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U.S. Department of Energy
Grand Junction Office Remedial Action Project

# Final Report of the Radiological Release Survey of Building 56 at the Grand Junction Office Facility

September 1997

MASTER




*Work Performed Under DOE Contract No. DE-AC13-96GJ87460 for the U.S. Department of Energy*

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Grand Junction Office Remedial Action Project

# Final Report of the Radiological Release Survey of Building 30B at the Grand Junction Office Facility

September 1997

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

Prepared by
*WASTREN-Grand Junction*
Grand Junction, Colorado

*WASTREN-Grand Junction* has been granted authorization to conduct remedial action under the Decontamination and Decommissioning Program. Remedial action was conducted at the DOE–GJO facility in accordance with all applicable or relevant and appropriate requirements.

Work Performed Under DOE Contract No. DE–AC13–96GJ87460
*Approved for public release; distribution is unlimited.*

# Signature Page

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# Abstract

The U.S. Department of Energy (DOE) Grand Junction Office (GJO) occupies a 61.7-acre facility along the Gunnison River near Grand Junction, Colorado. This site was contaminated with uranium ore concentrates and mill tailings during vanadium refining activities of the Manhattan Engineer District, and during sampling, assaying, pilot milling, storage, and brokerage activities conducted for the U.S. Atomic Energy Commission's domestic uranium procurement program. The DOE Defense Decontamination and Decommissioning Program established the GJO Remedial Action Project (GJORAP) to clean up and restore the facility lands, improvements, and underlying aquifer. *WASTREN-Grand Junction* is the site contractor for the facility and the remedial action contractor for GJORAP.

Building 30B and the underlying soil were found not to be radiologically contaminated; therefore, the building can be released for unrestricted use. Placards have been placed at the building entrances indicating the completion of the radiological release survey and prohibiting the introduction of any radioactive materials within the building without written approvals from the GJO Facilities Operations Manager. This document was prepared in response to a DOE–GJO request for an individual final release report for each GJO building.

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# Acronyms

| | |
|---|---|
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | *U.S. Code of Federal Regulations* |
| D&D | Decontamination and Decommissioning |
| DOE | U.S. Department of Energy |
| EPA | U.S. Environmental Protection Agency |
| FOS | Facilities Operations & Support contractor (*WASTREN-Grand Junction*) |
| FUSRAP | Formerly Utilized Sites Remedial Action Program |
| GJO | Grand Junction Office |
| GJORAP | Grand Junction Office Remedial Action Project |
| GJPORAP | Grand Junction Projects Office Remedial Action Program |
| ICRP | International Commission on Radiological Protection |
| IVC | independent verification contractor (Oak Ridge National Laboratory) |
| LTSM | long-term surveillance and maintenance |
| MDC | minimum detectable concentration |
| ORNL | Oak Ridge National Laboratory |
| RDC | radon decay-product concentration |
| ROD | Record of Decision |
| SARA | Superfund Amendments and Reauthorization Act |
| SFMP | Surplus Facilities Management Program |
| TAR | Technical Assistance & Remediation contractor (MACTEC-ERS) |
| U.S.C. | United States Code |
| WL | working level |

# I. Introduction and Background

This report summarizes the results of the radiological release survey for Building 30B at the U.S. Department of Energy Grand Junction Office (DOE–GJO) facility. After all Grand Junction Office Remedial Action Project (GJORAP) remedial action is completed, the DOE–GJO facility will be transferred to the Long-Term Surveillance and Maintenance (LTSM) Program to monitor the passive restoration of the underlying aquifer. Additional reports summarize the remediation and release surveys of the exterior land areas, the other buildings, and associated utilities on the DOE–GJO facility.

## Description of Facility

The DOE–GJO facility (Figure 1), 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. 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–GJO facility is approximately 4,560 feet, or 1,390 meters (m). The facility is situated on silty sandy gravel underlain by mudstone bedrock. Two bodies of water with associated wetlands are located on the DOE–GJO 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 semiarid climate prevails.

Access to the occupied portion of the facility currently is restricted by security personnel and a fence. There are approximately 36 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 Union Pacific Railroad right-of-way.

DOE–GJO facility lands were acquired by the U.S. War Department in 1943 for the Manhattan Engineer District. A vanadium 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 the 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–GJO facility, resulting in the on-site burial of approximately 247,000 cubic yards (189,000 cubic meters) of uranium mill products. Other potential sources of contamination included laboratory and vehicle-maintenance wastes and byproducts, and activities related to sampling and stockpiling uranium concentrates (including yellowcake—$U_3O_8$). Approximately 22 acres (8.9 hectares) of open land and 19 buildings were contaminated.

## Description of Project

In 1984, the DOE–GJO 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 (DOE 1989a).

The facility was transferred to the DOE Decontamination and Decommissioning (D&D) Program in 1988. The D&D Program is responsible for the surveillance and maintenance of surplus DOE facilities, and performing any necessary decontamination and decommissioning activities. DOE–GJO has specific responsibility for GJORAP under the D&D Program.

*WASTREN-Grand Junction* (*WASTREN*) is the Facilities Operations & Support (FOS) contractor for DOE–GJO, and is the remedial action contractor for GJORAP. The GJORAP

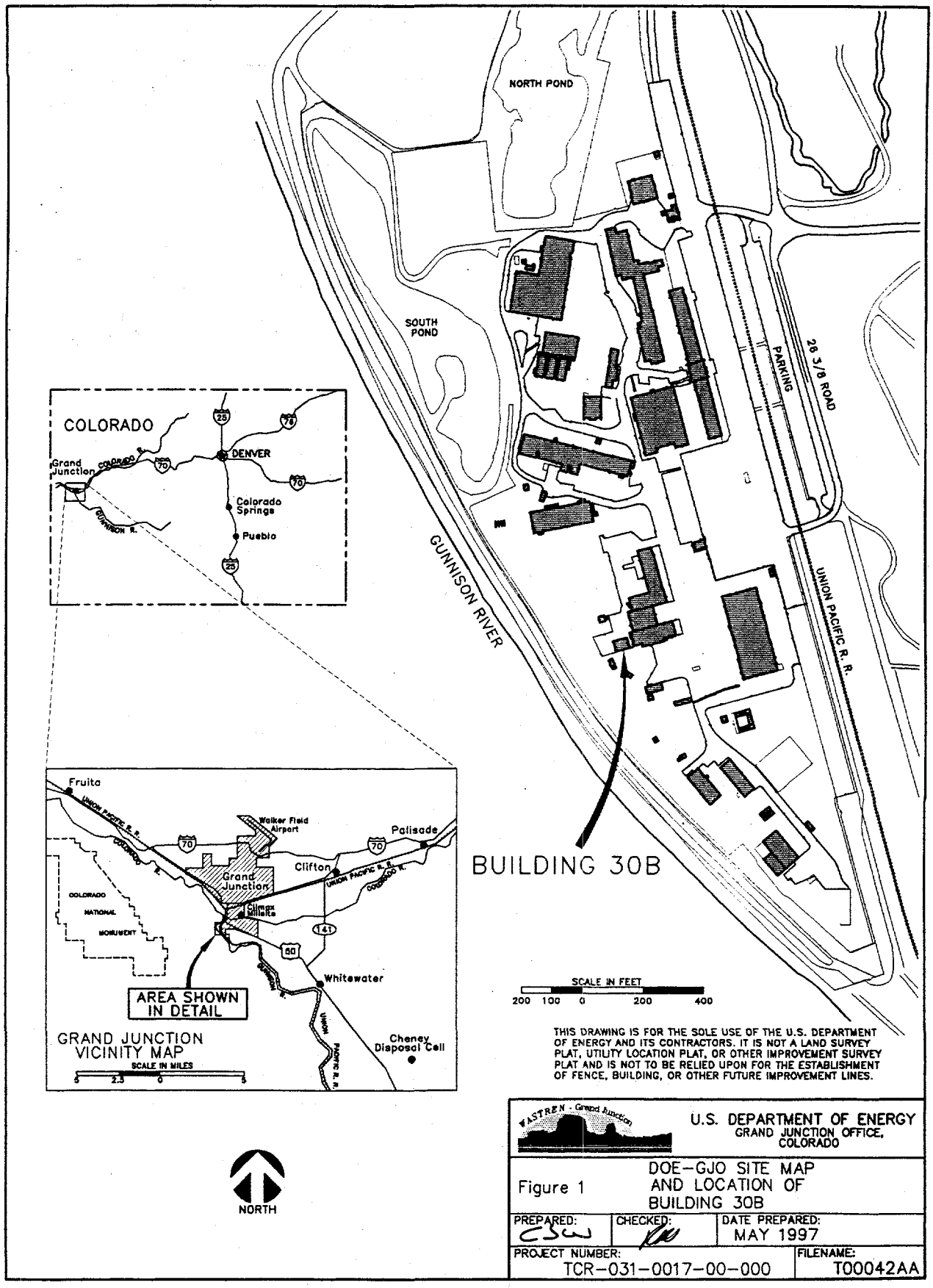


*Figure 1. DOE– GJO Site Map and Location of Building 30B*

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

### Description of Building 30B

Building 30B was erected on the DOE–GJO facility in 1980. It originally was used as a machine shop and electronics laboratory until converted to its present usage in 1985. Currently, Building 30B is being used to store and calibrate small field instruments and house personal protective equipment for the FOS Safety & Health Group. The building also houses contaminated trash in transit from controlled areas to radioactive material storage areas, and radioactive sources in controlled source cabinets.

The building has a footprint of approximately 1,217 square feet, or 113.1 square meters ($m^2$). It is a single-story steel frame structure with metal siding and a flat metal roof on a concrete foundation. The floor of the building is asphalt pavement.

### 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 (EPA) 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 O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, and all other applicable environmental regulations.

The DOE–GJO 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 GJORAP conformed to the applicable provisions of CERCLA, as amended by SARA, 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 has been 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 guideline documents that specify the authorized limits for releasing GJORAP buildings and open land (the applicable authorized limits are provided in Table 3). Remedial action activities on the facility have been conducted in accordance with approved plans and procedures (Appendix A) which incorporate the applicable provisions of Title 10, *U. S. Code of Federal Regulations*, Part 830 (10 CFR 830), Section 120, "Quality Assurance Requirements."

## 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 30B was not included in this study because it was outside the original scope of GJPORAP. Consequently, the release survey 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

*Table 1. Applicable or Relevant and Appropriate Standards*

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

[a]40 CFR 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 and Remote Surplus Facilities Management Program Sites* (DOE 1987b).
[c]DOE Order 5400.5, *Radiation Protection of the Public and the Environment.*

conclusion of GJORAP remedial action activities to address departures from the ROD, including the release survey of Building 30B.

### Characterization

A three-month-long radon decay-product concentration (RDC) measurement, completed in February 1990, was 0.0285 working level (WL) (DOE 1990c).

Building 30B was included in the 1993 comprehensive survey of the structures at the DOE–GJO facility. No radiological contamination was identified (Chem-Nuclear Geotech, Inc. 1993).

The soil within 3 m of the building was evaluated during the decontamination and decommissioning of the open land areas of the DOE–GJO facility. No remediation occurred adjacent to the building because the soil was found not to exceed the authorized limits (DOE 1995a).

### Remedial Design

A remedial design was not required because no radioactive contamination was identified with Building 30B.

## IV. Final Release Survey

Building 30B was surveyed in February and April 1997 in accordance with the *Survey Plan for Releasing the Buildings at the Grand Junction Projects Office for Unrestricted Use* (DOE 1995b).

The soil areas adjacent to and beneath Building 30B were classified as unaffected because the soil adjacent to the building was found not to be contaminated during remediation of the open land areas (DOE 1995a). One exterior soil survey unit was established: Survey Unit 1 (156m$^2$) consisting of the exterior ground surfaces within 3 m of the building.

