Northeast Utilities
Millstone - Unit 3

Independent Corrective Action Verification Program
(ICAVP)

Modification Review Checklist

CK-MP3-03-16, Rev. 0

Piping Design Review Checklist

Prepared by:	P.R. OLSON	P.R. Olson	4-7-97
	Name	Signature	Date
Approved by:	A.A. NEU	A.A. Neu	4-7-97
	Name	Signature	Date

IMPLEMENTATION

System		
Document No. / Rev. No.		
Modification No. / Rev. No.		
Verified by:		Date:
SRG Concurrence by:		Date:

Piping Design Review Checklist

Instructions

This set of checklists shall be used for the modification review process described in PI-MP3-03 and for the design process document review process described in PI-MP3-02. The application and use of these checklists shall be as follows:

1. The Verifier shall identify if the Design Process Document to be reviewed is;
   a. Identified as a document to be reviewed under the modification review process (PI-MP3-03) or
   b. Identified as a document to be reviewed under the design review process (PI-MP3-02).
2. The Verifier shall complete the Piping Design Consideration Checklist (see page 3) to define the design considerations applicable to the Design Process Document being reviewed.
   a. Enter the System name, Design Process Document Number / Rev. No. and, if applicable, the Modification No.
   b. If a design consideration is applicable to the Design Process Document, check (√) as applicable. Note that more than one design consideration may apply.
   c. If not applicable, check not applicable (NA).
   d. If other design considerations are addressed by the Design Process Document which are not covered by the checklists provided, list these design considerations under "Other".
   e. Print, sign and date when identification of applicable design considerations is completed.

   Note: Only those checklists for which a design consideration is identified in step 2 need be completed under step 3.
3. For each applicable design consideration identified, the Lead Verifier or Discipline Verifier, as applicable, shall complete the applicable Design Review Ckecklist (s) and comment page(s) as follows:
   a. Enter the System name, Design Process Document Number and, if applicable, the Modification No. on all checklist sheets. The sheets shall be sequentially numbered (i.e. 1,2,3 ect.). It is acceptable to add insert pages (i.e. 1A, 1B, 1C, etc.) if needed.
   b. Review the Design Process Document for each major design attribute on the checklist(s). A detailed list of potential design considerations follows each major design attribute in the checklist. These detailed items should be considered during the review and may form the basis for comments, but each item is not required to to be marked as to its acceptability. Each major design attribute should be addressed as follows:
      b.1 If the review determines the attribute is satisfied, check satisfactory (Y).
      b.2 If the review determines the attribute is not satisfied, check unsatisfactory (N) and enter a sequential comment number and enter the comment number and comment on the Piping Design Review Comment Form (see page 4).
      b.3 If the specific design consideration is not applicable, check not applicable (NA).
   c. Once the review is complete, sign and date the checklist cover sheet.
4. The SRG Lead shall indicate concurrence that the checklist has been implemented satisfactorily by signing and dating the checklist cover sheet.
5. The cover sheet and all applicable checklists and comment forms shall be included if the final project file copy.
6. Comments shall be processed as discrepancies in accordance with PI-MP3-11.

Piping Design Review Checklist

Piping Design Considerations Checklist

Checklist No.	Design Consideration	Applicability Yes (√)/ No (NA)
1.0	General Modeling and Design (ASME Class 1, 2 & 3 and B31.1 Piping)	_____
2.0	ASME Class 2 & 3 and B31.1 Stress Analysis	_____
3.0	ASME Class 1 Stress Analysis	_____
4.0	Hydraulic Transient Analysis	_____
5.0	Interaction Analysis	_____
6.0	Pipe Rupture Calculations and Design Considerations	_____
7.0	Resolution of Change Documents (Including modification close out for as built conditions)	_____
8.0	Simplified Small Bore Piping and Tubing Analysis	_____
9.0	Others (List)	_____

Prepared by _____ Signature _____ Date _____

Piping Design Review Checklist

Piping Design Review Comment Form

Comment No.	Comment

Prepared by _____ Signature _____ Date _____

Piping Design Review Checklist

General Modeling and Design Checklist
Applicable to ASME Class 1, 2 & 3 and B31.1 Piping

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
1.0	GENERAL MODELING AND DESIGN	_____
1.1	BASIC DATA	_____
1.2	DEAD WEIGHT ANALYSIS	_____
1.3	HYDRO WEIGHT ANALYSIS	_____
1.4	THERMAL EXPANSION ANALYSIS	_____
1.5	DISPLACEMENT ANALYSIS	_____
1.6	SEISMIC RESPONSE SPECTRA ANALYSIS	_____
1.7	SAFETY RELIEF VALVE ANALYSIS (SRVA)	_____
1.8	TIME HISTORY ANALYSIS	_____
1.9	HAND-PREPARED DESIGN CALCULATIONS	_____

