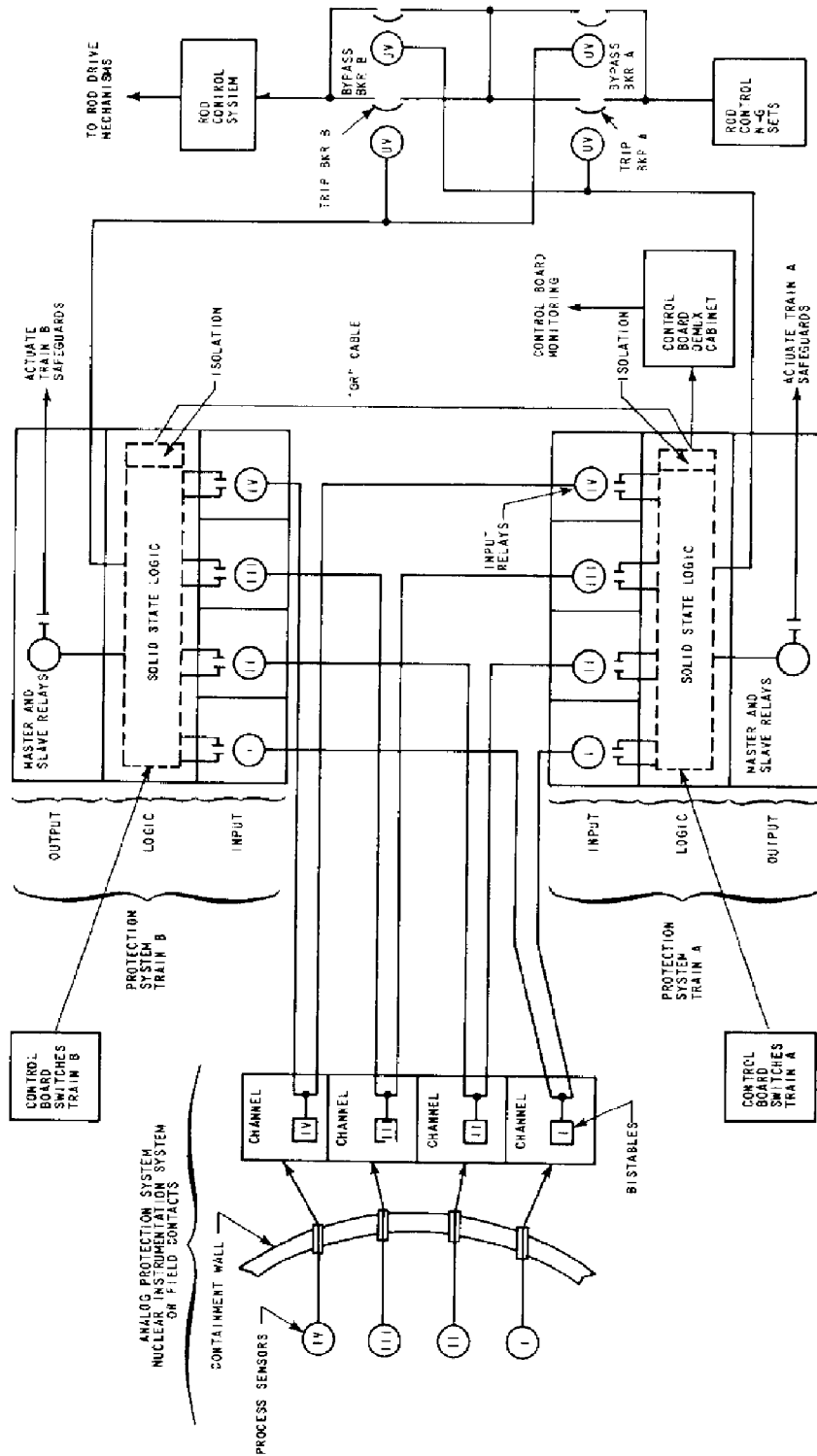


## Appendix 7B. Figures

Figure 7-1. Protection System Block Diagram





Instrumentation and Control System Diagrams - Index and Symbols

**LOGIC SYMBOLS**

SYMBOL	LOGIC FUNCTION	DESCRIPTION
	OR	A DEVICE WHICH PRODUCES AN OUTPUT ONLY WHEN ONE INPUT FOR MORE EXISTS.
	NOT	A DEVICE WHICH PRODUCES AN OUTPUT ONLY WHEN THE INPUT DOES NOT EXIST.
	AND	A DEVICE WHICH PRODUCES AN OUTPUT ONLY WHEN EVERY INPUT EXISTS.
	COINCIDENCE (2 OUT OF 3 SHOW)	A DEVICE WHICH PRODUCES AN OUTPUT WHEN THE PRESCRIBED NUMBER OF INPUTS EXIST (EXAMPLE: 2 INPUTS MUST EXIST FOR AN OUTPUT).
	ADJUSTABLE TIME DELAY	A DEVICE WHICH PRODUCES AN OUTPUT DELAYED BY A TIME DELAY (ADJUSTABLE).
	DEF RETURN MEMORY	A DEVICE WHICH RETAINS THE CONDITION OF OUTPUT CORRESPONDING TO THE LAST ENERGIZED INPUT, EXCEPT UPON INTERRUPTION OF POWER IT RETURNS TO THE OFF CONDITION.
	RETENTIVE MEMORY	A DEVICE WHICH RETAINS THE CONDITION OF OUTPUT CORRESPONDING TO THE LAST ENERGIZED INPUT EXCEPT UPON INTERRUPTION OF POWER.
	RETENTIVE MEMORY WITH ACTUATION BLOCK	A DEVICE HAVING RETENTIVE MEMORY AND ACTUATION SIGNAL-BLOCK LOGIC FUNCTIONS AS INDICATED BY THE DIAGRAM BELOW.

**ADDITIONAL SYMBOLS**

SYMBOL	DESCRIPTION
	INSTRUMENT CHANNEL BISTABLE: A TAG NUMBER OF "B" DENOTES A GENERIC BISTABLE ASSOCIATED WITH A GENERIC DE TYPICAL FUNCTIONAL BLOCK.
	OUTPUT INDICATOR
	BISTABLE OUTPUT IS A LOGIC "1" WHEN THE MEASURED PARAMETER IS GREATER THAN THE SETPOINT VALUE.
	BISTABLE OUTPUT IS A LOGIC "1" WHEN THE MEASURED PARAMETER IS LESS THAN THE SETPOINT VALUE.
	BISTABLE OUTPUT IS A LOGIC "1" WHEN THE MEASURED PARAMETER DEVIATES FROM THE NORMAL VALUE BY MORE THAN THE SETPOINT AMOUNT.
	NON-INSTRUMENT BISTABLE
	ALARM ANNUNCIATOR (ALARMS ON THE SAME SHEET WITH THE SAME SUBSCRIPT SHOW A COMMON ANNUNCIATOR WINDOW)
	REACTOR TRIP "FIRST OUT" ANNUNCIATOR
	TURBINE TRIP "FIRST OUT" ANNUNCIATOR
	INDICATOR LAMP
	P - PERMISSIVE STATUS LIGHTS, T - TRIP STATUS LIGHTS
	COMPUTER INPUT
	LOGIC INFORMATION TRANSMISSION
	ANALOG INFORMATION TRANSMISSION
	ANALOG OUTPUT
	A - ANALOG INDICATOR, R - RECORDER, RD - RECORDER 2 PEN
	SI - RECORDER 3 PEN, RI - RECORDER 8 PEN
	ANALOG SUPPLY

