TECHNICAL EVALUATION REPORT

MASONRY WALL DESIGN

VIRGINIA ELECTRIC AND POWER COMPANY

SURRY POWER STATION UNITS 1 AND 2

NRC DOCKET NO. 50-280, 50-281

NRC TAC NO. 42867, 42868

NRC CONTRACT NO. NRC-03-81-130

FRC PROJECT C5508

FRC ASSIGNMENT 6

FRC TASK 240

Prepared by

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Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: N. C. Chokshi

April 24, 1985

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FRANKLIN RESEARCH CENTER
DIVISION OF ARVIN/CALSPAN
20th & RACE STREETS, PHILADELPHIA, PA 19103

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APPENDIX B - SKETCHES OF WALL MODIFICATIONS

FOREWORD

This Technical Evaluation Report was prepared by Franklin Research Center under a contract with the U.S. Nuclear Regulatory Commission (Office of Nuclear Reactor Regulation, Division of Operating Reactors) for technical assistance in support of NRC operating reactor licensing actions. The technical evaluation was conducted in accordance with criteria established by the NRC.

1. INTRODUCTION

1.1 PURPOSE OF REVIEW

The purpose of this review is to provide a technical evaluation of the Licensee response to IE Bulletin 80-11 [1] with respect to compliance with the Nuclear Regulatory Commission (NRC) masonry wall criteria. In addition, if the Licensee plans repair work on masonry walls, the planned methods, and procedures are reviewed for acceptability.

1.2 GENERIC ISSUE BACKGROUND

In the course of conducting inspections at the Trojan Nuclear Plant, Portland General Electric Company determined that some concrete masonry walls did not have adequate structural strength. Further investigation indicated that the problem resulted from errors in engineering judgment, a lack of established procedures and procedural details, and inadequate design criteria. Because of the implication of similar deficiencies at other operating plants, the NRC issued IE Bulletin 80-11 on May 8, 1980.

IE Bulletin 80-11 required licensees to identify plant masonry walls and their intended functions. Licensees were also required to present reevaluation criteria along with the analysis results of all safety-related walls. If modifications were proposed, licensees were to state the methods and schedules for the modifications.

1.3 PLANT-SPECIFIC BACKGROUND

In response to IE Bulletin 80-11, Virginia Electric and Power Company submitted to the NRC letters with attachments dated July 7, 1980 through October 29, 1981 [2-14] describing the status of masonry walls at Surry Power Station Units 1 and 2. The information in these letters was reviewed, and requests for additional information were sent to the Licensee on May 21, 1982 [15]. The Licensee responded to these requests [16-18].

The Licensee identified 119 walls as safety-related in both Units 1 and 2 according to IE Bulletin 80-11. The working stress method was used to qualify the walls, and 79 walls were found acceptable. Two walls were accepted after

equipment was removed from the wall, and 31 walls were modified. The remaining 7 walls in the fuel building were not acceptable under extreme loading cases, and they have been removed and replaced with "blow-off" metal siding attached to a steel girt system in the same fashion as that used in the North Anna plant [19], which reduced the total number of safety-related walls to 112. These modifications are identical in both the North Anna and Surry plants and are intended for the same function. The adequacy of this modification technique has been addressed in the NRC staff Safety Evaluation Report related to the spent fuel pool expansion issue of the North Anna plant. In general, the masonry walls were designed as partition walls, fire protection walls, or shield walls. All masonry walls at the plant are unreinforced except for horizontal joint reinforcements. Some walls are hollow, others are solid masonry blocks.

Masonry wall types and materials for Surry Power Station Units 1 and 2 are given below:

Wall Types:

Total number of walls	339
Safety-related walls	112
Walls requiring modifications	31

Wall Functions: Partition, shielding, fire protection

Construction Materials:

Hollow masonry units	ASTM C90 and ASTM C129
Solid masonry units	ASTM C145
Mortar	Type S, M, or N

2. REVIEW CRITERIA

The basic documents used for guidance in this review were the criteria developed by the Structural Geotechnical Engineering Branch (SGEB) of the NRC (attached as Appendix A to this report), the Uniform Building Code [20], and ACI 531-79 [21].

