Appendix 3A. Tables

Table 3-1. Summary of Criteria - Structures

Structures	**Q.A. Required**	**Category**	**Normal Wind**	**Dead and Equipment**	**Live**	**Loading Containment Accident Pressure**	**Seismic**		**Tornado**		**Remarks Including Any Environmental Requirements**
							OBE	**SSE**	**Wind**	**Missile**	
Containment	X	I	-	X	X	X	X	X	-	-	Thermal Stresses and Partial Vacuum in Annulus. Equipment Missile Protected
Containment and Reactor Building Foundation Slab	X	I	X	X	X	X	X	X	X	-	Thermal Stresses
Containment Interior Concrete (including Emergency Sump)	X	I	-	X	X	-	X	X	-	-	Differential Accident Pressure; Pipe Rupture Loads; Thermal Stresses. Equipment Missile Protected
Containment Penetrations including Personnel Hatches and Equipment Hatches	X	I	-	X	X	X	X	X	-	-	Checked for Potential Pipe Whipping

Structures	Q.A. Required	Category	Normal Wind	Dead and Equipment	Live	Loading Containment Accident Pressure	Seismic		Tornado		Remarks Including Any Environmental Requirements
							OBE	SSE	Wind	Missile	
Containment Structural Steel	X	I	-	X	X	X	X	X	-	-	Thermal Stresses
Containment Divider Barrier Seal	X	I	-	-	-	X	X	X	-	-	
Nuclear Service Water Pipe	X	I	-	X	X	-	X	X	X	X	Soil and Water Pressures on Buried Portion Hydraulic Pressures. Moving Equipment Loads. Static Seismic Analysis. Spec. By Mech. Section.
Nuclear Service Water Structures[2]	X	I	X	X	X	-	X	X	X	X	Soil and Water Pressures.
Standby Nuclear Service Water Pond Dam and Outlet Works[3]	X	I	X	X	X	-	X	X	-	-	New Mark’s Method of Seismic Analysis of Dams

Structures	Q.A. Required	Category	Normal Wind	Dead and Equipment	Live	Loading Containment Accident Pressure	Seismic		Tornado		Remarks Including Any Environmental Requirements
							OBE	SSE	Wind	Missile	
Auxiliary Building, Including Diesel Building[3]	X	I	X	X	X	-	X	X	X	X	Soil and Water Pressures on Substructure; Tornado Pressure Drop
Fuel Pool	X	I	X	X	X	-	X	X	X	-	Thermal Stresses and Cask Drop
Fuel Building	X	I	X	X	X	-	X	X	X	X	
Fuel Storage Racks (New & Spent)	X	I	-	X	X	-	X	X	-	-	Thermal Stresses
Main Stream and Feedwater Supports, Through Isolation Valve and First Support Outside Reactor Building	X	I	X	X	X	-	X	X	X	X	Pipe Loads
Reactor Building	X	I	X	X	X	-	X	X	X	X	Tornado Pressure Drop. Soil and Water Pressure on Substructure

Structures	**Q.A. Required**	**Category**	**Normal Wind**	**Dead and Equipment**	**Live**	**Loading Containment Accident Pressure**	**Seismic**		**Tornado**		**Remarks Including Any Environmental Requirements**
							OBE	**SSE**	**Wind**	**Missile**	
Station Vent[1]	X	I	X	X	X	-	X	X	X	-	
Refueling Water Storage Tank Foundations	X	I	X	X	X	-	X	X	X	-	
Tornado Missile Protection	X	I	X	X	X	-	X	X	X	X	
Relay House		III	X	X	X	-	-	-	-	-	
230 Kv Switch Station Steel and Fdts.	-	III	X	X	X	-	-	-	-	-	
Step-Up and Auxiliary Transformer Foundation	-	III	X	X	-	-	-	-	-	-	
Access Railroad, including Structures	-	III	X	X	X	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads
Hazardous Waste Storage House	-	III	-	X	X	-	-	-	-	-	

Structures	Q.A. Required	Category	Normal Wind	Dead and Equipment	Live	Loading Containment Accident Pressure	Seismic OBE	Seismic SSE	Tornado Wind	Tornado Missile	Remarks Including Any Environmental Requirements
Condenser Cooling Water Pipe	-	III	X	X	X	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads
LPSW Water Intake Structure	-	III	-	X	X	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads
LPSW Discharge Structure	-	III	-	X	X	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads
Missile Barriers Protecting Safety-Related Equipment	X	I	-	X	X	-	X	X	-	-	
Battery Racks	X	I	-	X	X	-	X	X	-	-	
Intake Canal, Discharge Canal, Dike and Riprap	-	III	X	X	X	-	-	-	-	-	

Structures	**Q.A. Required**	**Category**	**Normal Wind**	**Dead and Equipment**	**Live**	**Loading Containment Accident Pressure**	**Seismic**		**Tornado**		**Remarks Including Any Environmental Requirements**
							OBE	**SSE**	**Wind**	**Missile**	
Oxygen, Hydrogen and Nitrogen Houses and Bottled Storage House	-	III	X	X	X	-	-	-	-	-	
Main Steam Line Supports, Excluding First Support, Outside Reactor Building	-	III	X	X	X	-	-	-	-	-	
Service Building	-	III	X	X	X	-	-	-	-	-	
Turbine Building Equipment Supports	-	III	-	X	X	-	-	-	-	-	
Turbine Building Substructure	-	III	X	X	X	-	-	-	-	-	Soil and Water Pressures
Turbine Building Super-structure	-	III	X	X	X	-	-	-	-	-	

Structures	Q.A. Required	Category	Normal Wind	Dead and Equipment	Live	Loading Containment Accident Pressure	Seismic		Tornado		Remarks Including Any Environmental Requirements
							OBE	SSE	Wind	Missile	
Turbine-Generator Foundation	-	III	-	X	X	-	-	-	-	-	Per Manufacturer's Recommendations
Yard Drainage	-	III	-	X	X	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads
Hot Machine Shop, Decontamination Rooms, Shipping and Receiving Areas	-	III	X	X	X	-	-	-	-	-	Moving Equipment Loads
NSW Conduit Manholes (Safety-Related)[3]	X	I	-	X	-	-	X	X	-	X	Soil and Water Pressures. Moving Equipment Loads
Electrical Cable Trenches (Non-NSR)	-	III	-	-	-	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads

Structures	Q.A. Required	Category	Normal Wind	Dead and Equipment	Live	Loading Containment Accident Pressure	Seismic OBE	Seismic SSE	Tornado Wind	Tornado Missile	Remarks Including Any Environmental Requirements
Cooling Tower Structures (Non-NSR)	-	III	X	X	X	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads
Waste Water Treatment Sys (Non-NSR)	-	III	-	X	-	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads
RWS Tank Pipe Trench (Safety-Related)	X	I	-	X	X	-	X	X	-	X	
Sanitary Sewage System (Non-NSR)	-	III	-	-	-	-	-	-	-	-	Soil and Water Pressures. Moving Equipment Loads
Stand-by Shutdown Facility (Non-NSR)	-	III	X	X	X	-	-	-	-	-	

Structures	**Q.A. Required**	**Category**	**Normal Wind**	**Dead and Equipment**	**Live**	**Loading Containment Accident Pressure**	**Seismic**		**Tornado**		**Remarks Including Any Environmental Requirements**
							OBE	**SSE**	**Wind**	**Missile**	
Containment Recirculation Sump Strainer Assembly	X	I	-	X	X	-	X	X	-	-	Thermal Loads
Monitor Tank Building Structural Steel	-	III	X	X	X	-	-	-	-	-	Meets requirements of Reg. Guide 1.143
Monitor Tank Building Foundation and Concrete Walls	X	III	X	X	X	-	X	-	-	-	Meets requirements of Reg. Guide 1.143

Symbols:

OBE = Operating Basis Earthquake

SSE = Safe Shutdown Earthquake

X = Designed For

- = Not Designed For

Notes:

1. The Station Vent is not designed for tornado missiles.
2. Includes SNSW discharge structures, SNSW intake structure, NSW intake structure and NSW & SNSW Pump Structure.
3. Foundation slabs included.

Table 3-2. Summary of Criteria - Equipment

							Seismic		Tornado	
Equipment	**Scope**	**Quality Assurance Required**	**Category**[3]	**Code**	**Location**	**Rad. Source** [2]	**OBE**	**SSE**	**Wind**	**Missile**
Cranes:										
Containment Polar Crane	D	X	II	As Applicable	C	-	X	X	-	-
Cask Crane	D	X	II	As Applicable	AB	-	X	X	-	-
Cranes (Excluding Reactor Building and Fuel Handling)	D	-	III	As Applicable	-	-	-	-	-	-
Refueling Machine	W	X	II	As Applicable	C	-	X	X	-	-
Fuel Handling Machine	W	X	II	As Applicable	AB	-	X	X	-	-
Tanks:										
Recycle Monitor	D	-	III	ASME VIII	AB	P	X	-	-	-
Laundry and Hot Shower	D	-	III	ASME VIII	AB	X	X	-	-	-
Waste Monitor	D	-	III	ASME VIII	AB	P	X	-	-	-
Mixing and Settling	D	-	III	ASME VIII	AB	P	-	-	-	-
Mixing and Settling Reagent	D	-	III	ASME VIII	AB	-	-	-	-	-
Floor Drain	D	X	II	ASME VIII	AB	X	X	X	-	-
Chemical Drain	D	-	III	ASME VIII	AB	X	-	-	-	-
RCP Motor Oil Drain	D	X	II	ASME VIII	C	P	X	X	-	-
Waste Gas Decay	D	X	I	ASME III	AB	X	X	X	-	-
Waste Drain	D	X	I	ASME III	AB	X	X	X	-	-

Equipment	**Scope**	**Quality Assurance Required**	**Category^3**	**Code**	**Location**	**Rad. Source ^{2}**	**Seismic**		**Tornado**	
							OBE	**SSE**	**Wind**	**Missile**
Waste Evaporator Feed	D	X	II	ASME VIII	AB	X	X	X	-	-
Vent. Unit Cond. Drain	D	X	II	ASME VIII	AB	X	X	X	-	-
Spent Resin Storage	D	X	I	ASME III	AB	X	X	X	Note (4)	Note (4)
Refueling Water Storage	D	X	I	ASME III	YD	P	X	X	X	-
Reactor Makeup Water Storage	D	X	III	ASME VIII	YD	P	X	X	X	-
Boron Recycle Holdup	D	X	I	ASME III	AB	X	X	X	Note (4)	Note (4)
Boric Acid	D	X	I	ASME III	AB	X	X	X	Note (4)	Note (4)
Fuel Oil Storage (buried)	D	X	I	ASME III	YD	-	X	X	-	-
Component Cooling Surge	D	X	I	ASME III	AB	-	X	X	-	-
Steam Gen. Blowdown	D	-	III	ASME VIII	TB	-	-	-	-	-
Backwash	D	-	III	ASME VIII	TB	-	-	-	-	-
Upper Surge	D	-	III	ASME VIII	TB	-	-	-	-	-
Condensate Storage	D	-	III	ASME VIII	TB	-	-	-	-	-
Upper Surge Dome	D	-	III	ASME VIII	TB	-	-	-	-	-
Evap. Concentrate Holdup	D	-	III	ASME VIII	AB	X	-	-	-	-
Demin. Water Storage	D	-	III	ASME VIII	SB	-	-	-	-	-
Heater Blowoff	D	-	III	ASME VIII	TB	-	-	-	-	-
"C" Heater Drain	D	-	III	ASME VIII	TB	-	-	-	-	-
RCW Storage	D	-	III	ASME VIII	SB	-	-	-	-	-
Turbine Oil Transfer	D	-	III	ASME VIII	TB	-	-	-	-	-

							Seismic		Tornado	
Equipment	**Scope**	**Quality Assurance Required**	**Category**[3]	**Code**	**Location**	**Rad. Source** [2]	**OBE**	**SSE**	**Wind**	**Missile**
Fire Protection Pressurizer	D	-	III	ASME VIII	SB	-	-	-	-	-
Filtered Water (Not Code Stamped)	D	-	III	ASME VIII	SB	-	-	-	-	-
YT Sulfuric Acid (Abandoned)	D	-	III	ASME VIII	YD	-	-	-	X	-
Evap. Concentrates Batch	D	-	III	ASME VIII	AB	X	X	X	-	-
Aux. Boiler Blowoff	D	-	III	ASME VIII	SB	-	-	-	-	-
Clean Lube Oil Storage (buried)	D	-	III	ASME VIII	YD	-	-	-	-	-
Used Lube Oil Storage (buried)	D	-	III	ASME VIII	YD	-	-	-	-	-
Standby Shutdown Diesel Fuel Oil Storage	D	-	III	ASME VIII	YD	-	-	-	-	-
RCP Motor Oil Fill Tank	D	-	III	ASME VIII	YD	-	-	-	-	-
Ice Cond. Glycol Mixing and Storing	D	-	III	ASME VIII	AB	-	-	-	-	-
Ice Making Sol. Mixing	D	-	III	ASME VIII	AB	-	-	-	-	-
Instrument Air Receivers	D	-	III	ASME VIII	SB	-	-	-	-	-
Station Air Receivers	D	-	III	ASME VIII	SB	-	-	-	-	-
WC Caustic Storage	D	-	III	ASME VIII	CB	-	-	-	-	-
Chemical Addition Supply	D	-	III	ASME VIII	SB	-	-	-	-	-
Drinking Water	D	-	III	ASME VIII	SB	-	-	-	-	-
Make-up Demin. Caustic Storage	D	-	III	ASME VIII	SB	-	-	-	-	-
Vacuum Priming	D	-	III	ASME VIII	SB	-	-	-	-	-
YT Dispersant Storage (Abandoned)	D	-	III	Note (5)	CB	-	-	-	-	-

							Seismic		Tornado	
Equipment	**Scope**	**Quality Assurance Required**	**Category**[3]	**Code**	**Location**	**Rad. Source** [2]	**OBE**	**SSE**	**Wind**	**Missile**
YT Organic Biocide Storage	D	-	III	Note (5)	CB	-	-	-	-	-
Aux. Boiler Chem. Feed	D	-	III	ASME VIII	SB	-	-	-	-	-
FWP Seal Leakoff	D	-	III	ASME VIII	TB	-	-	-	-	-
M.S. Isolation Valve Air	D	-	III	ASME VIII	DH	-	-	-	-	-
Radwaste Batching	D	-	III	ASME VIII	AB	X	-	-	-	-
Filtered Water Clearwell	D	-	III	ASME VIII	SB	-	-	-	-	-
Chilled Water System Compression	D	X	I	ASME III	AB	-	X	X	-	-
Aux. Boiler Chem. Feed Tank "B"	D		III	ASME VIII	SB	-	-	-	-	-
Aux. Feedwater Cond. Storage	D		III	ASME VIII	SB	-	-	-	-	-
CPD Decant Monitor Tank	D		III	ASME VIII	TB	-	-	-	-	-
Fuel Oil Day Tank	D	X	I	ASME III	DG	-	X	X	-	-
Equipment Decontamination	D	X	II	ASME VIII	AB	-	X	X	-	-
Oil and Grit Removal	D	X	III	ASME VIII	AB	X	-	-	-	-
Auxiliary Monitor Tanks, A, B & C	D	X	III	ASME VIII	MT	X	-	-	-	-
Powdex Storage Tank	D	X	III	ASME VIII	MT	X	-	-	-	-
Hydrazine Volume Control Receiver	D	-	III	ASME VIII	SB	-	-	-	-	-

							Seismic		Tornado	
Equipment	**Scope**	**Quality Assurance Required**	**Category[3]**	**Code**	**Location**	**Rad. Source [2]**	**OBE**	**SSE**	**Wind**	**Missile**

Notes:

1. Polar crane and cask crane designed for seismic loads in unloaded condition only.
2. X = Source of radiation.

   - = No source of radiation.

   P = Possible source of radiation.
3. Category II and III Structures are not safety related.
4. Located in a Category 1 Structure which has been designed for Tornado Wind and Missiles.
5. ASTM D 3299-74 or NBS Voluntary Product Standard PS 15-69 as applicable.

Symbols:

AB = Auxiliary Building
C = Containment
D = Duke
TB = Turbine Building
SB = Service Building
YD = Yard
W = Westinghouse

X = Designed For
- = Not Designed For
OBE = Operating Basis Earthquake
SSE = Safe Shutdown Earthquake
DH = Dog House
CB = Chemical Building
DG = Diesel Generator Building
MT = Monitor Tank Building

Table 3-3. Summary of Codes and Standards for Components of Water-Cooled Nuclear Power Units. (by NRC Quality Group Class and ANS Safety Class)

Component	**Quality Group Class A ANS Safety Class 1, SC-1**	**Quality Group Class B ANS Safety Class 2, SC-2**	**Quality Group Class C ANS Safety Class 3, SC-3**	**Quality Group Class D ANS Non-Nuclear Safety, NSS**
Pressure Vessels	ASME Boiler & Pressure Vessel Code, Section III, Class 1	ASME Boiler & Pressure Vessel Code, Section III, Class 2	ASME Boiler & Pressure Vessel Code, Section III, Class 3	ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, API-620
0-15 psig Storage Tanks	-	ASME Boiler & Pressure Vessel Code, Section III, Class 2	ASME Boiler & Pressure Vessel Code, Section III, Class 3	ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, API-620
Atmospheric Storage Tanks	-	ASME Boiler & Pressure Vessel Code, Section III, Class 2	ASME Boiler & Pressure Vessel Code, Section III, Class 3	ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, API-620
Piping	ASME Boiler & Pressure Vessel Code, Section III, Class 1	ASME Boiler & Pressure Vessel Code, Section III, Class 2	ASME Boiler & Pressure Vessel Code, Section III, Class 3	ANSI B31.1 Duke Power Company Specifications
Pumps and Valves	ASME Boiler & Pressure Vessel Code, Section III, Class 1	ASME Boiler & Pressure Vessel Code, Section III, Class 2	ASME Boiler & Pressure Vessel Code, Section III, Class 3	Valves - ANSI B31.1.0 Pumps – Manufacturer's Standards

Note:

1. Exception is taken for all the details of the referenced ASME Code section since the ASME Code does not cover buried piping. See Section 3.7.3.12

Table 3-4. Summary of Criteria - Mechanical System Components

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
AD	Standby Shutdown Diesel System										
	Pumps	D	NNS	-	-	SSF	-	-	-	-	-
	Valves	D	NNS	B31.1	-	B, O, SSF	-	-	-	-	-
	Tanks	D	NNS	ASME VIII, -	-	B, SSF	-	-	-	-	-
AS	Auxiliary Steam System										
	Valves[22]	D	NNS	B31.1	X	AB	-	X	X	-	-
BB	Steam Generator Blowdown System										
	Steam Generator Blowdown Tank	D	NNS	VIII	-	TB	P	-	-	-	-
	Steam Generator Blowdown Pump	D	NNS	-	-	TB	P	-	-	-	-
	Steam Generator Blowdown Recovery HX	D	NNS	VIII	-	TB	P	-	-	-	-
	Steam Generator Blowdown Demineralizers	D	NNS	VIII	-	TB	P	-	-	-	-
	Valves	D	2,NNS	III-2,	X	C,TB	P	X	X	X	X
	Steam Generator Blowdown Demineralizer Prefilters	D	NNS	VIII	-	TB	P	-	-	-	-
BW	Steam Generator Wet Layup Recirculation										
	Isolation Valves (CA System)	D	2	III-2	X	DH	-	X	X	X	X
	Isolation Valves (BB System)	D	NNS	B31.1	X	DH	-	X	X	-	-
CA	Auxiliary Feedwater System										

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Auxiliary Feedwater Pumps (Motor Driven)	D	3	III-3	X	AB	-	X	X	X	X
	Aux. Feedwater Pumps (Turbine Driven)	D	3	III-3	X	AB	-	X	X	X	X
	Aux. FDWP Turb. Lube Oil Cooler	D	3	III-3	X	AB	-	X	X	X	X
	Valves	D	2	III-2	X	C, DH	-	X	X	X	X
		D	3	III-3	X	AB	-	X	X	X	X
		D	NNS	B31.1	X	AB	-	X	X	-	-
CF	Feedwater System										
	Valves	D,W	2	III-2	X	C,DH	-	X	X	X	X
CM	Condensate System										
	Valves[22]	D	NNS	B31.1	X	AB	P	X	X	-	-
CS	Condensate Storage System										
	Valves[22]	D	NNS	B31.1	X	AB	-	X	X	-	-
FD	Diesel Generator Engine Fuel Oil System										
	Tanks										
	Day	D	3	III-3	X	DB	-	X	X	X	X
	Fuel Oil[16]	D	3	III-3	X	B	-	X	X	X	X
	Pumps										
	Engine Driven	D	3	III-3	X	DB	-	18	18	X	X
	Motor Driven Booster	D	3	III-3	X	DB	-	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Recirculation	D	NNS	Manuf. - Standards	-	O	-	-	-	-	-
	Filters										
	Recirculation	D	NNS	Manuf. - Standards	-	O	-	-	-	-	-
	Relief Valves	D	3	III-3	X	DB	-	X	X	X	X
	Valves										
	- All Valves (Excluding FD8, FD9, FD10, FD11, FD16, FD17, FD81, FD82, FD83, and FD84)	D	3	III-3	X	DB,B	-	X	X	X	X
	- FD16, FD17, FD81, FD82, FD83, and FD84	D	NNS	B31.1	-	O	-	-	-	-	-
	Strainers										
	Engine Driven	D	3	III-3	X	DB	-	18	18	X	X
	Motor Driven Booster	D	3	III-3	X	DB	-	X	X	X	X
FW	Refueling Water System										
	Refueling Water Storage Tank	D	2	III-2	X	0	P	X	X	X	-
	Refueling Water Pump	D	NNS	-	-	AB	P	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Refueling Water Recirculating Pump	D	NNS	-	-	AB	P	-	-	X	X
	Refueling Water Pump Strainer	D	NNS	-	-	AB	P	-	-	X	X
	Valves	D	2,NNS	III-2, B31.1	X,-	AB	P	X-	X-	X	X
GH	Generator Hydrogen System										
	Valves	D	NA	-	-	AB	-	-	-	-	-
GN	Nitrogen System										
	Nitrogen Vessels	D	NA	VIII[17],	-	O	-	-	-	-	-
	Valves	D	NA	VIII	-	AB,TB	-	-	-	-	-
GS	Hydrogen Bulk Storage System										
	Hydrogen Bulk Storage Cylinders	D	NA	VIII[17],	-	O	-	-	-	-	-
	Valves	D	NA	-	-	AB	-	-	-	-	-
KC	Component Cooling System										
	Component Cooling Surge Tank	D	3	III-3	X	AB	P	X	X	X	X
	Component Cooling Pump	D	3	III-3	X	AB	P	X	X	X	X
	Component Cooling Drain Sump Pump	D	NA	-	-	AB	P	-	-	X	X
	Component Cooling HX (tube)	D	3	III-3	X	AB	-	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Component Cooling HX (shell)	D	3	III-3	X	AB	P	X	X	X	X
	Valves	D	2,3,NNS	III-2, III-3, B31.1	X,X,-	AB,C,AB	P	X,X,-	X,X,-	X	X
	KC Sump Pump Y. Strainer	D	NNS	-	-	AB	P	-	-	X	X
KD	Diesel Generator Cooling Water System										
	Cooling Water Heat Exchangers										
	(tube)	D	3	III-3	X	DB	-	X	X	X	X
	(shell)	D	3	III-3	X	DB	-	X	X	X	X
	Pumps										
	Circulation	D	3	III-3	X	DB	-	18	18	X	X
	Keep Warm	D	3	III-3	X	DB	-	X	X	X	X
	Jacket Water Heater	D	3	III-3	X	DB	-	X	X	X	X
	Standpipe	D	3	III-3	X	DB	-	X	X	X	X
	Temperature Regulating Valves	D	3	III-3	X	DB	-	X	X	X	X
	Valves	D	3	III-3	X	DB	-	X	X	X	X
KF	Spent Fuel Cooling System										
	Pump										
	Fuel Pool Cooling	D	3	III-3	X	AB	X	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Fuel Pool Skimmer	D	NNS	-	-	AB	X	-	-	X	X
	Fuel Transfer Canal Unwatering	D	NNS	-	-	AB	X	-	-	X	X
	Fuel Pool Cooling Heat Exchanger										
	(tube)	D	3	III-3	X	AB	X	X	X	X	X
	(shell)	D	3	III-3	X	AB	P	X	X	X	X
	Fuel Pool Cooling Demineralizer	D	NNS	VIII	-	AB	X	-	-	X	X
	Filters										
	Fuel Pool Cooling Pre-Filter	D	NNS	VIII	-	AB	X	-	-	X	X
	Fuel Pool Cooling Post-Filter	D	NNS	VIII	-	AB	X	-	-	X	X
	Fuel Pool Skimmer	D	NNS	VIII	-	AB	X	-	-	X	X
	Fuel Pool Skimmer Strainer	D	NNS	VIII	-	AB	X	-	-	X	X
	Fuel Pool Cooling Pump Strainer	D	3	-	X	AB	X	X	X	X	X
	Valves	D	3,NNS	III-3, B31.1	X,-	AB,C	X	X-	X-	X	X
KR	Recirculated Cooling Water System										
	Valves[22]	D	NNS	B31.1.1	X	AB,TB	-	-	-	-	-
LD	Diesel Generator Lube Oil System										
	Clean Lube Oil Storage Tank	D	NNS	VIII	-	B		-	-	-	-

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Used Lube Oil Storage Tank	D	NNS	VIII	-	B		-	-	-	-
	Diesel Gen. Eng. Lube Oil Sump Tank	D	3	III-3	X	DB	-	X	X	X	X
	Diesel Gen. Eng. Lube Oil Transfer Pumps	D	NNS	Manuf. - Standards	-	DB	-	18	18	X	X
	Engine Driven Lube Oil Pump	D	3	III-3	X	DB	-	18	18	X	X
	Clean Lube Oil Tank Transfer Pump	D	NNS	Manuf. - Standards	-	O	-	-	-	-	-
	Used Lube Oil Tank Transfer Pump	D	NNS	Manuf. - Standards	-	O	-	-	-	-	-
	Prelube Oil Pump	D	3	III-3	X	DB	-	X	X	X	X
	Sump Tank Heaters	D	3	III-3	X	DB	-	X	X	X	X
	Full Flow Filters	D	3	III-3	X	DB	-	X	X	X	X
	Lube Oil Coolers	D	3	III-3	X	DB	-	X	X	X	X
	Prelube Oil Filter	D	3	III-3	X	DB	-	X	X	X	X
	Strainers	D	3	III-3	X	DB	-	18	18	X	X
	Relief Valves	D	3	III-3	X	DB	-	X	X	X	X
	Valves										
	(1) LD23, LD28, LD86, LD89, LD67, LD87, LD88, LD61, LD66, LD68, LD62, LD63, LD64, LD65, LD85, LD53, and LD58	D	NNS	B31.1	-	DB,O	-	-	-	X,-	X,-

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	(2) #LD17, LD18, LD19, LD71, LD72, LD2, LD26, LD4, LD27, LD47, LD48, LD32, LD49, LD78, LD79, LD56, LD31, LD57, LD34, LD101, LD100, and LD1	D	3	III-3	X	DB	-	[18]	[18]	X	X
	(3) All Other Valves	D	3	III-3	X	DB	-	X	X	X	X
NB	Boron Recycle System										
	Pumps										
	Evaporator Feed	W	NNS	-	-	AB	X	-	-	X	X
	Reactor Makeup Water	W	NNS	-	-	AB	-	-	-	X	X
	Tanks										
	Holdup [11]	D	3	III-3	X	AB	X	X	X	X	X
	Reactor Makeup Water Storage [11]	D	NNS	VIII	-	0	-	-	-	X	-
	Reagent	W	NNS	VIII	-	AB	-	-	-	X	X
	Demineralizers										
	Evaporator Feed	W	3	III-3	X	AB	X	X	X	X	X
	Evaporator Condensate	W	NNS	-	-	AB	P	-	-	X	X
	Filters										
	Evaporator Feed	W	3	III-3	X	AB	X	X	X	X	X
	Evaporator Condensate	W	NNS	-	-	AB	P	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Evaporator Concentrates	W	NNS	-	-	AB	P	-	-	X	X
	Evaporator - Gas Stripper Pkg.	W	NNS [23]	VIII	-	AB	X	-	-	X	X
	Evaporator Condensate Return Unit	D	NA	VIII	-	AB	-	-	-	X	X
	Valves	D	2,3	III-2,3	X	AB,C	X	X	X	X	X
	Recycle Holdup Tank Air Ejector										
	Strainer	D	3	III-3	X	AB	X	X	X	X	X
	Sample Vessels	D	NNS	[10]	X	AB	X	-	-	X	X
NC	Reactor Coolant System										
	Reactor Vessel	W	1	III-1	X	C	X	X	X	X	X
	Fuel Assemblies	W/B	NA	-	X	C	X	X	X	X	X
	Control Rod Assemblies	W/B	2	-	X	C	X	X	X	X	X
	Burnable Poison Rod Assemblies	W/B	NNS	-	X	C	X	-	-	X	X
	Reactor Vessel Internals	W	2	III-2	X	C	X	X	X	X	X
	Control Rod Drive Mechanisms										
	Non Pressure Housing	W	NNS	-	X	C	X	-	-	X	X
	Pressure Housing	W	1	III-1	X	C	-	X	X	X	X
	Reactor Coolant Pumps	W	1	III-1	X	C	X	X	X	X	X
	Steam Generators (tube)	W/B	1	III-1	X	C	X	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Steam Generators (shell)	W/B	2	III-2	X	C	X	X	X	X	X
	Pressurizer	W	1	III-1	X	C	X	X	X	X	X
	Pressurizer Relief Valves	D	1	III-1	X	C	X	X	X	X	X
	Pressurizer Safety Valves	D	1	III-1	X	C	X	X	X	X	X
	Pressurizer Relief Tank	W	NNS	VIII	X	C	P	X	X	X	X
	RC Pump Motor Drain Tanks	D	NNS	VIII	-	C	P	X	X	X	X
	RC Pump Motor Drain Tank Pump	D	NNS	-	-	C	P	X	X	X	X
	Valves	D	1,2,3, NNS	III-1,2,3 B31.1	X	C,AB	X	X	X	X	X
	Pressurizer Relief Tank Samp Vessel	D	NNS	10	-	AB	X	-	-	X	X
ND	Residual Heat Removal System										
	RHR Pumps	W	2	III-2	X	AB	X	X	X	X	X
	RHR Heat Exchangers (tube)	W	2	III-2	X	AB	X	X	X	X	X
	RHR Heat Exchangers (shell)	W	3	III-3	X	AB	P	X	X	X	X
	Valves	D	1,2	III-1,2	X	C,AB	X	X	X	X	X
NF	Ice Condenser Refrigeration System										
	Ice Baskets	W	2	10	X	C	-	X	X	X	X
	Ice Bed Doors	W	2	10	X	C	-	X	X	X	X
	NF Refrigeration Units	W	NA	-	-	AB	-	-	-	X	X
	Ice Machine	W	NA	-	-	AB	-	-	-	X	X
	Air Handling Units	W	NA	10	-	C	P	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Valves	D	2	III-2	X	C,AB	P	X	X	X	X
	Glycol Strainers	W	NA	-	-	AB	-	-	-	X	X
	Ice Bin & Annex Cond. Units	W	NA	-	-	AB	-	-	-	X	X
	Ice Bin	W	NA	-	-	AB	-	-	-	X	X
	Ice Annex	W	NA	-	-	AB	-	-	-	X	X
	Ice Bin & Annex Air Handlers	W	NA	-	-	AB	-	-	-	X	X
	Ice Blower Package	W	NA	-	-	AB	-	-	-	X	X
	Ice Cond. Cyclone Receiver	W	NA	-	-	C	-	-	-	X	X
	Rotary Valve Assembly	W	NA	-	-	AB	-	-	-	X	X
	NF Floor Cooling Defrost Heater	W	NA	-	-	C	-	-	-	X	X
	NF Slab Cooling	W	NA	B31.1	-	C	-	X	X	X	X
	NF Glycol Bypass Strainer	W	NA	VIII	-	AB	-	-	-	X	X
	Pumps										
	NF Glycol	W	NA	-	-	AB	-	-	-	X	X
	NF Glycol Mixing & Storage	D	NA	VIII	-	AB	-	-	-	X	X
	Ice Making Solution Feed	D	NA	VIII	-	AB	-	-	-	X	X
	NF Floor Cooling	W	NNS	-	-	C	-	-	-	X	X
	Tanks										
	Glycol Mixing & Storage	D	NNS	VIII	-	AB	-	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Ice Making Solution Mixing	D	NNS	VIII	-	C	-	-	-	X	X
	NF Glycol Expansion	W	NNS	VIII	-	C	-	-	-	X	X
NI	Safety Injection System										
	Pumps										
	Safety Injection	W	2	III-2	X	AB	X	X	X	X	X
	UHI Makeup and Testing (Unit 1 PVAP abandoned, Unit 2 PVAP deleted)	D	NNS	-	-	AB	-	-	-	X	X
	Tanks										
	U1 UHI Water Accumulator (Unit 1 abandoned)	W	2	III-2	X	AB	-	X	X	X	X
	U1 UHI Nitrogen Accumulator (Unit 1abandoned)	W	2	III-2	X	AB	-	X	X	X	X
	U1 & 2 UHI Surge (both units abandoned)	W	2	III-2	X	AB	-	X	X	X	X
	U1 & 2 Accumulator	W	2	III-2	X	C	-	X	X	X	X
	Valves	D&W	1,2,3	III-1,2,3	X	C,AB	P	X	X	X	X
	Gas/Water Inter. Membrane	W	2	III-2	X	AB	-	X	X	X	X
NM	Nuclear Sampling System										
	Sample Vessels	D	NNS	10	-	AB	X	-	-	X	X
	Sample Heat Exchanger (tube)	D	NNS	B31.1	-	AB	X	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Sample Heat Exchanger (shell)	D	NNS	B31.1	-	AB	X	-	-	X	X
	Delay Coil[26]	D	2	III-2	X	C	X	X	X	X	X
	Valves	D	2,3	III-2,3	X	C,AB	X	X	X	X	X
NR	Boron Thermal Regeneration System										
	Heat Exchangers										
	Moderating (tube)	W	3	III-3	X	AB	X	X	X	X	X
	Moderating (shell)	W	3	III-3	X	AB	X	X	X	X	X
	Letdown Chiller (tube)	W	3	III-3	X	AB	X	X	X	X	X
	Letdown Chiller (shell)	W	NNS	VIII	-	AB	-	-	-	X	X
	Letdown Reheat (tube)	W	2	III-2	X	AB	X	X	X	X	X
	Letdown Reheat (shell)	W	3	III-3	X	AB	X	X	X	X	X
	Chiller Units	W	NA	-	-	AB	-	-	-	X	X
	Chiller Surge Tanks	W	NNS	VIII	-	AB	-	-	-	X	X
	Boron Chiller Pumps	W	NA	-	-	AB	-	-	-	X	X
	NR Thermal Regeneration Demineralizers	W	3	-	X	AB	X	X	X	X	X
	Valves	D	2,3	III-2,3	X	AB	X	X	X	X	X
NS	Containment Spray System										
	Containment Spray Pumps	D	2	III-2	X	AB	X	X	X	X	X
	Deleted Per 2006 Update										

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Containment Spray HX (tube) Deleted Per 2006 Update	D	3	III-3	X	AB	P	X	X	X	X
	Containment Spray HX (Shell) Deleted Per 2006 Update	D	2	III-2	X	AB	X	X	X	X	X
	Containment Spray Nozzles	D	2	-	X	C	P	X	X	X	X
	Valves	D	2	III-2	X	C	P	X	X	X	X
NV	Chemical and Volume Control System Pumps										
	(RECIPROCATING CHARGING PUMP NO. 1 HAS BEEN ABANDONED IN PLACE PER NSM CN-11392/00) (RECIPROCATING CHARGING PUMP NO. 2 HAS BEEN ABANDONED IN PLACE PER NSM CN-21392/00)										
	Centrifugal Charging	W	2	III-2	X	AB	X	X	X	X	X
	Boric Acid Transfer	W	3	III-3	X	AB	-	X	X	X	X
	Boric Acid Batching Tank	D	NNS	-	-	AB	-	-	-	X	X
	Boric Acid Recirculation	D	3	III-3	X	AB	-	X	X	X	X
	Heat Exchangers										
	Regenerative	W	2	III-2	X	C	X	X	X	X	X
	Letdown (tube)	W	2	III-2	X	AB	X	X	X	X	X
	Letdown (shell)	W	3	III-3	X	AB	P	X	X	X	X
	Excess Letdown (tube)	W	2	III-2	X	C	X	X	X	X	X
	Excess Letdown (shell)	W	2	III-2	X	C	P	X	X	X	X
	Seal Water (tube)	W	2	III-2	X	AB	X	X	X	X	X
	Seal Water (shell)	W	3	III-3	X	AB	P	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Tanks										
	Volume Control	W	2	III-2	X	AB	X	X	X	X	X
	Boric Acid Batching	W	NNS	VIII	X	AB	-	-	-	X	X
	Chemical Mixing	W	NNS	VIII	X	AB	-	-	-	X	X
	RCP Seal Standpipe	W	NNS	VIII	-	C	-	-	-	X	X
	U2 Boron Feed Tank	W/D	NNS	III[25]	-	AB	X	X	X	X	X
	(RECIPROCATING CHARGING PUMP NO. 1 SUCTION PULSATION DAMPENER HAS BEEN ABANDONED IN PLACE PER NSM CN-11392/00)										
	(RECIPROCATING CHARGING PUMP NO. 2 SUCTION PULSATION DAMPENER HAS BEEN ABANDONED IN PLACE PER NSM CN-21392/00)										
	(RECIPROCATING CHARGING PUMP NO. 1 DISCHARGE PULSATION DAMPENER HAS BEEN ABANDONED IN PLACE PER NSM CN-11392/00										
	(RECIPROCATING CHARGING PUMP NO. 2 DISCHARGE PULSATION DAMPENER HAS BEEN ABANDONED IN PLACE PER NSM CN-21392/00)										
	Demineralizers										
	Mixed Bed	W	3	III-3	X	AB	X	X	X	X	X
	Cation Bed	W	3	III-3	X	AB	X	X	X	X	X
	Filters										
	Reactor Coolant	W	2	III-2	X	AB	X	X	X	X	X
	Seal Water Return	W	2	III-2	X	AB	X	X	X	X	X
	Seal Water Injection	W	2	III-2	X	AB	X	X	X	X	X
	Boric Acid	W	3	III-2	X	AB	X	X	X	X	X
	Letdown Orifices	W	2	III-2	X	C	X	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Boric Acid Blender	W	3	III-3	X	AB	-	X	X	X	X
	Valves	D	1,2,3	III-1,2,3	X	C,AB	X	X	X	X	X
NW	Containment Valve Injection Water Sys										
	Surge Chamber	D	2	III-2	X	AB	-	X	X	X	X
	Valves	D	2,3	III-2,3	X	AB	-	X	X	X	X
		D	NNS	B31.1	X	AB	X	-	-	X	X
RC	Condenser Circulating Water System										
	Condenser Circulating Water Pumps	D	NA	-	-	O	-	-	-	-	-
	Valves	D	NA	-	-	TB,O	-	-	-	-	-
RF	Interior Fire Protection System										
	Valves[22]	D	2,NNS, NA	III-2, B31.1,	X	TB,SB,RB, AB	-	-	-	-	-
RL	Conventional Low Pressure Service Water System										
	Pumps	D	NA	-	-	RL	-	-	-	-	-
	Strainer Pit Sump Pumps	D	NA	-	-	RL	-	-	-	-	-
	Strainers	D	NA	-	-	RL	-	-	-	-	-
	Valves	D	NA	-	-	RL,SB	-	-	-	-	-
RN	Nuclear Service Water System										
	NSW Pumps	D	3	III-3	X	RN	-	X	X	X	X
	NSW Strainers	D	3	III-3	X	RN	-	X	X	X	X
	Valves	D	2,3	III-2,3	X	RN,AB,O,C	-	X	X	X	X

								Seismic[8]		Tornado[9]	
System	**Component or System**	**Scope[2]**	**Safety Class[3]**	**Code[4]**	**QA Reqd.[5]**	**Location[6]**	**Rad. Source[7]**	**OBE**	**DBE**	**Wind**	**Missile**
RY	Exterior Fire Protection										
	Fire Protection Pumps	D	NA	[15]	X	0	-	-	-	-	-
	Valves	D	NA	-	X	O,B	-	-	-	-	-
SA	Main Steam to Auxiliary Equipment										
	Valves[22]	D	2	III-2	X	AB,DH	-	X	X	X	X
SB	Main Steam Bypass to Condenser System										
	Turbine Bypass Valves	D	NA	-	-	TB	-	-	-	-	-
SM	Main Steam System										
	Main Steam Isolation Valves	D	2	III-2	X	DH	-	X	X	X	X
SV	Main Steam Vent to Atmosphere System										
	Power Operated Relief Valves	D	2	III-2	X	DH	-	X	X	X	X
	Safety/Relief Valves	D	2	III-2	X	DH	-	X	X	X	X
TE	Feedwater Pump Turbine Exhaust										
	Valves[22]	D	3	III-3	X	AB	-	X	X	X	X
VA	Auxiliary Building Ventilation System										
	Aux. Building Radwaste Area Supply Units	D	NNS	-	-	AB	P	-	-	X	X
	Aux. Building Supply Units	D	NNS	-	-	AB	P	X	X	X	X
	Aux. Building Filtered Exhaust Filter Trains	D	3	[12]	X	AB	P	X	X	X	X
	Aux. Building Filtered Exhaust Fans	D	3	AMCA[14]	X	AB	P	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Auxiliary Building Unfiltered Exhaust Fans	D	NA	-	-	AB	-	X	X	X	X
	Misc. Aux. Bldg. Air Handling Units By Contractor	D	NA	-	-	AB	P	-	-	X	X
	Auxiliary Building Filtered Exhaust Ducting and Dampers	D	3		X	AB	P	X	X	X	X
	Auxiliary Shutdown Panel Supply Units	D	3	III-3	X	AB	-	X	X	X	X
VB	Breathing Air System										
	Valves[22]	D	2,NNS, NA	III-2, B31.1, NA	X	SB,AB,RB	-	-	-	-	-
VC	Control Area AC System										
	Control Room Air Handling Units	D	3	III-3 AMCA[14]	X	AB	-P	X	X	X	X
	Control Room Area Pressurizing Filter Train	D	3	[12]	X	AB	-P	X	X	X	X
	Switchgear Room Air Handling Units	D	3	III-3	X	AB	-	X	X	X	X
	Ducting and Dampers	D	3	-	X	AB	P	X	X	X	X
VD	Diesel Building Ventilation System										
	Diesel Building Normal Ventilation Fans	D	NNS	-		DB	-	-	-	X	X
	Diesel Building Normal Heating Coils	D	NNS	-		DB	-	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Diesel Building Ventilation Filters	D	NNS	-	X	DB	-	-	-	X	X
	Diesel Building Generator Ventilation Fans	D	3	AMCA[12]	X	DB	-	X	X	X	X
	Ducting and Dampers	D	3	-	X	DB	-	X	X	X	X
VE	Annulus Vent System										
	Annulus Vent Fans	D	3	AMCA[12]	X	AB	X	X	X	X	X
	Annulus Vent Filter Train	D	3	[12]	X	AB	X	X	X	X	X
	Dampers	D	3	-	X	AB	X	X	X	X	X
	Ducting	D	3	-	X	AB	X	X	X	X	X
VF	Fuel Pool Ventilation System										
	Fuel Pool Supply Unit	D	NNS	-	-	AB	P	X	X	X	X
	Fuel Handling Area Exhaust Filter Train	D	3	[12]	X	AB	P	X	X	X	X
	Fuel Handling Area Exhaust Fans	D	3	AMCA[14]	X	AB	P	X	X	X	X
	Ducting and Dampers	D	3	-	X	AB	P	X	X	X	X
VG	Diesel Generator Engine Starting Air System										
	Air Compressors	D	NNS	B31.1	X	DB	-	22	22	X	X
	Starting Air Tanks	D	3	III-3	X	DB	-	X	X	X	X
	D/G Starting Air After Cooler (shell)	D	NNS	---	-	DB	-	22	22	X	X
	D/G Starting Air After Cooler (tube)	D	NNS	---	-	DB	-	22	22	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Starting Air Dryers	D	NNS	VIII	X	DB	-	22	22	X	X
	Relief Valves	D	3	III-3	X	DB	-	X	X	X	X
	Valves										
	(1) #VG1, VG2, VG3, VG4, VG45, VG46, VG47, VG48, VG36, and VG80	D	NNS	B31.1	-	DB	-	X	X	X	X
	(2) Valves between starting air aftercoolers and check valves VG5, VG6, VG49, and VG50	D	NNS	Manuf. - Standards	-	DB	-	-	-	X	X
	(3) (Valves Supplied On Engine Skid) VG25, VG26, VG27, VG28, VG29, VG30, VG31, VG32, VG69, VG70, VG71, VG72, VG73, VG74, VG75, and VG76.	D	18	18	X	DB	-	18	18	X	X
	(4) All Other Valves	D	3	III-3	X	DB	-	X	X	X	X.
VI	Instrument Air System										
	Instrument Air Compressors	D	NA	-	-	SB	-	-	-	-	-
	Instrument Air After Coolers	D	NA	-	-	SB	-	-	-	-	-
	Deleted Per 2007 Update										
	Instrument Air Receiver	D	NA	VIII	-	SB	-	-	-	-	-
	Instrument Air Dryers	D	NA	-	-	SB	-	-	-	-	-
	Valves[22]	D	2	III-2	X	C,AB	-	X	X	X	X
VJ	Computer Area A/C System										

