by precipitation and filtration to reduce radioactivity of liquids to very low levels. Liquids are then evaporated to separate them from the remaining salts held in solution. The nonradioactive evaporator condensate is used for boiler feed water or cooling tower make-up water as needed. The slurries from the treatment processes and the evaporation salts are blended and converted into a concrete (i.e., saltcrete) for management as a mixed solid waste.

A small amount of process liquid wastes are not compatible with the treatment system described above. These wastes are segregated and are converted to solid form by mixing with cement and absorbents. (Refer to special setups under TRU mixed wastes in Table 4-2.)

Small amounts of miscellaneous laboratory liquid wastes are generated which also are not compatible with the normal treatment processes. These wastes are solidified in small-scale facilities and managed as TRU solid waste (included in Table 4-2 as special setups).

Liquid organic wastes are managed, based on their radioactive content. All are processed in Building 774. The TRU mixed liquids are blended with a commercial solidifying agent, a process which produces a TRU mixed solid waste. The low-level mixed organic liquids are currently being held in temporary storage pending a decision to solidify or incinerate.

Currently, most of the industrial liquid wastes generated in buildings containing radioactive materials are mixed into the radioactive waste stream (DOE, 1986). There is no dual system in place to allow for separate management of nonradioactive hazardous chemical wastes from these buildings. RFP plans to perform a feasibility study on the installation of such a system.

- Solar Evaporation Ponds

The 207 series solar evaporation ponds were constructed over an extended time period, beginning in the 1950s, primarily to store and volume reduce, by natural evaporation, low-level radioactive process wastes containing high nitrates and treated acid waste containing aluminum hydroxide (DOE, 1986). These ponds consist of Pond 207-A, Pond 207-B (North, Center, and South), and Pond 207-C. Today, they no longer receive process wastes, although Ponds 207-A and 207-C would reportedly be used to store liquid wastes if Building 374 were shut down in an emergency situation. Planned improvements include the installation of new storage tanks to receive excess process liquid and to provide emergency storage capacity. After these tanks are installed, the ponds will be closed. Closure and post-closure plans are currently being prepared in accordance with the terms of the compliance agreement (Section 4.1.1).

Over time, these ponds are known to have received more than just low-level radioactive liquid wastes. Other wastes discharged to the ponds include sanitary sewage sludge, lithium metal, sodium nitrate, ferric chloride, lithium chloride, sulfuric acid, ammonium persulfate, hydrochloric acid, nitric acid, hexavalent chromium, and solutions containing cyanide in concentrations of less than 20 parts per million (DOE, 1986). Reportedly, solvents have not been routinely discharged to the ponds; however, low concentrations of solvents may have been present as minor constituents in other process wastes discharged to the ponds.

During the history of pond operation leakage has been observed. To prevent pond leakage from entering the North Walnut Creek drainage, a series of two groundwater interceptor trenches were constructed. These trenches and a pump system intercept and collect pond seepage and return the water to Pond 207-B North. This water can also be placed in Pond 207-A, Ponds 207-B Center and South, and Pond 207-C.

The intercepted groundwater generally contains slightly elevated concentrations of alpha and beta radioactivity. The major chemical constituent is nitrate, at concentrations ranging from 500 to 800 mg/l. Additionally, two samples, which were collected to meet an NPDES discharge permit requirement, were found to have trace concentrations (2 to 3 ppm) of chloroform and trichloroethylene (RI, 1986). Based on these data, the intercepted groundwater might be considered a radioactive mixed waste.

Corrective actions at the ponds have already been initiated. All three of the 207-B ponds have been emptied in the recent past (early 1980s) and their sludges removed. Pond 207-B North is still receiving water from the interceptor trenches. The sludge from Pond 207-A is currently being removed and processed into "pondcrete," a low-level mixed solid waste (see below under Mixed Wastes).

Detailed characterization of the pond waters and sludges will be included in the closure plan. This plan will also present results of ongoing groundwater investigations. Available groundwater quality data are included in this report under Section 3.4. Additional findings related to the solar ponds are presented in Section 4.5.

- **West Spray Field**

The "west spray field" was used over a 6-year period to dispose of excess water from the solar evaporation ponds (i.e., Ponds 207-B North and Center). Water was applied through an agricultural irrigation system on a field approximately 2,000 feet x 2,000 feet in size. The system was shut down in the third quarter of 1985. Excess water from the ponds is now pumped to Building 374 for forced evaporation. Investigations are currently under way to determine whether any contamination is resulting from the land application and whether a closure plan is needed. Investigations include analysis of soil borings and groundwater samples.

Mixed Solid Wastes

- **Saltcrete**

Saltcrete is an end product of the waste treatment process in Building 374, which receives liquid process wastes containing uranium or low levels of plutonium. It is a combination of evaporation brine, nitrate salts, and cement. Saltcrete contains low concentrations of

listed hazardous constituents (i.e., up to 100 ppb acetone, and less than 50 ppb methylene chloride, methyl ethyl ketone, and toluene) (Wickland, 1987). DOE and Rockwell International will attempt to have the waste reclassified as nonhazardous or delisted in order to resume off-site disposal at NTS. If the waste is not reclassified or delisted, it may have to stay on-site until NTS or another facility obtains a permit for disposal of mixed wastes. In the interim, saltcrete is being stored in a building that has only a few months of storage capacity at the current rate of generation (i.e., Building 964, an old equipment storage shed located just east of the solar evaporation ponds).

- **Pondcrete**

Pondcrete is sludge that is being dredged from one of the solar evaporation ponds (Pond 207-A) and immobilized in concrete for particulate and free-liquid control. Pondcrete contains the same listed hazardous constituents as saltcrete at the same concentration ranges (Wickland, 1987). Similar attempts will also be made to reclassify or delist the waste. Pondcrete is currently being stored on asphalt parking pad east of Building 750. Containers are on pallets and are covered by a fiber-impregnated plastic.

- **Uranium Metal Wastes**

Uranium metal wastes consist of uranium oxide and uranium chips and fines. Uranium chips and fines, which are generated from fabrication operations and are pyrophoric, are converted into stable uranium oxide in a raked-hearth incinerator in Building 447. The uranium oxide is considered a mixed waste by the state, because the chips and fines contain oils and solvents before they are oxidized. Small quantities of uranium chips not converted to uranium oxide also are cemented together with other metal chips. Disposal of uranium metal wastes currently requires a permitted mixed waste disposal facility. Until such a facility becomes available or the wastes are delisted, they will be stored on-site. Currently uranium metal wastes are stored in Building 884.

- **Sewage Sludge**

The sewage sludge contains low-level radioactivity, silver, and beryllium fines. It also contains sulfide, which is reactive. The radioactivity results from uranium contamination of the sanitary sewage system that occurred in the 1950s. Silver is present because spent photographic solutions are discharged to the system (refer to Section 4.1.2.1). Sources of

beryllium and sulfide are still unknown. The sewage sludge is currently being stored in Building 884.

- **Combustibles**

Organic liquid wastes and other combustibles with low-level radioactivity are also being stored on-site. The mixed waste liquids are being stored in two 10,000-gallon tanks located in Building 774. One of the tanks is full, and the other is nearing its capacity. When the second tank becomes full, the liquids will be stored in drums that will be placed in cargo containers. Other combustibles include soft wastes such as chemical wipes and rags that contain regulated solvents. These wastes are also being stored in Building 884. RFP is in the process of modifying an incinerator in Building 776 to burn all of these combustibles, but, because of the lengthy permitting process, the incinerator cannot be permitted until late 1987 at the earliest (Ficklin, 1986). If a permit can be obtained, the wastes will have to be stored on-site until DOE establishes a mixed waste disposal facility somewhere in the United States.

- **Lead**

NTS no longer accepts waste that contains lead. Some lead-bearing low-level waste is now being sent to the Idaho National Engineering Laboratory (INEL), but DOE wants to reduce the volume of non-FRU wastes disposed of at INEL. In order to reduce shipments of lead-bearing, low-level wastes to INEL, RFP has started to store this waste in Building 776 awaiting establishment of a mixed waste disposal facility somewhere in the United States. If planned ship-out projects are implemented on schedule, significant volumes of lead-bearing, low-level waste will accumulate on-site.

- **Scrap Beryllium**

Scrap beryllium is still being sent to NTS as LLW. It is contaminated with depleted uranium. RFP's beryllium metal (except beryllium dust) is not a hazardous waste under RCRA. The Federal regulations exempt beryllium waste if it is incidental to the production process. This Federal exemption applies at RFP; however, Colorado regulations consider all beryllium wastes as hazardous. Reportedly, the State is aware that scrap beryllium is being shipped to NTS, but as of mid-February 1987, has not taken a position regarding its management as a waste.

4.1.2.3 Radioactive Wastes

Over 99 percent of process wastes generated at RFP contain radioactivity. Approximately 95 percent of these wastes are the result of processing plutonium (i.e., plutonium fabrication, plutonium recovery, and americium separation) and are TRU wastes (i.e., TRU and TRU mixed wastes). After liquid waste processing, which involves evaporation and solidification, the radioactive waste proportions change. Approximately 60 percent of the wastes are LLW (i.e., low-level and low-level mixed wastes), and the remaining 40 percent are TRU wastes (TRU and TRU mixed wastes; RI, 1986).

Quantities of radioactive wastes generated at RFP have been increasing over the past few years (Figure 4-3). Increases are related to an increase in the production rate at the plant and to major facility modifications. Many of the facility modifications create radioactive wastes as old, contaminated equipment is removed. In addition, LLW has increased because of more effective segregation of TRU and LLW and generation of pondcrete (refer to Section 4.1.2.2). Summary data on nonhazardous radioactive wastes generated at Rocky Flats in FY 1985 are given in Table 4-3. The wastes included in the table are all solids. Radioactive and mixed liquid wastes are converted to mixed solid wastes, as discussed in Section 4.1.2.2. Some of the radioactive solid waste may be mixed waste. The RFP has conducted extensive waste characterization since the DOE Environmental Survey and may have determined that some of the wastes may be mixed wastes.

RFP's transuranic and low-level solid wastes are sent off-site for disposal, except low-level mixed wastes. The radioactive solid waste process flow is shown in Figure 4-4. LLW is shipped to the Nevada Test Site (NTS) for shallow land burial, and TRU waste (including TRU mixed waste) is shipped to the Idaho National Engineering Laboratory (INEL) for interim, retrievable storage. When the Waste Isolation Pilot Plant (WIPP) is ready to start receiving wastes, the RFP will send TRU waste (including TRU mixed waste) directly there.

The RFP is required to certify that radioactive wastes shipped off-site meet the acceptance criteria of the receiving facilities. The criteria specify a number of physical properties of the waste forms and their packages, as well as waste package data reporting requirements. Because RFP's TRU wastes will be ultimately disposed at WIPP, they will have to meet the WIPP Waste Acceptance Criteria (WIPP-WAC). RFP is currently in the process of modifying some of its waste processing operations to ensure that all of its TRU wastes meet the WIPP-WAC. Compliance with these criteria will also enable RFP's TRU wastes to be sent directly from INEL to WIPP without further treatment. INEL will have to

FIGURE 4-3

RADIOACTIVE WASTE GENERATED AT ROCKY FLATS PLANT
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986

TABLE 4-3
ESTIMATED RADIOACTIVE WASTE GENERATION
(FY 1985)

Waste	Quantity (ft ³)	Source (Bldg. No.)
TRU Waste		
Graphite Molds	2,130	707
Scarfed Graphite	270	707
Plexiglass	90	707, 771, 776, 777
Heavy Metals	970	707, 771, 774, 776, 777, 779
Ful-Flo Filters	180	771
Combustibles	56,800	707, 771, 774, 776, 777, 779, 559, 371
Glovebox Filters	1,500	371, 771
Insulation	620	707, 771, 776, 777
Leaded Rubber Gloves	440	371, 559, 771, 707, 776, 777, 779
Firebrick	530	771
Soil & Rubble	620	371, 771
Cemented Insulation and Filter Media	270	771, 707, 776, 777, 779
SS&C Heels	180	771
Salt, salt scrub	90	776
Cemented Resin	180	771
Glass	1,250	559, 771, 779
Leached Raschig Rings	1,500	371, 771
Light Metal	6,750	371, 707, 771, 776, 777, 774
Classified Shapes	1,600	707, 776, 777
HEPA Filters	16,500	371, 559, 707, 771, 774, 776, 777, 779
Miscellaneous Waste	180	371, 559, 707, 771, 774, 776, 777, 779
SUBTOTAL	92,650	

TABLE 4-3
ESTIMATED RADIOACTIVE WASTE GENERATION
(FY 1985)
PAGE TWO

Waste	Quantity (ft ³)	Source (Bldg. No.)
LLW		
Plexiglass	670	444, 865, 881, 883
Combustibles	51,000	371, 441, 559, 707, 771, 776, 777, 779, 865, 881, 883
Insulation & Filter Media	1,350	444, 771, 776, 881
Soil & Rubble	22,900	General Site Cleanup
Raschig Rings	260	865
Light Metal	83,300	371, 441, 559, 707, 771, 776, 777, 779, 865, 881, 883
HEPA Filters	12,100	371, 441, 559, 707, 771, 776, 777, 779, 865, 881, 883
Miscellaneous	1,300	
SUBTOTAL	172,850	
TOTAL	265,530	

Source: DOE Environmental Survey team, adapted from Rockwell International, Long Range Waste Management Plan for Rocky Flats, (RI, 1986).

FIGURE 4-4
SOLID RADIOACTIVE WASTE PROCESS FLOW DIAGRAM
DOE SURVEY - ROCKY FLATS PLANT
AUGUST 1986

treat uncertified TRU waste received before sending it to WIPP. LLW must meet the Defense Low-Level Waste Acceptance Criteria for the NT5.

Waste Processing

Some solid wastes can be packaged directly for off-site disposal, but others require processing. The generators within RFP are responsible for minimizing the amount and volume of solid waste generated and for assuring that radioactively contaminated waste shipped to a waste processing area is in a form suitable for processing. Solids containing recoverable radioactive material are segregated to be processed through recovery operations. When possible, the volume of waste is reduced by compaction, cutting, or disassembly.

The principal processing location for TRU solid wastes is the vault located in Building 775. The facility performs six principal functions: (1) reduces the size of waste gloveboxes and equipment; (2) removes plutonium from miscellaneous metals and rubber gloves; (3) repacks waste from drums to waste boxes; (4) inspects waste during repacking to ensure compliance with WIPP-WAC; (5) welds closures of metal waste boxes filled with TRU waste; and (6) compacts HEPA filters. Contaminated, surplus equipment and gloveboxes are generally reduced in size. Miscellaneous scrap metals and gloves that are contaminated with large amounts of plutonium are washed to reduce the amount of plutonium contained in waste packages. Glovebox leaded gloves that have been exposed to nitric acid are washed in a small ball mill to remove lead nitrate and neutralize acid residues. Drummed waste may be repacked into standard crates to reduce the number and total volume of waste containers that are shipped off-site. During repacking, the waste materials are carefully inspected to ensure that the waste forms comply with WIPP-WAC.

The Advanced Size Reduction Facility (ASRF), which is being constructed in Building 776, will replace the existing vault for size reduction operations. The ASRF will steam clean and size reduce large equipment items and gloveboxes. The major difference between ASRF operations and existing operations is in removal of workers from the immediate vicinity of the work. Most of the ASRF operations will be conducted either in an enclosed hot cell using remote manipulators or direct handling through glove ports.

Building 889 is a facility constructed specifically for volume reduction and decontamination of equipment contaminated with uranium and beryllium. No plutonium-contaminated materials are allowed in the facility. Much of the equipment that is processed through the building is reused or released for sale through the General Services Administration. Ducts, drums, and similar items are

cut up or crushed for volume reduction, packaged as LLW, and shipped to NTS for disposal. HEPA filters from uranium and beryllium processing areas are crushed for volume reduction and packaged for LLW disposal.

Inclinerators at RFP are described in Section 3.1.2.1. One, located in Building 771, burns low-level plutonium-contaminated plastic, paper, rubber, and cloth. Two others, located in Building 776, burn plutonium-contaminated solid and liquid waste. The RFP is in the process of trying to obtain a RCRA permit to burn low-level radioactive mixed wastes.

Waste Packaging and Assay

Radioactive solid wastes are packaged for shipment in accordance with established written procedures. Wastes are segregated into several categories for packaging according to (a) density and chemical composition, (b) the amount and kind of radioactive material involved, if any, and (c) physical characteristics, such as bulk, weight, shape, and sharp edges or points that could affect packaging. If the plutonium content is sufficiently high to permit economic recovery, the package will be declared a residue and will be placed into the recovery inventory. If the waste package contains less than 100 nCi/g of alpha activity, it is classified and managed as LLW. All other wastes from plutonium areas are managed as TRU.

TRU wastes are generally collected in 55-gallon drums. The majority of these drums are sent to the size reduction facility, where the waste is repacked into crates to reduce the number of containers that must be handled and shipped. Some wastes are packaged in drums as they are generated. This latter situation applies mainly to solidified liquids, which are not amenable to repacking. Drums contain a polyethylene liner, and crates contain a PVC lining. When the crate is full, the lining is sealed and backfilled with argon; then the top lid of the crate is welded shut, and the crate is leak checked.

Rocky Flats uses three types of packaging for LLW: plywood crates, 55-gallon drums, and triple-walled corrugated fiberboard boxes. The triple-walled boxes are used only for saltcrete and pondcrete.

After wastes are packaged and before they are shipped, radiation monitoring personnel check the outside of the containers to assure that they are free of surface radioactive contaminants and that the amount of penetrating radiation is within established guidelines (HSE 21.01, May 1986). Wastes packaged into drums are assayed using either low specific activity counters or active/passive neutron

counters. If wastes are repacked into crates, the crates are assayed either by gamma radiation crate counters or active/passive neutron counters. Wastes packaged directly into crates are assayed by active/passive neutron counters.

The RFP Quality Department verifies radioactive-contaminated waste going off-site for compliance with all applicable Federal (DOE and DOT) requirements. Reportedly, inspectors visually examine 100 percent of the drums and crates generated inside the perimeter security zone (PSZ) before they are shipped off-site. All of these packages also undergo real-time radiography. Inspectors conduct regular audits of waste operations in buildings outside the PSZ (Reinhart, 1986).

Once packages are accepted for shipment, they are transferred to Building 664. In this building, packages are segregated by waste classification until shipment quantities have accumulated. In addition, radiography and safeguards assays are conducted, information on the packages is entered into a computerized information management system, and shipping documents are prepared. The building also maintains the files for the waste package inspection forms and the real-time radiography videotapes. Currently, TRU wastes are shipped to INEL via MX railcars. These cars are unusually heavy-duty cars that are specifically designed to resist damage by contact with other cars in a train. LLW packages are shipped to NTS by semi-trailer truck.

4.1.2.4 Nonhazardous Wastes

Non-process wastes that are determined to be nonhazardous and nonradioactive are disposed in the active, on-site landfill (also referred to as the present landfill). Materials include

- Waste paper and trash.
- Packaging material.
- Construction and maintenance debris.
- Carbon and graphite.
- Empty gas cylinders and chemical containers.
- Cafeteria garbage.
- Clarifier grease removed from sewage during treatment.
- Dried sedimentation sludge from the water treatment plant.
- Asbestos waste.

Most of this solid waste is compacted before being transported to the landfill. Materials disposed at the landfill are reportedly spread and covered with dirt on a daily basis. Procedures require that

materials be monitored at the landfill before burial. However, the DOE Environmental Survey team found that there is no adequate system to ensure this. Procedures also require that all wastes disposed in the landfill should be recorded on WPR forms and in the waste management operating log.

The active landfill was placed in service in 1968 and expanded in 1974. The landfill construction includes a drainage system designed to intercept and direct subsurface and surface water away from the landfill. A leachate system and a holding pond were built to collect rain that falls onto the landfill and percolates through it. Water from the pond is spray irrigated onto adjacent land to control the pond volume, approximately monthly. No water is reportedly discharged from the pond downstream.

An estimated 9 million pounds of solid waste is disposed annually at this on-site landfill (DOE, 1986). However, the existing volume has recently increased because of construction activity at the plant site. The remaining life of the landfill is estimated to range from 3 to 7 years.

In the past, the landfill may have received some low-level radioactive and hazardous wastes. Potential groundwater impacts of the landfill are currently being investigated (refer to Sections 3.4 and 4.5). In addition, RFP plans to conduct an investigation of the landfill to determine if it contains hazardous constituents. The program will include the following:

- Review of historical records.
- Development of updated drawings.
- Exploratory drilling and sampling.
- Evaluation of the leachate collection system.
- Assessment of the need to close the facility.

As part of the DOE Environmental Survey, sampling and analysis of the drainage network sediments is being conducted to determine if pollutants are migrating from the landfill and the unlined holding pond and appearing downstream. This aspect of the sampling and analysis portion of the Environmental Survey will complement the surface water and groundwater monitoring being conducted by RFP.

Insufficient controls are in place to prevent the disposition of radioactive and hazardous materials in the landfill. Existing controls on radioactive materials include (1) a sophisticated alarm system at portals to the Perimeter Security Zone (PSZ), which detects radioactive substances leaving the

plutonium production area; (2) requirements that wastes be monitored prior to being placed in a locked dumpster; and (3) radiological monitoring at the landfill. However, the controls in the non-PSZ areas are inadequate to prevent radioactive wastes being sent to the landfill, and this material may get covered at the landfill prior to monitoring. In addition, there is no access control at the landfill to examine wastes before disposal. Wastes that have not been evaluated by waste management personnel could be disposed of in the landfill (i.e., low-level radioactive and hazardous wastes). There is also no control to ensure that the asbestos and graphite pits are used only for their intended purposes. Problems in disposal of asbestos waste are presented in Section 4.2.

4.1.2.5 Oxnard Support Facility

The majority of the wastes at the Oxnard Support Facility are sent to the municipal landfill. Scrap metals are sold to recyclers. The used solvent from the vapor degreaser is picked up twice a year by the solvent vendor for reclamation. By agreement with the county, the chemicals used in the laboratory for testing purposes are diluted prior to being discharged to the sanitary sewer. Cutting oils are collected at each machine and put in drums to be sent to an oil reclaimer.

The use of an outside contractor to reclaim hydraulic oil has been discontinued. The facility has an oil processing unit that it is now using to reclaim the oil. In addition to eliminating recycled hydraulic oil as a possible source of PCB contamination, this unit has also resulted in a cost saving. The water removed from the hydraulic oil in this device is used as quench water in the forging operation.

A tank farm located north of Building 5 contains tanks to hold effluent from the pit under Building C (10,000 gallons), used oil (2,000 gallons), reclaimed oil (2,600 gallons), and quench water (5,000 gallons). The tank farm is surrounded by a concrete block wall for secondary containment. The tank farm sits on a concrete pad. Water or spills that collect on the pad are syphoned into the holding tank.

4.1.3 Findings

4.1.3.1 Category I

There were no Waste Management Category I findings.

4.1.3.2 Category II

1. Active Landfill. The potential exists for low-level radioactive or hazardous wastes to be disposed of at the plant's active landfill, and therefore, for releases of radioactive and hazardous substances to the environment. Current practices do not provide sufficient controls to prevent mingling of these wastes with nonradioactive/nonhazardous wastes. In non-PSZ buildings, opportunity exists for low-level radioactive or hazardous wastes to be disposed in containers for nonradioactive/nonhazardous wastes. These containers are not locked or inspected before the wastes are taken to the landfill. In addition, not all wastes are monitored for radioactivity prior to burial. Further, there is no custodial control at the landfill to ensure that wastes are acceptable, and that disposals are in designated areas and in accordance with site procedures. For example, when inspected, the working face of the landfill contained broken bags of asbestos, and the graphite pit contained asbestos material, wood, and metal shavings. Insufficient controls could result in the migration of pollutants to downstream surface waters and sediments and into the groundwater, as well as the dispersal of asbestos fibers.

2. Improper Waste Storage. Wastes were observed improperly stored in several locations throughout the plant. Drums were seen stored partially full and uncovered, without labels, out-of-doors and appearing abandoned, not on pallets, not easily inspectable, and/or with chemical products. Some wastes were observed in split plastic bags on building floors and outdoors on the ground without tags.

Such storage practices could result in the release of radioactive and hazardous constituents to the environment and pose a threat to human health and the environment. For example, drums left outdoors for long periods of time will become weathered and corroded, and eventually will leak their contents. Some specific observations are cited below.

- The second-floor storage area in Building 776 contained unlabelled waste drums with unknown contents. The drums were not on pallets and were too crowded together to easily inspect and retrieve if necessary. One open drum contained scrap metal as well as an empty can of paint thinner and a can with the radiation symbol, indicating the potential for waste mingling (i.e., hazardous waste with nonhazardous waste, and low-level radioactive waste with nonradioactive waste). There were also combustible wastes (paper/oily wastes) in untagged plastic bags on the floor, which could have been low-level radioactive wastes.

- Outside Building 776, on the west side of the building, there were three unlabelled waste boxes and twelve unlabelled waste cans.
- Outside Building 770, there were five unlabelled drums that appeared very weathered.
- Outside Building 730, there were three abandoned drums and trash in untagged, split plastic bags on the ground. The bags contained waste filters and booties, which were probably low-level radioactive waste.
- Building 732 contained untagged plastic bags of trash that could have been low-level radioactive waste.

RCRA container regulations include some of the following requirements:

- Containers holding hazardous waste must always be closed during storage, except when it is necessary to add or remove waste.
- Containers must be in good condition; wastes in leaking or damaged containers must be recontainerized.
- Storage areas must be inspected weekly for leaks and deterioration; all containers should be labelled, inspectable, and stored off the ground or floor to minimize exposure to ground moisture or spilled liquids.
- Under final permit requirements, containers must be placed in a containment system that is capable of containing leaks and spills.

4.1.3.3 Category III

1. Mixed Waste Accumulation. RFP generates several mixed, low-level radioactive and hazardous wastes. Until the fall of 1986, most of these wastes were being sent to the Nevada Test Site (NTS) for shallow land burial. However, recent waste analyses have indicated that the wastes have hazardous characteristics or contain listed wastes. Therefore, because there is at present no approved treatment or disposal site available for these wastes, they are being stored on-site. However, storage capacity in adequate facilities is limited. At current rates of generation, the storage capacity of most facilities, presently used to store mixed wastes, is rapidly being reached.

Once these facilities can no longer be used, mixed wastes could accumulate in inadequately protected areas, and containers would be susceptible to damage and/or deterioration, potentially resulting in the release of radioactive and hazardous constituents into the environment.

Low-level radioactive mixed waste currently stored on-site includes "saltcrete," "pondcrete," uranium metal wastes, sewage sludge, organic liquids (i.e., oil and solvents), lead from strip-out operations, hydrogen fluoride, metal heat-treating salts, and solids contaminated with PCBs. Cleanup wastes from several inactive waste disposal sites and spill areas also will be classified as mixed waste and may be stored on-site. Some of these wastes and corresponding site storage practices are described below.

Saltcrete is an end product of the waste treatment process in Building 374, which receives liquid process wastes containing uranium or low levels of plutonium. It is a combination of evaporation brine, nitrate salts, and cement. Saltcrete contains low concentrations of listed hazardous constituents (i.e., up to 100 ppb acetone, and less than 50 ppb methylene chloride, methyl ethyl ketone, and toluene; Wickland, 1987). DOE and Rockwell International will attempt to have the waste reclassified as nonhazardous or delisted in order to resume off-site disposal at NTS. If the waste is not reclassified or delisted, it may have to stay on-site until NTS or another facility obtains a permit for disposal of mixed wastes. In the interim, saltcrete is being stored in Building 964, an old equipment storage shed located just east of the solar ponds. This building has only a few months of storage capacity remaining at the current rate of generation (i.e., until late summer 1987). RFP then plans to store saltcrete outdoors on covered asphalt pads. These pads may not offer sufficient protection to avoid container deterioration. Condensation that would be produced under the plastic cover could cause deterioration of the cardboard boxes. It has also been determined by RFP personnel that saltcrete would leach nitrates if exposed to precipitation.

Pondcrete is sludge that is being dredged from one of the solar evaporation ponds (Pond 207-A) and immobilized in concrete for particulate and free-liquid control. Pondcrete contains the same listed hazardous constituents as saltcrete at the same concentration ranges (Wickland, 1987). Similar attempts will also be made to reclassify or delist the waste. Approximately 16,000 boxes of pondcrete are currently being stored on an asphalt parking pad east of Building 750. This pad will be full by mid-August 1987 and will require expansion. Containers are on pallets and are covered by a fiber-impregnated plastic. Condensation that is produced under the plastic could cause deterioration of the cardboard boxes.

Uranium metal wastes consist of uranium oxide and uranium chips and fines. Uranium chips and fines, which are generated from fabrication operations and are pyrophoric, are converted into stable uranium oxide in a raked-hearth incinerator in Building 447. The uranium oxide is considered a mixed waste by the state, because the chips and fines contain oils and solvents before they are oxidized. Small quantities of uranium chips not converted to uranium oxide also are cemented along with other metals chips. Disposal of uranium metal wastes currently requires a permitted mixed waste disposal facility. Until such a facility becomes available or the wastes are delisted, they will be stored on-site. Currently, uranium metal wastes are stored in Building 884. When the storage capacity in this building is exceeded, RFP plans to store the wastes outdoors in cargo containers.

The sewage sludge contains low-level radioactivity, silver, and beryllium fines. It also contains sulfide, which is reactive. The radioactivity results from uranium contamination of the sanitary sewage system that occurred in the 1950s. Uranium residuals are still present. Silver is present because spent photographic solutions are discharged to the system. Sources of beryllium and sulfide are still unknown. The sewage sludge is currently being stored in Building 884. When the storage capacity in this building is exceeded, RFP plans to store the sludge outdoors in cargo containers.

Organic liquids wastes and other combustibles with low-level radioactivity are also being stored on-site. The mixed waste liquids are being stored in two 10,000-gallon tanks located in Building 774. One of the tanks is full, and the other is very near its capacity. When the second tank becomes full, the liquids generated will be stored in drums that will be placed in outdoor cargo containers. Approximately 1,000 gallons of organic liquids are being generated every month (Wickland, 1987). Other combustibles include soft wastes such as chemical wipes and rags that contain regulated solvents. These wastes are now being stored in Building 884. When storage capacity is no longer available in this building, the wastes will be stored outdoors in cargo containers. The RFP is in the process of modifying an incinerator in Building 776 to burn all of these combustibles, but because of the lengthy permitting process, the incinerator cannot be permitted until late 1987 at the earliest (Ficklin, 1986). If a permit cannot be obtained, the wastes will have to be stored on-site until DOE establishes a mixed waste disposal facility somewhere in the United States.

