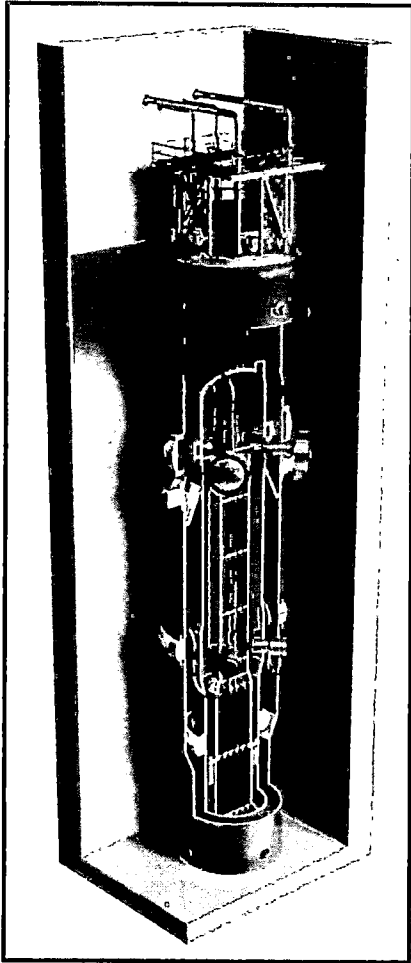


Enclosure 1:

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

NuScale Nonproprietary

NuScale FSAR Tier 2, Ch. 10 ACRS Presentation



Zack Houghton, P.E.

Mechanical Design Engineering Manager

February 20th, 2019

PM-0219-64501

Revision: 0

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Template #: 0000-21727-F01 R5

Acronyms

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

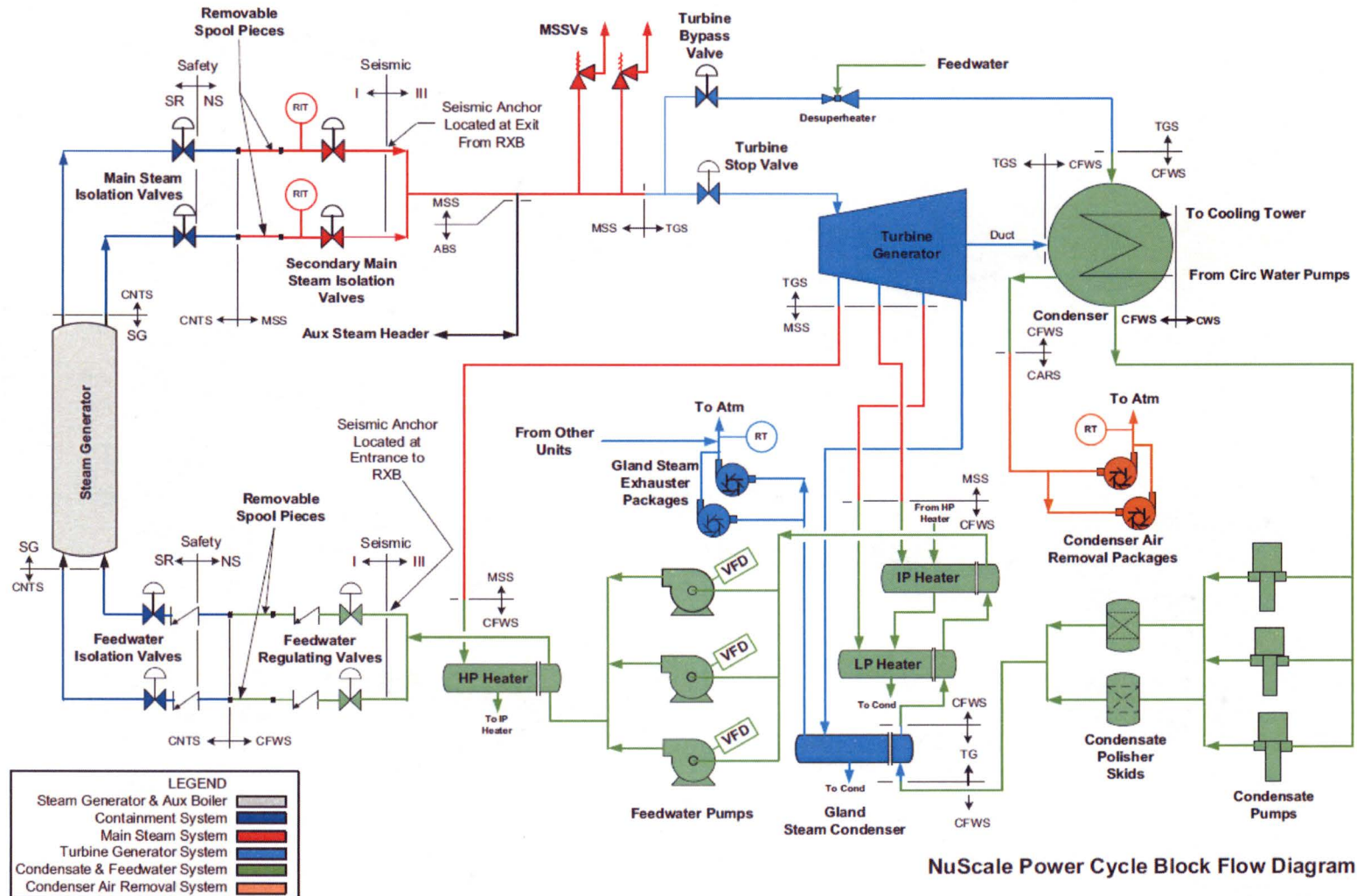
- 10.1 Summary description
- 10.2 Turbine Generator
- 10.3 Main Steam Supply System
- 10.4 Other Features of Steam and Power Conversion System

