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Formerly Utilized Sites Remedial Action Program (FUSRAP)
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Post-Remedial Action Report for the Chapman Valve Site

Indian Orchard, Massachusetts

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POST-REMEDIAL ACTION REPORT

FOR THE

CHAPMAN VALVE SITE

INDIAN ORCHARD, MASSACHUSETTS

NOVEMBER 1996

Prepared for

United States Department of Energy

Oak Ridge Operations Office

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By

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ACRONYMS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
BNI	Bechtel National, Inc.
CHV	Chapman Valve Site
DAC	derived air concentration
DCG	derived concentration guide
DOE	U.S. Department of Energy
FUSRAP	Formerly Utilized Sites Remedial Action Program
HEPA	high-efficiency particulate air
IVC	independent verification contractor
ORNL	Oak Ridge National Laboratory
PMC	project management contractor
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
TCLP	toxicity characteristic leaching procedure

UNITS OF MEASURE

cm	centimeter
dpm	desintegrations per minute
ft	foot
g	gram
in.	inch
L	liter
µCi	microcurie
µg	microgram
ml	milliliter
mrem	millirem
pCi	picocurie
yr	year

1.0 INTRODUCTION

1.1 BACKGROUND

This report documents the remedial action conducted at the Chapman Valve site (CHV) in Indian Orchard, Massachusetts, from July to September 1995. The remedial action was conducted following the expedited protocol, which is an efficient, cost-effective, and environmentally acceptable approach for this small site. Use of this approach complied with state and local regulations.

Remedial activities at CHV were performed as part of the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP was established to identify and clean up or otherwise control sites where residual radioactive contamination remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. FUSRAP was established in 1974 and currently includes 46 sites in 14 states. CHV was designated for remedial action under FUSRAP in 1992.

FUSRAP objectives for CHV were to

- remove or otherwise control radioactive contamination above current DOE guidelines, and
- achieve and maintain compliance with applicable criteria for the protection of human health and the environment.

Bechtel National, Inc. (BNI), the project management contractor (PMC) for FUSRAP, assisted DOE's Oak Ridge Operations Office in the planning, management, and implementation of the cleanup of CHV. Oak Ridge National Laboratory (ORNL) was the independent verification contractor (IVC) for the remedial action.

1.2 HISTORY

CHV is located in Indian Orchard, a suburb of Springfield, Massachusetts, at 203 Hampshire Street (Figure 1). The site was formerly owned and operated by the Chapman Valve Manufacturing Company. The Crane Company has owned the site since 1981 but vacated the building in 1987. In 1991, the building was still standing and in reasonably good condition; however, harsh winter conditions had resulted in the deterioration of the building, and a structural inspection indicated that the roof was unsafe (Klotsas to Boyer 1992).

In 1948, Chapman Valve set aside an area in the western end of building 23 (Figure 2) for the machining of uranium rods for the Atomic Energy Commission's (AEC's) Brookhaven National Laboratory. Uranium operations were terminated on November 8, 1948, at which time Chapman Valve had in its possession more than 27,000 pounds of metal scrap, oxides, and sweepings. This material was removed from the site several months after the contract was completed.

1.3 EXTENT OF CONTAMINATION

A 1992 survey indicated that the residual uranium contamination found at CHV was typical of Manhattan Engineer District/AEC operations (ORNL 1992). The contamination was limited to interior areas and included floors, walls, and overhead beams.

The PMC performed additional radiological surveys in November and December 1994 to supplement and refine existing survey information (BNI 1995). Characterization findings confirmed the presence of contamination in the western end of Building 23 (Figures 2, 3, 4, and 5). These findings are in agreement with historical process information obtained during interviews conducted with a former Chapman Valve supervisor. According to the supervisor, a temporary wall was constructed across the center portion of the building from floor to ceiling between columns A-7 and B-7 (Figure 2).

Additional contamination was identified in the southwest corner of grid A-1 at the former location of a chip burner that exhausted to the atmosphere through a nearby window. (Grid numbers are derived from the northwestern column number of the grid.) The exhaust location and the shape of the roof of the building caused more contamination to be deposited on the south roof than on the north roof, as indicated by characterization measurements. The uranium storage area was located in Room B-4 on the south side of the building between columns B-4 and B-7 (Figure 2). Characterization results showed no subsurface soil contamination below the floor slab.

Levels of contamination decreased from west to east in the building, and survey and sampling results from the east end indicated near-background radiological conditions. The exterior of the building, except for the roof and several locations on the west and south exterior walls, indicated near-background radioactivity.

Chemical sampling results indicated the presence of lead-based paint on the cranes, electrical boxes, and structural steel. Asbestos was found in the composite roof material and the electrical box insulation.

2.0 REMEDIAL ACTION GUIDELINES

Radioactive contamination at CHV consisted primarily of natural uranium. Table 1 lists the DOE residual contamination guidelines for release of formerly contaminated properties for use without radiological restrictions. The guidelines listed in Table 1 were applied to the crane, floor, and drain lines. These guidelines were adopted by DOE based on their compatibility with U.S. Environmental Protection Agency (EPA) criteria for remedial action found in 40 CFR 192, "Uranium Mill Tailings Remedial Action Program," and are contained in DOE Order 5400.5, "Radiation Protection of the Public and the Environment."

The remedial action approach for the Chapman Valve site was somewhat unique. Site characterization was performed in 1995, and the results were documented in a technical memorandum (BNI 1995a). A hazard assessment, which focused on future use radiological dose, was completed to assist in determining the appropriate remedial action methods (BNI 1996b). Based on this hazard assessment, supplemental standards as defined in DOE Order 5400.5 were approved by DOE-HQ (Wagoner to Price 1995). Under the future use scenario involving a demolition worker performing commercial operations with no radiological controls, the predicted radiological dose was 5.6 mrem/yr. The predicted dose for a worker at a facility where steel from the building would be smelted was 16 mrem/yr (O'Connell to Kopotic 1995). These scenarios were considered conservative but realistic given future plans for the structure. Based on the results of the hazard assessment and the approved supplemental standards, and consistent with DOE's policy of reducing contaminant levels as low as reasonably achievable (ALARA), the remedial action efforts focused on eliminating removable contamination and decontaminating the most highly contaminated areas of the building. Further details of the remedial action are provided in Section 3.0.

3.0 REMEDIAL ACTION

Because of the potential for salvage and reuse of the crane and the possibility that the base slab would remain intact following future building demolition, the crane and floor were decontaminated to comply with the DOE residual contamination guidelines listed in Table 1. It was determined that a supplemental guideline of 15,000 dpm/100 cm^2 average for the horizontal surfaces of an entire truss was protective of a future demolition worker and that contamination on the walls and roof contributed only a negligible dose to the worker; therefore, decontamination of the wall and roof surfaces was not necessary. However, in accordance with DOE's ALARA policy, removable contamination on horizontal wall surfaces was remediated. This remedial action approach was approved by the Massachusetts Department of Environmental Protection (Weinberg to Pantaleoni 1995) and the Massachusetts Department of Public Health (O'Connell to Kopotic 1995).

During remedial action, areas under failing roof sections were identified, and appropriate precautions such as posting, barricading, and limiting access were taken to ensure the safety of workers.

3.1 DECONTAMINATION ACTIVITIES

Decontamination activities at CHV lasted approximately eight weeks, from July to September 1995. All remediation efforts were confined to the interior of Building 23. Designation and characterization surveys revealed contamination on interior building surfaces in the western third of Building 23, between columns 1 and 8, and on a bridge crane located in grid A-23 (see Figure 2). During floor removal, contamination above criteria was found under a concrete ramp just inside the west equipment door and in a drain line in room B-4. Techniques used in the remedial action are summarized in Table 2.

Volume reduction, waste minimization, and cost saving techniques employed during the remedial action included segregating, sampling, and surveying the wastes produced. Using washable protective clothing and a personnel contamination monitor were also implemented as cost saving and waste minimization techniques. Total costs for remedial action are presented in Table 3. Specific examples of waste minimization and cost saving measures at CHV are described below.

- Concrete and debris were surveyed to determine whether contaminant levels were above criteria. The material below criteria was placed inside the building and left onsite, with property owner concurrence.

- Paint removed from the crane was treated by acid dissolution and solidified with concrete to reduce the content of leachable lead to the extent that toxicity characteristic leaching procedure (TCLP) results were below the limits specified in the Resource Conservation and Recovery Act (RCRA). The levels of lead in the resulting concrete monoliths were determined to be below radiological guidelines, and the monoliths were left onsite, with the concurrence of the property owner and the State of Massachusetts.

- Remediation workers wore washable Protech-2000 coveralls rather than standard Tyvek protective clothing. Using the washable coveralls reduced waste volumes associated with disposable protective clothing. As an additional benefit, workers found that the Protech-2000 fabric coveralls were more comfortable to wear than Tyveks. Interstate Nuclear Services was contracted to provide laundry service for the washable protective clothing.

- An Eberline PCM-2 personnel contamination monitor was used at the access control point instead of a standard manual frisk, reducing the time required to ensure that workers exiting the controlled area are not contaminated. The PCM-2 monitor completes the contamination check in one minute; a standard hand frisk takes approximately five minutes. The PCM-2 also ensures a more consistent exit survey than the conventional hand frisk performed by the individual.

The following sections contain descriptions of decontamination techniques for each remediated area.

10-Ton Bridge Crane

Residual surface contamination was removed from the bridge crane located at grid A-23 (see Figure 2) by hand scraping with putty knives and vacuuming. The crane was decontaminated without disturbing painted surfaces except for several small areas where it was necessary to remove the paint along with the contamination. Before the paint was removed, the high-efficiency particulate air- (HEPA-) filtered vacuums were emptied to minimize the amount of material requiring treatment. Very-small-quantity-generator status permitted treatment and disposal of the lead-based paint onsite. The paint was dissolved in an acid solution and then mixed with concrete. The resulting concrete monoliths were surveyed and determined to be below the DOE residual surface contamination guidelines listed in Table 1. With the concurrence of the property owner and the State of Massachusetts, the concrete monoliths were left onsite. The wooden decking was removed from the crane and decontaminated using the same technique that was used on the crane. The decontaminated boards were also left onsite.

Overhead Trusses

The upper horizontal surfaces of trusses in the main bay of Building 23 from truss 1 to truss 8 were decontaminated by using HEPA-filtered vacuums to remove contaminated dust. In one area of truss 2, abrasive decontamination was required to meet the supplemental limits set for CHV. The radioactive dust generated from the operation was mixed with concrete to eliminate the potential for fugitive dust during transport and handling of the waste. The concrete/dust was placed in an intermodal container for disposal at a licensed disposal facility.

Horizontal Wall Surfaces

Horizontal surfaces on the walls of the main bay from column 1 to column 8 were decontaminated with a HEPA-filtered vacuum. Decontaminated surfaces included the crane rail, window sills, radiators, and a large pipe on the north wall. Preliminary hazard assessment calculations indicated that the wall contamination did not contribute significantly to the dose to a future demolition worker; however, because the dose to the demolition worker was primarily from removable contamination, the horizontal surfaces were vacuumed to remove the contamination, in accordance with DOE's ALARA policy. The radioactive dust generated from the operation was mixed with concrete to eliminate the potential for fugitive dust during transport and handling of the waste. The concrete/dust was placed in an intermodal container for disposal at a licensed disposal facility.

Floor

A backhoe and skid steer loader equipped with a hoe-ram attachment were used to remove the wooden block and concrete pads above the base slab in the main bay and the B-series rooms on the south side of Building 23 between columns 1 and 8. The wooden blocks and concrete pads were considered clean material based on volumetric sampling results (BNI 1995b) and were placed in a clean pile. This material was left onsite, with the concurrence of the property owner. The floor was vacuumed with HEPA-filtered vacuums, and the dust was collected.

Self-tapping steel floor anchors were removed with a jackhammer and surveyed. Any floor anchors containing above-background contamination were placed in the intermodal container for disposal at the licensed disposal facility. Areas of the floor that required further decontamination were mechanically cleaned with side grinders equipped with vacuum shrouds connected to HEPA-filtered vacuums. During the survey of the floor, it was determined that part of the ramp at the west equipment door of Building 23 needed to be removed to provide access to contamination under the ramp. The portions of the ramp requiring removal were broken up with a jackhammer and a skid steer loader equipped with a hoe-ram attachment.

Shovels were then used to remove the contaminated soil below the ramp. All radioactive dust collected during the decontamination of the floor was mixed with concrete to eliminate the potential for fugitive dust during transport and handling of the waste. The concrete/dust was then placed in an intermodal container for disposal at a licensed disposal facility.