_____ _____ _____
Prepared by Signature Date

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.0	General Modeling and Design		
1.1	BASIC DATA		
1.1.1	Are the materials at all elements in compliance with the reference design basis drawings?		
1.1.2	Is the specified internal peak pressure (higher of design pressure and maximum operating pressure) for each data point correctly coded in psig? Are the material properties coded correctly?		
1.1.3	Are the uniform weights on the geometry cards coded correctly?		
1.1.4	For all non submerged piping, does the uniform weight on each geometry card include the pipe weight, normal operating content weight, insulation weight and jacketing weight?		
1.1.5	For all submerged piping, does the uniform weight on each geometry card include the pipe weight and hydrodynamic mass.		
1.1.6	Is the insulation weight correctly specified on the analytical drawings, based on the insulation type identified in the piping Line List?		
1.1.7	For each pipe geometry input, is the correct outside diameter of pipe/pipe fitting specified?		
1.1.8	For each pipe geometry input, is the correct wall thickness of pipe/pipe fitting specified?		
1.1.9	If any special modeling geometry's (e.g., equipment or valve flexibility, expansion joints, special restraint configurations, etc.) were used in the analysis, are they appropriate?		
1.1.10	Is the correct radius in feet coded on all tangent point data cards?		
1.1.11	Does the basic data accurately represent the pipe routing shown on the reference design basis isometric drawings?		
1.1.12	Are the data point types coded correctly?		
1.1.13	Are the coded location and angularity changes of all supports within the appropriate design tolerance criteria?		
1.1.14	Is the restraint type on the restraint drawing in compliance with the coding (unless it is a specified snubber/variable rigid restraint change)?		
1.1.15	Is at least one data point coded approximately		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	halfway between any two restraints in the same direction or between a restraint and an anchor?		
1.1.16	For header subsystems where the ratio of run piping out side diameter to the branch piping outside diameter is less than 3.0, or other specific criteria, are all branch lines modeled in the analysis of header subsystem?		
1.1.17	For header subsystems where the ratio of run piling outside diameter to the branch piping outside diameter is greater than or equal to 3.0, is an element of the branch subsystem coded?		
1.1.18	For branch subsystems anchored at the header subsystem, is the anchor modeled correctly?		
1.1.19	Are all anchors coded at their proper locations?		
1.1.20	Are the anchor types coded correctly using appropriate modeling techniques?		
1.1.21	Are all trunnion and stanchion supports properly coded?		
1.1.22	Are all penetrations modeled correctly after consideration of the sealant material?		
1.1.23	Is the length/diameter ratio(L/D)of all straight pipe elements and curved pipe elements on large diameter bends within appropriate acceptance criteria?		
1.1.24	Is there a smooth transition in length/diameter ratio (L/D) from element to element?		
1.1.25	Is the frequency of all pipe elements greater than 33 Hz?		
1.1.26	Are all valves where the perpendicular distance from the C.G. to the pipe center line is less than or equal to 1/2 the outside diameter of the pipe, modeled as a single element?		
1.1.27	If the answer to 1.1.26 is yes, does the uniform weight on all geometry cards include the valve weight, insulation weight and jacketing weight?		
1.1.28	Are all valves where the perpendicular distance from the C.G. to the pipe center line is greater than 1/2 the outside diameter of the pipe, modeled as three weightless elements?		
1.1.29	If the answer to 1.1.28 is yes, has the valve C.G. been correctly located, considering both valve and operator?		
1.1.30	Is the valve operator orientation with respect to the pipe properly modeled for all three element valves?		
1.1.31	Is the outside diameter of the valve(s) coded		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	correctly?		
1.1.32	Is the wall thickness of the valve(s) on the geometry card(s) equal to the maximum valve body wall thickness (obtained from vendor 'valve drawing) or two times the wall thickness of the adjoining pipe?		
1.1.33	If a valve has reducers at its ends, have they been correctly model led in accordance with the reference acceptance criteria?		
1.1.34	Are all valve skew angles (orientations) coded correctly?		
1.1.35	If applicable have the data points of all valve been correctly specified on the valve acceleration save data card?		
1.1.36	Are interfaces with the piping contractor's piping properly modeled?		
1.1.37	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.2	DEAD WEIGHT ANALYSIS		
1.2.1	Are the weights not modeled as uniform weight (e.g., restraint hardware weights, pipe fitting weights, etc.) included as data point lumped masses or fixed end force sets?		
1.2.2	Are all data point lumped masses coded correctly with respect to magnitude and direction?		
1.2.3	Are the data point lumped masses for all three element valves (including contents and insulation) coded at the valve		
1.2.4	For all data point lumped masses, is the global (- direction unrestrained in the weight analysis?		
1.2.5	Are the weights for all single element valves (including contents and insulation) coded as uniform weight?		
1.2.6	For spring hangers modeled as upward forces, has the correct preload been specified?		
1.2.7	If fixed end force sets were used, are the sign and magnitude of forces and moments coded correctly?		
1.2.3	Are all the global Y-direction restraint reactions n the. weight analysis positive?		
1.2.9	Are the deflections of all data points in the		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	subsystem within the appropriate allowable Limit?		
1.2.10	If pipe deflections exceed the appropriate allowable Limit, is the general slope or the line still maintained?		
1.2.11	Are all risers stable?		
1.2.12	Is the overall supporting system balanced (i.e., no large differences between hanger loads or excessive upward deflections)?		
1.2.13	Does the weight analysis satisfy the equilibrium check?		
1.2.14	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.3	HYDRO WEIGHT ANALYSIS	_____	_____
1.3.1	If the subsystem carries only steam, is a separate hydro weight analysis performed?		
1.3.2	Have the pipe weights and all other masses been correctly modified to account for the weight of water?		
1.3.3	Are all variable and/or spring hangers considered as pinned (rigid) during the hydro weight analysis?		
1.3.4	Does the hydro weight analysis satisfy the equilibrium check?		
1.3.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.4	THERMAL EXPANSION ANALYSIS	_____	_____
1.4.1	Is a thermal expansion analysis performed for each thermal mode shown in the appropriate design basis document with consideration for cut off temperature and thermal anchor movements?		
1.4.2	Is a thermal expansion analysis performed for cold modes of operation (i.e. for temperatures less than 70° F) to obtain the maximum thermal stress range?		
1.4.3	For each thermal mode analysis, is the correct temperature assigned to the affected pipe		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	elements?		
1.4.4	If applicable, for each thermal mode, is the ambient temperature coded at each modeled stanchion or trunnion element?		
1.4.5	Are the thermal anchor movements and rotations identified on the applicable design documents or as calculated for equipment nozzles and header connections input correctly?		
1.4.6	If applicable have the sources of each terminal header anchor movement shown on the appropriate design basis reference drawings been properly referenced by subsystem name calculation number revision and data point?		
1.4.7	Are the terminal header anchor movements obtained from an approved piping stress analysis?		
1.4.8	Are the thermal modes of the header subsystem in compliance with the modes of this subsystem?		
1.4.9	Are the deflections for all data points in this subsystem within the appropriate allowable limit?		
1.4.10	Does the thermal analysis satisfy. the equilibrium check?		
1.4.11	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.5	DISPLACEMENT ANALYSTS		
1.5.1	HEADER DISPLACEMENT	_____	_____
1.5.1.1	If the subsystem is a branch line, are the dynamic deader displacement analyses performed for all applicable dynamic loads?		
1.5.1.2	Is the input for header displacements and rotations in compliance with the latest approved header subsystem analysis?		
1.5.13	For each dynamic load, are six displacement groups considered for each header connection?		
1.5.1.4	Are the header rotations correctly specified?		
1.5.1.5	Other checks, explain.		

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	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.5.2	BUILDING DISPLACEMENT		
1.5.2.1	Is a building displacement analysis required?		
1.5.2.2	If a building displacement analysis was performed, is the correct computer file name used in each analysis?		
1.5.2.3	Are the correct record numbers used for every support in this analysis?		
1.5.2.4	Is the source of the building displacement input data properly referenced in this piping stress analysis?		
1.5.2.5	Are all header anchor data points included in the correct support group, considering the upstream and downstream restraint attachment locations in the header subsystem?		
1.5.2.6	Has each of the applicable dynamic load been considered?		
1.5.2.7	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.5.3	SEISMIC RELATIVE SUPPORT DISPLACEMENT ANALYSIS		
1.5.3.1	Is a seismic relative support displacement analysis required?		
1.5.3.2	If applicable, is the correct computer file name used in each analysis?		
1.5.3.3	Are the dynamically active restraints(rigids, snubbers and anchors) specified at the correct data points and properly divided into support groups?		
1.5.3.4	Are the correct record numbers used for every support group locations in this analysis?		
1.5.3.5	Is the source of the input data properly referenced?		
1.5.3.6	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.6	SEISMIC RESPONSE SPECTRA ANALYSIS		
1.6.1	Are the seismic response spectra files (i.e.,		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	computer file name, revision, element name, location, elevation, damping, etc.) properly used in this analysis?		
1.6.2	If this is a branch subsystem, are the header seismic response spectra correctly specified?		
1.6.3	Are the restraint hardware weights, pipe fitting weights and other lumped masses coded correctly?		
1.6.4	If applicable, is the method of eigen value calculation used correct?		
1.6.5	Are the damping values for the applicable seismic response spectra correct as per the Regulatory Guide 3.61?		
1.6.6	Do the seismic time duration's comply with the reference acceptance criteria?		
1.6.7	Are the mode shapes printed in the computer output?		
1.6.8	Is square root of the absolute double sum method used to combine she dynamic modal responses?		
1.6.9	For each seismic response spectra analysis, does the last modal period fall on the ZPA of the enveloped response spectra in each direction?		
1.6.10	Are the deflections for all data points in this subsystem reasonable?		
1.6.11	If applicable, is the effect of seismic differential anchor movements considered correctly?		
1.6.12	Does the dynamic analysis satisfy the orthogonality check for the modal vectors?		
1.6.13	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.7	SAFETY RELIEF VALVE ANALYSIS(SRVA)	_____	_____
1.7.1	If applicable, have the effects of safety relief valve discharge been considered properly?		
1.7.2	Has the valve opening time been specified correctly?		
1.7.3	Does the steam stagnation pressure and density reflect the SRV set point?		
1.7.4	Are the pipe ID and pipe segment lengths input properly identified in the analysis?		
1.7.5	Are the pipe submerged lengths input data correctly calculated?		