In general, the materials, testing, analysis, design, construction, and inspection of safety-related concrete masonry walls should conform to the SGEB criteria. For operating plants, the loads and load combinations for qualifying the masonry walls should conform to the appropriate specifications in the Final Safety Analysis Report (FSAR) for the plant. Allowable stresses are specified in Reference 21 and the appropriate increase factors for abnormal and extreme environmental loads are given in the SGEB criteria (Appendix A).

3. TECHNICAL EVALUATION

This evaluation is based on the Licensee's earlier responses [2-14] and subsequent responses [16-18] to the requests for additional information [15]. The Licensee's criteria [4, 13] were evaluated with regard to the design and analysis method, loads and load combinations, allowable stresses, construction specifications, and materials. The Licensee's response to the request for additional infomation was also reviewed.

3.1 EVALUATION OF LICENSEE'S CRITERIA

The Licensee reevaluated the masonry walls at the Surry Power Station using the following criteria:

- Allowable stresses are based on the Uniform Building Code [20] and ACI 531-79 [21]
- Load combinations are according to the FSAR, which includes dead loads and seismic loads
- The working stress design method of analysis is used
- Masonry walls are reevaluated for earthquake on the basis of determining the effects of inertial loads, equipment loads, and interstory displacement effects. The spectral approach is used along with the following criteria:
  - 2% damping is used for unreinforced walls for operating basis earthquake (OBE).
  - 4% damping is used for unreinforced walls for safe shutdown earthquake (SSE).
  - To account for variations in material properties and assumed boundary conditions, the seismic response for masonry walls will be calculated using amplified response spectra for which the peak has been peak broadened.
  - Equipment loads are calculated based on a load distributed uniformly over part or all of the area of wall, depending on the arrangement of the supports. The result may be applied as a single concentrated load or a line load, as appropriate.
  - Interstory displacements are imposed on the wall, where required, and its effects accounted for in the reevaluation analysis.
- The walls are modeled as beams or plates.

- Independent laboratory testing was performed on masonry materials to assure compliance with the applicable ASTM specification for compressive strength and absorption.

Other than those areas identified in Section 4, the Licensee's criteria have been reviewed and found to be technically adequate and in compliance with the SGEB criteria. The review of the Licensee's response to the request for additional information follows.

Request 1

Provide and justify the boundary conditions and modeling techniques used for the reevaluation of masonry walls at the Surry plant and, using sample calculations, indicate how the potential for block pullout was considered at equipment attachments.

Response 1

In response to this request, the Licensee provided sketches to illustrate typical boundary conditions used for the reevaluation of masonry walls at Surry Power Station Units 1 and 2. The Licensee also provided types of boundary conditions and their justifications, modeling techniques, and sample calculations for block pullout.

a. Boundary Conditions

The boundary conditions were taken as free, fixed, simple, or elastic supports. The following are the criteria used by the Licensee to determine the boundary conditions:

- Seismic loads are reversible; therefore, supports had to provide restraint in both directions.

- Consideration was given to the relative stiffness of the block wall and its supports. If rigid boundary could not be justified for a specific wall, then the analysis included the effect of the support's elasticity.

- Shear load transfer mechanisms were only considered at block-to-block and block-to-concrete interfaces. No shear transfer was considered for block-to-steel interfaces or across expansion joints or commpressible materials. (Free boundary conditions were assumed.)

- Fixity was considered in the following cases. (a) Fixity was used at the base of a block wall built on a concrete slab if a cantilevered wall would exist (i.e., three sides of wall free).

(b) At the perpendicular intersection of two block walls, fixity was taken at those corner joints constructed of alternating courses of running bond. If fixity was taken, then the relative stiffness of the walls had to be accounted for and the reaction was carried into the supporting wall.

For the cantilevered walls, the mortar bed joints at the base cannot be relied upon to prevent rotation of the walls at the base. Some modifications need to be done to assure the moment transfer mechanism takes place at the base. The review of other plants indicated that for a similar situation, some clamping devices are provided at the base to assure the load is transferred properly at the base. See additional discussion in Response 10.

b. Modeling Techniques

All walls were analyzed using grid models. Effects of out-of-plane loads at penetrations from pipe, conduit, or ducts were considered.

c. Block Pullout

The potential for block pullout was considered by development of local block loading criteria including shell face pullout and core pullout. As stated in the sample calculation, an on-site testing program was performed at Surry Power Station on May 8, 13, 15, and 20, 1981. The test indicated that failure loads for the 3/8-in ϕ Hilti sleeve anchor failed as a result of excessive slippage of the anchor system; however, the failure loads were well above the 350-lb allowable for C-90 block. Several 1/2-in ϕ Hilti sleeve anchors had a spall cone failure mechanism. The smallest load which involved a spall cone failure was 1871 lb, which is well above the 350-lb allowable load for C-90 block.

