U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

SECTION 11.2 LIQUID WASTE MANAGEMENT SYSTEMS

REVIEW RESPONSIBILITIES

Primary - Effluent Treatment Systems Branch (ETSB)

Secondary - Radiological Assessment Branch (RAB)
Structural Engineering Branch (SEB)

I. AREAS OF REVIEW

At the construction permit (CP) stage, ETSB reviews the information in the applicant's preliminary safety analysis report (PSAR) in the specific areas that follow. During the operating license (OL) stage of review, ETSB review consists of confirming the design accepted at the CP stage and evaluating the adequacy of the applicant's technical specifications in these areas.

1. The liquid radwaste treatment system design, design objectives, design criteria, methods of treatment, expected releases, and principal parameters used in calculating the releases of radioactive materials in liquid effluents. The ETSB review will include the system piping and instrumentation diagrams (P&IDs), and process flow diagrams showing methods of operation and factors that influence waste treatment, e.g., system interfaces and potential bypass routes.

2. Equipment design capacities, expected flow and radionuclide concentrations, expected decontamination factors for radionuclides, and available holdup time. The system design capacity relative to the design and expected input flows, and the period of time the system is required to be in service to process normal waste flows. The availability of standby equipment, alternate processing routes, and interconnections between subsystems. This information is used in the ETSB review to evaluate the overall system capability to meet anticipated demands imposed by major processing equipment downtime and waste volume surges due to anticipated operational occurrences.

3. The quality group classifications of piping, and equipment, and the bases governing the design criteria chosen. Provisions to prevent, control and collect releases of radioactive material in liquids due to tank overflows from all plant systems, outside reactor containment having the potential to incur such releases. Design and expected temperatures and pressures, and materials of construction of the components of the liquid waste management system.

4. Design provisions incorporated in the equipment and facility design to reduce leakage and facilitate operation and maintenance in accordance with the guidelines of Branch Technical Position, ETSB 11-1 (Revision 1).

5. Special design features that would reduce liquid input volumes or discharge of radioactive material in liquid effluents. Special design features, topical reports incorporated by reference, and data obtained from previous experience with similar systems which are submitted with the SAR.

6. The technical specifications proposed by the applicant for process and effluent control will be reviewed at the operating license stage (FSAR).

Design provisions incorporated to sample and monitor radioactive materials in liquid process and effluent streams are reviewed under Standard Review Plan (SRP) 11.5.

RAB will provide calculated doses based on the ETSB liquid source terms for inclusion in the staff's Environmental Impact Statement and Safety Evaluation Report.

SEB evaluates the applicant's proposed seismic design classification of structures housing the liquid radwaste system.

The consequences of liquid tank failures having the potential to release radioactive liquids are evaluated in SRP 15.7.3.

II. ACCEPTANCE CRITERIA

The applicant's design should meet the following criteria:

1. The liquid radwaste treatment system should have the capability to meet the requirements specified in 10 CFR Parts 20 and 50 and the dose design objectives specified in Appendix I to 10 CFR Part 50, including provisions to treat liquid radioactive waste such that:

   a. The calculated annual total quantity of all radioactive material released from each reactor at the site to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 3 millirems to the total body or 10 millirems to any organ.

   b. In addition to a. above, the liquid radwaste treatment systems should include all items of reasonably demonstrated technology that when added to the system sequentially and in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor.

   c. The concentrations of radioactive materials in liquid effluents released to an unrestricted area should not exceed the limits in 10 CFR Part 20, Appendix B, Table II, Column 2.

2. The liquid radwaste treatment system should be designed to meet the anticipated processing requirements of the station. Adequate capacity should be provided to process liquid wastes during periods when major processing equipment may be down for maintenance (single failures) and during periods of excessive waste generation. ETSB will accept systems that have adequate capacity to process the anticipated wastes and that are capable of operating within the design objectives during normal operation, including anticipated operational occurrences. To meet these processing demands, ETSB will consider interconnections between subsystems, redundant equipment, and reserve storage capacity.

3. The seismic design classification of structures housing liquid radwaste systems, the quality group classification of liquid radwaste treatment equipment, and provisions to prevent and collect spills from indoor and outdoor storage tanks should conform to the guidelines of Branch Technical Position (BTP) ETSB 11-1 (Rev. 1) attached to this plan.