**DEVICE FUNCTION LETTERS AND NUMBERS**

LETTER	DESCRIPTION
1	1" CHANNEL
1B	LOGIC CHANNEL
1C	REACTOR CHANNEL
1D	PRECISION CHANNEL
1E	OPERATION CHANNEL
1F	TEMPERATURE CHANNEL
1G	TEMPERATURE CHANNEL
1H	TEMPERATURE CHANNEL
1I	TEMPERATURE CHANNEL
1J	TEMPERATURE CHANNEL
1K	TEMPERATURE CHANNEL
1L	TEMPERATURE CHANNEL
1M	TEMPERATURE CHANNEL
1N	TEMPERATURE CHANNEL
1O	TEMPERATURE CHANNEL
1P	TEMPERATURE CHANNEL
1Q	TEMPERATURE CHANNEL
1R	TEMPERATURE CHANNEL
1S	TEMPERATURE CHANNEL
1T	TEMPERATURE CHANNEL
1U	TEMPERATURE CHANNEL
1V	TEMPERATURE CHANNEL
1W	TEMPERATURE CHANNEL
1X	TEMPERATURE CHANNEL
1Y	TEMPERATURE CHANNEL
1Z	TEMPERATURE CHANNEL
2	2" CHANNEL
2B	LOGIC CHANNEL
2C	REACTOR CHANNEL
2D	PRECISION CHANNEL
2E	OPERATION CHANNEL
2F	TEMPERATURE CHANNEL
2G	TEMPERATURE CHANNEL
2H	TEMPERATURE CHANNEL
2I	TEMPERATURE CHANNEL
2J	TEMPERATURE CHANNEL
2K	TEMPERATURE CHANNEL
2L	TEMPERATURE CHANNEL
2M	TEMPERATURE CHANNEL
2N	TEMPERATURE CHANNEL
2O	TEMPERATURE CHANNEL
2P	TEMPERATURE CHANNEL
2Q	TEMPERATURE CHANNEL
2R	TEMPERATURE CHANNEL
2S	TEMPERATURE CHANNEL
2T	TEMPERATURE CHANNEL
2U	TEMPERATURE CHANNEL
2V	TEMPERATURE CHANNEL
2W	TEMPERATURE CHANNEL
2X	TEMPERATURE CHANNEL
2Y	TEMPERATURE CHANNEL
2Z	TEMPERATURE CHANNEL

**POSITION SWITCH DEVELOPMENTS**

**GENERAL NOTES (FOR ALL SHEETS)**

- IN ALL LOGIC CIRCUITS, THE INDICATED ACTIVATION OF A SYSTEM OR DEVICE OCCURS WHEN A LOGIC "1" SIGNAL IS DEFINED TO BE PRESENT WHEN THE BISTABLE OUTPUT VOLTAGE IS 50%.
- EXCEPT WHERE INDICATED OTHERWISE, THE FOLLOWING IS TRUE: ALL LOGIC CIRCUITS ARE REDUNDANT THAT IS EVERY LOGIC CIRCUIT, SIGNAL LINE, OR OUTPUT LINE LOCATED IN A PROTECTION CHANNEL, IS A REDUNDANT CHANNEL. BISTABLE, MANUAL CONTROLS DO NOT HAVE REDUNDANT ACTUATORS, BUT DO HAVE REDUNDANT CONTACTS WHERE LOGIC IS REDUNDANT. SO THAT A SIGNAL IN EITHER TRAIL WILL ACTIVATE.
- WHENEVER A PROCESS SIGNAL IS USED FOR CONTROL AND IS DERIVED FROM A PROTECTION CHANNEL, ISOLATION MUST BE PROVIDED.
- THIS SET OF DRAWINGS ILLUSTRATES THE FUNCTIONAL REQUIREMENTS OF THE REACTOR CONTROL AND PROTECTION SYSTEM, INCLUDING ENGINEERING SPECIFICATIONS, THIS DRAWING IS NOT INTENDED TO BE AN ACTUAL HARDWARE IMPLEMENTATION, FOR HARDWARE IMPLEMENTATION, REFER TO THE FOLLOWING REFERENCES:
  - 100000 REACTOR CONTROL SYSTEM SCHEMATIC
  - 100000 SOLID STATE PROTECTION SYSTEM INTERCONNECTION
  - 100000 NUCLEAR INSTRUMENTATION SOURCE RANGE BLOCK
  - 100000 NUCLEAR INSTRUMENTATION INTERMEDIATE RANGE BLOCK
  - 100000 NUCLEAR INSTRUMENTATION PRIMARY RANGE BLOCK
  - 100000 NUCLEAR INSTRUMENTATION AUXILIARY CHANNELS BLOCK
  - 100000 PRESSURE CONTROL SYSTEMS BLOCK DIAGRAM
  - 271000 ELEMENTARY WIRING DIAGRAM
- THIS SET OF DRAWINGS IS IDENTICAL FOR UNITS 1 AND 2 EXCEPT FOR THE TAG NUMBERS.
  - FOR UNIT 1 TAG NUMBERS ADD A "1" EXAMPLE: 09H-440
  - FOR UNIT 2 TAG NUMBERS ADD A "2" EXAMPLE: 09H-440
- FOR CONTINUATION, SEE CNM 2399-83-8068 001 PRESSURIZER PRESSURE AND LEVEL CONTROL SYSTEM FUNCTIONAL REQUIREMENTS. FOR REFERENCE, SEE CNM 2399-83-8067 001 CONTROL BUILDER SHEETS.
- FOR CONTINUATION, SEE CNM 2399-83-8061 001 STEAM DUMP CONTROL SYSTEM FUNCTIONAL REQUIREMENTS. FOR REFERENCE, SEE CNM 2399-83-8067 001 CONTROL BUILDER SHEETS.
- FOR CONTINUATION, SEE CNM 2399-83-8069 001 REHEATER CONTROL SYSTEM FUNCTIONAL REQUIREMENTS. FOR REFERENCE, SEE CNM 2399-83-8067 001 CONTROL BUILDER SHEETS.
- FOR CONTINUATION, SEE CNM 2399-83-8063 001 DVCs AND MISCELLANEOUS NSS CONTROL SYSTEM FUNCTIONAL REQUIREMENTS. FOR REFERENCE, SEE CNM 2399-83-8067 001 CONTROL BUILDER SHEETS.
- FOR CONTINUATION, SEE CNM 2399-83-8064 001 REACTOR CONTROL SYSTEM FUNCTIONAL REQUIREMENTS. FOR REFERENCE, SEE CNM 2399-83-8067 001 CONTROL BUILDER SHEETS.

