10.0 STEAM AND POWER CONVERSION SYSTEM

10.1 MAIN STEAM SYSTEM

10.1.1 DESIGN BASIS

The Main Steam System (MSS) is designed to transfer steam from the steam generators to the turbine throttle stop valves, the reheaters, and the turbine-driven pumps. The MSS also controls steam generator pressure by means of steam bypass, dump, or safety valves (high pressure) and main steam isolation valves (MSIVs) (low pressure).

The system is designed to accommodate electrical load changes from 15 to 100% power at a rate of 5% per minute and at greater rates over smaller load change increments, up to a step change of 10%. This is normally accomplished by manual control element assembly movement and adjustment of Reactor Coolant System (RCS) soluble boron concentration. Component design data is contained in Table 10-1.

10.1.2 SYSTEM DESCRIPTION

The MSS is shown in Figures 10-1 (Unit 1) and 10-9 (Unit 2).

Steam generated in each of the two steam generators is piped through the containment wall in separate 34" OD lines. The lines have the flexibility to take the relative movement due to thermal expansion. Each steam line has eight spring-loaded safety valves which discharge to the atmosphere, and an atmospheric dump valve system which relieves at a pressure lower than the setting of the safety valves (Section 10.1.2). This system also discharges to the atmosphere.

The main steam lines are designed to withstand the maximum possible discharge from any one relief valve locally and the full steam generator capacity with all eight valves discharging simultaneously. A stress analysis was performed to determine the effects on the main steam lines, assuming that all steam generator relief valves discharge concurrently. The analysis includes the effects of system weight, internal pressure, seismic and blowdown thrust loads. Bending, torsional loads, and deflections were generated in the analysis.

Mechanical restraints and supports are designed to sustain all the concurrently acting thermal, seismic and seismic anchor movement loads on the piping systems. The supports are designed to carry dead weight, insulation and the contents in the piping system. Supports permit free movement in longitudinal and lateral direction caused by thermal expansion or contraction and earthquake. Restraints and supports at the isolation valves and stop valves are designed to carry, in addition to the above mentioned loads, the dynamic loads due to sudden closure of stop valves.

10.1.2.1 Main Steam Safety Valves

Overpressure protection for the shell side of the steam generators and the main steam line piping up to the inlet of the turbine stop valve is provided by 16 spring-loaded ASME Code main steam safety valves (MSSVs) which discharge to the atmosphere. Eight of these safety valves are mounted on each of the main steam lines upstream of the steam line isolation valves, but outside the containment. The MSSVs are designed for full flow relief pressure of 1085 psig, thereby ensuring that the secondary system pressure will be limited to within 110% of its design pressure of 1015 psia during the most severe anticipated system operational transient. The opening pressure of the valves is set in accordance with ASME Code allowances, with the minimum set pressure at 935 psig, and the maximum set pressure at 1050 psig. At the nominal set pressure, these valves can pass a steam flow equivalent to an Nuclear Steam Supply System power level of

2737 MWt, coincident with an assumed loss of condenser heat sink (i.e., no steam bypass to the condenser). The total relieving capacity for all valves on both of the steam lines in either unit is 12.18×10^6 lbs/hr of saturated steam at 100% rated thermal power (6.088×10^6 lbs/hr per steam generator).

Thrust loadings due to the sudden opening of the MSSVs as well as the unbalanced internal pressure in the discharge stack, which contribute to the force and moments acting on the main steam headers and MSSV inlet piping, were considered in the stress analysis of the MSS. Support and restraint locations, as well as material thicknesses, were selected to accommodate expected loads and reduce material stress. The main steam line code safety valves are tested and maintained in accordance with the requirements of Section XI of the ASME Boiler and Pressure Vessel (B&PV) Code.

In hot standby, two MSSVs per steam generator are required to provide adequate relieving capacity for removal of both decay heat and reactor coolant pump heat from the RCS via either of the two steam generators. This requirement is provided to facilitate the post-overhaul setting and operability testing of the MSSVs, which can only be conducted when the RCS is at or above 500°F. It allows operation within these operating conditions with a minimum number of functional MSSVs so that the set pressure for the remaining valves can be adjusted in the plant. This is the most accurate means for adjusting safety valve set pressures since the valves will be in thermal equilibrium with the operating environment.

