**U.S. Department of Energy
Grand Junction Projects Office Remedial Action Project
Final Report of the Decontamination and
Decommissioning of Building 6
at the Grand Junction Projects Office Facility**

July 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 6 at the
Grand Junction Projects Office Facility**

July 1996

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

Prepared by
Rust Geotech
Grand Junction, Colorado

Technical Coordination and Reports Project Number TCR-031-0001-00-000
Technical Coordination and Reports Document Number T0000100

Rust Geotech has been granted authorization to conduct remedial action under the Decontamination and Decommissioning Program. Remedial action was conducted in accordance with all applicable or relevant and appropriate requirements.

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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 domestic uranium procurement program funded by the U.S. Atomic Energy Commission. The DOE Defense Decontamination and Decommissioning Program established the GJPO Remedial Action Project to clean up and restore the facility lands, improvements, and the underlying aquifer. The site contractor for the facility, Rust Geotech, is also the remedial action contractor.

Radiological contamination was identified in Building 6, and the building was demolished in 1992. The soil area within the footprint of the building has been remediated in accordance with the identified standards and the area can be released for unlimited exposure and unrestricted use. This document was prepared in response to a DOE request for an individual final report for each contaminated GJPO building.

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Acronyms

ACM	asbestos-containing material
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
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

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I. Introduction and Background

This report summarizes the results of the remedial action conducted on Building 6 at the U.S. Department of Energy (DOE) Grand Junction Projects Office (GJPO) facility. This building was radiologically contaminated. The selected remedial action alternative, demolition, was implemented in 1992. 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 other buildings and associated utilities on the DOE-GJPO facility will be summarized in separate reports. The certification of the soil in this area was addressed also in the *Final Report of the Decontamination and Decommissioning of the Exterior Land Areas at the Grand Junction Projects Office Facility* (DOE 1995b).

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 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. 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 (yd³), or 189,000 cubic meters (m³), 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 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)

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

Program. The D&D Program is responsible for the surveillance and maintenance of surplus DOE facilities, including the performance of any necessary decontamination and decommissioning activities. DOE-GJPO has specific responsibility for 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 6

Building 6 was a two-story masonry structure with a pitched shingle roof. The building had a footprint of 1,060 square feet or 99 square meters (m²). It was constructed in 1953 to house a bench-scale pilot mill for testing resin-in-pulp uranium milling processes. Milling activities commenced in 1953 and continued until December 1954, processing a total of approximately 2,500 tons (2,300 metric tons) of uranium ore (DOE 1987a). The building was used subsequently as laboratory and office space.

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 CERCLA 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 regulations 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 the *Quality Assurance Program for Nuclear Facilities NQA-1* (ASME 1989).

III. Work Performed

Remedial Investigation/Feasibility Study and Record of Decision

The Remedial Investigation/Feasibility Study—Environmental Assessment for GJPORAP was released in 1989 (DOE 1989a). Building 6 was not included in this study because it was outside the original scope of GJPORAP. Consequently, remediation of this building was not addressed in the Record of Decision (ROD) (DOE 1990a).

Post-ROD Changes—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 6.

Characterization

Building 6 was surveyed for radiological hazards in 1989 (DOE 1989c). The survey included measurements of gamma exposure rates; alpha and beta-gamma scans, direct measurements, and smears; measurements of the radium-226 (Ra-226) content of the concrete floors; and radon decay-product concentration (RDC) measurements. Additionally, the concrete floor was cored and logged, and the soil beneath the floor was sampled and analyzed.

Radiological Contamination—The characterization survey identified surface contamination on the interior walls and floors, on horizontal surfaces of the steel and wood structural members, on exterior wall surfaces, and on an associated concrete sump and steam pipe chase. Preliminary RDC measurements averaged 0.027 working level (WL), indicating that RDC results would exceed the guideline. Soil collected from the sump had an Ra-226 concentration of 313.3 picocuries per gram (pCi/g). The gamma exposure rates ranged as high as 71 microroentgens per hour ($\mu\text{R/h}$). Beta-gamma surface activities ranged as high as 397,122 disintegrations per minute per 100 square centimeters (dpm/100 cm^2). Alpha surface activities ranged as high as 8,520 dpm/100 cm^2 .