NTS no longer accepts waste that contains lead. Some lead-bearing low-level waste is now being sent to INEL, but DOE wants to reduce the volume of non-TRU wastes disposed of at INEL. To reduce shipments of lead-bearing, low-level wastes to INEL, RFP has started to store this waste in Building 776 awaiting establishment of a mixed waste disposal facility somewhere in the United States. As of May 1987, there were approximately 25 drums of this waste being stored.

Because only small quantities of this waste are being generated, there is more than a year of storage capacity remaining in this building.

4.1.3.4 Category IV

1. Off-site Recycle or Disposal. The procedure governing the disposition of materials to be sent off-site for recycle or disposal (HSE 21.01, May 1986) is based on alpha or combined plutonium and americium activity concentrations. A gamma analysis is also required. However, not all samples are analyzed for alpha or combined plutonium and americium, and the gamma scan, as used, is not sensitive enough to detect low levels of uranium isotopes or the low-energy gamma ray from americium-241. Plutonium-239 does not have any significant gamma rays and requires alpha analysis for quantification of low concentrations.

Even though controls are inadequate, the potential risk is minimal. Based on the sources of materials going off-site, materials to be recycled or disposed of are likely to only contain low levels of radioactivity. There is also no evidence of significant levels of radioactivity going off-site.

2. Nonradioactive Wastes in Radioactive Waste streams. Some nonradioactive wastes end up in the radioactive waste streams and subsequently are being treated, stored, and disposed of as radioactive mixed waste (DOE, 1986). Practices in some areas containing radioactive materials do not segregate and manage radioactive and nonradioactive wastes differently. This is in conflict with DOE's policy of minimizing radioactive wastes.

3. Hole in Wall at Oxnard Tank Farm. In the event of a spill, oil could leak onto the ground through a hole in the secondary containment wall at the Oxnard Support Facility Tank Farm.

The concrete block wall that was constructed around the Tank Farm has a hole in the northeast corner. Any spills or leaks that would escape through this hole could contaminate the groundwater. The groundwater at Oxnard is only 4 to 8 feet below the surface elevation, depending upon the season of the year. The sandy soil on which the facility is built would do little to impede the flow of spilled material to this shallow water table.

4. Filters from Oxnard Oil Processing Unit. Filters used in the oil processing unit at Oxnard might be considered a hazardous waste.

The oil processing unit has cartridge-type filters on the inlet and outlet. The coarse (25 micron) filter on the inlet is replaced once or twice per year. Approximately 12 to 20 filters are used for the finer (6 micron) filtration of the effluent. When these filters become dirty, they are removed from the unit, cleaned in the vapor degreaser, and placed in the dumpster for disposal at the municipal landfill. Since waste oil is a listed hazardous waste in California, along with 1,1,1-trichloroethane used in the vapor degreaser, the acceptability of this practice should be verified with the County Waste Management Agency. There is also the possibility that the vapor degreaser could be considered a hazardous waste treatment device requiring an appropriate permit.

4.2 Toxic and Chemical Materials

This section of the report deals with toxic substances and chemicals used for production, maintenance, and as building materials. The main categories of materials under consideration are polychlorinated biphenyls (PCBs), asbestos, process chemicals, and pesticides.

4.2.1 Background Information

The Toxic Substances Control Act (TSCA) of 1976 enables EPA to develop adequate data on the effects of chemicals on health and the environment and to regulate the use of toxic chemicals to reduce unreasonable risk of injury to health or the environment. It grants EPA the authority to (1) require industry to provide information on chemicals used and manufactured, (2) require industry to test the health and environmental effects of chemicals used and manufactured and (3) control production, distribution, use, and disposal of certain chemicals that cause unreasonable risk of injury to health and the environment.

Regulations published to date require reports to EPA, and prescribe restrictions on the production, use, and disposal of specific substances. Under the reporting requirements, facilities must notify EPA of any chemicals exported and report their inventory of imported and manufactured chemicals. In addition, facilities must submit safety, health, and environmental data on specific substances. The restrictions on production, use, and disposal cover polychlorinated biphenyls (PCBs), asbestos, polybrominated biphenyls (PBBs), 2,3-dibromopropyl phosphate, fully halogenated chlorofluoroalkanes, and waste material containing tetrachlorodibenzo-p-dioxin (TCDD).

The Environmental Survey team at the RFP considered the TSCA-regulated materials— PCBs, asbestos, and fully halogenated chlorofluoroalkanes. In addition, pesticide/herbicide use and

nonradioactive hazardous/toxic chemical storage were investigated to determine if any activity resulted in any environmental problems.

4.2.2 General Description of Pollution Sources/Controls

4.2.2.1 Polychlorinated Biphenyls (PCBs)

The RFP has more than 10,000 gallons of PCB fluids in use in electric utility system components, including transformers and capacitors, and in hydraulic systems. As of December 31, 1985, there were 54 pad-mounted PCB or PCB-contaminated transformers on-site. There are also at least 98 pole-mounted transformers and approximately 600 large capacitors. The PCB content of the pole-mounted transformers is largely unknown, whereas 363 large capacitors are known to contain PCBs. Hydraulic fluids used in some on-site machinery, such as forges, lathes, borers, and elevators, are suspected by RFP to be contaminated with PCBs.

PCB waste materials are stored in several locations at RFP. Nonradioactive PCB waste is stored in three outdoor cargo containers (trailers) located near the landfill. These trailers provided adequate protection from the elements as well as secondary containment. Radioactive solid PCB wastes are placed in 55-gallon drums and stored for disposal in Building 776. During the Environmental Survey at RFP, it was observed that 16 drums of radioactive PCB solid waste had been placed inside a newly constructed, caged, PCB storage area for disposal. However, several drums of radioactive solid PCB waste were observed within Building 776; these drums had not yet been transferred into the special caged area. No radioactive liquid PCB wastes are stored at the RFP.

It was speculated that, during the 1950s, 1960s, and 1970s, PCB-contaminated waste oil may have been used for on-site dust control (Handschy, 1986); however, the Survey Team found no documentation or other information to support this suspicion.

On August 6, 1986, the Environmental Protection Agency levied a fine of \$111,000 against Rockwell International, operator of the RFP, for violations of PCB regulations. The following violations were observed during an unannounced PCB inspection conducted on January 30, 1986:

- Six transformers were leaking.
- Eight transformers were not listed in the 1984 PCB Annual Report.
- No quarterly PCB inspection was held during the August 1985 - January 1986 period.

- Inadequate signs were posted on PCB transformer enclosures.
- A pole-mounted transformer in storage was leaking.

As a result of this action, the Rocky Flats Plant has made resolution and cleanup of the PCB problem a priority concern. The following actions, some of which were under consideration prior to the EPA fine, were in progress during August 1986:

- Seven electricians from the Maintenance Group were reassigned to the Plant Power Group and seven persons from the Decontamination Crew were recruited to clean up leaking pad-mounted, PCB transformers.
- All 54 known pad-mounted PCB or PCB-contaminated transformers were examined, and 48 were found to be leaking. By August 22, 1986, 43 of the 48 leaking transformers had been cleaned up.
- Contaminated soil and/or gravel surrounding leaking PCB transformers was removed and disposed off-site as PCB waste.
- Contaminated transformer surfaces were solvent washed and cleaned.
- Leaking transformer valves were tightened, and absorbent materials or catch basins were placed beneath valves.
- An electrician now performs a daily inspection of leaking transformers.
- PCB warning signs were installed on PCB transformer enclosure doors.
- A contract has been signed with General Electric Company (GE) to repair leaking transformers and to flush and refill PCB transformers with non-PCB fluids so that they meet EPA guidelines for non-PCB transformers (<50 ppm PCBs). Under this \$1.8 million program, entitled "Environmental Hazard Elimination," 29 pad-mounted transformers containing 50 to 3,000 ppm PCBs will be drained and refilled with PCB-free fluids. Sixteen older PCB-filled transformers will be replaced. The remaining PCB transformers will be the "youngest," and they are not expected to exhibit any problems in the near future.

The priority with which this work will be performed is as follows:

- (1) Indoor PCB transformers.
- (2) Transformers near food areas (one is within 200 feet of a cafeteria).
- (3) Leaking transformers.
- (4) Other transformers.

A large PCB capacitor in the basement of Building 444 exploded during December 1984. This explosion created a PCB mist, which contaminated the basement and required approximately 8 weeks to be cleaned up. According to RFP personnel, no release of PCB outside Building 444, or any other environmental problem in connection with this incident, occurred. In 1985, Rocky Flats submitted to DOE a \$2.5 million plan entitled "PCB Fire Hazard Elimination" to remove all on-site indoor PCBs. This plan was an outgrowth of an EPA ruling related to PCB fire in public buildings. To date, this project has not been funded, but RFP expects to resubmit the plan to DOE for further consideration.

As indicated earlier, not much is currently known regarding the integrity or PCB content of pole-mounted transformers. Most pole-mounted transformers do not have valves, hence they must be removed from service to be sampled. Physical examination is complicated by height and proximity to energized electrical circuits. The RFP is proposing to have plant power personnel examine each pole-mounted transformer and to sample the oil in out-of-service transformers. Transformers observed to be leaking would be the first to be sampled and analyzed. According to this plan, all PCB transformers containing more than 50 ppm PCBs would be targeted for replacement.

At last count, there were 517 known large capacitors on-site. However, it is estimated that over 600 large (containing 3 or more pounds of dielectric fluid) capacitors are in use at RFP. There was no inventory of small capacitors. Of the 517 large capacitors, between 75 to 100, known to have been leaking, have been replaced. In lieu of information regarding the PCB content of a leaking capacitor, it is considered PCB-containing. There is no containment nor inspection program for capacitors, although RFP expects that indoor capacitors will be included under the "PCB Fire Hazard Elimination" program. The RFP presumes that a few leaking, pole-mounted capacitors would also fall under the scope of this proposed program.

Prior to 1979, it cannot be established whether hydraulic systems in use at RFP were tested for PCB-contaminated hydraulic fluids. The Environmental Survey team interviews with plant personnel indicated that PCB contamination of hydraulic fluids was considered possible, if not probable. In the

fall of 1985, a forge was shipped from RFP to the support facility at Oxnard, California. Analysis of the fluid drained from this forge revealed that it contained approximately 200 ppm PCBs. The hydraulic fluids from two forges in Building 883 were also analyzed and found to contain 2 to 3 percent PCBs. After draining, flushing, and refilling with non-PCB fluids, the forges were found to contain 2,000 to 4,000 ppm PCB. Subsequent draining and flushing has allowed these forges to be classified as PCB-contaminated, and workers must wear suitable protection (Handschy, 1986). A program to sample and analyze the fluids from all hydraulic machines, including forges, lathes, bores, elevators, etc., in the 800 complex, the 400 complex, and in the plutonium complex is planned to be initiated at Rocky Flats during September 1986. There are several heat-transfer systems associated with mechanical presses that may contain PCB-contaminated fluids. These systems will be included in the hydraulic fluid sampling and analysis program.

As part of the intensive PCB effort at RFP, the Plant Power Group will be examining switches, circuit-breakers, and other equipment containing dielectric fluids. There is currently no information about the fluids contained in these devices.

PCB items are stored for reuse and for disposal at Rocky Flats. Three metal cargo containers (trailers) are located outdoors and used to store nonradioactive PCB waste materials and PCB-contaminated equipment. Two of these cargo containers are located inside the perimeter security zone and one is located near the active landfill. All provide adequate containment for the waste drums and no PCB contamination of the environment is expected from these areas. Radioactive solid PCB waste materials (e.g., small capacitors, cleanup materials, etc) are stored inside Building 776. A new, metal-caged storage area has recently been constructed in Building 776, and drums of radioactive solid PCB waste are being transferred into this designated storage area. The Environmental Survey team did not find any potential for PCB environmental contamination, with current PCB/radioactive waste handling. However, since this waste must be stored on-site indefinitely, the limited capacity of this storage could be rapidly exhausted if any major radioactive PCB contamination occurs. No radioactive liquid PCB waste materials are currently in storage at Rocky Flats. In the past, radioactive liquid PCBs were shipped to Los Alamos for disposal.

PCB analyses are performed on-site in the General Laboratory (Building 881), or they are performed by outside contractors such as General Electric and Transformer Consultants.

No specific sampling of potential PCB sources (e.g., transformers, capacitors) was requested as part of the DOE Environmental Survey, since the program undertaken by Rocky Flats was comprehensive

enough to satisfy Survey needs. However, PCB analyses will be performed on water, soil, and sediment samples collected during the sampling and analysis phase of the Environmental Survey.

In February 1984 the Oxnard Support Facility was advised by its oil reclaimer that there were PCBs in the used oil that had been sent to the reclaimer for processing. Subsequent investigation by the facility indicated that there was no contamination of the soil or the groundwater in the areas tested adjacent to the building. However, several hydraulic systems, the pit under Building 6, the waste oil collection system, and some drums of old hydraulic oil and die lubricant contained residual PCBs. An experienced PCB cleanup contractor was hired to remove the contamination, and a program was instituted that assured that all hydraulic oils and lubricants received at the site were PCB free. The cleanup of the site was completed in the spring of 1985. However, in May 1986 Oxnard was advised by the RFP that a hammer and pumping unit which had recently been shipped to Oxnard was rumored to contain PCBs. Testing showed that the pumping unit did contain PCBs, and a contractor was called in to clean up this unit. The PCB levels in the hydraulic system for the hammer and pumping unit were found to be approximately 250 ppm (as Aroclor 1248).

4.2.2.2 Asbestos

Asbestos-containing materials have been used throughout the RFP. Asbestos-containing building insulation materials and transite pipe are common. The RFP has implemented policies and procedures covering the removal and disposal of these materials. Plant Safety, Health and Environment personnel monitor such activities to ensure compliance with the established procedures.

The RFP has a Plant Asbestos Hazard Inventory which lists the specific building, room, and location of on-site asbestos hazards. It also categorizes the priority for asbestos cleanup associated with each site. As of August 15, 1986, there were 449 plant sites on the Asbestos Hazard Inventory, a prioritized list. Of the 449 sites, 153 were identified as requiring only minor repairs or having minimal damage.

Asbestos removal or cleanup work reportedly must be performed in the following Rocky Flats Buildings: 111, 112, 121, 122, 123, 124, 125, 331, 333, 334, 373, 440, 442, 443, 444, 447, 450, 551, 559, 560, 675, 701, 702, 703, 705, 706, 707, 708, 750, 771, 772, 774, 776, 777, 778, 779, 782, 865, 875, 881, 883, 886, 889, 910, 985, and 991. Each of these buildings could contain more than one asbestos hazard site.

According to written notification from the RFP to EPA Region VIII and to the Colorado Department of Health, the estimated amount of asbestos to be removed during 1986 was approximately 500 linear feet of pipe insulation. Each major renovation job exceeding the reporting limits of 80 linear meters (260 linear feet) on pipes and 15 square meters (160 square feet) on other facility components is reported individually to the EPA and the Colorado Department of Health.

Depending upon the job, asbestos removal and cleanup work is performed either by plant maintenance personnel or by outside contractors. Plant maintenance personnel perform asbestos removal work during weekends to minimize the potential exposure of other plant employees to asbestos. All asbestos workers must attend a training course on asbestos handling/safety prior to being allowed to conduct asbestos work. Photographic evidence was provided to the Environmental Survey team which indicated that air monitoring for asbestos is performed before, during, and after asbestos removal and cleanup. Rooms requiring asbestos removal are enclosed in plastic prior to the initiation of work. Pipes undergoing asbestos repair/removal are encased in glovebags to prevent asbestos dispersal.

According to RFP procedures, the Health, Safety and Environment (HS&E) Group must sign off on all asbestos removal projects to ensure that the "Safe Handling of Asbestos" policy is followed. A hygienist from HS&E monitors each asbestos removal project requiring the use of glovebags to ensure compliance with the plant's asbestos removal procedure. Currently, a formal written procedure detailing the removal of asbestos in enclosed rooms is being prepared.

Approximately 80 percent of all removed asbestos is contaminated with low-level radioactivity and hence is designated a low-level, radioactively contaminated waste and it is shipped to the Nevada Test Site for shallow land burial. The other 20 percent of asbestos waste (nonradioactive) is buried in a special section of the Rocky Flats active landfill. Rocky Flats has no plans to dispose of nonradioactive asbestos off-site. As will be discussed later, on-site asbestos disposal is considered to be a potential environmental problem at Rocky Flats. Reportedly, records on the quantity of asbestos disposed on-site exist but this information was not available for review by the Environmental Survey team.

The RFP Industrial Hygiene Procedures Manual documents the RFP Asbestos Control Program for the facility. Briefly, this program includes the following:

1. Procedures for Engineering Reviews and maintaining an Engineering Authorization Tracking System for asbestos removal.
2. Procedure for identifying asbestos in buildings.
3. Procedure for conducting an Asbestos Hazard Inventory.
4. Procedures for repair or removal of pipe insulation and for cutting transite.
5. Disposal of asbestos-containing materials.
6. Selection of respiratory protection.
7. Air sampling for asbestos.
8. Personnel training requirements.
9. Radiation monitoring interface.

The RFP Asbestos Control Program as written goes beyond OSHA requirements by conducting an extensive area air sampling program in every building on the plant site containing asbestos and by extensive building inspections. Personnel monitoring samples are made part of the medical record of those individuals sampled by placing the results into the Occupational Health Information System. They are also used to augment environmental monitoring data.

Most of the asbestos identified on-site has been chrysotile, with lesser amounts of amosite being observed (Richen, 1986). Neither pre-Survey review of Rocky Flats records nor on-site Survey interviews gave any historical evidence of visible emissions of asbestos (NESHAP regulation) to the environment.

The Industrial Hygiene Group, the Waste Operations Group and the Environmental Analysis and Control Group collaborate to establish asbestos waste disposal requirements. Waste Operations is responsible for maintaining disposal records for radioactively contaminated asbestos, and Environmental Analysis and Control is responsible for maintaining disposal records for nonradioactive asbestos waste (see Section 4.1.2.4). The Industrial Hygiene Group performs all personal monitoring of asbestos during removal and cleanup. Group members have no current

responsibility for asbestos waste disposal although, reportedly, they periodically visit the asbestos disposal area of the on-site landfill to ascertain that asbestos is being disposed properly. The Environmental Survey team has been informed that, in the near future, the Industrial Hygiene Group plans to install air sampling equipment at the landfill to monitor asbestos.

All personal asbestos monitoring samples collected by the Industrial Hygiene Group at the RFP are sent to a nearby, off-site contract laboratory (CSMRI-Analytica, Inc.) for analysis by phase contrast microscopy according to the NIOSH P&CAM 239 procedure. The RFP has limited capability for analyzing a few asbestos samples under extenuating circumstances; the use of an experienced, qualified, economical, and rapid off-site laboratory is preferred by the RFP personnel. The Industrial Hygiene Group also occasionally uses an instrument known as a fibrous aerosol monitor to perform "real-time" asbestos monitoring, especially during indoor asbestos surveys.

4.2.2.3 Fully Halogenated Chlorofluoroalkanes

According to the Rocky Flats Plant chemical inventory, several thousand gallons of chlorofluoroalkanes are stored and/or utilized on-site (see Table 4-4). These materials are chiefly used for refrigeration and for degreasing and metal cleaning. Among the materials used in quantity are freon 12, freon 22, freon TF, freon 11, freon 502, and Genesolv-D. Because of their low boiling points, these compounds are stored and handled either as gases or as highly volatile liquids. In either case, potential environmental contamination would be in the form of volatile gaseous emissions. Chlorofluoroalkane gases and liquids were observed to be stored in a manner appropriate to their volatility throughout the many plant buildings where they were used. Bulk storage of chlorofluoroalkanes was in accordance with the facility's Incompatible Materials Storage System. The Environmental Survey team did not detect any instances of environmental problems due to storage and use of chlorofluoroalkanes.

4.2.2.4 Pesticides/Herbicides

During the past 4 years, the Plant Services Group has been responsible for pesticide/herbicide applications at Rocky Flats. Prior to that time, outside certified pesticide applicators were hired to apply pesticides/herbicides on-site, including the buffer zone. Since 1982, few pesticides/herbicides have been used except within and in the immediate vicinity of the fenced security zone surrounding the PSZ security zone area. The materials used currently include 2,4-D for weed control and Ureabor, Tordon, and Hyvar XL for sterilization. Roundup is used to keep the electrical substation areas vegetation-free. The Environmental Survey team has been informed that, in the future, the only

TABLE 4-4

STORAGE OF CHLOROFLUOROALKANES AT RFP

	Quantity ¹	Location
Freon 12	30 LB	B444
	6 CN	B771
	10 CN	B334
	3 TC	B551
	10 CN	B552
	75 LB	B777
Freon 22	6 CN	B771
	10 CN	B334
	14 CN	B552
Freon TF	165 GL	B776
	55 GL	B778
	30 GL	B771
	55 GL	B778
	110 GL	B334
	165 GL	B885
	55 GL	B662
	55 GL	B460
	10 GL	B559
	5 GL	B865
	165 GL	B453
	55 GL	B778
	1 LT	B771
	500 ML	B334
	10 GL	B559
	55 GL	B121
	100 GL	B707
	5 GL	B460
	3 GL	B371

TABLE 4-4
STORAGE OF CHLOROFLUOROALKANES AT RFP
PAGE TWO

	Quantity ¹	Location
Freon TF (continued)		
	30 GL	B371
	220 GL	B444
	110 GL	B881
	55 GL	B444
	55 GL	B460
	65 GL	B707
Freon 11	250 GR	B779
	250 GR	B779
	1400 LB	B551
	30 GL	B334
Freon 502	1 C4	B707
	1 C4	B552
	10 CN	B334
Genesolv D	60 GL	B777
	55 GL	B440
Freon 113	2 LT	B771
Freon 503	2 C4	B778
	1 C4	B707
Freon 80	5 GL	B440
Freon 94-5M	55 GL	B440
Freon TF (PCA Solvent)	53 GL	B551
Freon TMC	1 LB	B881
Gentron 12	2 C1	B778

¹LB = pound; CN = Cylinder N.O.S. (not otherwise specified);
 TC = Ton Cylinder; GL = Gallon; LT = Liter; ML = Milliliter;
 GR = Gram; C4 = Cylinder (approximately 4 feet long x 1 foot
 diameter); C1 = Cylinder (approximately 1 foot long; small lecture
 bottle).

material anticipated to be used is Roundup. All pesticides/herbicides and fertilizers and most associated application equipment (except for a tractor and a large spray tank) are stored in Building 367. Pesticide/herbicide mixing and equipment cleanup take place outside Building 367 within the berm surrounding this building. A variety of other apparently unused pesticides/herbicides are also stored in Building 367. These include Vapona, Banrel, Rozol Tracking Powder, and Kelthane. While this building is located in an isolated area of the plant site, its general poor condition and the poor housekeeping observed inside indicated the possibility of localized soil contamination with pesticides/herbicides.

There is one plant employee who possesses a valid EPA pesticide applicator's license. This person is responsible for instructing other plant personnel in the proper application of pesticides/herbicides and for supervising application work. The RFP requires each employee applying pesticides/herbicides to pass a written exam prior to being authorized to work. An annual report of pesticide application is required to be prepared. The pesticide storage building is reportedly checked on a daily basis during the summer and approximately weekly during the winter. Pesticide/herbicide purchases are made once per year in the spring, and purchase records are maintained. It has been reported to the Environmental Survey team that obsolete pesticides/herbicides are to be considered hazardous wastes and are to be stored accordingly until they are shipped off-site for disposal.

Sampling and analysis of the soil in the vicinity of Building 367 and along a nearby drainage ditch is being conducted as part of the DOE Environmental Survey. Samples are being analyzed for the following materials: Toxicon, Kelthane, Malathion, 2,4-D and its esters, Sevin, Hyvar XL, Ureabor, Roundup, and Dazinon. These materials, among others, are stored in Building 367.

4.2.2.5 Nonradioactive Toxic/Hazardous Chemical Storage and Control

There are approximately 2,500 chemicals from 600 different manufacturers used at Rocky Flats. The most recent nonradioactive chemical inventory was conducted between March 1985 and January 1986. Among the bulk hazardous chemicals used at Rocky Flats are nitric acid, hydrofluoric acid, sulfuric acid, sodium hydroxide, potassium hydroxide, carbon tetrachloride, and chlorine and fluorine gas. Except for chlorine and fluorine, these materials are stored in tanks throughout the facility. The identity, quantity, and location of the chemicals in use at RFP are contained in the RFP 1985/1986 Chemical Inventory. Chlorine is stored in compressed gas cylinders or tanks, and fluorine is stored in banks of cylinders contained within two buildings (B371 and B772) especially designed to handle fluorine. Other hazardous materials stored on-site in significant quantities are hydrochloric acid, propane, various metals and metal cyanides, chlorinated hydrocarbons, flammable solvents and

paints, hydrogen and acetylene. The remaining chemicals generally consist of small quantity packages used throughout the plant site both for analytical and research purposes. Gasoline (18,000 gallons) and diesel fuel (98,000 gallons) are stored in on-site underground tanks, and No. 6 fuel oil (2.8 million gallons) is kept in on-site underground and above-ground tanks. No outside drum storage areas were observed at RFP.

The Rocky Flats Plant has recently (July 22, 1986) implemented a Hazardous Materials Control Program, which outlines the work practices required for safe handling of nonradioactive hazardous materials, and the plant makes hazard information available to affected employees. This program is designed to ensure that no person will be exposed to significant risk of harm, no buildings or equipment will be damaged, and no adverse effects on the environment will occur due to nonradioactive materials. Important aspects of the Hazardous Materials Control Program follow.

- Hazardous Materials Inventory - currently conducted approximately every 2 years.
- Hazard Evaluation - Material Safety Data Sheets must be provided with each chemical purchased.
- Hazard Ratings - a National Fire Protection Association hazard rating is required for each hazardous material at the RFP.
- Hazardous Materials Labels - every container at the RFP must be labeled with the material it contains and hazardous materials must also have appropriate warning labels.
- Material Safety Data Sheets - A master file of MSDSs is maintained for each hazardous material at RFP.
- Employee Training - Each employee receives classroom and on-the-job training regarding safe handling of hazardous materials.

The RFP purchasing policy is that no hazardous materials are to be acquired via telephone purchase agreements. Warehouse custodians are to refuse delivery of any hazardous material without a label. Packaging for shipment, labeling, and transporting of hazardous materials to and on the site is strictly controlled (Petrocchi, 1986).

The Rocky Flats Fire Department maintains surveillance of flammable and combustible materials to ensure their safe handling, use, and storage. Where different hazardous materials are stored together, as in a warehouse or bulk storage area, the plant's Incompatible Materials Storage System (INMAT) is used to minimize any hazards caused by close storage of potentially reactive materials. The storage hazards are minimized by assigning separated storage categories (locations) for those chemicals which are significantly incompatible with each other.

Among other control measures to prevent hazardous materials from entering the environment are dikes around large storage tanks, gloveboxes or other enclosures, malfunctioning or upset sensors and alarms, and fire and overheat detectors, alarms, and extinguishing equipment. The Environmental Survey team inquired as to the availability and use of underground tank leak detection systems at RFP. The team was advised that gasoline and diesel fuel storage tank inventory readings are made daily and before and after each fuel delivery. Monthly and yearly inventories are also compiled, and in this manner the RFP expects that underground tank leaks would be indicated by inventory discrepancies. Fuel-oil storage tank meter readings are made monthly and before and after each fuel delivery. Inventory irregularities would also indicate underground fuel-oil tank leaks. The RFP believes this system is adequate.

The on-site Environmental Survey of toxic/hazardous chemical storage and control did not indicate a need for sampling and analysis.

4.2.3 Findings

4.2.3.1 Category I

There are no Category I toxic and chemical materials findings.

4.2.3.2 Category II

1. Inadequate PCB Labeling. Accidental use of improperly labeled PCB oil could lead to PCB contamination of RFP equipment and systems, and inadvertent releases to the environment. Six 55-gallon drums of transformer oil were discovered in Building 554 during a hazardous/toxic chemical inventory tour of RFP by the Survey team. The labels on all drums indicated that the transformer oil was a non-PCB silicone fluid, but a packing list glued to one drum stated that these six drums contained "transformer oil (used PCBs)." One drum obviously had been opened previously and, based upon the packing list, was therefore suspected to contain PCBs or PCB-contaminated

fluids. The contents of this drum were to be analyzed to determine whether it did contain PCBs. The other five drums appeared to have their original seals and were unopened. All of these drums were to be sampled and analyzed by the RFP.

2. Landfill Disposal Practices. Improper disposal practices at the landfill make it possible for friable asbestos to enter the environment. Environmental Survey team visits to the active landfill revealed the following:

- Asbestos-labeled materials were observed to be improperly disposed of in the general landfill and in the designated graphite disposal pit. Also nonasbestos waste construction materials were observed in the asbestos disposal pit.
- While asbestos waste was properly double-bagged and labeled prior to arrival at the asbestos disposal pit, it apparently was not carefully placed in the pit since many of the bags were observed to be torn and their contents spilled. This asbestos waste (roofing material) was found to be friable. The arrival and disposal of asbestos waste material was actually observed, and the bagged asbestos waste was seen to be dumped without regard for the integrity of the bags. Small quantities of dust were generated during the dumping of the bags, and the person who dumped this material was not wearing any respiratory protection.
- At the beginning of the on-site Survey, a brief visit to the asbestos disposal pit revealed it to be only partially filled. By the end of the first week the pit was nearly full and the material in the asbestos pit had not been covered daily to prevent dispersal of asbestos by the wind.
- Neither the entire landfill area nor the asbestos disposal pit have any fencing surrounding them. Fencing of the landfill was reportedly considered unnecessary, since the landfill is within the enclosed boundaries of the plant. (Fencing of the landfill is currently under consideration.)

Sampling and analysis of soil surrounding the active landfill for asbestos is being conducted as part of the DOE Environmental Survey in order to ascertain whether the landfill is a source of asbestos entering the environment due to lack of control of landfill operations.