The building surfaces were also classified as unaffected, because existing survey data and the history of the building indicated a low potential for contamination. Two survey units were established: Survey Unit 2 (355m$^2$) consisting of the interior walls, floor, and ceiling; and Survey Unit 3 (268 m$^2$) consisting of the exterior walls and roof.

Oak Ridge National Laboratory (ORNL) at Grand Junction was the independent verification contractor (IVC) for GJORAP. Oversight activities were conducted by representatives of

the FOS Safety & Health Group and GJORAP Project Management.

## Instrumentation

Radiation detection instruments were calibrated and used in accordance with the FOS *Calibration and Control Program Manual*. The instruments were checked daily for current calibration and proper operation. Calibrations used traceable standards and complied with 10 CFR 835, "Occupational Radiation Protection," DOE Order O 420.1, *Facility Safety,* and DOE Order O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*. Minimum detectable concentrations (MDCs) were calculated to ensure sufficient instrument sensitivity for measuring beta-gamma activity and gamma exposure rates at or below the authorized limits (*WASTREN* 1997b). MDCs are provided in Appendix B, Table B–1.

## Background Determinations

Gamma-exposure-rate and radionuclide-concentration background values, determined for the DOE–GJO facility during previous investigations, are summarized in Table 2. Beta-gamma background activities used for this release survey were based on an average ambient air activity of 1500 disintegrations per minute per 100 square centimeters (dpm/100 $cm^2$) plus material-specific activities determined from measurements collected on construction materials similar to those used on the DOE–GJO facility (*WASTREN* 1997a, DOE 1997). The applicable beta-gamma background activities are listed in Appendix B, Tables B–2 through B–4.

## Reference Grids

A 1-m by 1-m survey grid, tied to the southwest corner of the building and the DOE–GJO facility survey grid, was established for the building-surface survey units. Survey Unit 1 (exterior ground surfaces) was divided into eight approximately equal verification cells of 25 $m^2$ or less.

## Scanning Results

One hundred percent of the exposed ground surface and the floor were scanned for gamma activity. Gross gamma exposure rates for the exterior ground surfaces and the floor are shown in Appendix B, Figures B–1 and B–2, respectively.

One-square-meter grid blocks were scanned for beta-gamma activity at randomly-selected locations on the building surfaces. Measured activities are listed in Appendix B, Tables B–2 and B–3.

## Direct Measurements

Direct beta-gamma measurements were taken within the scanned grid blocks for statistical analysis. These measurement results are provided in Appendix B, Tables B–2 and B–3. Results of additional measurements taken behind building surfaces are included in

*Table 2. Gamma Exposure Rate and Soil Concentration Background Values for the DOE–GJO Facility*

| Criterion | Background Value | Source of Data |
|---|---|---|
| Gamma Exposure Rate | 14 $\mu$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: $\mu$R/h = microroentgens per hour; pCi/g = picocuries per gram

Appendix B, Table B–4. Measurement locations are shown in Appendix B, Figures B–1 through B–6. The projected upper limits of the mean activities, calculated at the 95 percent confidence level, indicate that the surface activities on the building surfaces do not exceed the authorized limits (Appendix B, Table B–7). The additional measurements indicated no significantly elevated activities.

In addition to measurements on building surfaces, direct beta-gamma measurements were taken on exterior soil surfaces within 3 m of the building to screen for uranium. No significantly elevated activities were measured (Appendix B, Table B–4).

Alpha activity was not measured because any alpha-emitting contaminant at this site would also emit a detectable beta particle. For surfaces, uranium is the alpha-emitting contaminant of concern. Since uranium emits beta and alpha particles in a ratio nearly 1:1, compliance with authorized limits for beta-gamma activity demonstrates compliance with authorized limits for alpha activity.

Interior and exterior gamma exposure rates were measured 1 m above the floor or ground. Measurement locations are shown in Appendix B, Figures B–1 and B–2, and results are provided in Appendix B, Table B–5. The projected upper limits of the mean exposure rates, calculated at the 95 percent confidence level, indicate that the gamma exposure rates do not exceed the interior authorized limit or exterior guideline (Appendix B, Table B–7).

### RDC Results

The average of three RDC measurements taken in Building 30B during a three-month-long period in 1997 was 0.0025 WL, which indicates that the working level is below the authorized limit.

### Sample Results

Soil samples were collected at the location of highest surface gamma exposure rate within each verification cell. The samples were analyzed for Ra-226, Th-230, and total uranium. The results demonstrate that the radionuclide concentrations do not exceed the authorized limits for radionuclide concentrations in hot spots or averaged over 100 $m^2$ (Appendix B, Table B–6). The projected upper limits of the mean concentrations, calculated at the 95 percent confidence level, indicate that the radionuclide concentrations do not exceed the authorized limits. Ra-226 concentrations measured in a 1-m deep borehole at location 30B–V–2a (Appendix B, Figure B–1) did not exceed the authorized limit for subsurface layers.

## V. Cost and Schedule

Project costs and the schedule for the radiological release survey of Building 30B will be presented in a summary final report addressing all GJORAP buildings.

## VI. Occupational Exposure

Health and safety procedures were followed in accordance with *The GJO Health and Safety Standards* and *The GJO Site Radiological Control Manual* to ensure personnel associated with the release survey activities were protected from radiological and nonradiological hazards.

## VII. Waste Volumes

Building 30B did not require remediation; therefore, no radiologically-contaminated materials were generated.

## VIII. Final Condition

All release requirements identified for GJORAP have been met for Building 30B (Table 3). The IVC will issue a Statement of Verification to signify concurrence that the release survey has achieved program objectives.

*Table 3. Certification Summary for All Survey Units*

| Certification Criteria | Number of Observations | Authorized Limit | Results[a] |
|---|---|---|---|
| Surface Activity (building surfaces only) | 60 direct beta-gamma measurements | Alpha or beta-gamma activity shall not exceed 5,000 dpm/100 $cm^2$ fixed averaged over 1 $m^2$. | Maximum beta-gamma = 620 dpm/100 $cm^2$<br>$\mu_{95\%}$ = 300 dpm/100 $cm^2$ for Survey Unit 2<br>$\mu_{95\%}$ = 120 dpm/100 $cm^2$ for Survey Unit 3 |
| | 0 smears[b] | Alpha or beta-gamma activity shall not exceed 1,000 dpm/100 $cm^2$ removable. | Maximum direct beta-gamma = 620 dpm/100 $cm^2$ |
| | 60 scan beta-gamma measurements[b] | Alpha or beta-gamma activity shall not exceed 15,000 dpm/100 $cm^2$ maximum averaged over 100 $cm^2$. | Maximum direct beta-gamma = 620 dpm/100 $cm^2$ |
| Gamma Exposure Rate (habitable areas only) | 4 static measurements[c] | ≤ 20 $\mu$R/h above background[d] | Maximum rate = 1.1 $\mu$R/h<br>$\mu_{95\%}$ = 0.6 $\mu$R/h |
| | 100% floor scan | ≤ 20 $\mu$R/h above background[d] | Ranged from -1.9 to 0.3 $\mu$R/h |
| Radon Decay-Product Concentration (habitable areas only) | 3 three-month measurements | Annual average shall not exceed 0.02 WL, to the extent practicable, and in no case shall exceed 0.03 WL. | $\bar{x}$ = 0.0025 WL |
| Radionuclide Concentrations in Soil | | Ra-226 and Th-230: | |
| | 9 individual samples | Shall not exceed 5 pCi/g above background[d] in the 15-cm surface layer, averaged over 100 $m^2$. | Ra-226: $\bar{x}_{max}$ = 3.0 pCi/g<br>$\bar{x}$ = 2.1 pCi/g<br>$\mu_{95\%}$ = 3.7 pCi/g<br>Th-230: $\bar{x}_{max}$ = 1.3 pCi/g<br>$\bar{x}$ = 0.3 pCi/g<br>$\mu_{95\%}$ = 2.0 pCi/g |
| | None | Shall not exceed 15 pCi/g above background[d] in any 15-cm-thick soil layer more than 15 cm below the surface, averaged over 100 $m^2$. | Not applicable |
| | | Total uranium: | |
| | 9 individual samples | Shall not exceed 106 pCi/g above background[d] in any 15-cm–thick layer, averaged over 100 $m^2$. | $\bar{x}_{max}$ = 1.5 pCi/g<br>$\bar{x}$ = 1.0 pCi/g<br>$\mu_{95\%}$ = 1.7 pCi/g |
| Soil Hot-Spot Criteria | As required for samples exceeding authorized limits | Limit = (authorized limit) x $(100/area)^{0.5}$ | $S_{hg}$ = 11.0 pCi/g<br>Ra-226: 30B–V–8 = 9.1 pCi/g<br>Th-230: 30B–V–8 = 7.6 pCi/g |

[a]Net results (background subtracted).
[b]Compliance was demonstrated by a combination of scans and direct measurements. Direct measurements were made at locations of highest elevated activity if elevated activity was present. Otherwise, direct measurements were made at the centers of the 1-$m^2$ grid blocks.
[c]Gamma exposure rates were measured 1 m above the floor.
[d]Background values are summarized in Table 2.

*Table 3 (continued). Certification Summary for All Survey Units*

Key for Table 3:

| | | |
|---|---|---|
| dpm/100 $cm^2$ | = | disintegrations per minute per 100 square centimeters |
| cm | = | centimeter(s) |
| $m^2$ | = | square meter(s) |
| $\mu_{95\%}$ | = | upper limit of the true population mean at the 95 percent confidence level |
| $\mu$R/h | = | microroentgens per hour |
| WL | = | working level |
| Ra-226 | = | radium-226 |
| Th-230 | = | thorium-230 |
| pCi/g | = | picocuries per gram |
| $\bar{x}$ | = | mean of all sample concentrations |
| $\bar{x}_{max}$ | = | maximum concentration averaged over a contiguous 100 $m^2$ area |
| $S_{hg}$ | = | hot spot limit (from DOE 1987b) |

Building 30B can be released for unrestricted use. Placards have been placed at the building entrances indicating the completion of the radiological release survey and prohibiting the introduction of any radioactive materials within the building without written approvals from the GJO Facilities Operations Manager.

Because of the limitations of current technology and procedures for identifying and remediating radiologically-contaminated materials, unknown deposits of contamination may be identified 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–GJO facility is routinely surveyed for radiation and other hazards.

At the time of this report, contamination is still present in other buildings located on the DOE–GJO facility; access to these areas is controlled and will be addressed by future GJORAP remedial actions. After the interior remedial actions are completed, the DOE–GJO facility will be managed as an LTSM site by DOE until the alluvial aquifer is restored by natural flushing.

## IX. Lessons Learned

Several lessons were learned during release survey activities involving the DOE–GJO buildings in FY 1997. The experience gained has been applied to subsequent surveys, and should be considered for use on other DOE projects. The following lessons have been learned:

- Radiological protection managers should ensure that survey technicians and their trainers are fully trained and tested on every type of equipment that will be used for performing release surveys. A small quantity of unusable data were collected because survey crew members misinterpreted the display on a new type of survey instrument. Although the problem was caught early, it could have resulted in a large quantity of useless and expensive data. Special care is required when new types of equipment are introduced into the field. Furthermore, it may be desirable to involve manufacturers' technical representatives in the initial training and testing of personnel who will use the equipment.

- Project team members should be encouraged to think critically about all project activities so that wasteful or otherwise inappropriate practices are recognized and eliminated as soon as possible. An example of this process occurred when personnel not directly involved in the release surveys questioned the practice of measuring beta-gamma background activity on surfaces in the same buildings being surveyed for release. This practice could mask contamination by incorporating its activity in the background measurement, thus compromising the validity of release survey results. A subsequent study of beta-gamma activities

contributed by common building materials indicated that most background measurements for beta-gamma activity in the DOE-GJO buildings can be performed by measuring ambient background activity in air.