Nonradiological Contamination—Asbestos was identified in Building 6 in window glazing and caulking compounds, flooring, and as nonfriable asbestos cement board used for soffits and ceiling tiles. During abatement activities in March 1992, elemental mercury was identified.

Remedial Design

Remedial action alternatives, presented in the *Grand Junction Projects Office Remedial Action Project, Decommissioning Project Plan for Buildings 6 and 31* (DOE 1991), included decontamination, using conventional construction methods or high-pressure washing, and demolition. The selected alternative was demolition (DOE 1992). The building was documented in accordance with the National Historic Preservation Act (Chem-Nuclear Geotech, Inc. 1991).

The remediation process involved demolishing the building and removing the foundation and associated utilities. The underlying soil and adjacent areas were remediated. Radiologically contaminated materials were impounded at the Cheney Disposal Cell. Nonradiological hazardous materials were properly managed. After removal of uranium mill tailings and other associated contaminated material, the affected areas were reconstructed.

Table 1. Applicable or Relevant and Appropriate Regulations

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

^aTitle 40, *U.S. Code of Federal Regulations* (CFR) Section 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

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

^cDOE Order 5400.5, *Radiation Protection of the Public and the Environment*.

Decontamination Operations

Summary of Remedial Action—Asbestos abatement in Building 6 occurred in March 1992 and the building was demolished in April 1992. Excavation of soil beneath the building continued until gamma measurements indicated that all soil with elevated gamma activity was removed. The depth of the excavation ranged from 48 to 72 inches.

Radiological Contamination—Radiological contamination was removed from within the footprint of Building 6, as indicated by the results of soil sample analyses and gamma exposure rate scans (Appendix B, Table B-1).

Nonradiological Contamination with Associated Radiological Contaminants—Approximately 37 yd³ (28 m³) of radiologically contaminated asbestos-containing material (ACM) was disposed at the Cheney Disposal Cell.

Approximately 4.8 pounds (2.2 kilograms) of radiologically contaminated soil and building debris mixed with mercury was removed from Building 6. Analysis of the material, using the Toxicity Characteristic Leach Procedure method, indicated a leachable mercury concentration of 0.39 milligrams per liter (mg/L), which exceeds the Resource Conservation and Recovery Act (RCRA) toxicity characteristic limit of 0.2 mg/L for that metal (DOE 1995a). This material is stored in plastic bags on 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.

Nonradiological Contamination—Sixty-two bags of nonfriable ACM was shipped for

disposal to Waste Control Management—Nevada, in Salt Lake City, Utah.

IV. Final Release Survey

The final status surveys of the soil underlying the location of Building 6 were conducted in accordance with the *Rust Health and Safety Manual*, Volume 1 (Manual 103), the *Rust Field Assessments Procedures Manual*, and approved plans (DOE 1990c). This work was conducted prior to the adoption of the *Survey Plan for Releasing the Buildings at the Grand Junction Projects Office for Unrestricted Use* (DOE 1995c).

Oak Ridge National Laboratory—Grand Junction was the independent verification contractor (IVC) for GJPORAP. Oversight activities were conducted by representatives of the RAC QA Section and 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 DOE Order 5480.11, *Radiation Protection for Occupational Workers*, Change 2, 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.

Table 2. Background Values for the DOE-GJPO Facility

Criterion	Background Value	Source of Data
Gamma Exposure Rate—Exterior	14 μ 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
Thorium-232 Concentration in Soil	1.0 pCi/g	DOE 1990b
Total Uranium Concentration in Soil	2.0 pCi/g	DOE 1990b

Reference Grids

Grids were established over the affected area to reference the locations of measurements and samples. Grids were established locally for each individual remediation site; each grid was tied to a permanent feature on the site such as a building corner. All permanent features are referenced to a benchmark east of the GJPO facility. For Building 6, two verification areas were established (Figure 2). Area V-552 followed the Large Area Verification Procedure (DOE 1994), and the excavation floor was gridded into 30- by 30-foot blocks. In Area V-533, the excavation was gridded into 10- by 10-foot blocks.