Drain Line

A ductile iron drain line discovered in Room B-4 (see Figure 3) after removal of the wooden blocks was determined to be contaminated above criteria. The drain line was removed by breaking the concrete with jackhammers and a skid steer loader equipped with a hoe-ram attachment. Lead seals in the joints of the pipe were segregated by breaking the pipe away from the seal. A total of 145 ft of 4-in. drain line was removed and placed in an intermodal container for shipment to the disposal facility. The lead seals were surveyed and released for recycling at a local lead recycling company.

3.2 CONTAMINATION CONTROL DURING REMEDIAL ACTION

During the remedial action, engineering and administrative controls such as dust control, hazardous work permits, and personal protective equipment (PPE) were used to protect remediation workers and members of the public from exposure to radiation in excess of applicable standards and in accordance with a site-specific safety and health plan for CHV.

All personnel working in contaminated areas were required to wear protective coveralls, hard hats, safety glasses, hearing protection, boots, and gloves. If conditions warranted, additional PPE such as face shields were used. Site conditions did not necessitate the use of personnel respiratory protection except in the HEPA-filtered vacuum changeout tent.

Workers leaving radioactively restricted work areas were scanned at the control point by a personnel contamination monitor and subjected to a hand and foot frisk to ensure that they were not contaminated and to prevent the spread of contamination.

The potential primary exposure pathways from radioactive material to workers and members of the general public were inhalation and ingestion of radioactively contaminated airborne dust generated during the remedial action. HEPA filtration units were used to control the spread of dust and minimize the potential for contaminants to become airborne. In addition, a fine water mist was sprayed to control dust during floor removal and during transport of material to the intermodal container. All equipment used in the controlled area was surveyed before being released from the site.

During remediation, particulate air monitoring devices were placed in the areas being remediated. Monitoring locations were selected to provide data for the worst-case scenario. Concentrations of uranium-238 ranging from 1.5×10^{-14} to 5.8×10^{-13} µCi/ml were conservatively derived by collecting air particulate samples daily from lapel air samplers worn by workers. After gross activity per volume of air passing through the filter was determined, the source of all activity on the filter was conservatively assumed to be uranium-238. The derived air concentrations (DACs) were then compared with the applicable DOE guideline, which is a DAC of 2.0×10^{-11} µCi/ml for occupational exposures to airborne uranium-238 (DOE Order 5480.11).

Area air particulate sampling was also performed adjacent to areas being remediated to ensure that no member of the general public was exposed to radioactivity above DOE guidelines (DOE Order 5400.5). Because all remediation activities were conducted inside Building 23 and there were no open vents in the building, it was determined that exterior air particulate monitoring was not required. Data were collected daily from an Eberline RAS-1 high-volume monitor and counted after four days to allow for radon decay. The limits in DOE Order 5400.5 are derived concentrations guides (DCGs); a DCG is the concentration of a particular radionuclide that would provide an effective dose equivalent of 100 mrem/yr (the DOE basic dose limit) to an individual continuously exposed to the radionuclide by one pathway for an entire year. Concentrations of uranium-238 measured by area particulate monitors ranged from 1.5×10^{-15} to 3.1×10^{-13} µCi/ml. The DCG is 2.0×10^{-12} µCi/ml for uranium-238.

4.0 POST-REMEDIAL ACTION SAMPLING/SURVEYING RESULTS

After each portion of the property was decontaminated, a radiological survey of the area was conducted to confirm that all radioactive contamination above the cleanup criteria had been removed. Initial post-remediation surveys were conducted by Thermo Nuclear Services (TN) on behalf of the PMC. Survey techniques used during post-remediation and verification surveys included direct surface contamination measurements, removable contamination measurements, external gamma radiation exposure rate measurements, and soil sampling. The initial post-remediation surveys were conducted in accordance with TN procedures and PMC instruction guides. The IVC performed independent verification surveys of the floor, trusses, and bridge crane using survey techniques that were similar or identical to those used by TN. The IVC survey data will be issued in a separate verification report for CHV.

4.1 POST-REMEDIAL ACTION SURVEY DATA

Post-remedial action survey data for each decontaminated area are discussed in the following sections.

10-Ton Bridge Crane

Post-remedial action activities on the crane included surveys of direct and removable contamination and sampling of paint and dust residues to determine whether the waste should be classified as a RCRA mixed waste. Figure 6 shows the survey locations, and Table 4 presents the survey data. A total of 169 locations were surveyed. Direct alpha and beta-gamma average surface contamination readings were 44 and 520 dpm/100 cm^2, respectively. Average removable alpha and beta-gamma readings were 3 and 42 dpm/100 cm^2, respectively. The crane was decontaminated to comply with the DOE residual contamination guidelines listed in Table 1.

Table 9 presents sampling results used in bench-scale tests to determine whether treatment of the paint and dust residues was a feasible waste minimization technique. After the material was dissolved in acid and stabilized in a concrete monolith, a sample was collected to determine the classification of the waste. The sample result for TCLP lead was 338 µg/L; for cadmium the result was 3.0 µg/L. Both results are well below the RCRA limits of 5,000 µg/L for lead and 1,000 µg/L for cadmium.

Overhead Trusses

Surveys of fixed and removable contamination were conducted on the trusses to determine the effectiveness of the decontamination effort. The results of these surveys are included in Table 5. The maximum fixed averages per truss for alpha and beta-gamma contamination were 2,114 and 12,261 dpm/100 cm^2, respectively. Both of these readings, which were from truss 2, were below the supplemental limit of 15,000 dpm/100 cm^2 average per truss. All readings for removable contamination were below 1,000 dpm/100 cm^2. An additional survey conducted on non-horizontal surfaces and between welded angles of the trusses confirmed that the supplemental limits had not been exceeded and that these areas did not require decontamination.

Horizontal Wall Surfaces

The ALARA approach to decontamination of the horizontal wall surfaces was to remove the contamination that exhibited a potential for resuspension or migration. Survey locations for the west, north, and south walls are shown in Figures 7, 8, and 9. Survey results for the west, north, and south walls are presented in Tables 6, 7, and 8. The maximum and average removable alpha measurements for the west wall were 164 and 17 dpm/100 cm^2; for the north wall, the maximum and average measurements were 850 and 35 dpm/100 cm^2; and measurements on the south wall were 111 and 17 dpm/100 cm^2, respectively. The maximum and average removable beta-gamma measurements for the west wall were

191 and 70 dpm/100 cm^2; for the north wall, the measurements were 3,197 and 58 dpm/100 cm^2; and measurements on the south wall were 319 and 45 dpm/100 cm^2, respectively. Except for a single reading on the north wall, all measurements were below the criterion of 1,000 dpm/100 cm^2 for removable contamination.

Floor

Figure 10 shows survey results of 1,598 survey locations on the floor of Building 23; all results were below DOE Order 5400.5 criteria. Fixed beta-gamma contamination was the contaminant of concern on the floor; therefore, only fixed beta-gamma measurements are summarized in Figure 10. The average fixed beta-gamma measurement was 914 dpm/100 cm^2; the minimum was -872 dpm/100 cm^2; and the maximum was 4,934 dpm/100 cm^2. (Negative numbers indicate that the measurement was less than the minimum detectable activity and that after background was subtracted, the numerical value was negative.) A soil sample was also collected in the area where part of the west equipment door ramp was removed. Analytical results are presented in Table 9. The analytical result for uranium-238 was 2.0 pCi/g; for radium-226, the result was 0.47 pCi/g; and for thorium-232, the result was 0.41 pCi/g. A site-specific uranium guideline for CHV was not determined; however, these results were well below the typical uranium-238 guideline of 35 to 50 pCi/g for a FUSRAP site. The radium-226 and thorium-232 results are below the DOE Order 5400.5 criterion of 5 pCi/g for surface soils.

Drain Line

Following the removal of 145 ft of the 4-in. drain line in room B-4, three composite samples were collected in the trench to determine whether the decontamination effort was successful (see Table 9). The maximum level for uranium-238 was 0.62 pCi/g; for radium-226, the maximum was 0.47 pCi/g; and for thorium-232, the maximum was 0.50 pCi/g. A site-specific uranium guideline for CHV was not determined; however, the results are well below the typical uranium-238 guideline of 35 to 50 pCi/g for a FUSRAP site. The radium-226 and thorium-232 results are below the DOE Order 5400.5 criterion of 5 pCi/g for surface soils. Contaminated drain piping was placed in an intermodal container and shipped to a licensed facility for disposal.

4.2 HAZARD ASSESSMENT/EXPOSURE SCENARIOS

A hazard assessment was prepared to document the post-remediation condition of CHV (BNI 1995b). A summary of the exposure scenarios is included in this PRAR, and the results of the hazard assessment are summarized in Table 10. The hazard assessment also includes calculations to determine the total mass of uranium at CHV and the volumetric activity of the rubble resulting from building demolition.

The hazard assessment is based on the fact that contamination at CHV is found only in limited portions of Building 23. The total curie content of all affected building components is approximately 6 μCi. In addition, Building 23 is deteriorating, abandoned, and likely to be demolished.

The hypothetical demolition phases representing each of the building components, potential reuse or recycling of the components, and significant conditions and assumptions are described in the following exposure scenarios.

Roof Demolition

Contamination is consolidated into built-up roofing material. The primary exposure pathway is inhalation of contaminated dust. The primary dust-producing activities would be destroying the roof with heavy equipment (allowing the roof components to fall to the ground) and using heavy equipment to load the roof rubble into trucks. This scenario is plausible but conservative because the roof contains asbestos and the likely scenario would include appropriate asbestos controls, which would mitigate the release of airborne radioactivity and limit worker exposure.

Wall Demolition

Large quantities of dust would be produced during the use of a wrecking ball (or other forceful demolition technique) to dismantle the walls of Building 23. The impact of the ball would be approximately 20 ft above the ground and would dislodge surface contamination on the walls and glass surface. More dust would be produced as clean portions of the brick, mortar, and glass were pulverized. To maximize the potential exposure scenario, it is assumed that demolition is performed one wall at a time, and the rubble from one wall is removed before the next wall is demolished. In addition to the initial plume, contaminated dust would be resuspended as rubble is removed.

Structural Steel Demolition

No airborne contamination would result from demolition of the exposed steel surfaces because the surfaces were decontaminated during remedial action. Some areas such as gusset plates and intersections of steel members that were difficult to access could be a source of airborne contamination as the trusses are removed; therefore, it is assumed that some of the contamination from inaccessible areas will be dislodged as the steel building framework is dismantled. The contamination on the inaccessible surfaces is assumed to be the same as that on the exposed surfaces surveyed during characterization. The contamination is from deposited dust, which is assumed to be 0.1 cm thick.

The primary potential exposure pathways are inhalation and ingestion. The activity generating the most airborne contamination will be toppling the supporting beams and allowing the trusses to fall to the ground, where they will subsequently be salvaged for scrap. It is assumed that torch cutting will be performed to size the metal for transport. Airborne contamination will be released during the felling, cutting, and removal of the trusses. Assuming that all trusses are felled in a very short time period, the contaminated plume from the felling of any one truss will not have dissipated when the next truss is felled; therefore, the plume of airborne contamination will include all the contamination released from the trusses.

Personal contamination (and subsequent ingestion) will potentially occur as the trusses are handled during cutting and removal.

Steel Recycling

Potential exposures from reuse or recycling of the steel were considered for three activities:

- torch cutting the steel to the size necessary for smelting,
- sand blasting the steel to remove lead-based paint so that the smelter will accept the steel, and
- disposing of the slag after the steel is smelted.

Floor Removal

The floor of Building 23 is composed of concrete, fire brick, or wooden blocks, with wooden blocks covering more than 90 percent of the floor area. A concrete base slab is under the fire bricks and wooden blocks. Isolated areas of contamination were found on the surface of the floor, in adhesive between the wooden blocks, in gaps in the fire brick, and possibly on the concrete base slab. The dose was calculated for a potential future worker removing the blocks left onsite during remedial action.

Reuse of Building Materials

The dose was calculated for an individual living in a small building constructed with the contaminated materials from CHV (Table 10). The building walls are constructed of materials from the west wall, the ceiling includes the roofing material, and the floor is constructed of the wooden blocks from the floor of Building 23.

4.3 CONCLUSIONS OF HAZARD ASSESSMENT

Residual contamination on the roof and walls of Building 23 will not result in a radiation dose above 100 mrem to any member of the general public. The maximum dose to a hypothetical demolition worker is estimated to be 5.6 mrem, and offsite exposure to the general public would be much less. Brick comprises approximately 64 percent of the mass of the contaminated portion of Building 23. The natural (background) radioactivity found in brick at the site is approximately 6.4 pCi/g. The radioactivity added by the surface contamination ranged from 0.18 to 1.5 pCi/g: an increase of approximately 23 percent. Because of the low radiation dose calculated for roof and wall contamination (and the fact that these calculations were very conservative and likely overestimated the dose), supplemental limits for these building components would probably be the same as those used for the current contamination levels, and no remedial action would need to be performed in these areas. The use of a hazard assessment and the development of supplemental limits resulted in a cost saving of $2 million for the remedial action at CHV.

