# FINAL REPORT ON THE
# DESIGN REVIEW OF PLANT SHIELDING AND
# ENVIRONMENTAL QUALIFICATION OF
# EQUIPMENT FOR SPACES/SYSTEMS
# OUTSIDE CONTAINMENT WHICH MAY BE
# USED IN POST-ACCIDENT OPERATIONS
# EDWIN I. HATCH NUCLEAR PLANT UNITS 1 AND 2

July 24, 1981

## I. INTRODUCTION

Item II.B.2 of NUREG 0737 (previously Section 2.1.6.b of NUREG 0578) requires that a comprehensive review of plant shielding be completed to assure that vital access areas within the plant are not rendered inaccessible due to high dose rates and that essential equipment is not degraded such that it fails to serve its safety function. The initial review was completed and transmitted to meet the required date of January 1, 1980.

The subject report identified certain areas within both Hatch Unit 1 and Unit 2 which were potential problem areas. Table 1 in the original report identified each of the potential areas. The result of the reevaluation of each of these areas is presented below in the order which they were identified on Table 1 of the original report.

## II. SUMMARY AND CONCLUSION

This evaluation completes the requirement as specified in Item II.B.2 of NUREG 0737. As explained in the original report a detailed component level review of all essential electrical equipment is being conducted under the auspices of I.E. Bulletin 79-01B and has not therefore been covered in depth within this report. If any deficiencies are identified under 79-01B they will be addressed in that report.

With the plant modifications outlined in this report, it has been determined that the areas addressed as potential problem areas in the original report are no longer considered problems. The plant modifications are designed and under revision. It is anticipated that the installation of shielding will be complete by January 1, 1982.

## III. CONTAINED SOURCE TERMS

The source terms which were used in the original evaluation were again used for the purposes of this evaluation. The following release fractions were used as a basis for determining the concentrations for contained sources:

Containment atmosphere: 100% noble gases, 25% halogens
Suppression chamber liquid: 50% halogens, 1% solids
Reactor steam: 100% noble gases, 25% halogens

The above release fractions were applied to the total curies available for the particular chemical species (i.e. noble gas, halogen, or solid) for an equilibrium fission product inventory for a light water reactor core.

The important modeling parameters, decay time and dilution volume obviously have an important affect on the shielding analyses. The following sections outline the rational for the selection of values for these key parameters.

A. Decay Time

For the purposes of developing a set of accident radiation zone maps no decay time was assumed. The zone maps (Figure 7 through Figure 14) are developed to be used as a tool by the plant staff along with a set of decay curves (Figures 5 and 6) to quantitatively assess the plant status quickly at any time following an abnormal occurrence.

For the purposes of evaluating personnel exposure in vital areas of the plant decay times consistant with the time for which access is required were used.

B. Dilution Volume

The volume used for dilution is important, affecting the calculations of dose rate in a linear fashion. The following dilution volumes were used with the release fractions and decay times indicated above to arrive at the final source terms for the review.

Containment atmosphere: Drywell and suppression chamber free volume

Suppression chamber liquid: The volume of the reactor coolant system plus the suppression chamber volume at its minimum allowable level.

Reactor steam: Reactor coolant system normal vapor volume.

IV. REACTOR BUILDING AIRBORNE SOURCE

In addition to the doses which are derived from the above sources an airborne activity source in the reactor building was evaluated. The airborne activity will give both gamma and beta dose rates but only gamma is of major concern since the beta radiation can be effectively shielded with protective clothing. Thyroid dose due to iodine inhalation is ignored since personnel will be expected to wear air packs.

A. Assumptions used in the analysis.

Listed below are the assumptions used to determine the gamma dose rate from the airborne activity:

Core Activity - Based on TID 14844 with core power level of 2550 MWt.

Core Release to Containment - 25% iodine
100% noble gases

Containment Volume - 256,000 cubic feet

RB Volume @ 130' - 0" El. - 299,300 cubic feet
Total - 1,056,000 cubic feet

Containment Leak Rate - 1.2 v/o per day

SGTS Exhaust Rate - two cases considered:

1) 3,000 cfm
2) 3,000 cfm (first 10 days); then 6,000 cfm thereafter

Inherent in this model is the assumption of complete mixing within the RB volume of the radioactivity leaked from the containment. The RB volume used does not include any of the common refueling floor volume which results in conservative concentrations. Also assumed was the continuous containment leak rate of 1.2 v/o per day which is conservative for the first day and very conservative for subsequent days post-LOCA.

2. Results of the analysis

The results of the analysis are presented in Table I.

TABLE I
Post-LOCA Airborne Gamma Dose Rates

| Time Post-LOCA (days) | Case A R/hr | Case B R/hr |
|---|---|---|
| 5 | 34 | 34 |
| 10 | 18 | 18 |
| 20 | 5.9 | 2.9 |
| 30 | 2.0 | 1.0 |

V. RESULTS OF THE REEVALUATION

A. Sample cask retrieval - Unit 2

1. Description of the Problem

The location of the sample cask for the liquid sample on Unit 2 was over the RHR corner room. The operator would have had to enter elevation 130' and disconnect the sample cask and remove it to the hot machine shop.

2. Results of the Evaluation

It was determined that an operator would receive a dose of 100 mr, without consideration of the airborne source, while disconnecting the sample cask and removing it from the 130' elevation to the hot machine shop. Although this dose is considered acceptable during the accident situation, the location of the sample cask will be changed due to the installation of the inline sample system. One inline sample system will be used for both Hatch Unit 1 and Unit 2. The sample cask will be located in the hot machine shop where the radiation level does not consistute a personnel or equipment hazard under the worst postulated accident conditions.

B. Access to elevation 130 in the Reactor Building

1. Description of the Problem

The original report indicated that general access to the 130' elevation of the Reactor Building in the area above the torus chamber was limited by the dose rate from the torus compartment which is shielded by a two (2) foot concrete floor slab. Access to specific areas was further limited by the core spray lines on both units which run through the 130' elevation with virtually no shielding. Subsequently the potential airborne

dose rate in the Reactor Building was found to be very high also.

2. Results of the evaluation

In order to improve access and limit the radiation dose received by equipment in the area of the core spray lines on elevation 130', appropriate portions of the lines will be shielded with one inch of steel. The degree to which they are to be shielded has been determined such that thirty(30) days after the postulated accident the dose rate from all of the contributing sources will not preclude an operator from making an inspection tour or performing some minor maintenance such as the replacement of a combination starter.

Providing for access thirty (30) days after an accident has been based on the following:

a) Access to the Reactor Building after an accident is not required for proper ECCS actuation and operation.

b) The airborne source in the Reactor Building would be largely dissipated.

c) The installation of core spray line shields required for access in thirty (30) days will not require major structural modifications to the building.

d) The installation of massive shields which are required for access prior to thirty (30) days is not practical from a construction point of view.

C. High radiation doses to equipment in the corner rooms where the RHR and RCIC pumps are located and in the HPCI rooms in the Reactor Building.