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	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.7.6	Is the fluid density input correctly calculated?		
1.7.7	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.8	TIME HISTORY ANALYSIS		
1.8.1	For all appropriate restraint and anchor locations, have the time histories and multiplication factors been specified correctly?		
1.8.2	If this is a branch subsystem, have the header subsystem name and header data point been specified cot-correctly?		
1.8.3	Are the restraint hardware weights, pipe fitting weights and other lumped masses coded correctly?		
1.8.4	Is the integration time step in seconds small enough?		
1.8.5	If this is a header subsystem, are the time histories saved for all appropriate branch subsystem data point locations?		
1.8.6	Does the time history analysis satisfy the orthogonality check for the modal vectors?		
1.8.7	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
1.9	HAND PREPARED DESIGN CALCULATIONS		
1.9.1	Are the hand-prepared design calculations property documented in accordance with approved procedures?		
1.9.2	Has a procedure or method of design calculations been properly referenced and defined?		
1.9.3	Is the input data from other piping stress calculation packages or sources properly referenced and identified in this piping stress calculation package?		
1.9.4	If any non-standard formulas, equations, constants, etc., are used, are they properly		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	referenced and identified or are the supporting derivations included in this piping stress calculation package?		
1.9.5	Are the design calculations logically composed and justifiable for their intended purpose?		
1.9.6	Has the accuracy of the design calculations been verified?		
1.9.7	Other checks, explain.		

Piping Design Review Checklist

ASME Class 2 & 3 and B31.1 Stress Analysis Checklist

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
2.0	CLASS 2&3 AND B31.1 PIPING STRESS ANALYSIS	_____
2.1	COMBINED STRESSES	_____
2.2	COMBINED REACTIONS	_____
2.3	COMBINED ACCELERATIONS	_____
2.4	EQUIPMENT NOZZLE ALLOWABLE LOADS	_____
2.5	FLUED HEAD AND DRYWELL PENETRATION ALLOWABLE LOADS	_____
2.6	CLASS 2&3 WELDED ATTACHMENT DESIGN	_____
2.7	WELDED ANCHOR ATTACHMENT DESIGN	_____
2.8	FUNCTIONAL CAPABILITY REQUIREMENTS	_____
2.9	FLANGED JOINT ANALYSIS	_____

Prepared by _____ Signature _____ Date _____

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.0	Class 2 & 3 and B31.1 Piping Stress Analysis		
2.1	COMBINED STRESSES		
2.1.1	Is appropriate combined stress analysis included with this piping stress calculation package for all data points in this subsystem?		
2.1.2	Is the allowable stress, Sc, for the specified pipe material calculated at the subsystem ambient temperature?		
2.1.3	Is the allowable stress, Sh for the specified pipe material(s) calculated at the subsystem's highest temperature?		
2.1.4	Are all save tape load I.D.'s identified and input correctly?		
2.1.5	Have all the thermal modes shown on the appropriate design basis reference drawings been considered in the thermal range set?		
2.1.6	If the number of thermal expansion mode cycles exceed the program default value, are they specified?		
2.1.7	Is the specified internal peak pressure (higher of design pressure and maximum operating pressure) for each data point correctly coded in psig?		
2.1.8	Are the Load combinations correct as per approved procedures?		
2.1.9	If applicable, are the hydro weight load combinations considered properly?		
2.1.10	Are the pipe stresses for each service level at all data points in this subsystem within the applicable code allowable stresses?		
2.1.11	Have the stress intensification factors of all non 90 degree tee nodes been properly increased in accordance with the appropriate acceptance criteria?		
2.1.12	If non standard stress intensification factors were used, have they been calculated correctly and the stresses properly amplified?		
2.1.13	Are pipe breaks identified based on stress criteria?		
2.1.13	Other checks, explain.		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.2	COMBINED REACTIONS		
2.2.1	Is appropriate combined reaction analysis included with this piping stress calculation package for all restraints, anchors and valve ends in this subsystem?		
2.2.2	Are all save tape load I.D.'s identified and input correctly?		
2.2.3	Have the subsystem name and reference design basis isometric drawing number been correctly identified in the computer input?		
2.2.4	Are all anchor and restraint information cards include the proper identification and description of all restrained data points?		
2.2.5	Are the load combinations correct as per approved procedures?		
2.2.6	If applicable, are the hydro weight load combinations considered properly?		
2.2.7	Are all snubbers and variable supports reviewed to determine if they can be replaced by rigid restraints in accordance with the appropriate acceptance criteria?		
2.2.8	Are all vertical rigid rod hangers and spring hangers loaded in tension?		
2.2.9	Are all elbow lug supports loaded in tension?		
2.2.10	Are all stanchion supports loaded in compression?		
2.2.11	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.3	COMBINED ACCELERATIONS		
2.3.1	If the subsystem has any valves, is the combined acceleration analysis properly performed?		
2.3.2	Have the subsystem, design basis isometric drawings, and valve descriptions been correctly identified in the input?		
2.3.3	Are the correct data points specified for each valve (valve cg for three element valves and valve ends for single element valves)?		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.3.4	Have all save tape load I.D.'s been identified and input correctly?		
2.3.5	Are the load combinations correct as approved procedures?		
2.3.6	Are the coordinate system and units for valve accelerations consistent with those of the allowable accelerations?		
2.3.7	Are the valve accelerations within the allowable values?		
2.3.8	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.4	EQUIPMENT NOZZLE ALLOWABLE LOADS	_____	_____
2.4.1	Is there any equipment nozzle in this subsystem?		
2.4.2	Are the load combinations correct as per the vendor's recommendation?		
2.4.3	Are the coordinate system and units for the equipment nozzle loads consistent with those of the allowable loads provided by the manufacturers?		
2.4.4	Are the equipment nozzle loads within the allowable loads provided by the manufacturers?		
2.4.5	Are there any expansion joints in this subsystem?		
2.4.6	Are the expansion joint loads and displacements within the allowable values provided by the manufacturers?		
2.4.7	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.5	FLUED HEAD AND DRYWELL PENETRATION ALLOWABLE LOADS	_____	_____
2.5.1	Are there any penetrations in this subsystem?		
2.5.2	Are the load combinations correct as per the piping analyses from both sides of the penetration?		
2.5.3	Are the coordinate system and units for the penetration loads consistent with those of the allowable loads?		
2.5.4	Are the penetration loads within the allowable loads?		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.5.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.6	CLASS 2&3 WELDED ATTACHMENT DESIGN		
2.6.1	Have calculations been performed for all integral welded attachments (e.g., shear lugs, stanchions, trunnions, elbow lugs, circumferential tugs) in this subsystem?		
2.6.2	Are the welded attachment dimensions in compliance with the reference design basis drawings?		
2.6.3	Are the welded attachment materials in compliance with the reference design basis drawings?		
2.6.4	Are the loads at all the welded attachment data points correctly obtained from the piping analysis?		
2.6.5	Are the primary pipe stresses at all the welded attachment data points correctly obtained from the piping analysis?		
2.6.6	Is the clamp fit-up (shim details) assumed in compliance with the reference design basis drawings?		
2.6.7	Are the assumptions clearly specified and correct?		
2.6.8	Are all the welded attachment designs performed in accordance with the' approved acceptance criteria?		
2.6.9	Are the directions and magnitudes of the loads correctly used in this design?		
2.6.10	For a piping subsystem, where the temperature is greater than the subsystem's ambient temperature, has the effect of friction loads been considered properly in the design of the stanchions on slide bearing supports?		
2.6.11	Is the temperature of each stanchion/trunnion support, modeled as a pipe element, specified at subsystems ambient temperature?		
2.6.12	Are the total pipe stresses (primary plus local) at all the welded attachment data points, within the		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	code allowable stresses?		
2.6.13	Have qualification calculations been performed for all welds which are not on the pipe but are part of the assembly?		
2.6.14	Has the accuracy of the design calculations been verified?		
2.6.15	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.7	WELDED ANCHOR ATTACHMENT DESIGN	_____	_____
2.7.1	Have calculations been performed for all integral welded anchor attachments in this subsystem?		
2.7.2	Is the design input information for this calculation correct?		
2.7.3	Are the assumptions clearly specified and correct?		
2.7.4	Are all the welded anchor attachment designs performed in accordance with the approved acceptance criteria?		
2.7.5	If a structural anchor attachment is to be seismically designed, were the seismic loads considered from both sides of the anchor?		
2.7.6	Has the accuracy of the design calculations been verified?		
2.7.7	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.8	FUNCTIONAL CAPABILITY REQUIREMENTS	_____	_____
2.8.1	Does the piping subsystem require a functional capability check as per as defined by approved procedures?		
2.8.2	Are the functional capability requirements properly addressed in this piping stress calculation package?		
2.8.3	Is the functional capability evaluation performed as per the requirements specified in approved procedures?		
2.8.4	Are the functional capability requirements		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	satisfied at all applicable data points in this subsystem?		
2.8.5	Are the allowable stresses used for the functional capability check correct?		
2.8.6	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
2.9	FLANGED JOINT ANALYSIS		
2.9.1	Are there any flanged joints in this subsystem?		
2.9.2	Is the design input information for this calculation correct?		
2.9.3	Are the assumptions clearly specified and correct?		
2.9.4	Are all the flanged joint evaluations performed in accordance with approved procedures?		
2.9.5	Are the stresses at all the flanged joint data points within the code allowable stresses?		
2.9.6	Has the accuracy of the design calculations been verified?		
2.9.7	Other checks, explain.		