								Seismic[8]		Tornado[9]	
System	**Component or System**	**Scope[2]**	**Safety Class[3]**	**Code[4]**	**QA Reqd.[5]**	**Location[6]**	**Rad. Source[7]**	**OBE**	**DBE**	**Wind**	**Missile**
	Computer Area Air Handling Units	D	NNS	-		SB	-	-	-	-	-
	Computer Area Air Heating Coils	D	NNS	-		SB	-	-	-	-	-
VK	Standby Shutdown Facility Ventilation System										
	Unit Heaters	D	NNS	-	-	SSF	-	-	-	-	-
	Supply Fans	D	NNS	-	-	SSF	-	-	-	-	-
	Air Handling Unit	D	NNS	-	-	SSF	-	-	-	-	-
	Ducting and Dampers	D	NNS	-	-	SSF	-	-	-	-	-
VN	Diesel Generator Engine Air and Exhaust System										
	Intake Filter	D	18	18	X	DB	-	18	X	X	X
	Intake Silencers	D	18	18	X	DB	-	18	X	X	X
	Exhaust Silencers	D	18	18	X	DB	-	18	X	X	X
	Valves	D	3	III-3	X	DB	-	X	X	X	X
VP	Containment Purge and Containment Ventilation System										
	Containment Purge Supply Units	D	NNS	-	-	AB	P	-	-	X	X
	Containment Purge Air Exhaust Fans	D	NNS	AMCA[14]	-	AB	P	X	X	X	X
	Containment Purge Air Exhaust Filters	D	NNS	12	-	AB	P	X	X	X	X
	Incore Instr. Room Purge Exhaust Filter	D	NNS	12	-	AB	P	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Incore Instr. Purge Supply Unit	D	NNS	-	-	AB	P	X	X	X	X
	Valves	D	2	III-2	X	RB,C	P	X	X	X	X
	Ducting and Dampers	D	NNS	-	-	AB,C,RB	P	X	X	X	X
VQ	Containment Air Release and Addition System										
	Filters	D	NNS	-	-	AB	P	-	-	X	X
	Valves	D	2	III-2	X	AB,C	P	X	X	X	X
	Fans	D	NA	-	-	AB	P	-	-	X	X
VS	Station Air System										
	Station Air Compressors	D	NA	-	-	SB	-	-	-	-	-
	Station Air Aftercoolers	D	NA	-	-	SB	-	-	-	-	-
	Station Air Receiver	D	NA	VIII	-	SB	-	-	-	-	-
	Station to Instrument Air Oil Filters	D	NA	-	-	SB	-	-	-	-	-
	Valves[22]	D	2	III-2	X	C,AB	-	X	X	X	X
VV	Containment Ventilation System										
	Upper Containment Ventilation Units	D	NNS	-	-	C	P	-	-	X	X
	Upper Containment Return Air Fans	D	NNS	-	-	C	P	-	-	X	X
	CRDM Vent Fans	D	NNS	-	-	C	P	-	-	X	X
	Lower Containment Vent Units	D	NNS	-	-	C	P	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Containment Aux. Carbon Filter Units	D	NNS	-	-	C	P	-	-	X	X
	Containment Aux. Carbon Filter Unit Fans	D	NNS	-	-	C	P	-	-	X	X
	Incore Instr. Room Ventilation Units	D	NNS	-	-	C	P	-	-	X	X
	Containment Pipe Tunnel Booster Fans	D	NNS	AMCA[12]	-	C	P	X	X	X	X
	Ducting and Dampers	D	NNS	-	-	C	P	X	X	X	X
VX	Containment Air Return and Hydrogen Skimmer System										
	Air Return Fans	D	2	AMCA[12]	X	C	X	X	X	X	X
	Hydrogen Skimmer Fans	D	2	AMCA[12]	X	C	X	X	X	X	X
	Post Accident Elec. Hydrogen Recombiner Pkg.	W	2	20	X	C	X	X	X	X	X
	Valves	D	2	III-2	X	C	X	X	X	X	X
VY	Containment Hydrogen Sample & Purge System										
	Containment Hydrogen Purge Inlet Blower	D	NNS	10		RB	-	-	-	X	X
	Containment Sample Vessel	D	NNS	10		AB	X	-	-	X	X
	Valves[22]	D	2,NNS	III-2, B31.1		AB,C	X	X	X	X	X
VZ	Nuclear Service Water Pump Structure Ventilation System										
	Ventilation Fans	D	3	AMCA[12]	X	RN	-	X	X	X	X
	Dampers and Ducting	D	3	-	X	RN	-	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Normal Fans	D	3	-	X	RN	-	X	X	X	X
WC	Conventional Waste Water Treatment System										
	Pumps										
	WC Settling Pond Mixing	D	NA	-	-	O	-	-	-	-	-
	WC Recirculation	D	NA	-	-	O	-	-	-	-	-
	WC Caustic Feed	D	NA	-	-	O	-	-	-	-	-
	WC Chemical Addition Pit Sump	D	NA	-	-	O	-	-	-	-	-
	WC Settling Pond Mixing Pump Pit Sump	D	NA	-	-	O	-	-	-	-	-
	WC Final Holdup Pond Inlet & Outlet Valve Pit Sump	D	NA	-	-	O	-	-	-	-	-
	WC Sulfuric Acid Storage Tank										
	Containment Sump	D	NA	-	-	O	-	-	-	-	-
	Transformer Base Drainage Sump	D	NA	-	-	O	-	-	-	-	-
	WC Caustic Storage Tank	D	NA	D100	-	O	-	-	-	-	-
	Valves	D	NA	-	-	SB	-	-	-	-	-
WE	Equipment Decontamination										
	Equipment Decontamination Pump and Accumulator	D	NA	-	-	AB	-	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Equipment Decontamination Tank	D	NNS	D100	-	AB	-	-	-	X	X
	Valves	D	2	21	X	C,AB	-	X	X	X	X
	Fuel Cask Decon Pit Sump Pump Strainer	D	NNS	10	-	AB	P	-	-	X	X
	Fuel Cask Decon Pit Sump Pump	D	NNS	-	-	AB	P	-	-	X	X
	Deleted Row (s) Per 2004 Update										
	Agitated Cleaning Tank	D	NA	-	-	AB	P	-	-	-	-
WG	Gaseous Waste Disposal System										
	Waste Gas Compressor Package	D	NNS	B31.1	-	AB	X	X	X	X	X
	Waste Gas Hydrogen Recombiner Pkg.	W	3	10	X	AB	X	X	X	X	X
	Waste Gas Decay Tank	D	3	III-3	X	AB	X	X	X	X	X
	Waste Gas Sample Vessel	D	NNS	10	-	AB	X	-	-	X	X
	Waste Gas Analyzers	D	NNS	B31.1	-	AB	X	X	X	X	X
	Gas Decay Tank Drain Pump	W	NNS	-	-	AB	X	-	-	X	X
	Waste Gas Decay Tank Gas Traps	W	NNS	-	-	AB	X	-	-	X	X
	Moisture Separators	D	3	III-3	X	AB	X	X	X	X	X
	Valves	D	2,3	III-2,3	X	C,AB	X	X	X	X	X
WL	Liquid Radwaste System										
	Tanks										

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Containment Ventilation Condensate Drain	D	NNS	VIII	-	AB	P	-	-	X	X
	Floor Drain	D	NNS	VIII	-	AB	X	-	-	X	X
	Laundry and Hot Shower	D	NNS	VIII	-	AB	X	-	-	X	X
	Mixing and Settling	D	NNS	VIII	-	AB	P	-	-	X	X
	Mixing and Settling Tank Reagent	D	NNS	VIII	-	AB	-	-	-	X	X
	Reactor Coolant Drain	W	NNS	VIII	-	C	X	-	-	X	X
	Recycle Monitor	D	NNS	VIII	-	AB	P	-	-	X	X
	Waste Drain	D	3	III-3	X	AB	X	X	X	X	X
	Waste Evaporator Feed	D	NNS[23]	VIII	-	AB	X	-	-	X	X
	Waste Evaporator Reagent	W	NNS	VIII	-	AB	-	-	-	X	X
	Waste Monitor	D	NNS	VIII	-	AB	P	-	-	X	X
	Steam Generator Drain	D	NNS	VIII	-	AB	X	-	-	X	X
	Reactor Coolant Drain Tank Gas Space Line	D	3	III-3	X	AB	X	X	X	X	X
	Outside Containment Isolation Valves										
	Sample Vessel										
	Various Sample Vessels	D	NNS	10	-	AB	P	-	-	X	X
(WL)	Pumps										
	Containment Ventilation Condensate Drain	D	NA	-	-	AB	P	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8]		Tornado[9]	
								OBE	DBE	Wind	Missile
	Floor Drain Tank	W	NNS	-	-	AB	X	-	-	X	X
	Laundry and Hot Shower Tank	W	NNS	-	-	AB	X	-	-	X	X
	Mixing and Settling Tank	D	NNS	-	-	AB	P	-	-	X	X
	Mixing and Settling Tank Metering	D	NA	10	-	AB	-	-	-	X	X
	Mixing and Settling Tank Sludge	D	NNS	-	-	AB	P	-	-	X	X
	Reactor Coolant Drain Tank	W	NNS	-	-	C	X	-	-	X	X
	Recycle Monitor Tank Pump A	W	NNS	-	-	AB	P	-	-	X	X
	Recycle Monitor Tank Pump B	D	NNS	-	-	AB	P	-	-	X	X
	Steam Generator Drain	D	NNS	-	-	C	P	-	-	X	X
	Waste Drain Tank Pumps A&B	D	NNS	-	-	AB	X	-	-	X	X
	Waste Evap. Feed Tank Pump A	W	NNS	-	-	AB	X	-	-	X	X
	Waste Evap. Feed Tank Pump B	D	NNS	-	-	AB	X	-	-	X	X
	Waste Monitor Drain Tank	W	NNS	-	-	AB	P	-	-	X	X
	Sump Pumps										
	Containment Floor and Equipment	D	NNS	-	-	C	X	-	-	X	X
	Floor Drain	D	NNS	-	-	AB	P	-	-	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Incore Instrument Tunnel	D	NNS	-	-	C	P	-	-	X	X
	NS & ND Pump Room	D	3	III-3	X	AB	X	X	X	X	X
	Steam and Motor-Driven Aux. FW Pumps Pit	D	3	III-3	X	AB	P	X	X	X	X
	UHI Room	D	NNS	-	-	AB	-	-	-	X	X
	Waste Evaporator Feed Tank	D	NNS	-	-	AB	P	-	-	X	X
	Strainers										
	Floor Drain Tank Pre-Strainer	D	NNS	VIII	-	AB	P	-	-	X	X
	Floor Drain Tank	W	NNS	VIII	-	AB	P	-	-	X	X
	Laundry and Hot Shower Pre-Strainer	D	NNS	VIII	-	AB	P	-	-	X	X
	Laundry and Hot Shower	W	NNS	VIII	-	AB	P	-	-	X	X
	Sump Pump Brg. Lube Inj. Separators	D	3	III-3	X	AB	X	X	X	X	X
	Demineralizers										
	Waste Evap Condensate	W	NNS	VIII	-	AB	X	-	-	X	X
	Floor Drain Tank Secondary Demineralizer	W	NNS	VIII	-	AB	X	-	-	X	X
	Floor Drain Tank Primary Demineralizer	D	NNS	VIII	-	AB	X	-	-	X	X
	Reactor Coolant Drain Tank Heat										
	Exchanger (tube)	W	2	III-2	X	C	X	X	X	X	X
	Exchanger (shell)	W	3	III-3	X	C	P	X	X	X	X

System	Component or System	Scope[2]	Safety Class[3]	Code[4]	QA Reqd.[5]	Location[6]	Rad. Source[7]	Seismic[8] OBE	Seismic[8] DBE	Tornado[9] Wind	Tornado[9] Missile
	Filters										
	Floor Drain Tank	W	NNS	VIII	-	AB	X	-	-	X	X
	Laundry and Hot Shower Primary	W	NNS	VIII	-	AB	X	-	-	X	X
	Laundry and Hot Shower Secondary	D	NNS	VIII	-	AB	X	-	-	X	X
	Waste Evap. Cond.	W	NNS	VIII	-	AB	X	-	-	X	X
	Waste Evap. Feed Filter A	W	NNS	VIII	-	AB	X	-	-	X	X
	Waste Evap. Feed Filter B	D	NNS	VIII	-	AB	X	-	-	X	X
	Floor Drain Tank Post Filter	W	NNS	VIII	-	AB	X	-	-	X	X
	Waste Evap. Cond. Return Unit	D	NA	VIII	-	AB	X	-	-	X	X
	Waste Evaporator Pkg.	W	NNS[23]	VIII	-	AB	X	-	-	X	X
	Valves	D	2,3, NNS	III-2,3, B31.1	X	AB	X	X	X	X	X
WN	Diesel Generator Room Sump Pump System										
	Diesel Generator Room Sump Pumps	D	3	III-3	X	DB	-	X	X	X	X
	Valves	D	3,NA	III-3	X,-	AB,DB	-	X	X	X	X
WP	Turbine Building Sump Pump System										
	Valves[22]	D	NNS	B31.1	-	TB	P	-	-	-	-
WS	Solid Radwaste System										
	Tanks										

								Seismic[8]		Tornado[9]	
System	**Component or System**	**Scope[2]**	**Safety Class[3]**	**Code[4]**	**QA Reqd.[5]**	**Location[6]**	**Rad. Source[7]**	**OBE**	**DBE**	**Wind**	**Missile**
	Spent Resin Storage Tank	D	3	III-3	X	AB	X	X	X	X	X
	Evaporator Concentrates Holdup	D	NNS	D100	-	AB	X	-	-	X	X
	Evaporator Concentrates Batch	D	NNS	VIII [21]	-	AB	X	-	-	X	X
	Chemical Drain Tank	D	NNS	VIII	X	AB	X	-	-	X	X
	Binder Storage	D	NNS	VIII	-	B	X	-	-	X	X
	Radwaste Batching	D	NNS	VIII	-	AB	X	-	-	X	X
	Pumps										
	Spent Resin Sluice	W	NNS	-	-	AB	X	-	-	X	X
	Chemical Drain Tank	W	NNS	-	-	AB	X	-	-	X	X
	Binder	D	NNS	-	-	O	-	-	-	-	-
	Spent Resin Sluice Filter	W	NNS	B31.1	X	AB	X	-	-	X	X
	Hydraulic Compactor	D	NNS	-	-	AB	P	-	-	X	X
	Valves	D	NNS	B31.1	X	AB	X	X	X	X	X
	Radwaste Transfer Skid	D	NNS	B31.1	-	AB	X	-	-	X	X
	Dewatering Pump Skid	D	NNS	B31.1	-	AB	P	-	-	X	X
WZ	Groundwater Drainage System										
	Aux. Bldg. Groundwater Drainage Sump Pumps A1, B2	D	3	III-3	X	O	-	X	X	X	X
	Aux. Bldg. Groundwater Drainage Sump Pumps A2, B1, C, C2	D	NNS	B31.1	-	0	-	X	X	X	X

								Seismic[8]		Tornado[9]	
System	**Component or System**	**Scope[2]**	**Safety Class[3]**	**Code[4]**	**QA Reqd.[5]**	**Location[6]**	**Rad. Source[7]**	**OBE**	**DBE**	**Wind**	**Missile**
	Turbine Bldg. Groundwater Drainage Sump Pumps	D	NA	[10]	-	O	-	-	-	X	X
	Valves	D	3	III-3	X	O	-	X	X	X	X
YA	Conventional Chemical Addition System										
	Valves	D	NNS	B31.1	-	AB,TB,SB	-	-	-	-	-
YC	Control Area Chilled Water System										
	Control Area Chilled Water Pumps	D	3	III-3	X	AB	-	X	X	X	X
	Control Area Chiller	D	3	III-3	X	AB	-	X	X	X	X
YD	Drinking Water System										
	Valves[22]	D	NA	B31.1	X	AB	-	X	X	X	X
YJ	Computer Area Chilled Water System										
	Computer Room Chillers	D	NNS	-	-	SB	-	-	-	-	-
	Computer Room Chiller Pumps	D	NNS	-	-	SB	-	-	-	-	-
YM	Makeup Demineralized Water System										
	Valves[22]	D	NA	B31.1	X	AB	-	X	X	X	X
	Containment Isolation Valves	D	2	III-2	X	AB,C	-	X	X	X	X
YO	Turbine Building Chilled Water System										
	Turbine Building Chillers	D	NNS	VIII	-	0	-	-	-	-	-
	Turbine Building Chilled Water Pumps	D	NNS	-	-	0	-	-	-	-	-

								Seismic[8]		Tornado[9]	
System	**Component or System**	**Scope[2]**	**Safety Class[3]**	**Code[4]**	**QA Reqd.[5]**	**Location[6]**	**Rad. Source[7]**	**OBE**	**DBE**	**Wind**	**Missile**
YV	Containment Chilled Water System										
	Containment Chillers	D	NNS	VIII	-	0	-	-	-	-	-
	Containment Chilled Water Pumps	D	NNS	-	-	0	-	-	-	-	-
	Valves	D	NNS	B31.1	-	0	-	-	-	-	-
ZD	Diesel Generator Engine Crankcase Vacuum System										
	Valves	D	3	III-3	X	DB	-	X	X	X	X

Notes:

1. Equipment located in the Containment and Auxiliary Building not designated as design for seismic loading will be checked to verify that fault of such equipment will not result in the loss of function of safety class equipment.
2. D = Duke
   W = Westinghouse
   B = Babcock & Wilcox
3. 1 = Safety Class 1
   2 = Safety Class 2
   3 = Safety Class 3
   NNS = Non-Nuclear Safety
   NA = Not Applicalbe
4. III-1 = ASME Boiler and Pressure Vessel Code – Section III, Class 1
   III-2 = ASME Boiler and Pressure Vessel Code – Section III, Class 2
   III-3 = ASME Boiler and Pressure Vessel Code – Section III, Class 3
   VIII = ASME Boiler and Pressure Vessel Code – Section VIII
   B31.1.0 = ANSI B31.1.0 (1967)
   D100 = American Water Works Association, Standard for Steel Tanks, Standpipes, Reservoirs, and Elevated Tankjs for Water Storage, AWWA, D100
   API-620 = American Petroleum Institute Recommended Rules for Design and Construction of Large Welded Low Pressure Storage Tanks
   ACI = American Concrete Institute
   AMCA = Air Moving and Conditioning Association

								Seismic[8]		Tornado[9]	
System	**Component or System**	**Scope[2]**	**Safety Class[3]**	**Code[4]**	**QA Reqd.[5]**	**Location[6]**	**Rad. Source[7]**	**OBE**	**DBE**	**Wind**	**Missile**

NFUL = National Fire Underwriters Laboratory

5. Safety related quality assurance required: X = Yes; - = No

6. C = Containment
RB = Reactor Building
AB = Auxiliary Building
TB = Turbine Building
SB = Service Building
DB = Diesel Building
DH = Dog House
O = Outdoors above ground
B = Buried in ground
RN = Nuclear Service Water Pumphouse
RL = Low Pressure Service Water Pumphouse
SSF = Standby Shutdown Facility

7. X = Source of Radiaition
– No source of radiation
P = Possible source of radiation

8. X = Designed for
\- = Not designed for

9. X = Protected by virtue of location in a structure designed for tornado wind and missiles

10. As Applicable

11. Tank is provided with diaphragm membrane for oxygen exclusion

12. Performance test required

13. Redundant electric heaters are supplied

14. AMCA Class III and performance tested in accordance with AMCA Standard Test Code for air moving devices.

15. United Laboratories

16. Tanks are designed for all external forces due to soil and water, including buoyancy.

								Seismic[8]		**Tornado[9]**	
System	**Component or System**	**Scope[2]**	**Safety Class[3]**	**Code[4]**	**QA Reqd.[5]**	**Location[6]**	**Rad. Source[7]**	**OBE**	**DBE**	**Wind**	**Missile**

17. ASME Code Case 1205
18. The Diesel Generator Engine and engine mounted components and piping are Seismic Category I, seismically qualified in accordnace with IEEE Standard 344-1975. The seismic qualification stems from a modal analysis based on mathematical model derived fromexperimentally generated data from low level inpedance test performed by the manufacturer. Tests were conducted under two excitation spectrums (2-13 Hz and 9-35 Hz) to cover the relavent frequency band of the seismic disturbance. The results of the modal analysis, published by Delaval in report number 75017-705 Volumes I, II, and III, constitutes the seismic qualification
19. ASME, C13
20. See Table 6-79
21. As documented in Engineering Justification Report SES-JR-10, the one inch containment isolation valves for this system were purchased as Duke Class F instead of Duke Class B. This was necessary due to the high system design pressure (8000 psig) which exceeded the pressure/temperature ratings of the ASME Section 1 1 1 Code.
22. Although this system is not functionally safety-related, portions of the system's piping and valves are designed to seismic Category 2.
23. Exceptions:
    a. Evaporator vessels are seismic.
    b. Steam supply piping is seismic and built to ANSI-B31.1.0 (1967).
24. Component cooling water supply piping is built to ASME III, Class 3.
25. Boron Feed Tank were formerly Unit-2, Class 2, UHI water and gas accumulators and have been rerated for lower pressures and temperatures. Tanks were modified in accordance w/ Section XI in order to maintain Section III Design. N-Stamps have been removed from tanks and have non-safety related Duke Class E & F.
26. The delay coil has been abandoned in place per EC 112660 (U-1) and EC 112663 (U-2) based on ALARA dose considerations.

Table 3-5. System Piping Classification

Duke System Piping Class	NRC Quality Group	ANS Safety Class	Code Design Criteria	Seismic Category I
A	A	1	Class 1, ASME Section III, 1974[2]	Yes
B	B	2	Class 2, ASME Section III, 1974[2]	Yes
C	C	3	Class 3, ASME Section III, 1974[2,4]	Yes
E	D	NNS	ANSI B31.1.0 (1973)[3]	No
F	D	NNS	ANSI B31.1.0 (1973)[3]	No
G	-	-	ANSI B31.1.0 (1973)[3]	No
H	-	-	Duke Power Company Specifications	No

Notes:

1. Code Applicability: Due to the numerous code references located throughout this SAR, no attempt is made to revise these references as Codes are amended, superseded or substituted. The code references specified above are the basis for design and materials. Duke Power Company established an “effective code date” for the station in accordance with 10CFR50.55a, reviews and may elect to comply with portions of or all the latest versions of the above Codes unless material and/or design commitments have progressed to a stage of completion such that it is not practical to make a change. When only portions of Code Addenda are utilized, the appropriate engineering review of the entire addenda assures that the overall intent of the Code is still maintained.

   Specific provisions of ASME Code editions and Addenda later than those identified on the above table may be utilized with the mutual consent of Duke Power and the N Type Certificate Holder (if other than Duke). Whenever specific provisions of a later code are utilized, all related requirements will also be satisfied.

2. 1974 Edition including Summer 1974 Addenda.
3. 1973 Edition including Summer 1974 Addenda.
4. Unit 2 Diesel Generator 12" RN supply and return piping installed to the ASME BPV Code, 1998 Edition including 2000 Addenda as amended by Code Relief Request 06-CN-003.

Table 3-6. System Valve Classification

Duke System Piping Class	NRC Quality Group	ANS Safety Class	Code Design Criteria	Designed for Seismic Loading
A	A	1	Class 1, ASME Section III, 1971	Yes
B	B	2	Class 2, ASME Section III, 1971	Yes
C	C	3	Class 3, ASME Section III, 1971	Yes
E	D	NNS	ANSI B31.1.0 (1973)(1)	No
F	D	NNS	ANSI B31.1.0 (1973)(1)	Yes
G	-	-	ANSI B31.1.0 (1973)(1)	No
H	-	-	Duke Power Company Specifications	No

Note:

1. 1973 Edition including Summer 1974 Addenda.

Table 3-7. Equipment Generated Missiles Safety Related Structures Design Characteristics

Structure	Total Number of Structures	Area of Structure Roof Within Plant	Thickness of Structure Roof
Reactor Building	2	14588 sq ft	27 in.
Auxiliary Building	1	70640	24
Fuel Building	2	13849	24
Diesel Generator Building	2	14179	36
Upper Head Injection Building	2	4284	24
Main Steam Doghouse	4	1890	24
Nuclear Service Water Pump Structure	1	4144	24
Main Steam and Feedwater Piping Restraints		Note 1	Note 1

Note:

1. The Main Steam and Feedwater Piping Restraints may be considered as a wall with an infinitesimal roof area and infinite roof thickness.Considered for low trajectory turbine missiles only.

Table 3-8. Summary Of Control Rod Drive Mechanism Missile Analysis

Postulated Missile	Weight (lb)	Thrust Area (sq. in.)	Impact Area (sq. in.)	Impac Velocity (ft/sec)	Kinetic Energy (ft-lb)	Penetration (in.)
Mechanism Housing Plug	11	4.91	7.07	440	33,000	0.6 (steel)
Drive Shaft	135	2.40	2.41	189	66,500	10.67 (concrete)
Drive Shaft Latched	1200	12.57	11.04	32	23,000	<0.6 (steel)

Table 3-9. Piping Temperature Element Assembly - Missile Characteristics

1.	For a tear around the weld between the boss and the pipe:		
	Characteristics	"Without well"	"With well"
	Flow discharge area	0.11 sq in.	0.60 sq in.
	Thrust area	7.1 sq in.	9.6 sq in.
	Missile weight	11.0 lb	15.2 lb
	Area of impact	3.14 sq in.	3.14 sq in.
	$\frac{\text{Missile Weight}}{\text{Impact Area}}$	3.5 psi	4.84 psi
	Velocity	20 ft/sec	120 ft/sec
2.	For a tear at the junction between the temperature element assembly and the boss for the "without well" element and at the junction between the boss and the well for the "with well" element.		
	Characteristics	"Without well"	"With well"
	Flow discharge area	0.11 sq in.	0.60 sq in.
	Thrust area	3.14 sq in.	3.14 sq in.
	Missile weight	4.0 lb	6.1 lb
	Area of impact	3.14 sq in.	3.14 sq in.
	$\frac{\text{Missile Weight}}{\text{Impact Area}}$	1.27 psi	1.94 psi
	Velocity	75 ft/sec	120 ft/sec

Table 3-10. Characteristics Of Other Missiles Postulated Within Reactor Containment

	Reactor Coolant Pump Temperature Element	**Instrument Well of Pressurizer**	**Pressurizer Heaters**
Weight	1.86 lb	5.5 lb	15 lb
Discharge Area	0.37 sq in.	0.442 sq in.	0.80 sq in.
Thrust Area	0.79 sq in.	1.35 sq in.	2.4 sq in.
Impact Area	0.1 sq in.	1.35 sq in.	2.4 sq in.
$\frac{\text{Missile Weight}}{\text{Impact Area}}$	18.6 psi	4.1 psi	6.25 psi
Velocity	240 ft/sec	100 ft/sec	55 ft/sec

Table 3-11. Hypothetical Missile Data 43-Inch Last Stage Bucket, 1800-RPM Low Pressure Turbine

Fragment Group	Fragment Weight	Energy Range Boundaries		Missile Sectional Pressure
		Minimum	Maximum	
		Stage Group 1		
		(Turbine Stage 7 : 120% Speed)		
120° Sector (2 Fragments Per Group)	8200 lb	1.0 E7 ft-lb	2.2E7 ft-lb	2400 lb/sq ft
60° Sector (1 Fragment Per Group)	4100	0	1.8 E7	1200
Small (3 Fragments Per Group)	1400	0	8.0 E6	900
Extra Small (10 Fragments Per Group)	200	0	2.0 E6	450 lb/sq ft
		Stage Group 2		
		(Turbine Stage 1-3 : 180% Speed)		
120° Sector (2 Fragments Per Group)	2000 lb	0 ft-lb	8.0 E6 ft-lb	2300 lb/sq ft
60° Sector (1 Fragment Per Group)	1000	0	8.0 E6	1200
Small (3 Fragments Per Group)	300	0	5.0 E6	900
Extra Small (10 Fragments Per Group)	100	0	2.0 E6	450

Stage Group 3				
(Turbine Stage 4-6 : 180% Speed)				
120° Sector (2 Fragments Per Group)	4000 lb	0 ft-lb	1.7 E7 ft-lb	2800 lb/sq ft
60° Sector (1 Fragment Per Group)	2000	0	1.6 E7	1400
Small (3 Fragments Per Group)	600	0	8.0 E6	900
Extra Small (10 Fragments Per Group)	150	0	2.0 E6	450
Stage Group 4				
(Turbine Stage 7 : 180% Speed)				
120° Sector (2 Fragments Per Group)	8200 lb	2.6 E7 ft-lb	5.3 E7 ft-lb	2400 lb/sq ft
60° Sector (1 Fragment Per Group)	4100	0	3.8 E7	1200
Small (3 Fragments Per Group)	1400	0	1.6 E7	900
Extra Small (10 Fragments Per Group)	200	0	3.0 E6	450

Table 3-12. Turbine Missile Strike Probability High Trajectory Missiles

Plant Region	Area of Plant Region (1 Unit)	Total Lifetime Probability of Hitting Region Assuming Turbine Failure[1]	
		(Design Overspeed)	(Destructive Overspeed)
		Failure	Failure
Reactor Building	14588 sq ft	8.8 E-4	2.6 E-3
Auxiliary Building [2]	70640	4.2 E-3	1.0 E-2
Fuel Building	13849	8.3 E-4	2.5 E-3
Diesel Generator Building	14179	8.5 E-4	2.6 E-3
Upper Head Injection Building	4284	2.6 E-4	7.7 E-4
Main Steam [3] Doghouse	3780	2.3 E-4	6.8 E-4
Nuclear Service Water Pump Structure	4144	2.5 E-4	7.5 E-4

Notes:

1. These numbers may be thought of as the probability of striking the particular plant region, assuming one stage of a low pressure turbine fails either by brittle fracture (design overspeed failure) or ductile fracture (destructive overspeed failure). It is also assumed that each stage produces 16 missiles as noted in Section 3.5.1.3.3.
2. The Auxiliary Building is shared between Units 1 and 2. The area and probabilities given for the Auxiliary Building subsequently apply to both units combined and not specifically to one unit.
3. The two Main Steam Doghouses for a given unit are separated by the Reactor Building. As a result, a strike on one doghouse will not compromise the safety of the plant. In our analysis the two doghouses are considered as one combined structure.

Table 3-13. Turbine Missile Penetration and Damage Probabilities High Trajectory Missiles

Missile Identity		Energy Group (K)	Critical Thick-ness (ft)	Reactor Blds.		Auxiliary Bldg.		Fuel Bldg.		Diesel Generator Bldg.		Upper Head Inj. Tank Bldg.		Main Steam[5] Doghouse		Nuclear Service Water Pump Stuc.	
Stage Group(I)	**Fragment Group(J)**			**P3[1]**	**P4[2]**	**P3[3]**	**P4**	**P3**	**P4**	**P3**	**P4**	**P3**	**P4**	**P3**	**P4**	**P3**	**P4**
1	1	1	1.77	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	1	2	2.15	0.0	0.0	1	0.15E-10	1	0.30E-11	0	0.0	1	0.93E-12	1	0.82E-12	1	0.90E-12
1	1	3	2.50	0.17	0.37E-12	1	0.11E-10	1	0.21E-11	0	0.0	1	0.64E-12	1	0.56E-12	1	0.62E-12
1	1	4	2.83	0.35	0.55E-12	1	0.77E-11	1	0.15E-11	0	0.0	1	0.46E-12	1	0.41E-12	1	0.45E-12
1	2	1	0.38	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	2	2	1.01	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	2	3	1.52	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	2	4	1.94	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	3	1	0.37	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	3	2	0.94	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	3	3	1.38	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	3	4	1.74	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	4	1	0.30	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	4	2	0.72	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	4	3	1.00	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	4	4	1.22	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	1	1	0.68	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	1	2	1.80	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	1	3	2.71	0.29	0.56E-12	1	0.93E-11	1	0.18E-11	0	0.0	1	0.56E-12	1	0.50E-12	1	0.55E-12
2	1	4	3.48	0.61	0.59E-12	1	0.48E-11	1	0.93E-12	1	0.95E-12	1	0.29E-12	1	0.25E-12	1	0.28E-12
2	2	1	0.66	0.0	0.0	0	0.0	0		0	0.0	0	0.0	0	0.0	0	0.00
2	2	2	1.62	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	2	3	2.32	0.051	0.12E-13	1	0.12E-11	1	0.23E-12	0	0.0	1	0.70E-13	1	0.62E-13	1	0.68E-13
2	2	4	2.86	0.37	0.45E-13	1	0.59E-12	1	0.12E-12	0	0.0	1	0.36E-13	1	0.32E-13	1	0.35E-13

Missile Identity		Energy Group (K)	Critical Thick-ness (ft)	Reactor Blds.		Auxiliary Bldg.		Fuel Bldg.		Diesel Generator Bldg.		Upper Head Inj. Tank Bldg.		Main Steam(5) Doghouse		Nuclear Service Water Pump Stuc.	
Stage Group(I)	Fragment Group(J)			P3(1)	P4(2)	P3(3)	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4
2	3	1	0.92	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.0
2	3	2	2.00	0.0	0.0	1	0.22E-11	1	0.44E-12	0	0.0	1	0.14E-12	1	0.12E-12	1	0.13E-12
2	3	3	2.68	0.28	0.46E-13	1	0.81E-12	1	0.16E-12	0	0.0	1	0.49E-13	1	0.43E-13	1	0.47E-13
2	3	4	3.20	0.51	0.43E-13	1	0.41E-12	1	0.80E-13	1	0.82E-13	1	0.25E-13	1	0.22E-13	1	0.24E-13
2	4	1	0.63	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	4	2	1.12	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	4	3	1.48	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	4	4	1.74	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	1	1	0.87	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	1	2	2.30	0.038	0.18E-12	1	0.23E-10	1	0.45E-11	0	0.0	1	0.14E-11	1	0.12E-11	01	0.13E-11
3	1	3	3.45	0.60	0.10E-11	1	0.83E-11	1	0.16E-11	1	0.17E-11	1	0.50E-12	1	0.44E-12	1	0.48E-12
3	1	4	4.42	0.84	0.73E-12	1	0.42E-11	1	0.82E-12	1	0.84E-12	1	0.25E-12	1	0.23E-12	1	0.25E-12
3	2	1	0.77	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	2	2	1.89	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	2	3	2.71	0.29	0.69E-13	1	0.12E-11	1	0.23E-12	0	0.0	1	0.70E-13	1	0.62E-13	1	0.68E-13
3	2	4	3.34	0.56	0.68E-13	1	0.59E-12	1	0.12E-12	1	0.12E-12	1	0.36E-13	1	0.32E-13	1	0.35E-13
3	3	1	0.77	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	3	2	1.74	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	3	3	2.38	0.092	0.024E-13	1	0.13E-11	1	0.25E-12	0	0.0	1	0.76E-13	1	0.67E-13	11	0.74E-13
3	3	4	2.85	0.36	0.48E-13	1	0.06E-12	1	0.13E-12	0	0.0	1	0.39E-13	1	0.34E-13	1	0.38E-13
3	4	1	0.38	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	4	2	0.87	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	4	3	1.19	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	4	4	1.42	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	1	1	3.69	0.67	0.41E-13	1	0.30E-12	1	0.59E-13	1	0.60E-13	1	0.18E-13	1	0.16E-13	1	0.18E-13

Missile Identity		Energy Group (K)	Critical Thick-ness (ft)	Reactor Blds.		Auxiliary Bldg.		Fuel Bldg.		Diesel Generator Bldg.		Upper Head Inj. Tank Bldg.		Main Steam(5) Doghouse		Nuclear Service Water Pump Stuc.	
Stage Group(I)	Fragment Group(J)			P3(1)	P4(2)	P3(3)	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4
4	1	2	4.26	0.81	0.33E-13	1	0.20E-12	1	0.39E-13	1	0.40E-13	1	0.12E-13	1	0.11E-13	1	0.12E-13
4	1	3	4.76	0.91	0.26E-13	1	0.14E-12	1	0.28E-13	1	0.28E-13	1	0.85E-14	1	0.75E-14	1	0.82E-14
0.21E-13	1	4	5.23	0.98		1	0.10E-12	1	0.21E-13	1	0.21E-13	1	0.63E-14	1	0.56E-14	1	0.61E-14
4	2	1	0.75	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	2	2	1.80	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	2	3	2.55	0.20	0.24E-14	1	0.57E-13	1	0.11E-13	0	0.0	1	0.35E-14	1	0.31E-14	1	0.33E-14
4	2	4	3.12	0.48	0.29E-14	1	0.29E-13	1	0.57E-14	1	0.58E-14	1	0.18E-14	1	0.16E-14	1	0.17E-14
4	3	1	0.67	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.0
4	3	2	1.57	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	3	3	2.17	0.0	0.0	1	0.11E-12	1	0.22E-13	0	0.0	1	0.68E-14	1	0.60E-14	1	0.66E-14
4	3	4	2.63	0.25	0.29E-14	1	0.58E-13	1	0.11E-13	0	0.0	1	0.35E-14	1	0.31E-14	1	0.34E-14
4	4	1	0.42	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	4	2	0.94	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	4	3	1.27	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	4	4	1.51	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
				0.45E-11			0.93E-10		0.18E-10		0.38E-11		0.56E-11		0.50E-11		0.54E-11

Total damage probability per structure for one unit resulting from a strike by one Missile from one low pressure Turbine hood over 40 year lifetime of plant

Notes:

1. Values of P3 for the Reactor Building are based on the effective concrete thickness compared with the critical thickness. The effective thickness takes into account the angle of impact with the curved concrete surface. P3, for the Reactor building, is the ratio of the penetrable roof area to the total roof area projected to the horizontal plane.
2. P4 is the total damage probability from a particular turbine missile produced from one low pressure turbine hood striking one of the specified structures during the 40 year lifetime of the plant.
3. P3 for all structures except the Reactor Building is based on the actual concrete thickness compared to the critical thickness. P3 is 1 if the missile can penetrate the structure (critical thickness greater than actual thickness), and 0 if the missile can not penetrate (critical thickness less than the actual thickness).
4. The Auxiliary Building is shared between Units 1 and 2. The total damage probabilities subsequently apply to both units combined and not specifically to one unit.
5. The two Main Steam Doghouse for a given unit are separated by the Reactor Building. As a result, a strike on one doghouse will not compromise the safety of the plant. In our analysis, the two doghouses are considered as one combined structure.
6. Refer to section 3.5.1.3.4. for a discussion of the validity of the values in this table.

Table 3-14. Turbine Missile Total Plant Damage Probability High Trajectory Missiles

Structure	Number of Structures Per Plant	Multiplier[1]	Damage Probability (P4) Per Structure [2]	Total Plant Damage Probability Per Structure [3]
Reactor Building	2	6	4.5 E-12	5.4 E-11
Auxiliary Building	1	6	9.3 E-11	5.6 E-10
Fuel Building	2	6	1.8 E-11	2.2 E-10
Diesel Generator Building	2	6	3.8 E-12	4.6 E-11
Upper Head Injection Building	2	6	5.6 E-12	6.7 E-11
Main Steam Doghouse	2(4)	6	5.0 E-12	6.0 E-11
Nuclear Service Water Pump Structure	1	6	5.4 E-12	3.2 E-11
		Total Plant Damage Probability[3]	1.0 E-9	

Notes:

1. All damage probabilities derived in our analysis are for missiles from one low pressure turbine hood. The multiplier adjusts these probabilities to account for the higher generation probability from the six low pressure hoods at Catawba.
2. These values of P4 from Table 3-13 give the damage probability for one unit due to a strike by missiles from one low pressure turbine hood over the 40 year life of the plant.
3. The total plant damage probability is the product of the damage probability for one low pressure turbine hood, the multiplier and the number of structures for plant.
4. Refer to section 3.5.1.3.4 for a discussion of the validity of the values in this table.