- Good communication and coordination of activities is essential for limiting unnecessary delays and costs. For example, organizations that prepare survey plans should also be involved in the release surveys. A staff member from the organization that prepared the GJORAP survey plan met with the survey crews each morning and occasionally during each day to answer survey crews' questions and observe the work. As a result, problems related to staffing, recording data, reading survey instruments, and interpreting the plan were identified and corrected before they resulted in delays to the project or significantly increased costs.

## X. References


Chem-Nuclear Geotech, Inc., 1993. *Comprehensive Building Survey Completion Report for Building 30B*, memorandum from K.D. Briar to D.M. Frye, U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, July 6.

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.

_____, 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.

_____, 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 Project, Radiological Assessment for Construction Phase IB*, prepared by UNC Geotech, Inc., for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, April.

_____, 1990c. *Results of the U.S. Department of Energy Indoor Radon Survey*, Volume 2, DOE–ID–12584–75 Vol. 2, prepared by UNC Geotech for the U.S. Department of Energy Grand Junction Projects Office, Grand Junction, Colorado, August.

_____, 1990d. *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.

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

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

_____, 1997. *Survey for Determining Background Activities of Common Building Materials,* prepared by *WASTREN-Grand Junction* for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, August.

*WASTREN-Grand Junction*, 1997a. *Ambient Air Activity for Release Surveys of Buildings 11, 19, 29, 30B, 54, and 56,* memorandum from S.G. Corle to GJORAP Building Files, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, August 8.

_____, 1997b. *MDC Calculations for GJORAP*, memorandum from R.L. Morris to S.G. Corle, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, August 22.

# Appendix A

# Applicable Program and Quality Assurance Requirements and Procedures

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The following manuals and guidance documents were used as applicable for conducting GJORAP administrative and performance activities. The specific manuals and documents pertinent to the activities associated with the release survey of this building are noted in the text of this report.

## Joint Contractor Manuals

*The GJO Quality Assurance Manual* (GJO 1)

*The GJO Health and Safety Standards* (GJO 2)

*The GJO Site Radiological Control Manual* (GJO 3)

*The GJO Training Manual* (GJO 4)

*The GJO Construction Procedures Manual* (GJO 5)

*The GJO Environmental Procedures Catalog* (GJO 6)

*The GJO Formality of Operations Manual* (GJO 7)

*The GJO Emergency Preparedness & Response Plan* (GJO 8)

## FOS Contractor Manuals

*Safety and Health Manual*

*Environmental Compliance Manual*

*Operations Management Manual*

*Information Services Manual*

*Project Management Controls System Description*

*Budget Manual*

*Site Management Manual*

*Calibration and Control Program Manual*

*Information Management Support Manual*

*Grand Junction Projects Office Remedial Action Project Quality Assurance Program Plan* (P–GJPO–141, Rev. 6)

*Grand Junction Projects Office Remedial Action Project Records Management Plan* (P–GJPO–143)

*Grand Junction Projects Office Remedial Action Project Health and Safety Plan* (P–GJPO–144, Rev. 7)

*Engineering Support Procedures Manual*

*AutoCAD Standards Manual*

*Analytical Chemistry Laboratory Administrative Plan and Quality Control Procedures*

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

## TAR Contractor Manual

*Field Services Procedures Manual* (Manual MAC–3000)

## Other Guidance

10 CFR 830, "Nuclear Safety Management."

10 CFR 835, "Occupational Radiation Protection."

40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

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 O 420.1, *Facility Safety*

DOE Order O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees.*

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, Change 2.

DOE Order 5700.6C, *Quality Assurance,* Change 1.

DOE Order 5820.2A, *Radioactive Waste Management.*

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

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

*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.

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

*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*, NUREG/CR 5849 [draft], prepared by Oak Ridge Associated Universities for the U.S. Nuclear Regulatory Commission, June 1992.

*Procedures for Completion and Deletion of National Priority List Sites*, 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.

*Quality Assurance Program for Nuclear Facilities*, ANSI/ASME NQA–1, American Society of Mechanical Engineers, 1989.

*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*, ORNL, October 1991.

# Appendix B

# Final Radiological Conditions

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## Appendix B Table Summary

Table B–1 provides MDC calculation results for the instruments used for beta-gamma activity and gamma exposure rate measurements. Beta-gamma scan and direct-measurement survey data for the building surfaces are listed in Tables B–2 and B–3. Table B–4 presents the results of additional measurements made during the release survey. Interior and exterior static gamma exposure rate measurement data are provided in Table B–5. Listed in Table B–6 are the soil sample results for the exterior ground area located within 3 meters of Building 30B. Table B–7 presents the statistical summary of the measurement results.

## Appendix B Figure Summary

The verification cells and sample and measurement locations for the exterior ground area are shown on Figure B–1. Figures B–2 through B–6 show the locations where beta-gamma scans were performed and direct measurements were made on the surfaces of the building. Interior gamma scans of the floor surface and static gamma measurement locations (1 m above the floor) are shown on Figure B–2.

*Table B–1. Survey Instrumentation Sensitivities*

| Type of Measurement | Instrumentation | | MDC[a] | |
|---|---|---|---|---|
| | Detector | Meter | Static | Scan |
| Beta-Gamma | Eberline SHP–340 Gas Proportional | Eberline E–600 | 530 dpm/100 $cm^2$ | 1700 dpm/100 $cm^2$ |
| Gamma | Same as meter | Mount Sopris SC–132 Portable Scintillometer[b] | Not calculated[c] | 3.4 $\mu$R/h |

[a]Calculations include background counts for a specified time period. Equations and calculations are provided in *MDC Calculations for GJORAP* (*WASTREN* 1997b).

[b]The instrument has a 1.5 x 1.5-inch sodium iodide detector.

[c]The calculation of MDC for static gamma measurements is not appropriate due to empirical characteristics of the measurement method and associated variables. However, instrument detection is expected to be at least as sensitive as the scan MDC.

Key for Table B–1:

| | | |
|---|---|---|
| MDC | = | minimum detectable concentration |
| dpm/100 $cm^2$ | = | disintegrations per minute per 100 square centimeters |
| $\mu$R/h | = | microroentgens per hour |

The following equations and factors were used to calculate instrument sensitivities (from *WASTREN* 1997b):

$$Static\ MDC_{\beta-\gamma} = \frac{3 + 4.65 * \sqrt{C_b}}{T * \epsilon_T * A * K} = \frac{3 + 4.65 * \sqrt{230}}{1 * 0.19 * 73 * 0.01} = 530\ dpm/100\ cm^2$$

$$Scan\ MDC_{\beta-\gamma} = \frac{\frac{d' * \sqrt{B_r * T}}{T}}{\sqrt{E_{hf}} * \epsilon_T * A * K} = \frac{\frac{2 * \sqrt{230 * 1/60}}{1/60}}{\sqrt{1} * 0.19 * 73 * 0.01} = 1700\ dpm/100\ cm^2$$

$$Scan\ MDC_{\gamma} = \frac{\frac{d' * \sqrt{B_r * T}}{T}}{\sqrt{E_{hf}} * \epsilon_i * K} = \frac{\frac{2 * \sqrt{6300 * 1/60}}{1/60}}{\sqrt{0.65} * 450 * 1} = 3.4\ \mu R/h$$

Where:

| | | |
|---|---|---|
| $MDC_{\beta-\gamma}$ | = | minimum detectable concentration for measuring beta-gamma activities |
| $MDC_{\gamma}$ | = | mimimum detectable concentration for measuring gamma exposure rates |
| $C_b$ | = | background counts for a count time T |
| T | = | count time or observational interval in minutes |
| $\epsilon_T$ | = | total detector efficiency in counts per disintegration (based on 1997 calibration) |
| A | = | probe area in square centimeters |
| K | = | unit or time conversion factors |
| d' | = | index of sensivity |
| $B_r$ | = | applicable background count rate in counts per minute |
| $E_{hf}$ | = | human factors efficiency |
| $\epsilon_i$ | = | instrument efficiency in counts per minute per $\mu$R/h (based on 1997 calibration where exposure rate ($\mu$R/h) = cps x 0.0748 + 6.03; therefore 105 cps = 13.9 $\mu$R/h, and 1 $\mu$R/h = 450 cpm) |

*Table B–2. Survey Unit 2 Surface Measurement Data*

| Loc. No. | Surface | Media | Background Activity[a] | Scan Beta-Gamma Activity | | | | Direct Beta-Gamma Activity | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Gross Max. | Gross Min. | Net Max. | Net Min. | Gross | Net |
| 31 | Interior Wall | Insulation | 1500 | 2020 | 1384 | 520 | -116 | 1573 | 73 |
| 32 | Interior Wall | Insulation | 1500 | 1661 | 1216 | 161 | -284 | 1501 | 1 |
| 33 | Interior Wall | Insulation | 1500 | 2010 | 994 | 510 | -506 | 1399 | -101 |
| 34 | Interior Wall | Insulation | 1500 | 2030 | 1474 | 530 | -26 | 1776 | 276 |
| 35 | Interior Wall | Insulation | 1500 | 1962 | 1529 | 462 | 29 | 1599 | 99 |
| 36 | Interior Wall | Insulation | 1500 | 1736 | 1232 | 236 | -268 | 1461 | -39 |
| 37 | Interior Wall | Insulation | 1500 | 1956 | 1100 | 456 | -400 | 1383 | -117 |
| 38 | Interior Wall | Insulation | 1500 | 1758 | 1185 | 258 | -315 | 1638 | 138 |
| 39 | Interior Wall | Insulation | 1500 | 2080 | 1099 | 580 | -401 | 1389 | -111 |
| 40 | Interior Wall | Insulation | 1500 | 2270 | 1478 | 770 | -22 | 1999 | 499 |
| 41 | Interior Wall | Insulation | 1500 | 1878 | 1240 | 378 | -260 | 1874 | 374 |
| 42 | Interior Wall | Insulation | 1500 | 2260 | 1722 | 760 | 222 | 2100 | 600 |
| 43 | Floor | Asphalt | 1800 | 2490 | 1685 | 690 | -115 | 2420 | 620 |
| 44 | Floor | Asphalt | 1800 | 2540 | 1970 | 740 | 170 | 2120 | 320 |
| 45 | Floor | Asphalt | 1800 | 2780 | 1497 | 980 | -360 | 1998 | 198 |
| 46 | Floor | Asphalt | 1800 | 2470 | 1526 | 670 | -274 | 2050 | 250 |
| 47 | Floor | Asphalt | 1800 | 2230 | 1694 | 430 | -106 | 1933 | 133 |
| 48 | Floor | Asphalt | 1800 | 2880 | 1978 | 1080 | 178 | 2240 | 440 |
| 49 | Floor | Asphalt | 1800 | 2440 | 1775 | 640 | -25 | 2410 | 610 |
| 50 | Floor | Asphalt | 1800 | 2480 | 2012 | 680 | 212 | 2390 | 590 |
| 51 | Floor | Asphalt | 1800 | 2860 | 1785 | 1060 | -15 | 2240 | 440 |
| 52 | Ceiling | Insulation | 1500 | 2010 | 1501 | 510 | 1 | 1737 | 237 |
| 53 | Ceiling | Insulation | 1500 | 2190 | 1423 | 690 | -77 | 1560 | 60 |
| 54 | Ceiling | Insulation | 1500 | 2100 | 1551 | 600 | 51 | 1671 | 171 |
| 55 | Ceiling | Insulation | 1500 | 2320 | 1447 | 820 | -53 | 1773 | 273 |
| 56 | Ceiling | Fiberglass | 1500 | 2500 | 1155 | 1000 | -345 | 1763 | 263 |
| 57 | Ceiling | Insulation | 1500 | 2130 | 1533 | 630 | 33 | 1723 | 223 |
| 58 | Ceiling | Insulation | 1500 | 2011 | 1355 | 511 | -145 | 1769 | 269 |
| 59 | Ceiling | Insulation | 1500 | 2011 | 1406 | 511 | -94 | 1691 | 191 |
| 60 | Interior Wall | Insulation | 1500 | 1500 | 941 | 0 | -559 | 1206 | -294 |

[a]Background activity includes average background ambient air and average material-specific activities (DOE 1997, *WASTREN* 1997a).

