Report No. SAI-1-148-08-781

EVALUATION OF SEISMIC RESPONSE CHARACTERISTICS OF HOT CELLS AND RELATED STRUCTURES AND EQUIPMENT AT THE UCC STERLING FOREST RESEARCH CENTER

TECHNICAL EVALUATION REPORT

Prepared By:

Science Applications, Inc.
800 Oak Ridge Turnpike
Oak Ridge, TN 37830

Prepared For:

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Draft - November 17, 1983

NRC Contract NRC-02-83-035, Task Order 7

NOTICE

EXECUTIVE SUMMARY

This Technical Evaluation Report (TER) has been prepared by Science Applications, Inc. (SAI), under contract from the U.S. Nuclear Regulatory Commission (NRC) staff, to document an evaluation of the seismic response characteristics of hot cells and related structures and equipment located at the Sterling Forest Laboratory, Tuxedo, New York, and operated by the Union Carbide Corporation.

Included in this report is a description of those portions of the Sterling Forest Laboratory that are significant in determining its behavior under earthquakes, a description of anticipated failure modes, and an evaluation of seismic response characteristics.

It is concluded that no failure will occur to the facility or its contents under the expected maximum seismic ground acceleration of 0.2 g.

TABLE OF CONTENTS

1.0 INTRODUCTION

This Technical Evaluation Report (TER) documents an evaluation of the seismic response characteristics of Hot Cells and related structures and equipment located at the Sterling Forest Research Center, Tuxedo, New York. This TER has been prepared by Science Applications, Inc. (SAI) for the U.S. Nuclear Regulatory Commission (NRC), Division of Fuel Cycle and Material Safety.

The Sterling Forest Research Center is operated by the Union Carbide Corporation (UCC) as a production facility for certain radioactive isotopes. The NRC is currently processing a renewal application from UCC for the portion of this laboratory that is used to process radioactive materials. This TER has been prepared in support of the NRC review of this renewal application.

Section 2.0 of this TER contains a description of those portions of the Sterling Forest Research Center that have been considered during the seismic response characteristics evaluation documented herein. Section 3.0 contains a description of the various potential failure modes, caused by a potential seismic event, that have been identified for each of the structures and/or mechanical components described in Section 2.0.

An evaluation of the seismic response characteristics of each of the structures and/or mechanical components identified in Section 2.0 is presented in Section 4.0 for each pertinent failure mode identified in Section 3.0. Finally, conclusions reached by SAI during this evaluation are summarized in Section 5.0.

It should be noted that references are denoted by "[1]" throughout this TER. A complete list of references, together with a list of drawings, evaluated during the course of this evaluation is given in Section 6.0.

This page is intentionally blank.

2.0 FACILITY DESCRIPTION

This section contains a description of those portions of the Sterling Forest Research Center that have been considered during the seismic response characteristics evaluation contained in this report. Each area considered is located in the Hot Laboratory Building and/or the canal connecting the hot cells to the reactor pool.

2.1 HOT LABORATORY BUILDING

The Hot Laboratory Building is a concrete structure 225 feet long by 57 feet wide by 37 feet high. The building contains five hot cells; operating area, charging area, and top access area for the hot cells; shipping area; waste drum storage area; exhaust system; and various office, laboratory and other support areas. A plan view of the Hot Laboratory Building is shown in Figure 2.1. This figure also shows the reactor pool and the canal connecting the pool to the hot cells.

2.2 HOT CELLS

The five hot cells are general purpose units designed to accommodate a variety of experiments, radiochemical separations of isotopes, physical testing for evaluation of irradiated material, solid state investigations and metallurgical work. A general description of the cells is presented below.

Each of the cell walls contain penetrations for manipulators, other equipment and electrical connections. Although these penetrations are not leak-proof, air flow from inside the cells to adjacent areas is prevented by maintaining a negative pressure inside the cells relative to the adjacent areas. This negative pressure is maintained through the exhaust system described in Section 2.5. The cells are separated from each other by four foot thick, high density, reinforced concrete walls.

Cell 1 is 16 feet wide by 10 feet long by 15 feet in height. Two Corning four foot thick glass shielding window are located in the front shielding wall between Cell 1 and the operating area. The windows are constructed from five sections of 3.3 density lead glass each 9-1/2 inches thick. Access is provided from Cell 1 to the canal through a water-filled entry way at the back of the cell. This entry way contains an access hatch which is normally left open.