**INDEX**

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17	DCES CONT. VLV. SIG. & TRIP LOGIC	18
18	DCES CONTROLLER NAME SCHED CONT.	19
19	DCES MODELS & LOGIC - UNIT 1	20
20	DCES SIGNALS, SELECTOR LOGIC	21
21	DCES SIGNALS, SELECTOR LOGIC	22
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**QA CONDITION 1**

WESTHOUSE ELECTRIC CORPORATION  
 NUCLEAR ENERGY SYSTEM, FAYETTEVILLE, PA., U.S.A.

DUKE POWER COMPANY  
 CATAWBA UNIT 2  
 FUNCTIONAL DIAGRAMS  
 INDEX AND SYMBOLS

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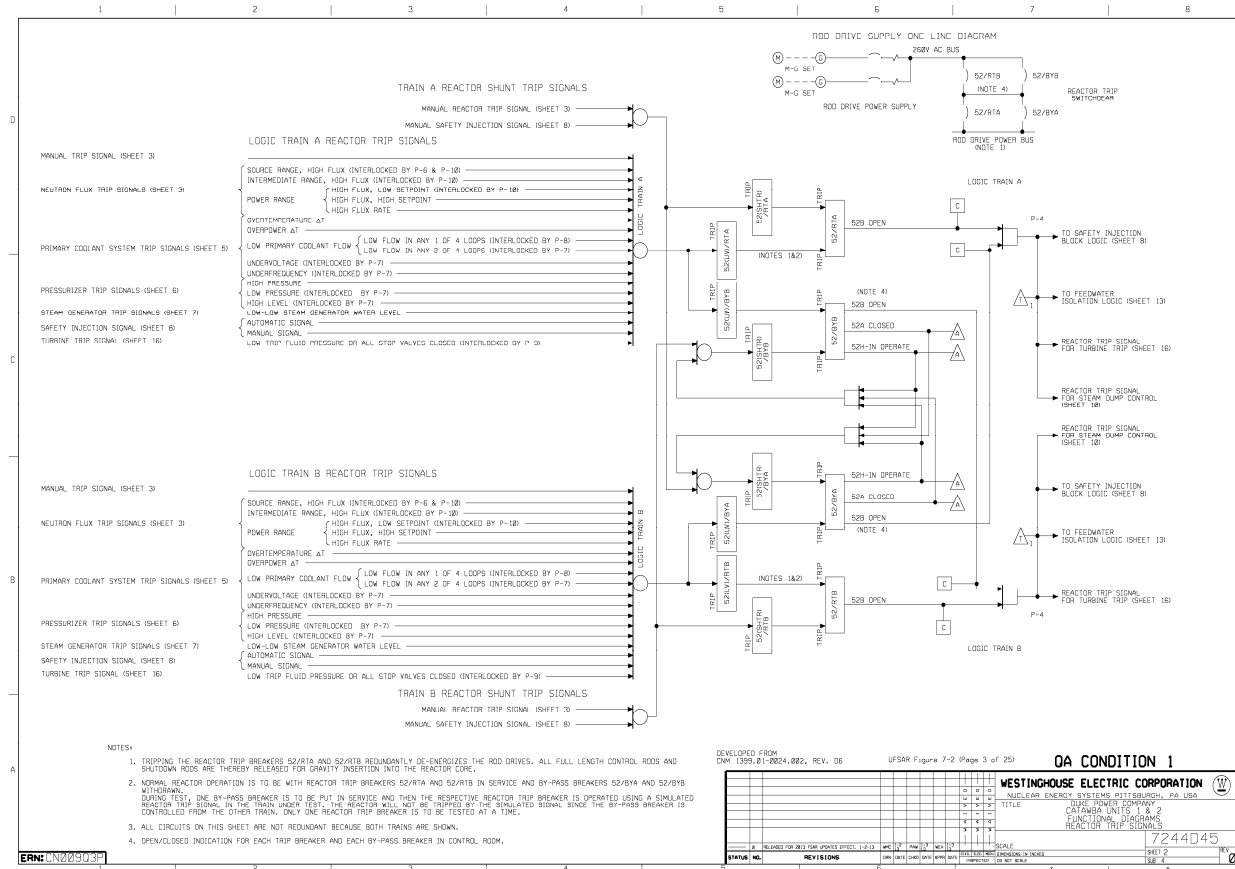
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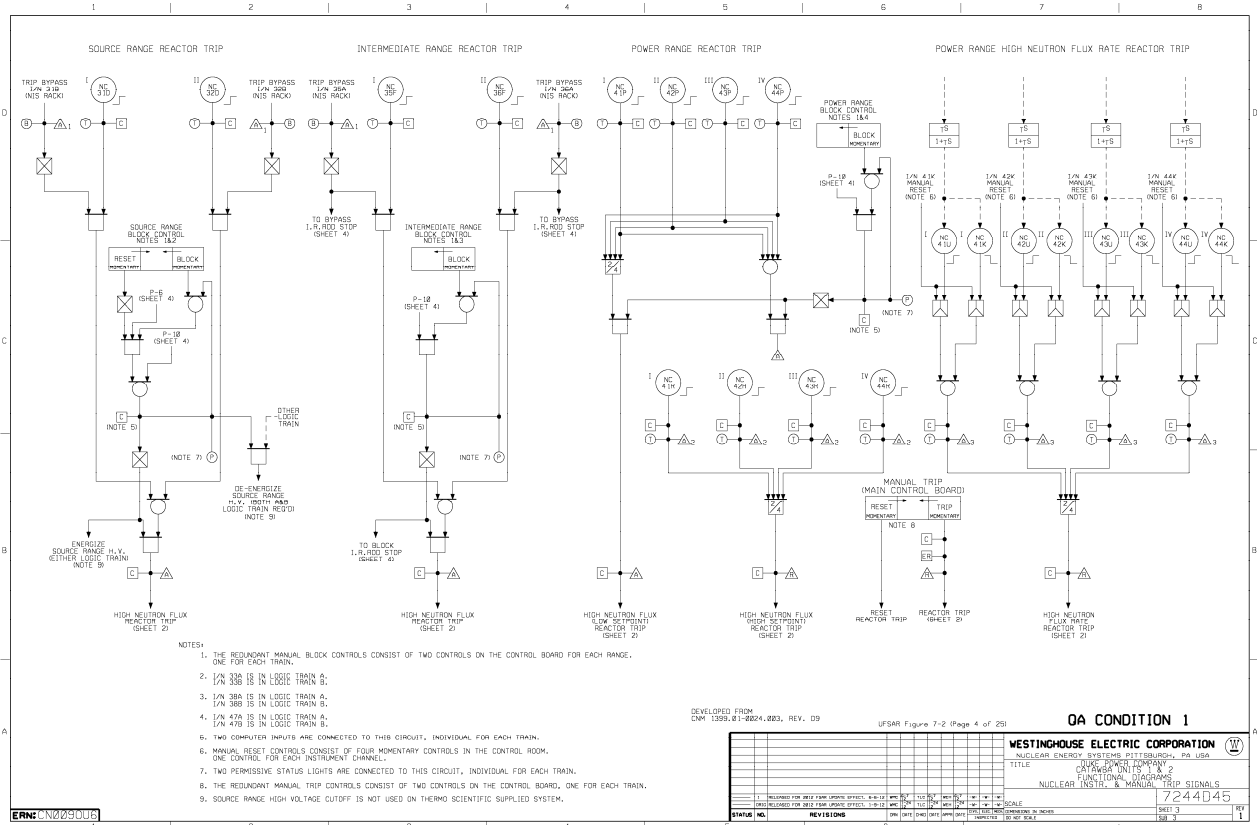
REVISIONS