Piping Design Review Checklist

ASME Class 1 Stress Analysis Checklist

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
3.0	CLASS 1 PIPING STRESS ANALYSIS	
3.1	FITTING INVENTORY	
3.2	PIPING SYSTEM DESIGN BASIS PRESSURE TEMPERATURE TRANSIENT HISTORY (PTTH)GENERATION	
3.3	HIGH AND LOW LOAD SET INVENTORY	
3.4	HIGH AND LOW ENVELOPE LOAD SETS	
3.5	THERMAL TRANSIENT STRESS ANALYSIS	
3.6	ADDITIONAL FATIGUE THERMAL MODES	
3.7	STRESS INDICES	
3.8	COMPUTER STRESS ANALYSIS	
3.9	HAND-PREPARED DESIGN CALCULATIONS	
3.10	NB-3640 PRESSURE DESIGN EVALUATION NB-3643.1 MINIMUM THICKNESS OF PIPE WALL	
3.11	NB-3642.1 MINIMUM THICKNESS OF PIPE WALL	
3.12	NB-3643 PRESSURE DESIGN CALCULATIONS FOR SOCKET WELDED BOSS	
3.13	COMPUTER OUTPUT REVIEW	
3.14	CLASS 1 WELDED ATTACHMENT DESIGN	
3.15	WELDED ANCHOR ATTACHMENT DESIGN	
3.16	FLUED HEAD AND DRYWELL PENETRATION ALLOWABLE LOADS	
3.17	EQUIPMENT NOZZLE ALLOWABLE LOADS	
3.18	COMBINED ACCELERATIONS	
3.19	FUNCTIONAL CAPABILITY REQUIREMENTS	
3.20	NB-3658 FLANGED JOINT ANALYSIS	

