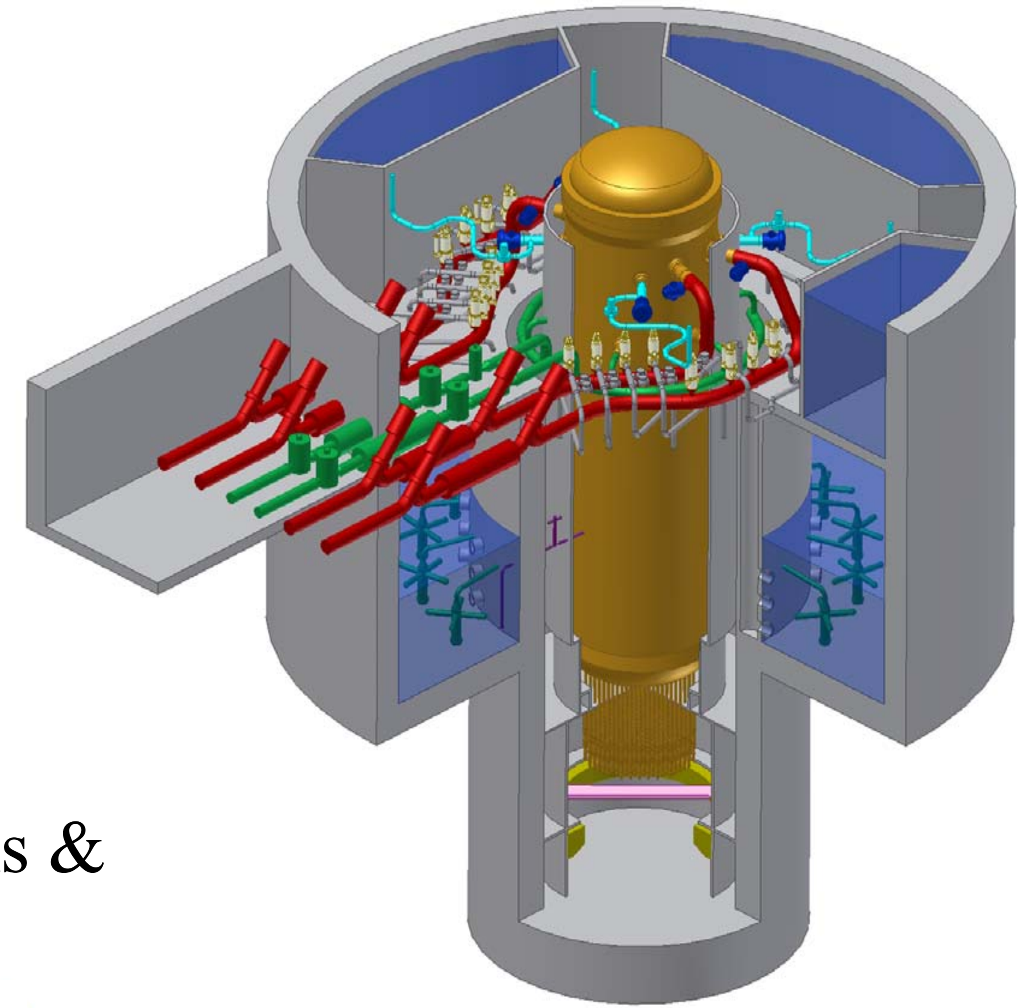


ESBWR Safety Systems & Piping Review

Jerry Deaver

March 9, 2005

imagination at work

Agenda

- Overview of Proposed Piping Analysis to Support Design Certification
- High Energy & Safety Related Mechanical Systems Review
  - Control Rod Drive System
  - Standby Liquid Control System
  - Passive Containment Cooling System
  - Gravity Driven Cooling System
  - Isolation Condenser Cooling System
  - Reactor Water Cleanup/Shutdown Cooling System
  - Nuclear Boiler System
- Containment Design
- ESBWR Piping Selected for Analysis and Proposed Extent of Analysis
- Piping Dynamic Load Comparison
- Environment Fatigue on Piping
- Piping Documentation to Support DCD
- Summary

Piping Analysis Approach for ESBWR Certification

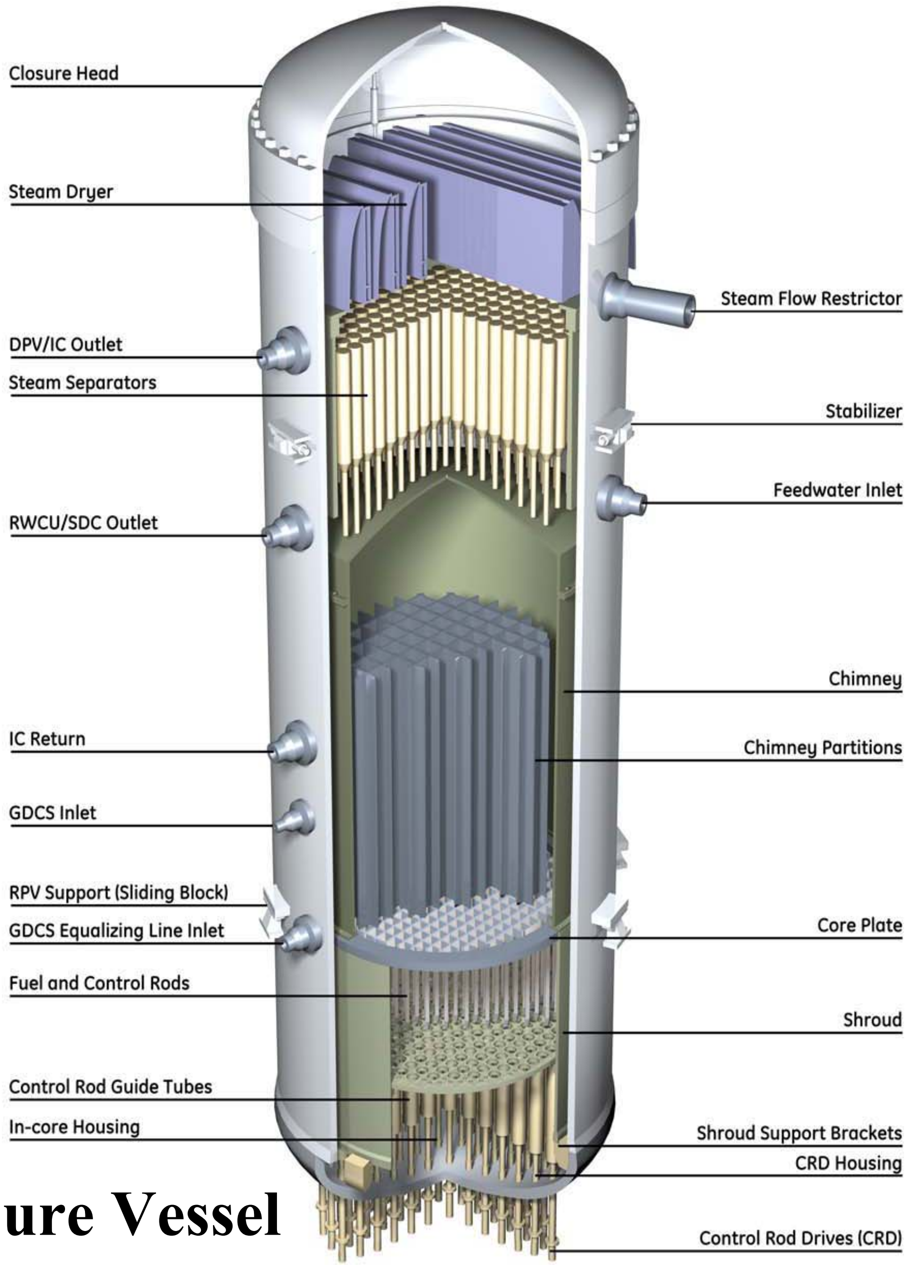
- ABWR Certification
  - Used Design Acceptance Criteria
    - No Thermal or Dynamic piping analysis submitted for review
    - Review focused on acceptance of methods to be used and Commitment to Follow Established Industry Standards
- ESBWR Approach
  - Perform Thermal Stress Analysis on lines of safety significance
    - use 80% Stress Ratio Limit Criteria & Fatigue Usage < 0.1
  - Plant Experience has Demonstrated that Thermal Stresses always Provide the Limiting Design Constraints
  - Once these are satisfied, Dynamic Loads can be Accommodated by Adjusting Piping Supports

Piping Analysis Approach for ESBWR Certification

- ESBWR Approach (cont'd)
  - Select Safety Significant Piping using Selection Criteria
  - Perform Thermal Stress Analysis using Stress Ratio and Fatigue Usage Criteria
  - Compare ESBWR Reactor Building Response Spectrum to Previous Plants to Assure Past Experience is Relevant
    - i.e. once thermal stresses are satisfied, dynamic loads can be accommodated by adjusting pipe supports

Piping Analysis Selection Criteria

1. High Energy Lines
2. High Thermal Expansion Differences between Anchor Locations
3. High Stressed Lines From Previous Experience
4. Large Pipe Size
5. Significant Thermal Transients (prior Experience)
6. ASME Class 1 (Inside Containment)



Reactor Pressure Vessel

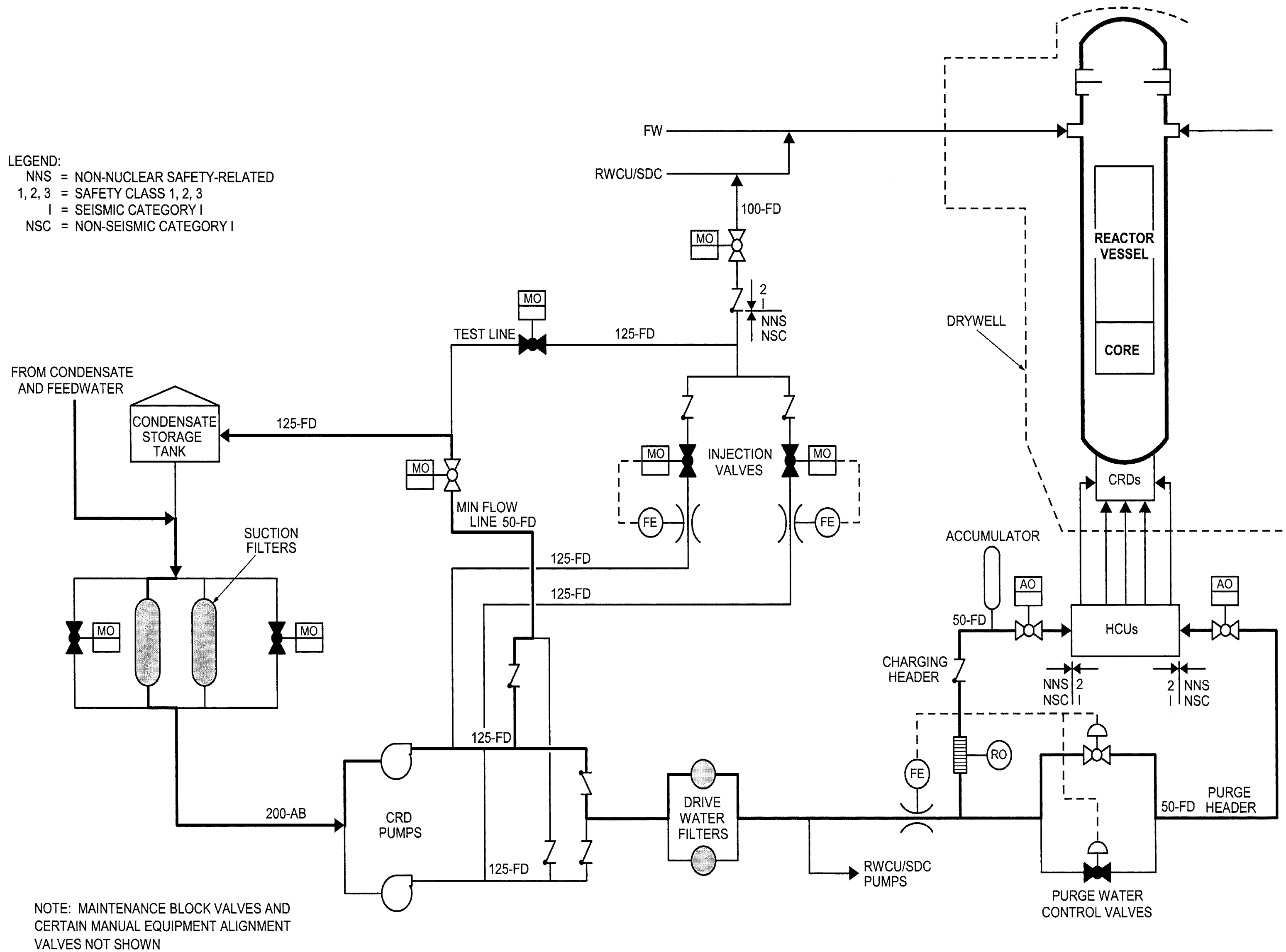
Pipe Selection Summary

System / Criterion →	**1**	**2**	**3**	**4**	**5**	**6**	**Analyze?**
Control Rod Drive System	Y	N	N	N	N	N	N
Standby Liquid Control System	Y	N	N	N	N	N	N
Passive Containment Cooling System	N	N	N	N	N	N	N
Gravity Driven Cooling System	Y, but Limited	N	N	N	Y	Y	N
Isolation Condenser Cooling System	Y	Y	Y	Y	N	Y	Y
Reactor Water Cleanup/Shutdown Cooling System	Y	Y	N	Y	N	Y	Y
Nuclear Boiler System							
Feedwater Lines	Y	Y	Y	Y	Y	Y	Y
Main Steam Lines	Y	Y	Y	Y	N	Y	Y

CRD System

Safety Related Functions

1. Scram in Response to Manual or Automatic Signals from Reactor Protection System
2. Detect Separation of Control Rod from Drive Mechanism
3. Prevent Control Rod Ejection from the Core due to Break in Drive Mechanism Pressure Boundary or Failure of attached Scram Line



Control Rod Drive System

CRD System Details

- System is the Same as Prior BWRs with Fine Motion Control Rod Drives (First used for ABWR)
  - Motor Driven to Adjust Position of CRDs
  - Hydraulic CRD Insertion by HCUs for Scram
- Since Fuel Bundles are 2’ shorter, CRD components are also 2’ shorter
- For Natural Circulation Plants, the CRD System Provides the Only Means to Change Reactor Power Levels

