

**U.S. Department of Energy  
Grand Junction Projects Office Remedial Action Project  
Final Report of the Decontamination and  
Decommissioning of Building 34  
at the Grand Junction Projects Office Facility**

**August 1996**



*U.S. Department of Energy  
Grand Junction Projects Office*

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Grand Junction Projects Office Remedial Action Project

**Final Report  
of the Decontamination and Decommissioning  
of Building 34 at the  
Grand Junction Projects Office Facility**

August 1996

Prepared for  
U.S. Department of Energy  
Albuquerque Operations Office  
Grand Junction Projects Office

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Grand Junction, Colorado

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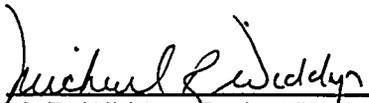
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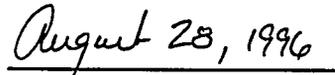
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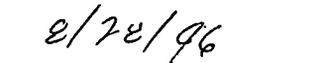
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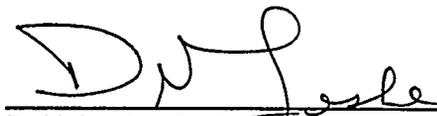
  
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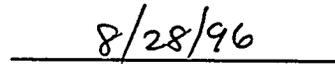
  
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## Abstract

The U.S. Department of Energy (DOE) Grand Junction Projects Office (GJPO) occupies a 61.7 acre facility along the Gunnison River near Grand Junction, Colorado. This site was contaminated with uranium ore and mill tailings during uranium refining activities of the Manhattan Engineer District and during pilot milling experiments conducted for the U.S. Atomic Energy Commission's domestic uranium procurement program. The DOE Defense Decontamination and Decommissioning Program established the Grand Junction Projects Office Remedial Action Project to clean up and restore the facility lands, improvements, and the underlying aquifer. The site contractor for the facility, Rust Geotech, was also the remedial action contractor.

Building 34 was radiologically contaminated and the building was demolished in 1996. The soil area within the footprint of the building was analyzed and found to be not contaminated. The area can be released for unlimited exposure and unrestricted use. This document was prepared in response to a DOE request for an individual closeout report for each contaminated GJPO building.

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# Acronyms

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	<i>U.S. Code of Federal Regulations</i>
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
FS	Feasibility Study
FUSRAP	Formerly Utilized Sites Remedial Action Program
GJPO	Grand Junction Projects Office
GJPORAP	Grand Junction Projects Office Remedial Action Project
IVC	Independent Verification Contractor
LTSM	Long-Term Surveillance and Maintenance
QA	quality assurance
RAC	Remedial Action Contractor
RCRA	Resource Conservation and Recovery Act
RDC	Radon Decay-product Concentration
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SFMP	Surplus Facilities Management Program
U.S.C.	United States Code
V-area	verification area

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## I. Introduction and Background

This report summarizes the results of the remedial action conducted on Building 34 at the U.S. Department of Energy (DOE) Grand Junction Projects Office (GJPO) facility. The surfaces of the foundation, floor, and metal structure and skin of this building were radiologically contaminated, and the building was demolished in 1996. The soil within the building footprint complies with applicable regulations and can be released for unrestricted use and unlimited exposure. After all Grand Junction Projects Office Remedial Action Project (GJPORAP) remedial action is completed, the facility is expected to be transferred to the Long-Term Surveillance and Maintenance (LTSM) Program to allow restoration of the aquifer. The remediation of the exterior land areas and the other buildings and associated utilities on the DOE-GJPO facility will be summarized in separate reports.

### Description of Facility

The DOE-GJPO facility is located approximately 0.6 mile (1 kilometer) south and west of populated areas of the city of Grand Junction in Sections 26 and 27, Township 1 South, Range 1 West, Ute Principal Meridian, Mesa County, Colorado (Figure 1). The facility occupies approximately 61.7 acres\* (25 hectares) of floodplain within an accretionary bend along the east bank of the Gunnison River.

The elevation of the DOE-GJPO facility is approximately 4,560 feet (1,390 meters). The facility is situated on silty sandy gravel underlain by mudstone bedrock. Two bodies of water with associated wetlands are located on the DOE-GJPO facility: the North Pond and the South Pond. A freshwater alluvial aquifer underlying the facility is in direct hydraulic contact with the ponds and the Gunnison River. A semi-arid climate prevails.

