SMUD

SACRAMENTO MUNICIPAL UTILITY DISTRICT

RANCHO SECO NUCLEAR GENERATING STATION
UNIT NO. 1

PRELIMINARY SAFETY ANALYSIS REPORT
Volume III

NOVEMBER 1967

Docket No. 50-312
February 2, 1968

AMENDMENT NO. 1

SACRAMENTO MUNICIPAL UTILITY DISTRICT

RANCHO SECO NUCLEAR GENERATING STATION

UNIT NO. 1

Amendment No. 1 to the Sacramento Municipal Utility District's Preliminary Safety Analysis Report includes both replacement pages and new pages and tabs. All pages to be inserted are identified as Amendment 1. Any technical text material changed by this amendment is coded in the outside margin by a black bar and the numeral one.

Before inserting the Amendment 1 material (contained in this new Volume V) in the different volumes, it is suggested that the Appendix 5 material be removed from Volume IV to provide space. After the Amendment 1 material has been inserted, Appendix 3 should be the first amendment in the new Volume V. The List of Effective Pages should be checked to verify the completeness of Volumes I thru V.

It should be noted that License Application page 4 is replaced with a new page 4 plus two new additional pages, 8 and 9.

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April 15, 1968

AMENDMENT NO. 2

SACRAMENTO MUNICIPAL UTILITY DISTRICT

RANCHO SECO NUCLEAR GENERATING STATION

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Amendment No. 2 to the Sacramento Municipal Utility District's Preliminary Safety Analysis Report includes both replacement pages and new pages and tabs. All pages to be inserted are identified as Amendment 2, except the reprinted appendices. Any technical text material changed by this amendment is coded in the outside margin by a black bar and the numeral two.

Before inserting the Amendment 2 material in the different volumes, it is suggested that Appendices 2A, 2C, 2D and 2E be removed from Volume IV, discarded and replaced with the new reprinted appendices 2A, 2C, 2D, and 2E. Additionally, remove Appendices 3 and 4 (including tabs) from Volume V and place at the back of Volume IV. The list of Effective Pages should be checked to verify the completeness of Volumes I thru V.

It should be noted that three new additional pages, 10, 11 and 12 are to be added to the License Application.

The response to letter from Peter A. Morris, Director, Division of Reactor Licensing to E. K. Davis, General Counsel, Sacramento Municipal Utility District, dated March 21, 1968, is arranged in the question order of the above letter. For convenience a cross reference of the AEC DRL question number and SMUD response number is presented below. Response to questions are to be inserted into the volumes according to the assigned SMUD number.

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10. STEAM AND POWER CONVERSION SYSTEM

10.1 DESIGN BASES

10.1.1 OPERATING AND PERFORMANCE REQUIREMENTS

The steam and power conversion system for the unit will be designed to remove heat energy from the reactor coolant in the two steam generators and convert it to electrical energy. The closed feedwater cycle will condense the steam, and the heated feedwater will be returned to the steam generators. The entire system will be designed for the maximum expected energy (2584 Mwt) from the nuclear steam supply system.

Upon loss of full load, the system will dissipate all the energy existent or produced in the reactor coolant system through steam relief to the condenser and the atmosphere. The unit will be designed to maintain station auxiliary load without a reactor trip on loss of full load. The steam bypass to the condenser and atmospheric relief valves will be utilized as necessary to achieve this load reduction.

10.1.2 ELECTRICAL SYSTEM CHARACTERISTICS

The station will be designed for load following operation. The maximum rate of change of load is noted in 10.1.3.

10.1.3 FUNCTIONAL LIMITATIONS

The rate of change of reactor power will be limited to values consistent with the characteristics of the reactor coolant system and its control systems. These limitations in the reactor coolant system will be reflected as functional limitations in the steam and power conversion system. Increasing reactor power transients between 20 and 90 percent of full load will be limited to ramp changes of 10 percent per minute and step increases of 10 percent. Power variations above 90 percent will be limited to 3 percent per minute. Decreasing reactor power transients between 90 and 20 percent of full load will be limited to ramp changes of 10 percent per minute and step decreases of 10 percent.

