Enclosure 2

TVA
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TENNESSEE VALLEY AUTHORITY
Division of Nuclear Engineering

LEAD CIVIL ENGINEER INSTRUCTION

BFEP-TI-C2

TITLE: OPERABILITY CRITERIA FOR EVALUATION OF LOWER DRYWELL ACCESS PLATFORMS - BROWNS FERRY

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	REVISION R0	R1	R2	R3	R4	R5
ISSUE DATE	MAY 23 1988					
PREPARED	[signature]					
CHECKED	[signature]					
REVIEWED	[signature]					
APPROVED	[signature]					

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Revision: 0

R–Denotes review A–Denotes approval

ENGINEERING AND TECHNICAL SERVICES (E&TS)															
CEB		EEB		MEB		NEB		ECB		Contracts Section					
R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A

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REVISION LOG

BFEP-TI-C2

Revision No.	DESCRIPTION OF REVISION	Date Approved

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1.0 INTRODUCTION

1.1 Description

The lower drywell access platforms include two main platforms, one at elevation 584 feet 11 inches, and one at elevation 563 feet 2 inches. The flooring is standard grating, with 1-1/2-inch by 3/16-inch load bars. The grating and support steel extend from the reactor pedestal to the drywell shell at elevation 563 feet 2 inches and from the sacrificial shield wall to the drywell shell at elevation 584 feet 11 inches.

The platforms are supported by 24-inch-deep, wide-flange beams radiating from the reactor pedestal and sacrificial shield wall to the drywell shell. The radial support beams for elevation 584 feet 11 inches are field-welded to header beams in the sacrificial shield wall. The radial support beams for elevation 563 feet 2 inches are field-bolted to embedded plates in the outside face of the reactor pedestal. All radial beams are supported by beam seats welded to the drywell shell. Lubrite pads under the radial beams allow drywell shell expansion. Shear bars welded to the bottom flange of the radial beams on both sides of the beam seat prevent lateral movement of the beams. Intermediate grating support beams at 6 feet 6 inches maximum spacing are framed between the radial beams. Additional support beams are framed between both the radial and grating support beams for equipment, HVAC, cable tray, and piping system attachments. For remainder of drywell platforms, see BFN-50-C-7100, Attachment G.

1.2 Purpose

The purpose of these criteria is to establish the requirements for operability evaluation of the lower drywell access platforms.

1.3 Scope

1.3.1 The requirements of this document shall apply to the lower platform structural steel inside the drywell at elevation 584 feet 11 inches and elevation 563 feet 2 inches as denoted in Reference 5.2.

2.0 DESIGN SPECIFICATIONS

For this structural design or evaluation, AISC specifications (Ref 5.1) shall be used.

3.0 LOADS AND LOADING COMBINATIONS

3.1 Loading Definitions

3.1.1 D - Deadload, including structural steel, permanent equipment, and attached systems, e.g., piping, HVAC, cable trays, etc., shall be a minimum of 40 psf.

3.1.2 L_o - Outage and maintenance loads, including any moveable equipment loads and other loads which vary with intensity and occurrence during an outage, i.e., these loads shall not be present while the plant is operating. An L_o of 100 psf applied to the loadable open areas shall be evaluated as a baseline outage and maintenance live load for the initial analysis using these criteria. As concentrated live loads due to outage or maintenance procedures are identified, these loads shall be evaluated against the baseline case. If the results of the concentrated loads exceed the baseline case, the concentrated loads must be evaluated per these criteria.

3.1.3 E - Loads due to effects of OBE on structural steel and permanent floor-mounted equipment. This excludes support loads from attached piping, HVAC ducts, and cable trays (these loads are defined in Section 3.1.9).

3.1.4 E' - Loads due to effects of DBE on structural steel and permanent floor-mounted equipment. This excludes support loads from attached piping, HVAC ducts, and cable trays (these loads are defined in Section 3.1.9).

3.1.5 Y_r - Equivalent static load on the structure generated by the pipe whip reaction from pipe rupture restraints attached to the drywell steel.