4. ETSB will accept system designs that contain provisions to control leakage and facilitate operation and maintenance in accordance with the guidelines of Branch Technical Position (BTP) ETSB 11-1 (Rev. 1).

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from this review plan, as may be appropriate for a particular case.

1. In the ETSB review of the liquid waste treatment system, the P&IDs and system process flow diagrams are reviewed to determine all sources of liquid input volumes, the points of collection of liquid waste, the flow paths of liquids through the system including all bypasses, the treatment provided, and the points of release of liquid effluents to the environment. This information is used to calculate the quantity of radioactive materials released annually in liquid effluents during normal operation, including anticipated operational occurrences, using the parameters given, the GALE Code, and calculational techniques given in Regulatory Guides 1.BB and 1.CC. A complete Fortran listing of the GALE computer code is given in these Regulatory Guides. The results of this calculation will be used to determine whether the proposed treatment system design meets the acceptance criterion of 11.1.c. Compliance with the acceptance criteria given in Section II.1.a concerning exposures to the total body or critical organ of an individual in an unrestricted area will be determined based on RAB dose calculations using the ETSB-calculated source term.

   Compliance with the acceptance criterion given in II.1.b concerning the cost-benefit analysis will be determined based on RAB man-rem dose calculations in conjunction with ETSB cost-benefit studies.

2. The ETSB review of the liquid waste treatment system design capacity will encompass three major areas:

a. The system capability to process wastes in the event of a single major equipment item failure, e.g., an evaporator outage.

b. The system capability to accept additional wastes during operations which result in excessive liquid waste generation.

c. The system capability to process wastes at design basis fission product leakage levels, i.e., from 1% of the fuel producing power in a PWR or, in a BWR, consistent with a noble gas release of 100 μCi/sec/MWt measured after 30 minutes delay.

ETSB will compare the average input flows to the design flows to determine the fraction of time individual subsystems must be online to process normal liquid waste inputs. ETSB will review the operational flexibility designed into the system, i.e., cross connections between subsystems, redundant or reserve processing equipment, and reserve storage capacity. Based on the usage factors and operational flexibilities, ETSB will evaluate the overall system capability to process wastes in the event of (a), (b), or (c), above, by comparing the design flows to the potential process routes and equipment capacities. ETSB will assume evaporators are unavailable for 2 consecutive days per week for maintenance. If two days holdup capacity or an alternative evaporator are not available for the process stream, ETSB will assume the stream is processed by an alternate route or discharged to the environment, consistent with the guidelines of Regulatory Guides 1.BB and 1.CC.

3. ETSB compares the quality group classification for the liquid radwaste systems and the seismic design for the structures housing the systems with the guidelines of BTP ETSB 11-1 (Rev. 1). ETSB assures that the design includes provisions to prevent and collect leakage due to overflows and spillage from indoor and outdoor storage tanks, in conformance with the guidelines of BTP ETSB 11-1 (Rev. 1).

4. ETSB compares the system design, system and building layout, equipment design, method of operation, and provisions to reduce leakage and facilitate operations and maintenance with the guidelines of BTP ETSB 11-1 (Rev. 1). ETSB will evaluate special design features provided to control leakage from system components and topical reports on systems designs on a case-by-case basis.

5. ETSB reviews the technical specifications proposed by the applicant for process and effluent control (OL). The reviewer will determine that the content and intent of the technical specifications are in agreement with the requirements developed as a result of the staff's review. The review will include the evaluation or development of appropriate limiting conditions for operation and their bases consistent with the plant design.

IV. EVALUATION FINDINGS

ETSB verifies that sufficient information has been provided and that the review is adequate to support conclusions of the following type, to be included in the staff's safety evaluation report:

"The liquid radwaste treatment systems include the equipment and instrumentation to control the release of radioactive materials in liquid effluents."

In our evaluation, we have considered releases of radioactive materials in liquid effluents for normal operation including anticipated operational occurrences based on expected radwaste inputs over the life of the plant and have determined that for each reactor on the _____ site the release of radioactive materials in liquid effluents will not result in an annual dose or dose commitment to any individual in an unrestricted area from all pathways of exposure in excess of 3 millirems to the total body and 10 millirems to any organ.