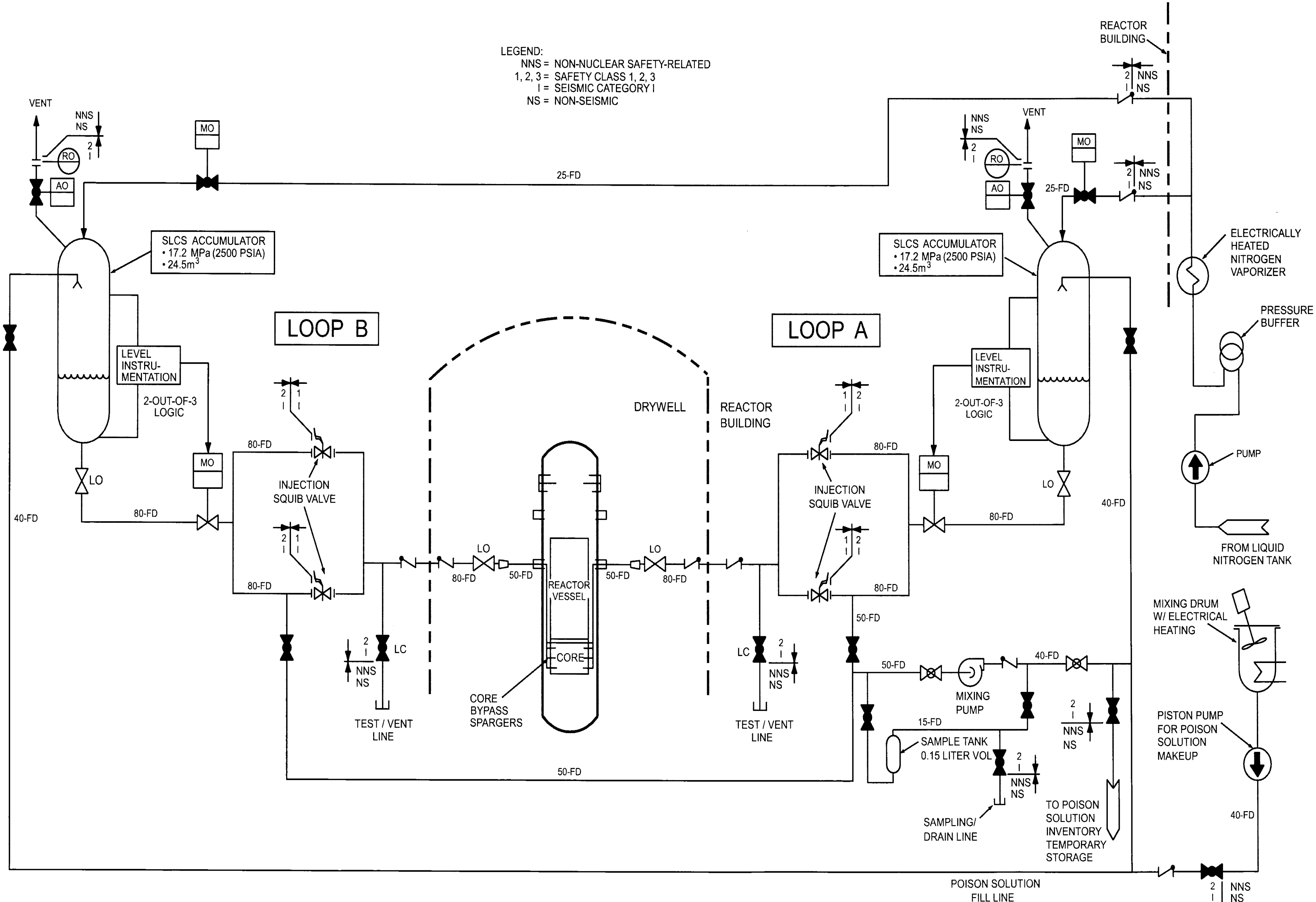
CRD Piping

- Only CRD Scram Lines (1.25”) are Inside Primary Containment
- Prior Evaluations have Exempted CRD Insert Lines from having Pipe Whip Restraints
- Piping Materials are Low Carbon Stainless Steel
- All Piping beyond CRD Pumps is Considered to be High Energy Lines (within Reactor Building)
- Not Necessary to do Piping Analysis for Design Certification
  - Small Line Size
  - Very Similar to Piping in Previous BWRs

Standby Liquid Control System

Safety Related Functions

- Provides Backup Function to CRD System for Reactivity Control to Shutdown Reactor



Standby Liquid Control System

SLC System Details

- Contains Two Separate but Identical Loops
- Each Loop Pressurized by Nitrogen Accumulator Tank Containing Sodium Pentaborate Solution (SPBS)
- Injection to RPV is Actuated by Squib Valves (2 valves in parallel - same as BWRs prior to ABWR)
- Piping from RPV to Squib Valves has the same Pressure & Temperature as RPV
- Design Pressure of Accumulator is 17.24 Mpa (2500 psi)
- Capable of Injecting 2060 Gallons of SPBS in 10 Minutes

SLC Piping

- Injection Portion of SLC Piping System is Classified as High Energy
- SLC Piping is 3” or Smaller
- Materials are Low Carbon Stainless Steel
- Not Necessary to do Piping Analysis to Support Design Certification

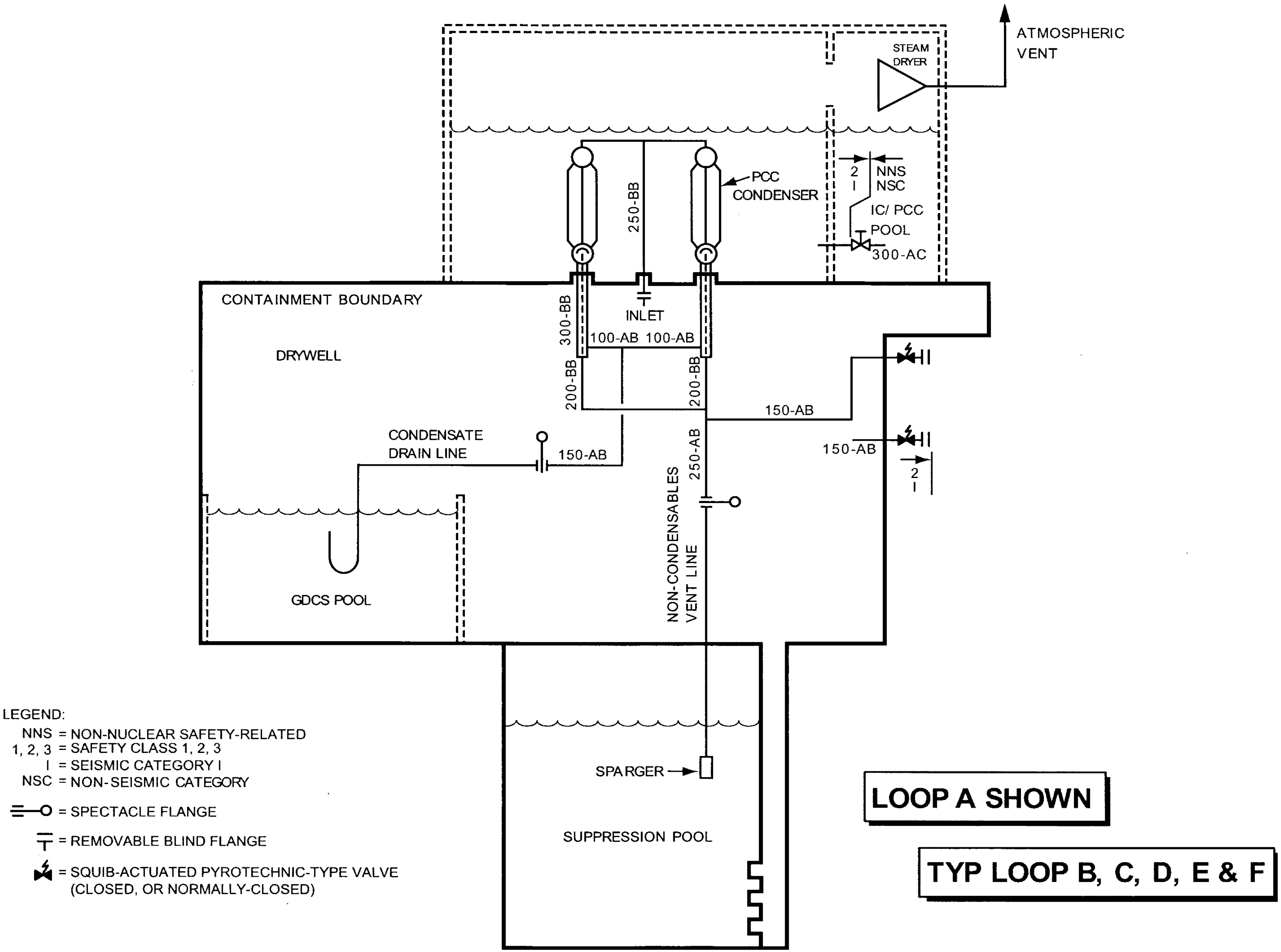
  - Small Pipe Size

  - Flexible Lines with Relatively Low RPV Differential Thermal Expansion

Passive Containment Cooling System

Safety Related Function

1. Provides Passive Heat Removal for the Containment to Keep it below its Design Pressure and Temperature



Passive Containment Cooling System

PCCS System Details

- PCCS Condensers are an Extension of the Containment Pressure Boundary
- Design Pressure = 758.5 kPa(g) (110 psig)

  Design Temperature = 171°C (340°F)
- Six Loops
- Condensate from Condenser Drains into Gravity Driven Pools
- Non-Condensables Vent to Suppression Pool

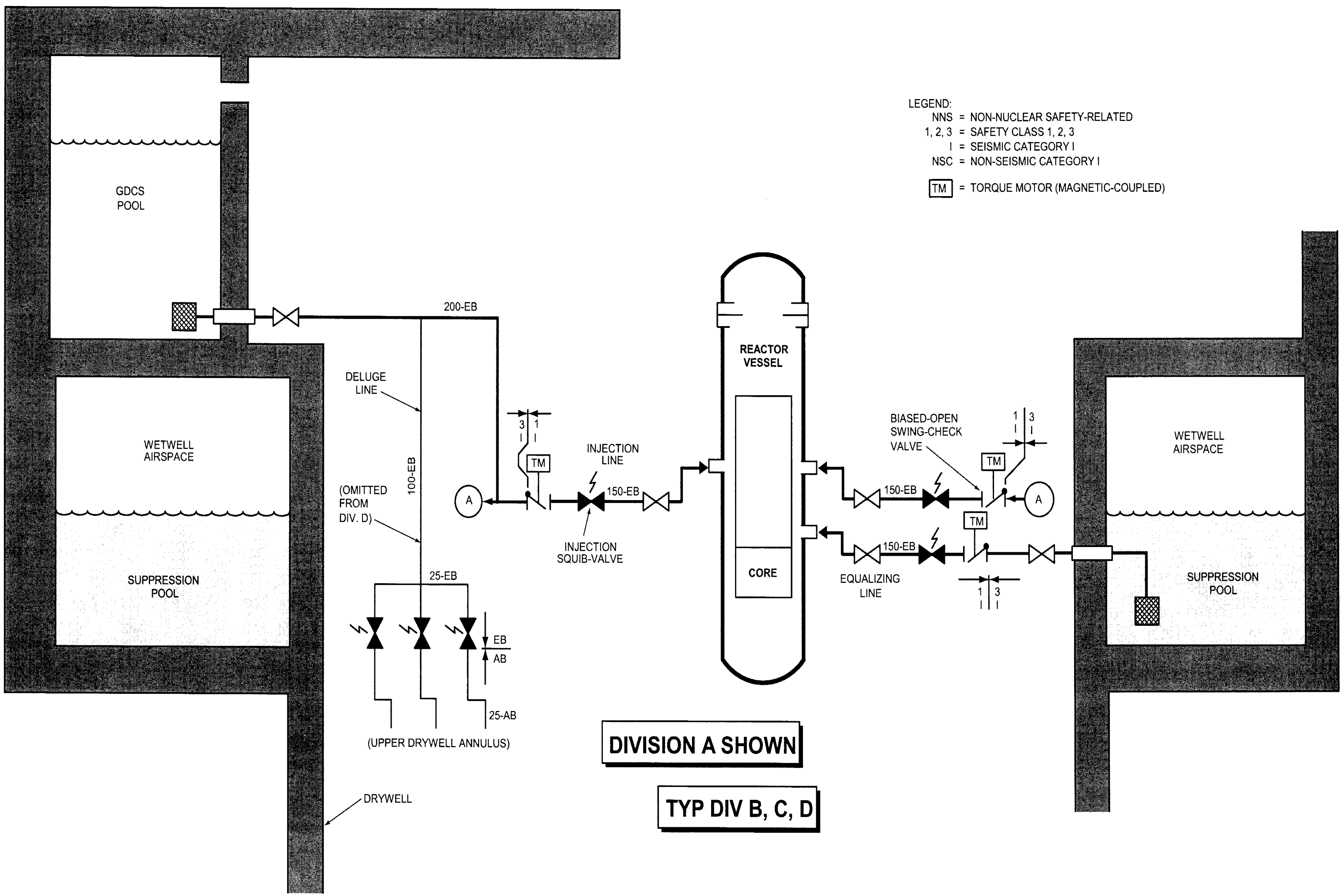
PCCS Piping

- Piping Sees Only Low Pressure and Temperature Conditions of the Containment
- Piping Materials are Stainless Steel
- Not Necessary to do Piping Analysis for Design Certification
  - Classified as Moderate Energy
  - Only used in Severe Accident Conditions

Gravity Driven Cooling System

Safety Related Functions

1. Provides Passive Emergency Core Cooling after any Event that Threatens Reactor Coolant Inventory following RPV Depressurization
2. Provide Passive Injection of Water to Keep Fuel Covered following a LOCA
3. In the Event of a Severe Accident with High Temperature in the Lower Drywell, Flooding is Provided below RPV



Gravity-Driven Cooling System

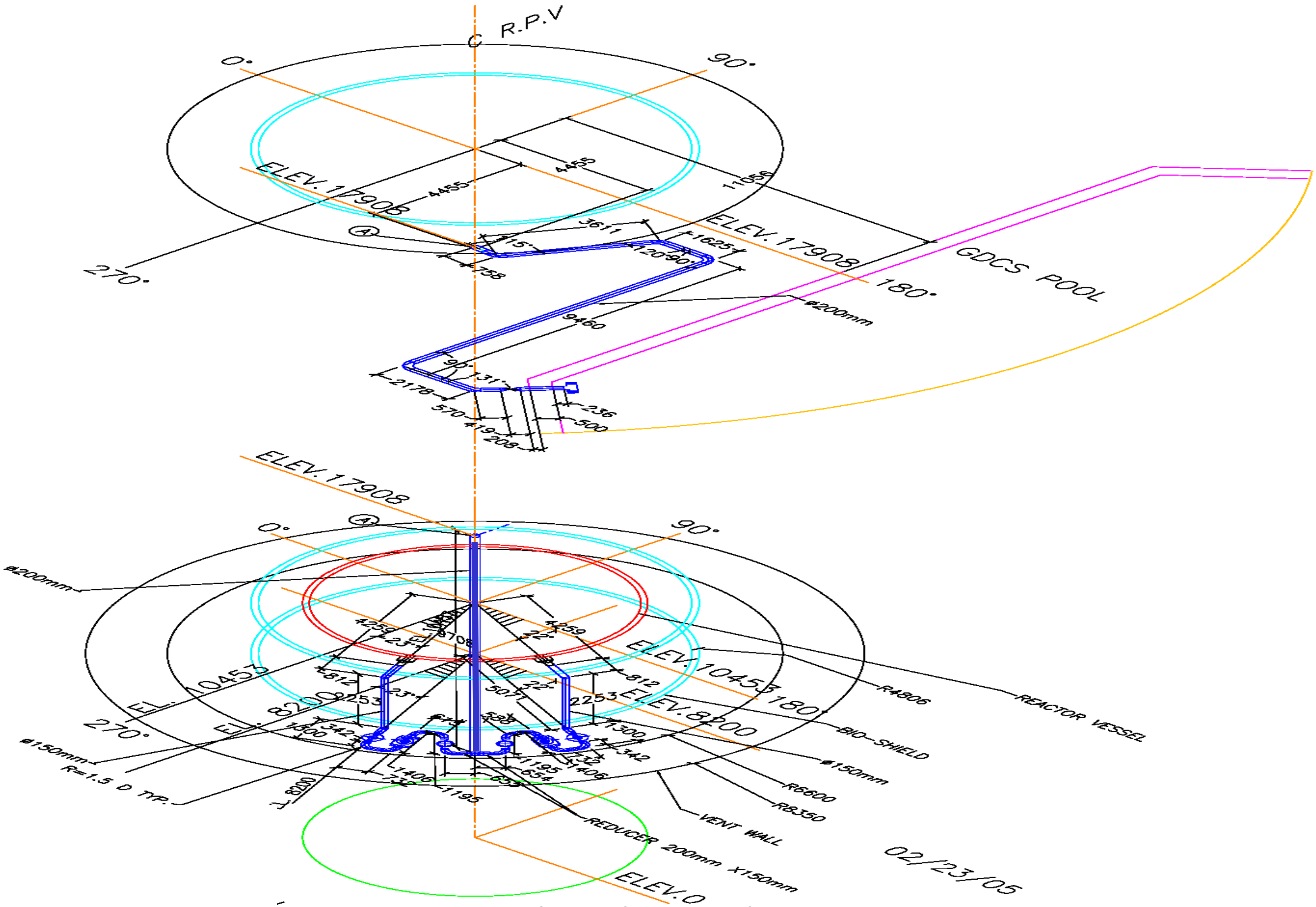
GDCS System Details

- Four Independent Loops
- Three Gravity Driven Pools in Upper Containment
- System Actuated by Squib Valves (2 Valves in Parallel for Each Line)
- GDCS Pools are open to the Drywell
- Piping to RPV has Biased Open Check Valves to Prevent Outlet Water Flow from RPV

