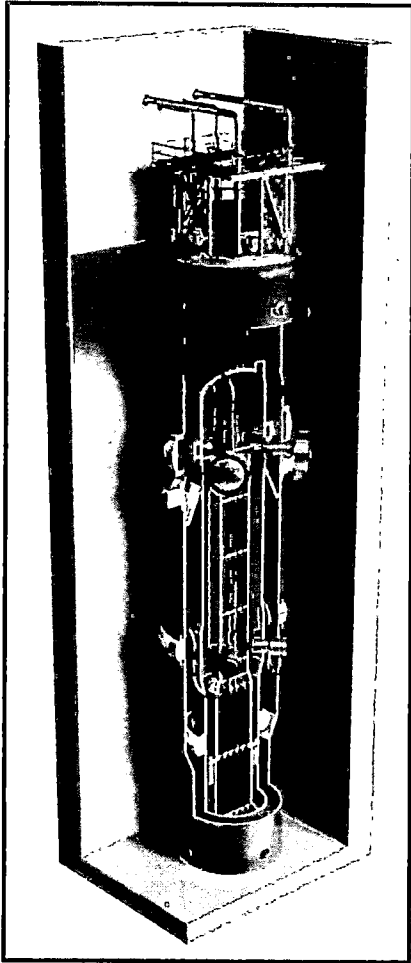


**Enclosure 1:**

"ACRS Presentation Chapter 10 – Steam and Power Conversion System," PM-0219-64501, Revision 0

NuScale Nonproprietary

# NuScale FSAR Tier 2, Ch. 10 ACRS Presentation



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Revision: 0

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Template #: 0000-21727-F01 R5

# Acronyms

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ABS: Auxiliary Boiler System  
CARS: Condenser Air Removal System  
CFWS: Condensate and Feedwater System  
CNTS: Containment System  
COL: Combined Operating License  
CPS : Condensate Polishing System  
CWS: Circulating Water System  
DCA: Design Certification Application  
DHR HX: Decay Heat Removal Heat Exchanger  
EPRI: Electric Power Research Institute  
FAC: Flow-accelerated Corrosion  
FW: Feedwater  
FWRV: Feedwater Regulation Valve  
FWT : Feedwater Treatment System  
GDC: General Design Criteria  
HP: High Pressure  
IP: Intermediate Pressure  
ITAAC: Inspections, Tests, Analyses, and Acceptance Criteria  
LP: Low Pressure

MC: Main Condenser  
MS: Main Steam  
MSIBV: Main Steam Isolation Bypass Valve  
MSIV: Main Steam Isolation Valve  
MSS: Main Steam System  
MSSV: Main Steam Safety Valve  
NEI: Nuclear Energy Institute  
NS: Non safety-related  
NSAC: Nuclear Safety Analysis Center  
PDC: Principal Design Criteria  
RG: Regulatory Guide  
RIT: Radiation Indicating Transmitter  
RT: Radiation Transmitter  
RXB: Reactor Building  
SR: Safety-related  
SG: Steam generator  
TEWAC: Totally Enclosed Water to Air Cooled  
TG: Turbine generator  
TGS: Turbine Generator System  
VFD: Variable Frequency Drive

# Ch. 10 - Topics

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- 10.1 Summary description
- 10.2 Turbine Generator
- 10.3 Main Steam Supply System
- 10.4 Other Features of Steam and Power Conversion System