5.0 POST-REMEDIAL ACTION STATUS

Analytical results from post-remedial action surveys indicate that the levels of radioactivity in the remediated areas meet applicable DOE cleanup guidelines. A summary of remedial action at CHV is provided in Table 11. The IVC has reviewed the post-remedial action surveys and results and has verified that the remediated areas comply with the established DOE guidelines for the site. No areas of contamination above DOE guidelines or supplemental limits remain at the site.

After completing the verification survey, the IVC will report its findings and recommendations to DOE Headquarters and the DOE Oak Ridge Operations Office. DOE will review the report to verify that the remedial action was successful, and a certification docket will then be prepared. The certification docket officially certifies that the site has been successfully remediated to established criteria. The issuance of the certification docket will be documented through publication of a notice in the *Federal Register*.

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GLOSSARY

Alpha-emitting - See **Radiation**

Ambient Background Radiation - Ambient background radiation refers to naturally occurring radiation emitted from either cosmic (e.g., from the sun) or terrestrial (i.e., from the earth) sources. Exposure to this type of radiation is unavoidable, and its level varies greatly depending on geographic location. For example, New Jersey typically receives 100 millirem per year (mrem/yr), Colorado receives about 115 mrem/yr, and some areas in South America receive up to 7000 mrem/yr. Naturally occurring terrestrial radionuclides include uranium, radium, potassium, and thorium (see **Radionuclide**). The dose levels do not include the concentrations of naturally occurring radon inside buildings.

Beta-gamma-emitting - See **Radiation**

Centimeter - A centimeter (cm) is a metric unit of measurement for length; 1 inch is equal to 2.54 cm; 1 foot is equal to approximately 30 cm.

Contamination - The term "contamination" is used generally to mean a concentration of one or more radioactive materials that exceeds naturally occurring levels. Contamination may or may not exceed the DOE cleanup guidelines.

Disintegrations per minute - Disintegrations per minute (dpm) is the measurement indicating the amount of radiation being released from a substance per minute.

Dose - As used in this report, dose is actually dose equivalent and is used to relate absorbed dose (mrad) to an effect on the body. Dose is measured in mrem. For comparison, a dose of 500,000 mrem to the whole body within a short time causes death in 50 percent of the people who receive it; a dose of 5,000,000 mrem may be delivered to a cancerous tumor during radiation treatment; normal background radiation at or near sea level results in an annual dose of about 100 mrem; DOE radiation protection standards limit the dose that may be received by members of the general public to 100 mrem/yr above background levels; living in a brick house typically results in a dose of about 75 mrem/yr above the background level.

Exposure Rate - Exposure rate is the rate at which radiation imparts energy to the air. Exposure is typically measured in microroentgens (μR), and exposure rate is typically expressed as μR/hr. The dose to the whole body can be approximated by multiplying the exposure rate by the number of hours of exposure. For example, if an individual were exposed to gamma radiation at a rate of 20μR/hr for 168 hr/week (continuous exposure) for 52 weeks/yr, the whole-body dose would be approximately 175 mrem/yr.

Gamma Radiation - See **Radiation**

Meter - A meter (m) is a metric unit of length; 1 m is equal to approximately 39 inches.

Microroentgen - A microroentgen (μR) is a unit used to measure radiation exposure. For further information, see **Exposure Rate**.

Millirem - The millirem (mrem) is the unit used to measure radiation dose to man. The DOE dose limit is 100 mrem above background radiation levels within any one-year period for members of the general public. Naturally occurring radioactive substances in the ground result in a yearly exposure of about 100 mrem to each member of the population. To date, no difference can be detected between the health of population groups exposed to 100 mrem/yr above background and the health of groups who are not exposed.

Natural Background Radiation - Natural background radiation refers to radiation emitted from the naturally occurring radionuclides found in manmade materials. The concentrations of the radionuclide, and thus the radiation, will vary widely because of variation in the composition of the materials.

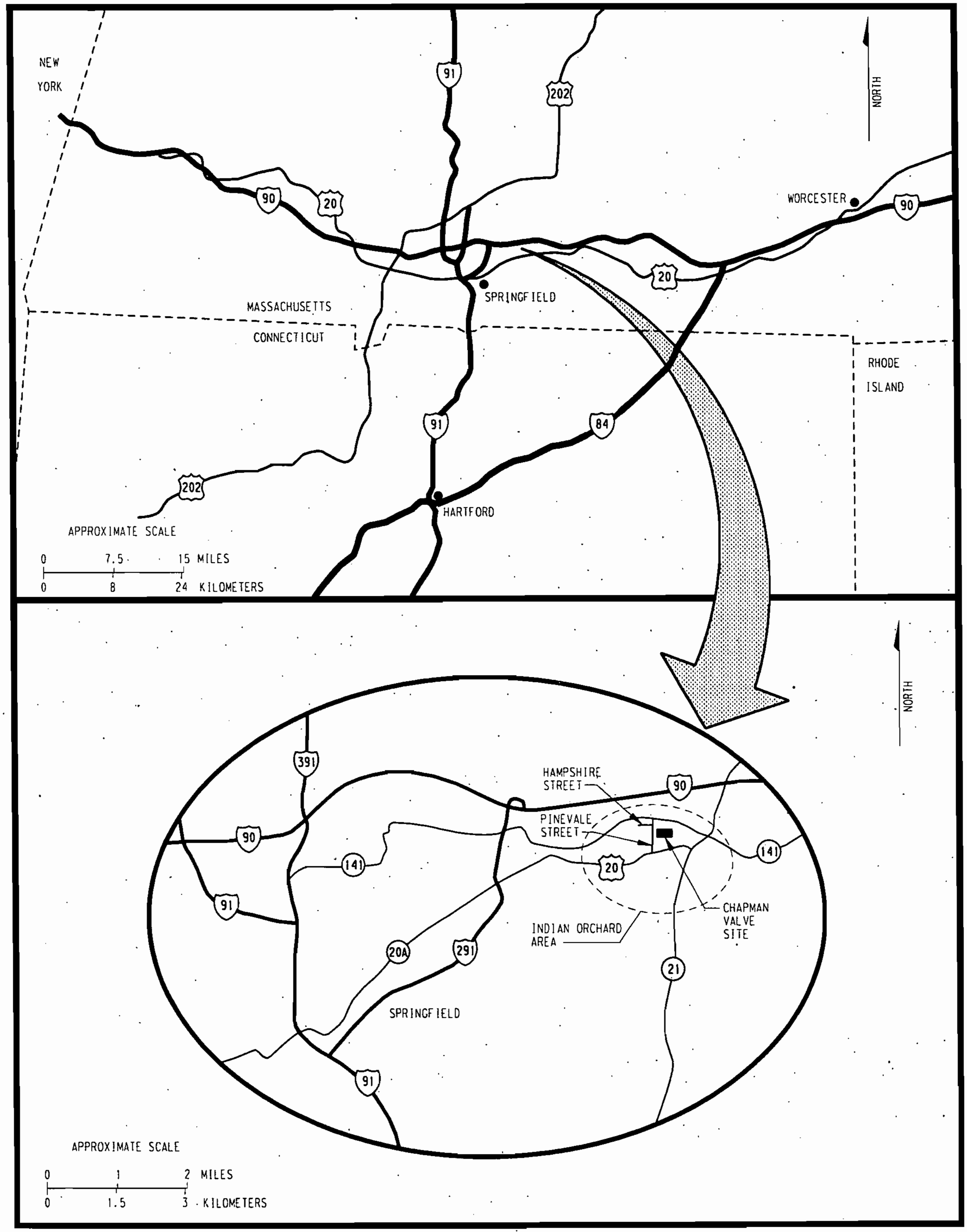
Radiation - There are three primary types of radiation: alpha, beta, and gamma. Alpha radiation travels less than an inch in air before it stops, and it cannot penetrate the outer layers of human skin. Beta radiation can penetrate the outer layers of skin but cannot reach the internal organs. Gamma radiation, the most penetrating type, can usually reach the internal organs.

Radionuclide - Radioactive elements are also referred to as radionuclides. For example, uranium-235 is a radionuclide, uranium-238 is another, thorium-232 is another, and so on.

Remedial Action - Remedial action is a general term used to mean cleanup of contamination that exceeds DOE guidelines. It refers to any action required so that a property may be certified as being in compliance with guidelines and may therefore be released for future use. Remedial action also includes restoring remediated properties to their original conditions as far as possible.

Uranium - Uranium is a naturally occurring radioactive element. The principal use of refined uranium is for the production of fuel for nuclear reactors. Uranium in its natural form is not suitable for use as a fuel source.