As a result, the Licensee confirmed that the allowable values for block pullout are higher than those calculated.

The Licensee's response is technically adequate and in compliance with the SGEB criteria.

Request 2

Using sample calculations, indicate how the effects of higher modes of vibration are included in the analysis.

Response 2

The Licensee indicated that walls having high fundamental frequencies away from resonance were analyzed using the envelopes of the amplified response spectra (ARS). For walls having natural frequencies in the resonant range, a dynamic analysis was carried out and the responses due to at least the first ten modes were obtained by the square root of the sum of the squares (SRSS).

A sample calculation for walls having high fundamental frequencies away from resonance was provided. The wall analyzed is 4 ft 6 in wide and 7 ft 4 in high and is constructed by solid blocks 12 in x 8 in x 16 in. The maximum tensile stress normal to bed joint due to inertial and equipment load is 4 psi, which is less than the allowable of 40 psi.

In addition, a STRUDL computer program input file was provided which indicated that the Licensee has employed dynamic analysis for walls having natural frequencies in the resonant range. Also, it indicated that the responses of the wall were obtained by the SRSS of at least the first ten modes.

The Licensee's response is adequate and in compliance with the SGEB criteria.

Request 3

Provide sample calculations to show the analytical approach used for obtaining the stresses in single-wythe and multiple-wythe walls.

Response 3

In response to this request, the Licensee indicated that single-wythe walls were analyzed based on conventional beam or plate equations with the boundary conditions and modeling techniques stated in Response 1. Multiple-wythe walls were analyzed in a similar manner except that in-plane shear stresses and out-of-plane tension stresses were considered to be transfered accross the collar joint.

With regard to single-wythe walls, sample calculations were provided for an 8-in, hollow, lightweight block wall with the following conditions:

- Two-way slab, a = 8.17 ft, b = 10.27 ft
- The wall fundamental frequency is 87.8 cps
- Firewall, four sides simply supported
- Total attached load on wall is 1483 lb
- Accelerations due to earthquake are:
  - Horizontal SSE = 0.43g
  - Horizontal OBE = 0.30g
  - Vertical SSE = 0.55g
  - Vertical OBE = 0.37g
- Wall is unreinforced.

The results of the single-wythe sample calculation are listed below.

Type of Stress (SSE)	Calculated Stress	Licensee Allowable*
Maximum tensile stress (parallel to bed joint)	30.81 psi	67 psi
Maximum tensile stress (normal to bed joint)	24.12 psi	35 psi
Maximum compressive stress	38.62 psi	298 psi
Maximum shear stress	4.82 psi	40 psi

The sample calculations indicated that the computed stresses for the combined loading of inertia, interstory relative displacement, and equipment attached load were found to meet the intent of the SGEB allowables.

With regard to multi-wythe walls, sample calculations were provided for a 18-in, solid, normal-weight block wall. The 18-in wall has three layers of 6-in x 8-in x 16-in blocks.

The wall was analyzed under the following conditions:

- Vertical beam strip, L = 8.06 ft
- The wall fundamental frequency is 25.4 cps (using plate formula)

*The Licensee allowable meets the intent of the SGEB allowable as discussed in Response 4.

- Shielding wall, cantilevered from floor
- Total attached load on wall is 970.75 lb
- Accelerations due to earthquake are:

Horizontal DBE = 0.48g	Vertical DBE = 0.30g
Horizontal OBE = 0.35g	Vertical OBE = 0.21g

The results of the multi-wythe wall sample calculation are listed below.