Prepared by _____ Signature _____ Date _____

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.0	CLASS 1 PIPING STRESS ANALYSIS		
3.1	FITTING INVENTORY		
3.1.1	Are all thermal stress discontinuities (i.e., gamma plugs, valve ends, dissimilar metal welded joints, equipment nozzles, safe ends, branch connections, tees, SOLs, elbows, bends, reducers, flanges, couplings, penetrations, flued heads, shear lugs, trunnions, stanchions, welded anchors, etc.) properly identified?		
3.12	Are the material types properly used for each pipe size and pipe fitting from appropriate spool piece drawings?		
3.1.3	Is the data point representing the pipe fitting specified correctly based on the appropriate design basis reference drawings?		
3.1.4	Are the similar pipe fittings / discontinuities enveloped properly into representative but more conservative pipe fitting?		
3.1.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.2	PIPING SYSTEM DESIGN BASIS PRESSURE TEMPERATURE TRANSIENT HISTORY (PTTH) GENERATION		
3.2.1	If applicable, for each line, has a PTTH been completed for each event as described in the original system thermal transient calculations?		
3.2.2	If applicable, are the following input data correctly used from the original system thermal transient calculations to the PTTH for each Line:		
a.	Piping fluid pressure time history?		
b.	Piping fluid temperature time history?		
c.	Piping fluid flow rate time history?		
d.	Equipment or header temperature time history?		
e.	Have all of the above time histories been synchronized?		
3.2.3	Are all load sets properly identified by additional event index numbers and event descriptions for the following:		
a.	Each piping fluid pressure maximum and		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	minimum?		
b.	Each piping fluid temperature maximum and minimum?		
c.	Each piping fluid flow rate maximum and minimum?		
d.	Each equipment or header temperature maximum and minimum?		
3.2.4	Are all static thermal expansion modes correctly identified for each load set?		
3.2.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.3	HIGH AND LOW LOAD SET INVENTORY	_____	_____
3.3.1	Is the following information recorded correctly for each high/low load set?		
a.	Load Set ID number and corresponding event description?		
b.	Piping fluid temperature?		
c.	Piping fluid pressure?		
d.	Equipment or header temperature?		
e.	Piping temperature change, rate and total temperature change(ΔT)?		
f.	The design basis number of occurrences associated with each event?		
3.3.2	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.4	HIGH AND LOW ENVELOPE LOAD SETS	_____	_____
3.4.1	Are all load sets identified previously included correctly in an envelope load set?		
3.4.2	Is each load set grouped as follows for High/Low envelope load sets:		
a.	Similar maximum/minimum piping fluid temperatures and pressures?		
b.	Similar maximum/minimum equipment or header temperatures?		
c.	Similar magnitudes for piping temperature change rates and flow rates?		
3.4.3	Is the following information referred to each		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	high envelope load set correctly defined to represent the group:		
a.	The highest piping fluid pressure?		
b.	The largest temperature change rate?		
c.	The largest fluid flow rate for each line?		
d.	The thermal expansion mode with the highest piping fluid temperature and equipment or header temperature?		
e.	If the enveloped event has no fluid flowing, is the appropriate equipment or header connection thermal expansion mode used?		
f.	The assigned number of occurrences for the envelope load set equal to the summation of the number of occurrences of individual load set that they represent?		
g.	The maximum temperature distribution range?		
3.4.4	Is the following information referred to each low envelope load set correctly defined to represent the group:		
a.	The lowest piping fluid pressure?		
b.	The largest temperature change rate?		
c.	The largest fluid flow rate for each line?		
d.	The thermal expansion mode with the lowest piping fluid temperature and equipment or header temperatures?		
e.	If the enveloped event has no fluid flowing, is the appropriate equipment or header connection thermal expansion mode used?		
f.	The assigned number of occurrences for the envelope load set equal to the summation of the number of occurrences of individual load set that they represent?		
g.	The maximum temperature distribution range?		
3.4.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.5	THERMAL TRANSIENT STRESS ANALYSIS	_____	_____
3.5.1	Is the temperature distribution of all axisymmetric solids (e.g., pipe fittings and all straight pipe weld locations) which experience a flow thermal transient condition evaluated based on non-linear heat transfer program?		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.5.2	Is the temperature distribution of all axisymmetric solids (e.g., pipe fittings and all straight pipe weld locations) which experience a no flow thermal transient condition evaluated properly?		
3.5.3	Are all input data for pipe fitting dimensions specified correctly based on the appropriate design basis reference drawings?		
3.5.4	Are the thermal transient forcing function parameters of fluid (i.e. flow rate, conductivity, viscosity, Reynolds Number, Prandtl Number, film coefficient, density, velocity) evaluated at appropriate temperatures?		
3.5.5	Are the thermal transient forcing function parameters of material (i.e. thermal conductivity, specific heat, density, Young's Modulus of Elasticity, coefficient of thermal expansion)evaluated at appropriate temperatures?		
3.5.6	Are the fluid flow and no flow thermal transient conditions consistent with the PTTH's?		
3.5.7	Are the thermal transients to be forced on the model consistent with PTTH and envelope load sets?		
3.5.8	Are the d/t values (d = inside diameter of pipe fitting, t = average thickness of pipe fitting) correctly evaluated on either side of the gross structural and/or material discontinuity location?		
3.5.9	Are the time increments and number of time step's correctly specified for the forcing function to obtain an accurate solution?		
3.5.10	Are all events run for the appropriate time to obtain maximum stresses?		
3.5.11	Is the ambient temperature correctly specified?		
3.5.12	Is a sufficient length of pipe analyzed for no fluid flow thermal transient condition?		
3.5.13	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.6	ADDITIONAL FATIGUE THERMAL MODES		
3.6.1	Does every high and low envelope Load set		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	have a fatigue thermal mode associated with it?		
3.6.2	Is the temperature correctly specified at every pipe element?		
3.6.3	Is the stagnant fluid temperature profile correctly specified for 'No Flow' condition?		
3.6.4	Have equipment or header movements been evaluated at the correct temperature for all specified thermal modes?		
3.6.5	Are all stresses and displacements reasonable for each fatigue thermal mode?		
3.6.6	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.7	STRESS INDICES		
3.7.1	Are the data point types correctly specified for each pipe fitting or discontinuity in the Basic Data?		
3.7.2	Are the data point types correctly specified for all elbow/elbow or bend/elbow butt welded joints (or butt welded joints separated by less than 1 pipe OD)?		
3.7.3	Are the indices correctly specified for all taps on elbows or bends?		
3.7.4	Are the indices correctly specified and referenced for all gamma plugs?		
3.7.5	Are the indices correctly specified and referenced for all reducing elbows?		
3.7.6	Are the data point types correctly specified for all reducers?		
3.7.7	Are the reducer cone angle a, distances L1 and L2 correctly specified?		
3.7.8	If the answer to 3.7.7 is are these values based upon approved sketches?		
3.7.9	If indices are calculated using the applicable computer program or other applicable methods, are these properly documented and referenced in this piping stress calculation-on package?		
3.7.10	Other checks, explain.		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.8	CLASS 1 COMPUTER STRESS ANALYSIS		
3.8.1	Are all the data points in every Class A portion of this piping system correctly specified?		
3.8.2	Has the fatigue curve been correctly specified?		
3.8.3	Are the values of 'Sm' (Design Stress Intensity) and 'Sy'(Yield Strength) for pipe and fitting evaluated at the maximum operating temperature?		
3.8.4	Are the save tape ID numbers correctly specified for all applicable loads?		
3.8.5	Are the number of cycles correctly specified for all applicable fatigue Loads?		
3.8.6	If applicable, is the correct multiplication factor specified for each load?		
3.8.7	Does every high and low envelope load set have a pressure mode associated with it?		
3. 8.8	Is the pressure correctly specified at each data point in the Class A port-ion of this piping system?		
3.8.9	Is the assigned number of cycles for each pressure mode equal to the summation of the number of occurrences of all envelope load sets that they represent?		
3.8.10	Is the design pressure mode correctly specified in Code Equation 9?		
3.8.11	Do all data points in every Class A portion of this piping system have a set of thermal transient stresses specified for each high and low envelope load set?		
3.8.12	Are the thermal transient stresses used in the Stress analysis input deck/file element obtained from the appropriate thermal transient computer run?		
3.8.13	Is the proper sign convention assigned for each thermal transient stress value?		
3.8.14	For Lines with temperature distribution analysis, has the proper sign convention been assigned for the (TA-TB) stress terms based on different Section A and Section B definition?		
3.8.15	If time phasing is applied for transient stresses, is it properly used and documented?		
3.8.16	Has one stress range been defined, including all high and low envelope load sets? 3.8.17 Are the thermal, pressure and thermal transient modes		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	properly specified together, as defined by each high and low envelope load set?		
3.8.17	Are the thermal, pressure and thermal transient modes properly specified together, as defined by each high and low envelope load set?		
3.8.18	Is the number of cycles correctly specified for each mode, corresponding to the number of cycles of the envelope load set that it represents?		
3.8.19	Is a detailed computer output for Piping Stress Analysis included with this piping stress calculation package?		
3.8.20	Are the load combinations correctly specified as per applicable guidelines?		
3.8.21	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.9	HAND-PREPARED DESIGN CALCULATIONS		
3.9.1	Are the hand-prepared design calculations properly documented in accordance with the applicable guidelines?		
3.9.2	Has a procedure or method of design calculations been properly referenced and defined?		
3.9.3	Is the input data from other piping stress calculation packages or sources properly referenced and identified in this piping stress calculation package?		
3.9.4	If any non-standard formulas, equations, constants, etc., are used, are they properly referenced and identified or are the supporting derivations included in this piping stress calculation package?		
3.9.5	Are the design calculations logically composed and justifiable for their intended purpose?		
3.9.6	Has the accuracy of the design calculations been verified?		
3.9.7	Other checks, explain,.		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.10	NB-3640 PRESSURE DESIGN EVALUATION NB-3641.1 MINIMUM THICKNESS OF PIPE WALL		
3.10.1	Is the design pressure correct?		
3.10.2	Is the minimum thickness of pipe wall correctly specified per the ASTM Specification		
3.10.3	Is the corrosion allowance correctly included 'to determine the minimum thickness of pipe wall as per the reference acceptance criteria?		
3.10.4	Is the ratio of "Actual Minimum Thickness of Pipe Wall" to the "Required Minimum Thickness of Pipe Wall" greater than or equal to 3.0? i.e. ta/tm >3.0		
3.10.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.11	NB-3642.1 MINIMUM THICKNESS OF PIPE WALL		
3.11.1	Is the design pressure correct?		
3.11.2	Is the minimum thickness of pipe wall correctly specified per the ASTM Specification?		
3.11.3	Is the corrosion allowance correctly included to determine the minimum thickness of pipe wall as per the reference acceptance criteria?		
3.11.4	Has the required minimum thickness of pipe wall been increased by 20%?		
3.11.5	Is the ratio of Actual Minimum Thickness of Pipe Wall" to the "Required Minimum Thickness of Pipe Wall" greater than or equal to 3.0?(i.e., ta/tm > 3.0		
3.11.6	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.12	NB-3643 PRESSURE DESIGN CALCULATIONS FOR SOCKET WELDED BOSS		
3.12.1	Are the openings for all socket welded bosses evaluated?		
3.12.2	Are the values of "Sin" (Design Stress Intensity) for the pipe and pipe fitting evaluated at the		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	design temperature?		
3.12.3	Is the ratio of the "Total Available Reinforcement" to the "Required Reinforcement" greater than or equal to 3.0? ie AA/A ≥ 3.0		
3.12.4	Is the ratio of the area bounded by the "Reinforcement Limit" to the "Required Reinforcement," greater than or equal to 2/3?(i.e., AA/A ≥ 2/3)		
3.12.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.13	COMPUTER OUTPUT REVIEW	_____	_____
3.13.1	Is the ASME Boiler and Pressure Vessel Code Equation 9 satisfied at each data point?		
3.13.2	Is Code Equation 10 or Equations 12 and 13 satisfied at each data point in the Class A portion of this piping system?		
3.13.3	Is the Cumulative Usage Factor at each data point on Class A portion of this piping system 3.0?		
3.13.4	Have all pipe nodes in a break exclusion area met the ASME Boiler and Pressure Vessel Code, Section III, NB-3600 pipe rupture criteria		
a.	Cumulative Usage Factor < 0.1		
b.	Eq. 10 or Eq. 12 and Eq. 13 < 2.4 Sm		
3.13.5	Are pipe breaks identified based on stress criteria?		
3.13.6	Are all pipe fittings, meshes, PTTH's, transient results and computer runs included with this piping stress calculation package properly documented		
3.13.6	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.14	CLASS 1 WELDED ATTACHMENT DESIGN	_____	_____
3.14.1	Have calculations been performed for all integral welded attachments (e.g., shear lugs, stanchions, trunnions, elbow lugs, circumferential lugs) in the Class A portion of this piping system?		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.14.2	Are the welded attachment dimensions in compliance with the spool piece drawings?		
3.14.3	Are the welded attachment materials in compliance with the spool piece drawings?		
3.14.4	Are the loads at all the welded attachment data points correctly obtained from the piping analysis?		
3.14.5	Is the clamp fit-up (shim details) assumed in compliance with the reference design basis drawings?		
3.14.6	Are the assumptions clearly specified and correct?		
3.14.7	Are the welded attachment designs performed in accordance with the approved acceptance criteria?		
3.14.8	Are the directions and magnitudes of the loads correctly used in this design?		
3.14.9	For a piping subsystem, where? the temperature is greater than the subsystem's ambient temperature, has the effect of friction loads been considered properly in the design of the stanchions on slide bearing supports?		
3.14.10	Is the temperature of each stanchion/trunnion support, modeled as a pipe element, specified at subsystem's ambient temperature?		
3.14.11	Are the pipe bending moments at the welded attachment location correctly specified?		
3.14.12	Are the primary Load combinations correctly specified as per applicable guidelines?		
3.14.13	Are the maximum load combinations conservatively specified?		
3.14.14	Are the thermal, pressure and thermal transient modes properly specified together, as defined by each high and tow envelope load set?		
3.14.15	Are the number of cycles correctly specified for all applicable fatigue loads?		
3.14.16	Are the fatigue load combinations correctly specified as per applicable guidelines?		
3.14.17	Are the total pipe stresses(primary plus local) at all the welded attachment data points in this subsystem within the code allowable stresses?		
3.14.18	Have qualification calculations been performed for all welds which are not on the pipe but are within scope of work?		
3.14.19	Has the accuracy of the design calculations been verified?		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.14..20	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.15	WELDED ANCHOR ATTACHMENT DESIGN		
3.15.1	Have calculations been performed for all integral welded anchor attachments in the Class A portion of this piping system?		
3.15.2	Is the design input information for these calculations correct?		
3.15.3	Are the assumptions clearly specified and correct?		
3.15.4	Are all the welded anchor attachment designs performed in accordance with the approved acceptance criteria?		
3.15.5	If a structural anchor is to be seismically designed, are the seismic Loads properly considered from both sides of the anchor?		
3.15.6	Has the accuracy of the design calculations been verified?		
3.15.7	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.16	FLUED HEAD AND DRYWELL PENETRATION ALLOWABLE LOADS		
3.16.1	Are there any penetrations in the Class A portion of this subsystem?		
3.16.2	Are the load combinations correct as per the piping analysis from both sides of the penetration?		
3.16.3	Are the coordinate system and units for the penetration Loads consistent with those of the allowable Loads? Are the penetration loads within the allowable loads?		
3.16.4	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.17	EQUIPMENT NOZZLE ALLOWABLE		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	LOADS		
3.17.1	Is there any equipment nozzle in the Class A portion of this subsystem?		
3.17.2	Are the load combinations correct as per the vendor's recommendation?		
3.17.3	Are the equipment nozzle loads within the allowable loads provided by the manufacturers?		
3.17.4	Are there any expansion joints in this subsystem.		
3.17.5	Are the expansion joint loads and displacements within the allowable values provided by the manufacturers?		
3.17.6	Are the coordinate system and units for the equipment nozzle loads consistent with those of the allowable loads provided by the manufacturers?		
3.17.7	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.18	COMBINED ACCELERATIONS		
3.18.1	If the piping system has any valves, is the combined acceleration analysis properly performed?		
3.18.2	Have the piping subsystem, design basis isometric drawings, valve I.D.'s and valve descriptions been correctly identified in the input?		
3.18.3	Have all save tape load I.D.s been identified and input correctly?		
3.18.4	Are the load combinations correct as per applicable guidelines?		
3.18.5	Are the correct data points specified for each valve (valve C.C. for three element valves and valve ends for single element valves)?		
3.18.6	Are the coordinate system and units for the valve accelerations consistent with those of the allowable accelerations?		
3.18.7	Are the valve accelerations within the allowable values?		
3.18.8	Other checks, explain.		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.19	FUNCTIONAL CAPABILITY REQUIREMENTS		
3.19.1	Does the piping subsystem require a functional capability check as per applicable guidelines?		
3.19.2	Are the functional capability requirements properly addressed in this piping stress calculation package?		
3.19.3	Are the functional capability requirements satisfied at all applicable data points in this subsystem? Are the Functional capability evaluation performed as per the requirements specified in applicable guidelines?		
3.19.4	Are the allowable stresses used for the functional capability check correctly specified?		
3.19.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
3.20	NB-3658 FLANGED JOINT ANALYSIS		
3.20.1	Are there any flanged joints in the Class A portion of this subsystem?		
3.20.2	Is the design input information for this calculation correct?		
3.20.3	Are the assumptions clearly specified and correct?		
3.20.4	Are all the flanged joint evaluations performed in accordance with approved procedures?		
3.20.5	Are the stresses at all the flanged joint data points within the code allowable stresses?		
3.20.6	Has the accuracy of the design calculations been verified?		
3.20.7	Other checks, explain.		