1. Results of the evaluation.

As indicated above all essential equipment is being evaluated at the component level under the auspices of I.E. Bulletin 79-01B. The equipment in the RHR, RCIC and HPCI rooms will be exposed to the maximum total integrated dose $1.86 \times 10^6$ rads, $2.4 \times 10^5$ rads and $2.4 \times 10^6$ rads respectively. If during the evaluation conducted for I.E. Bulletin 79-01B a component is found to be deficient corrective action will be detailed within that report. There is no personnel access required to these rooms to mitigate any accident condition.

D. Access to the areas inside the southern portion of the railroad air lock on Unit 1.

1. Results of the evaluation

The area outside the portion of the railroad airlock doors that are in a direct line of sight of the core spray line could be subjected to a high radiation field in the unlikely event of an accident. The station radiation operating procedures recognize this possiblity and require the area to be evaluated and access to be restricted as required.

E. Access to the area outside the truck door on Unit 2.

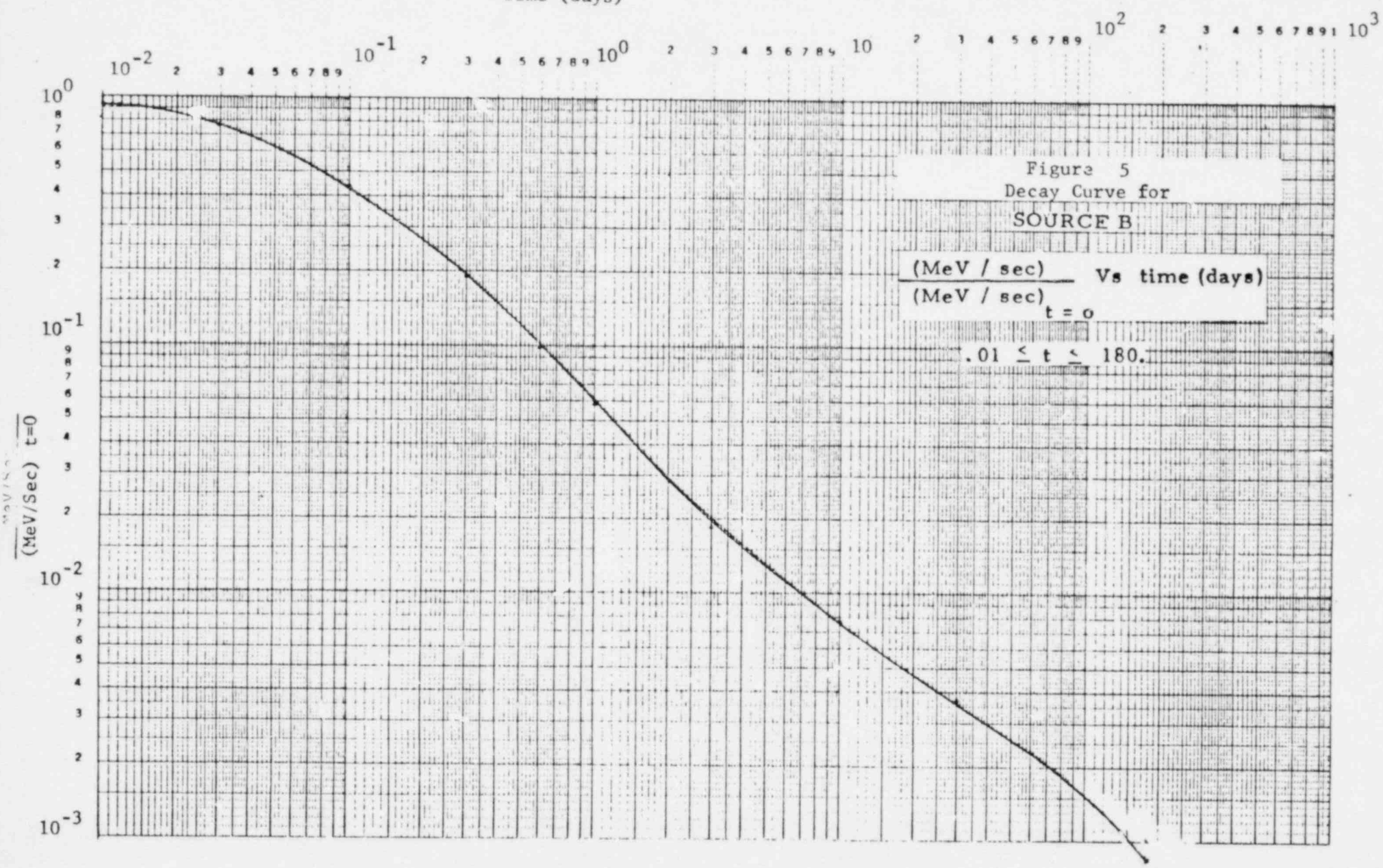
1. Description of the problem.

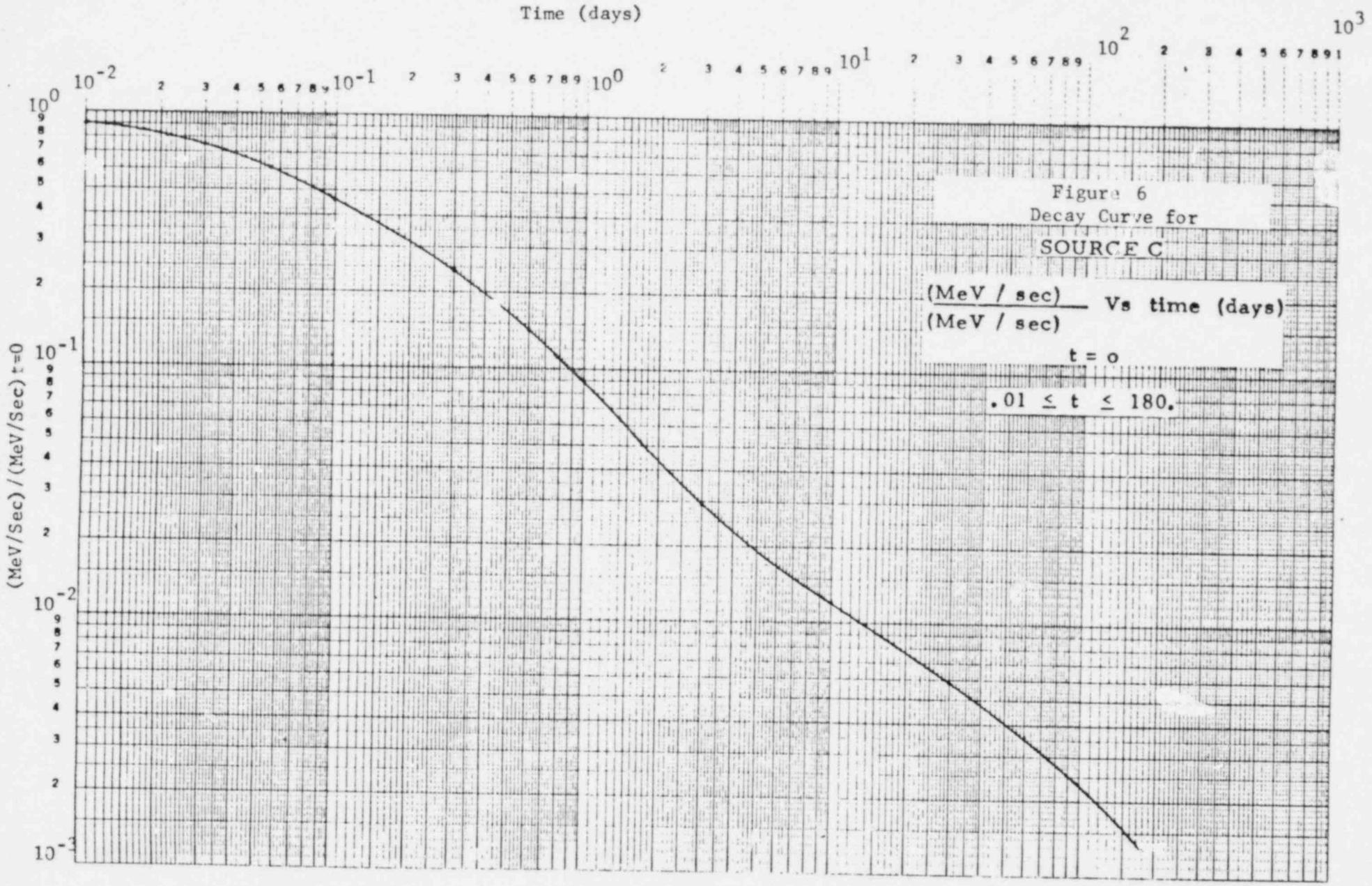
The yard area outside the truck door on Hatch Unit 2 has been identified as a potential area of concern because of the possibility of excessive exposure to plant personnel in the yard area outside the door. This is normally an unlimited access area. The dose contribution would be primarily from the core spray line near the truck door.