We have also considered the potential effectiveness of augmenting the proposed liquid radwaste treatment systems using items of reasonably demonstrated technology and have determined that further effluent treatment will not effect reductions in the cumulative population dose reasonably expected within a 50 mile radius of the reactor at a cost of less than $1000 per man rem or man-thyroid-rem.

We have also considered the potential consequences resulting from reactor operation, and we have determined the concentrations of radioactive materials in liquid effluents in unrestricted areas will be a small fraction of the limits in 10 CFR Part 20, Appendix B, Table II, Column 2.

We have considered the capabilities of the proposed liquid radwaste treatment system to meet the anticipated demands of the plant due to anticipated operational occurrences and have concluded that the system capacity and design flexibility are adequate to meet the anticipated needs of the plant.

We have reviewed the applicant's quality assurance provisions for the liquid radwaste systems, the quality group classifications used for system components, and the seismic design classification applied to structures housing these systems. The design of the systems and structures housing these systems meet the acceptance criteria as set forth in Branch Technical Position, ETSB 11-1 (Rev. 1).

We have reviewed the provisions incorporated in the applicant's design to control the release of radioactive materials in liquids due to inadvertent tank overflows and conclude that the measures proposed by the applicant are consistent with our acceptance criteria as set forth in Branch Technical Position, ETSB 11-1 (Rev. 1).

Based on the foregoing evaluation, we conclude that the proposed liquid radwaste treatment system is acceptable. The basis for acceptance has been conformance of the applicant's design, design criteria, and design bases for the liquid radioactive waste treatment systems to the Commission's Regulations and to applicable guides, as referenced above, as well as staff technical positions and industry standards.

V. REFERENCES

1. 10 CFR Part 20, "Standards for Protection Against Radiation," and Appendix B, "Concentration in Air and Water Above Natural Background."

2. 10 CFR § 50.34a, "Design Objectives for Equipment to Control Releases of Radioactive Material in Effluents - Nuclear Power Reactors."

3. 10 CFR § 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

4. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

5. 10 CFR Part 51, Licensing and Regulatory Policy and Procedures For Environmental Protection.

6. 10 CFR Part 50, Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as Practicable" for radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.

7. Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1.

8. Regulatory Guide 1.BB, "Calcuation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Pressurized Water Reactors (PWRs)."

9. Regulatory Guide 1.CC, "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Boiling Water Reactors (BWRs)."

10. Branch Technical Position ETSB 11-1 (Rev. 1), "Design Guidance for Radioactive Waste Management Systems Installed in Light-Water-Cooled Nuclear Power Reactor Plants," attached to this plan.

BRANCH TECHNICAL POSITION - ETSB NO. 11-1 (Rev. 1)

Design Guidance for Radioactive Waste Management Systems
Installed in Light-Water-Cooled Nuclear Power Reactor Plants

A. Background

An aspect of nuclear power plant operation is the control and management of liquid, gaseous and solid radioactive waste[1/] generated as a byproduct of nuclear power. We have established acceptable design guidance, seismic and quality group classifications, and quality assurance provisions for radioactive waste management systems including steam generator blowdown systems. For the purpose of this position paper, the radioactive waste management systems are considered to begin at the interface valves(s) in each line from other systems provided for collecting wastes that may contain radioactive materials and to terminate at the point of controlled discharge to the environment, at the point of recycle back to storage for reuse in the reactor, or at the point of storage of packaged solid wastes prior to shipment offsite to a licensed burial ground. The steam generator blowdown system begins at, but does not include, the outermost containment isolation valve on the blowdown line and terminates at the point of controlled discharge to the environment, at the point of interface with other liquid waste systems, or at the point of recycle back to the secondary system.

Except as noted below the positions set forth in this paper do not apply to the reactor coolant cleanup system, the condensate cleanup system, the chemical and volume control system, sumps and floor drains provided for collecting liquid wastes, the boron recovery system, building ventilation systems (heating, ventilating and air conditioning) and chemical fume hood exhaust systems. Positions set forth in this paper regarding provisions to control releases of radioactive materials in liquids due to tank overflows apply to all plant systems, outside reactor containment, having the potential to incur such releases.