FIGURES



R76F010.DGN

Figure 1
Approximate Location of Chapman Valve Site

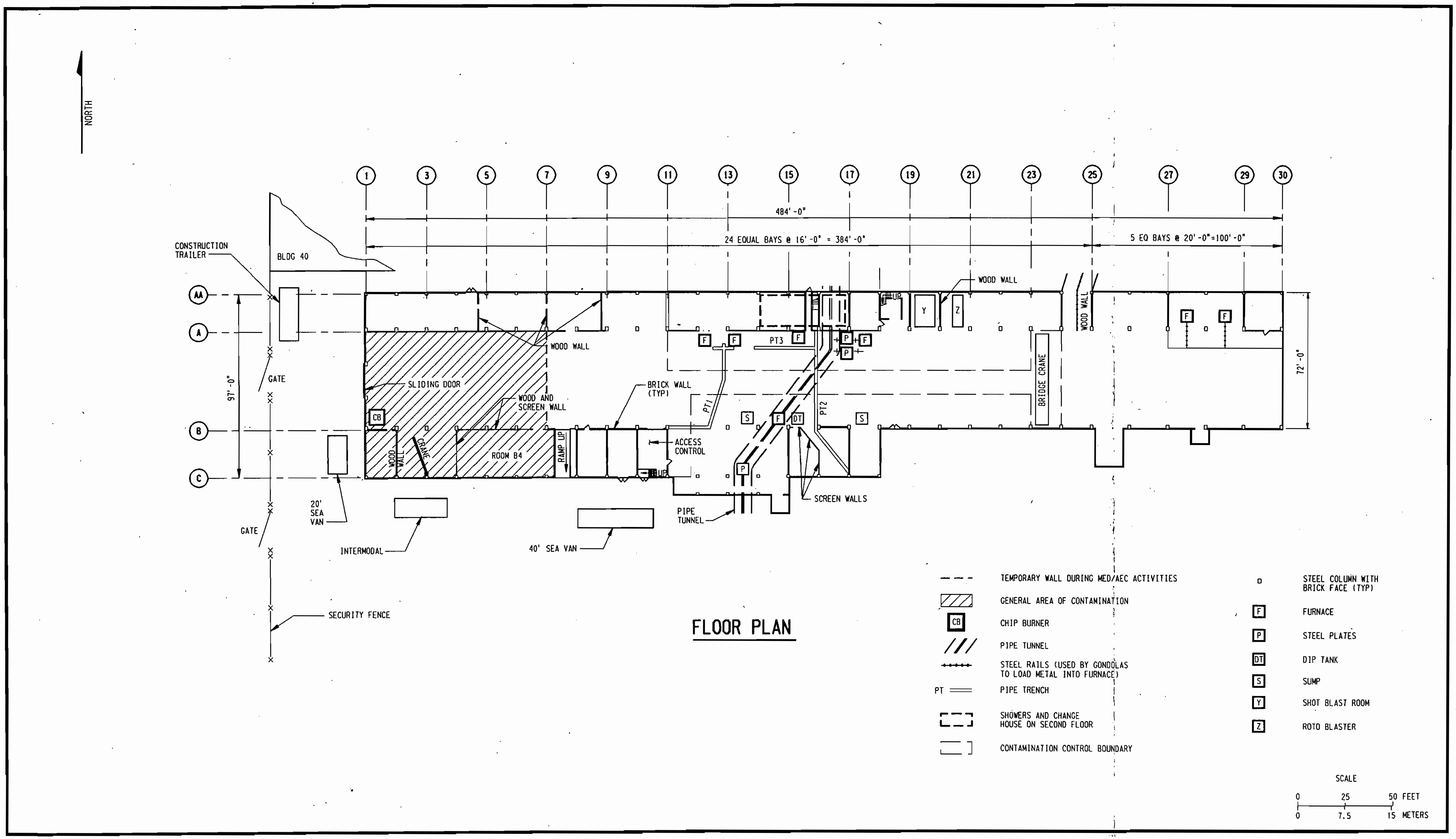
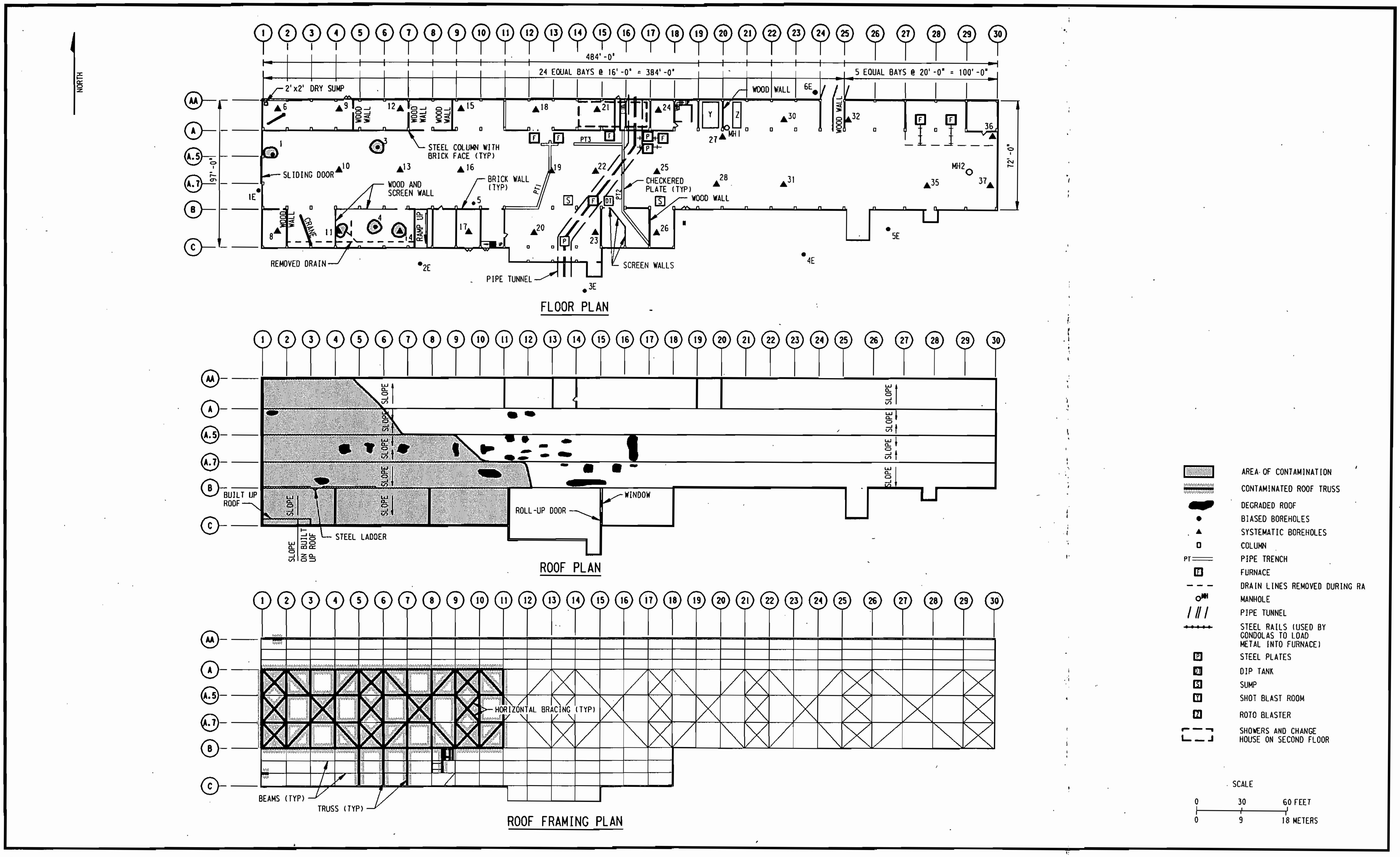
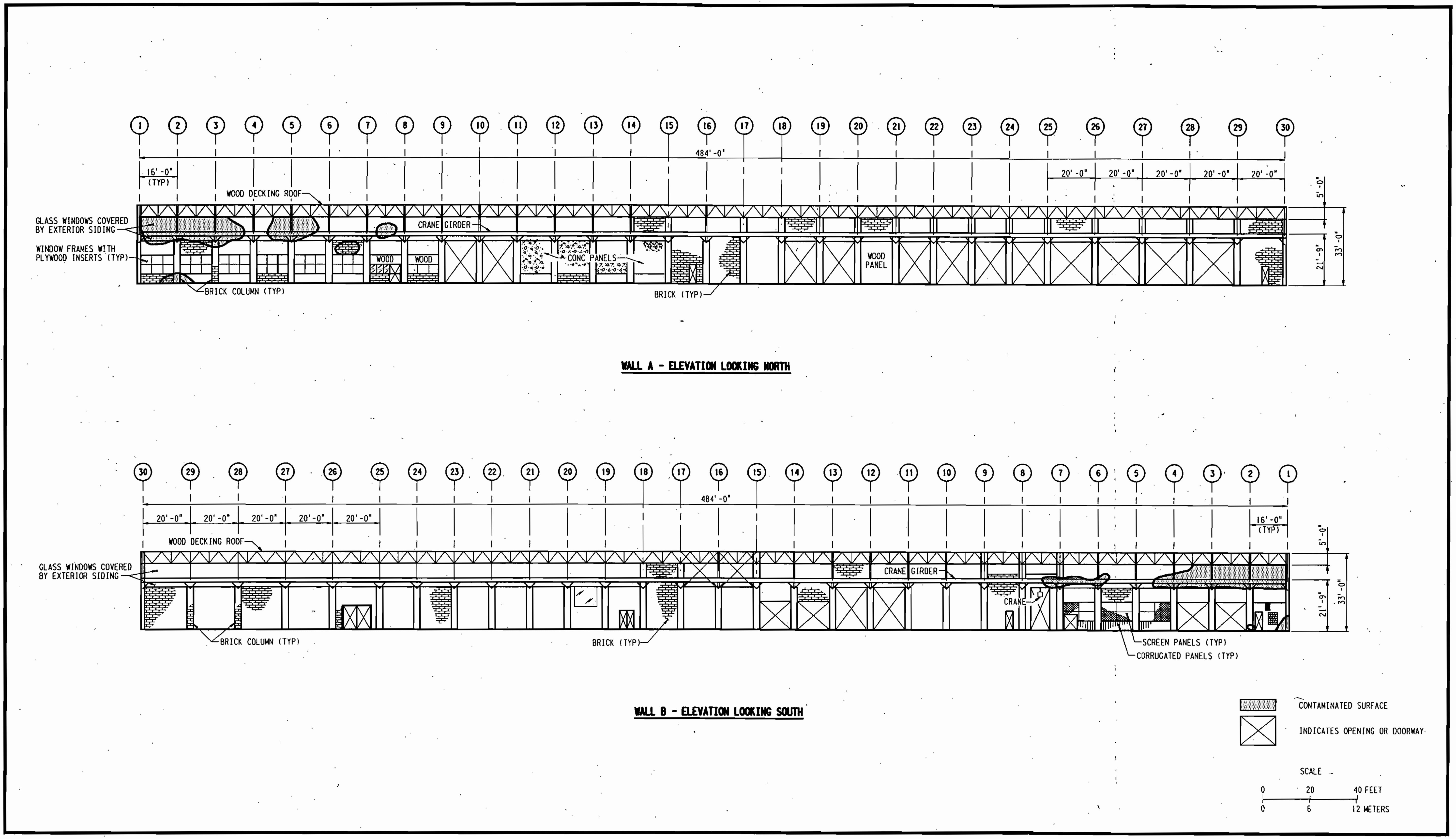