Ch. 10.1 Summary Description

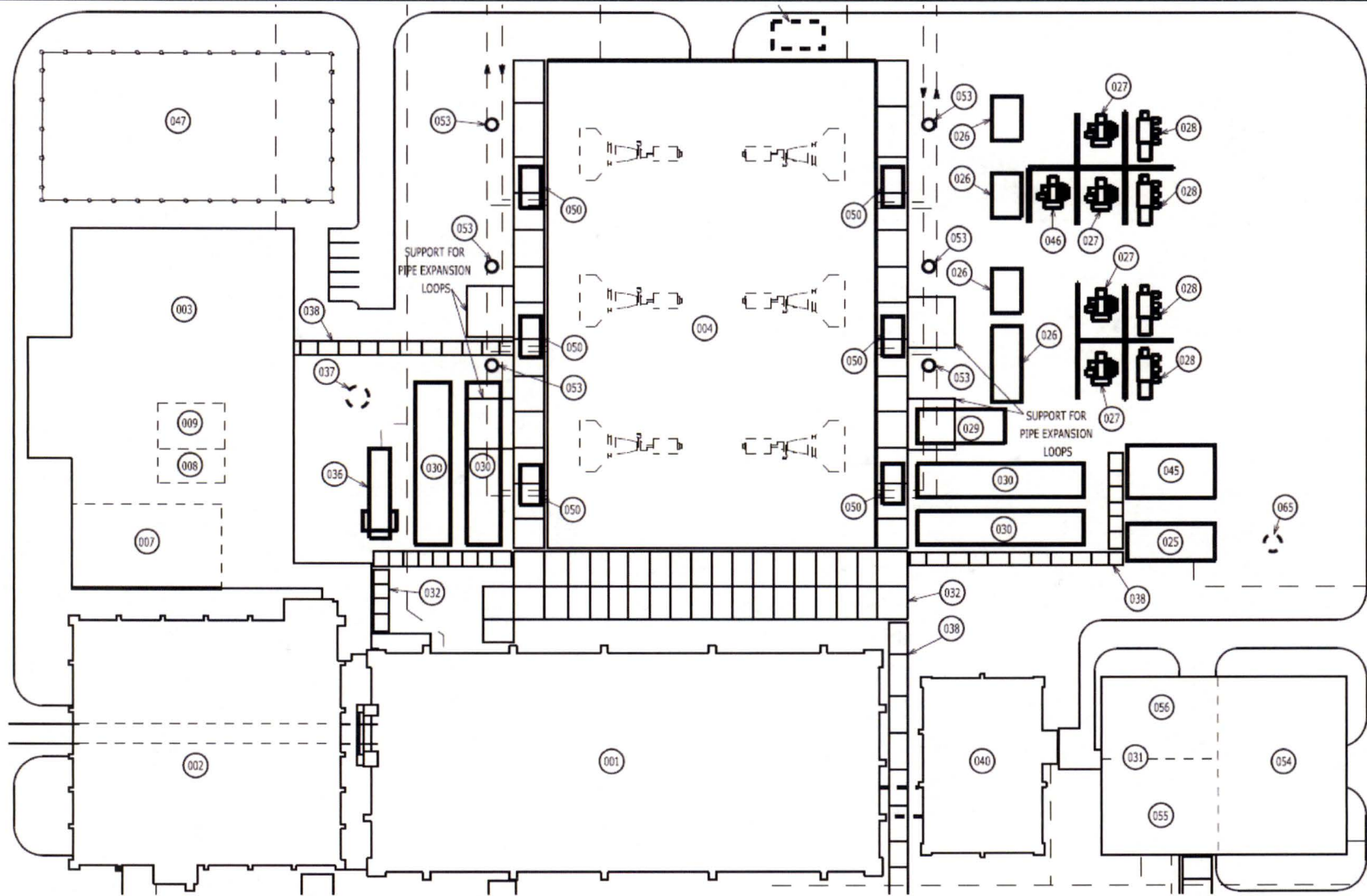
- The NuScale steam and power conversion system is comprised of the following systems:
 - Turbine generator system
 - Main steam system
 - Main condenser
 - Condenser air removal system
 - Turbine gland sealing system
 - Turbine bypass system
 - Circulating water system
 - Condensate polishing system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