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2	ISSUED FOR REV. FOR UFSAR FIGURE 7-2	10/10/83	J. J. WILSON	J. J. WILSON

Instrumentation and Control System Diagrams - Index and Symbols

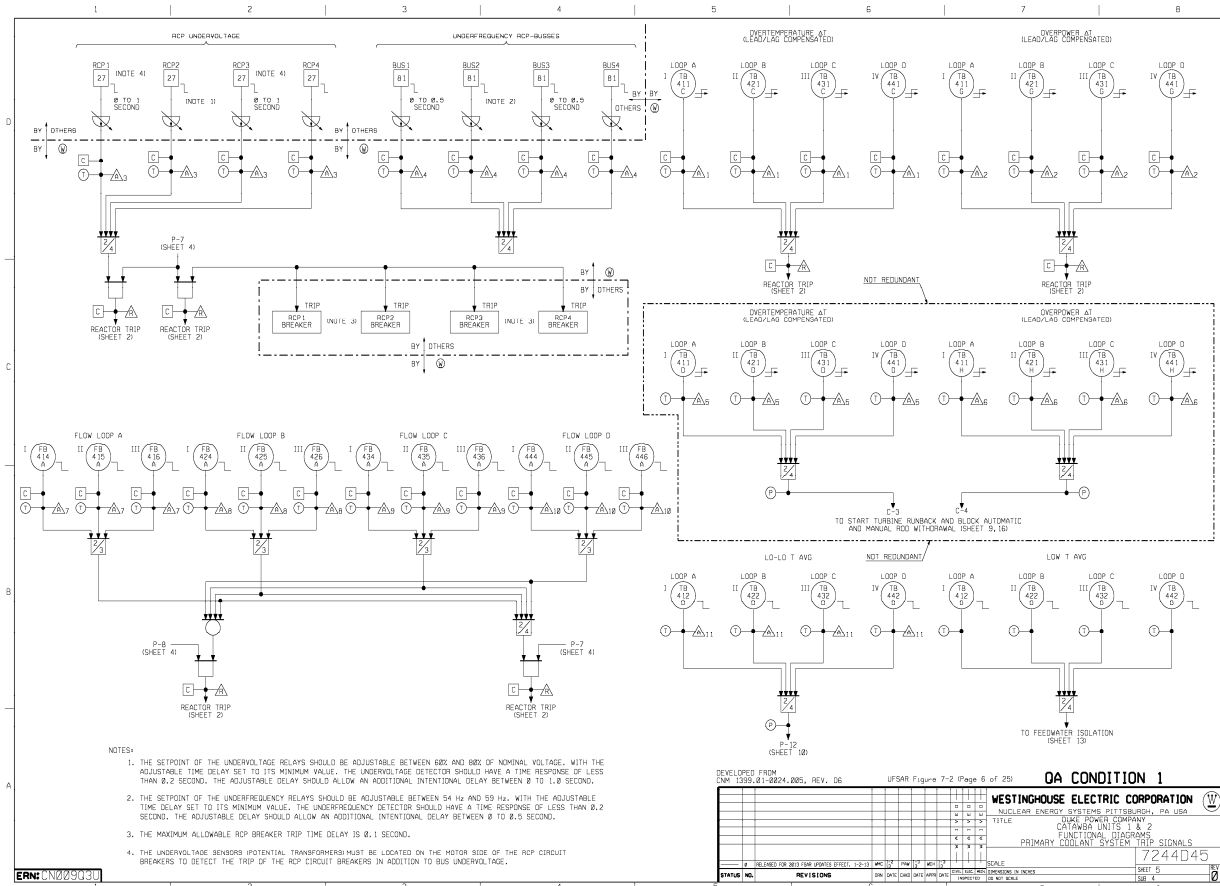


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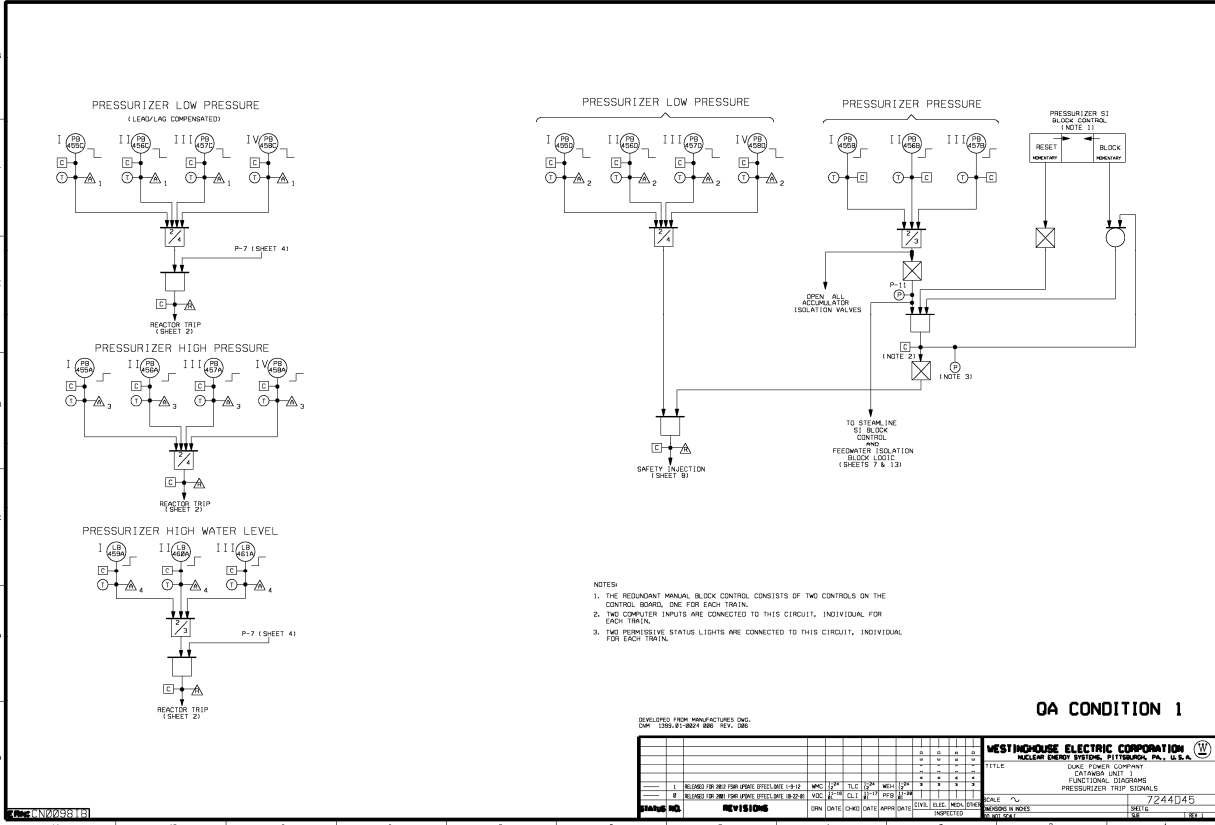