Access to the occupied portion of the facility is restricted by security personnel and a fence.

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\* Previous to the reacquisition of Black Bridge Park, the facility occupied approximately 56.4 acres.

There are approximately 40 structures on the facility. Beyond the fence are vehicle parking lots to the east and an earthen dike along the Gunnison River to the west and north. The area adjacent to the facility to the north was formerly Black Bridge Park, now owned by DOE. The facility is bordered on the east by the Southern Pacific Railroad (formerly the Denver and Rio Grande Western Railroad) right-of-way.

DOE-GJPO facility lands were acquired by the U.S. War Department in 1943 for the Manhattan Engineer District. A refinery was operated on the site from 1943 to 1946 to treat and concentrate uranium oxide. The U.S. Atomic Energy Commission operated a uranium-concentrate sampling plant and assay laboratory on site until 1974. Pilot-scale uranium ore mills were operated from 1953 to 1958, processing 30,000 tons (27,200 metric tons) of ore (DOE 1987a). Mill operations were the primary source of contaminated materials at the DOE-GJPO facility, resulting in the on-site burial of approximately 247,000 cubic yards (yd<sup>3</sup>), or 189,000 cubic meters (m<sup>3</sup>), of uranium ore tailings. Other potential sources of contamination included laboratory and vehicle-maintenance wastes and by-products and activities related to sampling and stockpiling of uranium concentrates. Approximately 22 acres (8.9 hectares) of open land and 19 buildings were contaminated.

### Description of Project

In 1984, the DOE-GJPO facility was accepted into the DOE Surplus Facilities Management Program (SFMP) for the purpose of eliminating health hazards resulting from uranium mill tailings and associated contaminated materials at the facility; and to bring contaminated portions of the facility, including the underlying aquifer, into compliance with applicable environmental regulations. In 1988, the facility was transferred to the DOE Decontamination and Decommissioning (D&D) Program. The D&D Program is responsible for the surveillance and maintenance of surplus DOE facilities, including the performance of any

