GPU Nuclear

TER 15737-2-G03-104 REV. 4

ISSUE DATE March 8, 1985

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TMI-2

DIVISION

TECHNICAL EVALUATION REPORT

FOR

Containment Air

Control Envelope (CACE)

COG ENG C.L. Rid DATE 3/8/85

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COG ENG MGR. C.L. Rid for R.L. Rider DATE 3/8/85

NO	DATE	REVISIONS	BY	CHECKED	GROUP SUPERVISOR	MGR. DESIGN ENGINEERING
4	6/6/85	Revised and Issued for Use				
3	3/8/85	Revised and Issued for Use				
				CHIEF ENGINEER NA		

Rev.	SUMMARY OF CHANGE
0	Issued for Use
1	Revised and Issued for Use
2	Revised and Issued for Use
3	Revised to reflect changes in the operation of the containment purge system, to clarify the radiation monitoring equipment and to reflect revised isotopic distribution.
4	Revised to allow operational controls over surface radioactivity limits, and airborne radioactivity limits prior to opening the roll up door.

SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.
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REVISION STATUS SHEET

BECHTEL

DOCUMENT TITLE: Technical Evaluation Report for Containment Air Control Envelope

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Containment Air Control Envelope
Technical Evaluation Report
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1.0 INTRODUCTION

1.1 General

The Containment Air Control Envelope (CACE) provides space to mobilize equipment and materials needed to support the in-containment activities through defueling. Location of the CACE at the equipment hatch allows equipment and materials to be moved into and out of the containment building with a minimum of difficulty through the equipment hatch airlock doors. The CACE will serve as an aid in the control of the spread of contamination and airborne radioactivity during those times when the airlock doors are opened in accordance with procedures approved by the NRC.

This report does not apply to removal of the equipment hatch. A separate report will be prepared for removal of the equipment hatch.

1.2 Organization of Report

This report is organized as follows:

After this introduction, a description of the design and operational considerations is presented. This is followed by a discussion of the safety issues associated with the facility. The report concludes with the safety evaluation required by 10 CFR 50, paragraph 50.59, "Changes, Tests and Experiments."

1.3 Conclusion

The evaluation of the safety concerns detailed in this report results in the following conclusions:

- o The CACE fulfills the need for a facility which allows a large entryway into and out of the containment while acting as an aid in the control of the spread of contamination and airborne activity.
- o The construction and operation of the facility is not an unreviewed safety question as defined in 10 CFR 50 paragraph 50.59.

2.0 FACILITY DESCRIPTION

2.1 Purpose of the Facility

The CACE is used as a staging/packing area for materials and equipment requiring transfer into or out of the reactor building, while helping to control airborne releases from the reactor building. Contaminated material may be wiped down, wrapped, or otherwise protected prior to being brought into the CACE to ensure surface radioactivity does not exceed limits established by the Radiological Controls Department. 4

This building is temporary and is not designed to satisfy the criteria for a permanent TMI Unit 2 facility. The CACE is not designed to function as a storage area for radioactive waste, but will be used to temporarily stage radioactive material.

2.2 Summary Description

2.2.1 Location

As shown on Figure 1, the CACE is located southwest of the Unit 2 reactor building at the equipment hatch. The building is built on top of the existing control building area roof slab at the 305' elevation.

Access through the CACE personnel or roll-up door or through the M-20 area (El. 280'-6" of the control building area) is controlled by Radiological Control Procedures.

2.2.2 Design Basis

The facility helps to control the releases of contamination and airborne radioactivity from the reactor building when both the equipment hatch airlock doors are open in accordance with procedures approved by the NRC. It also controls particulate releases from contaminated materials brought into the CACE from the reactor building. The CACE is a temporary facility which will be removed or upgraded to satisfy the criteria for a permanent TMI Unit 2 facility prior to plant restart.

The CACE structure is classified as Important to Safety for fire protection only. The HVAC equipment is classified as Not Important to Safety; however, the ventilation exhaust monitors are classified Important to Safety as the exhaust path is a release point. | 3

The CACE is designed for the probable natural phenomena as required by the local building codes. It does not have as part of its design basis the severe natural phenomena used for permanent nuclear power plant structures. These severe natural phenomena, such as tornadoes, safe shutdown earthquakes (SSE), and probable maximum floods, are not postulated to occur during the short-term design life of the CACE.

The CACE is designed to conform with 10 CFR Part 20.1 (c). This ensures that personal exposures associated with the CACE are ALARA. Transit and short-term staging of contaminated material in the CACE contributes to keeping exposures ALARA. In addition, access to the building will be controlled in accordance with the Radiological Control Procedures in effect at TMI Unit 2.

