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Mr. Robert Giardina
Power Systems Branch
Division of System Integration
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Bob,

Enclosed is my second version of the safety evaluation of SNUPPS 10.1, 10.2, 10.3, 10.4.1, and 10.4.4 for you to tear apart. Please give me your further advises and inputs at your convenience.

Thank you for your patience.

Erwin

ERWIN FISCHER-COLBRIE
NSS/Safeguards Program
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Enclosure

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10.0 STEAM AND POWER CONVERSION SYSTEM

10.1 Summary Description

In this section a general description is given of the system and its overall function, protective features, its important design features and performance characteristics. In addition to these features, the applicant should provide a general discussion of the criteria and bases of the various steam and condensate instrumentation systems in section 10.1 of the FSAR. The FSAR should differentiate between normal operation instrumentation and required safety instrumentation. (Open item 1, 10.1). This open item of 10.1 will be pursued with the Applicant and the results will be reported in a supplement to this report.

10.2 Turbine Generator

The Turbine Generator (TG) receives high pressure steam from the main steam system and converts a portion of the thermal steam energy into electrical energy. The associated turbine control and overspeed protection system is designed to control turbine action under all normal and abnormal conditions and to assure that a loss of its full load will not cause the turbine to overspeed beyond acceptable limits. The turbine control and overspeed protection system is, therefore, essential to the overall safe operation of the plant.

The TG is manufactured by the General Electric Company. The generator is designed for 1,373,000 kVA at 1,800 rpm under 75 psig hydrogen pressure.

The turbine consists of double flow, high pressure and low pressure elements in tandem. Four combined moisture separation-reheater assemblies are provided between the high pressure and the low pressure elements.

Turbine control and overspeed protection is provided by the Electro-Hydraulic Control (EHC) system. This system utilizes electronic control in conjunction with high pressure hydraulic actuating techniques. The system comprises electrical control circuits for steam pressure control, speed control, load control, and steam control valve positioning. Overspeed protection at loss of load is achieved by three independent and diverse systems.

The normal electric speed control which on loss of load closes the control and intercept valves uses two independent rotor speed control circuits. Loss of both speed signals will initiate trip via the Emergency Trip System (ETS). As turbine stage pressure decreases, extraction nonreturn valves swing closed. Control and intercept valves are designed to be fully closed at 104% of the design speed.

The mechanical overspeed control is activated when the speed rises to 110% of the nominal speed. Mechanical overspeed trip signals all valves to close by dumping ETS pressure. This speed can only be reached if the normal control fails to function. For reliability, two-out-of-three logic is employed in both mechanical and electrical overspeed trip circuitry. Operation of air relay dump valves then releases spring closure mechanisms of extraction nonreturn valves.

The electrical backup overspeed control signals all valves to close at 111% of normal speed. In case of failure of both normal and mechanical overspeed control, the three speed pickups for the electrical backup overspeed trip provide signals independent of the speed control unit.

Additional turbine trips can be accomplished by the following events:

- Emergency trip pushbutton in control room
- Moisture separator high level
- Low condenser vacuum
- Low lube oil pressure

- o LP turbine exhaust hood high temperature
- o Reactor trip
- o Thrust bearing wear
- o Manual trip handle on front standard
- o Loss of stator coolant
- o Low hydraulic fluid pressure
- o Any generator trip
- o Loss of EHC electrical power
- o Excessive vibration

The main stop and control valves are in series and have completely independent operating control and operating mechanisms. The primary function of the main stop valves is to quickly shut off the steam flow to the turbine. Their closure time is 0.19 sec. Closure of either all four stop valves or all four control valves shuts off all main steam flow to the HP turbine. The combined stop and intercept valves are also in series and have completely independent operating controls and operating mechanisms. Closure of either all six stop valves or all six intercept valves shuts off all moisture separator reheater outlet steam flow to the three LP turbines.

With the overspeed systems closing at least two valves in series in each steamline, failure of one valve to operate would not disable the overspeed control function.

The extraction steam valving closure times are shown to be about 0.2 seconds. Discuss in more detail the valve closure times and extraction steam valve arrangement in relation to stable turbine operation after a turbine generator system trip (SRP 10.2 Part III, items 3, 4) (Open item 1, 10.2)

The electrical and mechanical overspeed trip devices can be tested remotely at rated speed, under load, by means of lighted pushbuttons on the EHC test panel. Operation of the overspeed protection devices under controlled, overspeed condition is checked at startup and after each refueling.

An inservice inspection program for the main steam stop and control valves and reheat valves is provided and includes: (a) dismantling and inspection of at least one main steam stop valve, one main steam control valve, and one reheat stop valve, and one reheat intercept valve, at approximately 3-1/3 year intervals during refueling or maintenance shutdowns coinciding with the inservice inspection schedule required by ASME Code Section XI; (b) exercising and observing as required the main steam stop and control, reheat stop, and intercept valves.

The applicant will include pre-operational and startup tests of the turbine generator in accordance with Regulatory Guide 1.68, "Initial Test Programs for Water Cooled Power Plants."