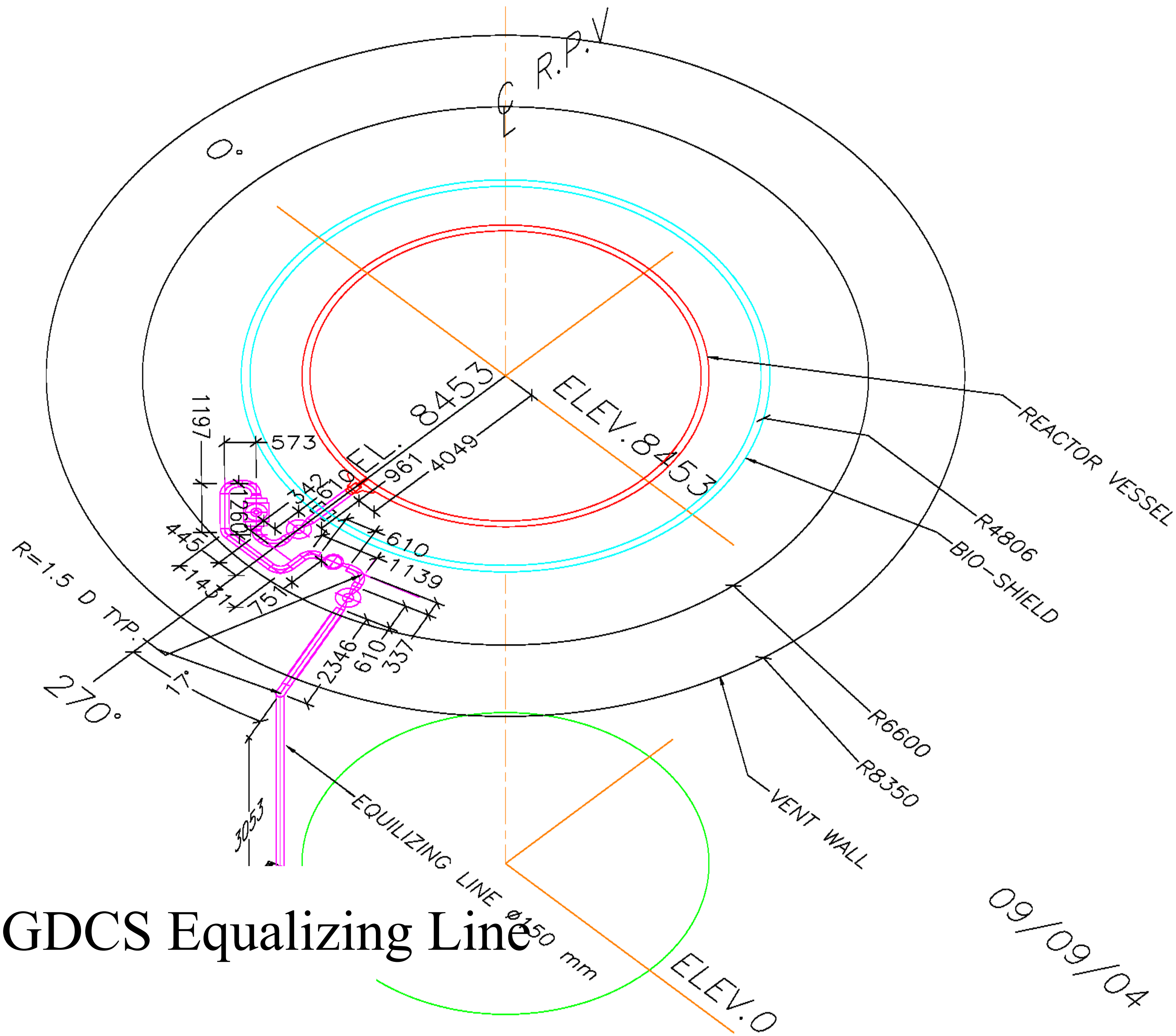
GDCS Piping

Three Separate Subsystems

- GDCS (Short Term) Injection Lines (6”) from Pool to RPV to flood RPV after Depressurized
  - Only Piping from RPV to Squib valve are Classified as High Energy
- GDCS (Long Term) Equalizing Lines (6”) from Suppression Pool to RPV
  - Only Piping from RPV to Squib valve are Classified as High Energy
- GDCS Deluge Lines (2”) branch from Injection Piping to Flood Lower Drywell Volume
  - Not Classified as High Energy



GDCS Injection Line



GDCS Equalizing Line

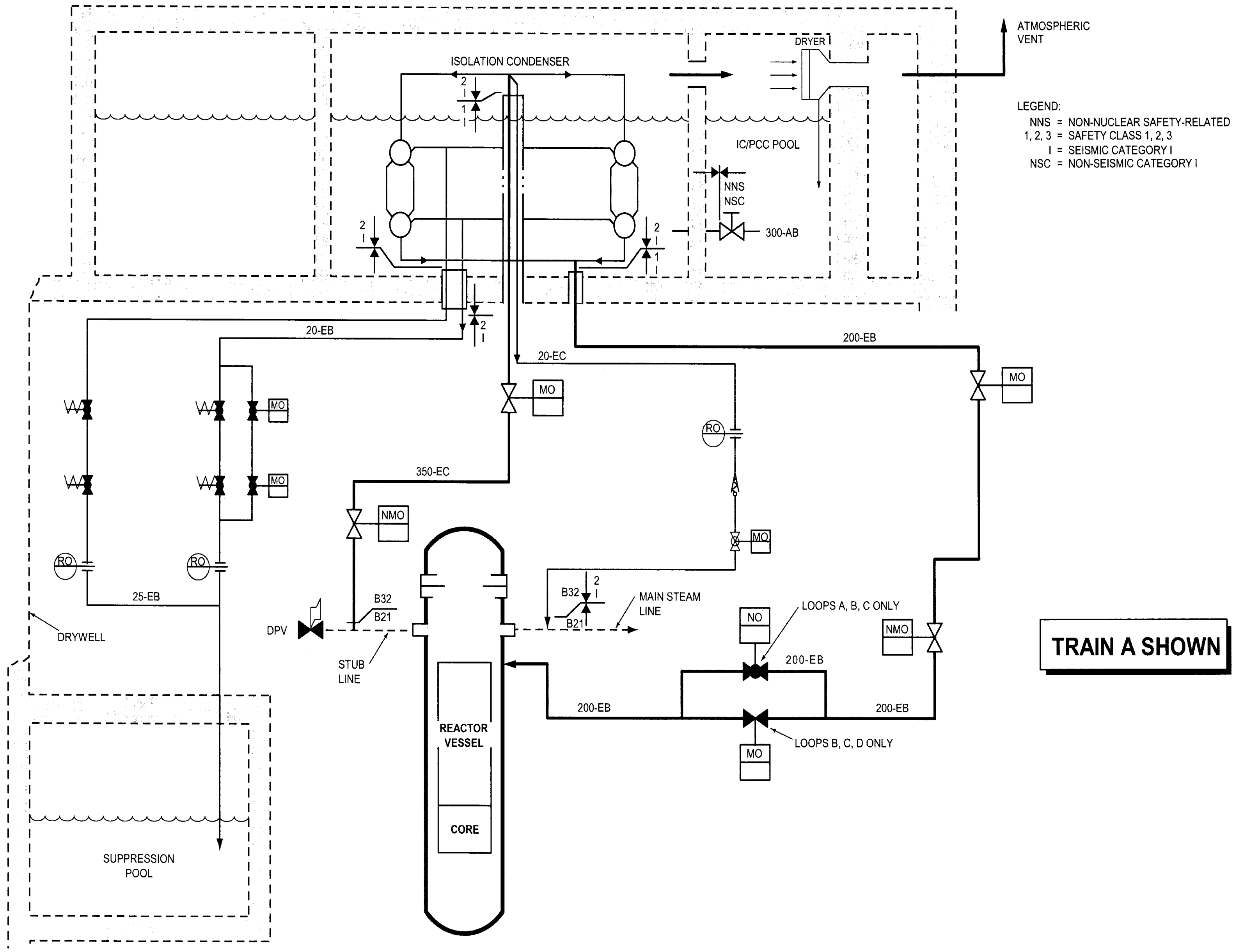
GDCS Piping (Continued)

- Piping Materials are Stainless Steel
- GDCS Piping is Routed to Avoid Contact with Larger High Energy Pipes
- Piping Analysis is not Considered Necessary to Support Design Certification
  - Short Lengths of High Energy Piping
  - Differential Expansion from RPV is Minimal (0.35" Maximum Vertical Growth)
  - Piping has Flexibility that will make both Thermal and Dynamic Loads Easy to Analyze
- Pipe Whip Restraints will not be Necessary

Isolation Condenser System

Safety Related Functions

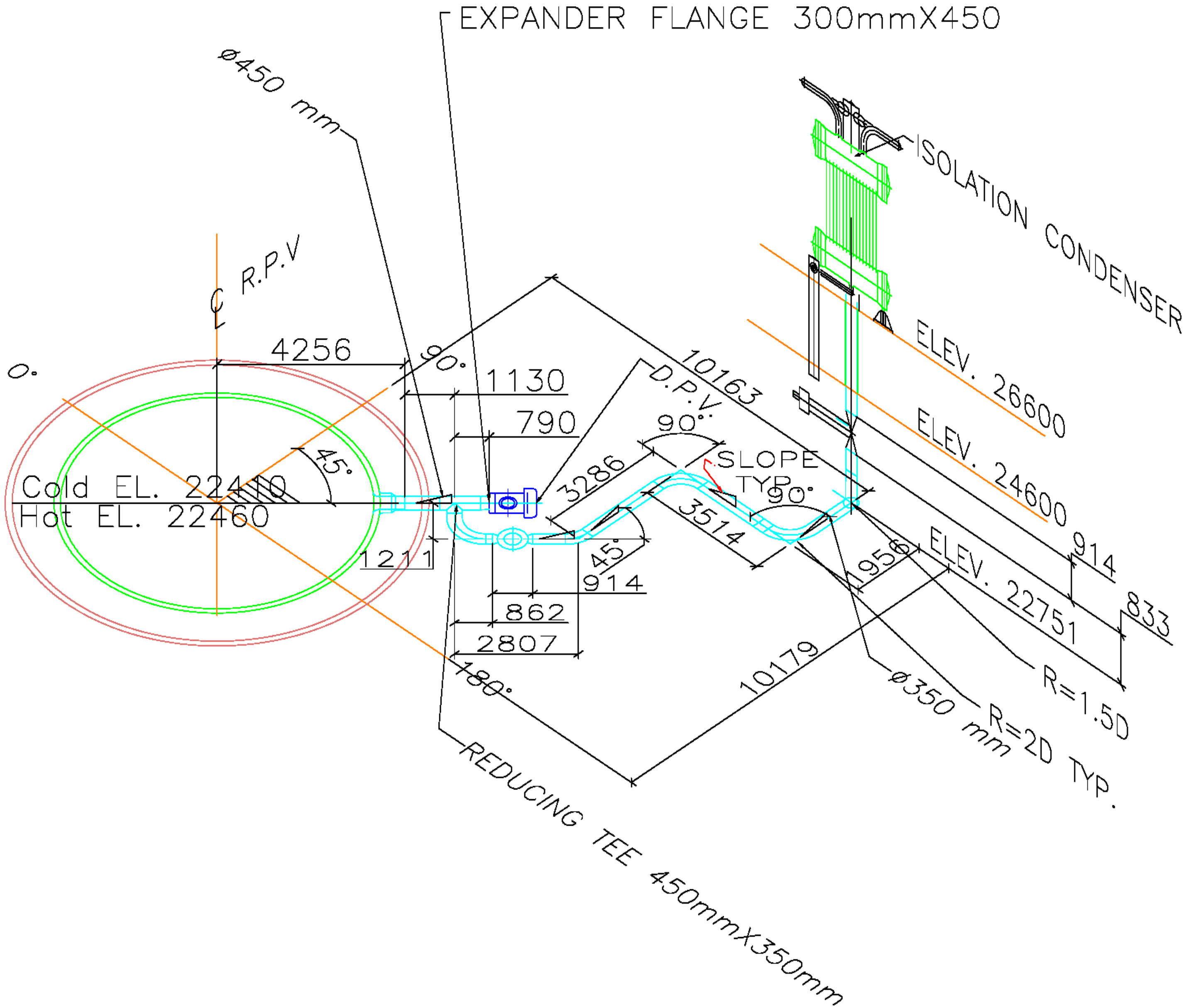
1. Provides Passive Shutdown Cooling for the Reactor under the following Events:
   - MSIV Valve Position < 92% Open in 2 or More Steam Lines
   - RPV Pressure > 7.447 MPag (1080 psig) for 10 seconds
   - Reactor Water Level Below Level 2
   - Operator Remote Manual Initiation



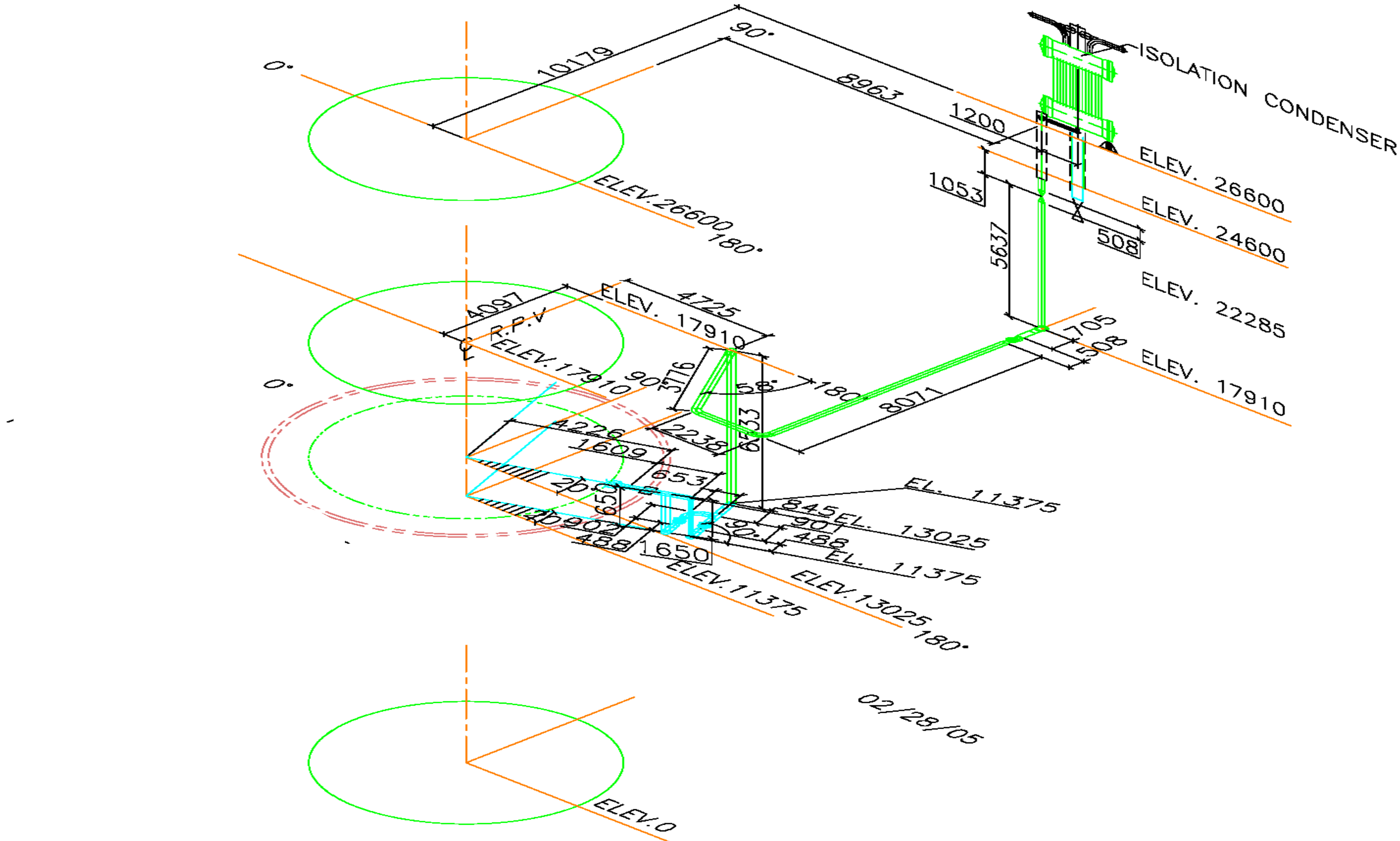
Isolation Condenser System

IC System Details

- Isolation Condensers (IC) are an Extension of the Containment Pressure Boundary
- System follows RPV Temperature and Pressure
- RPV Outlet Pipe (14” pipe) to IC has Steam Environment
- Return Piping (8” pipe) has Condensate Water/ Reactor Water
- System Actuated by Condensate Return Valves (Parallel motor driven and nitrogen actuated Valves)
- 4 Loops