4.2.3.3 Category III

1. Pesticide/Herbicide Storage. Large quantities of unused pesticides/herbicides are stored in Building 367, which lacks proper security and containment for possible spills. The absence of vegetation around the entrance to the building is a good indication of potentially high concentrations of pesticides/herbicides in the soil.

- Although the building is normally locked, the windows were ajar and numerous cracks and spaces existed between the walls and the concrete pad floor. The containment berm surrounding the building is eroded to nearly ground level in several areas, and the potential exists for water runoff into a nearby drainage ditch.
- The overall housekeeping in and around Building 367 was very poor (e.g., an empty pesticide container was observed on the ground outside of the door). There are several old 55-gallon drums of 2,4-D dimethylamine ester, a material no longer expected to be used. One drum was observed to be open during the on-site Survey. At least 12 multi-gallon (≤ 5 gallons each) containers of Tordon were stored in a haphazard manner, a factor which increases the possibility of spills. Various other apparently obsolete pesticides/herbicides were stacked on top of each other or stored in a potentially hazardous manner (e.g., acidic and basic materials stored in close proximity inside a cabinet).
- The floor showed obvious evidence of previous chemical spills and/or leaks.
- Sampling and analysis of soil in the vicinity of Building 367 is being conducted as part of the DOE Environmental Survey. Samples will be analyzed for Tordon, Kelthane, Malathion, 2,4-D, Sevin, Hyvar XL, Ureabor, Roundup and Diazinon.

2. PCB Transformer Near Roof Drain. PCBs leaking from a rooftop transformer on Building 447 could eventually end up in one of the holding ponds. It has been reported to the Environmental Survey team that transformer 447-1 leaked PCB fluid in the past near a roof drain which discharges into the drainage system. Sampling and analysis of sediments in the holding ponds for PCBs is being conducted as part of the DOE Environmental Survey. The potential for such leaks still exists.

3. Underground Storage Tanks. Deterioration with subsequent leakage and environmental contamination may be undetected due to the lack of an underground storage tank (UST) monitoring

program. RFP does not have a detailed inventory control program to detect tank leakage, nor has it made any field measurements or conducted any sampling and analysis of soils and groundwater around tanks.

RFP contains thirty-three underground petroleum storage tanks (Table 4-5). Twenty-eight of them are in-service, and twenty-one are made of steel. Only two of the in-service steel tanks have cathodic protection. In addition, ten of the in-service steel tanks are 15 years old or older. Steel tanks that are not cathodically protected and 15 years old or older have a high probability of leakage.

Seven of the in-service tanks are made of fiberglass. Four are 15 years old or older. These tanks could also be leaking petroleum products.

All five of the out-of-service underground petroleum storage tanks are made of steel, were unprotected, and were over 15 years old when taken out of service. Four of the five tanks have been emptied and filled with either concrete or sand. The fifth probably contains some residual of its former content (i.e., No. 2 fuel oil). These tanks could have leaked while in service and contaminated adjacent areas.

At the time of the DOE Environmental Survey, RFP had no plans to conduct any tank evaluation or monitoring program to determine if in-service underground petroleum storage tanks were leaking. No sampling and analysis under the Survey was recommended for this finding.

4.2.3.4 Category IV

1. Leaking Capacitors: Capacitors under electric furnaces in the Building 444 basement show evidence of leakage onto the floor. Since the PCB content of these capacitors is not known, the potential for environmental contamination, although minimal, does exist. This finding was observed by and reported to a member of the RFP staff.

2. Asbestos Disposal Recordkeeping: Records of asbestos disposal in the active landfill area are not complete. On-site personnel are able to dump materials in the landfill without recording the type and quantity of material deposited. The Environmental Analysis and Control Group is responsible for maintaining such records. Waste Operations does maintain adequate records of the off-site shipment of radioactively contaminated asbestos, however.

TABLE 4-5
UNDERGROUND PETROLEUM STORAGE TANKS

Inventory Number	Status	Age (Years)	Capacity (Gallons)	Content	Material of Construction	Corrosion Protection
120 SE	In use	1	1,000	Diesel	Steel	Cathodic
124 S	In use	15	500	Diesel	Fiberglass	None
127 W	In use	8	550	Diesel	Fiberglass	Unknown
381 N	In use	6	47,500	Diesel	Steel	Unknown
331 N-1	In use	15	6,000	No. 2 Fuel Oil	Fiberglass	Unknown
331 N-1A	In use	15	6,000	No. 2 Fuel Oil	Fiberglass	Unknown
331 N-2	In use	15	6,000	Unleaded gasoline	Fiberglass	Unknown
331 N-3	In use	10	18,000	Gasoline	Steel	None
443 SE	In use	16	1,500	Diesel	Steel	None
443 E-3	In use	34	20,000	No. 6 Fuel Oil	Steel	None
443 E-2	In use	34	20,000	No. 6 Fuel Oil	Steel	None
443 E-4	In use	20	20,000	No. 6 Fuel Oil	Steel	None
443 NE	In use	10	2,793	Diesel	Fiberglass	None
559 NE	In use	19	1,000	No. 2 Fuel Oil	Steel	None
562 E	In use	11	2,000	No. 2 Fuel Oil Diesel	Steel	Unknown
709 NW	In use	18	4,000	No. 2 Fuel Oil Diesel	Steel	None
716 SE	In use	17	4,000	Diesel	Steel	None
727 W	In use	11	3,000	No. 2 Fuel Oil Diesel	Steel	None
729 E	In use	12	650	No. 2 Fuel Oil Diesel	Steel	None
771 SE	In use	34	3,000	Diesel	Steel	Unknown
771 S	In use	13	5,260	Diesel	Fiberglass	Unknown
776 N	In use	1	1,000	No. 2 Fuel Oil Diesel	Steel	Unknown
776 NW	In use	18	500	Diesel	Steel	None
779 NE	In use	11	500	No. 2 Fuel Oil Diesel	Steel	Unknown
827 S	In use	15	2,000	No. 2 Fuel Oil Diesel	Steel	Unknown
881 A-NE	POOS, emptied in 1976	30	1,000	No. 2 Fuel Oil Residual	Steel	Unknown

TABLE 4-5
UNDERGROUND PETROLEUM STORAGE TANKS
PAGE TWO

Inventory Number	Status	Age (Years)	Capacity (Gallons)	Content	Material of Construction	Corrosion Protection
881 S	In use	30	2,100	Diesel	Steel	Unknown
881 S-1A	POOS, emptied in 1977, filled with concrete	30	21,000	No. 6 Fuel Oil	Steel	Unknown
881 S-2A	POOS, emptied in 1977, filled with concrete	30	21,000	No. 6 Fuel Oil	Steel	Unknown
881 S-3A	POOS, emptied in 1977, filled with concrete	30	21,000	No. 6 Fuel Oil	Steel	Unknown
883 N	POOS, emptied in 1979, filled with sand	28	500	No. 2 Fuel Oil	Steel	Unknown
920 NW	In use	1	1,000	Diesel	Steel	Cathodic
989 E	In use	13	3,000	Diesel	Steel	None

POOS = Permanently out of service.

Source: DOE, Albuquerque Operations, Underground Storage Tank Inventory for the Rocky Flats Plant, Attachment I, Petroleum Tanks, April 1986.

3. PCB/Chemical Drum Labeling. Improper labeling of drums can be misleading and potentially hazardous.

Substation 517-518, which previously was used as a PCB waste storage area still maintains PCB warning signs on the gate access door even though the enclosed transformers are non- PCB and PCBs are no longer stored there.

Waste drums next to transformer 516 showed both PCB and hazardous waste labels. When the Environmental Survey team brought this to the attention of a plant employee, the hazardous waste labels were immediately removed as being improper and an "oversight."

The presence of unlabelled drums around the facility indicates inadequate management practices for handling hazardous materials (e.g., old, unlabeled, rusting drums were observed near solar pond 207B and the 55-gallon drum of "transformer oil (used PCBs)" found in Building 554).

The spray tank used for pesticide applications was examined at its storage area near Building 331 and it was found to have no label that it was used for pesticide spraying.

4. Spill Prevention Plan. On-site interviews with RFP staff generally indicated a lack of training and knowledge of any formal spill prevention plan or procedure.

5. Pesticide/Herbicide Application Documentation. Documentation of the pesticide/ herbicide application program at Rocky Flats is minimal. Because of changes in personnel, responsibility for maintaining up-to-date pesticide application records has become unclear and recordkeeping has diminished. Lack of adequate knowledge concerning pesticide application is indicative of poor management practices and increases the potential for environmental problems.

6. Oxnard PCB Storage. PCB-contaminated material at the Oxnard Support Facility is improperly stored for disposal.

Four drums of material used for cleaning up PCBs in a lathe recently received from RFP were sitting on the loading dock outside of Building 2. The drums had been filled and properly labeled by the cleanup contractor and were put on the dock awaiting pickup by the disposal contractor. Oxnard personnel indicated that disposal would take place within 2 weeks.

7. Containment Dikes. Many tanks storing hazardous chemicals do not have dikes that would contain the contents in the event of a catastrophic release.

The 5,000-gallon carbon tetrachloride storage tank outside Building 707 could potentially leak into a nearby storm drain (rear door No. 18 of Building 707).

Concrete containment basins for the 3,000-gallon sodium hydroxide and sulfuric acid tanks outside Building 443 are too small to contain massive spills. Several years ago the sodium hydroxide tank accidentally drained, and the containment overflow ran down Central Avenue into a drainage ditch, where it was neutralized with acetic acid.

The 30,000-gallon potassium hydroxide tank outside Building 771 is surrounded by an earthen dike, much too small to contain a major spill.

The 5,000-gallon potassium hydroxide tank near door No. 1 of Building 714 has a small, worn berm which offers little, if any, containment. The nearby nitric acid storage tank has no containment. Possible leaks or spills are expected to go directly into the soil.

9. Paint and Oil Storage. The paint and oil storage in Building 885 shows poor housekeeping. Cans and drums are stored haphazardly both inside and especially outside. Rainwater reportedly flows through this building toward the nearby cargo container (trailer). Any spilled organics may be carried with this rain water.

9. Uncapped Monitoring Well at Oxnard. An uncapped monitoring well at the Oxnard Support Facility could be a potential source for polluting the groundwater. Three of the four wells installed to determine whether PCBs had reached the groundwater have been filled in. The one remaining well, located northeast of Building 6, is not capped. This is a potential pathway for inadvertent contamination of the groundwater.

At the time of the Environmental Survey at Oxnard, the facility had not developed a formal SPCC plan. Subsequently, Oxnard has contacted the RFP for guidance on preparation of a SPCC plan.

4.3 Direct Radiation

This section discusses sources and exposures to off-site locations from direct or external radiation and the overall assessment of radiation dose to members of the general public, as a consequence of RFP activities.

4.3.1 Background Information

The background radiation in the vicinity of the Rocky Flats Plant is a consequence of both natural and man-made sources. Natural background radiation is expected to be somewhat higher in this area than in many other regions in the United States because of the elevation and the relatively high concentrations of naturally occurring radioactive materials such as uranium, thorium, and members of their decay chains. Locations at high elevations will have a higher background than those at lower elevations (e.g., sea level) because at the higher elevations there is a thinner layer of atmosphere to absorb cosmic radiation. The USEPA reports gamma radiation dose rates for locations throughout the United States on a quarterly basis. During the period January-March, 1986, EPA reported measured dose rates equivalent to annual doses of between 154 ± 47 mrem in Denver, Colorado and 62 ± 56 mrem in Harrisburg, Pennsylvania (EPA, 1986).

Because of the random nature of radioactive decay and the numerous contributors to background radiation levels, it is not possible to predict the exact background radiation in an area or to accurately differentiate the relative contributions from background and man-made sources. It is possible, however, to estimate typical background levels and also estimate background due to natural sources. To determine the contribution of RFP to the direct radiation levels in the vicinity of the plant, it is necessary to estimate the radiation level from non-RFP sources. One approach to this is to measure the radiation level at a location that is nearby but sufficiently removed from the plant that plant sources will not contribute significantly to the measurement. For RFP, radiation levels at Denver, Colorado, can be considered to be background. The major components of background radiation exposure are natural sources. There are four categories of natural sources of background radiation exposure: (1) cosmic radiation; (2) cosmogenic nuclides -- those radionuclides that are created by the interaction of cosmic radiation with the atmosphere, the earth's surface, or structures; (3) primordial nuclides (external) -- the external radiation exposure received from radionuclides that were created during the formation of the earth; and (4) primordial nuclides (internal) -- the radiation dose received from the ingestion or inhalation of primordial radionuclides and their decay products (primarily from inhalation of radon gas). Table 4-6 provides an estimate of the average annual natural background radiation dose for the Denver Metropolitan Area

TABLE 4-6

**ESTIMATED AVERAGE ANNUAL NATURAL BACKGROUND
RADIATION DOSE FOR DENVER METROPOLITAN AREA**

Source	Effective Dose Equivalent (rem)
Cosmic Radiation	0.050
Cosmogenic Nuclides	0.0015
Primordial Nuclides-External	0.072
Primordial Nuclides-Internal	0.1326
Total for One Year (Rounded)	0.26

Source: "Annual Environmental Monitoring Report, U.S. Department of Energy, Rocky Flats Plant, January through December 1985", Environmental Analysis and Control Section, Rockwell International, Golden, Colorado, RFP-ENV-85 (R1, 1986).

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(including RFP) (RI, 1986). Of the four sources listed, the primordial nuclides (internal) source does not contribute to the external or direct radiation dose; however, it is the major contributor to the total background radiation dose to members of the public.

As part of its Annual Environmental Monitoring Report, the Rocky Flats Plant is required to provide an assessment of the potential plant contribution to the public radiation dose (DOE, 1986). In 1985, the Department of Energy (DOE) adopted an interim environmental radiation protection standard to be implemented in calendar year 1985 (DOE, 1985). It is DOE policy to follow the guidance of the National Council on Radiation Protection and Measurements (NCRP) to the extent practicable with respect to radiation protection standards. A comprehensive revision of previous NCRP recommendations on a basic radiation protection system is still under development. However, current NCRP guidance is available regarding protection of the public in its September 18, 1984 advice to the Environmental Protection Agency published under the title "Control of Air Emissions of Radionuclides." In this document, the NCRP endorses the recommendation of the International Commission on Radiological Protection (ICRP) to limit the continuous exposure of any member of the public from other than medical sources and natural background to 100 mrem per year whole body dose equivalent. The previously recommended limit of 500 mrem per year is retained for non-continuous exposures. These recommendations are now adopted as interim standards for DOE environmental activities for all exposure pathways.

The ICRP has recommended calculating radiation dose using an approach that allows direct comparison of the effective dose for different organs by reflecting the distribution of, and organ sensitivity to, various radionuclides. This is accomplished by applying "weighting factors" to the doses received by individual organs. The weighting factors are expressed as the fraction of the total risk for the entire body attributable to the organ. The sum of the dose equivalents for the individual organs provides an estimate of the total effect of the radiation on the whole body. This is referred to as a whole-body dose equivalent. The NCRP, unlike the ICRP, has not as yet finalized its recommendations for limiting risk from radiation exposures on a basis of the whole-body dose equivalent. Pending other guidance from the NCRP, DOE deemed it appropriate to implement this concept, as embodied in ICRP Publications No. 26 et seq., for DOE environmental programs. Included with the interim standard was a revision of the dose conversion factor tables to be used for calculating dose from intakes of radioactive materials. These tables were utilized by the Rocky Flats Plant in assessing the plant contribution to the public radiation dose for 1985.

40 CFR 61.93 states that dose equivalents to members of the general public shall be calculated using EPA models AIRDOS-EPA and RADRISK, or other procedures, including those based on

environmental measurements, that EPA has determined to be suitable. Because of the complex terrain surrounding the Rocky Flats Plant, these codes are inappropriate; no dispersion code that is capable of accommodating a complex terrain has been accepted by EPA. Rocky Flats Plant is currently basing its dose assessments on actual monitoring data. This approach has been accepted for interim use by DOE's Albuquerque Operations Office, (Daugherty, 1986) which has requested its approval by EPA.

4.3.2 General Description of Pollution Sources/Control

The Rocky Flats Plant may contribute to the radiation dose to members of the general public through exposure to external gamma radiation, inhalation of contaminated airborne particulates, and ingestion of contaminated water. The sources and controls of radioactive materials that might lead to the latter two have been discussed in Sections 3.1 and 3.3. External gamma exposure could result from gamma-emitting radionuclides stored or handled at the Rocky Flats Plant site and gamma-emitting materials released from the plant and deposited on off-site properties. The plutonium used at the Rocky Flats Plant contains trace quantities of plutonium-241 (less than 0.5 percent), which decays to americium-241, a nuclide that emits a low-energy gamma ray in conjunction with its alpha decay. In addition, there will be some gamma radiation emitted from the depleted and enriched uranium handled on-site, but because of the low specific activity of the uranium isotopes present, this does not constitute a significant gamma source.

Aerial gamma radiation surveys of the Rocky Flats plant site have been conducted by EG&G, Inc. (EG&G, 1975). These surveys have indicated six areas with elevated gamma activity levels from americium-241: (1) Building 664 - Waste Storage and Shipping; (2) Building 440 - Modification Center; (3) Solar Evaporation Ponds; (4) 903 Area - Oil Drum Leakage; (5) Building 771 - Plutonium Recovery Facility; and (6) Cargo containers in the 700 area, near Building 771. Because of the low energy of the americium gamma ray, which is not highly penetrating, and the extended distance between the radioactive materials and the Rocky Flats Plant property line, these on-site materials do not contribute significantly to the off-site radiation dose.

Radioactive materials that are deposited on the soil surface as a consequence of past releases of radioactive materials could result in an external gamma exposure to an individual on contaminated lands. This is described as ground-plane irradiation. The extent of soil contamination resulting from the Rocky Flats Plant's releases is discussed in Section 3.2. Other than in on-site areas of maximum plutonium/americium soil contamination (primarily in the 903 Area, as discussed in Section 3.2), ground-plane irradiation is not a significant dose contributor.

4.3.3 Environmental Monitoring Program

A routine environmental monitoring program is in place to measure radionuclides in various media (see Sections 3.1.3, 3.2.3, 3.3.3, and 3.4.3). In addition, thermoluminescent dosimeters (TLDs) are used to measure the external penetrating gamma radiation exposure at 47 locations on and off the plant site. Replicate TLD's are located at each site for an exposure period of 3 months. The TLDs are located at 19 sites within the plant security fence, 16 perimeter sites 2 to 4 miles from the plant center, and in 12 communities located within 30 miles of the plant. The TLDs are placed 1 meter above ground level. The mean annual measured doses for the three location categories are shown in Table 4-7. The measured doses are not statistically different from backgrounds observed throughout the United States (EPA, 1985; 1986). The doses observed in the RFP monitoring program are at the levels of of background gamma radiation in the area.

Potential public radiation dose commitments, which could have resulted from plant operations, were calculated from average radionuclide concentrations measured at the DOE property boundary and in surrounding communities. Inhalation, water ingestion, and ground-plane irradiation are the principal pathways of exposure. Swimming and consumption of foodstuffs are considered insignificant pathways, since there is only limited swimming and fishing in the area and most of the locally consumed foodstuffs are produced at locations far from the plant (RI, 1986). Dose conversion factors used for the inhalation and water ingestion pathways were derived from the tables provided by DOE. The relative abundances of plutonium and americium isotopes in the plutonium used at Rocky Flats were used to calculate composite dose conversion factors for inhalation. The fractions of ingested radionuclides that are absorbed from the gastro-intestinal tract and the lung clearance classes for inhaled radionuclides were chosen to maximize the associated dose conversion factors. An inhalation rate of $2.66 \times 10^{-4} \text{ m}^3/\text{s}$ and a water ingestion rate of 2 liters (2.1 quarts) per day were derived from data for reference man and were included in the factors (ICRP, 1975). Each of the dose conversion factors used is for a 50-year dose commitment from one year of chronic exposure. Ground-plane irradiation dose conversion factors are from published data by D.C. Kocher (Kocher, 1981; 1983).

The inhalation source term is based on plutonium-239 and -240 concentrations measured in ambient air samples. Although a portion of the plutonium found in air is a consequence of residual fallout from past nuclear weapons tests, for the purposes of the dose assessment, it has been assumed that all of the observed plutonium originated from the Rocky Flats Plant. The ingestion source terms are based on measured concentrations of plutonium, americium, uranium, and tritium in water.

TABLE 4-7**ENVIRONMENTAL THERMOLUMINESCENT DOSIMETER MEASUREMENTS**

Location Category	Mean Annual Measured Dose (mrem)	95% Confidence Interval on the Mean (mrem) ^a	95% Confidence Interval on an Individual Measurement (mrem) ^b
On site	151	± 4	± 37
Perimeter	137	± 2	± 22
Community	153	± 5	± 39

a. Calculated as 1.96 standard deviations of the mean.

b. Calculated as 1.96 standard deviations of the individual measurements.

Source: "Annual Environmental Monitoring Report, U.S. Department of Energy, Rocky Flats Plant, January through December 1985", Environmental Analysis and Control Section, Rockwell International, Golden, Colorado, RFP-ENV-85. (RI, 1986)

Ground-plane irradiation source terms are based on measured values of plutonium activity in soil (Krey, 1976); the dose is received from the gamma rays from americium-241 in-growth in the Rocky Flats plutonium. As for the inhalation pathway, the ingestion source term assumes that all of the measured activity originates from the Rocky Flats Plant. By not subtracting the background contributions to the inhalation and ingestion source terms, the contribution of the Rocky Flats Plant to the public dose is being over-estimated.

The calculated value for the maximum site-boundary dose assumes that an individual is continuously present at the plant perimeter location where the maximum annual average concentration of plutonium in air is observed. This area is actually uninhabited. The calculation further assumes that this hypothetical individual obtains his entire water supply from Walnut Creek at Indiana Street, a plant effluent release point. Since this stream flows only intermittently and could not serve as the sole water supply for any individual, this assumption is conservative.

For the 1985 maximum community dose, the only significant pathway was found to be inhalation of plutonium in air (RI, 1986). The inhalation source term is based on the maximum annual average plutonium concentration measured in community air.

The Rocky Flats Plant contribution to the public radiation dose is calculated as the 50-year committed dose equivalent from 1 year of chronic intake/exposure. In addition, the organ-specific doses to the liver, bone surfaces, and lungs, are calculated. The maximum site boundary and maximum community doses are presented in Table 4-5. The DOE interim radiation protection standard for members of the public for prolonged periods of exposure is 0.1 rem/yr. The interim air emission standard is 7.5×10^{-2} rem/yr for any organ, for internally-deposited radionuclides. The maximum site boundary and maximum community effective equivalent doses are 0.6 percent, respectively, of the interim DOE standard. If all of the dose to the bone were obtained through the air pathway, the doses would be equivalent to 12 and 0.8 percent (for the maximum site boundary and maximum community, respectively) of the air emission standard for any organ.

It is informative to compare the calculated doses with the estimated natural background radiation dose for the Denver Metropolitan Area, summarized in Table 4-5 (RI, 1986). The estimated background effective dose equivalent is 0.26 rem/yr. The maximum site boundary and maximum community effective equivalent 50-year doses are only 0.23 and 0.01 percent, respectively, of the Denver area background. These doses do not contribute significantly to the public dose.

TABLE 4-8

FIFTY-YEAR COMMITTED DOSE EQUIVALENT FROM ONE YEAR
OF CHRONIC INTAKE/EXPOSURE

Source	Effective Dose Equivalent (rem)	Liver (rem)	Bone Surfaces (rem)	Lung (rem)
Maximum Site Boundary Location	6×10^{-4}	3×10^{-4}	9×10^{-3}	1×10^{-4}
Maximum Community	3×10^{-5}	1×10^{-4}	6×10^{-4}	6×10^{-5}

Source: "Annual Environmental Monitoring Report, U.S. Department of Energy, Rocky Flats Plant, January through December 1985", Environmental Analysis and Control Section, Rockwell International, Golden, Colorado, RFP-ENV-85, (RI, 1986).

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The dose commitment for all individuals, to a distance of 50 miles, may be based on the calculated maximum community dose assessments. The maximum community dose may be considered to be the upper limit to the eighty kilometer dose. The estimated committed effective dose equivalent and committed dose equivalents for each of the specific organs are all less than 1×10^{-3} rem. A level of "1 mrem/yr" or less is specified as a *de minimis* (Inconsequential) level of exposure in the DOE Guide entitled, "A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)." (DOE, 1980) The Guide states,

Radiation-induced mutations and diseases have not been discovered in populations that are or have been exposed to doses of 100 mrem/yr or less. Hence, it is reasonable to suggest that no health effects will be discerned if a population is exposed to an additional 1 percent of the level; i.e., 1 mrem/yr. An annual dose of 1 mrem should be regarded as a level which is clearly *de minimis*.

Based on the *de minimis* concept in the Guide and on the maximum community dose estimates, the dose commitment for all individuals to 80 kilometers is considered to be *de minimis*.

Dose assessments for the period 1981 through 1984 were comparable to those reported for 1985.

4.3.4 Findings

4.3.4.1 Category I

There are no direct-radiation-related Category I findings.

4.3.4.2 Category II

There are no direct-radiation-related Category II findings.

4.3.4.3 Category III

There are no direct-radiation-related Category III findings.

4.3.4.4 Category IV

1. Dose Assessments. Dose assessments are based on environmental monitoring data rather than AIRDOS-EPA or RADRISK codes as specified by 40 CFR 61.93. DOE's Albuquerque Operations Office has requested EPA approval of this approach, since these codes are not applicable to dispersion in the complex terrain surrounding the Rocky Flats Plant.

4.4 Quality Assurance

This section of the report discusses measures taken at RFP to ensure the production of accurate and precise environmental sampling and analytical data.

4.4.1 Background Information

Quality control (QC) includes all the means taken by an analyst or an analytical laboratory to make certain that the total measurement system, including the analyst's performance and matrix problems, are calibrated correctly or accounted for in all ensuing analyses. Quality assurance (QA) includes all the means taken within or beyond the laboratory to make certain that the measurement systems in different laboratories in a monitoring network remain in calibration with a common external standard, hence with each other. QA/QC seeks to assure that analyses of the same substances taken by different analysts at different times and places are of the same quality and are comparable within known statistical confidence limits (NBS, 1985).

4.4.2 General Description of Data Handling Procedures

RFP utilizes two on-site laboratories plus several outside contractor laboratories to generate environmental monitoring data. The two on-site laboratories are

1. Health Safety & Environmental Labs (Building 123) (HS & E).

- Responsible for in-vitro bioassay, thermoluminescent dosimetry, industrial hygiene samples, workplace and effluent air samples, and environmental monitoring samples, including radioactive and nonradioactive parameter measurements of air, water, soil, and occasional biota samples. The following analyses are routinely performed on environmental and effluent samples:

- (1) Total Air Filter Counting (Pu specific alpha).
- (2) Tennelec Air Filter Counting (Gross alpha & gross beta).
- (3) Gamma Spectral Analysis.
- (4) Alpha Spectral Analysis (Pu-239, -238, Am-241, U-238, -233, -234).
- (5) Beta Liquid Scintillation (Tritium).
- (6) Iodometric Titration (Chlorine).
- (7) Bacteria.
- (8) Atomic Absorption (Beryllium).

2. General Lab (Building 881).

- Provides environmental data for all routine water analysis parameters, including routine wet chemical testing, metals, and organics. The following analyses are performed on plant effluent streams, process wastes, and soil residues:
 - (1) Dissolved metallic elements, including tests for 31 cations by emission spectroscopic techniques, and 17 elements by atomic absorption techniques (including beryllium in airborne effluent sample filters).
 - (2) Oxygen demand tests, including total organic carbon, dissolved oxygen, chemical oxygen demand, and biological oxygen demand (5-day incubation).
 - (3) Nutrient tests, including free ammonia and amines, ortho and total phosphate phosphorus, nitrate and nitrite anions, Kjeldahl nitrogen, and total nitrogen.
 - (4) Physical tests, including pH, conductivity, color, total dissolved solids, suspended solids, turbidity, and specific gravity.
 - (5) Soap residues (as alkyl sulfonate).
 - (6) Oil and grease residues, by extraction and infrared or gravimetric detection, and by visual observation.
 - (7) Specific chemical species, including total hardness (as calcium carbonate), alkalinity (as hydroxide, bicarbonate, or carbonate), chloride, fluoride, cyanide, sulphate, and hexavalent chromium.

- (8) Radioactive species, including gross alpha and beta by gas proportional detection, tritium by liquid scintillation detection; radium, cesium-134, and strontium-89 or -90 by gravimetric separation followed by gas proportional detection. Isotopes of plutonium, americium, thorium, uranium, neptunium, and curium are determined by ion exchange and liquid extraction techniques followed by alpha pulse height analysis.
- (9) Organic toxic species, including Bromacil, Endrin, Lindane, methoxychlor, toxaphene, phenol, polychlorinated-biphenyls, 2,4-D, 2,4,5-TP (Silvex), and total organic halogen.

The outside contractor laboratories include

1. Weston Analytical Laboratories, Inc.

- Provides on-site mobile laboratory analyses of hydrogeological samples for routine wet chemistry and metals plus sample extractions for organics.
- Organic extracts are shipped to Weston laboratories in Lionville, Pennsylvania, or Stockton, California, for GC and GC/MS analyses.

2. Accu-Labs Research (Wheat Ridge, Colorado)

- Provides most environmental organic measurements requiring GC and GC/MS analyses, such as volatile organic compounds (VOCs) and pesticides.

Since the off-site outside contractor laboratories are participants in the Environmental Protection Agency's Contract Laboratory Program, they have already implemented detailed quality assurance/quality control programs, so no further survey of their programs was undertaken.

The following components of the RFP QA/QC program were addressed during the Survey:

Organization

Quality assurance/quality control program plans for both the HS&E Laboratories and the General Laboratory are documented. They include detailed breakdowns of laboratory activities and responsibilities. QA/QC coordinators in each laboratory are clearly specified. The QA/QC coordinator

of the HS&E Laboratories is responsible for laboratory QA as well as sampling, since the HS&E laboratory personnel perform virtually all environmental sampling with the exception of that provided by outside contractors (i.e., hydrogeological sampling). Sampling and analysis QA efforts have not been effectively integrated and coordinated until recently. Reportedly, sampling was such a serious problem that at times the General Lab data reports included disclaimers stating that the General Lab was not responsible for erroneous data caused by improper sampling techniques.

Salaried professional staff scientists review and approve all data at Rocky Flats. The RFP Chemistry Standards Group, a group independent of the RFP analytical laboratories, prepares and submits spiked and blind QA standard samples to the RFP laboratories.