The turbine generator system meets the recommendations of Branch Technical Positions ASB 3-1, Protection Against Postulated Piping Failures in Fluid Systems Outside Containment" and MEB 3-1, "Postulated Break and Leakage Locations in Fluid System Piping Outside Containment." Evaluation of protection against dynamic effects associated with the postulated pipe system failure is covered in section 3.6 of this report. However, an additional discussion is needed what protection will be provided for the turbine overspeed control system equipment, electrical wiring and hydraulic lines from the effects of high or moderate energy pipe failure so that the turbine overspeed protection system will not be damaged to preclude its safety function (SPR 10.2, Part III, Item 8). (Open item 2, 10.2).

A description with the aid of drawings should be provided in the FSAR of the bulk hydrogen storage facility including its location and distribution system and also including the protective measures considered in the design to prevent fires and explosions during operations such as filling and purging the generator, as well as during normal operations (Open item 3, 10.2).

The scope of review of the trubine generator included descriptive information in section 10.2 of the FSAR, flow charts and diagrams. The basis for acceptance in our review was conformance of the design criteria and bases and design of the turbine generator system to acceptance criteria to Section II of Standard Review Plan 10.2 and industry standards.

Based on our review, we conclude that the turbine-generator overspeed protection system is in conformance with the above cited criteria and design basis, it can perform its designed safety functions, and is acceptable after the above identified three open items have been pursued with the applicant and satisfactorily clarified. The results will be reported in a supplement to this report.

10.3 Main Steam Supply

The Main Steam Supply System (MSSS) transports steam from the nuclear steam supply system to the power conversion system and various safety related and non-safety related auxilaries. The portion of the MSSS from the steam generator to the steam generator isolation valves is safety related and is required to function following a Design Base Accident (DBA) and to achieve and maintain the plant in a safe shutdown condition. Section 10.3.1.1 of the FSAR describes the safety design bases for the safety related portion of the MSSS. An adquate safety evaluation of the safety related portion of the MSSS is given in Section 10.3.3 of the FSAR, except for the following items:

In the event of a steam line break upstream of the Main Steam Isolation Valve (MSIV) certain systems downstream can be used for mitigation of the accident. If these systems are not available or decision is made to use other means to shut down the reactor a description is needed in the FSAR of how these systems are secured to assure positive steam shut off. The description shall include what operator's actions (if any) are required. (Issue No. 1 of NUREG 0138) (Open item 1, 10.3)

Additional information is needed on the system capability to withstand the effects of pipe whip and jet impingement forces associated with pipe breaks (SRP 10.3-3) Open item 2, 10.3)

The scope of review of the main steam supply system (between the main steam isolation valves and up to and including the turbine stop valves) included descriptive information in section 10.3 of the FSAR, and flow charts and diagrams. The basis for acceptance in the staff review was conformance of the design criteria and bases and design of main steam supply system to the acceptance criteria in Section II of Standard Review Plan 10.3.

Based on our review, we conclude the main steam supply system between the main steam isolation valves and up to and including the turbine stop valves is in conformance with the above cited criteria and design bases, it can perform its designed functions, and is, therefore, acceptable after the two open items identified above have been pursued with the applicant and satisfactorily clarified. The results will be reported in a supplement to this report.

10.4.1 Main Condenser

The main condenser is the steam cycle heat sink. During normal operation, it is capable of accepting and condensing full load main turbine exhaust steam, steam generator feedwater pump turbine exhaust steam, and up to 40% of the main steam flow turbine bypass steam. The main condenser is also a collection point for other steam cycle miscellaneous flows, drains, and vents.

The main condenser is utilized as a heat sink in the initial phase of reactor cool down during a normal plant shutdown. It is a multi-pressure, three shell, deaerating unit.

The main condensers are not required to effect or support safe shutdown of the reactor or to perform in the operation of reactor safety features.

Although some of the following items have been described in the FSAR, the FSAR should show a tabulation of the following characteristics and performance requirements of the main condenser including such items as: 1) the number of condenser tubes, material and total heat transfer surface, 2) overall dimensions of the condenser, 3) number of passes, 4) hot well capacity, 5) special design features, 6) minimum heat transfer, 7) normal and maximum steam flows, 8) normal and maximum cooling water temperature, 9) normal and maximum exhaust steam temperature with no turbine by-pass flow and with maximum turbine bypass flow, 10) limiting oxygen content in the condensate in cc per liter, and 11) other pertinent data. (SRP 10.4.1, Part III, item 1). (Open item 1, 10.4.1)

The FSAR also does not specifically discuss the measures that are taken 1) to prevent loss of vacuum, and 2) to prevent corrosion/erosion of condenser tubes and components (SRP 10.4.1 Part III item 1) (open item 2, 10.4.1)

There is also a need to provide the permissible cooling water inleakage and time of operation with inleakage to assure that condensate/feedwater quality can be maintained within safe limits. (SRP 10.4.1, Part III, item 2). (Open item 3, 10.4.1)

An indication is also needed as to what design provisions have been made to preclude failures of condenser tubes or components from turbine by-pass blowdown or other high temperature drains into the condenser shell. (SRP 10.4.1, Part III, item 3). (Open item 4, 10.4.1)

The effect of loss of main condenser vacuum on the operation of the main steam isolation valves needs discussion in the FSAR (SRP 10.4.1, Part III item 3). (open item 5, 10.4.1)

The scope of review of the main condenser included layout drawings and descriptive information of the condenser in section 10.4.1 of the FSAR. The basis for acceptance in the staff review was conformance of the design criteria and bases and design of the condenser to the acceptance criteria in Section II of Standard Review Plan 10.4.1 and industry standards.