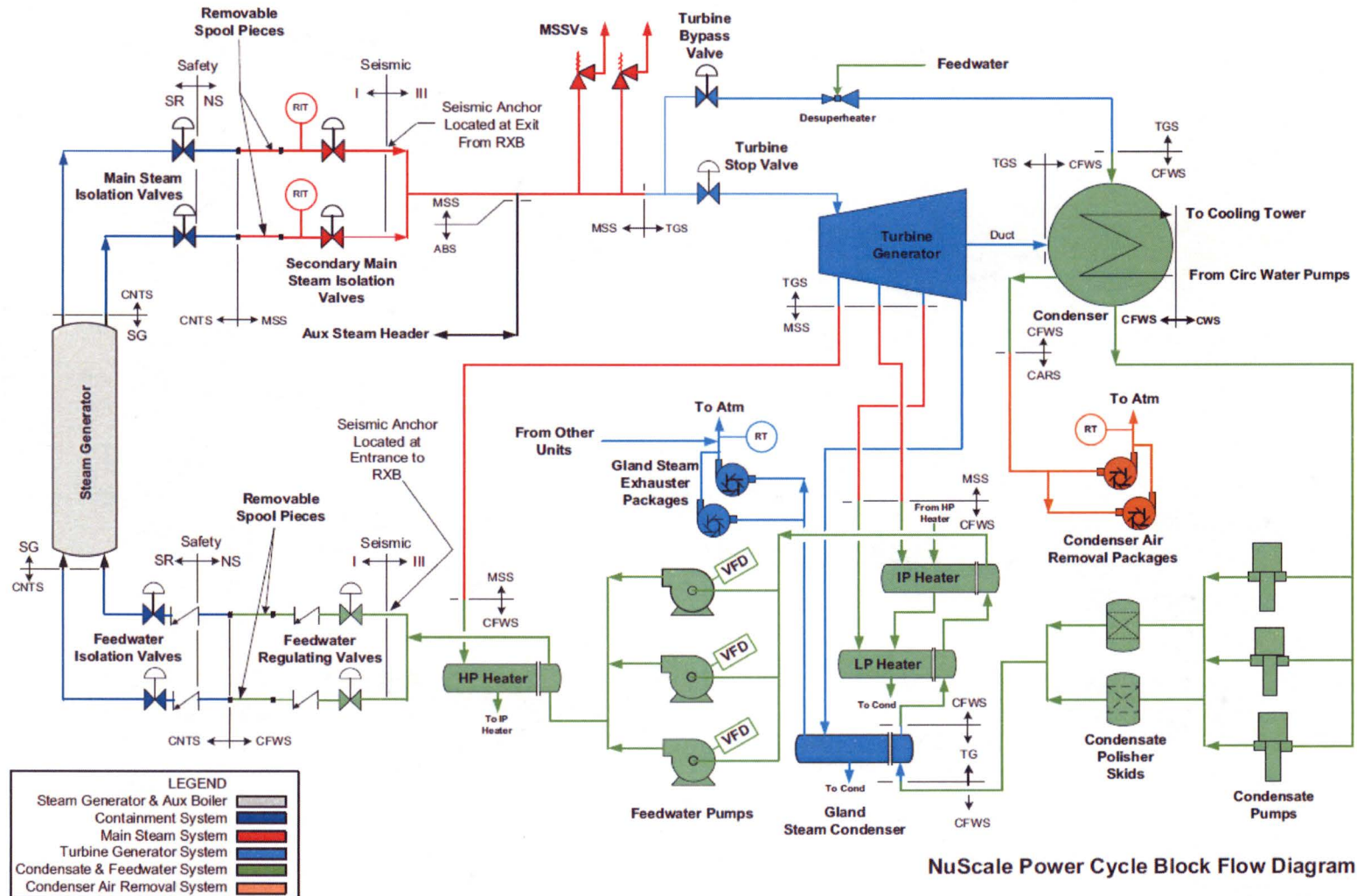
# Ch. 10.1 Summary Description

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- The NuScale steam and power conversion system is comprised of the following systems:
  - Turbine generator system
  - Main steam system
  - Main condenser
  - Condenser air removal system
  - Turbine gland sealing system
  - Turbine bypass system
  - Circulating water system
  - Condensate polishing system
  - Condensate and feedwater system
  - Auxiliary boiler system
  - Feedwater treatment system