The application of pipe rupture loads only at those locations where mitigation exists is consistent with the baseline approach to pipe rupture design inside the drywell. Only those locations where GE and/or TVA negotiated pipe rupture mitigation as part of the original design need be considered. See design criteria, BFN-50-C-7105, section 4.2 for further information.

3.1.6 T_o - Thermal effects and loads during startup, normal operating, or shutdown conditions, based on the most critical transient or steady-state condition.

3.1.7 T_a - Thermal loads under thermal conditions generated by the postulated pipe break accident and including T_o.

3.1.8 RFE - Restraint of free end displacement loads due to thermal reactions from attached piping systems, based on the most critical thermal condition.* RFE loads can be subdivided as follows:

3.1.8.1 RFE_{ul} - RFE reactions which contribute to uplift.

3.1.8.2 RFE_s - All other RFE reactions, i.e., reactions which do not contribute to uplift.

*If reduced conservatism is needed, RFE loads may be defined for upset, emergency, and faulted conditions corresponding to the associated dynamic loading conditions (DYNB, DYNC & DYND).

3.1.9 DYNB, DYNC, and DYND - Dynamic Reaction of attached systems, e.g., piping, HVAC, cable trays, etc., due to upset (service level B), emergency (service level C), and faulted (service level D) dynamic events, respectively.

Note: Not all attached systems are analyzed for the faulted condition; therefore, some reaction points on the floor steel will only have upset and emergency loading.

3.1.9.1 Dynamic Reaction Phasing

Dynamic reactions from attached systems are transmitted to the floor steel through rigid restraints and snubbers. Based on the location and orientation of these restraints, different assumptions can be made regarding the phasing of these dynamic loads. These assumptions shall be grouped into three general categories as follows and they must be coordinated with the organization responsible for the system dynamic analysis.

Group A - Phasing Known

When two or more dynamic restraints act together to restrain a particular motion or mode of vibration of an attached system, in-phase reaction loads can be assumed. For example, reactions resulting from a matched pair of vertical snubbers on a piping system would fall into this group.

Group B - Random Phasing

When a dynamic restraint acts independently to restrain a particular motion or mode of vibration of an attached system, this reaction can be considered randomly phased with other dynamic reactions.

Group C - Worst Case Phasing

When two or more dynamic restraints act to restrain a particular location of an attached system in more than one direction, a phasing relationship for these restraints cannot be assumed. For example, two snubbers which restrain essentially the same point on a piping system and whose lines of action are skewed to each other would fall into this group. The results of these reactions must be summed absolutely to determine an enveloping condition.

If further justification or additional analysis can show a phasing relationship between group C restraint loads, these restraints can be treated as group A restraints.

3.1.9.2 Procedure for Determining DYNB, DYNC, and DYND

3.1.9.2.1 As a minimum, the following procedure shall be used to determine the dynamic reaction load cases.

A. Assign each dynamic reaction to one of the groups defined in section 3.1.9.1. This requires engineering judgment. Justification for these groupings shall be included as part of the analysis calculation in accordance with section 4.0 of these criteria.

B. Group A reactions shall be arranged into load sets per the phasing assumed. Each load set shall be evaluated separately with the results of each evaluation constituting a dynamic load step.

C. Each group B reaction shall be evaluated separately with the results of each evaluation constituting a dynamic load step.

D. Group C reactions shall be arranged into load sets per their potential for phasing. Each reaction in the load set shall be evaluated separately. The absolute summation of the results of each reaction in the load set shall constitute a dynamic load step.

E. Combine all dynamic load steps using the square root of the sum of the squares (SRSS) method to form DYNB, DYNC, or DYND.

3.1.9.2.2 Figure 3.1 provides a graphic summary of this procedure.

3.1.10 DYBD - Larger of DYNB or DYND. To determine DYBD, screen each DYNB load step against the corresponding DYND load step. (Note that in some instances no DYND load step exists. In these cases, use the DYNB load step.) Combine the screened load steps using the SRSS method to form DYBD.