10.1.4 SECONDARY FUNCTIONS

The steam and power conversion system will provide steam for driving the two one-half capacity feedwater pumps. Steam will also be used for the condenser air removal equipment, gland steam seal system, the radwaste process equipment, and the 5 percent emergency feedwater pump when required.

10.2 SYSTEM DESIGN AND OPERATION

10.2.1 SCHEMATIC FLOW DIAGRAM

The steam and power conversion system is shown in Figure 10.2-1. The closed cycle feedwater heaters will be half-size units (two parallel strings). De-aeration will be accomplished in the condenser hotwell. A bypass of 15 percent of full load main steam flow to the condenser will be provided.

Three one-half capacity condensate pumps will be in normal use at all times to avoid tripping of the unit if one condensate pump is lost. Each of the two feedwater pumps will be at least one-half capacity.

There will be a total of five minutes condensate storage at full load in the condenser hotwells.

There will also be two 5 percent capacity, emergency feedwater pumps, one turbine driven and one motor driven, which take suction from the condensate train or condensate storage tank and pump to the steam generators. Steam for the turbine drive will come from the main steam line and from the hot reheat line.

The main steam lines and the feedwater lines will be the only lines of the steam and power conversion system which penetrate the reactor building. These lines can be isolated by the main stop valves and the feedwater line valving. Each of the lines or common header leaving the main steam line before the main stop valves has valves to complete the isolation of a steam generator. These lines are: 2

a. Steam bypass

b. Steam relief valves to atmosphere

c. Supply to steam reheaters

d. Supply header to condenser, feed pump turbines, air ejectors, emergency feed pump turbine, gland steam seal system, and radwaste system

10.2.2 CODES AND STANDARDS

The turbine-generator equipment will conform to the applicable USASI, ASME and IEEE standards.

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The design, materials and details of construction of the feedwater heaters will be in accordance with both the ASME Code, Section VIII, "Unfired Pressure Vessels," and the Standards of Feedwater Heater Manufacturers' Association, Inc.

The condenser equipment will be in accordance with the Standards for Steam Surface Condensers as published by the Heat Exchange Institute.

10.2.3 DESIGN FEATURES

The condenser air ejector off-gas will be continuously monitored with an alarm to indicate high radiation levels. The air ejector off-gas will be released through the plant vent, as will the feedwater heater relief valve line.

10.2.4 SHIELDING

No radiation shielding will be required for the components of the steam and power conversion system. Continuous access to the components of this system will be possible during normal conditions.

10.2.5 CORROSION PROTECTION

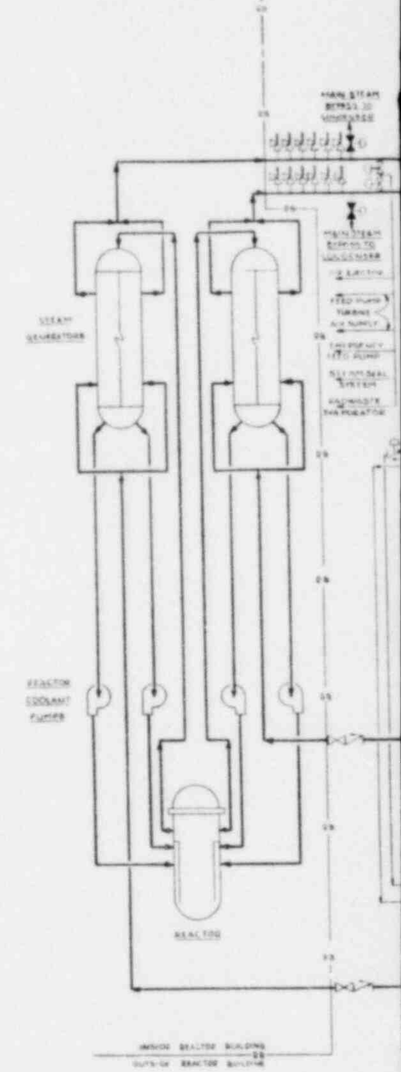
Hydrazine will be added to the feedwater for oxygen control, and ammonia will be used to maintain the pH at the optimum value for the materials of construction for the system. No other additives are contemplated.