Figure 2
Chapman Valve
Building 23 - Plan View



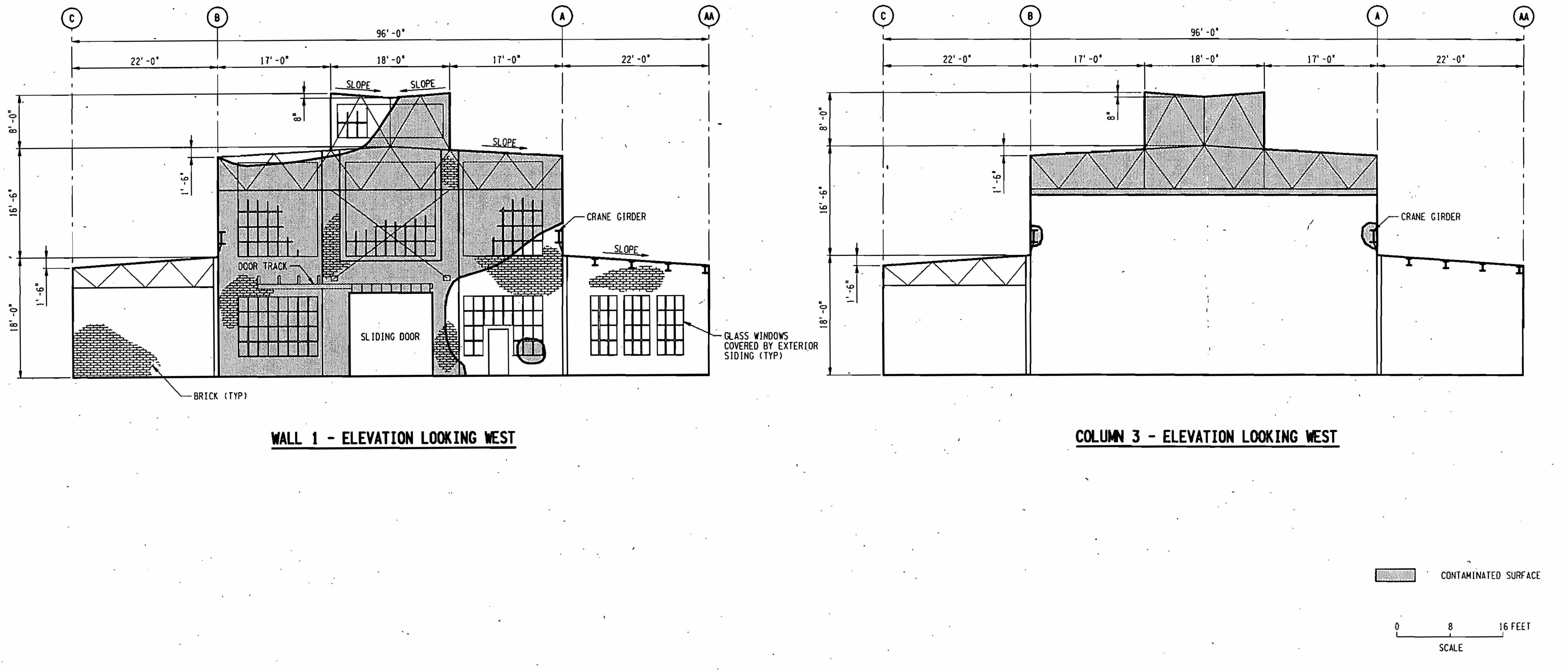
R76F007.DGN

Figure 3
Chapman Valve - 1994 Characterization Results
Plan Views



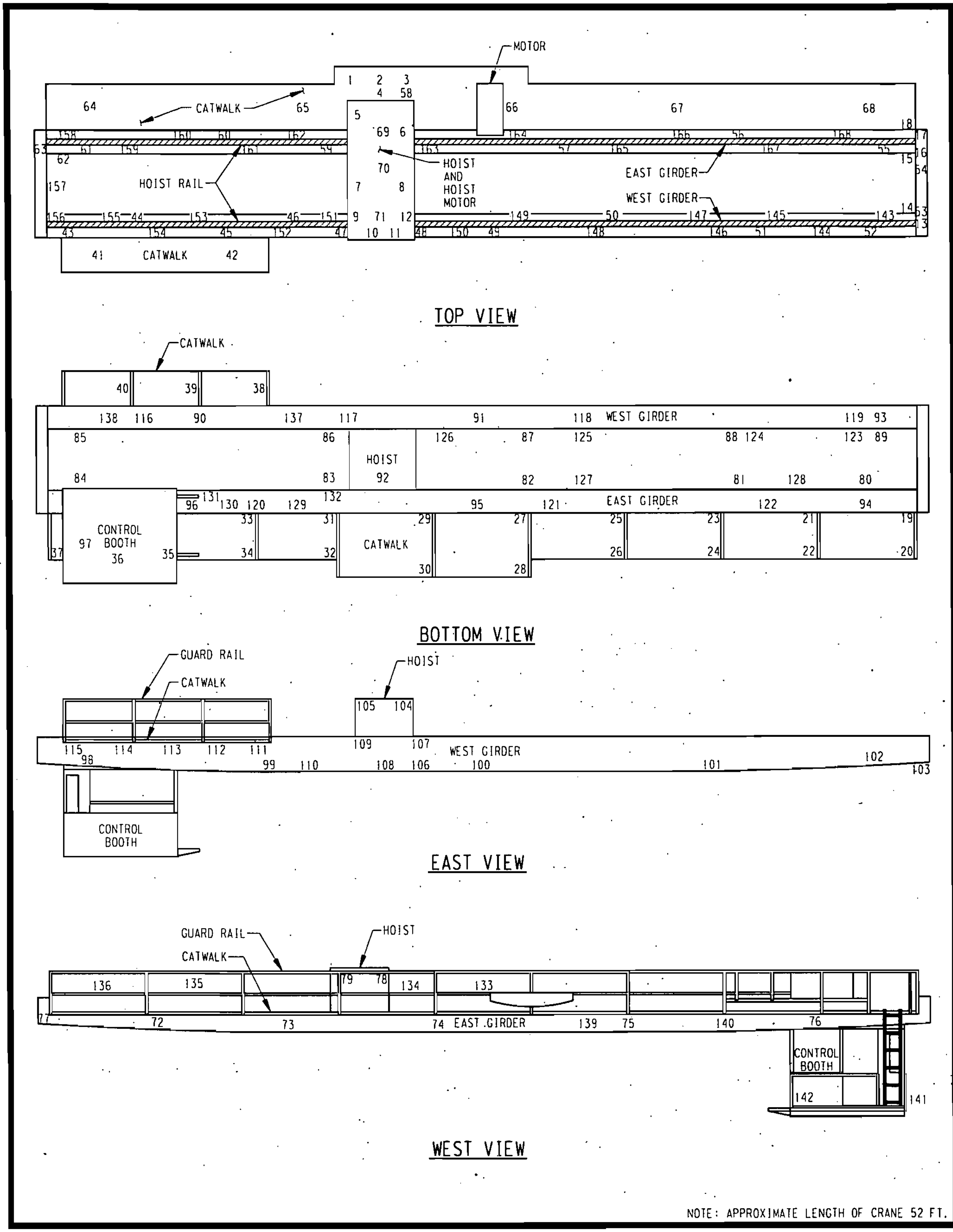
R76F006.DGN

Figure 4
Chapman Valve - 1994 Characterization Results
Interior North and South Walls



