

July 26, 1982

Docket No. 50-213
LS05-82-07-063

Mr. W. G. Council, Vice President
Nuclear Engineering and Operations
Connecticut Yankee Atomic Power Co.
Post Office Box 270
Hartford, Connecticut 06101

Dear Mr. Council:

SUBJECT: SEP TOPIC III-6, SEISMIC DESIGN CONSIDERATIONS,
STAFF GUIDELINES FOR SEISMIC EVALUATION CRITERIA
FOR THE SEP GROUP II PLANTS

During meetings with licensees concerning seismic reevaluation of SEP Group II Plants (Haddam Neck, Yankee, LaCrosse, San Onofre Unit 1, and Big Rock Point) licensee questions concerning acceptance criteria and reanalysis methods have been discussed. In order to facilitate our reviews and respond to questions raised we are forwarding the enclosed "Reevaluation Guideline Seismic Criteria for SEP Group II Plants." These guidelines reflect the NRC decision to request seismic reanalysis for only the Safe Shutdown Earthquake and are consistent with our approach to reanalysis of other SEP facilities. With respect to questions concerning the acceptability of your analytical methods, the staff will perform an audit review of selected analyses.

Sincerely,

Original signed by

Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

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*SEE PREVIOUS CONCURRENCE

OFFICE	SEP B*	SEP B*	SEP B*	SEP B	MEB	ORB #5	ORB #5
KHerring:bl	SBrown	RHermann	WRussell	RBosnak	CTropf	DCrutchfield	
7/13/82	7/13/82	7/13/82	7/13/82	7/26/82	7/23/82	7/26/82	

Docket No. 50-213
LS05-82-

Mr. W. G. Council
Nuclear Engineering and Operations
Connecticut Yankee Atomic Power Co.
Post Office Box 270
Hartford, Connecticut 06101

Dear Mr. Council:

SUBJECT: SEP BRANCH REEVALUATION GUIDELINE SEISMIC CRITERIA
FOR THE SEP GROUP II PLANTS - SEP TOPIC III-6

In order to facilitate the staff reviews of the seismic reanalysis of your facility and ensure consistency in the licensee reanalysis and staff review, we are forwarding the attached "Reevaluation Guideline Seismic Criteria for SEP Group II Plants." The enclosed guideline seismic criteria has been developed by the SEP Branch staff in conjunction with its consultants. Satisfaction of this criteria provides a minimally acceptable level of seismic resistance for the items in your facility only when appropriate analyses are performed. The acceptability of the analytical techniques will be determined based upon an audit review of your analyses.

Sincerely,

Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

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Mr. W. G. Council

cc
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REEVALUATION GUIDELINE
SEISMIC CRITERIA FOR SEP GROUP II PLANTS
(EXCLUDING STRUCTURES)

INTRODUCTION

In support of NRC's Systematic Evaluation Program (SEP) for Group II Plants, the following Reevaluation Criteria have been established. These criteria include recommended load combinations with allowable stresses and/or loads for piping systems, component supports, concrete attachments, and equipment. These criteria are based on linear elastic analyses having been performed. The acceptance criteria are generally based on the ASME Code. For situations not covered by these criteria, compatible criteria shall be developed by the licensee and will be reviewed on a case-by-case basis.

DEFINITIONS

- Code = ASME Boiler and Pressure Vessel Code, Section III, "Nuclear Power Plant Components," 1980 Edition, Winter 1980 Addenda.
- P_m = General membrane stress. This stress is equal to the average stress across the solid section under consideration, excludes discontinuities and concentrations, and is produced only by mechanical loads.
- P_b = Bending stress. This stress is equal to the linear varying portion of the stress across the solid section under consideration, excludes discontinuities and concentrations, and is produced only by mechanical loads.