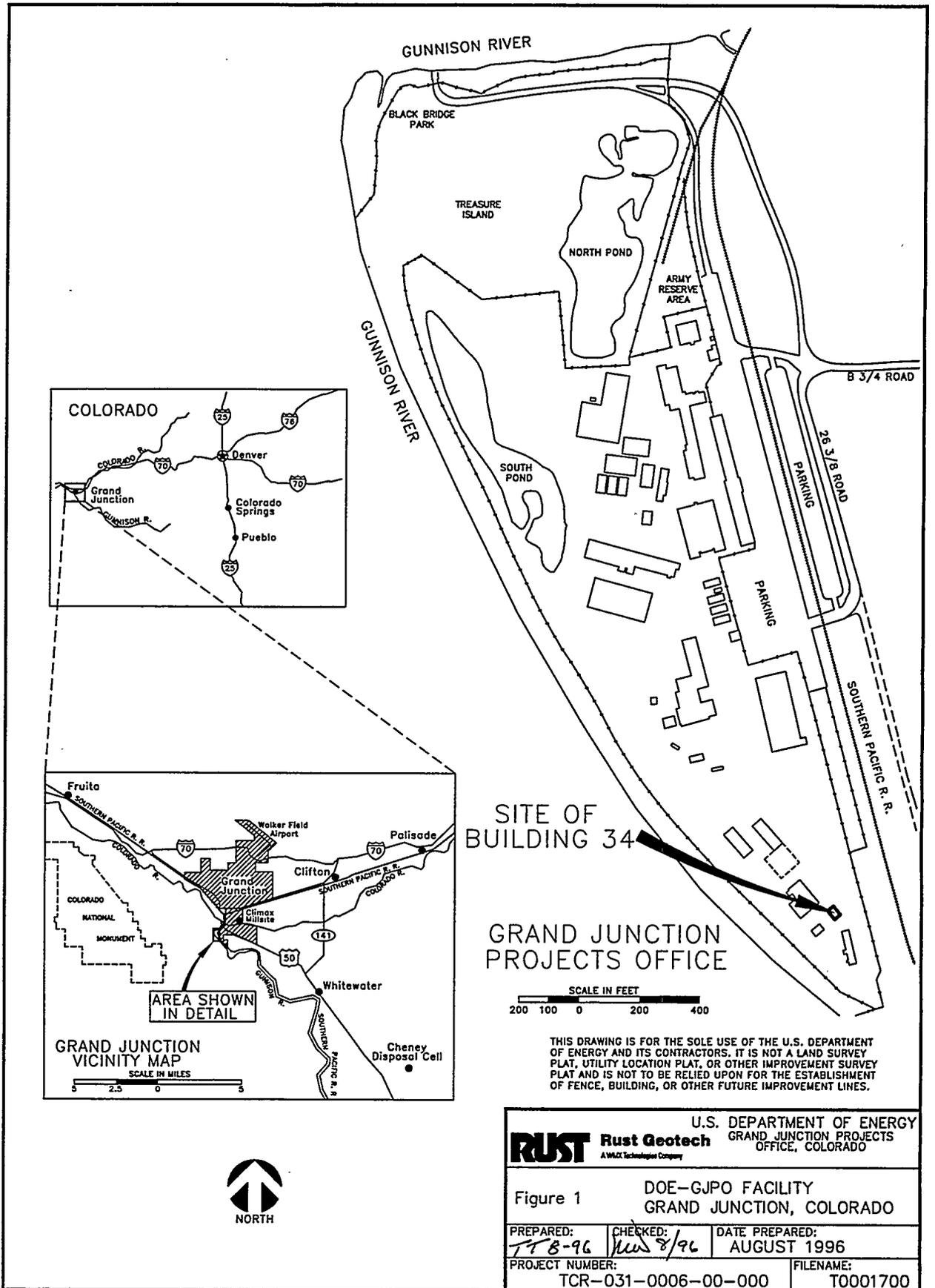


Figure 1. Site Map of the DOE-GJPO Facility, Grand Junction, Colorado

necessary decontamination and decommissioning activities. DOE-GJPO has specific responsibility for the GJPORAP under the D&D Program. Rust Geotech is the Remedial Action Contractor (RAC) for GJPORAP.

The GJPORAP organization and implementation strategy was defined in the *Grand Junction Projects Office Remedial Action Project Remedial Action Plan* (DOE 1990c).

## Description of Building 34

Building 34 was a steel-frame structure with metal siding and roof and a concrete slab floor, built on a concrete stem wall foundation. The building was constructed in 1954 as a boiler house for the large pilot mill. Subsequently, it was used for storage. The building had a footprint of 800 square feet (ft<sup>2</sup>) or 74 square meters (m<sup>2</sup>).

## Basis for Remedial Action

In 1980, the U.S. Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 United States Code [U.S.C.] 9601). In 1986, Congress amended CERCLA with the Superfund Amendments and Reauthorization Act (SARA). Section 120 of SARA and Executive Order 12580, *Superfund Implementation*, directed DOE to coordinate with the U.S. Environmental Protection Agency to respond to actual or potentially imminent releases of hazardous substances into the environment at federally owned DOE facilities. D&D Program policy specifies that remedial action will be conducted in accordance with DOE Order 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations*, and all other applicable environmental regulations.

The DOE-GJPO facility was evaluated using the Hazard Ranking System. Although the resulting score of 14.6 (DOE 1989b) did not qualify the facility for placement on the National Priorities List, remedial action under GJPORAP conformed to the applicable provisions of CERCLA, as amended by SARA, and the Uranium Mill Tailings Radiation Control Act (42 U.S.C. 7901), the National Environmental

Policy Act (42 U.S.C. 4321), and other applicable Federal and State regulations. Remedial action was conducted with an emphasis on maintaining all health and safety risks as low as reasonably achievable.

## II. Decommissioning Criteria, Objectives, and Work Scope

### Applicable Guidelines and Standards

Table 1 presents the guidelines that specify the authorized limits for GJPORAP.

Remedial action activities were conducted in accordance with the Rust *Quality Assurance [QA] Manual* (Manual 101) and approved plans and procedures (Appendix A), which incorporated the applicable provisions of 10 CFR 830.120, "Quality Assurance Requirements."

## III. Work Performed

### Remedial Investigation/Feasibility Study and Record of Decision

The Remedial Investigation/Feasibility Study [FS]-Environmental Assessment for GJPORAP was released in 1989 (DOE 1989a). Building 34 was one of the four buildings included in the original scope of GJPORAP and addressed in the FS. The selected remedial action alternative, detailed in the FS, specified that the building would be decontaminated using vacuuming, pressure washing or abrasion, or localized removal and replacement of building components. The building would be returned to unrestricted use for storage. This alternative was adopted in the Record of Decision (ROD) (DOE 1990a).