The design and construction of radioactive waste management and steam generator blowdown systems should provide assurance that radiation exposures to operating personnel and to the general public are maintained at low and acceptable levels, by assuring that these systems are designed to quality standards conducive to increasing system reliability, operability, and availability. In development of this design guidance, the NRC staff has reviewed a number of designs and concepts submitted in license applications and operating system histories. The NRC staff has been guided by current industry practices and the cost of design features, taking in account the potential impact on the health and safety of operating personnel and the general public.

The design guidance given in this position paper provides reasonable assurance that equipment and components used in the radioactive waste management and blowdown systems are designed, constructed, installed and tested on a level commensurate with the health and

1/ Radioactive waste used in this guide means liquid, gaseous, or solids containing radioactive material resulting from operation of a LWR which by design or operating practice may be or will be processed prior to final disposition.

safety of the public and plant operating personnel. Instrumentation and controls associated with the waste management and blowdown systems should be designed to a quality commensurate with their intended function.

This position paper sets forth minimum branch requirements and is not intended to prohibit the implementation of other equivalent design codes, standards, or quality assurance measures than those indicated herein.

In addition to the design guidance given for radwaste systems, recommendations are given for provisions to preclude the inadvertent release of radioactive materials in liquids due to spills or overflows from both radwaste and non-radwaste system tanks located inside or outside of plant structures.

B. Branch Technical Position

I. Systems Handling Radioactive Materials in Liquids

a. The liquid radwaste treatment system, including the steam generator blowdown system downstream of the second containment isolation valve should meet the following criteria:

(1) The systems should be designed and tested in accordance with the codes and standards listed in Table I, to include the provisions in (2) below and in Section IV of this position paper.

(2) Materials for pressure retaining components should conform to the requirements of one of the specifications for materials listed in Section II of the ASME Boiler and Pressure Vessel Code, except that malleable, wrought, or cast iron materials and plastic pipe should not be used. Manufacturer's material certificates of conformance with material specifications may be provided in lieu of certified materials test reports.

(3) Foundations and adjacent walls of structures that house the liquid radwaste system should be designed to the seismic criteria described in Section V to a height sufficient to contain the liquid inventory in the building.

(4) Equipment and components used to collect, process, and store liquid radioactive waste need not be designed to the seismic criteria given in Section V.

b. All tanks located outside reactor containment and containing radioactive materials in liquids should be designed to prevent uncontrolled releases of radioactive materials due to spillage in buildings or from outdoor storage tanks. The following design features should be included for tanks that may contain radioactive materials:

(1) All tanks, both inside and outside the plant including the condensate storage tank(s) should have provisions to monitor liquid levels and to alarm potential overflow conditions.

(2) All tanks should have overflows, drains, and sample lines should be routed to the liquid radwaste treatment system.[1/]

(3) Indoor tanks should have curbs or elevated thresholds with floor drains routed to the liquid radwaste treatment system.[1/]

(4) Outdoor tanks should have a dike or retention pond capable of preventing run-off in the event of a tank overflow and have provisions for sampling collected liquids and routing them to the liquid radwaste treatment system.

II. Gaseous Radioactive Waste (Radwaste) System

a. The gaseous radwaste treatment system, including systems provided for treatment of normal offgas releases from the main condenser vacuum system for a BWR and for the treatment of gases stripped from the primary coolant for a PWR should meet the following criteria:

(1) The systems should be designed and tested in accordance with the codes and standards listed in Table 1, to include the provisions in (2) below and in Section IV of this position paper.

(2) Materials for pressure retaining components should conform to the requirements of one of the specifications for materials listed in Section II of the ASME Boiler and Pressure Vessel Code except that malleable, wrought, or cast iron materials and plastic pipe should not be used. Manufacturer's material certificates of conformance with material specifications may be provided in lieu of certified materials test reports.

(3) Those portions of the gaseous radwaste treatment system which by design are intended to store or delay the release of gaseous radioactive waste, including portions of structures housing these systems should be designed to the seismic design criteria given in Section V of this position paper. For systems that normally operate at pressure above 1.5 atmospheres (absolute), this should include isolation valves, equipment, interconnecting piping, and components located between the upstream and downstream valves used to isolate these components from the rest of the system (e.g., waste gas storage tanks in a PWR). For systems that operate near ambient pressure and retain gases on charcoal adsorbers, only the tank elements and the building housing the tanks are included (e.g., charcoal delay tanks in a BWR).