Note: All measurements were read in dpm/100 $cm^2$ and were collected with an Eberline E–600 meter with an Eberline SHP–340 probe to measure gross beta-gamma activity.

*Table B–3. Survey Unit 3 Surface Measurement Data*

| Loc. No. | Surface | Media | Background Activity[a] | Scan Beta-Gamma Activity | | | | Direct Beta-Gamma Activity | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Gross Max. | Gross Min. | Net Max. | Net Min. | Gross | Net |
| 1 | Exterior Wall | Steel Siding | 1500 | 2145 | 1095 | 645 | -405 | 1950 | 450 |
| 2 | Exterior Wall | Steel Siding | 1500 | 1764 | 974 | 264 | -526 | 1165 | -335 |
| 3 | Exterior Wall | Steel Siding | 1500 | 2050 | 1475 | 550 | -25 | 1796 | 296 |
| 4 | Exterior Wall | Steel Siding | 1500 | 1972 | 1250 | 472 | -250 | 1678 | 178 |
| 5 | Exterior Wall | Steel Siding | 1500 | 1848 | 1126 | 348 | -374 | 1396 | -104 |
| 6 | Exterior Wall | Steel Siding | 1500 | 1990 | 1162 | 490 | -338 | 1494 | -6 |
| 7 | Exterior Wall | Steel Siding | 1500 | 1861 | 1047 | 361 | -453 | 1304 | -196 |
| 8 | Exterior Wall | Steel Siding | 1500 | 1694 | 1196 | 194 | -304 | 1579 | 79 |
| 9 | Exterior Wall | Steel Door | 1500 | 2030 | 1060 | 530 | -440 | 1415 | -85 |
| 10 | Exterior Wall | Steel Door | 1500 | 1962 | 1235 | 462 | -265 | 1363 | -137 |
| 11 | Exterior Wall | Steel Siding | 1500 | 1691 | 1151 | 191 | -349 | 1527 | 27 |
| 12 | Exterior Wall | Steel Siding | 1500 | 1833 | 1022 | 333 | -478 | 1422 | -78 |
| 13 | Exterior Wall | Steel Siding | 1500 | 1959 | 1093 | 459 | -407 | 1763 | 263 |
| 14 | Exterior Wall | Steel Siding | 1500 | 2040 | 1306 | 540 | -194 | 1566 | 66 |
| 15 | Exterior Wall | Steel Siding | 1500 | 2030 | 1195 | 530 | -305 | 1540 | 40 |
| 16 | Exterior Wall | Steel Siding | 1500 | 1918 | 1056 | 418 | -444 | 1579 | 79 |
| 17 | Exterior Wall | Steel Siding | 1500 | 1897 | 1294 | 397 | -206 | 1645 | 145 |
| 18 | Exterior Wall | Steel Siding | 1500 | 1881 | 1280 | 381 | -220 | 1605 | 105 |
| 19 | Roof | Steel | 1500 | 2020 | 1215 | 520 | -285 | 1444 | -56 |
| 20 | Roof | Steel | 1500 | 2030 | 1262 | 530 | -238 | 1437 | -63 |
| 21 | Roof | Steel | 1500 | 1954 | 1359 | 454 | -141 | 1415 | -85 |
| 22 | Roof | Steel | 1500 | 2316 | 1627 | 816 | 127 | 1784 | 284 |
| 23 | Roof | Steel | 1500 | 1922 | 1238 | 422 | -262 | 1394 | -106 |
| 24 | Roof | Steel | 1500 | 1920 | 1389 | 420 | -111 | 1631 | 131 |
| 25 | Roof | Steel | 1500 | 1833 | 1113 | 333 | -387 | 1498 | -2 |
| 26 | Roof | Steel | 1500 | 2220 | 1470 | 720 | -30 | 1570 | 70 |
| 27 | Roof | Steel | 1500 | 2130 | 1109 | 630 | -391 | 1763 | 263 |
| 28 | Roof | Steel | 1500 | 2130 | 1309 | 630 | -191 | 1653 | 153 |
| 29 | Roof | Steel | 1500 | 1983 | 1271 | 483 | -229 | 1688 | 188 |
| 30 | Roof | Steel | 1500 | 2020 | 1320 | 520 | -180 | 1904 | 404 |

[a]Background activity includes average background ambient air and average material-specific activities (DOE 1997, *WASTREN* 1997a).

Note: All measurements were read in dpm/100 $cm^2$ and were collected with an Eberline E–600 meter with an Eberline SHP–340 probe to measure gross beta-gamma activity.

*Table B–4. Additional Measurement Data*

| Loc. No.[a] | Surface | Media | Background Actvity[b] | Scan Beta-Gamma Activity | | | | Direct Beta-Gamma Activity | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Gross Max. | Gross Min. | Net Max. | Net Min. | Gross | Net |
| 30B-V-2 | Exterior Ground | Soil | 1800 | NM | NM | N/A | N/A | 2450 | 950 |
| 30B-V-2a | Exterior Ground | Soil | 1800 | NM | NM | N/A | N/A | 2960 | 1460 |
| 30B-V-3 | Exterior Ground | Soil | 1800 | NM | NM | N/A | N/A | 2270 | 770 |
| 30B-V-4 | Exterior Ground | Soil | 1800 | NM | NM | N/A | N/A | 1999 | 199 |
| 30B-V-5 | Exterior Ground | Soil | 1800 | NM | NM | N/A | N/A | 2140 | 340 |
| 30B-V-6 | Exterior Ground | Soil | 1800 | NM | NM | N/A | N/A | 2553 | 753 |
| 30B-V-7 | Exterior Ground | Soil | 1800 | NM | NM | N/A | N/A | 2170 | 370 |
| 30B-V-8 | Exterior Ground | Soil | 1800 | NM | NM | N/A | N/A | 2680 | 1180 |
| 32a | Interior Wall | Steel | 1800 | NM | NM | N/A | N/A | 1527 | 27 |
| 34a | Interior Wall | Steel | 1500 | NM | NM | N/A | N/A | 1461 | -39 |
| 35a | Interior Wall | Steel | 1500 | NM | NM | N/A | N/A | 1448 | -52 |
| 37a | Interior Wall | Steel | 1500 | NM | NM | N/A | N/A | 1658 | 158 |
| 38a | Interior Wall | Steel | 1500 | NM | NM | N/A | N/A | 1822 | 322 |
| 39a | Interior Wall | Steel | 1500 | NM | NM | N/A | N/A | 1343 | -157 |
| 52a | Ceiling | Steel | 1500 | NM | NM | N/A | N/A | 1950 | 450 |
| 53a | Ceiling | Steel | 1500 | NM | NM | N/A | N/A | 1507 | 7 |
| 54a | Ceiling | Steel | 1500 | NM | NM | N/A | N/A | 1540 | 40 |
| 55a | Ceiling | Steel | 1500 | NM | NM | N/A | N/A | 1612 | 112 |
| 57a | Ceiling | Steel | 1500 | NM | NM | N/A | N/A | 1992 | 492 |
| 58a | Ceiling | Steel | 1500 | NM | NM | N/A | N/A | 1809 | 309 |
| 59a | Ceiling | Steel | 1500 | NM | NM | N/A | N/A | 1920 | 420 |

[a]Alpha-numeric location numbers (e.g. 32a) represent intrusive measurements taken on material under or behind the surface material.

[b]Background activity includes average background ambient air and average material-specific activities (DOE 1997, *WASTREN* 1997a).

Note: All measurements were read in dpm/100 $cm^2$ and were collected with an Eberline E–600 meter with an Eberline SHP–340 probe to measure gross beta-gamma activity.

Key for Table B–4:
NM = no measurement
N/A = not applicable

*Table B–5. Gamma Exposure Rate Measurement Data*

**Interior Static Measurements**

| Location Number | Gross | | Net[a] |
|---|---|---|---|
| | cps | μR/h | μR/h |
| G1 | 80 | 12.1 | -1.9 |
| G2 | 120 | 15.1 | 1.1 |
| G3 | 70 | 11.3 | -2.7 |
| G4 | 80 | 12.1 | -1.9 |

**Exterior Static Measurements**

| Location Number | Gross | | Net[a] |
|---|---|---|---|
| | cps | μR/h | μR/h |
| 30B–V–1 | 100 | 13.6 | -0.4 |
| 30B–V–2 | 100 | 13.6 | -0.4 |
| 30B–V–2a | 100 | 13.6 | -0.4 |
| 30B–V–3 | 100 | 13.6 | -0.4 |
| 30B–V–4 | 90 | 12.8 | -1.2 |
| 30B–V–5 | 100 | 13.6 | -0.4 |
| 30B–V–6 | 100 | 13.6 | -0.4 |
| 30B–V–7 | 105 | 14.0 | 0.0 |
| 30B–V–8 | 110 | 14.3 | 0.3 |

[a]Background gamma exposure rate for the facility is 14 μR/h (Table 2).

Note: Gamma exposure rates were read in cps and were measured with a Mount Sopris SC-132 scintillometer at 1 m above the floor or ground.

Key for Table B–5:

cps = counts per second
μR/h = microroentgens per hour (μR/h = cps x 0.0748 + 6.1)

*Table B–6. Soil Sample Results for Exterior Areas*

| Sample Number | Cell Area ($m^2$) | Soil Sample Ticket No. | Sample Depth[a] (cm) | Concentration (pCi/g) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Ra-226 | | Th-230 | | Total Uranium | |
| | | | | Gross | Net[b] | Gross | Net[b] | Gross | Net[b] |
| 30B–V–1 | 18.9 | NCM 065 | 0 – 15 | 2.20 ± 0.49 | **1.2** | 1.5 | **-0.5** | 4.4 | **2.4** |
| 30B–V–2 | 18.0 | NCM 066 | 0 – 15 | 1.88 ± 0.48 | 0.9 | 1.3 | -0.7 | 3.0 | 1.0 |
| 30B–V–2a | 18.0 | NCM 067 | 0 – 15 | 2.22 ± 0.43 | **1.2** | 2.3 | **0.3** | 4.9 | **2.9** |
| 30B–V–3 | 22.9 | NCM 068 | 0 – 15 | 3.09 ± 0.57 | **2.1** | 2.1 | **0.1** | 3.0 | **1.0** |
| 30B–V–4 | 22.1 | NCD 153 | 8 – 23 | 2.13 ± 0.50 | 1.1 | 1.2 | **-0.8** | 2.0 | 0.0 |
| 30B–V–5 | 16.5 | NCD 149 | 8 – 23 | 1.64 ± 0.56 | 0.6 | 0.74 | -1.3 | 1.8 | -0.2 |
| 30B–V–6 | 17.3 | NCD 150 | 8 – 23 | 1.95 ± 0.59 | 1.0 | 1.2 | -0.8 | 2.4 | 0.4 |
| 30B–V–7 | 20.0 | NCD 151 | 8 – 23 | 2.51 ± 0.53 | **1.5** | 0.75 | -1.3 | 2.0 | **0.0** |
| 30B–V–8 | 20.6 | NCD 152 | 0 – 15 | 10.11 ± 1.01 | **9.1**[c] | 9.6 | **7.6**[c] | 3.4 | **1.4** |

[a]Subsurface soil sample depths indicate the presence of an overlying pavement not included in the sample.
[b]See Table 2 for background concentrations used to calculate net concentrations.
[c]Laboratory results for individual sample 30B–V–8 exceed the Ra-226 and Th-230 authorized limits for the surface layer; however, the maximum 100 $m^2$ averages (see Note 4) are less than the authorized limits, and the sample results do not exceed the hot spot limit [$S_{hg}$ = (5.0) x $(100/20.6)^{0.5}$ = 11.0 pCi/g]. Therefore, the release criteria for the surface soil layer are met.