The salaried professional staff, including the laboratory managers, are responsible for ensuring that chain-of-custody procedures are implemented. However, the HS&E Laboratories maintain a chain-of-custody only for highly radioactive samples, more out of safety considerations than to ensure sample integrity. As a matter of practice, the General Laboratory maintains more thorough chain-of-custody documentation. A revised sampling procedures manual, emphasizing chain-of-custody sample control, has recently been prepared and chain-of-custody procedures are beginning to be emphasized. On-site observations by the Environmental Survey team indicate that chain-of-custody procedures were inadequate, especially in the HS&E Laboratories.

Records

Both the HS&E Laboratories and the General Laboratory maintain their laboratory and sampling records in limited access areas. Depending upon the analytical measurement, raw data is retained for several months to several years after a final report has been issued. The final report is retained indefinitely, but the old raw data is usually destroyed. No consistency nor standard procedures for record maintenance were observed during the on-site Survey.

Sample logbooks are maintained in both the HS&E Laboratories and in the General Laboratory. While they are useful, these logbooks do not necessarily contain all specific information about a sample such as collection time and location or the dates of analysis and reporting.

The HS&E Laboratories reportedly maintain records of all calibration graphs or charts but these calibrations were not readily retrievable for examination due to the method of storage. The General Laboratory maintains adequate records of calibration information.

Few, if any, instrument maintenance records are maintained either in the HS&E Laboratories or in the General Laboratory.

Environmental Survey team review of some analyst's notebooks in the HS&E Laboratories generally revealed them to be adequately maintained. In the General Laboratory, laboratory notebooks were observed to be well-maintained.

Laboratory calibration standards are prepared by the Chemistry Standards Group, a group independent from the laboratory. Preparation of these standards was observed to be well-documented.

All laboratory chemicals used at RFP are of at least the purity specified in the analytical procedures. No spot checking of laboratory chemical purity is routinely performed by the RFP laboratories.

Sampling Procedures

A sampling schedule for select environmental discharges at RFP is presented in the Catalogue of Monitoring Activities at Rocky Flats (Setlock, 1986). A sampling procedures manual has recently been revised to be consistent with EPA-accepted and other recognized sampling protocols (e.g., ASTM). This manual reportedly was prepared as a result of frequent improper sampling procedures such as the use of incorrect sample containers, poor labeling, and inadequate preservation. Sample handling and transportation procedures are taught to RFP sampling personnel. These personnel must successfully pass a sampling competency test. Each employee receives repeat training and testing until he passes the competency test. The sampling procedure manual prescribes sample container cleaning and preparation, labeling, sample collection, sample preservation, sample storage conditions, and holding times.

Sample collection procedures describe proper sampling instrument maintenance and calibration, however, some records of such maintenance and calibration were observed by the Environmental Survey team to be incomplete and sometimes nonexistent.

Instruments

RFP laboratories do not prepare written maintenance procedures for each instrument used for sample analysis, preferring instead to utilize instrument maintenance procedures described in manufacturer's instrument manuals.

Laboratory instrumentation and equipment appear to be more thoroughly maintained in the General Lab than in the HS&E Laboratories. This impression may be influenced by the overall rundown condition of the HS&E Laboratories in Building 123. No formal instrument maintenance schedules and records are maintained in either laboratory. Informal maintenance or maintenance-as-required is the observed policy.

Each analytical procedure contains a detailed description of instrument calibration. The analyst is responsible for recalibrating an analytical instrument before sample analysis is attempted. Calibration procedures are as nearly identical to sample analysis procedures as is practical. Calibration frequency is specified in each analytical procedure. All calibration standards are traceable to the National Bureau of Standards or equivalent through the Chemistry Standards Group.

Reportedly, laboratory personnel are trained in instrument use by experienced analysts using instrument manufacturer's manuals and documented procedures as guides.

Analytical Procedures

Laboratory manuals, which detail each analytical procedure, are used in the RFP laboratories. The Catalogue of Monitoring Activities lists all analyses performed on environmental samples at RFP. All nonradioactive parameter monitoring procedures are reportedly consistent with EPA or other standard analytical methods. All procedures are periodically reviewed, usually on an annual basis, and modified as necessary in each RFP laboratory. Where non-EPA-approved procedures are used, RFP has not petitioned EPA regarding their acceptance.

The HS&E Laboratories rely upon the analyst to replace obsolete or modified procedures in his laboratory procedure manual. The General Laboratory requires the laboratory manager or his designee to replace obsolete or modified procedures in each analyst's procedure manual. The Environmental Survey team observed that the General Laboratory procedure manuals were generally better kept (e.g., up-to-date procedures) than those examined in the HS&E Laboratories.

Each analytical protocol describes the calibration procedure utilizing standards and blanks. As mentioned previously, all primary standards are traceable to the National Bureau of Standards or equivalent, and all reagents reportedly are at least of the quality specified in the procedures. New

reagents are not logged in at their time of arrival in the laboratories at present; however, the General Laboratory has indicated that it is preparing to implement this policy.

Written procedures specify the frequency of preparing fresh standards. The Environmental Survey team found that the HS&E Laboratories had numerous old, outdated standards on hand.

Internal Quality Assurance Procedures

Since most calculations are performed by calculator or computer, most calculations are not rechecked as long as they are not outside of expected ranges. Abnormal or unusual results are checked for proper calculation. Rocky Flats laboratories rely upon historical data trends and analysts' experience to signify reliability of analytical results.

There is no formal procedure for spiking samples either in the field or in the laboratory; however, the Chemistry Standards Group does supply periodic standard QA samples for laboratory analysis. These samples are not truly blind, since different sample containers are used to submit these QA samples to the laboratories for analysis. The HS&E Laboratories do not run any routine replicate samples, reportedly because of their already large sample load. The General Laboratory analyzes all samples in duplicate and reports the average value unless a wide variation indicates some problem such as sample nonhomogeneity. In such a case, another duplicate analysis of new homogenized samples would be performed.

The HS&E Laboratories analyze certified (Chemistry Standards Group-National Bureau of Standards) radioactive calibration standards to ensure the precision and accuracy of radiochemical measurements. The General Laboratory follows a more routine protocol for precision and accuracy using replicates and blind standards.

Monthly QA results are reported by the Chemistry Standards Group. These results are used by the HS&E Laboratories and by the General Laboratory to construct QA/QC control charts or control tables to monitor precision and accuracy. However, because no true blind samples are currently submitted from the Chemistry Standards Group, these QA/QC results are not of the highest reliability. The possibility of special treatment and handling of these samples exists as long as they can be distinguished from normal samples.

No written procedures to verify the recovery of a parameter over time were presented for review but the data summary tables presented to the Environmental Survey team indicated that such procedures exist.

Neither the HS&E Laboratories nor the General Laboratory currently utilize fully computerized laboratory data management systems, although such systems are reportedly being contemplated for calendar year 1987. The HS&E Laboratories do use a VAX computer system for the Environmental Monitoring Program data management, but it requires substantial manual data entry.

The General Laboratory was found by the Environmental Survey team to have good awareness of QA/QC and a comprehensive QA/QC program in operation. Laboratory operations and procedures were well-documented.

Education of Personnel

Sampling and laboratory analysis personnel at RFP must have at least a high school education, including 1 year of chemistry, physics, and/or math. Employment histories of each employee detail the educational and training qualifications for sampling and laboratory analysis work. Field and laboratory personnel are required to successfully complete a 3- or 4-year "progression" program during which they are trained in all technical aspects of sampling and analytical work at Rocky Flats. However, no specific precision and accuracy levels are required for analysts prior to being qualified for a job, completion of the progression program being sufficient. Professional judgment of the supervisory staff is useful in determining whether a person is fully qualified in sample analysis.

Outside Laboratory

As mentioned in the introduction to this section, environmental analyses for organics are generally sent to outside contract laboratories. All such samples are packaged and shipped according to U.S. Department of Transportation regulations.

No formal procedures from outside laboratories for the handling, storage, preservation, and chain-of-custody of samples were reviewed during the on-site Survey. Apparently, documentation exists but it was not readily retrievable. Hence, sample contamination or alteration must be considered a possibility for off-site sample analyses. However, because only reputable laboratories are used (e.g., all are participants in the EPA Contract Laboratory Program), such contamination and

alteration are expected to be unlikely. Chain-of-custody weaknesses are expected to be more of a problem prior to the sample leaving RFP than at the off-site analytical laboratory.

Outside contractor laboratories, since they are structured according to EPA Contract Laboratory Program guidelines, are expected to provide analytical data of Level 1 to Level 2 quality.

No QA/QC procedures for conducting a contract laboratory audit were available for review.

External Quality Assurance

The HS&E Laboratories participate in two laboratory intercomparison programs: (1) EPA's Environmental Monitoring Systems Laboratory (EMSL) Crosscheck Program and (2) DOE's Environmental Measurements Laboratory (EML) Crosscheck Program. Results of participation in these programs during 1985 are shown in Tables 4-9 and 4-10 (RI, 1987).

The General Laboratory participates in a voluntary USGS water standard analysis program on a biannual basis. Standard EPA compliance samples in support of the NPDES Monitoring Program are analyzed yearly to demonstrate laboratory performance.

The Albuquerque Operations Office of the Department of Energy periodically conducts Environmental Monitoring Appraisals of the RFP. The most recent such appraisal was conducted during May 19-23, 1986. Among the findings related to quality assurance were the following:

1. Some groups use loose-leaf notebooks to record environmental monitoring information and practices.
2. Old procedures or undocumented procedures are used during the rewriting and reissuance of procedures before they are implemented.
3. Laboratory samples are assigned an identification number which associates the sampling location to the sample number. This number gives the analyst a means to identify a sample location; hence, no samples are "blind."
4. The HS&E Laboratories procedures are in review/revision and many are reportedly awaiting typing.

TABLE 4-9

HEALTH, SAFETY AND ENVIRONMENTAL LABORATORIES PARTICIPATION
IN THE EPA ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
CROSSCHECK PROGRAM DURING 1985

Isotope Reported	Matrix	Method	Number of Analysis Reported	Relative Percent Error
Gross Alpha	Water	Zinc Sulfide Scintillator	4	-.3
Zn-65	Water	Gamma Spectral	2	1.53
Cs-134	Water	Gamma Spectral	2	-1.2
Cs-137	Water	Gamma Spectral	3	1.26
H-3	Water	Beta Liquid Scintillation	2	1.11
Gross Alpha	Water	Zinc Sulfide Scintillator	1	4.15
Co-60	Water	Gamma Spectral	1	1.15

Source: "Annual Environmental Monitoring Report, U.S. Department of Energy, Rocky Flats Plant, January through December 1985", Environmental Analysis and Control Section, Rockwell International, Golden, Colorado, RFE-ENV-85, April 25, 1986, (RI, 1986).

TABLE 4-10

**HEALTH, SAFETY AND ENVIRONMENTAL LABORATORIES PARTICIPATION
IN THE DOE ENVIRONMENTAL MEASUREMENTS LABORATORY
CROSSCHECK PROGRAM DURING 1985**

Isotope Reported	Matrix	Method	Number of Analysis Reported	Relative Percent Error
Co-60	Filter	Gamma Spectral	2	.84
Cs-137	Filter	Gamma Spectral	2	1.11
Co-60	Soil	Gamma Spectral	1	1.21
Cs-137	Soil	Gamma Spectral	1	1.43
U-238	Soil	Alpha Spectral	1	.84
Cs-137	Tissue	Gamma Spectral	1	.92
Th-228	Tissue	Gamma Spectral	1	1.81
Pu-239	Tissue	Alpha Spectral	1	1.08
U-234	Tissue	Alpha Spectral	1	1.69
U-238	Tissue	Alpha Spectral	1	3.75
Co-60	Vegetation	Gamma Spectral	1	.86
Cs-137	Vegetation	Gamma Spectral	1	1.04
Pu-239	Vegetation	Alpha Spectral	1	1.07
Co-60	Water	Gamma Spectral	2	1.04
Cs-137	Water	Gamma Spectral	2	1.21
H-3	Water	Beta Liquid Scintillation	1	2.05
Mn-54	Water	Gamma Spectral	1	1.12
Ce-144	Water	Gamma Spectral	1	1.18
Cd	Deionized Water	Atomic Absorption	1	1.07
Mn	Deionized Water	Atomic Absorption	1	.83
Pb	Deionized Water	Atomic Absorption	1	1.04
Zn	Deionized Water	Atomic Absorption	1	1.03
Cd	Lake Water	Atomic Absorption	1	1.06
Mn	Lake Water	Atomic Absorption	1	.84
Pb	Lake Water	Atomic Absorption	1	1.13
Zn	Lake Water	Atomic Absorption	1	1.06

Source: "Annual Environmental Monitoring Report, U.S. Department of Energy, Rocky Flats Plant, January through December 1985", Environmental Analysis and Control Section, Rockwell International, Golden, Colorado, RFP-ENV-85, April 25, 1986, (RI, 1986).

5. No formal QA program for the VAX computer system in the HS&E Laboratories.
6. Due to reorganization and lack of internal audits since July 1984, the HS&E Laboratories should undergo an external audit to determine whether the laboratory program is technically defensible and complete.

It has been reported to the Environmental Survey team that RFP is in the process of arranging for an independent outside audit of the HS&E Laboratories in the near future (Daugherty, 1986).

4.4.3 Findings

4.4.3.1 Category I

There are no quality-assurance-related Category I findings.

4.4.3.2 Category II

There are no quality-assurance-related Category II findings.

4.4.3.3 Category III

There are no quality-assurance-related Category III related findings.

4.4.3.4 Category IV

1. Quality Assurance Documentation - HS&E Laboratories. There is not sufficient documentation to support the validity of environmental data. The HS&E Laboratories in Building 123 were found to have a poorly documented QA program, which has been recognized, and for which improvement is anticipated. Observations by the Survey team revealed inadequate laboratory and QC practices and poor housekeeping. Laboratory management and personnel are aware of the importance of QA/QC but state that they do not have time to spend on QA/QC due to the large sample load. Nonexistent or inadequate documentation are the most obvious weaknesses in the HS&E Laboratories. The Environmental Survey team found no confirmed evidence of invalid data but current QA/QC is insufficient to defend validity of data. Analytical data generated in the HS&E Laboratories are not expected to be erroneously low or falsely negative mainly on the basis of the existence of

corroborative data collected by the State of Colorado and exchanged during monthly meetings, and external quality assurance interlaboratory comparison programs.

4.5 Inactive Waste Sites and Releases

This section of the report deals with inactive waste sites and releases, their locations, and their potential or actual effects on the environment.

4.5.1 Background

The Environmental Survey has identified 10 sites considered to be existing or possible sources of significant environmental contamination as a result of past waste disposal and releases (including spills and leaks). The identification of these sites was based on an independent review of environmental records, personnel interview files, aerial photographs, discussions with plant personnel, and site inspections. A discussion of most of these sites is already provided in several documents, including

- Final Environmental Impact Statement, Rocky Flats Plant Site (DOE, 1980)
- Comprehensive Environmental Assessment and Response Program (CEARP); Draft Phase 1 - Installation Assessment, and Draft Phase 2 - Installation Generic Monitoring Plan (DOE, 1986)
- Rocky Flats Plant 1986 Waste Management Site Plan (RI, 1986)
- Compliance Agreement (EPA, 1986)
- Final Environmental Impact Statement, Rocky Flats Plant Site (DOE, 1980)

In compliance with DOE Order 5480.14, the Albuquerque Operations Office has implemented the Comprehensive Environmental Assessment and Response Program (CEARP) to identify and assess whether past waste management and disposal practices may have resulted in environmental problems. The program will also identify and implement remedial action as appropriate. The CEARP Draft Phase 1 - Installation Assessment for the Rocky Flats Plant was completed on April 24, 1986.

The CEARP will support, as appropriate, other DOE environmental studies that are required to meet a July 31, 1986, compliance agreement and order on consent with EPA Region 8 and the Colorado Department of Health. The purpose of this agreement is to resolve issues related to mixed (radioactive and hazardous) wastes and hazardous wastes at Rocky Flats. The DOE has agreed among other things, to take actions related to site characterization and corrective actions for solid

waste management units and for releases and threatened releases of "hazardous substances, pollutants, or contaminants" as defined by CERCLA (Comprehensive Environmental Response, Compensation and Liability Act).

4.5.2 General Description of Pollution Sources/Controls

The Rocky Flats Plant is currently proposed for listing on the National Priorities List (EPA, 1987) because at least one individual site at the plant received a Hazard Ranking System (HRS) score greater than 28.5. Three sites received HRS scores greater than 28.5. Two of the three sites are identified later in this section. The third, identified as groundwater, is discussed in Section 3.4.2, General Description of Pollution Sources/Control.

Ten sites at Rocky Flats are considered to be existing or possible sources for significant environmental contamination. These sites are believed to contain radioactive and/or hazardous substances as a result of past waste disposal practices and plant operations. Other known waste burial and release sites at Rocky Flats (identified in CEARP Phase 1) are of potential environmental concern but are of less immediate importance than the sites identified below. The 10 sites of primary concern are

- Original landfill
- Present landfill
- Solar evaporation ponds
- 881 Hillside
- Trenches
- 903 Pad/Mound Area
- Area north of Building 371
- Abandoned Process Waste Water Collection System
- Active Aboveground and Inactive Underground Carbon Tetrachloride Tanks around Building 776
- Former Chemical Storage Site East of Building 551

The selection of these sites was based in part on known wastes that were buried and/or spilled at these areas, and the likely mobility of these waste contaminants in soil and water (i.e., surface and groundwater). Also, a preliminary review of recent hydrogeologic and geophysical data strongly suggests that some of these areas in particular may already be general sources for off-site contaminant migration at Rocky Flats (refer to Section 3.4, Hydrogeology).

Following is a brief overview of the sites. For each site, the location and past waste disposal practices and spill/leak incidents are described. Several of the site descriptions have been taken from the CEARP Phase 1 report. For the Interim report, a facility site plan will be included to identify the location of areas of inactive waste disposal and releases that are discussed in this report. Unless otherwise noted, the sites identified below are proposed under CEARP for either supplemental reconnaissance field study (Phase 1) or site characterization (Phase 2). As necessary, site characterization may be initiated instead by Rocky Flats (in lieu of CEARP) in order to meet regulatory compliance schedules with EPA and the state.

Original Landfill

The original landfill is located south of the Building 460 area and outside the security fenced area. It is situated along a steep embankment north of the Interceptor ditch that flows east to Woman Creek. The landfill measures approximately 124 x 400 feet and has an estimated volume of 2 million cubic feet.

From 1952 to 1968, the landfill was used to dispose of general plant wastes, including radioactive and probably hazardous substances. About 44 pounds of depleted uranium ash were disposed in this landfill (Owen, 1973). Persons interviewed have indicated that this landfill may have also received nonradioactive wastes generated at the plant, including solvents and possibly beryllium (DOE, 1986).

There is no detailed information (e.g., trip logs, waste manifests) available regarding the contents of this landfill. When the Building 460 outfall was excavated and repaired in the summer of 1986 it was believed that low-level radioactive wastes may have been uncovered during the excavation of the collapsed pipe sections (Illsley, 1986). Documentation could not be found by the Environmental Survey team to confirm or refute this report.

The following text provides additional background on the Building 460 outfall.

In 1984, an outfall was constructed for the Building 460 drainage system. This outfall cut directly through the landfill and discharged drainage water down the steep face of the landfill and into an Interceptor ditch. The landfill was already known to be susceptible to slumping due to the seeps along the toe (Fitzsimmons, 1986). This condition weakens the stability of the landfill. The potential for structural damage to the outfall as a result of an unstable soil foundation was recognized prior to

the construction of the outfall and a decision was made to accept this risk (Draft Finding Incident Report, 1986).

On July 20, 1986, an intense localized storm occurred at Rocky Flats and caused major flooding at several nearby buildings. Either prior to or during this storm, the landfill experienced a major slump, causing two intermediate sections of outfall pipe to separate and sink into the ground about 4 feet. As a result, the dirt collapsed around these failed sections and the outfall became at least partially blocked (Draft Finding Incident Report, 1986).

The week following the storm, repairs were made to the damaged outfall in the landfill. The damaged pipe section was replaced with corrugated steel pipe. The new pipe is supported and anchored by steel beams driven into the undisturbed soil below the landfill. Concrete endwalls were also constructed to anchor both ends of the repaired outfall. Drainage water now is discharged from the outfall (at the downstream endwall) onto a concrete spillways which then connects to a semi-circular steel corrugated tailpiece (about 60 feet in length) and extends approximately two-thirds of the way down the steep face of the landfill. At this point, water is freely discharged down the uncompacted and unvegetated face of the landfill.

Inspection of the landfill by the Environmental Survey team on August 18, 1986, revealed that slumping continued to be a problem near the top and appeared to be progressing up the face of the landfill. The outfall tailpiece appeared twisted and misaligned because the supporting soil foundation was also slumping and eroding. Also, the concrete spillway has separated from the endwall and has moved down the hillside by a distance of approximately 3 inches.

Present Landfill

The present landfill (also referred to as the active landfill) is located on the north side of the plant about 900 feet outside the security fenced area. The landfill area is approximately 30 to 40 acres.

The landfill began operating in 1968 when the original landfill was terminated. In 1974, the present landfill was expanded. Leachate from the landfill is collected in a pond immediately downstream and is periodically spray irrigated. (See Section 4.1.1.4, Non-hazardous Wastes.)

An estimated 9 million pounds of waste are disposed annually at this landfill. Persons previously interviewed (DOE, 1986) indicated that this landfill may have received a variety of organic and inorganic materials, including solvents, paints, chromates, and electro-discharge machining fluid.

Until about six months ago, access to the landfill was unrestricted and outside contractors working at RFP were known to discard waste material (of unknown nature and quantity) into the landfill (Illsley, 1986). Construction debris and discarded asbestos insulation are also disposed in the landfill. The landfill received about 2,200 pounds of sanitary sewage sludge between 1968 and 1970. This sludge is suspected to have contained heavy metals and radioactivity. Leachate has reportedly contained tritium and long-lived alpha radioactivity (DOE, 1980).

The present landfill is one of the three sites that received an HRS score greater than 28.5. This site was assigned an HRS score of 34 (DOE, 1986).

Solar Evaporation Ponds

The solar evaporation ponds are located at the northeast corner of the plant inside the Perimeter Security Zone (PSZ). The 207 Series solar evaporation ponds (i.e., 207-A, 207-B, and 207-C) were constructed over an extended period of time, beginning in the 1950s. The ponds were primarily used to store and volume reduce, by natural evaporation, low-level radioactive process wastes containing high nitrates and treated acid wastes containing aluminum hydroxide. Other wastes included lithium metal, sodium nitrate, ferric chloride, lithium chloride, sulfuric acid, ammonium persulfate, hydrochloric acid, nitric acid, hexavalent chromium, cyanide, sanitary sewage sludge, and radioactive liquid wastes from the beagle dog studies conducted at the Colorado State University. Oils and solvents reportedly have been kept out of the ponds to prevent the formation of surface scum which could hamper evaporation.

Originally at this site, there was a clay-lined pond near Building 779 that held effluent from the treatment of liquid wastes in Building 774. The effluent was thick with aluminum hydroxide and difficult to filter. The effluent was frequently solidified with cement and shipped off-site (reportedly to the Nevada Test Site). Pond A was constructed later to hold this effluent prior to treatment and shipment. Pond A was lined with planking and asphalt; however, the pond subsequently leaked because the bottom liner buckled. Ponds B - North, Center, and South were constructed in 1960 to provide additional storage. These ponds were also constructed with asphalt over planking. On hot days, the asphalt cement would slide and crack and eventually allowed leakage. Pond C was constructed in 1970 (over the original clay-lined pond) to provide additional storage. This pond has not been known to leak.

Today, these ponds no longer receive process wastes, although Ponds 207-A and 207-C would be used to store liquid wastes if Building 374 was to shut down under an emergency situation. The

sludge from Pond 207-A is currently being removed and processed into "pondcrete," a low-level mixed solid waste. All three of the 207-B ponds were emptied of wastes in the early 1980s and the sludges removed and shipped to the Nevada Test Site. Planned improvements include the installation of new storage tanks to receive excess process liquid and to provide emergency storage capacity. After these tanks are installed, all of the ponds will be closed. Closure and post-closure plans are currently being prepared in accordance with the terms of the compliance agreement.

During the history of pond operation, leakage has been observed. To prevent pond leakage from entering the North Walnut Creek drainage, a series of two groundwater interceptor trenches were constructed. These trenches and a pump system intercept and collect pond seepage and return the water to Pond 207-B North, or to the other ponds as necessary. The intercepted groundwater contains slightly elevated concentrations of alpha and beta radioactivity. The major chemical constituent is nitrate, at concentrations ranging from 500 to 800 mg/l. Additionally, samples taken in 1982 from the intercepted groundwater revealed trace concentrations (2 to 3 ppm) of chloroform and trichloroethylene (RI, 1985), and the presence of cadmium, lead, nickel, selenium, and thallium.

The solar evaporation ponds are one of the three sites that received an HRS score greater than 28.5. This site was assigned an HRS score of 46 (DOE, 1985).

881 Hillside

The 881 Hillside (approximately 15 acres) is an aggregation of five inactive waste disposal and spill sites co-located on a hillside that extends both south and east from Building 881. The hillside is also bordered on the south by a service road and an interceptor ditch which flows eastward to Woman Creek. The hillside area is mostly located inside the security fenced area. A brief description of each of the 881 Hillside sites follows.

- An area east of Building 881 was used to dispose of 320 tons of plutonium-contaminated soil (about 7 d/m/g alpha activity) from the Building 776 fire (1969) and to dispose of approximately 60 cubic yards of plutonium-contaminated soil (about 250 d/m/g alpha activity) from the Building 774 waste storage tank area. The contaminated soil was then covered with approximately 3 feet of soil and fill material (Owen, 1973).
- There is an area east of Building 881 that was reportedly used for dumping liquids and for disposing and burying empty drums (nature and quantity of waste unknown). This activity took place some time prior to 1969, according to people interviewed (DOE, 1986).

- In 1973, a major oil leak (unknown quantity) occurred immediately south of Building 881 (which is located at the top of the 881 Hillside). The source of this leak was believed to be the underground fuel storage tanks immediately south of the building. Fuel oil seeped down the hillside. Straw was used to limit the spread of the oil. Afterward, the leak was repaired and the contaminated soil was removed and taken to the Present Landfill (Owen, 1973). It is unknown whether oil-contaminated soil remains around the tanks or within the 881 Hillside as a result of this fuel leak.
- An area south of Building 881 was used as a oil sludge pit in 1958. Approximately 30 to 50 drums of oil sludge from cleaning storage tanks were emptied into the pit (Owen, 1973). It was covered when this disposal operation ceased. The concentration of the oil residues at this site is unknown.
- Persons interviewed (DOE, 1986) indicated that an area south of Building 881 also may have been used to bury unknown types and quantities of chemicals. No documentation could be found to verify this alleged practice.

Trenches

There are eleven burial trenches on the east side of the plant where low-level radioactive wastes, oils, and solvents are known to have been disposed. Other wastes (nature and quantity unknown) may have been buried as well. The trenches (numbered 1 through 11) are located both inside the security fenced area (trenches 1 and 2) and outside (trenches 3 through 11). Trench perimeters are identified in the field with metal corner stakes. Following is a brief description of the trenches.

- Trench T-1 is located north of Central Avenue and immediately west of the East Guard Gate. It was used from 1952 to 1962, and contains 125 drums filled with depleted uranium chips coated with small amounts of lathe coolant (a mixture of about 70 percent hydraulic oil and 30 percent carbon tetrachloride). This trench was covered with about 2 feet of soil (Owen, 1973). Two drums were uncovered when weeds were cut in 1982; one drum was found to contain an oily sludge with 4.3 picoCuries per gram of plutonium and 2.5 microCuries per gram of uranium (DOE, 1986).
- Trench T-2 is located within the 900 Area, south of the 903 drum storage area (i.e., 903 Pad) and west of the former reactive metal destruction-site. This trench measures

about 50 x 300 feet and was used prior to 1968 for the disposal of sanitary sewage sludge, and flattened drums contaminated with uranium and plutonium (Owen, 1973).

- Trench T-3 is located east of the East Access Gate (Gate 9) and outside the security fence. This trench measures about 50 x 300 feet and was used prior to 1968 for the disposal of flattened drums contaminated with uranium and plutonium. This trench also received substantial quantities of sanitary sewage sludge (Owen, 1973).
- Trenches T-4 through T-11 are located east of the East Access Gate (Gate 9) and outside the security fence. These trenches, approximately 50 x 300 feet each, were used from 1954 to 1968 for the disposal of flattened drums contaminated with uranium and plutonium. Radioactivity of the buried wastes ranges from 800 to 8,000 d/m/g. Trenches T-4 and T-11 also contain some uranium/plutonium-contaminated asphalt plating from the solar evaporation ponds and unknown quantities of sanitary sewage sludge (Owen, 1973).

903 Pad/Mound Area

The 903 Pad/Mound Area refers to four separate waste disposal and/or spill sites located at the east side of the plant inside the security fenced area. These areas are known or suspected to have been storage or disposal sites for radioactive wastes, oil sludges, solvents, and possibly other waste contaminants. The 903 Pad/Mound area possibly contains wastes similar to those in the "trenches." Following is a brief discussion of the four sites identified within the 903 Pad/Mound area.

- The 903 Pad (903 Drum Storage Area) is located south of Central Avenue. Prior to 1967, it was used to store about 5,240 drums of spent machine cutting oil (i.e., lathe coolant that is a mixture of about 70 percent hydraulic oil and 30 percent carbon tetrachloride). Approximately 3,570 of these drums contained plutonium. During storage, the soil around the pad area became contaminated from leaking drums. Between 1967 and 1968, all the drums were removed. The waste oil was taken to Building 774 for treatment. The drums and waste sludge were shipped off-site to the Idaho National Engineering Laboratory for disposal. After the drums were removed, efforts were undertaken to scrape the ground and move the plutonium contaminated soil onto a relatively small area, cover it with fill material, and top it with an asphalt containment cover. This work was completed in November 1969. Measurements in 1970 indicated that an estimated 11.4 Ci of plutonium leaked into the soil before the drums were removed, most (about 8.6 Ci) of which remained on-site (DOE, 1980). It is also estimated that about 1.7 Ci of plutonium

remains beneath the asphalt pad (Owen, 1973; Krey, 1975). Mineral oil and solvents may also remain in the soil from previously leaking drums which contained lathe coolant.

