DEC 2 9 1982

Docket Nos: 50-329
and 50-330

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 and 2

SUBJECT: SUMMARY OF MEETING HELD WITH CONSUMERS POWER ON TORNADO MISSILE PROTECTION - JUNE 11, 1982

On June 11, 1982, the NRC staff met in Bethesda, Maryland with Consumers Power Company and Bechtel to discuss protection against tornado missiles at the Midland Plant. This subject relates to Section 3.5.2 of the Midland SER (NUREG-0793) and was listed as outstanding open item #3 in that document. A list of meeting attendees is attached as Enclosure 1. Enclosure 2 is a compilation of the handouts and visual aids used in the course of the meeting.

SUMMARY

Consumers Power Company (CPCo) made a detailed presentation of the modeling and approach to protect safety-related equipment from tornado missiles. The existing missile protection, the safety-related items not specifically protected, and a deterministic and probabilistic evaluation of their vulnerability are described in the attached slides (Enclosure 2). The probabilistic evaluation specifically applies to Midland an EPRI generic study (EPRI NP-768 and EPRI NP-769). The staff indicated that they intend to review the EPRI study and that final acceptance of the CPCo analysis would necessarily follow this review. The review of the EPRI study is expected to take approximately six months.

CPCo will make a formal submittal of the information discussed during this meeting. The staff will complete its safety evaluation following submittal of the supplementary information and will report the results in a future SSER.

/S/

Ronald W. Hernan, Project Manager
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Enclosures:
As stated

cc: See next page

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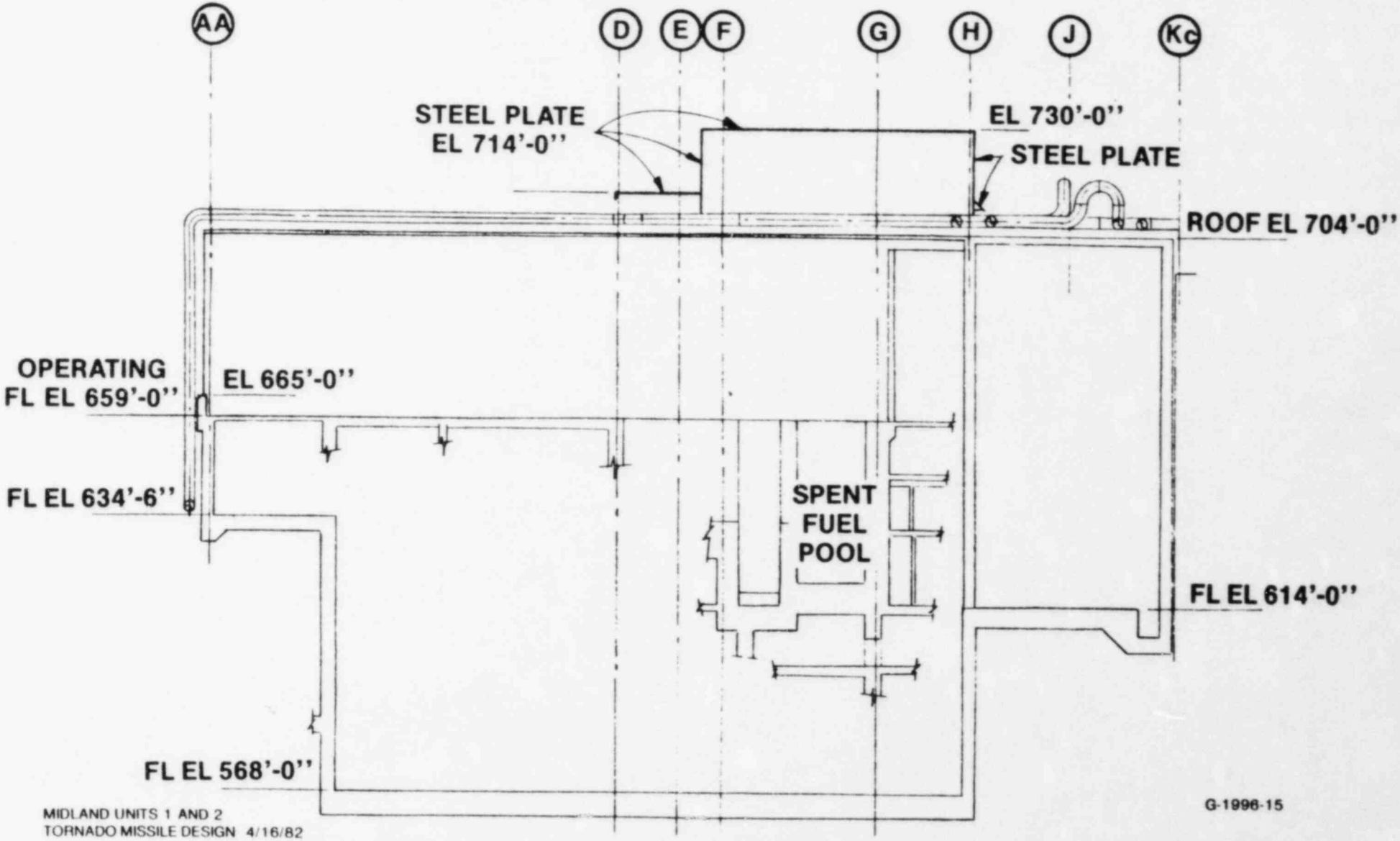
Deterministic tornado missile design has been provided for safe shutdown systems and support systems

ENCLOSURE 2

Safety system vulnerability to tornado missiles is very limited

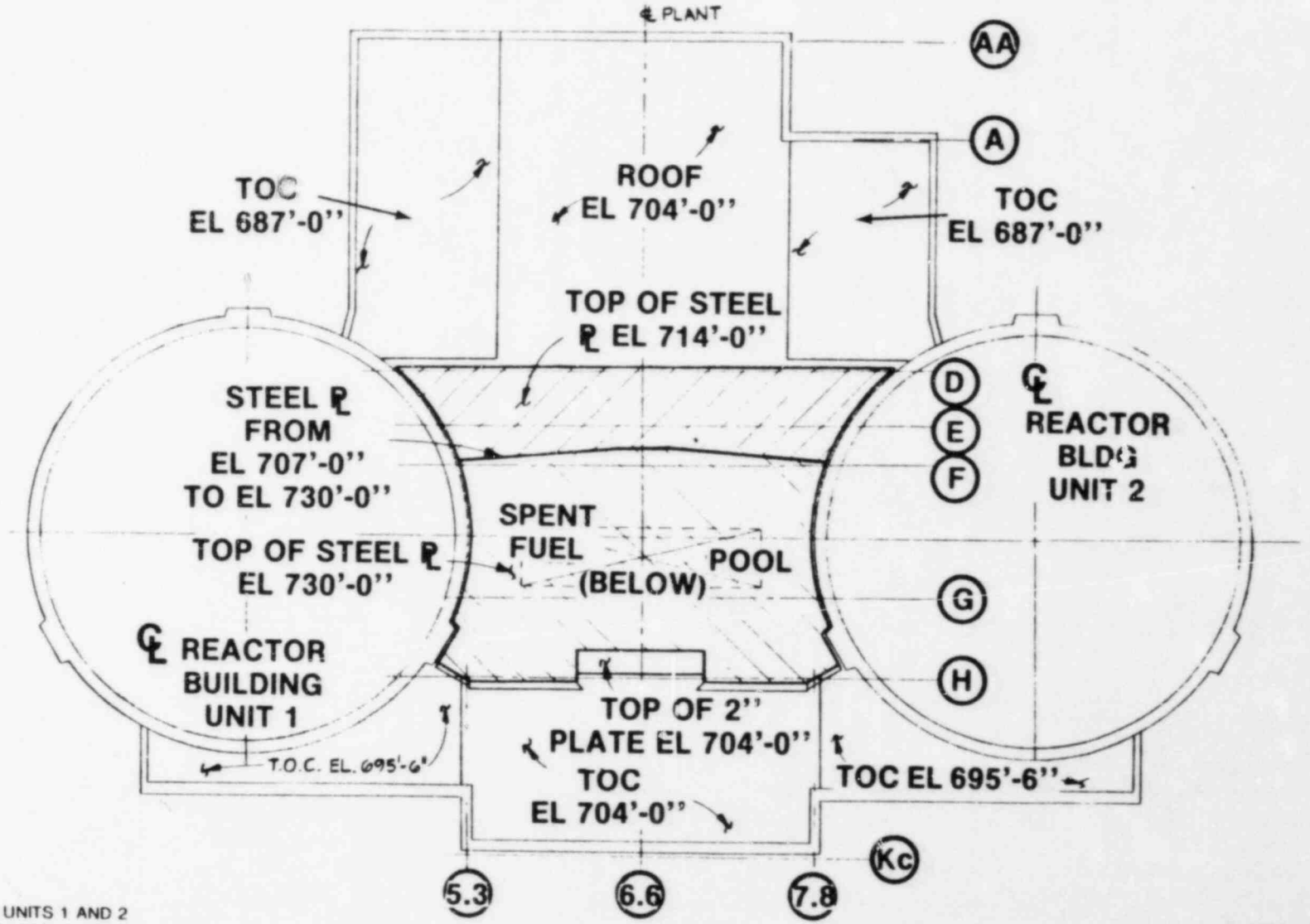
AUXILIARY BUILDING
TORNADO MISSILE PROTECTION
TYPICAL SECTION
(looking east)



MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-15

AUXILIARY BUILDING
TORNADO MISSILE PROTECTION
PLAN NEAR ROOF



MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-16

PERSPECTIVE VIEW OF MIDLAND AUXILIARY BUILDING MISSILE PROTECTION

(inside looking north from el 691')