Isolation Condenser Steam Line



Isolation Condenser Condensate Return Line

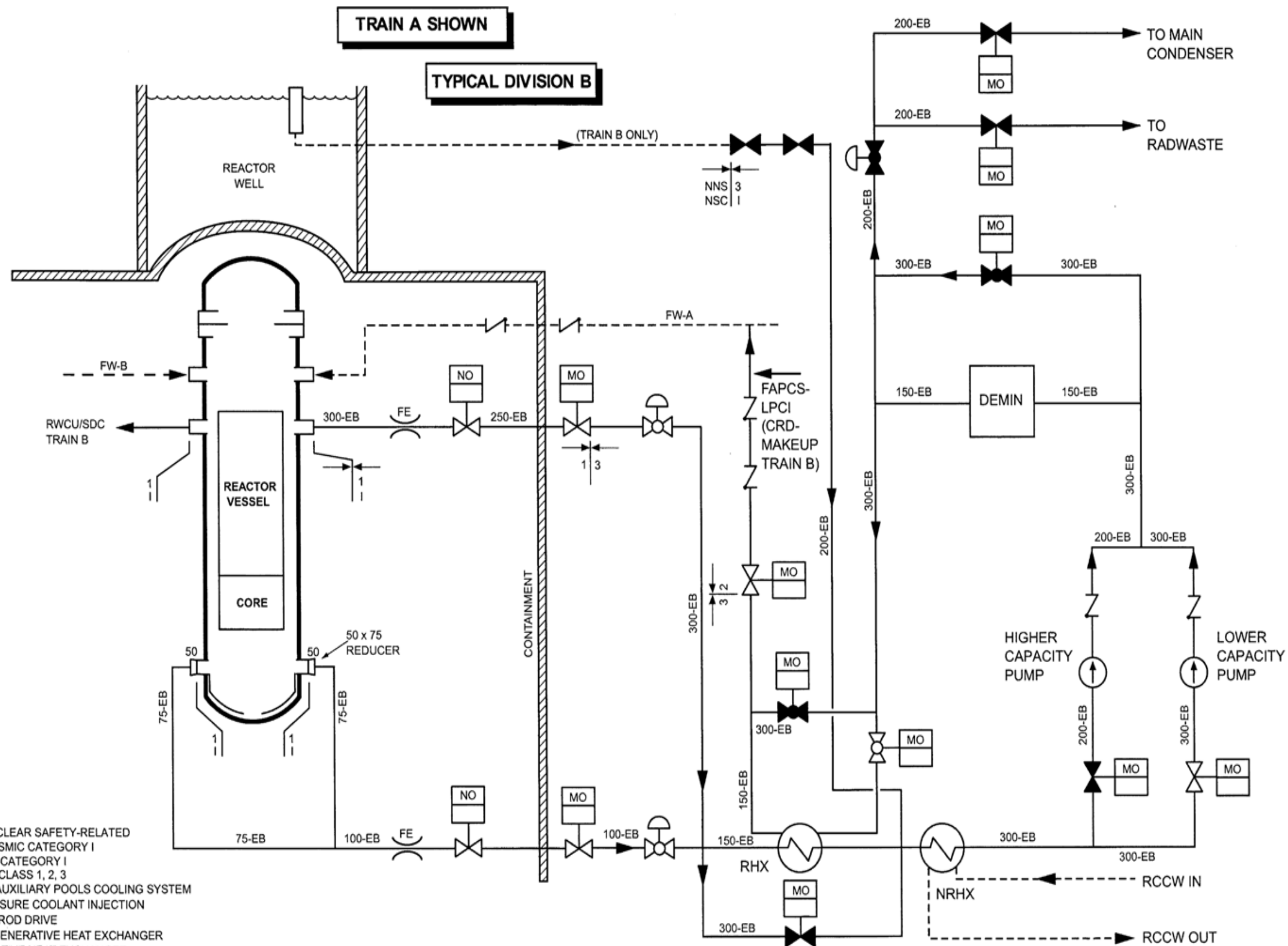
IC System Piping

- System Contains Two Pipes that are Larger High Energy Lines
  - IC Steam 14” Piping ; Carbon Steel Material
  - IC Return 8” Piping ; Stainless Steel Material
- Condensate Return Piping is Routed to Avoid Contact with Larger Piping
- IC Steam Piping is Considered more Limiting than Condensate Return Line:
  - Pipe Size is Larger
  - Pipe Lengths are Shorter with Less Flexibility (~12 m vs 29 m)
  - Differential Thermal Expansion at Connection to RPV is Greater (1.97” vs. 0.70” Vertical growth)

Reactor Water Cleanup/ Shutdown Cooling System

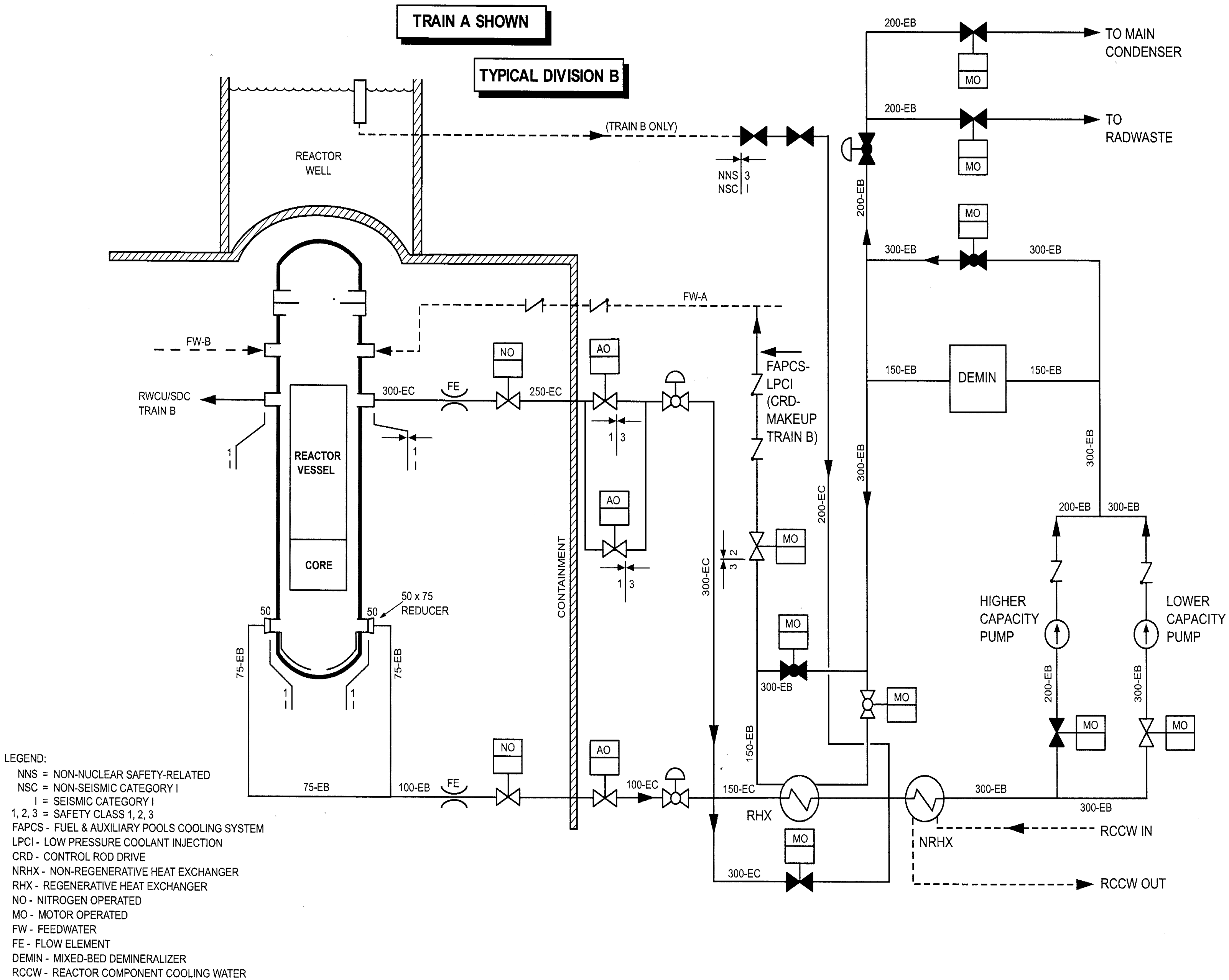
Functions (Non-Safety)

1. Provide Heating for Reactor Startup in Conjunction with Feedwater System
2. Reactor Water Cleanup
3. Provide Reactor Shutdown Cooling
4. Overboards Excess Water to the Main Condenser during Reactor Startup



LEGEND:
- NNS = NON-NUCLEAR SAFETY-RELATED
- NSC = NON-SEISMIC CATEGORY I
- I = SEISMIC CATEGORY I
- 1, 2, 3 = SAFETY CLASS 1, 2, 3
- FAPCS - FUEL & AUXILIARY POOLS COOLING SYSTEM
- LPCI - LOW PRESSURE COOLANT INJECTION
- CRD - CONTROL ROD DRIVE
- NRHX - NON-REGENERATIVE HEAT EXCHANGER
- RHX - REGENERATIVE HEAT EXCHANGER
- NO - NITROGEN OPERATED
- MO - MOTOR OPERATED
- FW - FEEDWATER
- FE - FLOW ELEMENT
- DEMIN - MIXED-BED DEMINERALIZER
- RCCW - REACTOR COMPONENT COOLING WATER

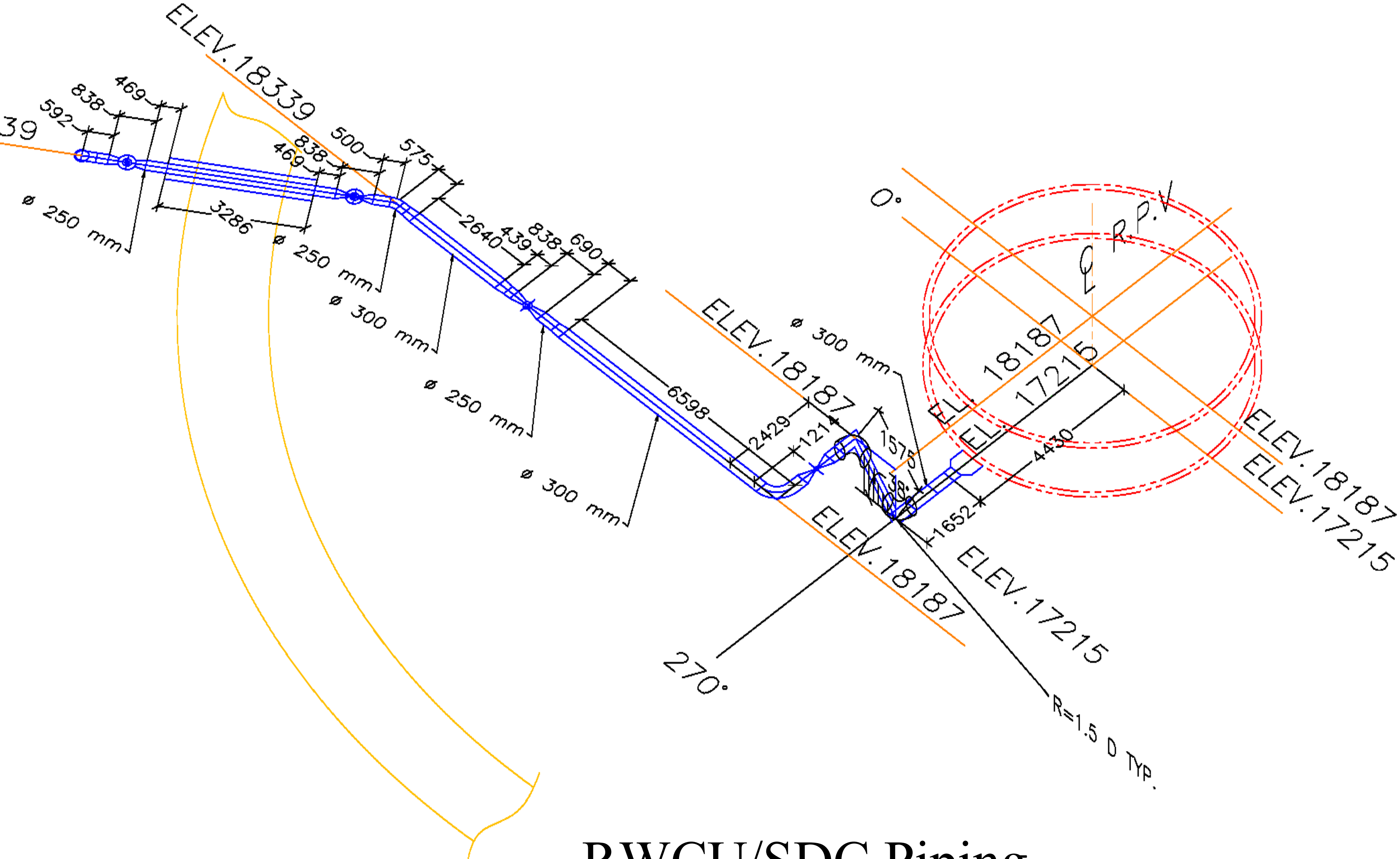
Reactor Water Cleanup/Shutdown Cooling System



Reactor Water Cleanup/Shutdown Cooling System

RWCU/SDC System Details

- Two Outlet 12” piping Connections to the RPV above Core Region
- Four 2” Drain Lines from Bottom of RPV
- System follows RPV Temperature and Pressure
- Pipe Routing Minimizes Amount of Piping in Containment



RWCU/SDC Piping

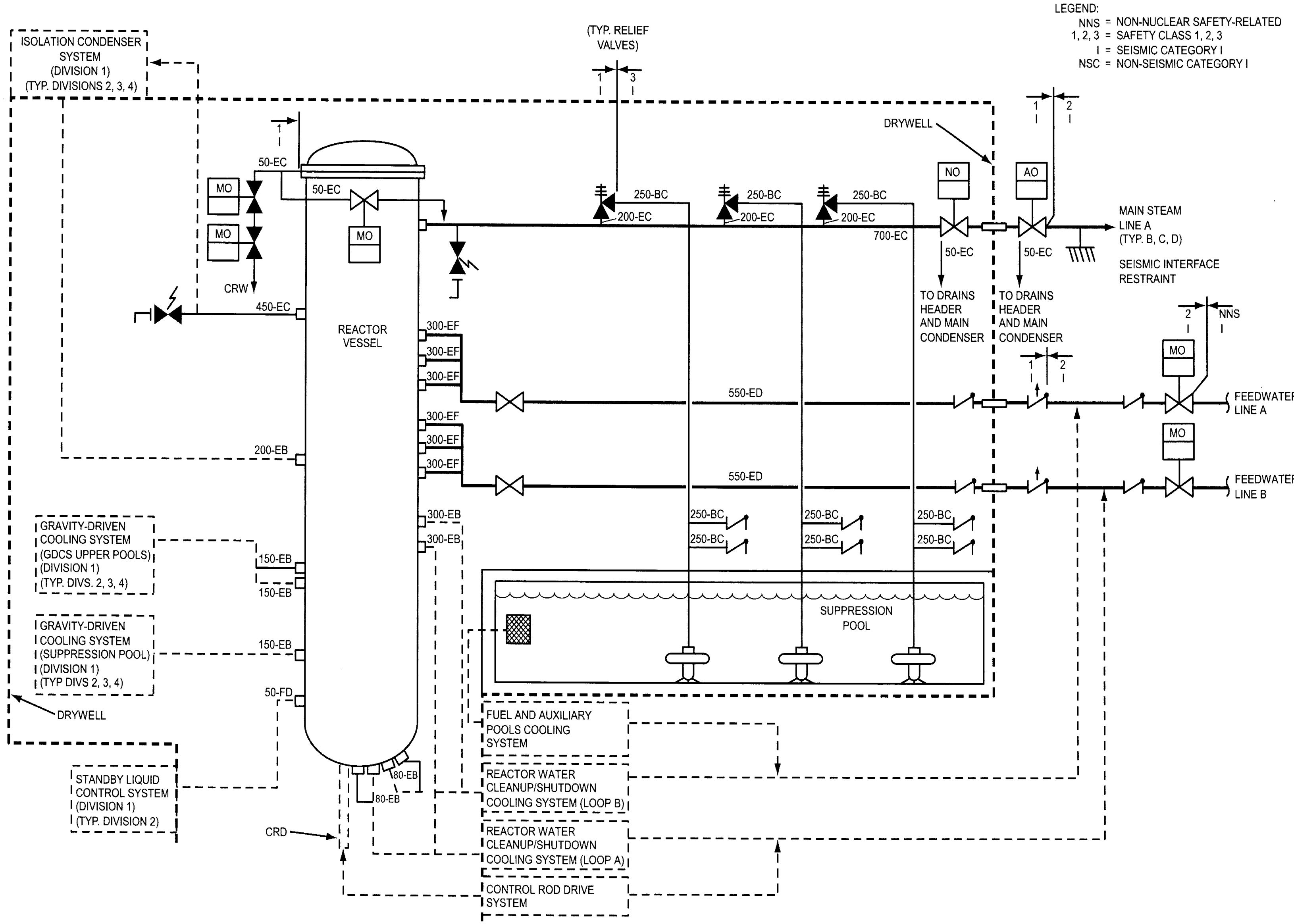
RWCU/SDC Piping

- Piping Material inside Containment:
  - 12’ Outlet Pipe is Carbon Steel
  - 2’ Drain Line is Low Carbon Stainless Steel
- Piping within Containment is High Energy
- 12” Outlet Pipe is more Limiting than Drain Lines
  - Larger Pipe Size
  - Greater Differential Thermal Expansion at RPV Connection