Table 3-15. Design Basis Tornado Generated Missiles

No.	Description	Dimensions	Impact Area	Weight (lbs)	Mass $\frac{w}{g}$ (lb-sec^2/ft)	Velocity (ft/sec)		Kin. Energy (ft-lb) $\frac{1}{2}\left(m\,\upsilon^2\right)$	
						Horiz.	Vert.	Horiz.	Vert.
1	Wood Plank	3.62 x 11.37"x12'	41.2 in^2	115	3.57	272	190	132,061	64,439
2	Steel Pipe	6" dia, 15' long, Sch 40	34.5 in^2	287	8.91	171	120	130,269	64,152
3	Steel Rod	1" dia, 3 ft. long	0.79 in^2	8.8	0.27	167	117	3,765	1,848
4	Utility Pole	13.5" dia, 35' long	143.1 in^2	1124	34.91	180	126	565,542	277,116
5	Steel Pipe	12" dia, 15' long, Sch 40	127.68 in^2	750	23.29	154	108	276,173	135,827
6	Automobile	28 sq. ft frontal	4032 in^2	3990	123.91	194	136	2,331,738	1,145,920

Table 3-16. Design Basis Tornado Generated Missiles - Minimum Barrier Thicknesses

MIN. THICKNESS FOR 4000 PSI BARRIER								
	MODIFIED PETRY FORMULA				MODIFIED N.D.R.C. FORMULA			
MISSILE No.	**Penetration Depth Horiz Strike (D)**	**Min. Thickness (3D)**	**Penetration Depth Vert Strike (D)**	**Min. Thickness (3D)**	**Penetration Depth Horiz Strike (D)**	**Min. Thickness (3D)**	**Penetration Depth Vert Strike (D)**	**Min. Thickness (3D)**
1	2.08	6.24	1.09	3.27	4.31	12.93	3.13	9.39
2	2.66	7.98	1.36	4.08	4.83	14.50	3.51	10.54
3	3.44	10.32	3.44	10.32	1.70	5.10	1.70	5.10
4	2.79	8.37	1.42	4.26	7.24	21.72	5.25	15.75
5	1.54	4.62	0.79	2.37	5.39	16.17	3.92	11.76
6	0.40	1.20	0.21	0.63	7.50	22.50	5.43	16.29

MIN. THICKNESS FOR 5000 PSI BARRIER								
	MODIFIED PETRY FORMULA				MODIFIED N.D.R.C. FORMULA			
MISSILE No.	**Penetration Depth Horiz Strike (D)**	**Min. Thickness (3D)**	**Penetration Depth Vert Strike (D)**	**Min. Thickness (3D)**	**Penetration Depth Horiz Strike (D)**	**Min. Thickness (3D)**	**Penetration Depth Vert Strike (D)**	**Min. Thickness (3D)**
1	1.40	4.20	0.74	2.22	4.08	12.24	2.96	8.88
2	2.19	6.57	1.11	3.33	4.57	13.71	3.32	9.96
3	2.29	6.87	2.29	6.87	1.61	4.83	1.61	4.83
4	1.86	5.58	0.94	2.82	6.85	20.55	4.97	12.91
5	1.17	3.51	0.59	1.77	5.10	15.30	3.70	11.10
6	0.27	0.81	0.14	0.42	7.09	21.27	5.14	15.42

Note:

1. All Penetration Depths and Min. Barrier Thicknesses are in inches.

Table 3-17. High-Energy Mechanical Piping Systems Analyzed for Consequences of Postulated Piping Breaks

High-Energy Piping System	System Identification	Pipe Break Protection Method		
Steam Generator Blowdown Recycle System	BB	(1)	(2)	
Auxiliary Feedwater System (Motor Driven Pump Portion)	CA	(1)	(2)	
Main Feedwater System	CF	(1)	(2)	(3)
Reactor Coolant System	NC	(1)	(2)	
Safety Injection System	NI	(1)	(2)	
Boron Thermal Regeneration System	NR	(1)		
Chemical and Volume Control System (Letdown Portion and Sealwater Injection)	NV	(1)	(2)	
Main Steam Supply to Auxiliary Equipment System	SA	(1)		
Main Steam System	SM	(1)	(2)	(3)
Main Steam Vent to Atmosphere System	SV	(1)	(2)	
Boron Recycle System	NB	(1)		
Liquid Radwaste System	WL	(1)		
Solid Radwaste System	WS	(1)		

Notes:

Pipe Break Protection Methods Legend:

1. Physical Separation
2. Piping Restraints
3. Structural enclosures, guard pipes, etc., (designed specifically for pipe break)

High-Energy Systems may contain moderate-energy portions; however, for brevity, systems only are listed in this table.

Table 3-18. Moderate-Energy Mechanical Piping Systems Analyzed for Consequences of Postulated Piping Breaks

System	System Identification	Pipe Break Protection Method	
Moderate-Energy Safety Related Systems			
Auxiliary Feedwater System (Turbine Driven Portion)	CA	(1)	(2)
Diesel Fuel Oil System	FD	(1)	
Refueling Water System	FW	(1)	
Component Cooling System	KC	(1)	
Diesel Generator Cooling Water System	KD	(1)	
Spent Fuel Cooling System	KF	(1)	
Diesel Generator Lube Oil System	LD	(1)	
Boron Recycle System	NB	(1)	
Residual Heat Removal System	ND	(1)	
Containment Spray System	NS	(1)	
Nuclear Service Water System	RN	(1)	(3)
Main Steam Supply to Aux. Equipment	SA	(1)	
FWP Turbine Exhaust	TE	(1)	
Waste Gas System	WG	(1)	
Liquid Radwaste System	WL	(1)	
Solid Radwaste System	WS	(1)	
Filtered Water System	YF	(1)	
Auxiliary Bldg Cooling Water System	YN	(1)	
Control Area Chilled Water System	YC	(1)	(2)
Other Moderate-Energy Systems			
Auxiliary Steam System	AS	(1)	
Recirculated Cooling Water System	KR	(1)	
Ice Condenser Refrigeration System	NF	(1)	
Fire Protection System	RF	(1)	(2)
Equipment Decontamination System	WE	(1)	
Chemical Addition System	YA	(1)	
Plant Heating System	YH	(1)	
Make-up Demineralizer System	YM	(1)	

System	System Identification	Pipe Break Protection Method

Notes:

Pipe Break Protection Methods Legends:

1. Physical Separation
2. Piping Spray Shields
3. ISI Augmented Inspections performed (see Table 6-103)

Table 3-19. Comparison of Duke Pipe Rupture Criteria And NRC Requirements of Branch Technical Positions APCSB 3-1 (November 1975), MEB 3-1 (November 1975), and NRC Regulatory Guide 1.46 (May 1973)

NRC Criteria	**Duke Criteria**
APCSB 3-1, Section B.2.c Section B.2.c. requires that piping between containment isolation valves be provided with pipe whip restraints capable of resisting bending and torsional moments produced by a postulated failure either upstream or downstream of the valves. Also, the restraints should be designed to withstand the loadings from postulated failures so that neither isolation valve operability nor the leaktight integrity of the containment will be impaired. Terminal ends should be considered to originate at a point adjacent to the required pipe whip restraints.	SAR Section 3.6.2 Duke criteria is generally equivalent to NRC criteria as clarified below: The containment structural integrity is provided for all postulated pipe ruptures. In addition, for any postulated rupture classified as a loss of coolant accident, the design leak tightness of the containment fission product barrier will be maintained. Penetration design is discussed in SAR Section 3.6.2.4. This section also discussed penetration guard pipe design criteria. Terminal ends are defined as piping originating at structure or component that act as rigid constraint to the piping thermal expansion.
APCSB 3-1, Section B.2.d 1. The protective measures, structures, and guard pipes should not prevent the access required to conduct inservice inspection examination. 2. For portions of piping between containment isolation valves, the extent of inservice examinations completed during each inspection interval should provide 100 percent volumetric examination of circumferential and longitudinal pipe welds. 3. Inspection ports should be provided in guard pipes to permit the required examination of circumferential welds. Inspection ports should not be located in that portion of guard pipe passing through the annulus. 4. The areas subject to examination should be defined in accordance with Examination Categories C-F and C-G for Class 2 piping welds in Tables IWC-2520.	Duke criteria is different than the NRC criteria due to the code effective date as described below: ASME Class 2 piping welds will be inspected in accordance with requirements given in SAR Section 6.6.

NRC Criteria	**Duke Criteria**
APCSB 3-1, Appendix A High Energy fluid systems are defined as those systems that, during normal plant conditions, are either in operation or maintained pressurized under conditions where either or both of the following are met: 1. maximum operating temperature exceeds 200°F, or 2. maximum operating pressure exceeds 275 psig.	SAR Section 3.6.1.1.2 Duke criteria is the same as NRC criteria with expansion of definition as clarified below: 1. Non-liquid systems with a maximum normal pressure less than 275 psig are not considered high energy regardless of the temperature. Such low pressure systems (i.e., Auxiliary Steam, 50 psig, 320°F) do not contain sufficient sensible energy to develop sudden, catastrophic failures. Propagation of a crack to a full failure is extremely unlikely. 2. Exception to the 200°F threshold for high energy systems is taken for non-water systems such as ethylene glycol. Such systems that operate at less than their boiling temperature are considered moderate energy.
APCSB 3-1, Appendix A In piping runs which are maintained pressurized during normal plant conditions for only a portion of the run (i.e., up to the first normally shut valve) a terminal end of such runs is the piping connection to this closed valve.	SAR Section 3.6.2.1.2.1 Duke criteria is different from NRC criteria as described and justified below: Terminal ends are considered at piping originating at structure or components that act as rigid constraint to the piping thermal expansion. Typically, the anchors assumed for the code stress analysis would be terminal ends. Stresses in the system on either side of the closed valve will be about the same; therefore, terminal end classification based on constraint and high stresses are not applicable. Duke analysis considers these closed valve locations to assure high stresses are not developed as a result of rigid constraint from nearby anchors of component connections in the non-pressurized portion of the piping.

NRC Criteria	Duke Criteria
MEB 3-1, Section B.1.b(6) Section B.1.b(6) requires that guard pipe assemblies between containment isolation valves meet the following requirements: 1. The design pressure and temperature should not be less than the maximum operating temperature and pressure of the enclosed pipe under normal plant conditions. 2. The design stress limits of Paragraph NE-3131(c) should not be exceeded under the loading associated with design pressure and temperature in combination with the safe shutdown earthquake. 3. Guard pipe assemblies should be subjected to a single pressure test at a pressure equal to design pressure.	SAR Section 3.6.2.4 Duke criteria is different from NRC criteria as described and justified below: Guard pipes provided between containment isolation valves are designed in accordance with SAR Section 3.6.2.4. Guard pipes are subjected to a pressure test as required by the material specification before welding to the penetration assembly. It is impractical to test guard pipes in the finished penetration assembly due to the configuration and potential damage to internal process pipe and associated insulation. Independent design analysis have been conducted to provide assurance that Duke penetration designs are acceptable. In addition, the extent of NDT conducted on guard pipes to flued head butt weld is such to assure integrity of design.
MEB 3-1, Sections B.1.c(2) Breaks in non-nuclear piping should be postulated at the following location: 1. Terminal ends, 2. At each intermediate pipe fitting, welded attachment, and valve.	SAR Section 3.6.2.1.2.1 Duke criteria is generally equivalent to NRC criteria as described and justified below: Breaks in Duke Class F piping (non-nuclear, seismic) are postulated at terminal ends and at intermediate locations based on the use of ASME Section III analysis techniques, the same as Duke Class B and C piping. Duke Class F piping is constructed in accordance with ANSI B31.1 and is dynamically analyzed and restrained for seismic loadings similar to ASME Section III piping. Materials are specified, procured, received, stored, and issued under Duke's QA program similar to ASME Section III materials except that certificate of compliance in lieu of mill test reports are acceptable on minor components, and construction documentation for erected materials is not uniquely maintained. Construction documentation for erected materials is generically maintained. MTR are required for the bulk of piping materials.

NRC Criteria	**Duke Criteria**
MEB 3-1, Section B.2.e Through-wall cracks may be postulated instead of breaks in those fluid systems that qualify as high energy fluid systems for short operational periods. This operational period is defined as about 2 percent of the time that the system operates as a moderate energy fluid system.	SAR Section 3.6.1.1.2 Duke criteria is generally equivalent to NRC criteria as clarified below: The operational period that classifies such systems as moderate energy is either: 1. One percent of the normal operating lifespan of the plant, or 2. Two percent of the time period required to accomplish the system design function.
Regulatory Guide 1.46 Longitudinal breaks are postulated in piping runs 4 inches nominal pipe size and larger. Circumferential breaks are postulated in piping runs exceeding 1 inch nominal pipe size.	SAR Section 3.6.2.1.2.3 Duke criteria is the same as NRC Branch Technical Position APCSB 3-1 and roughly equivalent to Regulatory Guide 1.46 with expansion of definition as described below: Longitudinal breaks are postulated in piping runs 4 inches nominal pipe size and larger except that longitudinal breaks are not postulated at terminal ends where the piping has no longitudinal welds.
Regulatory Guide 1.46 A whipping pipe should be considered capable of rupturing an impacted pipe of smaller nominal pipe size and lighter wall thickness.	SAR Section 3.6.2.1.2 Duke criteria is the same as NRC Branch Technical Position APCSB 3-1 and roughly equivalent to Regulatory Guide 1.46 with expansion of definition as described below: The energy associated with a whipping pipe is considered capable of (a) rupturing impacted pipes of smaller nominal pipe sizes, and (b) developing through-wall cracks in larger nominal pipe sizes with thinner wall thicknesses.

NRC Criteria	Duke Criteria
Regulatory Guide 1.46	SAR Section 3.6.1.1.2
Measures for restraint against pipe whipping as a result of the design basis breaks postulated... need not be provided for piping where ... the following applies: Both of the following piping system conditions are met: 1. the design temperature is 200°F or less, and 2. the design pressure is 275 psig or less.	Duke criteria is generally equivalent to Regulatory Guide 1.46 with expansion of definition as described below: High energy piping is reviewed for pipe whipping and is defined as those systems that during normal plant conditions are either in operation or maintained pressurized under conditions where either or both of the following are met: 1. maximum temperature exceeds 200°F, or 2. maximum pressure exceeds 275 psig, except that (1) non-liquid piping system with a maximum pressure less than or equal to 275 psig are not considered high energy regardless of the temperature, and (2) for liquid systems other than water, the atmospheric boiling temperature can be applied. Systems are classified as moderate energy if the total time that either of the above conditions are met is less than either: 1. one (1) percent of the normal operating lifespan of the plant, or 2. two (2) percent of the time period required to accomplish its system design function.

Note:

1. Pipe breaks in the RCS primary loop are not postulated for consideration in certain aspects of plant design as defined in Reference 2, Section 3.6.3 (References).

Table 3-20. Postulated Break Locations For The Main Coolant Loop

Location of Postulated Rupture		Type
1.[1]	Reactor Vessel Outlet Nozzle	Circumferential
2.[1]	Reactor Vessel Inlet Nozzle	Circumferential
3.[1]	Steam Generator Inlet Nozzle	Circumferential
4.[1]	Steam Generator Outlet Nozzle	Circumferential
5.[1]	Reactor Coolant Pump Inlet Nozzle	Circumferential
6.[1]	Reactor Coolant Pump Outlet Nozzle	Circumferential
7.[1]	50° Elbow on the Intrados	Longitudinal
8.[1]	Loop Closure Weld in Crossover Leg	Circumferential
9.	Residual Heat Removal (RHR) Line/Primary Coolant Loop Connection	Circumferential (Viewed from the RHR line)
10.	Accumulator (ACC) Line/Primary Coolant Loop Connection	Circumferential (Viewed from ACC line)
11.	Pressurizer Surge (PS) Line/Primary Coolant Loop Connection	Circumferential (Viewed from the PS line)

Note:

1. Reference 1, Section 3.6.3 (References) defines the original basis for postulating pipe breaks in the reactor coolant system primary loop. Reference 2, Section 3.6.3 (References) provides the basis for eliminating this previously postulated pipe break from certain aspects of design consideration.

Table 3-21. Stress Criteria For Reactor Containment Mechanical Penetrations(2) Duke Class B

	Condition	Piping Loads	Criteria
1.	Normal	Thermal Displacement +Pressure +Weight	ASME III, NC-3600
2.	Upset	Thermal Displacement +OBE (Displacement) +Pressure +Weight +OBE (Inertia)	ASME III, NC-3600
3.	Faulted	Thermal Displacement +SSE (Displacement)(1) +Pressure +Weight +SSE (Inertia) +Pipe Rupture	ASME CODE CASE 1606

Notes:

1. For the faulted condition, the displacement induced stresses are considered primary stresses.
2. All mechanical piping penetrations of the Containment Vessel are Duke Class B.

Table 3-22. Stress Allowables for Design of Pipe Rupture Restraints

	Stress	Allowable
1.	Tension[2]	
	a. On the net section, except at pinholes b. On the net section at pinholes in eye bars and pin connected plates of built up members	1.5 x (allowable stress from AISC manual)
2.	Shear[2]	1.5 x (allowable stress from AISC manual)
3.	Compression[2]	1.5 x (allowable stress from AISC manual) ≤ 0.9 Fy[1]
4.	Bending[2]	1.5 x (allowable stress from AISC manual) ≤ 0.9 Fy[1]
5.	Combined Stresses[2]	1.5 x (allowable stress from AISC manual)
6.	Bolts[2] a. Tension b. Shear	1.5 x (allowable stress from AISC manual)
7.	Welds[2] a. full penetration b. partial penetration c. fillet	1.5 x (allowable stress from AISC manual)
8.	Crushing strength of crush pads are designed and purchased in accordance with individual device requirements shown on applicable drawings.	
9.	Crush pipes are designed using yield strength per actual mill test reports.	

Notes:

1. Fy is the minimum specified yield stress of steel being used.
2. Fy may be increased by 10% to account for strain rate effects due to dynamically applied loads.

Table 3-23. Deleted Per 1990 Update

Table 3-24. Deleted Per 2001 Update

Table 3-25. Summary of Modal Contributions to Total Forces for North South Earthquake

Shears (kips)

Member	N-S Modes 1	4	6	8	11	13	16	Sq. Root Sum of Sq.
15	688	218	99	65	41	17	8	732
14	1,361	409	183	109	59	21	9	1,437
13	2,336	622	231	101	38	3	6	2,429
12	3,233	775	233	59	1	26	18	3,331
11	3,914	862	212	14	30	38	19	4,012
10	5,042	932	131	78	71	29	1	5,128
9	6,315	825	50	150	41	31	25	6,370
8	7,054	629	174	126	13	30	1	7,086
7	7,906	357	310	74	74	15	29	7,923
6	8,937	200	342	86	41	43	21	8,947
5	9,621	700	206	158	54	7	13	9,651
4	10,067	1,099	37	142	97	28	10	10,128
3	10,411	1,463	157	30	57	30	21	10,515
2	10,688	1,814	371	136	43	8	1	10,847
1	10,756	1,913	434	191	80	25	13	10,934

Moments (ft-kips)

Member	N-S Modes 1	4	6	8	11	13	16	Sq. Root Sum of Sq.
15	6,314	1,998	906	599	375	155	71	6,725
14	18,798	5,746	2,586	1,599	915	344	154	19,904
13	35,154	10,109	4,201	2,304	1,181	344	153	36,900
12	48,910	13,402	5,195	2,564	1,185	327	109	51,023
11	71,749	18,431	6,434	2,644	1,185	215	79	74,366
10	123,438	27,987	7,776	2,647	1,010	297	83	126,768
9	188,706	36,520	7,777	1,852	281	297	174	192,281
8	209,877	38,410	7,260	298	143	113	175	213,401

Moments (ft-kips)								
	N-S Modes							
Member	1	2	3	4	5	6	7	Sq. Root Sum of Sq.
7	291,556	42,100	6,739	851	655	269	175	294,519
6	357,077	42,144	3,545	855	958	271	123	359,382
5	443,716	40,631	1,031	1,194	957	105	153	445,015
4	533,923	34,336	1,160	2,461	468	146	153	534,455
3	623,443	24,496	1,159	2,730	900	407	126	625,557
2	718,969	11,639	3,470	2,732	901	408	126	719,077
1	812,222	20,817	7,230	1,543	525	34	119	812,463

Table 3-26. Comparison Of Response Spectrum And Time-History Responses

MASS POINT	ACCELERATIONS (Ft/Sec^2)		MOMENTS (X10^3 FT-K)		SHEARS (X10^3 KIPS)	
	RESPONSE SPECTRUM	TIME-HISTORY	RESPONSE SPECTRUM	TIME-HISTORY	RESPONSE SPECTRUM	TIME-HISTORY
1	1.54	.64	813	1009	10.93	14.38
2	2.99	1.49	719	888	10.85	14.03
3	4.04	2.45	626	768	10.51	12.96
4	5.31	3.68	534	653	10.13	12.13
5	6.57	5.07	445	542	9.65	11.40
6	8.11	6.96	359	437	8.95	10.40
7	9.97	9.33	295	359	7.92	9.06
8	10.45	9.95	213	262	7.09	8.03
9	12.1	11.96	192	234	6.37	7.12
10	13.8	13.80	127	158	5.13	5.63
11	14.82	14.83	74	97	4.01	4.34
12	15.53	15.49	51	68	3.33	3.57
13	16.59	16.43	37	49	2.43	2.57
14	18.04	17.45	20	28	1.44	1.49
15	19.65	18.83	7	10	.73	.75

Note:

1. Refer to Table 3-25 for mathematical model.

Table 3-27. Comparison of Two Dimensional Versus Three Dimensional Analysis

		ORIGINAL TWO DIMENSIONAL DESIGN			REVISED THREE DIMENSIONAL DESIGN					
MEM	**ELEV**	**AX[2] KIPS**	**SY KIPS**	**SZ KIPS**	**AX KIPS**	**SY KIPS**	**SZ KIPS**	**Ax**	**Δ% Sy**	**Sz**
								Note 3		Note 1
1	548+0	6039.	10372	10926	4729	10410	10926	28	-	-
2	556+8	5612	10274	10839	4673	10308	10840	20	-	-
3	565+5	4847	9910	10506	4472	9931	10506	8	-	-
4	574+3	4261	9504	10119	4260	9513	10120	-	-	-
5	583+2	3757	9019	9641	4020	9018	9642	-7	-	-
6	592+2	3191	8321	8939	3690	8313	8939	-14	-	-
7	599+6	2565	7367	7914	3196	7357	7914	-20	-	-
8	609+10	2173	6614	7080	2811	6608	7080	-23	-	-
9	612+10	1853	5970	6365	2484	5967	6365	-25	-	-
10	623+2	1345	4831	5126	1944	4838	5125	-31	-	-
11	633+5	1039	3794	4011	1482	3804	4010	-30	-	-
12	639+3	839	3158	3330	1208	3169	3330	-31	-	-
13	643+6	587	2312	2429	854	2323	2429	-31	-	-
14	650+6	328	1375	1438	483	1384	1437	-32	-	-
15	659+8	160	700	732	239	705	732	-33	-	-

		ORIGINAL TWO DIMENSIONAL DESIGN			REVISED THREE DIMENSIONAL DESIGN				Δ%	
MEM	ELEV	AX[2] KIPS	SY KIPS	SZ KIPS	AX KIPS	SY KIPS	SZ KIPS	Ax	Sy	Sz

Notes:

1. Less than 1%.
2. Ax is D.L. x .13G: .13G is 2/3 of ground response at 20 cps.
3. + is over, - is under.

Table 3-28. Static and Seismic Incremental Lateral Earth Pressures for Check of Substructure Walls Using Mononobe-Okabe Incremental Lateral Pressure

Structure	Static Lateral Pressure		Seismic Increment	
	Max. Pressure (KSF)	**Resultant Force (K/ft)**	**Max. Pressure (KSF)**	**Resultant Force[1] (K/ft)**
Auxiliary Building	3.156	79.70	1.13	28.56
Reactor Building	3.025	73.21	1.085	26.25
Outside Doghouse	2.750	60.5	0.986	21.7
Fuel Pool	2.708	58.68	0.971	21.04
Diesel Gen. Bldg.	2.375	45.13	0.852	16.18
Discharge Structures	0.3575	0.9831	0.2227	0.6125
Intake Structures	0.4550	1.593	0.2835	0.992
Pipe Trench To FWST & RMWST	1.462	11.09	1.344	10.19
	0.643	2.143	0.591	1.970
NSW Pump Structure	5.174	138.6	2.210	59.22
NSW Conduit Manholes (Examp.)	1.116	6.462	1.026	5.941

Note:

1. Force applied at a point two-thirds of the wall height above the base.

Table 3-29. Scope Limits for Alternate Seismic Analysis

Duke Piping Classes:			B, C, or F
Nominal Pipe Sizes:			4" and less
Load Case Types:			weight pressure thermal seismic
Design Conditions:			
	≤ 1" sched.	10s	≤ 300 F and ≤ 275 psi
		40	≤ 300 F and ≤ 685 psi
		80	≤ 650 F and ≤ 2485 psi
		160	≤ 650 F and ≤ 2485 psi
	> 1" ≤ 4" sched.	10s	≤ 300 F and ≤ 275 psi
		40	≤ 300 F and ≤ 685 psi
		80	≤ 300 F and ≤ 1485 psi
		160	≤ 300 F and ≤ 1485 psi
Operating Conditions:			Systems, or portions of systems for which high energy piping failure postulations are required in accordance with Section 3.6.1, are excluded from Alternate Seismic Analysis.

Table 3-30. Seismic Instrumentation Inplementation

Instrument	Required Location per Section C of Regulatory Guide 1.12	Catawba Implementation
Triaxial Peak accelerograph	1.a.(1) Selected location on Reactor equipment.	Lifting lug of NI accumulator tank 1A at elev. 588' – 6 1/8".
Triaxial Peak accelerograph	1.a.(2) Selected location on Reactor piping	Strap mounted of intersection of Reactor Coolant piping and Pressurizer surge line.
Triaxial peak accelerograph	1.a.(3) Most pertinent location on one of the following outside of containment structure: 1. Seismic Category I equipment 2. Seismic Category I Piping	Base of Safety Injection Charging Pump 1A.
Remote (Control room) Indicating Triaxial H/V Response Spectrum Recorder	1.b. Containment foundation	Reactor Building basement slab.
Triaxial H/V Response Spectrum Recorder	1.c.(1) Selected location on the reactor equipment or piping supports	Pressurizer lower support structure.
Triaxial H/V Response Spectrum Recorder	1.c.(2) The most pertinent location on one of the following outside of the of the containment structure: 1. Seismic Category I equipment support or appropriate floor location 2. Seismic Category I piping support or appropriate floor location.	Mounted to the floor of the Auxiliary Building at elevation 577'-0".
Triaxial H/V Response Spectrum Recorder	1.c.(3) At the foundation of an independent Seismic Category I structure where the response is different from that of the reactor containment structure.	Not applicable

Instrument	Required Location per Section C of Regulatory Guide 1.12	Catawba Implementation
Triaxial Time-History Accelerograph	(a) "Free Field" (ANSI N 18.5, Section 4.1.1)	Not applicable
Triaxial Time-History Accelerograph	(b) Containment Foundation (ANSI N-18.5, Section 4.1.1)	Reactor Building basement slab
Triaxial Time-History Accelerograph	(c) Containment Structure or Reacator Building (ANSI N-18.5, Section 4.1.1)	Attached to the Containment at approximately Containment mid-height.
Triaxial Seismic Switch	Containment Foundation (ANSI N-18.5, Section 4.1.3)	Reactor Building basement slab

Table 3-31. Codes and Specificatons for Design of Category I Structures

Structural Component	Design Codes and Specifications
Concrete	ACI 318-71
Deleted Per 2001 Update	
	Regulatory Guide No. 1.15, Rev. 1
Concrete Reinforcement	ASTM A615-72, Grades 40 and 60
Cadwelds	Regulatory Guide No. 1.10, Rev. 1 (See Note 1)
Structural Steel and Plates	ASTM A-36
	AISC, 1971
	NCIG-01 Rev. 2 "Visual Weld Acceptance Criteria for Structural Welding a Nuclear Power Plants" – EPRI NP-5380
Containment Vessel Shell	Subsection NE Section III of the ASME Code 1971 Edition including addenda through Summer 1972.

Notes:

1. Valid test results are used. A valid test is a test whose failure is in the Cadweld Splice and not in the bar or near testing machine grips. Test samples for B Series Splices will be sister Splices only.

Deleted Item Per 2001 Update

Abbreviations:

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
NCIG	Nuclear Construction Issues Group
EPRI	Electric Power Research Institute

Table 3-32. Load Combinations for Category I Structures

All the major loads to be encountered and/or to be postulated in a Category I structure are listed into four categories described below. All the loads listed, however, are not necessarily applicable to all the structures and their elements in the plant. Loads and the applicable load combinations for which each structure will be designed will depend on the conditions to which that particular structure could be subjected.

1. NORMAL LOADS

Normal loads are those loads to be encountered during normal plant operation and shutdown. They include the following:

D	Dead loads or their related internal moments and forces, including any permanent equipment loads and hydrostatic loads, excluding H_w as defined below under extreme environmental loads.
L	Live loads or their related internal moments and forces, including any movable equipment loads and other loads which vary with intensity and occurrence, such as soil pressure.
P'	Buoyant force of probable maximum flood excluding H_w.
T_o	Thermal effects and loads during normal operating or shutdown conditions, based on the most critical transient or steady state condition and
R_o	Pipe reactions during normal operating or shutdown conditions, based on the most critical transient or steady state condition.

2. SEVERE ENVIRONMENTAL LOADS

Severe environmental loads are those loads that could infrequently be encountered during the plant life. Included in this category are:

E	Loads generated by the Operating Basis Earthquake, and
W	Loads generated by the design wind specified for the plant.

3. EXTREME ENVIRONMENTAL LOADS

Extreme environmental loads are those loads which are credible but are highly improbable. They include:

H_w	Hydrostatic pressure as defined in Section 2.4.13.5.
E'	Loads generated by the Safe Shutdown Earthquake, and
W_t	Loads generated by the Design Basis Tornado specified for the plant. They include loads due to the tornado wind pressure (W_w), loads due to the tornado-created differential pressures (W_p), and loads due to the tornado-generated missiles (W_m).

The combined effect of W_w, W_p, and W_m will be determined in a conservative manner for each particular structure or portion thereof, as applicable, by using one or more of the following combinations as appropriate:

1. $W_t = W_w$
2. $W_t = W_p$
3. $W_t = W_m$
4. $W_t = W_w + 0.5\ W_p$
5. $W_t = W_w + W_m$
6. $W_t = W_w + 0.5\ W_p + W_m$

4. ABNORMAL LOADS

Abnormal loads are those loads generated by a postulated high energy pipe break accident within a building and/or compartment thereof. Included in this category are the following:

P_a	Pressure equivalent static load within or across a compartment and/or building, generated by the postulated break, and including an appropriate dynamic load factor to account for the dynamic nature of the load.
T_a	Thermal loads under thermal conditions generated by the postulated break and including T_o.
R_a	Pipe reactions under thermal conditions generated by the postulated break and including R_o.
Y_r	Equivalent static load on the structure generated by the reaction on the broken high-energy pipe during the postulated break, and including an appropriate dynamic load factor to account for the dynamic nature of the load.
Y_j	Jet impingement equivalent static load on a structure generated by the postulated break, and including an appropriate dynamic load factor to account for the dynamic nature of the load.
Y_m	Missile impact equivalent static load on a structure generated by or during the postulated break, such as pipe whipping, and including an appropriate dynamic load factor to account for the dynamic nature of the load.

In determining an appropriate equivalent static load for Y_r, Y_j and Y_m, elasto-plastic behavior may be assumed with appropriate ductility ratios and as long as excessive deflections will not result in loss of function of any safety related system.

5. OTHER DEFINITIONS

S	For concrete structures, S is the required section strength based on the Working Stress Design methods and the allowable stresses defined in Section 8.10 of ACI 318-71. For structural steel, S is the required section strength based on the elastic design methods and the allowable stresses defined in Part 1 of the AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," February 12, 1969.
U	For concrete structures, U is the section strength required to resist design loads and based on methods described in ACI 318-71.

Y For structural steel, Y is the section strength required to resist design loads and based on plastic design methods described in Part 2 of AISC *Specification for the Design, Fabrication and Erection of Structural Steel for Buildings*, February 12, 1969.

Load Combinations And Acceptance Criteria For Category I Concrete Structures

The following set of load combinations and allowable design limits will be used for all Category I concrete structures:

1. LOAD COMBINATIONS FOR SERVICE LOAD CONDITIONS

Either the Working Stress Design method or the Strength Design method may be used.

a) If the WSD method is used, the following load combinations will be satisfied:

1) $S = D + L$

2) $S = D + L + E$

3) $S = D + L + W$

If thermal stresses due to T_o and R_o are present, the following combinations will also be satisfied:

1a) $1.3S = D + L + T_o + P_o$

2a) $1.3S = D + L + T_o + R_o + E$

3a) $1.3S = D + L + T_o + R_o + W$

Both cases of L having its full value or being completely absent will be checked for.

b) If the Strength Design method is used, the following load combinations will be satisfied:

1) $U = 1.4D + 1.7 L$

2) $U = 1.4 D + 1.7 L + 1.9 E$

3) $U = 1.4 D + 1.7 L + 1.7 W$

If thermal stresses due to T_o and R_o are present, the following combinations will also be satisfied:

1b) $U = (0.75) (1.4 D + 1.7 L + 1.7 T_o + 1.7 R_o)$

2b) $U = (0.75) (1.4 D + 1.7 L + 1.9 E + 1.7 T_o + 1.7 R_o)$

3b) $U = (0.75) (1.4 D + 1.7 L + 1.7 W + 1.7 T_o + 1.7 R_o)$

Both cases of L having its full value or being completely absent will be checked for with the following combinations:

2b′) $U = 1.2 D + 1.9 E$

3b′) $U = 1.2 D + 1.7 W$

Where soil and/or hydrostatic pressures are present, in addition to all the above combinations where they have been included in L and D respectively, the requirements of Section 9.3.4 and 9.3.5 of ACI 318-71 will also be satisfied.

2. LOAD COMBINATIONS FOR FAULTED LOAD CONDITIONS

For these conditions, which represent Extreme Environmental, Abnormal, Abnormal/Severe Environmental and Abnormal/Extreme Environmental conditions, respectively, the Strength Design method will be used and the following load combinations will be satisfied:

4) $U = D + L + T_o + R_o + H_w$

5) $U = D + L + T_o + R_o + E'$

6) $U = D + L + T_o + R_o + W_t$

7) $U = D + L + T_a + R_a + 1.5\ P_a$

8) $U = D + L + T_a + R_a + 1.25\ P_a + 1.0\ (Y_r + Y_j + Y_m) + 1.25\ E$

9) $U = D + L + T_a + R_a + 1.0\ P_a + 1.0\ (Y_r + Y_j + Y_m) + 1.0\ E'$

In combinations (7), (8) and (9), the maximum values of P_a, T_a, R_a, Y_j, Y_r and Y_m, including an appropriate dynamic load factor, will be used unless a time-history analysis is performed to justify otherwise. Combinations (6), (8) and (9) will be satisfied first without the tornado missile load in (6) and without Y_r, Y_j and Y_m in (8) and (9). When considering these loads, however, local section strength capacities may be exceeded under the effect of these concentrated loads, provided there will be no loss of function of any safety related system.

Both cases of L having its full value or being completely absent will be checked for.

Load Combinations And Acceptance Criteria For Category I Steel Structures

The following set of load combinations and allowable design limits will be used for all Category I steel structures:

1. LOAD COMBINATIONS FOR SERVICE CONDITIONS

Either the elastic working stress design methods of Part 1 of AISC, or the plastic design methods of Part 2 of AISC, may be used.

a) If the elastic working stress design methods are used:

1) $S = D + L$

2) $S = D + L + E$

3) $S = D + L + W$

If thermal stresses due to T_o and R_o are present, the following combinations will also be satisfied:

1a) $1.5\ S = D + L + T_o + R_o$

2a) $1.5\ S = D + L + T_o + R_o + E$

3a) $1.5\ S = D + L + T_o + R_o + W$

Both cases of L having its full value or being completely absent will be checked for.

b) If plastic design methods are used:

1) $Y = 1.7\ D + 1.7\ L$

2) $Y = 1.7\ D + 1.7\ L + 1.7\ E$

3) $Y = 1.7\ D + 1.7\ L + 1.7\ W$

If thermal stresses due to T_o and R_o are present, the following combinations will also be satisfied:

1b) $Y = 1.3\ (D + L + T_o + R_o)$

2b) $Y = 1.3\ (D + L + E + T_o + R_o)$

3b) $Y = 1.3\ (D + L + W + T_o + R_o)$

Both cases of L having its full value or being completely absent will be checked for.

2. LOAD COMBINATIONS FOR FAULTED LOAD CONDITIONS

The following load combinations will be satisfied:

a) If elastic-working stress design methods are used:

4) $1.6\ S = D + L + T_o + R_o + H_w$

5) $1.6\ S = D + L + T_o + R_o + E$

6) $1.6\ S = D + L + T_o + R_o + W_t$

7) $1.6\ S = D + L + T_a + R_a + P_a$

8) $1.6\ S^{(1)} = D + L + T_a + R_a + P_a + 1.0\ (Y_j + Y_r + Y_m) + E$

9) $1.7\ S^{(1)} = D + L + T_a + R_a + P_a + 1.0\ (Y_j + Y_r + Y_m) + E'$

b) If plastic design methods are used:

4) $.90\ Y = D + L + T_o + R_o + H_w$

5) $.90\ Y = D + L + T_o + R_o + E'$

6) $.90\ Y = D + L + T_o + R_o + W_t$

7) $.90\ Y = D + L + T_a + R_a + 1.5\ P_a$

8) $.90\ Y = D + L + T_a + R_a + 1.25\ P_a + 1.0\ (Y_j + Y_r + Y_m) + 1.25\ E$

9) $.90\ Y = D + L + T_a + R_a + 1.0\ P_a + 1.0\ (Y_j + Y_r + Y_m) + 1.0\ E'$

In combinations 2(a) and (b), thermal loads can be neglected when it can be shown that they are secondary and self-limiting in nature and where the material is ductile.

In combinations (7), (8) and (9), the maximum values of P_a, T_a, R_a, Y_j, Y_rm, including an appropriate dynamic load factor, will be used unless a time-history analysis is performed to justify otherwise.

Combinations (6), (8) and (9) will be first satisfied without the tornado missile load in (6) and without Y_r, Y_j and Y_m in (8) and (9). When considering these loads, however, local section strengths may be exceeded under the effect of these concentrated loads, provided there will be no loss of function of any safety related system.

Load Combinations And Acceptance Criteria For Category I Foundations

In addition to the load combinations and acceptance criteria referenced above, all Category I foundations will also be checked against sliding and overturning due to earthquakes, winds, and tornadoes and against floatation due to floods in accordance with the following:

	Minimum Factors of Safety		
Load Combination	Overturning	Sliding	Floatation
a. D + H + E	1.5	1.5	---
b. D + H + W	1.5	1.5	---
c. D + H + E′	1.1	1.1	---
d. D + H + W_t	1.1	1.1	---
e. D + F′	---	---	1.5
f. D + L + H_w	1.1	1.1	1.1

Where H is the laterial earth pressure and F’ is the bouyant force of the probable maximum flood.

The minimum factor of safety against flotation of all Category 1 structures used the following procedures:

1. Uplifting/bouyant force - groundwater assumed to rise to grade elevation (593.5).
2. Dead Load - The total weight of the structure was determined including weights of the major pieces of equipment.

The uplifting/bouyant force was then compared to the total dead load.

Note:

1. For these two combinations, (8) and (9), in computing the required section strength, S, the plastic section modulus of steel shapes may be used.

Table 3-33. Concrete Mix Designs

		Course Aggregate Size
Mix	**Compressive Strength**	**S. C. Aggregate No. and N.C. And ASTM Size No.**
A1	3000 psi	67
A2	3000 psi	57
B1	4000 psi	67
B2	4000 psi	57
C1	5000 psi	67
C2	5000 psi	57
D2	2000 psi	57

Note:

1. The strength of the concrete is acceptable if the average of three consecutive test cylinders meets or exceeds the specified 28-day strength, and no individual strength test falls more than 500 psi below the specified 28-day strength.

Table 3-34. Quality Control Tests for Aggregates

	Method of Test		
Required test	**Fine and/or Course Aggregate ASTM**	**Course Aggregate As Applicable AASHO**	**Test Frequency**
Gradation	C136-81		Daily during production
Moisture Content	C566-67		Daily during production
Material Finer than No. 200 Seive	C117-68	T11-70	Daily during production
Organic Impurities	C40-73		Annually
Clay Lumps and Friable Particles	C142-71	T112-68	Annually
Lightweight Pieces	C123-69	T113-70	Annually
Soft Particles	C851-76		Annually
Los Angeles Abrasion	C131-69 or C535-69	T96-70	Annually
Potential Reactivity	C289-71		Annually
Soundness	C88-73	T104-68	Annually
Flat and Elongated Particles	C119-53 (CRD)	-	Annually

Table 3-35. Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 1 General Req.		Requires copies of structural drawings, typical details and specifications be signed by licensed engineer (seal not required).	Recommends inspectors be experienced and familiar with ACI and ASTM standards.	Duke requires drawings and specifications be prepared under supervision of licensed engineers.
		Requires inspection by Owner.		Inspections are performed by Owner representative (Quality Control).
Chapter 2 Definitions	Massive concrete not specifically mentioned.	Requires areas to be treated as massive concrete to be identified on drawings or specification.		Current practice is in accordance with ACI 349. Duke's concrete specification requires that areas treated as massive concrete to be designated on the drawings.
Chapter 3 Materials		Excludes use of air-entraining Portland Cement.		Duke concrete specification meets the intent of ACI 349 by requiring that Type I or II cement be used.

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
	No test reports required.	Requires test report on each cement shipment. No cement can be used prior to receipt of 7 day mill test strength. Excludes use of light weight aggregate concrete.		Duke QA Procedure requires mill tests for each shipment. Results are verified to meet ASTM C150 before use of cement is allowed. Duke concrete specification meets the intent of ACI 349 by requiring that agregrates comply with standards such as ASTM C33 which excludes light weight aggregrates.
	Allows use of railsteel and axle steel bars. Allows Grade 90 bars.	Requires use of billet steel reinforcing bars of Grade 60 or less only.		Steel specification requires that rebar comply with ASTM A615 grades 40 and/or 60 as specified on the bill of materials which meets the intent of ACI 349.
Chapter 4 Concrete Quality	Gives mix design criteria for use in lieu of trial batch method of proportioning mix.	Requires use of trial batch method of mix design.		Duke concrete specification which is in accordance with ACI 349, requires that mixes be determined by trial batches.
		Gives method of determining water/cement ration for fly ash mixes.		Fly ash mixes are not used at Catawba in safety related structures.

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
	Requires use of Type V cement for sulfate exposure.	Defines sulfate exposure. Allows fly ash mix for sulfate exposure conditions.		Sulfate conditions do not exist at Catawba.
	Requires 1 strength test/day/concrete class.	Permits test internal increase by 50 Yd^3/100 psi lower standard deviation if standard deviation for 30 tests in a class is less than 600 psi.	Requires test frequency per ANSI N45.2.5-74.	Current practice is in accordance with Reg. Guide. Concrete specification requires test frequency found in ANSI N45.2.5.
Chapter 5 Mixing & Placing Concrete		Requires construction specifications specifically state: 1. Method of cleaning construction joints. 2. Method of curing. 3. Method of controlling temperature for hot weather concreting.		Concrete specification does not state methods. It requires joints to be cleaned, concrete to be cured and the temperature of the concrete as placed to be maintained no higher temperature for hot than 85°F. Appropriate Chapters of ACI 301 are referenced but selection of method is left to Construction Department.
	Allows placement of concrete without removal of water from place of deposit at the discretion of the owner.	Same as 318.	Requires removal of water before placement.	Duke Concrete specification references Chapter 8 of ACI 301 which complies with Regulatory Guide requirements.

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
	Allows partially hardened or contaminated concrete to be used at discretion of the Engineer.	Same as 318.	Prohibits use of such material.	Duke concrete specification references Chapter 8 of ACI 301 which prohibits the use of partially hardened material, therefore, it complies with the Reg. Guide.
Chapter 6 Form work, Embedded pipes, and construction	Requires pressure test of embedded pipe to 50% above max. pressure (150 psi min.) for 4 hours.	Requires pressure test of embedded pipe "in accordance with the applicable standard".	Rev. 1 accepts ACI 349's requirements.	Duke complies with the position taken in Rev. 1 of the Reg. Guide.
	Limits presssure and temperature of embedded piping to 200 psi and 150°F.	Allows 200°F for localized areas. Allows 350° for accident or short term periods. Allows 650°F for local areas from fluid jet from pipe failure. Allows higher temperatures if supported by test results.		ACI 318 is more conservative than ACI 349.
	Requires vertical construction joints to be wetted and coated with cement grout before placing next lift.	Requires all joints be shown on plans or approval by engineer. Defective or contaminated concrete to be removed. Vertical joints to be saturated with water. Grout not required.		Duke shows all joints on plans and complies to ACI 349 except that joints are dampened and not saturated prior to placement which is in accordance with ACI 301.