- The Mound Area is located near the East Guard Gate. It was used as a waste burial site and at one time contained 1,405 drums filled with depleted uranium and beryllium wastes. The wastes were mostly solid; however, some drums were filled with lathe coolant. Cleanup of the mound area was completed in 1970, and the materials removed were shipped off-site to the Idaho National Engineering Laboratory. Subsequent soil sampling in the vicinity of the excavated mound area indicated 0.8 to 112.5 d/m/g alpha activity. This radioactive contamination is suspected to have come from the 903 Drum Storage Area rather than from the Mound Area (Owen, 1973). A limited quantity of mineral oil and solvents, along with the alpha contamination, may remain in the soil from leaking lathe coolant.
- Locations along the perimeter road south of the old East Guard Gate (Gate 2) were used as solvent storage areas. Persons interviewed (DOE, 1986) indicated that there may have been multiple leaks or spills. Also, at one time the perimeter road received a top dressing of "used" motor oil for dust control (a practice that has been discontinued). It is not known if solvents or oil residues remain in the soil at this site.
- An oil burn pit was located north of the 903 Drum Storage Area and Central Avenue. This pit was used in 1957, and again from 1961 to 1965 to burn approximately 1,083 drums of oil containing uranium. The residues from the burning operations and some flattened drums were covered with backfill. The pit was subsequently cleaned up during the 1970s (DOE, 1986). This site has been proposed for Phase 5 under CEARP, which will verify and document that the previous remedial action has adequately removed the environmental contaminants.

Area North of Building 371

Recent Environmental Survey data (see Section 3.4, Hydrogeology) suggest that an area north of Building 371 (perhaps inside and/or outside the fenced area) may be a general source of contaminant migration (i.e., high specific conductivity). There is no known active or inactive waste disposal or release site(s) in this general area. Building 371 was constructed as the site for plutonium recovery operations in 1981. There are several small buildings north of Building 371 that provide general support services to Building 371. Otherwise, the area north of Building 371 is undeveloped.

Plant personnel (Illsley, Greengard, Panton, 1986) interviewed could not provide a reasonable explanation for the apparent contaminant migration which seems to originate from this general location. This area was not identified in the CEARP Phase 1 report as a known or suspected inactive disposal or spill site. The report likely predated recent environmental data that indicate this area as being a possible source of environmental contamination. However, CEARP will consider this area in future studies.

Abandoned Process Wastewater Collection System

RFP's old process waste collection system consisted of waste lines and holding tanks. Seventeen of the holding tanks are still in place and are included in DOE's underground storage tank inventory. Fourteen are made of concrete, two are made of steel and installed with no cathodic protection, and one is made of stainless steel. All are more than 15 years old. Based on their age and material of construction, all could have been deteriorated and leaking before being taken out of service.

At the time of the DOE Environmental Survey, RFP had no immediate plans to remove additional elements of the abandoned collection system or to conduct any sampling and analysis to investigate if the system leaked in the past or is a current source of contamination.

Active Aboveground and Inactive Underground Carbon Tetrachloride Tanks around Building 776

An active aboveground carbon tetrachloride tank is located within a diked area south of Building 776. This 5,000 gallon storage tank reportedly ruptured (DOE, 1986) in June 1981, releasing an unknown quantity of solvent onto the ground. There is also an inactive 5,000-gallon underground storage tank located north of the Building 776 compressor house. This tank is abandoned and valved off. It has not been flushed. It reportedly overflowed in the 1970s during tank filling operations. There were also reports of small leaks and spills from this tank (DOE, 1986).

Former Chemical Storage Site East of Building 551

Prior to the mid-1970s, a nonradioactive chemical storage area reportedly existed east of Building 551. This area was used to store drums of acids, oils, soaps, and solvents. It is possible that leaks may have occurred in this area and the soil could be contaminated (Owen, 1973). This area was paved over sometime during the 1970s.

4.5.3 Findings

Except for the solar evaporation ponds, the sites identified below have been recommended by the Environmental Survey team for sampling and analysis. Samples will be analyzed for contaminants such as organics, heavy metals, and/or radionuclides, depending on the site's history. A site characterization has been already initiated at the solar evaporation ponds, and therefore no further sampling is recommended by the Environmental Survey team.

4.5.3.1 Category I

There are no Category I findings for inactive waste sites or releases.

4.5.3.2 Category II

1. Building 460 Outfall/Original Landfill. The discharge from the outfall for Building 460 may be washing waste contaminants from a known inactive landfill into the surface water and groundwater. The outfall cuts directly through the landfill (i.e., the "original landfill") and discharges storm water onto the downsloping face of the landfill. The landfill is located on a steep (approximately 30 to 40 degree slope) hillside south of Building 460. It was operated from 1952 to 1968 for the disposal of general plant wastes, depleted uranium ash, and possibly organic solvents and beryllium. The landfill is unlined and uncapped:

The landfill is already slumping and eroding along the lower third of the hillside. Uncovered and exposed wastes (e.g., hand tools, carbon molds, metal turnings) are clearly visible along this region.

Uncontrolled surface runoff and infiltration appear to be worsening the slumping and erosion. Surface runoff from the landfill flows into an interceptor ditch that is located near the base of the landfill and discharges into Woman Creek. Contaminants from the exposed waste area can be washed away by the runoff into the interceptor ditch. Water can also infiltrate the uncompacted soil surface and percolate into the buried wastes. Dissolved contaminants can leach from the buried wastes and infiltrate the groundwater. Seeps are evident at the base of the landfill.

In July 1986, a section of the outfall collapsed and sank approximately 4 feet into the landfill as a result of a storm event. The fact that the outfall was later repaired and fortified to continue discharging storm water onto the surface of the inactive landfill raises a serious concern. No

apparent attention has been given toward protecting the landfill from continued erosion and slumping by water runoff and infiltration.

4.5.3.3 Category III

1. Original Landfill. The original landfill, located south of the Building 460 area and outside the security fenced area, may be a possible source of groundwater and surface-water contamination. The landfill, which is located on a steep hillside, is experiencing slumping and erosion. Uncovered wastes near the base of the landfill include hand tools, metal turnings, and carbon molds. Contaminants from the exposed wastes can be washed away by runoff into an interceptor ditch near the base of the landfill. Water can also infiltrate the uncapped landfill and percolate into the buried wastes. Dissolved contaminants can leach from the buried wastes and infiltrate the groundwater. Seeps are evident at the base of the landfill.

2. Present Landfill. The present landfill may be a possible source of groundwater contamination. This site is addressed in Section 3.4.4.3, Category III Findings for Groundwater, and Section 4.1.3.3, Category III Findings for Waste Management.

3. Solar Evaporation Ponds. The solar evaporation ponds may be a possible source of groundwater contamination. This site is addressed in Section 3.4.4.3, Category III Findings for Groundwater.

4. 881 Hillside. The 881 hillside may be a possible source of soil and groundwater contamination. The 881 hillside is an aggregation of five inactive waste disposal and release sites co-located on a hillside that extends both south and east from Building 881. Wastes buried, dumped, and released along this hillside include plutonium-contaminated soil, fuel, oil, oil sludge, and unknown hazardous chemicals. The hillside is uncapped and unlined, but vegetated. Wastes that have been buried or dumped at this site have contaminated the soil. Water can infiltrate the soil cover and percolate into the underlying wastes. Contaminants can leach from the wastes and infiltrate the groundwater. (This site is also discussed in Section 3.4, Hydrogeology.)

5. Trenches. The trenches may be a possible source of groundwater contamination. There are 11 buried trenches (designated T-1 through T-11) on the east side of the plant where low-level radioactive wastes, oils, and solvents are known to have been disposed. The trenches are unlined and uncapped, but vegetated. Water can infiltrate through the soil cover and percolate into the underlying wastes. Contaminants can leach from the wastes and infiltrate the groundwater.

The trenches are known to have received sanitary sewage sludges and drums containing plutonium and uranium contaminated wastes, including lathe coolant (i.e., 70 percent hydraulic oil and 30 percent carbon tetrachloride).

6. 903 Pad/Mound Area. The 903 Pad/Mound Area may be a possible source of soil and groundwater contamination. This area refers to four separate waste disposal and/or release sites located in the same general area at the east end of the plant. These sites are known or suspected to have been disposal and/or release sites for low-level radioactive wastes, oil sludges, solvents, and possibly other waste contaminants. In general, wastes that have been dumped, burned, buried, or released at these sites have contaminated the soil. Also, water can infiltrate these sites and percolate into the underlying wastes. Contaminants can leach from the wastes and infiltrate the groundwater. (This area is also discussed in Section 3.4, Hydrogeology.)

The four sites of the 903 Pad/Mound Area are

- The 903 Pad (903 Drum Storage Area), located south of Central Avenue. Prior to 1967, it was used to store about 5,240 drums of spent machine cutting oil. Approximately 3,570 of these drums contained plutonium. During storage, the soil around the pad area became contaminated from leaking drums. There are no provisions to divert surface runoff around the 903 Pad. Measurements in 1970 indicated that an estimated 11.4 Ci of plutonium leaked into the soil before the drums were removed, most (about 8.6 Ci) of which remains on-site (DOE, 1980). It is also estimated that about 1.7 Ci of plutonium remains beneath the asphalt pad (Owen, 1973; Krey, 1975). Mineral oil and solvents may also remain in the soil from previously leaking drums which contained lathe coolant.
- The Mound Area is located near the East Guard Gate. It was formerly used as a waste burial site (unlined) and at one time contained 1,405 drums filled with depleted uranium and beryllium wastes. The wastes were mostly solid; however, some drums were filled with lathe coolant. Cleanup of the mound area was achieved in 1970, and the materials removed were packaged and shipped off-site to a DOE disposal facility as radioactive waste. A limited quantity of mineral oil and solvents, along with the alpha contamination, may remain in the soil from leaking lathe coolant. The site is uncapped.

- Locations along the perimeter road south of the old East Guard Gate (Gate 9) were used as solvent storage areas.
- A oil burn pit was located north of the 903 Drum Storage Area and Central Avenue. This unlined pit was used in 1957 and from 1961 to 1965 to burn approximately 1,083 drums of oil containing uranium.

7. Area North of Building 371. Recent data suggest that an area north of Building 371 (perhaps inside and/or outside the fenced area) may be a possible source of groundwater contamination. There is no known inactive waste disposal or release site in this general area. Field studies suggest this area is a possible source of high specific conductivity in the groundwater.

Building 371 was constructed and used for plutonium operation, beginning in 1981. There are several small buildings north of Building 371 which provide general support services to Building 371. (This site is also discussed under Hydrogeology - Section 3.4.3, Environmental Monitoring Program.)

8. Abandoned Process Waste Water Collection System. RFP's abandoned process wastewater collection system may have leaked while in service and contaminated area soils and groundwater. Elements of this system that have not been removed could also be an existing source of contamination. The nature of contamination could be both radioactive and chemical. RFP's old process waste water collection system consisted of waste lines and holding tanks. Seventeen of the holding tanks are still in place and are included in DOE's underground storage tank inventory (Table 4-11). Fourteen are made of concrete, two are made of steel and installed with no cathodic protection, and one is made of stainless steel. All are over 15 years old. Based on their age and/or material of construction, all could have been deteriorated and leaking before being taken out of service.

At the time of the Environmental Survey, RFP had no immediate plans to remove additional elements of the abandoned collection system or to conduct any sampling and analysis to investigate if the system leaked in the past or is a current source of contamination.

The Environmental Survey team chose to investigate three of the abandoned waste holding tanks. Tanks 429-1, 728-1, and 728-2 contain groundwater. Groundwater could become contaminated as it passes through these tanks.

TABLE 4-11

INACTIVE UNDERGROUND WASTE TANKS

Inventory Number	Age (Years)	Date Retired	Material of Construction	Capacity (Gallons)
429-1	33	06/82	Concrete	3,000
728-1	33	09/84	Concrete	25,000
728-2	33	09/84	Concrete	25,000
730-1	30	12/82	Concrete	22,500
730-2	30	12/82	Concrete	22,500
730-3	30	12/82	Concrete	4,500
730-4	30	12/82	Concrete	4,500
731-1	26	07/82	Concrete	2,000
731-2	26	07/82	Concrete	2,000
771-C	18	1984	Stainless Steel	500
774	33	07/82	Concrete	30,000
828-1	22	1978	Steel	250
828-2	22	1978	Steel	250
865-1	16	05/82	Concrete	3,000
865-2	16	05/82	Concrete	3,000
889 W-1	20	05/83	Concrete	1,000
889 W-2	20	05/83	Concrete	1,000

Source: DOE, Albuquerque Operations, Underground Storage Tank Inventory for the Rocky Flats Plant, Attachment II, CERCLA Reportable Tanks, April 1986.

9. Active Aboveground and Inactive Underground Carbon Tetrachloride Tanks around Building 776. There are two chemical storage tanks around Building 776 that may be a source of soil and groundwater contamination.

An active aboveground carbon tetrachloride tank is located within a diked area south of Building 776. This 5,000-gallon tank ruptured in June 1981 (DOE, 1986) and spilled an unknown quantity of chemical solvent unto the ground, contaminating the soil. The tank and the area was cleaned up. It is not known whether sampling and analyses were conducted to verify that the contamination was completely removed.

There is also an inactive underground storage tank located north of the Building 776 compressor house (identified as No. 730 CT in the underground storage tank inventory for the Rocky Flats Plant, Attachment II, CERCLA Reportable Tanks, DOE, April 1986). It was installed in the early 1960s with no cathodic protection. This abandoned 5,000-gallon steel tank once contained carbon tetrachloride. The tank reportedly overflowed during filling operations and also leaked at various times (DOE, 1986). Although the spills were cleaned up, it is not known whether sampling and analysis were conducted to verify that the contamination was completely removed. It has since been valved off but has not been flushed.

10. Former Chemical Storage Site East of Building 551. Prior to the mid-1970s, a chemical drum storage area existed east of Building 551. These chemicals were non-radioactive (nature and quantity unknown). The drums may have leaked and, as a result, the soil could have become contaminated (Owen, 1973).

The chemical drum storage operation was later terminated and the area was paved. Other than a gamma survey, the soil was not analyzed for contamination prior to being paved.

4.5.3.4 Category IV

There are no Category IV findings for inactive waste sites or releases.

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APPENDIX A

SURVEY PARTICIPANTS

PRELIMINARY

**RFP SURVEY PARTICIPANTS
AUGUST 11-26, 1986**

DOE

Team Leader:	J. E. Fitzgerald
Assistant Team Leader:	T. T. Traceski
Operations Office Representative:	R. Reddick

NUS

Coordinator:	R. E. Tarbert
QA/Toxics:	C. A. Kieda
Air:	T. F. Eckle
Radiation:	J. D. Yesso
Hydrogeology:	M. S. Robison

ICF

Waste Management:	G. M. Kelly
Inactive Waste Sites:	R. L. Scullin

APPENDIX B

SITE-SPECIFIC SURVEY ACTIVITIES

PRELIMINARY

B.1 PRE-SURVEY PREPARATION

The DOE Office of Environmental Audit, Assistant Secretary for Environment, Safety, and Health selected a team to conduct an environmental Survey at the Rocky Flats Plant (RFP) near Golden, Colorado, and Oxnard, California. RFP is operated for DOE by the North American Space Operations Group of Rockwell International Corporation. Mr. Joseph Fitzgerald was designated DOE Team Leader, and Mr. Thomas Traceski, the Assistant Team Leader. Other team members included technical specialists from NUS Corporation and ICF Corporation. Oak Ridge National Laboratory was designated to provide a Sampling and Analysis (S&A) team for the RFP Survey and to perform the laboratory analytical services.

As a prelude to a pre-Survey site visit, the Survey Team Leader and Assistant Team Leader provided a briefing on the overall Survey effort to senior management at the Albuquerque Operations Office on July 7, 1986. Technical specialists from NUS and ICF joined the Team Leader at the Los Alamos National Laboratory on July 8, 1986 for a two-day review of the Comprehensive Environmental Assessment and Response Program files for RFP. A pre-Survey site visit to RFP at Golden, Colorado was conducted on July 10 and 11, 1986, by the Team Leader, the NUS technical coordinator, and two representatives from the ORNL Sampling and Analysis team. Following introductions, RFP personnel presented an overview of activities at the facility and discussed environmental issues of concern to them. The logistics of the upcoming Survey were discussed and a plant tour was provided. In addition, separate visits were made to EPA Region VIII and the Colorado Department of Health to inform them of the survey plan and to hear their concerns.

Subsequently, NUS and ICF technical specialists intensively reviewed the environmental documents and reports that were obtained during the pre-Survey visit. Based on that review, a Survey Plan for the RFP site was prepared, which discussed the specific approach to the Survey for each of the technical disciplines and included a proposed schedule of activities for on-site activities. The Survey Plan was transmitted through the Albuquerque Operations Office to Rockwell during the week of August 4, 1986.

B.2 ONSITE ACTIVITIES

The on-site portion of the Survey was conducted at Rocky Flats during the period of August 11-22, 1986, and at Oxnard, California during August 25-26, 1986. The opening meeting held on August 11, 1986 was attended by representatives from DOE Headquarters, the Albuquerque Operations Office, the Rocky Flats Area Office, Rockwell International Corporation,

NUS Corporation, and ICF Corporation. Discussions during this meeting centered on the purpose of the Survey, logistics at RFP, and an introduction of the personnel involved.

During the on-site portion of the Survey, team members reviewed additional file materials including permits and applications, background studies, engineering drawings, accident reports, and operating logbooks. The production process was thoroughly analyzed to identify existing and potential pollutants. Site operations and monitoring procedures were observed. Extensive interviews were conducted with plant personnel regarding environmental controls, operations, monitoring and analysis, past operations, regulatory permits, and waste management.

Daily meetings of the Survey team members were held to report observations and compare findings. The team also coordinated daily with Rockwell to arrange for specific site personnel and facilities to be available, as needed, on the following day. The sampling and analysis requirements identified by the Survey team members were discussed as they developed with ORNL personnel.

A site closeout briefing was held on August 22, 1986, at which the DOE Team Leader presented the preliminary observations of the Survey team. These observations were classified as preliminary, because additional research and, in some cases, additional field sampling were required to positively confirm the observations.

B.3 SAMPLING AND ANALYSIS

Oak Ridge National Laboratory (ORNL) evaluated the sampling and analysis requests made by the survey team and determined sampling and analysis logistics, costs, and schedules. The Sampling and Analysis Plan prepared by ORNL included sections on quality assurance and health and safety. The Sampling and Analysis team completed work at the site during September and October 1986.

B.4 REPORT PREPARATION

A Preliminary Report for RFP will be prepared to summarize the findings from the on-site Survey effort. This report will be provided to the Albuquerque Operations Office and the RFP contractor for review. The findings presented in the Preliminary Report are subject to change until comments are received from the site and S&A results are available. At that time, the comments and S&A results will be evaluated and an Interim Report will be prepared.

APPENDIX C

SURVEY PLAN

PRELIMINARY

ENVIRONMENTAL SURVEY PLAN

ROCKY FLATS PLANT

AUGUST 11-22, 1986

GOLDEN, COLORADO

1.0 INTRODUCTION

The Environmental Survey a is one time baseline inventory of existing environmental problems and environmental risks at DOE operating facilities. It will be conducted in accordance with the principles and procedures contained in the Draft Environmental Survey Manual distributed on May 16, 1986.

The Environmental Survey is an internal management tool to aid the Secretary and Under Secretary in allocating resources for maintaining progressive environmental programs and for mitigating environmental problems at DOE facilities.

2.0 SURVEY IMPLEMENTATION

The Environmental Survey will be managed by the Team Leader, Joseph Fitzgerald and the Assistant Team Leader, Thomas Traceski. Constance Soden serves as the Albuquerque Operations Office representative on the Environmental Survey team. Technical support is provided by NUS Corporation personnel as follows:

Richard Tarbert	NUS Coordinator/Surface Water
Charles Kieda	QA/TSCA
Tom Eckle	Air
David Yesso	Radiation
Gerard Kelly	RCRA/Solid Waste
Ronald Scullin	CERCLA
Mary Robison	Hydrogeology

2.1 Pre-Survey Activities

Survey team members began reviewing RFP environmental documents that were available at NUS offices in June, 1986. A team consisting of Messrs. Fitzgerald, Traceski, Tarbert, Tom Kitchings and Robert Fitts (Oak Ridge National Laboratory), Elmer Burd (NUS Health and Safety Advisor) and Ms. Soden conducted a pre-survey site visit on July 10 and 11, 1986 to become acquainted with key DOE and Rockwell personnel and to become familiar with the site. They toured the facility and gathered documents that were assembled by site personnel in response to the memorandum announcing the pre-survey site

visit and requesting environmental information of interest to the Survey Team for planning purposes. Earlier in that week, Messrs. Fitzgerald, Traceski, and Kelly and Ms. Robison had visited the Los Alamos National Laboratory to examine information in the files pertaining to Rocky Flats. Pertinent documents were transferred to NUS Pittsburgh offices for use by team members during the planning stage of the survey.

2.2 On-Site Activities

The Environmental Survey will be conducted from August 11, 1986 through August 22, 1986, with Messrs. Traceski and Tarbert visiting the Precision Forge Operation in Oxnard, California beginning on August 25, 1986. The Agenda is as shown in Table 1. It is expected that modifications will be made as appropriate to minimize disruption of site activities, to enhance survey efficiency and effectiveness, and as members of the survey team continue reviewing the documents prior to the survey, and during the actual site visit.

Interviews and consultations will be conducted with environmental, safety, operations, waste management, purchasing and warehousing personnel, among others, in the course of the Environmental Survey.

2.3 Sampling and Analysis

Based on available site environmental information and the results of the survey activities on site, the sampling and analysis (S&A) phase of the survey process will be implemented approximately 4 weeks after the completion of the

site visit. This effort is expected to have a 2-4 week duration and will be conducted by Oak Ridge National Laboratories (ORNL). John Murphy will be the ORNL Team Leader for the sampling and analysis. Results of the S&A effort will be transmitted to the Environmental Survey Team Leader.

2.4 Conclusions and Reporting on the Survey

A close-out briefing will be conducted as noted on the agenda to describe the general conclusions of the site activities. A Draft Environmental Survey Report will be completed during the first week of October. Within 4 weeks of the availability of the analytical results from the sampling and analysis phase of the Environmental Survey, an Interim Environmental Survey Report will be completed.

PRELIMINARY

TABLE 1

	G. Kelly RCRA	R. Scullin CERCLA
Monday 8-11	AM-Introductory Briefings and Driving Tour of Plant 12:30 pm Respiratory Program 1:30 pm Core Program 3:30 pm Be Program	AM-Introductory Briefings and Driving Tour of Plant 12:30 pm Respiratory Program 1:30 pm Core Program 3:30 pm Be Program
Tuesday 8-12	Observe Waste Management Operations inside PSZ	Spill and Burial Sites inside PSZ
Wednesday 8-13	Continue with interviews and record examination inside PSZ	Observe 903 pad and spill and burial sites on east end of plant
Thursday 8-14	Continue previous days activities	Continue with observation of sites on East End. Research documentation for HRS Ranking. Review Files
Friday 8-15	AM - Active Landfill PM - Review documents in EA&C Files	AM - Active Landfill PM - Graphite Dump Review Files
Monday 8-18	Observe Waste Management Operations outside PSZ	Observe 400 & 800 area spill and burial sites
Tuesday 8-19	Continue with interviews and record examination outside PSZ	Continue previous days activities; Follow-up on items as needed.
Wednesday 8-20	Follow-up on items as needed	Observe tanks and pipe locations that have had leaks.
Thursday 8-21	Interviews with Team Leader. Coordinate with Sampling and Analysis Team Leader. Catch up on unfinished items.	
Friday 8-22	Close-out meeting with RFP and RFAO management.	

TABLE 1 (cont'd)

	M. Robison Hydrogeology	R. Tarbert Surface Water
Monday 8-11	AM-Introductory Briefings and Driving Tour of Plant 12:30 pm Respiratory Program 1:30 pm Core Program 3:30 pm Be Program	AM-Introductory Briefings and Driving Tour of Plant 12:30 pm Respiratory Program 1:30 pm Core Program 3:30 pm Be Program
Tuesday 8-12	Groundwater sampling Observations	Observe Process Water users and treatment plants inside PSZ
Wednesday 8-13	Meet briefly with T. Greengard. Observe seeps along streams and drainage ditches.	Observe seeps along streams and drainage ditches.
Thursday 8-14	Offsite Reconnaissance and catch-up. Meet with Hydro-Search.	Review EA&C Master File correspondence. Visit Bloomfield and Lake Arthur facilities Catch-up.
Friday 8-15	AM - Active Landfill PM - Meet with T. Greengard	Review EA&C Master File Records
Monday 8-18	Observe solar ponds and well drilling in PSZ	Observe Process Water users outside PSZ, sewage treatment plant, and water treatment plant
Tuesday 8-19	Observe A-4 Pond Discharge and NPDES Sampling. Look at other outfalls. Tour perimeter of plant.	Observe A-4 Pond Discharge and NPDES Sampling. Look at other outfalls. Tour perimeter of plant.
Wednesday 8-20	Catch-up and Coordinate on areas of potential sources of organic contamination.	Catch-up
Thursday 8-21	Interviews with Team Leader, Coordinate with Sampling and Analysis Team Leader, Catch up on unfinished items.	
Friday 8-22	Close-out meeting with RFP and RFAO management.	

TABLE 1 (cont'd)

	T. Eckle Air	D. Yesso Radiation
Monday 8-11	AM-Introductory Briefing and Driving Tour of Plant 12:30 pm Respiratory Program 1:30 pm Core Program 3:30 pm Be Program	AM-Introductory Briefings and Driving Tour of Plant 12:30 pm Respiratory Program 1:30 pm Core Program 3:30 pm Be Program
Tuesday 8-12	Look at records for source inventory	Observe Process Water users and treatment plants inside PSZ
Wednesday 8-13	Observe 903 Pad area and ambient air monitoring	Observe 903 Pad area and look at records of radiometric survey data
Thursday 8-14	Observe solar ponds and stacks in the PSZ	Review air release solid waste ponds and solar ponds inside PSZ
Friday 8-15	Visit Steam Plant Bldg. 122 Incinerator and M.A.A.M.	AM - Active Landfill PM - Catch-up
Monday 8-18	Observe Beryllium operations and ventilation exhaust system sampling	Observe spill sites in 800 area. Examine ambient air records
Tuesday 8-19	Review meteorology and M.A.A.M. QA/QC	Visit Chem Standards and Radiochemistry Labs
Wednesday 8-20	Observe Environmental Science (air) Lab and meteorological installation	Visit Environmental Science (air) Lab and RAD monitoring group
Thursday 8-21	Interviews with Team Leader, Coordinate with Sampling and Analysis Team Leader, Catch up on unfinished items.	
Friday 8-22	Close-out meeting with RFP and RFAO management.	

TABLE 1 (cont'd)

C. Kieda
QA/TSCA

Monday 8-11	AM Introduction Briefing and Driving Tour of Plant 12:30 pm Respiratory Program 1:30 pm Core Program 3:30 pm Be Program
Tuesday 8-12	Observe PCB and toxic chemical storage areas outside PSZ
Wednesday 8-13	Observe PCB and toxic chemical storage areas inside the PSZ
Thursday 8-14	Review herbicide and pesticide usage. Catch-up day.
Friday 8-15	AM - Active Landfill PM - Graphite Dump
Monday 8-18	Visit General and Physical Metrology Labs
Tuesday 8-19	Visit Chem Standard and Filter Certification Labs
Wednesday 8-20	Visit Environmental Science (air) Lab and RAD monitoring group
Thursday 8-21	Interviews with Team Leader, Coordinate with Sampling and Analysis Team Leader, Catch up on unfinished items.
Friday 8-22	Close-out meeting with RFP and RFAO management.

3.0 QUALITY ASSURANCE

3.1 Issue Identification

The quality assurance area of this environmental survey will be primarily an evaluation of the site sampling and analytical performance at Rocky Flats. The intent will be to review the quality assurance procedures for collecting process effluent and environmental samples, for performing the laboratory analytical work to identify and quantify pollutants and for evaluating and reporting the data. Verification that appropriate procedures are being followed will be the goal of the quality assurance review. Aspects of the quality assurance program relating to environmental management of the Rocky Flats Plant which will be addressed include operator and analyst training, equipment and instrument calibration and maintenance, precision and accuracy studies, blank, replicate and spike sample results, sample handling and chain-of-custody procedures, data reduction, reporting and documentation and calculation and logbook reviews.

Sampling and analysis procedures will be reviewed to check on proper implementation. Available quality assurance audits will be examined for sampling and analytical activities. QA programs practiced at the Rocky Flats Plant will be surveyed.

3.2 Records Required

During the Rocky Flats Plant site visit, the following records/documents should be available:

- o Quality Assurance Plans for the Environmental Sciences Group and any supporting analytical laboratories.
- o Environmental Science Group laboratory and sampling procedures manuals.
- o QA audits of environmental sample collection and analysis.
- o Periodic or annual QA reports for the Rocky Flats Environmental Sciences Group.
- o DOE Environmental Measurements Lab (EML) and EPA results for QA samples.
- o Training records for sampling and laboratory personnel.
- o Instrument maintenance logs and calibration records (for laboratory and field equipment)
- o Laboratory notebooks, standard data reporting forms and sampling logbooks.
- o Precision and accuracy studies.
- o Interlaboratory results of standard samples.

4.0 SURFACE WATER

4.1 Issue Identification

The preliminary review of the documents received from Rocky Flats indicate that surface water issues at this time are attributable to other sources. The plant has practically achieved "zero discharge" of wastes by recycle and evaporation and only discharge treatment plant effluent offsite when weather conditions prevent the entire flow from being kept on plant site by evaporation and spray irrigation. There have only been two technical violations of the NPDES discharge permit within the last 5 years, neither of which resulted in a discharge of waters offsite that did not meet the terms of the permit. Runoff and spills are contained in ponds and control measures are in place to keep capacity in the ponds available in the event of a spill during storm conditions.

An area of focus will be on the sewage treatment plant being operated at capacity with flow split 70-30 between the two primary sections. Another focus will be on the possible buildup of radionuclides in the soils in the spray irrigation areas. The information reviewed indicates that while concentrations of these parameters are within acceptable criteria in the discharged water, there is no indication that soils in these areas are routinely sampled to determine if radionuclides are building up.