3.1.11 DYCD - Larger of DYNC or DYND. Use the procedure outlined in 3.1.10 above substituting DYNC for DYNB.

3.2 Loading Combinations and Allowable Stresses

As stated in section 1.1, all radial platform support beams are supported on one end by beam seats welded to the drywell shell. Since the beam seats do not have hold down capability, the potential for lifting off the beam seats as well as the beam stress must be evaluated. Loading combinations and allowable stresses for stress and uplift evaluations are specified in Table 3.2.1 and Table 3.2.2.

4.0 DESIGN AND ANALYSIS PROCEDURES

The design and analysis procedures utilized for the drywell steel structures shall be in accordance with reference 5.1.

A summary of analysis procedures as well as justification for assumptions shall be documented in a DNE Calculation package.

For the evaluation of framed beam connections the results of the connection test program, as described in Reference 5.3, may be used as a supplement to the requirements of the AISC specifications.

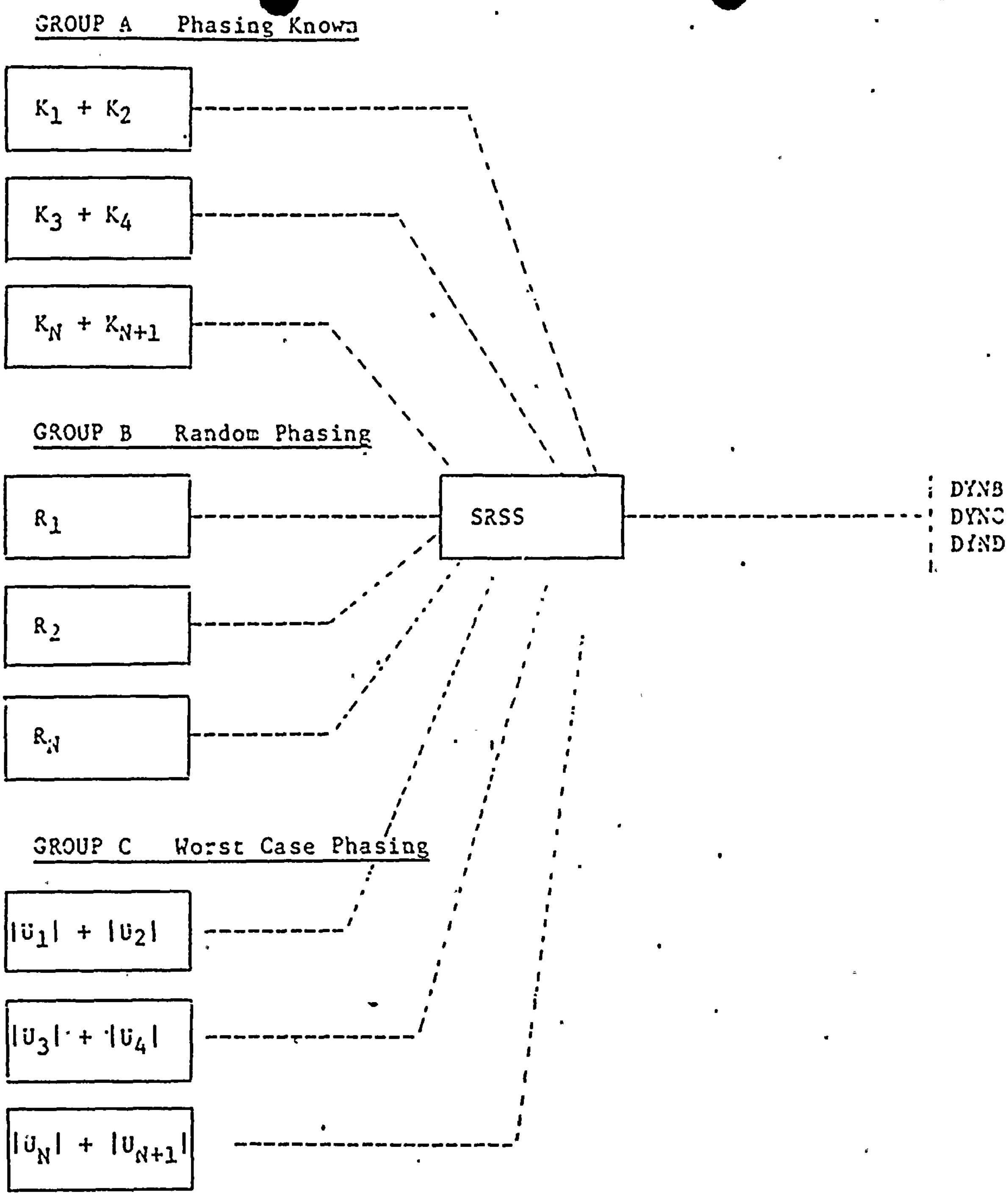
5.0 REFERENCES

5.1 American Institute of Steel Construction (AISC), Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, Eighth Edition, 1978.

5.2 TVA drawings 48N442, 48N443, 48N444, 48N1015-series, 48N1016-series, 48N1028, and 48N1115 or successor configuration control Document Drawings.

5.3 BFN - Test Verification of Drywell Floor Steel Connections (B46870206 001).

5.4 TVA, Civil Design Standard, DS-C1.7.1, "General Anchorage Concrete," May 1983.



Ki = Individual group A reaction

Ri = Individual group B reaction

Ui = Individual group C reaction

Figure 3.1

Combination of Dynamic Reactions from Attached Systems

TABLE 3.2.1

LOADING COMBINATIONS AND ALLOWABLE STRESSES

Combination No	Combination	Allowable Stress(1)	