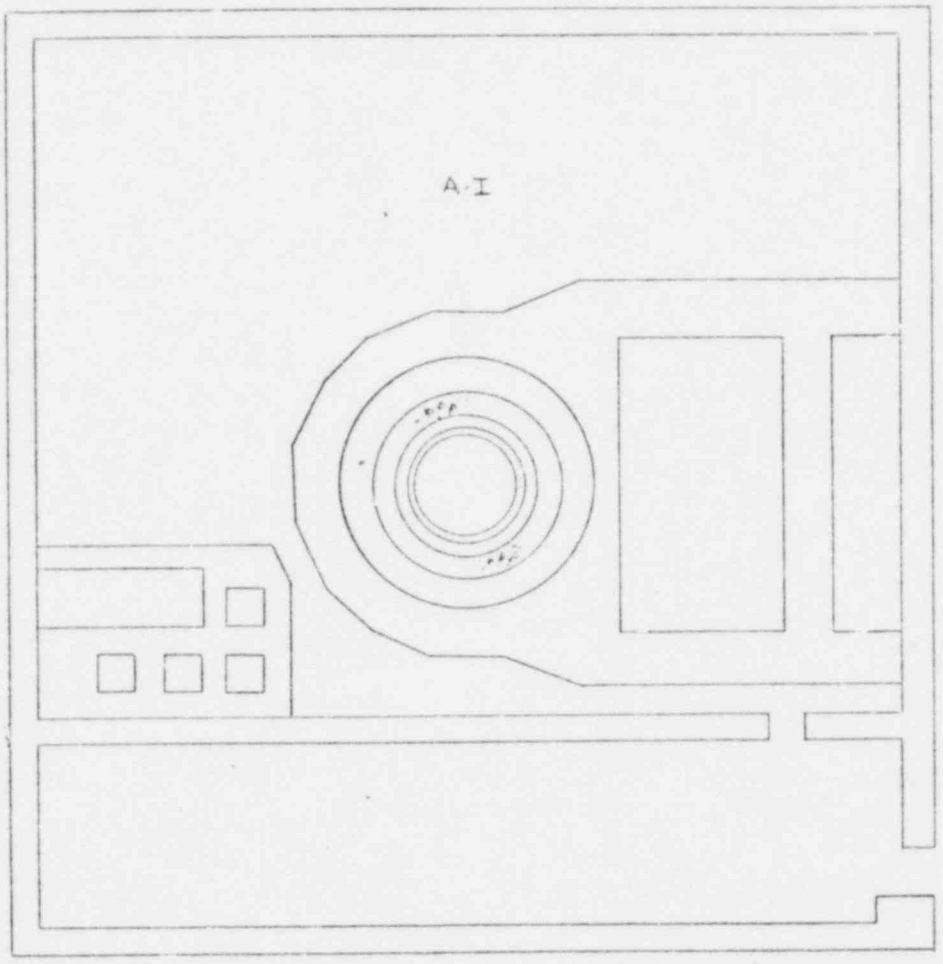
2. Results of the evaluation

One inch of steel will be installed to shield the vertical piping run from elevation 130'- 0" to 144' - 6½". The shielding on the line will reduce the dose at the door to some degree; however, as has been previously indicated it is not practical to shield the spray line to the extent required to eliminate the yard dose concern. The station radiation operating procedures recognize that during the early stages of an event the dose rate outside the door could be high. The procedures require that the area be surveyed and access restricted as required.

The Accident Zone Maps which were attached to the original report written for submission by January 1, 1980 have been modified to reflect the results of this study and assigned figure and revision numbers to assure traceability In addition, the decay curves for sources B (Figure 5 - Diluted Primary Coolant) and C (Figure 6 - Drywell Atmosphere) have been included to provide the information required to predict the dose rate in each area at any time after the event.


Time (days)
$10^{-2}$ 2 3 4 5 6 7 8 9 $10^{-1}$ 2 3 4 5 6 7 8 9 $10^{0}$ 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 $10^{2}$ 2 3 4 5 6 7 8 9 1 $10^{3}$
$10^{0}$ $10^{-1}$ $10^{-2}$ $10^{-3}$
(MeV/Sec) t=0
Figure 5
Decay Curve for
SOURCE B
(MeV / sec) / (MeV / sec) t = o Vs time (days)
.01 ≤ t ≤ 180.


Time (days)
$10^{-2}$ 2 3 4 5 6 7 8 9 $10^{-1}$ 2 3 4 5 6 7 8 9 $10^{0}$ 2 3 4 5 6 7 8 9 $10^{1}$ 2 3 4 5 6 7 8 9 $10^{2}$ 2 3 4 5 6 7 8 9 1 $10^{3}$
(MeV/Sec) / (MeV/Sec) t=0
$10^{0}$ $10^{-1}$ $10^{-2}$ $10^{-3}$
Figure 6
Decay Curve for
SOURCE C
(MeV / sec) / (MeV / sec) Vs time (days)
t = o
.01 ≤ t ≤ 180.