III. Solid Radioactive Waste (Radwaste) System

a. The solid radwaste system consists of slurry waste collection and settling tanks, spent resin storage tanks, phase separators, and tanks, equipment, and components

[1/] Retention by an intermediate sump or drain tank, designed for handling radioactive materials and having provisions for routing to the liquid radwaste system is acceptable.

used to solidify wastes prior to offsite shipment. The solid radwaste handling and treatment system should meet the following criteria:

(1) The system should be designed and tested in accordance with the codes and standards listed in Table 1 to include the provisions in (2) below and in Section IV of this paper.

(2) Materials for pressure retaining components should conform to the requirements of one of the specifications for materials listed in Section II of the ASME Boiler and Pressure Vessel Code except that malleable, wrought, or cast iron materials and plastic pipe should not be used. Manufacturer's material certificates of conformance with material specifications may be provided in lieu of certified materials test reports.

(3) Foundations and adjacent walls of structures that house the solid radwaste system should be designed to the seismic criteria given in Section V of this position paper to a height sufficient to contain the liquid inventory in the building.

(4) Equipment and components used to collect, process or store solid radioactive waste need not be designed to seismic criteria referenced above.

IV. Additional Design, Construction, and Testing Criteria

In addition to the requirements inherent in the codes and standards listed in Table 1, the following criteria, as minimum, should be implemented for components and systems considered in this guide.

a. The Quality Assurance provisions described in VI of this guide should be applied.

b. Pressure retaining components of process systems should utilize welded construction to the maximum practicable extent. Process piping systems include the first root valve on sample and instrument lines. Flanged joints or suitable rapid disconnect fittings should be used only where maintenance or operational requirements clearly indicate that such construction is preferable. Screwed connections in which threads provide the only seal should not be used except for instrumentation connections where welded connections are not suitable. Process lines should not be less than 3/4-inch. Screwed connections backed up by seal welding, socket welding or mechanical joints may be used on lines 3/4-inch or greater, but less than 2 1/2-inch, nominal size. For lines 2 1/2-inch nominal size and above, pipe welds should be of the butt-joint type. Backing rings should not be used in lines carrying resins or other particulate material. All welding constituting the pressure boundary of pressure retaining components should be performed in accordance with ASME Pressure and Vessel Code Section IX.

c. Completed process systems should be pressure tested to the maximum practicable extent. Piping systems should be hydrostatically tested in their entirety except at atmospheric tank connections where no isolation valves exist. Testing of piping systems should be performed in accordance with applicable ASME or ANSI codes, but in no case less than 75 psig. The test pressure should be held for a minimum of 30 minutes with no leakage indicated. Testing provisions should be incorporated to enable periodic evaluation of the operability and required functional performance of active components of the system.

V. Seismic Design Requirements for Radioactive Waste Management Systems and Structures Housing Radioactive Waste Management Systems

a. Seismic Design Requirements Gaseous Radioactive Waste Management Systems[1/]

(1) For the evaluation of support elements in the gaseous waste system, a simplified seismic analysis procedure to determine seismic loads may be used. The simplified procedure consists of consideration of the system as a single degree of freedom system and picking up a seismic response value from applicable floor response spectra, once the fundamental frequency of the system is determined. The floor response spectra should be obtained analytically (Section V.b) from the application of Regulatory Guide 1.60 design response spectra normalized to OBE level maximum ground acceleration at the foundation of the building housing the gaseous radwaste system.

(2) The allowable stresses to be used for the system support elements should be those given in the AISC Manual of Steel Construction, 7th edition 1970, including the one-third allowable stress increase provision for load combinations involving earthquake loads. For design of concrete foundations of the system, where applicable, use of the ACI 318-71 code with one-third increase in allowable stress for seismic loads is acceptable.

(3) The construction and inspection requirements for the support elements should comply with those stipulated in AISC or ACI Codes as appropriate.

b. Seismic Design Requirements for Buildings Housing Radwaste Systems

(1) Define input motion at the foundation of the building housing the radwaste systems. The motion should be defined by normalizing the Regulatory Guide 1.60 spectra to the OBE maximum ground acceleration selected for the plant.