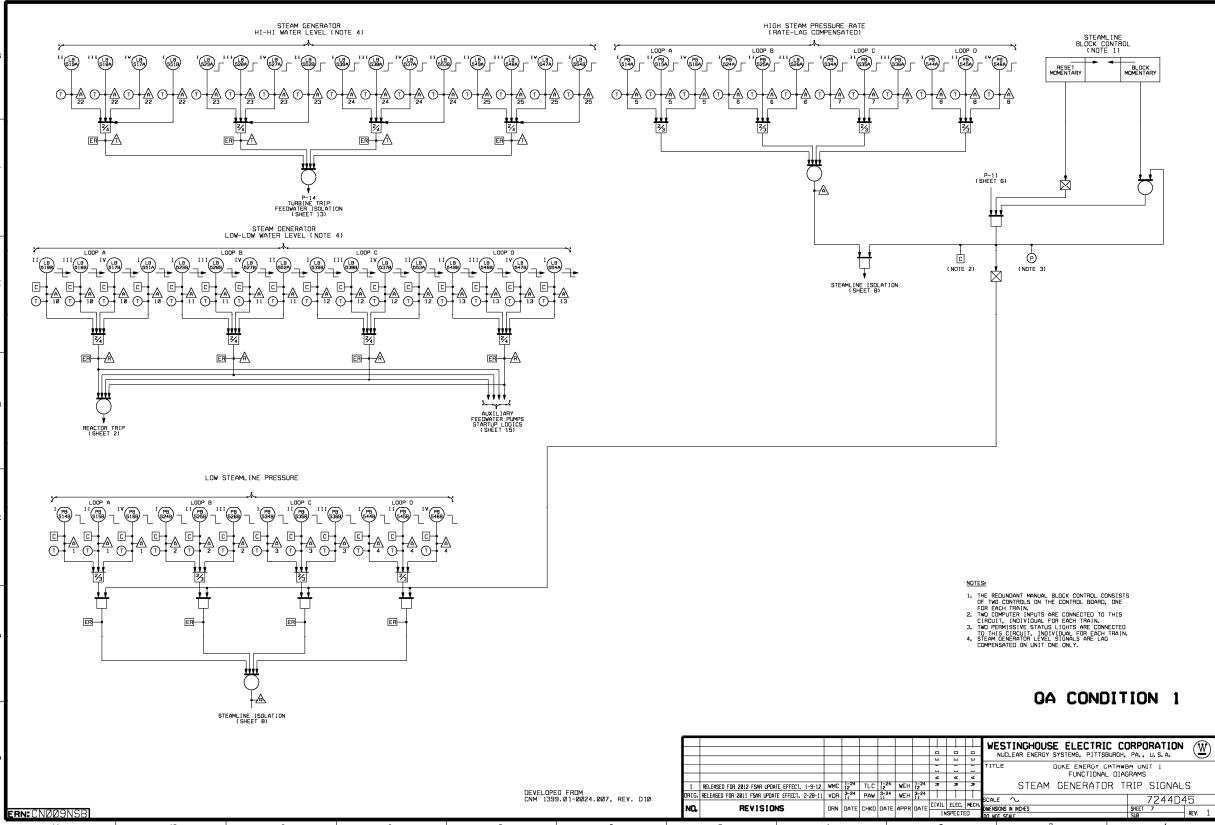


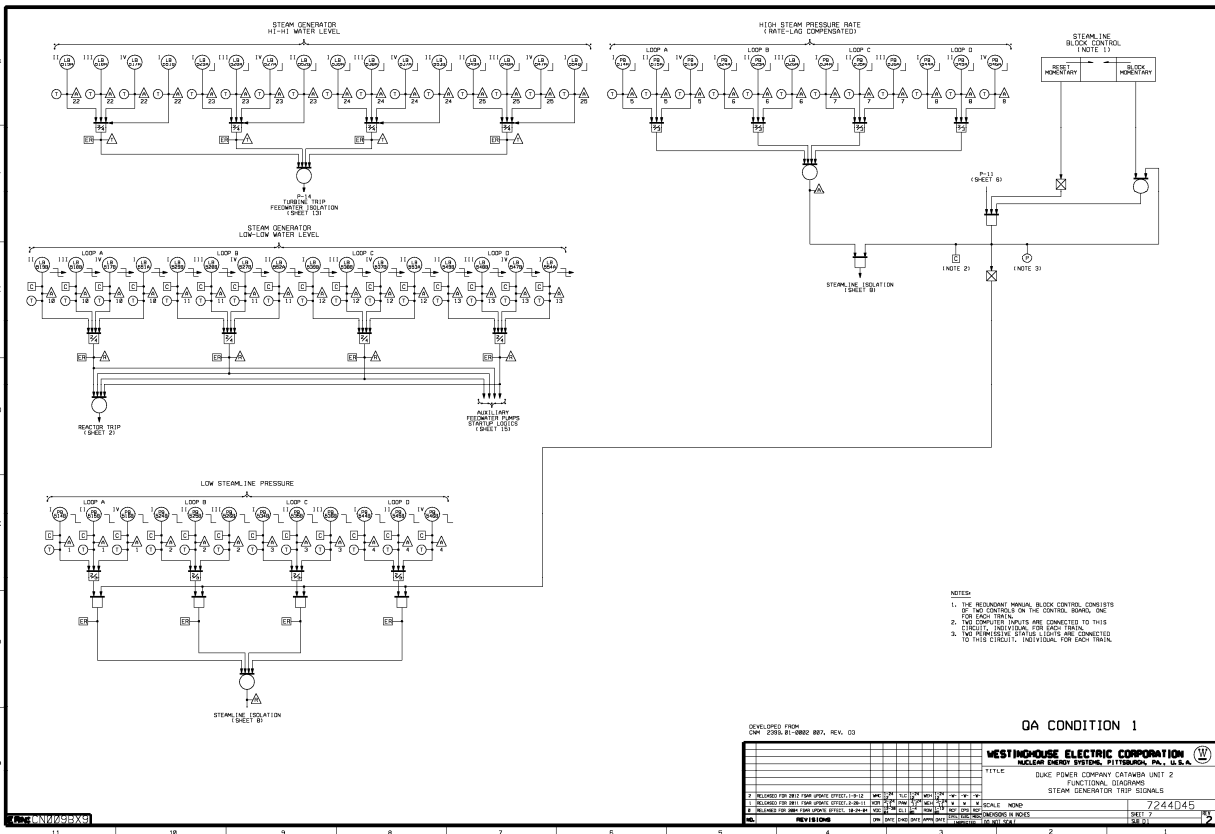
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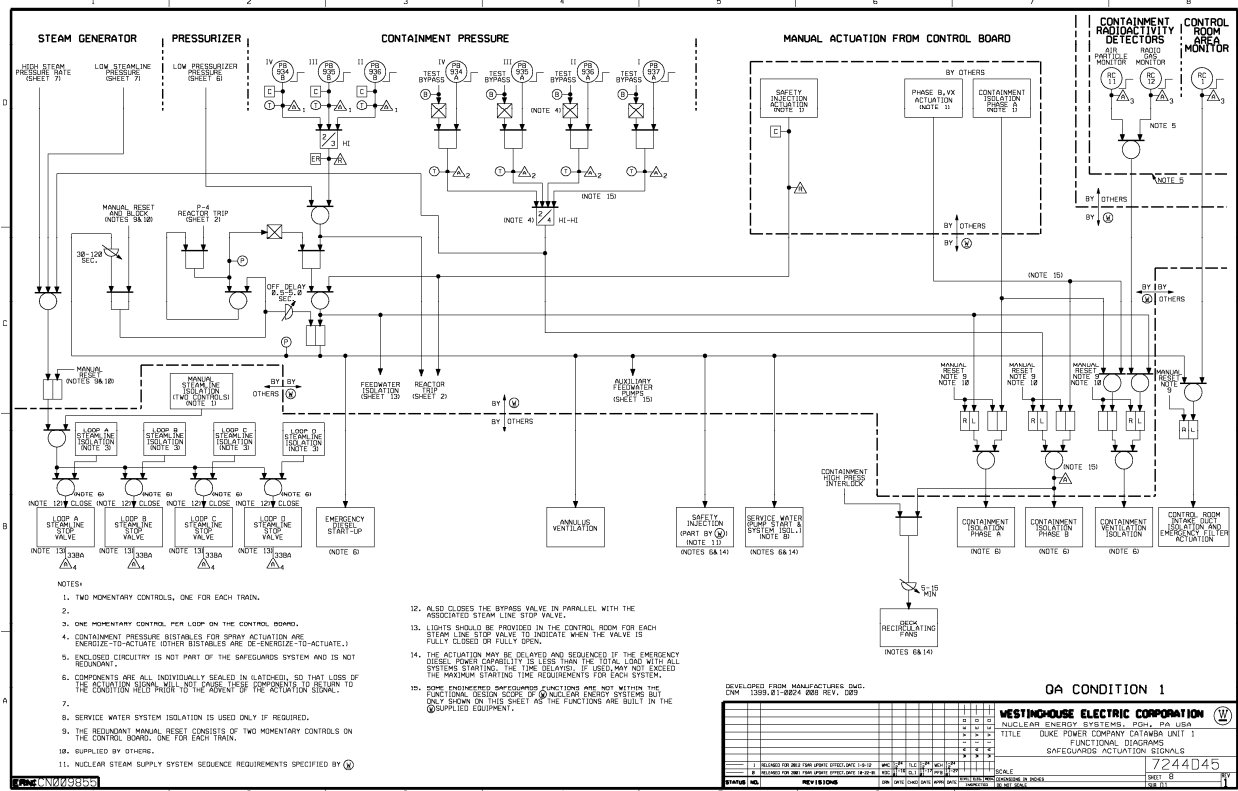