Notes:

1) Ra-226 was analyzed by gamma spectrometry.
2) Th-230 and total uranium were analyzed by induction-coupled plasma-mass spectrometry with a flow-injection analysis system.
3) Analytical laboratory measurement methods, results, uncertainties, and quality control for these samples are contained in the Grand Junction Office Analytical Laboratory *Analytical Report*, Volumes 1 and 2, for Project L20A41000, June 11, 1997. All Ra-226 results were above minimum detectable activities. Uncertainties were not calculated for Th-230 and total uranium.
4) Bolded results were used to calculate the maximum net mean concentrations for contiguous areas totalling approximately 100 $m^2$, which are: Ra-226 = 3.0 pCi/g; Th-230 = 1.3 pCi/g; Uranium = 1.5 pCi/g

Key for Table B–6:

| | | |
|---|---|---|
| $m^2$ | = | square meter(s) |
| cm | = | centimeter(s) |
| pCi/g | = | picocuries per gram |
| Ra-226 | = | radium-226 |
| Th-230 | = | thorium-230 |

*Table B–7. Statistical Summary of Measurement Surveys*

**Net Building Surface Beta-Gamma Activity**

| Survey Unit | Surfaces | n | $t_{95\%,d.f.}$ | Net Activity (dpm/100 $cm^2$) | | |
|---|---|---|---|---|---|---|
| | | | | $\bar{x}$ | s | $\mu_{95\%}$ |
| 2 | Interior walls, floor, ceiling | 30 | 1.699 | 222.87 | 234.75 | 300 |
| 3 | Exterior walls, roof | 30 | 1.699 | 65.60 | 178.70 | 120 |

**Net Interior Gamma Exposure Rates**

| n | $t_{95\%,d.f.}$ | Net Gamma Exposure Rates ($\mu$R/h) | | |
|---|---|---|---|---|
| | | $\bar{x}$ | s | $\mu_{95\%}$ |
| 4 | 2.353 | -1.35 | 1.68 | 0.6 |

**Net Exterior Gamma Exposure Rates**

| n | $t_{95\%,d.f.}$ | Net Gamma Exposure Rates ($\mu$R/h) | | |
|---|---|---|---|---|
| | | $\bar{x}$ | s | $\mu_{95\%}$ |
| 9 | 1.860 | -0.37 | 0.40 | -0.1 |

**Net Soil Concentrations (Surface Layer)**

| Contaminant | n | $t_{95\%,d.f.}$ | Net Concentrations (pCi/g) | | | |
|---|---|---|---|---|---|---|
| | | | $\bar{x}_{max.}$ | $\bar{x}$ | s | $\mu_{95\%}$ |
| Ra-226 | 9 | 1.860 | 3.0 | 2.08 | 2.67 | 3.7 |
| Th-230 | 9 | 1.860 | 1.3 | 0.29 | 2.80 | 2.0 |
| Total Uranium | 9 | 1.860 | 1.5 | 0.99 | 1.09 | 1.7 |

Note: See Tables B–2, B–3, B–5, and B–6 for the survey data.

Key for Table B–7:

| | | |
|---|---|---|
| dpm/100 $cm^2$ | = | disintegrations per minute per 100 square centimeters |
| $\mu$R/h | = | microroentgens per hour |
| pCi/g | = | picocuries per gram |
| n | = | number of measurements |
| $t_{95\%,d.f.}$ | = | Student's t distribution statistic for n-1 degrees of freedom at 95% confidence |
| $\bar{x}_{max.}$ | = | maximum mean of soil sample concentrations representing contiguous areas totalling approximately 100 $m^2$ (not used to calculate s and $\mu_{95\%}$) |
| $\bar{x}$ | = | sample mean |
| s | = | sample standard deviation |
| $\mu_{95\%}$ | = | upper limit of the true population mean at the 95% confidence level, derived from: |

$$\mu_{95\%} = \bar{x} + t_{95\%} \frac{s}{\sqrt{n}}$$

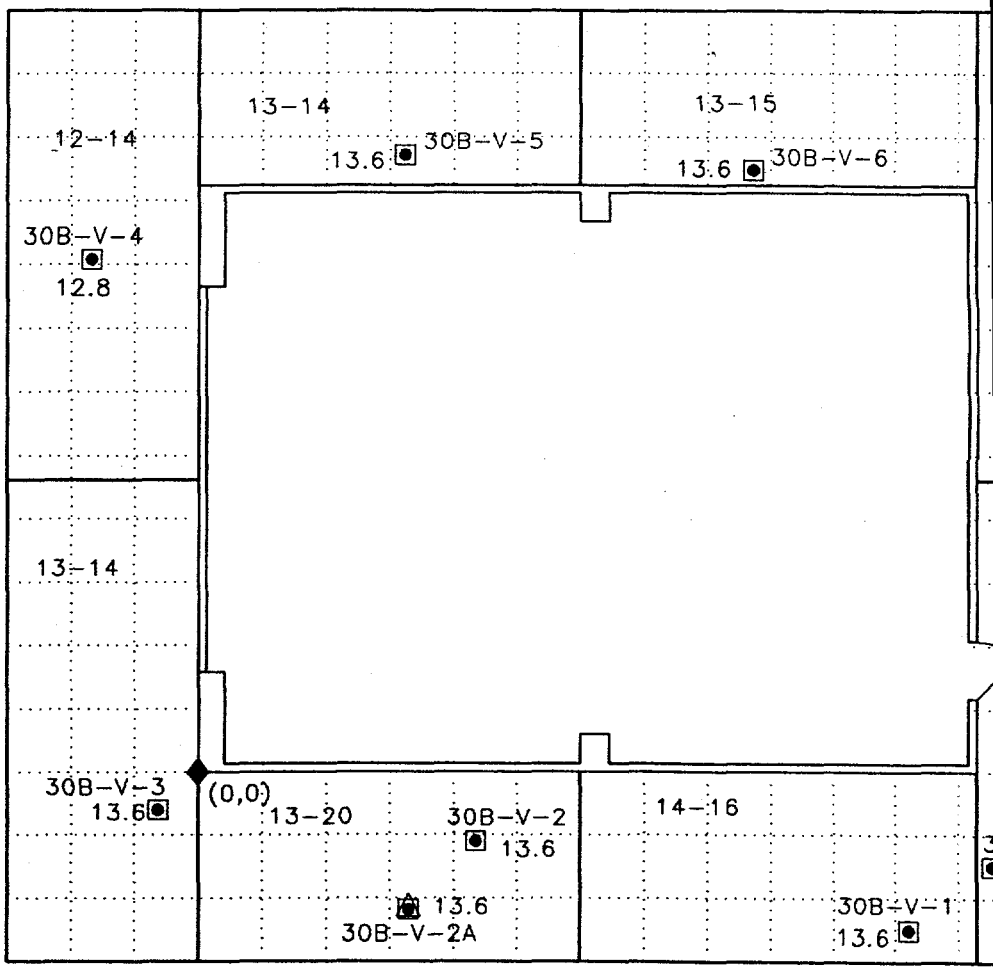
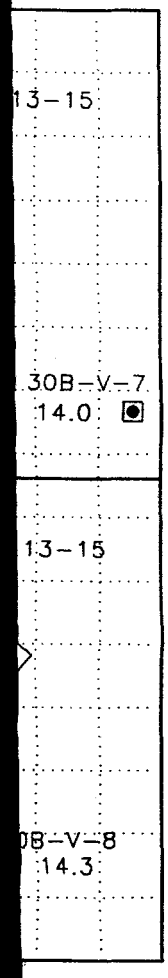
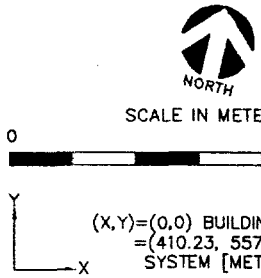



*Figure B-1. Building 30B*




LEGEND

| | |
|---|---|
| ◆ | BASE COORDINATE FOR 1-METER GRID SYSTEM |
| ● | DIRECT MEASUREMENT LOCATION |
| □ | SOIL SAMPLE LOCATION |
| △ | BOREHOLE LOCATION |
| 30B-V-2 | SOIL SAMPLE IDENTIFIER |
| 13.6 | GAMMA EXPOSURE RATE MEASUREMENT AT 1 M ABOVE GROUND (μR/h) |
| 12-14 | GAMMA EXPOSURE RATE RANGE AT GROUND LEVEL (μR/h) |
| ▭ | EXTERIOR VERIFICATION AREA BOUNDARY |

WASTREN - Grand Junction

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GRAND JUNCTION OFFICE, COLORADO