- P_D = Design or maximum operating pressure loads.
- SSE = Inertial loads due to Safe Shutdown Earthquake (SSE) and design mechanical loads where applicable.
- T = Loads due to thermal expansion of attached pipe (constraint of free end displacement).
- W = Loads due to weight effects.
- AM = Loads due to SSE anchor movement effects.
- S_{bk} = Critical Buckling stress.
- S_m = Allowable stress intensity at temperature listed in ASME Code.
- S_D = Ultimate tensile strength at temperature listed in ASME Code.
- P_l = Local membrane stress. This stress is the same as P_m except that it includes the effect of discontinuities.
- S_h = ASME Code Class 2 allowable stress value. The allowable stress shall correspond to the metal temperature at the section under consideration.
- S_y = Yield strength at temperature listed in ASME Code.

SPECIAL LIMITATIONS

1. Critical buckling loads (stresses) must be determined taking into account combined loadings (i.e., axial, bending, and shear), initial imperfections, residual stresses, inelastic deformation, and boundary conditions. Both gross and local buckling must be evaluated.

Critical buckling loads (stresses) shall be determined using acceptable methods such as those contained in NASA Plates and Shells Manual or ASME Code Case N-284. The allowable load (stress) shall be limited to $2/3 S_{bk}$ thus determined.

2. Where stresses exceed material yield strength, it shall be demonstrated that brittle failures and detrimental cyclic effects are precluded, and that dynamic analysis assumptions are not nonconservatively affected. Where significant cyclic effects are identified, it shall be demonstrated that the structure or component is capable of withstanding ten full peak deformation cycles.
3. Where results of analysis indicate that the allowable stresses of the original construction code are exceeded in any of the load combinations specified herein, it shall be demonstrated that the in-situ item was designed and fabricated using rules compatible with those required for the appropriate ASME Code Class (Subsection NX2000, 4000, 5000, and 6000). In cases where compatibility with the appropriate ASME Code Subsections was not substantially achieved, appropriate reductions in these limits shall be established, justified, and applied.

ACCEPTANCE CRITERIA FOR PIPING

Using Code Class 2 analytical procedures (Equation (9), NC-3653-1), the following stresses are not to be exceeded for the specified piping:

$$\text{Class 1: } P_m + P_b = |W + P_D| + |SSE| \leq 1.8 S_h$$

$$\text{Class 2: } P_m + P_b = |W + P_D| + |SSE| \leq 2.4 S_h$$

The effects of thermal expansion must meet the requirements of Equation (10) or (11) of NC-3653.2, including moment effects of anchor displacements due to earthquake if anchored displacement effects were omitted from Equation (9) of NC-3662. Class 1 analytical procedures (NB-3600) can also be utilized if appropriate allowable stresses specified in NB-3650 are used.

Branch lines shall be analyzed including the inertial and displacement input due to the response of the piping to which it is attached at the attachment point.

ACCEPTANCE CRITERIA FOR COMPONENT SUPPORTS

<u>Imposed Load Combinations</u>	<u>Acceptance Criteria^a</u>	
	<u>Linear</u>	<u>Plate and Shell</u>
The higher of:		
W		$P_m \leq 1.0 S_m$
or	Code Subsection NF Design, Level A, and Level B Limits	
W + T		$P_m + P_b \leq 1.5 S_m$
The higher of:	-----	
W + SSE + AM		$P_m \leq 0.45 S_u$
or	Code Subsection NF Level D Limits	
W + T + SSE + AM		$P_m + P_b \leq 0.7 S_u$

In addition to the above criteria, the allowable buckling stress shall be limited to $2/3 S_{bk}$, where S_{bk} is determined in accordance with Special Limitation 1.

a. These load combinations shall be used in lieu of those specified in ASME Code Subsection NF. In addition, for brittle types of material not specified in the Code, appropriate stress intensification factors for notches and stress discontinuities shall be applied in the analysis.

ACCEPTANCE CRITERIA FOR CONCRETE ATTACHMENTS

I. Concrete Expansion Anchor Bolts^a

Load Combinations: Same as for component supports.