Ch. 10.1 Summary Description

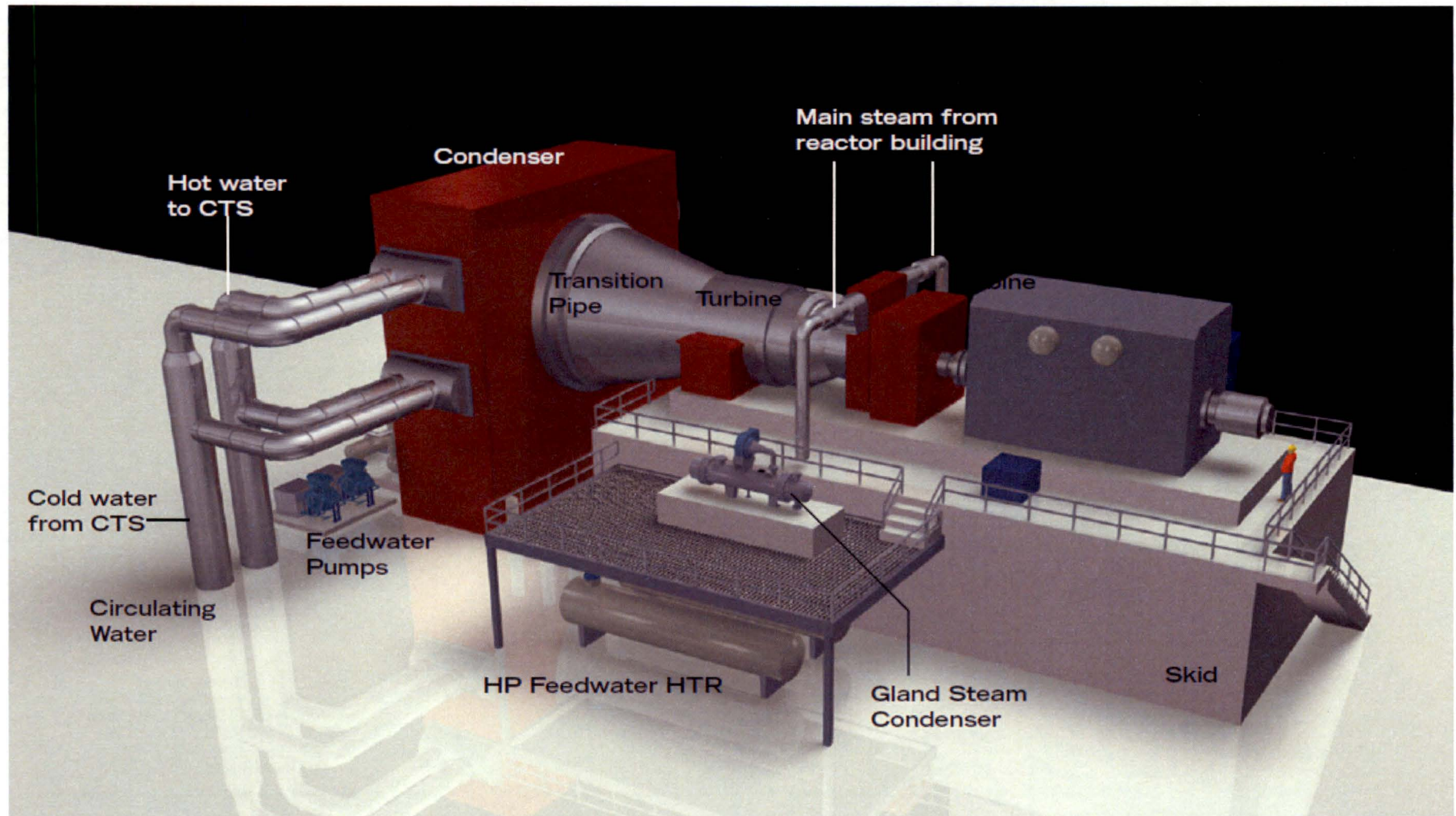
Figure 10.1-1: Power Conversion System Block Flow Diagram