Cells 2, 3 and 4 are 6 feet wide by 10 feet long by 12.5 feet in height, while Cell 5 is 6 feet wide by 10 feet long by 25 feet in height. Each of these cells is equipped with a Corning four foot thick glass shielding window.

Major access to all the cells is possible through the rear doors (7 feet wide by 6 feet high by 4 feet thick) which can be withdrawn through the use of electrical drives. The access doors move on steel rails located in the floor of the charging area.

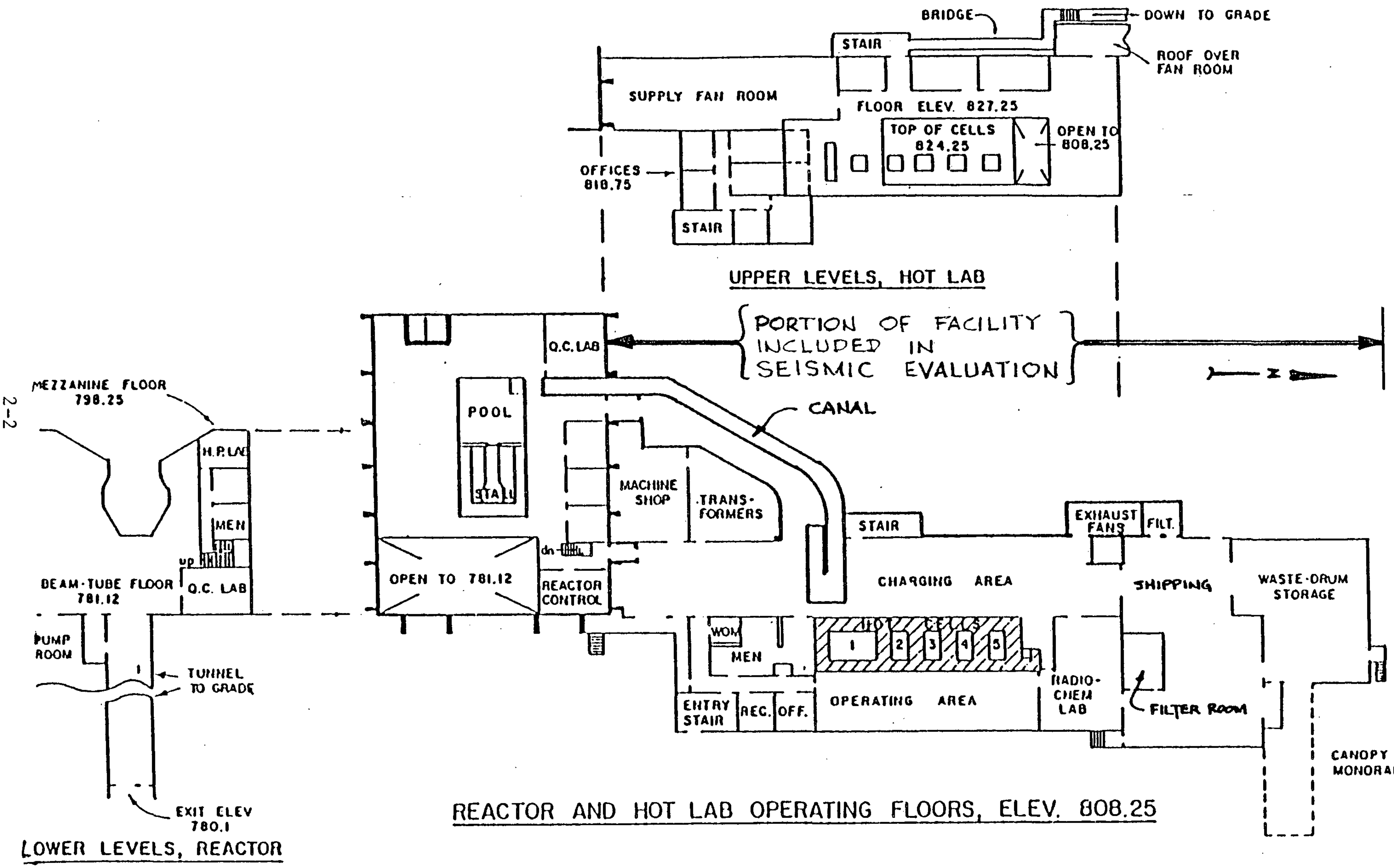

Figure 2.1. Plan View of Hot Laboratory and Reactor Buildings.