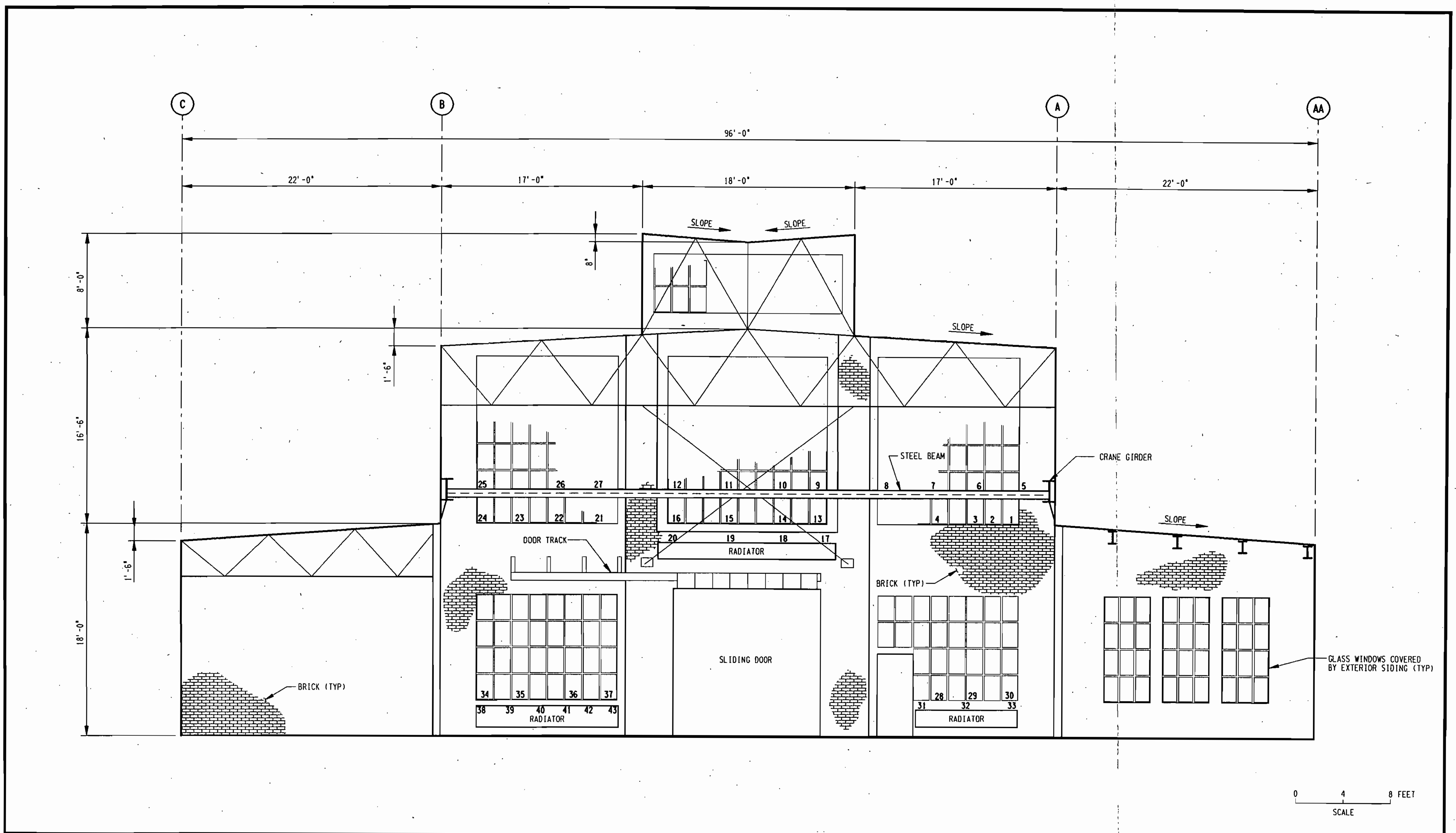
R76F008.DGN

Figure 5
Chapman Valve - 1994 Characterization Results
Interior West Wall



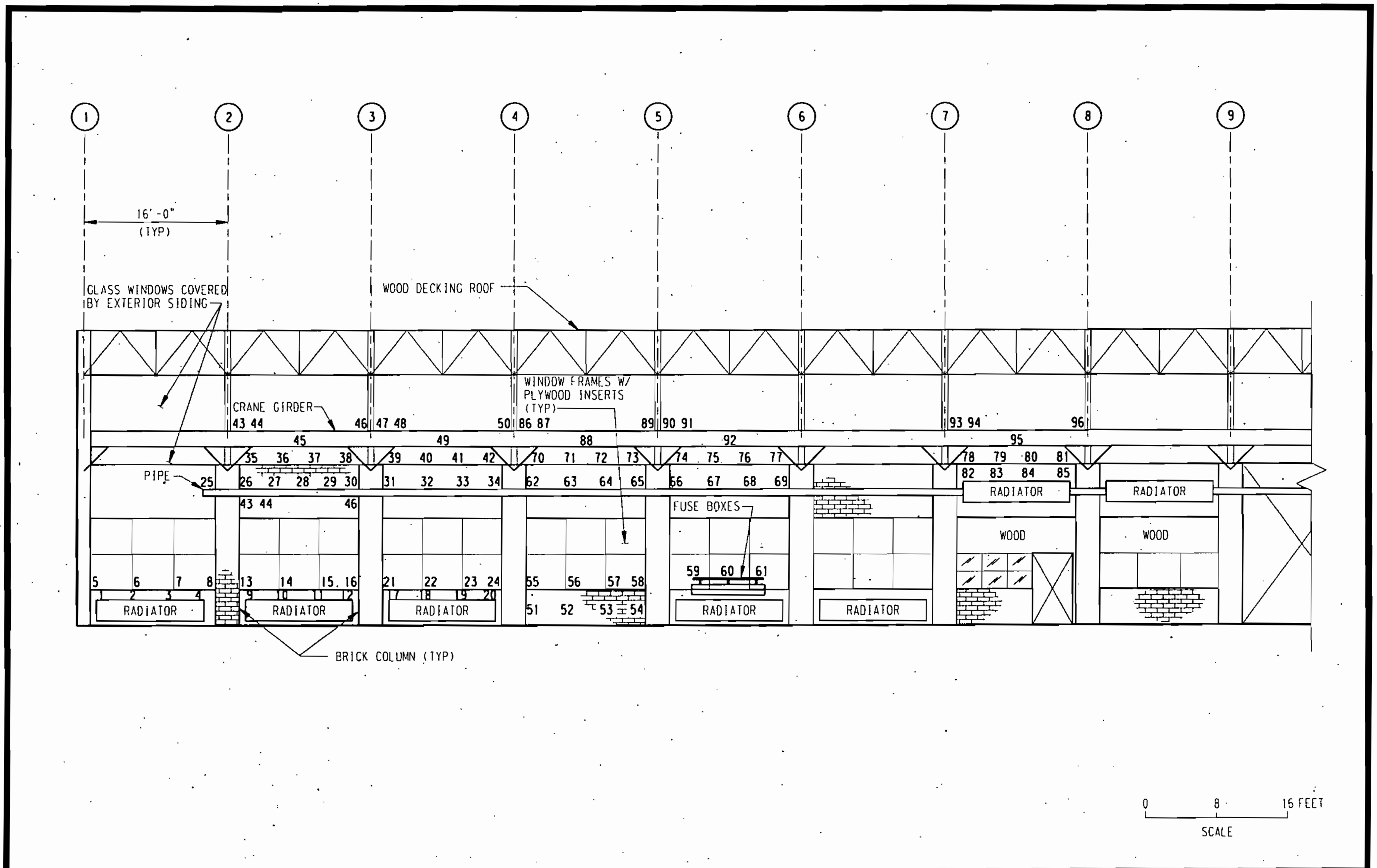
R76F011.DGN

Figure 6
Post-Remedial Action Survey Locations on Overhead Crane



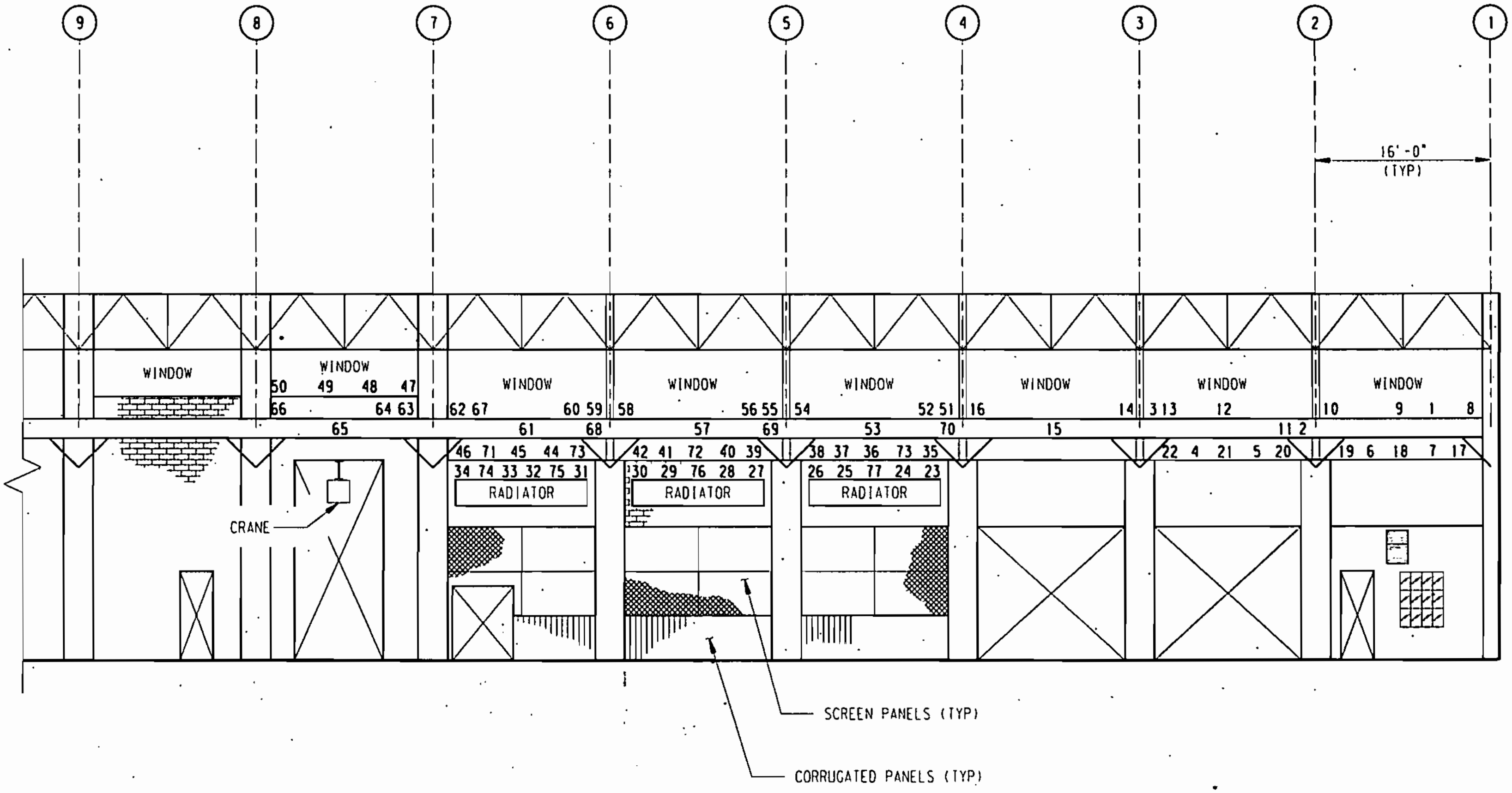
R76F005.DGN

Figure 7
Post-Remedial Action Survey Locations
Interior West Wall



R76F003.DGN

Figure 8
Post-Remedial Action Survey Locations
Interior North Wall



R76F004.DGN

Figure 9
Post-Remedial Action Survey Locations
Interior South Wall

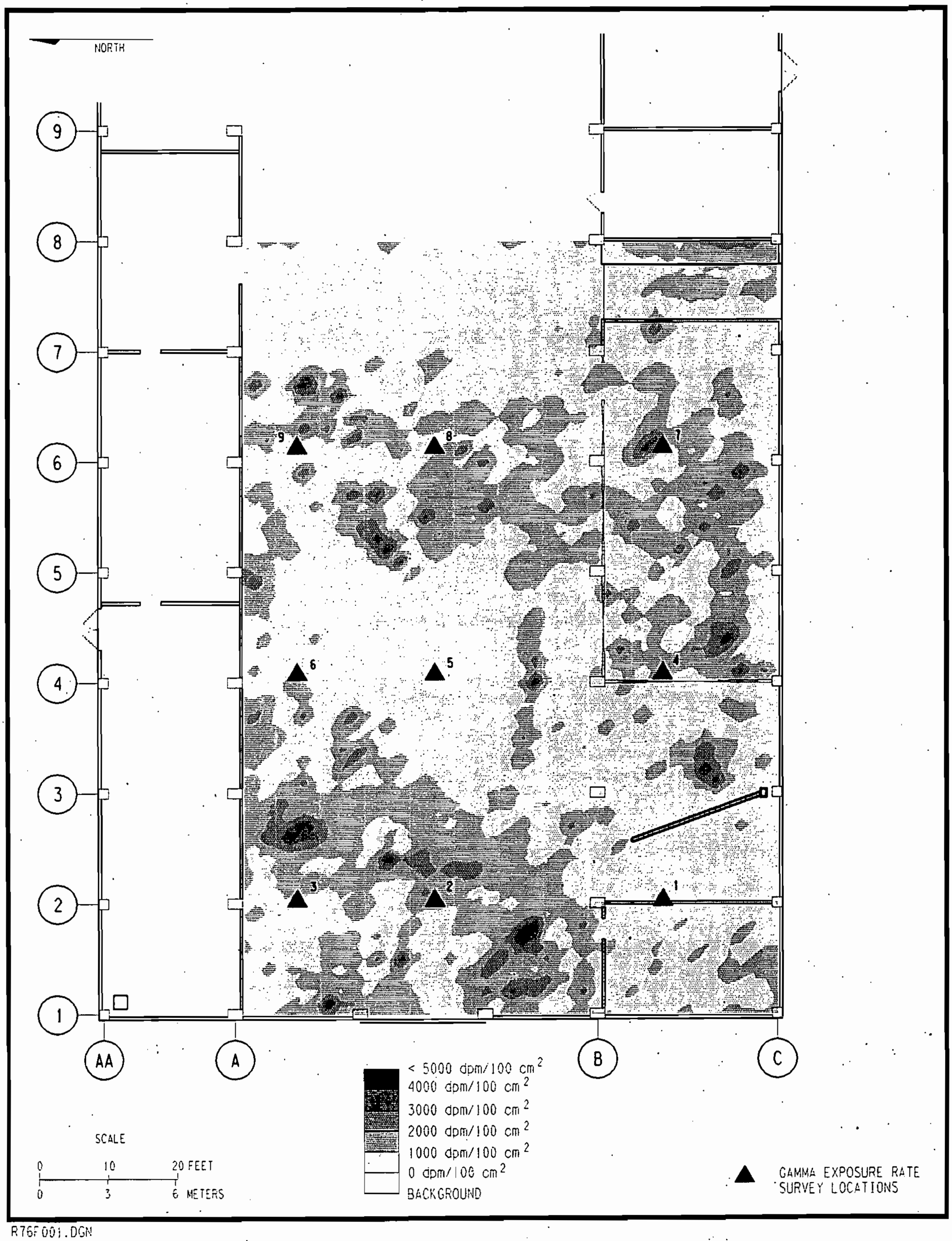


Figure 10
Chapman Valve Post-Remedial Action Floor Survey

TABLES

TABLE 1
SUMMARY OF RESIDUAL CONTAMINATION GUIDELINES

BASIC DOSE LIMITS

The basic limit for the annual radiation dose (including all pathways except radon) received by an individual member of the general public is 100 mrem/yr above background. In implementing this limit, DOE applies as-low-as-reasonably achievable principles to set site-specific guidelines.

SOIL GUIDELINES

Radionuclide	Soil Concentration (pCi/g) Above Background[a,b,c]
Radium-226 Radium-228 Thorium-230 Thorium-232	5 pCi/g when averaged over the first 15 cm of soil below the surface and over any contiguous 100-m^2 surface area; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer and over any contiguous 100-m^2 surface area.
Total Uranium	Site-specific uranium guideline for Chapman Valve was not determined.

STRUCTURE GUIDELINES

Airborne Radon Decay Products

Generic guidelines for concentrations of airborne radon decay products shall apply to existing occupied or habitable structures on private property that has no radiological restrictions on its use; structures that will be demolished or buried are excluded. The applicable generic guideline (40 CFR 192) is: In any occupied or habitable building, the objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL[d]. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL. Remedial actions are not required in order to comply with this guideline when there is reasonable assurance that residual radioactive materials are not the cause.

External Gamma Radiation

The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restrictions on its use shall not exceed the background level by more than 20 μR/h and will comply with the basic dose limits when an appropriate-use scenario is considered.

Indoor/Outdoor Structure Surface Contamination

	Allowable Surface Residual Contamination[e] (dpm/100 cm^2)		
Radionuclide[f]	Average[g,h]	Maximum[h,i]	Removable[h,j]
Transuranics, Ra-226, Ra-228, Th-230, Th-228 Pa-231, Ac-227, I-125, I-129[k]	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224 U-232, I-126, I-131, I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above[l]	5,000 β - γ	15,000 β - γ	1,000 β - γ

Z4.19 4392.5

TABLE 1
(CONTINUED)

[a]These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If either thorium-230 and radium-226 or thorium-232 and radium-228 are both present, not in secular equilibrium, the guidelines apply to the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that (1) the dose for the mixtures will not exceed the basic dose limit, or (2) the sum of ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1 ("unity").

[b]These guidelines represent allowable residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m^2 surface area.

[c]If the average concentration in any surface or below-surface area less than or equal to 25 m^2 exceeds the authorized limit or guideline by a factor of $(100/A)^{1/2}$, where A is the area of the elevated region in square meters, limits for "hot spots" shall also be applicable. Procedures for calculating these hot spot limits, which depend on the extent of the elevated local concentrations, are given in the DOE Manual for Implementing Residual Radioactive Materials Guidelines, DOE/CH/8901. In addition, every reasonable effort shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit for soil, irrespective of the average concentration in the soil.

[d]A working level (WL) is any combination of short-lived radon decay products in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of potential alpha energy.

[e]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[f]Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

[g]Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of less surface area, the average should be derived for each such object.

[h]The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at a depth of 1 cm.

[i]The maximum contamination level applies to an area of not more than 100 cm^2.

[j]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area, and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that total residual surface contamination levels are within the limits for removable contamination.

[k]Guidelines for these radionuclides are not given in DOE Order 5400.5; however, these guidelines are considered applicable based on "DOE Guidelines for Residual Radioactive Materials at FUSRAP and Remote SFMP Sites," Revision 2, March 1987.

[l]This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

Source: DOE Order 5400.5 and 40 CFR 192

Table 2
Decontamination Techniques Used at the Chapman Valve Site

Type	Description
HEPA Vacuuming	High-efficiency particulate air- (HEPA-) filtered vacuum cleaners were used to remove loose contamination and dust. HEPA-filtered vacuums were also used in conjunction with other techniques (grinding, wire brushing, etc.) to eliminate the airborne contamination associated with these techniques.
Jackhammering	Conventional jackhammers were used on small areas to remove anchor bolts from the concrete slab. Skid steer loaders equipped with hoe-ram attachments were used to remove the wooden blocks from the floor and to break up the concrete pads to expose the base slab.
Excavation	Contaminated concrete and debris were removed from the building with a skid steer loader. Removal of contaminated soil from the west ramp and excavation of the pipe were performed with shovels.
Wire Brushing	Small areas on the overhead trusses requiring rework were wire brushed to remove contamination.
Scraping	Putty knives were used to scrape contamination from the surface of the 10-ton crane and from wooden planks removed from the crane deck.

Table 3

Cost of Remedial Action at the Chapman Valve Site

Description	Amount
Direct costs	$269,000
Radiological laboratory/HP support	184,000
Chemical laboratory	11,000
Direct hire labor	273,500
Transportation	12,000
Disposal	24,000
Final engineering reports	51,000
Home office support	143,500
Total RA costs	$968,000
Hazard assessment supplemental limits cost savings	$2,000,000

Table 4

Post-Remedial Action Survey Data - Crane[a]

Location	Direct (dpm/100 cm2)		Removable (dpm/100 cm^2)[b]		Location	Direct (dpm/100 cm^2)		Removable (dpm/100 cm^2)[b]	
Number	Alpha	Beta/Gamma	Alpha	Beta/Gamma	Number	Alpha	Beta/Gamma	Alpha	Beta/Gamma
1	16	201	2	84	33	8	-177	-[b]-	-[b]-
2	1	513	2	110	34	15	25	-[b]-	-[b]-
3	-6	313	-1	-19	35	15	-354	-[b]-	-[b]-
4	9	223	2	20	36	15	-76	-[b]-	-[b]-
5	1	335	-1	-53	37	1	354	-[b]-	-[b]-
6	-6	112	-1	-45	38	-5	-101	-[b]-	-[b]-
7	-6	201	-1	15	39	8	-380	-[b]-	-[b]-
8	-6	402	-1	41	40	21	708	-[b]-	-[b]-
9	-6	380	-1	110	41	26	101	-[b]-	-[b]-
10	16	491	2	3	42	12	557	-[b]-	-[b]-
11	9	313	5	80	43	19	-127	-[b]-	-[b]-
12	1	134	-1	50	44	-3	177	-[b]-	-[b]-
13	9	357	2	114	45	4	633	-[b]-	-[b]-
14	9	201	2	11	46	4	481	-[b]-	-[b]-
15	1	290	-1	-15	47	134	1493	8	73
16	37	0	2	33	48	220	2378	5	87
17	9	112	2	20	49	163	2606	-2	77
18	-6	290	-1	24	50	55	708	-[b]-	-[b]-
19	15	1670	-2	7	51	4	936	-[b]-	-[b]-
20	-5	-329	-[b]-	-[b]-	52	12	354	-[b]-	-[b]-
21	48	1771	4	15	53	19	734	-[b]-	-[b]-
22	15	177	-[b]-	-[b]-	54	19	911	-[b]-	-[b]-
23	21	607	-[b]-	-[b]-	55	19	405	-[b]-	-[b]-
24	1	633	-[b]-	-[b]-	56	-3	607	-[b]-	-[b]-
25	21	253	-[b]-	-[b]-	57	12	531	-[b]-	-[b]-
26	55	3416	1	45	58	148	1695	8	77
27	15	329	-[b]-	-[b]-	59	91	2075	12	39
28	8	2049	1	-53	60	26	253	-[b]-	-[b]-
29	21	-278	-[b]-	-[b]-	61	19	0	-[b]-	-[b]-
30	35	1619	10	63	62	62	354	-[b]-	-[b]-
31	28	1569	4	11	63	12	177	-[b]-	-[b]-
32	48	531	-[b]-	-[b]-	64	-3	633	-[b]-	-[b]-

