

ATTACHMENT 65001.20

INSPECTION OF SAFETY-RELATED PIPING DESIGN ACCEPTANCE CRITERIA (DAC)-RELATED ITAAC

PROGRAM APPLICABILITY: 2503

65001.20-01 INSPECTION OBJECTIVES

01.01 To verify the piping design was completed in accordance with the piping Design Acceptance Criteria (DAC) and the methodology in the Design Control Document (DCD), the ASME Code Section III requirements, and any additional requirements provided in license conditions in the COL.

01.02 To determine whether licensee records establish an adequate basis for the acceptance for closure of Inspection, Test, Analysis and Acceptance Criteria (ITAAC) for piping DAC.

65001.20 -02 INSPECTION REQUIREMENTS AND GUIDANCE

Background: Design Acceptance Criteria (DAC) are a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies, in a limited number of technical areas, in making a final safety determination to support a design certification. DAC is to be objective (measurable, testable, or subject to analysis using pre-approved methods), and must be verified as a part of the ITAAC performed to demonstrate that the as-built facility conforms to the certified design (SECY 92-053).

There are three process options for DAC/ITAAC resolution:

- a. Resolve during the design certification or amendment to the design certification
- b. Resolve as part of COL review
- c. Resolve after COL is issued

In the first two options, the applicant will submit the design information and the NRC will document its review in a safety evaluation. In the third option, the COL holder notifies the NRC of availability of design information and the staff will document its review in an inspection report.

Should the third option be implemented for a first standard plant design, subsequent COL applicants may reference the first standard plant closure documentation and close the DAC/ITAAC under the concept of "one issue, one review, one position," identified in NRC guidance. The staff may elect to confirm that the basis (documentation) for DAC/ITAAC closure from a first standard design to subsequent COL applicants is consistent. Documentation and results of DAC/ITAAC inspection will be archived in the Construction Inspection Program Information Management System (CIPIMS).

Description of Piping DAC: Piping DAC is a set of methodology and criteria pertaining to piping design documented in the DCD upon which the NRC staff relies in making a final safety determination regarding the piping design requirement to support a design certification in lieu of reviewing the piping design. DAC represent a set of design commitments which are to be verified as part of the Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) once the design is complete.

In every design to date, the applicant chose to delay completing the piping design until later in the construction period. Separate ITAAC are included for verification that the design meets the regulations and for verification that the plant was built in accordance with the design. To date, applicants have elected to resolve the piping DAC as part of the COL review or after the COL is issued, not as part of the design certification.

02.01 Inspection Plan/Scoping. Although the scope of piping DAC encompasses all safety-related ASME Class 1, 2, and 3 piping system, the system selection for inspection should consider risk significance, operating experience, new design, complexity of system transients, and safety significance of the piping systems. As a minimum, all risk significant piping packages should be completed to the point where the Design Specifications and Reports are certified prior to beginning the inspection.

For example, AP1000, Rev. 18, Table 3.9-20, "PIPING PACKAGES CHOSEN TO DEMONSTRATE PIPING DESIGN FOR PIPING DAC CLOSURE (in addition to Class 1 lines larger than 1 inch in diameter)" provides a list of piping packages which should be completed prior to the beginning of the inspection.

Similar lists can be established for other standard designs, as needed, where the piping DAC is to be resolved after issuance of the COL. This list was prepared for AP1000 because of the status of the design when the applicant attempted to address the piping DAC during the design certification amendment. If this approach is to be taken, it should be negotiated prior to the inspection. The licensee should provide their list of risk significant piping and the inspection team leader should review and request the addition of other piping that they feel should be included based on risk. All of the design for piping on the list should be complete (Design Reports certified) prior to the team arriving on site.

There is a possibility that some of the piping design work may be sub-contracted to different design companies/agencies for completion. During early preparation for a piping DAC inspection, the team leader should obtain information about the involved design resources from the licensee and the design agency. Effort should be made to select at least one to two samples from each sub-contracted design company. To expedite the inspection process, it may be beneficial to request that representatives of all parties involved and the necessary documentation be present at one location to support one inspection.