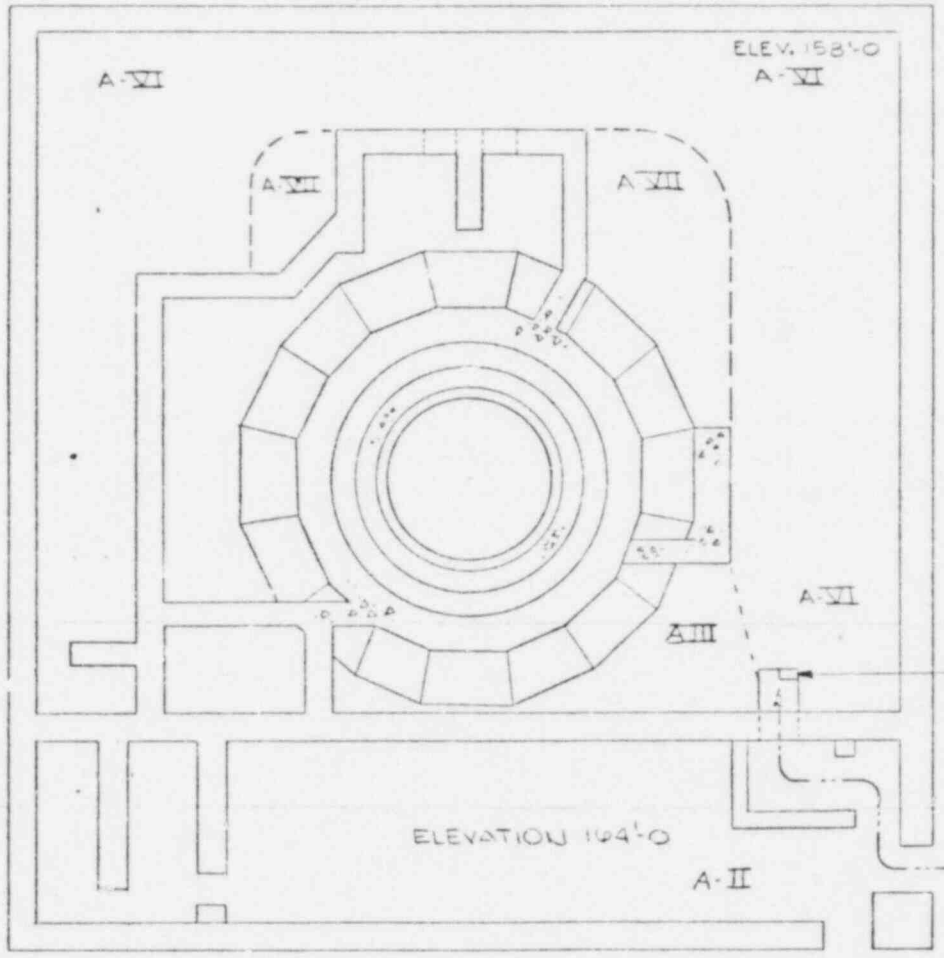



| ACCIDENT ZONE DESIGNATION | $\dot{D}$, DOSE RATE (REM/HR.) |
|---|---|
| A-I | $0 < \dot{D} \leq 0.015$ |
| A-II | $0.015 < \dot{D} \leq 0.100$ |
| A-III | $0.100 < \dot{D} \leq 5$ |
| A-IV | $5 < \dot{D} \leq 50$ |
| A-V | $50 < \dot{D} \leq 500$ |
| A-VI | $500 < \dot{D} \leq 5000$ |
| A-VII | $5000 < \dot{D} \leq 50,000$ |
| A-VIII | $50,000 < \dot{D} \leq 500,000$ |

NOTE:
ACCIDENT ZONE DESIGNATIONS ARE AT TIME ZERO. THE DECAY CURVE SHOULD BE USED TO ASCERTAIN DOSE RATES AT TIMES AFTER TIME ZERO.

FIG. 7 REV. 0

| | |
|---|---|
| BECHTEL - GAITHERSBURG, MD - JOB 6511 | EDWIN I. HATCH NUCLEAR PLANT - UNIT NO. 1 |
| SOUTHERN SERVICES, INC. FOR | BUILDING REVISED ACCIDENT ZONE REACTOR BUILDING ELEVATION 228'-0" |
| GEORGIA POWER CO., ATLANTA, GA. GENERAL ENGINEERING DEPARTMENT | |
| DRAWN BY ____ DATE ____ TRACED BY ____ SCALE ____ APPROVED ____ | REVISIONS ____ |
| | NUMBER: LOCATION 1 DRAWING 10 552 B— |