2.2.3 Building Description

The CACE, shown in Figures 2 and 3, is located adjacent to the reactor building. It is attached to the missile shield door

structure and the control building area roof slab which are seismically separated from the reactor building. The missile shield door will be rolled back as shown in Figure 3 and the joints between the door structure and the adjacent structures will be sealed. The missile shield door will remain rolled back for the duration of CACE use. The building has a structural steel frame with 2-hour fire rated metal siding for a fire from outside the CACE. The roof is non-fire rated galvanized metal decking. Access to the CACE is through a personnel door located on the north side of the building and a 27' roll-up truck door on the west side of the building. Personnel can also gain entry through the M-20 area and through the equipment hatch airlock from the reactor building. Interior surfaces of the CACE are covered with sheet metal for ease of decontamination.

2.3 Major Systems

2.3.1 HVAC

2.3.1.1 Design Bases

The CACE HVAC design assures the following:

a. Minimize the exfiltration of airborne contaminants to the outside environment
b. Maintain the concentration of airborne particulate in the CACE below the limits defined in 10 CFR 20, Appendix B for 40 hour occupancy
c. Direct air flow from the outside, through the CACE and into the reactor building
d. Maintain a negative pressure inside the CACE with respect to the outside environment
e. Limit differential pressure across the CACE walls to a maximum of 2 inches w.g.
f. Operate in a manner not to reduce the reactor building average air temperature below 50°F
g. Provide ventilation for the CACE

2.2.1.3 System Description

2.3.1.3.1 General Description

The CACE HVAC System consists of two filtered exhaust units, their associated ductwork, dampers, controls and three pressure relief intakes. The system interfaces with the reactor building purge system on an operational basis when both equipment hatch airlock doors are open. The purge system maintains the reactor building atmosphere at a slightly higher negative pressure than the CACE to induce air flow from the outside, through the CACE and into the reactor building. There is no physical connection between the two ventilation systems.

The filtered exhaust system has three functions--to provide internal cleanup of the CACE atmosphere; to inhibit exfiltration by exhausting the building inleakage; and to reduce the amount of airborne particulate released to the environment. This system will be operated only when one or both equipment hatch airlock doors are closed. The exhaust units take inlet air from the CACE atmosphere, process the exhaust through a prefilter and HEPA filters, and discharge to the outside environment. The ventilation exhaust will be monitored for particulates in compliance with the Recovery Operations Plan. The HEPA filters will not be shop tested, but will be DOP tested in place.

Counterweighted pressure relief dampers are provided to limit differential pressure across the CACE walls to a maximum of 2 inches w.g. (negative pressure inside the CACE with respect to the outside environment). The dampers provide pressure relief to protect the structure.

Supplemental heating and cooling equipment will be provided for use, if required, to maintain a suitable environment for personnel and equipment.

2.3.1.3.2 System Operation

EXHAUST SYSTEM - The filtered exhaust system will be operated, when one or both equipment hatch airlock doors are closed, when it is necessary to remove any airborne particulate contamination that may be present in the CACE. The system is started by a local handswitch. Normally one unit will be operated at a time, but both filter units may be operated simultaneously if required. The exhaust system need not be operated when the roll-up truck door is open.

The exhaust system unit takes inlet air from the CACE atmosphere, processes the exhaust through a high efficiency prefilter and HEPA filters before discharging to the outside environment. An isolation damper is provided in each exhaust duct and each exhaust duct is isokinetically sampled for particulate activity. The radiation monitor is provided with local readout and alarm. Actuation of the alarm trips the filter unit and closes the isolation damper on high radiation. The handswitches provided on each filter unit may also be used to initiate building isolation.

PRESSURE RELIEF - Actuation of the relief mode is initiated by counterweighted pressure relief dampers set to open when differential pressure across the CACE walls exceeds 0.75 inches w.g. The dampers are provided for pressure relief only to protect the structure. The dampers will normally be closed.

SUPPLEMENTAL HEATING AND COOLING - Supplemental heating and cooling units will be operated, if required, to maintain a suitable environment for personnel and equipment. The heating and cooling

units will be portable and will be operated independently of the CACE ventilation system. When operating, the units will also be used to circulate air in the CACE when one or both equipment hatch airlock doors are closed. Heating equipment will maintain a minimum temperature of 50°F in the CACE during winter. This equipment will be configured to ensure no release pathway is created from the CACE to the environment.

REACTOR BUILDING PURGE SYSTEM - Whenever both equipment hatch personnel airlock doors are open, the reactor building purge system will be operated in one of two modes.