Ch. 10.1 Summary Description



Power Island Layout



Ch 10.2 Turbine generator system

- 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

- 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

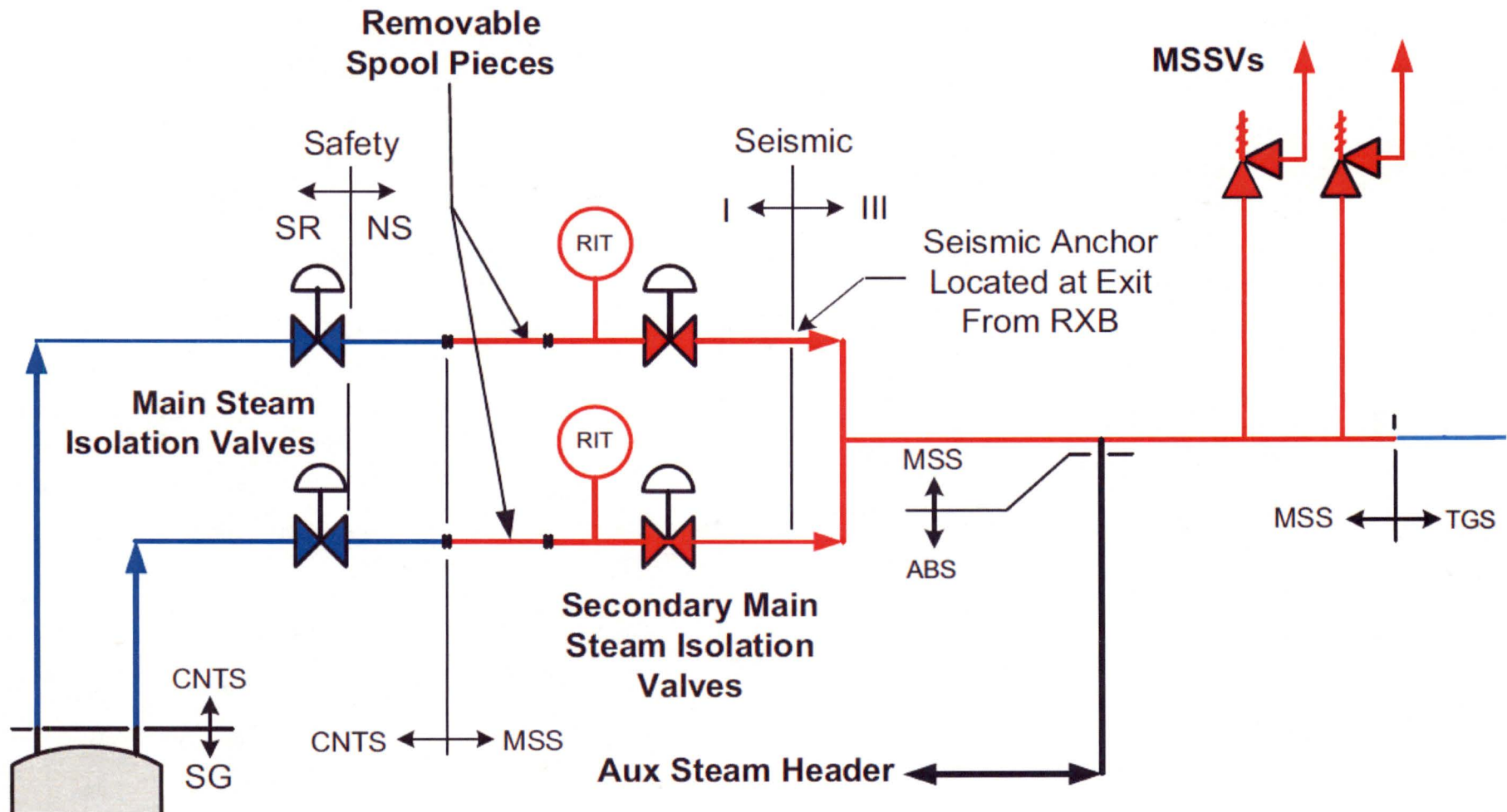
- Turbine bypass system
 - Capable of supplying 100% rated power steam flow to main condenser
 - Minimized potential for main steam release or reactor trip on load rejection