Figure B-1 BUILDING 30B EXTERIOR GROUND SURVEY

| PREPARED: | CHECKED: | DATE PREPARED: |
|---|---|---|
| | | JUNE 1997 |

PROJECT NUMBER: TCR-031-0017-00-000 FILENAME: T00066AA

*xterior Ground Survey*

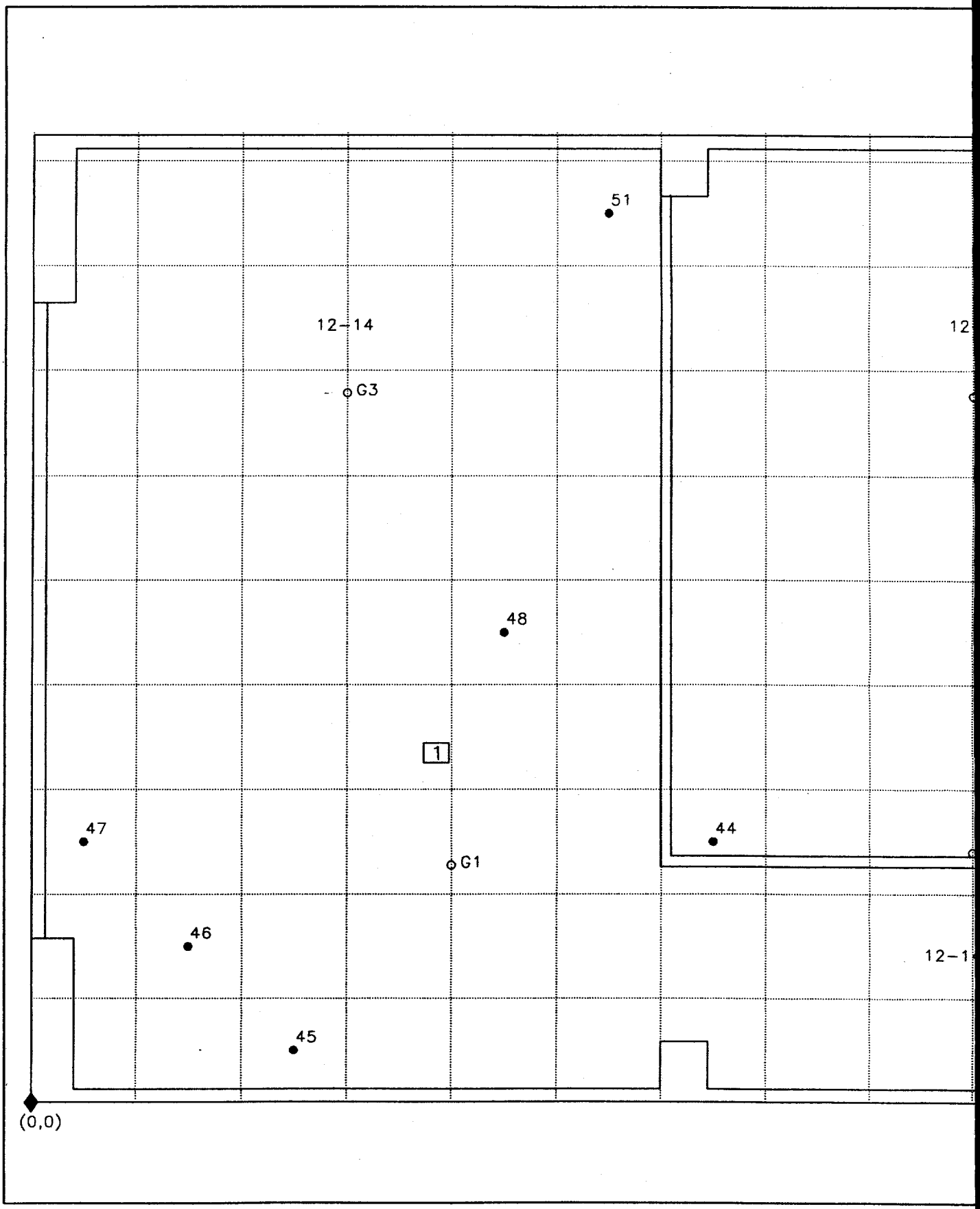
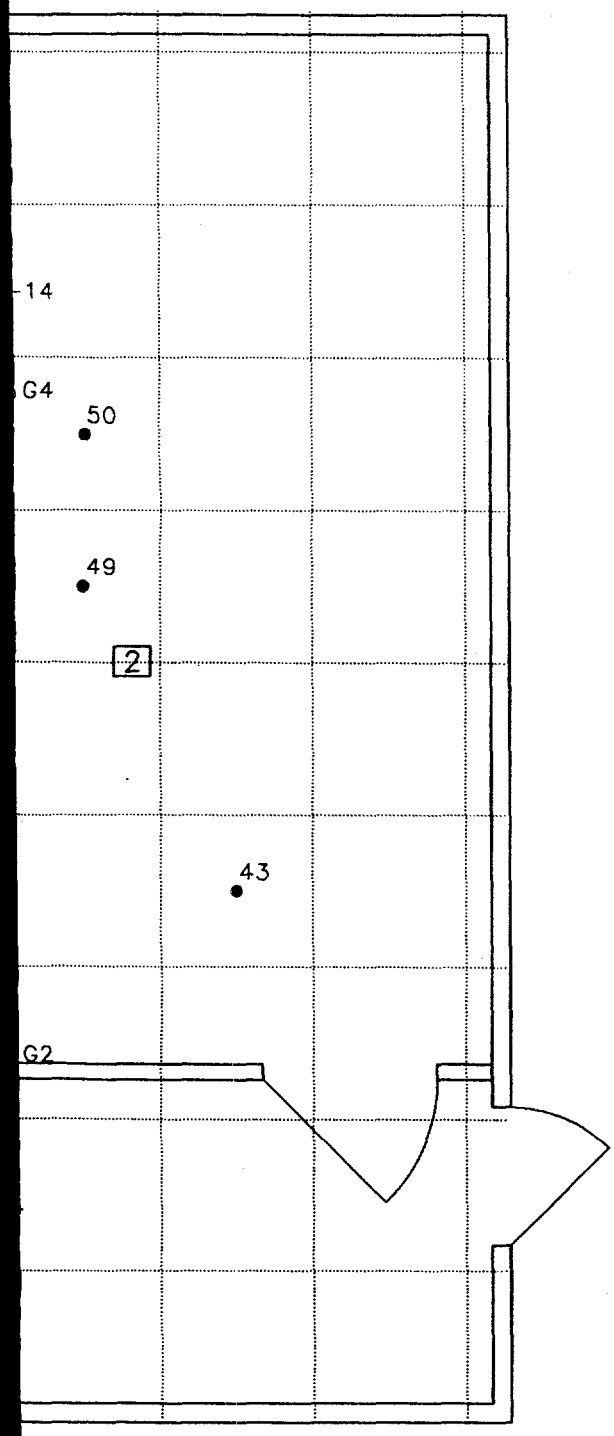



*Figure B–2. Building 30B Floor*




NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(410.23, 557.33) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

| | |
|---|---|
| ◆ | BASE COORDINATE FOR 1-METER GRID SYSTEM |
| ● | DIRECT MEASUREMENT LOCATION |
| o | GAMMA EXPOSURE RATE MEASUREMENT LOCATION AT 1 M ABOVE FLOOR |
| 35 | MEASUREMENT LOCATION NUMBER |
| 12-14 | GAMMA EXPOSURE RATE RANGE AT FLOOR LEVEL ($\mu$R/h) |
| [2] | ROOM NUMBER |

EASTERN - Grand Junction

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE, COLORADO

Figure B-2 BUILDING 30B FLOOR AND INTERIOR GAMMA SURVEY

| PREPARED: | CHECKED: | DATE PREPARED: |
|---|---|---|
| | | JUNE 1997 |

| PROJECT NUMBER: | FILENAME: |
|---|---|
| TCR-031-0017-00-000 | T00067AA |

*and Interior Gamma Survey*

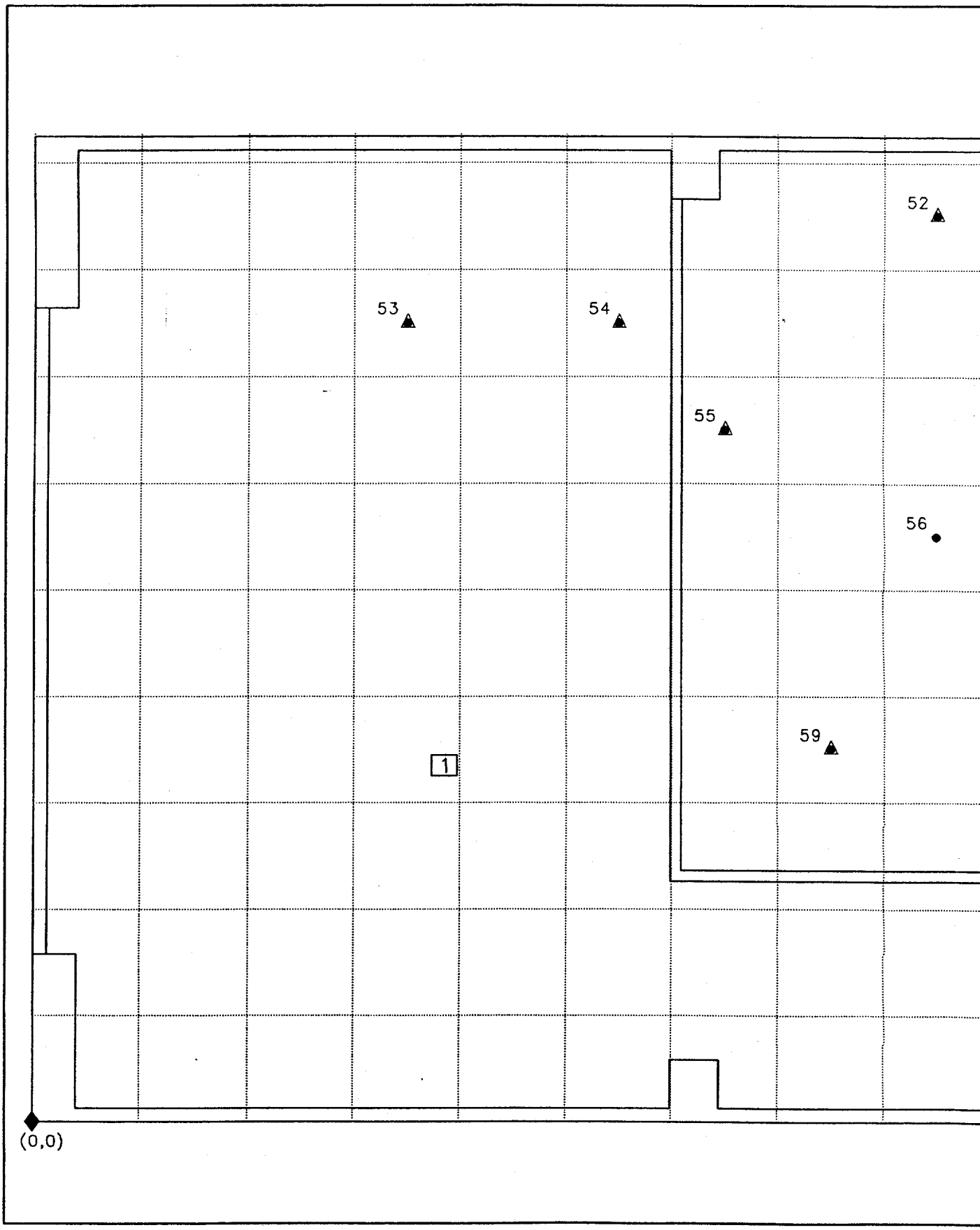
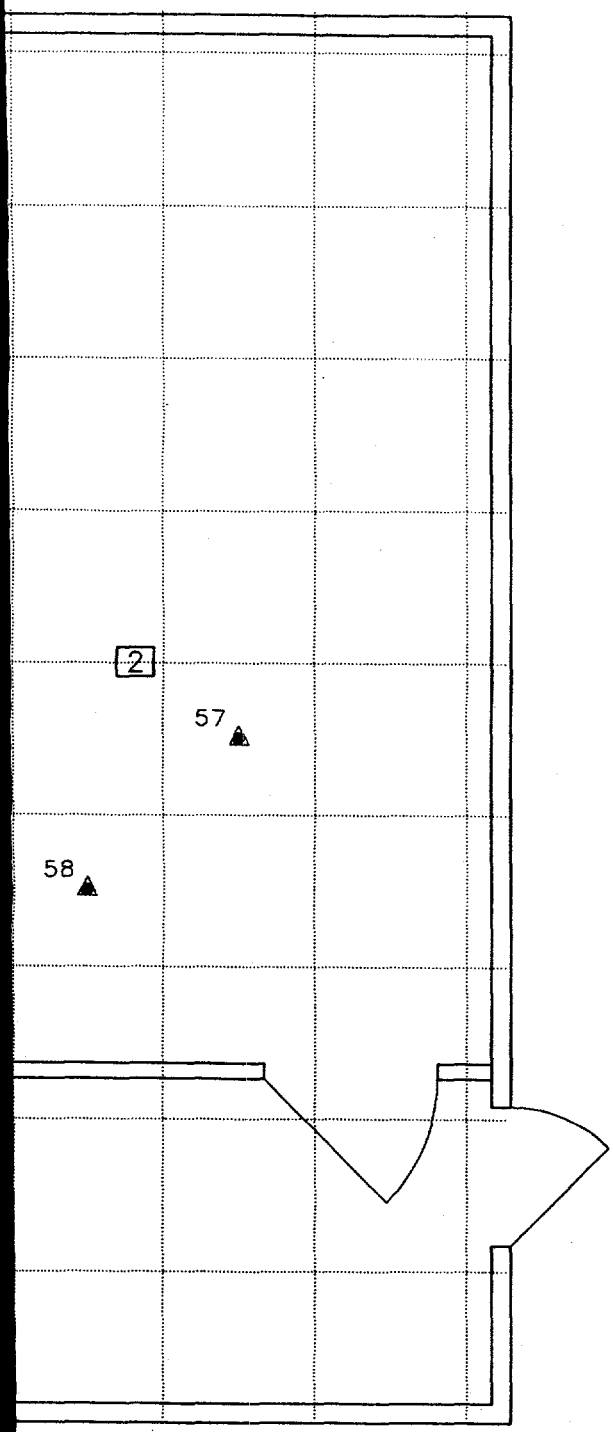