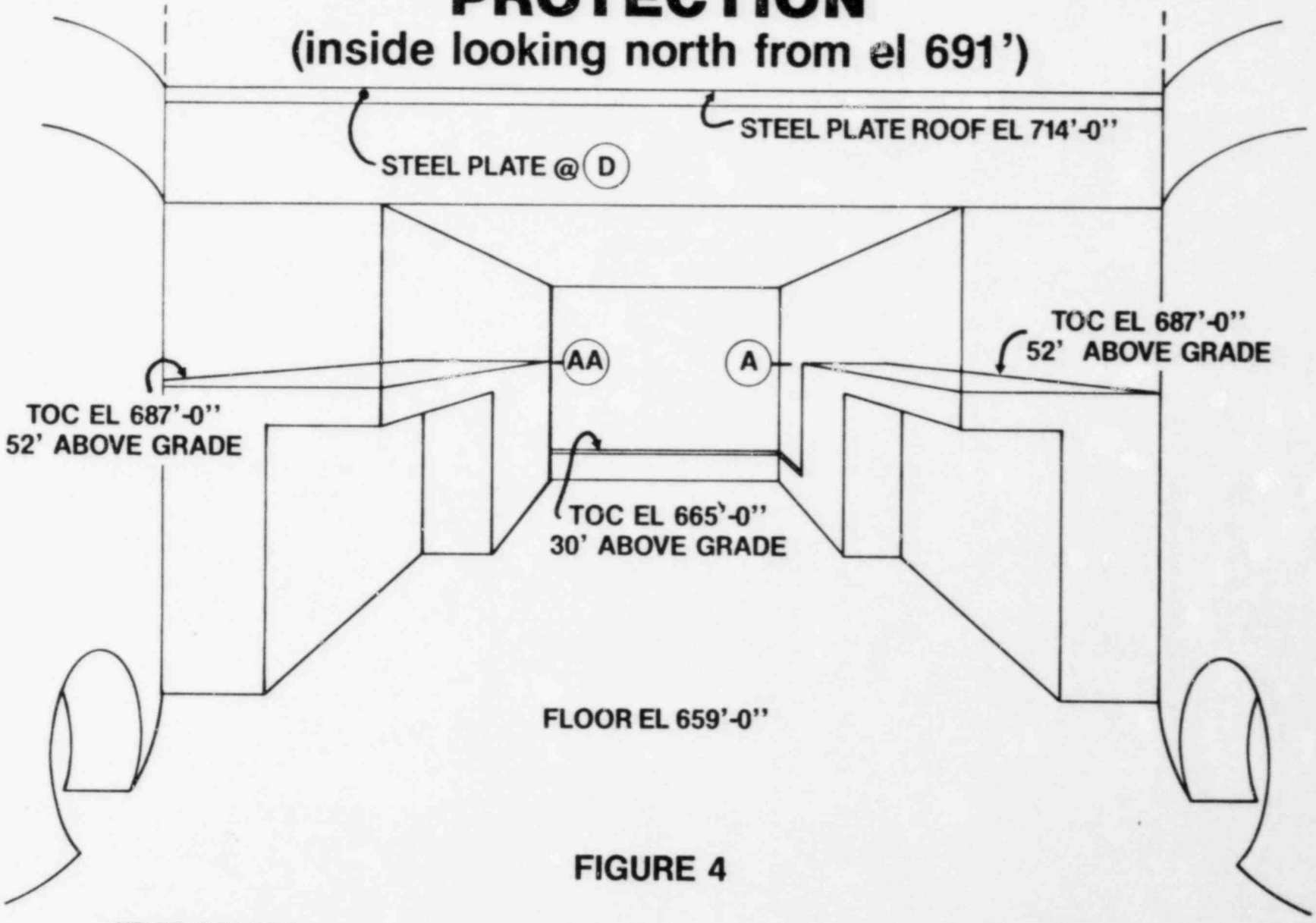


FIGURE 4

MIDLAND UNIT 1 AND 2
TORNADO MISSILE DESIGN 5/25/82

G-2527-04

PERSPECTIVE OF MIDLAND AUXILIARY BUILDING MISSILE PROTECTION

(looking south from el 716' outside)

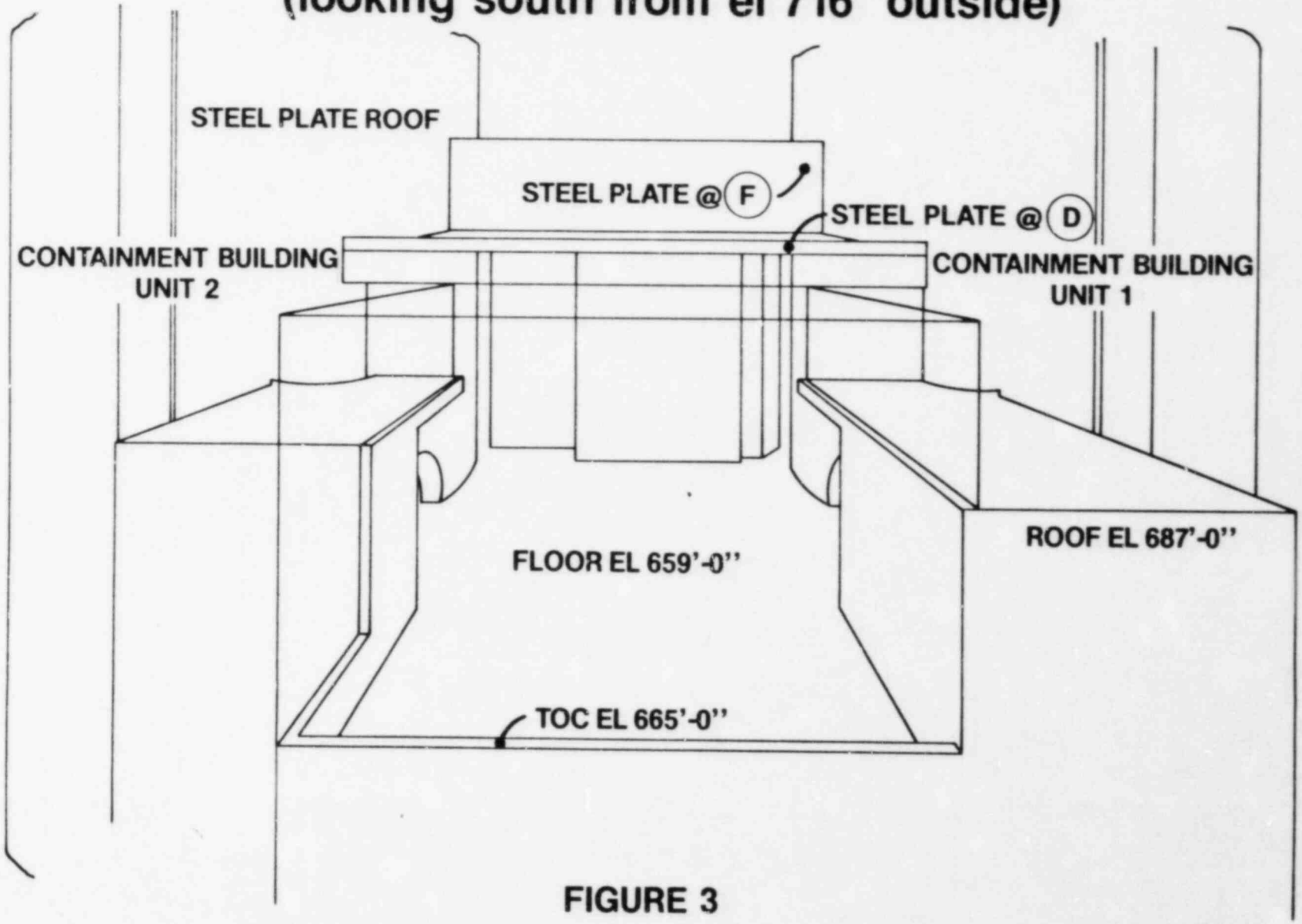
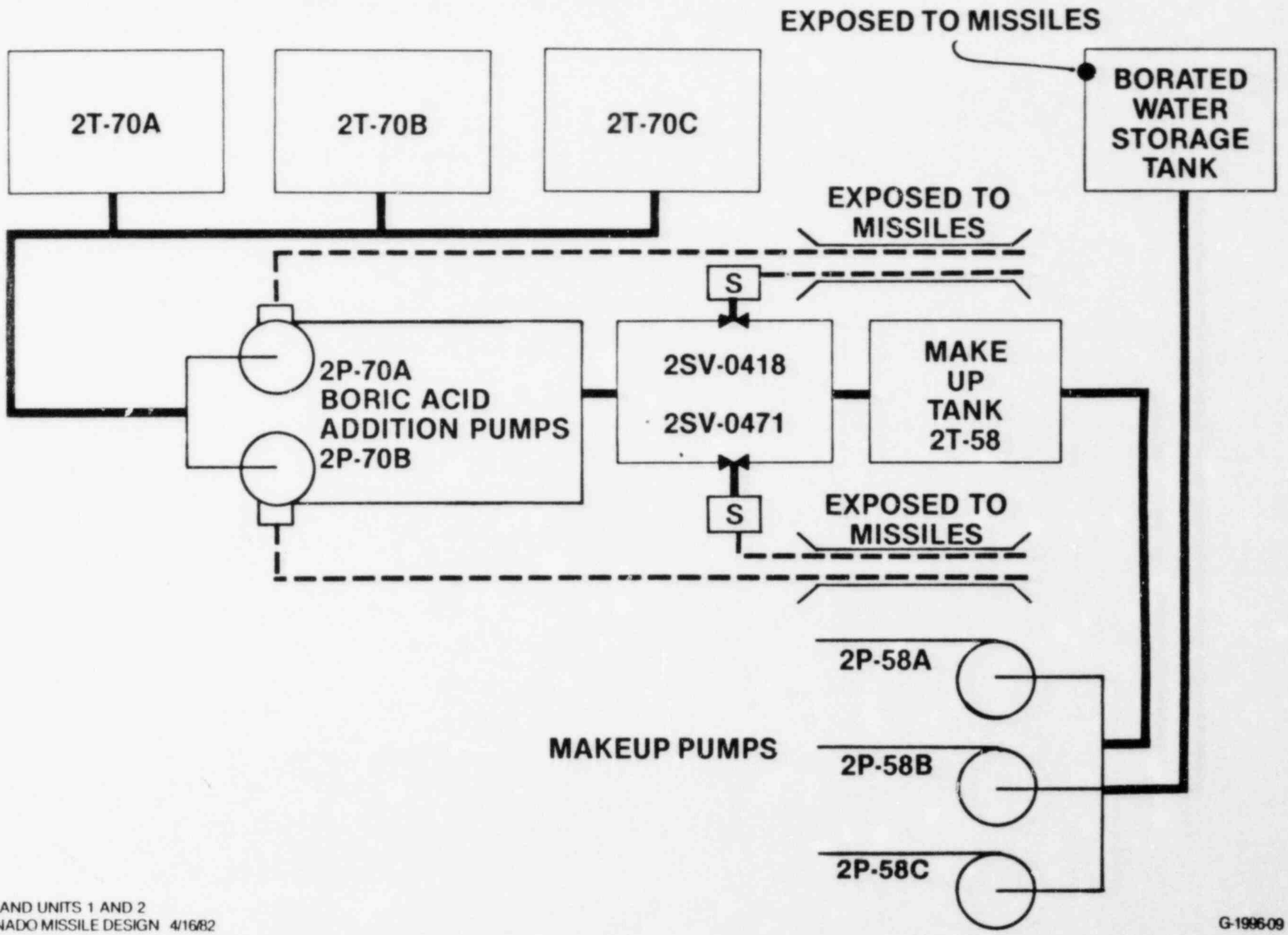


