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Richard C. DeYoung, Assistant Director
for Pressurized Water Reactors
Directorate of Licensing

ALVIN W. VOGTLE NUCLEAR PLANT UNITS 1, 2, 3 & 4, DOCKET NOS. 50-424/425/426/427

Plant Name: Alvin W. Vogtle Nuclear Plant, Units 1, 2, 3 & 4
Licensing Stage: CP
Docket Numbers: 50-424/425/526/427
Responsible Branch and Project Manager: PWR#2, L. Crocker
Requested Completion Date: 5/18/73
Applicants Response Date Necessary for Completion of Next Action: N.A.
Description of Response: Answers to Request for Additional Information
Review Status: Awaiting Applicant's Response

A review of the information furnished by the applicant in the PSAR and the referenced information in RESAR-3 through amendment #3 has been completed by the Mechanical Engineering Branch. Areas in which additional information is required are identified in the enclosure.

DKT.#
50-424

Original signed by
R. R. Maccary

R. R. Maccary, Assistant Director
for Engineering
Directorate of Licensing

Enclosure:
Request for Additional Information

cc w/encl:
S. H. Hanauer, DRTA
J. M. Hendrie, L
K. Kniel, L
J. P. Knight, L
L. P. Crocker, L
R. J. Bosnak, L

Docket Files 50-424/425/426/627
L, Reading File
L:MEB File

cc w/o encl:
A. Giambusso, L
W. G. McDonald, L

OFFICE ▶	L:MEB	L:MEB	L:MEB	L:AD/E		
SURNAME ▶	RJBosnak:jm	SNHou	JPKnight	RRMaccary		
DATE ▶	4/26/73	4/26/73	5/18/73	5/18/73		

Form AEC-318 (Rev. 9-53) AECM 0240 GPO 643-16-81465-1 445-678

ALVIN W. VOGTLE NUCLEAR PLANT UNITS 1-4

DOCKET NOS. 50-424/425/426/427

REQUEST FOR ADDITIONAL INFORMATION

3.6 Protection Against Postulated Pipe Rupture

1. The material in Section 3.6 covering protection against postulated pipe rupture inside containment is not definitive enough to determine whether the protection criteria is adequate and how protection will actually be accomplished. The AEC staff position on protection against pipe whip inside containment is contained in Regulatory Guide 1.46. Provide criteria consistent with Regulatory Guide 1.46.

2. Provide the design criteria to be employed to assure that high energy fluid piping systems outside containment will comply with General Design Criterion #4. An acceptable method for compliance would be physical separation or isolation of high energy piping systems from other systems, structures or components important to safety. Indicate how Vogtle Units 1, 2, 3 and 4 will achieve compliance.

3. With regard to the techniques to be utilized for determination of required protection against pipe whip inside containment provide:

   A. A description of the methods used to postulated the time functions of:

(a) the jet thrust force on the ruptured pipe, and

(b) the jet impingement force on a distant object.

B. A summary should be provided of the dynamic analysis methods used to:

(a) Verify the design adequacy of pipe whip restraints, and

(b) Verify that the motion of unrestrained ruptured piping will not damage structures, systems or components which are important to safety to an unacceptable degree.

3.9 Mechanical Systems and Components

1. Clarify that it is your intention to perform confirmatory type preoperational vibration test for reactor internals on all units of Vogtle plant using Indian Point 2 as the designated prototype. Identify any design differences between Vogtle and Indian Point 2 which may lead to different response behavior of the reactor internal structures under flow-induced vibration. In addition, provide a description of the preoperational vibration test program intended for Vogtle plant. If the elements of the intended test program differ substantially from those recommended in AEC Safety Guide 20, submit the basis and justification for these differences.

2. Clarify your intention to provide a description of the dynamic system analysis methods and procedures that will be used to confirm the structural design adequacy of the reactor coolant system (unaffected loop) and the reactor internals (including fuel element assemblies, control rod assemblies and drives) under the LOCA loading, or identify the applicable topical report.

3. The design stress limits for ASME Class 1, 2 and 3 components listed in Sections 3.9.2 (3.9.2.3, .4 and .9), the stress limit and load combination criteria of Tables 3.6-8 and 3.6-9 of the PSAR and Sections 3.9 and 5.2 of RESAR-3 are not acceptable. Table I attached provides a summary of limits which are

acceptable to the regulatory staff. Unless you propose to adopt these design limits provide the basis for using any limit that exceeds those listed in Table I and demonstrate the adequacy of the design safety margins proposed.