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 7	Placement tolerances are stricter than ACI 301.	Tolerances on bar placement liberalized to ACI 301 standards.		Duke concrete specification complies with 349 except that a larger positive tolerance is allowed for clear distance to formed surfaces. This tolerance assures that adequate cover is maintained and correlated better with the design requirements on depth “d”.
		Requires test on full welded splices and full positive connections.		Duke test positive connections in accordance with ANSI N45.2.5.
		Requires welded splices or positive connections for splicing load-carrying rebar located in regions with membrane tension normal to splice.		Duke practice does not comply with ACI 349.
Chapter 8 Analysis & Design General Considerations	Gives procedure for Alternate Design Method	Eliminates Alternate Design Method.	Strength Design Method is not applicable for structures intended as pressure barriers. Designs will be reviewed by NRC on a case-by-case basis.	Alternate Design Method is not used at Catawba.
	Allows use of fillers in concrete joist construction.	Prohibits use of fillers in concrete joist construction.		Fillers are not used at Catawba.

Code Section	**ACI 318**	**ACI 349**	**Regulatory Guide 1.142 Rev. 1, Oct. 1981**	**Justification**
Chapter 9 Strength & Serviceability Requirements		Requires consideration of dynamic response of concrete structure, foundation, and surrounding soil.		Duke's practice is in accordance with ACI 349.
		Requires following load combinations:		Duke's practices are in accordance with the Reg. Guide and ACI 349. Duke's combinations are provided in 3-32 of the FSAR.
	1. $U = 1.4D + 1.7L$	1. $U = 1.4D + 1.7L + 1.7R_o$		
	2. $U = .75 (1.4D + 1.7L + 1.7W)$	2. $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7E_o + 1.7R_o$	2. $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.9E_o + 1.7R_o$	
	3. $U = 0.9D + 1.3W$	3. $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7R_o$		
	4. $U = .75 (1.4D + 1.7L + 1.1E)$	4. $U = D+F+L+H+T_o+ R_o+ E_{ss}$		
	5. $U = 1.4D + 1.7L + 1.7H$	5. $U = D+F+L+H+ T_o+ R_o+ W_t$		
	6. $U = 0.9D + 1.7H$	6. $U = D+F+L+H+ T_a+ R_a+ 1.25P_a$	6. $U = D+F+L+H+ T_a+ R_a+ 1.5P_a$	
		7. $U = D+F+L+H+T_a+R_a+ 1.15P_a +1.0(c_r + Y_j +Y_m) + 1.15E_o$	7. $U = D + F + L + H + T_a + R_a + 1.25 P_a + 1.0 (Y_r + Y_j+Y_m) + 1.25 E_O$	
		8. $U = D+F+L+H+T_a+R_a+ 1.0P_a + 1.0 (Y_r + Y_j + Y_m) + 1.0 E_{ss}$		

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
		9. $U = 0.75 (1.4D + 1.7L + 1.4T_o + 1.7R_o)$	9. $U = .75 (1.4D + 1.7L + 1.7T_o + 1.7R_o)$	
		10. $U = 0.75 (1.4D + 1.4F + 1.7L + 1.7H + 1.7E_o + 1.4T_o + 1.7R_o)$	10. $U = .75 (1.4D + 1.4F + 1.7L + 1.7H + 1.9E_o + 1.7T_o + 1.7R_o)$	
		11. $U = 0.75 (1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.4T_o + 1.7R_o)$	11. $U = .75 (1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7T_o + 1.7R_o)$	
		Requires consideration of prestress, crane loads, vibration, impact, shrinkage, creep and differential settlement for normal loads (Comb. 1 to 3).	Effects of differential settlement should be included in all load combinations.	
		When D or L reduces effects of other loads, coefficients shall be .9 for D and O for L.	For all loading conditions, when any load reduces the effects of other loads, the coefficient for the load is always present and acts simultaneously, otherwise coefficient = 0.	
		For combination 7 and 8 local strength can be exceeded for Y_r, Y_j, Y_m, if no loss of safety-related system results.	Section strengths must be adequate for forces in comb. 7 and 8 without Y_r, Y_j, and Y_m.	

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
		Allows time-history analysis for pipe-rupture loads (combinations 6, 7, and 8).	Local exceedance of section strength for tornado missiles for comb. 5 acceptable provided strength is adequate for forces of combination 5 without tornado missiles.	
Chapter 10 Flexure & Axial Loads		Specifies minimum temperature and shrinkage reinforcing for massive concrete.		There is no massive concrete in any nuclear safety related structures at Catawba.
Chapter 11 Shear & Torsion		Gives permissable shear stresses for slabs subject to loads with forces in the plane of the slab (i.e., missile loads).		Current practice is in accordance with ACI 349 and Reg. Guide.
	Specifically addresses openings in slabs.	Slab opening section deleted.	Provisions of AIC 318 are acceptable.	
		Sets allowable shear stress values for punching shear in walls.		
Chapters 12 thru 17		No significant changes.		
Chapter 18 Prestressed Concrete	Maximum water/cement ratio for grout for bonded tendons = 0.5.	Limits w/c ratio to .45.		There is no pre-stressed concrete in any of Catawba's nuclear safety related structures.

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
	Requires member temperature at time of grouting bonded tendons to be above 50°F. Temperature must be maintained above 50°F for 48 hours.	Requires member temperature above 35°F maintained until job cured grout cubes reach 800 psi. Grout temperature limited to 90°F during mixing and pumping.		
Chapter 19 Shells	Applys only to thin shell concrete structures.	Applys only to the design of shell concrete structures having thicknesses equal to or greater than 12 in.		Duke's design practice does comply with ACI 349.
Appendix A Special Provisions for Seismic Design		Not included in ACI-349.	ACI-349 lacks specific requirements to assure ductility of framed structures. Adherance to ACI-318 Appendix A is acceptable.	Current practice is in accordance with ACI-318.

Table 3-36. Shell Wall Design Forces and Reinforcement

AREA OF CONCERN	MAX. SHEAR OR TENSION	MAX. MOMENT	REINF. REQUIRED	REINF. PROVIDED
Ring Beam Vertical	$N\phi = 1255.$ lbs.	$M\phi = 41,394$ in-lb.	.715 in^2/ft total	Outside Face: #11's @ 18" Plus #8's @ 12" = 1.83 in^2/ft
				Inside Face: #11's & #8's @ 18" = 1.57 in^2/ft
Ring Beam Horizontal	$N\theta = 715.5$ K	$M\theta = 372.5$ Ft-k	Outside Face: 5.04 in^2/ft	Outside Face: 5#11's/ft = 7.8 in^2/ft
			Inside Face: 14.84 in^2/ft	Inside Face: 10#11's/ft = 15.6 in^2/ft
Dome Junction W/Ring Beam (x = 132.5°, K-SHELL Model)	Radial: $Q\phi = 0.25$ K/in $N\phi = 2.1$ K/in $N = 0.7$ K/in $N\theta = 0.6$ K/in	Radial: $M\phi = 23.75$ K-in/in $M\theta = 4.7$ K-in/in $Q\theta = 0.05$ K/in	Radial Steel: 0.771 in^2/ft	Radial Steel: #11's @ 18" = 1.04 in^2/ft
	Hoop: $Q\phi = 1.0$ K/in $N\phi = 2.8$ K/in $N = 0.0$ $N\theta = 5.6$ K/in	Hoop: $M\phi = 73$ K-in/in $M\theta = 14.7$ K-in/in $Q\theta = 0.0$	Hoop Steel: 1.17 in^2/ft	Hoop Steel: #10's @ 12" = 1.27 in^2/ft
Shell Wall Junction W/Foundation Mat X = 0, K-SHELL Model	Vertical: $N\phi = 5.3$ K/in	Vertical: $M\phi = 471.8$ K-in/in	Vertical: 5.74 in^2/ft.	Vertical: 2 #11s @ 6" = 6.24 in^2/ft
	Hoop: $N\theta = 1.0$ K/in	Hoop: $M\theta = 89.7$ K-in/in	Hoop: 1.25 in^2/ft	Hoop: #11's @ 12" = 1.56 in^2/ft

Table 3-37. Containment Vessel Loading Combinations

(1) $D + L + P_t + T_t$

(1a) $D + CL$

(2) $D + L + T_o + R_o$

(3) $D + L + T_o + R_o + E$

(4) $D + L + T_a + R_a + P_a + E$

(5) $D + L + T_e + R_e + P_e + E$

(6) $D + L + T_a + R_a + P_a + E'$

(7) $D + L + T_e + R_e + P_e + E'$

(8) $D + L + T_a + R_a + P_a + Y_r + Y_j + Y_m + E'$

(9) $D + L + F_L + E$

(10) $D + P_L + E'$

Where

CL = Construction loads

P_t = Test pressure

T_t = Test temperature

P_e = External pressure due to the internal vacuum created by accidental trip of the Containment spray system.

T_e = Thermal loads during conditions causing P_e

F_L = Loads caused by post-LOCA flooding, if any.

P_L = Loads caused by LOCA (Pressure Transient)

For additional definitions, see Table 3-32.

Table 3-38. Containment Stress Limits

		Primary Stresses					
Loading Combination No.		**Gen. Memb. P_m**	**Local Memb. P_L**	**Bend + Local Memb. $P_B + P_L$**	**Primary & Sec. Stresses**	**Peak Stresses**	**Buckling**
(1)		$.9S_y$	$1.25S_y$	$1.25S_y$	$3S_m$	Consider for Fatigue Analysis	Note (3)
(2) & (3)		S_m	$1.5S_m$	$1.5S_m$	$3S_m$	Consider for Fatigue Analysis	Note (3)
(4) & (5)		S_m	$1.5S_m$	$1.5S_m$	N/A	N/A	Note (3)
(6) & (7) & (10)	Not integral and continuous	S_m	$1.5S_m$	$1.5S_m$	N/A	N/A	Note (3)
	Integral and continuous	The Greater of $1.2S_m$ or S_y	The Greater of $1.8S_m$ or $1.5S_y$	The Greater of $1.8S_m$ or $1.5S_y$	N/A	N/A	Note (3)
(8)	Not integral and continuous	The Greater of $1.2S_m$ or S_y	The Greater of $1.8S_m$ or $1.5S_y$	The Greater of $1.8S_m$ or $1.5S_y$	N/A	N/A	Note (3)
	Integral and continuous	85% of Stress Intensity Limits of Appendix F			N/A	N/A	Note (3)
(9)		$1.5S_m$	The Greater of $1.8S_m$ or $1.5S_y$	The Greater of $1.8S_m$ of $1.5S_y$	N/A	N/A	Note (3)

Loading Combination No.	Primary Stresses			Primary & Sec. Stresses	Peak Stresses	Buckling
	Gen. Memb. P_m	Local Memb. P_L	Bend + Local Memb. $P_B + P_L$			

Notes:

1. Thermal stresses are not considered in computing P_m, P_L, and P_B.
2. Thermal effects are considered in:
   a. Specifying stress intensity limits as a function of temperature.
   b. Analyzing effects of cyclic operation (NB-3222.4).
3. Buckling stress limits and factors of safety are defined in Section 3.8.2.5.2 per ASME Code Case N-284.

Table 3-39. Deleted Per 1997 Update

Table 3-40. Containment Materials

Material Location	Material Specification
Base Liners	SA 516, Grade 60
Base Liner Embedments	SA 516, Grade 60 and/or ASTM A36
Knuckle Plate	SA 516, Grade 60
Shell and Dome Plate	SA 516, Grade 60
Penetrations (Piping and Electrical)	SA 333, Grade 6 and/or SA 516, Grade 60
Personnel Locks	SA 516, Grade 70
Stiffeners	SA 516, Grade 60
Equipment Hatch	SA 516, Grade 60 and/or Grade 70
Anchor Bolts	SA 320-L43
Anchor Bolts Anchor Plates	SA 516, Grade 60

Table 3-41. Containment Allowable Stress Intensities

Loading Combination		Primary Stresses			
		General Memb. P_m	Local Memb. P_L	Bending + Local Memb. $P_B + P_L$	Primary & Secondary Stresses
(1)		28,800	40,000	40,000	49,500
(2) & (3)		16,500	24,750	24,750	49,500
(4) & (5)		16,500	24,750	24,750	N/A
(6) & (7)	Not Integral & continuous	16,500	24,750	24,750	N/A
	Integral and continuous	32,000	48,000	48,000	N/A
(8)	Not integral & continuous	32,000	48,000	48,000	N/A
	Integral and continuous	35,700	53,550	53,550	N/A
(9)		24,750	48,000	48,000	N/A

Notes:

1. All units are pounds per square inch.
2. Allowables given are for elastic analysis

Table 3-42. Containment Stress Intensities

		Location on Containment Vessel				
Load Combination	**Stress (Fiber) Location**	**Base 552+0**	**Mid-Panel(3) 624+5**	**Stiffener(3) 629+5**	**Dome-Cyl. Jct. 663+9**	**Maximum**
1	Middle	13,250	17,618	9,060	13,890	18,180
	Extreme	31,952	17,783	21,605	14,243	31,952
2	Middle	9,786	555	506	640	9,786
	Extreme	17,662	558	647	844	17,662
3	Middle	10,020	1,200	1,137	849	10,020
	Extreme	17,974	968	1,242	918	17,974
4	Middle	5,467	15,504	8,101	12,065	15,520
5	Middle	2,404	2,134	1,804	1,426	3,046
6 & 8(2)	Middle	6,304	15,706	8,550	12,287	15,770
7	Middle	3,313	2,778	2,359	1,771	4,182
9	Middle	1,915	1,200	1,137	599	4,837

Notes:

1. All stresses are in psi
2. Load combination 8 is identical to load combination 6 except for the addition of jet impingement and pipe support loads. These are localized loads whose allowable magnitudes are established considering the local effects superimposed on the overall stresses
3. The mid-panel and stiffener stresses are typical

Table 3-43. Containment Buckling Factors of Safety

Part Of Containment	Load Combination	Overall Buckling	Local Buckling
Cylinder	3	7.04	4.73
	6	2.18	2.33
	6(2)	3.05	1.97(1)
Dome	6(2)	4.01	4.01
	7	2.23	2.23

Notes:

1. Analyzed shell thickness .05" less than nominal, therefore actual safety factor is greater than 2.00.
2. Includes effects of short term pressure transient.

Table 3-44. Statistical Containment Material Properties Based on Mill Test Reports

	UNIT 1			UNIT 2		
	Mean	**Variance**	**Standard Deviation**	**Mean**	**Variance**	**Standard Deviation**
Yield Strength (KSI)	50.132	3.629	1.905	50.04	4.062	2.014
Ultimate Strength (KSI)	69.598	2.979	1.726	69.37	3.246	1.802
% Elongation	29.322	1.854	1.362	29.115	3.034	1.742

Table 3-45. Ultimate Containment Capacity Analysis Summary

	Location	Ultimate Internal Pressure (PSI)	Criterion
1.	Containment Shell	72	Nonlinear Axisymmetric Analysis
2.	Base Anchorage	81	Concrete Shear
3.	Penetrations		
	a. Personnel Air Lock	79	Plastic Moment in Bulkhead
	b. Equipment Hatch	80	Tensile Failure of Hatch Cover Spider
	c. Spare Penetrations	1275	Yield of Pipe Cap
	d. Electrical Penetrations	> 72	Connector Module Leakage
	e. Bellows Assemblies	> 72	Manufacturer's Recommendation
	f. Purge Penetrations	> 72	Specified to Manufacturer

Table 3-46. Design Properties of Seals

A) Membrane Seals:

	Durometer	Tensile	Elongation	Compression Set
Initial	65	2260 psi	470%	14.1%

B) Compressible Seals:

	Durometer	Tensile	Elongation	Compression Set
Initial	40	1400 psi	800%	12.88%

Note:

1. These seals were originally tested in accordance with ASTM D-2000-73. Replacement seals may be specified and tested per the latest version of ASTM D-2000 in use at the time of procurement provided the applicable requirements of the revised standard are evaluated as essentially the same as the applicable requirements of ASTM D-2000-73.

Table 3-47. Catawba Compartment Pressurization Analysis

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS								
							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
1 and 2	0.8100E+01	0.0270	H.L. 1	-0.6020E+01	0.0180	H.L. 2	0.1134E+02	-0.8428E+01
1 and 6	0.1156E+02	0.0360	H.L. 1	-0.1181E+02	0.0360	H.L. 6	0.1618E+02	-0.1653E+02
1 and 7	0.1636E+02	0.2860	C.L. 1	-0.2200E+00	0.0360	C.L. 6	0.2212E+02	-0.3080E+00
1 and 8	0.1580E+02	0.3040	C.L. 1	-0.2200E+00	0.0360	C.L. 6	0.2212E+02	-0.3080E+00
1 and 9	0.1539E+02	0.3040	C.L. 1	-0.2200E+00	0.0360	C.L. 6	0.2155E+02	-0.3080E+00
1 and 25	0.1413E+02	0.2320	C.L. 1	-0.2200E+00	0.0360	C.L. 6	0.1978E+02	-0.3080E+00
1 and 26	0.1390E+02	0.2320	C.L. 1	-0.4800E+00	2.5180	C.L. 6	0.1946E+02	-0.6720E+00
1 and 27	0.1135E+02	0.0380	H.L. 1	-02300E+00	0.0360	C.L. 6	0.1589E+02	-0.3220E+00
1 and 28	0.1396E+02	0.2320	C.L. 1	-0.5000E+00	2.3380	C.L. 6	0.1954E+02	-0.7000E+00
1 and 33	0.1167E+02	0.0450	H.L. 1	-0.2240E+01	0.0900	H.L. 5	0.1634E+02	-0.3136E+01
1 and 34	0.1296E+02	0.2140	C.L. 1	-0.4200E+00	2.5180	C.L. 6	0.1814E_02	-0.5880E+00
1 and 40	0.1115E+02	0.0360	H.L. 1	-0.2200E+00	0.0360	C.L. 6	0.1561E+02	-0.3080E+00
2 and 1	0.6020E+01	0.0180	H.L. 2	-0.8100E+01	0.0270	H.L. 1	0.8428E+01	-0.1134E+02
2 and 3	0.7620E+01	0.0630	H.L. 1	-0.5940E+01	0.0270	H.L. 3	0.1067E+02	-0.8316E+01
2 and 10	0.1203E+02	0.3040	C.L. 2	0.0	0.0090	C.L. 6	0.1684E+02	0.0
2 and 25	0.1135+02	0.1260	H.L. 2	0.0	0.0090	C.L. 6	0.1589E+02	0.0
2 and 26	0.1085E+02	0.1170	H.L. 2	-0.4800E+00	2.4820	C.L. 6	0.1519E+02	-0.6720E+00
2 and 27	0.8720E+01	0.0720	H.L. 1	-0.1500E+00	2.4820	C.L. 6	0.1221E+02	-0.2100E+00
2 and 28	0.1096E+02	0.1170	H.L. 2	-0.4900E+00	2.4100	C.L. 6	0.1534E+02	-0.6860E+00
2 and 33	0.8880E+01	0.0630	H.L. 1	-0.1420E+01	0.0810	H.L. 5	0.1243E+02	-0.1988E+01
2 and 41	0.9350E+01	0.0630	H.L. 1	0.0	0.0090	C.L. 6	0.1309E+02	0.0
3 and 2	0.5940E+01	0.0270	H.L. 3	-0.7620E+01	0.0630	H.L. 1	0.8316E+01	-0.1067E+02

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
3 and 4	0.5980E+01	0.0270	H.L. 3	-0.7340E+01	0.0270	H.L. 4	0.8372E+01	-0.1028E+02
3 and 13	0.9920E+01	0.3040	C.L. 3	0.0	0.0180	C.L. 6	0.1389E+02	0.0
3 and 14	0.9710E+01	0.3040	C.L. 3	0.0	0.0180	C.L. 6	0.1359E+02	0.0
3 and 15	0.9410E+01	0.3580	C.L. 3	0.0	0.0180	C.L. 6	0.1317E+02	0.0
3 and 25	0.9190E+01	0.2140	H.L. 4	0.0	0.0180	C.L. 6	0.1287E+02	0.0
3 and 27	0.7420E+01	0.0450	H.L. 3	-0.4300E+00	2.5720	C.L. 1	0.1039E+02	-0.6020E+00
3 and 28	0.8790E+01	0.2140	H.L. 3	-0.4700E+00	2.4100	C.L. 6	0.1231E+02	-0.6580E+00
3 and 29	0.1022E+02	0.4840	C.L. 3	-0.5500E+00	2.4640	C.L. 6	0.1431E+02	-0.7700E+00
3 and 30	0.8780E+01	0.2140	H.L. 4	-0.4600E+00	2.4640	C.L. 6	0.1229E+02	-0.6440E+00
3 and 33	0.6930E+01	0.0360	H.L. 3	-0.1150E+01	0.1440	H.L. 4	0.9702E+01	-0.1610E+01
3 and 35	0.9100E+01	0.2140	H.L. 4	-0.4900E+00	2.3560	C.L. 6	0.1274E+02	-0.6860E+00
3 and 42	0.7300E+01	0.1080	H.L. 1	0.0	0.0180	C.L. 6	0.1022E+02	0.0
4 and 5	0.6460+01	0.0270	H.L. 4	-0.6680E+01	0.0540	H.L. 6	0.9044E+01	-0.9352E+01
4 and 16	0.1074E+02	0.3040	C.L. 4	0.0	0.0090	C.L. 6	0.1404E+02	0.0
4 and 17	0.1017E+02	0.3040	C.L. 4	0.0	0.0090	C.L. 6	0.1424E+02	0.0
4 and 18	0.9520E+01	0.3400	C.L. 4	0.0	0.0090	C.L. 6	0.1333E+02	0.0
4 and 25	0.9530E+01	0.1080	H.L. 6	0.0	0.0090	C.L. 6	0.1334E+02	0.0
4 and 29	0.1021E+02	0.4480	C.L. 4	-0.5600E+00	2.4640	C.L. 1	0.1429E+02	-0.7840E+00
4 and 30	0.9190E+01	0.1080	H.L. 6	-0.4700E+00	2.5540	C.L. 1	0.1287E+02	-0.6580E+00
4 and 31	0.8090E+01	0.0360	H.L. 4	-0.3800E+00	2.5900	C.L. 6	0.1133E+02	-0.5320E+00
4 and 33	0.7830E+01	0.0360	H.L. 4	-0.1110E+01	0.2140	C.L. 1	0.1096E+02	-0.1554E+01
4 and 36	0.9370E+01	0.1080	H.L. 6	-0.4800E+00	2.4640	C.L. 1	0.1312E+02	-0.6720E+00
4 and 43	0.8240E+01	0.0900	H.L. 6	0.0	0.0090	C.L. 6	0.1154E+02	0.0

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
5 and 4	0.6680E+01	0.0540	H.L. 6	-0.6460E+01	0.0270	H.L. 4	0.9352E+01	-0.9044E+01
5 and 6	0.5940E+01	0.0180	H.L. 5	-0.8280E+01	0.0270	H.L. 6	0.8316E+01	-0.1159E+02
5 and 19	0.1159E+02	0.2860	C.L. 5	0.0	0.0	C.L. 6	0.1623E+02	0.0
5 and 20	0.1116E+02	0.2860	C.L. 5	0.0	0.0	C.L. 6	0.1562E+02	0.0
5 and 21	0.1060E+02	0.3220	C.L. 5	0.0	0.0	C.L. 6	0.1484E+02	0.0
5 and 25	0.1125E+02	0.1170	H.L. 5	0.0	0.0	C.L. 6	0.1575E+02	0.0
5 and 30	0.1080E+02	0.1170	H.L. 5	-0.5000E+00	2.5540	C.L. 1	0.1512E+02	-0.7000E+00
5 and 31	0.8280E+01	0.0630	H.L. 6	-0.1600E+00	2.4640	C.L. 1	0.1159E+02	-0.2240E+00
5 and 32	0.1065E+02	0.1170	H.L. 5	-0.5000E+00	2.5540	C.L. 1	0.1491E+02	-0.7000E+00
5 and 33	0.8650E+01	0.0630	H.L. 6	-0.1480E_01	0.0900	H.L. 2	0.1211E+02	-0.2072E+01
5 and 44	0.9160E+01	0.0630	H.L. 6	0.0	0.0	C.L. 6	0.1282E+02	0.0
6 and 5	0.8280E+01	0.0270	H.L. 6	-0.5940E+01	0.0180	H.L. 5	0.1159E+02	-0.8316E+01
6 and 22	0.1581E+02	0.2860	C.L. 6	-0.2100E+00	0.0360	C.L. 1	0.2213E+02	-0.2940E+00
6 and 23	0.1521E+02	0.3040	C.L. 6	-0.2100E+00	0.0360	C.L. 1	0.2129E+02	-0.2940E+00
6 and 24	0.1482E+02	0.3040	C.L. 6	-0.2100E+00	0.0360	C.L. 1	0.2075E+02	-0.2940E+00
6 and 25	0.1357E+02	0.2320	C.L. 6	-0.2100E+00	0.0360	C.L. 1	0.1900E+02	-0.2940E+00
6 and 30	0.1332E+02	0.2140	C.L. 6	-0.5000E+00	2.5900	C.L. 1	0.1865E+02	-0.7000E+00
6 and 31	0.1156E+02	0.0360	H.L. 6	-0.2200E+00	0.0360	C.L. 1	0.1618E+02	-0.3080E+00
6 and 32	0.1320E+02	0.2140	C.L. 6	-0.5000E+00	2.5900	C.L. 1	0.1848E+02	-0.7000E+00
6 and 33	0.1185E+02	0.0450	H.L. 6	-0.2280E+01	0.0900	H.L. 2	0.1659E+02	-0.3192E+01
6 and 37	0.1238E+02	0.1170	H.L. 6	-0.4400E+00	2.5900	C.L. 1	0.1733E+02	-0.6160E+00
6 and 45	0.1136E+02	0.0360	H.L. 6	-0.2100E+00	0.0360	C.L. 1	0.1590E+02	-0.2940E+00
7 and 1	0.2200E+00	0.0360	C.L. 6	-0.1636E+02	0.2860	C.L. 1	0.3080E+00	-0.2290E+02

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
7 and 2	0.0	0.0090	C.L. 6	-0.1090E+02	0.2860	C.L. 1	0.0	-0.1526E+02
7 and 8	0.3480E+01	0.1080	H.L. 2	-0.1020E+01	0.2500	H.L. 1	0.4872E+01	-0.1428E+01
7 and 10	0.5200E+01	0.2860	H.L. 2	-0.3490E+01	0.2320	H.L. 1	0.7280E+01	-0.4886E+01
7 and 25	0.7540E+01	0.1260	H.L. 2	-0.2550E+01	0.2680	H.L. 1	0.1056E+02	-0.3570E+01
7 and 40	0.0	0.0990	C.L. 6	-0.1082E+02	0.2860	C.L. 1	00	-0.1515E+02
8 and 1	0.2200E+00	0.0360	C.L. 6	-0.1580E+02	0.3040	C.L. 1	0.3080E+00	-0.2212E+02
8 and 7	0.1020E+01	0.2500	H.L. 1	-0.3480E+01	0.1080	H.L. 2	0.1428E+01	-0.4872E+01
8 and 9	0.3000E+01	0.1440	H.L. 2	-0.9100E+00	0.2320	H.L. 1	0.4200E+01	-0.1274E+01
8 and 11	0.4290E+01	0.2680	H.L. 2	-0.2770E+01	0.2140	H.L. 1	0.6006E+01	-0.3878E+01
8 and 25	0.6440E+01	0.1440	H.L. 2	-0.2210E+01	0.2860	H.L. 1	0.9016E+01	-0.3094E+01
9 and 1	0.2200E+00	0.0360	C.L. 6	-0.1539E+02	0.3040	C.L. 1	0.3080E+00	-0.2155E+02
9 and 8	0.9100E+00	0.2320	H.L. 1	-0.3000E+01	0.1440	H.L. 2	0.1274E+01	-0.4200E+01
9 and 12	0.3350E+01	0.2500	H.L. 2	-0.2230E+01	0.2680	H.L. 1	0.4690E+01	-0.3122E+01
9 and 25	0.4730E+01	0.1710	H.L. 2	-0.1730E+01	0.2860	H.L. 1	0.6622E+01	-0.2422E+01
9 and 38	0.4910E+01	0.1710	H.L. 2	-0.1200E+01	0.2860	H.L. 1	0.6874E+01	-0.1680E+01
10 and 2	0.0	0.0090	C.L. 6	-0.1203E+02	0.3040	C.L. 2	0.0	-0.1684E+02
10 and 7	0.3490E+01	0.2320	H.L. 1	-0.5200E+01	0.2860	H.L. 2	0.4886E+01	-0.7280E+01
10 and 11	0.2990E+01	0.1080	H.L. 1	-0.7500E+00	0.2860	H.L. 2	0.4186E+01	-0.1050E+01
10 and 13	0.5540E+01	0.1170	H.L. 1	-0.3820E+01	0.2680	H.L. 2	0.7756E+01	-0.5348E+01
10 and 25	0.6770E+01	0.1260	H.L. 1	-0.2270E+01	0.2860	H.L. 2	0.9478E+01	-0.3178E+01
10 and 41	0.1000E-01	0.0360	C.L 2	-0.7530E+01	0.2860	C.L. 2	0.1400E-01	-0.1054E+02

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
11 and 2	0.00	0.0090	C.L. 6	-0.1163E+02	0.2860	C.L. 2	0.0	-0.1628E+02
11 and 8	0.2770E+01	0.2140	H.L. 1	-0.4290E+01	0.2680	H.L. 2	0.3878E+01	-0.6006E+01
11 and 10	0.7500E+00	0.2860	H.L. 2	-0.2990E+01	0.1080	H.L. 1	0.1050E+01	-0.4186E+01
11 and 12	0.2720E+01	0.1440	H.L. 1	-0.9500E+00	0.2860	C.L. 2	0.3808E+01	-0.1330E+01
11 and 14	0.4510E+01	0.1350	H.L. 1	-0.2890E+01	0.2500	H.L. 2	0.6314E+01	-0.4046E+01
11 and 25	0.5770E+01	0.1440	H.L. 1	-0.1530E+01	0.3040	H.L. 2	0.8078E+01	-0.2142E+01
12 and 2	0.0	0.0090	C.L. 6	-0.1105E+02	0.3220	C.L. 2	0.0	-0.1547E+02
12 and 9	0.2230E+01	0.2680	H.L. 1	-0.3350E+01	0.2500	H.L. 2	0.3122E+01	-0.4690E+01
12 amd 11	0.9500E+00	0.2860	C.L. 2	-0.2720E+01	0.1440	H.L. 1	0.1330E+01	-0.3808E+01
12 and 15	0.2530E+01	0.1350	H.L. 1	-0.2510E+01	0.3220	H.L. 1	0.3542E+01	-0.3514E+01
12 and 25	0.4090E+01	0.2550	H.L. 5	-0.1220E+01	0.3040	H.L. 2	0.5726E+01	-0.1708E+01
12 and 39	0.4700E+01	0.2500	H.L. 5	-0.9900E+00	0.2680	C.L. 2	0.6580E+01	-0.1386E+01
13 and 3	0.0	0.0180	C.L. 6	-0.9920E+01	0.3040	C.L. 3	0.0	-0.1389E+02
13 and 10	0.3820E+01	0.2680	H.L. 2	-0.5540E+01	0.1170	H.L. 1	0.5348E+01	-0.7756E+01
13 and 14	0.2730E+01	0.1600	H.L. 6	-0.4500E+00	0.3760	H.L. 3	0.3822E+01	-0.6300E+00
13 and 16	0.4440E+01	0.2500	H.L. 4	-0.4770E+01	0.1440	H.L. 6	0.6216E+01	-0.6678E+01
13 and 25	0.6300E+01	0.1710	H.L. 1	-0.1230E+01	0.3040	H.L. 3	0.8820E+01	-0.1722E+01
13 and 24	0.0	0.0900	C.L. 6	-0.5820E+01	0.3040	C.L. 3	0.0	-0.8148E+01
14 and 3	0.0	0.0180	C.L. 6	-0.9710E+01	0.3040	C.L. 3	0.0	-0.1359E+02
14 and 11	0.2890E+01	0.2500	H.L. 2	-0.4510E+01	0.1350	H.L. 1	0.4046E+01	-0.6314E+01
14 and 13	0.4500E+00	0.3760	H.L. 3	-0.2730E+01	0.1800	H.L. 6	0.6300E+00	-0.3822E+01
14 and 15	0.2490E+01	0.1800	H.L. 1	-0.8600E+00	0.2860	H.L. 3	0.3486E+01	-0.1204E+01

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
14 and 17	0.3610E+01	0.2680	H.L. 4	-0.3850E+01	0.1620	H.L. 6	0.5054E+01	-0.5390E+01
14 and 25	0.5210E+01	0.1890	H.L. 1	-0.1000E+01	0.3040	C.L. 3	0.7294E+01	-0.1400E+01
15 and 3	0.0	0.0180	C.L. 6	-0.9410E+01	0.3580	C.L. 3	0.0	-0.1317E+02
15 and 12	0.2510E+01	0.3220	H.L. 1	-0.2530E+01	0.1350	H.L. 1	0.3514E+01	-0.3542E+01
15 and 14	0.8600E+00	0.2860	H.L. 3	-0.2490E+01	0.1800	H.L. 1	0.1204E+01	-0.3486E+01
15 and 18	0.2710E+01	0.3400	H.L. 5	-0.2230E+01	0.1620	H.L. 6	0.3794E+01	-0.3122E+01
15 and 25	0.3720E+01	0.2140	H.L. 1	-0.8500E+00	0.3220	H.L. 3	0.5208E+01	-0.1190E+01
15 and 46	0.4140E+01	0.2140	H.L. 1	-0.8000E+00	0.2680	H.L. 3	0.5796E+01	-0.1120E+01
16 and 4	0.0	0.0090	C.L. 6	-0.1074E+02	0.3040	C.L. 4	0.0	-0.1504E+02
16 and 13	0.4770E+01	0.1440	H.L. 6	-0.4440E+01	0.2500	H.L. 4	0.6678E+01	-0.6216E+01
16 and 17	0.2630E+01	0.1800	H.L. 1	-0.8600E+00	0.3040	H.L. 4	0.3682E+01	-0.1204E+01
16 and 19	0.3110E+01	0.2500	H.L. 5	-0.4390E+01	0.1170	H.L. 6	0.4354E+01	-0.6146E+01
16 and 25	0.6230E+01	0.1980	H.L. 1	-0.2240E+01	0.2860	H.L. 4	0.8722E+01	-0.3136E+01
16 and 43	0.1000E-01	0.0360	C.L. 4	-0.6680E+01	0.2860	H.L. 4	0.1400E-01	-0.9352E+01
17 and 4	0.0	0.0090	C.L. 6	-0.1017E+02	0.3040	C.L. 4	0.0	-0.1424E+02
17 and 14	0.3850E+01	0.1620	H.L. 6	-0.3610E+01	0.2680	H.L. 4	0.5390E+01	-0.5054E+01
17 and 16	0.8600E+00	0.3040	H.L. 4	-0.2630E+01	0.1800	H.L. 1	0.1204E+01	-0.3682E+01
17 and 18	0.2380E+01	0.1710	H.L. 6	-0.1070E+01	0.2860	H.L. 4	0.3332E+01	-0.1498E+01
17 and 20	0.2430E+01	0.2500	H.L. 5	-0.3490E+01	0.1260	H.L. 6	0.3402E+01	-0.4886E+01
17 and 25	0.5100E+01	0.1710	H.L. 6	-0.1480E+01	0.2860	H.L. 4	0.7140E+01	-0.2072E+01
18 and 4	0.0	0.0090	C.L. 6	-0.9520E+01	0.3400	C.L. 4	0.0	-0.1333E+02

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
18 and 15	0.2230E+01	0.1620	H.L. 6	-0.2710E+01	0.3400	H.L 5	0.3122E+01	-0.3794E+01
18 and 17	0.1070E+01	0.2860	H.L. 4	-0.2380E+01	0.1710	H.L. 6	0.1498E+01	-0.3332E+01
18 and 21	0.2010E+01	0.3040	H.L. 6	-0.2240E+01	0.3760	C.L. 3	0.2814E+01	-0.3136E+01
18 and 25	0.3500E+01	0.1980	H.L. 6	-01030E+01	0.3220	H.L. 4	0.4900E+01	-0.1442E+01
18 and 47	0.4130E+01	0.2500	H.L. 1	-0.1150E+01	0.2680	H.L. 4	0.5782E+01	-0.1610E+01
19 and 5	0.0	0.0	C.L. 6	-0.1159E+02	0.2860	C.L. 5	0.0	-0.1623E+02
19 and 16	0.4390E+01	0.1170	H.L. 6	-0.3110E+01	0.2500	H.L. 5	0.6146E+01	-0.4354E+01
19 and 20	0.2890E+01	0.1080	H.L. 6	-0.7800E+00	0.2860	H.L. 5	0.4046E+01	-0.1092E+01
19 and 22	0.3370E+01	0.2320	H.L. 6	-0.4880E+01	0.2860	H.L. 5	0.4718E+01	-0.6832E+01
19 and 25	0.6610E+01	0.2140	H.L. 2	-0.2330E+01	0.2860	H.L. 5	0.9254E+01	-0.3262E+01
19 and 44	0.1000E-01	0.0360	C.L. 5	-0.7190E+01	0.2860	C.L. 5	0.1400E-01	-0.1007E+02
20 and 5	0.0	0.0	C.L. 6	-0.1116E+02	0.2860	C.L. 5	0.0	-0.1562E+02
20 and 17	0.3490E+01	0.1260	H.L. 6	-0.2430E+01	0.2500	H.L. 5	0.4886E+01	0-3402E+01
20 and 19	0.7800E+00	0.2860	H.L. 5	-0.2890E+01	0.1080	H.L. 6	0.1092E+01	-0.4046E+01
20 and 21	0.2650E+01	0.1440	H.L. 6	-0.9600E+00	0.2860	C.L. 5	0.3710E+01	-0.1344E+01
20 and 23	0.2650E+01	0.2140	H.L. 6	-0.4040E+01	0.2680	H.L. 5	0.3710E+01	-0.5656E+01
20 and 25	0.5640E+01	0.1440	H.L. 6	-0.1550E+01	0.2860	H.L. 5	0.7896E+01	-0.2170E+01
21 and 5	0.0	0.0	C.L. 6	-0.1060E+02	0.3220	C.L. 5	0.0	-0.1484E+02
21 and 18	0.2240E+01	0.3760	C.L. 3	-0.2010E+01	0.3040	H.L. 6	0.3136E+01	-0.2814E+01
21 and 20	0.9600E+00	0.2860	C.L. 5	-0.2650E+01	0.1440	H.L. 6	0.1344E+01	-0.3710E+01
21 and 24	0.2110E+01	0.2680	H.L. 6	-0.3170E+01	0.2500	H.L. 5	0.2954E+01	-0.4438E+01
21 and 25	0.4090E+01	0.2500	H. L. 2	-0.1270E+01	0.3040	H.L. 5	0.5726E+01	-0.1778E+01

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
21 and 48	0.4700E+01	0.2500	H.L. 2	-0.1020E+01	0.2680	C.L. 5	0.6580E+01	-0.1428E+01
22 and 6	0.2100E+00	0.0360	C.L. 1	-0.1581E+02	0.2860	C.L. 6	0.2940E+00	-0.2213E+02
22 and 19	0.4880E+01	0.2860	H.L. 5	-0.3370E+01	0.2320	H.L. 6	0.6832E+01	-0.4718E+01
22 and 23	0.3450E+01	0.1080	H.L. 5	-0.1050E+01	0.2500	H.L. 6	0.4830E+01	-0.1470E+01
22 and 25	0.7510E+01	0.1260	H.L. 5	-0.2570E+01	0.2500	H.L. 6	0.1051E+02	-0.3598E+01
22 and 45	0.0	0.0270	C.L. 6	-0.1057E+02	0.2860	C.L. 6	0.0	-0.1480E+02
23 and 6	0.2100E+00	0.360	C.L. 1	-0.1521E+02	0.3040	C.L. 6	0.2940E+00	-0.2129E+02
23 and 20	0.4040E+01	0.2680	H.L. 5	-0.2650E+01	0.2140	H.L. 6	0.5656E+01	-0.3710E+01
23 and 22	0.1050E+01	0.2500	H.L. 6	-0.3450E+01	0.1080	H.L. 5	0.1470E+01	-0.4830E+01
23 and 24	0.3010E+01	0.1440	H.L. 5	-0.9300E+00	0.2320	H.L. 6	0.4214E+01	-0.1302E+01
23 and 25	0.6420E+01	0.1440	H.L. 5	-0.2180E+01	0.2860	H.L. 6	0.8988E+01	-0.3052E+01
24 and 6	0.2100E+00	0.0360	C.L. 1	-0.1482E+02	0.3040	C.L. 6	0.2940E+00	-0.2075E+02
24 and 21	0.3170E+01	0.2500	H.L. 5	-0.2110E+01	0.2680	H.L. 6	0.4438E+01	-0.2954E+01
24 and 23	0.9300E+00	0.2320	H.L. 6	-0.3010E+01	0.1440	H.L. 5	0.1302E+01	-0.4214E+01
24 and 25	0.4670E+01	0.1710	H.L. 5	-0.1750E+01	0.2860	H.L. 6	0.6538E+01	-0.2450E+01
24 and 49	0.4850E+01	0.1800	H.L. 5	-0.1220E+01	0.2860	H.L. 6	0.6790E+01	-0.1708E+01
25 and 25	0.0	2.9680	C.L. 6	0.0	2.9680	C.L. 6	0.0	0.0
26 and 1	0.4800E+00	2.5180	C.L. 6	-0.1390E+02	0.2320	C.L. 1	0.6720E+00	-0.1946E+02
26 and 2	0.4800E+00	2.4820	C.L. 6	-0.1085E+02	0.1170	H.L. 2	0.6720E+00	-0.1519E+02
26 and 27	0.3300E+00	2.4460	C.L. 6	0.6610E+01	0.2320	H.L. 1	0.4620E+00	-0.9254E+01

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
26 and 28	0.1500E+00	0.2860	C.L. 1	-0.1000E+00	0.6460	C.L. 5	0.2100E+00	-0.1400E+00
26 and 32	0.5900E+00	0.4480	C.L. 2	-0.5600E+00	0.2320	H.L. 1	0.8260E+00	-0.7840E+00
26 and 34	0.7000E-01	2.3920	C.L. 6	-0.1060E+01	0.2320	H.L. 1	0.9800E-01	-0.148E+01
26 and 52	0.3800E+00	0.5920	C.L. 5	-0.2500E+00	0.2320	H.L. 1	0.5320E+00	-0.3500E+00
27 and 1	0.2300E+00	0.0360	C.L. 6	-0.1135E+02	0.0360	H.L. 1	0.3220E+00	-0.1589E+02
27 and 2	0.1500E+00	2.4820	C.L. 6	-0.8720E+01	0.0720	H.L. 1	0.2100E+00	-0.1221E+02
27 and 3	0.4300E+01	2.5720	C.L. 1	-0.7420E_01	0.0450	H.L. 3	0.6020E+00	-0.1039E+02
27 and 26	0.6610E+01	0.2320	H.L. 1	-0.3300E+00	2.4460	C.L. 6	0.9254E+01	-0.4620E+00
27 and 28	0.6670E+01	0.2320	H.L. 1	-0.3500E+00	2.3200	C.L. 6	0.9338E+01	-0.4900E+00
27 and 34	0.5740E+01	0.4120	C.L. 1	-0.2700E+00	2.5900	C.L. 6	0.8036E+01	-0.3780E+00
27 and 35	0.7360E+01	0.4120	C.L. 1	-0.3700E+00	2.3560	C.L. 6	0.1030E+02	-0.5180E+00
27 and 40	0.4480E+01	1.5280	C.L. 4	-0.5670E+01	0.0900	H.L. 1	0.6272E+01	-0.7938E+01
27 and 41	0.4600E+01	1.3660	C.L. 4	-0.3920E+01	0.1170	H.L. 2	0.6440E+01	-0.5488E+01
27 and 42	0.4530E+01	1.7260	C.L. 1	-0.4020E+01	0.1800	H.L. 6	0.6328E+01	-0.5628E+01
28 and 1	0.5000E+00	2.3380	C.L. 6	-0.1396E+02	0.2320	C.L. 1	0.7000E+00	-0.1954E+02
28 and 2	0.4900E+00	2.4100	C.L. 6	-0.1096E+02	0.1170	H.L. 2	0.6860E+00	-0.1534E+02
28 and 3	0.4700E+00	2.4100	C.L. 6	-0.8790E+01	0.2140	H.L. 3	0.6580E+00	-0.1231E+02
28 and 26	0.1000E+00	0.6460	C.L. 5	-0.1500E+00	0.2860	C.L. 1	0.1400E+00	-0.2100E+00
28 and 27	0.3500E+00	2.3200	C.L. 6	-0.6670E+01	0.2320	H.L. 1	0.4900E+00	-0.9338E+01
28 and 29	0.5500+01	1.0960	C.L. 2	-0.1100E+00	2.5540	C.L. 5	0.7770E+01	-0.1540E+00
28 and 30	0.5800E+00	0.4120	C.L. 3	-0.5800E+00	0.4660	C.L. 5	0.8120E+00	-0.8120E+00
28 and 35	0.1470E+01	0.7540	C.L. 1	-0.6000E-01	1.6180	C.L. 6	0.2058E+01	-0.8400E-01