In the first mode the reactor building purge exhaust system is operated to maintain a minimum capture velocity (200 fpm) through the open airlock in order to prevent uncontrolled outflow from the reactor building. This mode is to be used only when the CACE doors are to be maintained open. 3

In the second mode the reactor building purge exhaust system is operated in a manner that maintains a negative pressure in the reactor building and CACE. To maintain the CACE at a negative pressure slight enough to avoid opening the CACE relief dampers, one or both purge supply train isolation dampers may also be opened.

2.3.2 Other Major Systems

Electrical

Electrical service is provided to supply power for lighting, receptacles and electrically operated equipment. All electrical systems and the metal structure are grounded.

Communications

Communications systems consist of surveillance cameras, a sound powered phone and dedicated P.A. system linked directly to the command center and/or the control room.

Radiation Monitoring

A mobile airborne particulate monitor with local alarm, readout and recorder is provided for monitoring local air activities. Each exhaust fan has a constant air monitor with local readout and alarm. No permanent area radiation monitors are planned to be installed in the CACE since the radiation levels inside the CACE are expected to be low. Portable area radiation monitors will be added if required. 3

2.4 Equipment Hatch Removal

The CACE provides an area large enough to allow for removal and reinstallation of the equipment hatch. The roll-up truck door has

been provided to allow removal of the equipment hatch from the CACE. The initial use of the CACE will only utilize opening of the airlock doors and will not utilize removal of the equipment hatch.

3.0 TECHNICAL EVALUATION

This section summarizes the licensing issues which were considered in the design of the CACE. These issues deal with the expected performance of the facility during normal operations and various design basis events.

The licensing issues associated with the operation of the CACE are:

- o Demonstrating compliance with 10 CFR Part 20 with respect to on-site dose limits.
- o Demonstrating compliance with 10 CFR Part 50, Appendix I, with respect to offsite radiation doses due to normal operations within the CACE.
- o Assessing the consequences of potential accidents in the CACE that could lead to radioactive releases to the environment.
- o Demonstrating compliance with the principles of ALARA.
- o Demonstrating that the design conditions specified in the TMI-2 General Project Design Criteria (GPDC) are satisfied.

Each of these issues is addressed in the following sections.

3.1 Dose Assessment and Accident Analysis

3.1.1 On-Site Dose Assessment

The CACE is designed for material handling activities that transfer material into and out of the reactor building. Measurements of the dose rate outside of the equipment hatch have been taken with the equipment hatch airlock doors closed and open. At a point approximately 6 ft. from the outer airlock door a dose rate of approximately .3 mrem/hr has been measured with the doors closed, while with both airlock open a dose rate of approximately .6(mrem/hr) has been measured. Since .6 mrem/hr is the limit for an unrestricted area as defined by 10 CFR Part 20, paragraph 105(b)(2) and material handling may result in an increase in the general area dose rate in the CACE to a level above the unrestricted area limit, access to the CACE will be controlled by Radiological Control Procedures.

The staging of contaminated material in the CACE will temporarily increase the inside and possibly the outside area dose rates. Therefore, any staging of contaminated material within the CACE will be controlled, monitored, and the operation reviewed prior to implementation in accordance with Radiological Control Procedures

on a case-by-case basis. This does not preclude the establishment of procedures or limits for tasks which are generic in nature, such as staging of contaminated trash from the reactor building.

3.1.2 Offsite Dose Assessment

3.1.2.1 Normal Operations

The handling of contaminated material in the CACE was evaluated to determine the resultant offsite doses. The only source for airborne radioactivity in the CACE will be the result of activities related to handling contaminated material from the containment. To assess this dose the following assumptions were made:

a. The maximum exposed contaminated surface area that will be staged through the CACE annually is equivalent to the surface area of 10,000 drums (20,957 square meters).

b. The surface contamination is 50,000 dpm/100 cm^2.

c. 10^{-3} of the surface contamination is released due to material handling. This release fraction is conservatively based on the airborne release fraction due to a fire.

d. No credit is taken for the CACE building or the CACE ventilation system.

e. Isotopic distribution of contaminated surface is 90.6% Cs137, 4.6% Cs134, and 4.8% Sr90. 3

Table 3-1 lists the estimated annual airborne releases based on the above assumptions.