Scanning Results

No structural surfaces remain in this area; therefore, scanning for alpha or beta-gamma surface activity was not conducted. One hundred percent of the exposed soil surface was scanned for gamma activity. Gross gamma exposure rates ranged from 16 to 25 $\mu\text{R/h}$ (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

In Area V-552, a soil sample aliquot was collected from each block at the point of highest gamma activity. In Area V-533, a soil sample aliquot was collected from the center of each block. The aliquots were composited into samples representing the first 6 inches (15 cm) of soil of the excavation floor. The area represented by these samples extended beyond the footprint of Building 6 (Figure 2). These samples were analyzed for Ra-226, thorium-230 (Th-230), thorium-232, and potassium-40 (Appendix B, Table B-1). As a cost-saving measure, analysis for total uranium was not conducted because the samples exhibited beta-gamma activity of less than 2,500 dpm/100 cm^2 when scanned at the time of collection. Extensive sampling conducted previously in other areas had shown that activities below this value indicated a measurable

uranium concentration that was still within the authorized limit, and sample analyses results indicated that uranium was probably not a contaminant of concern.

Exposure Rates

No interior areas remain after demolition of Building 6; therefore, discrete gamma exposure rate measurements were not taken.

V. Cost and Schedule

The project costs and the schedule for remediation of Building 6 will be presented in the summary final report of the GJPORAP remediation of the interior areas of the DOE-GJPO facility.

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

VII. Waste Volumes

The remediation of Building 6 generated a total of 560 tons (508 metric tons) of radiologically contaminated material, representing a volume of approximately 350 yd^3 (270 m^3) of contaminated material, including building debris and soil. This material was disposed at the Cheney Disposal Cell.

VIII. Final Condition

All decontamination requirements identified in the ROD for GJPORAP have been met for the soil at the former location of Building 6 (Table 3). The IVC will issue a Statement of Verification to signify its concurrence that this

Figure 2. Extent of Contamination and Verification Areas

Table 3. Building 6 Certification Summary

Certification Criterion	Authorized Limit	Number of Observations	Results
Gamma Exposure Rate (habitable areas only)	< 20 μ R/h above background. ^a	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% of surface Alpha and beta-gamma: none	Gamma: gross exposure rate range was 16 to 25 μ R/h. ^b 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 ² fixed, 1,000 dpm/100 cm ² removable, averaged over 1 m ² .	None	Not applicable (no structural surfaces).
Radionuclide Concentrations (soil surfaces only)	Ra-226, Th-230, and Th-232: Shall not exceed 5 pCi/g above background ^a in the 15-cm surface layer, averaged over 100 m ² .	None	Not applicable (excavation depth > 15 cm).
	Shall not exceed 15 pCi/g above background ^a in any 15-cm-thick soil layer more than 15 cm below the surface, averaged over 100 m ² .	2 composite samples comprising 13 aliquots	Ra-226: 3.1 pCi/g maximum ^{b, c} Th-230: 3.2 pCi/g maximum ^{b, c} Th-232: 1.0 pCi/g maximum ^{b, c}
	Total uranium: Shall not exceed 106 pCi/g above background ^a in any 15-cm layer, averaged over 100 m ² .	Samples scanned for beta-gamma activity	Not analyzed (surface activity < 2,500 dpm/100 cm ²).
Hot Spot Criteria	Limit = (guideline value)(100/area) ^{0.5}	As required	Maximum concentrations below hot spot limit.

^aBackground activities are summarized in Table 2.

^bGamma exposure rates and radionuclide concentrations include background.

^cRadionuclide concentrations were determined by laboratory analysis.

Key:

cm	=	centimeter(s)
dpm/100 cm ²	=	disintegrations per minute per 100 square centimeters
m ²	=	square meter(s)
pCi/g	=	picocuries per gram
Ra-226	=	radium-226
Th-230	=	thorium-230
Th-232	=	thorium-232
μ R/h	=	microrentgens per hour
WL	=	working level

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. The area, therefore, 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; these areas will be addressed by future GJPORAP remedial actions. Access to these areas is controlled. 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 action has occurred.

IX. Lessons Learned

Lessons learned during remediation of Building 6 have been incorporated into subsequent operations. These lessons will be presented in a summary final report of the GJPORAP remediation of the interior areas.

X. References

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *U.S. Code of Federal Regulations*.

American Society of Mechanical Engineers (ASME), 1989. *Quality Assurance Program for Nuclear Facilities*, NQA-1, New York.

Chem-Nuclear Geotech, Inc., 1991. "Historic Documentation of Building 6 and 31, GJPORAP," letter from C.L. Jacobson to E.R. Bray of U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, December 20, 1991.