Piping Design Review Checklist

Hydraulic Transient Analysis Checklist

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
4.0	HYDRAULIC TRANSIENT ANALYSIS	_____

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Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
4.0	HYDRAULIC TRANSIENT ANALYSIS		
4.1	Is the analyzed subsystem modeled as a set of consecutive piping leg segments?		
4.2	Are elbows, branch connections, reducers or an intersecting point appropriately treated as leg ends?		
4.3	Is the program applicable for the calculation of pressure, velocity and force transients in a liquid filled piping system?		
4.4	Are the following input quantities correct for each of the hydraulic transient events?		
a.	Piping material property		
b.	Piping inside diameter		
c.	Number of piping legs		
d.	Piping leg segments		
e.	Number of junctions		
f.	Fluid flow velocity		
g.	Fluid flow weight density		
h.	Hydraulic grade line		
i.	Piping leg segment reference elevation datum		
j.	Valve closure time		
k.	Vessel pressure		
l.	Pump characteristics		
4.5	Are the different sets of boundary condition characteristics for pump, valve, check valve, tank, pressurizer, etc., properly considered in the water hammer transient computations?		
4.6	Are the number of time steps correct between printing of results?		
4.7	Are the number of time steps correct between result outputs for saved file?		
4.8	Is the saturation pressure of the fluid evaluated at appropriate temperatures of the piping system?		
4.9	Is the ambient pressure of the fluid coded correctly?		
4.10	Is the Darcy Weisbach Friction Factor(DWFF) or equivalent appropriately used to calculate friction factors for piping legs with zero velocity?		
4.11	Is the following time information correctly specified such that an accurate solution will be obtained?		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
a.	Time step		
b.	Run end time		
c.	Save file end time		
4.12	Are the following specified junction description correctly coded?		
a.	Junction name		
b.	Junction type		
c.	Maximum pressure difference indicator		
d.	Elevation		
e.	Resistance coefficient		
4.13	Is the input data applicable for these design calculations?		
4.14	Is the force time history output correct at all piping leg segments?		
4.15	Is the file name of saved file properly documented in this piping analysis?		
4.16	Are the design calculations properly documented in accordance with approved procedures or criteria documents?		
4.17	Have all of the reference design document been sufficiently identified by author, title, revision, date, drawing number, file number, etc.?		
4.18	Are there any open assumptions or input data used that must be verified in the future?		
4.19	Has all of the input data been approved for use in these design calculations?		
4.20	Other checks, explain.		