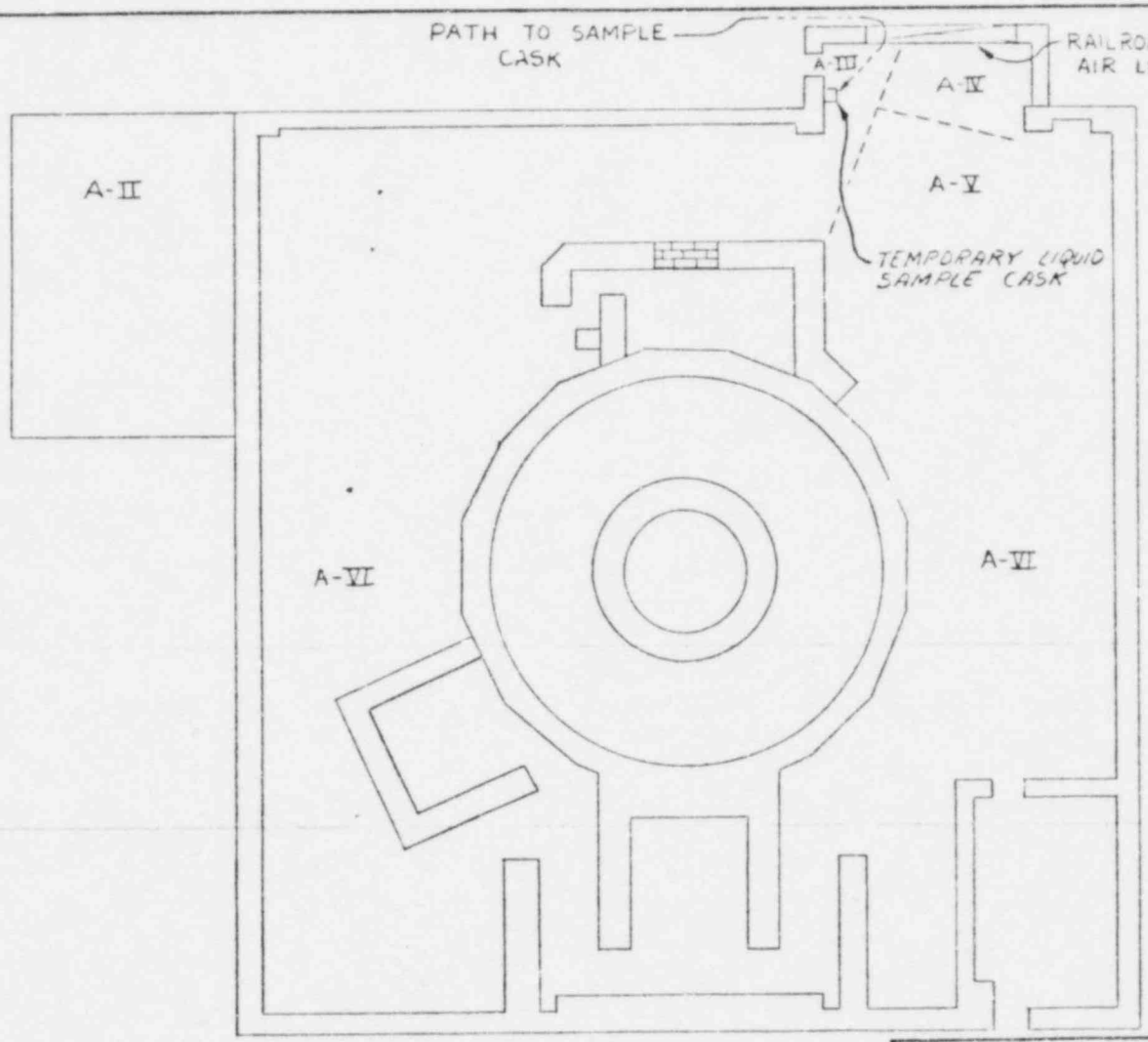



| ACCIDENT ZONE DESIGNATION | $\dot{D}$, DOSE RATE (REM/HR.) |
|---|---|
| A-I | $0 < \dot{D} \leq 0.015$ |
| A-II | $0.015 < \dot{D} \leq 0.100$ |
| A-III | $0.100 < \dot{D} \leq 5$ |
| A-IV | $5 < \dot{D} \leq 50$ |
| A-V | $50 < \dot{D} = 500$ |
| A-VI | $500 < \dot{D} \leq 5000$ |
| A-VII | $5000 < \dot{D} \leq 50,000$ |
| A-VIII | $50,000 < \dot{D} \leq 500,000$ |

NOTE:
ACCIDENT ZONE DESIGNATIONS ARE AT TIME ZERO. THE DECAY CURVE SHOULD BE USED TO ASCERTAIN DOSE RATES AT TIMES AFTER TIME ZERO

FIG. 8 REV. 0

| | |
|---|---|
| BECHTEL - GAITHERSBURG, MD. - JOB 6511 | EDWIN I. HATCH NUCLEAR PLANT - UNIT No. 1 |
| SOUTHERN SERVICES, INC., FOR | SHIELDING REVIEW ZONE MAP |
| GEORGIA POWER CO., ATLANTA, GA. GENERAL ENGINEERING DEPARTMENT | REACTOR BUILDING ELEVATION 158'-0" & 104'-0" |
| DRAWN BY ____ DATE ____ | REVISIONS |
| TRACED BY ____ SCALE ____ | NUMBER: LOCATION 10-502 DRAWING 8— |
| APPROVED ____ | |




| ACCIDENT ZONE DESIGNATION | $\dot{D}$, DOSE RATE (REM/HR.) |
|---|---|
| A-I | $0 < \dot{D} \leq 0.015$ |
| A-II | $0.015 < \dot{D} \leq 0.100$ |
| A-III | $0.100 < \dot{D} \leq 5$ |
| A-IV | $5 < \dot{D} \leq 50$ |
| A-V | $50 < \dot{D} \leq 500$ |
| A-VI | $500 < \dot{D} \leq 5000$ |
| A-VII | $5000 < \dot{D} \leq 50{,}000$ |
| A-VIII | $50{,}000 < \dot{D} \leq 500{,}000$ |

NOTE:
ACCIDENT ZONE DESIGNATIONS ARE AT TIME ZERO. THE DECAY CURVE SHOULD BE USED TO ASCERTAIN DOSE RATES AT TIMES AFTER TIME ZERO.

FIG 9 REV 1

BECHTEL - GAITHERSBURG, MD. - JOB 6511
SOUTHERN SERVICES, INC., FOR
GEORGIA POWER CO., ATLANTA, GA.
GENERAL ENGINEERING DEPARTMENT

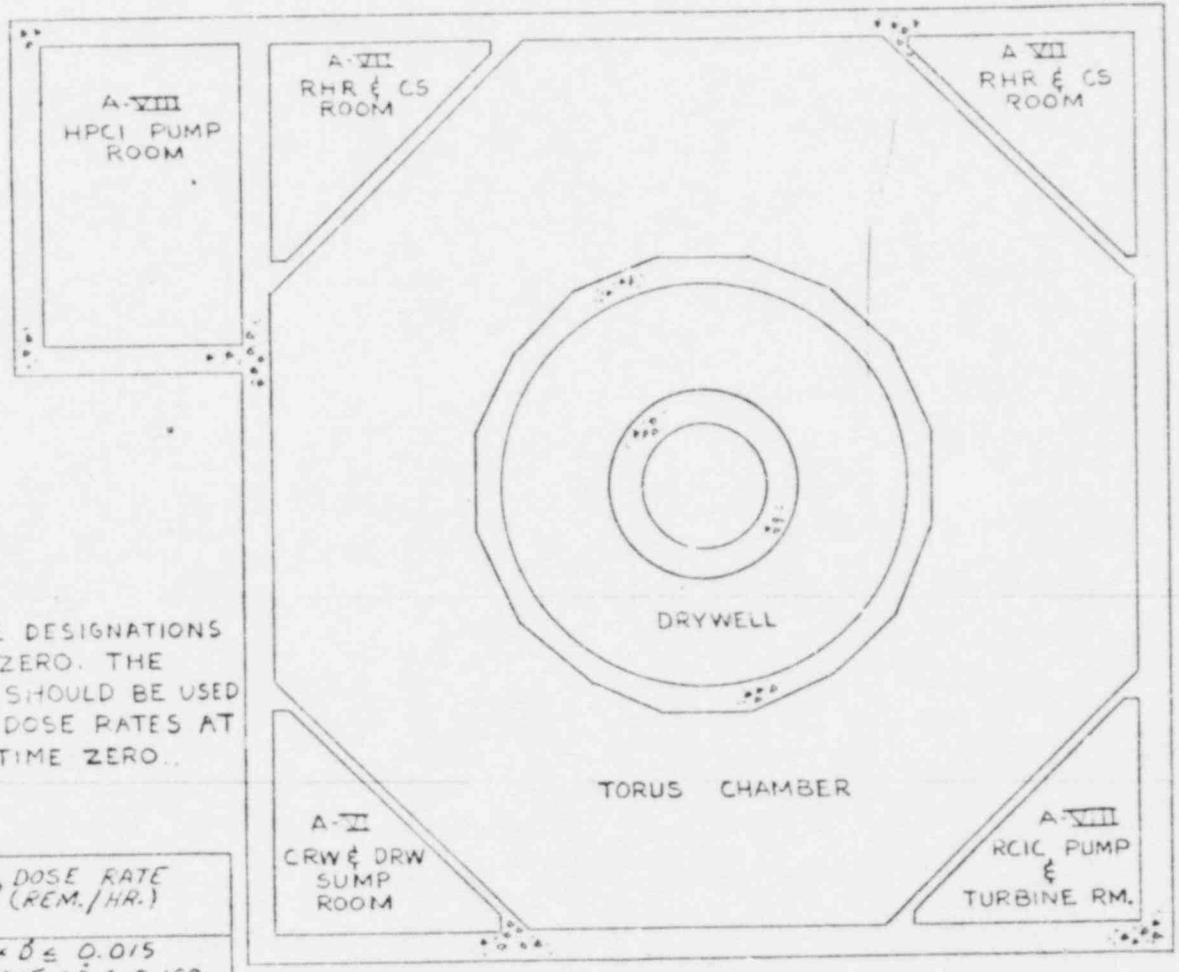
EDWIN I. HATCH NUCLEAR PLANT - UNIT NO. 1
SHIELDING REVIEW ZONE MAP
REALTOR BLDG EL. 130'-0"