A.	$D + L_o$	1.0 S	(3)
B.	$D + E + DYNB$	1.0 S	(3)
C.	$D + L_o + E + DYNB$	1.0 S	(3)
D.	$D + E + DYNB + T_o + RFE_s$	1.5 S	(4)
E.	$D + L_o + E' + DYNC$	1.6 S	(4)
F.	$D + E' + DYNC + T_o + RFE_s$	1.6 S	(4)
G.	$D + E' + DYCD + Y_r^{(2)}$	1.6 S	(4)
H.	$D + DYND + T_a + RFE_s$	1.6 S	(4)
I.	$D + E + DYBD + T_a + RFE_s + Y_r^{(2)}$	1.6 S	(4)
J.	$D + E' + DYCD + T_a + RFE_s + Y_r^{(2)}$	1.6 S	(4)

Notes:

(1) S - For structural steel, S is the allowable stress based on elastic elastic design methods defined in AISC (Reference 5.1). The one-third increase in allowable stresses AISC Code (Ref 5.1) due to Seismic loadings is not permitted.

In the above factored load combinations, thermal loads (To and Ta) can be neglected when it can be shown that they are secondary and self-limiting in nature and where the material is ductile.

The requirements of TVA Civil Design Standard DS-C1.7.1, as applicable, (References 5.4) shall be applied for evaluation and design of concrete anchorages for supports.

(2) Only one pipe whip reaction should be considered at any given time; however, all postulated breaks for which pipe rupture mitigation structures exist and are attached to drywell steel must be considered.

TABLE 3.2.2

LOADING COMBINATIONS FOR UPLIFT EVALUATION(1)

Combination	Static Loading	Dynamic Loading
A	$.9D + T_o + RFE_{ul}$	--
B	$.9D$	DYNB + E
C	$.9D + T_o + RFE_{ul}$	DYNB + E
D	$.9D$	DYNC + E'
E	$.9D + T_o + RFE_{ul}$	DYNC + E'
F	$.9D + T_a + RFE_{ul}$	DYND + E + Y_r
G	$.9D + T_a + RFE_{ul}$	DYND + E' + Y_r

Note:

(1) In each combination, it must be shown that the magnitude of the beam seat reaction due to static loading is greater than the reaction due to dynamic loading, unless an adequate tiedown exists or the magnitude of uplift is within acceptable limits of 0.05 inches.