Rust Geotech. *Field Assessments Procedures Manual*, U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado.

_____. *Health and Safety Manual* (Manual 103), Volume 1, U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado.

_____. *Quality Assurance Manual* (Manual 101), U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado.

U.S. Department of Energy (DOE), 1986. *Radiologic Characterization of the Department of Energy Grand Junction Projects Office Facility*, GJ-41, prepared by Bendix Field Engineering Corporation for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, January 1986.

_____, 1987a. *Historical Survey of the Grand Junction Projects Office Facility—Hazardous (Non-Radioactive) Wastes*, prepared by UNC Technical Services, Inc., for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, February.

_____, 1987b. *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites*, Rev. 2, March.

_____, 1989a. *Final Remedial Investigation/Feasibility Study—Environmental Assessment for the U.S. Department of Energy Grand Junction (Colorado) Projects Office Facility*, DOE/EA-0402, prepared by UNC Geotech, Inc., for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, July.

_____, 1989b. "Review of Remedial Investigation/Feasibility Study (RI/FS) for a Site Which Is Not Included on the National Priorities List (NPL)," letter from Dee Williamson, U.S. Department of Energy Grand Junction Projects Office, to David Schaller, U.S. Environmental Protection Agency Region VIII, Grand Junction, Colorado, August 4.

_____, 1989c. *Grand Junction Projects Office Remedial Action Program, Radiological Assessment of Building 6*, prepared by UNC Geotech, Inc., for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, August 9.

_____, 1990a. *Grand Junction Projects Office Remedial Action Project, Declaration for the Record of Decision and Record of Decision Summary* [includes the *Responsiveness Summary*], prepared by UNC Geotech, Inc., for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, April.

_____, 1990b. *Grand Junction Projects Office Remedial Action Program, Radiological Assessment for Construction Phase 1B*, prepared by UNC Geotech, Inc., for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, April.

_____, 1990c. *Grand Junction Projects Office Remedial Action Project Remedial Action Plan*, P-GJPO-142, prepared by UNC Geotech, Inc., for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, December.

_____, 1991. *Grand Junction Projects Office Remedial Action Project, Decommissioning Project Plan for Buildings 6 and 31*, P-GJPO-145, prepared by Chem-Nuclear Geotech, Inc., for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, August.

_____, 1992. "Building 6 and 31 Decommissioning Project Plan for the Grand Junction Projects Office (GJPO) Remedial Action Plan," letter from M.K. Tucker to J.R. Bolliger of Chem-Nuclear Geotech, Inc., Grand Junction, Colorado, January 2.

_____, 1994. *Grand Junction Projects Office Remedial Action Project, Justification for Certifying 47 Large-Area Verification Areas at the Grand Junction Projects Office*, GJ-GJPO-94-1, prepared by Rust Geotech for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, November.

_____, 1995a. *Analytical Report*, DOE-GJPO Analytical Laboratory Requisition No. 13599, prepared by Rust Geotech for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, February 23.

_____, 1995b. *Final Report of the Decontamination and Decommissioning of the Exterior Land Areas at the Grand Junction Projects Office Facility*, DOE/ID/12584-220, prepared by Rust Geotech for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, September.

_____, 1995c. *Survey Plan for Releasing the Buildings at the Grand Junction Projects Office for Unrestricted Use*, P-GJPO-150, prepared by Rust Geotech for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, December.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, Change 1.

DOE Order 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations*, Change 5.

DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards*.

DOE Order 5480.11, *Radiation Protection for Occupational Workers*, Change 2.

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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

Productivity/Quality Improvement Manual
(Manual 109)

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

Health and Safety Desktop Procedures
(Manual 303)

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

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

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

Other Guidance

40 CFR 261, "Identification and Listing of
Hazardous Waste."

40 CFR 300, "National Oil and Hazardous
Substances Pollution Contingency Plan."

*A Manual for Implementing Residual
Radioactive Material Guidelines Using RESRAD
Version 4.0*, Argonne National Laboratory, June
1989.

"Approval of the Grand Junction Projects Office
Remedial Action Project: National
Environmental Policy Act and Comprehensive
Environmental Response, Compensation, and
Liability Act Documents" DOE, February 29,
1990.