Access to all cells is also possible via top roof openings containing removable plugs. The roof and roof plugs of all cells are 3-1/4 foot thick magnetite concrete with a density of 240 lbs/ft3. The roof plug is made up of three 14-inch thick concrete slabs which must be removed individually with a 10-ton capacity overhead crane. A 6-inch diameter charging sleeve located in the center of the roof plug is fitted with an 8-inch long lead filled steel plug. Two 4-inch diameter charging sleeves are also provided through the roof. They have magnetite plugs 6 inches in diameter at the exterior surface and are stepped to 4 inches in diameter 18 inches from the interior surface.

The floor under the cells is a 12 inch thick reinforced concrete mat that is supported by concrete fill having a minimum thickness of 22 inches. The concrete fill rests on bedrock.

2.3 CANAL

A canal containing water 12 feet deep connects Cell 1 with the reactor pool. Radioactive samples, specimens, isotopes, etc., are transferred through this canal and brought into Cell 1 via an automatic elevator mechanism. The canal floor is also used to store certain radioactive materials.

The canal walls and floor are constructed of one foot thick reinforced concrete. The ceiling over the canal area is a 16 inch thick reinforced concrete slab.

Two overhead, monorail cranes are located in the canal area. A one ton crane runs the full length of the canal over the center of the canal. A ten ton crane crosses the canal near the east end of the canal near the point where the canal enters the hot cell.

2.4 WASTE STORAGE AREA

The Waste Storage Area is located in the north end of the Hot Laboratory Building and contains one hundred individual storage cells, each sized to contain on 55 gallon drum. The storage cells are located under the floor of the storage area and are arranged similar to a honey-comb with 4 feet of reinforced concrete (normal density) shielding around their outer perimeter. Each cell has a concrete shield plug 4 feet deep and is vented to the cell exhaust ventilation filter room.

Radioactive waste from in-cell processing is stored in this facility prior to disposal.

2.5 EXHAUST SYSTEM

The Hot Laboratory ventilation system is designed to assure a continuous, positive flow of air from clean (non-radioactive) areas to contaminated or radiation areas as illustrated in Fig. 2.2. There are two major supply fans. One fan supplies 19,000 cfm of air to the first floor offices, loading dock, second floor offices, operating area, and the Radiochemical Laboratory. A second fan supplies 6,000 cfm of air to three laboratories on the second