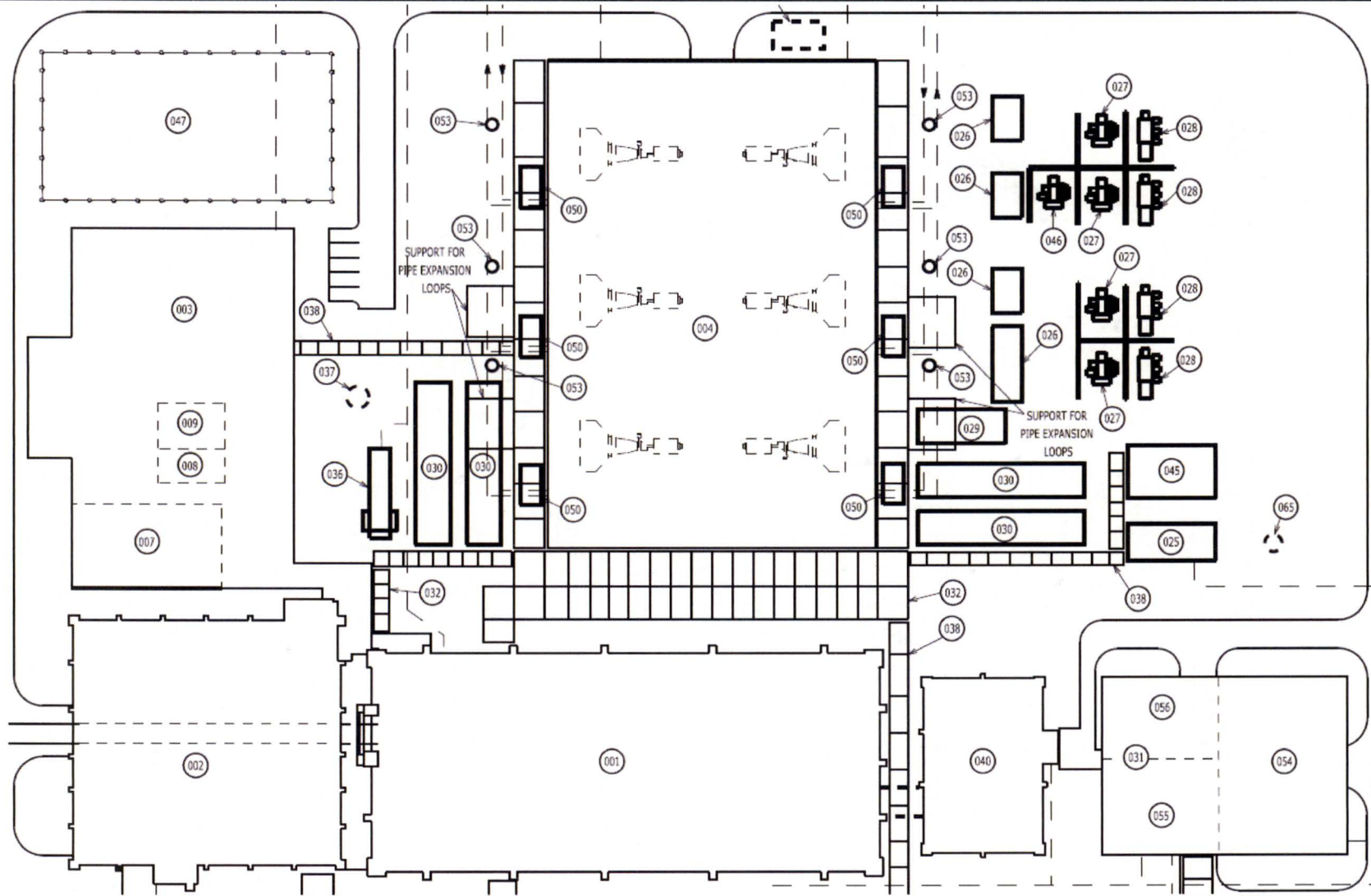
# Ch. 10.1 Summary Description

Figure 10.1-1: Power Conversion System Block Flow Diagram



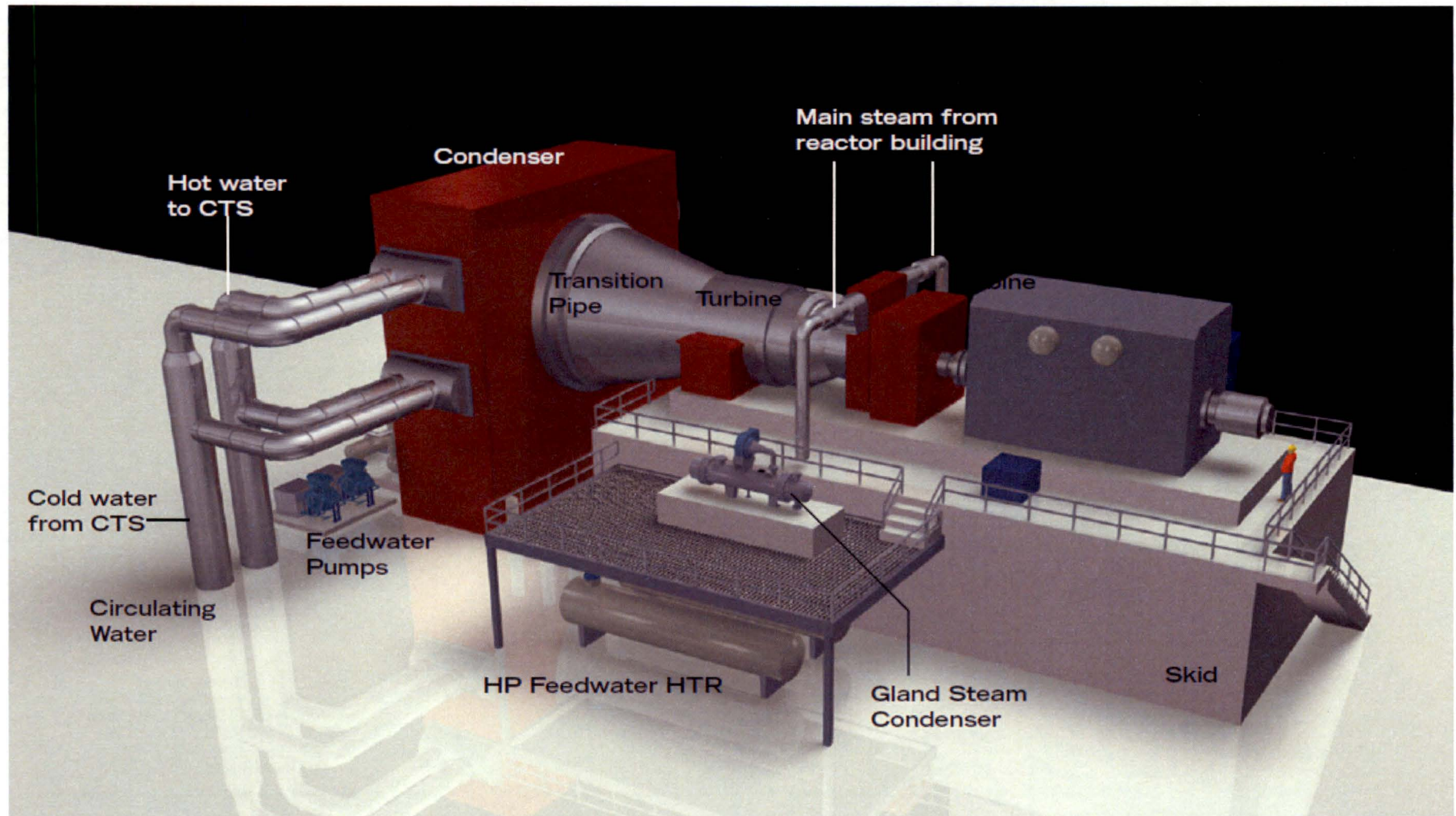
NuScale Power Cycle Block Flow Diagram

# Ch. 10.1 Summary Description





# Power Island Layout





# Ch 10.2 Turbine generator system

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- Converts thermal energy from SG into rotational energy
- Turbine control valves regulate steam flow from SG
- Generator directly coupled with turbine
- Vendor to be selected by COL applicant

Component	Parameter	Value
Turbine	Rotor	Single Turbine, 10 stage condensing
	RPM	3600 rpm
Generator	Power Output	50 MWe
	Cooling Type	TEWAC

# Missile Protection

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- Missile protection addressed in Section 3.5
  - All essential equipment located inside the reactor or control buildings
  - Barrier approach taken per RG 1.115 to credit reactor and control building walls as a missile barrier.
  - No missile generation probability analysis or rotor integrity program credited
  - Overspeed protection system similar in design to industry standard

# Turbine Bypass

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- Turbine bypass system
  - Capable of supplying 100% rated power steam flow to main condenser
  - Minimized potential for main steam release or reactor trip on load rejection

