2.8 Steam and Power Conversion Systems

2.8.1 Turbine-Generator System

1.0 Description

The turbine-generator system is a non-safety-related system that converts the energy of the steam produced in the steam generators into mechanical shaft power and then into electrical energy.

The flow of steam is directed from the steam generators to the turbine through the main steam system, turbine stop valves, and turbine control valves. After expanding through the turbine, which drives the main generator, exhaust steam is transported to the main condenser.

Turbine overspeed control is provided by a separate turbine overspeed protection system, in addition to the normal speed control function, and is included to minimize the possibility of turbine rotor failure and turbine missile generation.

Turbine rotor integrity is provided through the combined use of selected materials with suitable toughness, analyses, testing, and inspections. Turbine rotor components and turbine stop and control valves will be inservice tested and inspected at intervals in accordance with industry practice or as specified by the manufacturer to meet turbine missile generation probability requirements.

The probability of turbine material and overspeed related failures resulting in external turbine missiles is $< 1x10^{-4}$ per turbine year.

2.0 Arrangement

2.1 The basic configuration of the turbine-generator system is shown in Figure 2.8.1-1—Turbine-Generator System Basic Configuration.

2.2 The orientation of the turbine-generator is favorable with respect to protection from turbine missiles.

2.3 The location of the turbine-generator system equipment is listed in Table 2.8.1-1—Turbine-generator System Equipment Mechanical Design.

3.0 Instrumentation and Controls (I&C) Design Features, Displays, and Controls

3.1 Controls exist in the main control room (MCR) to trip the turbine-generator.

3.2 Overspeed protection systems are listed in Table 2.8.1-2—Turbine-Generator System Equipment I&C and Electrical Design.

4.0 Electrical Power Design Features

4.1 Turbine stop valves and turbine control valves fail closed on loss of power.

5.0 Inspections, Tests, Analyses, and Acceptance Criteria

5.1 Table 2.8.1-3—Turbine-Generator System Inspections, Tests, Analyses, and Acceptance Criteria specifies the inspections, tests, and acceptance criteria for the turbine-generator system.

Table 2.8.1-1—Turbine-Generator System Equipment Mechanical Design

Equipment Description	Equipment Tag Number(1)	Equipment Location	ASME Code Section III	Function	Seismic Category
Turbine Stop Valve 1 Turbine Stop Valve 2 Turbine Stop Valve 3 Turbine Stop Valve 4	30MAA11AA010 30MAA12AA020 30MAA13AA030 30MAA14AA040	Turbine Building	N/A	Close	N/A
Turbine Control Valve 1 Turbine Control Valve 2 Turbine Control Valve 3 Turbine Control Valve 4	30MAA11AA011 30MAA12AA012 30MAA13AA013 30MAA14AA014	Turbine Building	N/A	Close	N/A
Turbine-generator	N/A	Turbine Building	N/A	N/A	N/A

1) Equipment tag numbers are provided for information only and are not part of the certified design.

Table 2.8.1-2—Turbine-Generator System Equipment I&C and Electrical Design

Equipment Description	Equipment Tag Number(1)	Equipment Location	IEEE Class 1E	EQ –Harsh Env.	PACS
Overspeed Protection System	N/A	Turbine Building	N/A	N/A	N/A
Backup Overspeed Protection System	N/A	Turbine Building	N/A	N/A	N/A

1) Equipment tag numbers are provided for information only and are not part of the certified design.

Table 2.8.1-3—Turbine-Generator System Inspections, Tests, Analyses, and Acceptance Criteria

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
1.0	Turbine disk integrity is provided through the combined use of selected materials with suitable toughness, analyses, design, testing, and inspections.	An analysis of turbine rotor material property data, turbine rotor and blade design, and pre-service inspection and testing will be conducted. This information will be available for review greater than one year before loading the fuel.	An analysis exists that includes turbine material property data, rotor and blade design analyses (including loading combinations, assumptions and warm-up time) demonstrating sufficient safety margin to withstand loadings from overspeed events, and pre-service testing and inspection information (including scope, methods and acceptance criteria).
1.0	The probability of turbine material and overspeed related failures resulting in external turbine missiles is $< 1x10^{-4}$ per turbine year.	A material and overspeed failures analysis will be performed on the as-built turbine design.	An analysis exists that documents that the probability of turbine material and overspeed related failures resulting in external turbine missiles is $< 1x10^{-4}$ per turbine year.
2.1	The basic configuration of the turbine-generator system is shown on Figure 2.8.1-1.	Inspections of the as-built system as shown on Figure 2.8.1-1 will be conducted.	The as-built turbine-generator system conforms with the basic configuration as shown in Figure 2.8.1-1.
2.2	The location of the turbine-generator system equipment is in the Turbine Building.	An inspection will be performed of the location of the equipment.	The turbine-generator equipment is located in the Turbine Building.
4.1	Controls exist in the MCR to trip the turbine-generator.	Tests will be performed for the existence of control signals from the MCR.	Controls exist in the MCR to trip the turbine-generator.
5.1	Turbine stop valves and turbine control valves fail closed on loss of power.	Testing will be performed for the turbine stop valves and turbine control valves to fail closed on loss of power.	Following loss of power, turbine stop valves and turbine control valves fail closed.