Type of Stress (SSE)	Calculated Stress	Licensee Allowable
Maximum tensile stress (normal to bed joint)	61.3 psi	67 psi
Maximum compressive stress	76.7 psi	298 psi
Maximum shear stress	4.2 psi	40 psi
Combined collar joint stress	5.6 psi	12 psi

The sample calculations indicated that the computed stresses for the combined loading of inertia and equipment attached loads were found to be within the SGEB allowables except for the case of tension normal to bed joint. Response 4 provides justifications and sources of conservatisms for accepting the Licensee's increased factor. Therefore, it is concluded that the Licensee's response is adequate and meets the intent of the SGEB criteria.

Request 4

Justify the increase factor of 1.67 used in the criteria for allowable stresses. The allowable working stresses for load conditions which represent abnormal/severe and abnormal/extreme environmental conditions such as a design basis earthquake (DBE) may be multiplied by factors shown in the table in the SGEB criteria which are given below:

Type of Stress	Factor
Shear reinforcement and/or bolts	1.5

Type of Stress	Factor
Masonry tension parallel to bed joint	1.5
Shear carried by masonry	1.3
Masonry tension perpendicular to bed joint	
-for reinforced masonry	0.0
-for unreinforced masonry	1.3

Response 4

In this response, the Licensee stated that all allowable stress levels given in the SGEB criteria are met except for masonry tension perpendicular to the bed joint. With reference to National Concrete Masonry Association (NCMA) test data for masonry tension perpendicular to the bed joint, the Licensee indicated that the factor of 1.67 provides a minimum average factor of safety of 2.3 with respect to the NCMA test results for masonry tension perpendicular to bed joint. Moreover, in order to determine the extent to which this increased allowable stress was used to establish that the walls were acceptable, the calculated tension perpendicular and parallel to the bed joint stress values were reviewed for all walls. The results of this review indicated that all but 9 walls meet the SGEB criteria. For these 9 walls, the only stress not meeting the SGEB criteria is the tension perpendicular to the bed joint and the calculated stresses show an increase of 1.32 to 1.65 over the allowable working stress. These values are greater than the SGEB factor of 1.3 but less than the 1.67 increase allowed in the Licensee's criteria. However, the 1.67 increase factor is felt to be reasonable in light of the conservative values used for damping: 2% for OBE and 4% for SSE as opposed to 4% and 7% allowed by the SGEB.

Therefore, the Licensee's response is considered adequate and meets the intent of the SGEB criteria.

Request 5

Provide sketches of the proposed wall modifications and indicate how these modifications will correct the wall deficiencies.

Response 5

In response to this request, the Licensee provided sample sketches of the wall modifications. One set of sketches is an example of a wall which was modified by changing its boundary conditions and adding steel plates on both sides of an existing structural member to provide a pinned boundary. Another set of sketches is an example of a wall modification which reduced the unsupported span of the wall by adding vertical and horizontal members. Appendix B of this report presents the sketch of the typical wall modifications.

The Licensee's response is satisfactory and in compliance with the SGEB criteria.

Request 6

Provide the status of the proposed wall modifications.

Response 6

The Licensee confirmed that 31 walls that required modifications had been installed as indicated in Reference 14.

The remaining seven walls in the fuel building were not acceptable under extreme loading cases and they have been removed and replaced with "blow-off" metal siding attached to a steel girt system in the same fashion as that used in the North Anna plant [19]. These modifications are identical in both the North Anna and Surry plants and are intended for the same function. The adequacy of this modification technique has been addressed in the NRC staff Safety Evaluation Report related to the spent fuel pool expansion issue of the North Anna plant.

Request 7

Provide the results of the analysis of masonry walls which do not satisfy working stress criteria in terms of actual stresses versus allowable stresses.

Response 7

The Licensee confirmed in this response that all walls except those seven walls in the fuel building are within the allowable stress limits. (Discussions about the allowable stresses are given in detail in Response 4 above.)

Request 8

The Licensee indicated that arching theory and other inelastic analyses are used to qualify some masonry walls. The NRC, at present, does not accept the application of these analytical techniques to masonry walls in nuclear power plants in the absence of conclusive evidence to justify the application. Indicae the number of walls which have been analyzed using these techniques.

Response 8

In response to this request, the Licensee confirmed that no arching or other inelastic analyses were used to qualify the masonry walls.

The Licensee's response has resolved this concern.

Request 9

Justify the allowable stresses used for collar joints.