**Post-ROD Changes**—The selected remedial action alternative was implemented in 1989. The building was decontaminated but could not be released for unrestricted use because of the potential for additional radiological contamination in inaccessible locations such as behind structural members and in sheet metal

laps. Because the cost of achieving free release would exceed the value of the building, the selected alternative was changed to demolition.

An Explanation of Significant Differences will be prepared at the conclusion of GJPORAP remedial action activities to address departures from the ROD, including the demolition of Building 34.

### Characterization

In 1982, Building 34 was surveyed for gamma exposure rates. In 1986, the building was surveyed for alpha contamination, gamma exposure rates, radium-226 (Ra-226) concentrations of the underlying soil, and radon decay-product (RDC) concentrations. After decontamination operations in 1989, the building was surveyed regularly to ensure that site personnel were not exposed to radiological risks. The building was included in the 1993 comprehensive survey of facility radiological conditions. These surveys included measurements of gamma exposure rates and alpha and beta-gamma scans, direct measurements, and smears. Additional gamma and beta-gamma survey data, soil samples, and a sample of expansion joint material were collected in 1995.

**Radiological Contamination**—In the 1986 survey, no alpha activity, gamma exposure

rates, or Ra-226 concentrations exceeding the guidelines were detected, but RDCs ranging as high as 1.48 working levels (WL) were recorded (DOE 1986). In 1993, fixed beta-gamma surface activities ranging as high as 32,571 disintegrations per minute per 100 square centimeters (dpm/100 cm<sup>2</sup>) were identified on the concrete foundation and the steel surfaces of Building 34 (Chem-Nuclear Geotech, Inc. 1993). Analysis of a sample of expansion joint material collected from the perimeter of the building indicated Ra-226, thorium-230 (Th-230), and total uranium concentrations of 9.5, 62.4, and 78.3 picocuries per gram (pCi/g), respectively (DOE 1995b).

**Nonradiological Contamination**—Asbestos insulation on steam pipes and asbestos cement board were removed in 1987. Nonfriable asbestos was identified in window caulking.

### Remedial Design

Specifications for the 1989 decontamination work were included in the design for Construction Phase IA. In 1995, a preliminary design investigation was conducted to assess the physical condition and extent of contamination in Building 34 (Rust 1995). The remedial design for the demolition of Building 34 called for dismantling the structure and, as a separate contract activity, removing the concrete

*Table 1 Applicable or Relevant and Appropriate Standards*

Type of Occurrence	Standard
Contamination in Soil	40 CFR 192 <sup>a</sup> FUSRAP/SFMP Guidelines <sup>b</sup> DOE Order 5400.5 <sup>c</sup>
Surface Activity (structural surfaces)	FUSRAP/SFMP Guidelines <sup>b</sup> DOE Order 5400.5 <sup>c</sup>
Gamma Exposure Rate (interior areas)	40 CFR 192 <sup>a</sup> FUSRAP/SFMP Guidelines <sup>b</sup> DOE Order 5400.5 <sup>c</sup>
Radon Decay-Product Concentration (interior areas)	40 CFR 192 <sup>a</sup> FUSRAP/SFMP Guidelines <sup>b</sup> DOE Order 5400.5 <sup>c</sup>

<sup>a</sup>Title 40, *U.S. Code of Federal Regulations* (CFR) Section 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

<sup>b</sup>*Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program* [FUSRAP] and *Remote Surplus Facilities Management Program Sites*, (DOE 1987b).

<sup>c</sup>DOE Order 5400.5, *Radiation Protection of the Public and the Environment*.

foundation and floor slab. All materials were surveyed and uncontaminated materials were unconditionally released for salvage or disposal at the Mesa County Landfill. Radiologically contaminated materials were disposed at the Cheney Disposal Cell. After the removal of uranium mill tailings and other associated contaminated material, the remediated area was reconstructed.

## Decontamination Operations

**Summary of Remedial Action**—Building 34 was decontaminated to a condition of controlled access in January 1989 during Construction Phase IA. The process included chipping fixed beta-gamma contamination from portions of the concrete foundation and approximately 15 ft<sup>2</sup> (1.4 m<sup>2</sup>) of the concrete floor; brushing, vacuuming, and sweeping contaminated dust from horizontal surfaces; and removing a contaminated vent. The exterior areas adjacent to Building 34 were remediated in 1989 during Construction Phase IB (Figure 2).