Piping Design Review Checklist

Interaction Analysis Checklist

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
5.0	INTERACTION ANALYSIS	_____
5.1	PROCEDURES/METHODOLOGIES	_____
5.2	ENGINEERING JUDGMENTS	_____
5.3	REFINED REQUIRED CLEARANCE CALCULATIONS	_____
5.4	COMPUTER-AIDED ANALYSIS	_____
5.5	DOCUMENTATION OF-DESIGN CALCULATIONS	_____

Prepared by _____ Signature _____ Date _____

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
5.0	INTERACTION ANALYSIS		
5.1	PROCEDURES/METHODOLOGIES		
5.1.1	Are the required interaction calculations properly performed in accordance with the approved acceptance criteria?		
5.1.2	Are all potential interactions justifiably resolved?		
5.1.3	Is the methodology used to resolve a specific interaction (e.g., Engineering Judgments, Refined Required Clearance calculations, Impact Analyses, etc.) clearly identified?		
5.1.4	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
5.2	ENGINEERING JUDGMENTS		
5.2.1	Are all engineering judgments used to resolve the interactions logically composed with adequate explanations and clearly documented in these piping interaction identification calculations?		
5.2.2	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
5.3	REFINED REQUIRED CLEARANCE CALCULATIONS		
5.3.1	Are the partial clearances of interacting components properly determined?		
5.3.2	Are the required total clearances of the interacting components properly evaluated?		
5.3.3	Are the as-built clearances appropriate to resolve the interactions considering the calculated required total clearances?		
5.3.4	Other checks, explain.		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
5.4	COMPUTER-AIDED ANALYSIS		
5.4.1	Is the program applicable for this calculation?		
5.4.2	Does the input data:		
a.	Conform with the design input?		
b.	Correctly define the problem for the program algorithm?		
c.	Contain sufficient accuracy to produce results within any numerical Limitation of the program?		
5.4.3	Are the results:		
a.	Consistent with the input?		
b.	Correct and within the stated assumptions and limitations of the program?		
c.	If a programmable calculator or microcomputer generated program was used in this analysis is the program file audit trail as used by the preparer adequate?		
d.	Are the methodologies used in the validation adequately validate the program for this application?		
5.4.4	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
5.5	DOCUMENTATION OF DESIGN CALCULATIONS		
5.5.1	Are the interaction design calculations properly documented in accordance with approved procedures or criteria?		
5.5.2	Is the following information recorded correctly in this piping interaction calculations?		
a.	Purpose		
b.	Input Data		
c.	Assumptions		
d.	References		
5.5.3	Have the reason and the scope of work for the design calculations been clearly stated?		
5.5.4	Are the assumptions clearly specified and correct?		
5.5.5	Has all of the input data been approved for use in these design calculations?		
5.5.6	Is the input data applicable for these design calculations?		
5.5.7	Are there any open assumptions or input data		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	used that must be verified in the future?		
5.5.8	If the answer to 5.5.7 is "Yes," has it been clearly stated?		
5.5.9	Have all of the reference design documents been sufficiently identified by author, title, revision, date, drawing number, tile number, etc.?		
5.5.10	Has all of the design information been satisfactorily evaluated?		
5.5.11	Other checks, explain.		

Piping Design Review Checklist

Pipe Rupture Calculations and Design Considerations Checklist

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
6.0	PIPE RUPTURE CALCULATIONS	_____
6.1	DETERMINATION OF PIPE BREAK AND RESTRAINT LOCATIONS	_____
6.2	PIPE DATA	_____
6.3	RESTRAINT LOAD CALCULATIONS	_____
6.4	SUPPORT LENGTH, OVERHANG LENGTH AND GAP DATA	_____
6.5	COMPUTER-AIDED DESIGN CALCULATIONS	_____
6.6	HAND PREPARED DESIGN CALCULATIONS	_____
6.7	DOCUMENTATION OF DESIGN CALCULATIONS	_____

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Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
6.0	PIPE RUPTURE CALCULATIONS		
6.1	DETERMINATION OF PIPE BREAK AND RESTRAINT LOCATIONS		
6.1.1	Is the high energy portion of the subsystem properly identified based on the P&ID and/or equivalent identifying document?		
6.1.2	Are pipe breaks postulated in accordance with the approved acceptance criteria?		
6.1.3	If the answer to 6.1.2 is "No," has the design basis of postulated pipe break locations been identified?		
6.1.4	Are the pipe break numbers and locations properly marked on the design basis drawings?		
6.1.5	Are the restraint numbers and locations properly marked on the design basis drawings?		
6.1.6	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
6.2	PIPE DATA		
6.2.1	Does the following pipe data shown in the pipe whip restraint design data tables agree with the data used for the piping analysis?		
a.	Piping diameter		
b.	Piping wall thickness		
c.	Fluid flow area		
d.	Unit weight		
e.	Plastic moment		
f.	Fluid pressure and temperature		
6.2.2	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
6.3	RESTRAINT LOAD CALCULATIONS		
6.3.1	Are the pipe whip restraint blow down force calculations performed in accordance with the approved acceptance criteria?		
6.3.2	Does the point of application and orientation of the load on the restraint acting in the plane of the		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	restraint agree with the design basis drawings and approved acceptance criteria?		
6.3.5	Are the tip weights property calculated?		
6.3.6	If applicable, are the reaction-deflection curves or restraint force time histories properly generated?		
6.3.7	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
6.4.	SUPPORT LENGTH, OVERHANG LENGTH AND GAP DATA		
6.4.1	Is the applicable support length properly calculated?		
6.4.2	Is the overhang length property calculated?		
6.4.3	Are the gaps properly calculated?		
6.4.4	If the answer to 6.4.3 is "Yes," has the design bases used to calculate the gaps been noted properly in the pipe whip restraint design data tables?		
6.4.5	Is the final overhang length and gap data based on as built documentation?		
6.4.6	Is the final piping thermal analysis based on the as built routing?		
6.4.7	Has the original pipe whip restraint design input data tables been updated, to reflect the final overhang length and gap data?		
6.4.8	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
6.5	COMPUTER-AIDED DESIGN CALCULATIONS		
6.5.1	Is the following information identified ?		
a.	Program Acronym		
b.	Program lumber		
c.	Run I.D.		
d.	Run Date		
6.5.2	Is the program applicable for the design calculation?		
6.5.3	Does the input data:		
a.	Conform with the design input?		

b.	Correctly define the problem for the program algorithm?		
c.	Contain sufficient accuracy to produce results within any numerical limitation of the program?		
6.5.4	Are the results:		
a.	Consistent with the design input?		
b.	Correct and within the stated assumptions and limitations of the program?		
6.5.5	For dynamic transient analysis, have the adequacy of the following been verified by response spectra time history?		
a.	Integration time' step		
b.	Time duration of integration		
6.5.6	For dynamic transient analysis, are the damping constants and correct?		
6.5.7	If static analysis is used, have satisfactory justifications been provided?		
6.5.8	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
6.6	HAND PREPARED DESIGN CALCULATIONS	_____	_____
6.6.1	Has a procedure or method of design calculations been properly referenced and defined?		
6.6.2	Is the input data from other piping stress calculation packages or sources properly referenced and identified?		
6.6.3	If any non-standard formulas, equations, constants, etc., are used, are they properly referenced?		
6.6.4	Are the design calculations logically composed and justifiable for their intended purpose?		
6.6.5	Other checks, explain.		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
6.7	DOCUMENTATION OF DESIGN CALCULATIONS	_____	_____
6.7.1	Are the pipe rupture design calculations properly documented?		
6.7.2	Is the following information recorded correctly in this piping stress calculation package?		
a.	Purpose		
b.	Input Data		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
c.	Assumptions		
d.	References		
6.7.3	Have the reason and the scope of work for the design calculations been clearly stated?		
6.7.4	Are the assumptions clearly specified and correct?		
6.7.5	Has all of the input data been approved for use in these design calculations?		
6.7.6	Is the input data applicable for these design calculations?		
6.7.7	Are there any open assumptions or input data used that must be verified in the future?		
6.7.8	If the answer to 6.7.7 is "Yes," has it been clearly stated?		
6.7.9	Have all of the reference design documents been sufficiently identified by author, title, revision, date, drawing number, file number, etc.?		
6.7.10	Has all of the design information been justifiably evaluated?		
6.7.11	Other checks, explain.		