Response 9

In this response, the Licensee stated that the allowable tension and shear stresses in collar joints are taken to be 8 psi and 12 psi for OBE and SSE loads, respectively. The Licensee referred to tests conducted at the Trojan plant which indicated an average tensile bond strength of 194 psi. The SSE allowable stress of 12 psi at Surry Power Station Units 1 and 2 is only 6% of the ultimate test value for tensile bond strength. Shear bond and tensile bond strengths are taken to be the same.

The Licensee's response is adequate and in compilance with SGEB criteria.

Request 10 (Reference 18)

With respect to the boundary conditions used in the analysis, the Licensee indicated in Reference 16 that fixity was assumed at the base of a block wall built on a concrete slab. Also, at the perpendicular

intersection of two block walls, fixity has been assumed in the corner joints formed by the alternating courses of the running bond. The Licensee is requested to provide the technical basis for assuming fixed-end conditions for these cases. It is believed that without some clamping devices to prevent rotation at the wall boundary, the assumed boundary conditions may not be valid.

Response 10

The Licensee restated its assumption that the mortar bed joint at the base of the cantilevered wall can be relied upon to transfer the induced moment. For the cantilevered walls, it is questionable whether the mortar bed joint could perform this intended function. The review of other plants indicated that for a similar situation, some clamping devices are installed to assure the load is transferred properly at the base.

It is recommended that one of the following options be implemented for these walls:

- Clamping devices should be installed at the base of the wall to provide positive means for load transfer.
- Structural steel supports should be provided to change the boundary conditions at the free edges.

3.2 EVALUATION OF LICENSEE'S APPROACH TO WALL MODIFICATIONS

In the response to Question 5 (Section 3.1), the Licensee indicated that modifications were performed to change the boundary conditions and/or reduce the unsupported span. The Licensee also provided a sample modification with illustrative drawings. The Licensee's approach to wall modifications has been reviewed and considered satisfactory. (Appendix B provides sample modifications.)

4. CONCLUSIONS

A detailed study was performed to provide a technical evaluation of the masonry walls at Surry Power Station Units 1 and 2. A review of the Licensee's criteria and the additional information provided by the Licensee led to the conclusions given below.

Except for two items listed below, the criteria used for reevaluation of the masonry walls, along with the additional information provided by the Licensee, satisfy the intent of the SGEB criteria and are found adequate.

- A total of 9 walls exceeded the SGEB stress allowables for tension normal to bed joint (the actual increase values vary from 1.32 to 1.65). As indicated in Response 4, the increase factors are greater than 1.3 (SGEB allowable) but less than 1.67 (Licensee allowable). However, because of conservative values used for damping (2% for OBE and 4% for SSE as opposed to 4% and 7% allowed by the SGEB), it is judged that the allowable used by the Licensee is considered to meet the intent of the SGEB criteria.

- For the cantilevered walls, the Licensee is requested to provide positive means to assure the moment transfer mechanisms taking place at the base of the walls. See Response 10 for more details.

With regard to seven walls in the fuel building, the Licensee stated that it has removed and replaced them with "blow-off" metal siding attached to a steel girt system in the same fashion as that used in the North Anna plant [19]. These modifications are identical in both the North Anna and Surry plants and are intended for the same function. The adequacy of this modification technique has been addressed in the NRC staff Safety Evaluation Report related to the spent fuel pool expansion issue of the North Anna plant.

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Subject: IE Bulletin 80-11, Masonry Block Walls - Surry Power Station Units 1 and 2
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Subject: Surry Power Station Units 1 and 2
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APPENDIX A

SGEB CRITERIA FOR SAFETY-RELATED MASONRY WALL EVALUATION
(DEVELOPED BY THE STRUCTURAL AND GEOTECHNICAL ENGINEERING BRANCH
(SGEB) OF THE NRC)
July 1981

FRANKLIN RESEARCH CENTER
DIVISION OF ARVIN/CALSPAN
20th & RACE STREETS, PHILADELPHIA, PA 19103

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1. General Requirements

The materials, testing, analysis, design, construction, and inspection related to the design and construction of safety-related concrete masonry walls should conform to the applicable requirements contained in Uniform Building Code - 1979, unless specified otherwise, by the provisions in this criteria.