It is recognized that piping design packages will likely be changed as the plant is built. These changes are required to be reconciled by the ASME Code and will be inspected

as part of a separate ITAAC or set of system based ITAAC at each site that will specifically look at reconciliation of the as-built design.

02.02 Design Inspections. The following tasks should be performed across a sample of ASME design specifications and design reports:

- a. Review the piping Design Specifications for each chosen piping segment to verify that it uses the design inputs specified in the DCD or required in ASME Code. Aspects that should be verified include:
 1. Code and Code Cases
 2. Requirements, including materials, manufacturing, testing & examination, and quality assurance
 3. Design Input (e.g., structure)
 4. Design Input including temperature and pressure
 5. Load Condition including seismic, accident, thermal, dead weight
 6. Other Conditions (e.g., design life)
- b. Review the Design Reports/Stress Reports to verify that the resulting design meets the Design Specification and that the design was developed using the methodology called out in the DCD and the ASME Code. The calculations and/or analysis for the following should be reviewed as necessary to make this verification. The level of review should be guided by inspector experience, risk significance of the piping, and operating experience in determining the analysis to verify.
 1. Review piping analysis input (references: Line list or P&ID, etc.)
 - (a) Pipe size
 - (b) Schedule/Wall thickness
 - (c) Insulation weight
 - (d) Material
 - (e) Design pressure
 - (f) Design temperature
 2. Review support input
 - (a) Support Stiffness
 - (b) Snubber/Spring
 3. Review the modeling of additional masses due to weight from support members/snubbers/springs and branch piping.
 4. Review the licensee's assumption and open items (e.g., valve weight) in the design report

5. Ensure that Computer Codes used in completing the design are listed in Section 3.9.1 of the DCD and have been verified
6. Review piping package model scope
 - (a) Decoupling criteria
 - (b) anchor to (equivalent) anchor
7. Review thermal analysis
 - (a) Thermal modes by referencing P&IDs, system description, etc.
 - (b) Thermal Anchor Movements consideration of displacement from run pipe, supported from steel containment shell, etc.
 - (c) Thermal stratification consideration for Pressurizer surge line, RHR/SIS (DCD, Bulletins 88-08 and 88-11, EPRI Report TR-103581, EPRI Report TR-1011955). Stratification monitoring data will be used to verify surge line design analysis.
8. Review seismic analysis
 - (a) Damping value, response spectra/time history input
 - (b) Response spectra input (amplified response spectra for non-rigid equipment, piping)
 - (c) Individual support motion (ISM) method support groups & modal combination method
 - (d) Modal combination method for uniform support motion (USM) (RG 1.92)
 - (e) Seismic anchor movement (SAM) consideration
 - (f) Combination of inertia & SAM
9. Review dynamic analysis considerations: valve open/closure events (MSIV, SRV, TSV) by referencing P&IDs, system description, etc.
10. Review building settlement case: piping support movement consideration for inter-building piping
11. Review fatigue evaluation
 - (a) Design transient/cycles
 - (b) Environmental assisted fatigue (EAF) Fen factor (RG 1.207, NUREG/CR-6909) for Code Class 1 piping (Note: RG 1.207 does not apply to AP1000 & ABWR)
 - (c) ASME Code fatigue requirements (NB-3653) for Code Class 1 piping
 - (d) Stress Reduction Factor for Code Class 2 & 3 piping (NC/ND-3600)
12. Review ASME Code stress qualification delineated in NB/NC/ND-3600
 - (a) Stress indices for weld, reducer, elbow, branch, etc.