4. The position of Section 3.9.2.5 of the PSAR regarding the use of Code Cases for ASME Class 2 and 3 components is not acceptable. It is noted that RESAR-3 provides no indication as to the use of Code Cases for ASME Class 1 components. The use of ASME Code Cases for all classes of construction requires specific approval by the Commission in accordance with 10 CFR 50.55a, refer to (a)(2) ii and footnote 6 of the regulation. Provide a list of the Code Cases desired to be used.

5. Section 3.7.2.1.1.3 of the PSAR implies that dynamic analysis alone is one of the methods of evaluation to qualify mechanical equipment. Provide the specific criteria which will be used to guarantee operability of mechanical equipment under faulted condition loads when a dynamic analysis without performance testing is employed in the design of this equipment.

6. Section 3.9.1.1 of the PSAR presents a partially acceptable basis to confirm the structural design of the piping and piping restraints. Attachment I entitled "Regulatory Position - Preoperational Piping Dynamic Effects Test Program" presents the basis for a program which is complete and which would be acceptable at the Operating Licensing

stage. State your intentions to develop such a program for submittal in the FSAR for Alvin W. Vogtle Nuclear Plant, Units 1, 2, 3 and 4.

7. Provide a detailed description of an operability assurance program for confirming that ASME Class 1, 2 and 3 active* valves 2 inches and greater in nominal pipe size will function properly under normal, emergency and faulted plant conditions.** This program may include either the in-situ application of vibratory devices to superimpose the vibratory loadings on the valve operator and associated mounted devices or laboratory or shop testing under equivalent simulated loadings that will ensure valve operability. The test program may be based upon selectively testing a representative number of active valves in the piping system according to valve type, accident load level, size, etc. on a prototype basis.

8. Sections 3.9.2.8 of the PSAR and 5.2.2 of RESAR-3 covering the design of pressure relieving stations in seismic Category I piping systems are not acceptable in that design for dynamic

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*Active valves are those whose operability is relied upon to perform a safety function such as safe shutdown of the reactor or mitigation of the consequences of a postulated pipe break in the reactor coolant pressure boundary.

**Normal, Emergency and Faulted Plant Conditions relate to the loadings, and environment under which the valve is required to open or close during normal operation, emergency incidents and postulated faults (accidents) which affect the system in which the valve is installed.

effects is not covered. Your response should include the method of determining the discharge thrust load including all dynamic effects and the method of stress evaluation for open and closed systems. Design should be via a standard dynamic hydraulic/structural analysis or alternatively the equivalence of the method used should be justified and the adequacy of the design safety margins which are proposed should be demonstrated.

9. Provide the basis for the selection of allowable stresses as listed in Table 5.2-6 of RESAR-3 for ASME Class 1 component supports and Table 3.9-4 of RESAR-3 for ASME Class 2 and 3 component supports. Include information for faulted, emergency and normal/upset operating conditions and particularly those situations involving supports to an active pump or valve. Indicate whether RESAR-3 applies for the design of Class 2 and 3 component supports since there is apparently no coverage in the PSAR.

TABLE I

SEISMIC CATEGORY I COMPONENT	LOADING COMBINATIONS [1,3]	PRIMARY MEMBRANE + PRIMARY BENDING STRESS DESIGN LIMIT	ASME CODE [2] DESIGN LIMIT [4] (PARAGRAPH)
ASME Code [2] Class 1 Vessels	[UPL or NPL] + .5SSE EPL NPL + SSE + DSL	$1.5\ S_m$ $1.8\ S_m$ Refer to Appendix F of Section III	NB-3223 NB-3224 NB-3225
Class 1 Piping	[UPL or NPL] + .5SSE EPL NPL + SSE + DSL	$1.5\ S_m$ $2.25\ S_m$ $3.0\ S_m$	NB-3654 NB-3655 NB-3656
Class 1 Valves (Non-active) by Analysis	[UPL or NPL] + .5SSE EPL NPL + SSE + DSL	$1.5\ S_m$ $1.8\ S_m$ Refer to Appendix F of Section III	NB-3223 or NB-3512.2 [5] NB-3224 NB-3225
Class 1 Valves (Non-active) by Standard Design	[UPL or NPL] + .5SSE EPL NPL + SSE + DSL	$1.1\ P_r$ $1.2\ P_r$ [6,7] $1.5\ P_r$	
Class 1 Valves (Active) by Analysis	[UPL or NPL] + .5SSE EPL NPL + SSE + DSL	$1.5\ S_m$ $1.5\ S_m$ [8,9,10] $1.5\ S_m$	NB-3223 or NB-3512.2 [5] NB-3223 or NB-3512.2 NB-3223 or NB-3512.2
Class 1 Valves (Active) by Standard Design	[UPL or NPL] + .5SSE EPL NPL + SSE + DSL	$1.1\ P_r$ $1.1\ P_r$ [8] $1.1\ P_r$	
Class 1 Pumps (Non-active) by Analysis	[UPL or NPL] + .5SSE EPL NPL + SSE + DSL	$1.65\ S_m$ $1.8\ S_m$ Refer to Appendix F of Section III	NB-3223 or NB-3411 [5] NB-3224 NB-3225
Class 1 Pumps (Active) by Analysis	[UPL or NPL] + .5SSE EPL NPL + SSE + DSL	$1.65\ S_m$ $1.65\ S_m$ [8,9,10] $1.65\ S_m$	NB-3223 or NB-3411 [5] NB-3223 or NB-3411 NB-3223 or NB-3411