"Calculation of Total Uranium Specific Activity
From Total Uranium Chemical Concentration by
Weight," Rust Geotech, November 11, 1994.

*Community Relations in Superfund: A
Handbook*, EPA, January 1992.

*Defense Decontamination and Decommissioning
Program: Program Management Plan*, DOE,
December 1989.

DOE Order 4700.5, *Project Control System
Guidelines*.

DOE Order 5400.4, *Comprehensive
Environmental Response, Compensation, and
Liability Act Requirements*.

DOE Order 5700.6C, *Quality Assurance*.

DOE Order 5820.2A, *Radioactive Waste
Management*.

Exemption No. DOT-E 10594, Research and
Special Programs Administration, U.S.
Department of Transportation, May 28, 1992.

*Environmental Implementation Guide for
Radiological Survey Procedures*, draft report,
DOE, November 1992.

GJPORAP/IVC Project Management Summary,
ORNL, May 1994.

*Grand Junction Projects Office Remedial Action
Project (GJPORAP), Grand Junction, Colorado,
Community Relations Plan Update*, DOE,
July 1990.

*Grand Junction Projects Office Remedial Action
Project, Health and Safety Plan*, DOE, February
1994.

*Grand Junction Projects Office Remedial Action
Project Quality Assurance Program Plan*,
Rev. 5, DOE, September 1990.

*Grand Junction Projects Office Remedial Action
Project, Radiological Sampling and Verification
Plan, Phase IVA*, DOE, November 1993.

Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, U.S. Nuclear Regulatory Commission, 1982.

Interim Final Guidance on Preparing Superfund Decision Documents: The Proposed Plan, The Record of Decision, Explanation of Significant Differences, The Record of Decision Amendment, EPA, July 1989.

Limits for Intakes of Radionuclides by Workers, International Commission on Radiological Protection (ICRP), August 1982.

Manual for Conducting Radiological Surveys in Support of License Termination, Oak Ridge Associated Universities, June 1992.

Procedures for Completion and Deletion of National Priority List Sites, U.S. Environmental Protection Agency (EPA), October 1988.

Project Plan for the U.S. Department of Energy Grand Junction Projects Office Remedial Action Project, DOE, March 1986.

"Proposed GJPORAP Release Criteria and Scope Impacts," DOE, July 20, 1989.

Public Participation in Environmental Restoration Activities, DOE, November 1991.

Radiometric Survey of the Grand Junction Facility, U.S. Department of Energy (DOE), May 1982.

Recommendations of the ICRP, ICRP, August 1987.

Record of Decision for Remedial Action at the Climax Uranium Company Uranium Mill Site, Grand Junction, Colorado, DOE, August 1988.

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.

Work Plan for Independent Verification of the Grand Junction Projects Office Remedial Action Project, Oak Ridge National Laboratory (ORNL), October 1991.

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Appendix B

Final Radiological Conditions

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Table B-1 summarizes the post-excavation sampling and measurement results for the verification areas (V-areas) encompassing the site of Building 6. The samples were acquired prior to backfilling. Each sample is a composite comprising individual aliquots representing the 6-inch-thick soil layer at the bottom of the excavation. Each sample was analyzed for radium-226 (Ra-226) using the Opposed Crystal System (OCS). The samples also were analyzed by the U.S. Department of Energy Grand Junction Projects Office analytical laboratory for Ra-226, potassium-40 (K-40), and thorium-232 (Th-232) using gamma spectroscopy and thorium-230 (Th-230) using alpha spectroscopy, in accordance with procedures specified in the reports of the analytical results. The concentrations of all isotopes are expressed in picocuries per gram (pCi/g) and include background. The post-excavation gamma exposure rate ranges are expressed in microroentgens per hour (μ R/h). The V-areas are shown on Figure 2.

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

Verification Area	Gamma Exposure rate (μ R/h)	Soil Sample Ticket No.	Concentration (pCi/g)					Average Depth of Excavation (inches)
			Ra-226 (OCS)	Ra-226 (lab)	K-40 (lab)	Th-230 (lab)	Th-232 (lab)	
V-533	18 - 21	NAP 155	2.2	3.1	18.5	3.2	1.0	48
V-552	16 - 25	NAP 160	1.7	1.1	18.1	1.1	0.9	72