FIGURE 3

MIDLAND UNIT 1 AND 2
TORNADO MISSILE DESIGN 5/25/82

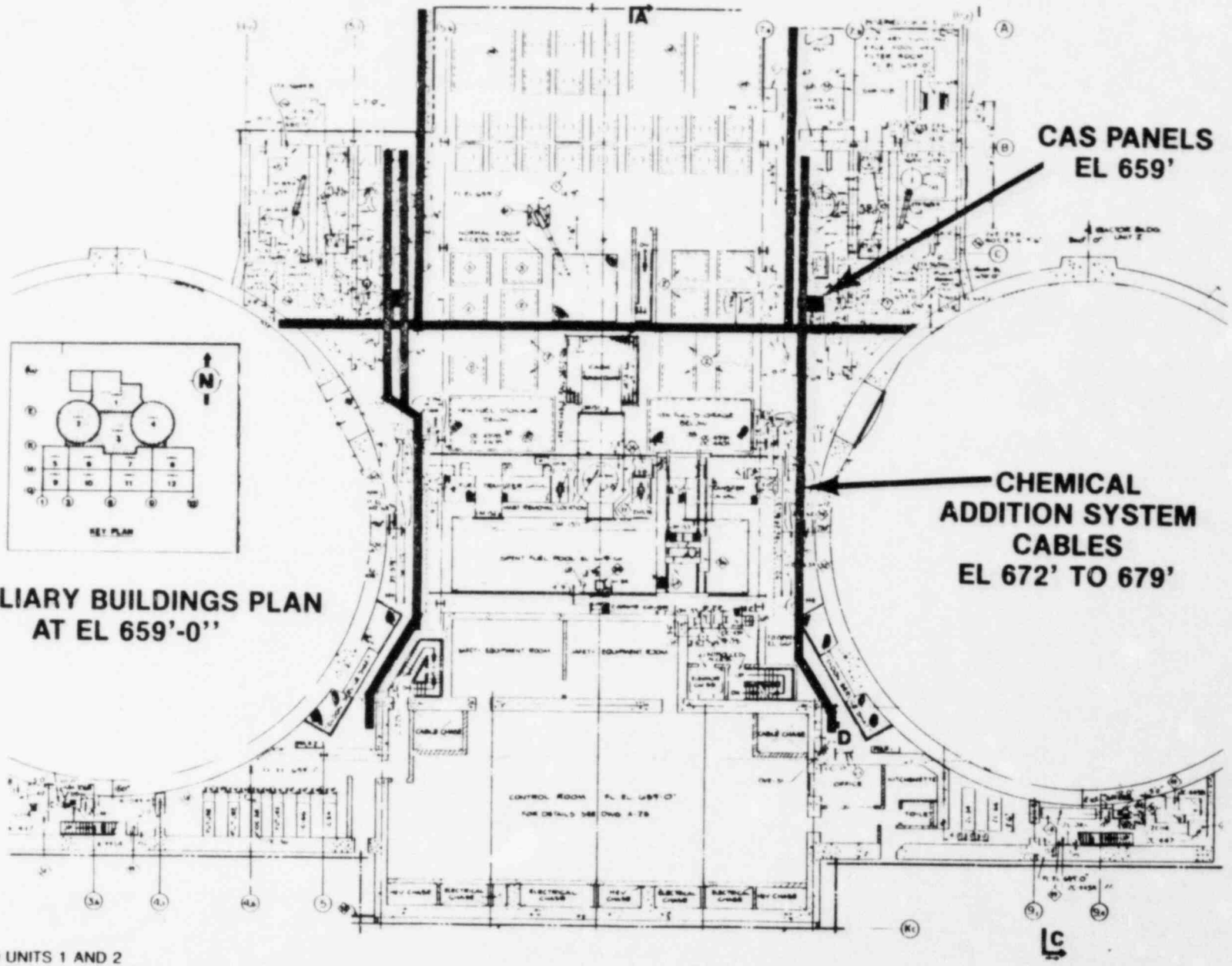
G-2527-03

CHEMICAL ADDITION SYSTEM
SIMPLIFIED FOR ALTERNATE SHUTDOWN MODE



MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-09



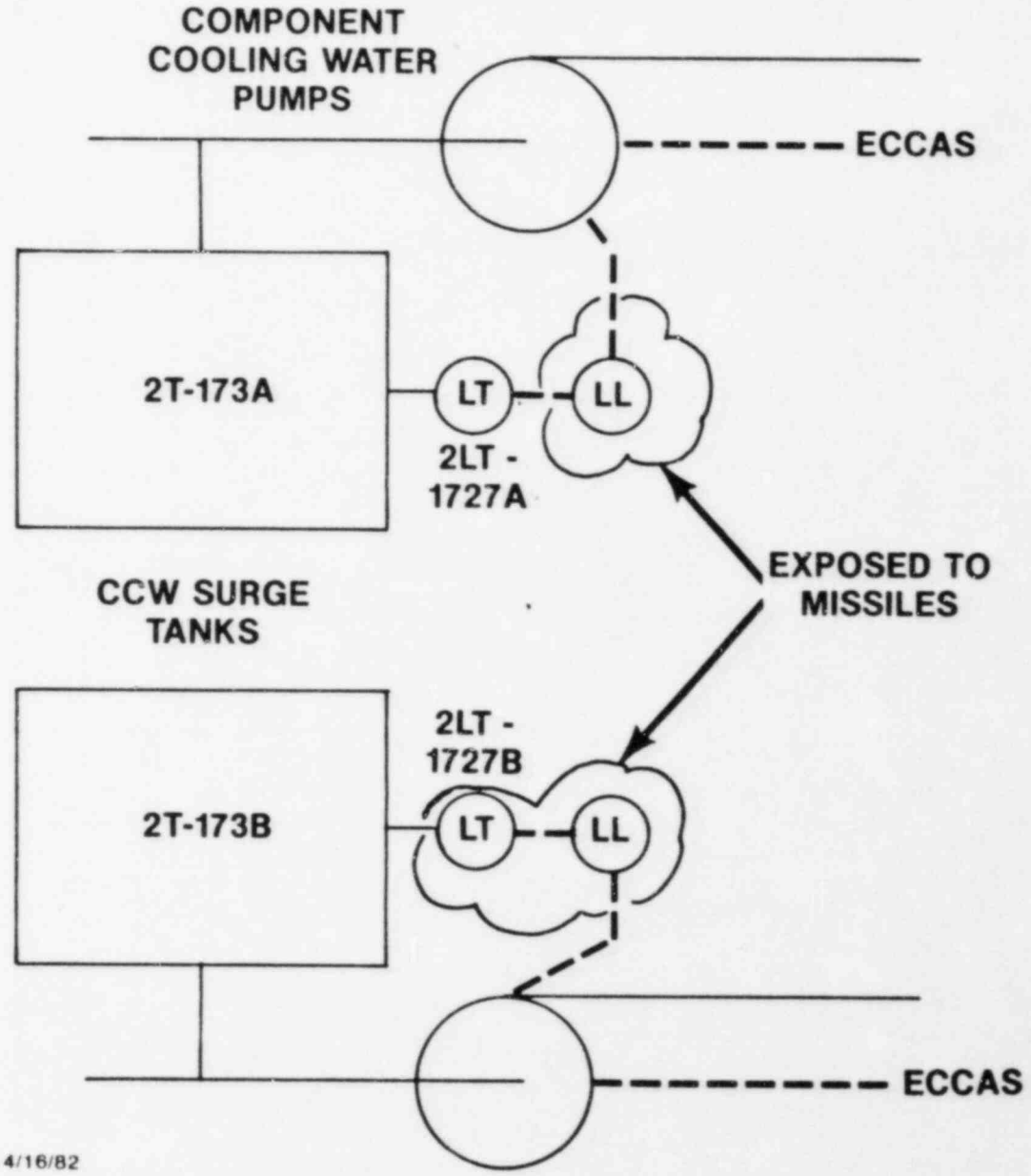
MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-08

CHEMICAL ADDITION SYSTEM MISSILE DAMAGE (CAS)

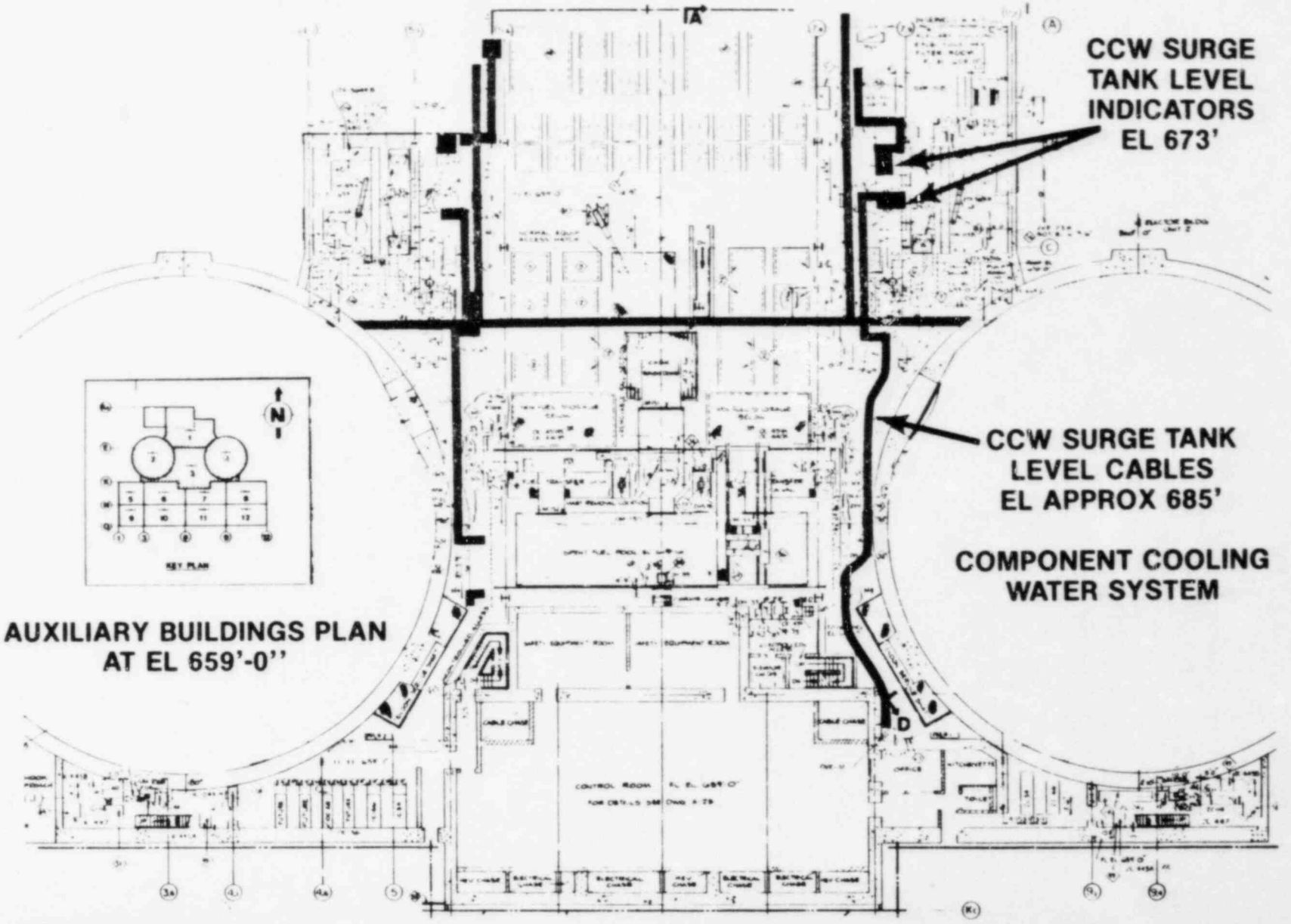
- THE BWST MUST BE FUNCTIONALLY INOPERABLE FOR CAS TO BE REQUIRED FOR SAFE SHUTDOWN
- DAMAGE TO BOTH CAS TRAINS IS REQUIRED TO CAUSE CAS FAILURE
- MULTIPLE-COMPONENT MISSILE DAMAGE IS REQUIRED TO CAUSE CAS FAILURE (routing precludes missile damage to both trains from single missile)
- CRITICAL TRAJECTORIES ARE IMPROBABLE