Acceptance Criteria:^b

Wedge type: 1/4 ultimate as specified by manufacturer.

Shell type: 1/5 ultimate as specified by manufacturer.

II. Grouted Bolts: Replace^{a, b, c}

III. Concrete Embedded Anchors^a

Load Combinations: Same as for component supports.

Acceptance Criteria^b: $0.7 S_u$

a. Base plate flexibility effects must be considered.

b. Both pullout and shear loads must be considered in combined loading situations.

c. Unless stresses in the bolts and structure to which they are attached are shown to be sufficiently low to preclude concrete/grout/steel interface bond failures. Load combinations are the same as those for component supports.

ACCEPTANCE CRITERIA FOR MECHANICAL EQUIPMENT

<u>Component</u>	<u>Loading Combination^b</u>	<u>Criteria</u>
Pressure vessels and heat-exchangers	$ W + P_U + SSE + Nozzle\ Loads $	$P_m \leq 2.0 S_H$ $(P_m \text{ or } P_R) + P_b \leq 2.4 S_H$
Active pumps and other mechanical components ^{a,d}	$ W + P_U + SSE + Nozzle\ Loads $	$P_m \leq 1.5 S_H$ $(P_m \text{ or } P_R) + P_b \leq 1.8 S_H$
Inactive pumps and other mechanical components	$ W + P_U + SSE + Nozzle\ Loads $	$P_m \leq 2.0 S_H$ $(P_m \text{ or } P_R) + P_b \leq 2.4 S_H$
Active valves ^{a,d}	$ W + P_U + SSE + Nozzle\ Loads $	Extended Structure: $P_m \leq 1.5 S_H$ $(P_m \text{ or } P_R) + P_b \leq 1.8 S_H$ Nozzle loads: ^c
Inactive valves	$ W + P_U + SSE + Nozzle\ Loads $	Extended Structure: $P_m \leq 2.0 S_H$ $(P_m \text{ or } P_R) + P_b \leq 2.4 S_H$ Nozzle loads: ^c

Bolt stress shall be limited to: tension - S_y but $\leq .7 S_D$
shear - $.6 S_y$ but $\leq .42 S_D$

a. Active pumps, valves, and other mechanical components (e.g., CRDs) are defined as those that must perform a mechanical motion to accomplish a system safety function.

b. Nozzle loads shall include all piping loads (including seismic and thermal anchor movement effects) transmitted to the component during the SSE.

c. Piping loads at piping/active-valve interfaces shall be limited to below yield stress of the attached piping considering all piping loads (including seismic and thermal anchor movement effects).

d. It shall be demonstrated that deformation induced by the loading on these pumps, valves and other mechanical components (e.g., CRDs) do not introduce detrimental effects (such as binding, impact, or brittle failures) for pump internals and valve operators. For valve operators integrally attached to valve bodies, binding can be considered precluded if stresses in the valve body and operator housing and supports are shown to be less than yield. In these evaluations, all loads (including seismic and thermal anchor movement effects) shall be included.

ACCEPTANCE CRITERIA FOR TANKS

Load Combinations: $\sqrt{\text{Normal Operating Loads}} + \sqrt{\text{SSE Inertia Loads}}$
 $+ \sqrt{\text{Dynamic Fluid Pressure Loads}^a}$

Acceptance Criteria: Smaller of S_y or $0.7 S_u$. In addition, the allowable buckling stress shall be limited to $2/3 S_{bk}$, where S_{bk} is determined in accordance with Special Limitation 1.

a. Dynamic fluid pressure shall be considered in accordance with accepted and appropriate procedures; e.g., USAEC TID-7024. Horizontal and vertical loads shall be determined by appropriately combining the loads due to vertical and horizontal earthquake excitation considering that the loads are due to pressure pulses within the fluid. These loads shall also be applied, in combination with other loads, in tank support evaluations.