- (b) Deflection limit specified in design specification
- 13. Review additional stress qualification: Functional Capability of piping system
- 14. Review loading combination for pipe stresses
- c. Review pipe support design
 - 1. Applicable Codes (ASME Code, Section III, Subsection NF)
 - 2. Jurisdictional boundary
 - 3. Loads and load combinations
 - 4. Pipe support base plate and anchor bolt design
 - 5. Use of energy absorbers and limit stops
 - 6. Use of snubbers
 - 7. Pipe support stiffness
 - 8. Seismic self-weight excitation
 - 9. Design of supplementary steel
 - 10. Consideration of friction forces
 - 11. Pipe support gaps and clearances
 - 12. Instrumentation line support criteria
 - 13. Pipe deflection limits

Guidance: All of the tasks may not be applicable for every design package selected for review (e.g., building settlement) and do not need to be verified for every package. A sample of each from several packages and an increased sample where concerns identified would be appropriate. The inspector(s) may find it advantageous to provide/generate a check-list for the attributes listed above for use during the review of each package. (Note, inspection should not be done by checklist or included in the inspection report, although use of a checklist may be a useful inspection tool.)

The AP1000 DCD, Rev 18, Table 3.9-19, CRITICAL PIPING DESIGN METHODS AND CRITERIA (PIPING DESIGN CRITERIA) provides a comprehensive listing of piping design commitments and the associated Tier 2 reference (paragraph or table) for the details of each commitment. This list is attached as an example of the methodologies which could be verified during this inspection. This list is not required and may not be available for every design. It does, however, give a good overview of the methodologies to look for. Whether the methodology applies should be verified in the DCD.

Inspection Sample Guidance: The DAC inspection should verify at least 10 to 15 piping design packages (anchor to anchor or equivalent anchor) with different characteristics described above. In addition to the ASME Code Design Specification and Reports for

the chosen lines, all documents referenced in the specification and report, relevant design analyses, drawings, and calculations should be available for the inspection.

As stated in paragraph 02.01, above, there is a possibility that some of the piping design work may be sub-contracted to different design companies/agencies for completion. During early preparation for the inspection, the team leader should obtain information about the design resources used by the licensee and the design agency. Effort should be made to select at least one to two samples from each sub-contract design company involved with safety-related piping design work.

During the preparations for the inspection, the team should select a sample of 15 to 20 piping packages and identify those packages to the licensee and design agency. The final sample selection of 10 to 15 packages for review will be done when the team arrives at the location of the inspection.

The following list includes AP1000 piping sections that may be of interest for inclusion in the sample due to the more challenging conditions to be addressed or issues known in industry:

- Pressurizer surge line, RHR/SIS (thermal stratification as identified in IE Bulletins 88-08 and 88-11)
- Main steam line (hydro dynamic loading, turbine stop valve closure event)
- Feedwater line (hydro dynamic loading, stratification)
- Pressurizer spray line, safety & relief line (high thermal transient, high fatigue)
- CVCS charging & letdown (thermal fatigue due to charging & letdown flow shut and return to service)
- Reactor coolant loop (safety- significance, Class 1 fatigue evaluation)
- HPSI/LPSI (high thermal transient fatigue)
- Head vent (hydro dynamic loading)
- Passive core cooling system (dynamic transient due to squib valve actuation, new design)

65001.20-03 RESOURCE ESTIMATE

The estimated hours for completing the piping DAC inspection are 210 staff hours based on a two week inspection by three NRC staff members. In addition, the estimated hours for preparation and documentation are 70 hours and 120 hours respectively.

65001.20-04 REFERENCES

ASME B&PV Code Section III, Applicable Revision

Facility Final Safety Analysis Report (FSAR) and Design Certification Document (DCD)

Facility Final Safety Evaluation Report (SER)

EPRI Report TR-103581, "Thermal Stratification, Cycling, and Striping"

EPRI Report TR-1011955, "Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Line."

NRC Bulletin 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems."

NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification"

NUREG/CR-6909, "Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials"

RG 1.207, "Guidelines for Evaluating Fatigue Analyses Incorporating the Life Reduction of Metal Components Due to the Effects of the Light-Water Reactor Environment for New Reactors"

END

Attachment 1
Revision History for 65001.20

Commitment Tracking Number	Issue Date	Description of Change	Training Needed	Training Completion Date	Comment Resolution Accession Number
N/A	ML111100647 xx/xx/xx CN xx-xxx	1. Initial issuance to support ITAAC related inspections under 10CFR52. 2. Researched commitments for 4 years and found none.	None	N/A	N/A