Nuclear Boiler System

Safety Related Functions

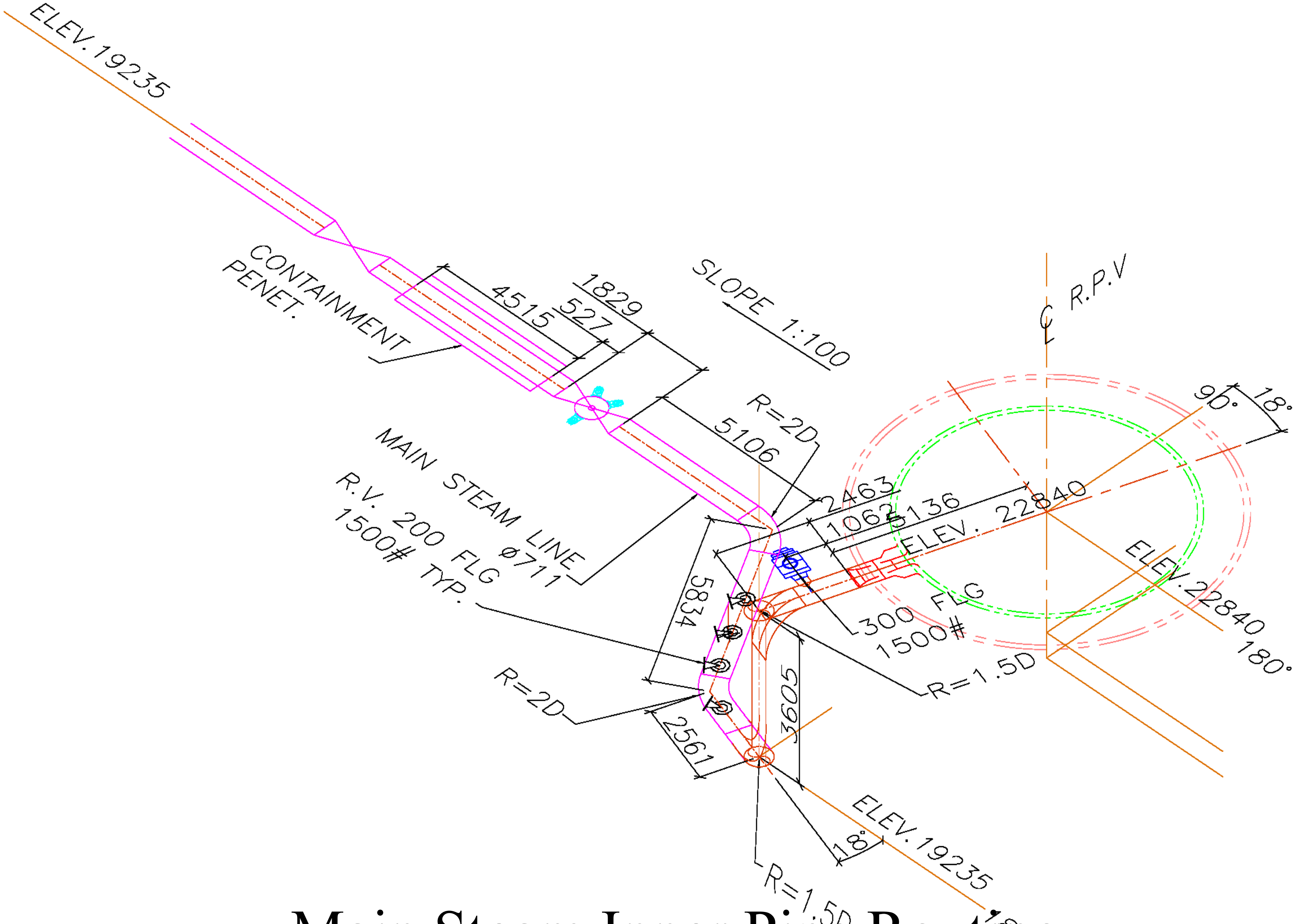
1. Provide Containment Isolation for the Main Steam and Feedwater Lines
2. Maintain Reactor Coolant Pressure Boundary
3. Provide Overpressure Protection in Conjunction with Reactor Protection System Scram Function
4. Provide Automatic Depressurization of the RPV by ADS (SRVs and DPVs) for LOCA
5. Monitors Reactor Pressure, RPV Water Level, MSIV Position, SRV Position, DPV Position and Leakage



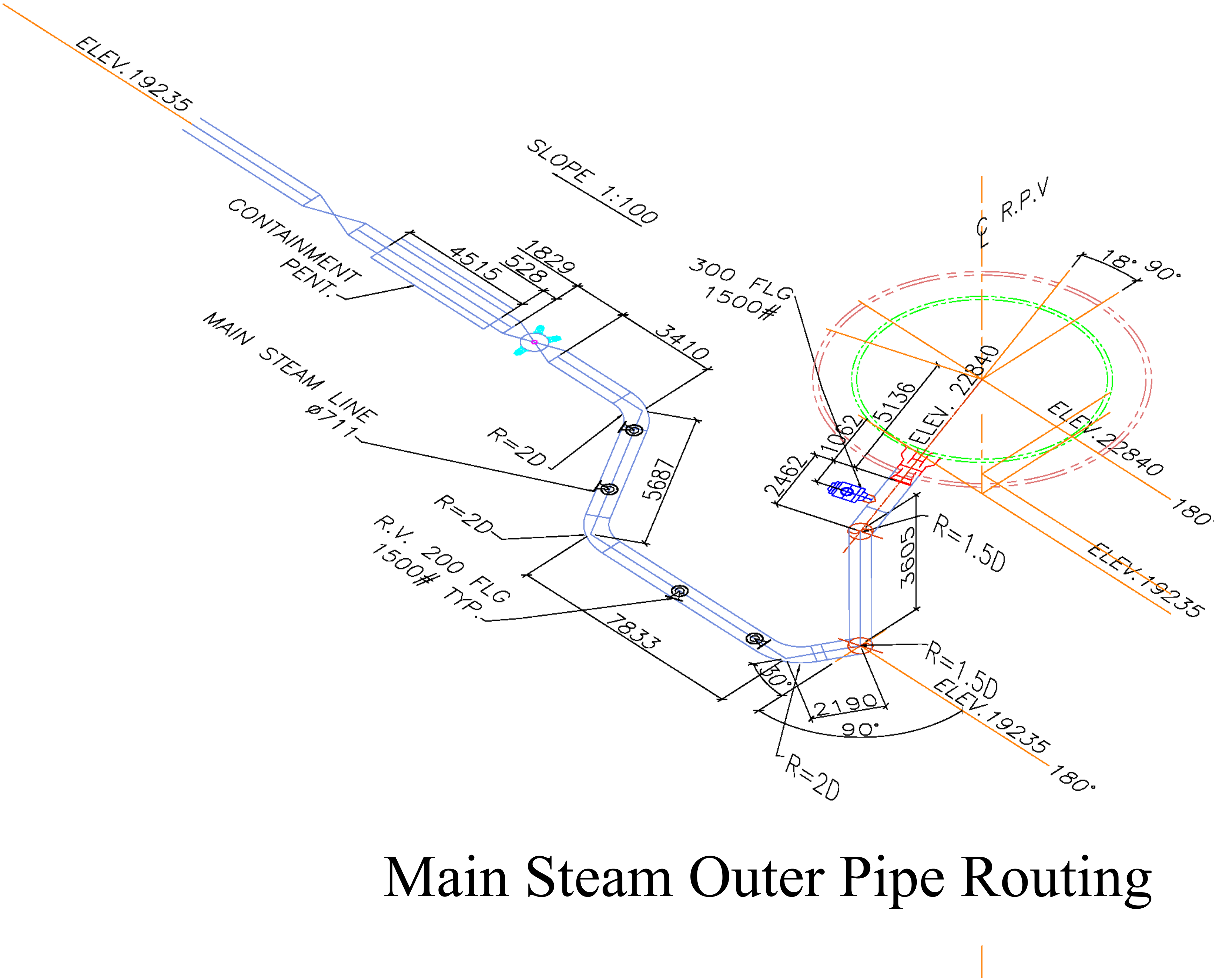
Nuclear Boiler System

NBS System Details

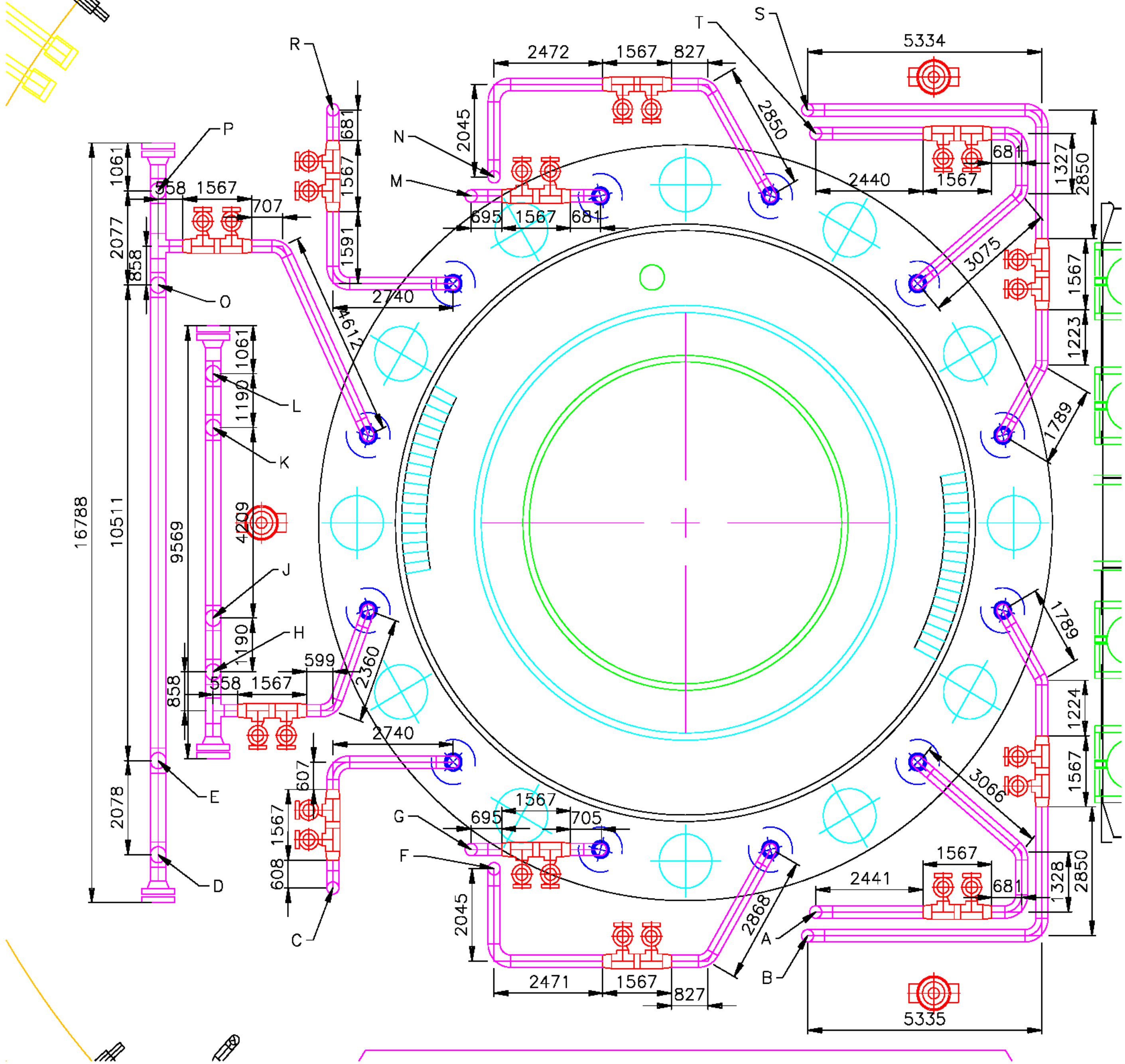
- Provides Main Steam Outlet and Reactor Pressure Control, Feedwater Inlet, and RPV Water Level Instrumentation (same as prior BWRs)
- Provides Passive Depressurization (Squib) Valves as Alternates to SRVs
- Four Main Steam Lines
- Two Feedwater Lines (Each line has 3 risers from a header that attach to the RPV)