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
29 and 3	0.5500E+00	2.4640	C.L. 6	-0.1022E+02	0.4840	C.L. 3	0.7700E+00	-0.1431E+02
29 and 4	0.5600E+00	2.4640	C.L. 1	-0.1021E+02	0.4480	C.L. 4	0.7840E+00	-0.1429E+02
29 and 28	0.1100E+00	2.5540	C.L. 5	-0.5550E+01	1.0960	C.L. 2	0.1540E+00	-0.7770E+01
29 and 30	0.1400E+00	2.2660	C.L. 4	-0.5570E+01	1.0780	C.L. 2	0.1960E+00	-0.7798E+01
29 and 35	0.1100E+00	2.4460	C.L. 5	-0.5160E+01	1.0780	C.L. 1	0.1540E+00	-0.7224E+01
29 and 36	0.1400E+00	2.2660	C.L. 2	-0.5200E+01	1.0960	C.L. 2	0.1960E+00	-0.7280E+01
29 and 42	0.4000E+01	2.2660	C.L. 6	-0.6790E+01	0.1800	H.L. 6	0.5600E+01	-0.9506E+01
29 and 43	0.4020E+01	2.2120	C.L. 1	-0.7150E+01	0.2680	H.L. 1	0.5628E+01	-0.1001E+02
30 and 3	0.4600E+00	2.4640	C.L. 6	-0.8780E+01	0.2140	H.L. 4	0.6440E+00	-0.1229E+02
30 and 4	0.4700E+00	2.5540	C.L. 1	-0.9190E+01	0.1080	H. L. 6	0.6580E+00	-0.1287E+02
30 and 5	0.5000E+00	2.5540	C.L. 1	-0.1080E+02	0.1170	H.L. 5	0.7000E+00	-0.1512E+02
30 and 28	0.5800E+00	0.4660	C.L. 5	-0.5800E+00	0.4120	C.L. 3	0.8120E+00	-0.8120E+00
30 and 29	0.5570E+01	1.0780	C.L. 2	-0.1400E+00	2.2660	C.L. 4	0.7798E+01	-0.1960E+00
30 and 31	0.3500E+00	2.5540	C.L. 1	-0.6500E+01	0.2320	H.L. 6	0.4900E+00	-0.9100E+01
30 and 32	0.1200E+00	0.7540	H.L. 2	-0.2800E+00	0.5380	C.L. 2	0.1680E+00	-0.3920E+00
30 and 36	0.1390E+01	0.7540	C.L. 6	-0.4000E-01	1.6360	C.L. 3	0.1946E+01	-0.5600E-01
30 and 50	0.6800E+00	0.7360	C.L. 6	-0.2000E-01	0.1800	C.L. 6	0.9520E+00	-0.2800E-01
31 and 4	0.3800E+00	2.5900	C.L. 6	-0.8090E+01	0.360	H.L. 4	0.5320E+00	-0.1133E+02
31 and 5	0.1600E+00	2.4640	C.L. 1	-0.8280E+01	0.0630	H.L. 6	0.2240E+00	-0.1159E+02
31 and 6	0.2200E+00	0.0360	C.L. 1	-0.1156E+02	0.0360	H.L. 6	0.3080E+00	-0.1618E+02
31 and 30	0.6500E+01	0.2320	H.L. 6	-0.3500E+00	2.5540	C.L. 1	0.9100E+01	-0.4900E+00
31 and 32	0.6340E+01	0.4660	C.L. 6	-0.3500E+00	2.5540	C.L. 1	0.8876E+01	-0.4900E+00
31 and 36	0.7170E+01	0.4300	C.L. 6	-0.3500E+00	2.6980	C.L. 1	0.1004E+02	-0.4900E+00

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
31 and 37	0.5550E+01	0.4660	C.L. 6	-0.2900E+00	2.6260	C.L. 1	0.7770E+01	-0.4060E+00
31 and 43	0.4440E+01	1.7260	C.L. 6	-0.3970E+01	0.1800	H.L. 1	0.6216E+01	-0.5558E+01
31 and 44	0.4550E+01	1.4020	C.L. 3	-0.3870E+01	0.1890	H.L. 2	0.6370E+01	-0.5418E+01
31 and 45	0.4510E+01	1.4380	C.L. 3	-0.5510E+01	0.0810	H.L. 6	0.6314E+01	-0.7714E+01
32 and 5	0.5000E+00	2.5540	C.L. 1	-0.1065E+02	0.1170	H.L. 5	0.7000E+00	-0.1491E+02
32 and 6	0.5000E+00	2.5900	C.L. 1	-0.1320E+02	0.2140	C.L. 6	0.7000E+00	-0.1848E+02
32 and 26	0.5600E+00	0.2320	H.L. 1	-0.5900E+00	0.4480	C.L 2	0.7840E+00	-0.8260E+00
32 and 30	0.2800E+00	0.5380	C.L. 2	-0.1200E+00	0.7540	H.L. 2	0.3920E+00	-0.1680E+00
32 and 31	0.3500E+00	2.5540	C.L. 1	-0.6340E+01	0.4660	C.L. 6	0.4900E+00	-0.8876E+01
32 and 37	0.600E-01	2.9680	C.L. 1	-0.1050/E+01	0.2140	H.L. 6	0.8400E-01	-0.1470E+01
33 and 1	0.2240E+01	0.0900	H.L. 5	-0.1167E+02	0.0450	H.L. 1	0.3136E+01	-0.1634E+02
33 and 2	0.1420E+01	0.0810	H.L. 5	-0.8880E+01	0.0630	H.L. 1	0.1988E+01	-0.1243E+02
33 and 3	0.1150E+01	0.1440	H.L. 4	-0.6930E+01	0.0360	H.L. 3	0.1610E+01	-0.9702E+01
33 and 4	0.1110E+01	0.2140	C.L. 1	-0.7830E+01	0.0360	H.L. 4	0.1554E+01	-0.1096E+02
33 and 5	0.1480E+01	0.0900	H.L. 2	-0.8650E+01	0.0630	H.L. 6	0.2072E+01	-0.1211E+02
33 and 6	0.2280E+01	0.0900	H.L. 2	-0.1185E+02	0.0450	H.L. 6	0.3192E+01	-0.1659E+02
33 and 25	0.8840E+01	0.1980	H.L. 1	-0.2000E-01	0.0360	C.L. 4	0.1238E+02	-0.2800E-01
34 and 1	0.4200E+00	2.5180	C.L. 6	-0.1296E+02	0.2140	C.L. 1	0.5880E+00	-0.1814E+02
34 and 25	0.6840E+01	1.5460	C.L. 5	0.0	0.0630	C.L. 6	0.9576E+01	0.0
34 and 26	0.1060E+01	0.2320	H.L. 1	-0.7000E-01	2.3920	C.L. 6	0.1484E+01	-0.9800E-01
34 and 27	0.2700E+00	2.5900	C.L. 6	-0.5740E+01	0.4120	C.L. 1	0.3780E+00	-0.8036E+01
34 and 40	0.4490E+01	1.6540	C.L. 4	-0.8120E+01	0.1170	H.L. 1	0.6286E+01	-0.1137E+02

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
35 and 3	0.4900E+00	2.3560	C.L. 6	-0.9100E+01	0.2140	H.L. 4	0.6860E+00	-0.1274+02
35 and 27	0.3700E+00	2.3560	C.L. 6	-0.7360E+01	0.4120	C.L. 1	0.5180E+00	-0.1030E+02
35 and 28	0.6000E-01	1.6180	C.L. 6	-0.1470E+01	0.7540	C.L. 1	0.8400E-01	-0.2058E+01
35 and 29	0.5160E+01	1.0780	C.L. 1	-0.1100E+00	2.4460	C.L. 5	0.7224E+01	-0.1540E+00
35 and 42	0.4480E+01	1.6380	C.L. 6	-0.6520E+01	0.1800	H.L. 6	0.6272E+01	-0.9128E+01
36 and 4	0.4800E+00	2.4640	C.L. 1	-0.9370E+01	0.1080	H.L. 6	0.6720E+00	-0.1312E+02
36 amd 29	0.5200E_01	1.0980	C.L. 2	-0.1400E+00	2.2660	C.L. 2	0.7280E+01	-0.1960E+00
36 and 30	0.4000E-01	1.6360	C.L. 3	-0.1390E+01	0.7540	C.L. 6	0.5600E-01	-0.1946E+01
36 and 31	0.3500E+00	2.6980	C.L. 1	-0.7170E+01	0.4300	C.L. 6	0.4900E+00	-0.1004E_02
36 and 43	0.4460E+01	1.6180	C.L. 1	-0.6400E+01	0.2500	H.L. 1	0.6244E+01	-0.8960E+01
36 and 50	0.3000E-01	1.6540	C.L. 3	-0.8400E+00	0.7900	C.L. 6	0.4200E-01	-0.1176E+01
37 and 6	0.4400E+00	2.5900	C.L. 1	-0.1238E+02	0.1170	H.L. 6	0.6160E+00	-0.1733E+02
37 and 25	0.6850E+01	1.5640	C.L. 5	0.0	0.0180	C.L. 6	0.9590E+01	0.0
37 and 31	0.2900E+00	2.6260	C.L. 1	0.5550E+01	0.4660	C.L. 6	0.4060E+00	0.7770E+01
37 and 32	0.1050E+01	0.2140	H.L. 6	-0.6000E-01	2.9680	C.L. 1	0.1470E+01	-0.8400E-01
37 and 45	0.4470E+01	1.6180	C.L. 3	-0.7970E+01	0.0990	H.L. 6	0.6258E+01	-0.1116E+02
38 and 1	0.2200E+00	0.0360	C.L. 6	-0.1462E+02	0.2860	C.L. 1	0.3080E+00	-0.2047E+02
38 and 9	0.1200E+01	0.2860	H.L. 1	-0.4910E+01	0.1710	H.L. 2	0.1680E+01	-0.6874E+01
38 and 25	0.1850E+01	0.1530	H.L. 2	-0.7300E+00	0.2680	H.L. 1	0.2590E+01	-0.1022E+01
38 and 39	0.1930E+01	0.1530	H.L. 2	-0.2150E+01	0.1530	H.L. 1	0.2702E+01	-0.3010E+01

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
39 and 2	0.0	0.0090	C.L. 6	-0.1076E+02	0.2320	C>L. 2	0.0	-0.1506E+02
39 and 12	0.9900E+00	0.2680	C.L. 2	-0.4700E+01	0.2500	H.L. 5	0.1388E+01	-0.6580E+01
39 and 25	0.1580E+01	0.1530	H.L.1	-0.7000E+00	0.2680	C.L. 5	0.2212E+01	-0.9800E+00
39 and 38	0.2150E+01	0.1530	H.L. 1	-0.1930E+01	0.1530	H.L. 2	0.3010E+01	-0.2702E+01
39 and 46	0.1870E+01	0.2320	H.L. 5	-0.1880E+01	0.1890	H.L. 1	0.2618E+01	-0.2632E+01
40 and 1	0.2200E+00	0.0360	C.L. 6	-0.1115E+02	0.0360	H.L. 1	0.3080E+00	-0.1561E+02
40 and 7	0.1082E+02	0.2860	C.L. 1	0.0	0.0990	C.L. 6	0.1515E+02	0.0
40 amd 25	0.8710E+01	0.1170	H.L. 1	0.0	0.0990	C.L. 6	0.1219E+02	0.0
40 and 27	0.5670E+01	0.0900	H.L. 1	-0.4480E+01	1.5280	C.L. 4	0.7938E+01	-0.6272E+01
40 and 34	0.8120E+01	0.1170	H.L. 1	-0.4490E+01	1.6540	C.L. 4	0.1137E+02	-0.6286E+01
40 and 41	0.5090E+01	0.0720	H.L. 1	-0.2190E+01	0.0630	H.L. 2	0.7126E+01	-0.3066E+01
41 and 2	0.0	0.0090	C.L. 6	-0.9350E+01	0.0630	H.L. 1	0.0	-0.1309E+02
41 and 10	0.7530E+01	0.2860	C.L. 2	-0.1000E-01	0.0360	C.L. 2	0.1054E+02	-0.1400E-01
41 and 25	0.7690E+01	0.2320	H.L. 6	-0.1000E-01	0.0360	C.L. 2	0.1077E+02	-0.1400E-01
41 and 27	0.3920E+01	0.1170	H.L. 2	-0.4600E+01	1.3660	C.L. 4	0.5488E+01	-0.6440E+01
41 and 40	0.2190E+01	0.0360	H.L. 2	-0.5090E+01	0.0720	H.L. 1	0.3066E+01	-0.7126E+01
41 and 42	0.6090E+01	0.1080	H.L. 1	-0.3100E+01	0.0810	H.L. 3	0.8526E+01	-0.4340E+01
42 and 3	0.0	0.0180	C.L. 6	-0.7300E+01	0.1080	H.L. 1	0.0	-0.1022E+02
42 and 13	0.5820E+01	0.3040	C.L. 3	0.0	0.0900	C.L. 6	0.8148E+01	0.0
42 and 25	0.6730E+01	0.1620	H.L. 1	0.0	0.0900	C.L. 6	0.9422E+01	0.0
42 and 27	0.4020E+01	0.1800	H.L. 6	-0.4520E+01	1,7260	C.L. 1	0.5628E+01	-0.6328E+01
42 and 29	0.6790E+01	0.1800	H.L. 6	-0.4000E+01	2.2660	C.L. 6	0.9506E+01	-0.5600E+01

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
42 and 35	0.6520E+01	0.1800	H.L. 6	-0.4480E+01	1.6360	C.L. 6	0.9128E+01	-0.6172E+01
42 and 41	0.3100E+01	0.0810	H.L. 3	-0.6090E+01	0.1080	H.L. 1	0.4340E+01	-0.8526E+01
42 and 43	0.4190E+01	0.1440	H.L. 1	-0.5140+01	0.1350	H.L. 6	0.5866E+01	-0.7196E+01
43 and 4	0.0	0.0090	C.L. 6	-0.8240E+01	0.0900	H.L. 6	0.0	-0.1154E+02
43 and 16	0.6680E+01	0.2860	H.L. 4	-0.1000E-01	0.0360	C.L. 4	0.9352E+01	-0.1400E-01
43 and 25	0.6610E+01	0.1890	H.L. 1	-0.1000E-01	0.0360	C.L. 4	0.9254E+01	-0.1400E-01
43 and 29	0.7150E+01	0.2880	H.L. 1	-0.4020E+01	2.2120	C.L. 1	0.1001E+02	-0.5628E+01
43 and 31	0.3970E+01	0.1800	H.L. 1	-0.4440E+01	1.7260	C.L. 6	0.5558E+01	-0.6216E+01
43 and 36	0.6400E+01	0.2500	H.L. 1	-0.4460E+01	1.6180	C.L. 1	0.8960E+01	-0.6244E+01
43 and 42	0.5140E+01	0.1350	H.L. 6	-0.4190E+01	0.1440	H.L. 1	0.7196E+01	-0.5866E+01
43 and 44	0.2620E+01	0.0720	H.L. 4	-0.4970E+01	0.0990	H.L. 6	0.3668E+01	-0.6958E+01
43 and 50	0.6210E+01	0.1800	H.L. 1	-0.4430E+01	1.6540	C.L. 1	0.8964E+01	-0.6202E+01
44 and 5	0.0	0.0	C.L. 6	-0.9160E+01	0.0630	H.L. 6	0.0	-0.1282E+02
44 and 19	0.7190E+01	0.2860	C.L. 5	-0.1000E-01	0.0360	C.L. 5	0.1007E+02	-0.1400E-01
44 and 25	0.7690E+01	0.2320	H.L. 1	-0.1000E-01	0.0360	C.L> 5	0.1077E+02	-0.1400E-01
44 and 31	0.3870E+01	0.1890	H.L. 2	-0.4550E+01	1.4020	C.L. 3	0.5418E+01	-0.6370E+01
44 and 43	0.4970E+01	0.0990	H.L. 6	-0.2620E+01	0.0720	H.L. 4	0.6958E+01	-0.3668E+01
44 and 45	0.2300E+01	0.0990	H.L. 4	-0.5260E+01	0.0720	H.L. 6	0.3220E+01	-0.7364E+01
45 and 6	0.2100E+00	0.3600	C.L. 1	-0.1136E+02	0.0360	H.L. 6	0.2940E+00	-0.1590E+02
45 and 22	0.1057E+02	0.2860	C.L. 6	0.0	0.0270	C.L. 6	0.1480E+02	0.0
45 and 25	0.8620E+01	0.1170	H.L. 6	0.0	0.0270	C.L. 6	0.1207E+02	0.0
45 and 31	0.5510E+01	0.0810	H.L. 6	-0.4510E+01	1.4380	C.L. 3	0.7714E+01	-0.6314E+01

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
45 and 37	0.7970E+01	0.0990	H.L. 6	-0.4470E+01	1.6180	C.L. 3	0.1116E+02	-0.6258E+01
45 and 44	0.5260E+01	0.0720	H.L. 6	-0.2300E+01	0.0990	H.L. 4	0.7364E+01	-0.3220E+01
46 and 3	0.0	0.0180	C.L. 6	-0.9520E+01	0.2140	H.L. 4	0.0	-0.1333E+02
46 and 15	0.8000E+00	0.2680	H.L. 3	-0.4140E+01	0.2140	H.L. 1	0.1120E+01	-0.5796E+01
46 and 25	0.1590E+01	0.2140	H.L. 6	-0.7400E+00	0.2500	H.L. 6	0.2226E+01	-0.1036E+01
46 and 48	0.1590E+01	0.2140	H.L. 6	-0.1920E+01	0.2320	C.L. 1	0.2226E+01	-0.2688E+01
47 amd 4	0.0	0.0090	C.L. 6	-0.9740E+01	0.2500	H.L. 1	0.0	-0.1364E+02
47 and 18	0.1150E+01	0.2680	H.L. 4	-0.4130E+01	0.2500	H.L. 1	0.1610E+01	-0.5782E+01
47 and 25	0.1580E+01	0.2140	H.L. 1	-0.7400E+00	0.2500	H.L. 1	0.2212E+01	-0.1036E+01
47 and 46	00.2000E+01	0.2140	H.L. 1	-0.2150E+01	0.2140	H.L. 6	0.2800E+01	-0.3010E+01
47 and 48	0.2050E+01	0.1800	H.L. 6	-0.1880E+01	0.1620	H.L. 4	0.2870E+01	-0.2632+01
48 and 5	0.0	0.0	C.L. 6	-0.1063E+02	0.1080	H.L. 5	0.0	-0.1488E+02
48 and 21	0.1020E+01	0.2680	C.L. 5	-0.4700E+01	0.2500	H.L. 2	0.1428E+01	-0.6580E+01
48 and 25	0.1580E+01	0.1530	H.L. 6	-0.7000E+00	0.2680	C.L. 2	0.2212E+01	-0.9800E+00
48 and 47	0.1880E+01	0.1620	H.L. 4	-0.2050E+01	0.1800	H.L. 6	0.2632E+01	-0.2870E+01
48 and 49	0.2170E+01	0.1530	H.L. 6	-0.1900E+01	0.1530	H.L. 5	0.3038E+01	-0.2660E+01
49 amd 6	0.2100E+00	0.0360	C.L. 1	-0.1403E+02	0.2860	C.L. 6	0.2940E+00	-0.1964E+02
49 and 24	0.1220E+01	0.2860	H.L. 6	-0.4850E+01	0.1800	H.L. 5	0.1708E+01	-0.6790E+01
49 and 25	0.1830E+01	0.1530	H.L. 5	-0.7600E+00	0.2500	C.L. 3	0.2562E+01	-0.1064E+01
49 and 48	0.1900E+01	0.1530	H.L. 5	-0.2170E+01	0.1530	H.L. 6	0.2660E+01	-0.3038E+01

CATAWBA NUCLEAR STATION COMPARTMENT DIFFERENTIAL PRESSURES EXTREME VALUES
CALCULATED VALUES OF DIFFERENTIAL PRESSURE (PSI) – ACROSS COMPARTMENTS

							Design Diff Pressure (+ 1.4* Diff Pressure)	
Between Compartments	**Maximum Diff Pressure**	**Time (SEC)**	**Element**	**Minimum Diff Pressure**	**Time (SEC)**	**Element**	**Maximum**	**Minimum**
50 and 4	0.4800E+00	2.4640	C.L. 1	-0.9280E+01	0.1080	H.L. 6	0.6720E+00	-0.1299E+02
50 and 29	0.5450E+01	1.0960	C.L. 2	-0.1400E+00	2.2660	C.L. 2	0.7630E+01	-0.1960E+00
50 and 30	0.2000E-01	0.1800	C.L. 6	-0.6800E+00	0.7360	C.L. 6	0.2800E-01	-0.9520E+00
50 and 36	0.8400E+00	0.7900	C.L. 6	-0.3000E-01	1.6540	C.L. 3	0.1176E+01	-0.4200E-01
50 and 43	0.4430E+01	1.6540	C.L. 1	-0.6210E+01	0.1800	H.L. 1	0.6202E+01	-0.8694E+01
50 and 51	0.6400E+00	1.6900	C.L. 6	-0.8170E+01	0.4660	C.L. 3	0.8960E+00	-0.1144E+02
50 and 52	0.2500E+00	0.7000	C.L. 2	-0.7600E+00	0.6640	C.L. 6	0.3500E+00	-0.1064E+01
50 and 53	0.2900E+00	0.7360	C.L. 2	-0.7700E+00	0.7360	C.L. 6	0.4060E+00	-0.1078E+01
51 and 50	0.817E+01	0.4660	C.L. 3	-0.6400E+00	1.6900	C>l. 6	0.1144E+02	-0.8960E+00
51 and 52	0.7900E+01	0.5200	C.L. 3	-0.5700E+00	2.3560	C.L. 6	0.1106E+02	-0.7980E+00
51 and 53	0.7840E+01	0.5380	C.L. 4	-0.5900E+00	1.6720	C.L. 6	0.1098E+02	-0.8260E+00
52 and 1	0.4900E+00	2.5000	C.L. 6	-0.1371E+02	0.2680	C.L. 1	0.6860E+00	-0.1919E+02
52 and 26	0.2500E+00	0.2320	H.L. 1	-0.3800E+00	0.5920	C.L. 5	0.3500E+00	-0.5320E+00
52 and 50	0.7600E+00	0.6640	C.L. 6	-0.2500E+00	0.700	C.L. 2	0.1064E+01	-0.3500E+00
52 and 51	0.5700E+00	2.3560	C.L. 6	-0.7900E+01	0.5200	C.L. 3	0.7980E+00	-0.1106E+02
52 and 53	0.3600E+00	0.5560	C.L. 4	-0.3300E+00	0.6100	C.L. 2	0.5040E+00	-0.4620E+00
53 and 1	0.4900E+00	2.5180	C.L. 6	-0.1354E+02	0.3040	C.L. 1	0.6860E+00	-0.1896E+02
53 and 6	0.5200E+00	2.5000	C.L. 1	-0.1314E+02	0.2320	C.L. 6	0.7280E+00	-0.1840E+02
53 and 50	0.7700E+00	0.7360	C.L. 6	-0.2900E+00	0.7860	C.L. 2	0.1078E+01	-0.4060E+00
53 and 51	0.5900E+00	1.6720	C.L. 6	-0.7840E+01	0.5380	C.L. 4	0.8260E+00	-0.1098E+02

Table 3-48. Maximum Blowdown LOCA Load Resultants For The Containment Interior Structure

LOADING	MAXIMUM VALUE	BREAK LOCATION	TIME
OVERTURNING MOMENT	229,430 FT-K	Hot Leg - 6	.286 SEC.
HORIZONTAL SHEAR	4,849 KIPS	Cold Leg - 3	.970 SEC.
UPLIFT	7,247 KIPS	Cold Leg - 5	1.366 SEC.

Table 3-49. Crane Wall Design

I. GOVERNING LOADS

Lower Crane Wall	Upper Crane Wall
L(1) Gravity	U(1) Gravity and Seismic Combined
L(2) Seismic	U(2) DBA
L(3) DBA	U(3) Locally Applied Loads
L(4) Locally Applied Loads (eg, pipe restraints, NSSS supports, etc)	
L(1), L(2), and L(3) are used for general design.	U(1) and U(2) are used for general design.
L(4) Additional rebar was added for these loads	U(3) Additional rebar was added for these loads

II. LOAD COMBINATIONS (for ultimate strength design)

$U = 1.4D + 1.9E$

$U = 1.2D + 1.9E$

$U = D + E'$

$U = D + 1.5\,P_a$

$U = D + 1.25\,P_a + 1.25\,E$

$U = D + P_a + E'$

where:

D = Dead Weight

E = OBE

E′ = SSE

P_a = DBA Compartment Differential Pressure

For the upper crane wall, dead weight is included in seismic load.

III. CRITICAL DESIGN FORCES AND DESIGN OF REINFORCING BARS

Lower Crane Wall

Elev	Horizontal Tension (k/ft)	Reinforcing Moment (ftK/ft)	Reinf	Elev	Vertical P (k/ft)	Reinforcing M (ftK/ft)	Inside Face	Outside Face
592+2	87	-	#11 @ 8″	592+2″+	-83	245	#11 @ 1°10′	#11 @ 45′
583+2	61	131	#11 @ 8″	592+2″-	-140	158	#11 @ 1°10′	#11 @ 45′
574+2	59	125	#11 @ 8″	582+2″+	-131	71	#11 @ 1°10′	#11 @ 1°10′
565+5	84	-	#11 @ 8″	582+2″-	-169	26	#11 @ 1°10′	#11 @ 1°10′
556+8	124	144	#11 @ 6″	574+2″+	-166	26	#11 @ 1°10′	#11 @ 1°10′
				574+2″-	-195	0	#11 @ 1°10′	#11 @ 1°10′

Horizontal Reinforcing				Vertical Reinforcing				
Elev	Horizontal Tension (k/ft)	Reinforcing Moment (ftK/ft)	Reinf	Elev	Vertical P (k/ft)	Reinforcing M (ftK/ft)	Inside Face	Outside Face
				565+5″-	-172	114	#11 @ 1°5′	#11 @ 45′
				565+5″-	-189	-58	#11 @ 1°5′	#11 @ 45′
				556+8″+	-169	108	#11 @ 1°15′	#11 @ 45′
				556+8″-	-201	64	#11 @ 1°15′	#11 @ 45′

Upper Crane Wall

Elev	Horizontal Tension (k/ft)	Reinforcing Moment (ftK/ft)	Inside Face	Outside Face	Elev	Vertical P (k/ft)	Reinforcing M (ftK/ft)	Inside Face	Outside Face
668+10	66	120			634+4			#11 @ 1°15′	#11 @ 1°15′
660+10	73	194			634+4			#11 @ 50′	#11 @ 1°15′
652+10	144	426	Two Layers @ 12″ for each face		620+10-	Forces above these Elev. Are not critical		#11 @ 50′	#11 @ 1°15′
644+10	130	523			620+10	102	63	#11 @ 50′	#11 @ 50′
636+10	179	391			612+10+	102	111	#11 @ 50′	#11 @ 50′
628+10	58	393			612+10-	98	193	#11 @ 50′	#11 @ 50′
620+10	70	368			(1)604+10	95	279	#11 @ 50′	#11 @ 50′
612+10	75	378							
604+10	162	522							

Notes:

1. At localized high stress areas, there are five#18 on the inside face and six #18 on the outside face.
2. P = (-) Tension
3. M = (-) Tension on inside face
   (+) Tension on outside face

Table 3-50. Design Transients for the Reactor Coolant System Including the Westinghouse D-5 and BWI Replacecment Steam Generators (RSGs)

DESIGN TRANSIENTS(1)	CONDITION (2)	ALLOWABLE OCCURRENCES(3)		NSSS COMPO-NENTS (4)	RESIDUAL HEAT REMOVAL PIPING(4)	SAFETY INJECTION PIPING	CHEMICAL AND VOLUME CONTROL PIPING	PRESSUR-IZER SURGE LINE	PRESSUR-IZER RELIEF PIPING	PRESSUR-IZER SPRAY PIPING	REACTOR COOLANT DRAIN LINES
		UNIT 1	UNIT 2								
(*)Heatup/Startup	Normal	200	200	X	X	X	X	X	X	X	X
(*)Shutdown/ Cooldown	Normal	200	200	X	X	X	X	X	X	X	X
RHR Suction	Normal	200	200	-	X	-	-	-	-	-	-
RHR Injection	Normal	200	200	-	-	X	-	-	-	-	-
(*)Plant Loading at 5%/min (15% to 100%)	Normal	13,200	13,200	X	X	X	X	X	X	X	X
(*)Plant Unloading at 5%/min (100% to 15%)	Normal	13,200	13,200	X	X	X	X	X	X	X	X
Plant Loading (0% to 15%)	Normal	500	500	X(8)	-	-	-	-	-	-	-
Small Step Load Increase 15 - 25%	Normal	300	n/a	X	-	-	-	-	-	-	-
(*)Small Step Load Increase 90 - 100%	Normal	2,000	2,000	X	X	X	X	X	X	X	X
Small Step Load Decrease 25 - 15%	Normal	300	n/a	X	-	-	-	-	-	-	-
(*)Small Step Load Decrease 100 - 90%	Normal	2,000	2,000	X	X	X	X	X	X	X	X
(*)Large Step Load Decrease (with steam dump)	Normal	200	200	X	X	X	X	X(3)	X	X	X
Feedwater Cycling at No Load	Normal	2,000	2,000	X	-	-	-	-	-	-	-
Loop Out of Service Normal Pump Shutdown	Normal	80	80	X	-	-	-	-	-	-	-

DESIGN TRANSIENTS(1)	CONDITION (2)	ALLOWABLE OCCURRENCES(3)		NSSS COMPONENTS (4)	RESIDUAL HEAT REMOVAL PIPING(4)	SAFETY INJECTION PIPING	CHEMICAL AND VOLUME CONTROL PIPING	PRESSURIZER SURGE LINE	PRESSURIZER RELIEF PIPING	PRESSURIZER SPRAY PIPING	REACTOR COOLANT DRAIN LINES
		UNIT 1	UNIT 2								
Loop Out of Service Normal Pump Startup	Normal	70	70	X	-	-	-	-	-	-	-
Boron Concentration Equalization	Normal	26,400	26,400	X	-	-	-	-	-	-	-
RCP 1stStrt/LstStop, Cold	Normal	750	500	X	-	-	-	-	-	-	-
RCP 1stStrt/LstStop, Hot	Normal	3,750	2,500	X	-	-	-	-	-	-	-
RCS Venting Affected Loops	Normal	0(9)	0(9)	X	-	-	-	-	-	-	-
RCS Venting Unaffected Loops	Normal	0(9)	0(9)	X	-	-	-	-	-	-	-
Vacuum Refill	Normal	480	480	X	-	-	-	-	-	-	-
(*)Steady State Fluctuations	Normal	Infinite	Infinite	X(5)	X	X	X(2)	X	X	X	X
Pressurizer Safety Valve Operation	Normal	60	60	-	-	-	-	-	X	-	-
Pressurizer Relief Valve Operation	Normal	100	100	-	-	-	-	-	X	-	-
LTOP Pressurizer PORV Op	Normal	n/a	n/a	-	-	-	-	-	X(10)	-	-
Deleted Per 2010 Update											
Auxiliary Spray Actuation during Cooldown	Normal	200	200	-	-	X(7)	X(1)	-	X(7)	-	-
Auxiliary Spray Actuation during Heatup	Normal	200	200	-	-	-	X(7)	-	-	X(7)	-
Refueling	Normal	80	80	X	X	X	-	-	-	-	-

DESIGN TRANSIENTS[1]	CONDITION [2]	ALLOWABLE OCCURRENCES[3]		NSSS COMPO-NENTS [4]	RESIDUAL HEAT REMOVAL PIPING[4]	SAFETY INJECTION PIPING	CHEMICAL AND VOLUME CONTROL PIPING	PRESSUR-IZER SURGE LINE	PRESSUR-IZER RELIEF PIPING	PRESSUR-IZER SPRAY PIPING	REACTOR COOLANT DRAIN LINES
		UNIT 1	UNIT 2								
Normal Charging/Letdown Shutoff and Return to Service	Normal	60	60	-	-	-	X	-	-	-	-
Letdown Trip with Prompt Return to Service	Normal	200	200	-	-	-	X	-	-	-	-
Letdown Trip with Delayed Return to Service	Normal	20	20	-	-	-	X	-	-	-	-
Charging Trip with Prompt Return to Service	Normal	20	20	-	-	-	X	-	-	-	-
Charging Trip with Delayed Return to Service	Normal	20	20	-	-	-	X	-	-	-	-
Charging Flow 50% Increase	Normal	24,000	24,000	-	-	-	X	-	-	-	-
Charging Flow 50% Decrease	Normal	24,000	24,000	-	-	-	X	-	-	-	-
Letdown Flow 40% Decrease and Return to Normal	Normal	2,000	2,000	-	-	-	X	-	-	-	-
Letdown Flow 60% Increase	Normal	24,000	24,000	-	-	-	X	-	-	-	-
Letdown Shutoff and Momentary Excess Letdown	Normal	100	100	-	-	-	X	-	-	-	-
Switch of Chg. Pump Suction	Normal	180	180	-	-	-	X	-	-	-	-
(*)Reactor Trip from Full Power	Upset	230	230	X	X	X	X	X	X	X	X
(*)Inadvertent Auxiliary Spray	Upset	10	10	X	-	-	X	-	-	X	-

DESIGN TRANSIENTS(1)	CONDITION (2)	ALLOWABLE OCCURRENCES(3)		NSSS COMPO-NENTS (4)	RESIDUAL HEAT REMOVAL PIPING(4)	SAFETY INJECTION PIPING	CHEMICAL AND VOLUME CONTROL PIPING	PRESSUR-IZER SURGE LINE	PRESSUR-IZER RELIEF PIPING	PRESSUR-IZER SPRAY PIPING	REACTOR COOLANT DRAIN LINES
		UNIT 1	UNIT 2								
(*)Loss of Power (Blackout with Natural Circulation)	Upset	40	40	X	X	X	X	X	X3,4)	X	X
(*)Loss of Load without Immediate Turbine or Reactor Trip	Upset	80	80	X	X	X	X	X(3,4)	X(3,4)	X	X
(*)Loss of Flow in One Loop	Upset	80	80	X	X	X	X	X	X	X	X
(*)Reactor Trip with Cooldown and Inadvertent SIS Actuation	Upset	10	10	X	X	X	X	X	X	X	X
(*)Inadvertent RCS Depressurization	Upset	20	20	X	X	X	X	X	X(3,4)	X	X
Inadvertent SI Accumulator Blowdown during Plant Cooldown	Upset	4	4	-	-	X	-	-	-	-	-
High Head Safety Injection	Upset	22	22	-	-	X	-	-	-	-	-
Boron Injection	Upset	48	48	-	-	X	-	-	-	-	-
Inadvrt RCP Start @ 48% Pwr	Upset	15	10	X	-	-	-	-	-	-	-
Control Rod Drop	Upset	0(9)	0(9)	X	-	-	-	-	-	-	-
Excessive MFW Flow	Upset	45	30	X	-	-	-	-	-	-	-
Excessive Bypass Feedwater	Upset	0(9)	0(9)	X	-	-	-	-	-	-	-
Bypass Line Tempering Valve Failure	Upset	n/a	40	X	-	-	-	-	-	-	-

DESIGN TRANSIENTS[1]	CONDITION (2)	ALLOWABLE OCCURRENCES[3]		NSSS COMPO-NENTS (4)	RESIDUAL HEAT REMOVAL PIPING[4]	SAFETY INJECTION PIPING	CHEMICAL AND VOLUME CONTROL PIPING	PRESSUR-IZER SURGE LINE	PRESSUR-IZER RELIEF PIPING	PRESSUR-IZER SPRAY PIPING	REACTOR COOLANT DRAIN LINES
		UNIT 1	UNIT 2								
Cold Feedwater to Dry, Pressurized RSG	Upset	2	n/a	X	-	-	-	-	-	-	-
Complete Loss of Flow	Upset	0(9)	0(9)	X	-	-	-	-	-	-	-
Nrml PORV Op, Water Solid	Upset	1	10	-	-	-	-	-	X(10)	-	-
PzrSafety Vlv Op WatrSolid	Upset	1	1	-	-	-	-	-	X	-	-
(*)Large Steam Break	Faulted	1	1	X	X	X	X	X	X(3,4)	X	X
(*)Pipe Rupture	Faulted	1	1	X(11)	X	X	X	X	X	X	X
High Head Safety Injection	Faulted	2	2	-	-	X	-	-	-	-	-
Boron Injection	Faulted	2	2	-	-	X	-	-	-	-	-
Steam Generator Tube Rupture	Faulted	8	1	X	-	-	-	-	-	-	-
Cold Feedwater to Dry, Depressurized RSG	Faulted	1	n/a	X	-	-	-	-	-	-	-
(*)Turbine Roll Test	Test	10	10	X(12)	X	X	X	X	X	X	X
(*)Hydrostatic Test	Test	5	5	X	X	X	X	X	X	X	X
(*)Primary Side Leak Test	Test	50	50	X	X	X	X	X	X	X	X
Secondary Side Hydro	Test	10	10	X	-	-	-	-	-	-	-
Secondary Side Leak Test	Test	80	80	X	-	-	-	-	-	-	-
Tube Leak Test Secondary Side Pressure 200	Test	600	400	X	-	-	-	-	-	-	-

DESIGN TRANSIENTS[1]	CONDITION (2)	ALLOWABLE OCCURRENCES[3]		NSSS COMPO-NENTS (4)	RESIDUAL HEAT REMOVAL PIPING[4]	SAFETY INJECTION PIPING	CHEMICAL AND VOLUME CONTROL PIPING	PRESSUR-IZER SURGE LINE	PRESSUR-IZER RELIEF PIPING	PRESSUR-IZER SPRAY PIPING	REACTOR COOLANT DRAIN LINES
		UNIT 1	UNIT 2								
Tube Leak Test Secondary Side Pressure 400	Test	300	200	X	-	-	-	-	-	-	-
Tube Leak Test Secondary Side Pressure 600	Test	180	120	X	-	-	-	-	-	-	-
Tube Leak Test Secondary Side Pressure 840	Test	80	80	X	-	-	-	-	-	-	-
Deleted Per 2010 Update											

Notes:

1. Pressurizer surge line is analyzed for 80 occurrences of transient C-7, the final cooldown spray.
2. Pressurizer surge line is analyzed for 150,000 initial fluctuations and 3,000,000 random fluctuations.
3. These transients are conditions which can cause the PORV's to open. Although a total of 341 such transients are shown, the PORV inlet lines are analyzed for 100 such occurrences. (Other piping/components are designed for the indicated transients rather than for the PORV event itself.)
4. These transients are conditions which can cause the PSVs to open. Although a total of 141 are shown, for analysis of the safety valves 60 occurrences were assumed. (Other piping/components are designed for the indicated transients rather than for the PSV event itself.)
5. Various NSSS components are analyzed for 150,000 to 30,000,000 fluctuations of various minor amplitudes.
6. Deleted Per 2010 Update.
7. Auxiliary Spray Actuation during cooldown analyzed for 150 occurrences at 240° F. and 50 occurrences at 170° F. An additional 200 events have been analyzed for water solid Heatup.
8. The steam generators are designed for several cycles of swapping of main feedwater supply between the auxiliary and the main feedwater nozzles with and without tempering flow during plant loading and unloading and large step load decrease. The RSGs are designed for 100 swaps without tempering flow and 750 with tempering flow. The D-5 S/Gs are designed for 80 initiations of AFW without the equivalent of tempering flow and 2150 with.
9. Some components are not designed for this event, thus it is not considered to have been part of the analysis for any component. If it occurs, it will be dispositioned, by, for example, considering it as another, actually analyzed event.
10. Unit 1 is analyzed for 1 occurrence of either LTOP Pressurizer PORV Op or Nrml PORV Op, Water Solid; Unit 2 for 10.
11. This condition has been excused for RCS pressure boundary qualification by Leak Before Break. Some components analyzed after LBB was approved were not analyzed for this condition.
12. Since Turbine Roll Test is performed only prior to fuel load, the RSGs are not designed for this event.

(*) Transient specified for Reactor Vessel design [Sections 3.9.4.3.1 and 3.9.5.2]

DESIGN TRANSIENTS(1)	CONDITION (2)	ALLOWABLE OCCURRENCES(3)		NSSS COMPO-NENTS (4)	RESIDUAL HEAT REMOVAL PIPING(4)	SAFETY INJECTION PIPING	CHEMICAL AND VOLUME CONTROL PIPING	PRESSUR-IZER SURGE LINE	PRESSUR-IZER RELIEF PIPING	PRESSUR-IZER SPRAY PIPING	REACTOR COOLANT DRAIN LINES
		UNIT 1	UNIT 2								

Column Notes:

1. This column presents the design transients which have been analyzed for the Class 1 piping systems and the Reactor Coolant nozzles. All transients are assumed to occur at full power except the following

Plant Condition	Power Level
Heatup/Startup	0%
Cooldown/Shutdown	0%
Unit Loading at 5% per min.	15%
Step Load Increase of 10%	90%
Deleted Per 2010 Update	
All Test Conditions	0%
Steam Line Break	0%

2. Conditions are defined as the following:

Normal any condition in the course of system startup, operation in the design power range, hot standby and system shutdown, other than Upset, Faulted, or Test Conditions.

Upset any deviation from normal conditions anticipated to occur often enough that design should include a capability to withstand the conditions without operational impairment, including transients caused by a fault in a system component requiring its isolation from the system, transients resulting from any single operator error or control malfunction, and transients caused by a loss of load or power. Upset conditions also include any abnormal incidents not resulting in a forced outage and also forced outages for which the corrective action does not include any repair of mechanical damage.

As a minimum, 5 OBE's were postulated over the life of the plant. Each OBE contained at least 10 cycles at maximum stress levels. Refer also to Section 3.7.3.2.

Deleted Per 2010 Update

Faulted (limiting Faults) - Those combinations of condition associated with extremely-low-probability, postulated events whose consequences are such that the integrity and operability of the nuclear station may be impaired to the extent that considerations of public health and safety are involved. In accordance with the ASME Code, faulted conditions are not included in fatigue evaluations. Some components/piping segments are individually qualified for faulted events which are not listed because the unit as a whole is therefore not qualified for such.