Based on our review we conclude that the main condenser is in conformance with the above cited criteria and design bases, it can perform its designed function and is therefore acceptable after the five above identified open items have been pursued with the applicant and satisfactorily clarified. The results will be reported in a supplement to this report.

10.4.4 Turbine Bypass System

The Turbine Bypass System (TBS) provides operational flexibility so that the plant may accept certain load changes without disturbing the nuclear steam supply system. The TBS is designed to discharge a stated percentage of rated main steam flow directly to the main condensers, bypassing the turbine. This steam bypass enables the plant to take step load reduction up to the TBS capacity without the reactor or turbine tripping.

There are 12 air activated turbine bypass valves. Seven valves discharge into the low pressure condenser, four valves discharge into the intermediate condenser, and a single valve discharges into the high pressure condenser. The valves are pilot-operated, spring-opposed, and fail closed upon loss of air or loss of power to the control system.

The TBS is not a safety related system and is not required for plant shut down following an accident.

The turbine bypass (TBS) includes all components and piping from the branch connection at the main steam system to the main condensers. The scope of review of the turbine bypass system for the SNUPPS plants included layout drawings, piping and instrumentation diagrams, and descriptive information for the TBS and auxiliary supporting systems that are essential to its operation.

The following items have been found to need additional information and discussion to be included in the FSAR.

Although partially described in the FSAR additional description (with the aid of drawings) is needed of the turbine by-pass valves and associated control. The discussion shall include the number, size, principle of operation, construction, set points, and the malfunctions and/or modes of failure considered in the design of the turbine by-pass system. (SRP 10.4.4, Part III, Item 1.) ((Open item 1, 10.4.4)

Additional description (with the aid of drawings) should be provided of the turbine by-pass system (condenser dump valves and atmosphere dump valves) and associated instruments and controls. The discussion should include: 1) the size, principle of operation, construction, and set points of the valves, 2) the malfunctions and/or modes of failure considered in the design of the system. (SRP 10.4.4, Part III, Items 1 and 2) (Open item 2, 10.4.4)

In section 10.4.4 tests and initial field inspection have been discussed but not the frequency and extent of inservice testing and inspection of the turbine by-pass system. This information should be provided in the FSAR. (SRP 10.4.4, Part II). (Open item 3. 10.4.4)

Provision of the results of an analysis is needed indicating that failure of the turbine by-pass system high energy line will not have an adverse effect or preclude operation of the turbine speed control system or any safety related componemts or systems located close to the turbine by-pass system. (SRP 10.4.4, Part III, item 4). (Open item 4, 10.4.4)

Assurance is needed that a high energy line failure of the turbine by-pass system will not have an adverse effect or preclude operation of turbine speed controls or any safety-related components or systems located close to the turbine bypass system. (SRP 10.4.4, Part III, item 4). (Open item 5, 10.4.4)

Section 10.4.4 of the FSAR describes the TBS and states in 10.4.2.2 that the TBS dumps steam to the condenser through condenser spargers. Fig 10.3-1 Sheet 3 of the FSAR shows the TBS. On this figure also six separate lines ar shown branching off the TBS line prior to the TBS valves. These lines are labeled "to condenser sparger" and seem to have normally open valves. With the set of diagrams explain the purpose of these lines and confirm that the valves are normally closed. (Open item 6, 10.4.4)

The applicant will include pre-operational and startup tests of the turbine bypass system in accordance with recommendations of Regulatory Guide 1.68, "Inititial Test Programs for Water Cooled Reactor Power Plants." The turbine bypass system meets the recommendations of Branch Technical Positions ASB 3-1, "Protection Against Postulated Piping Failures in Fluid System Piping Outside Containment." Evaluation of protection against dynamic effects associated with the postulated pipe system failures is covered in Section 3.6 of this report.

The scope of review of the turbine bypass system included drawings, piping and instrumentation diagrams and descriptive information of the system in section 10.4.4 of the FSAR.

The basis for acceptance in the staff review was conformance of the design criteria and bases and design of the turbine bypass system to the acceptance criteria in Section II of Standard Review Plan 10.4.4 and industry standards.

Based on our review we conclude that the turbine bypass system is in conformance with the above cited criteria and design bases. It can perform its designed function, and is, therefore, acceptable after the six open items identified above have been pursued with the applicant and satisfactorily clarified. The results will be reported in a supplement to this report.