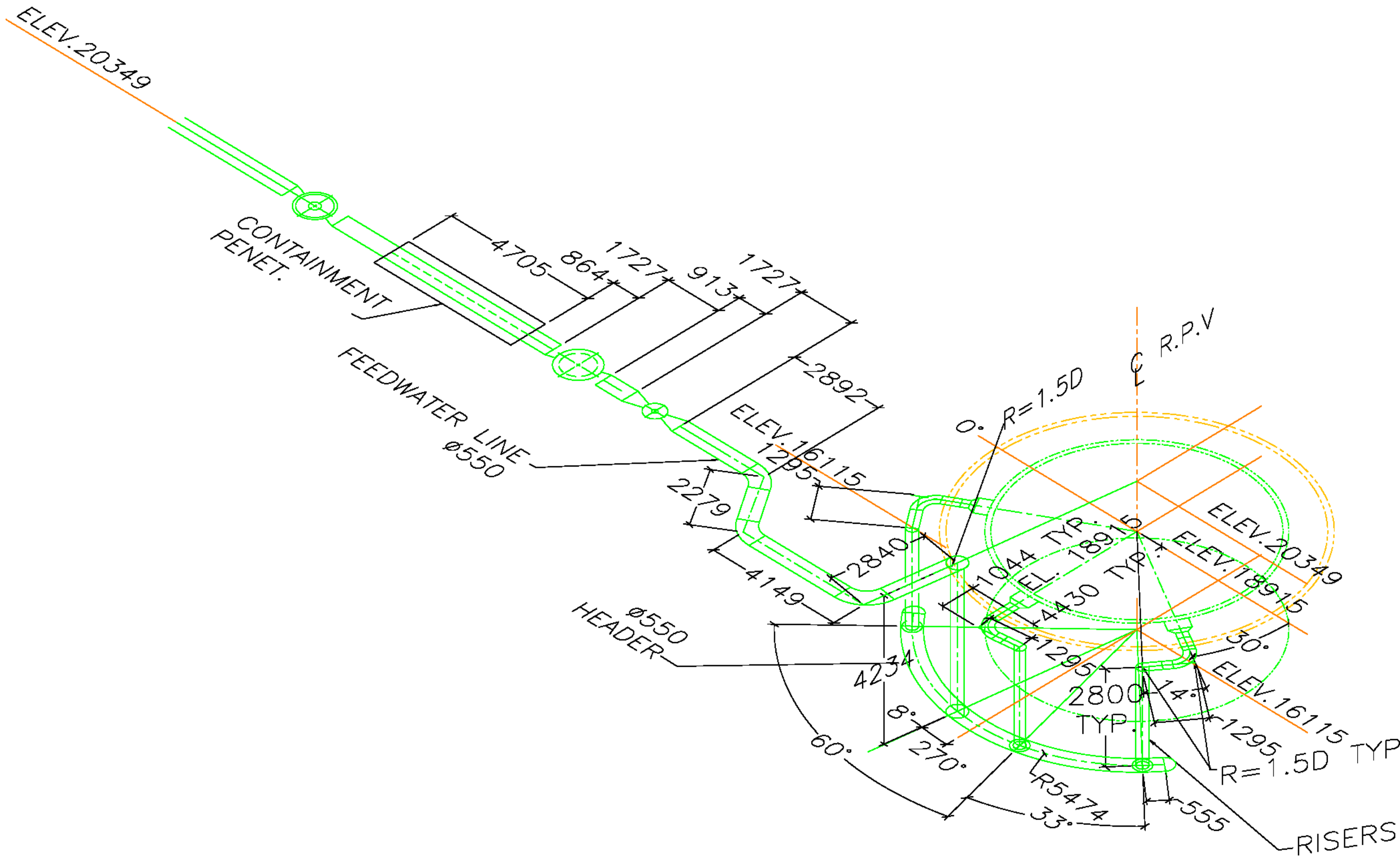
Main Steam Inner Pipe Routing



Main Steam Outer Pipe Routing



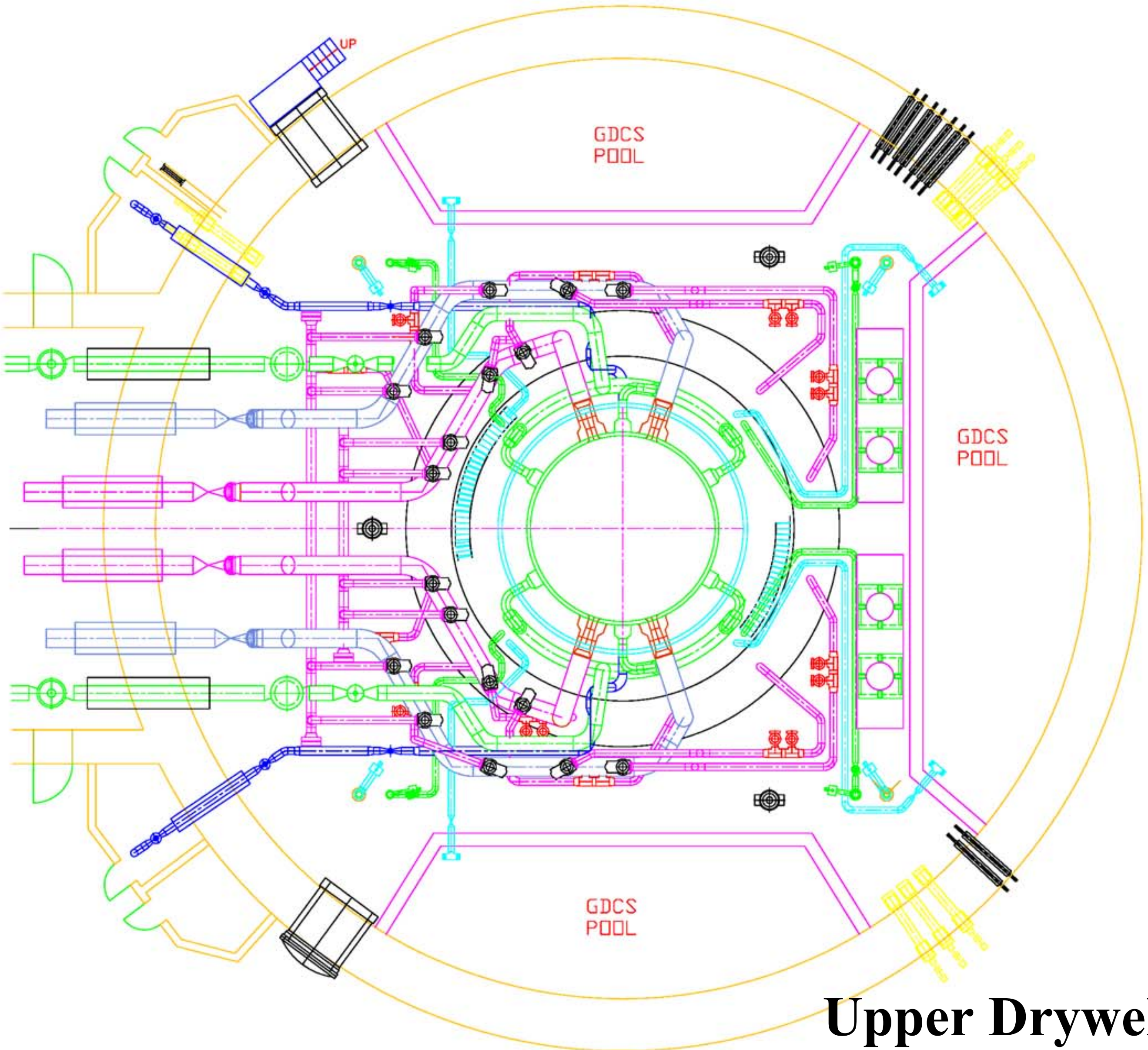
SRV Discharge Pipe Routing



Feedwater Line

Nuclear Boiler Piping

- Piping Material is Carbon Steel
- Piping within Containment is High Energy
- Main Steam Lines are Very Similar to Prior BWRs
- Feedwater Lines are Similar to prior BWRs (has some additional lengths to provide more flexibility)
- Both Main Steam & Feedwater Piping will be Analyzed



Upper Drywell Plan View

ELEVATION 17500 TO 21000

ESBWR Containment Design

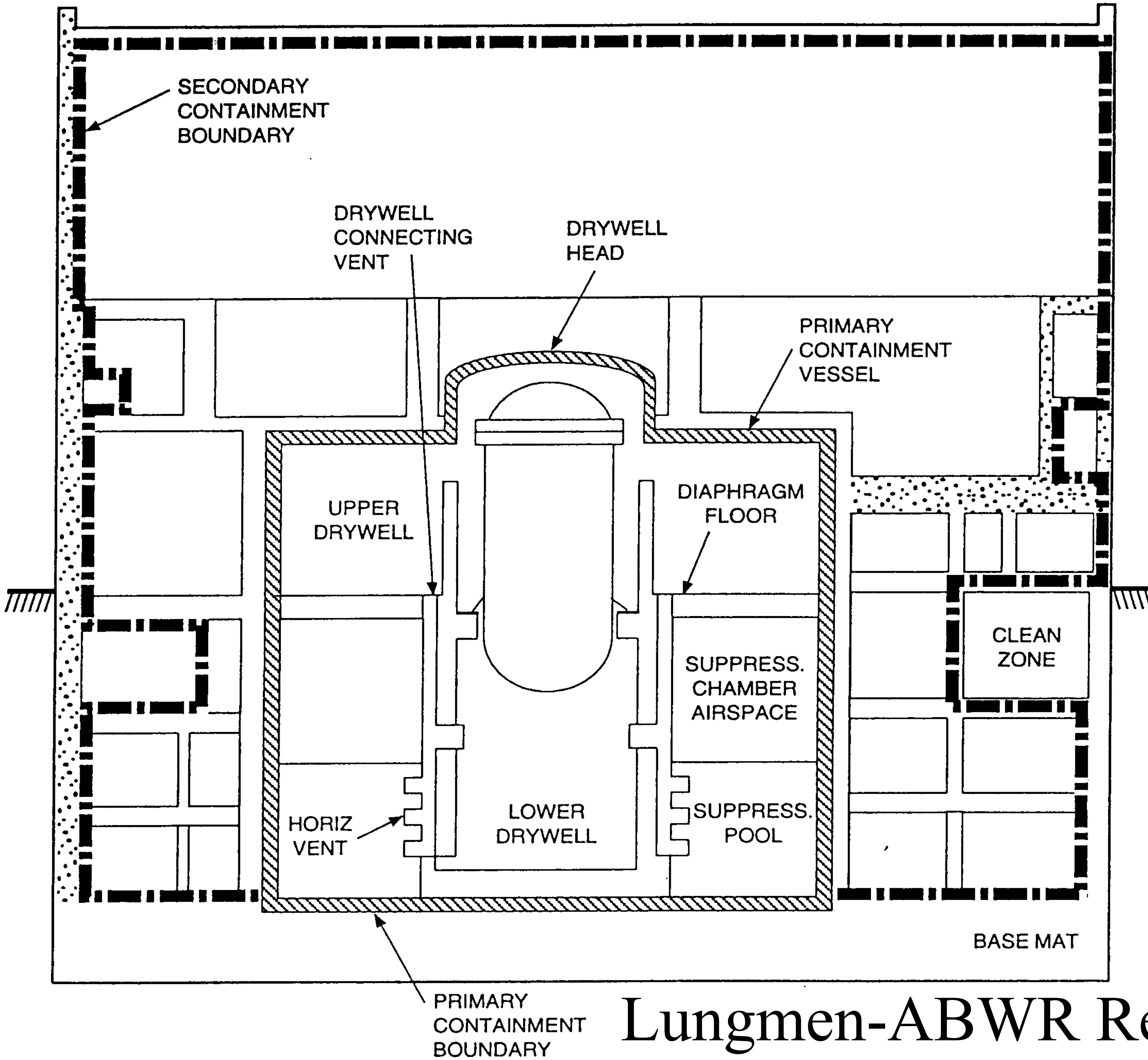
- Purpose - To Limit Fission Product Release to the Environment and Provide a Leak Tight Vessel Enclosing the RPV
- Fundamental Components
  - Drywell
  - Suppression Pool
  - Suppression Chamber (Wetwell Gas Space)
  - Vent System
  - Gravity Driven Cooling System Pools
- Inerted with Nitrogen during Normal Operation

Comparison of Containment Designs

- ESBWR & ABWR have the Same Basic Components in Containment
- Main Differences are:

- ESBWR has Gravity Driven Pools inside Containment
- Suppression Pool is Elevated to the Core Region

No Significant Changes in Containment Loads is Anticipated



Lungmen-ABWR Reactor Building/Containment

Piping Requirements for ABWR Certification

- Commitments:
  - Piping systems will be designed to meet their ASME Code class and Seismic Category Requirements
  - Fatigue analysis will be performed for ASME class 1 piping including environmental effects
  - Other commitments related to Thermal Stratification, Erosion/Corrosion, Brittle Fracture, Pipe Break Analysis etc.
- Methods and Computer codes were validated
- No Analysis was performed

Selected Piping to Perform Analysis

Currently Being Performed to Support DCD

Inside Containment

- Main Steam Lines (28") Including SRV Discharge Lines (10")
- Feedwater (12" & 22")
- Reactor Water Cleanup/Shutdown Cooling Line (12")
- Isolation Condenser Line from RPV to Isolation Condenser (14" & 18")

Containment Piping not Selected for Analysis

- Small Lines (3” or less)
  - Drain Lines (Main Steam, RWCU/SDC)
  - RPV Water Level Instrument Lines
  - RPV Bottom Head Drain Lines
  - CRD Insert Lines
  - Standby Liquid Control
- Low Pressure Lines
  - Gravity Driven Lines – Max. Size 6”

    (Limited piping with High Pressure & smaller differential thermal expansion)
  - PCCS Piping
- Other
  - Isolation Condenser Return Line

    (less severe than Iso Condenser steam line from RPV to Condenser)

Proposed Piping Analysis/Evaluation to Support ESBWR Design Certification

- ASME Code Thermal Analysis (heatup and transients including thermal stratification) for Selected Class 1 Piping inside Containment

  Criteria:
  - 0.80 x ASME Code limit for Eq. 12
  - Fatigue Usage Less Than 0.10
- Erosion/Corrosion Evaluation of Feedwater and Main Steam Piping

Basis for Proposed Pipe Analysis for ESBWR

- Experience from Lungmen Project
- Thermal Loads for Piping inside Containment are predominate for BWRs
- The Calculated Fatigue Usage is predominately a result of Thermal Transient Cycling
- Seismic Loads are Site Specific COL Items
- Stresses from Dynamic Loads can be Modified by Adjusting Pipe Supports (There are Substantial Containment Structures Available to Attach Pipe Supports To)
- Thermal Stresses can not be changed after Pipe Routing is Fixed
- Commitments made for ABWR Certification have been Fully Met for Actual Projects

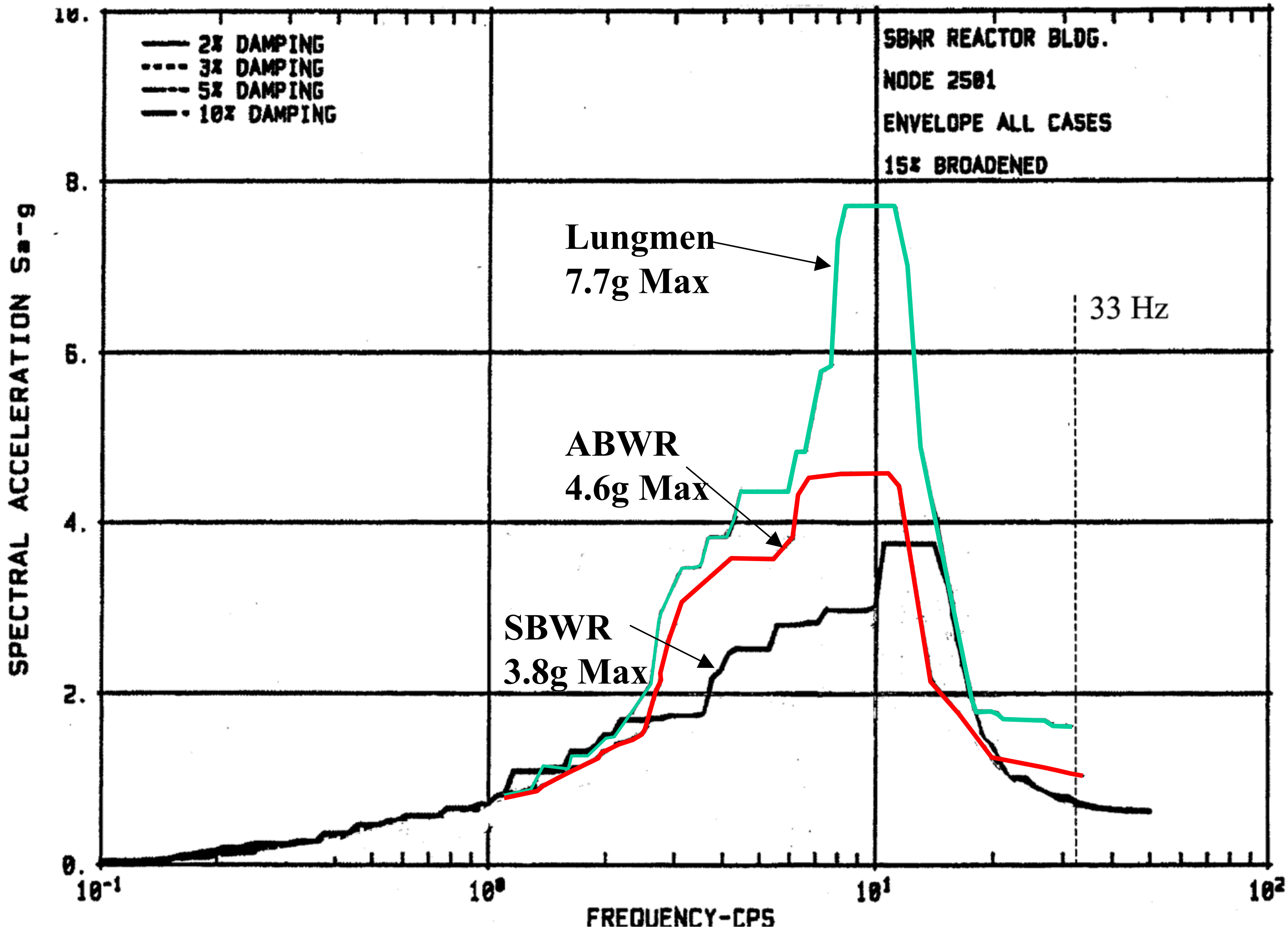
Lungmen Project - Containment Piping Experience