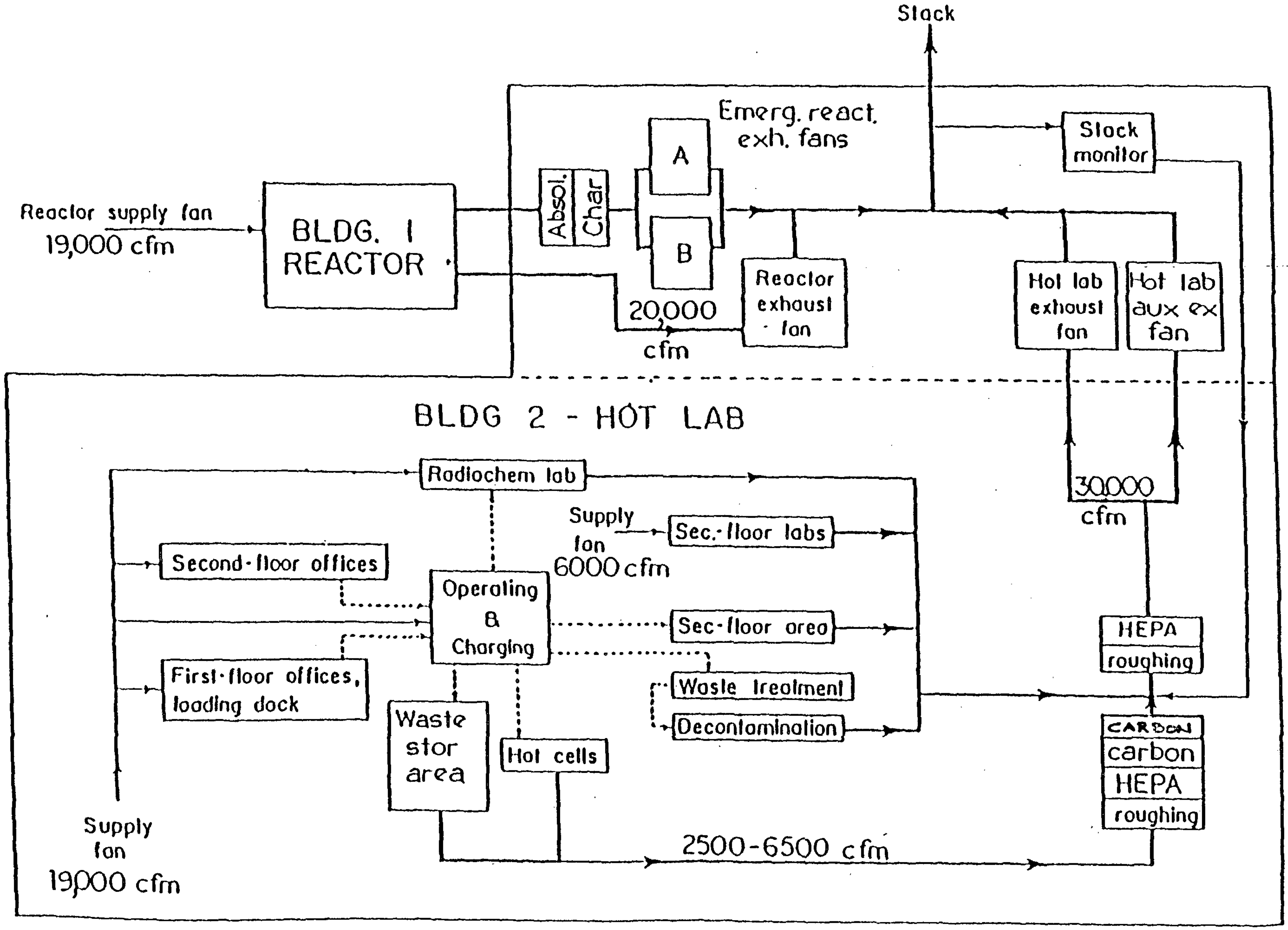

Figure 2.2. Schematic of Reactor and Hot Lab Air Flow.

floor.

The cells are maintained at a negative pressure with respect to the operating area and the charging area.

All exhaust air from the Hot Laboratory Building passes through roughing filters and absolute filters in the main filter bank prior to discharge, via the exhaust fan, to the stack. The exhaust air from the hot cells is prefiltered through roughing, HEPA, and charcoal filters. Exhaust air from all hoods or glove boxes is prefiltered through roughing and HEPA filters before it passes through the main filter bank. Charcoal filters are provided for hoods or glove boxes in which radioactive iodine is processed. The 50 horsepower exhaust fan, operating on normal power, has a capacity of 30,000 cfm against a head of 7.5 inches of water. In the event of a power failure, the fan is automatically switched onto an emergency power system (gasoline driven generator) and operates at 1/2 speed on this emergency power supply.

An auxiliary fan (5 horsepower) with a capacity of 8,000 cfm against a head of 3 inches of water is provided as backup for the 50 horsepower fan. This fan can be operated on either normal or emergency power.

If a rear door of any cell or the door to the decontamination room is opened, the flow of air can be increased by the adjustable louver dampers in the cell filter bank. Normal in-cell operations are not conducted unless normal ventilation is functional.

Exhaust air from the Hot Laboratory Building is added to the exhaust air from the reactor area and the combined flow discharges into a 4 foot diameter vent header which leads to a stack. Its base is located on a ridge at an elevation of 945 feet. The stack is 50 feet high and the top of the stack is at an elevation of 995 feet, about 187 feet above the main floor of the Hot Laboratory Building.

This page is intentionally blank.

3.0 POTENTIAL FAILURE MODES

This section contains a description of the failure modes, caused by a potential seismic event, that have been identified for each of the structures and/or mechanical components described in Section 2.0. An evaluation of the seismic response characteristics of each of these structures and/or mechanical components for each pertinent failure mode are contained in Section 4.0.

3.1 HOT CELLS

Three potential failure modes have been identified that directly involve the Hot Cells. These involve the collapse or major cracking of the concrete walls of the cells, the opening up of penetrations and the tipping over and/or rupture of certain apparatus inside a cell.

The collapse or cracking of the concrete walls of the cells to the extent that the exhaust system could not keep the pressure inside the cells less than that of surrounding areas would constitute a major structural failure and, as discussed further in Section 4.0, would be highly unlikely since the exhaust system is designed to keep the pressures at proper levels even with access doors into the cells open.

The opening of penetrations to the extent that the exhaust system could not keep the pressure inside the cells less than that of surrounding areas is also considered to be highly unlikely since, as noted above, the exhaust system is designed to keep pressures at proper levels even with large openings into the cells. However, as discussed in Section 4.0, the possible enlargement of openings in or near penetrations is considered to be more likely than the complete failure of the concrete cell walls, floor or ceiling.