The dose to the public was calculated for these releases based on the following parameters:

a. The nearest garden and milk cow are located 1.1 miles east of the release point. The corresponding meteorological dispersion and deposition parameters at this location are 6.91×10^{-6} sec/m^3 and $2.05 \times 10^{-8}/m^2$ for X/Q and D/Q, respectively, at this location. 3

b. The nearest residence is 0.5 mile east of the release point. The corresponding meteorological parameters are 2.57×10^{-5} sec/m^3 and $9.5 \times 10^{-8}/m^2$ for X/Q and D/Q, respectively, at this location.

c. The nearest milk goat is 1.2 miles north of the release point. The corresponding meteorological parameters are 7.83×10^{-6} sec/m^3 and $1.71 \times 10^{-8}/m^2$ for X/Q and D/Q, respectively, at this location.

d. The vegetable intake for the individual of interest is assumed to be from the location of the nearest milk cow and garden rather than from the nearest garden alone. This approach provides a higher calculated dose to the individual.

e. The dose rate from the ground plane source was calculated based on the location of the nearest residence as described in b. above.

The resulting annual dose to the maximally exposed individual is summarized in Table 3-2.

3.1.2.2 Contaminated Material Fire

For the purpose of evaluating the consequences of a potential fire in the CACE the following assumptions were made:

a. The maximum number of curies in the CACE at any one time is limited to 10 curies distributed as 90.6% Cs137, 4.6% Cs134, and 4.8% Sr90. | 3

b. A release fraction of 10^{-3} was used to estimate the airborne release based on the Atomic Energy Commission report, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," December 1972.

c. No credit was taken for HEPA filtration or the CACE building.

The resulting inhalation dose was calculated at the exclusion area boundary distance of 610 meters. The 1-hour meteorological dispersion parameter (X/Q) of 6.1×10^{4} sec/m^3 for a ground level release was used as discussed in Appendix 2D of the Three Mile Island Unit 2 Final Safety Analysis Report (FSAR). The resulting doses are tabulated in Table 3-3.

3.1.2.3 High Velocity Winds

From the TMI-2 FSAR, the design wind velocity, based on the 100-year recurrence interval, is 80 miles per hour at 30 feet above grade. The CACE is designed to withstand this condition.

An evaluation was conducted to assess the radiological consequences of a wind condition at the design wind velocity. Assumptions used in this analysis include the following:

a. The maximum number of curies in the CACE at any one time is limited to 10 curies distributed as 90.6% Cs137, 4.6% Cs134, and 4.8% Sr90. | 3

b. A conservative release fraction of 10^{-3} was used to estimate the airborne releases.

c. No credit was taken for the ventilation or the CACE building.

The resulting inhalation dose was calculated at the exclusion area boundary distance of 610 meters. The meteorological dispersion parameter of 6.8×10^{-6} sec/m^3 for an 80 mile per hour wind was used. The resulting doses are tabulated in Table 3-4.

3.2 Occupational Exposure

It is expected that the general area dose rates that will be experienced in the CACE will be less than 1 mrem/hr. This dose rate will result in a small, but uncalculated, occupational exposure. However, use of the CACE reduces personnel exposure below that which would occur if the CACE were not used. Worker exposure is reduced because the CACE provides a lower background area to stage and assemble large pieces of equipment which would otherwise have to be transported into the containment and assembled there. This same area will allow contaminated material from the reactor building to be placed in drums or LSA boxes in a low radiation area. This will result in lower occupational exposure for activities associated with the reactor building. The minimum number of persons needed to perform activities are assigned to ensure that total exposure is ALARA. Access and operations within the CACE are controlled by Radiological Control procedures.

3.3 Design Conditions

The design conditions which must be satisfied are specified in the TMI-2 GPDC. These fall into three categories: normal operation, incidents of moderate frequency, and infrequent incidents. Each of these categories is addressed below.

3.3.1 Normal Operations

Normal operation conditions are discussed in the previous sections. These operations will be carried out without unplanned or uncontrolled releases of radioactive materials to the environment as a result of:

- any radioactive material transferred into the CACE will be wiped down, wrapped, or otherwise protected to meet the limits established by the Radiological Controls Department. 4

- When both equipment hatch airlock doors are open, the air flow will be from the CACE into the containment, and exhausted to the environment through the containment purge exhaust system.

- Prior to opening the roll up doors, airborne radioactivity levels will be determined to be within acceptable limits as defined by the Radiological Controls Department. 4

3.3.2 Incidents of Moderate Frequency

The CACE and the equipment provided with the CACE serve no safety related functions and since there is no interface with any safety system, it will not interfere with the performance of any safety related feature. Therefore, loss of electrical power in the CACE, inadvertent actuation of a component provided with the CACE, single operator error associated with the operation of the CACE, or a single failure of an active component in the CACE will not endanger the health and safety of the public.