10.2.6 IMPURITIES CONTROL

Impurities in the steam and power conversion system will be controlled by a polishing demineralizer sized for at least one-half flow. The makeup water to the steam and power conversion system will be treated by a separate demineralizer.

10.2.7 RADIOACTIVITY

Under normal operating conditions, there will be no radioactive contaminants present in the steam and power conversion system. It is possible for this system to become contaminated only through steam generator tube leaks. In this event, monitoring of the steam generator shell side sample points and the air ejector off-gas will detect any contamination. Leakage of radioactivity from the condensate system into the cooling water system cannot occur. The circulating water pressure will be greater than 20 psig because of the head developed for the cooling towers.


MAIN STEAM BYPASS TO CONDENSER
STEAM GENERATORS
FEED PUMP TURBINE
REACTOR COOLANT PUMPS
REACTOR
INSIDE REACTOR BUILDING
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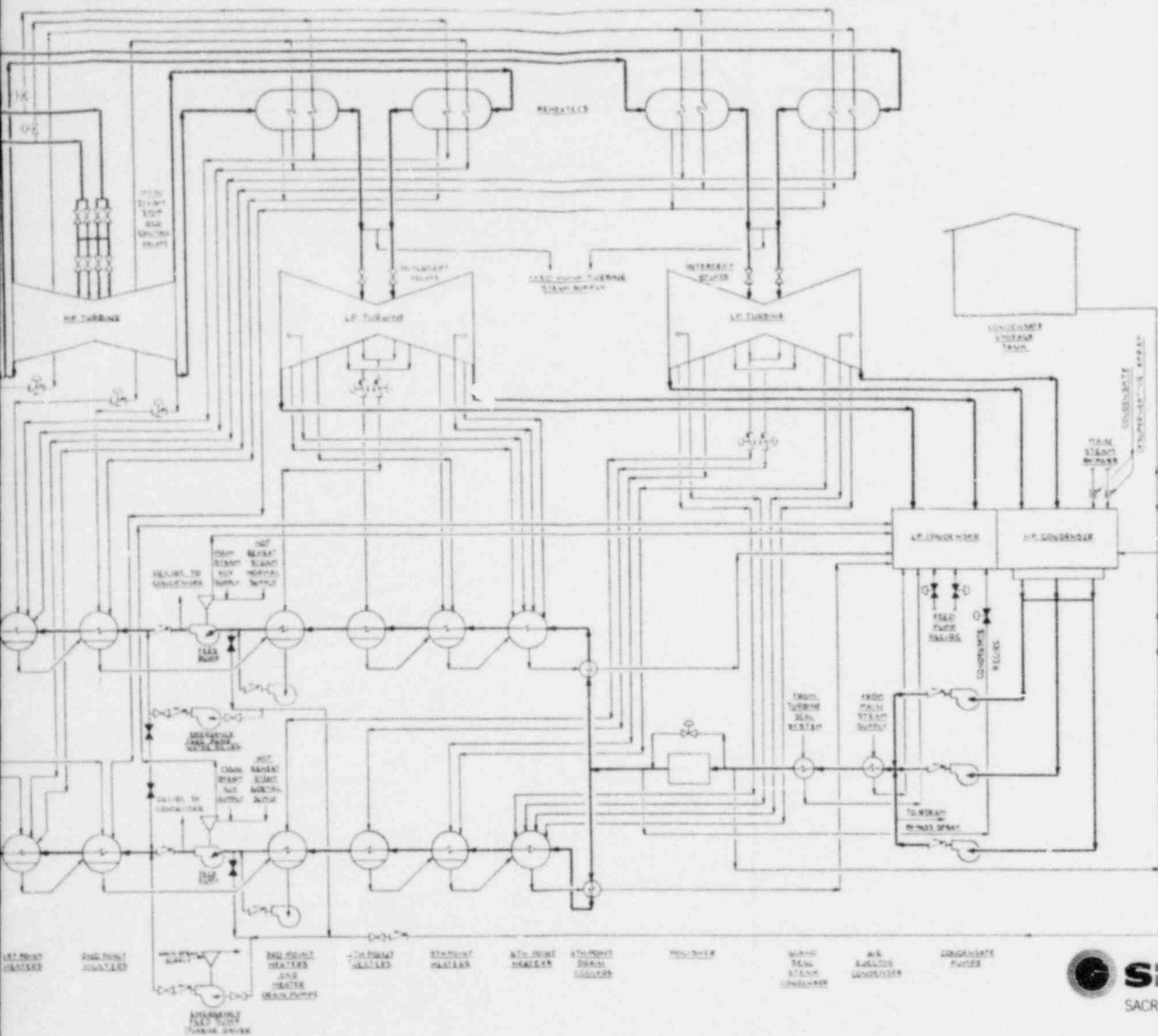