Piping Design Review Checklist

Resolution of Change Documents and As Built Analysis Checklist

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
7.0	RESOLUTION OF CHANGE DOCUMENTS AND AS -BUILT ANALYSIS	_____

_____ _____ _____
Prepared by Signature Date

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
7.0	RESOLUTION OF CHANCE DOCUMENTS		
7.1	Is the information contained in the design change documents properly compared and evaluated with the as analyzed condition based on the requirements of appropriate acceptance criteria?		
7.2	Are all design change document dimensions, angularity, etc., within the allowable tolerance limits?		
7.3	Are all outside of tolerance dimensions, angularity, etc., justifiably resolved?		
7.4	If the answer to 7.3 is "Yes," are the required reconciliation calculations, reanalysis, logically composed engineering judgments, etc., properly included in these design calculations?		
7.5	Are the pipe stresses within the applicable code allowable?		
7.6	Are the support loads affected?		
7.7	If the answer to 7.6 is "Yes," is the support design verified?		
7.8	Are all equipment nozzle loads within the allowable loads provided by the manufacturers?		
7.9	Are the valve accelerations within the allowable values?		
7.10	if applicable, is the rated fluid flow still maintained considering the effect of design change documents?		
7.11	Has the information contained in the design change documents been approved for use?		
7.12	Are there any open items that must be verified in the future?		
7.13	If the answer to 7.12 is yes has it been clearly stated?		
7.14	Have all of the reference design documents been sufficiently identified by author, title, revision, date, drawing number, file number, etc.?		
7.15	Has all of the design information been justifiably evaluated?		
7.16	Are the resolutions of design change documents properly documented in accordance with applicable guidelines?		
7.17	Other checks, explain.		

Piping Design Review Checklist

Simplified Small Bore Piping and Tubing Analysis Checklist

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
8.0	SIMPLIFIED SMALL BORE PIPING AND TUBING ANALYSIS	_____
8.1	PRESSURE STRESS	_____
8.2	GRVITY LOAD	_____
8.3	THERMAL EXPANSION	_____
8.4	SEISMIC ANALYSIS	_____
8.5	EFFECTIVE WEIGHT	_____
8.6	SEISMIC ANCHOR MOVEMENT (SAM)	_____
8.7	NON OPERATING VENTS AND DRAINS	_____
8.8	BUILDING SETTLEMENT	_____

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Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
8.0	Simplified Small Bore Piping and Tubing Analysis		
8.1	PRESSURE STRESS		
8.1.1	Is the correct internal pressure (P) used?		
8.1.2	Is the correct pipe outside diameter (D)used?		
8.1.3	Is the correct pipe schedule used?		
8.1.4	Is the correct factor (K) used from applicable guidelines for stainless and carbon steel?		
8.1.5	If pipe is other than given in applicable guidelines, is the factor (K) properly calculated?		
8.1.6	Is the longitudinal pressure stress calculated correctly?		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
8.2	GRAVITY LOAD		
8.2.1	Is the pipe insulated?		
8.2.2	If yes, is the insulation density specified ?		
8.2.3	If yes to 8.2.1, is the insulation thickness specified?		
8.2.4	Is the pipe contents liquid or gas?		
8.2.5	Is the pipe material carbon or stainless steel, or copper tubing?		
8.2.6	Are all support spacing within the allowable spans given in applicable guidelines?		
8.2.7	Are all support loads calculated correctly?		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
8.3	THERMAL EXPANSION		
8.3.1	Is the correct value of Young's Modulus (E) used?		
8.3.2	Is the correct change in pipe temperature (ΔT) used?		
8.3.3	Is the correct coefficient of linear expansion for the metal used?		
8.3.4	Is the correct length of cold pipe used?		
8.3.5	Is the pipe thermal expansion calculated correctly?		
8.3.6	Is the correct offset length for thermal expansion		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	used?		
8.3.7	Have the pipe stresses been used with correct S.I.F.?		
8.3.8	Is the number of equivalent full temperature cycles available?		
8.3.9	Is the allowable stress in cold and hot condition correct?		
8.3.10	Is the 'S' allowable calculated correctly?		
8.3.11	Were correct pipe stresses obtained from applicable guidelines?		
8.3.12	Were correct support reactions obtained from applicable guidelines?		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
8.4	SEISMIC ANALYSIS		
8.4.1	Are guides provided at all concentrated masses, at all extended masses, and at each change of direction		
8.4.2	Is the support spacing within allowable?		
8.4.3	Were the correct guidelines used with respect to the system locations within the plant?		
8.4.4	Were correct support reactions obtained from applicable guidelines?		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
8.5	EFFECTIVE WEIGHT		
8.5.1	Were correct pipe spans considered in calculation for each seismic restraint?		
8.5.2	Are the effective weights calculated correctly?		
8.5.3	Have all three directions (x,y,z) been considered?		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
8.6.	SEISMIC ANCHOR MOVEMENT "SAM"		
8.6.1	Is the small pipe connected to a large pipe		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
	(header)?		
8.6.2	Is the small pipe connected to equipment?		
8.6.3	Is pipe passing through and anchored to a floor?		
8.6.4	Is the pipe anchored to a wall going to another building?		
8.6.5	Is the small pipe in one building connected to same structure or floor?		
8.6.6	Are header, equipment, or anchor displacements correct and properly documented?		
8.6.7	Were seismic displacements of the wall/floor, where the first support in each direction is, added to the header, equipment or anchor displacements?		
8.6.8	If the answer to 8.6.2 is yes, are any of the first supports connected to the same floor/wall as the equipment or anchor?		
8.6.9	If the answer to 8.6.8 is yes, was pipe checked for flexibility above and below the floor?		
8.6.10	If yes to 8.6.4, were seismic displacements assumed out of phase?		
8.6.11	Is the total of header, equipment, or anchor displacements less than 1/16 inch?		
8.6.12	If no to 8.6.11, is there enough piping flexibility to absorb there displacements using tables?		
8.6.13	Were correct pipe stresses obtained?		
8.6.14	Were correct support reactions obtained?		

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
8.7.	NON-OPERATING VENTS AND DRAINS	_____	_____
8.7.1	Is vent or drain of a type that is prequalified pr approve procedures?		
8.7. 2	Are the dimensions within tolerance?		
8.7.3	Are valve-weights available and not greater than than the prequlified cases?		
8.7.4	if the answer to 8.7.1, 2 or 3 is no are unique calculations prepared?		

Piping Design Review Checklist

	DESCRIPTION	ACCEPTANCE CHECK Y/N/NA	COMMENT
8.8	BUILDING SETTLEMENT		
8.8.1	Is piping passing through one building to another?		
8.8.2	If yes, was a 3/4 inch vertical movement applied at first vertical seismic support?		
8.8.3	If a spring support is present between the first seismic support, is it capable of accommodating a 3/4 inch in vertical displacement?		
8.8.4	Were correct pipe stresses obtained?		
8.8.5	Were they added to thermal and "SAM" stresses?		
8.8.6	Were correct support reactions on both sides of seismic joint?		

Piping Design Review Checklist

Other Analytical Topics Checklist

Review Checklist No. and Subsections	Title	Applicability Yes (√)/ No (NA)
9.0	Other Analytical Topics List topics below with disposition (Acceptable or Unacceptable). Comments are to be entered on a Design Review Comment Form.	_____

_____ _____ _____

Prepared by | Signature | Date