Table 4 - Continued

Post-Remedial Action Survey Data - Crane[a]

Location Number	Direct (dpm/100 cm^2) Alpha	Direct (dpm/100 cm^2) Beta/Gamma	Removable (dpm/100 cm^2)[b] Alpha	Removable (dpm/100 cm^2)[b] Beta/Gamma	Location Number	Direct (dpm/100 cm^2) Alpha	Direct (dpm/100 cm^2) Beta/Gamma	Removable (dpm/100 cm^2)[b] Alpha	Removable (dpm/100 cm^2)[b] Beta/Gamma
65	4	860	-[b]-	-[b]-	96	4	531	-[b]-	-[b]-
66	19	734	-[b]-	-[b]-	97	-3	405	-[b]-	-[b]-
67	26	961	-[b]-	-[b]-	98	12	304	-[b]-	-[b]-
68	270	3238	5	83	99	112	2758	8	80
69	83	1189	5	90	100	4	455	-[b]-	-[b]-
70	-3	886	-[b]-	-[b]-	101	19	354	-[b]-	-[b]-
71	-3	759	-[b]-	-[b]-	102	40	810	-[b]-	-[b]-
72	148	3669	-2	60	103	26	810	-[b]-	-[b]-
73	40	3087	5	46	104	19	683	-[b]-	-[b]-
74	12	202	-[b]-	-[b]-	105	55	860	-[b]-	-[b]-
75	62	936	-[b]-	-[b]-	106	-43	-578	-[b]-	-[b]-
76	19	101	-[b]-	-[b]-	107	-43	-509	-[b]-	-[b]-
77	4	582	-[b]-	-[b]-	108	-33	-254	-[b]-	-[b]-
78	12	127	-[b]-	-[b]-	109	-43	-462	-[b]-	-[b]-
79	-3	329	-[b]-	-[b]-	110	-43	-185	-[b]-	-[b]-
80	199	3719	8	87	111	-43	-162	-[b]-	-[b]-
81	98	1645	12	107	112	-24	-624	-[b]-	-[b]-
82	40	1113	2	90	113	-43	-509	-[b]-	-[b]-
83	26	961	-[b]-	-[b]-	114	-43	-971	-[b]-	-[b]-
84	12	810	-[b]-	-[b]-	115	-33	-948	-[b]-	-[b]-
85	91	1898	-2	63	116	-24	-879	-[b]-	-[b]-
86	62	3137	5	107	117	-24	-462	-[b]-	-[b]-
87	-3	633	-[b]-	-[b]-	118	-43	-486	-[b]-	-[b]-
88	19	481	-[b]-	-[b]-	119	-33	-832	-[b]-	-[b]-
89	4	708	-[b]-	-[b]-	120	22	-254	-[b]-	-[b]-
90	33	25	-[b]-	-[b]-	121	-43	-624	-[b]-	-[b]-
91	12	329	-[b]-	-[b]-	122	-43	-555	-[b]-	-[b]-
92	12	506	-[b]-	-[b]-	123	-24	-786	-[b]-	-[b]-
93	4	177	-[b]-	-[b]-	124	4	-809	-[b]-	-[b]-
94	12	582	-[b]-	-[b]-	125	13	-439	-[b]-	-[b]-
95	12	734	-[b]-	-[b]-	126	-43	-254	-[b]-	-[b]-

Table 4 - Continued

Post-Remedial Action Survey Data - Crane[a]

Location Number	Direct (dpm/100 cm^2) Alpha	Direct (dpm/100 cm^2) Beta/Gamma	Removable (dpm/100 cm^2)[b] Alpha	Removable (dpm/100 cm^2)[b] Beta/Gamma	Location Number	Direct (dpm/100 cm^2) Alpha	Direct (dpm/100 cm^2) Beta/Gamma	Removable (dpm/100 cm^2)[b] Alpha	Removable (dpm/100 cm^2)[b] Beta/Gamma
127	-24	-786	-b-	-b-	149	459	736	-b-	-b-
128	-33	-647	-b-	-b-	150	552	5348	9	-17
129	689	-324	-b-	-b-	151	274	4641	1	58
130	198	-69	-b-	-b-	152	98	368	-b-	-b-
131	143	23	-b-	-b-	153	43	-57	-b-	-b-
132	319	-92	-b-	-b-	154	15	85	-b-	-b-
133	87	-370	-b-	-b-	155	-4	-170	-b-	-b-
134	235	3237	-1	-3	156	24	538	-b-	-b-
135	161	671	-b-	-b-	157	24	-311	-b-	-b-
136	13	1156	-1	-10	158	24	-226	-b-	-b-
137	4	324	-b-	-b-	159	70	1585	1	31
138	-43	69	-b-	-b-	160	256	538	-b-	-b-
139	-33	-254	-b-	-b-	161	89	198	-b-	-b-
140	-43	-925	-b-	-b-	162	61	-113	-b-	-b-
141	-43	-416	-b-	-b-	163	98	311	-b-	-b-
142	13	-879	-b-	-b-	164	172	1330	12	20
143	172	651	-b-	-b-	165	80	-170	-b-	-b-
144	24	311	-b-	-b-	166	43	-85	-b-	-b-
145	43	481	-b-	-b-	167	33	283	-b-	-b-
146	6	1471	12	17	168	70	-198	-b-	-b-
147	89	396	-b-	-b-	169	61	-198	-b-	-b-
148	302	283	-b-	-b-				-b-	-b-
					AVERAGE	44	520	3	42
					DOE Guideline	5000	5000	1000	1000

[a] Negative numbers indicate that the measurement was less than the minimum detectible activity and that after background was subtracted, the numerical value was negative.

[b] Transferable surface readings were not taken because direct readings were less than the transferable criterion of 1000 dpm/100 cm^2 for that location.

Table 5

Post-Remedial Action Survey Data - Trusses and Overheads[a]

			Horizontal Surfaces (dpm/100 cm^2)				Non-Horizontal Surfaces (dpm/100 cm^2)				Light Fixtures (dpm/100 cm^2)			
			Direct		Removable		Direct		Removable		Direct		Removable	
Truss Number	Number of Locations		Alpha	Beta/ Gamma	Alpha	Beta/ Gamma	Alpha	Beta/ Gamma	Alpha	Beta/ Gamma	Alpha	Beta/ Gamma	Alpha	Beta/ Gamma
1	160	Average	452	5657	24	112	702	3173	27	128	859	3758	65	227
		Maximum	2221	27841	101	302	1776	7330	78	244	1471	4810	117	339
		Minimum	4	139	-2	0	4	-277	-2	41	161	2798	35	132
2	101	Average	2114	12261	18	125	1869	6175	20	107	794	2336	2	62
		Maximum	17577	111967	193	539	17397	18280	88	573	1300	3677	7	79
		Minimum	-9	277	-2	-25	102	948	-2	-17	59	-185	-2	44
3	69	Average	907	4266	29	70	889	5383	17	61	-[b]-	-[b]-	-[b]-	-[b]-
		Maximum	9973	28806	368	634	5916	27419	55	129	-[b]-	-[b]-	-[b]-	-[b]-
		Minimum	26	113	-2	-20	7	-85	-2	0	-[b]-	-[b]-	-[b]-	-[b]-
4	68	Average	361	1773	11	55	483	2221	21	48	-[b]-	-[b]-	-[b]-	-[b]-
		Maximum	1024	17827	42	180	1450	10017	192	502	-[b]-	-[b]-	-[b]-	-[b]-
		Minimum	26	-792	-2	14	7	-481	0	-19	-[b]-	-[b]-	-[b]-	-[b]-
5	150	Average	422	1783	7	27	316	1245	3	19	432	1186	18	17
		Maximum	4724	14591	58	98	741	4185	9	62	808	4324	35	49
		Minimum	17	-347	-2	-36	-7	-162	-1	-19	4	-254	-1	-39
6	67	Average	243	1395	9	27	114	815	1	10	-[b]-	-[b]-	-[b]-	-[b]-
		Maximum	1400	17940	131	310	715	8319	8	76	-[b]-	-[b]-	-[b]-	-[b]-
		Minimum	-8	-453	-1	-16	-7	-283	-1	-29	-[b]-	-[b]-	-[b]-	-[b]-
7	71	Average	329	1923	3	36	201	865	2	18	-[b]-	-[b]-	-[b]-	-[b]-
		Maximum	1773	12507	15	173	902	5263	9	156	-[b]-	-[b]-	-[b]-	-[b]-
		Minimum	13	-509	-1	-31	-6	-509	-1	-14	-[b]-	-[b]-	-[b]-	-[b]-
8	43	Average	344	2567	14	32	287	1592	10	-10	-[b]-	-[b]-	-[b]-	-[b]-
		Maximum	1389	20141	42	123	556	5388	28	42	-[b]-	-[b]-	-[b]-	-[b]-
		Minimum	0	-439	0	-33	93	-90	-1	-114	-[b]-	-[b]-	-[b]-	-[b]-
1 to 8[c]	40	Average	161	627	2	8	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-
		Maximum	1895	11084	25	256	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-
		Minimum	-22	-315	0	-62	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-	-[c]-
Supplemental Limit[d]			15000	15000	1000	1000	15000	15000	1000	1000	15000	15000	1000	1000

[a] Negative numbers indicate that the measurement was less than the minimum detectible activity and that after background was subtracted the numerical value was negative.

[b] These truss areas did not contain light fixtures.

[c] This survey was performed on the underside of horizontal surfaces and in the area between back-to-back welded angles on all eight trusses. Non-horizontal surfaces and light fixtures were not surveyed.

[d] The supplemental limit is an average for the truss; there is no maximum limit.

Table 6

Post-Remedial Action Survey Data - West Wall[a]

Location Number	Direct (dpm/100 cm^2)		Removable (dpm/100 cm^2)[b]		Location Number	Direct (dpm/100 cm^2)		Removable (dpm/100 cm^2)[b]	
	Alpha	Beta/Gamma	Alpha	Beta/Gamma		Alpha	Beta/Gamma	Alpha	Beta/Gamma
1	100	4075	-1	18	22	989	8263	19	187
2	82	3792	-1	24	23	878	80985	9	119
3	193	8489	-1	4	24	322	5490	-1	-6
4	137	14375	5	45	25	626	23147	19	52
5	1304	37295	12	119	26	774	11149	2	65
6	878	61743	42	401	27	4470	14544	108	170
7	2508	15903	9	123	28	6	2999	2	-30
8	693	22977	5	106	29	6	6112	12	18
9	600	59479	75	221	30	70	4980	2	18
10	2230	130787	164	919	31	43	1471	-1	18
11	4824	60045	9	113	32	61	170	-[b]-	-[b]-
12	3731	5433	138	594	33	6	1075	9	18
13	44	5999	5	38	34	154	30730	2	-37
14	248	4301	-1	28	35	302	12620	2	-16
15	359	34692	2	89	36	395	26033	15	4
16	433	10922	2	14	37	376	10413	9	31
17	174	14997	9	31	38	24	4075	9	4
18	63	16921	5	92	39	43	3679	5	-9
19	137	22354	5	102	40	43	1585	2	-64
20	433	6508	5	18	41	61	6452	-1	-57
21	878	15167	2	85	42	24	2999	2	-30
					Average	708	19410	17	70
					Doe Guideline	-[c]-	-[c]-	-[c]-	-[c]-

[a] Negative numbers indicate that the measurement was less than the minimum detectible activity and that after background was subtracted, the numerical value was negative.

[b] Removable surface readings were not taken because direct readings were less than the removable criteria of 1000 dpm/100 cm^2 for that location.

[c] The walls were decontaminated to comply with DOE's ALARA policy, and the data collected are intended to be used in the final hazard assessment calculation; therefore, there are no specific surface criteria that apply to the walls.