Principle contacts at Rocky Flats will be Ron Henry in EA&C and the Sewage Treatment Plant Operator.

4.2 Records Required

Records that may be reviewed during the site visit to obtain additional information include:

- o EA & C Operating/Control Procedures

- EA-C-2 Discharge from Ponds B-3 and A-3
- EA-C-3 Spraying from Landfill Pond and A-2
- EA-C-7 Runoff and Spill Control
- EA-C-10 Discharge from Dams A-4, B-5, and C-2
- EA-C-11 Bldg. 374 Evaporator Product Water
- EA-S-3 Water Sampling Procedure
- EA-S-4 Soil Sampling Procedure

- o Analytical data used for preparation of NPDES monitoring reports.
- o Operators log books and reports for treatment plant operations and maintenance.
- o Monitoring equipment, operating and maintenance logs.

5.0 AIR

5.1 Issue Identification

Issues related to nonradioactive air contaminants will require a plant-wide assessment of emission sources, techniques and equipment used to control and monitor emissions and procedures to obtain and process ambient-air quality data. Contaminants of major concern in the process area include total suspended particulates (TSP), sulfur dioxide (SO₂), nitrogen oxides (NO_x), beryllium (Be), hydrogen fluoride (HF), and volatile organic compounds (VOC). In addition to the process emission sources, attention will be given to the identification of process fugitive and fugitive dust emissions and procedures used to mitigate emissions of this type.

The survey will involve the preparation of an inventory of air-contaminant emission points based on a review of existing air permits, permit applications, operating procedures, and physical inspection of facilities. Incinerators and steam-plant boilers have been identified for inclusion in the inventory. Emphasis will be placed on identifying other sources of air contaminants. Existing control equipment and procedures will be reviewed to assess the adequacy of emission controls. The effluent monitoring program will also be evaluated.

A review of the mobile ambient air monitoring system will involve inspection of the ambient samplers, and documentation applicable to calibration procedures, and data acquisition, validation, and processing.

Throughout this survey, a major emphasis will be placed on assessing the validity and utility of the data to characterize the overall environmental impact of plant operations.

EA&C Contacts are expected to be:

R.J. Crocker - Nonradioactive Air Effluents

D. L. Barr - Beryllium Emissions Data

5.2 Records Required

- o Sampling Procedure for Stacks, EA-S-1
- o Sampling Procedures for Ambient Air, EA-S-2
- o Air Pollution Episode Response Procedure, EA-ERP-2
- o Meteorological Data Acquisition SOPs and QA/QC Manual
- o MAAM SOPs and QA/QC Manual
- o 1985 Audit Report - MAAM
- o Permit 85JED52L, May 28, 1985 for Fugitive Dust Remedial Action
- o Vent-by-Vent Data on Beryllium Emissions
- o Point Source Registrations
- o Inventory of Sources of Criteria and NESHAP Pollutants

6.0 RADIOLOGICAL

6.1 Issue Identification

Several specific areas of radiological interest have been identified through a review of available documentation. These may be categorized as: 1) routine process emissions; 2) on-site burial and leaks of radioactive materials; 3) contamination of surface and near surface soils; 4) contamination of holding pond and reservoir sediments; and 5) groundwater/surface water contamination. The specific issues that must be investigated are:

- o Calibration, maintenance and placement of air emission controls, stack samplers and monitors, and ambient air samplers.
- o Quality assurance data for environmental radianalysis.
- o Results of radiometric surveys.
- o Monitoring and characterization of 903 Area and nearby soils.
- o Characterization of on-site burial and leaks of radioactive materials.
- o Leakage of radioactive materials into the groundwater from solar evaporation ponds.
- o Radionuclide concentrations in west spray field.
- o Radionuclide concentrations in reservoirs.
- o Adequacy of groundwater monitoring wells.
- o Characterization of the radiological content of mixed wastes and sanitary landfill wastes.
- o Monitoring of tritium in groundwater, surface waters and air.

Plutonium, the most serious radiological material at Rocky Flats Plant is most hazardous through an inhalation pathway. Consequently, air emissions and soil resuspension are the primary concerns. Annual process air releases of plutonium have been estimated to be about 100 uCi. The soil resuspension release, primarily from soils near the 903 Area is estimated to be 4400 uCi. Because of the relative magnitudes of these sources, the survey will place particular emphasis on soil contamination. C.T. Illsley will be the primary contact for this issue, although other personnel will be identified in discussions with Mr. Illsley to permit more detail interviews.

6.2 Records Required

The records presently identified for review during the site visit include the following:

- o Results of the on-site radiometric surveys
- o Radioanalytical QA documentation
- o Laboratory and sampling procedures
- o Effluent monitoring calibration and maintenance records
- o Emission control maintenance records
- o Raw data from effluent and environmental monitoring
- o EPA - sponsored soil sampling comparison reports
- o Environmental monitoring reports from CDH and DOE-EML
- o Great Western Reservoir monitoring reports generated after February 14, 1985
- o Evidence of availability of key documents referenced in procedures.

7.0 TOXIC SUBSTANCES

7.1 Issue Identification

The toxic substances survey will address raw materials and process-related chemicals used at the Rocky Flats Plant site as well as the usage, handling, storage and disposal of polychlorinated biphenyls (PCBs), asbestos, pesticides/herbicides and hazardous substances. The tracking, control and management of these substances will be reviewed. The current inventory of PCB containing and PCB-contaminated electrical equipment and hydraulic equipment will be investigated. The condition of this equipment and its potential for environmental contamination will be examined. However, the large amount of such equipment [23 transformers and 392 capacitors known to contain PCBs (1984)] precludes examination of each item, so only a portion of this equipment will actually be inspected. Obsolete or used PCB equipment and contaminated materials in storage will be checked for proper labeling, containment, packaging, protection and inventory controls. Disposal records will be reviewed and disposal practices will be discussed. PCB inspection and reporting (TSCA) will be checked.

Projects involving the demolition/disposal of asbestos or asbestos-containing materials at the plant will be reviewed for proper handling, disposal and environmental monitoring. On-site asbestos disposal areas will be visited to ensure that proper disposal is being performed.

Pesticide/herbicide usage records will be reviewed. Pesticide applicator training, purchasing and application records, storage and disposal practices and environmental monitoring will be checked.

Toxic and hazardous materials, which are stored and used in large amounts on-site, will be examined from the perspectives of storage and handling to prevent environmental contamination. Among the areas to be examined will be the acid tank farm, fluorine buildings, oil and paint storage, solvent storage, HF storage, flammable storage, metal storage, gas cylinder storage and toxic gas storage.

Storage of chlorofluorocarbons will also be examined.

Primary contacts at Rocky Flats are expected to be:

Mary Jameson - QA

Steve Sadler - Asbestos

John Handschy - TSCA/PCBs

Charles Hilsley - Pesticides/Herbicides

7.2 Records Required

During the Rocky Flats site visit, the following records/documents regarding toxic/hazardous substances should be available for review:

- o Toxic substances inventory and purchasing records of chemicals.
- o Toxic substances labeling and tracking system, if any.
- o Procedures for handling, controlling and managing toxic substances.
- o PCB annual inventory documents (1985).
- o PCB transformer/capacitor inspection records (1980 - present).

- o Storage records of PCB contaminated items and equipment (1980 - present).
- o Disposal records for PCB items.
- o PCB storage, handling and disposal procedures.
- o Correspondence with fire department on PCB containing electrical equipment.
- o Locations of all buildings and areas containing asbestos.
- o Asbestos removal, handling and disposal procedures and environmental monitoring information.
- o Records of asbestos use in equipment and support facilities.
- o On-site asbestos disposal area maps
- o Pesticide training, handling, storage and disposal records and operating procedures.
- o Current hazardous materials inventory.
- o Pesticide annual reports (1980 - 1985)
- o EA&C operating/control procedures

8.0 WASTE MANAGEMENT

8.1 Issue Identification

The waste management review is intended to determine if wastes are properly managed. The review will examine management of all waste streams, including radioactive/non-hazardous wastes, non-radioactive/hazardous wastes, radioactive/hazardous mixed wastes, and non-radioactive/non-hazardous wastes. The review will consist of four types of activities: 1) inspections; 2) interviews; 3) file reviews and; 4) comparison of findings with findings previously documented. Each of these activities will be conducted daily as various RFP areas are assessed.

Emphasis will be placed on those facilities seeking hazardous waste permit approval and on the identification of hazardous waste management activities that have potential for an adverse environmental effect. Based on our review of Rockwell and DOE documents, specific subject areas will include:

- o Waste characterization;
- o Treatment efficiencies and capacities;
- o Waste storage capacities;
- o Land application and disposal;
- o Waste packaging, staging, and shipping;
- o Waste minimization;
- o Facility closure; and
- o Waste management practices, including training, waste inventory control, recordkeeping, and inspection protocols.

Areas to be inspected include:

- o Process areas;
- o Waste generation points;
- o Waste accumulation points;
- o Waste handling areas (e.g., areas for waste segregation, size reduction and packaging);
- o Waste treatment units;
- o Decontamination areas;
- o Waste storage facilities and areas;
- o Waste shipping areas; and
- o Sanitary landfill.

Waste management operations and practices will be studied. Facilities, operations and practices will be compared with existing descriptions. We will determine if waste generation points and waste streams have been identified and are properly managed to prevent unauthorized releases.

Interviews will be conducted at facilities inspected to determine the specifics of facilities' waste management practices and to determine conformance with printed waste management procedures. Employees to be interviewed include those working in the following groups:

- o Environmental Analysis and Control (e.g., G.H.Setlock);
- o Regulatory Compliance (e.g., D.D. Hornbacher);
- o Waste Operations (i.e., A.C. Ficklin, R.D. Gaskins, other managers, supervisors and operators)
- o Waste Management Programs;
- o Quality Engineering and Control;
- o Utilities;
- o Traffic;
- o Safeguards and Security; and
- o Maintenance.

8.2 Records Required

Files on each waste management activity will be reviewed, as well as documents not previously received and reviewed. Specific documents and files include:

- o H,S&E Manual;
- o Material Hazards Manual;
- o Plans for Renovations/Upgrading, New Facilities, and Closure;
- o "As-Built" Drawings;
- o Waste Analysis Plan and Records;
- o Waste Processing Request Forms for Non-Process Wastes;
- o Operating Logs for Storage Areas;
- o Manifests;
- o Incident and Unusual Occurrence Reports; and
- o Personnel Training Records.

Additional documents and updates to existing documents also will be identified and reviewed.

9.0 INACTIVE WASTE SITES/RELEASES (CERCLA)

9.1 Issue Identification

The survey will attempt to identify environmental problems and potential risks associated with the storage and disposal of hazardous substances at the Rocky Flats facility. The survey will focus on current and future risks related to the following:

- o Past land disposal practices;
- o Past spills/releases from tanks, ponds, pipes, pits, trenches; and
- o Potential for future spills/releases.

Facilities that have handled or are currently handling hazardous, mixed and low-level radioactive substances will be inspected and assessed. These facilities include the old graphite dump, present landfill, solar ponds, burn pits, incinerator sites, burial areas at the east end of the facility, waste storage areas, abandoned process and waste pipes, and selected chemical/fuel storage tanks (where spills have been reported). These facilities will be reviewed in terms of the materials that they contain, the integrity of the facilities, and past and potential releases of hazardous substances. Underground storage tanks will be reviewed by other members of the survey team.

The survey team will want to review available material pertaining to the supplemental CEARP Phase I (i.e., site locations of all burial and spill sites, and reconnaissance field data pertaining to HRS/MHRS evaluations).

The team will also want to review the "interview files" regarding the CEARP Phase I draft report and the files pertaining to the Rockwell radiometric survey of 1975 - 1983. We will be equally interested in reviewing the HRS/MHRS ranking procedures used for the CEARP Phase I report.

Primary contacts for the CERCLA portion of the survey will be C.T. Illsley of Environmental Analysis and Control, Regulatory Compliance and Plutonium Operations - Waste Operations personnel.

9.2 Records Required

The following records, among others, will be reviewed at the site:

- o Waste management plans (old and current)
- o SOPs regarding management of hazardous substances, disposal areas and storage areas
- o Hazardous substances inventories
- o Listing of areas used for hazardous substances use, storage, receiving and shipping, and disposal
- o Historical files on past operations and processes, substances used, and methods of handling and disposal
- o Files on past off-site waste handling and disposal
- o Records of facility expansion and building rubble disposal
- o Descriptions and notifications of inactive waste sites and potential areas of contamination

- o Description of all waste management facilities, including buried tanks and structures
- o Past aerial photographs of the facility
- o "Interview files" for the draft CEARP Phase I report
- o Rockwell files pertaining to the radiometric survey of 1975 - 1983
- o Survey of the Status of the Existing Process Waste Lines, September 1976.

10.0 HYDROGEOLOGY

10.1 Issue Identification

The preliminary review of documents for the Rocky Flats Plant indicates that the major areas of focus will be:

- o The presence of a high TDS, high nitrate contaminant plume in groundwater near the solar ponds.
- o The possibility of insufficient characterization of tritium and uranium contamination in groundwater.
- o The presence of volatile organic contamination in groundwater. Elevated organic levels appear to be spatially related to Building 881, the contaminated soil burial site east of Building 881, old burial trenches near the east gate, buildings 371 and 374, and the sanitary landfill. TCE and PCE are present in groundwater, although they have not been used on site in the past 10 years.

- o Inadequacy of existing wells because construction details are generally unknown and the wells tap more than one hydrogeologic unit. Thus, both water level and chemistry data are composite results and, therefore, difficult to interpret.
- o Inappropriate sampling procedures for groundwater are inappropriate.

Revision of sampling procedures, installation of new wells, and investigation of the extent of contamination are all in progress.

The issues to be dealt with during the survey involve the determination of the status of recent and on-going studies, and the review of plans for further studies.

10.2 Records Required

Records and documents to be reviewed include the following:

- o Geophysical survey report (EM conductivity plume tracking)
- o Soil gas survey report
- o Operations plan for drilling of new monitoring wells
- o Work plan for current investigations
- o Prioritization of CEARP sites
- o Map of 65 registered wells within three miles of the solar ponds
- o Current sampling procedures

APPENDIX D

**COMPLIANCE AGREEMENT AND ORDER OF CONSENT
BETWEEN DOE, EPA, AND COLORADO DEPARTMENT OF HEALTH**

PRELIMINARY

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION VIII

RCRA VIII-86-06
CERCLA VIII-86-09

IN THE MATTER OF:

Department of Energy
Rocky Flats Plant
Golden, Colorado

Respondent

COLORADO
DEPARTMENT OF HEALTH

COMPLIANCE AGREEMENT

This Compliance Agreement ("Agreement") is entered into by the United States Environmental Protection Agency ("EPA"), the United States Department of Energy ("DOE"), and the Colorado Department of Health ("CDH").

1. STATEMENT OF PURPOSE

The mutual objectives of EPA, CDH, and DOE in entering into this Agreement are:

- a. to resolve issues related to, and to establish requirements for, hazardous waste, including radioactive mixed waste, compliance at the DOE's Rocky Flats Plant ("Plant") pursuant to CDH and EPA hazardous waste authorities;
- b. to establish requirements for the investigation of, and corrective action for, any releases of hazardous waste, radioactive mixed waste, or constituents from any solid waste management units ("SWMU") and other areas at the Plant, consistent with the requirements of the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. § 6901 et seq.
- c. to establish procedures pursuant to the Comprehensive Environmental

- Response, Compensation, and Liability Act of 1980 ("CERCLA"), 42 U.S.C. § 9601 et seq., and Executive Order No. 12088 (43 Federal Register 47707, "Federal Compliance With Pollution Control Standards") for the cooperation, exchange of information, and participation of DOE and EPA in the development, implementation and monitoring of appropriate remedial actions, consistent with the National Contingency Plan ("NCP"), 40 C.F.R. Part 300, for releases and threatened releases of "hazardous substances, pollutants, or contaminants" as defined in CERCLA (hereinafter referred to collectively as "hazardous substances") at the Rocky Flats Plant;
- d. to establish requirements for: (i) the performance of a remedial investigation to determine fully the nature and extent of any threat to the public health or welfare or the environment that may be caused by the release, or threatened release, from the Rocky Flats Plant of hazardous substances; (ii) the performance of a feasibility study to identify and evaluate alternatives for appropriate remedial action to prevent or mitigate the migration or the release or threatened release of any hazardous substance from the Plant; and (iii) the implementation of remedial action as may be necessary to protect public health, welfare, or the environment.

2. BASIS OF AGREEMENT

- a. This Agreement is entered into pursuant to EPA's authority under RCRA, EPA's authority under sections 104 and 106 of the CERCLA; EPA's authority and responsibility under Executive Order 12316, (46 Federal Register 42237, "Responses to Environmental Damage"); EPA's and DOE's authority and responsibility under Executive Order No.

12088, (43 Federal Register 47704, "Federal Compliance With Pollution Control Standards"); DOE's authority under the Atomic Energy Act of 1954, as amended (42 U.S.C. § 2201) ("AEA"), and CDH's authority under sections 25-15-301(4) and 25-15-308, C.R.S., of the Colorado Hazardous Waste Act ("CHWA"). DOE acknowledges its obligations under section 6001 of RCRA.

- b. DOE agrees that the requirements of this Agreement that pertain to regulatory compliance with hazardous waste and radioactive mixed waste requirements are requirements which have become effective pursuant to RCRA within the meaning of section 7002(a) of RCRA. DOE also agrees that CDH is a "person" within the meaning of section 7002(a) of RCRA. In the event of any action filed by any person under section 7002(a) of RCRA alleging any violation of any such requirements of this Agreement, DOE will not contend that the aforesaid provisions of this Agreement are not requirements that have become effective pursuant to RCRA, or that CDH is not a "person" within the meaning of section 7002(a), or that this Agreement is not enforceable under section 7002(a).

3. DEFINITIONS AND APPLICABILITY

This Agreement shall be applicable as follows:

- a. For the purpose of categorization and applicability to this Agreement only (but not as a general definition outside the scope of this Agreement) the following terms shall be used herein as indicated:
- 1) the term "hazardous waste" shall apply to hazardous waste that is not mixed with "source, special nuclear or by-product material" as those terms are defined in the AEA;

- ii) The term "radioactive mixed waste" shall apply to wastes that contain hazardous wastes subject to RCRA and radioactive wastes subject to the AEA.
- iii) This Agreement shall not apply to "transuranic material" or to hazardous waste mixed with transuranic material, which shall be stored and ultimately shipped to DOE's Waste Isolation Pilot Plant. For this Agreement, the term "transuranic material" shall apply to any material including but not limited to waste material, which is contaminated with alpha-emitting transuranic radionuclides with half-lives greater than 20 years, in concentrations greater than 100 nanocuries per gram of material, and whose atomic number is greater than 92.
- iv) Notwithstanding the definitions contained in ii and iii above, an intentionally created mixture of hazardous waste and transuranic material, which mixture is not necessary in connection with processing or treatment operations, shall nevertheless be considered to be radioactive mixed waste for the purpose of this Agreement.
- b. The terms "Rocky Flats," "Plant," "Rocky Flats Plant," "Rocky Flats facility," "facility," and "site" mean the U. S. Government owned facility known as the Rocky Flats Plant located north of Golden, Colorado.
- c. The abbreviation "HSWA" shall mean the Hazardous and Solid Waste Amendments of 1984 to RCRA.
- d. All other terms shall have the meaning set forth in RCRA, CERCLA,

CHWA, the NCP, and implementing regulations, as appropriate unless specified otherwise.

- e. CDH's approval role and authority for corrective action under this Agreement and the attached Schedules are limited by the extent of its authorization by EPA to implement RCRA, and do not extend to any actions or activities undertaken provided for, or required pursuant to CERCLA. EPA shall have the sole approval role under CERCLA, following consultation with CDH. CDH reserves any and all authority it has under state law and regulations and RCRA related to corrective action.

4. FINDINGS OF FACT

EPA and CDH make the following Findings of Fact without admission of any such facts by DOE:

- a. DOE is an agency of the federal government and is subject to regulation of its hazardous waste management activities pursuant to section 6001 of RCRA, 42 U.S.C. § 6961. DOE is a "person" as defined in section 101(21) of CERCLA, 42 U.S.C. § 9601(21).
- b. The Rocky Flats facility is owned by the United States and is under the custody of and controlled by DOE. The facility was established by the U. S. Atomic Energy Commission in 1951, and began operations the following year. The facility has been and continues to be used for the production of components for nuclear weapons in accordance with DOE's authority and responsibility under the AEA.
- c. DOE is the only agency or entity authorized by law to produce nuclear weapons for national defense (42 U.S.C. §§ 2121, 2122). DOE, in the exercise of its exclusive statutory authority to

- produce nuclear weapons, is the owner of the Rocky Flats Plant and a proper party to seek and obtain permits for the treatment, storage, and disposal of hazardous waste.
- d. Under Contract DE-AC04-76DP 03533, DOE has, since July 1, 1975, engaged Rockwell International Corporation ("Rockwell") to perform management services in support of DOE's production activities at the Rocky Flats Plant. These services include activities required to meet the obligations of DOE under this Agreement.
 - e. DOE and Rockwell are generators as defined in 40 C.F.R. section 260.10, and 6 CCR 1007-3, section 260.10.
 - f. DOE owned and Rockwell operated the facility on and after November 19, 1980.
 - g. Consistent with section 3010 of RCRA, 42 U.S.C. § 6930, DOE and Rockwell notified EPA of hazardous waste activity at the Plant. In their notification dated August 18, 1980, DOE and Rockwell identified themselves as a generator, treater, storer, and/or disposer of hazardous waste at the facility.
 - h. In their notification of August 18, 1980, DOE and Rockwell identified themselves as handling the following hazardous wastes at the facility:
 - (1) Hazardous wastes exhibiting the characteristics of ignitability, corrosivity, or EP toxicity.
 - (2) Hazardous wastes from certain non-specific sources.
 - i. DOE and Rockwell filed a Part A RCRA permit application on November 14, 1980, which identified certain hazardous wastes.
 - j. In their permit application submitted on November 1, 1985, DOE and Rockwell notified the State, pursuant to the CHWA, of the

handling of certain hazardous wastes. Said permit application did not include radioactive mixed waste streams or units. DOE's position is that CDH has jurisdiction over hazardous waste, but has no jurisdiction over radioactive mixed waste until authorized by EPA. CDH asserts jurisdiction over radioactive mixed waste and issued on December 4, 1985, a Notice of Intent to Deny DOE's Part B permit application on the grounds of incompleteness.

- k. In their permit application submitted on November 8, 1985, DOE and Rockwell notified EPA, pursuant to section 3004 of RCRA, 42 U.S.C. § 6925, and section 3010 of RCRA, 42 U.S.C. 6930, of their handling of certain radioactive mixed wastes.
- l. Since the establishment of the facility in 1952, materials defined as hazardous substances have been produced and disposed of at various locations at the facility.
- m. Certain hazardous substances, radioactive mixed wastes, hazardous wastes, or constituents thereof remain on, under, or near the facility, and have been detected in groundwater at the facility.
- n. Groundwater, surface water, and air pathways provide routes for the potential migration of hazardous substances, radioactive mixed wastes, or hazardous wastes or constituents thereof from the Rocky Flats facility into the environment.
- o. The migration of such hazardous materials from the facility may present a threat to the public health, welfare, and the environment.
- p. The Rocky Flats facility contains both active and inactive SWMU which are potential sources for the release of hazardous substances or hazardous wastes or constituents thereof.
- q. The permit application submitted on November 8, 1985, to EPA by

DOE and Rockwell pursuant to section 3005 of RCRA, 42 U.S.C. § 6925, and implementing regulations identified a number of units subject to RCRA regulations including incinerators, treatment/storage tanks, surface impoundments, and land application/land disposal facilities.

- r. EPA has agreed to use its best efforts to authorize the State of Colorado to regulate radioactive mixed waste on or before September 30, 1986, CDH has filed a request for authorization to regulate radioactive mixed waste under RCRA.
- s. Pursuant to section 105 of CERCLA, 42 U.S.C. § 9605, EPA proposed the Rocky Flats site for inclusion on the National Priorities List ("NPL") on October 15, 1984, but has not issued a final list that includes Federal facilities.

5. CONCLUSIONS OF LAW AND DETERMINATIONS

- 1. Based on the Findings of Fact set out above and the administrative record, the Director of the Waste Management Division, EPA, Region VIII, and the Director of the Toxic Substances and Waste Management Division of CDH have determined, without admission of any such determination by DOE, that:
 - a. The Rocky Flats site is a "facility" as defined in the EPA and CDH hazardous waste regulations, and was in existence on November 19, 1980.
 - b. The Rocky Flats facility is subject to the generator, interim status, corrective action, and permitting requirements for radioactive mixed waste and for hazardous waste, and DOE and Rockwell have interim status for the Rocky Flats facility to treat and store those wastes identified in subparagraphs 4.i, j, and k hereof.

- c. DOE is an owner and Rockwell is an operator of the facility within the meaning of RCRA and CHWA.
- d. Certain wastes and constituents thereof found at the facility are hazardous wastes or constituents thereof as defined pursuant to RCRA and CHWA.
- e. In view of the potential for release of hazardous waste, radioactive mixed waste and/or constituents into the environment from the DOE facility, and the necessity for compliance with RCRA and CHWA requirements, EPA and CDH have determined that the actions specified herein are necessary to protect human health and the environment.

2. Based on the Findings of Fact set out above, and the administrative record, EPA has determined, without admission of any such determinations by DOE, that:

- a. The Rocky Flats site is a facility as defined in section 101(9) of CERCLA, 42 U.S.C. 9601(9). The facility was in existence on November 11, 1980.
- b. DOE is a person within the meaning of section 101(21) of CERCLA, 42 U.S.C. § 9601(21).
- c. DOE owns and Rockwell operates the facility within the meaning of section 107(a) of CERCLA, 42 U.S.C. § 9607, and section 101(20)(A) of CERCLA, 42 U.S.C. § 9601(20)(A).
- d. Certain materials, wastes, and constituents thereof found at the site are hazardous substances.
- e. There is or has been a release of hazardous waste, hazardous substances, and/or hazardous constituents into the environment

within the meaning of RCRA, and section 101(22) of CERCLA, 42 U.S.C. § 9601(22).

- f. The past, present, and potential future migration of hazardous substances at the facility into the environment constitutes or may constitute an actual or threatened release as defined in section 101(22) of CERCLA, 42 U.S.C. § 9601(22).
- g. The actual or threatened release of hazardous substances from the Rocky Flats facility may present an endangerment to the public health, welfare, and/or the environment within the meaning of section 106 of CERCLA, 42 U.S.C. § 9606.
- h. Based on the potential release of hazardous substances into the environment from the Rocky Flats facility, EPA has determined that the actions specified herein are necessary to protect public health, welfare, and/or the environment.

NOW THEREFORE, the parties to this Agreement, with the mutual goal to protect the public health, welfare, and the environment, and believing that the actions set forth herein are in the public interest, have entered into this Agreement to achieve hazardous and radioactive mixed waste compliance at the Rocky Flats facility and to achieve the purposes set forth in this Agreement. Accordingly, IT IS AGREED AS FOLLOWS:

6. REGULATORY COMPLIANCE - HAZARDOUS WASTE

- a. DOE will comply with the CHWA and CDH's hazardous waste regulations found at 6 CCR 1007-3 (hereafter also referred to as "the CDH hazardous waste regulations") in its management of hazardous wastes at the Plant.
- b. DOE will comply with Schedule 1 attached hereto and incorporated

herein by reference which contains a timetable for generator and interim status compliance.

- c. 1. DOE and Rockwell will submit to CDH a revised Part B permit application in accordance with Schedule 1 for all hazardous waste activities and units at the Plant as required by the CDH hazardous waste regulations. The revised Part B permit application shall be combined with the radioactive mixed waste permit application discussed hereafter and the combined permit application shall be submitted to both EPA and CDH.
2. CDH will be the agency contacted regarding the combined permit application. CDH shall have review authority over the hazardous waste portion of the combined application and EPA shall have review authority over the radioactive mixed waste and HSWA portions of the permit application until CDH is authorized pursuant to section 3006 of RCRA, 42 U.S.C. § 6926, to regulate radioactive mixed waste or to implement HSWA. EPA retains full authority to implement and enforce HSWA as well as its permit review authority pursuant to 40 C.F.R. section 271.134. EPA shall use its best efforts to coordinate its actions pursuant to RCRA under this subparagraph c, including subsections 3004(u) and (v), 42 U.S.C. § 6924(u) and (v), with CDH's authorities.
3. A joint EPA-CDH permit for hazardous and radioactive mixed waste will be issued unless, prior to issuance, EPA has authorized CDH to implement the HSWA provisions and/or to regulate radioactive mixed waste, in which case CDH will issue all portions of the permit for which CDH has received EPA authorization.
- d. DOE will provide a waste analysis plan, and documents preliminary

thereto, for hazardous waste, as well as documents identifying hazardous and solid waste management units and changes to interim status, to CDH as required by CDH's hazardous waste regulations, in accordance with Schedule 2 attached hereto and incorporated herein by reference.

- e. DOE shall submit documents and take actions related to site characterization and corrective action for any SWMU's in accordance with Schedule 3 attached hereto and incorporated herein by reference. Completion of the tasks in Schedule 3 shall be integrated with, and conducted in a manner consistent with, the comparable activities for CERCLA areas, as required by paragraph 10 hereof. Upon approval of plans for site characterization and corrective action by EPA and CDH, DOE shall implement the plans in accordance with the schedules therein.
- f. DOE shall provide closure plans and post-closure plans for all units which are to be closed in accordance with Schedule 4 attached hereto and incorporated herein by reference.
- g. References in Schedules 1 through 4 to radioactive mixed wastes, HSWA, or CERCLA requirements are for the purposes of describing the integrated technical program which will be followed by the parties and do not imply CDH enforcement authority with respect to matters other than hazardous waste unless and until authorized by EPA under section 3006 of RCRA, 42 U.S.C. § 6926.