TABLE I (Cont'd)

SEISMIC CATEGORY I COMPONENT	LOADING[1,3] COMBINATIONS	PRIMARY MEMBRANE + PRIMARY BENDING STRESS DESIGN LIMIT	ASME CODE[2] DESIGN LIMIT[4] (PARAGRAPH)
ASME Code[2] Class 2 & 3 Vessels (Sect. VIII, Div. 1)	[UPL or NPL] + .5SSE	1.1 S	
	EPL	1.1 S[11,12]	
	NPL + SSE + DSL	1.5 S	
Class 2 Vessels (Sect. VIII, Div. 2)	[UPL or NPL] + .5SSE	1.5 S_m	NB-3223
	EPL	1.8 S_m	NB-3224
	NPL + SSE + DSL	Refer to Appendix F of Section III	NB-3225
Class 2 & 3 Piping	[UPL or NPL] + .5SSE	1.2 S_h	NC-3611.1(b)(4)(c)(b)(1)
	EPL	1.8 S_h	NC-3611.1(b)(4)(c)(b)(1)[13]
	NPL + SSE + DSL	2.4 S_h	NC-3611.1(b)(4)(c)(b)(2)
Class 2 & 3 Pumps (Non-active)	[UPL or NPL] + .5SSE	1.65 S	
	EPL	1.65 S[12]	
	NPL + SSE + DSL	1.8 S	
Class 2 & 3 Pumps (Active)	[UPL or NPL] + .5SSE	1.65 S	
	EPL	1.65 S[12,14]	
	NPL + SSE + DSL	1.65 S	
Class 2 & 3 Valves (Non-active)	[UPL or NPL] + .5SSE	1.1 P_r	
	EPL	1.1 P_r[6]	
	NPL + SSE + DSL	1.2 P_r	
Class 2 & 3 Valves (Active)	[UPL or NPL] + .5SSE	1.1 P_r	
	EPL	1.1 P_r[6,14]	
	NPL + SSE + DSL	1.1 P_r	

TABLE I NOTES

1/ UPL - Upset Plant Condition Loadings

NPL - Normal Plant Condition Loadings

SSE - Safe Shutdown Earthquake

EPL - Emergency Plant Condition Loadings

DSL - Dynamic System Loads - (Under Faulted Plant Conditions)

2/ Section III of the ASME Boiler and Pressure Vessel Code including the 1972 Winter Addenda thereto.

3/ Identification of the specific transients or events to be considered under each plant condition will be addressed in a future safety guide.

4/ Applies to all components (vessels, piping, pumps, and valves) that are relied upon to cope with the effects of specified plant conditions.

5/ As an alternate, the design limits specified in NB-3411 and NB-3512.2 for large pumps and large valves, respectively, may be used in conjunction with the design limits of NB-3223.

6/ P_r - The pressure rating corresponding to the maximum transient temperature for each plant condition, as specified in Tables NB-3531, 1 to 7, for Class 1 valves or as specified in NC-3500 and ND-3500 for Class 2 and 3 valves, respectively.

7/ The design limits for the upset and emergency plant conditions are consistent with the limits set forth in a proposed revision to Section III identified by agenda item N 72-85 of the Subcommittee on Nuclear Power.

8/ In addition to compliance with the design limits specified, assurance of operability under all design loading combinations should be provided by any appropriate combination of the following suggested measures:

a. in situ testing (e.g., preoperational testing after the component is installed in the plant).

b. full-scale prototype testing.

c. reduced-scale prototype testing.

d. detailed stress and deformation analyses (includes experimental stress and deformation analyses).

If superposition of test results for other than the combined loading condition is proposed, the applicability of such a procedure should be demonstrated. The design limits for non-active pumps and valves designed by analysis may be used for the applicable loading combinations if assurance is provided by detailed stress and deformation analyses that operability is not impaired when designed to these limits. Similarly, the primary-pressure ratings (P_r) for non-active valves designed by standard design rules may be used for the applicable loading combinations if appropriate testing demonstrates that operability is not impaired when the valve is so rated.