COMPONENT COOLING WATER



MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-11



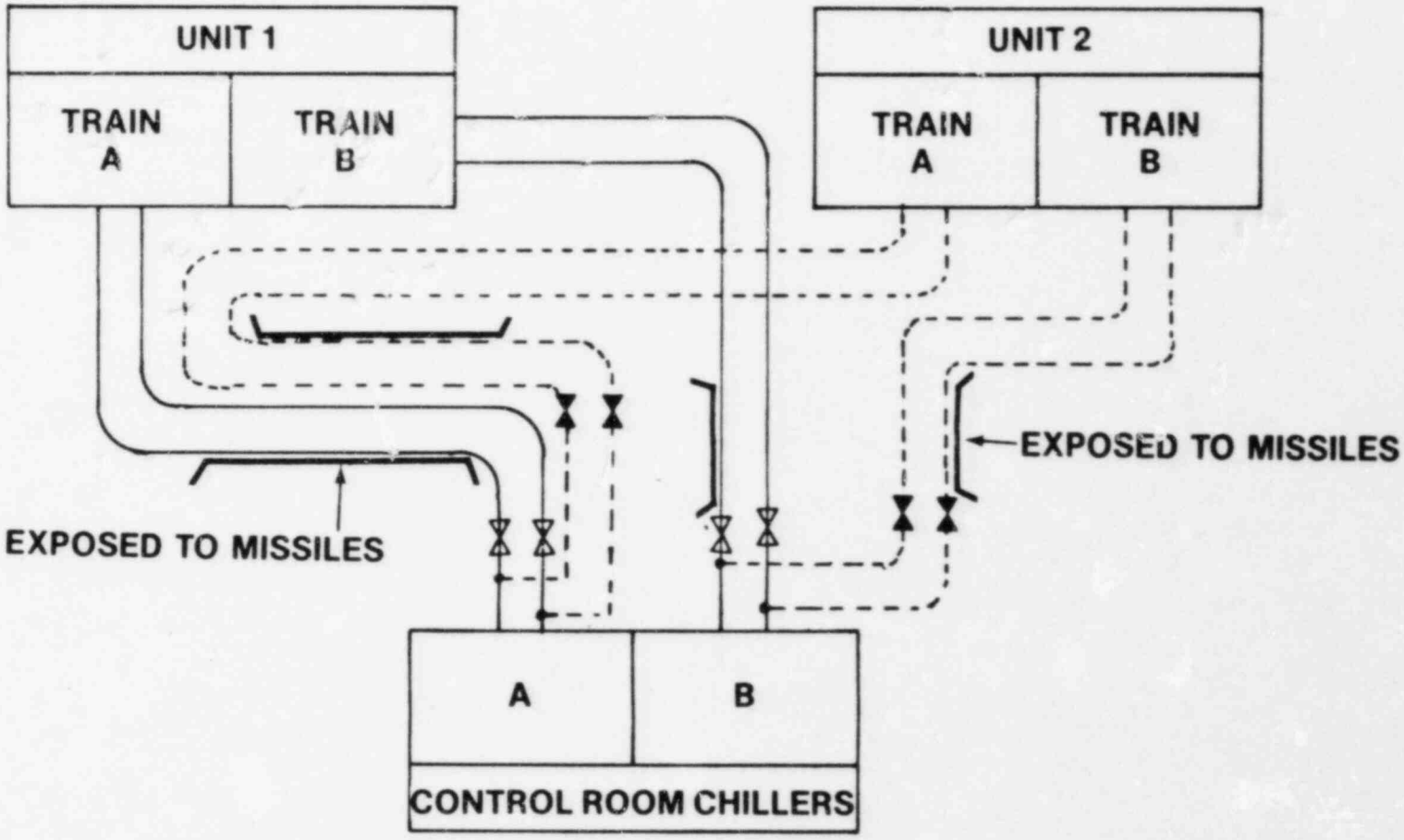
MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-10

COMPONENT COOLING WATER SYSTEM (CCWS) MISSILE DAMAGE

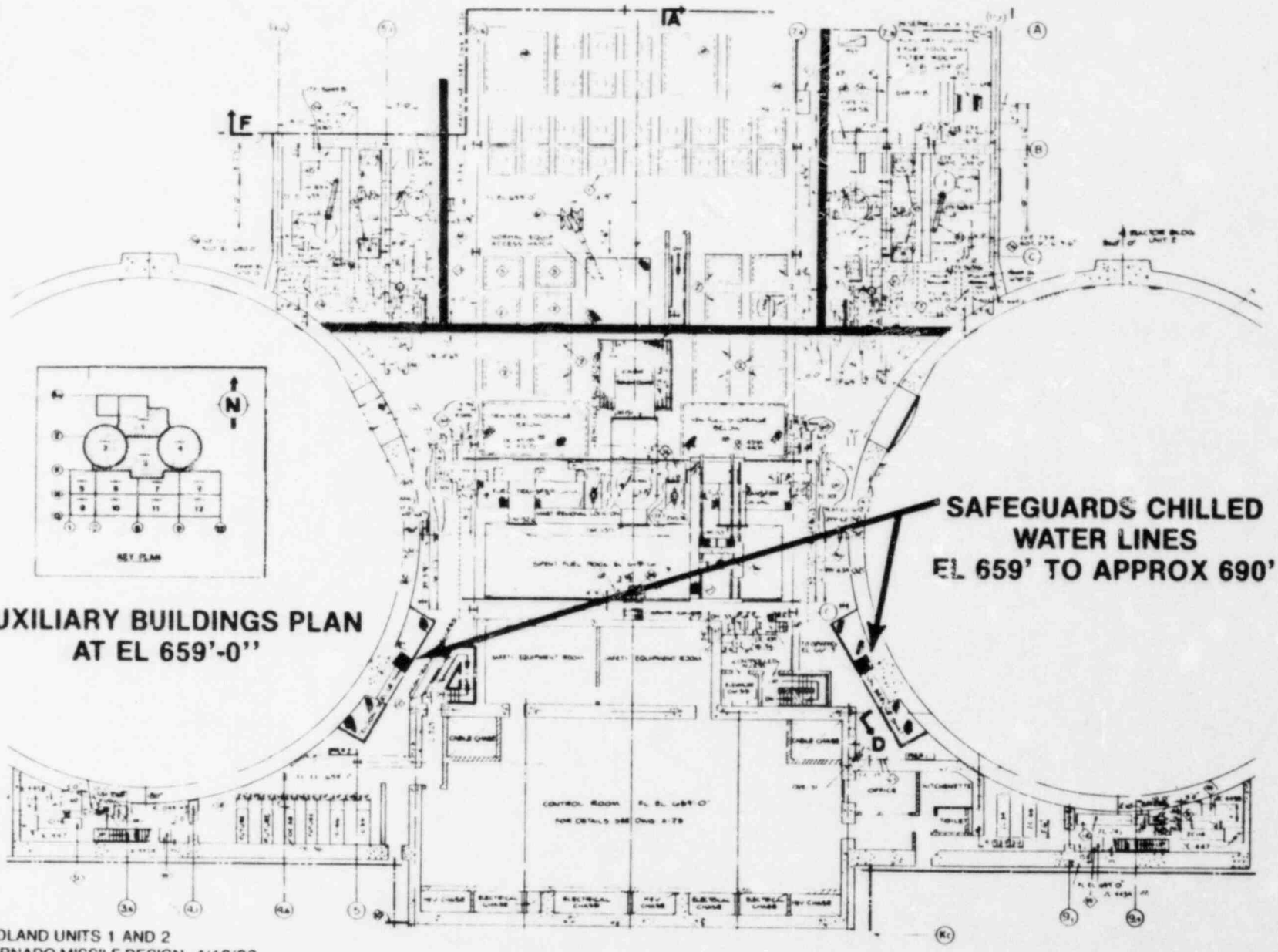
- DAMAGE TO BOTH TRAINS IS REQUIRED TO CAUSE CCWS FAILURE
- SEPARATION REQUIRED BY FIRE PROTECTION MAKES AFFECTING BOTH TRAINS DIFFICULT
- CRITICAL TRAJECTORIES ARE IMPROBABLE
- ECCAS WILL OVERRIDE PUMP TRIP/BLOCK

SAFEGUARDS CHILLED WATER



MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-13

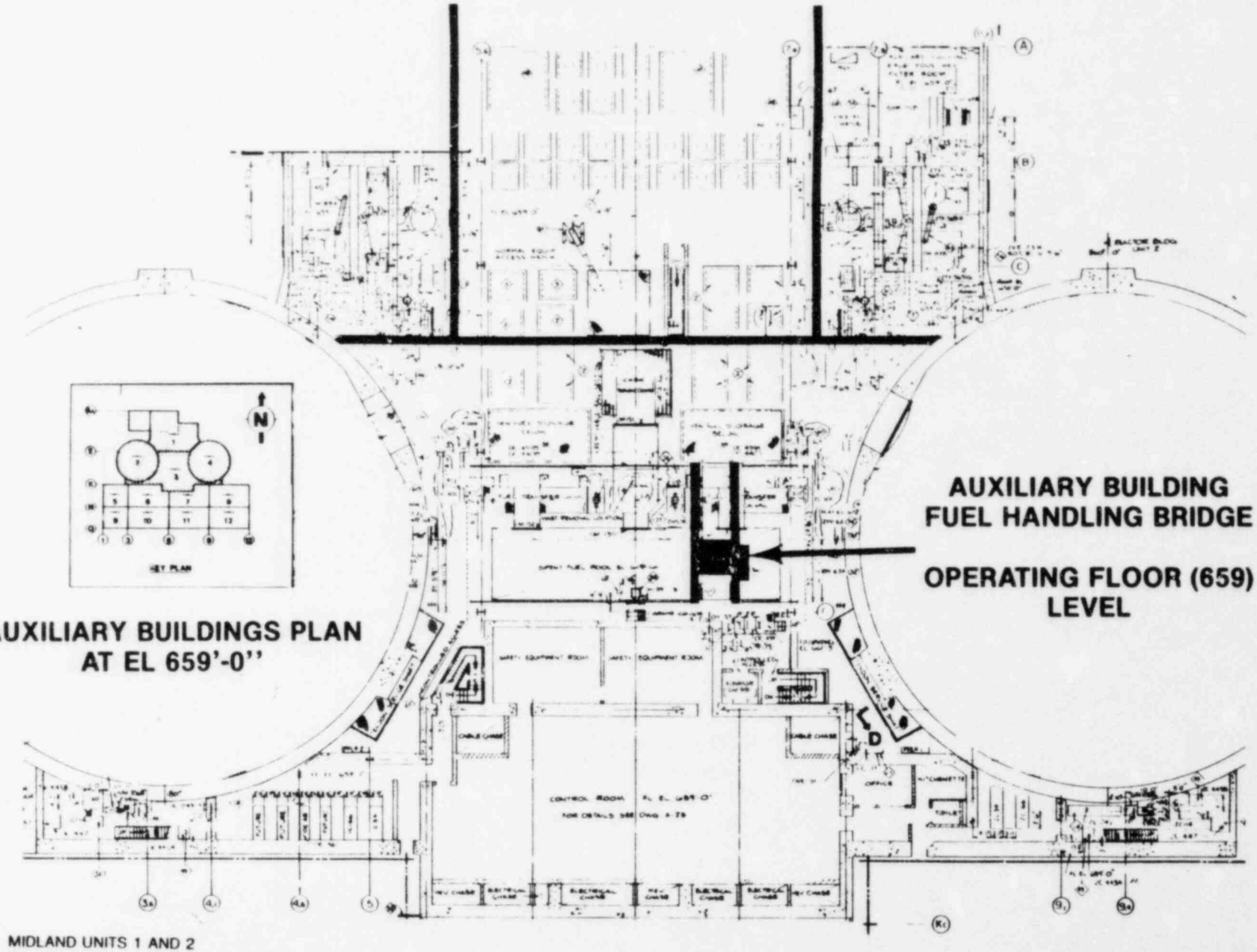


MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-12

SAFEGUARDS CHILLED WATER SYTEM (SCWS)

- DAMAGE TO BOTH SCWS TRAINS IS REQUIRED TO CAUSE SCWS FAILURE
- EXPOSED PIPING FOR OPPOSITE TRAINS ON OPPOSITE SIDES OF PLANT
- CRITICAL TRAJECTORIES ARE IMPROBABLE



MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-07

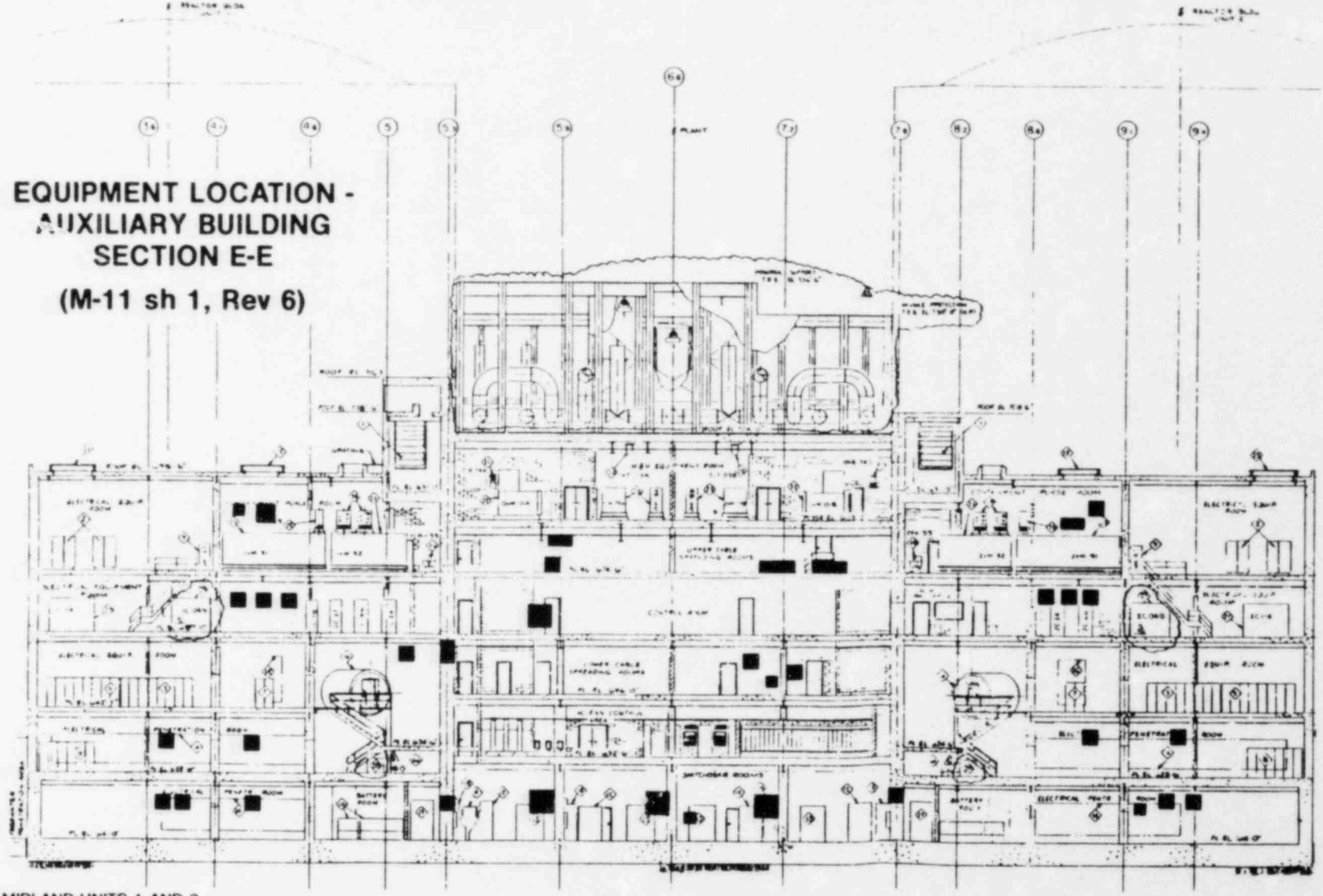
AUXILIARY BUILDING FUEL HANDLING BRIDGE (ABFHB)

- CONSIDERED DUE TO PROXIMITY TO SPENT FUEL
- IMPACT DOES NOT AFFECT SAFE SHUTDOWN
- NOT EXPECTED TO BECOME AIRBORNE
- LARGE MISSILES NOT CONSIDERED AT AUXILIARY BUILDING OPERATING DECK LEVEL

LOCATIONS OF SOUTH WALL ELECTRICAL PENETRATIONS

EQUIPMENT LOCATION - AUXILIARY BUILDING SECTION E-E

(M-11 sh 1, Rev 6)

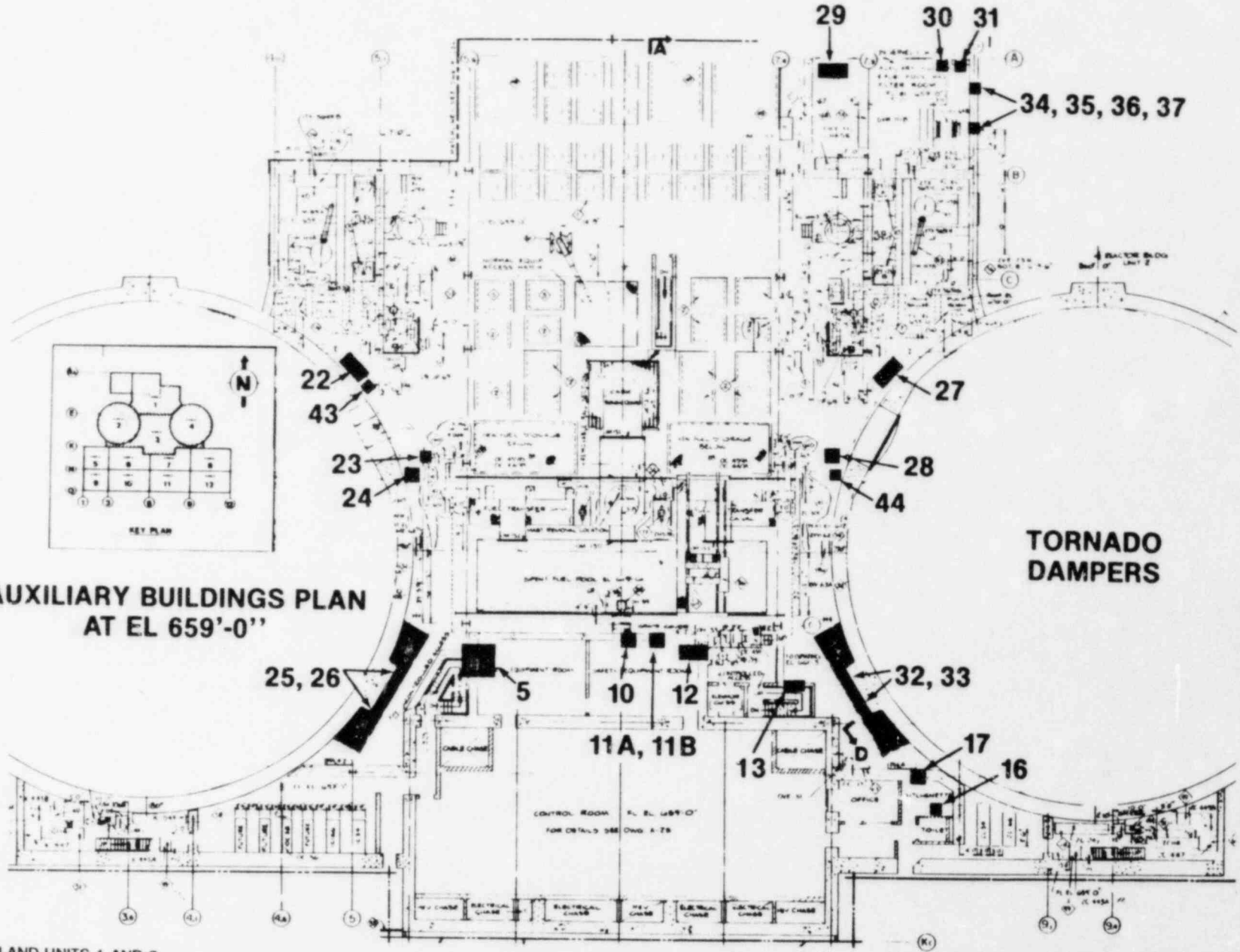


MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-06

SOUTH WALL ELECTRICAL PENETRATIONS

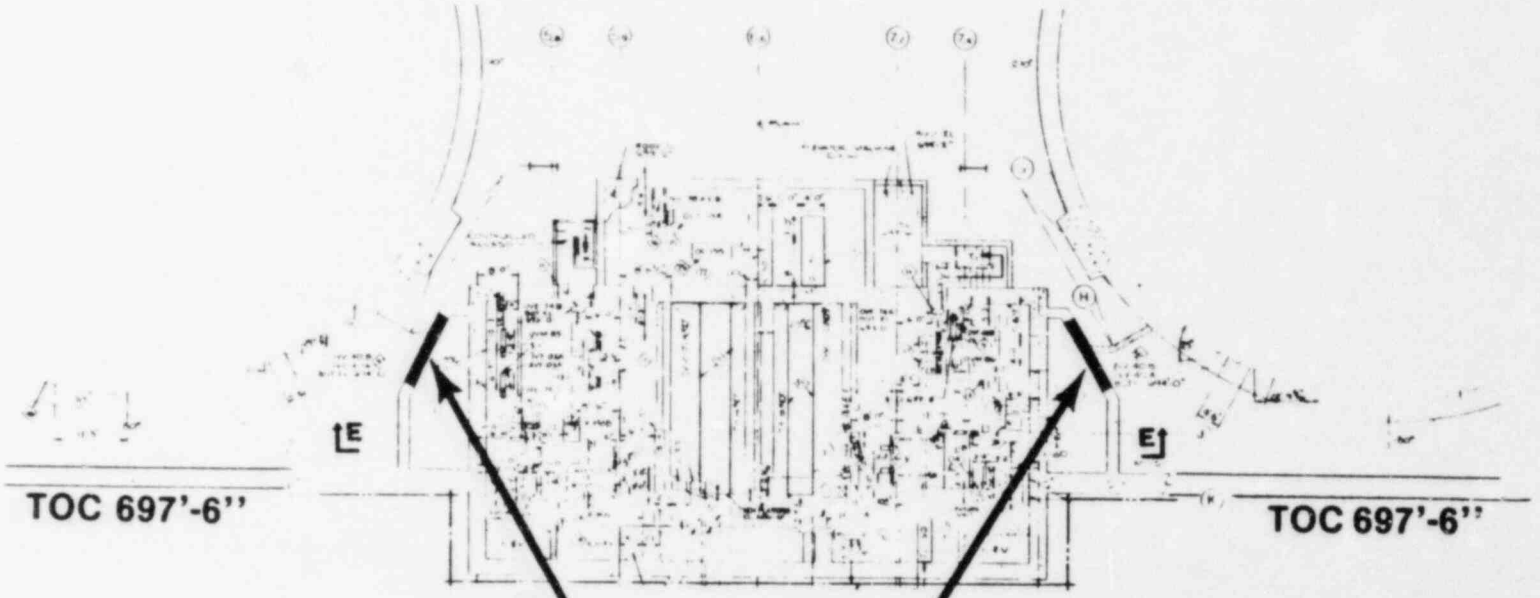
- CABLE PASSING THROUGH PENETRATIONS NOT REQUIRED FOR SHUTDOWN
- PENETRATIONS FILLED WITH CABLE, TRAYS, AND SEALANT
- ALL PENETRATIONS ARE SHIELDED FROM DIRECT MISSILE IMPACT BY TURBINE BUILDING STRUCTURE AND EQUIPMENT
- MISSILES GOING THROUGH PENETRATIONS WILL MOST LIKELY AFFECT SINGLE TRAIN EQUIPMENT



MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-04

PARTIAL PLAN
ELEVATION 694'-0''



MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-1996-05

HVAC TORNADO DAMPERS -GENERAL

- OUTER AUXILIARY BUILDING WALL DESIGNED TO WITHSTAND 3 psi △P DESIGN BASIS TORNADO
- COMPARTMENTALIZATION WITHIN AUXILIARY BUILDING RESULTS IN NEED TO ISOLATE AUXILIARY BUILDING PRESSURE BOUNDARY (dampers)
- COMPONENTS EVALUATED FOR 3 psi △P OUTSIDE AUXILIARY BUILDING PRESSURE BOUNDARY NOT ADVERSELY AFFECTED BY △P. COMPONENTS INSIDE ARE OF SIMILAR TYPES

SUMMARY

- MIDLAND MISSILE PROTECTION DETERMINISTICALLY DESIGNED
- SAFE SHUTDOWN FUNCTIONS PROTECTED
- SOME LIMITED VULNERABILITY
- LOSS OF SHUTDOWN FUNCTIONS VERY UNLIKELY

PART II
QUANTITATIVE ANALYSIS

A probabilistic analysis has been performed to substantiate the limited nature of the vulnerability to missile failures

WHAT IS ACCEPTABLE?