The above-ground structure of Building 34 was removed in January 1996 and the concrete slab and foundation and some of the underlying soil were removed in April 1996. The remediation process involved disassembling the steel building and breaking up the foundation and floor slab. Contaminated materials were hauled by truck to the Cheney Disposal Cell. Uncontaminated materials were surveyed and unconditionally released in accordance with the *Rust Health and Safety Desktop Procedures Manual* and either salvaged or disposed at the Mesa County Landfill. The windows with the asbestos-containing putty were found to be free of radiological contamination and were disposed at the Mesa County Landfill.

**Radiological Contamination**—The steel structural members were found to have fixed beta-gamma surface contamination in previously inaccessible areas ranging as high as 20,000 dpm/100 cm<sup>2</sup>; these were decontaminated and unconditionally released (Rust 1996a). Radiologically contaminated building debris, including sheet metal siding and concrete, was removed from within the area of Building 34, as

indicated by the results of soil sample analyses and gamma exposure rate scans.

**Radiological Contamination with Associated Nonradiological Contaminants**—A sample of roof flashing was found to contain 880,000 micrograms per liter (µg/L) of leachable lead when analyzed using the Toxicity Characteristic Leach Procedure method, which exceeds the RCRA regulatory limit of 500 µg/L for this metal (DOE 1996). Asbestos-containing mastic was identified adhering to the flashing. This waste is currently controlled and managed at the DOE-GJPO facility in accordance with the RCRA Treatment, Storage, and Disposal permit for DOE-GJPO pending treatment and/or disposal at an approved facility. Asbestos-containing mastic was identified on other building components, which were disposed at the Cheney Disposal Cell.

## IV. Final Release Survey

The final status survey of the soil underlying the location of Building 34 was conducted in accordance with the *Survey Plan for Releasing the Buildings at the Grand Junction Projects Office for Unrestricted Use* (DOE 1995a), as modified in March 1996 (Rust 1996b). The area of Building 34 was classified as affected because of the potential for contamination exceeding the cleanup criteria. One survey unit was established on the soil surface remaining after removal of the concrete foundation.

Oak Ridge National Laboratory at Grand Junction was the independent verification contractor (IVC) for GJPORAP. Oversight activities were conducted by RAC QA personnel and by representatives of the Colorado Department of Public Health and Environment.

## Instrumentation

Radiation detection instruments were calibrated and used in accordance with the *Rust Field Assessments Procedures Manual*. The instruments were checked for current calibration and proper operation before and after each



survey. Calibrations used traceable standards and complied with 10 CFR 835, "Occupational Radiation Protection" and DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards*.

## Background Determinations

Background values determined for the DOE-GJPO facility are summarized in Table 2.

## Reference Grids

Six verification areas (V-areas) less than or equal to 25 m<sup>2</sup> each were established over the area of Building 34 and referenced to the documented location of the building.

## Scanning Results

No structural surfaces remain in this area; therefore, direct scanning for alpha or beta-gamma surface activity was not conducted. One hundred percent of the exposed soil surface was scanned for gamma activity; gamma exposure rates ranged from 14 to 17 micro-roentgens per hour ( $\mu\text{R/h}$ ), as presented in Appendix B, Table B-1.

## Direct Measurements

No structural surfaces remain in this area; therefore, direct measurements for alpha or beta-gamma surface activity were not taken.

## Sample Results

Soil samples comprising up to 4 aliquots, representing the first 6 inches (15 centimeters) of soil in the bottom of the excavation, were

collected systematically from each V-area. Because the radionuclide concentrations of all V-areas, each 25 m<sup>2</sup> or less, were below the authorized limits, the mean radionuclide concentrations of any 100 m<sup>2</sup> area on the remediated surface will be below the authorized limits (Appendix B, Table B-1). The soil sample and gamma scan results demonstrate that the radionuclide concentrations in the remediated area do not exceed the hot spot criterion. The upper limit of the mean radionuclide concentrations were calculated at the 95 percent confidence level; the soil within the remediated area complies with the cleanup standards (Appendix B, Table B-1).

## Gamma Exposure Rates

No interior areas remain after demolition of Building 34; therefore, gamma exposure rate measurements were not taken.

## V. Cost and Schedule

Project costs and the schedule for the remediation of Building 34 will be presented in the summary final report of the GJPORAP remediation of interior areas.