Lungmen Line #	System	Eq 12 Max Stress Ratio (Thermal)	Eq 13 Max Stress Ratio (Dynamic)	Eq 14 Max Fatique
B21-2501A	Main Steam	0.70	0.46	0.079
B21-2502A	Main Steam	0.60	0.50	0.068
B21-2503A	Main Steam	0.54	0.50	0.076
B21-2504A	Main Steam	0.75	0.49	0.099
N22-2501	Feedwater	0.79	0.61	0.085
N22-2502	Feedwater	0.79	0.63	0.085
E11-2501	RHR	0.54	0.53	0.074
E11-2502	RHR	0.78	0.75	0.077
E22-2501	High Pressure Core Flooder	0.60	0.45	0.079

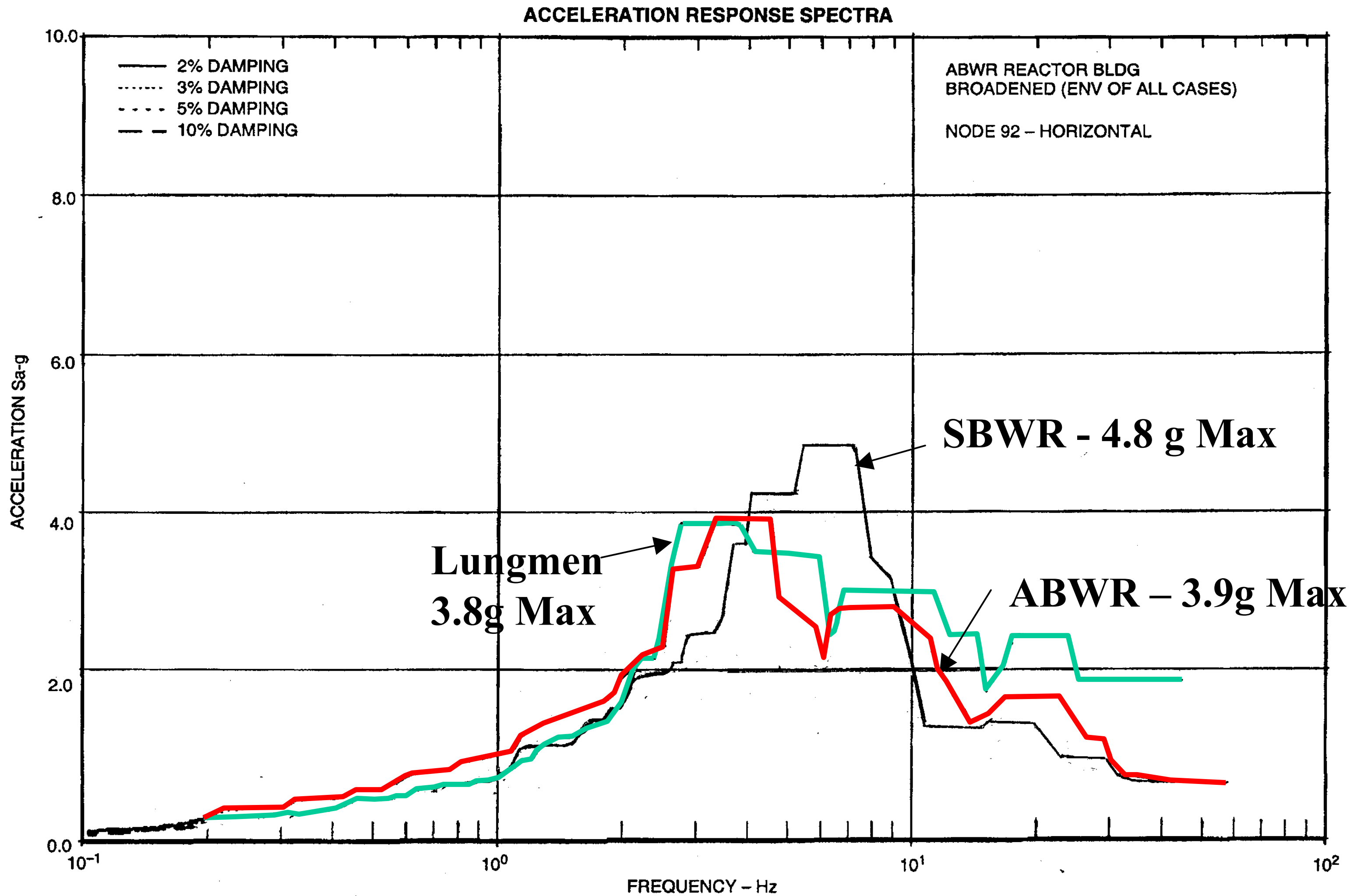
Lungmen Seismic Ground Acceleration = .4 g

Dynamic Time History Plots at Diaphragm Floor

- SSE Vertical
- SSE Horizontal
- SRV Vertical
- SRV Horizontal
- LOCA Vertical
- LOCA Horizontal