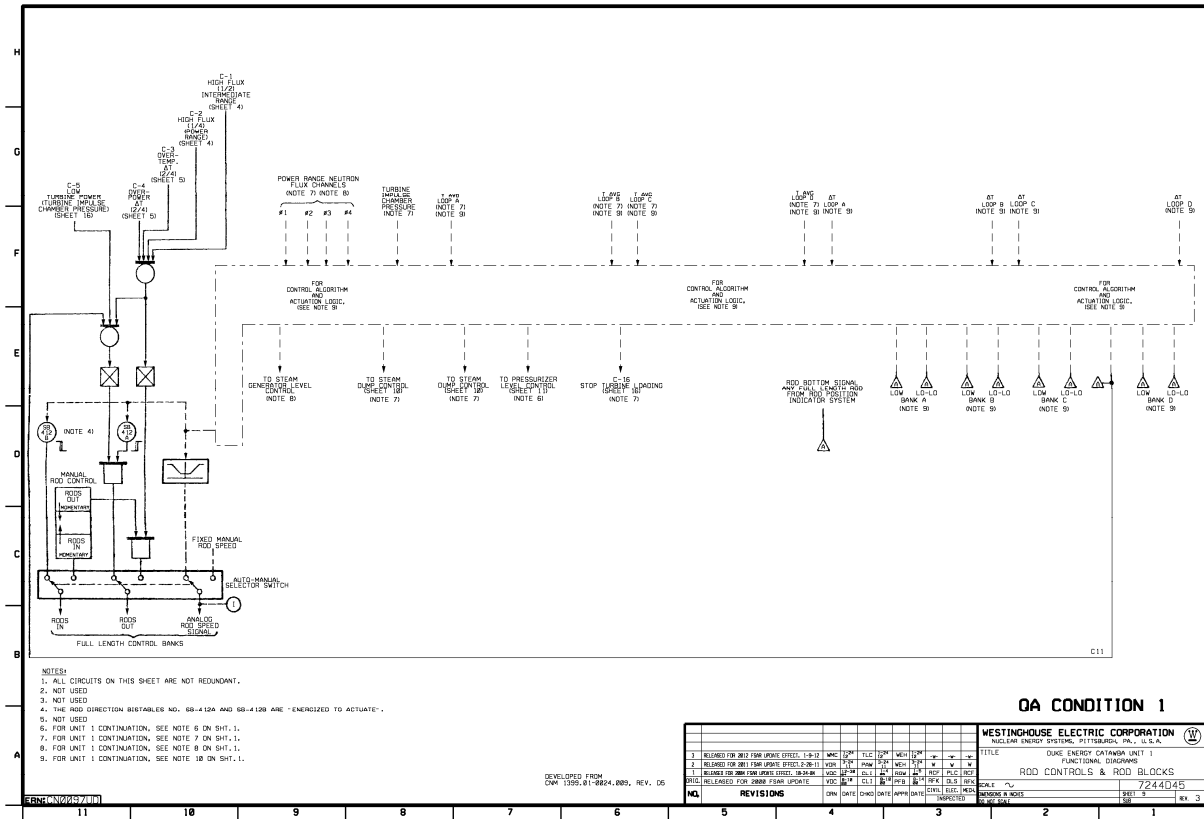


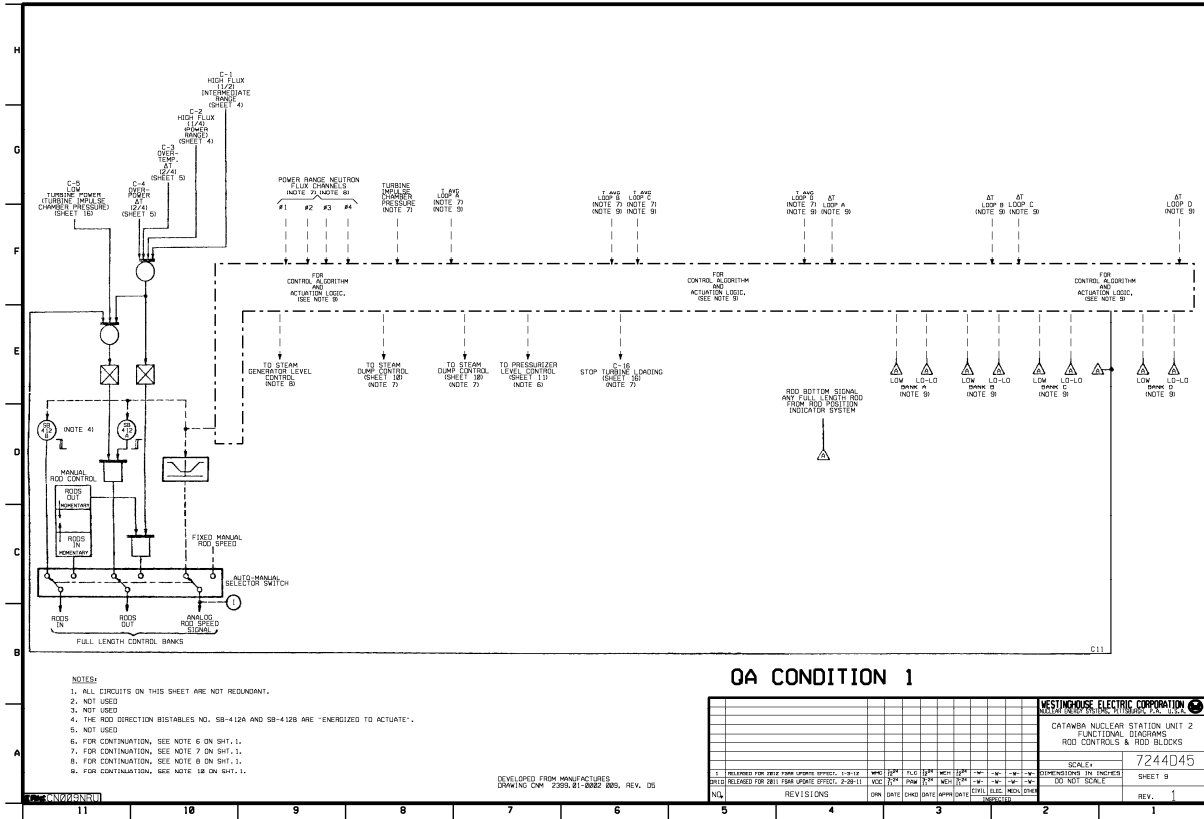










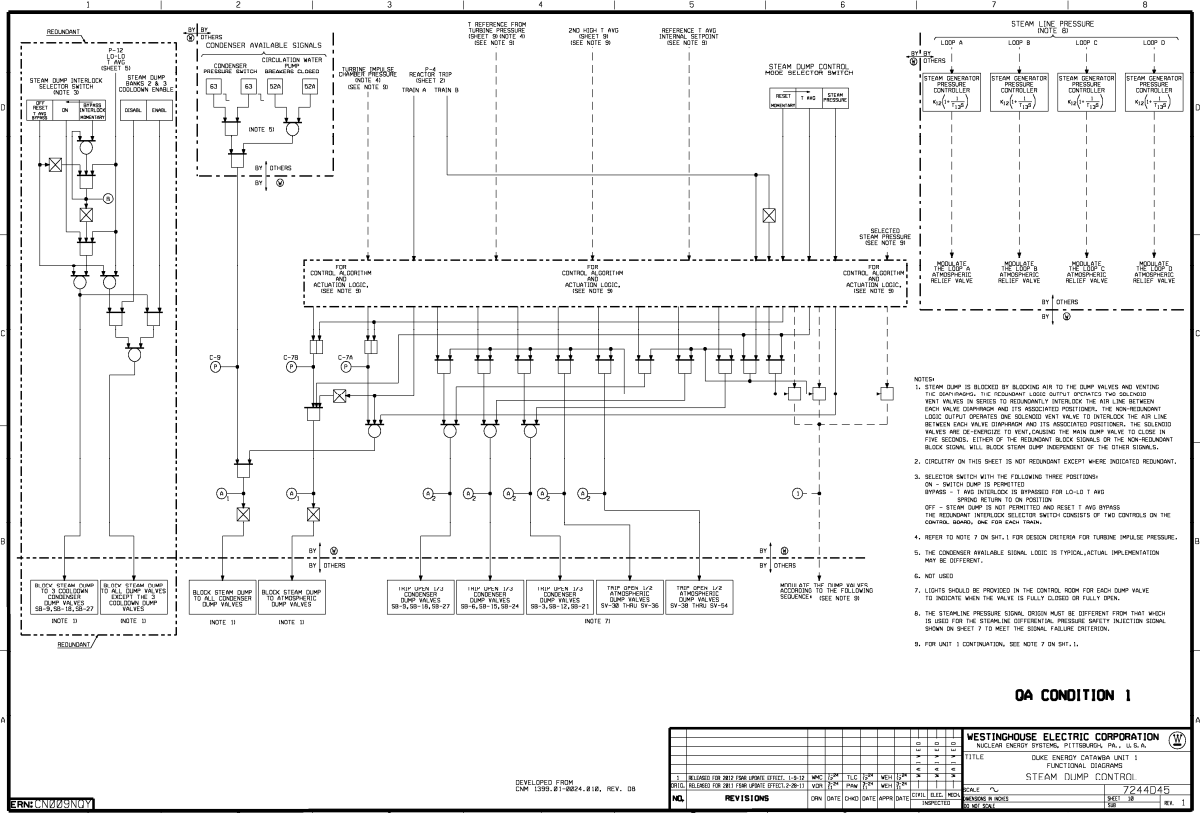


- NOTES:
1. ALL CIRCUITS ON THIS SHEET ARE NOT REDUNDANT.
  2. NOT USED
  3. NOT USED
  4. THE ROD DIRECTION BISTABLES NO. SB-412A AND SB-412B ARE "ENERGIZED TO ACTUATE".
  5. NOT USED
  6. FOR CONTINUATION, SEE NOTE 6 ON SHY. 1.
  7. FOR CONTINUATION, SEE NOTE 7 ON SHY. 1.
  8. FOR CONTINUATION, SEE NOTE 8 ON SHY. 1.
  9. FOR CONTINUATION, SEE NOTE 9 ON SHY. 1.