One SSE event is postulated over the life of the plant. Refer also to Section 3.7.3.2.

Test Test conditions are those tests in addition to the 10 hydrostatic or pneumatic tests permitted by NB-6222 and NB-6322 (ASME Section III) including leak tests or subsequent hydrostatic tests.

Number of occurrences is the minimum controlling calculated or postulated number of occurrences for the plant design life, including period of extended operation, considering ASME Section III and XI limits.

3. **X** transient analyzed for this piping/components (however, some transients are not analyzed for all NSSS components)

- transient not analyzed for this piping/components

Table 3-51. Loading Combinations for ASME Class I Components and Supports

Condition Classification	Loading Combination
Design	Design Pressure, Design Temperature, Deadweight, Operating Basis Earthquake
Normal	Normal Condition Transients, Deadweight
Upset	Upset Condition Transients, Deadweight, Operating Basis Earthquake
Faulted	Faulted Condition Transients, Deadweight, Safe Shutdown Earthquake or (Safe Shutdown Earthquake and Pipe Rupture Loads)

Notes:

1. Refer to Table 3-52 for Applicable Stress Criteria.
2. Refer to Section 3.9.1.4.6 for Load Combination Method.

Table 3-52. Allowable Stresses for ASME Section III Class I Components

Operating Condition Classification	Vessels/Tanks	Piping	Pumps
Normal	ASME Section III NB 3222	ASME Section III NB 3653	ASME Section III NB 3222
Upset	ASME Section III NB 3223	ASME Section III NB 3654	ASME Section III NB 3223
Faulted	ASME Section III NB 3225 F1323.1 See Section 3.9.1.4	ASME Section III NB 3652 F1360 See Section 3.9.1.4	ASME Section III NB3225 F1323.1 See Section (No active class 1 pump used)

Notes:

1. See Table 3-53 for Class 1 Valve Faulted Conditions.
2. A test is performed in lieu of analysis for the reactor vessel pads as discussed in Section 3.9.1.4.6.

Table 3-53. Class I Valve Faulted Condition Criteria.)

Active	**Inactive**
1. Calculate Pm from para. NB3545.1 with Internal Pressure Ps = 1.25 Ps	1. Calculate Pm from para. NB3545.1 with Internal Pressure Ps = 1.50Ps
Pm ≤ 1.5Sm	Pm ≤ 2.24Sm or 0.7Su
2. Calculate Sn from para. NB3545.2 with	2. Calculate Sn from para. NB3545.2 with
Cp = 1.5	Cp = 1.5
Ps = 1.25Ps	Ps = 1.50Ps
Qt2 = 0	Qt2 = 0
Ped = 1.3X value of Ped from equations of 3545.2(b)(1)	Ped = 1.3X value of Ped from equations of NB3545.2(b)(1)
Sn ≤ 3Sm	Sn ≤ 3Sm

Notes:

1. Pe, Pm, Pb, Qt, Cp, Sn & Sm as defined by Section III ASME Code

Table 3-54. Maximum Reactor Vessel Displacements at Reactor Vessel Centerline

	Maximum Horizontal Displacement (inches)	Maximum Vertical Displacement (inches)	Maximum Rotation (radians)
85 Square Inch RPV Inlet	0.105 -0.0	0.046 -0.039	0.00033 -0.00058
85 Square Inch RPV Outlet	0.086 -0.0	0.007 -0.035	0.00005 -0.00034
Double Ended Pump Outlet	0.050 -0.005	0.009 -0.034	0.00022 -0.00023

Table 3-55. Maximum Reactor Vessel Support Loads For Postulated Pipe Rupture Conditions

LOCA Maximum Vertical Load Per Support Including Deadweight	LOCA Maximum Horizontal Load Per Support
(Kips)	(Kips)
3460	2680

Table 3-56. Computer Programs Used in Analysis

Application:		**ANSYS**
A.	**Author:**	Swanson Analysis Systems, Inc. P. O. Box 65 Houston, Pennsylvania 15342
	Source:	Control Data Corporation
	Version:	Revision 3
	Facility:	CDC Rockville
B.	**Description:** Large-scale finite-element program for structural, heat transfer and fluid-flow analysis. ANSYS performs linear and non-linear elastic analysis of structures subjected to static loads (pressure, temperature, concentrated forces and prescribed displacements) and dynamic excitations (transient and harmonic). The program considers the effects of plasticity, creep, swelling and large deformations. Transient and steady-state heat transfer analyses consider conduction, convection and radiation effects. Coupled thermal-fluid, coupled thermal- electric and wave-motion analysis capabilities are available. Structural and heat transfer analyses can be made in one, two or three dimensions, including axisymmetric and plane problems. **Extent and Limitation of its application:** The ANSYS computer program is used to perform static elastic finite element analysis on pipe supports and welded attachments to piping.	
C.	**Verification:** The Control Data Corporation verified this version of the ANSYS program by a comparison of one hundred twenty six test problems with published analytical results.	

Table 3-57. Computer Programs Used in Analysis

Application:		**ANSYS**
A.	**Author:**	Swanson Analysis Systems, Inc. P. O. Box 65 Houston, Pennsylvania 15342
	Source:	University of Computing Company
	Version:	Revision 3 and 4
	Facility:	UCC Dallas
B.	**Description:** Large scale finite-element program for structural, heat transfer and fluid-flow analysis. ANSYS performs linear and nonlinear elastic analysis of structures subjected to static loads (pressure, temperature, concentrated forces and prescribed displacements) and dynamic excitations (transient and harmonic). The program considers the effects of plasticity, creep, swelling and large deformations. Transient and steady-state heat transfer analyses consider conduction, convection and radiation effects. Coupled thermal-fluid, coupled thermal-electric and wave-motion analysis capabilities are available. Structural and heat transfer analyses can be made in one, two or three dimensions, including axisymmetric and plane problems. **Extent and Limitation of its application:** The ANSYS computer program is used to perform static elastic finite element analysis on pipe supports and welded attachments to piping.	
C.	**Verification:** The University of Computing Company verified this version of the ANSYS program by a comparison of hand calculations and analytical results published in literature.	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-58. Computer Programs Used in Analysis

Application:		***STARDYNE***
A.	***Author:***	*STARDYNE Project Office* *System Development Corporation* *2500 Colorado Avenue* *Santa Monica, California 90406*
	Source:	*Control Data Corporation*
	Version:	*Level 03/01/81 and Level 02/04/82*
	Facility:	*CDC Rockville*
B.	***Description:*** *Finite element static and dynamic structural analysis. A STARDYNE static analysis will predict the stresses and deflections resulting from pressure, temperature, concentrated forces and enforced displacements. Dynamic analysis will predict the node displacements, velocities, accelerations, element forces and stresses from transient, harmonic, random or shock excitations. STARDYNE is user oriented, containing automatic node and element generation features that reduce the effort required to generate input. Plots of the original model and deformed structural shapes help the user evaluate results. Contour plots show surface stress for two-dimensional elements. The program creates time histories of element forces and stresses, and of node displacements, velocities, and accelerations.* ***Extent and Limitation of its application:*** *The STARDYNE computer program is used to perform static elastic finite element analysis on pipe supports and welded attachments to piping.*	
C.	***Verification:*** *The Control Data Corporation verified the computer program using the following methods:* *Level 03/01/81 Three tests problems used in verification which have an MEB acceptable similar program; two tests problems have hand calculations; and one test problem has published analytical results.* *Level 02/04/82 Three test problems used in verification which have an MEB acceptable similar program; two test problems have hand calculations; and 33 test problems have published analytical results.*	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-59. Computer Programs Used in Analysis

Application:		***UNISTRUC II***
A.	***Author:***	*Jack Washham* *Control Data Corporation* *Application Resource Center* *4201 Lexington Avenue North* *Arden Hills, Minn. 55112*
	Source:	*Control Data Corporation*
	Version:	*09/04/81*
	Facility:	*CDC Rockville and Duke Power CDC*
B.	***Description:*** *The UNISTRUC program is an interactive graphic pre- and post-processor used to reduce time needed for structural design and analysis. With UNISTRUC an engineer can quickly and automatically generate a finite element model at an interactive graphics terminal (instead of hand coding), check the model visually and submit it to one or a number of finite element applications for analysis. Results can be scanned for data needed to interpret the solution; modifications, if needed, can be submitted immediately.* ***Extent and Limitation of its application:*** *The UNISTRUC program is used as a preprocessor/postprocessor for the finite element programs ANSYS and STARDYNE.*	
C.	***Verification:*** *The Control Data Corporation verified the UNISTRUC program. This application is a pre- and post-processor for finite element applications NASTRAN, ANSYS, STARDNYNE, EASE2, and GTSTRUDL. The testing of UNISTRUC involves translating test problems into each of these five applications' format and then spot checking the results of each of the five applications against the others.*	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-60. Computer Programs Used in Analysis

Application:		***GENERIC***
A.	***Author:***	*Teledyne Engineering Services* *303 Bear Hill Road* *Waltham, Massachusetts 02154*
	Source:	*Teledyne Engineering Services*
	Version:	*Revision B June 11, 1979*
	Facility:	*UCC Dallas*
B.	***Description:*** *The purpose of the GENERIC program is to generate a finite element model of a typical steel baseplate which is secured to a concrete slab through the use of anchor bolts. The GENERIC program is a preprocessor/postprocessor to the ANSYS structural analysis program. The preprocessor performs the finite element generation and the postprocessor computes and tabulates anchor bolt loads, maximum plate deflections, loads in the concrete elements and shear elements, as well as the average bending stresses across the length and width of the plate.* ***Extent and Limitation of its application:*** *The GENERIC program is used to analyze typical base-plate designs.*	
C.	***Verification:*** *Teledyne performed the verification of the GENERIC program. Both experimental and analytical work was performed in this generic program. Shear-tension interaction test and cyclic test of concrete expansion anchors was performed and a pre- and post- processor to an existing finite element program were developed to facilitate baseplate analysis.*	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-61. Computer Programs Used in Analysis

Application:		***BASEPLATE***
A.	***Author:***	*Jeff Swanson* *Design Associates International* *4105 Lexington Avenue North* *Arden Hills, Minn. 55112*
	Source:	*Control Data Corporation*
	Version:	*2.0*
	Facility:	*CDC Rockville*
B.	***Description:*** *The program BASEPLATE is a preprocessor/postprocessor to the STARDYNE computer code for the specific purpose of analyzing flexible baseplates.* ***Extent and Limitation of its application:*** *The BASEPLATE program is used to analyze support base plates.*	
C.	***Verification:*** *The Control Data Corporation verified BASEPLATE by comparing ten test problems with hand calculations and by running nine additional test problems used to check diagnostics. Duke Power verified BASEPLATE by comparing one test problem with the program GENERIC. The Duke Power test problem included plate, frame, stiffners, anchor bolts, and a ground weld.*	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-62. Computer Programs Used in Analysis

Application:		***BASEPLATE II***
A.	***Author:***	*Richard S. Holland* *Ernst, Armand, and Botti Associates, Inc.* *60 Hickory Drive* *Waltham, Massachusetts 02154*
	Source:	*Power Computing Company*
	Version:	*2.9*
	Facility:	*PCC Dallas/Kansas City*
B.	***Description:*** *The program BASEPLATE II is a preprocessor/postprocessor to the STARDYNE and ANSYS computer codes for the specific purpose of analyzing flexible baseplates.* ***Extent and Limitation of its application:*** *The BASEPLATE II program is used to analyze support baseplates.*	
C.	***Verification:*** *The initial version of BASEPLATE II used by Duke Power was verified by Control Data Corporation. Six test problems were run to ensure the correct generation of the STARDYNE input data and correct interpretation of STARDYNE output data by comparison to STARDYNE data format. Duke Power also checked the program by comparing one test problem with the program GENERIC. The Duke Power test problem included plate, frame, stiffness, anchor bolts, and a ground weld.* *Subsequent versions of BASEPLATE II used by Duke Power were verified by Control Data Corporation.* *Version 2.9 was verified by Duke Power by comparing the results of ten test problems with the same problems run on the verified Version 2.8. Version 2.9 was also verified by Power Computing Company.*	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-63. Computer Programs Used in Analysis

Application:		***RELAP IV***
A.	***Author:***	*Aerojet Nuclear Company* *P. O. Box 1625* *Idaho Falls, Idaho 83415*
	Source:	*Control Data Corporation*
	Version:	*Mod 5 Revision 4.504*
	Facility:	*CDC Rockville*
B.	***Description:*** *Reactor Loss-of-Coolant Accident Program. Calculates one-dimensional, unsteady multiphase flow in complex pipe networks. Developed for analyzing large-break loss-of-coolant accidents, RELAP IV simulates the effects of hardware, such as pumps and valves, non-adiabatic surfaces, and the reactor core on the fluid behavior.* ***Extent and Limitation of its application:*** *The RELAP IV computer program is used to develop pressure and temperature conditions in the Auxiliary Building as a result of different pipe rupture events. Also, the program is used to determine flow rates of several pipes to calculate flood levels in the Auxiliary and Reactor Buildings.*	
C.	***Verification:*** *The Control Data Corporation verified RELAP IV by comparing test problems with those supplied in published literature.*	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-64. Computer Programs Used in Analysis

Application:		***RELAP IV***
A.	***Author:***	*Aerojet Nuclear Company* *P. O. Box 1625* *Idaho Falls, Idaho 83415*
	Source:	*University Computing Company*
	Version:	*Mod 5 Revision*
	Facility:	*UCC Dallas*
B.	***Description:***	*Reactor Loss-of-Coolant Accident Program. Calculates one-dimensional, unsteady multiphase flow in complex pipe networks. Developed for analyzing large-break loss-of-coolant accidents, RELAP IV simulates the effects of hardware, such as pumps and valves, non- adiabatic surfaces, and the reactor core on the fluid behavior.*
	Extent and Limitation of its application:	*The RELAP IV computer program is used to develop pressure and temperature conditions in the Auxiliary Building as a result of different pipe rupture events. Also, the program is used to determine flow rates of several pipes to calculate flood levels in the Auxiliary and Reactor Buildings.*
C.	***Verification:***	*The University of Computing Company verified RELAP IV by a comparison of hand calculations and analytical results published in literature.*

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-65. Computer Programs Used in Analysis

Application:		***RELAP V***
A.	***Author:***	*EG & G Idaho, Inc.* *P. O. Box 1625* *Idaho Falls, Idaho 83415*
	Source:	*Control Data Corporation*
	Version:	*2.10*
	Facility:	*CDC Rockville*
B.	***Description:*** *Reactor Transient Analysis Program. An advanced thermal- hydraulics program for analyzing complex transients in nuclear reactors and piping network. One-dimensional methodology calculates unsteady steam and/or water flow. The equations can calculate non-homogeneous, non-equilibrium conditions between steam and liquid phases. Models simulate hardware such as pumps and valves, non-adiabatic walls, and reactor control systems.* ***Extent and Limitation of its application:*** *The computer program RELAP V is used to calculate piping system transient forces resulting from a postulated pipe rupture, valve actuation, or pump transients.*	
C.	***Verification:*** *The Control Data Corporation verified the program by test results compared to those supplied by INEL (EG & G Idaho, Inc.) the author; in addition, the Edward's Pipe Problem compares RELAP V data to experimental data.*	

Table 3-66. Computer Programs Used in Analysis

Application:		**PRTHRUST/PIPERUP**
A.	**Author:**	QUADREX Corporation 1700 Dell Avenue Campbell, California 95008
	Source:	Control Data Corporation
	Version:	1.3.1
	Facility:	CDC Rockville
B.	**Description:** Nonlinear analysis for piping systems subjected to postulated ruptures. PRTHRUST calculates blowdown forces for both longitudinal and circumferential breaks and provides for modeling of all major components. PIPERUP analyzes an elastic-plastic solution while considering the effects of strain hardening, gaps and pipewhip restraints. **Extent and Limitation of its application:** The computer program PRTHRUST is used to calculate piping system transient forces resulting from one of the following: Postulated Pipe Rupture; Control, Relief, or Stop Valve Actuation; or Pump Transients. The computer program PIPERUP is used to perform elastic plastic analysis of piping systems subjected to concentrated static or dynamic time history forcing functions.	
C.	**Verification:** The Quadrex corporation performed the verification of PRTHRUST/PIPERUP. The Control Data Corporation ran two test problems to check the workability of the program.	

Table 3-67. Computer Programs Used in Analysis

Application:		**PRTHRUST/PIPEUP**
A.	**Author:**	QUADREX Corporation 1700 Dell Avenue Campbell, California 95008
	Source:	University Computing Company
	Version:	1.3.1
	Facility:	UCC Dallas
B.	**Description:** Nonlinear analysis for piping systems subjected to postulated ruptures. PRTHRUST calculates blowdown forces for both longitudinal and circumferential breaks and provides for modeling of all major components. PIPERUP analyzes an elastic-plastic solution while considering the effects of strain hardening, gaps and pipewhip restraints. **Extent and Limitations of its application:** The computer program PRTHRUST is used to calculate piping system transient forces resulting from one of the following: Postulated Pipe Rupture; Control, Relief, or Stop Valve Actuation; or Pump Transients. The computer program PIPERUP is used to perform elastic plastic analysis of piping systems subjected to concentrated static or dynamic time history forcing functions.	
C.	**Verification:** The Quadrex corporation performed the verification of PRTHRUST/PIPERUP. University Computing Company will perform on their own verification in early 1983.	

Table 3-68. Computer Programs Used in Analysis

Application:		SUPERPIPE
A.	**Author:**	Impell Corporation (Formally EDS Nuclear, Inc.) 455 North Wiget Lane Walnut Creek, California 94598
	Source:	Impell Corporation (Formally EDS Nuclear, Inc.)
	Version:	February 28, 1978; May 15, 1978; July 1, 1978; October 1, 1978; November 15, 1979; January 31, 1982; and June 28, 1982, 22F-100: 09/2005
	Facility:	Impell Corporation (Formally EDS Nuclear, Inc.), CDC Cybernet Twin Cities, UCC Dallas, Duke Power CDC, and Duke Power - IBM

B. **Description:** SUPERPIPE is a computer program for the structural analysis and code compliance evaluation of piping systems, with particular emphasis on Class 1, 2, and 3 nuclear power piping designed to meet the requirements of the ASME Boiler and Pressure Vessel Code, Section III.

The piping system may be modeled by straight pipes, curved pipes, elbows, reducers, tees, branch connections, and other commonly-used piping attachments.

Principal features of the program include the following:

1. Static and thermal stress analysis by the direct stiffness method.
2. Frequencies and mode-shapes computation, using the subspace interaction method or the Q-R method.
3. Dynamic response analysis by the modal-superposition time-history analysis, the direct-integration time-history analysis or the response spectrum analysis.
4. Seismic analysis of multiple-excited piping systems by the “multiple-response-spectrum approach.”
5. Combination of directional and modal responses according to USNRC Regulatory Guide 1.92.
6. Code compliance evaluation according to ASME Boiler and Pressure Vessel Code, Section III, for Class 1, 2, and 3 nuclear piping (user's choice of code addendum).
7. Determination of pipe-break locations.
8. Fatigue damage computations.
9. Built-in library of standard material properties, cross-sectional properties, flexibility factors, and stress intensification factors.
10. Restart options to store, recall, and modify piping geometry, and to perform analysis and code compliance evaluation in stages.
11. Options to print-out support loads and displacement summaries, nozzle and penetration load summaries, and code compliance summary.
12. Options to plot piping geometry and mode shapes.

Extent and Limitation of its application: All routines of the SUPERPIPE program are used as detailed in the description.

Application:	**SUPERPIPE**
C.	**Verification:** The program has been bench-marked against the EDS program PISOL and foreign programs like NUPIPE and PIPESD. This program has been verified by bench-marking to an ASME sample problem, by comparison to detailed analysis performed manually, by comparison to results achieved using similar programs, as described above, and by comparison to results achieved using the previous version of SUPERPIPE. The bench-mark problems specified in NUREG CR-1677 have been evaluated using this program and the results have been transmitted to the NRC.

Table 3-69. Computer Programs Used in Analysis

Application:		**ANSYS**
A.	**Author:**	Swanson Analysis Systems, Inc. P. O. Box 65 Houston, Pennsylvania 15342
	Source:	Swanson Analysis Systems
	Version:	Revision 3
	Facility:	EDS Nuclear, Inc. and CDC Cybernet Twin Cities

B. **Description:** ANSYS is a general purpose program for structural, heat-transfer and fluid-flow analysis. In structural analysis, the program can consider static and dynamic; elastic, plastic, creep and swelling small and large deflection conditions. In the heat-transfer or fluid-flow analysis, it can consider linear and nonlinear; steady-state and transient conditions. The program has the capability of analyzing piping systems, two-dimensional axisymmetric solids, three-dimensional solids and axisymmetric and three-dimensional shells.

Extent and Limitation of its application: ANSYS is used to perform finite element static elastic analysis on piping components to obtain stress levels for NB 3600.

C. **Verification:** Verification consists of comparing program calculated solutions with 1) known theoretical solutions, 2) experimental results, and 3) other calculated solutions. The readily available theoretical solutions used for comparison to the program solutions are found in numerous published documents. Several of the documents are listed below:

1. "Strength of Materials, Part I, Elementary Theory and Problems" by S. Timoshenko.
2. "Strength of Materials Part II, Advanced Theory and Problems" by S. Timoshenko.
3. "An Introduction to the Mechanics of Solids" by S. H. Crandall and N. C. Dahl.
4. "Formulas for Stress and Strain" by R. J. Roark.

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-70. Computer Programs Used in Analysis

Application:		**EDSSAAS**
A.	***Author:***	*Impell Corporation (Formally EDS Nuclear, Inc.)* *455 North Wiget Lane* *Walnut Creek, California 94598*
	Source:	*SAASII/Impell Corporation (Formally EDS Nuclear, Inc.)*
	Version:	*August 31, 1979*
	Facility:	*CDC Cybernet Twin Cities and Impell Corporation (Formally EDS Nuclear Inc.)*
B.	***Description:*** *EDSSAAS is a finite element program designed for the stress analysis of axisymmetric solids subjected to axisymmetric load. It is specifically useful for the stress analysis of components (nozzles, valves, etc.). The program is a modified version of SAASII, developed by the Aerospace Corporation, San Bernardino, California.* ***Extent and Limitations of its application:*** *EDSSAAS is used to perform finite element static elastic analysis on piping components to obtain stress levels for NB 3600.*	
C.	***Verification:*** *The program is currently verified to handle elastic analyses of soilds modeled with quadrilateral and triangular 2-D elements with orthotropic temperature dependent material properties. The axisymmetric loading can be mechanical (pressure and discrete nodal loads) and/or thermal (nodal temperatures).* *The program has been verified by running test cases using SAASII and comparing the results. This version of EDSSAAS was verified by rerunning problems used for the verification of the previous version (v. 7/26/77) and comparing results.*	

Table 3-71. Computer Programs Used in Analysis

Application:		**SPECT1A**
A.	**Author:**	Impell Corporation (Formally EDS Nuclear, Inc.) 455 North Wiget Lane Walnut Creek, California 94598
	Source:	Impell Corporation (Formally EDS Nuclear, Inc.)
	Version:	January 20, 1978
	Facility:	Impell Corporation (Formally EDS Nuclear, Inc.) and CDC Cybernet Twin Cities
B.	**Description:** SPECT1A modifies and combines period or frequency based digitized seismic response spectra and produces punched card decks for subsequent use in SUPERPIPE. Punched card sets of time-value/acceleration pairs may be linearized, enveloped, averaged, and spread using various options. **Extent and Limitations of its application:** All routines of the SPECT1A program are used as detailed in the description.	
C.	**Verification:** The purpose of this program is data manipulation only. No calculations as such are performed. The program has therefore been verified by comparing the output to data manipulated manually.	

Table 3-72. Computer Programs Used in Analysis

Application:		**TRANS2A**
A.	**Author:**	Impell Corporation (Formally EDS Nuclear, Inc.) 455 North Wiget Lane Walnut Creek, California 94598
	Source:	Impell Corporation (Formally EDS Nuclear, Inc.)
	Version:	March 15, 1977
	Facility:	Impell Corporation (Formally EDS Nuclear, Inc.) and CDC Cybernet Twin Cities
B.	**Description:** TRANS2A is a computer program which determines radial temperature distributions and gradient in a pipe wall experiencing fluid temperature excursions. TRANS2A determines these temperature distributions and gradients by solution of the unsteady one-dimensional axisymmetric heat transfer equation. **Extent and Limitation of its application:** All routines of the TRANS2A program are used as detailed in the description.	
C.	**Verification:** TRANS2A has been extensively tested and compared with independent results for sample problems. TRANS2A temperature distributions agree favorably with calculations using TRANS1A and the EDS proprietary finite-element program TAPAS. Calculations for thermal gradient terms ΔT_1 and ΔT_2 compare favorably with results from TRANS1A and with the values derived from charts published by McNeill and Brock in "Engineering Data File - Charts for Transient Temperature in Pipes," 1971.	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-73. Computer Programs Used in Analysis

Application:		***EDSMESH***
A.	***Author:***	*Impell Coporation (Formally EDS Nuclear, Inc.)* *455 North Wiget Lane* *Walnut Creek, California 94598*
	Source:	*Impell Corporation (Formally EDS Nuclear, Inc.)*
	Version:	*August 31, 1979*
	Facility:	*CDC Cybernet Twin Cities and Impell Corporation (Formally EDS Nuclear, Inc.)*
B.	***Description:*** *EDSMESH is a general purpose, two dimensional finite element mesh generator. With minimal user input, the program generates a finite element mesh, plots the mesh and writes the mesh information on tape for use in finite element analysis programs. It is specifically designed for use with EDS Component Analysis Package (GAP1) consisting of EDSSAAS, EDSASAAS and EDSPOT.* ***Extent and Limitation of its application:*** *All routines of the EDSMESH program are used as detailed in the description.*		
C.	***Verification:*** *This program has been verified by developing sample finite element meshes with the program and comparing these models to previously generated finite element meshes.*		

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-74. Computer Programs Used in Analysis

Application: ***EDSLIN***

A.

Author:	*Impell Corporation (Formally EDS Nuclear, Inc.)* *455 North Wiget Lane* *Walnut Creek, California 94598*
Source:	*Impell Corporation (Formally EDS Nuclear, Inc.)*
Version:	*August 1, 1980*
Facility:	*CDC Cybernet Twin Cities and Impell Corporation (Formally EDS Nuclear, Inc.)*

B. ***Description:*** *EDSLIN is a post processor to finite element stress and thermal analyses of axisymmetric solids (components), it linearizes stress and/or temperature profiles across user-specified cuts through the thickness of the component, for compatibility with the ASME Section III NB-3000 code definitions.*

The purpose underlying the program is the correlation of finite element results (stress/temperature) to the ASME Code stress categories (NB-3200) and temperature terms (NB-3650).

Extent and Limitations of its application: *All routines of the EDSLIN program are used as detailed in the description.*

C. ***Verification:*** *The program has been verified by comparison to detailed analysis performed manually. The manually performed analysis consisted of:*

1. *determination of stress/temperature at each internal point along the section*
2. *determination of average temperature and linear temperature distrubution across the section.*
3. *determination of principal stresses and stress intensities for membrane, linear and total stresses.*

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-75. Computer Programs Used in Analysis

Application:		***EDSFLOW***
A.	***Author:***	*Impell Corporation (Formally EDS Nuclear, Inc.)* *455 North Wiget Lane* *Walnut Creek, California 94598*
	Source:	*RELAP IV Mod 5 / Impell Corporation (Formally EDS Nuclear, Inc.)*
	Version:	*1.01 February 12, 1980*
	Facility:	*CDC Cybernet Twin Cities*
B.	***Description:*** *EDSFLOW is a computer program for the analysis of the thermal/hydraulic behavior of light water reactor systems subjected to postulated transients such as those resulting from loss of coolant, pump failure, or rapid depressurization. It is a modified version of the RELAP4/MOD5 program developed for NRC by the Idaho National Engineering Laboratory.* ***Extent and Limitation of its application:*** *EDSFLOW is used primarily for time-history analysis of hydraulic forces on piping systems during rapid transient (i.e. safety valve blowdown). It is also used for transient containment building subcompartment pressure/temperature analysis.*	
C.	***Verification:*** *EDSFLOW has been verified by comparison to RELAP4/MOD5 thermal/hydraulic predictions for two pressurizer safety/relief valve discharge transients and one PWR main steam hammer analysis.*	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-76. Computer Programs Used in Analysis

Application:		***FRCON4***
A.	***Author:***	*Impell Corporation (Formally EDS Nuclear, Inc.)* *455 North Wiget Lane* *Walnut Creek, California 94598*
	Source:	*Impell Corporation (Formally EDS Nuclear, Inc.)*
	Version:	*February 8, 1978*
	Facility:	*CDC Cybernet Twin Cities*
B.	***Description:*** *FRCON4 is a computer program for the computation of the time-histories of the unbalanced forces during water and/or steam piping systems transients.* *The program reads the thermal-hydraulic transient time-histories generated (on tape) by the EDSFLOW program and computes the corresponding force time-histories by the integral force equation technique. The calculated force time-histories are written on tape, in a format that is compatible with the input formats of the structural dynamic analysis programs EDSGAP and SUPERPIPE.* ***Extent and Limitation of its application:*** *All routines of the FRCON4 program are used as detailed in the description.*	
C.	***Verification:*** *The program has been verified by comparison to Moody test data for superheated steam discharge into a pipe. It has also been compared to hand calculations, tables and graphs published by Moody for other fluid conditions liquid and subcooled and saturated steam with regard to blowdown thrust forces.*	

Table 3-77. Computer Programs Used in Analysis

Application:		**CATNAP**
A.	**Author:**	Impell Corporation (Formally EDS Nuclear, Inc.) 455 North Wiget Lane Walnut Creek, California 94598
	Source:	Impell Corporation (Formally EDS Nuclear, Inc.)
	Version:	May 26, 1978
	Facility:	Impell Corporation (Formally EDS Nuclear, Inc.) CDC Cybernet Twin Cities
B.	**Description:** CATNAP is a special-purpose program which evaluates load combinations for defined service conditions induced on a nozzle due to the stiffness of the attached piping. Pipe stiffness, RCL and RPV seismic displacements, LOCA displacements, seismic inertia moments, and gravity moments are input to the program. Design condition and faulted condition evaluations are performed at the centerline intersection of the RCL and auxiliary pipe; seismic primary-plus-secondary stress (i.e., fatigue), and thermal expansion evaluations are performed at the auxiliary line safe-end-weld. "Worst-case" resultant moments conditions are obtained through evaluation of all possible permutations of the sign combination of unsigned and conditionally signed displacements and rotations in combination with signed moments. Output from the program summarizes actual worst-case resultant moment and ratio to allowable for the defined service conditions. **Extent and Limitations of its application:** All routines of the CATNAP program are used as detailed in the description.	
C.	**Verification:** The purpose of this program is data manipulation only. No calculations as such are performed. The program has therefore been verified by comparing the output to data manipulated manually.	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-78. Computer Programs Used in Analysis

Application:		***SIMPWIP***
A.	***Author:***	*Impell Corporation (Formally EDS Nuclear, Inc.)* *455 North Wiget Lane* *Walnut Creek, California 94598*
	Source:	*Impell Corporation (Formally EDS Nuclear, Inc.)*
	Version:	*August 15, 1979*
	Facility:	*Impell Corporation (Formally EDS Nuclear, Inc.) and UCC Dallas*
B.	***Description:*** *SIMPWIP is a computer program for the simplified time-history analysis of pipe whip problems. The program provides a conservative estimate of the restraint forces and deformations, during the initial impact phase up to the time the piping system initially stops after impact with the restraints. SIMPWIP can handle both circumferential and longitudinal pipe rupture events. The program assumes the motions of the system to be two-dimensional and in the small-deflection range.* ***Extent and Limitations of its application:*** *All routines of the SIMPWIP program are used as detailed in the description.*	
C.	***Verification:*** *The program has been verified by comparison with the results of the hand calculated problem.*	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-79. Computer Programs Used in Analysis

Application:		***PWHIP***
A.	***Author:***	*Impell Corporation (Formally EDS Nuclear, Inc.)* *455 North Wiget Lane* *Walnut Creek, California 94598*
	Source:	*Impell Corporation (Formally EDS Nuclear, Inc.)*
	Version:	*October 20, 1977*
	Facility:	*Impell Corporation (Formally EDS Nuclear, Inc.)*

B. ***Description:*** *PWHIP is a computer program for the nonlinear dynamic response analysis of three-dimensional beam/piping systems restrained with energy-absorbing devices.*

Principle features of the program include the following:

1. *The finite element library consists of:*
   - a. *Two different types of inelastic beam elements, differing in post-yield behavior.*
   - b. *Energy-absorbing restraint elements (inelastic tension element - i.e., U-bar element, inelastic compression element, and friction disc element).*
2. *Both inelastic material nonlinearities and geometric "gap" non-linearities can be included in the analysis.*
3. *Static loads may be applied to the structure prior to the application of the dynamic loads, provided the structural behavior is elastic during the static loading phase.*
4. *Large deformation of the energy-absorbing devices are permitted; but the response of the main structure - beam/pipe elements - is restricted to small deformation.*
5. *Damping may be specified as mass-proportional or stiffness-proportional.*

Extent and Limitation of its application: *All routines of the PWHIP program are used as detailed in the description.*

C. ***Verification:*** *PWHIP has been verified by comparison analyses with closed form text book solutions, and solutions generated by the general finite program ANSYS.*

Table 3-80. Computer Programs Used in Analysis

Application:		**STRUDL Version: Release 2.7 thru 5.4**
A.	**Author:**	McDonnell Douglas Automation Company Box 516 St. Louis, Missouri
	Source:	MCAUTO
	Version:	Release 2.7 through 4.7
	Facility:	Duke Power
B.	**Description:** Large scale general purpose finite element program for structural analysis. **Extent and Limitation of its application:** MCAUTO STRUDL is used to perform static elastic analysis of pipe supports.	
C.	**Verification:** MCAUTO STRUDL has been verified by comparison of the results with either hand calculations, closed form solutions found in standard text books or solutions from other programs.	

Table 3-81. Computer Programs Used in Analysis

Application:		**ANSYS**
A.	**Author:**	Swanson Analysis Systems, Inc. P. O. Box 65 Houston, Pennsylvania 15342
	Source:	Swanson Analysis Systems, Inc.
	Version:	Revision 3 and 4
	Facility:	Duke Power
B.	**Description:** Large-scale finite-element program for structural, heat transfer and fluid-flow analysis. ANSYS performs linear and nonlinear elastic analysis of structures subjected to static loads (pressure, temperature, concentrated forces and prescribed displacements) and dynamic excitations (transient and harmonic). The program considers the effected of plasticity, creep, swelling and large deformations. Transient and steady-state heat transfer analyses consider conduction, convection and radiation effects. Coupled thermal-fluid, coupled thermal-electric and wave-motion analysis capabilities are available. Structural and heat transfer analyses can be made in one, two or three dimensions, including axisymmetric and plane problems. **Extent and Limitation of its application:** The ANSYS computer program is used to perform static elastic finite element analysis on pipe supports and welded attachments to piping.	
C.	**Verification:** The ANYSY program has been verified by comparison with a series of test problems of a published analytical solutions.	

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-82. Computer Programs Used in Analysis

Application:		***Quickpipe***
A.	***Author:***	*Impell Corporation (formally EDS Nuclear, Inc.)* *Southeast Region Office* *333 Technology Park/Atlanta* *Norcross, Georgia 30092*
	Source:	*Impell Corporation*
	Version:	*3A dated June 25, 1984*
	Facility:	*Impell Corporation*
B.	***Description:*** *Quickpipe is a computer program for the structural analysis and code compliance evaluation of small bore piping systems. It is used for qualification of ASME Section III, Class 2 and 3 piping as well as some seismic qualification of ANSI B31.1 piping. Quickpipe can perform the analysis by means of either a stress-controlled or frequency-controlled basis for gravity, thermal and/or seismic loading cases. The program also features suitable algorithms to optimize excessive support locations spotted in the analysis if desired. Quickpipe is an extension of Impell Corporation's Superpipe program developed primarily as an alternative to the hand calculation methods required by the Alternate Analysis procedures described in Section 3.7.3.8.3.* ***Extent and Limitation of its application:*** *Quickpipe is limited to analysis of "4" and under nominal piping systems.*	
C.	***Verification:*** *The program has been bench-marked against the Impell program Superpipe.*	

Table 3-83. CRDM Moments - Head Adaptor Location

	LONGEST (IN-LB)	SHORTEST (IN-LB)
OBE	54,800	33,591
SSE	102,750	62,983
LOCA	101,300	143,125
FAULTED	144,289	156,370

Note:

1. FAULTED = $\mathrm{SSE}^2 + \mathrm{LOCA}^2$

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-84. Piping Systems Included In Vibration Test Program

System
Reactor Coolant System
Safety Injection System
Residual Heat Removal System
Containment Spray System
Chemical and Volume Control System
Boron Recycle System
Boron Thermal Regeneration System
Component Cooling System
Liquid Radwaste System
Fuel Pool Cooling and Cleanup System
Diesel Generator Fuel Oil System
Diesel Generator Cooling Water System
Diesel Generator Lub Oil System
Nuclear Service Water System
Refueling Water System
Main Steam System
Feedwater System
Auxiliary Feedwater System
Steam Dump System
Control Area Chilled Water System
Steam Generator Blowdown Recycle System
Recirculated Cooling Water System

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-85. Piping Systems Included In Transient Vibration Test Program

System	***Transient Type***	***Type Measurement***	***Simultaneous Test***
NC	*NC Pump Start*	*Vibration measurement at selected points*	*HFT*
	NC Pump Trip	*Vibration measurement at selected points*	*HFT*
	NC PORV Cycling	*Post transient inspection*	*HFT*
BB	*Initiation of S/G Blowdown*	*Post transient inspection*	*S/G BD Test*
	Isolation of S/G Blowdown	*Post transient inspection*	*S/G BD Test*
CA	*(Motor driven Pump Start)*	*Post transient inspection*	*Aux. FDW F.T.*
	(Motor driven Pump trip)	*Post transient inspection*	*Aux. FDW F.T.*
	AFWPT Cold Start	*Post transient inspection*	*Aux. FDW F.T.*
	AFWPT Trip	*Post transient inspection*	*Aux. FDW F.T.*
CF	*Isolation Valve Closure*	*Post transient inspection*	*HFT*
NI	*NI Pump Start*	*Post transient inspection of pump discharge piping*	*ESF*
	CCP Pump Start	*Post transient inspection of pump discharge piping*	*ESF*
NV	*Letdown Isolation*	*Post transient inspection*	*HFT*
SM	*Main Steam Isolation (individually)*	*Post transient inspection*	*SM isolation HFT*
	Main Steam PORV Discharge	*Post transient inspection*	*HFT*
CF, SM	*Loss of Electrical Load 100% FP*	*Post transient inspection*	*Power Escalation Testing*
CF, SM	*Turbine Trip ~70% FP*	*Post transient inspection*	*Power Escalation Testing*

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Table 3-86. ***Piping Systems Included In Thermal Expansion Test Program***

Steam Generator Blowdown System
Feedwater System
Reactor Coolant System
Residual Heat Removal System
Safety Injection System
Chemical and Volume Control System
Main Steam to Auxiliary Equipment
Main Steam
Auxiliary Feedwater
Boron Thermal Regeneration

Table 3-87. Maximum Deflections Allowed for Reactor Internal Support Structures

Component	Allowable Deflections (in)	No-Loss-of Function Deflections (in)
Upper Barrel		
radial inward	4.1	8.2
radial	1.0	1.0
Upper Package	0.10	0.15
Rod Cluster Guide Tubes	1.00	1.75

Table 3-88. Design Loading Combinations for ASME Code Class 2 and 3 Components and Supports

CONDITION CLASSIFICATION	LOADING COMBINATION(1, 2)
Design	Design Pressure, Design Temperature, Deadweight
Normal	Normal Condition Pressure, Normal Condition Metal Temperature, Deadweight, Nozzle Loads
Upset	Upset Condition Pressure, Upset Condition Metal Temperature, Deadweight, Nozzle Loads, Operating Basis Earthquake
Faulted	Faulted Condition Pressure, Faulted Condition Metal Temperature, Deadweight, Nozzle Loads, Safe Shutdown Earthquake

Notes:

1. Temperature is used to determine allowable stress only.
2. Nozzle loads, pressures, and temperature are those associated with the respective plant operating conditions (i.e., normal, upset, emergency, and faulted), as noted for the component under consideration.
3. Refer to Table 3-90 through Table 3-94 for Stress Criteria.

Table 3-89. Design Loading Combinations for ASME Code Core Support Structures

Condition Classification	Loading Combination
Design	Design Pressure, Design Temperature, Deadweight
Normal	Normal Condition Pressure, Normal Condition Metal Temperature, Deadweight, Nozzle Loads
Upset	Upset Condition Pressure, Upset Condition Metal Temperature, Deadweight, Nozzle Loads, Operating Basis Earthquake
Faulted	Faulted Condition Pressure, Faulted Condition Metal Temperature, Deadweight, Nozzle Loads, Safe Shutdown Earthquake

Note:

1. By contract, this plant preceeded the application of Subsection NG of Section III of the ASME Code. Therefore, these internals are not "stamped" and no specific stress report is required. Nonetheless, the internals are designed to meet the intent of the code.

Table 3-90. Stress Criteria for Safety Related ASME Class 2 and Class 3 Tanks

Design	**Stress Limits**
Design and Normal	$\sigma_m \leq 1.0$ S $(\sigma_m$ or $\sigma_L)$ + $\sigma_b \leq 1.5$ S
Upset	$\sigma_m \leq 1.1$ S $(\sigma_m$ or $\sigma_L)$ + $\sigma_b \leq 1.65$ S
Faulted	$\sigma_m \leq 2.0$ S $(\sigma_m$ or $\sigma_L)$ + $\sigma_b \leq 2.4$ S

Notes:

1. Applies for tanks designed in accordance with ASME III, NC-3300.
2. Refer to Table 3-88 for Load Combinations.

Table 3-91. Stress Criteria for Safety Related Class 2 Tanks

Design	Stress Limits
Design and Normal	$P_m \leq 1.0\ S_m$ $P_L \leq 1.5\ S_m$ $(P_m \text{ or } P_L) + P_b \leq 1.5\ S_m$
Upset	$P_m \leq 1.1\ S_m$ $P_L \leq 1.65\ S_m$ $(P_m \text{ or } P_L) + P_b \leq 1.65\ S_m$
Faulted	$P_m \leq 2.0\ S_m$ $P_L \leq 3.0\ S_m$ $(P_m \text{ or } P_L) + P_b \leq 3.0\ S_m$

Notes:

1. Applies for tanks designed in accordance with ASME III, NC-3200.
2. Refer to Table 3-88 for Load Combinations.

Table 3-92. Stress Criteria for ASME Code Class 2 and Class 3 Inactive Pumps

Design	**Stress Limits**	**P_{max}**(1)
Design and Normal	$\sigma_m \leq 1.0$ S $(\sigma_m$ or $\sigma_L) + \sigma_b \leq 1.5$ S	
Upset	$\sigma_m \leq 1.1$ S $(\sigma_m$ or $\sigma_L) + \sigma_b \leq 1.65$ S	1.1
Faulted	$\sigma_m \leq 2.0$ S $(\sigma_m$ or $\sigma_L) + \sigma_b \leq 2.4$ S	1.5

Notes:

1. The maximum pressure shall not exceed the tabulated factors listed under. P_{max} times the design pressure.
2. Refer to Table 3-88 for Load Combinations.