Table 7

Post-Remedial Action Survey Data - North Wall[a]

Location Number	Direct (dpm/100 cm²) Alpha	Direct (dpm/100 cm²) Beta/Gamma	Removable (dpmM/100 cm²)[b] Alpha	Removable (dpmM/100 cm²)[b] Beta/Gamma	Location Number	Direct (dpm/100 cm²) Alpha	Direct (dpm/100 cm²) Beta/Gamma	Removable (dpm/100 cm²)[b] Alpha	Removable (dpm/100 cm²)[b] Beta/Gamma
1	20	5018	5	-16	34	419	1711	19	-16
2	48	2428	15	-3	35	270	2844	22	18
3	104	2914	22	-3	36	622	2960	12	18
4	187	2336	9	11	37	270	3908	29	68
5	2	3839	-1	-13	38	761	2567	22	24
6	39	2243	2	-9	39	270	3307	2	-37
7	2	2752	2	-16	40	94	3422	2	-23
8	57	2613	12	-16	41	187	4902	12	62
9	2	2729	-1	-37	42	215	4394	32	18
10	113	3839	22	-23	43	57	1156	9	126
11	39	2312	9	-57	44	743	3006	5	143
12	30	2567	5	11	45	919	8949	12	11
13	104	2798	15	-43	46	1762	36698	850	3197
14	94	1896	2	45	47	39	301	-[b]-	-[b]-
15	113	2613	12	-30	48	947	25714	15	45
16	57	2891	5	-9	49	1104	3839	65	265
17	11	3908	2	4	50	965	6914	-1	-43
18	57	2359	15	-6	51	11	1781	5	46
19	11	2474	2	-9	52	11	1017	-2	-28
20	178	1734	-1	4	53	30	185	-[b]-	-[b]-
21	94	2914	5	11	54	2	1295	1	39
22	85	2497	2	-23	55	215	1457	11	19
23	2	2289	-1	31	56	30	925	-[b]-	-[b]-
24	48	3006	12	-64	57	11	1226	1	-15
25	233	12071	32	-40	58	11	647	-[b]-	-[b]-
26	919	10082	15	4	59	76	139	-[b]-	-[b]-
27	243	3422	25	48	60	11	439	-[b]-	-[b]-
28	122	856	9	18	61	48	69	-[b]-	-[b]-
29	39	5272	5	-9	62	150	1017	11	-8
30	326	5365	35	72	63	530	1503	28	-28
31	345	1688	5	-43	64	307	717	-[b]-	-[b]-
32	317	1526	2	-9	65	30	301	-[b]-	-[b]-

Table 7 - continued

Post-Remedial Action Survey Data - North Wall[a]

Location	Direct (dpm/100 cm^2)		Removable (dpm/100 cm^2)[b]		Location	Direct (dpm/100 cm^2)		Removable (dpm/100 cm^2)[b]	
Number	Alpha	Beta/Gamma	Alpha	Beta/Gamma	Number	Alpha	Beta/Gamma	Alpha	Beta/Gamma
33	919	1503	22	79	66	104	856	-[b]-	-[b]-
67	363	740	-[b]-	-[b]-	82	169	1064	18	-35
68	132	763	-[b]-	-[b]-	83	39	509	-[b]-	-[b]-
69	539	1434	-2	33	84	548	6544	31	185
70	11	2127	5	-5	85	132	1572	21	29
71	178	1064	8	22	86	48	23	-[b]-	-[b]-
72	280	1202	18	39	87	1021	14268	31	155
73	243	2428	21	9	88	48	3645	15	39
74	94	555	-[b]-	-[b]-	89	576	3076	15	-62
75	30	1804	11	-59	90	20	-416	-[b]-	-[b]-
76	169	532	-[b]-	-[b]-	91	1437	27749	25	243
77	85	2405	18	-28	92	2595	4648	213	266
78	94	-185	-[b]-	-[b]-	93	345	-46	-[b]-	-[b]-
79	910	2012	38	-45	94	372	2359	34	100
80	11	1526	-2	39	95	446	7307	101	209
81	335	1896	11	46	96	48	4116	5	-32
					Average	1001	2823	35	58
					Doe Guideline	-[c]-	-[c]-	-[c]-	-[c]-

[a] Negative numbers indicate that the measurement was less than the minimum detectible activity and that after background was subtracted, the numerical value was negative.

[b] Removable surface readings were not taken because direct readings were less than the removable criterion of 1000 dpm/100 cm^2 for that location.

[c] The walls were decontaminated to comply with DOE's ALARA policy, and the data collected are intended to be used in the final hazard assessment calculation; therefore, there are no specific surface criteria that apply to the walls.

Table 8

Post-Remedial Action Survey Data - South Wall[a]

Location	Direct (dpm/100 cm^2)		Removable (dpm/100 cm^2)[b]		Location	Direct (dpm/100 cm^2)		Removable (dpm/100 cm^2)[b]	
Number	Alpha	Beta/Gamma	Alpha	Beta/Gamma	Number	Alpha	Beta/Gamma	Alpha	Beta/Gamma
1	2564	41709	22	265	34	354	740	-[b]-	-[b]-
2	7	283	-[b]-	-[b]-	35	261	1272	21	33
3	2230	7074	5	102	36	761	8140	34	134
4	44	12677	-1	11	37	67	1665	11	-39
5	304	7866	5	52	38	428	4255	18	5
6	82	3056	-1	1	39	196	5850	15	94
7	545	2264	-1	-23	40	483	7538	28	-5
8	3710	17714	5	55	41	122	971	11	-25
9	191	849	39	150	42	539	2451	8	-56
10	3358	9508	111	319	43	215	694	-[b]-	-[b]-
11	691	26005	9	31	44	85	971	-[b]-	-[b]-
12	209	3735	5	24	45	122	2336	1	-25
13	1450	9508	22	153	46	641	2497	28	-1
14	135	2490	15	52	47	122	6428	8	-8
15	432	2490	72	252	48	132	1873	1	-35
16	80	1471	9	-3	49	30	1734	5	-1
17	7804	20543	88	241	50	39	3214	8	26
18	784	14488	12	72	51	67	-162	-[b]-	-[b]-
19	580	44822	19	126	52	446	4509	38	56
20	2228	67572	32	153	53	558	925	-[b]-	-[b]-
21	5414	11375	25	99	54	1947	5758	68	161
22	691	13639	22	24	55	-7	-324	-[b]-	-[b]-
23	11	2867	1	-59	56	354	1665	5	-76
24	196	4671	1	-62	57	169	902	-[b]-	-[b]-
25	67	324	-[b]-	-[b]-	58	409	5943	44	175
26	187	2428	11	-15	59	48	-370	-[b]-	-[b]-
27	39	2960	-2	-45	60	261	2127	5	49
28	67	2035	5	-12	61	372	2197	21	16
29	1067	1202	8	26	62	187	2359	18	138
30	104	2821	1	16	63	30	763	-[b]-	-[b]-
31	178	5319	15	-52	64	2	-624	-[b]-	-[b]-
32	-7	7215	-2	2	65	169	694	-[b]-	-[b]-

Table 8 - Continued

Post-Remedial Action Survey Data - South Wall[a]

Location Number	Direct (dpm/100 cm²) Alpha	Direct (dpm/100 cm²) Beta/Gamma	Removable (dpm/100 cm²)[b] Alpha	Removable (dpm/100 cm²)[b] Beta/Gamma	Location Number	Direct (dpm/100 cm²) Alpha	Direct (dpm/100 cm²) Beta/Gamma	Removable (dpm/100 cm²)[b] Alpha	Removable (dpm/100 cm²)[b] Beta/Gamma
33	567	4278	11	121	66	104	578	-[b]-	-[b]-
67	283	1188	32	106	73	450	22864	2	11
68	6	4358	2	-50	74	43	3679	2	-23
69	1469	3452	12	45	75	98	2320	15	-6
70	580	1075	9	-30	76	43	2037	5	-9
71	265	1981	9	85	77	6	1358	-1	-37
72	450	10696	12	75					
					Average	642	6387	17	45
					Doe Guideline	-[c]-	-[c]-	-[c]-	-[c]-

[a] Negative numbers indicate that the measurement was less than the minimum detectible activity and that after background was subtracted, the numerical value was negative.

[b] Transferable surface readings were not taken because direct readings were less than the transferable criterion of 1000 dpm/100 cm^2 for that location.

[c] The walls were decontaminated to comply with DOE's ALARA policy, and the data collected are intended to be used in the final hazard assessment calculation; therefore, there are no specific surface criteria that apply to the walls.

Table 9

Post-Remedial Action and Bench - Scale Sampling Results[a]

Location	TCLP Pb ug/L	TCLP Cd ug/L	U-238 pCi/g	Ra-226 pCi/g	Th-232 pCi/g
Dust from crane (mixed with concrete)	338	< 3.0	-[b]-	-[b]-	-[b]-
Bench Scale Test (Ratio 2)	315	< 3.0	-[b]-	-[b]-	-[b]-
Bench Scale Test (Ratio 4)	102	< 3.0	-[b]-	-[b]-	-[b]-
Bench Scale Test (Ratio 6)	302	< 3.0	-[b]-	-[b]-	-[b]-
Bench Scale Test (Ratio 3)	94.2	< 3.0	-[b]-	-[b]-	-[b]-
Bench Scale Test (Ratio 5)	< 46.6	< 3.0	-[b]-	-[b]-	-[b]-
Bench Scale Test (Ratio 1)	171	< 3.0	-[b]-	-[b]-	-[b]-
West Equipment Door Ramp	-[b]-	-[b]-	< 2.00	0.47	0.41
Room B4	-[b]-	-[b]-	0.26	0.47	0.50
Room B4	-[b]-	-[b]-	< 0.62	0.38	0.39
Room B4	-[b]-	-[b]-	< 0.54	< 0.3	0.42
DOE Soil Guideline	-[c]-	-[c]-	-[d]-	-[e]-	-[e]-
RCRA TCLP Limits	5000	1000	-[c]-	-[c]-	-[c]-

[a] Less than values (≤) are results less than the minimum detectable activity, and the number reported is less than the minimum detectable activity.

[b] Sample was not analyzed for this analyte.

[c] This set of guidelines does not apply to this analyte.

[d] There was no site-specific uranium guideline developed for CHV. A typical U-238 guideline for FUSRAP sites ranges from 35 to 50 pCi/g.

[e] DOE soil cleanup guideline for radium and thorium is 5 pCi/g in the top 6 inches of soil and 15 pCi/g greater than 6 inches below the surface of the soil.

Table 10
Hazard Assessment Summary

Dose Scenario	Calculated Number	Units
Building Demolition		
Roof Demolition	4.9	mrem
Wall Demolition	0.02	mrem
Structural Steel Demolition	0.76	mrem
Removal of Floor Blocks	0.0007	mrem
Total	5.6	mrem
Structural Steel Recycling		
Torch Cutting of Trusses	5.3	mrem
Sand Blasting of Trusses	10.7	mrem
Slag From Melting Trusses	0.29	mrem
Total	16.3	mrem
Reuse of Building Materials	17.3	mrem/yr
Activity of Building Rubble	4.4	pCi/g
Mass of Uranium in Rubble	20	lbs

TABLE 11
REMEDIAL ACTION SUMMARY

WBS	133	REMEDIATION AUTHORITY	
SITE	Chapman Valve	☒ NEPA/CERCLA	
		☐ SUPERFUND	
OWNER	Crane Company	☐ RCRA	
SITE ADDRESS	203 Hampshire Street		
CITY, STATE	Indian orchard, MA 05515		

ACTION	DATE	RESPONSIBLE ENTITY	DOCUMENT
DESIGNATION	December 15, 1992	DOE	Authorization for RA
CHARACTERIZATION	July 1992	ORNL	Results of Radiological Survey at the Former Chapman Valve Manufacturing Company, Indian Orchard, Massachusetts
CHARACTERIZATION	May 4, 1995	BNI	FUSRAP Technical memorandum - Chapman Valve Characterization Results
FINAL RA	September 1996	DOE/ORNL/BNI	FUSRAP Technical memorandum - Chapman Valve Post-Remedial Action Report

TOTAL VOLUME 750 cy
- To Remain In Situ 731 cy
- Volume Reduction 0
- Net Disposal 19 cy

Documentation Used: Hazard Assessment in FUSRAP Technical Memorandum - Chapman Valve Post-Remedial Action Report

TYPE OF WASTE FOR NET DISPOSAL:

REGULATORY	VOLUME	DISPOSAL SITE
☒ LLRW	19 cy	Clive, Utah
☐ 11(E)2		
☐ MIXED ______		Clive, Utah
☐ CHEMICAL ______		

PHYSICAL	VOLUME	DISPOSAL SITE
☒ BUILDING RUBBLE	6 cy	Clive, Utah
☒ SOIL	3 cy	Clive, Utah
☐ LIQUID		
☒ OTHER Dust Mixed with Concrete	10 cy	Clive, Utah

TREATMENT TECHNOLOGIES APPLIED AT THE SITE:
Chemical Stabilization