The tipping over or rupture of certain apparatus inside the Hot Cells during an earthquake is considered to be a viable failure mode for those situations in which the apparatus contains contaminated material in such a form (e.g., liquid or gas) that it might flow out of the cell into surrounding areas and, ultimately, beyond the site boundary even if the exhaust system were operating or if the exhaust system were inoperative for a short time.

3.2 CANAL

Two potential failure modes have been identified that involve the canal between the Hot Cells and the reactor pool. These include the rupture of the canal walls and/or floor and the dropping of a heavy object into the canal.

The rupture or severe cracking of the canal walls and/or floor could possibly permit water in the canal to be released. However, a significant release of this type is considered to be highly unlikely since the canal has been built directly on bedrock and, as such, there would be no place for the water to go once it left the immediate area of the building. Furthermore, such a release of water would probably be slow enough that the canal could be kept full of water through the use of external emergency sources of water under any conceivable failure scenario.

Such a release, if sufficiently large, would expose contaminated materials that were either stored in the pool or being moved through the pool. Furthermore, such a release, if sufficiently large, might expose a direct path for air to flow from inside Hot Cell 1 to the area inside the Hot Laboratory Building adjacent to the canal since the hatch between the canal and Hot Cell 1 is usually left open.

The dropping of a heavy object into the canal might result either from the collapse of the Hot Laboratory Building in such a way that pieces of roof and/or walls could fall into the canal or by a failure of one of the overhead monorail crane supports in the area of the canal. While this failure could result in severe damage to the Hot Laboratory Building, it would probably not result in the release of contaminated materials unless the object ruptured a highly radioactive container being stored in the canal.

3.3 WASTE STORAGE AREA

The rupture of the reinforced concrete structure surrounding the radioactive materials stored under the floor of the waste storage area could result in the release of contaminated materials to the inside of the Hot Laboratory Building and ultimately to the site boundary if the building perimeter was penetrated during the seismic event. It should be noted that a release of the type noted here is considered to be highly unlikely since the contaminated materials are always stored in drums and since the storage drums are qualified to survive transportation to their ultimate storage location.

3.4 EXHAUST SYSTEM

Three potential failure modes have been identified that involve the exhaust system. These involve the failure of the exhaust fans, the filters or filter mounting structures, and the exhaust system ductwork.

A failure of either the primary or the backup exhaust fan would permit pressures inside the Hot Cells to equalize with pressures in the operating and charging areas and would result in possible leakage of contaminants from the Hot Cells into these adjacent areas in the facility. Any such leakage could eventually migrate to the site boundary, especially if the outer walls of the Hot Laboratory Building collapse.

A failure of the filter system could potentially be very serious since such a failure could permit contaminants to be quickly forced by the exhaust fans to flow from the contaminated area directly out the stack and to the site boundary. The seriousness of this potential failure is, in many situations, reduced somewhat since several failures must often occur at the same time to cause the failure. For example, two sets of roughing, HEPA and charcoal filters have been placed in series in the flow path between the Hot Cells and waste storage area and the exhaust fan (See Fig. 2.2). Both sets of filters would have to fail before the contaminants would have a completely free flow path through the system.

4.0 ESTIMATED SEISMIC RESPONSE CHARACTERISTICS

The seismic response characteristics presented in this section have been generally determined on the basis of a comparison with the seismic response characteristics of similar structures/mechanical components that have previously been evaluated or through the use of simplified, but conservative structural analysis techniques. A rather thorough evaluation of the seismic response characteristics of the hot cells and adjacent structures in Building 102 of the General Electric Vallecitos Nuclear Center (GEVNC) which is located in the Vallecitos Valley of California near San Francisco Bay was performed for the NRC by the Los Alamos Scientific Laboratory (LASL) and a several other contractors. The results of this evaluation are used extensively in the following discussion since the Vallecitos facility was subjected to a more severe seismic event than is expected at the site of the Sterling Forest Research Center.

A maximum ground acceleration level for the site of the Hot Laboratory Building has been specified by the NRC staff to be 0.2 g's. Consequently, only potential structural failures that could occur under seismic loads from earthquakes of magnitude less than 0.2 g's are considered to be possible structural failures of interest during the evaluation presented in this section.

4.1 HOT CELLS

As noted in Section 2.2, the walls and ceiling of the hot cells are constructed of 4 foot thick reinforced concrete. The floor under the cells is constructed of 12 inch thick reinforced concrete which rests on concrete fill that is at least 22 inches thick. The concrete fill rests on bedrock.