The use of other standards or codes, such as ACI-531, ATC-3, or NCMA, is also acceptable. However, when the provisions of these codes are less conservative than the corresponding provisions of the criteria, their use should be justified on a case-by-case basis.

In new construction, no unreinforced masonry walls will be permitted. For operating plants, existing unreinforced walls will be evaluated by the provisions of these criteria. Plants which are applying for an operating license and which have already built unreinforced masonry walls will be evaluated on a case-by-case basis.

2. Loads and Load Combinations

The loads and load combinations shall include consideration of normal loads, severe environmental loads, extreme environmental loads, and abnormal loads. Specifically, for operating plants, the load combinations provided in the plant's FSAR shall govern. For operating license applications, the following load combinations shall apply (for definition of load terms, see SRP Section 3.8.4II-3).

(a) Service Load Conditions

(1) $D + L$

(2) $D + L + E$

(3) $D + L + W$

If thermal stresses due to T_o and R_o are present, they should be included in the above combinations as follows:

(1a) $D + L + T_o + R_o$

(2a) $D + L + T_o + R_o + E$

(3a) $D + L + T_o + R_o + W$

Check load combination for controlling condition for maximum 'L' and for no 'L'.

(b) Extreme Environmental, Abnormal, Abnormal/Severe Environmental, and Abnormal/Extreme Environmental Conditions

(4) $D + L + T_o + R_o + E$

(5) $D + L + T_o + R_o + W_t$

(6) $D + L + T_a + R_a + 1.5\ P_a$

(7) $D + L + T_a + R_a + 1.25\ P_a + 1.0\ (Y_r + Y_j + Y_m) + 1.25\ E$

(8) $D + L + T_a + R_a + 1.0\ P_a + 1.0\ (Y_r + Y_j + Y_m) + 1.0\ E'$

In combinations (6), (7), and (8) the maximum values of P_a, T_a, R_a, Y_j, Y_r, and Y_m, including an appropriate dynamic load factor, should be used unless a time-history analysis is performed to justify otherwise. Combinations (5), (7), and (8) and the corresponding structural acceptance criteria should be satisfied first without the tornado missile load in (5) and without Y_r, Y_j, and Y_m in (7) and (8). When considering these loads, local section strength capacities may be exceeded under these concentrated loads, provided there will be no loss of function of any safety-related system.

Both cases of L having its full value or being completely absent should be checked.

3. Allowable Stresses

Allowable stresses provided in ACI-531-79, as supplemented by the following modifications/exceptions, shall apply.

(a) When wind or seismic loads (OBE) are considered in the loading combinations, no increase in the allowable stresses is permitted.

(b) Use of allowable stresses corresponding to special inspection category shall be substantiated by demonstration of compliance with the inspection requirements of the SEB criteria.

(c) When tension perpendicular to bed joints is used in qualifying the unreinforced masonry walls, the allowable value will be justified by test program or other means pertinent to the plant and loading conditions. For reinforced masonry walls, all the tensile stresses will be resisted by reinforcement.

(d) For load conditions which represent extreme environmental, abnormal, abnormal/severe environmental, and abnormal/extreme environmental conditions, the allowable working stress may be multiplied by the factors shown in the following table:

Type of Stress	Factor
Axial or Flexural Compression[1]	2.5
Bearing	2.5
Reinforcement stress except shear	2.0 but not to exceed 0.9 fy
Shear reinforcement and/or bolts	1.5
Masonry tension parallel to bed joint	1.5
Shear carried by masonry	1.3
Masonry tension perpendicular to bed joint	
for reinforced masonry	0
for unreinforced masonry[2]	1.3

Notes

(1) When anchor bolts are used, design should prevent facial spalling of masonry unit.

(2) See 3(c).

4. Design and Analysis Considerations

(a) The analysis should follow established principles of engineering mechanics and take into account sound engineering practices.

(b) Assumptions and modeling techniques used shall give proper considerations to boundary conditions, cracking of sections, if any, and the dynamic behavior of masonry walls.

(c) Damping values to be used for dynamic analysis shall be those for reinforced concrete given in Regulatory Guide 1.61.

(d) In general, for operating plants, the seismic analysis and Category I structural requirements of FSAR shall apply. For other plants, corresponding SRP requirements shall apply. The seismic analysis shall account for the variations and uncertainties in mass, materials, and other pertinent parameters used.