- REGULATORY GUIDES
  - 1.117 - Tornado Design Classification
  - 1.76 - Design Basis Tornado for Nuclear Power Plants
  - Define DBT Parameters
- STANDARD REVIEW PLANS
  - 2.2.3 - Evaluation of Potential Accidents
  - 3.5.1.4 - Missiles Generated by Natural Phenomena
- ENGINEERING JUDGEMENT

STANDARD REVIEW PLAN 2.2.3

"...is acceptable if the design basis events include each postulated type of accident for which the expected rate of occurrence of potential exposures in excess of the 10 CFR Part 100 guidelines is estimated to exceed the NRC staff objective of approximately 10^{-7} per year..."

"...Approximately 10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower..."

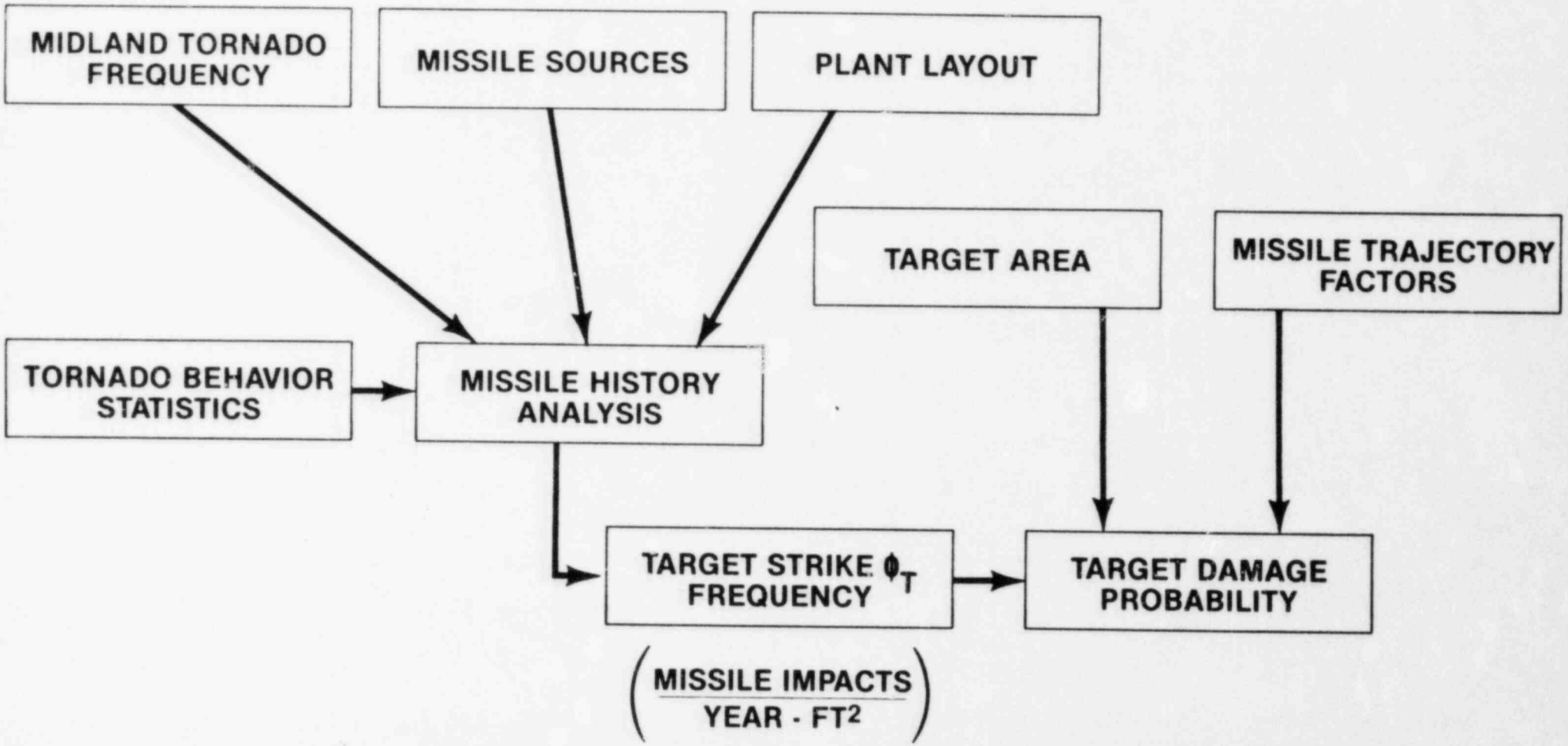
CRITERIA

- 10^{-7} PER YEAR
- CONSISTENT WITH DETERMINISTIC DESIGN REQUIREMENTS
- MUST CONSIDER ALL SIGNIFICANT RELEASE CONTRIBUTORS

ANALYSIS GROUND RULES

- EXISTING STUDIES WHERE POSSIBLE
- SIMPLE MATHEMATICAL MODELS
- MEAN VALUES OF PROBABILITIES
- CONSERVATISM APPLIED
  - Simplicity
  - Uncertainty
- POINT ESTIMATE WITH SIMPLE TREATMENT OF UNCERTAINTY
- ADDRESS DETERMINISTIC CRITERIA

TARGET ANALYSIS



BASES/ASSUMPTIONS

- TORNADO FREQUENCY
  - Midland Site Specific
  - Mean Value of 8.5×10^{-4}/Year (site impacts)
  - Based On:

    1953 - 1978 recorded data (1)

    1° x 1° area around site
  - Value Slightly Higher Than FSAR (6.5×10^{-4}/year) (2)

(1) Climatological data, national summary, U.S. environmental data and information service, vol 29, no. 13, 1978.
(2) Midland FSAR, subsection 2.3.1.2.6, tornadoes, rev 41, 2/82.

BASES/ASSUMPTIONS (cont'd)

- SITE MISSILE TRANSPORT
  - EPRI Monte Carlo Double Unit Plant Simulation (3) Results Applied Empirically to Midland Plant
  - Only Impact Probabilities Used (no damage models)
  - Missile Impacts for EPRI Plant Normalized per Unit Area. Based On Midland Safety Structure Surface Area

(3) Twisdale, LA, et. al., tornado missile risk analysis, EPRI NP-768, and tornado missile risk analysis - appendixes, EPRI NP-769, May 1978