# 10.3 Main Steam System

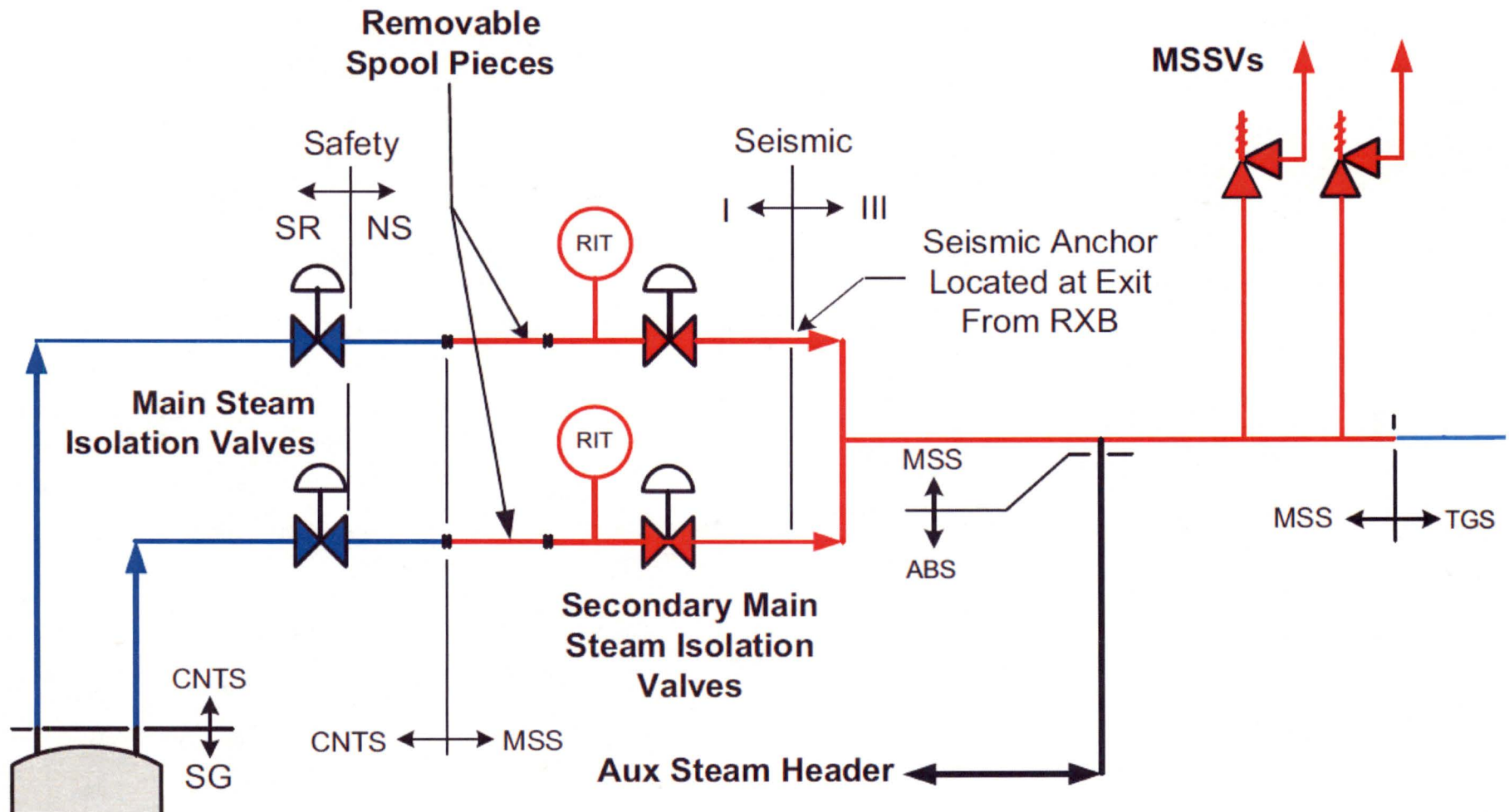
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- Main Steam System
  - Delivers steam from steam generators to:
    - Turbine generator
    - Gland seal regulator
    - Directly to condenser through bypass valve
  - Provides means of dissipating residual and sensible heat generated by module during hot standby and cooldown operations by bypassing turbine to main condenser
  - Transports extraction steam from turbine to feedwater heaters



# 10.3 Main Steam System

- Main Steam System Boundary



# 10.3 Main Steam System

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- Secondary steam isolations provided as backup to MSIVs
  - Nonsafety-related
  - Credited as backup protection for the safety-related isolations
  - Periodically tested per the Inservice Testing Program
  - Included within Technical Specifications
- Main Steam and Feedwater isolation valves are part of the containment system addressed in Chapter 6