*Figure B–3. Building*




NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(410.23, 557.33) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆ BASE COORDINATE FOR 1-METER GRID SYSTEM

● DIRECT MEASUREMENT LOCATION

△ INTRUSIVE MEASUREMENT LOCATION

35 MEASUREMENT LOCATION NUMBER

[2] ROOM NUMBER

EASTERN - Grand Junction

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE, COLORADO

Figure B-3 BUILDING 30B CEILING SURVEY

| PREPARED: | CHECKED: | DATE PREPARED: |
|---|---|---|
| | | JUNE 1997 |

| PROJECT NUMBER: | FILENAME: |
|---|---|
| TCR-031--0017-00-000 | T00068AA |

*0B Ceiling Survey*

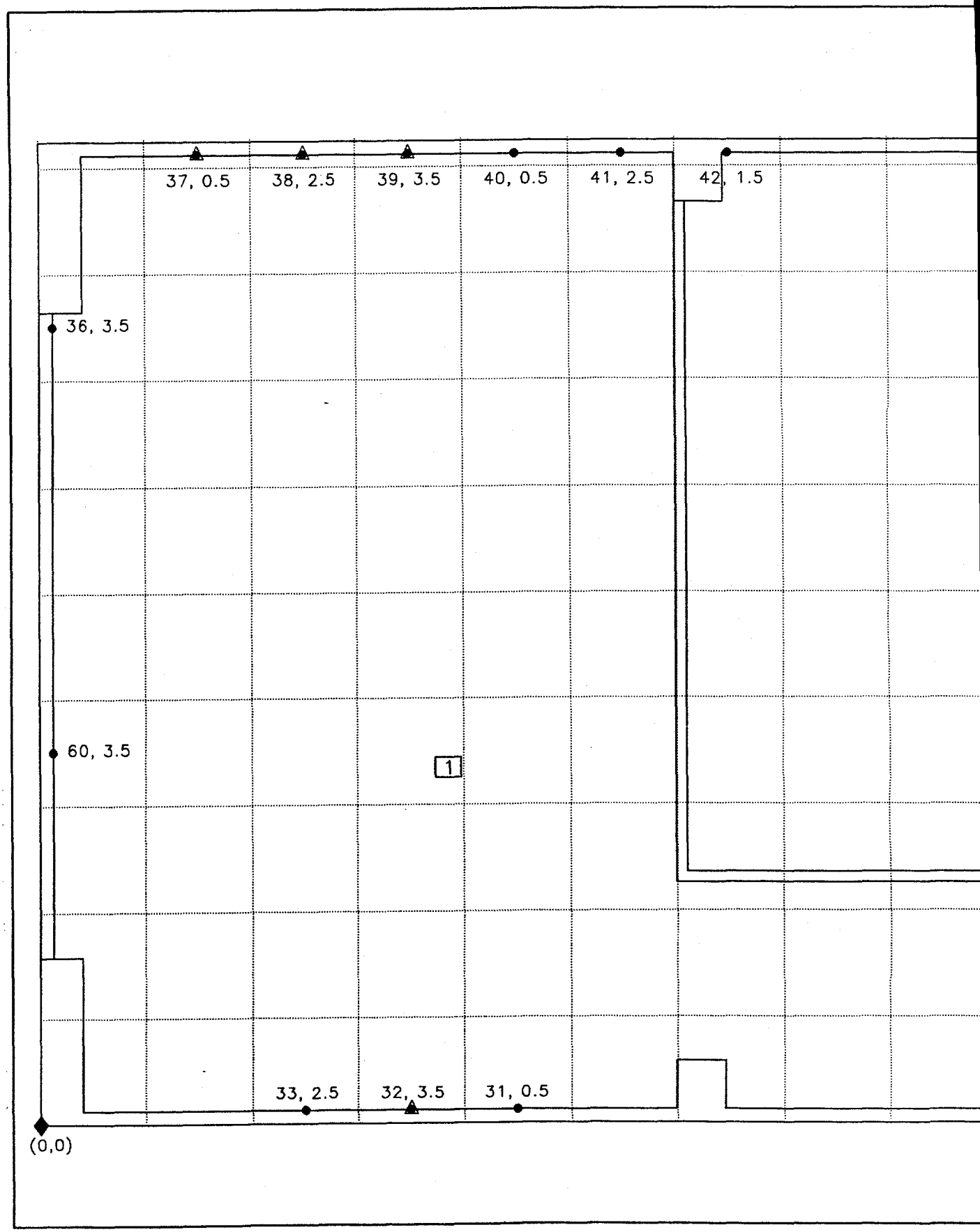
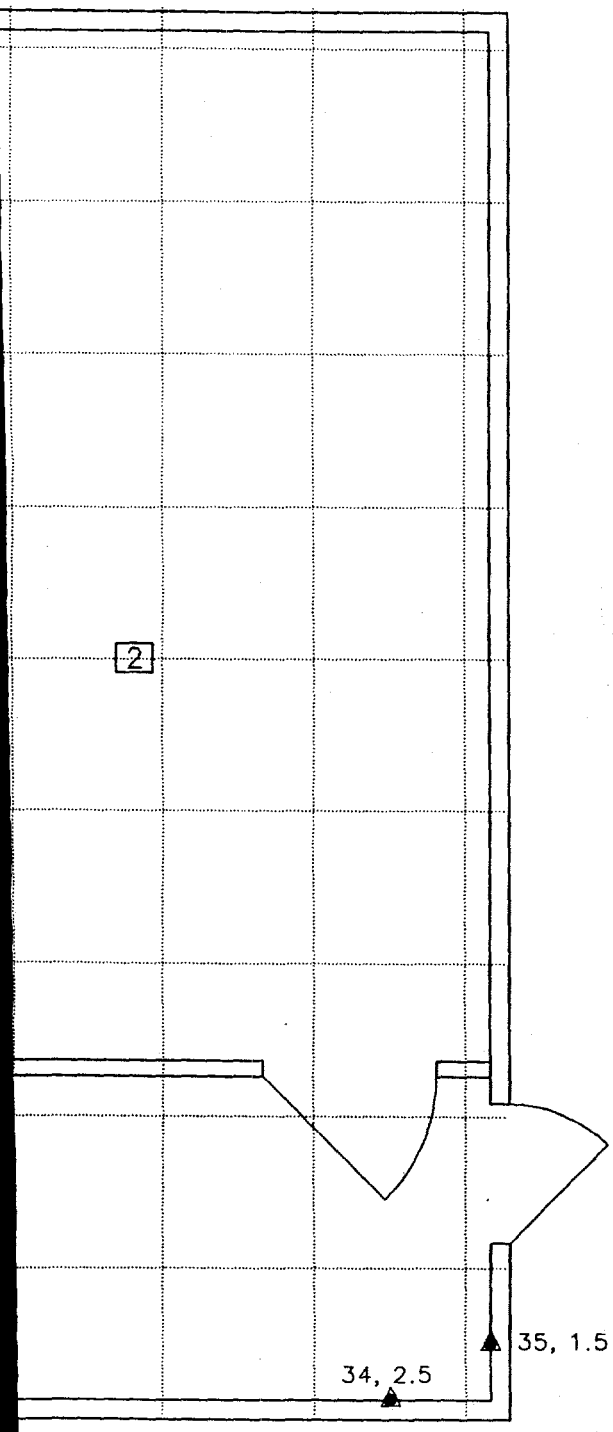



*Figure B–4. Building 30*




NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(410.23, 557.33) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

| | |
|---|---|
| ◆ | BASE COORDINATE FOR 1-METER GRID SYSTEM |
| ● | DIRECT MEASUREMENT LOCATION |
| △ | INTRUSIVE MEASUREMENT LOCATION |
| 35, 1.5 | MEASUREMENT LOCATION NUMBER, FOLLOWED BY HEIGHT ABOVE FLOOR (METERS) |
| [2] | ROOM NUMBER |