Since the hot cells at the GEVNC are constructed of 3 foot thick reinforced concrete and since these cells are shown in [1-4] to be capable of withstanding concurrent surface faulting and vibratory ground motion (shaking) in excess of 0.2 g's, it is concluded that no structural failure to the reinforced concrete walls, floor and ceiling of the hot cells at the Sterling Forest facility will occur at earthquake levels below the maximum expected level of 0.2 g.

As discussed in Section 3.1, the opening of penetrations through the hot cell walls to an extent that significant radioactive materials will migrate to the site boundary is considered highly unlikely unless the exhaust system fails. Even if the exhaust system fails, such a migration of radioactive materials will probably not occur unless the outer walls of the hot laboratory building collapse or are severely penetrated. Experience gained while evaluating other existing facilities of similar size, shape and construction suggest that these outer walls should not completely collapse at earthquake acceleration levels of less than 0.2 g. However, it is possible that masonry block walls of the type used to build some of the outer walls of the Hot Laboratory Building might crack and locally fail at earthquake acceleration levels between 0.10 g and 0.20 g.

The tipping over of apparatus inside a hot cell is considered to be highly unlikely at earthquake acceleration levels of less than 0.2 g since the massive weight of the cells would not permit significant enough motion to occur to cause such tipping. Even if such tipping does occur, no significant release of radioactive materials should be expected since most of the containers used in the hot cells are made of materials that will not rupture under the type of routine handling that can be expected to occur in a hot cell in which manipulators are used.

4.2 CANAL

Except for a portion of the canal at its east end adjacent to the hot cell area, the canal is completely surrounded by heavily reinforced concrete floor, walls and ceiling. These heavily reinforced structures are not expected to fail until acceleration levels are significantly higher than 0.2 g.

The portion of the canal immediately adjacent to the hot cell area is covered by a six inch thick concrete floor slab which is in turn supported by steel beams. Since the beams in this area are supported between the hot cells and the heavily reinforced concrete roof over the canal, it can safely be assumed that the roof will not fail until acceleration levels exceed the maximum expected acceleration level of 0.2 g.

The only structures/equipment identified that can fall into the canal are the one ton monorail crane that runs down the length of the canal and the ten ton monorail crane that crosses the canal in the area immediately adjacent to the hot cells. A failure of this latter crane is more likely than the former one since the roof over the east end of the canal is somewhat weaker than that over the rest of the canal. However, the failure of either crane under earthquake ground acceleration levels of less than 0.2 g is considered to be unlikely since the roof structures supporting the cranes are not expected to fail until accelerations exceed 0.2 g. Although very few details are available concerning the design of either of these monorail cranes, is can be noted that most cranes of this type will survive earthquakes of nearly the same magnitude as those earthquakes which will cause major damage to the structures supporting the cranes.

4.3 WASTE STORAGE AREA

As discussed in Section 3.3, a radioactivity release from the waste storage area is considered to be highly unlikely, especially at ground acceleration levels below 0.2 g. The reinforced concrete floor, walls and roof over this storage area should withstand earthquake levels much greater than 0.2 g without serious cracking or rupture. Furthermore, if such a failure does occur, the containers stored in the storage cells would undoubtedly survive without failure since they are designed to survive loads that might be endured during the transporting of the containers to their ultimate storage location.

4.4 EXHAUST SYSTEM

The primary exhaust fan is not expected to fail until earthquake ground accelerations are significantly greater than 0.2 g. This fan is supported on the ground floor of the Hot Laboratory Building through vibration isolators. Since the foundation for this floor is supported directly by bedrock, the seismic excitation level at the base of the exhaust fan vibration isolators should not exceed 0.2 g. The acceleration levels inside the exhaust fan and inside the exhaust fan motor should consequently not be expected to be as high as the accelerations to be expected during the normal operation of the fan.

The backup exhaust fan is located on the roof above the primary exhaust fan and, as such, will probably fail at a lower earthquake level than will the primary exhaust fan. Therefore, this backup fan should not be considered to be a backup for use in an earthquake situation.

The failure of either one of the several filters or their supporting structures could prove to be one of the potentially most serious failures in the event of an earthquake. This type of failure might include the opening up of a flow path through a filter after a severe shaking of the filter or the opening up of a flow path around the edge of a filter where it is mounted to the walls of the filter room. Conservative stress analyses made of typical mounts between filters and their supporting structures suggest that threshold seismic levels for failure of such mounts would have to be on the order of at least 1.0 g. Although the detailed design of the various filters used in the Hot Laboratory Building are unknown, it does not seem reasonable to expect that these filters would fail at acceleration levels lower than those which would fail their mounting structures.