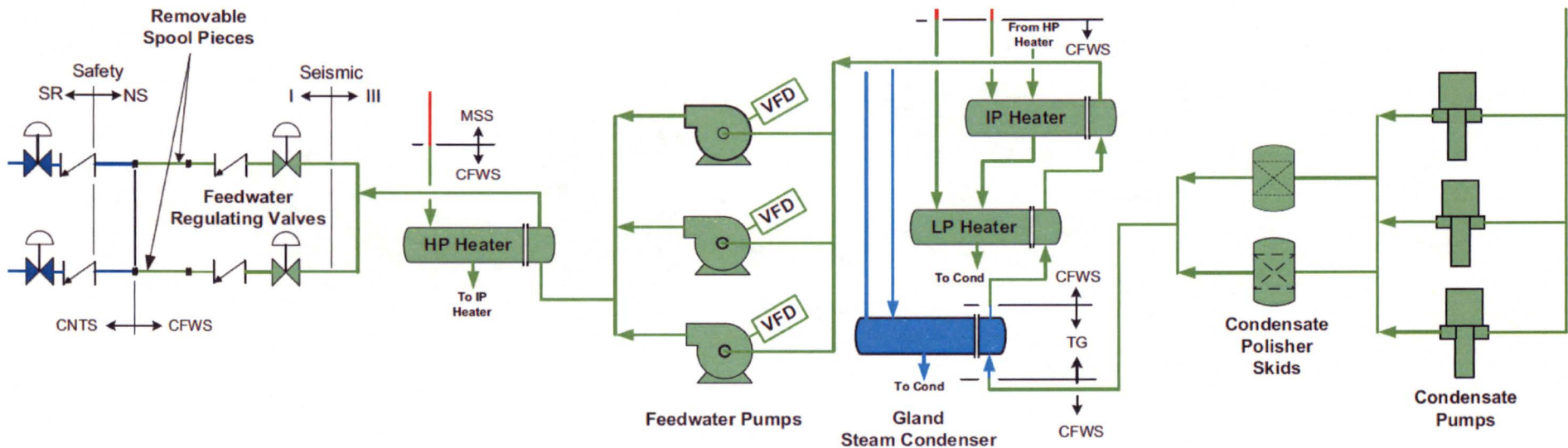
# 10.4 Other Features

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- Condensate and feedwater system (CFWS)
  - Supplies FW at necessary temperature, pressure, and chemistry to steam generator
  - Consists of:
    - Main Condenser
    - Condensate storage tank
    - Three feedwater pumps (2x 50% capacity, 1 on standby)
    - Three condensate pumps (2x 50% capacity, 1 on standby)
    - Three feedwater heaters (high, intermediate, and low-pressure)
    - Feedwater regulating and check valves
    - Condensate polishing subsystem
    - Feedwater treatment subsystem

# 10.4 Other Features

- Condensate and Feedwater System Boundary



# 10.4 Other Features

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- Feedwater Regulating Valves (FWRV) and Backup Feedwater Check Valves
  - Nonsafety-related
  - Credited as backup protection for the safety-related isolations
  - Periodically tested per the Inservice Testing Program
  - Included within Technical Specifications

# 10.4 Other Features

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- Feedwater treatment and condensate polishing
  - Full flow condensate polishing
  - All volatile chemistry (amine to control pH, oxygen scavenger to control dissolved oxygen)
  - Controls erosion and corrosion of CFWS components by monitoring and maintaining pH and dissolved oxygen levels
  - Chemistry program based on current revision of the EPRI PWR Secondary Water Chemistry Guidelines and NEI 97-06 (Steam Generator Program)

# 10.4 Other Features

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- Circulating water system (CWS)
  - Provides cooling water to main condenser
  - Two identical circulating water systems, each providing cooling water to six main condensers

# 10.4 Other Features

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- Auxiliary boiler system (ABS)
  - Supplies steam to systems when main steam is not available or not preferred
  - High-pressure feeds module heatup system during startup
  - Low-pressure feeds turbine gland seals, main condenser for deaeration, and condensate polishing regeneration system