Startup and/or power operation is allowable with MSSVs inoperable within the limitations of the Technical Specifications. The number of inoperable MSSVs will determine the necessary level of reduction in secondary system steam flow and thermal power required by the reduced reactor trip settings of the Power Level-High channels. The reactor trip setpoint reductions are derived on the following basis:

$$SP = \frac{(X) - (Y)(V)}{x} \; x \; 106.5$$

where:

SP	=	reduced reactor trip setpoint [percent of rated thermal power]
V	=	maximum number of inoperable safety valves per steam line
106.5	=	Power Level - High Trip Setpoint
X	=	Total relieving capacity of all safety valves per steam line [lbs/hour]
Y	=	Maximum relieving capacity of any one safety valve [lbs/hour]

10.1.2.2 Atmospheric Steam Dump and Bypass System

The steam dump and bypass system is used to rapidly remove RCS stored energy and to limit secondary steam pressure following a turbine-reactor trip. The atmospheric steam dump system consists of two automatically-actuated atmospheric dump valves which exhaust to the atmosphere. The turbine bypass system consists of four turbine bypass valves which exhaust to the main condenser. The power-operated steam dump valves and steam bypass valves reduce, but do not eliminate, the probability of the MSSVs opening following turbine and reactor trips from full power.

The system also provides a means of heat removal during hot standby and during a plant cooldown. The atmospheric steam dump valves are capable of removing reactor decay heat when the condenser is not available.

The removal of reactor decay heat via the atmospheric steam dump system is not a normal mode of operation. Main condenser vacuum will be maintained to enable removal of reactor decay heat through the steam bypass valves until the shutdown cooling system can be initiated. In the event of a loss-of-condenser vacuum, the turbine bypass valves close automatically and the atmospheric steam dump valves open to exhaust the steam generated by decay heat.

Incidents may occur which release steam through the steam dump valves for a short period of time. If an incident occurs which results in atmospheric steam dump system operation, the radioactivity released can be estimated using the steam generator activity obtained from a sample, the duration of dumping, the estimated flow rate during dumping and the measured meteorological conditions. Steam generator blowdown system, main steam line system, and condenser air removal system radiation monitors are also available.

The atmospheric dump valves are positioned by the reactor coolant average temperature error signal when the turbine is tripped. In the event of a turbine trip above a preset power level, a quick-opening signal is provided to fully open both the atmospheric dump valves and the turbine bypass valves. When T_{avg} is reduced to less than T_{γ} (Figure 7-15, Sheet 3), the steam dump valves are modulated as a function of T_{avg}, and the turbine bypass valves are modulated as a function of main steam header pressure.

The total respective capacities of the atmospheric steam dump and turbine bypass valves are 5% and 40% of steam flow with the reactor at full power.

The system controls are arranged for either automatic operation or remote manual control.

10.1.2.3 Main Steam Line Isolation

One main steam line isolation valve assembly is provided on each main line header. The MSIV is a "y"-type, bi-directional, balanced disk globe valve with an American National Standards Institute (ANSI) 600 primary pressure rating; the bonnet closure is of a pressure seal design body and disk seating surfaces, disk guides and backseat are integrally hardfaced with Stellite 21; limit switches are mounted on the yoke to provide full open, full closed and intermediate position indication. The valve is capable of shutting against pressure from either side. A motor operated bypass valve is provided to equalize pressure across the valve before opening. The MSIVs and their actuator systems are designed to Seismic Category I requirements. Descriptive drawings of the valve are shown in Figures 10-2, 10-2A, and 10-2B.

Closure of the MSIV within a maximum of six seconds after a trip signal is initiated, prevents rapid flashing and blowdown of water stored in the shell side of the steam generator, thus avoiding a rapid uncontrolled cooldown of the RCS. Also, the isolation valves prevent release of the contents of the secondary side of both steam generators to the containment in the event of the rupture of one main steam line inside the Containment Structure. During normal operation, these valves remain open; upon low steam generator pressure or high containment pressure, a steam generator isolation signal energizes the closing mechanism of the valves to stop the steam flow.

The manufacturer, Rockwell Manufacturing Company, has supplied fast acting, hydraulic-actuated stop and stop - check valves for use in steam and feedwater systems of the Fort St. Vrain HTGR. These valves are in 6 to 20" size, pressure class 600 to 2500 and of y-type or vertical stem construction. The manufacturer has supplied air actuated y-type balance disc valves in 16 to 26" size for use as steam isolation valves in U.S. boiling water reactors.

