## 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 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.

#### 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.

2.4 Turbine rotor integrity is provided through the combined use of selected materials with suitable toughness, analyses, testing, and inspections.

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

#### 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 The turbine generator has overspeed protection.

#### 4.0 Electrical Power Design Features

4.1 Turbine stop valves and turbine control valves as listed in Table 2.8.1-1 fail closed on loss of power.

## 5.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.8.1-3 lists the turbine-generator system ITAAC.

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

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

| Description | Tag Number(1) | 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 ITAAC (2 Sheets)**

| Commitment Wording | | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| 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 orientation of the turbine-generator is favorable with respect to protection from turbine missiles. | An inspection will be performed of the orientation of the turbine-generator. | The turbine-generator orientation is favorable relative to turbine missile protection. |
| 2.3 | The location of the turbine-generator system equipment is listed in Table 2.8.1-1. | An inspection will be performed of the location of the equipment. | The turbine-generator system equipment is located as listed in Table 2.8.1-1. |
| 2.4 | 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 requirements will be conducted. This information will be available for review greater than one year before loading the fuel. | An analysis exists and concludes that the turbine disk integrity meets the requirements of the manufacturer's turbine missile probability analysis: (1) turbine material property data, rotor and blade design analyses (including loading combinations, assumptions and warm-up time) demonstrating safety margin to withstand loadings from overspeed events, and (2) the requirements for pre-service testing and inspection information. |
| 2.5 | 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 and concludes that the probability of turbine material and overspeed related failures resulting in external turbine missiles is < 1x10-4 per turbine year. |
| 3.1 | 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. |

**Table 2.8.1-3—Turbine-Generator System ITAAC (2 Sheets)**

| Commitment Wording | | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| 3.2 | The turbine generator has overspeed protection. | a. Analyses will be performed on the overspeed protection system. | a. A report exists and concludes that the turbine overspeed protection systems are diverse. |
| | | b. Tests will be performed for operation of the overspeed and backup overspeed protection systems listed in Table 2.8.1-2. | b. Overspeed and backup overspeed turbine trips occur within the design limits for the systems listed in Table 2.8.1-2. |
| 4.1 | Turbine stop valves and turbine control valves as listed in Table 2.8.1-1 fail closed on loss of power. | Testing will be performed for the turbine stop valves and turbine control valves as listed in Table 2.8.1-1 to fail closed on loss of power. | Following loss of power, turbine stop valves and turbine control valves as listed in Table 2.8.1-1 fail closed. |

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