DRAWN BY _____ DATE _____
TRACED BY _____ SCALE _____
APPROVED _____

REVISIONS

NUMBER
LOCATION 10-502 | DRAWING B—

N29-81



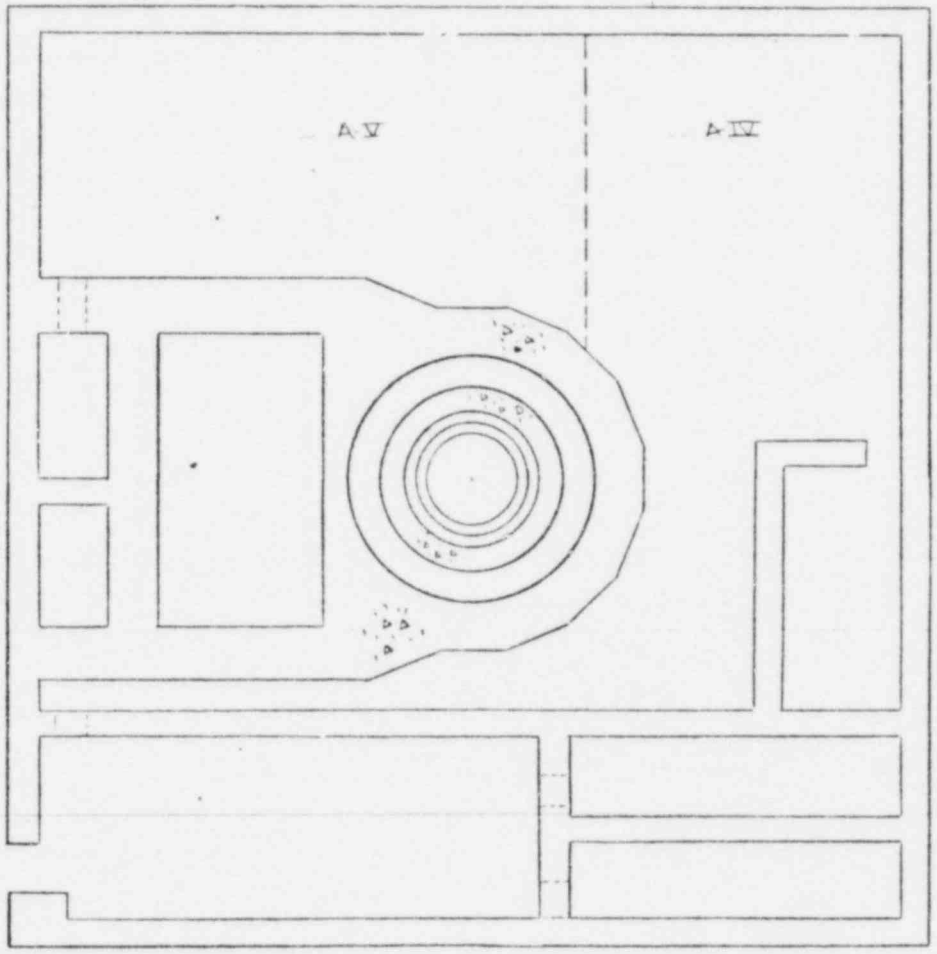

NOTE:
ACCIDENT ZONE DESIGNATIONS ARE AT TIME ZERO. THE DECAY CURVE SHOULD BE USED TO ASCERTAIN DOSE RATES AT TIMES AFTER TIME ZERO..

| ACCIDENT ZONE DESIGNATION | $\dot{D}$, DOSE RATE (REM./HR.) |
|---|---|
| A-I | $0 < \dot{D} \leq 0.015$ |
| A-II | $0.015 < \dot{D} \leq 0.100$ |
| A-III | $0.100 < \dot{D} \leq 5$ |
| A-IV | $5 < \dot{D} \leq 50$ |
| A-V | $50 < \dot{D} \leq 500$ |
| A-VI | $500 < \dot{D} \leq 5000$ |
| A-VII | $5000 < \dot{D} \leq 50,000$ |
| A-VIII | $50,000 < D \leq 500,000$ |

FIG. 10 REV. 0

| | |
|---|---|
| BECHTEL - GAITHERSBURG, MD. - JOB 6511 | EDWIN I. HATCH NUCLEAR PLANT - UNIT No. 1 |
| SOUTHERN SERVICES, INC., FOR | SHIELDING REVIEW ZONE MAP |
| GEORGIA POWER CO., ATLANTA, GA. GENERAL ENGINEERING DEPARTMENT | REACTOR BUILDING ELEVATION BELOW -30'-0" |

| | | | NUMBER | |
|---|---|---|---|---|
| DRAWN BY ____ DATE ____ | REVISIONS | | LOCATION | DRAWING |
| TRACED BY ____ SCALE ____ | | | 10.502 | B— |
| APPROVED ____ | | | | |