The actuator consists of a hydraulic cylinder directly coupled to a nitrogen accumulator and a control system designed to close the MSIV in case of either an upstream or downstream rupture using stored energy. The gas/hydraulic power package for each valve is separate. Physical separation, missile shielding and power supplies are arranged to prevent a single failure from disabling two hydraulic systems. Figure 10-3 shows a schematic diagram of the hydraulic actuation system for one valve.

The actuator piston is capable of counteracting the stem force resulting from a differential steam pressure of 1000 psi in either direction, in addition to the maximum calculated impingement forces. Speed control is accomplished by throttling oil flow at valves 2-26 and 3-26 (Figure 10-3) which act as an automatic adjusting orifice and a fixed orifice during closure. The orifices provide a constant oil flow rate independent of upstream pressure. Hydraulic pressure under the piston adjusts itself as necessary to counteract the stem force.

Valve closure forces were calculated using the peak magnitude stem and impingement forces mentioned above. The valve actuator was tested on a load cell under no flow and peak force conditions to ensure the 6.0 second closure time assumed in the accident analysis will be met under accident conditions. The maximum measured closure time difference between peak and no flow conditions is 0.8 seconds. The MSIVs' closure time is surveilled to 5.2 seconds, thus ensuring the valve will close within 6.0 seconds under accident conditions. These closure times do not include signal processing delay time.

The MSIV actuation system is a Rockwell A-180 valve-mounted gas/hydraulic stored-energy actuator. Energy for closure of the valve is provided by high pressure nitrogen contained in a spherical chamber above the hydraulic piston. The MSIV is held open by hydraulic fluid exerting pressure underneath the hydraulic piston. Closure of the valve occurs when either solenoid valve 2-89 or 3-89 opens releasing pilot pressure from either hydraulic dump valve 2-28 or 3-28 allowing the valve to open, thus releasing the hydraulic fluid from beneath the MSIV hydraulic piston. The fluid flows through independent manifolds to a common reservoir. A manual override device is available on each of the dump solenoid valves (2-89 and 3-89) which adds local closure capability to the valve. The MSIV will close within 6.0 seconds if either dump valve opens. The stored nitrogen energy provides the force to close the valve. Nitrogen pressure is continuously monitored with local annunciation of pressure, and Control Room annunciation of MSIV trouble, alerting plant personnel of an unusual condition. This ensures adequate nitrogen pressure is available at all times to close the MSIV.

The valve is a "Y"-pattern globe where the bonnet of the valve is at 45° to the flow centerline. This allows the body flow passage to conform to a high efficiency which results in a low pressure drop. The advantage of the balanced disk design is a reduced actuator size due to a reduction in disk loading. The design consists of a small check disk assembly located in the center of the main disk. The assembly opens during reverse flow conditions to equalize pressure above and below the disk. This balances not only disk pressure but also balances disk forces. With the disk pressures balanced, the nitrogen in the accumulator provides the force required to keep the valve closed for at least one hour against full reverse steam pressure. This provides each MSIV with the capability of holding reverse pressure until a cooldown to below 300°F can be accomplished.

Four pressure transmitters are monitored by four independent bistables for each steam generator. Each steam generator provides two independent pressure channel inputs to redundant engineered safety features actuation system (ESFAS) steam generator isolation two-out-of-four logic matrices. Upon actuation of a single two-out-of-four logic matrix on low steam generator pressure, both gas/hydraulic-operated main steam line isolation valves will close (Section 7.3). The valves are also closed by a containment spray actuation signal.

Automatic closing of the gas/hydraulic-operated MSIVs can be blocked by operating the isolation block switches as the steam pressure is decreased toward the isolation setpoint. The isolation block is automatically removed by a three-out-of-four logic when the steam generator pressure rises to 100 psi above the isolation setpoint pressure.

The operation of the Calvert Cliffs steam generator isolation valves will reliably prevent excessive energy release from the steam generators in the event of a major steam line rupture. This conclusion is based on design analysis, design verification tests, and inservice tests.

The analyses include:

a. A design analysis of the valve body, disk, check element, piston, bonnet, and pressure seal gasket to ensure the requirements of American Society of Mechanical Engineers (ASME) B&PV Code, 1971 Edition through Summer 1971 Addenda, was met.