Failure of the reactor building purge system will not result in an uncontrolled release of radioactivity to the environment. Pressure relief dampers are provided to protect the CACE from too great a negative pressure. 3

Normal operations in the CACE will involve the handling of contaminated radioactive material. During the course of handling the packages there is the possibility that a package could be broken open. This would not result in an uncontrolled release of radioactivity to the environment because of the design of the HVAC system, discussed in Section 2.3.1. Releases of radioactivity to the environment would be minimized by the filters in either the containment purge exhaust system or filtered exhaust system provided with the CACE. The result of a package breaking open is enveloped by the normal release calculation.

3.3.3 Infrequent Incidents

Rupture of tanks and pipe breaks are not considered because no tanks or liquid lines will be installed in the CACE. A fuel handling incident occurring in the CACE is not considered because fuel handling in the CACE is not planned. During fuel handling in the containment, the airlock doors will be shut. This will ensure that releases of radioactivity to the environment will be within acceptable limits. The effect of fire and an operating basis earthquake are considered below.

3.3.3.1 Operating Basis Earthquake

In the event of an OBE, the CACE will not cause any damage to the reactor building because of the seismic expansion joint that separates the reactor building from the control building and the missile shield door structure to which the CACE is attached. The consequences of the collapse of the CACE on the control building roof slab are considered bounded by an aircraft impact, described in the TMI-2 FSAR.

3.3.3.2 Fire Protection

As noted in Section 2.2.2, opening both of the personnel airlock doors is accomplished by procedures approved by the NRC. The

existing procedure requires that when both airlock doors are open, someone is to be standing by to close the doors expeditiously in the event of an emergency. Should a fire occur in the containment when both of the airlock doors are open, one of the doors will be closed by the individual required by the procedure, and the control room notified, thereby reestablishing the containment boundary and preventing an uncontrolled release of radioactivity to the environment. The addition of the CACE will not change the reactor building fire boundary since the equipment hatch will remain installed.

4.0 SAFETY EVALUATION

10 CFR 50, paragraph 50.59, "Changes, Tests and Experiment," permits the holder of an operating license to make changes to the facility provided the change does not involve a modification of the plant technical specifications and the change is determined not to be an unreviewed safety question. As summarized below, the operation of the CACE does require a modification to the plant technical specifications but is not deemed to be an unreviewed safety question as defined in 10 CFR 50.

4.1 Technical Specifications/Recovery Operations Plan

Operation of the CACE with respect to staging contaminated material will require a change to the Technical Specifications and the Recovery Operations Plan to specify the CACE ventilation as a possible release point. These changes will be made prior to operation of the CACE in this mode. A Recovery Operations Plan already exists (4.6.1.3, Rev. 17) which specifies the conditions under which both airlock doors can be simultaneously opened. Since the opening of the airlock doors will continue in accordance with the existing procedures, the construction and operation of the CACE does not require changes to the existing Recovery Operations Plan, except for the new release point.

4.2 Safety Question

The CACE does not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report. The containment integrity will be maintained with the CACE installed in accordance with existing technical specifications. As can be seen from Figures 2 and 3, the CACE is supported by the existing hatch shield area (i.e., missile shield support structure). The CACE is attached to the missile shield door structure and the control building area roof slab which are seismically separated from the reactor building itself. There is no interface between systems provided in the CACE and any safety related systems. Therefore, the CACE will not impact existing safety related structures or systems and there will be no increase in the probability of an accident or malfunction of equipment important to safety.The

possibility of an accident or malfunction of a different type than any previously evaluated in the safety analysis report is not created by the existence of the CACE. This is due primarily to the passive nature of the facility and the ability to quickly reestablish containment integrity in the event of an emergency. Also, the operation of the CACE does not result in a reduction in the margin of safety as defined in the technical specifications since the CACE does not impact any systems covered in the technical specifications and any release of radioactivity from the CACE will be monitored for compliance with environmental technical specifications.

Based on the above, the CACE is deemed not to be an unreviewed safety question as defined in 10 CFR 50.