9/ Secondary thermal effects (stresses and deformations) should be evaluated for the loading combinations EPL and NPL + SSE + DSL. Local effects (peak stresses) need not be considered for these loading combinations.

10/ Table I-3.0, "Permanent Strain Limiting Factors," of Appendix I of the ASME Boiler and Pressure Vessel Code, Section III, may be used as an aid in determining the relationship between design stress and deformation (see note 2 to Table I-1.2).

11/ Division 1 of Section VIII of the ASME Boiler and Pressure Vessel Code does not provide rules for design by analysis. If a detailed analysis is performed, Division 1 vessels should meet, as a minimum, equations a and b below.

a. $\sigma_m \leq 1.1S \geq \frac{\sigma_m + \sigma_b}{1.5}$ for [UPL or NPL] + .5SSE or EPL

b. $\sigma_m \leq 1.5S \geq \frac{\sigma_m + \sigma_b}{1.5}$ for NPL + SSE + DSL where: σ_m = primary membrane stress

σ_b = primary bending stress

S = allowable stress value as specified in Appendix I of Section III of the ASME Boiler and Pressure Vessel Code

12/ S refers to the allowable stress value as specified in Appendix I of Section III of the ASME Boiler and Pressure Vessel Code.

13/ For the loading combination, EPL, only equation 9 of NC-3651 need be met.

14/ In addition to compliance with the design limits specified, assurance of operability under all design loading combinations should be provided by any appropriate combination of the following suggested measures:

a. in situ testing (e.g., preoperational testing after the component is installed in the plant).

b. full-scale prototype testing.

c. reduced-scale prototype testing.

d. detailed stress and deformation analyses (includes experimental stress and deformation analyses).

If superposition of test results for other than the combined loading condition is proposed, the applicability of such a procedure should be demonstrated. The design limits for non-active pumps and valves may be used for the applicable loading combinations if appropriate analyses and/or testing as suggested above, confirms that operability is not impaired when designed to these limits.

Attachment I

REGULATORY POSITION

PREOPERATIONAL PIPING DYNAMIC EFFECTS TEST PROGRAM

Preoperational piping dynamic effects testing should be conducted during startup functional testing on piping systems and restraints classified as ASME Class 1 and Class 2 components. The purpose of these tests is to confirm that these components have been designed to withstand the dynamic loadings from operational transient conditions that will be encountered during service as required by ASME Section III par. NB-3622.3 and NC-3622. Acceptable testing programs to confirm the adequacy of the designs should consist of the Non-Instrumented Test Program described in 1 below and, if necessary, the Instrumented Test Program described in 2.

1. Non-Instrumented Test Program - An acceptable program should provide the following:

   a. A listing of the different flow modes of operation and transients such as pump trips, valve closures, etc. to which the components will be subjected during the test.* For example, the transients associated with the Reactor Coolant System heatup tests should include, but not necessarily be limited to:

      (1) Reactor coolant pump start
      (2) Reactor coolant pump trip
      (3) Operation of relief valves

   b. The criteria that will be used to determine if the vibration of the piping system is within acceptable levels, including the bases upon which these criteria were established. As a minimum, the acceptable vibratory amplitude or displacement (beyond the restraint limits) determined to be critical as a result of analyses and/or previous experience should be established for the piping systems identified above. During the tests, these systems should be observed by the piping designer to determine if the vibrations are within acceptable levels. Where the vibrations cannot be checked by observation or the area is inaccessible, an instrumented program as outlined in 2 below should be conducted.

   c. If vibration is noted beyond the acceptable levels set by the criteria of b. above, either corrective restraints should be designed and installed, or an instrumented test program as described in 2 below should be conducted. If during the test, the piping systems restraints are damaged, corrective restraints should be installed and another non-instrumented test should be performed to determine that the vibrations have been reduced to an acceptable level.

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*Additional guidance for the selection of such transients is provided in the "AEC Guide for Planning of Initial Startup Programs" December 7, 1970.

2. <u>Instrumented Test Program</u> - An acceptable program should provide the following:

a. Same as in 1.a above. Include instrumentation types and their location which will be used for measurement of vibration responses.

b. The test acceptance criteria (e.g., acceptable vibration amplitude), the permissible acceptance deviations, and the bases upon which these criteria were established to determine the adequacy of the design.

c. If vibration is noted beyond the acceptable levels set by the criteria of b. above, corrective restraints should be designed and installed. If during the test, the piping systems restraints are damaged, corrective restraints should be installed and another test should be performed to determine that the vibrations have been reduced to an acceptable level.