## VI. Occupational Exposure

The results of personnel and area monitoring of exposure of workers and the public to radiological and nonradiological hazards resulting from GJPORAP-related activities indicated no above-background exposures to

Table 2. Background Values for the DOE-GJPO Facility

Criterion	Background Value	Source of Data
Gamma Exposure Rate—Exterior	14 $\mu\text{R/h}$	DOE 1986
Radium-226 Concentration in Soil	1.0 pCi/g	DOE 1990b
Thorium-230 Concentration in Soil	2.0 pCi/g	DOE 1990b
Total Uranium Concentration in Soil	2.0 pCi/g	DOE 1990b

Key:  $\mu\text{R/h}$  = microrentgens per hour; pCi/g = picocuries per gram

radioparticulates, including radon daughters, ionizing radiation, or other hazards.

## VII. Waste Volumes

The remediation of Building 34 generated a total of 100 tons (91 metric tons) of contaminated material, representing a volume of approximately 78 yd<sup>3</sup> (60 m<sup>3</sup>) (Rust 1996c). This material was disposed at the Cheney Disposal Cell.

## VIII. Final Condition

All release requirements identified for GJPORAP have been met for the soil at the former location of Building 34 (Table 3). The IVC will issue a Statement of Verification to signify its concurrence that this portion of the remedial action has achieved program objectives.

Radiologically contaminated material has been removed, and all remediated areas comply with the applicable provisions of 40 CFR 192, FUSRAP/SFMP guidelines, and DOE Order 5400.5. Suspected occurrences of nonradiological contamination have been investigated, and all identified occurrences of nonradiological contamination have been remediated.

Remediated areas have been restored to comply with floodplain permits, the Endangered Species Act, and other applicable regulations. Groundwater sampling will provide further assurance that contaminated materials currently managed on site will not pose any threat to human health or the environment. Sufficient data have been collected to document the final site conditions and to demonstrate that the cleanup levels specified in the ROD were attained. These data and associated information are available to

the public and will be archived in the Certification Docket.

Because of the limitations of current technology and procedures for identifying and remediating radiologically contaminated materials, unknown deposits of contamination may be found in the future. The potential for encountering contamination during future construction activities will be determined and at-risk activities will be monitored for radiological and nonradiological contamination. The DOE-GJPO facility is routinely surveyed for radiation and other hazards.

No assessed hazardous substances were left in the remediated area; it can be released for unrestricted use and unlimited exposure. At the time of this report, contamination is still present in other interior areas of the DOE-GJPO facility; access to these areas is controlled and will be addressed by future GJPORAP remedial actions. After the interior remedial action is completed, the facility will be managed as an LTSM site by DOE until restoration of the alluvial aquifer by natural flushing has occurred.

## IX. Lessons Learned

Lessons learned during remediation of Building 34 have been incorporated into subsequent operations. These lessons will be presented in a summary final report of the GJPORAP remediation of the interior areas.

Table 3. Building 34 Certification Summary

Survey Unit: Excavation Surface (affected area, exterior soil surface)			
Certification Criteria	Authorized Limit	Number of Observations	Results
Gamma Exposure Rate (habitable areas only)	< 20 $\mu\text{R/h}$ above background <sup>a</sup>	None	Not applicable (no habitable areas).
Radon Decay-Product Concentration (habitable areas only)	Annual average shall not exceed 0.02 WL, to the extent practicable, and in no case shall exceed 0.03 WL.	None	Not applicable (no habitable areas).
Scans	Elevated activity will be investigated.	Gamma: scanned 100 percent of surface  Alpha and beta-gamma: none	Gamma: activities did not exceed background by more than 30 percent.  Alpha and beta-gamma: not applicable (no structural surfaces).
Surface Activity (structural surfaces only)	Alpha or beta-gamma activity shall not exceed 5,000 dpm/100 cm <sup>2</sup> fixed, 1,000 dpm/100 cm <sup>2</sup> removable, averaged over 1 m <sup>2</sup> .	None	Not applicable (no structural surfaces).
Radionuclide Concentrations (soil surfaces only)	Ra-226, and Th-230:  Shall not exceed 5 pCi/g above background <sup>a</sup> in the 15-cm surface layer, averaged over 100 m <sup>2</sup> .  Shall not exceed 15 pCi/g above background <sup>a</sup> in any 15-cm-thick soil layer more than 15 cm below the surface, averaged over 100 m <sup>2</sup> .	None  6 composite samples, each comprising up to 4 aliquots	Not applicable (excavation > 15 cm deep).  Ra-226: 1.3 pCi/g maximum <sup>b, c, d</sup> $\mu_{\alpha} = 1.6 \text{ pCi/g}^{\text{b, c}}$  Th-230: 1.2 pCi/g maximum <sup>b, c, d</sup> $\mu_{\alpha} = 1.2 \text{ pCi/g}^{\text{b, c}}$
	Total uranium:  Shall not exceed 106 pCi/g above background <sup>a</sup> in any 15-cm-thick layer, averaged over 100 m <sup>2</sup> .	6 composite samples, each comprising up to 4 aliquots	3.1 pCi/g maximum <sup>b, c, d</sup> $\mu_{\alpha} = 3.3 \text{ pCi/g}^{\text{b, c}}$
Hot Spot Criteria	Limit = (guideline value)(100/area) <sup>0.5</sup>	As required	Maximum concentrations below hot spot limit.