7. HAZARDOUS WASTE ENFORCEMENT

- a. CDH may enforce DOE's compliance herewith pursuant to its authorities and procedures under CHWA, the CDH hazardous waste

regulations and as appropriate, RCRA. The provisions of Schedules 1 through 4 related to hazardous waste are compliance orders issued by CDH pursuant to section 25-15-308(2), C.R.S. CDH's agreement to these Schedules is not to be construed as a waiver of any rights to seek civil penalties for past, present, or future violations of the CHWA, the CDH's hazardous waste regulations, or the schedules attached hereto. DOE reserves the right to contest any such claim for civil penalties.

- b. EPA shall enforce DOE's compliance herewith in the same manner as it enforces RCRA requirements with respect to federal facilities in an authorized state. If a particular dispute is not resolved to the satisfaction of either party through the normal enforcement process for federal agencies, either Party may invoke the conflict resolution procedures set out in sections 1-6 of Executive Order 12088, and/or sections 1-4 of Executive Order 12146, (44 FR 42657, "Management of Federal Legal Resources," (July 20, 1979).
- c. DOE agrees that the requirements of this Agreement that pertain to regulatory compliance with hazardous waste and radioactive mixed waste requirements are requirements which have become effective pursuant to RCRA within the meaning of section 7002(a) of RCRA. DOE also agrees that CDH is a "person" within the meaning of section 7002(a) of RCRA. In the event of any action filed by any person under section 7002(a) of RCRA alleging any violation of any such requirements of this Agreement, DOE will not contend that the aforestated provisions of this Agreement are not requirements that have become effective pursuant to RCRA, or that CDH is not a "person" within the meaning of section 7002(a), or that this

Agreement is not enforceable under section 7002(a).

8. RADIOACTIVE MIXED WASTE REGULATORY COMPLIANCE

- a. The parties agree that the framework for compliance for the Plant's radioactive mixed waste units under this Agreement is HSWA and 40 C.F.R. Parts 260-271. However, if during the term of the Agreement, EPA pursuant to section 3006 of RCRA, 42 U.S.C. § 6926, authorizes the State of Colorado to regulate radioactive mixed waste under RCRA, it is agreed that thereafter the regulatory framework for this paragraph 8 shall be the CDH hazardous waste regulations, in addition to HSWA.
- b. DOE will comply, with respect to its radioactive mixed wastes, with the requirements of 40 C.F.R. sections 262 and 265 to the extent that such compliance is not "inconsistent" with the requirements of the AEA, as described in subparagraph h hereof, in accordance with Schedule 1, which contains a timetable for generator and interim status compliance.
- c.
 1. DOE will submit in accordance with Schedule 1 a revised Part B permit application for all radioactive mixed waste activities and units by November 28, 1986. The permit application will be prepared to meet those requirements of the CDH hazardous waste regulations which, if applicable to radioactive mixed waste, would be more stringent than EPA's regulations. The revised radioactive mixed waste permit application shall be combined with the hazardous waste permit application discussed heretofore and the combined application shall be submitted to both EPA and CDH.
 2. EPA shall have review authority over the HSWA and radioactive

mixed waste portions of the permit application unless EPA has authorized CDH under section 3006 of RCRA, 42 U.S.C. § 6926, to regulate mixed waste at the Plant or to implement the HSWA provisions. The authority issuing the permit will be CDH provided that EPA has fully authorized the State by that time. If full authorization has not occurred prior to the time of permit issuance, the radioactive mixed waste and/or the HSWA portions of the permit shall be issued by EPA. EPA retains its permit review authority pursuant to 40 C.F.R. section 271.134.

- d. DOE will provide to CDH and EPA a waste analysis plan and documents preliminary thereto, for radioactive mixed waste as well as documents identifying radioactive mixed waste management units and changes to interim status in accordance with Schedule 2 attached hereto.
- e. DOE shall submit documents and take actions related to site characterization and corrective action for any SWMU's in accordance with Schedule 3 attached hereto. Completion of the tasks in Schedule 3 shall be integrated with, and conducted in a manner consistent with, the activities for CERCLA areas, as required by paragraph 10 hereof. Upon approval of plans for site characterization and corrective actions by EPA and CDH subject to paragraph 3(e), DOE shall implement the plans in accordance with the schedules therein.
- f. DOE shall provide closure plans and, where applicable, post-closure plans and post-closure permit applications for all units (other than those discussed in subparagraph g below) which are to be closed in accordance with Schedule 4 attached hereto.

- g. DOE will provide closure and post-closure plans, to CDH and EPA and perform closure and post-closure activities for Solar Ponds 207A, 207B, and 207C in accordance with Schedule 5 attached hereto and incorporated herein by reference. DOE will also provide documents required by 40 C.F.R. section 270 for any treatment, storage, and disposal activities undertaken pursuant to closure for which a permit is required.
- h. (1) DOE shall comply with respect to its radioactive mixed wastes with the generator and interim status standards of 40 C.F.R. Parts 262 and 265 and, after a permit is issued, with Part 264 and 270 standards, provided that such compliance is not inconsistent with DOE's obligations under the Atomic Energy Act of 1954 as amended. Such obligations include, inter alia, the protection of human health and the environment from radiation hazards associated with its operations and the production of nuclear weapons for the national defense.
- (2) Any determination of inconsistency between the technical requirements of the AEA and the technical requirements of RCRA or the State's EPA-authorized RCRA program shall be made after consultation between the Secretary of Energy and the Administrator, EPA. If such persons cannot agree on said determination, either party may invoke the dispute resolution mechanism of Executive Order 12088. The State shall be consulted in connection with such determination of technical inconsistency and its views given careful review and consideration by DOE and EPA.
- (3) Determinations of national security-related inconsistency between the requirements of the AEA and those of RCRA shall be

made solely by the DOE. The DOE shall notify the EPA and the State of any such determinations and the reasons therefor. EPA reserves whatever rights of appeal of such determinations it may have.

(4) CDH reserves any rights it may have to seek judicial review of such inconsistency determinations.

1. References in Schedules 1 through 5 to CERCLA requirements are for the purpose of describing the integrated technical program which will be followed by the parties and do not imply that RCRA or CWA enforcement authorities are applicable to CERCLA matters.

9. RADIOACTIVE MIXED WASTE ENFORCEMENT

- a. Compliance with paragraph 8 by DOE may be enforced by EPA in the same manner as it enforces RCRA requirements at any federal facility. If a particular dispute is not resolved to the satisfaction of either party through the normal enforcement process for federal agencies either Party may invoke the conflict resolution procedures set out in sections 1-6 of Executive Order 12088, and/or section 1-4 of Executive Order 12146.
- b. (1) CDH may at any time file an action under section 7002(a)(1)(A) alleging a violation of any requirement of RCRA expressed in this Agreement including but not limited to violations of Schedules 1-5 hereof and 40 C.F.R. Parts 260-270 for radioactive mixed wastes.
(2) CDH may, but is not required to, notify DOE in writing of such alleged violation prior to or concurrently with initiation of an action described in (1) above. If CDH does so notify DOE, the parties shall attempt to resolve informally the alleged violation.
(3) CDH expressly reserves the right to seek civil penalties in

an action brought under section 7002 for violations of the RCRA requirements expressed in the Agreement. DOE expressly reserves the right to contest the applicability of civil penalties.

(4) If EPA determines that CDH is authorized under section 3006 of RCRA, 42 U.S.C. § 6926, to regulate radioactive mixed waste, CDH may also enforce the requirements of the Agreement related to radioactive mixed waste pursuant to its authorities and procedures under CHWA and the CDH hazardous waste regulations.

10. REMEDIAL/CORRECTIVE ACTION

- a. The parties to this Agreement acknowledge that there may be overlap of CERCLA, RCRA, and CHWA authorities with respect to actual or potential contaminated areas at the Rocky Flats Plant. To the extent practicable, activities undertaken pursuant to RCRA, CHWA, and CERCLA shall be integrated into one technical program to avoid duplication of effort and to ensure protection of the public health, welfare, or the environment. DOE shall comply with applicable RCRA, CHWA, and CERCLA requirements.
- b. The parties acknowledge that DOE has developed and is presently implementing a program entitled the "Comprehensive Environmental Assessment and Response Program" (CEARP) which addresses SWMU and CERCLA areas at the Rocky Flats site. The parties agree that for all CERCLA response activities and corrective action at the site, the CEARP shall be consistent with the requirements of the National Contingency Plan (NCP) under CERCLA and applicable RCRA requirements including but not limited to the following:
 - (1) Remedial Investigation. The CEARP shall include a remedial investigation under CERCLA and the NCP which is consistent

with the NCP and with EPA's "Guidance on Remedial Investigations Under CERCLA." The geographic scope of the remedial investigation shall include the entire Rocky Flats site plus any additional areas where contamination originating from the site has been or may be identified. Such investigations may be completed separately for various operable units pursuant to an approved work plan. DOE shall submit a remedial investigation report to EPA and CDH, subject to paragraph 3(e), for review and approval.

- (2) Feasibility Study. The CEARP shall include a feasibility study under CERCLA and the NCP which is consistent with the NCP and EPA's "Guidance on Feasibility Studies Under CERCLA." The feasibility study shall include an analysis of alternatives for remedial action, and shall recommend an alternative to EPA for approval. DOE shall prepare a feasibility study report and shall submit such report to EPA and CDH, subject to paragraph 3(e), for review and approval.

- (3) Endangerment (Risk) Assessment. The CEARP shall include an endangerment assessment which is consistent with the NCP and applicable EPA guidance. DOE shall submit a report on the endangerment assessment to EPA and CDH, subject to paragraph 3(e), for review and approval.

- c. DOE shall deliver proposed response measures and proposed implementation schedules to EPA and CDH in accordance with Schedule 3 attached hereto and incorporated herein by reference. Any response measures and corrective action proposed for implementation under CERCLA and RCRA at the Rocky Flats site shall be subject to EPA

and CDH approval, subject to paragraph 3(e), and shall be consistent with the NCP and applicable RCRA guidance.

- d. The technical tasks and timeframes for accomplishment of the integrated program for SWMU and CERCLA areas which includes CERCLA/CEARP requirements are contained in Schedule 3 attached hereto and incorporated herein by reference.
- e. Following EPA and CDH approval of response measures and corrective actions, the remedial/corrective action alternative selected shall be incorporated into this Agreement, together with the schedules developed pursuant to Schedule 3 thereon, and shall thereafter be implemented by DOE.
- f. To provide for public comments as contemplated by the NCP on the CERCLA provisions of this Agreement and its subsequent implementation, the Parties agree to the following:
 - (1) Within 30 days of the effective date of this Agreement, DOE shall submit to EPA and CDH a draft communications strategy/community relations plan which includes activities and schedules for conducting a public involvement program consistent with the NCP, and EPA's guidance on community relations planning. A final strategy/plan shall be prepared within 14 days of receipt of EPA/CDH comments. After approval by EPA and CDH, the strategy/plan shall be implemented.
 - (2) EPA and DOE shall conform to the public comment requirements of the NCP and relevant EPA guidance with respect to CERCLA activities and reports generated under this Agreement.
 - (3) Prior notification shall be provided to all parties when issuing press releases.

(4) Upon DOE's submission to EPA of a final feasibility study report pursuant to this Agreement, EPA shall, consistent with the NCP, make both the remedial investigation report and the feasibility study report, available to the public for review and comment for at least twenty-one days.

- g. Nothing in this paragraph 10 shall preclude DOE, CDH, or EPA from taking any response actions which are deemed necessary to protect public health, welfare, and the environment. If a removal action is undertaken by DOE or EPA, it shall notify the other party within twenty-four (24) hours after the commencement of such action. If a remedial action is planned by DOE or EPA, it shall notify the other party before commencement of the same. EPA, CDH, or DOE actions taken pursuant to this subparagraph g do not release any party from any of the obligations to comply with the requirements of this Agreement.
- h. References in Schedule B to hazardous waste or radioactive mixed waste CMAA or RCRA requirements are for the purpose of describing the integrated technical program which will be followed by the parties and do not imply that CMAA or RCRA enforcement procedures are applicable to CERCLA matters. Additionally, CERCLA information submitted contemporaneously with the combined Part B permit application shall be for CERCLA review and approval only, and shall not be submitted for the purpose of seeking a permit for such CERCLA activities.

11. REMEDIAL/CORRECTIVE ACTION DISPUTE PROCEDURES

- a. (1) All disagreements, disputes, and conflicts ("disputes") arising between EPA and DOE under the provisions of paragraph 10 hereof

shall be subject to the terms and conditions of this paragraph

11. Either may invoke the dispute resolution process set forth herein by giving notice to the other party.

(2) EPA and DOE will, in good faith, undertake their best efforts to resolve any disputes involving CERCLA. EPA will consult with CDH in connection with such a dispute. In the event that agreement between DOE and EPA cannot be reached, either may request that the Parties appoint an official to a second level dispute resolution team, and these officials will, in good faith, attempt to resolve the dispute.

(3) If a particular dispute is not resolved within sixty (60) days after the dispute arises through the process described herein, either Party may invoke the conflict resolution procedures set out in sections 1-6 of Executive Order 12088 and/or section 1-4 of Executive Order 12146.

b. Disagreements, disputes, and conflicts ("disputes") between CDH and DOE arising under the provisions of paragraph 10 hereof related to corrective action for radioactive mixed waste shall be resolved as provided by paragraph 9(b). Disputes between CDH and DOE arising under the provisions of paragraph 10 relating to corrective action for hazardous waste shall be resolved as provided by paragraph 7(a).

12. GENERAL PROVISIONS

a. Access

1. Access to Plant. DOE will permit access to the Plant to EPA and CDH personnel for the general purpose of determining compliance by DOE with this agreement and shall include the

following specific purposes:

- (1) to inspect, review, and copy as necessary the documents and information to be provided hereunder;
- (2) to observe hazardous and radioactive mixed waste unit operations;
- (3) to observe groundwater monitoring wells and radioactive mixed waste operations related to the groundwater activities specified herein and in Schedule 3 to be performed by DOE.
- (4) to observe field work and to monitor any of the activities required by this Agreement; and
- (5) to conduct any other necessary sampling, monitoring, testing, and other information gathering, as determined by CDH and EPA.

Access to certain portions of the plant will be restricted to those EPA and CDH personnel with Q access security clearances. EPA and CDH personnel shall give prior notice to Plant personnel of their visit and will be accompanied by Plant personnel during such visit. EPA and CDH agree that its representatives shall comply with all rules and regulations established by DOE for the protection of health, safety, and security while at the Plant, including the requirements of Executive Order 12356. Nothing in this subparagraph a.1. shall preclude EPA and CDH from exercising or attempting to exercise their right or alleged right to enter and inspect the Plant site pursuant to their own statutes or regulations. DOE reserves all rights to control access to the site pursuant to the provisions of the AEA.

2. Offsite Access

To the extent that activities pursuant to the Agreement must be carried out on other than DOE property, DOE shall use its best efforts to obtain access agreements from the owners which shall provide reasonable access for DOE, EPA, and CDH representatives. In the event that DOE is unable to obtain such access agreements, DOE shall notify EPA and CDH regarding both the lack of agreements and efforts to obtain such access agreements, and EPA and CDH will, consistent with their statutory authorities, attempt to secure access.

b. Sampling

- (1) DOE shall make available to EPA and CDH all results of sampling, tests, or other data, generated by DOE or on its behalf with respect to the implementation of this Agreement within ten (10) days of their receipt by DOE. Similarly, EPA and CDH will make available to DOE the results of sampling, tests, or other data generated by EPA or CDH within ten (10) days after the results are available.
- (2) DOE shall notify EPA and CDH by telephone at least seven (7) days before conducting well drilling, installation of major equipment, or sampling performed pursuant to any of the Schedules attached hereto. At the request of EPA or CDH, DOE shall provide or allow EPA or CDH to observe field work and to take split or duplicate samples of all samples collected by DOE pursuant to this Agreement. At the request of DOE, EPA and CDH similarly shall provide or allow DOE or its

authorized representatives to take split or duplicate samples of all samples collected by EPA and CDH at the Rocky Flats facility.

- c. Submittal Review. Certain submittals by DOE under the Schedules attached hereto shall be provided to EPA and CDH, as appropriate, for comment at least two (2) weeks prior to the date in the Schedule. DOE shall provide a final submittal that incorporates EPA and CDH comments, as appropriate, by the later of the Schedule deadline or seven (7) days after DOE's receipt of the comments.
- d. Confidential Information and Security.
1. EPA and CDH Personnel. DOE agrees to process security clearances, in accordance with DOE procedures, for the personnel designated by EPA and CDH to have access to the Plant.
 2. DOE Documents and Information:
 - (1) DOE agrees to give to EPA and CDH-designated personnel with appropriate security clearances, access to any information relevant to waste generator and management requirements, or releases of hazardous substances, hazardous wastes, radioactive mixed waste, and their constituents that EPA and CDH reasonably need to fulfill their responsibilities under this Agreement.

Information may include Restricted Data, National Security Information classified under Executive Order 12356 and its predecessors, and Unclassified Controlled Nuclear Information under section 148 of the Atomic Energy Act of 1954, as amended.
 - (2) EPA and CDH agree to handle and safeguard such DOE

information in accordance with the AEA and DOE Orders and Executive Order 12356, and to establish, at their own expense, adequate facilities to safeguard such documents from theft or unauthorized use. EPA and CDH further agree to permit DOE to conduct regular security inspections of their facilities to assure compliance with this subparagraph.

- e. Record Preservation. EPA, DOE, and CDH agree that each shall preserve, during the pendency of the Agreement and for a minimum of six (6) years after its termination, all records and documents in their possession or in the possession of their division or employees which are generated, used, or reviewed in performing the work required under this Agreement, despite any retention policy to the contrary.
- f. Quality Assurance. Throughout all sample collection and analysis activities, DOE shall use CDH or EPA-approved quality assurance, quality control, and chain of custody procedures, as appropriate. In addition, DOE shall:
- (1) Follow the EPA guidance contained in the document entitled "Standard Operating Procedures for Field Samplers" (March 1986);
 - (2) Consult with EPA and CDH in planning for, and prior to, sampling and analysis;
 - (3) Inform EPA and CDH in advance which laboratories will be used by DOE, and ensure that EPA and CDH authorized representatives will have reasonable access to the laboratories and personnel used for analyses;
 - (4) Ensure that laboratories used by DOE perform analyses according

to EPA methods or other methods deemed satisfactory to EPA and CDH; and

- (5) Ensure that laboratories used by DOE for analyses participate in a quality assurance/quality control program equivalent to that which is followed by EPA and CDH. As part of such a program, and upon request by EPA or CDH, such laboratories shall perform analyses of samples provided by EPA or CDH to demonstrate the quality of the analytical data. A maximum annual number of four such samples may be provided to each laboratory.

g. Project Coordinators. Within fifteen (15) days from the effective date of this Agreement, EPA, CDH, and DOE shall each designate a Project Coordinator. Each Project Coordinator shall be responsible for overseeing the implementation of this Agreement. To the maximum extent possible, all communications between CDH, DOE, and EPA, and all documents, including reports, approvals, and other correspondence concerning the activities performed pursuant to the terms and conditions of the Agreement, be directed through the Project Coordinators. EPA, DOE, and CDH each have the right to change their respective Project Coordinator. Such a change shall be accomplished by notifying the other parties in writing at least one week prior to the change.

h. Rockwell's Performance of DOE's Obligations. DOE's obligations as specified herein may be carried out in whole or in part by DOE's management contractor for the Plant, Rockwell. Accordingly, any action taken by Rockwell in fulfillment of DOE's obligations under this Agreement shall be to the same effect as if performed

by DOE. If DOE's contract with Rockwell is terminated or expires prior to such time as the obligations of DOE are fully satisfied hereunder, DOE agrees to impose upon its successor contractor at Rocky Flats the same obligations as now imposed upon Rockwell with respect to the satisfaction of DOE's obligations hereunder. Notwithstanding any contract existing between DOE and Rockwell, DOE shall remain obligated under the terms of this Agreement.

1. Delay or Prevention of Performance

- (1) Subject to the provisions of subparagraphs below, DOE will use its best efforts to avoid any delay or prevention of the performance of activities identified in the Schedules attached to this Agreement. Any failure by DOE to meet the dates specified herein or in the Schedules shall be excused, and the time for completion extended, to the extent that such failure is caused by unforeseen circumstances beyond the control of DOE. Such circumstances shall include but not be limited to: acts of God, acts of war, fires, floods, strikes, insurrections, and riots. DOE shall notify the EPA and CDH within three (3) days of its knowledge of any such delay and the reasons therefor. Within ten (10) days of such notification, DOE shall provide EPA and CDH with a written report describing the length of the delay, the reason for the delay, efforts to minimize the delay and a proposed revised schedule.
- (2) If the parties agree that a delay is or was excusable, the parties shall modify the dates specified herein or in the Schedules to provide such additional time as may be necessary

to allow completion of the particular task or tasks and/or any succeeding phase of the work affected by such delay.

- (3) If the parties cannot agree on whether there is or was an excusable delay or the duration of such delay, EPA or CDH may take such action as provided for herein.

j. Funding. DOE's performance of commitments under the Schedules attached hereto is subject to the availability of appropriated funds for such purpose. If appropriated funds are not available to fulfill the obligations contained in the Schedules, CDH and EPA reserve the right to initiate such action as they deem appropriate, to the extent permitted by law.

k. Agency. This Agreement shall not be construed to create, either expressly or by implication, the relationship of agency between the parties. Neither EPA, DOE, or CDH shall be liable for the contracts, acts, errors, or omissions of the agents, employees, or contractors of the other Parties entered into, committed, or performed with respect to or in the performance of this Agreement.

l. EPA's and CDH's Obligations. In addition to obligations expressed elsewhere herein, the following specific obligations are made:

- (1) CDH agrees that simultaneously with the execution of this Agreement, it will issue a document which withdraws its "Notice of Intent to Terminate Interim Status and to deny a State Hazardous Waste Part B Permit Application..." dated December 4, 1985, and which references the compliance requirements contained in Schedule 1 attached hereto.
- (2) CDH and EPA agree to waive any civil penalties arising out

of or in connection with any alleged violation of RCRA, RCRA regulations, the CHWA, or the CDH hazardous waste regulations by DOE or Rockwell alleged to have occurred prior to the date of this Agreement with respect to management of the facility's radioactive mixed wastes, including the offsite transportation, storage, or disposal of radioactive mixed wastes.

- (3) CDH and EPA agree that during the term of this Agreement neither EPA nor CDH will seek, in any proceeding against DOE under RCRA, CERCLA, the CHWA or their implementing regulations before any administrative or judicial forum, to revise the activities and timetables contained in the Schedules attached hereto except in response to an emergency or circumstance which may present an immediate and substantial threat or an imminent and substantial endangerment to the public health, welfare, safety, and the environment.
- (4) CDH and EPA agree to provide DOE with technical assistance in connection with DOE's hazardous and radioactive mixed wastes and with the groundwater monitoring investigative efforts described herein.
- (5) Upon completion by DOE of the remedial actions requirements referenced in paragraph 10 hereof to the satisfaction of EPA, EPA, upon DOE's written request, shall respond to DOE in writing that DOE's actions taken pursuant to this Agreement were consistent with the NCP and that any clean-up remedy selected by EPA is the most appropriate remedy consistent with the NCP.

m. Legal Positions and Other Remedies Preserved

- (1) Except as provided in paragraph 1(2) hereof, CDH reserves the right, to the extent permitted by State or Federal law, to seek civil penalties against DOE with respect to any alleged past, present, or future violation of RCRA, the CHWA, and the CDH hazardous waste regulations.
- (2) This Agreement shall not constitute a concession or admission by DOE, EPA or CDH on the issue of the State's regulatory authority (including the authority to impose civil penalties) over radioactive mixed waste without authorization by EPA under section 3006 of RCRA, 42 U.S.C. § 6926, and this Agreement shall not be pleaded as evidence on that issue by DOE, EPA or CDH in any case or proceeding filed to resolve that issue. If CDH files any case or proceeding regarding radioactive mixed wastes except as provided in paragraph 9(b) herein, DOE and CDH agree that DOE's obligations to CDH under paragraphs 8 and 9 shall be voidable at the election of DOE, without further obligations to CDH hereunder.
- (3) Nothing in this Agreement including the findings of fact, conclusions of law, and determinations of EPA and CDH, is intended nor shall be construed as an admission of fact or law by DOE, an estoppel or waiver of defenses by DOE for any purpose, or an acknowledgement by DOE of any liability whatsoever, except as specifically provided for in this Agreement.
- (4) Except as provided for in this Agreement, the parties hereto will not be deemed to have waived or altered any of their

respective existing or future legal rights, duties, obligations, or remedies by entering into this Agreement, including such rights, duties, obligations, or remedies as may exist under CERCLA, RCRA, CHWA, or the AEA.

- (5) Nothing in this Agreement shall prevent EPA, CDH, or DOE from exercising their duty to protect public health, welfare, and the environment to the extent permitted by law.
- (6) Notwithstanding anything else in this Agreement, EPA expressly reserves any rights it may have to bring an action under section 7003 of RCRA and section 106 of CERCLA and CDH expressly reserves any right it may have to bring an action under section 7002(a)(1)(B) of RCRA or under section 25-15-301(4), C.R.S. DOE expressly reserves the right to assert any defenses it may have in connection with any such actions.
- (7) With the exception of paragraph 1(2), nothing in this Agreement shall preclude EPA or CDH from taking any enforcement action under any statutes administered by EPA or CDH, nor constitute or be construed as a release from any claim, cause of action, or demand, in law or equity, against Rockwell International Corporation, or any other person, firm, partnership, or corporation not a signatory to the Agreement for any liability it may have arising out of or relating in any way to the generation, storage, transportation, release, or disposal of any hazardous substances, hazardous wastes, radioactive mixed wastes, pollutants, or contaminants located at, taken to, or taken from the Rocky Flats facility.

Notwithstanding the preceding paragraph, EPA and CDH agree during the term of this Agreement not to initiate proceedings against Rockwell International Corporation under RCRA, CERCLA, the CHWA or their implementing regulations before any administrative or judicial forum, for injunctive relief regarding activities specified in the schedules herein, if DOE is in compliance with the activities in the Schedules, except in response to an emergency or circumstance which may present an immediate and substantial threat, or an imminent and substantial endangerment, to the public health, welfare, safety, or the environment. Nothing in this paragraph shall be construed to release Rockwell from any liability it may have under any other statutes or regulations administered by EPA or CDH.

- (8) Except as provided in paragraph 12.1.(2), nothing in this Agreement shall be construed to release DOE and Rockwell for violations of RCRA or CERCLA related to off-site transportation, storage, or disposal of hazardous materials, or to natural resource damages.
- (9) Nothing in this Agreement shall be construed to be a general interpretation by EPA, CDH or DOE about the current or potential applicability of RCRA or the CHWA to any waste addressed in this Agreement, or of the general authority or responsibility of EPA to implement RCRA in authorized states.
- (10) Nothing in this Agreement shall be construed to resolve whether DOE is an operator of the facility.

- n. Other Applicable Laws. All actions required to be taken pursuant to this Agreement shall be undertaken in accordance with the requirements of all applicable local, State, and Federal laws and regulations, including the NCP.
- o. Modifications of Agreement. In the event there is an amendment or change to the statutes or regulations upon which this Agreement is based, such amendment or change shall govern and this Agreement shall be modified to reflect the amendment or change. During the pendency of negotiation of any such modification, the time schedules and obligations herein shall remain in effect to the extent that they do not conflict with the amendment or change. Otherwise, any Party may request a written modification of this Agreement, and if approved by the other Parties, such written modification shall be incorporated herein.
- p. Duration of Agreement. The parties agree to adhere to the terms of this Agreement so long as it remains in effect. The Agreement will be terminated when the following requirements are completed:
- (1) the requirements of paragraph 6 will be completed upon DOE's receipt of written notice from CDH and EPA that such requirements have been satisfactorily accomplished and upon a determination on the issuance of a Part B permit being made, which notice and permit shall not unreasonably be withheld;
 - (2) the requirements of paragraph 8 will be completed upon DOE's receipt of written notice from CDH and EPA that such requirements have been satisfactorily accomplished and upon

a determination on the issuance of a Part B permit being made, which notice and permit shall not unreasonably be withheld; and

- (3) the requirements of paragraph 10 will be completed upon DOE's receipt of written notice from EPA that such paragraph 10 requirements have been satisfactorily accomplished, which notice shall not unreasonably be withheld.

After completion of this Agreement, DOE will have a continuing obligation to comply with applicable statutes and regulations at the Rocky Flats facility.

q. Public Review. To provide for public review of this Agreement, the parties agree to the following:

- (1) A joint briefing will be conducted for elected officials on the contents of this Agreement.
- (2) This Agreement shall be available for public information at the next regularly scheduled state exchange meeting between DOE, CDH, and EPA.

r. Effective Date. This Agreement shall become effective upon the date of execution by the Parties.

The undersigned represent that they have the authority to execute this Agreement on behalf of their respective agencies.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

7/30/86
DATE

BY:
JOHN G. WELLES
REGIONAL ADMINISTRATOR
EPA REGION VIII

STATE OF COLORADO
BY COLORADO DEPARTMENT OF HEALTH

7/30/86
DATE

BY:
THOMAS M. VERNON, M.D.
EXECUTIVE DIRECTOR

UNITED STATES DEPARTMENT OF ENERGY

7/31/86
DATE

BY:
ALBERT E. WHITEMAN
AREA MANAGER
ROCKY FLATS AREA OFFICE

SCHEDULE 1

COMPLIANCE AND PART B PERMIT APPLICATION

Task 1.1 Compliance with Interim Status Requirements

Task 1.1 consists of a phased approach for DOE demonstration of compliance with CHWA generator and interim status requirements for hazardous waste operations and RCRA interim status requirements for radioactive mixed waste operations.

To complete Task 1.1, DOE shall demonstrate compliance with the applicable CHWA and RCRA notification, generator, interim status, and permit submittal requirements. Complete compliance with 6 CCR 1007-3 Parts 99, 100, 262, and 265 for hazardous waste and 40 CFR Parts 262, 265 and 270 for radioactive mixed waste shall be demonstrated by November 28, 1986 or a plan for achieving compliance for those items which are impossible to complete by November 28, 1986 shall be provided at least sixty (60) days prior thereto. Such plans shall be subject to review and approval by CDH or EPA, as appropriate.

Task 1.2 Complete Part B Permit Application

Task 1.2 consists of the submittal of a revised and complete Part B permit application for all hazardous waste and radioactive mixed waste management units and all identified releases at the Rocky Flats Plant.