TABLE 3-1

CALCULATED ANNUAL AIRBORNE RELEASES FROM THE CACE

Radionuclide	Annual Release (curies)	
Cs-137	4.27×10^{-5}	
Cs-134	2.18×10^{-6}	3
Sr-90	2.26×10^{-6}	

TABLE 3-2

ESTIMATED ANNUAL DOSE TO THE MAXIMALLY EXPOSED INDIVIDUAL FROM RELEASES FROM THE CACE

I. Annual Dose from Inhalation, Vegetable Intake, Cow Milk, and Ground Plane

	Dose to Organ (mrem/yr)				
Age Group	Bone	Total Body	Lung	Skin	Liver
Adult	7.2E-4	4.1E-4	2.2E-4	1.9E-4	5.7E-4
Teen	8.6E-4	3.8E-4	2.6E-4	1.9E-4	6.2E-4
Child	1.4E-3	3.5E-4	2.8E-4	1.9E-4	9.2E-4
Infant	1.5E-3	3.0E-4	3.3E-4	1.9E-4	1.5E-3

3

II. Annual Dose from Inhalation, Vegetable Intake, Goat Milk, and Ground Plane

	Dose to Organ (mrem/yr)				
Age Group	Bone	Total Body	Lung	Skin	Liver
Adult	1.0E-3	6.4E-4	2.5E-4	1.9E-4	7.8E-4
Teen	1.4E-3	6.1E-4	3.3E-4	1.9E-4	1.2E-3
Child	2.5E-3	5.3E-4	4.0E-4	1.9E-4	1.9E-3
Infant	3.2E-3	4.7E-4	5.5E-4	1.9E-4	3.5E-3

3

INHALATION DOSE ESTIMATE AT THE EXCLUSION AREA
BOUNDARY FOR A FIRE IN THE CACE

Organ	Controlling Age Group	Dose (mrem)
Bone	Teenager	1.5E-0
Total Body	Adult	1.9E-1
Lung	Teenager	2.4E-1
Liver	Teenager	2.2E-1

3

TABLE 3-4

INHALATION DOSE ESTIMATE AT THE EXCLUSION
AREA BOUNDARY FOR A HIGH VELOCITY WIND

Organ	Controlling Age Group	Dose (mrem)
Bone	Teenager	1.7E-2
Total Body	Adult	2.1E-3
Lung	Teenager	2.7E-3
Liver	Teenager	2.4E-3