<sup>a</sup>Background activities are summarized in Table 2.

<sup>b</sup>Gamma exposure rate and radionuclide concentrations include background.

<sup>c</sup>Radionuclide concentrations were determined by laboratory analysis.

<sup>d</sup>These maxima were determined for the 100 m<sup>2</sup> areas designated in Appendix B, Table B-2.

Note: Th-232 is not a contaminant of concern at the DOE-GJPO facility (DOE 1994).

Key:

- cm = centimeter(s)
- dpm/100 m<sup>2</sup> = disintegrations per minute per 100 square centimeters
- m<sup>2</sup> = square meter(s)
- $\mu\text{R/h}$  = microrentgens per hour
- $\mu_{\alpha}$  = upper limit of true average concentration of 100-m<sup>2</sup> areas at the 95-percent confidence level, based on soil sample results
- pCi/g = picocuries per gram
- WL = working level

## X. References

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## **Appendix A**

### **Applicable Program and Quality Assurance Requirements and Procedures**

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## **GJPORAP Program Management**

*Operations Management Policy Manual*  
(Manual 104)

*Project Control System Manual* (Manual 107)

*Management Policies Manual* (Manual 100),  
Section 1, "General Administration," and  
Section 12, "Organization Functions and  
Responsibilities"

Remedial Action Statements of Work

*Grand Junction Projects Office Desk Procedures  
Manual*

*Grand Junction Projects Office Remedial Action  
Project (GJPORAP), Grand Junction, Colorado,  
Community Relations Plan Update*

*Grand Junction Projects Office Remedial Action  
Project Quality Assurance Program Plan,*  
P-GJPO-141

*Grand Junction Projects Office Remedial Action  
Project Records Management Plan,*  
P-GJPO-143

## **GJPORAP Construction Management**

*Operations Management Policy Manual*  
(Manual 104)

*Operations Department Construction  
Procedures Manual*

## **Engineering**

*Engineering Process Planning Guidelines*

*AutoCAD Standards Manual*

## **Assessment/Verification**

*Land Survey Support Procedures*

*AutoCAD Standards Manual*

*Environmental Procedures Catalog*  
(Manual 116)

## **Laboratory Services**

### **Analytical Laboratory**

*Analytical Chemistry Laboratory Administrative  
Plan and Quality Control Procedures*

*Analytical Chemistry Laboratory Handbook of  
Analytical and Sample Preparation Procedures,*  
Volumes I, II, and III

*Gamma-Ray Spectroscopy System Operations  
Methods Manual*

### **Environmental Instrumentation Laboratory**

*Calibration Control Program for Measurement  
and Test Equipment and Measurement  
Standards*

*Electronics Laboratory Procedures*

## **Quality Assurance**

*Quality Assurance Desk Instructions and  
Administrative Procedures Manual*  
(Manual 301)

## **Health, Safety, and Security**

*Grand Junction Projects Office Remedial Action  
Project Health and Safety Plan, P-GJPO-144*

*Health and Safety Manual* (Manual 103)  
Volumes 1 and 2

## **Contracts and Procurement**

*Management Policies Manual* (Manual 100),  
Section 5, "Procurement"

*Procurement Manual*

*Stores, Property, and Transportation (SPAT)  
Manual* (Manual 114)

*Rust Guide for Preparing a Purchase  
Requisition*

## Information Services

### Computer Support

*Information Services Manual* (Manual 105)

### Publications and Records

*Management Policies Manual* (Manual 100),  
Section 2, "Documentation Systems," and  
Section 13, "Records Management"

## Human Resources

### Training and Employee Development

*Management Policies Manual* (Manual 100),  
Section 3, "Human Resources"

## Other Guidance

40 CFR 261, "Identification and Listing of  
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*SFMP Resource Manual*, DOE, 1989.