To complete Task 1.2, DOE and Rockwell shall deliver a combined hazardous and radioactive mixed waste Part B permit application on or before November 28, 1986. The submittal shall be in accordance with requirements of 6 CCR 1007-3 Parts 100 and 264 for hazardous waste, 40 CFR Parts 264 and 270 for radioactive mixed waste, and HSWA. Completion of this task will be measured by delivery of the combined Part B permit application.

SCHEDULE 2

ACTIVE WASTE STREAM AND UNIT IDENTIFICATION AND ANALYSES

Task 2.1 Active Waste Stream and Unit Identification for Area 1.

Task 2.1 consists of the submittal of active waste stream and unit identification information, for review and approval, for Area 1 (shown on Figure 1 attached hereto and incorporated herein by reference).

To complete Task 2.1, DOE shall deliver to EPA and CDH, for review and approval, on or before May 30, 1986, active waste streams and unit identifications for Area 1. The submittal shall include the identification of all waste streams generated or transferred into the area and a flow diagram tracing the path of waste movement(s). The waste stream identifications shall, as a minimum, include the following:

- a. Waste source(s), stream(s), unit identification number(s), and name(s);
- b. Description of quantities of waste(s) generated or managed;
- c. Description of generation process and general chemical content of the waste(s); for unit(s), a brief description of the unit(s);
- d. Next destination for the waste stream(s);
- e. Types of transport unit(s), methods of transport, and route; and,
- f. The source(s), stream(s), and unit(s) shall be shown on one or more diagrams to illustrate their locations and to show how the wastes are moved around the plant and their final destinations.

The listed items a. through f. shall be completed in accordance with the standards of 6 CCR 1007-3 and 40 CFR, as applicable. Completion of Task 2.1 will be measured by delivering the required information to CDH and EPA.

Task 2.2 Waste Analyses Procedures for Area 1

Task 2.2 consists of the development and submittal, for review and approval, of waste analyses procedures for Area 1 of Figure 1.

To complete Task 2.2, DOE shall deliver waste stream analysis procedures, for review and approval, for Area 1 on or before June 13, 1986. The submittal shall, at a minimum, include the following:

- a. Sampling plans specifying sampling methods, number and locations of the samples; and sampling protocols;
- b. List of waste streams to be sampled;
- c. Parameters to be analyzed and rationale for selection;
- d. Laboratory which will conduct analyses; and
- e. Quality Assurance and Quality Control methods.

The listed items a. through e. shall be completed in accordance with the standards of 6 CCR 1007-3 and 40 CFR, as applicable. Completion of these tasks will be measured by delivery of the required information to CDH and EPA for review and approval.

Task 2.3 Active Waste Stream and Unit Identification for All Areas

Task 2.3 consists of the complete and adequate submittal of all active waste stream and unit identifications located at the Rocky Flats Plant.

To complete Task 2.3, DOE shall deliver to CDH and EPA active waste stream identifications for all such active waste sources, streams and units on or before August 29, 1986. The identifications shall be complete and submitted documents shall meet the criteria as described in Task 2.1 for all such active waste streams and units at the Rocky Flats Plant.

Task 2.4 Waste Management Units List

Task 2.4 consists of a complete list of all hazardous and radioactive mixed waste units, and all identified SWMU and CERCLA areas.

To complete Task 2.4, DOE shall deliver a complete list of hazardous and radioactive mixed waste units, SWMU, and CERCLA areas to CDH and EPA on or before September 12, 1986. This submittal shall include all supporting data and justifications for such units.

Task 2.5 Waste Analyses Results from All Active Waste Sources and Streams

Task 2.5 consists of the submittal of a complete data package with waste analyses results of all active waste sources and streams at the Rocky Flats Plant. To complete Task 2.5, DOE shall deliver complete waste analysis results for all active waste sources and streams at the Rocky Flats Plant to CDH and EPA on or before October 17, 1986. The submittal shall include complete chemical and physical analysis of all hazardous and radioactive mixed waste sources and streams to the extent necessary to treat, store, or dispose of each waste stream in accordance with 6 CCR 1007-3 or 40 CFR, as applicable. Waste streams identified as transuranic material need not include a complete chemical and physical analysis. Waste streams shall be identified to the extent necessary to demonstrate that they are or are not hazardous or radioactive mixed wastes including all supporting data and justification for the identification. This task shall be completed in accordance with the applicable standards of 6 CCR 1007-3 or 40 CFR, as applicable.

Task 2.6 Revised Waste Analyses Section

Task 2.6 consists of a submittal, for review and approval, of a revised hazardous and radioactive mixed waste analyses plan for both permitting and regulatory compliance requirements.

To complete Task 2.6, DOE shall deliver such a revised waste analysis section as part of the combined Part B permit application on or before November 28, 1986. The submittal shall include information completely addressing the 6 CCR 1007-3 Part 100, Part 264, and Part 265 requirements and equivalent RCRA waste analysis requirements for a Part B permit application and Interim status compliance. The submittal shall be in accordance with: 6 CCR 1007-3 including but not limited to Sections 100.40, 100.41, 262.11, 264.13, and 265.13; 40 CFR Sections including but not limited to 262.11, 264.13, and 265.13; 40 CFR 270 Subpart B; and HSWA, as applicable.

Task 2.7 Changes and/or Amendments Under Interim Status

Task 2.7 consists of the preparation and delivery of requests for revisions of the Rocky Flats Part A permit application for hazardous and radioactive mixed waste activities and for any proposed changes under Interim Status for such activities.

To complete Task 2.7, DOE shall deliver required amendments to the Rocky Flats Part A application, and requests for changes under Interim Status, together with justification for such amendments or changes, to CDH and EPA on or before November 28, 1986 for review and approval. This submittal shall only include those changes which are in accordance with 6 CCR 1007-3 Sections 100.11 and 100.20 and 40 CFR 270.72.

Task 2.8 Revised Unit Specific Part B Permit Application Section

Task 2.8 consists of the submittal of a combined hazardous and radioactive mixed waste Part B permit application describing each treatment, storage and disposal unit to be permitted and its ancillary equipment.

To complete Task 2.8, DOE shall deliver unit specific information to CDH and EPA on or before November 28, 1986 as part of the revised Part B permit application. This submittal shall include information completely addressing the 6 CCR 1007-3 Part 100, Part 264, and Part 265 unit specific requirements for a Part B permit application and interim status compliance and 40 CFR Parts 264, 265, and 270, as applicable. The submittal shall be in accordance with: 6 CCR 1007-3 Part 264 Subparts I through O, Part 265 Subparts I through R, and section 100.41 (b); 40 CFR Part 264, Subparts I through O, Part 265, Subparts I through R, and Part 270, Subpart B; and HSWA, as applicable.

PRELIMINARY

SCHEDULE 3

SITE CHARACTERIZATIONS AND CORRECTIVE ACTION

Task 3.1 Plans for Geological and Hydrological Site Characterization

Task 3.1 consists of a comprehensive geological and hydrological draft work plan, for review and approval, which will meet requirements of the CHWA, RCRA, and CERCLA.

To complete Task 3.1, DOE shall compile all existing geological and hydrological data and deliver a work plan for detailed geological and hydrological site characterization to CDH and EPA on or before July 21, 1986. The existing data submittal shall compile the results of the DOE CEARP Phase 1 study, geophysical studies, soil gas survey, and any other pertinent required information. The submittal shall propose a work plan for obtaining a detailed geological and hydrological characterization of the site emphasizing the areas of contamination. The plan shall address, but not be limited to:

- a. Surface geological mapping of surficial deposits, outcrops, seeps and springs, and structures;
- b. Subsurface hydrogeologic and geologic characterization;
- c. Hydrological testing;
- d. Well and boring locations and descriptions;
- e. Surface water hydrology;
- f. Implementation schedules.

Completion of this Task will be measured by the compiled data being available for CDH and EPA review at the Plant and by delivery of a letter from DOE to CDH and EPA forwarding the work plan and an inventory of available data for review and approval. (Task 3.5 covers submittal of the results of this task.)

Task 3.2 SWMU and CERCLA Areas Identification and Draft Remedial Investigation Work Plan

Task 3.2 consists of a general description of all identified SWMU and CERCLA areas as well as a draft remedial investigation work plan for review and approval by EPA and CDH.

To complete Task 3.2 DOE shall deliver a draft work plan to CDH and EPA on or before July 31, 1986. The work plan shall identify all identified actual or potential SWMU and CERCLA areas and shall consist of methodologies for sampling plan development, data management procedures, health and safety planning, site characterization, and quality assurance/quality control. The work plan shall provide a preliminary priority order for conducting remedial investigations and shall integrate all identified SWMU and CERCLA areas into one list. Schedules for implementation of the remedial investigations for all identified SWMU and CERCLA areas will be submitted per Task 3.4. Specific remedial investigation plans will be developed and submitted under Task 3.8 for high-priority SWMU and CERCLA areas.

Task 3.3 Draft Feasibility Study Work Plan

Task 3.3 consists of the submittal of a draft work plan for performance of feasibility studies to EPA and CDH for review and approval.

To complete Task 3.3, DOE shall deliver a draft work plan to EPA and CDH on or before September 1, 1986. The work plan shall describe the methods and approach which DOE will use to conduct feasibility studies on SWMU and CERCLA areas. Schedules for the performance of a feasibility study for all SWMU and CERCLA areas will be submitted per Task 3.4. Specific feasibility study plans will be developed and submitted under Task 3.8 for high-priority SWMU and CERCLA areas.

Task 3.4 Comprehensive Remedial Investigation and Feasibility Study Schedules

Task 3.4 consists of the submittal, for review and approval, of a comprehensive schedule for remedial investigations and feasibility studies of all identified potential SWMU and CERCLA areas.

To complete Task 3.4 DOE shall deliver a comprehensive schedule to CDH and EPA on or before October 31, 1986 as part of the draft Part B permit application. The schedule shall meet the remedial investigation and feasibility study requirements of CERCLA, RCRA, the NCP, RCRA, and relevant guidance for all identified SWMU and CERCLA areas. The schedule shall consist of and be based on data obtained through DOE's CEARP program and any other pertinent studies including data gathered from the programs defined herein.

Task 3.5 Comprehensive Site Characterization Results

Task 3.5 consists of a comprehensive site characterization based on available data and work performed and approved under Task 3.1.

To complete Task 3.5, DOE shall deliver the results of available site characterizations to CDH and EPA on or before November 28, 1986. The submittal shall include the results of the approved geological and hydrological work plan defined in Task 3.1. The submittal shall also include chemical and physical characterization of SWMU and CERCLA areas based upon available data. Revised comprehensive schedules for performing remedial investigation and feasibility studies and remedial action at SWMU and CERCLA areas will be presented. The submittal shall be in accordance with: 6 CCR 1007-3 Sections 100.41(c), 265.90, and 265.91; 40 CFR 270 Subpart B, 265.90 and 265.91; and RCRA and CERCLA remedial investigation and feasibility study requirements; the NCP; and relevant

guidance. Completion of this task will be measured by submission of the results as part of the revised Part B permit application.

Task 3.6 Revised Ground Water Monitoring and Protection Submittal

Task 3.6 consists of the revised submittal of a comprehensive Ground Water Monitoring and Protection Program at the Rocky Flats Plant to address the requirements of the CHWA and RCRA.

To complete Task 3.6, DOE shall deliver a revised ground water monitoring and protection section to the Part B permit application to CDH and EPA on or before November 28, 1986. The submittal shall include information completely addressing ground water requirements for a Part B permit application, interim status compliance, and SWMU and CERCLA areas in accordance with the following regulations: 6 CCR 1007-3 Part 100, Part 264, and Part 265; 40 CFR Part 264, Part 265 and Part 270. The submittal shall be in accordance with: 6 CCR 1007-3 Part 264 Subpart F, Part 265 Subpart F, and section 100.41(c); and 40 CFR Part 264, Subpart F, Part 265, Subpart F, and Part 270, Subpart B. Completion of this task will be measured by submission of the required section as part of the revised Part B permit application.

Task 3.7 Radioecology and Airborne Pathway Data

Task 3.7 consists of the submittal for review and approval of radioecology and airborne pathway data for Rocky Flats.

To complete Task 3.7, DOE shall deliver to CDH and EPA a compilation of the radioecology and airborne pathway data on or before December 19, 1986.

Task 3.8 Plume and Source Characterizations and Proposed High Priority SWMU and CERCLA Areas for Corrective/Remedial Actions

Task 3.8 consists of the submittal by DOE of an integrated, comprehensive plan to EPA and CDH to delineate all sources and plumes at the Rocky Flats facility and propose high priority SWMU and CERCLA areas for corrective and/or remedial action under RCRA, CERCLA, or CHWA.

To complete Task 3.8, DOE shall: 1) deliver a list of high priority SWMU and CERCLA areas for corrective and/or remedial action on or before February 16, 1987, to EPA and CDH for review and approval; 2) deliver a complete plume and source characterization plan on or before February 16, 1987, to EPA and CDH for review and approval (The source characterization plan shall include, but not be limited to, a plan for complete physical and chemical characterization of all ground water contamination plumes and their sources and shall address the requirements of: 6 CCR 1007-3 100.41(c) and 265.93; 40 CFR 270 Subpart B, and 40 CFR 265.93); and 3) deliver a work plan and schedules for performance of remedial investigations and feasibility studies for all high priority SWMU and CERCLA areas on or before February 16, 1987, to EPA and CDH for review and approval. The work plan and schedules for performance of the remedial investigations and feasibility studies shall be consistent with the requirements of CERCLA, the NCP and relevant guidance, and with RCRA. The work plan shall also include tentative schedules for submittal of comprehensive remedial action and/or corrective action plans for implementation of response actions for all high priority SWMUs and CERCLA areas, and implementation schedules for such remedial and/or corrective action plans.

The submittal under this Task shall also include, but not be limited to, information which will address:

- a. The rate and extent of migration of hazardous waste and radioactive mixed waste and/or constituents, and hazardous substances in all potential migrations paths (air, soils, biota, surface and ground waters, etc.);
- b. The concentrations of hazardous waste and radioactive mixed waste and/or constituents and hazardous substances in surface and ground waters;
- c. Environmental pathways evaluation and endangerment/(risk) assessment plans; and
- d. Proposal of high-priority plumes and sources to be subject to corrective/remedial action.

DOE shall implement the plans approved under this Task in accordance with the schedules contained therein.

Task 3.9 Results of Source Characterizations and Remedial Investigations

Task 3.9 consists of the submittal of a remedial investigation report(s) summarizing the results of the plumes and source characterization plan performed under Task 3.8 for all high priority plumes and SWMU and CERCLA areas identified in Task 3.8.

To complete Task 3.9, DOE shall deliver such a remedial investigation report(s) to EPA and CDH on or before July 1, 1987. Such report(s) shall be subject to EPA and CDH review and approval with respect to all high priority SWMU and CERCLA areas. The remedial investigation report shall include all the information, data, and analyses generated from Task 3.8, and shall be consistent with the requirements of CERCLA, the NCP and relevant guidance, and RCRA.

Task 3.10 Integrated RCRA/CERCLA Corrective/Remedial Action Program for High Priority Areas

Task 3.10 consists of:

1) the submittal by DOE on or before March 1, 1988, of feasibility study reports scheduled under Task 3.8 for high priority SWMU and CERCLA areas to EPA and CDH for review and approval. Such feasibility reports shall contain comprehensive endangerment (risk) assessments. DOE shall also submit on or before March 1, 1988, preliminary schedules for implementation of the recommended remedial/corrective action.

2) Selection by EPA and CDH of remedial/corrective action response measures for high priority SWMU and CERCLA areas. EPA and CDH shall select such response measures as expeditiously as possible.

3) Within 30 days of the selection of remedial and/or corrective action response measures pursuant to subparagraph 2) above, DOE shall deliver to EPA and CDH for review and approval, a plan for implementation of remedial and/or corrective response measures. Such plan shall address releases from all high priority SWMU and CERCLA areas identified in Task 3.8, and shall contain schedules for implementation of the proposed response measures which shall be subject to EPA and CDH review and approval.

4) Upon EPA and CDH approval of the corrective/remedial action plan, DOE implementation of such plan shall be in accordance with the schedules contained therein.

All feasibility study reports, endangerment (risk) assessment, plans, and response measures submitted by DOE pursuant to this task shall be consistent with the requirements of RCRA, CERCLA,

the NCP and relevant guidance. For all remedial action under CERCLA, the requirements of CERCLA, the NCP and relevant guidance shall be met. For all corrective action, the requirements of RCRA, CHWA and relevant regulations and guidance, including but not limited to 40 CFR Part 264 and 6 CCR 1007-3 Part 264, shall be met. As applicable, the submittals shall include but not be limited to:

- a. A corrective action program including a schedule therefor for ground water high-priority areas that prevents hazardous substances and constituents from exceeding their respective concentration limits at the compliance points;
- b. a ground water monitoring program including a schedule therefor that meets the ground water protection standards under 6 CCR 1007-3 Section 264.92; 40 CFR Section 264.92; CERCLA, the NCP and relevant guidance, and that demonstrates the effectiveness of the corrective action program;
- c. a monitoring program for surface waters and other identified contaminant pathways and a schedule for implementation of the monitoring program.

Task 3.11 Comprehensive Remedial Investigation and Feasibility Study Update

Task 3.11 consists of the submittal of work plans and schedules for the performance of remedial investigation and feasibility studies for all remaining SWMU and CERCLA areas at the Rocky Flats facility which were not addressed in Tasks 3.8-3.10, including, but not limited to, any areas where contamination may have migrated off site.

To complete Task 3.11, DOE shall: 1) deliver, on or before June 1, 1988, a list of all such remaining SWMU and CERCLA areas to EPA

and CDH for review and approval; and 2) deliver, on or before June 1, 1988, a work plan and schedules for performance of remedial investigations and feasibility studies for all remaining SWMU and CERCLA areas to EPA and CDH for review and approval. The work plan and schedules for performance of the RI/FS shall be consistent with the requirements of CERCLA, the NCP and relevant guidance, and with RCRA. The work plan shall also include tentative schedules for submittal of comprehensive remedial and/or corrective action plans for implementation of response measures for all remaining SWMU and CERCLA areas, and tentative implementation schedules for such remedial and/or corrective action plans.

The submittal under this Task shall also include information which will address for all remaining SWMU and CERCLA areas:

- a. The rate and extent of migration of hazardous waste and radioactive mixed waste and/or constituents and hazardous substances in all potential migration paths (air, soils, biota, surface and ground waters, etc.);
- b. The concentrations of hazardous waste and radioactive mixed waste and/or constituents and hazardous substances in surface and ground waters;
- c. Environmental pathways evaluation and endangerment(risk) assessment plans, and;
- d. Proposal of remaining plumes and sources to be subject to corrective/remedial action.

DOE shall implement the work plans approved under this Task in accordance with the schedules therein.

Task 3.12 Results of Remedial Investigations for Remaining CERCLA Areas and SWMUs

Task 3.12 consists of the submittal of a remedial investigation report(s) for all remaining SWMU and CERCLA areas identified in task 3.11.

To complete Task 3.12, DOE shall deliver, in accordance with the schedules approved in Task 3.11, a remedial investigation report(s) for all remaining SWMU and CERCLA areas, to EPA and CDH for review and approval. The remedial investigation report shall include all the data, information and analyses generated from Task 3.11 and shall be consistent with the requirements of CERCLA, the NCP and relevant guidance, and RCRA.

Task 3.13 Integrated RCRA/CERCLA Corrective/Remedial Action Program for Remaining Areas

Task 3.13 consists of:

1) submittal by DOE of feasibility study reports as scheduled under Task 3.11 for remaining SWMU and CERCLA areas to EPA and CDH for review and approval. Such feasibility reports shall contain comprehensive endangerment (risk) assessments. DOE shall also submit preliminary schedules for implementation of the recommended remedial/corrective actions.

2) Selection by EPA and CDH of remedial/corrective action response measures for remaining SWMU and CERCLA areas. EPA and CDH shall select such response measures as expeditiously as possible.

3) Within 30 days of selection of remedial and/or corrective action response measures pursuant to subparagraph 2) above, DOE shall deliver to EPA and CDH for review and approval, a plan for implementation of remedial and or corrective response measures. Such plan shall address releases from all remaining SWMU and

CERCLA areas identified in Task 3.4, and shall contain schedules for implementation of the proposed response measures which shall be subject to EPA and CDH review and approval.

4) Upon approval of the corrective/remedial action plan, DOE shall implement such plan in accordance with the schedules contained therein.

All feasibility study reports, endangerment (risk) assessment, plans, and response measures submitted by DOE pursuant to this task shall be consistent with the requirements of RCRA, CERCLA, the NCP and relevant guidance. For all remedial action under CERCLA, the requirements of CERCLA, the NCP and relevant guidance shall be met. For all corrective action, the requirements of RCRA, CHWA and relevant regulations and guidance, including but not limited to 40 CFR Part 264 and 6 CCR 1007-3 Part 264, shall be met. As applicable, the submittals shall include but not be limited to:

- a. A corrective action program including a schedule therefor for remaining ground water areas that prevents hazardous substances and constituents from exceeding their respective concentration limits at the compliance points;
- b. a ground water monitoring program including a schedule therefor that meets the ground water protection standards under 6 CCR 1007-3 Section 264.92; 40 CFR Section 264.92; CERCLA, the NCP and relevant guidance, and that demonstrates the effectiveness of the corrective action program;
- c. a monitoring program for surface waters and other identified contaminant pathways and a schedule for implementation of the monitoring program.

SCHEDULE 4

CLOSURE AND POST-CLOSURE CARE PLANS

Task 4.1 Facility Wide Closure and Post-Closure Care Plans

Task 4.1 consists of Closure and Post-Closure Care Plans (where applicable) for all units to be closed at the Rocky Flats Plant.

To complete Task 4.1, DOE shall deliver Closure and Post-Closure Care Plans for all units to be closed to CDH and EPA on or before November 28, 1986. The submittal shall include Closure, and where applicable Post-Closure Care Plans, for all hazardous and radioactive mixed waste units for which Closure and Post-Closure Care Plans have not been submitted and which are to be closed. The submittal shall be in accordance with 6 CFR Parts 100, 264, and 265 and 40 CFR Parts 264, 265 and 270, as applicable. If appropriate, an application by DOE for a post-closure permit may be required by CDH or EPA.

PRELIMINARY

SCHEDULE 5

CLOSURE AND POST-CLOSURE CARE OF THE SOLAR EVAPORATION SURFACE IMPOUNDMENTS

Task 5.1 Closure Plan for Solar Evaporation Surface Impoundments

Task 5.1 consists of the submittal of a Closure Plan for the solar evaporation surface impoundments at the Rocky Flats Plant.

To complete Task 5.1, DOE shall deliver a closure plan to CDH and EPA for review and approval, for the solar evaporation surface impoundments on or before August 29, 1986. The Closure Plan shall completely address the requirements of 40 CFR Part 265 Subparts G and K for closure.

Task 5.2 Ground Water Monitoring System for the Solar Evaporation Surface Impoundments

Task 5.2 consists of the installation of ground water monitoring wells for the Solar Evaporation Surface Impoundments, with location and construction approved by CDH and EPA.

To complete Task 5.2, DOE shall complete installation of a ground water monitoring system for the solar evaporation surface impoundments by September 30, 1986. Completion of this task will include installation of no less than 20 monitoring wells upon approval of CDH and EPA for assessment and monitoring of releases from the solar evaporation surface impoundments. Wells shall be installed in accordance with 40 CFR Part 264 Subpart F and Part 270. Completion of this task shall be measured by a letter from DOE to CDH and EPA certifying installation of all the approved wells.

Task 5.3 Post-Closure Care Plan for Solar Evaporation Surface Impoundments

Task 5.3 consists of a submittal of a Post-Closure Care Plan, based on available data, for the solar evaporation surface impoundments including corrective action, health and exposure

assessment and plume delineation information required under 40 CFR Parts 264 and 270 and HSWA.

To complete Task 5.3, DOE shall deliver a Post-Closure Care Plan for the solar evaporation surface impoundments to CDH and EPA on or before November 28, 1986. The submittal shall include information completely addressing the post-closure requirements of 40 CFR Parts 264 and 270 and shall include a schedule for implementation of 40 CFR Part 264 Subpart F requirements. The submittal shall be in accordance with 40 CFR Part 264 Subpart G and sections 264.228 and 270.14(c) and all requirements under HSWA. The Plan may be modified thereafter to take into account additional ground water monitoring data obtained under Schedule 3.

PRELIMINARY

KEITH

ROCKY FLATS PLANT

2020

APPENDIX E

CHEMICAL SYMBOLS, ABBREVIATIONS, AND ACRONYMS

PRELIMINARY

acfm	-	Actual cubic feet per minute
ALARA	-	As Low As Reasonably Achievable
ALO	-	Albuquerque Operations Office
Am	-	Americium
APCD	-	Air Pollution Control Division
ASRF	-	Advanced Size Reduction Facility
ASTM	-	American Society for Testing and Materials
ATMX	-	Atomic Munition Explosive Rail Transport Car
BeO	-	Beryllium oxide
Btu	-	British thermal unit
Ca	-	Calcium
CCl ₄	-	Carbon tetrachloride
CDH	-	Colorado Department of Health
CEARP	-	Comprehensive Environmental Assessment and Response Program
CERCLA	-	Comprehensive Environmental Response, Compensation and Liability Act
CFR	-	Code of Federal Regulations
CHCl ₃	-	Chloroform
CI	-	Curie, 3.7×10^{10} disintegrations per second
Cl	-	Chlorine
cm	-	Centimeter
Co	-	Cobalt
CO	-	Carbon Monoxide
d/m/g	-	Disintegrations/minute/gram
DCA	-	1,2-dichloroethane
DCE	-	1,1-dichloroethylene
DCG	-	Derived Concentration Guide
DE	-	Diatomaceous earth
DOE	-	U.S. Department of Energy
EA&C	-	Environmental Analysis and Control
EM	-	Electromagnetic
EML	-	Environmental Measurements Laboratory
EMSL	-	Environmental Monitoring Systems Laboratory
EPA	-	U.S. Environmental Protection Agency
EP Toxicity	-	Extraction Procedure Toxicity
°F	-	Degree Fahrenheit
FY	-	Fiscal Year
FR	-	Federal Register
ft ³	-	Cubic feet
g	-	Gram
GC	-	Gas chromatograph
GC/MS	-	Gas chromatograph/mass spectrometer
GE	-	General Electric Co.
gpd	-	Gallons per day
gr/acf	-	Grains per actual cubic foot
GWR	-	Great Western Reservoir

HCO ₃	-	Bicarbonate
HEPA	-	High efficiency particulate air
HRS	-	Hazard Ranking System
HS&E	-	Health Safety & Environment
INEL	-	Idaho National Engineering Laboratory
ICRP	-	International Commission on Radiological Protection
K	-	Potassium
l	-	Liter
lb	-	Pound
LLW	-	Low-level waste (radioactive)
m	-	Meter
MCL	-	Maximum Contaminant Level
mg	-	Milligram
Mg	-	Magnesium
MHRS	-	Modified Hazard Ranking System
MPC	-	Maximum Permissible Concentration
mrem	-	Millirem
m/s	-	Meter per second
μCi	-	Microcurie
μCi/ml	-	Microcurie per milliliter
μg	-	Microgram
μm	-	Micrometer
N	-	Nitrogen
Na	-	Sodium
NAAQS	-	National Ambient Air Quality Standards
NCRP	-	National Council on Radiation Protection and Measurements
ND	-	Not Determined
NESHAP	-	National Emission Standard for Hazardous Air Pollutants
NIOSH	-	National Institute for Occupational Safety and Health
NO ₂	-	Nitrogen dioxide
NO ₃	-	Nitrate
NPDES	-	National Pollutant Discharge Elimination System
NRC	-	Nuclear Regulatory Commission
NTS	-	Nevada Test Site
O ₃	-	Ozone
ORNL	-	Oak Ridge National Laboratory
Pb	-	Lead
PBB	-	Polybrominated biphenyl
PCB	-	Polychlorinated biphenyl
PCE	-	Tetrachloroethylene
pCi	-	PicoCurie
pH	-	Negative logarithm of the hydrogen ion concentration. Acids have a pH less than 7; bases are greater than 7
PNL	-	Pacific Northwest Laboratory
POOS	-	Permanently Out of Service
PM-10	-	Inhalable particulates
POTW	-	Publicly Owned Treatment Works

ppb	-	Parts per billion
ppm	-	Parts per million
PSZ	-	Perimeter Security Zone
Pu	-	Plutonium
PVC	-	Polyvinyl chloride
QA	-	Quality assurance
QC	-	Quality control
RAPEN	-	Revised Air Pollution Emission Notice
R&D	-	Research and Development
RCRA	-	Resource Conservation and Recovery Act
rem	-	Roentgen equivalent man
RFP	-	Rocky Flats Plant
RI	-	Rockwell International
RI/FS	-	Remedial Investigation/Feasibility Study
RMCLs	-	Recommended Maximum Contaminant Levels
RO	-	Reverse osmosis
SAAM	-	Selective Alpha Air Monitor
SIP	-	State Implementation Plan
S&A	-	Sampling and Analysis
S&W	-	Swinerton & Walberg, Co.
SO ₂	-	Sulfur dioxide
SO ₄	-	Sulfate
SPCC	-	Spill Prevention Control and Countermeasure
SS&C Heels	-	Stainless steel and carbon heels
SWMU	-	Solid Waste Management Unit
TCA	-	1,1,1-trichloroethane
TCDD	-	Tetrachlorodibenzo-p-dioxin
TCE	-	Trichloroethylene
TDS	-	Total dissolved solids
TLD	-	Thermoluminescent dosimeter
TLLα	-	Total long-lived alpha
TOC	-	Total organic carbon
TOX	-	Total organic halogen
ty	-	Ton per year
TRAC	-	Terrain-Responsive Atmospheric Code
TRU	-	Transuranic
TSCA	-	Toxic Substances Control Act
TSDF	-	Treatment, Storage and Disposal Facility
TSP	-	Total Suspended Particulates
U	-	Uranium
U ₃ O ₈	-	Uranium oxide
USDA	-	United States Department of Agriculture
USEPA	-	United States Environmental Protection Agency
USGS	-	United States Geological Survey
VOC	-	Volatile organic chemical
wc	-	Water Column
WIPP	-	Waste Isolation Pilot Plant

WIPP-WAC - Waste Isolation Pilot Plant - Waste Acceptance Criteria
WPR - Waste processing request
Yr - Year

PRELIMINARY

- END -

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