(e) The analysis should consider both in-plane and out-of-plane loads.

(f) Interstory drift effects should be considered.

(g) In new construction, grout in concrete masonry walls, whenever used, shall be compacted by vibration.

(h) For masonry shear walls, the minimum reinforcement requirements of ACI-531 shall apply.

(i) Special constructions (e.g., multiwythe, composite) or other items not covered by the code shall be reviewed on a case-by-case basis for their acceptance.

(j) Licensees or applicants shall submit QA/QC information, if available, for staff's review.

In the event QA/QC information is not available, a field survey and a test program reviewed and approved by the staff shall be implemented to ascertain the conformance of masonry construction to design drawings and specifications (e.g., rebar and grouting).

(k) For masonry walls requiring protection from spalling and scabbing due to accident pipe reaction (Y_r), jet impingement (Y_j), and missile impact (Y_m), the requirements similar to those of SRP 3.5.3 shall apply. However, actual review will be conducted on a case-by-case basis.

5. References

(a) Uniform Building Code - 1979 Edition.

(b) Building Code Requirements for Concrete Masonry Structures ACI-531-79 and Commentary ACI-531R-79.

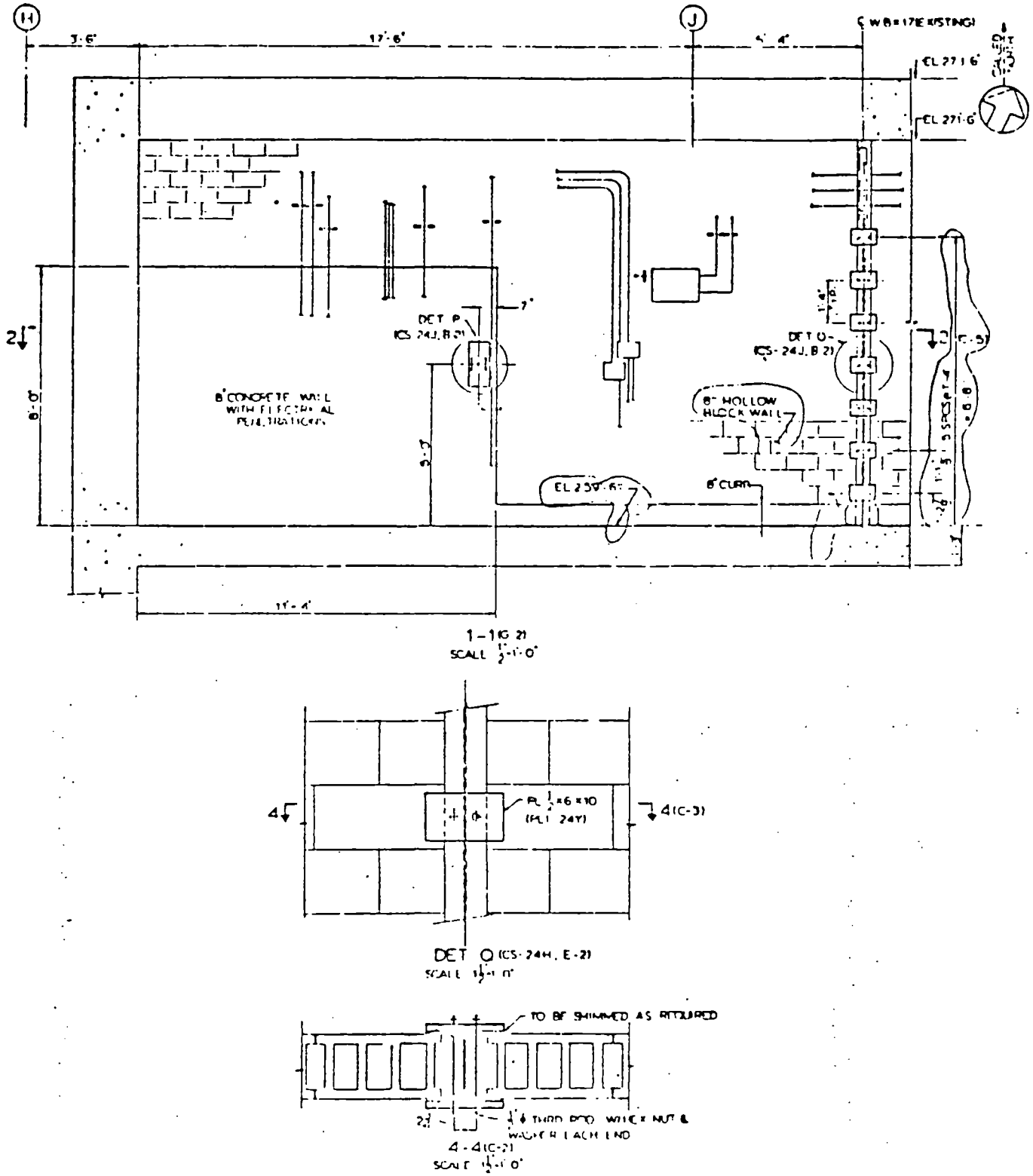
(c) Tentative Provisions for the Development of Seismic Regulations for Buildings - Applied Technology Council ATC 3-06.