*Verification and Certification Protocol for the Office of Environmental Restoration, Formerly Utilized Sites Remedial Action Program and Decontamination and Decommissioning Program*, Rev. 3, DOE, November 1990.

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## **Appendix B**

### **Final Radiological Conditions**

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Table B-1 summarizes the post-remediation sampling and measurement results for the soils underlying the site of Building 34. The samples were acquired prior to backfilling. Each sample is a composite of individual aliquots representing the 6-inch-thick soil layer at the bottom of the excavation. The samples were analyzed for radium-226 (Ra-226) using the Opposed Crystal System (OCS) and for Ra-226, thorium-230 (Th-230), and total uranium by the U.S. Department of Energy Grand Junction Projects Office analytical laboratory. The concentrations of these radionuclides are expressed in picocuries per gram (pCi/g) and include background. The post-remediation gamma exposure rate ranges are expressed in microrentgens per hour ( $\mu$ R/h). Contiguous verification areas (V-areas) were grouped into 100-m<sup>2</sup> areas to demonstrate compliance with the release criteria for soils (Table B-2). The remediated area is shown on Figure 2.

Table B-1. Post-Remediation Sample/Measurement Results for Exterior Soil Areas

Verification Area	Gamma Exposure Rate ( $\mu$ R/h)	Soil Sample Ticket No.	Concentration (pCi/g)				Average Depth of Excavation (inches)
			Ra-226 (OCS)	Ra-226 (lab)	Th-230 (lab)	Total Uranium (lab)	
34-V-1	14 - 16	NCK 778	1.8	1.3	1.1	3.6	24
34-V-2	14 - 16	NCK 779	1.5	1.6	1.2	3.5	24
34-V-3	14 - 17	NCK 780	2.9	0.3	1.3	2.8	24
34-V-4	14 - 17	NCK 781	3.2	1.3	1.1	2.3	18
34-V-5	14 - 17	NCK 782	3.4	1.4	1.1	2.4	18
34-V-6	14 - 16	NCK 783	3.1	1.3	1.1	2.0	6
Mean			2.7	1.2	1.2	2.8	
s			0.8	0.4	0.1	0.7	
$\mu_{\alpha}^a$			3.3	1.6	1.2	3.3	

<sup>a</sup>Calculated using n = 6 samples, df = 5, t-95% = 2.015.

Key:

- Mean = Arithmetic average of sample values (pCi/g)
- $\mu_{\alpha}$  = Upper limit of population mean (pCi/g) at 95-percent confidence (from equation 8-13 of *Manual for Conducting Radiological Surveys in Support of License Termination* [U.S. Nuclear Regulatory Commission 1992])
- df = Degrees of freedom (n-1)
- n = Number of samples
- s = Sample standard deviation (pCi/g)
- t-95% = Student's t distribution statistic for n degrees of freedom at 95-percent confidence

Table B-2. Mean Concentrations of 100-m<sup>2</sup> Soil Areas

100-m <sup>2</sup> Area <sup>a</sup>		Concentration (pCi/g)							
V-Areas <sup>b</sup>	n	Ra-226 (OCS)		Ra-226 (lab)		Th-230 (lab)		Uranium (lab)	
		Mean	s	Mean	s	Mean	s	Mean	s
V-1, V-2, V-3, V-4	4	2.4	1.3	1.1	0.6	1.2	0.1	3.1	0.6
V-5, V-6	2	3.3	0.2	1.3	0.1	1.1	0.0	2.2	0.3

<sup>a</sup>Contiguous V-areas were grouped into 100 m<sup>2</sup> areas. Because all soil sample analyses results are below the authorized limits, the average radionuclide concentrations of any 100 m<sup>2</sup> areas on the remediated surface will be below the authorized limits.

<sup>b</sup>All V-Area identifiers are preceded by " 34-."

Key:

- Mean = Arithmetic average of sample values (pCi/g)
- n = Number of samples
- s = Sample standard deviation (pCi/g)