Design verification tests include:

a. Hydrostatic tests of the system at the factory to ensure adequate system strength;
b. Operational tests of the actuation system at the factory to ensure system flow rates and pressures are in accordance with design;
c. Operational tests of the complete system, including the valve, after installation, to ensure adequate system force and time response; and,
d. Extensive prototype, qualification, and industry experience has demonstrated the ability of the actuator to perform its design function under all anticipated conditions.

The inservice tests will be performed both on-line and during shutdown periods over the life of the plant to ensure continued system reliability. These tests include:

a. A full stroke test performed per the Inservice Test Program; and,
b. Special tests, performed as necessary, to establish nitrogen and hydraulic fluid replacement requirements, and to confirm the strength adequacy of the pressure boundary.

10.1.2.4 <u>Flow Restrictors</u>

Each main steam line is equipped with an integral venturi flow restrictor in the main steam outlet nozzle and an in-line verturi flow restrictor inside the Containment Building. The worst case steam line break would occur between the integral verturi flow restrictor and the in-line venturi flow restrictor. Any break downstream of the in-line venturi flow restrictor would further restrict the steam flow.

10.1.3 DESIGN EVALUATION

The components of the MSS are conventional and of the type that have been extensively used in fossil fuel plants and in other nuclear power plants. Adequate instruments, controls, and protective devices are provided to assure reliable and safe operation. The equipment is designed to the applicable codes and standards and to the best commercial standards and practices.

Seismic Category I requirements are placed on the system up to and including the first isolation valve outside the containment. This includes main steam and feedwater piping up to the isolation valves, the atmospheric dump, the main steam safety valves, the MSIVs, and the steam generators. All other components are designed to Seismic Category II requirements.

10.1.4 TESTS AND INSPECTIONS

Equipment, instruments, and controls are regularly inspected in order to ensure proper functioning of the system. The turbine stop valves, reheater intercept valves, and extraction line non-return valves may be tested while the turbine is in operation.

Augmented Inservice Inspection Program for Main Steam and Main Feedwater Piping

The unencapsulated welds greater than four inches in nominal diameter in the main steam and main feedwater piping runs located outside the Containment and traversing safety-related areas or located in compartments adjoining safety-related areas shall be inspected per the following augmented inservice inspection program using the applicable rules, acceptance criteria and repair procedures of the ASME Boiler and Pressure Vessel Code, Section XI, endorsed in the Inservice Inspection Program, for Class 2 components.

Each weld must be examined in accordance with the above ASME Code requirements, except that 100% of the welds must be examined, cumulatively, during each ten year inspection interval. The welds to be examined during each inspection period shall be selected to provide a representative sample of the conditions of the welds. If these examinations reveal unacceptable structural defects in one or more welds, an additional 1/3 of the welds shall be examined and the inspection schedule for the repaired welds shall revert back as if a new interval had begun. If additional unacceptable defects are detected in the second sampling, the remainder of the welds shall also be inspected.

Alternatively, a Risk-Informed process for piping outlined in Electric Power Research Institute Topical Report 1006937 revision 0-A may be used for the weld selections and the determination of required additional examinations when defects are discovered.

10.1.5 SECONDARY SYSTEM-SPECIFIC ACTIVITY

To ensure that the resultant offsite radiation dose will be limited to a small fraction of 10 CFR 50.67 limits in the event of a steam line rupture, secondary system-specific activity is controlled by the Technical Specifications. The maximum dose allowed by the Technical Specifications also includes the effects of a coincident 100 gpd primary-to-secondary tube leak in the steam generator of the affected steam line, and concurrent loss of offsite electrical power. These values are consistent with the assumptions used in the accident analyses.

TABLE 10-1

DESIGN DATA FOR STEAM AND POWER CONVERSION SYSTEM COMPONENTS

Turbine-Generator

		Unit 1	Unit 2
a.	Turbine		
	Throttle pres.[(e)] (rat./VWO)	811/809.4 psia	815/815 psia
	Steam moisture (max.)[(a)]	0.374%	0.374%
	kW @ rating	956,804	950,285
	kW @ VWO	982,744	968,116
	Makeup	0%	0%
	Turbine back-pressure	2" Hg abs.	2" Hg abs.
	No. of extraction	6	6
b.	Generator		
	Rating (kVA)	1,020,000	1,036,000
	Power factor	0.9	0.9
	Voltage	25,000	22,000
	Hydrogen pressure	60 psig	75 psig