FIGURE 10.2-1
STEAM AND POWER
CONVERSION SYSTEM

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SACRAMENTO MUNICIPAL UTILITY DISTRICT

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10.3 SYSTEM ANALYSIS

10.3.1 TRIPS, AUTOMATIC CONTROL ACTIONS, AND ALARMS

Trips, automatic control actions, and alarms will be initiated by deviations of system variables within the steam and power conversion system. In the case of automatic corrective action in the steam and power conversion system, appropriate corrective action will be taken to protect the reactor coolant system. The more significant malfunctions or faults which cause trips, automatic actions or alarms in the steam and power conversion system are:

a. Turbine Trips

(1) Generator/electrical faults

(2) Loss of condenser vacuum

(3) Thrust bearing wear

(4) Loss of both feedwater pumps

(5) Turbine overspeed

(6) Reactor trip

b. Automatic Control Actions

(1) Feedwater flow lagging feedwater demand results in a reduction in power output.

(2) Low feedwater temperature results in a reduction in power output.

(3) High level in steam generator results in a reduction in feedwater flow.

(4) Low level in steam generator results in an increase in feedwater flow.

c. Principal Alarms

(1) Low pressure at feedwater pump suction

(2) Low vacuum in condenser

(3) Low water level in condenser hotwell

(4) High water level in condenser hotwell

(5) High water level in steam generator

(6) Low water level in steam generator

(7) High pressure in steam generator

(8) Low pressure in steam generator

(9) Low feedwater temperature

10.3.2 TRANSIENT CONDITIONS

The analysis of the effects of loss of full load on the reactor coolant system is discussed in 14.1.2.8. Analysis of the effects of partial loss of load on the reactor coolant system is discussed in 7.2.3.4.

10.3.3 MALFUNCTIONS

The effects of inadvertent steam relief or steam bypass are covered by the analysis of the steam line failure given in 14.1.2.9. The effects of an inadvertent rapid throttle valve closure are covered by the loss of full load discussion in 14.1.2.8.

10.3.4 OVERPRESSURE PROTECTION

Pressure relief is required at the system design pressure of 1050 psig, and the first safety valve bank will be set to relieve at this pressure. The design pressure is based on the operating pressure of 925 psia plus a ten percent allowance for transients and a four percent allowance for blowdown. Additional safety valve banks will be set at pressures up to 1104 psig, as allowed by the ASME Code.

The pressure relief capacity will be such that the energy generated at the reactor high power level trip setting can be dissipated through this system.

10.3.5 INTERACTIONS

Following a turbine trip, the control system will reduce reactor power output immediately. The safety valves will relieve excess steam until the output is reduced to the point at which the steam bypass to the condenser can handle all the steam generated.

In the event of failure of a single feedwater pump, there will be an automatic runback of the power output. The one feedwater pump remaining in service will carry approximately 60 percent of full load feedwater flow with feedwater to individual steam generators proportioned by control valves. If both feedwater pumps fail, the turbine will be tripped, and the emergency feedwater pump started. If reactor coolant system conditions reach trip limits, the reactor will trip.

10.3.6 OPERATIONAL LIMITS

The air ejector off-gas will be monitored for radioactivity, and safe operating limits will be established for the station.

10.4 TESTS AND INSPECTIONS

As is essential in successful operation of any modern power station, frequent functional operational checks will be made on vital valves, control systems and protective equipment.

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