3

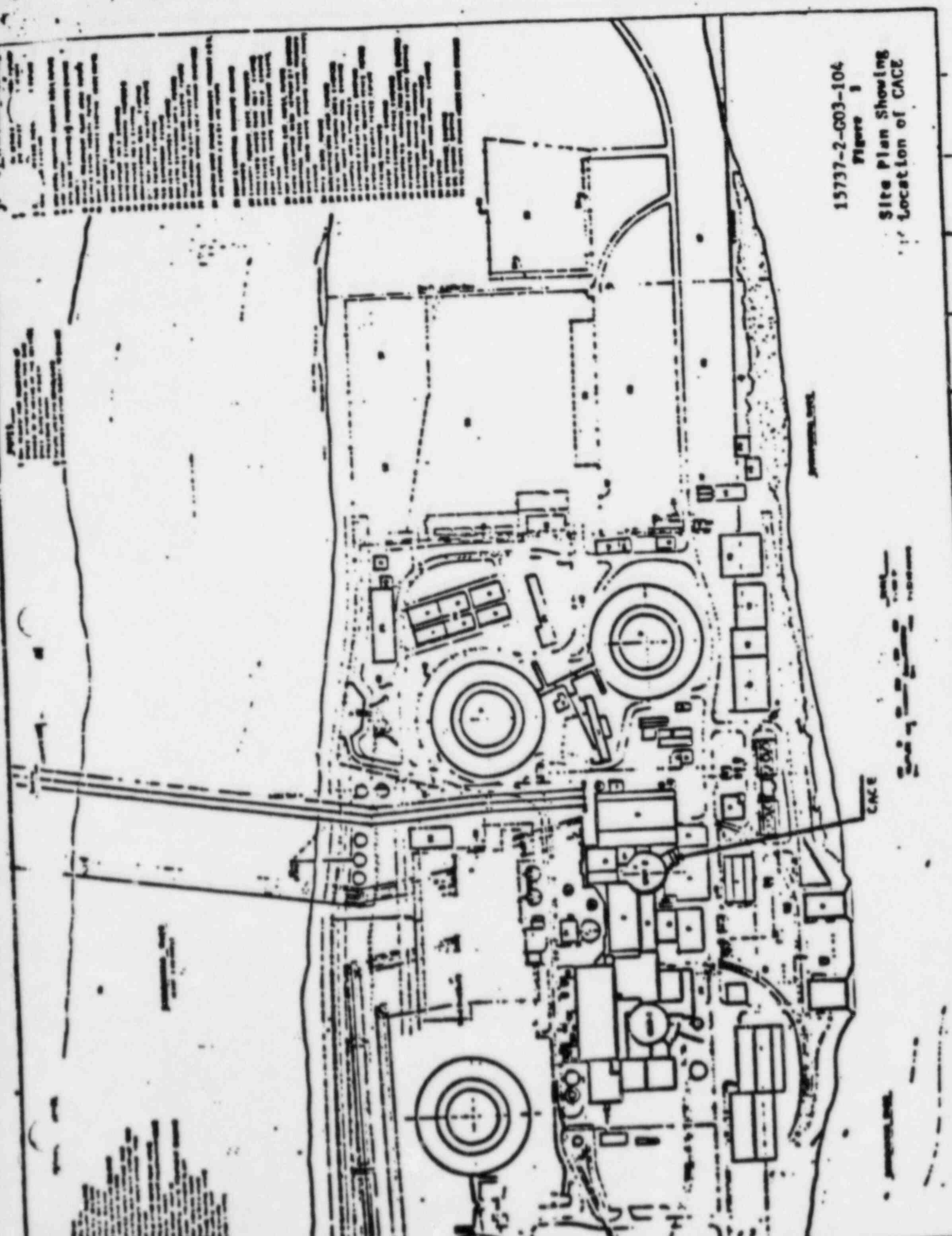

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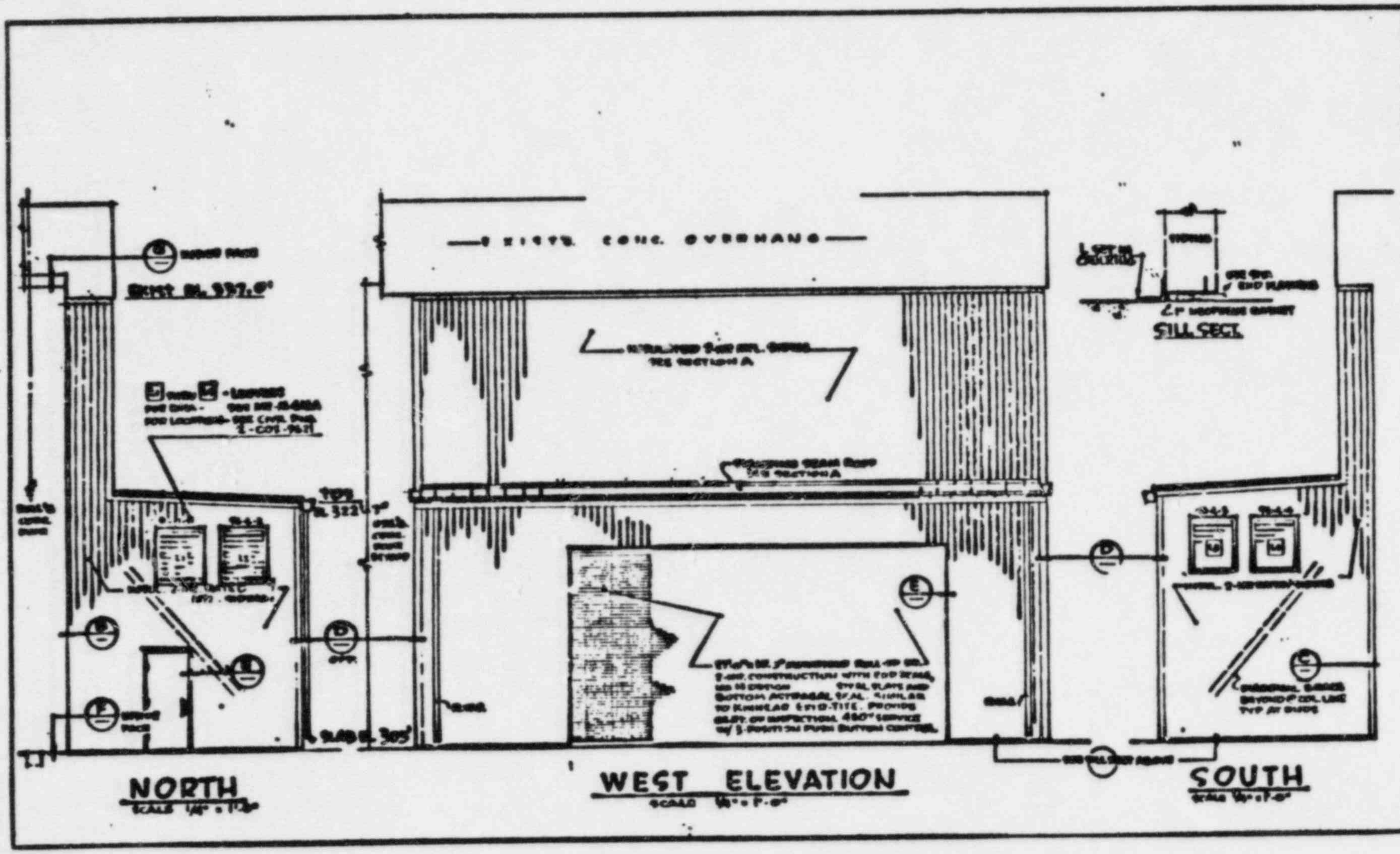
Figure 1
Site Plan Showing
Location of CACE