Steam Generator Feed Pumps

Type		Double suction, double volute, single stage, vertically split, horizontal centrifugal	
Quantity		2	2
Capacity each (gpm)		15,000	15,000
Head (ft)		2392	2316
Material			
	Case	ASTM A296, Gr CA15 or ASTM A487, Gr CA6NM Class A	
	Impeller	ASTM A296, Gr CA15 or ASTM A743, Gr CA6NM	
	Shaft	ASTM A276, Type 410	
Driver		Condensing, nonextracting, dual admission, horizontal steam turbine	
Codes		ASME B&PV Code, Section VIII, Standards of the Hydraulic Institute, National Electrical Manufacturers Association (NEMA), ANSI	

Steam Generator Steam-Driven Auxiliary Feed Pumps

Type		Horizontal, split case, multistage, centrifugal
Quantity		2 (per unit)
Capacity each (gpm)		700
Head (ft)		2490
Material		
	Case	ASTM A217, Gr C5
	Impeller	ASTM B148, Gr 9A, ASTM A743 Gr CA6NM or ASTM A296, Gr CA6NM
	Shaft	ASTM A276, Type 410; or ASTM A479, Type 410
Driver		Single stage, noncondensing steam turbine
Seismic requirements		Category I
Codes		ASME B&PV Code, Sections VIII and IX, Standards of the Hydraulic Institute, ANSI

TABLE 10-1

DESIGN DATA FOR STEAM AND POWER CONVERSION SYSTEM COMPONENTS

Steam Generator Motor-Driven Auxiliary Feed Pumps

Type	Horizontal, split case, multi-stage, single suction, opposed impeller centrifugal pump
Quantity	1 per unit
Capacity each (gpm)	450
Head (ft)	2800
Material	
Case	ASME SA-216-WCB
Impeller	ASTM A217, Gr CA-15
Shaft	ASTM A276, Type 410, Cond. T
Driver	Electric motor 500 hp, 4160 Volts, 60 Hz, 3 phase, 3500 rpm
Seismic requirements	Category I
Codes	ASME B&PV Code, Sections III, V, IX, Standards of the Hydraulic Institute, NEMA, ANSI

Condensate Pumps

Type	Vertical centrifugal
Quantity	3 (per unit)
Capacity each (gpm)	8250
Head (ft)	490
Material	
Case	ASTM A48, C1. 40
Impeller	ASTM A296, Gr CA15
Shaft	ASTM A276, Type 410
Driver	Electric motor 1250 hp, 4160 Volts, 60 Hz, 3 phase 1160 rpm
Codes	ASME B&PV Code, Sections VIII and IX, Standards of the Hydraulic Institute, NEMA, ANSI

Condensate Booster Pumps

Head (ft)	750
Capacity each (gpm)	8540
Material	
Case	ASTM A217, Gr C5
Impeller	ASTM A296, Gr CA15
Shaft	ASTM A276, Type 410
Driver	Electric motor 2000 hp, 4160 Volts, 60 Hz, 3 phase, 1780 rpm
Codes	ASME B&PV Code, Sections VIII and IX, Standards of the Hydraulic Institute, NEMA, ANSI

TABLE 10-1

DESIGN DATA FOR STEAM AND POWER CONVERSION SYSTEM COMPONENTS

Heater Drain Pumps	
Type	Vertical centrifugal
Quantity	2 (per unit)
Capacity each (gpm)	4290 (Unit 1); 4870 (Unit 2)
Head (ft)	900 (Unit 1); 740 (Unit 2)
Material	
Case	13-4 SS
Impeller	13-4 SS
Shaft	ASTM A276, Type 410 HT
Driver	Electric motor 1250 hp, 4160 Volts, 60 Hz, 3 phase 1760 rpm
Codes	ASME B&PV Code, Sections VIII and IX, Standards of the Hydraulic Institute, NEMA, ANSI
Condenser	
Type	Three shell, single pass with divided water boxes, surface condenser
Quantity	1 (per unit)
Design duty (Btu/hr)	5.910×10^9 (Unit 1); 5.886×10^9 (Unit 2)
Heat transfer area (ft^2)	453,000 (each)
Design pressure	Shell: 29.5" Hg vacuum Water box: 25 psig
Material	
Shell	ASTM A284, Gr C
Tubes	ASTM B676, Austenitic Stainless Steel and ASTM B338, Gr 2, Titanium (Unit 1) ASTM B338, Gr 2, Titanium (Unit 2)
Tube sheets	ASTM B169, Alloy 614 (Unit 1) ASTM SB265, Gr 1 and Gr 2 bonded to ASTM SA516, Gr 55 (Titanium on Carbon Steel) (Unit 2)
Codes	Standards of the Heat Exchange Institute
Feedwater Heaters	
Type	Closed, U-tube
Material	
Shell	ASTM A212, Gr B
Tubes	ASTM A249, Type 304L
Tube sheets	ASTM A212, Gr B
Codes	ASME B&PV Code, Section VIII, Heat Exchange Institute[(b)]