The complete collapse of the ductwork between the hot cells and the filters and the exhaust fan would result in a failure of the exhaust system. A failure of this type would not be expected during an earthquake unless large ground slippage or faulting (e.g., more than one foot) occurred directly under the building. This type of large ground displacement is not expected to occur in the bedrock surrounding this building and, consequently, the possibility of having this type of failure is considered to be remote.

This page is intentionally blank.

5.0 CONCLUSIONS

This section contains significant conclusions that have resulted from the seismic evaluation contained in this document. The most significant conclusion is that no potential failure has been identified that would be caused by an earthquake ground acceleration level of less than 0.2 g.

While no failure has been identified as resulting from earthquakes of less than the expected maximum ground acceleration level, several of the most likely system failure scenarios have been identified. The most significant of these scenarios are summarized below.

A most serious failure scenario would be one in which the filters failed and the remainder of the exhaust system did not fail. This would result in radioactive materials passing directly through the exhaust system, out the stack, and eventually to the site boundary. This failure is not expected to occur at earthquake levels of less than at least 1.0 g.

Another serious failure scenario would be one in which the exhaust system fails due to collapse of its underground ductwork or the complete failure of the exhaust fans and the corresponding collapse or serious penetration of the external concrete block walls of the Hot Laboratory Building. While these concrete block walls might fail at ground acceleration levels of slightly less than 0.2 g, the failure of the exhaust system is not expected to occur until ground accelerations reach far higher levels.

It is unlikely that a serious failure in the area of the canal will occur. A significant failure of the walls and/or floor of the canal such that the water will flow out of the canal is not expected due to their heavily reinforced construction and the fact that the canal is built over bedrock. There is some possibility that an overhead monorail crane might fall into the canal and rupture a container stored in the bottom of the canal that contains radioactive material. Such a failure is not expected to occur until ground acceleration levels exceed 0.2 g.

No failure has been postulated for the Waste Storage Area under any credible ground acceleration level due to the construction of this underground storage area and the fact that the waste material is stored in containers designed to survive transportation loads.

This page is intentionally blank.

6.0 REFERENCES

This section contains a list of documents and drawings that were reviewed during the preparation of this TER. The reference documents are listed in Section 6.1 and the list of drawings is contained in Section 6.2.

6.1 REFERENCE DOCUMENTS

The following documents were reviewed during the preparation of this TER.

1. Endebrock, Elton G., "Seismic Evaluation of Building 102 of the General Electric Vallecitos Nuclear Center," Prepared by Los Alamos Scientific Laboratory for Winston Burkhardt of the U.S. Nuclear Regulatory Commission, date unknown.

2. "Structural Condition Documentation and Structural Capacity Evaluation of Building 102 of the General Electric Company Vallecitos Nuclear Center, Task II - Structural Capacity Evaluation," Prepared by Engineering Decision Analysis Company, Inc. for the Nuclear Test Engineering Division, Lawrence Livermore Laboratory, Report No. EDAC 175-060.01, March 17, 1978.

3. Letter Report from N. M. Newmark and W. J. Hall, Nathan M. Newmark, Consulting Engineering Services, to Winston Burkhardt, NRC Fuel Reprocessing and Recycle Branch, Division of Fuel Cycling and Material Safety, "Seismic Evaluation of Building 102 at Vallecitos Site Contract NRC-03-78-150," September 29, 1980.

4. "Analysis of Structural Consequences of Fault Displacement Through RML Cells of Building 102, General Electric Nuclear Facility, Vallecitos, California," Prepared by Engineering Decision Analysis Company, Inc. for the Nuclear Test Engineering Division, Lawrence Livermore Laboratory, Report No. EDAC 175-061.1, March 1978.

5. The Effects of Natural Phenomena on the General Electric Company, Vallecitos Nuclear Center at Pleasanton, California, Docket No. 70-754, U. S. Nuclear Regulatory Commission, NUREG-0866, December 1981.

6. "Environmental Impact Appraisal, Union Carbide Corporation, Medical Products Division, Tuxedo, New York," related to License Renewal of Special Nuclear Materials License No. SNM-639, prepared by NRC Division of Fuel Cycle and Material Safety, May 1983.

7. "SNM-639 License Renewal Supporting Documentation (Draft)," prepared by Union Carbide Corporation, Sterling Forest Laboratory, Tuxedo, New York, August 8, 1983.