[1/] For which seismic capabilities are required in Section II(3).

A simplified analysis should be performed to determine appropriate seismic loads and floor response spectra pertinent to the location of the systems; i.e., an analysis of the building by a "several degrees of freedom" mathematical model and the use of an approximate method to generate the floor response spectra for radwaste systems and the seismic loads for the buildings. No time history or dynamic analysis is required.

(2) The simplified method for determination of seismic loads for the building consists of (a) calculation of first several modal frequencies and participation factors for the building, (b) determination of modal seismic loads by item (1) input spectra, and (c) combination of modal seismic loads by the square root of the sum of squares (SRSS) rule.

(3) With regard to generation of floor response spectra for radwaste systems, methods such as the Biggs or other equivalent procedures which give approximate floor response spectra without need for performing a time history analysis may be used.

(4) The load factors and load combinations to be used for the building should be those given in the ACI-318-71 Code. The allowable stresses for steel components should be those given in the AISC Manual of Steel Construction, 7th edition, 1970.

(5) The construction and inspection requirements for the building elements should comply with those stipulated in the AISC or ACI Code as appropriate.

(6) The foundation media of structures housing the radwaste systems should not liquify during the Operating Basis Earthquake.

c. In lieu of the requirements and procedures defined above, optional shield structures constructed around and supporting the radwaste systems may be erected to protect the radwaste systems from effects of housing structural failure. If this option is adopted, the procedures described in Section V.b only need to be applied to the shield structures while treating the rest of the housing structures as non-seismic Category I.

VI. Quality Assurance for Radioactive Waste Management Systems

A quality assurance program should be established that is sufficient to assure that the design, construction, and testing requirements are met. The quality assurance program should include the following:

a. Design and Procurement Document Control - Measures should be established to insure that the requirements of this position paper are specified and included in design and procurement documents and that deviations therefrom are controlled.

b. Control of Purchased Material, Equipment and Services - Measures should be established to assure that purchased material, equipment and construction services conform to the procurement documents.

c. Inspection - A program for inspection of activities affecting quality should be established and executed by, or for, the organization performing the activity to verify conformance with the documented instructions, procedures, and drawings for accomplishing the activity.

d. Handling, Storage, and Shipping - Measures should be established to control the handling, storage, shipping, cleaning and preservation of material and equipment in accordance with work and inspection instructions to prevent damage or deterioration.

e. Inspection, Test and Operating Status - Measures should be established to provide for the identification of items which have satisfactorily passed required inspections and tests.

f. Corrective Action - Measures should be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment and nonconformances are promptly identified and corrected.

TABLE 1

EQUIPMENT CODES

EQUIPMENT	CODES			
	Design and Fabrication	Materials[2]	Welder Qualifications and Procedure	Inspection And Testing
Pressure Vessels	ASME Code Section VIII, Div. 1	ASME Code Section II	ASME Code Section IX	ASME Code Section VIII, Div. 1
Atmospheric or 0-15 psig tanks	ASME Code[3] Section III, Class 3, or API 620 & 650, AWWA D-100	ASME Code[4] Section II	ASME Code Section IX	ASME Code[3] Section III, Class 3 or API 620; 650 AWWA D-100
Heat Exchanger	ASME Code Section VIII, Div. 1 and TEMA	ASME Code Section III	ASME Code Section IX	ASME Code Section VIII, Div. 1
Piping and Valves	ANSI 31.1	ASTM or ASME Code Section II	ASME Code Section IX	ANSI B 31.1
Pumps	Manufacturer's[1] Standards	ASME Code Section II or Manufacturer's Standard	ASME Code Section IX (as required)	ASME[3] Section III Class 3; or Hydraulic Institute

Notes:

(1) Manufacturer's standard for the intended service. Hydrotesting should be 1.5 times the design pressure.

(2) Material Manufacturer's certified test reports should be obtained whenever possible.

(3) ASME Code Stamp and material traceability not required.

(4) Fiberglass reinforced plastic tanks may be used in accordance with Part M, Section 10, ASME Boiler and Pressure Vessel Code, for applications at ambient temperature.

SRP 11.4