SITE MISSILE TRANSPORT-
IMPLICIT ASSUMPTIONS

- 5,000 POTENTIAL MISSILES DURING 3-YEAR CONSTRUCTION OVERLAP

- 1,000 POTENTIAL MISSILES WHILE BOTH UNITS OPERATING

PLAN VIEW OF SAFETY RELATED STRUCTURES -EPRI MODEL

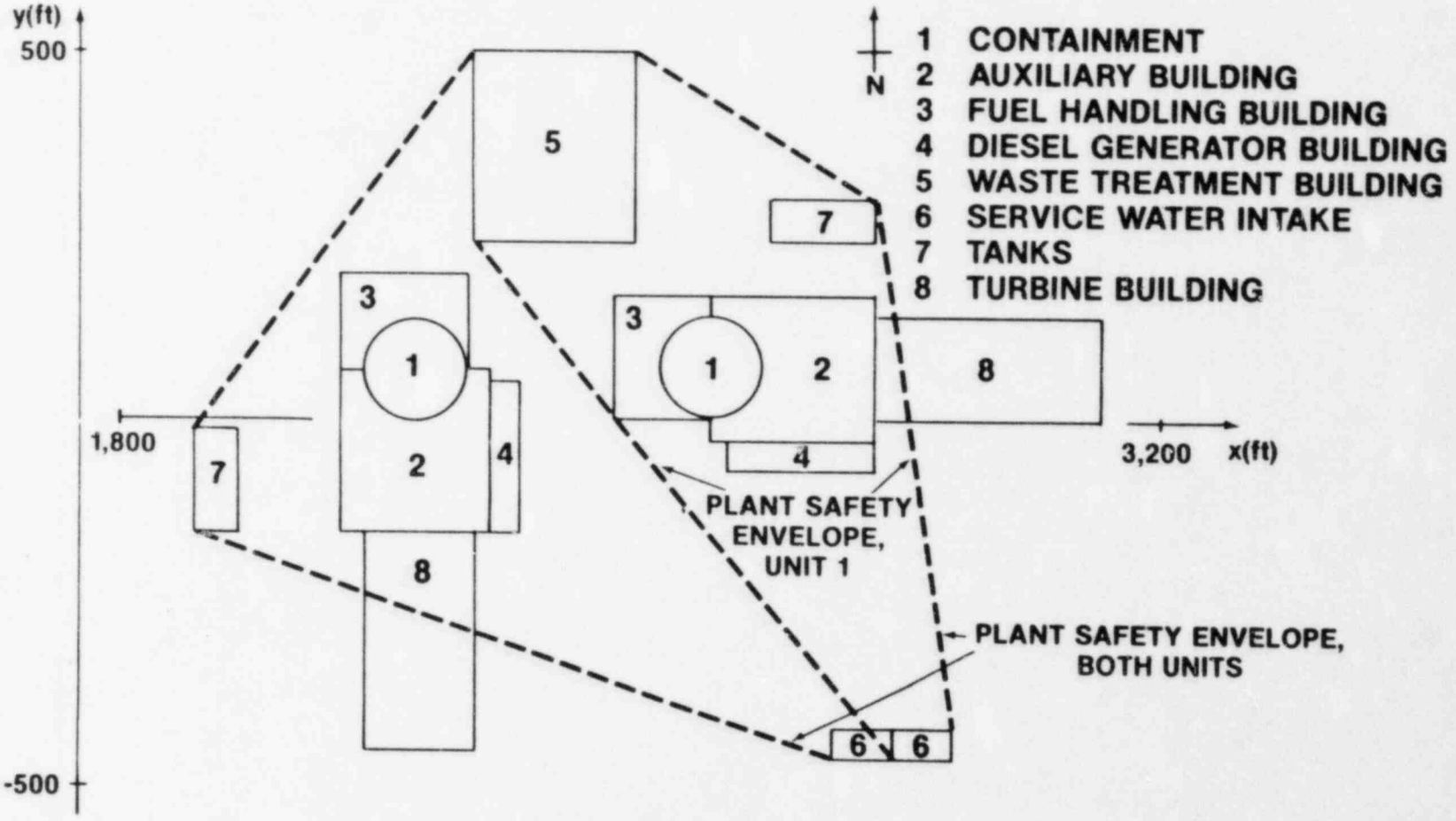


FIGURE B-1

MIDLAND UNITS 1 AND 2
TORNADO MISSILE DESIGN 4/16/82

G-2527-08

PLAN VIEW OF EPRI MODEL AND MIDLAND PLANT SAFETY STRUCTURES

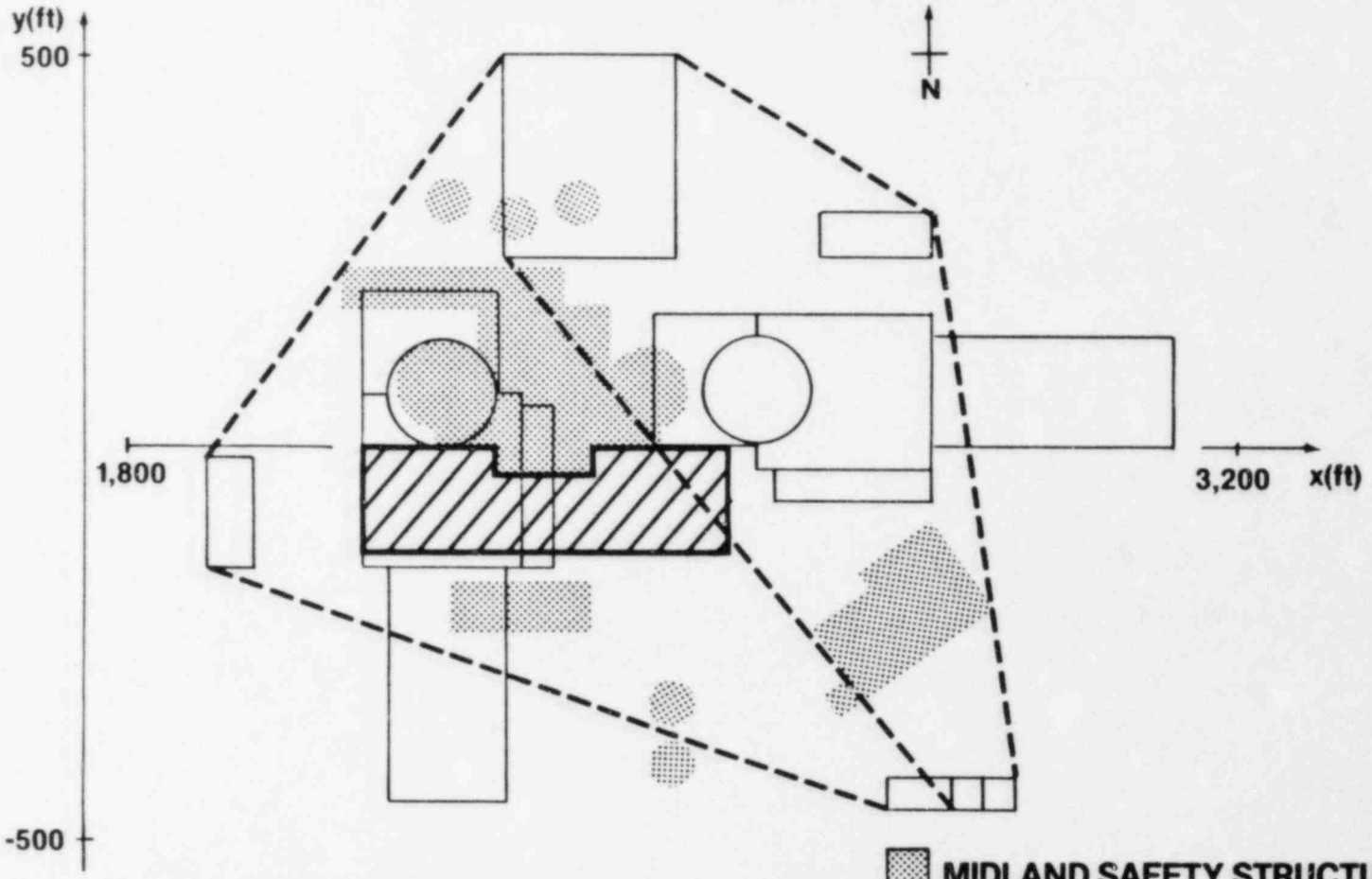


FIGURE B-2

MIDLAND UNIT 1 AND 2
TORNADO MISSILE DESIGN 5/25/82

G-2527-09

ADDITIONAL ASSUMPTIONS

- UNIFORM MISSILE DENSITY AT AVERAGE VALUE BECAUSE TARGETS >30 FEET ABOVE GRADE
- TARGET IMPACT PROBABILITY PROPORTIONAL TO TARGET SURFACE AREA
- STRAIGHT LINE TRAJECTORIES
- ISOTROPIC MISSILE DIRECTION DISTRIBUTION
- IMPACT TO NONPROTECTED EQUIPMENT RESULTS IN DAMAGE
- IMPACT TO DETERMINISTICALLY DESIGNED MISSILE BARRIERS RESULTS IN NO DAMAGE

- $\phi_{TARGET} = \phi_{\substack{SAFETY \\ STRUCTURES}} \times \frac{A_{TARGET}}{A_{\substack{SAFETY \\ STRUCTURES}}} \times P_G$

- ϕ_{TARGET} = FREQUENCY OF IMPACTING A SPECIFIC TARGET

- $\phi_{\substack{SAFETY \\ STRUCTURES}}$ = FREQUENCY OF IMPACTING A PLANT SAFETY STRUCTURE, CONSIDERING
  - Tornado Frequency at Site
  - Site Transport of Missiles
  - Tornado Intensity Distribution
  - Site Geometry
  - Number and Location of Potential Missiles

- A_{TARGET} = TARGET SURFACE AREA EXPOSED TO HEMISPHERE

- $A_{\substack{SAFETY \\ STRUCTURES}}$ = SAFETY STRUCTURE SURFACE AREA EXPOSED TO HEMISPHERE

- P_G = PROBABILITY THAT MISSILE BARRIER WIL NOT BLOCK TRAJECTORY

Φ SAFETY STRUCTURES

- 1.5×10^{-5}/YEAR
- BASED ON MIDLAND TORNADO FREQUENCY
- BASED ON EPRI MISSILE TRANSPORT RESULTS EMPIRICALLY APPLIED

A SAFETY STRUCTURES

- USING MIDLAND VALUE IN EQUATION RESULTS IN SIGNIFICANT CONSERVATISM

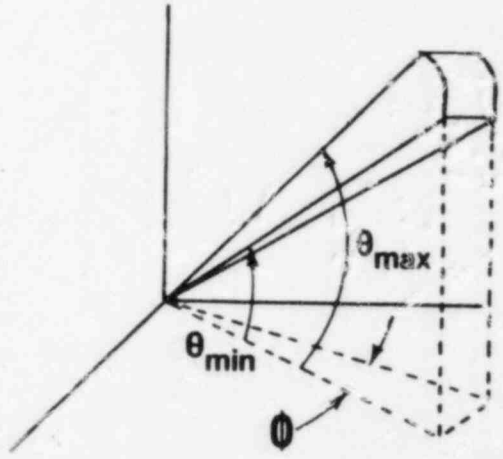
- MIDLAND AREA = 255,000 SQUARE FEET BASED ON AS-BUILT ESTIMATE

- VALUE OF 200,000 SQUARE FEET USED IN ANALYSIS (20% conservatism)

P_G

- MATHEMATICALLY DEFINED AS FRACTION OF HEMISPHERE FROM WHICH MISSILE SOURCE IS VISIBLE FROM TARGET

- DEFINED BY $P_G = \frac{\phi^\circ (\text{SIN } \theta_{max} - \text{SIN } \theta_{min})}{360}$



IS MODEL CONSISTENT WITH INTUITION?

- FOR A HEMISPHERE
  - $\Phi = 360$
  - $\theta_{max} = 90°$
  - $\theta_{min} = 0$
  - $P_G = \dfrac{360° \text{ (SIN } 90° - \text{SIN } 0°)}{360°} = 1$

- IF WE ASSUME THE TARGET IS THE SAFETY STRUCTURES
  - $A_{TARGET} = A_{SAFETY\ STRUCTURES}$
  - $P_G = 1$ (hemisphere - no missile barriers outside the plant)
  - $\Phi_{TARGET} = \Phi_{SAFETY\ STRUCTURES} \times \dfrac{A_{TARGET}}{A_{SAFETY\ STRUCTURES}} \times P_G = \Phi_{SAFETY\ STRUCTURES}$

SIMPLE PROBABILITY MODEL APPLIED TO EACH VULNERABLE COMPONENT

- NO RESISTANCE TO DAMAGE
- CONSERVATIVELY HIGH MISSILE SOURCE TERM
- WINDOW ANGLES CONSERVATIVELY ESTIMATED
- TARGET SURFACES APPROXIMATED BY LARGER SURFACES FOR COMPLEX SHAPES

SAFEGUARDS CHILLED WATER MISSILE-RELATED FAILURE MODES

- TRAIN A POWER + TRAIN B PIPING*
- TRAIN B POWER + TRAIN A PIPING*
- TRAIN A PIPING* + TRAIN B PIPING*

*Missile-related failure

SAFEGUARDS CHILLED WATER FAILURE

- IMPACT ASSUMED TO CAUSE COMPONENT FAILURE

- OTHER FAILURES CONSIDERED IN CONJUNCTION WITH MISSILE RELATED FAILURES
  - Opposite Train Power
  - Loss of Offsite Power

- $\phi_{IMPACT} = 1 \times 10^{-10}/YEAR$

CHEMICAL ADDITION SYSTEM MISSILE-RELATED FAILURE MODES

- BWST* + TRAIN A POWER + TRAIN B CABLES*
- BWST* + TRAIN A POWER + TRAIN B PUMP (BA)
- BWST* + TRAIN A POWER + TRAIN B SOV
- (BWST* + TRAIN A POWER + TRAIN B MU PUMP)
- (BWST* + TRAIN A POWER + TRAIN B POWER)
- BWST* + TRAIN A PUMP (BA) + TRAIN B CABLES*
- BWST* + TRAIN A PUMP (BA) + TRAIN B PUMP (BA)
- BWST* + TRAIN CABLES* + TRAIN B PUMP (BA)
- BWST* + TRAIN A CABLES* + TRAIN B CABLES*
- BWST* + TRAIN A CABLES* + TRAIN B SOV
- BWST* + TRAIN A SOV + TRAIN B CABLES*
- BWST* + TRAIN A SOV + TRAIN B SOV
- (BWST* + TRAIN A MU PUMP + TRAIN B MU PUMP)
- PLUS ALL COMPLEMENTARY CASES WITH TRAINS SWITCHED

*Missile-related failure

( ) Case where failure independent of missile-related failures

CHEMICAL ADDITION SYSTEM FAILURE

- IMPACT ASSUMED TO CAUSE COMPONENT FAILURE
- OTHER FAILURES CONSIDERED IN CONJUCTION WITH MISSILE-RELATED FAILURES
  - Opposite Train Power
  - BWST
  - SOVs
  - Pumps
- $\phi_{IMPACT} = 1 \times 10^{-10}$/YEAR

COMPONENT COOLING WATER MISSILE-RELATED FAILURE MODES

- TRAIN A POWER + TRAIN B LT*
- TRAIN A POWER + TRAIN B CABLE*
- TRAIN B POWER + TRAIN A LT*
- TRAIN B POWER + TRAIN A CABLE*
- TRAIN A LT* + TRAIN B CABLE*
- TRAIN A LT* + TRAIN B LT*
- TRAIN B LT* + TRAIN A CABLE*
- TRAIN A CABLE* + TRAIN B CABLE*

*Missile-related failure

COMPONENT COOLING WATER FAILURE

- IMPACT ASSUMED TO CAUSE COMPONENT FAILURE
- CABLE TRAINS A AND B CONSERVATIVELY ASSUMED TO BE VULNERABLE TO SINGLE MISSILE
- OTHER FAILURES CONSIDERED WITH MISSILE FAILURES
  - Loss of Offsite Power
  - Opposite Train Power
- $\phi_{IMPACT} = 4 \times 10^{-9}$/YEAR