6.2 LIST OF DRAWINGS

The following drawings were reviewed during the preparation of this TER.

- Drawings prepared by The Osborn Company, Architect-Engineering, of Cleveland, Ohio:

Drawing Number	Title
6847-1-A1, Rev. 11	Reactor Building - Plan at Elev. 808'-3"
6847-1-A4, Rev. 11	Reactor Building - Sections and Elevations
6847-1-M204, Rev. 11	Embedded Reactor Ductwork
6847-1-S108, Rev. 11	Reactor Building - Canal Plan and Sections
6847-1-S109, Rev. 11	Reactor Building - Canal Sections and Details
6847-2-M8, Rev. 16	Hot Laboratory, Exhaust Fan Room Plan, Sections and Details
6847-2-A1, Rev. 12	Hot Laboratory, First Floor Plan - Elev. 808'-3"
6847-2-A2, Rev. 12	Hot Laboratory, Upper Floor Plans
6847-2-A3, Rev. 11	Hot Laboratory, Elevations
6847-2-A4, Rev. 11	Hot Laboratory, Building Sections
6847-2-A5, Rev. 11	Hot Laboratory, Wall Sections
6847-2-A6, Rev. 13	Hot Laboratory, Toilet Rooms and Office Plans
6847-2-A7, Rev. 11	Hot Laboratory, Stair No. 2 and No. 3 Plan and Details
6847-2-A8, Rev. 12	Hot Laboratory, Entrance Stair and Details
6847-2-A9, Rev. 14	Hot Laboratory, Door Schedule and Details
6847-2-A10, Rev. 1	Hot Laboratory, Miscellaneous Details
6847-2-A11, Rev. 11	Hot Laboratory, Miscellaneous Details
6847-2-M1, Rev. 13	Hot Laboratory, First and Second Floor General Plans
6847-2-S1, Rev. 11	Hot Laboratory, Roof, Floor and Crane Girder Plans
6847-2-S2, Rev. 10	Hot Laboratory, Sections and Elevations

Drawing Number	Title
6847-2-S3, Rev. 10	Hot Laboratory, Section Column Schedule and Crane Girder Details
6847-2-S100, Rev. 12	Hot Laboratory, Foundation Plan and Details
6847-2-S101, Rev. 11	Hot Laboratory, Enlarged Plan and Details - Cell Foundations
6847-2-S102, Rev. 12	Hot Laboratory, Enlarged Plans and Sections - North End
6847-2-S103, Rev. 12	Hot Laboratory, Wall Elevations and Sections
6847-2-S104, Rev. 11	Hot Laboratory, Sections of Waste Treatment and Storage Room
6847-2-S105, Rev. 12	Hot Laboratory, Foundation Sections and Ground Floor Plan
6847-2-S106, Rev. 12	Hot Laboratory, Enlarged Plan of Hot Cells
6847-2-S107, Rev. 12	Hot Laboratory, East Wall Elevation and Sections of Hot Cells
6847-2-S110, Rev. 12	Hot Laboratory, Misc. Hot Cell Details
6847-2-S111, Rev. 12	Hot Laboratory, Details of Sleeves and Plugs
6847-2-S112, Rev. 12	Hot Laboratory, Foundation Sections and Details
6847-2-S113, Rev. 13	Hot Laboratory, Floor Slab Plans and Sections
6847-2-S108, Rev. 12	Hot Laboratory, Cross-Sections and Details - Hot Cells
6847-2-S118, Rev. 11	Hot Laboratory, Plant Sections of Exhaust Ducts
6847-L1, Rev. 7	Plan of Topography
6847-M11, Rev. 12	Hot Laboratory, HV & AC Air Flow Diagram
6847-S110, Rev. 12	Plan and Elevations of Exterior Exhaust Ducts and Stack

- Drawings prepared by Union Carbide Corporation, Corporate Research Laboratory, Tuxedo, New York:

Drawing Number	Title
E-101250D	Filter Room

o Drawings prepared by Bertram J. Cross Architect, P.C.:

Drawing Number	Title
1	Partial Plot Plan - Storage Facility
2	Floor Plan
3	Elevations
4	Building Sections
5	Foundation - Storage Facility
5R	Revised Cell Layout
6	Details
M-1	Revised Mechanical Exhaust Ducts
S-1	Structural - Storage Facility
None	Cell Plug and Form Detail (2 Versions)
101555	Mechanical Exhaust System