(d) Specification for the Design and Construction of Load-Bearing Concrete Masonry - NCMA August, 1979.

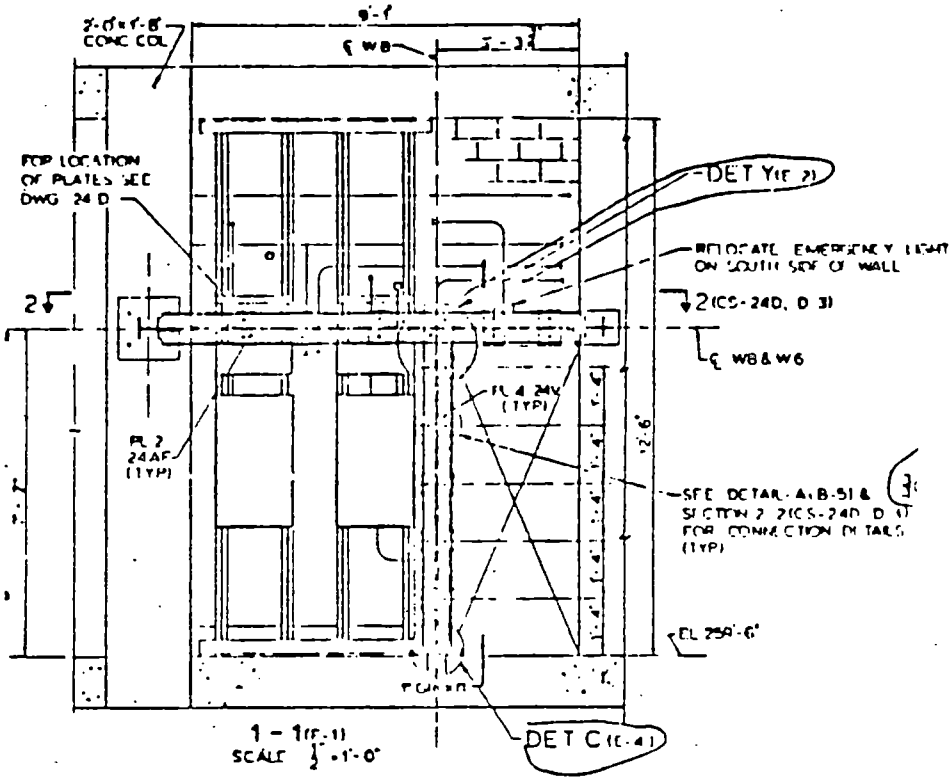
(e) Trojan Nuclear Plant Concrete Masonry Design Criteria Safety Evaluation Report Supplement - November, 1980.

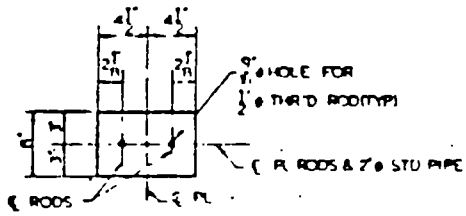
APPENDIX B

SKETCHES OF WALL MODIFICATIONS



Typical Wall Modification - Boundary Conditions





DETAIL - A (D-3) (CS-24D, C-18 & D-11)
SCALE 1 1/2" = 1'-0"

Typical Wall Modification - Span Reduction