Table 3-93. Design Criteria for Active Pumps

Design	Stress Limits
Design, Normal and Upset	$\sigma_m \leq 1.0$ S $\sigma_m + \sigma_b \leq 1.5$ S
Faulted	$\sigma_m \leq 1.2$ S $\sigma_m + \sigma_b \leq 1.8$ S

Note:

1. Refer to Table 3-88 for Load Combinations.

Table 3-94. Stress Criteria for Safety Related ASME Code Class 2 and Class 3 Valves

Design	Stress Limits[(1-4)]	P_{max}[(5)]
Design and Normal	Valve bodies shall conform to ASME Section III.	1.0
Upset	$\sigma_m \leq 1.1$ S $(\sigma_m$ or $\sigma_L) + \sigma_b \leq 1.65$ S	1.1
Faulted	$\sigma_m \leq 2.0$ S $(\sigma_m$ or $\sigma_L) + \sigma_b \leq 2.4$ S	1.5

Notes:

1. Valve nozzle (piping load) stress analysis is not required when both the following conditions are satisfied: 1) the section modulus and area of every plane, normal to the flow, through the region defined as the valve body crotch are at least 110% of those for the piping connected (or joined) to the valve body inlet and outlet nozzles: and, 2) code allowable stress, S, for valve body material is equal to or greater than the code allowable stress, S, of connected piping material. If the valve body material allowable stress is less than that of the connected piping, the required acceptance criteria ratio shall be 110% multiplied by the ratio of the pipe allowable stress to the valve allowable stress. If unable to comply with this requirement, an analysis in accordance with the design procedure for Class 1 valves is an acceptable alternate method.
2. Casting quality factor of 1.0 shall be used.
3. These stress limits are applicable to the pressure retaining boundary, and include the effects of loads transmitted by the extended structures, when applicable.
4. Design requirements listed in this Table are not applicable to valve stems, seat rings, or other parts of valves which are contained within the confines of the body and bonnet. Valve discs are designed to 110 percent of the maximum differential operating pressure.
5. The maximum pressure resulting from upset, emergency or faulted conditions shall not exceed the tabulated factors listed under P_{max} times the design pressure. If these pressure limits are met, the stress limits in Table 3-94 are considered to be satisfied.
6. Refer to Table 3-88 for Load Combinations.

Table 3-95. Stress Criteria and Load Combination Requirements for Duke Class A Piping

Condition	Load Combination	Applicable Stress Criteria
Design	Pressure +Weight +OBE	ASME III NB-3652 Σ (Primary) $\leq 1.5\ S_m$
Normal, Upset	Pressure +Weight +Thermal +Thermal transients +OBE (incl. anchor motions) +Relief Valve (as applicable) +Fluid dynamic effects	ASME III NB-3653 & 3654 Σ (Primary + Secondary) $\leq 3.0\ S_m$ Σ (Primary) $\leq 1.5\ S_m$
Faulted	Pressure +Weight +SSE +Pipe Rupture +Relief Valve (as applicable) +Fluid dynamic effects	ASME III Appendix F (F-1360) Σ (Primary) $\leq 3.0\ S_m$
Faulted	Pressure +Weight +Pipe Rupture +Relief Valve (as applicable) +Fluid dynamic effects	ASME III Appendix F (F-1360) Σ (Primary) $\leq 3.0\ S_m$

Notes:

1. Refer to Section 3.9.3.1.2 for load combination method.
2. Flange bolts are high strength SA 193-B7. High strength bolts SA 193-B7 meet the stress limit requirements specified in ASME Section III NB 3230 as verified in ORNL/Sub/2913-5.

Table 3-96. Stress Criteria and Load Combination Requirements for Duke Class B, C, and F Piping

Condition	Load Combination	Applicable Stress Criteria
Normal	Pressure +Weight +Thermal	ASME III NC- or ND-3652 Σ (Primary + Secondary) ≤ (S_h+ S_a)
Upset	Pressure +Weight +Thermal +OBE (incl. anchor motions) +Valve thrust +Fluid dynamic effects	ASME III NC- or ND-3652 Σ (Secondary) ≤ S_a Σ (Primary) ≤ 1.2 S_h
Faulted	Pressure +Weight +SSE +Valve thrust +Fluid dynamic effects +Pipe rupture	ASME Code Case 1606 Σ (Primary) ≤ 2.4 S_h
Faulted	Pressure +Weight +Valve thrust +Fluid dynamic effects +Pipe rupture	ASME Code Case 1606 Σ (Primary) ≤ 2.4 S_h
Faulted	Pressure +Weight +Tornado	ASME Code Case 1606 Σ (Primary) ≤ 2.4 S_h

Notes:

1. Refer to Section 3.9.3.1.3 for load combination method.
2. Flange bolts are high strength SA 193-B7. High strength bolts SA 193-B7 meet the stress limit requirments specified in ASME Section III NB 3230 as verified in ORNL/Sub/2913-3

Table 3-97. Stress Limits for Duke Safety Related Equipment and Values

	UPSET MODE			**FAULTED MODE**		
	Pressure-Retaining			**Pressure-Retaining**		
Type of Equipment	**σ_m**	**$(\sigma_m \text{ or } \sigma_L) + \sigma_b$**	**Non-Pressure Retaining**	**σ_m**	**$(\sigma_m \text{ or } \sigma_L) + \sigma_b$**	**Non-Pressure Retaining**
Vessles	1.0S	1.5S	σ_a	1.5S	2.25S	0.9 σ_4
Pumps						
Active	1.0S	1.5S	σ_a	1.0S	1.5S	0.9 σ_4
Passive	1.1S	1.65S	σ_a	1.2S	1.8S	0.9 σ_4
Valves						
Active	1.0S	1.5S	σ_a	1.5S	2.25S	0.9 σ_4
Passive	1.1S	1.65S	-	2.0S	2.4S	-

σ_m = General primary membrane stress intensity.

σ_L = Local primary membrane stress intensity.

σ_b = Primary bending stress intensity.

σa = AISC allowable working stress limit (without 33% seismic increase).

σ_4 = Yield strength of the material.

S = ASME Section III allowable stress intensity.

Table 3-98. Deleted Per 1990 Update

Table 3-99. Deleted Per 1990 Update

Table 3-100. Deleted Per 1990 Update

Table 3-101. Loading Conditions, Load Combination, and Allowable Stresses for Supports, Restraints and Anchors for Duke Classes A, B, C and F(6)

CONDITION	LOAD COMBINATION	NON-NF ALLOWABLE STRESSES(3)
Normal	Thermal(2) + Pressure (as applicable) + Weight	1.0S
Upset	Thermal(2) + Thermal Transients + OBE + OBE Seismic Anchor Movement + Pressure (as applicable) + Weight + Steam Hammer + Relief Valve	1.0S
Faulted	Thermal(2) (7) + Thermal Transients + 15/8 OBE + 15/8 OBE Seismic Anchor Movement + Pressure (as applicable) + Weight + Steam Hammer + Pipe Rupture (as applicable) + Relief Valve	1.5S
Hydro	Thermal(1) + Pressure (as applicable) + Weight	1.0S

Notes:

1. Thermal load for hydro conditions will be zero except for cold pulled systems.
2. Use greater of hot load or 1/3 cold load for cold pulled systems hot condition. Use cold load for cold pulled system cold condition.
3. Stress limits for those portions within the NF jurisdictional boundaries are in accordance with the applicable paragraphs of Subsection NF as described in Subsection 3.9.3.1.5.
4. For faulted and upset load conditions, a case which replaces seismic and seismic anchor movement with design bases Tornado, applied to outside piping, must also be considered.
5. S = allowable stress from AISC manual.
6. Stresses for Supports, Restraints, and Anchors on Duke Classes E, G, and H piping identified as necessary to prevent interaction with Classes A, B, C and F piping are limited to the value of this table.
7. Thermal and Thermal Transient Loads in the Faulted Condition are required to be added only when the response spectra used by the piping analysis was generated by direct generation.

Table 3-102. Loading Conditions and Load Combination Requirements for Snubbers Duke Classes A, B, C, F

CONDITION	LOAD COMBINATION
Normal and Upset	OBE OBE Seismic Anchor Movement + Steam Hammer + Relief Valve
Faulted	15/8 OBE 15/8 OBE Seismic Anchor Movement + Steam Hammer + Relief Valve

Notes:

1. For the Normal and Upset Conditions the total of applied piping loads to be less than manufacturer's Normal load rating.
2. For the Faulted Condition, the total of applied piping loads to be less than manufacturer's Faulted load rating.

Table 3-103. Active Pumps

PUMP	SAFETY SYSTEM	ANS SAFETY CLASS	NORMAL MODE	POST LOCA MODE	BASIS
Centrifugal Charging Pumps 1A, 1B	NV	2	ON/OFF	ON	Safety Injection
Residual Heat Removal Pumps 1A, 1B	ND	2	OFF	ON	Safety Injection
Safety Injection Pumps 1A, 1B	NI	2	OFF	ON	Safety Injection
Boric Acid Transfer Pumps 1A, 1B	NV	3	ON/OFF	OFF	Boration
Containment Spray Pumps 1A, 1B	NS	2	OFF	ON (P Signal)	Pressure Suppression
Turbine Drive Auxiliary Feedwater Pump (including Turbine)	CA	3	OFF	ON (S Signal)	Heat Sink for Primary Coolant
Motor Drive Auxiliary Feedwater Pumps 1A, 1B	CA	3	OFF	ON (S Signal)	Heat Sink for Primary Coolant
Component Cooling Pumps 1A1, 1A2, 1B1, 1B2,	KC	3	ON	ON (S Signal)	Cooling Water to Safety Related Equipment
Nuclear Service Water Pumps 1A, 1B, 2A, 2B	RN	3	ON	ON (S Signal)	Cooling Water to Safety Related Equipment
Control Area Chilled Water Pump 1, 2	YC	3	ON	ON (S Signal)	Control Room Habitability
Motor Driven Auxiliary Feedwater Pump Pit Sump Pumps 1A, 1B	WL	3	OFF	OFF	Flood Protection for Active Pumps
Steam Turbine Driven Auxiliary Feedwater Pump Pit Sump Pump 1A, 1B	WL	3	OFF	OFF	Flood Protection for Active Pumps
Containment Spray and Residual Heat Removal Pump Room Sump Pumps 1A, 1B	WL	3	OFF	OFF	Flood Protection for Active Pumps

Table 3-104. Active Valves

Unit 1 Valves		Unit 2 Valves	
Valve Number	**Description**	**Valve Number**	**Description**
1BB008A	S/G 1D Blowdown Inside Cont Isol	2BB008A	S/G 2D Blowdown Inside Cont Isol
1BB010B	S/G 1D Blowdown Cont Isol Otsd	2BB010B	S/G 2D Blowdown Cont Isol Otsd
1BB019A	S/G 1B Blowdown Inside Cont Isol	2BB019A	S/G 2B Blowdown Inside Cont Isol
1BB021B	S/G 1B Blowdown Cont Isol Otsd	2BB021B	S/G 2B Blowdown Cont Isol Otsd
1BB056A	S/G 1A Blowdown Cont Isol Insd	2BB056A	S/G 2A Blowdown Cont Isol Insd
1BB057B	S/G 1A Blowdown Cont Isol Otsd	2BB057B	S/G 2A Blowdown Cont Isol Otsd
1BB060A	S/G 1C Blowdown Inside Cont Isol	2BB060A	S/G 2C Blowdown Inside Cont Isol
1BB061B	S/G 1C Blowdown Cont Isol Otsd	2BB061B	S/G 2C Blowdown Cont Isol Otsd
1BB147B	S/G 1D Blowdown Cont Isol Byp	2BB147B	S/G 2D Blowdown Cont Isol Byp
1BB148B	S/G 1A Blowdown Cont Isol Byp	2BB148B	S/G 2A Blowdown Cont Isol Byp
1BB149B	S/G 1C Blowdown Cont Isol Byp	2BB149B	S/G 2C Blowdown Cont Isol Byp
1BB150B	S/G 1B Blowdown Cont Isol Byp	2BB150B	S/G 2B Blowdown Cont Isol Byp
1CA007A	CA Pump #1 Norm Suct Isol	2CA007A	CA Pump #2 Norm Suct Isol
1CA009B	CA Pump 1B Norm Suct Isol	2CA009B	CA Pump 2B Norm Suct Isol
1CA011A	CA Pump 1A Norm Suct Isol	2CA011A	CA Pump 2A Norm Suct Isol
1CA015A	CA Pump 1A Suct Frm RN Isol	2CA015A	CA Pump 2A Suct Frm RN Isol
1CA018B	CA Pump 1B Suct Frm RN Isol	2CA018B	CA Pump 2B Suct Frm RN Isol
1CA020	CA Pump #1 Miniflow Control	2CA020	CA Pump #2 Miniflow Control
1CA027	1A CA Pump Miniflow Control	2CA027	2A CA Pump Miniflow Control
1CA032	1B CA Pump Miniflow Control	2CA032	2B CA Pump Miniflow Control
1CA036	CA Pump #1 Flow To S/G 1D	2CA036	CA Pump #2 Flow To S/G 2D
1CA038A	CA Pump 1 Disch To S/G 1D Isol	2CA038A	CA Pump 2 Disch To S/G 2D Isol

Unit 1 Valves		**Unit 2 Valves**	
Valve Number	**Description**	**Valve Number**	**Description**
1CA040	CA Pump 1B Flow To S/G 1D	2CA040	CA Pump 2B Flow To S/G 2D
1CA042B	CA Pump B Disch To S/G 1D Isol	2CA042B	CA Pump B Disch To S/G 2D Isol
1CA044	CA Pump 1B Flow to S/G 1C	2CA044	CA Pump 2B Flow to S/G 2C
1CA046B	CA Pump B Disch to S/G 1C Isol	2CA046B	CA Pump B Disch to S/G 2C Isol
1CA048	CA Pump #1 Flow to S/G 1C	2CA048	CA Pump #2 Flow to S/G 2C
1CA050A	CA Pump 1 Disch to S/G 1C Isol	2CA050A	CA Pump 2 Disch to S/G 2C Isol
1CA052	CA Pump #1 Flow to S/G 1B	2CA052	CA Pump #2 Flow to S/G 2B
1CA054B	CA Pump 1 Disch To S/G 1B Isol	2CA054B	CA Pump 2 Disch To S/G 2B Isol
1CA056	CA Pump 1A Flow To S/G 1B	2CA056	CA Pump 2A Flow To S/G 2B
1CA058A	CA Pump A Disch To S/G 1B Isol	2CA058A	CA Pump A Disch To S/G 2B Isol
1CA060	CA Pump 1A Flow To S/G 1A	2CA060	CA Pump 2A Flow To S/G 2A
1CA062A	CA Pump A Disch to S/G 1A Isol	2CA062A	CA Pump A Disch to S/G 2A Isol
1CA064	CA Pump #1 Flow to S/G 1A	2CA064	CA Pump #2 Flow to S/G 2A
1CA066B	CA Pump 1 Disch to S/G 1A Isol	2CA066B	CA Pump 2 Disch to S/G 2A Isol
1CA085B	CA Pump #1 Suct Frm RN Hdr B	2CA085B	CA Pump #2 Suct Frm RN Hdr B
1CA116A	CA Pump #1 Suct Frm RN Hdr A	2CA116A	CA Pump #2 Suct Frm RN Hdr A
1CA149	1A S/G CF Bypass to CA Nozzle	2CA149	2A S/G CF Bypass to CA Nozzle
1CA150	1B S/G CF Bypass to CA Nozzle	2CA150	2B S/G CF Bypass to CA Nozzle
1CA151	1C S/G CF Bypass to CA Nozzle	2CA151	2C S/G CF Bypass to CA Nozzle
1CA152	1D S/G CF Bypass to CA Nozzle	2CA152	2D S/G CF Bypass to CA Nozzle
1CA185	1A S/G CF Temp Flow to CA Nozzle	2CA185	2A S/G CF Temp Flow to CA Nozzle
1CA186	1B S/G CF Temp Flow to CA Nozzle	2CA186	2B S/G CF Temp Flow to CA Nozzle
1CA187	1C S/G CF Temp Flow to CA Nozzle	2CA187	2C S/G CF Temp Flow to CA Nozzle

Unit 1 Valves		**Unit 2 Valves**	
Valve Number	**Description**	**Valve Number**	**Description**
1CA188	1D S/G CF Temp Flow to CA Nozzle	2CA188	2D S/G CF Temp Flow to CA Nozzle
1CF028	S/G 1A CF Ctrl	2CF028	S/G 2A CF Ctrl
1CF030	S/G 1A CF Byp Ctrl	2CF030	S/G 2A CF Byp Ctrl
1CF033	S/G 1A Feedwater Cont Isol	2CF033	S/G 2A Feedwater Cont Isol
1CF037	S/G 1B CF Ctrl	2CF037	S/G 2B CF Ctrl
1CF039	S/G 1B CF Bypass Control	2CF039	S/G 2B CF Bypass Control
1CF042	S/G 1B Feedwater Cont Isol	2CF042	S/G 2B Feedwater Cont Isol
1CF046	S/G 1C CF Ctrl	2CF046	S/G 2C CF Ctrl
1CF048	S/G 1C CF Bypass Control	2CF048	S/G 2C CF Bypass Control
1CF051	S/G 1C Feedwater Cont Isol	2CF051	S/G 2C Feedwater Cont Isol
1CF055	S/G 1D CF Ctrl	2CF055	S/G 2D CF Ctrl
1CF057	S/G 1D CF Byp Ctrl	2CF057	S/G 2D CF Byp Ctrl
1CF060	S/G 1D Feedwater Cont Isol	2CF060	S/G 2D Feedwater Cont Isol
1CF087	S/G 1D CF Cont Isol Bypass Control	2CF087	S/G 2D CF Cont Isol Bypass Control
1CF088	S/G 1C CF Cont Isol Bypass Control	2CF088	S/G 2C CF Cont Isol Bypass Control
1CF089	S/G 1B CF Cont Isol Bypass Control	2CF089	S/G 2B CF Cont Isol Bypass Control
1CF090	S/G 1A CF Cont Isol Bypass Control	2CF090	S/G 2A CF Cont Isol Bypass Control
1FD022	1A D/G Eng Fuel Oil Day Tank 1A Fill	2FD022	2A D/G Eng Fuel Oil Day Tank 2A Fill
1FD062	1B D/G Eng Fuel Oil Day Tank 1B Fill	2FD062	2B D/G Eng Fuel Oil Day Tank 2B Fill
1FW001A	FW Loop Isol	2FW001A	FW Loop Isol
1FW027A	ND Pump 1A Suct From FWST	2FW027A	ND Pump 2A Suct From FWST
1FW032B	FW Loop Isol	2FW032B	FW Loop Isol
1FW033A	FWST Recirc Loop Isol	2FW033A	FWST Recirc Loop Isol

Unit 1 Valves		**Unit 2 Valves**	
Valve Number	**Description**	**Valve Number**	**Description**
1FW049B	FWST Recirc Loop Isol	2FW049B	FWST Recirc Loop Isol
1FW055B	ND Pump 1B Suct From FWST	2FW055B	ND Pump 2B Suct From FWST
1KCC37A	1A KC Miniflow Isol	2KCC37A	2A KC Miniflow Isol
1KCC40B	1B KC Miniflow Isol	2KCC40B	2B KC Miniflow Isol
1KC001A	Aux Bldg Non-Ess Return Header Isol	2KC001A	Aux Bldg Non-Ess Return Header Isol
1KC002B	Aux Bldg Non-Ess Return Header Isol	2KC002B	Aux Bldg Non-Ess Return Header Isol
1KC003A	Rx Bldg Non-Ess Return Header Isol	2KC003A	Rx Bldg Non-Ess Return Header Isol
1KC018B	Rx Bldg Non-Ess Return Header Isol	2KC018B	Rx Bldg Non-Ess Return Header Isol
1KC050A	Aux Bldg Non-Essential Header Isol	2KC050A	Aux Bldg Non-Essential Header Isol
1KC051A	1A KC Recirc Line Isol	2KC051A	2A KC Recirc Line Isol
1KC053B	Aux Bldg Non-Essential Header Isol	2KC053B	Aux Bldg Non-Essential Header Isol
1KC054B	1B KC Recirc Line Isol	2KC054B	2B KC Recirc Line Isol
1KC056A	KC to ND Hx 1A Sup Isol	2KC056A	KC to ND Hx 2A Sup Isol
1KC057A	1A ND Hx Flow Control	2KC057A	2A ND Hx Flow Control
1KC081B	KC to ND Hx 1B Sup Isol	2KC081B	KC to ND Hx 2B Sup Isol
1KC082B	1B ND Hx Flow Control	2KC082B	2B ND Hx Flow Control
1KC228B	Rx Bldg Non-Essential Header Isol	2KC228B	Rx Bldg Non-Essential Header Isol
1KC230A	Rx Bldg Non-Essential Header Isol	2KC230A	Rx Bldg Non-Essential Header Isol
1KC305B	Exs Letdn Hx Supply Cont Isol	2KC305B	Exs Letdn Hx Supply Cont Isol
1KC315B	Exs Letdn Hx Ret Cont Isol	2KC315B	Exs Letdn Hx Ret Cont Isol
1KC320A	NCDT Hx Cool Supply Cont Isol	2KC320A	NCDT Hx Cool Supply Cont Isol
1KC332B	NCDT Hx Cooling Return Cont Isol	2KC332B	NCDT Hx Cooling Return Cont Isol
1KC333A	NCDT Hx Cool Ret Cont Isol	2KC333A	NCDT Hx Cool Ret Cont Isol

Unit 1 Valves		Unit 2 Valves	
Valve Number	**Description**	**Valve Number**	**Description**
1KC338B	NC Pumps Sup Hdr Cont Isol	2KC338B	NC Pumps Sup Hdr Cont Isol
Deleted per 2015 update			
Deleted per 2015 update			
Deleted per 2015 update			
Deleted per 2015 update			
1KC424B	NC Pumps Return Header Cont Isol	2KC424B	NC Pumps Return Header Cont Isol
1KC425A	NC Pumps Ret Hdr Cont Isol	2KC425A	NC Pumps Ret Hdr Cont Isol
1KC429B	Rx Bldg Drain Header Cont Isol	2KC429B	Rx Bldg Drain Header Cont Isol
1KC430A	Rx Bldg Drn Cont Isol	2KC430A	Rx Bldg Drn Cont Isol
1KD008	1A D/G Eng Driven Jacket Water Circulation	2KD008	2A D/G Eng Driven Jacket Water Circulation
	Pump Disch 3-Way Vlv		Pump Disch 3-Way Vlv
1KD023	1B D/G Eng Driven Jacket Water Circulation	2KD023	2B D/G Eng Driven Jacket Water Circulation
	Pump Disch 3-Way Vlv		Pump Disch 3-Way Vlv
1KF101B	FWST To Spent Fuel Pool	2KF101B	FWST To Spent Fuel Pool
1KF103A	FWST To Spent Fuel Pool	2KF103A	FWST To Spent Fuel Pool
1NB260B	RMWST Cont Isol	2NB260B	RMWST Cont Isol
1NC001	Unit 1 Pzr Safety Relief	2NC001	Unit 2 Pzr Safety Relief
1NC002	Unit 1 Pzr Safety Relief	2NC002	Unit 2 Pzr Safety Relief
1NC003	Unit 1 Pzr Safety Relief	2NC003	Unit 2 Pzr Safety Relief
1NC031B	Unit 1 Pzr PORV Isol	2NC031B	Unit 2 Pzr PORV Isol
1NC032B	Unit 1 Pzr PORV	2NC032B	Unit 2 Pzr PORV

Unit 1 Valves		Unit 2 Valves	
Valve Number	**Description**	**Valve Number**	**Description**
1NC033A	Unit 1 Pzr PORV Isol	2NC033A	Unit 2 Pzr PORV Isol
1NC034A	Unit 1 Pzr PORV	2NC034A	Unit 2 Pzr PORV
1NC035B	Unit 1 Pzr PORV Isol	2NC035B	Unit 2 Pzr PORV Isol
1NC036B	Unit 1 Pzr PORV	2NC036B	Unit 2 Pzr PORV
1NC053B	N2 to PRT Cont Isol	2NC053B	N2 to PRT Cont Isol
1NC054A	Nitrogen to Pzr Relief Tank Cont Isol	2NC054A	Nitrogen to Pzr Relief Tank Cont Isol
1NC056B	RMW Pump Disch Cont Isol	2NC056B	RMW Pump Disch Cont Isol
1NC195B	NC Pump Mtr Oil Fill Isol	2NC195B	NC Pump Mtr Oil Fill Isol
1NC196A	Unit 1 NC Pump Motor Oil Fill Isol	2NC196A	Unit 2 NC Pump Motor Oil Fill Isol
1NC250A	Unit 1 Reactor Head Vent Block	2NC250A	Unit 2 Reactor Head Vent Block
1NC251B	Unit 1 Reactor Head Vent	2NC251B	Unit 2 Reactor Head Vent
1NC252B	Unit 1 Reactor Head Vent Block	2NC252B	Unit 2 Reactor Head Vent Block
1NC253A	Rx Head Vent	2NC253A	Rx Head Vent
1ND001B	ND Pump 1A Suct Frm Loop B	2ND001B	ND Pump 2A Suct Frm Loop B
1ND002A	ND Pump 1A Suct Frm Loop B	2ND002A	ND Pump 2A Suct Frm Loop B
1ND024A	1A ND Hx Outlet to Letdown Hx	2ND024A	2A ND Hx Outlet to Letdown Hx
1ND025A	1A ND Pump Miniflow	2ND025A	2A ND Pump Miniflow
1ND026	1A ND Hx Outlet Control	2ND026	2A ND Hx Outlet Control
1ND027	1A ND Hx Bypass Control	2ND027	2A ND Hx Bypass Control
1ND028A	ND Supply to NV & 1A NI Pumps	2ND028A	ND Supply to NV & 2A NI Pumps
1ND032A	ND Train 1A Hot Leg Inj Isol	2ND032A	ND Train 2A Hot Leg Inj Isol
1ND036B	ND Pump 1B Suct Frm Loop C	2ND036B	ND Pump 2B Suct Frm Loop C
1ND037A	ND Pump 1B Suct Frm Loop C	2ND037A	ND Pump 2B Suct Frm Loop C

Unit 1 Valves		Unit 2 Valves	
Valve Number	**Description**	**Valve Number**	**Description**
1ND058B	1B ND Hx Outlet to Letdown Hx	2ND058B	2B ND Hx Outlet to Letdown Hx
1ND059B	1B ND Pump Miniflow	2ND059B	2B ND Pump Miniflow
1ND60	1B ND Hx Outlet Control	2ND060	2B ND Hx Outlet Control
1ND061	1B ND Hx Bypass Control	2ND061	2B ND Hx Bypass Control
1ND065B	ND Train 1B Hot Leg Inj Isol	2ND065B	ND Train 2B Hot Leg Inj Isol
1NF228A	Glycol Supply Outside Containment Isol	2NF228A	Glycol Supply Outside Containment Isol
1NF233B	Glycol Ret Cont Isol	2NF233B	Glycol Ret Cont Isol
1NF234A	Glycol Return Containment Isolation	2NF234A	Glycol Return Containment Isolation
1NI009A	NV Pmp C/L Inj Isol	2NI009A	NV Pmp C/L Inj Isol
1NI010B	NV Pmp C/L Inj Isol	2NI010B	NV Pmp C/L Inj Isol
1NI047A	C-Leg Accum N2 Sup Cont Isol	2NI047A	C-Leg Accum N2 Sup Cont Isol
1NI054A	C-Leg Accum A Disch Isol	2NI054A	C-Leg Accum A Disch Isol
1NI065B	C-Leg Accum B Disch Isol	2NI065B	C-Leg Accum B Disch Isol
1NI076A	C-Leg Accum C Disch Isol	2NI076A	C-Leg Accum C Disch Isol
1NI088B	C-Leg Accum D Disch Isol	2NI088B	C-Leg Accum D Disch Isol
1NI095A	Cold Leg Accumulator Check Valve Test Isol	2NI095A	Cold Leg Accumulator Check Valve Test Isol
1NI096B	C-Leg Accum Chk Vlv Tst Isol	2NI096B	C-Leg Accum Chk Vlv Tst Isol
1NI100B	NI Pmps Suct From FWST	2NI100B	NI Pmps Suct From FWST
1NI103A	1A NI Pump Suction	2NI103A	2A NI Pump Suction
1NI115A	NI Pump 1A Miniflow Isol	2NI115A	NI Pump 2A Miniflow Isol
1NI118A	NI Pump 1A to C-Leg Inj Isol	2NI118A	NI Pump 2A to C-Leg Inj Isol
1NI120B	NI Pmps to C-Leg Accum Fill	2NI120B	NI Pmps to C-Leg Accum Fill
1NI121A	1A NI Pump to Hot Legs B&C	2NI121A	2A NI Pump to Hot Legs B&C

Unit 1 Valves		Unit 2 Valves	
Valve Number	**Description**	**Valve Number**	**Description**
1NI122B	Hot Leg Injection Check Valve Test Isol	2NI122B	Hot Leg Injection Check Valve Test Isol
1NI135B	1B NI Pump Suction	2NI135B	2B NI Pump Suction
1NI136B	ND Supply to NI Pump 1B	2NI136B	ND Supply to NI Pump 2B
1NI144A	NI Pump 1B Miniflow Isol	2NI144A	NI Pump 2B Miniflow Isol
1NI147B	NI Miniflow Hdr to FWST Isol	2NI147B	NI Miniflow Hdr to FWST Isol
1NI150B	NI Pump 1B C-Leg Inj Isol	2NI150B	NI Pump 2B C-Leg Inj Isol
1NI152B	NI Pump 1B to H-Legs A&D	2NI152B	NI Pump 2B to H-Legs A&D
1NI153A	Hot Leg Injection Check Valve Test Isol	2NI153A	Hot Leg Injection Check Valve Test Isol
1NI154B	ND to Hot Legs Check Valve Test Isol	2NI154B	ND to Hot Legs Check Valve Test Isol
1NI162A	NI to C-Legs Inj Hdr Isol	2NI162A	NI to C-Legs Inj Hdr Isol
1NI173A	ND Header 1A to Cold Legs C & D	2NI173A	ND Header 2A to Cold Legs C & D
1NI178B	ND Hdr 1B to Cold Legs A & B	2NI178B	ND Hdr 2B to Cold Legs A & B
1NI183B	ND Hdr A&B Hot Leg Inj Isol	2NI183B	ND Hdr A&B Hot Leg Inj Isol
1NI184B	ND Pump 1B Cont Sump Suct	2NI184B	ND Pump 2B Cont Sump Suct
1NI185A	ND Pump 1A Cont Sump Suct	2NI185A	ND Pump 2A Cont Sump Suct
1NI332A	NI Pump Suct X-Over From ND	2NI332A	NI Pump Suct X-Over From ND
1NI333B	NI Pump Suct From ND	2NI333B	NI Pump Suct From ND
1NI334B	NI Pump Suct X-Over From ND	2NI334B	NI Pump Suct X-Over From ND
1NI438A	Emer N2 From CLA A to 1NC-34A	2NI438A	Emer N2 From CLA A to 2NC-34A
1NI439B	Emer N2 From CLA B to 1NC-32B	2NI439B	Emer N2 From CLA B to 2NC-32B
1NM003A	Pzr Liq Smpl Line Cont Isol	2NM003A	Pzr Liq Smpl Line Cont Isol
1NM006A	Pzr Steam Sample Line Containment Isol	2NM006A	Pzr Steam Sample Line Containment Isol
1NM007B	Pzr Smpl Hdr Cont Isol	2NM007B	Pzr Smpl Hdr Cont Isol

Unit 1 Valves		**Unit 2 Valves**	
Valve Number	**Description**	**Valve Number**	**Description**
1NM022A	1A Hot Leg Sample Containment Isol	2NM022A	2A Hot Leg Sample Containment Isol
1NM025A	1C Hot Leg Sample Containment Isol	2NM025A	2C Hot Leg Sample Containment Isol
1NM026B	Hot Leg Smpl Hdr Cont Isol	2NM026B	Hot Leg Smpl Hdr Cont Isol
1NM072B	1A Accumulator Sample Line Containment Isol	2NM072B	2A Accumulator Sample Line Containment Isol
1NM075B	1B Accumulator Sample Line Containment Isol	2NM075B	2B Accumulator Sample Line Containment Isol
1NM078B	1C Accumulator Sample Line Containment Isol	2NM078B	2C Accumulator Sample Line Containment Isol
1NM081B	1D Accumulator Sample Line Containment Isol	2NM081B	2D Accumulator Sample Line Containment Isol
1NM082A	Accum Smpl Hdr Cont Isol	2NM082A	Accum Smpl Hdr Cont Isol
1NM187A	1A S/G Upper Shell Sample Containment Isol	2NM187A	2A S/G Upper Shell Sample Containment Isol
1NM190A	1A S/G Blowdown Sample Containment Isol	2NM190A	2A S/G Blowdown Sample Containment Isol
1NM191B	1A S/G Sample Header Containment Isol	2NM191B	2A S/G Sample Header Containment Isol
1NM197B	1B S/G Upper Shell Sample Containment Isol	2NM197B	2B S/G Upper Shell Sample Containment Isol
1NM200B	1B S/G Blowdown Sample Containment Isol	2NM200B	2B S/G Blowdown Sample Containment Isol
1NM201A	1B S/G Sample Header Containment Isol	2NM201A	2B S/G Sample Header Containment Isol
1NM207A	1C S/G Upper Shell Sample Containment Isol	2NM207A	2C S/G Upper Shell Sample Containment Isol
1NM210A	1C S/G Blowdown Sample Containment Isol	2NM210A	2C S/G Blowdown Sample Containment Isol
1NM211B	1C S/G Sample Header Containment Isol	2NM211B	2C S/G Sample Header Containment Isol
1NM217B	1D S/G Upper Shell Sample Containment Isol	2NM217B	2D S/G Upper Shell Sample Containment Isol
1NM220B	1D S/G Blowdown Sample Containment Isol	2NM220B	2D S/G Blowdown Sample Containment Isol
1NM221A	1D S/G Sample Header Containment Isol	2NM221A	2D S/G Sample Header Containment Isol
1NS001B	NS Pmp B Suct From Cont Sump	2NS001B	NS Pmp B Suct From Cont Sump

Unit 1 Valves		**Unit 2 Valves**	
Valve Number	**Description**	**Valve Number**	**Description**
1NS003B	NS Pump 1B Suct From FWST	2NS003B	NS Pump 2B Suct From FWST
1NS012B	NS Spray Hdr 1B Cont Isol	2NS012B	NS Spray Hdr 2B Cont Isol
1NS015B	NS Spray Hdr 1B Cont Isol	2NS015B	NS Spray Hdr 2B Cont Isol
1NS018A	NS Pmp A Suct From Cont Sump	2NS018A	NS Pmp A Suct From Cont Sump
1NS020A	NS Pump 1A Suct From FWST	2NS020A	NS Pump 2A Suct From FWST
1NS029A	NS Spray Hdr 1A Cont Isol	2NS029A	NS Spray Hdr 2A Cont Isol
1NS032A	NS Spray Hdr 1A Cont Isol	2NS032A	NS Spray Hdr 2A Cont Isol
1NS038B	1B ND Pump to Containment Spray Header	2NS038B	2B ND Pump to Containment Spray Header
1NS043A	1A ND Pump to Containment Spray Header	2NS043A	2A ND Pump to Containment Spray Header
1NV001A	NC Letdown to Regen Hx Isol	2NV001A	NC Letdown to Regen Hx Isol
1NV002A	NC Letdown to Regen Hx Isol	2NV002A	NC Letdown to Regen Hx Isol
1NV010A	Letdown Orifice 1B Outlet Cont Isol	2NV010A	Letdown Orifice 2B Outlet Cont Isol
1NV011A	Letdown Orifice 1C Outlet Cont Isol	2NV011A	Letdown Orifice 2C Outlet Cont Isol
1NV013A	Letdown Orifice 1A Outlet Cont Isol	2NV013A	Letdown Orifice 2A Outlet Cont Isol
1NV015B	Letdn Cont Isol	2NV015B	Letdn Cont Isol
1NV037A	NV Sup to Pzr Aux Spray	2NV037A	NV Sup to Pzr Aux Spray
Deleted Per 2004 Update			
1NV089A	NC Pumps Seal Return Cont Isol	2NV089A	NC Pumps Seal Return Cont Isol
1NV091B	NC Pmps Seal Ret Cont Isol	2NV091B	NC Pmps Seal Ret Cont Isol
1NV122B	Loop C to Exs Letdown Hx Isol	2NV122B	Loop C to Exs Letdown Hx Isol
1NV123B	Loop C to Exs Letdown Hx Isol	2NV123B	Loop C to Exs Letdown Hx Isol
1NV188A	VCT Outlet Isol	2NV188A	VCT Outlet Isol
1NV189B	VCT Outlet Isol	2NV189B	VCT Outlet Isol

Unit 1 Valves		Unit 2 Valves	
Valve Number	**Description**	**Valve Number**	**Description**
1NV202B	NV Pmps A & B Recirc Isol	2NV202B	NV Pmps A & B Recirc Isol
1NV203A	NV Pumps A & B Recirc Isol	2NV203A	NV Pumps A & B Recirc Isol
1NV236B	Boric Acid to NV Pumps Suct	2NV236B	Boric Acid to NV Pumps Suct
1NV252A	NV Pumps Suct From FWST	2NV252A	NV Pumps Suct From FWST
1NV253B	NV Pumps Suct From FWST	2NV253B	NV Pumps Suct From FWST
1NV312A	Chrg Line Cont Isol	2NV312A	Chrg Line Cont Isol
1NV314B	Chrg Line Cont Isol	2NV314B	Chrg Line Cont Isol
1NV865A	Standby M/U Pump Suction From Xfr Tube	2NV865A	Standby M/U Pump Suction From Xfr Tube
1NV872A	Stdby M/U Pmp Filt Otlt	2NV872A	Stdby M/U Pmp Filt Otlt
1NW008A	1A NW Surge Chamber RN Supply	2NW008A	2A NW Surge Chamber RN Supply
1NW013A	NW to 1KC-425	2NW013A	NW to 2KC-425
1NW020A	1A NW Surge Chamber Outlet	2NW020A	2A NW Surge Chamber Outlet
1NW035A	Cont Vlv Inj Hdr 1A Cont Isol	2NW035A	Cont Vlv Inj Hdr 2A Cont Isol
1NW046A	SW to 1RN-484A	2NW046A	SW to 2RN-484A
1NW061B	1B NW Surge Chamber RN Supply	2NW061B	2B NW Surge Chamber RN Supply
1NW068B	Seal Water to 1RN487B / 1RN437B	2NW068B	Seal Water to 2RN487B / 2RN437B
1NW069B	1B NW Surge Chamber Outlet	2NW069B	2B NW Surge Chamber Outlet
1NW105B	Cont Vlv Inj Hdr 1B Cont Isol	2NW105B	Cont Vlv Inj Hdr 1B Cont Isol
1NW110B	NW Supply to 1KC-424B	2NW110B	NW Supply to 2KC-424B
1NW145B	Seal Water to 1KC-338B & 1RN-404B	2NW145B	Seal Water to 2KC-338B & 2RN-404B
1RF389B	Unit 1 RF Containment Isol	2RF389B	Unit 2 RF Containment Isol
1RF447B	RF Cont Isol	2RF447B	RF Cont Isol
1RF457B	Annulus Sprinkler Hdr Isol	2RF457B	Annulus Sprinkler Hdr Isol

Unit 1 Valves		**Unit 2 Valves**	
Valve Number	**Description**	**Valve Number**	**Description**
1RN001A	RN P/H Pit A From Lake		
1RN002B	RN P/H Pit A From Lake		
1RN003A	RN P/H Pit A From SNSWP		
1RN004B	RN P/H Pit B From SNSWP		
1RN005A	RN P/H Pit B Isol From Lake		
1RN006B	RN P/H Pit B Isol From Lake		
1RN011A	1A RN Pump Motor Cooler Inlet Isol	2RN011A	2A RN Pump Motor Cooler Inlet Isol
1RN020B	1B RN Pump Motor Cooler Supply Isol	2RN020B	2B RN Pump Motor Cooler Supply Isol
1RN028A	1A RN Pump Discharge Isol	2RN028A	2A RN Pump Discharge Isol
1RN030A	1A RN Strainer Backflush Isol	2RN030A	2A RN Strainer Backflush Isol
1RN036A	RN Pump Injection Filter Inlet X-Over Valve		
	Motor		
1RN037B	RN Pump Injection Filter Outlet X-Over Valve		
	Motor		
1RN038B	1B RN Pump Discharge Isol	2RN038B	2B RN Pump Discharge Isol
1RN040B	1B RN Strainer Backflush Isol	2RN040B	2B RN Strainer Backflush Isol
1RN047A	RN Supply X-Over Isol	2RN047A	RN Supply X-Over Isol
1RN048B	RN Supply X-Over Isol	2RN048B	RN Supply X-Over Isol
1RN049A	Non-Ess Supply Header Isol	2RN049A	Non-Ess Supply Header Isol
1RN050B	Non-Ess Supply Header Isol	2RN050B	Non-Ess Supply Header Isol
1RN051A	Non-Ess Ret Header Isol	2RN051A	Non-Ess Ret Header Isol
1RN052B	Non-Ess Ret Header Isol	2RN052B	Non-Ess Ret Header Isol
1RN053B	Station RN Discharge Header X-Over		

Unit 1 Valves		Unit 2 Valves	
Valve Number	**Description**	**Valve Number**	**Description**
1RN054A	Station RN Disch Header X-Over		
1RN057A	Station RN Disch to RL System		
1RN058B	RN Header B Return to SNSWP		
1RN063A	RN Header A Return to SNSWP		
1RN144A	1A NS Hx Inlet Isol	2RN144A	2A NS Hx Inlet Isol
1RN148A	1A NS Hx Outlet Isol	2RN148A	2A NS Hx Outlet Isol
1RN225B	NS Hx 1B Inlet Isol	2RN225B	NS Hx 2B Inlet Isol
1RN229B	1B NS Hx Outlet Isol	2RN229B	2B NS Hx Outlet Isol
1RN232A	1A D/G Hx Inlet Isol	2RN232A	2A D/G Hx Inlet Isol
1RN244A	A Control Room Area Chiller Condenser Auto		
	Control Valve		
1RN250A	1A RN Supply Header to CA Pumps Suction Isol	2RN250A	2A RN Supply Header to CA Pumps Suction Isol
1RN291	1A KC Hx Outlet Throttle	2RN291	2A KC Hx Outlet Throttle
1RN292B	1B D/G Hx Inlet Isol	2RN292B	2B D/G Hx Inlet Isol
1RN304B	Control Room Area Chiller B Cond Auto		
	Control Valve		
1RN310B	1B RN Header to CA Pumps Suction Isol	2RN310B	2B RN Header to CA Pumps Suction Isol
1RN351	1B KC Hx Outlet Throttle	2RN351	2B KC Hx Outlet Throttle
1RN404B	Upper Cont Vent Unit Supply	2RN404B	Upper Cont Vent Unit Supply
1RN437B	Lower Cont Vent Unit Supply	2RN437B	Lower Cont Vent Unit Supply
1RN484A	Lower Cont Vent Unit Return	2RN484A	Lower Cont Vent Unit Return
1RN487B	Lower Cont Vent Unit Return	2RN487B	Lower Cont Vent Unit Return
1RN839A	Aux Bldg Fuel Handling Radiation Area	2RN839A	Aux Bldg Fuel Handling Radiation Area