EASTERN - Grand Junction

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE, COLORADO

Figure B-4 BUILDING 30B INTERIOR WALL SURVEY

| PREPARED: | CHECKED: | DATE PREPARED: |
|---|---|---|
| CAW | | JUNE 1997 |

PROJECT NUMBER: TCR-031-0017-00-000

FILENAME: T00069AA

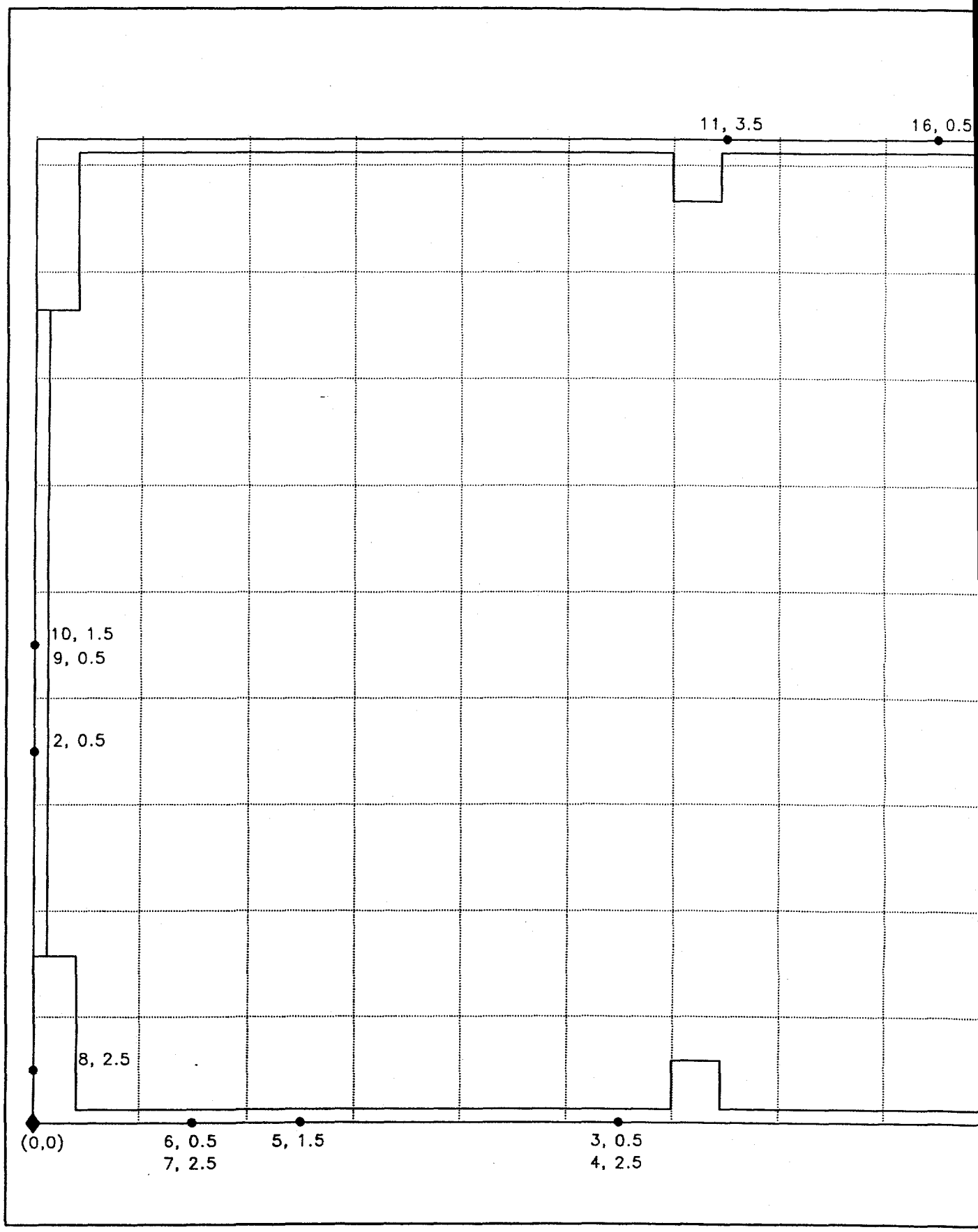
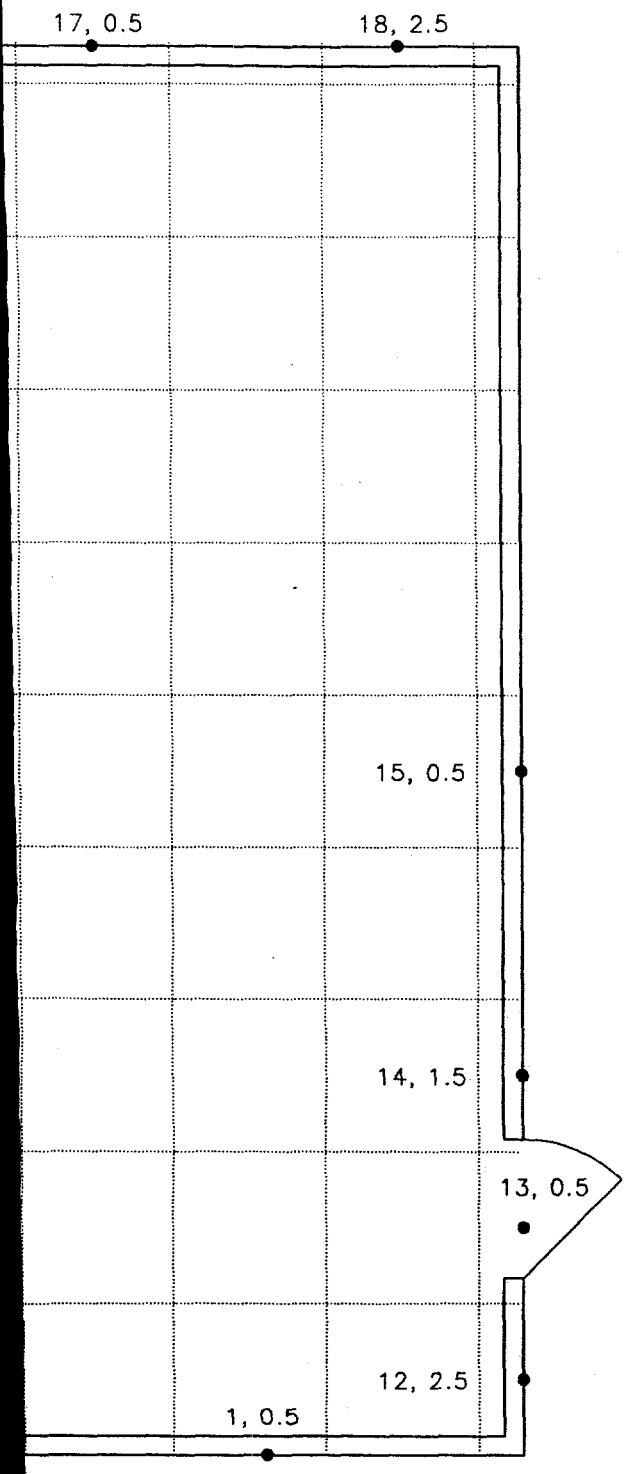



*Figure B–5. Building 30E*




NORTH

SCALE IN METERS

0 2

Y
X
(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(410.23, 557.33) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆ BASE COORDINATE FOR 1-METER GRID SYSTEM

● DIRECT MEASUREMENT LOCATION

35, 1.5 MEASUREMENT LOCATION NUMBER, FOLLOWED BY HEIGHT ABOVE FLOOR (METERS)

| | |
|---|---|
| EG&G EASTERN - Grand Junction | U.S. DEPARTMENT OF ENERGY GRAND JUNCTION OFFICE, COLORADO |
| Figure B-5 | BUILDING 30B EXTERIOR WALL SURVEY |
| PREPARED: | CHECKED: DATE PREPARED: JUNE 1997 |
| PROJECT NUMBER: TCR-031-0017-00-000 | FILENAME: T00070AA |

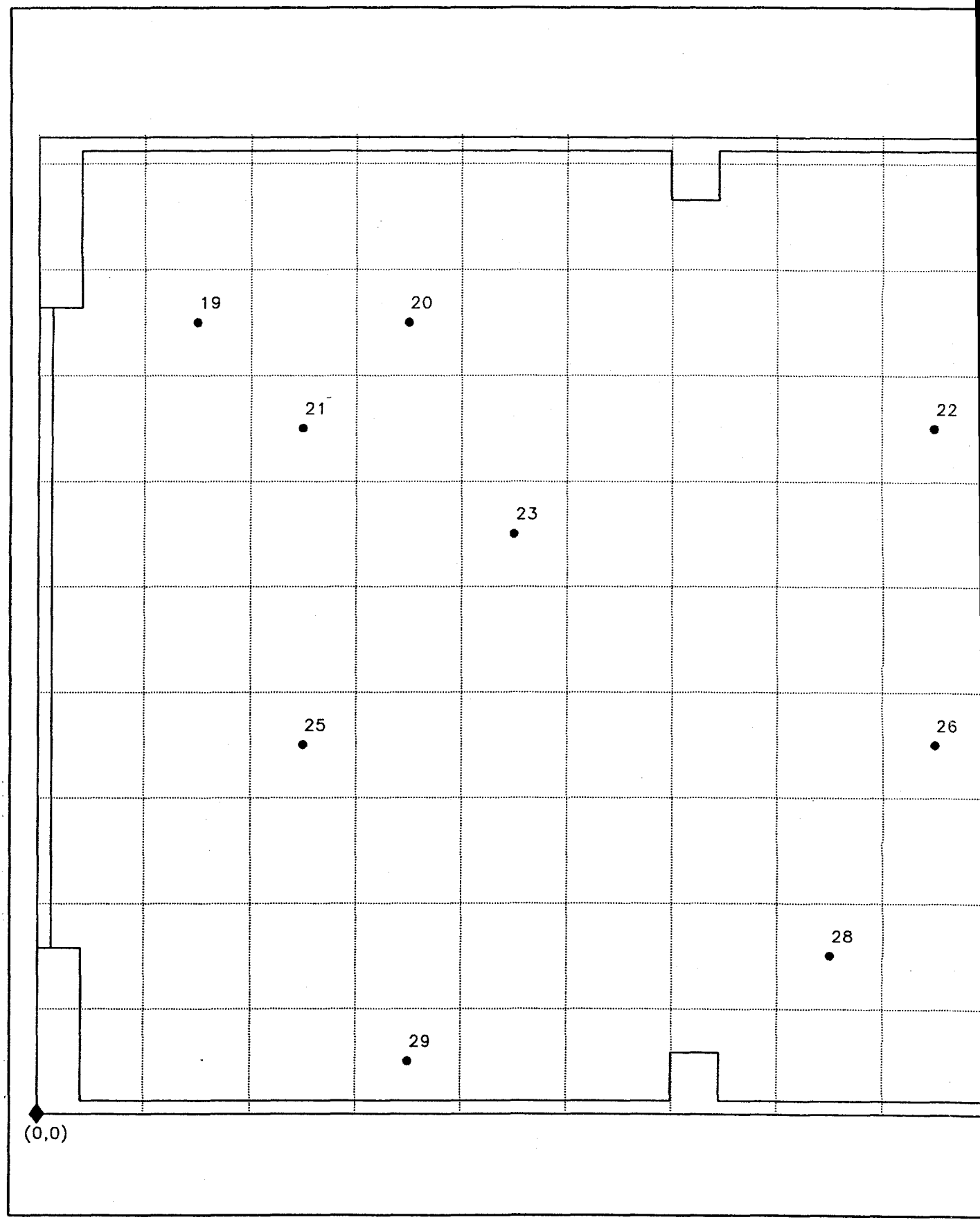
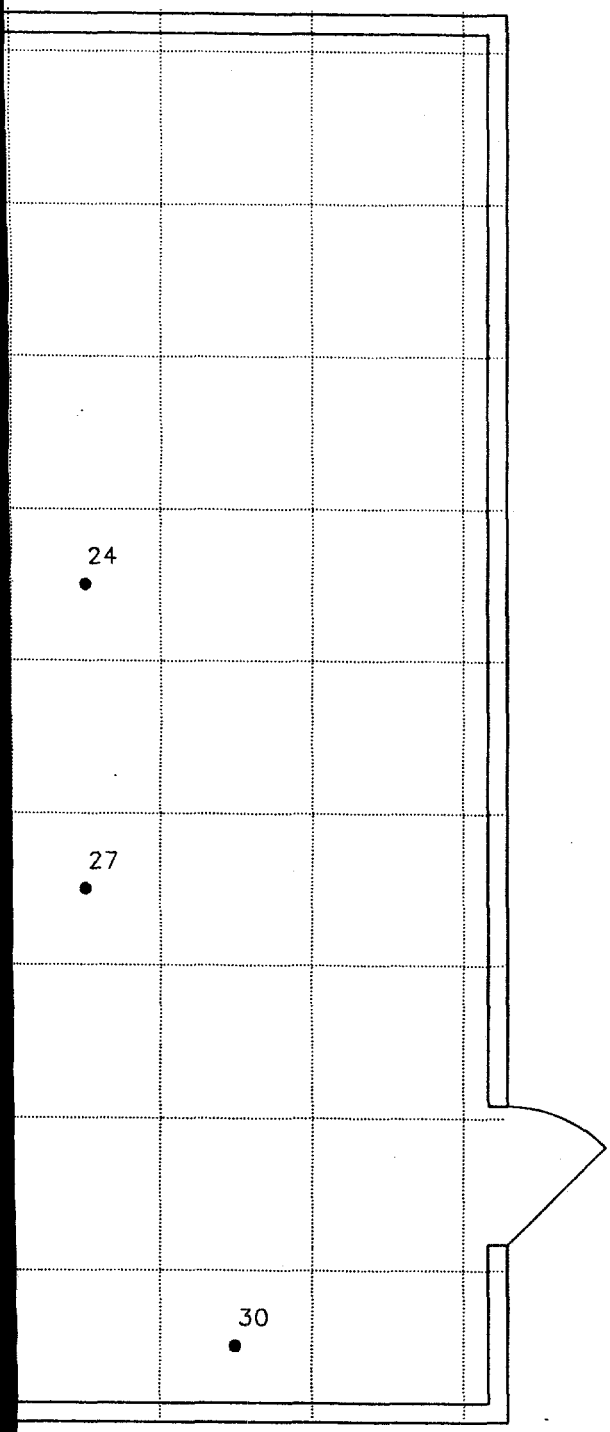



*Figure B–6. Building*




NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(410.23, 557.33) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆ BASE COORDINATE FOR 1-METER GRID SYSTEM

● DIRECT MEASUREMENT LOCATION

35 MEASUREMENT LOCATION NUMBER

EASTREN - Grand Junction

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE, COLORADO

Figure B-6 BUILDING 30B ROOF SURVEY

| PREPARED: | CHECKED: | DATE PREPARED: |
|---|---|---|
| CSW | PWK | JUNE 1997 |

| PROJECT NUMBER: | FILENAME: |
|---|---|
| TCR-031-0017-00-000 | T00071AA |

*0B Roof Survey*