TABLE 10-1

DESIGN DATA FOR STEAM AND POWER CONVERSION SYSTEM COMPONENTS

HEATER NO.	DESIGN DUTY EACH (Btu/hr)	DESIGN PRESSURE (psig)		DESIGN TEMP. (°F)		HEAT TRANSFER AREA EACH FT^2
		SHELL	TUBE	SHELL	TUBE	
11 A,B,C	168.40×10^6	50 +Vac.	300	300	300	10,160
12 A,B,C	182.00×10^6	50 +Vac.	300	300	300	13,585
13 A,B	311.00×10^6	75 +Vac.	700	350	325	16,905
14 A,B	162.40×10^6	125 +Vac.	700	375	375	11,830
15 A,B	297.00×10^6	225	700	425	400	22,210
16 A,B	370.50×10^6	475	1500	500	475	23,390
11 A,B,C (Drain Cooler)	20.30×10^6	50 +30" Hg Vac	300	300	300	2,780
21 A,B,C	134.20×10^6	50 +Vac.	300	300	300	11,320
22 A,B,C	140.16×10^6	50 +Vac.	300	300	300	10,555
23 A,B	156.63×10^6	50 +Vac.	700	300	300	12,645
24 A,B	151.30×10^6	75 +Vac.	700	350	350	11,360
25 A,B	51.71×10^6	150	700	400	375	21,120
26 A,B	595.10×10^6	450	1500	500	460	29,625
21 A,B,C (Drain Cooler)	23.30×10^6	50 +Vac.	300	300	300	2,490

TABLE 10-1

DESIGN DATA FOR STEAM AND POWER CONVERSION SYSTEM COMPONENTS

SYSTEM	APPLICABLE CODE	DESIGN PRESSURE (psig)	DESIGN TEMP. (°F)
Main Steam Piping	ANSI B31.1	1000	580
Main Steam Penetration Piping (including atmospheric dump)	ANSI B31.7, CL2	1000	580
Main Steam Line Flow Restrictors	ASME Sec III, CL II	1000	580
Main Steam Isolation Valves	ASME Sec III, CL II	1085	580
Main Steam Safety Valves	---	985	550
Feedwater	ANSI B31.1	1500[(c),(d)]	460
Feedwater Penetration	ANSI B31.7, CL2	1500[(c)]	460
Condensate	ANSI B31.1	612	400
Auxiliary Steam	ANSI B31.1	225	425
Auxiliary Feedwater Discharge (Steam Driven Train)	ANSI B31.1	1440	100
Auxiliary Feedwater Discharge (Motor Driven Train)	ASME Sec III, CL III	1480	100
Auxiliary Feedwater Suction (Steam-Driven Train)	ANSI B31.1	285	100
Auxiliary Feedwater Suction (Motor-Driven Train)	ASME Sec III, CL III	285	100

(a) This is the turbine design value for optimum operation. However, higher steam moisture values are within the total design envelope for turbine operation. Normal inspection, maintenance, repair, and replacement of the steam generator moisture separating equipment will limit the moisture carryover of the outlet steam, which feeds the turbine. This will prevent excessive turbine erosion and eliminate turbine damage, within the normal turbine inspection program.

(b) Also see Sections 10.2.2.1 and 10.2.3.

(c) Design pressure was revised from 1650 psig for feedwater penetration piping and 1600 psig for feedwater piping.

(d) 1400 psig may be used as the design pressure of the feedwater lines inside Containment when overpressure protection, as provided by the MSSVs, is demonstrated to be acceptable. The feedwater penetration pipe is excluded from this change.

(e) Actual turbine throttle pressure may be less than the design value due to steam generator tube plugging. However, for reduced throttle pressure the turbine-generator may not be capable of producing rated power output.