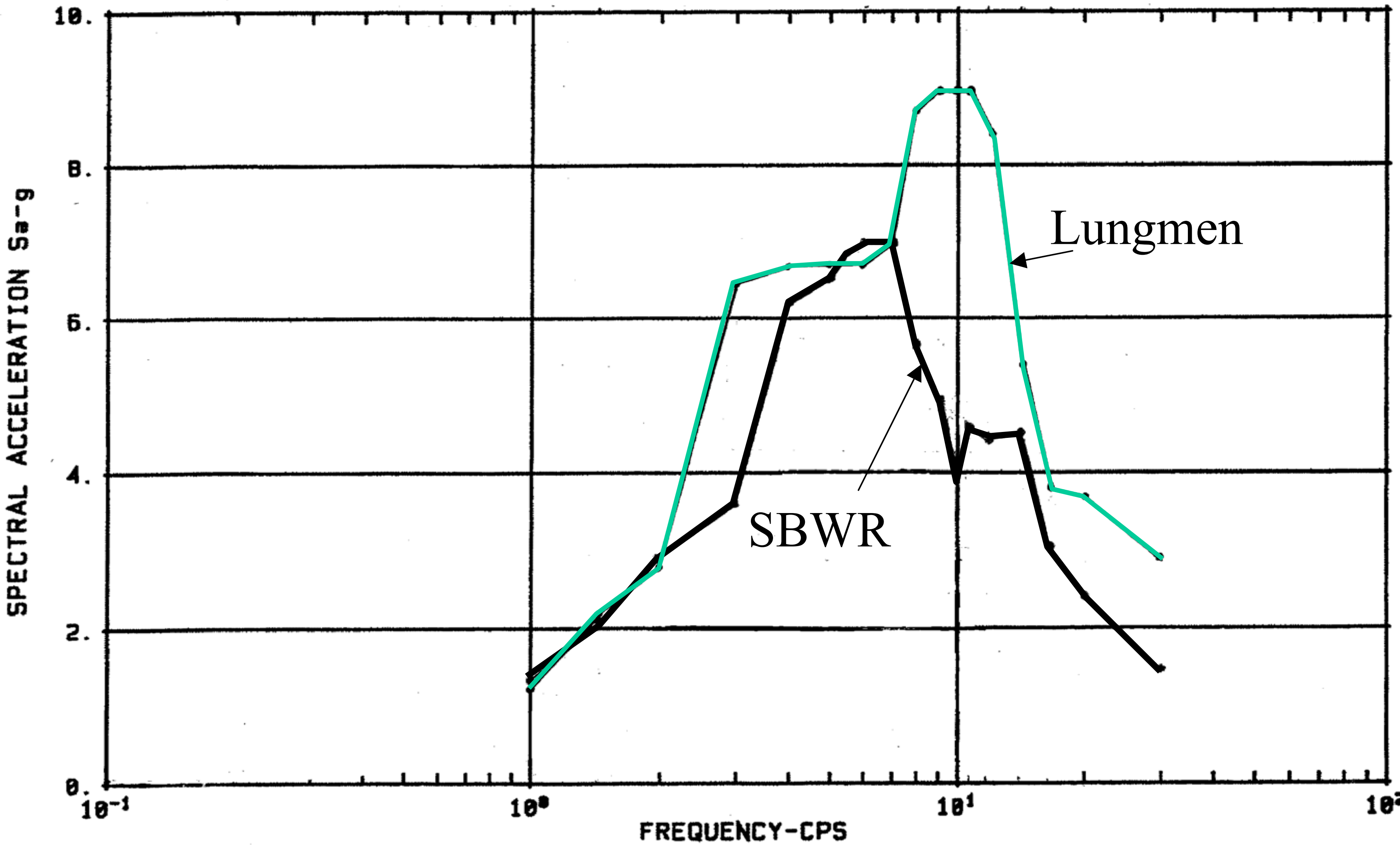


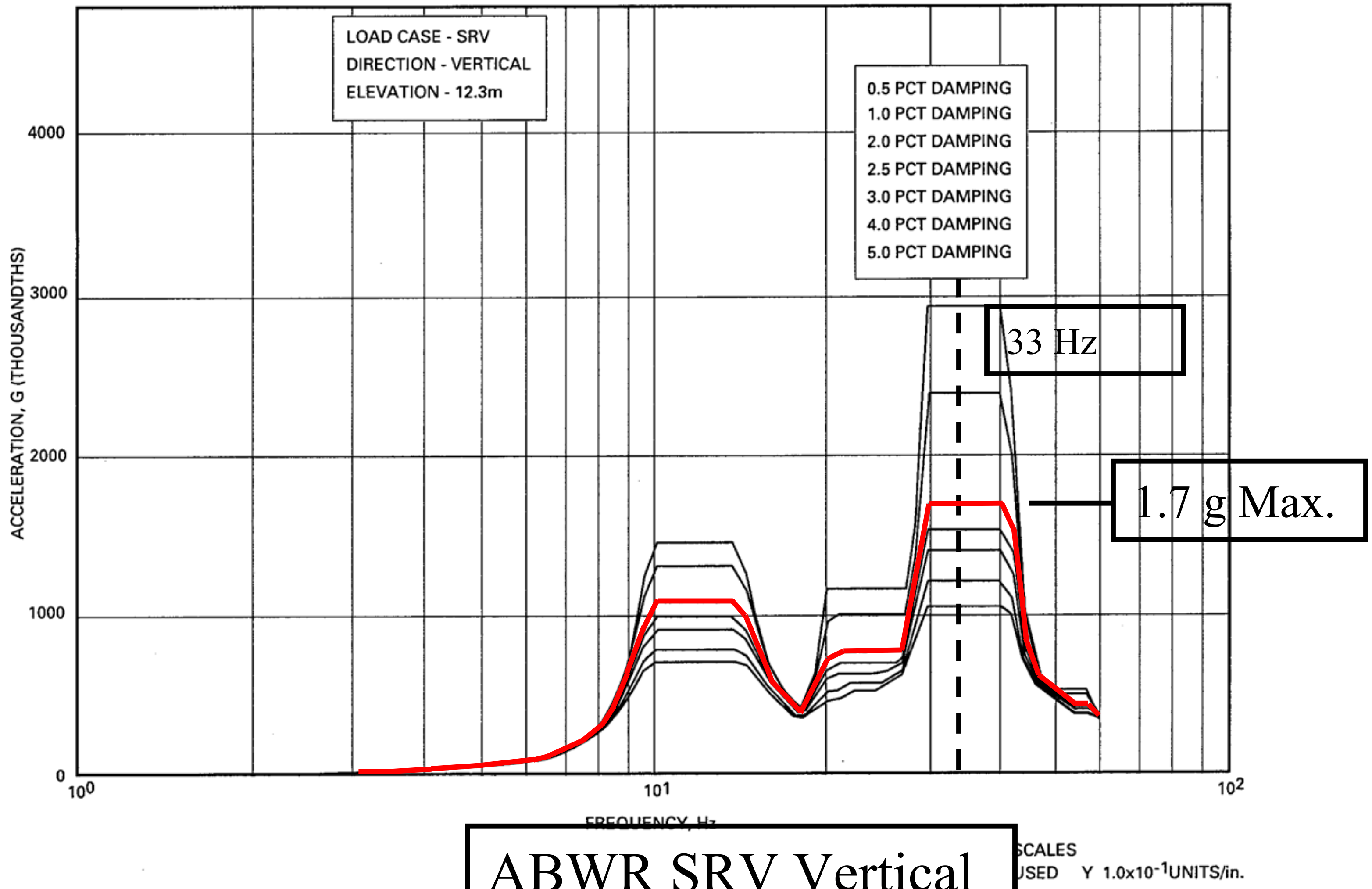
SSE Vertical Comparison



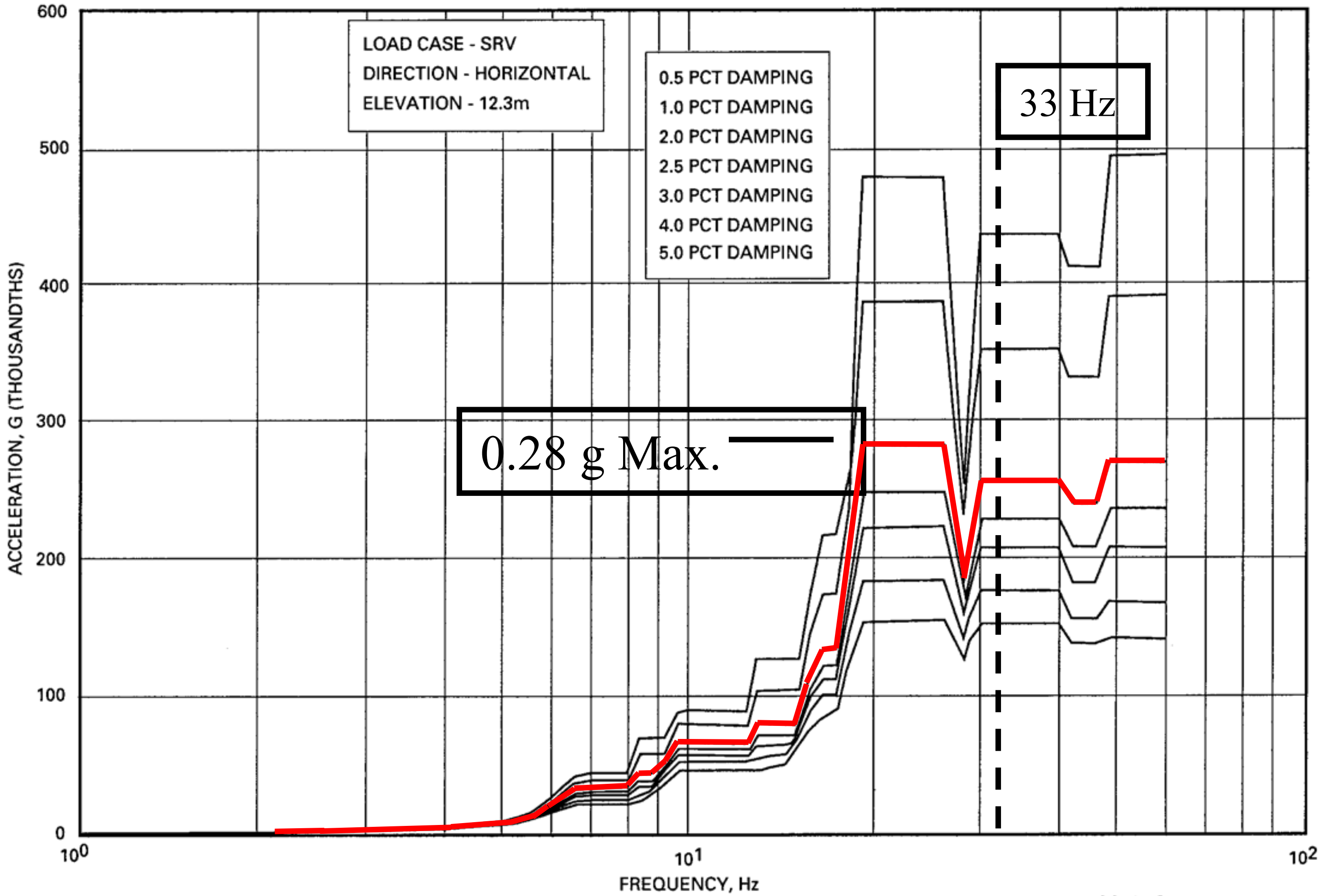
SSE Horizontal Comparison

SRSS of SSE Accelerations

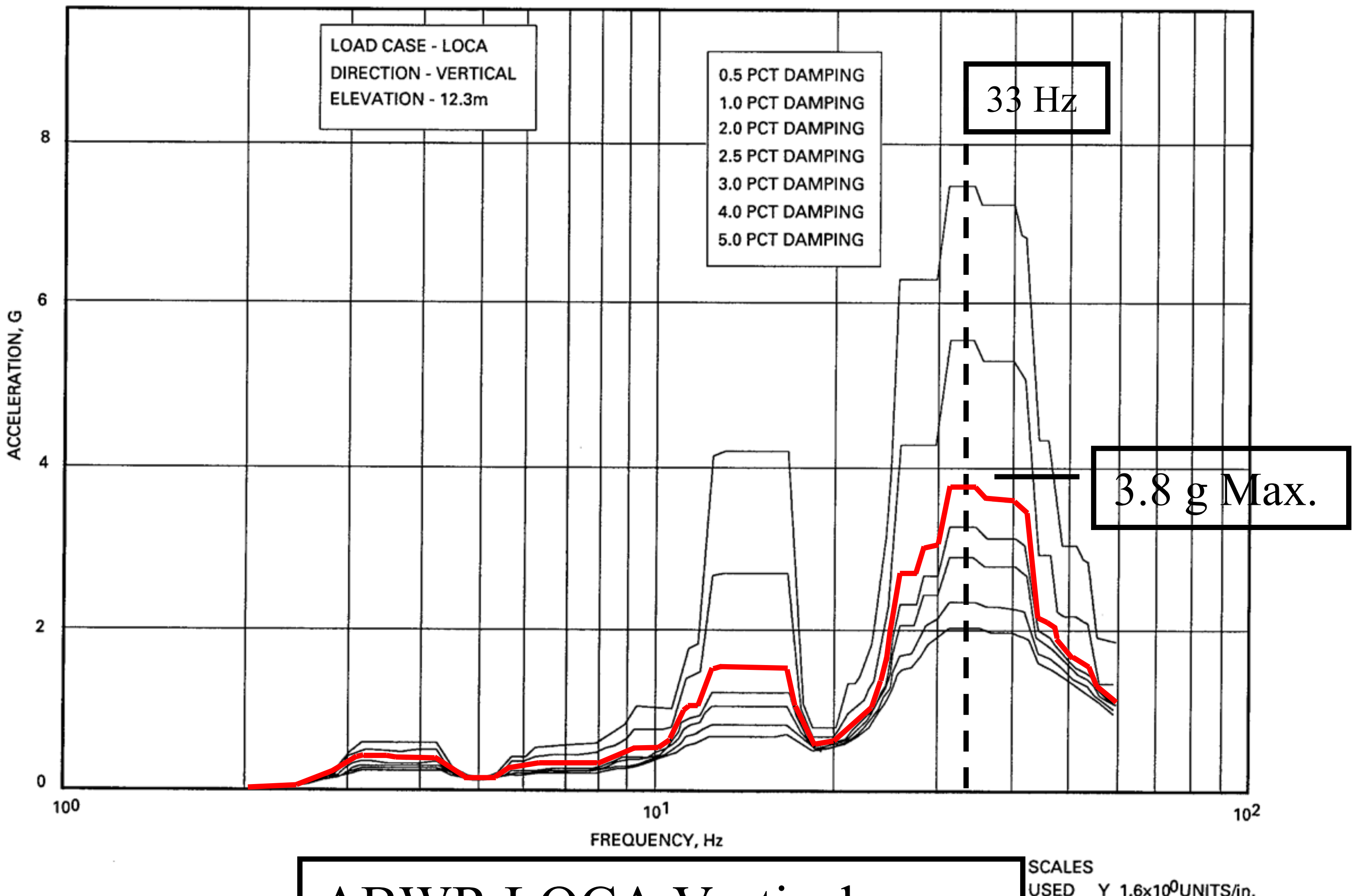




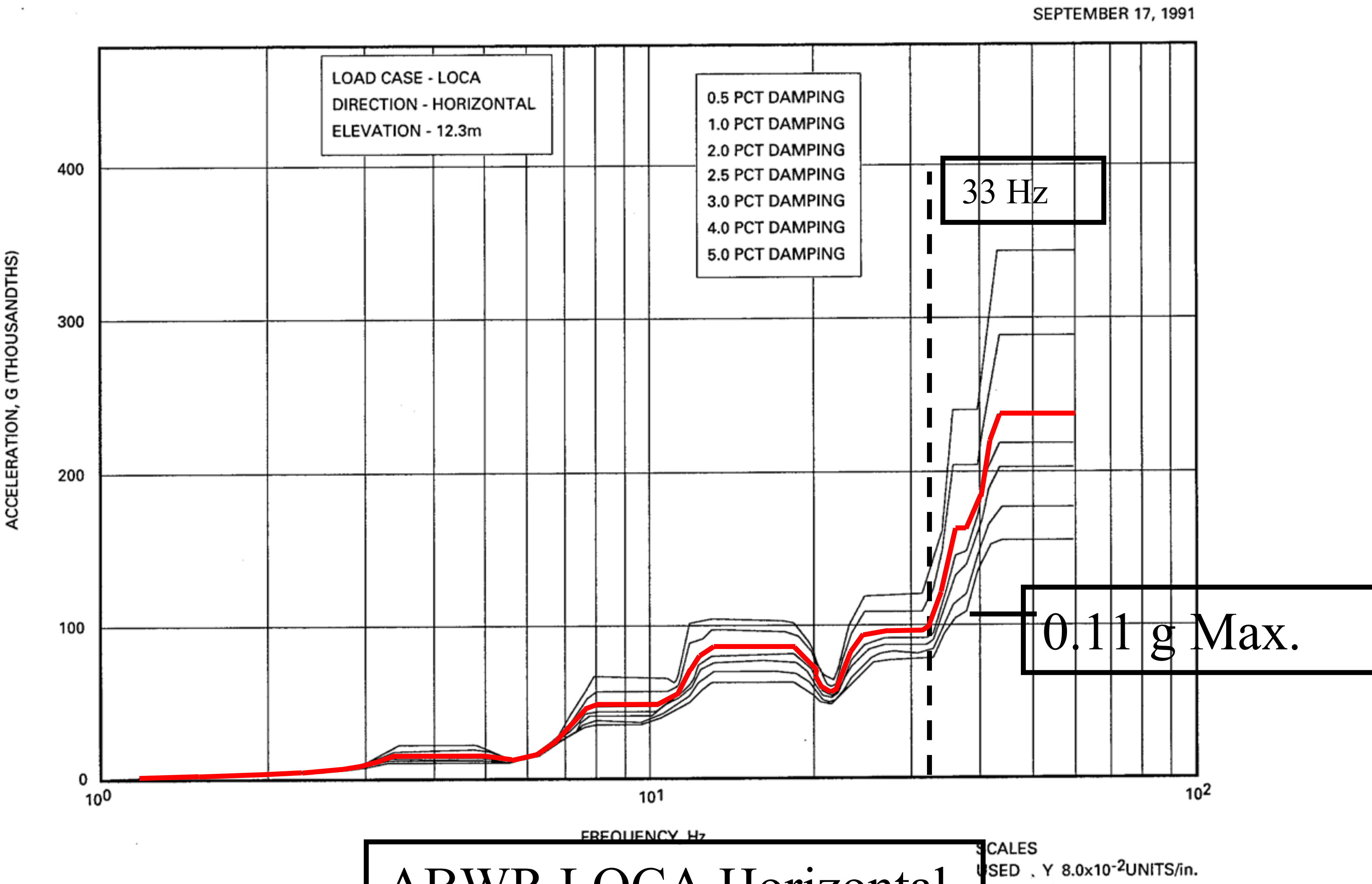
ABWR SRV Vertical



ABWR SRV Horizontal



ABWR LOCA Vertical



ABWR LOCA Horizontal

Comparison of Dynamic Maximum Accelerations at Diaphragm Floor Elevation

Dynamic Load	ABWR	Lungmen	SBWR
SSE VERTICAL	4.6 g	7.7 g	3.8 g
SSE HORIZONTAL	3.9 g	3.8 g	4.8 g
SRV VERTICAL	1.7 g	1.7 g	--
SRV HORIZONTAL	0.28 g	0.28 g	--
LOCA VERTICAL	3.8 g	3.8 g	--
LOCA HORIZONTAL	0.11 g	0.11 g	--

Conclusions Regarding Dynamic Loads

- SSE Accelerations are higher than Containment Values
- Peaks of SSE and Containment Load Time Histories do not Coincide
- SBWR & ESBWR SSE Loads are Expected to be Similar
- SSE and Containment Dynamic Load Analysis is Currently in Progress
- When ESBWR Dynamic Data is Available, it will be Evaluated against Data from Prior Plants to Confirm Relationship between Thermal and Dynamic Loads

Available Data Indicates that Historical relationship between Thermal and Dynamic Loads is Applicable to ESBWR

Background on Environmental Fatigue Effects on Piping

- Concern was raised based on Laboratory Data, Codes used for Early Reactor Designs and IGSCC
- Evaluated by NRC under GSI-190
  - Concluded that no Generic Regulatory Action was Required
  - No Change in Evaluation of Core Damage Frequency
  - Measure Fatigue Usages are Less Severe Than Original Plant Thermal Cycle Design Bases
  - Inservice Inspection Programs are in Place to Provide Early Detection of Cracking
- Reviewed as Part of Operating Licenses Renewals

ESBWR Commitments Related to Environmental Fatigue

- System Thermal Cycle and Transient Definition will be Consistent with Criteria Established for Prior BWRs
- ASME Class 1 Piping will be designed to have a Fatigue Usage Factor of Less Than 0.1 for 60 Years of Plant Operation
- Previously Established GE Fatigue Design Rules will be Applied to Piping Materials

Summary of ESBWR Piping Analysis Review

- The Same Methods and Standards Accepted in ABWR Certification will be Followed
- Proposed Analysis will Confirm that Pipe Routing will Meet Design Objectives
- Design Criteria Selected will Minimize Pipe Whip Restraints and Minimize Environmental Fatigue Concerns
- Prior BWR Experience Demonstrates that the Design Certification Commitments can be Met

Piping Related Documentation to be Provided in DCD

- Classification Summary (Table 3.2-1)
- System Schematic Diagrams
- Piping Line Designation Table
- Load Combinations and Acceptance Criteria for Safety-Related, ASME Code Class 1,2 and 3 Components, Component supports, and Class CS Structures (Table 3.9-2) - (Essentially the same as ABWR SSAR)
- Class 1 Piping Load Combinations and Acceptance Criteria for ASME Class 1 Piping

Example of Piping Classification Table

Table 3.2-1. Classification Summary

Principal Component[1]	Safety Desig.[2]	Location [3]	Quality Group[4]	QA Req. [5]	Seismic Category[6]
B NUCLEAR STEAM SUPPLY SYSTEMS					
B21 Nuclear Boiler System (NBS)					
1. Safety/relief discharge piping (including supports)	Q	CV	C	B	I
2. Piping and valves (including supports) for main steam (MSL) and feedwater (FW) lines up to and including the outermost containment isolation valves	Q	CV, RB	A	B	I
3. Piping (including supports) for MSL from outermost isolation valve to and including seismic interface restraint and FW from outermost isolation valve to the seismic interface restraint including the shutoff valve	Q	RB	B	B	I

Sample Piping Line Designations

Table X.X-X - Piping Line Designations

Standard Line Designation	Service	Temperature Range	Primary Rating	Material
AA	Cond. Water/ Reactor Water	-30 to 260°C (-20 to 500°F)	150 LB	Carbon Steel
AB	Cond. Water/ Reactor Water	-30 to 260°C (-20 to 500°F)	150 LB	Stainless Steel
AC	Steam	to 260°C (to 500°F)	150 LB	Carbon Steel
AD	Service Water	-30 to 260°C (-20 to 500°F)	150 LB	Carbon Steel
AE	Radwaste	-30 to 260°C (-20 to 500°F)	150 LB	Carbon Steel
AF	Radwaste	-30 to 260°C (-20 to 500°F)	150 LB	Stainless Steel
AG*	Demineralized Water		150 LB	Aluminium
AH	Steam Condensate	to 260°C (to 500°F)	150 LB	Carbon Steel
AL	Fuel Oil	-30 to 260°C (-20 to 500°F)	150 LB	Carbon Steel
BA	Cond. Water/ Reactor Water	-30 to 260°C (-20 to 500°F)	300 LB	Carbon Steel
BB	Cond. Water/ Reactor Water	-30 to 260°C (-20 to 500°F)	300 LB	Stainless Steel
BC	Steam	to 260°C (to 500°F)	300 LB	Carbon Steel
BD	Service Water	-30 to 260°C (-20 to 500°F)	300 LB	Carbon Steel
BE	Steam Condensate	to 260°C (to 500°F)	300 LB	Carbon Steel
BF	Offgas	-30 to 260°C (-20 to 500°F)	300 LB	Carbon Steel
BG	Liquid Nitrogen	-196 to 65.5°C (-320 to 150°F)	300 LB	Stainless Steel

Table 3.9-2

Load Combinations and Acceptance Criteria for Safety-Related, ASME Code Class 1, 2 and 3 Components, Component Supports, and Class CS Structures

Plant Event	**Service Loading Combination** (1), (2), (3)	**ASME Service Level** (4)
1. Normal Operation (NO)	N	A
2. Plant/System Operating Transients (SOT)	(a) N + TSV (b) N + SRV(5)	B B
3. NO + SSE	N + SSE	B(12), (13)
4. Infrequent Operating Transient (IOT), ATWS, DPV	(a) N(6) + SRV(5) (b) N + DPV(7)	C (14) C(14)
5. SBL	N + SRV(8) + SBL(9)	C(14)
6. SBL or IBL + SSE	N + SBL (or IBL)(9) + SSE + SRV(8)	D(10), (14)
7. LBL + SSE	N + LBL(9) + SSE	D(10), (14)
8. NLF	N + SRV(5) + TSV(11)	D(14)

Load Combinations and Acceptance Criteria for Class 1 Piping Systems

Condition	Load Combination for all terms (1) (2)	Acceptance Criteria
Design	PD + WT	Eq 9 $\leq$ 1.5 S_m NB-3652
Service Level A & B	PP, TE, ΔT1, ΔT2 , TA-TB, RV_1, RV_2I, RV_2D, TSV, SSEI, SSED	Fatigue - NB-3653: Eq 12 & 13 $\leq$ 3.0 S_m U < 1.0
Service Level B	PP + WT + (TSV) PP + WT + (RV_1) PP + WT + (RV_2I)	Eq 9 $\leq$ 1.8 S_m, but not greater than 1.5 S_y Pressure not to exceed 1.1P_a (NB-3654)
Service Level C	PP + WT + $[(CHUGI)^2 + (RV_1)^2]^{1/2}$ PP + WT + $[(CHUGI)^2 + (RV_2I)^2]^{1/2}$	Eq 9 $\leq$2.25 S_m, but not greater than 1.8 S_y Pressure not to exceed 1.5 P_a (NB-3654)
Service Level D	PP + WT + $[(SSEI)^2 + (TSV)^2]^{1/2}$ PP + WT + $[(SSEI)^2 + (CHUGI)^2 + (RV_1)^2]^{1/2}$ PP + WT + $[(SSEI)^2 + (CHUGI)^2 + (RV_2I)^2]^{1/2}$ PP + WT + $[(SSEI)^2 + (CONDI)^2 + (RV_1)^2]^{1/2}$ PP + WT + $[(SSEI)^2 + (CONDI)^2 + (RV_2I)^2]^{1/2}$ PP + WT + $[(SSEI)^2 + (API)^2]^{1/2}$	Eq 9 $\leq$ 3.0 S_m but not greater than 2.0 S_y Pressure not to exceed 2.0 P_a (NB-3654)

Summary

- Most Important & Limiting Piping has been Selected for Analysis to Support DCD
- Piping Selected for Analysis will Assure that ESBWR Piping will meet Design Certification Commitments when Detailed Design is Completed
- Content of Material in DCD will Provide Complete & Convenient Information for NRC Review