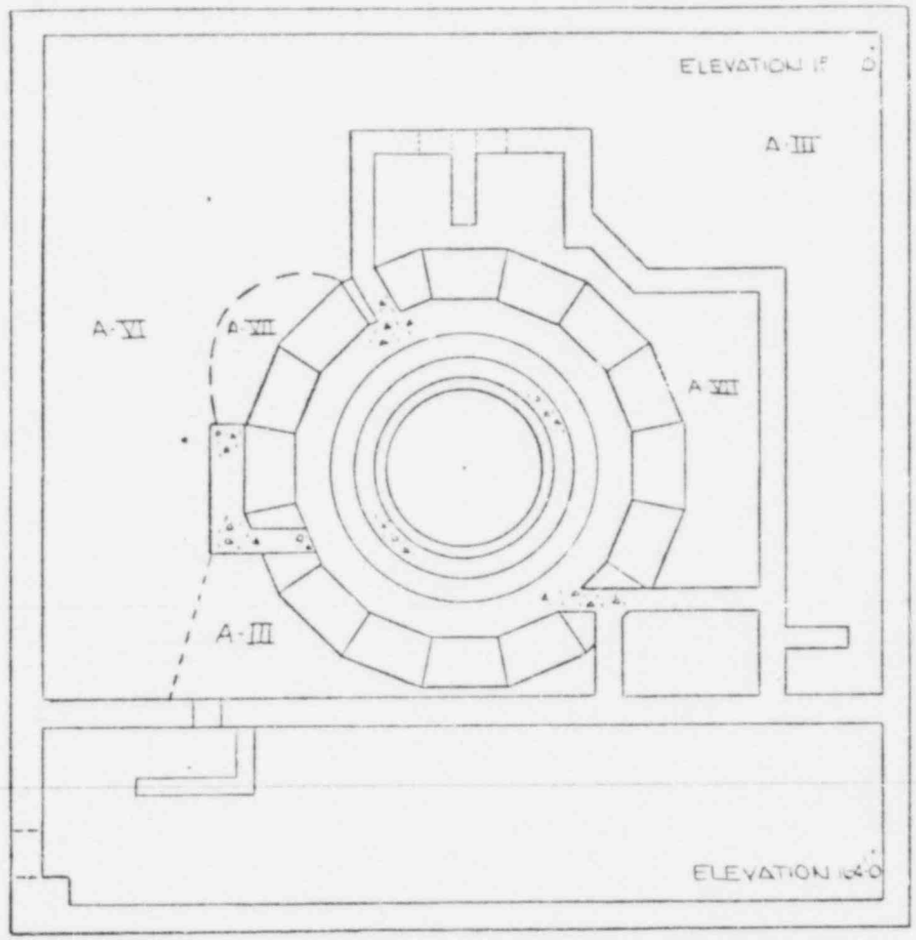

| ACCIDENT ZONE DESIGNATION | $\dot{D}$, DOSE RATE (REM/HR) |
|---|---|
| A - I | $0 < \dot{D} \leq 0.015$ |
| A - II | $0.015 < \dot{D} \leq 0.100$ |
| A - III | $0.100 < \dot{D} \leq 5$ |
| A - IV | $5 < \dot{D} \leq 50$ |
| A - V | $50 < \dot{D} \leq 500$ |
| A - VI | $500 < \dot{D} \leq 5000$ |
| A - VII | $5000 < \dot{D} \leq 50{,}000$ |
| A - VIII | $50{,}000 < \dot{D} \leq 500{,}000$ |

NOTE:

ACCIDENT ZONE DESIGNATIONS ARE AT TIME ZERO. THE DECAY CURVE SHOULD BE USED TO ASCERTAIN DOSE RATES AT TIMES AFTER TIME ZERO.

FIG. 11 REV 0

| | |
|---|---|
| BECHTEL - GAITHERSBURG, MD. - JOB 6511 | EDWIN I. HATCH NUCLEAR PLANT - UNIT No. 2 |
| SOUTHERN SERVICES, INC., FOR | SHIELDING REVIEW ZONE MAP REACTOR BUILDING ELEVATION 185'-0" |
| GEORGIA POWER CO., ATLANTA, GA. GENERAL ENGINEERING DEPARTMENT | |
| DRAWN BY ____ DATE ____ TRACED BY ____ SCALE ____ APPROVED ____ | REVISIONS ____ |
| | NUMBER: LOCATION 10 502 / DRAWING B— |

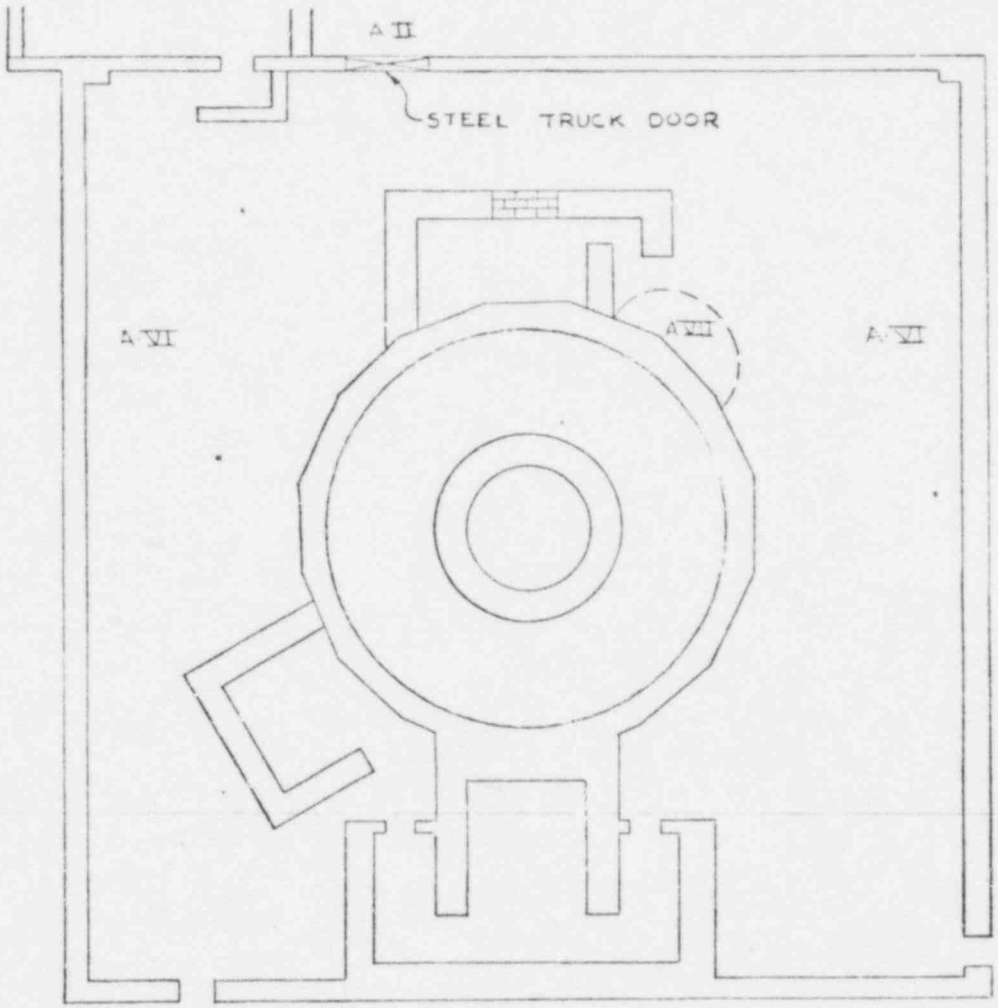



| ACCIDENT ZONE DESIGNATION | $\dot{D}$, DOSE RATE (REM/HR) |
|---|---|
| A - I | $0 < \dot{D} \leq 0.015$ |
| A - II | $0.015 < \dot{D} \leq 0.100$ |
| A - III | $0.100 < \dot{D} \leq 5$ |
| A - IV | $5 < \dot{D} \leq 50$ |
| A - V | $50 < \dot{D} \leq 500$ |
| A - VI | $500 < \dot{D} \leq 5{,}000$ |
| A - VII | $5{,}000 < \dot{D} \leq 50{,}000$ |
| A - VIII | $50{,}000 < \dot{D} \leq 500{,}000$ |

NOTE:
ACCIDENT ZONE DESIGNATIONS ARE AT TIME ZERO THE DECAY CURVE SHOULD BE USED TO ASCERTAIN DOSE RATES AT TIMES AFTER TIME ZERO.