10.3 Main Steam System

- 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

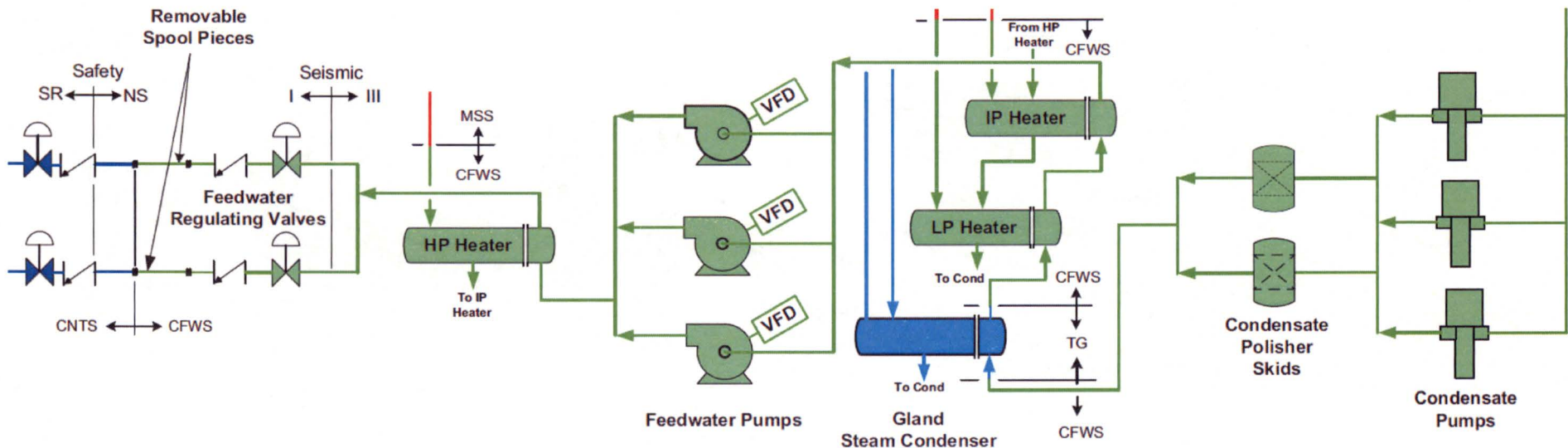
- Secondary steam isolations provided as backup to MSIVs
 - Nonsafety-related
 - Credited as backup protection for the safety-related isolations
 - Periodically tested per the Inservice Testing Program
 - Included within Technical Specifications
- Main Steam and Feedwater isolation valves are part of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

10.4 Other Features

- 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

- 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

- 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

- 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

- 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

Portland Office

6650 SW Redwood Lane,
Suite 210
Portland, OR 97224
971.371.1592

Corvallis Office

1100 NE Circle Blvd., Suite 200
Corvallis, OR 97330
541.360.0500

Rockville Office

11333 Woodglen Ave., Suite 205
Rockville, MD 20852
301.770.0472

Charlotte Office

2815 Coliseum Centre Drive,
Suite 230
Charlotte, NC 28217
980.349.4804

Richland Office

1933 Jadwin Ave., Suite 130
Richland, WA 99354
541.360.0500

Arlington Office

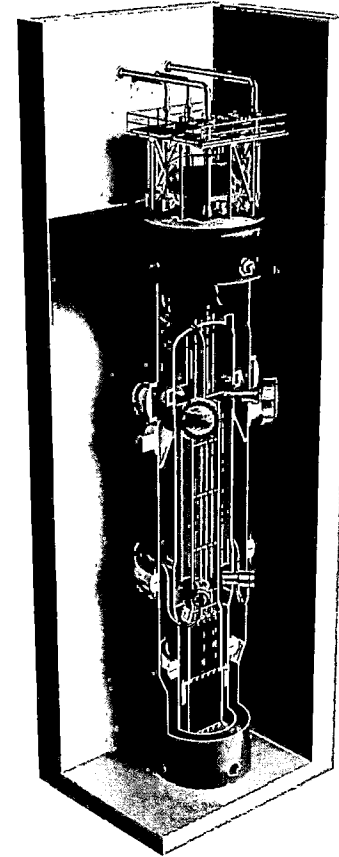
2300 Clarendon Blvd., Suite 1110
Arlington, VA 22201

London Office

1st Floor Portland House
Bressenden Place
London SW1E 5BH
United Kingdom
+44 (0) 2079 321700

<http://www.nuscalepower.com>

Twitter: @NuScale_Power



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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

Ambient pressure 14.7 psia
Ambient temperature 80 F
Ambient relative humidity 61.18 %
Ambient wet bulb temperature 70 F
Steam Turbine Gross power 50462 kW
Steam Generator Total heat transfer to water side 150734 BTU/s