AUXILIARY BUILDING FUEL HANDLING BRIDGE

- IMPACT ASSUMED TO CAUSE MAJOR BRIDGE FAILURE (very conservative)
- SIGNIFICANT FUEL FAILURES ASSUMED TO RESULT FROM BRIDGE FAILURE (very conservative)
- SURFACE AREA CONSERVATIVELY ESTIMATED
- ASSUMED PARKED AT MOST VULNERABLE LOCATION
- DESIGN PRECLUDES DIRECT MISSILE IMPACT TO FUEL
- $\phi_{IMPACT} = 1 \times 10^{-8}$/YEAR

DAMAGE TO SHUTDOWN EQUIPMENT FROM SOUTH WALL PENETRATIONS

- PENETRATIONS ASSUMED TO BE EMPTY (no cable, tray, or sealant)
- TURBINE BUILDING STRUCTURES AND COMPONENTS IGNORED
- ANY CRITICAL EQUIPMENT BEHIND PENETRATION ASSUMED TO BE DAMAGED
- LOSS OF SHUTDOWN ASSUMED FOR ANY COMBINATION OF OPPOSITE TRAIN EQUIPMENT LOSS
- ALL PENETRATIONS CONSIDERED EQUALLY
- $\phi_{DAMAGE} = 4 \times 10^{-9}$/YEAR

HVAC TORNADO DAMPER DAMAGE

- IMPACT ASSUMED TO CAUSE DAMPER FAILURE
- DAMPER FAILURE ASSUMED TO RESULT IN UNACCEPTABLE CONSEQUENCES
- HVAC DUCTS NEGLECTED FOR BLOCKING/DEFLECTING MISSILES
- $\Phi_{IMPACT} = 1 \times 10^{-8}$ PER YEAR (one or more dampers)

ANALYSIS COMPOSITE SUMMARY

Target	Impact Frequency (YR^{-1})
TORNADO DAMPERS	1E-8
COMPONENT COOLING WATER	4E-9
CHEMICAL ADDITION + BWST	1E-10
SAFEGUARDS CHILLED WATER	1E-10
AUXILIARY BUILDING FUEL HANDLING BRIDGE	1E-8
SHUTDOWN EQUIPMENT AT SOUTH WALL	4E-9
TOTAL	3E-8

SIGNIFICANCE OF RESULTS

- CONSERVATIVELY CALCULATED
- EVEN IF IMPACTS IMPLIED FAILURE, AND FAILURE IMPLIED EXCEEDING 10 CFR 100 GUIDELINES (not expected), THE TOTAL FREQUENCY DOES NOT EXCEED 10^{-7}/YEAR
- 95TH PERCENTILE TORNADO FREQUENCY (approximately 3 times mean) FOR MIDLAND SITE WILL NOT CAUSE FREQUENCY TO EXCEED 10^{-7}/YEAR
- SINGLE FAILURES HAVE BEEN PROBABILISTICALLY INCLUDED

MIDLAND AUXILIARY MISSILE PROTECTION

SHOWING CRANE SUPPORTS

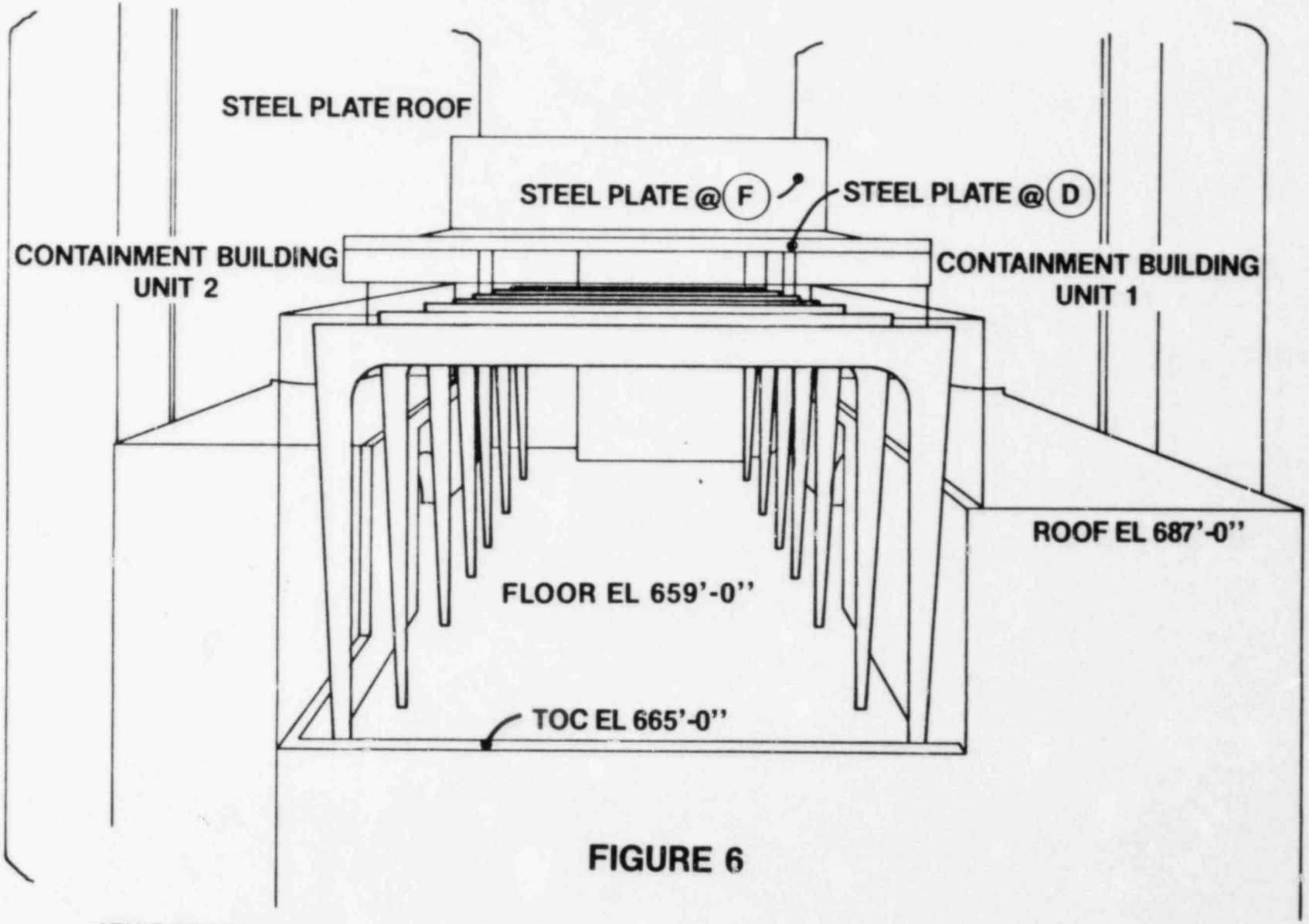


FIGURE 6

MIDLAND UNIT 1 AND 2
TORNADO MISSILE DESIGN 5/25/82

G-2527-06

MIDLAND AUXILIARY BUILDING
MISSILE PROTECTION
SHOWING CRANE SUPPORTS
(inside looking south from el 716')

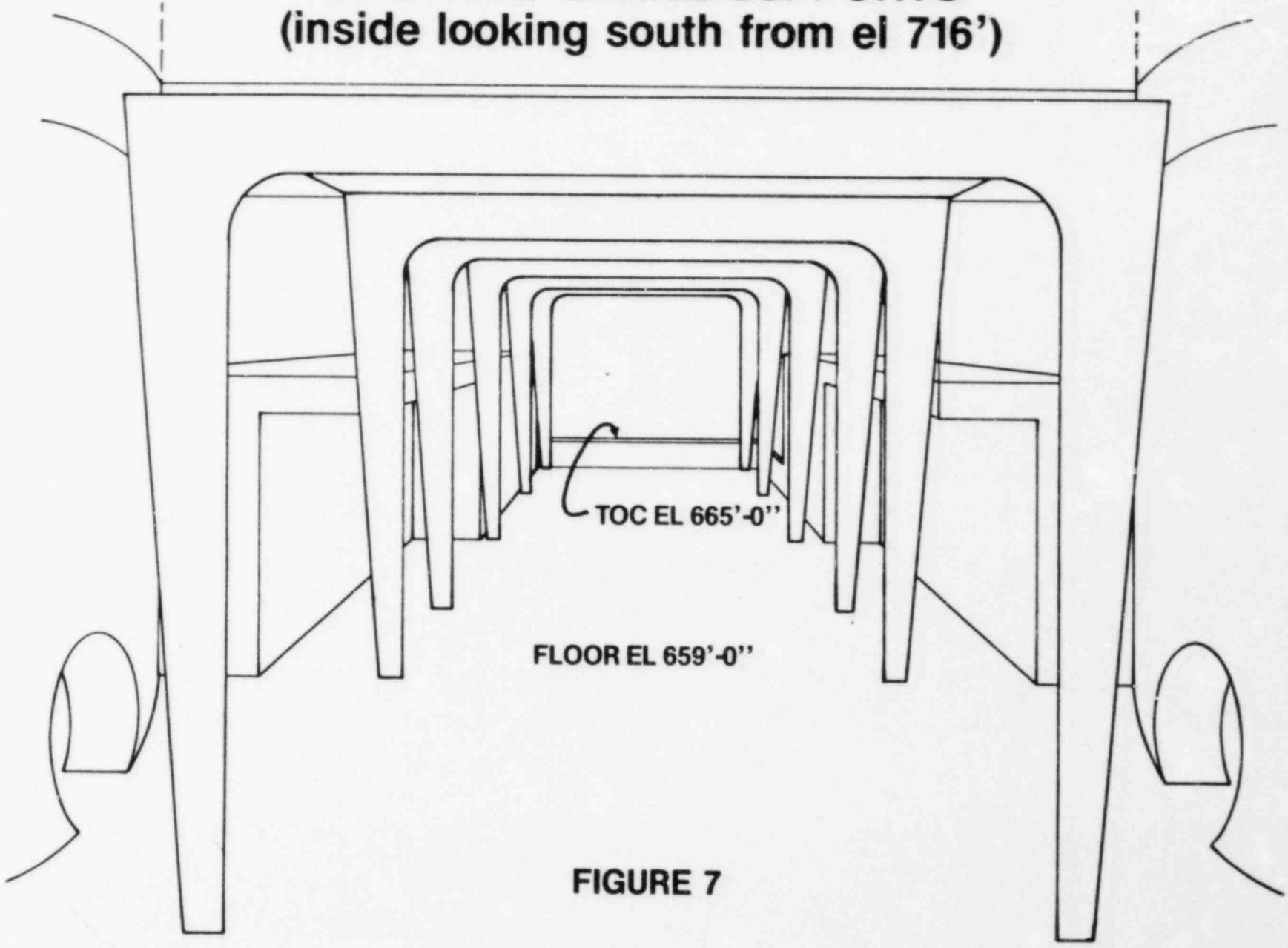


FIGURE 7

MIDLAND UNIT 1 AND 2
TORNADO MISSILE DESIGN 5/25/82

G-2527-07

CONCLUSIONS

- PROBABILISTIC ANALYSIS SUPPORTS THE NEED FOR DETERMINISTICALLY DESIGNED PROTECTION

- MIDLAND DESIGN PROVIDES REQUIRED MISSILE PROTECTION FOR SAFETY SYSTEMS

- THE AMOUNT OF VULNERABILITY OF MIDLAND SAFETY SYSTEMS TO TORNADO MISSILES DOES NOT WARRANT ADDITIONAL PROTECTION

MEETING SUMMARY DISTRIBUTION

Docket No(s): 50-329/330
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