Figure 2

Containment Air Control Envelope



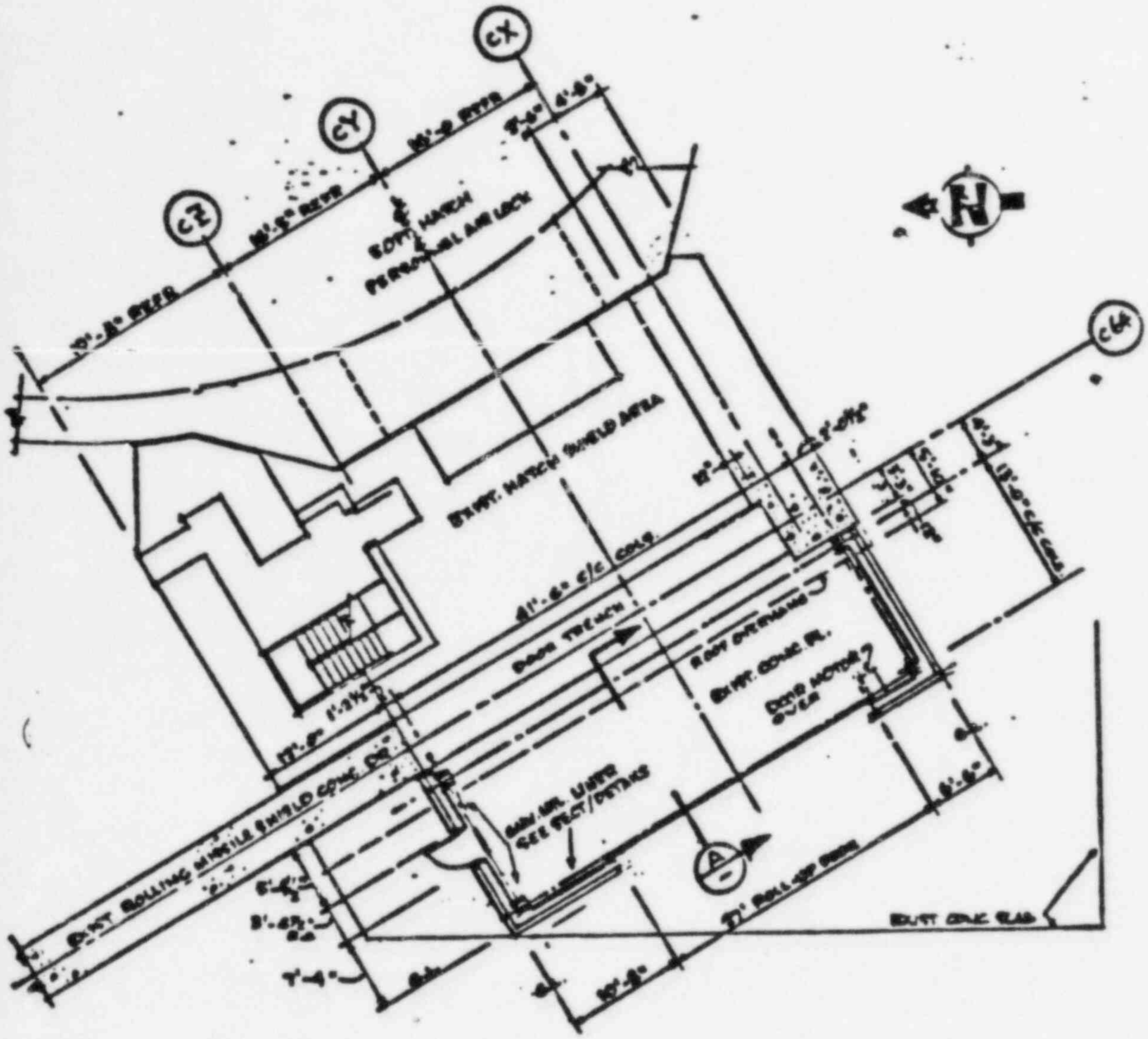


Figure 3

Containment Air Control Envelope