Unit 1 Valves		Unit 2 Valves	
Valve Number	**Description**	**Valve Number**	**Description**
	Supply		Supply
	Header Isol		Header Isol
1RN841B	Aux Bldg Fuel Handling Radiation Area Return	2RN841B	Aux Bldg Fuel Handling Radiation Area Return
	Header Isol		Header Isol
1RN843B	Station RN Disch to RL System	2RN843B	Station RN Disch to RL System
1RN846A	1A D/G Hx Return to SNSWP	2RN846A	2A D/G Hx Return to SNSWP
1RN847A	1A D/G Hx Return to Lake	2RN847A	2A D/G Hx Return to Lake
1RN848B	1B D/G Hx Return to SNSWP	2RN848B	2B D/G Hx Return to SNSWP
1RN849B	1B D/G Hx Return to Lake	2RN849B	2B D/G Hx Return to Lake
1SA002	1B S/G Main Steam Supply to CAPT	2SA002	2B S/G Main Steam Supply to CAPT
1SA005	1C S/G Main Steam Supply to CAPT	2SA005	2C S/G Main Steam Supply to CAPT
1SM001	1D S/G Main Steam Isol	2SM001	2D S/G Main Steam Isol
1SM003	1C S/G Main Steam Isol	2SM003	2C S/G Main Steam Isol
1SM005	1B S/G Main Steam Isol	2SM005	2B S/G Main Steam Isol
1SM007	1A S/G Main Steam Isol Valve	2SM007	2A S/G Main Steam Isol Valve
1SM009	S/G 1D SM Isol Byp	2SM009	S/G 2D SM Isol Byp
1SM010	1C S/G Main Steam Isol Bypass	2SM010	2C S/G Main Steam Isol Bypass
1SM011	1B S/G Main Steam Isol Bypass	2SM011	2B S/G Main Steam Isol Bypass
1SM012	S/G 1A SM Isol Byp	2SM012	S/G 2A SM Isol Byp
1SM074B	S/G 1D Otlt Hdr Bldwn C/V	2SM074B	S/G 2D Otlt Hdr Bldwn C/V
1SM075A	S/G 1C Otlt Hdr Bldwn C/V	2SM075A	S/G 2C Otlt Hdr Bldwn C/V
1SM076B	S/G 1B Otlt Hdr Bldwn C/V	2SM076B	S/G 2B Otlt Hdr Bldwn C/V
1SM077A	S/G 1A Otlt Hdr Bldwn C/V	2SM077A	S/G 2A Otlt Hdr Bldwn C/V

Unit 1 Valves		Unit 2 Valves	
Valve Number	Description	Valve Number	Description
1SV001	S/G 1D PORV Manual Ctrl	2SV001	S/G 2D PORV Manual Ctrl
1SV002	1D S/G Safety No 1	2SV002	2D S/G Safety No 1
1SV003	1D S/G Safety No 2	2SV003	2D S/G Safety No 2
1SV004	1D S/G Safety No 3	2SV004	2D S/G Safety No 3
1SV005	1D S/G Safety No 4	2SV005	2D S/G Safety No 4
1SV006	1D S/G Safety No 5	2SV006	2D S/G Safety No 5
1SV007	S/G 1C PORV Manual Ctrl	2SV007	S/G 2C PORV Manual Ctrl
1SV008	1C S/G Safety No 1	2SV008	2C S/G Safety No 1
1SV009	1C S/G Safety No 2	2SV009	2C S/G Safety No 2
1SV010	1C S/G Safety No 3	2SV010	2C S/G Safety No 3
1SV011	1C S/G Safety No 4	2SV011	2C S/G Safety No 4
1SV012	1C S/G Safety No 5	2SV012	2C S/G Safety No 5
1SV013	S/G 1B PORV Manual Ctrl	2SV013	S/G 2B PORV Manual Ctrl
1SV014	1B S/G Safety No 1	2SV014	2B S/G Safety No 1
1SV015	1B S/G Safety No 2	2SV015	2B S/G Safety No 2
1SV016	1B S/G Safety No 3	2SV016	2B S/G Safety No 3
1SV017	1B S/G Safety No 4	2SV017	2B S/G Safety No 4
1SV018	1B S/G Safety No 5	2SV018	2B S/G Safety No 5
1SV019	S/G 1A PORV Manual Ctrl	2SV019	S/G 2A PORV Manual Ctrl
1SV020	1A S/G Safety No 1	2SV020	2A S/G Safety No 1
1SV021	1A S/G Safety No 2	2SV021	2A S/G Safety No 2
1SV022	1A S/G Safety No 3	2SV022	2A S/G Safety No 3
1SV023	1A S/G Safety No 4	2SV023	2A S/G Safety No 4

Unit 1 Valves		**Unit 2 Valves**	
Valve Number	**Description**	**Valve Number**	**Description**
1SV024	1A S/G Safety No 5	2SV024	2A S/G Safety No 5
1SV025B	1D S/G PORV Isol	2SV025B	2D S/G PORV Isol
1SV026B	1C S/G PORV Isol	2SV026B	2C S/G PORV Isol
1SV027A	1A S/G PORV Isol	2SV027A	2A S/G PORV Isol
1SV028A	1B S/G PORV Isol	2SV028A	2B S/G PORV Isol
1VA028B	ABFU-1A Miniflow Inlt	2VA028B	ABFU-2A Miniflow Inlt
1VA029A	ABFU-1A Miniflow Otlt	2VA029A	ABFU-2A Miniflow Otlt
1VA030B	ABFU-1B Miniflow Otlt	2VA030B	ABFU-2B Miniflow Otlt
1VA031A	ABFU-1B Miniflow Inlt	2VA031A	ABFU-2B Miniflow Inlt
1VB083B	VB Cont Isol	2VB083B	VB Cont Isol
1VC005B	CRA Filt Inlet	2VC005B	CRA Filt Inlet
1VC006A	CRA Filt Inlet	2VC006A	CRA Filt Inlet
1VC007B	CR Area Filter Miniflow Isol	2VC007B	CR Area Filter Miniflow Isol
1VC008A	CR Area Filters X-Conn	2VC008A	CR Area Filters X-Conn
1VE004	Ann Vent 1A (AVF-1A) Miniflow Isol	2VE004	Ann Vent 2A (AVF-2A) Miniflow Isol
1VE009	Ann Vent Fan 1B (AVF-1B) Miniflow Isol	2VE009	Ann Vent Fan 2B (AVF-2B) Miniflow Isol
1VF001A	1A VF Filter Miniflow Outlet	2VF001A	2A VF Filter Miniflow Outlet
1VF002B	1B VF Filter Miniflow Outlet	2VF002B	2B VF Filter Miniflow Outlet
1VF003A	1B VF Filter Miniflow Inlet	2VF003A	2B VF Filter Miniflow Inlet
1VF004B	1A VF Filter Miniflow Inlet	2VF004B	2A VF Filter Miniflow Inlet
1VG025	D/G 1A Starting Air Inlet	2VG025	D/G 2A Starting Air Inlet
1VG026	D/G 1A Starting Air Inlet	2VG026	D/G 2A Starting Air Inlet
1VG027	D/G 1A Starting Air Inlet	2VG027	D/G 2A Starting Air Inlet

Unit 1 Valves		Unit 2 Valves	
Valve Number	Description	Valve Number	Description
1VG028	D/G 1A Starting Air Inlet	2VG028	D/G 2A Starting Air Inlet
1VG069	1B D/G Eng Starting Air Inlet	2VG069	2B D/G Eng Starting Air Inlet
1VG070	1B D/G Eng Starting Air Inlet	2VG070	2B D/G Eng Starting Air Inlet
1VG071	1B D/G Eng Starting Air Inlet	2VG071	2B D/G Eng Starting Air Inlet
1VG072	1B D/G Eng Starting Air Inlet	2VG072	2B D/G Eng Starting Air Inlet
1VI077B	VI Cont Isol	2VI077B	VI Cont Isol
1VI312A	VI to VP Cont Isol	2VI312A	VI to VP Cont Isol
Deleted Per 2007 Update			
1VQ002A	VQ Fan Suct From Cont Isol	2VQ002A	VQ Fan Suct From Cont Isol
1VQ003B	VQ Fan Suct From Cont Isol	2VQ003B	VQ Fan Suct From Cont Isol
1VQ015B	Cont Air Add Cont Isol	2VQ015B	Cont Air Add Cont Isol
1VQ016A	Cont Air Add Cont Isol	2VQ016A	Cont Air Add Cont Isol
1VS054B	VS Cont Isol	2VS054B	VS Cont Isol
1VX001A	1A Hydrogen Skimmer Fan Inlet Isol	2VX001A	2A Hydrogen Skimmer Fan Inlet Isol
1VX002B	1B Hydrogen Skimmer Fan Inlet Isol	2VX002B	2B Hydrogen Skimmer Fan Inlet Isol
Deleted Per 2007 Update			
1WL450A	NCDT Vent Cont Isol	2WL450A	NCDT Vent Cont Isol
1WL451B	NCDT Vent Cont Isol	2WL451B	NCDT Vent Cont Isol
1WL805A	NCDT Pump Disch Cont Isol	2WL805A	NCDT Pump Disch Cont Isol
1WL807B	NCDT Pumps Disch Cont Isol	2WL807B	NCDT Pumps Disch Cont Isol
1WL825A	Cont Sump Pmps Disch Cont Isol	2WL825A	Cont Sump Pmps Disch Cont Isol
1WL827B	Cont Smp Pmps Disch Cont Isol	2WL827B	Cont Smp Pmps Disch Cont Isol
1WL867A	VUCDT Cont Isol	2WL867A	VUCDT Cont Isol

Unit 1 Valves		**Unit 2 Valves**	
Valve Number	**Description**	**Valve Number**	**Description**
1WL869B	VUCDT Containment Isol	2WL869B	VUCDT Containment Isol
1YC077A	YC Loop-A M/U Isol		
1YC121B	YC Loop-B M/U Isol		
1YM119B	YM Cont Isol	2YM119B	YM Cont Isol

NOTES CONCERNING ACTIVE LIST

1. Systems may be identified from Valve Numbers:

BB	Steam Generator Blowdown Recycle System	RF	Interior Fire Protection System
CA	Auxiliary Feedwater System	RN	Nuclear Service Water System
CF	Feedwater System	SA	Auxiliary Steam System
FD	Diesel Generator Engine Fuel Oil System	SM	Main Steam System
FW	Refueling Water System	SV	Main Steam Vent to Atmosphere System
KC	Component Cooling System	VB	Breathing Air System
KD	Diesel Generator Engine Cooling Water System	VC	Control Room Ventilation System
KF	Spent Fuel Cooling System	VG	Diesel Generator Engine Starting Air System
NB	Boron Recycle System	VI	Instrument Air System
NC	Reactor Coolant System	Deleted Per 2007 Update	
ND	Residual Heat Removal System	VQ	Containment Air Release and Addition System
NF	Ice Condenser Refrigeration System	VS	Station Air System
NI	Safety Injection System	VX	Containment Air Return and Hydrogen Skimmer System
NM	Nuclear Sampling System	Deleted Per 2007 Update	
NS	Containment Spray System	WL	Liquid Waste Recycle System
NV	Chemical and Volume Control System	YC	Control Area Chilled Water System
NW	Containment Valve Seal Water Injection System	YM	Demineralized Water System

2. For the purpose of this table, as well as in the specification of valves, an active valve is defined as follows:
   Any operator actuated valve, powered by electricity, air, or hydraulic fluid which:
   1. Performs a Reactor Coolant System pressure boundary isolation function
   2. Performs an automatic Containment isolation function
   3. Is required to operate on safety signals S, T, or P, or
   4. Is required to proceed to plant cooldown following postulated LOCA and Safe Shutdown Earthquake (SSE).

   For these reasons, check valves and safety relief valves are not included as active valves, but these valves must meet all the seismic qualifications required by their ASME Code Class. Some safety relief valves are included because they act as containment isolation or reactor coolant pressure boundary isolation.

3. Instrument valves (e.g. IASV 5080, MISV 5230, et al) may be active but are not included in this list. Instrument valve safety class and function are found in the I &C List (H5 file).

Table 3-105. Deleted Per 2003 Update

Table 3-106. Deleted Per 2003 Update

Table 3-107. Control Complex Areas Ventilation Systems Analysis Results

Control Complex Area	Temperature[1]	Relative Humidity[1]
Control Room	75 F	45%
Cable Room	85 F	30%
Battery and Equipment Room	80 F	50%
Switchgear Rooms	85 F	30%
Motor Control Center Rooms	85 F	30%
Ventilation Equipment Rooms	100 F	30%
Electrical Penetration Rooms (EL 594)	85 F	30%

Note:

1. The temperature and relative humidity values are nominal and may vary by +5°F and +10% RH respectively.

Table 3-108. Comparison of Responses: Direct Generation (EDASP) Versus Time History 0.5% Critical Damping At Elev. 562+0

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.48	0.68	5.25	5.25	1.69	1.69
1.10	1.13	0.64	0.76	5.50	5.41	1.21	1.29
1.20	1.18	0.71	0.82	5.75	5.73	0.80	0.95
1.30	1.32	0.62	0.76	6.00	6.05	0.80	0.86
1.40	1.42	0.58	0.73	6.25	6.21	0.68	0.87
1.50	1.51	0.68	0.86	6.50	6.53	0.79	0.89
1.60	1.61	0.76	0.95	6.75	6.68	0.78	0.95
1.70	1.70	0.79	0.98	7.00	7.00	0.80	0.93
1.80	1.80	0.90	1.12	7.25	7.32	0.81	0.90
1.90	1.89	1.08	1.21	7.50	7.48	0.86	0.87
2.00	2.04	1.03	1.14	7.75	7.80	0.64	0.87
2.10	2.09	0.94	1.07	8.00	7.96	0.78	0.88
2.20	2.18	0.82	1.19	8.50	8.44	0.84	0.85
2.30	2.32	1.07	1.29	9.00	9.07	0.78	0.81
2.40	2.42	1.10	1.25	9.50	9.55	0.62	0.78
2.50	2.52	1.03	1.23	10.00	9.87	0.62	0.73
2.60	2.61	1.01	1.26	10.50	10.35	0.61	0.64
2.70	2.71	1.10	1.33	11.00	10.98	0.62	0.64
2.80	2.80	1.20	1.31	11.50	11.62	0.51	0.67
2.90	2.90	1.04	1.23	12.00	11.94	0.51	0.62
3.00	2.99	0.88	1.17	12.50	12.57	0.48	0.58
3.15	3.14	1.12	1.22	13.00	12.89	0.47	0.54
3.30	3.34	1.06	1.30	13.50	13.53	0.42	0.52
3.60	3.66	1.09	1.25	14.00	13.85	0.40	0.48
3.80	3.82	0.87	1.18	14.50	14.48	0.37	0.45
4.00	3.98	0.93	1.20	15.00	15.12	0.30	0.43
4.20	4.14	1.18	1.31	16.00	16.07	0.25	0.39
4.40	4.46	1.19	1.35	17.00	17.03	0.23	0.38
4.60	4.62	1.10	1.47	17.45	17.35	0.22	0.35
4.80	4.78	1.47	1.61	18.00	17.99	0.23	0.33

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	1.41	1.72	20.00	19.89	0.22	0.23

Table 3-109. Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 562+0

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	N/A	0.32	5.25	5.25	N/A	0.61
1.10	1.13	N/A	0.37	5.50	5.41	N/A	0.60
1.20	1.18	N/A	0.40	5.75	5.73	N/A	0.49
1.30	1.32	N/A	0.40	6.00	6.05	N/A	0.44
1.40	1.42	N/A	0.39	6.25	6.21	N/A	0.42
1.50	1.51	N/A	0.42	6.50	6.53	N/A	0.41
1.60	1.61	N/A	0.46	6.75	6.68	N/A	0.41
1.70	1.70	N/A	0.48	7.00	7.00	N/A	0.40
1.80	1.80	N/A	0.51	7.25	7.32	N/A	0.40
1.90	1.89	N/A	0.54	7.50	7.48	N/A	0.39
2.00	2.04	N/A	0.53	7.75	7.80	N/A	0.38
2.10	2.09	N/A	0.53	8.00	7.96	N/A	0.38
2.20	2.18	N/A	0.54	8.50	8.44	N/A	0.37
2.30	2.32	N/A	0.56	9.00	9.07	N/A	0.36
2.40	2.42	N/A	0.56	9.50	9.55	N/A	0.35
2.50	2.52	N/A	0.56	10.00	9.87	N/A	0.33
2.60	2.61	N/A	0.56	10.50	10.35	N/A	0.32
2.70	2.71	N/A	0.56	11.00	10.98	N/A	0.31
2.80	2.80	N/A	0.56	11.50	11.62	N/A	0.31
2.90	2.90	N/A	0.55	12.00	11.94	N/A	0.30
3.00	2.99	N/A	0.54	12.50	12.57	N/A	0.29
3.15	3.14	N/A	0.54	13.00	12.89	N/A	0.29
3.30	3.34	N/A	0.54	13.50	13.53	N/A	0.28
3.60	3.66	N/A	0.53	14.00	13.85	N/A	0.27
3.80	3.82	N/A	0.52	14.50	14.48	N/A	0.26
4.00	3.98	N/A	0.53	15.00	15.12	N/A	0.26
4.20	4.14	N/A	0.54	16.00	16.07	N/A	0.25
4.40	4.46	N/A	0.56	17.00	17.03	N/A	0.24
4.60	4.62	N/A	0.59	17.45	17.35	N/A	0.24
4.80	4.78	N/A	0.61	18.00	17.99	N/A	0.23

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	N/A	0.63	20.00	19.89	N/A	0.22

Table 3-110. Comparison of Responses: Direct Generation (EDASP) Versus Time History 0.5% Critical Damping At Elev. 595+4

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.49	0.69	5.25	5.25	3.94	4.12
1.10	1.13	0.65	0.77	5.50	5.41	2.84	4.14
1.20	1.18	0.72	0.82	5.75	5.73	1.63	2.10
1.30	1.32	0.63	0.77	6.00	6.05	1.09	1.32
1.40	1.42	0.60	0.74	6.25	6.21	0.77	0.94
1.50	1.51	0.70	0.89	6.50	6.53	0.61	0.68
1.60	1.61	0.79	0.98	6.75	6.68	0.58	0.61
1.70	1.70	0.81	1.01	7.00	7.00	0.58	0.59
1.80	1.80	0.93	1.16	7.25	7.32	0.61	0.58
1.90	1.89	1.13	1.26	7.50	7.48	0.58	0.58
2.00	2.04	1.08	1.19	7.75	7.80	0.50	0.60
2.10	2.09	0.99	1.12	8.00	7.96	0.57	0.62
2.20	2.18	0.86	1.26	8.50	8.44	0.66	0.64
2.30	2.32	1.14	1.37	9.00	9.07	0.68	0.64
2.40	2.42	1.18	1.34	9.50	9.55	0.56	0.65
2.50	2.52	1.01	1.32	10.00	9.87	0.55	0.63
2.60	2.61	1.10	1.36	10.50	10.35	0.53	0.59
2.70	2.71	1.21	1.46	11.00	10.98	0.57	0.62
2.80	2.80	1.32	1.44	11.50	11.62	0.54	0.66
2.90	2.90	1.15	1.37	12.00	11.94	0.52	0.64
3.00	2.99	0.98	1.32	12.50	12.57	0.50	0.63
3.15	3.14	1.29	1.40	13.00	12.89	0.54	0.61
3.30	3.34	1.26	1.51	13.50	13.53	0.55	0.61
3.60	3.66	1.37	1.52	14.00	13.85	0.51	0.60
3.80	3.82	1.10	1.49	14.50	14.48	0.45	0.59
4.00	3.98	1.21	1.57	15.00	15.12	0.43	0.60
4.20	4.14	1.60	1.81	16.00	16.07	0.35	0.63
4.40	4.46	1.78	1.98	17.00	17.03	0.32	0.72
4.60	4.62	1.75	2.36	17.45	17.35	0.31	0.73
4.80	4.78	2.44	2.85	18.00	17.99	0.32	0.71

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	2.69	3.56	20.00	19.89	0.30	0.39

Table 3-111. Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 595+4

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.30	0.32	5.25	5.25	1.15	1.30
1.10	1.13	0.37	0.38	5.50	5.41	1.10	1.27
1.20	1.18	0.38	0.41	5.75	5.73	0.90	1.01
1.30	1.32	0.35	0.40	6.00	6.05	0.75	0.81
1.40	1.42	0.40	0.40	6.25	6.21	0.67	0.66
1.50	1.51	0.43	0.44	6.50	6.53	0.56	0.57
1.60	1.61	0.45	0.47	6.75	6.68	0.52	0.51
1.70	1.70	0.44	0.50	7.00	7.00	0.49	0.48
1.80	1.80	0.48	0.53	7.25	7.32	0.46	0.45
1.90	1.89	0.55	0.56	7.50	7.48	0.44	0.43
2.00	2.04	0.59	0.56	7.75	7.80	0.41	0.42
2.10	2.09	0.58	0.55	8.00	7.96	0.40	0.41
2.20	2.18	0.54	0.57	8.50	8.44	0.38	0.40
2.30	2.32	0.62	0.59	9.00	9.07	0.39	0.39
2.40	2.42	0.64	0.60	9.50	9.55	0.37	0.38
2.50	2.52	0.60	0.60	10.00	9.87	0.35	0.37
2.60	2.61	0.61	0.61	10.50	10.35	0.35	0.36
2.70	2.71	0.66	0.62	11.00	10.98	0.34	0.36
2.80	2.80	0.65	0.62	11.50	11.62	0.34	0.36
2.90	2.90	0.60	0.61	12.00	11.94	0.33	0.36
3.00	2.99	0.58	0.61	12.50	12.57	0.33	0.35
3.15	3.14	0.59	0.62	13.00	12.89	0.35	0.35
3.30	3.34	0.59	0.63	13.50	13.53	0.36	0.35
3.60	3.66	0.67	0.65	14.00	13.85	0.35	0.34
3.80	3.82	0.64	0.66	14.50	14.48	0.33	0.34
4.00	3.98	0.66	0.70	15.00	15.12	0.33	0.34
4.20	4.14	0.70	0.76	16.00	16.07	0.32	0.35
4.40	4.46	0.82	0.84	17.00	17.03	0.30	0.35
4.60	4.62	0.91	0.95	17.45	17.35	0.30	0.35
4.80	4.78	0.98	1.08	18.00	17.99	0.30	0.34

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	1.05	1.21	20.00	19.89	0.29	0.31

Table 3-112. Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 628 + 8

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.49	0.69	5.25	5.25	6.71	7.14
1.10	1.13	0.66	0.78	5.50	5.41	5.07	7.22
1.20	1.18	0.74	0.84	5.75	5.73	3.21	4.19
1.30	1.32	0.64	0.79	6.00	6.05	2.29	2.87
1.40	1.42	0.61	0.76	6.25	6.21	1.61	2.14
1.50	1.51	0.72	0.91	6.50	6.53	1.34	1.52
1.60	1.61	0.81	1.01	6.75	6.68	1.12	1.21
1.70	1.70	0.84	1.05	7.00	7.00	0.85	0.97
1.80	1.80	0.97	1.20	7.25	7.32	0.81	0.84
1.90	1.89	1.18	1.31	7.50	7.48	0.76	0.74
2.00	2.04	1.14	1.24	7.75	7.80	0.62	0.66
2.10	2.09	1.05	1.18	8.00	7.96	0.63	0.62
2.20	2.18	0.92	1.33	8.50	8.44	0.57	0.57
2.30	2.32	1.32	1.45	9.00	9.07	0.60	0.55
2.40	2.42	1.27	1.43	9.50	9.55	0.54	0.54
2.50	2.52	1.13	1.42	10.00	9.87	0.52	0.54
2.60	2.61	1.20	1.48	10.50	10.35	0.50	0.53
2.70	2.71	1.32	1.59	11.00	10.98	0.50	0.54
2.80	2.80	1.46	1.58	11.50	11.62	0.51	0.57
2.90	2.90	1.26	1.51	12.00	11.94	0.52	0.57
3.00	2.99	1.09	1.47	12.50	12.57	0.49	0.57
3.15	3.14	1.46	1.58	13.00	12.89	0.55	0.57
3.30	3.34	1.47	1.73	13.50	13.53	0.58	0.57
3.60	3.66	1.67	1.81	14.00	13.85	0.53	0.58
3.80	3.82	1.37	1.81	14.50	14.48	0.50	0.59
4.00	3.98	1.54	1.98	15.00	15.12	0.57	0.60
4.20	4.14	2.05	2.35	16.00	16.07	0.46	0.66
4.40	4.46	2.43	2.68	17.00	17.03	0.44	0.78
4.60	4.62	2.53	3.36	17.45	17.35	0.44	0.81
4.80	4.78	3.52	4.27	18.00	17.99	0.43	0.80

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	4.13	5.73	20.00	19.89	0.42	0.52

Table 3-113. Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 628 + 8

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.31	0.32	5.25	5.25	1.90	2.19
1.10	1.13	0.37	0.38	5.50	5.41	1.87	2.20
1.20	1.18	0.38	0.42	5.75	5.73	1.60	1.81
1.30	1.32	0.36	0.41	6.00	6.05	1.31	1.47
1.40	1.42	0.41	0.41	6.25	6.21	1.16	1.20
1.50	1.51	0.45	0.45	6.50	6.53	0.93	1.02
1.60	1.61	0.47	0.48	6.75	6.68	0.85	0.89
1.70	1.70	0.46	0.51	7.00	7.00	0.73	0.79
1.80	1.80	0.50	0.55	7.25	7.32	0.67	0.72
1.90	1.89	0.57	0.58	7.50	7.48	0.66	0.67
2.00	2.04	0.63	0.58	7.75	7.80	0.62	0.63
2.10	2.09	0.62	0.58	8.00	7.96	0.60	0.60
2.20	2.18	0.58	0.61	8.50	8.44	0.56	0.55
2.30	2.32	0.66	0.63	9.00	9.07	0.52	0.52
2.40	2.42	0.69	0.64	9.50	9.55	0.49	0.50
2.50	2.52	0.64	0.65	10.00	9.87	0.48	0.49
2.60	2.61	0.67	0.66	10.50	10.35	0.47	0.47
2.70	2.71	0.72	0.68	11.00	10.98	0.45	0.46
2.80	2.80	0.72	0.68	11.50	11.62	0.43	0.46
2.90	2.90	0.67	0.68	12.00	11.94	0.44	0.45
3.00	2.99	0.64	0.68	12.50	12.57	0.44	0.45
3.15	3.14	0.67	0.70	13.00	12.89	0.45	0.44
3.30	3.34	0.68	0.74	13.50	13.53	0.46	0.44
3.60	3.66	0.82	0.78	14.00	13.85	0.46	0.44
3.80	3.82	0.79	0.83	14.50	14.48	0.45	0.44
4.00	3.98	0.80	0.91	15.00	15.12	0.44	0.44
4.20	4.14	0.92	1.03	16.00	16.07	0.43	0.44
4.40	4.46	1.16	1.19	17.00	17.03	0.43	0.45
4.60	4.62	1.32	1.40	17.45	17.35	0.42	0.45
4.80	4.78	1.46	1.66	18.00	17.99	0.42	0.45

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	1.64	1.95	20.00	19.89	0.41	0.42

Table 3-114 Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 662 + 0

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.50	0.70	5.25	5.25	9.46	10.18
1.10	1.13	0.67	0.79	5.50	5.41	7.33	10.35
1.20	1.18	0.75	0.85	5.75	5.73	4.85	6.37
1.30	1.32	0.66	0.80	6.00	6.05	3.57	4.54
1.40	1.42	0.62	0.78	6.25	6.21	2.56	3.52
1.50	1.51	0.73	0.93	6.50	6.53	2.22	2.61
1.60	1.61	0.84	1.03	6.75	6.68	1.97	2.17
1.70	1.70	0.87	1.08	7.00	7.00	1.43	1.76
1.80	1.80	1.00	1.24	7.25	7.32	1.42	1.54
1.90	1.89	1.22	1.36	7.50	7.48	1.33	1.33
2.00	2.04	1.20	1.29	7.75	7.80	1.01	1.17
2.10	2.09	1.10	1.23	8.00	7.96	1.09	1.08
2.20	2.18	0.96	1.40	8.50	8.44	0.89	0.92
2.30	2.32	1.30	1.53	9.00	9.07	0.80	0.82
2.40	2.42	1.35	1.51	9.50	9.55	0.76	0.75
2.50	2.52	1.26	1.51	10.00	9.87	0.69	0.70
2.60	2.61	1.29	1.58	10.50	10.35	0.65	0.66
2.70	2.71	1.42	1.71	11.00	10.98	0.63	0.63
2.80	2.80	1.59	1.71	11.50	11.62	0.60	0.61
2.90	2.90	1.37	1.65	12.00	11.94	0.59	0.60
3.00	2.99	1.20	1.61	12.50	12.57	0.58	0.59
3.15	3.14	1.63	1.75	13.00	12.89	0.58	0.58
3.30	3.34	1.67	1.94	13.50	13.53	0.58	0.57
3.60	3.66	1.95	2.08	14.00	13.85	0.57	0.57
3.80	3.82	1.62	2.12	14.50	14.48	0.55	0.57
4.00	3.98	1.85	2.38	15.00	15.12	0.56	0.57
4.20	4.14	2.48	2.88	16.00	16.07	0.56	0.58
4.40	4.46	3.07	3.37	17.00	17.03	0.54	0.61
4.60	4.62	3.31	4.35	17.45	17.35	0.54	0.63
4.80	4.78	4.60	5.67	18.00	17.99	0.54	0.63

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	5.64	7.89	20.00	19.89	0.53	0.56

Table 3-115 Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 662 + 0

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.31	0.33	5.25	5.25	2.66	3.09
1.10	1.13	0.38	0.39	5.50	5.41	2.67	3.14
1.20	1.18	0.39	0.42	5.75	5.73	2.34	2.65
1.30	1.32	0.36	0.42	6.00	6.05	1.93	2.17
1.40	1.42	0.41	0.42	6.25	6.21	1.70	1.80
1.50	1.51	0.46	0.46	6.50	6.53	1.37	1.52
1.60	1.61	0.48	0.50	6.75	6.68	1.20	1.33
1.70	1.70	0.48	0.53	7.00	7.00	1.05	1.19
1.80	1.80	0.53	0.57	7.25	7.32	1.01	1.08
1.90	1.89	0.60	0.60	7.50	7.48	0.97	0.99
2.00	2.04	0.66	0.61	7.75	7.80	0.90	0.92
2.10	2.09	0.66	0.61	8.00	7.96	0.87	0.87
2.20	2.18	0.61	0.64	8.50	8.44	0.78	0.79
2.30	2.32	0.71	0.67	9.00	9.07	0.73	0.74
2.40	2.42	0.74	0.68	9.50	9.55	0.70	0.70
2.50	2.52	0.69	0.69	10.00	9.87	0.67	0.67
2.60	2.61	0.73	0.71	10.50	10.35	0.64	0.64
2.70	2.71	0.79	0.73	11.00	10.98	0.62	0.62
2.80	2.80	0.78	0.74	11.50	11.62	0.60	0.61
2.90	2.90	0.73	0.75	12.00	11.94	0.59	0.60
3.00	2.99	0.71	0.76	12.50	12.57	0.58	0.59
3.15	3.14	0.75	0.79	13.00	12.89	0.57	0.58
3.30	3.34	0.79	0.84	13.50	13.53	0.57	0.57
3.60	3.66	0.96	0.92	14.00	13.85	0.56	0.56
3.80	3.82	0.93	1.00	14.50	14.48	0.56	0.56
4.00	3.98	0.97	1.12	15.00	15.12	0.56	0.55
4.20	4.14	1.16	1.30	16.00	16.07	0.55	0.55
4.40	4.46	1.50	1.54	17.00	17.03	0.54	0.54
4.60	4.62	1.73	1.85	17.45	17.35	0.54	0.54
4.80	4.78	1.95	2.25	18.00	17.99	0.54	0.54

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	2.23	2.67	20.00	19.89	0.53	0.53

Table 3-116 Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 691 + 2

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.50	0.71	5.25	5.25	11.62	12.60
1.10	1.13	0.67	0.80	5.50	5.41	9.12	12.83
1.20	1.18	0.76	0.86	5.75	5.73	6.14	8.12
1.30	1.32	0.67	0.81	6.00	6.05	4.59	5.89
1.40	1.42	0.63	0.79	6.25	6.21	3.35	4.63
1.50	1.51	0.75	0.94	6.50	6.53	2.93	3.50
1.60	1.61	0.85	1.05	6.75	6.68	2.68	2.97
1.70	1.70	0.89	1.10	7.00	7.00	1.99	2.45
1.80	1.80	1.03	1.27	7.25	7.32	1.96	2.15
1.90	1.89	1.26	1.40	7.50	7.48	1.88	1.88
2.00	2.04	1.24	1.33	7.75	7.80	1.39	1.66
2.10	2.09	1.14	1.27	8.00	7.96	1.54	1.55
2.20	2.18	1.00	1.45	8.50	8.44	1.28	1.33
2.30	2.32	1.36	1.59	9.00	9.07	1.24	1.18
2.40	2.42	1.41	1.57	9.50	9.55	1.07	1.07
2.50	2.52	1.32	1.58	10.00	9.87	1.00	0.99
2.60	2.61	1.36	1.66	10.50	10.35	0.91	0.91
2.70	2.71	1.51	1.80	11.00	10.98	0.87	0.87
2.80	2.80	1.69	1.81	11.50	11.62	0.83	0.85
2.90	2.90	1.45	1.75	12.00	11.94	0.77	0.82
3.00	2.99	1.28	1.72	12.50	12.57	0.80	0.79
3.15	3.14	1.76	1.89	13.00	12.89	0.75	0.77
3.30	3.34	1.83	2.10	13.50	13.53	0.74	0.75
3.60	3.66	2.18	2.29	14.00	13.85	0.72	0.74
3.80	3.82	1.82	2.37	14.50	14.48	0.70	0.72
4.00	3.98	2.10	2.69	15.00	15.12	0.66	0.71
4.20	4.14	2.82	3.30	16.00	16.07	0.64	0.70
4.40	4.46	3.56	3.91	17.00	17.03	0.64	0.71
4.60	4.62	3.92	5.12	17.45	17.35	0.63	0.70
4.80	4.78	5.45	6.78	18.00	17.99	0.63	0.70

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	6.79	9.60	20.00	19.89	0.62	0.64

Table 3-117 Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 691 + 2

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.32	0.33	5.25	5.25	3.27	3.82
1.10	1.13	0.38	0.39	5.50	5.41	3.30	3.88
1.20	1.18	0.39	0.43	5.75	5.73	2.94	3.32
1.30	1.32	0.37	0.42	6.00	6.05	2.43	2.74
1.40	1.42	0.42	0.43	6.25	6.21	2.15	2.28
1.50	1.51	0.47	0.47	6.50	6.53	1.74	1.94
1.60	1.61	0.49	0.51	6.75	6.68	1.54	1.70
1.70	1.70	0.49	0.54	7.00	7.00	1.36	1.52
1.80	1.80	0.51	0.59	7.25	7.32	1.30	1.38
1.90	1.89	0.62	0.62	7.50	7.48	1.25	1.27
2.00	2.04	0.69	0.63	7.75	7.80	1.15	1.18
2.10	2.09	0.68	0.64	8.00	7.96	1.11	1.11
2.20	2.18	0.64	0.66	8.50	8.44	1.00	1.01
2.30	2.32	0.74	0.70	9.00	9.07	0.93	0.93
2.40	2.42	0.78	0.72	9.50	9.55	0.90	0.88
2.50	2.52	0.72	0.73	10.00	9.87	0.84	0.84
2.60	2.61	0.78	0.75	10.50	10.35	0.80	0.80
2.70	2.71	0.84	0.78	11.00	10.98	0.78	0.78
2.80	2.80	0.83	0.79	11.50	11.62	0.76	0.76
2.90	2.90	0.78	0.80	12.00	11.94	0.75	0.74
3.00	2.99	0.75	0.82	12.50	12.57	0.73	0.72
3.15	3.14	0.82	0.86	13.00	12.89	0.71	0.71
3.30	3.34	0.88	0.92	13.50	13.53	0.69	0.70
3.60	3.66	1.07	1.03	14.00	13.85	0.67	0.69
3.80	3.82	1.05	1.13	14.50	14.48	0.66	0.68
4.00	3.98	1.11	1.29	15.00	15.12	0.66	0.68
4.20	4.14	1.34	1.52	16.00	16.07	0.65	0.67
4.40	4.46	1.77	1.82	17.00	17.03	0.64	0.66
4.60	4.62	2.05	2.22	17.45	17.35	0.64	0.65
4.80	4.78	2.33	2.72	18.00	17.99	0.63	0.65

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	2.71	3.29	20.00	19.89	0.62	0.64

Table 3-118. Comparison of Responses: Direct Generation (EDASP) Versus Time History 0.5% Critical Damping At Elev. 713+1

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.51	0.71	5.25	5.25	13.00	14.14
1.10	1.13	0.68	0.80	5.50	5.41	10.26	14.41
1.20	1.18	0.74	0.87	5.75	5.73	6.97	9.23
1.30	1.32	0.67	0.82	6.00	6.05	5.25	6.75
1.40	1.42	0.63	0.79	6.25	6.21	3.85	5.35
1.50	1.51	0.76	0.95	6.50	6.53	3.39	4.08
1.60	1.61	0.87	1.06	6.75	6.68	3.14	3.49
1.70	1.70	0.90	1.11	7.00	7.00	2.37	2.90
1.80	1.80	1.04	1.29	7.25	7.32	2.31	2.55
1.90	1.89	1.28	1.42	7.50	7.48	2.24	2.24
2.00	2.04	1.27	1.35	7.75	7.80	1.63	1.99
2.10	2.09	1.17	1.30	8.00	7.96	1.83	1.86
2.20	2.18	1.03	1.48	8.50	8.44	1.57	1.60
2.30	2.32	1.40	1.63	9.00	9.07	1.52	1.43
2.40	2.42	1.46	1.62	9.50	9.55	1.27	1.31
2.50	2.52	1.36	1.63	10.00	9.87	1.20	1.20
2.60	2.61	1.41	1.71	10.50	10.35	1.11	1.09
2.70	2.71	1.56	1.86	11.00	10.98	1.04	1.05
2.80	2.80	1.75	1.88	11.50	11.62	0.99	1.05
2.90	2.90	1.51	1.82	12.00	11.94	0.91	1.00
3.00	2.99	1.33	1.79	12.50	12.57	0.97	0.96
3.15	3.14	1.84	1.98	13.00	12.89	0.90	0.94
3.30	3.34	1.93	2.21	13.50	13.53	0.90	0.92
3.60	3.66	2.32	2.43	14.00	13.85	0.87	0.90
3.80	3.82	1.94	2.53	14.50	14.48	0.83	0.89
4.00	3.98	2.26	2.90	15.00	15.12	0.77	0.88
4.20	4.14	3.04	3.57	16.00	16.07	0.71	0.89
4.40	4.46	3.88	4.26	17.00	17.03	0.71	0.94
4.60	4.62	4.32	5.62	17.45	17.35	0.70	0.95
4.80	4.78	6.00	7.49	18.00	17.99	0.70	0.95

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	7.53	10.70	20.00	19.89	0.69	0.77

Table 3-119. Comparison of Responses: Direct Generation (EDASP) Versus Time History 5% Critical Damping At Elev. 713+1

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
1.03	1.04	0.32	0.33	5.25	5.25	3.65	4.28
1.10	1.13	0.38	0.39	5.50	5.41	3.71	4.36
1.20	1.18	0.40	0.43	5.75	5.73	3.32	3.75
1.30	1.32	0.37	0.43	6.00	6.05	2.75	3.11
1.40	1.42	0.43	0.43	6.25	6.21	2.43	2.59
1.50	1.51	0.48	0.47	6.50	6.53	1.98	2.21
1.60	1.61	0.50	0.52	6.75	6.68	1.75	1.94
1.70	1.70	0.50	0.55	7.00	7.00	1.56	1.74
1.80	1.80	0.55	0.60	7.25	7.32	1.50	1.57
1.90	1.89	0.63	0.63	7.50	7.48	1.43	1.45
2.00	2.04	0.71	0.64	7.75	7.80	1.32	1.35
2.10	2.09	0.70	0.65	8.00	7.96	1.27	1.27
2.20	2.18	0.66	0.68	8.50	8.44	1.14	1.15
2.30	2.32	0.76	0.72	9.00	9.07	1.07	1.07
2.40	2.42	0.80	0.74	9.50	9.55	1.03	1.00
2.50	2.52	0.75	0.75	10.00	9.87	0.97	0.95
2.60	2.61	0.81	0.78	10.50	10.35	0.92	0.91
2.70	2.71	0.87	0.81	11.00	10.98	0.90	0.88
2.80	2.80	0.86	0.83	11.50	11.62	0.88	0.86
2.90	2.90	0.81	0.84	12.00	11.94	0.87	0.84
3.00	2.99	0.78	0.86	12.50	12.57	0.84	0.82
3.15	3.14	0.86	0.91	13.00	12.89	0.82	0.81
3.30	3.34	0.94	0.97	13.50	13.53	0.79	0.80
3.60	3.66	1.14	1.10	14.00	13.85	0.78	0.79
3.80	3.82	1.12	1.22	14.50	14.48	0.76	0.78
4.00	3.98	1.20	1.40	15.00	15.12	0.74	0.77
4.20	4.14	1.47	1.66	16.00	16.07	0.72	0.76
4.40	4.46	1.94	2.00	17.00	17.03	0.71	0.75
4.60	4.62	2.25	2.45	17.45	17.35	0.71	0.75
4.80	4.78	2.58	3.02	18.00	17.99	0.70	0.74

Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS	Frequency EDASP	(J) T.H.	Acceleration T.H.(AVE)	Acceleration TH-EDAS
5.00	4.93	3.01	3.67	20.00	19.89	0.69	0.72

Table 3-120. Computer Programs Used in Analysis

Application:		**ADLPIPE**
A.	Author:	Research Engineers, Inc. 240 Bear Hill Rd., Suite 204 Waltham, MA 02451
	Source:	Research Engineers, Inc.
	Version:	4F10.1
	Facility:	J.D. Stevenson & Associates (S&A) 9217 Midwest Ave., Suite 200 Cleveland, OH 44125
B.	Description:	ADLPIPE is a computer program for the structural analysis of complex piping systems subjected to static and dynamic loads. A computer analysis is conducted to analyze the buried piping for seismic and temperature effects. This PC based program is used to analyze HDPE piping systems addressed in Catawba Relief Request 06-CN-003 approved by the NRC in SER's dated September 12, 2008 and May 27, 2009. The analysis considers the buried piping from the 42" header to the DG building wall. The analyses were performed by J.D. Stevenson and Associates, under their internal Quality Assurance (QA) program. **Extent and Limitation of its application:** This program is limited to piping in the Nuclear Service Water System (RN) from the supply and return headers to anchors at the Unit 2 diesel building walls. ADLPIPE is used on HDPE piping systems addressed by Catawba Relief Request 06-CN-003. The program was used to evaluate buried 6% Molybdenum Extra Nickel (6% Moly) attached to HDPE piping submitted in Catawba Relief Request 06-CN-003 as detailed in Appendix A and detailed supporting calculations provided for review. It was also used to evaluate Austenitic-ferritic stainless Steel (Duplex) piping attached to 16" HDPE in the RN lake return from the Unit 2 diesel generator building.
Application:		**ADLPIPE**
C.	**Verification:**	This program has been bench-marked against the program PIPESTRESS/CAE PIPE. ADLPIPE was validated according to the S&A QA manual. It was validated against verification problems supplied by the ADLPIPE vendor. The output was compared with a previously set bench-mark. All outputs agreed with the bench-marks. Additionally, a practical problem was run on both ADLPIPE and PIPESTRESS/CAE PIPE. The results obtained from the two analyses were consistent.