# Ch. 10 COL Items

Item No.	Description of COL Info Item
10.3-1	A COL applicant that references the NuScale Power Plant design certification will provide a site-specific chemistry control program based on the latest revision of the Electric Power Research Institute Pressurized Water Reactor Secondary Water Chemistry Guidelines and Nuclear Energy Institute (NEI) 97-06 at the time of the COL application.
10.3-2	A COL Applicant that references the NuScale Power Plant design certification will provide a description of the flow-accelerated corrosion monitoring program for the steam and power conversion systems based on Generic Letter 89-08 and the latest revision of the Electric Power Research Institute NSAC-202L at the time of the COL application.
10.4-1	A COL applicant that references the NuScale Power Plant design certification will determine the size and number of new and spent resin tanks in the condensate polishing system.
10.4-2	A COL applicant that references the NuScale Power Plant design certification will describe the type of fuel supply for the auxiliary boilers.
10.4-3	A COL applicant that references the NuScale Power Plant design certification will provide a secondary water chemistry analysis. This analysis will show that the size, materials, and capacity of the feedwater treatment system equipment and components satisfies the water quality requirements of the secondary water chemistry program described in Section 10.3.5, and that it is compatible with the chemicals used.

# Open Items

Item #	Summary Description
8.3-1	Related to requested exemption from GDC/PDC 34, "Residual Heat Removal," with respect to the system function of transferring residual and sensible heat from the reactor coolant system.

# Confirmatory Items (CI)

RAI Question #	NRC CI	Summary Description
10.03.06-5	10.3.6-1 10.3.6-3	Request to re-include text related to the FAC program into COL Item 10.3-2 and Section 10.3.6.3. The DCA was revised as requested.
10.03.06-6	None	Request to revise FSAR Tier 2, Section 10.3.6 to only discuss the non-safety related portions of the steam and power conversion systems. The DCA was revised as requested.
10.03.06-7	10.3.6-2	Request to revise the DCD to include justification describing how the NuScale SG program meets NEI 97-6 and EPRI SG management program guidance. The DCA was revised as requested.
10.04.06-7	None	Request to explicitly include EPRI Action Levels for secondary water chemistry into COL Item 10.3-1. NuScale considered the COL item adequate as written.
Conference Call	10.4.7-1	Request to include additional discussion on the role of maintenance and operating procedures on minimizing the occurrence of water hammer. The DCA was revised as requested.
Conference Call	10.4.11-1	Request to remove Table 10.4-22 and specify that tanks are constructed of corrosion resistant materials compatible with chemicals used. The DCA was revised as requested.

# RAIs

- Unresolved Closed

Question #	Summary Description
10.02-1	TGS – turbine overspeed trip setpoint, single failure criteria and protection against common cause failures
10.02-2	TGS – overspeed trip system diversity, defense-in-depth, trip logic, common components and impact of component failures
10.02.03-1	Request for ITAAC related to turbine rotor integrity/turbine missiles
10.02.03-2	Request for COL item related to a turbine inspection and testing program

- Waiting for Response/Supplemental

Question #	Summary Description
10.04.07-3	Request for COL item to provide operating and maintenance procedures to address water hammer issues for the CFWS
10.02-3	TGS – two independent diverse emergency overspeed protection trip systems

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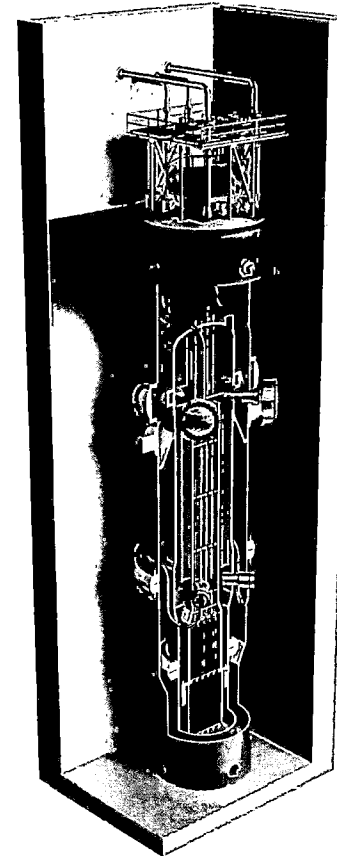
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# Backup Slides



# Heat Balance

**Figure 10.1-2: Flow Diagram and Heat Balance Diagram at Rated Power for Steam and Power Conversion System Cycle**