FIG. 12 REV 0

| | |
|---|---|
| BECHTEL - GAITHERSBURG, MD. - JOB 6511 | EDWIN I. HATCH NUCLEAR PLANT - UNIT NO. 2 |
| SOUTHERN SERVICES, INC., FOR | SHIELDING REVIEW ZONE MAP REACTOR BUILDING ELEVATION 98'-0" & 164'-0" |
| GEORGIA POWER CO., ATLANTA, GA. GENERAL ENGINEERING DEPARTMENT | |
| DRAWN BY ____ DATE ____ TRACED BY ____ SCALE ____ APPROVED ____ | REVISIONS ____ |
| | NUMBER: LOCATION 10.502 / DRAWING 8 |




| ACCIDENT ZONE DESIGNATION | $\dot{D}$, DOSE RATE (REM/HR.) |
|---|---|
| A-I | $0 < \dot{D} \leq 0.015$ |
| A-II | $0.015 < \dot{D} \leq 0.100$ |
| A-III | $0.100 < \dot{D} \leq 5$ |
| A-IV | $5 < \dot{D} \leq 50$ |
| A-V | $50 < \dot{D} \leq 500$ |
| A-VI | $500 < \dot{D} \leq 5000$ |
| A-VII | $5000 < \dot{D} \leq 50,000$ |
| A-VIII | $50,000 < \dot{D} \leq 500,000$ |

NOTE:

ACCIDENT ZONE DESIGNATION ARE AT TIME ZERO. THE DECAY CURVE SHOULD BE USED TO ASCERTAIN DOSE RATES AT TIMES AFTER TIME ZERO.

FIG. 13 REV 0

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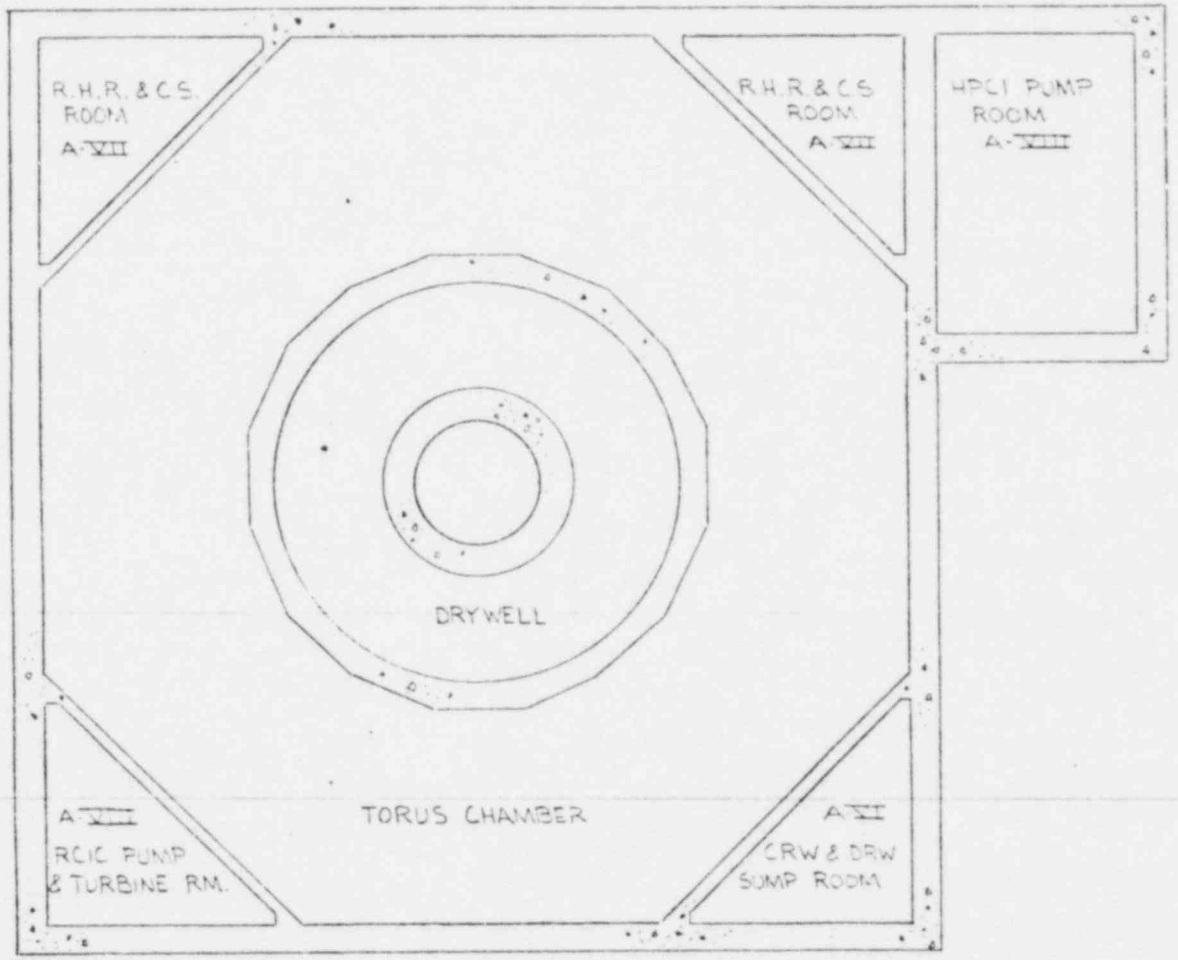
|---|---|
| BECHTEL - GAITHERSBURG, MD. - JOB 6511 | EDWIN I. HATCH NUCLEAR PLANT - UNIT No. 2 |
| SOUTHERN SERVICES, INC., FOR | SHIELDING REVIEW ZONE MAP REACTOR BUILDING ELEVATION (130'-0" |
| GEORGIA POWER CO., ATLANTA, GA. GENERAL ENGINEERING DEPARTMENT | |

| | | | |
|---|---|---|---|
| DRAWN BY | DATE | REVISIONS | NUMBER: LOCATION 10 502 / DRAWING B— |
| TRACED BY | SCALE | | |
| APPROVED | | | |




| ACCIDENT ZONE DESIGNATION | $\dot{D}$, DOSE RATE (REM/HR.) |
|---|---|
| A-I | $0 < \dot{D} \leq 0.015$ |
| A-II | $0.015 < \dot{D} \leq 0.100$ |
| A-III | $0.100 < \dot{D} \leq 5$ |
| A-IV | $5 < \dot{D} \leq 50$ |
| A-V | $50 < \dot{D} \leq 500$ |
| A-VI | $500 < \dot{D} \leq 5,000$ |
| A-VII | $5,000 < \dot{D} \leq 50,000$ |
| A-VIII | $50,000 < \dot{D} \leq 500,000$ |

NOTE:

ACCIDENT ZONE DESIGNATIONS ARE AT TIME ZERO. THE DECAY CURVE SHOULD BE USED TO ASCERTAIN DOSE RATES AT TIMES AFTER TIME ZERO.

FIG. 14 REV. 0

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|---|---|
| BECHTEL - GAITHERSBURG, MD. - JOB 6511 | EDWIN I. HATCH NUCLEAR PLANT - UNIT No. 2 |
| SOUTHERN SERVICES, INC., FOR<br>GEORGIA POWER CO., ATLANTA, GA.<br>GENERAL ENGINEERING DEPARTMENT | SHIELDING REVIEW ZONE MAP<br>REACTOR BUILDING ELEVATION<br>BELOW 130'-0" |
| DRAWN BY _____ DATE _____<br>TRACED BY _____ SCALE _____<br>APPROVED _____ | REVISIONS _____ |
| | NUMBER: LOCATION 10-522, DRAWING B— |