DEVELOPED FROM MANUFACTURER'S DRAWING CWH 2999.01-AN82 R05, REV. 05

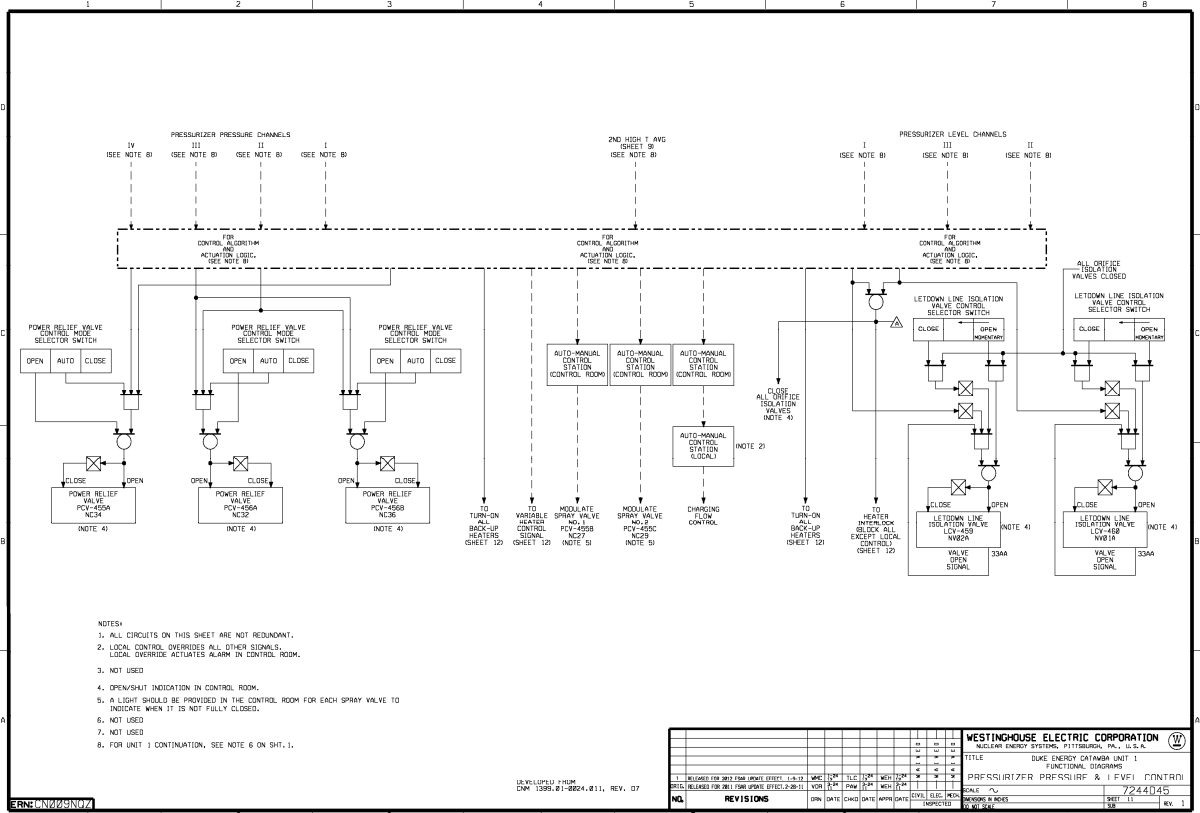
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REV. 1									
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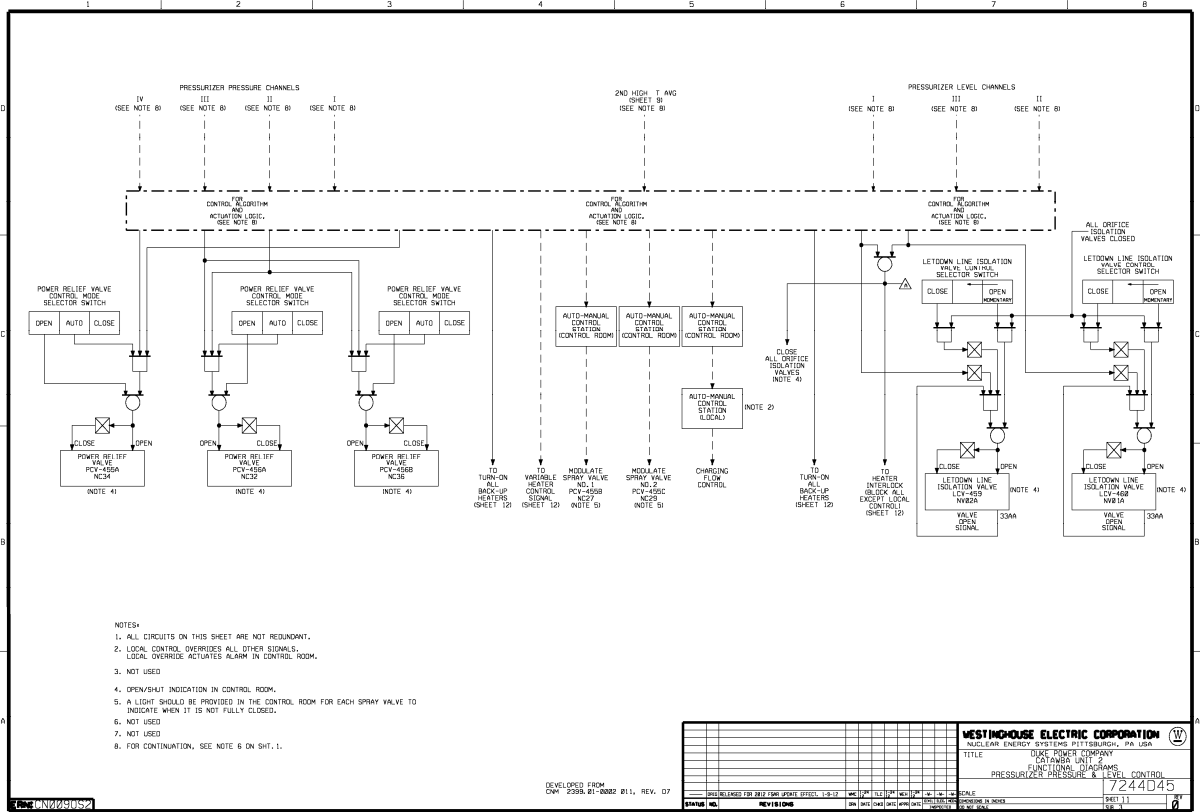






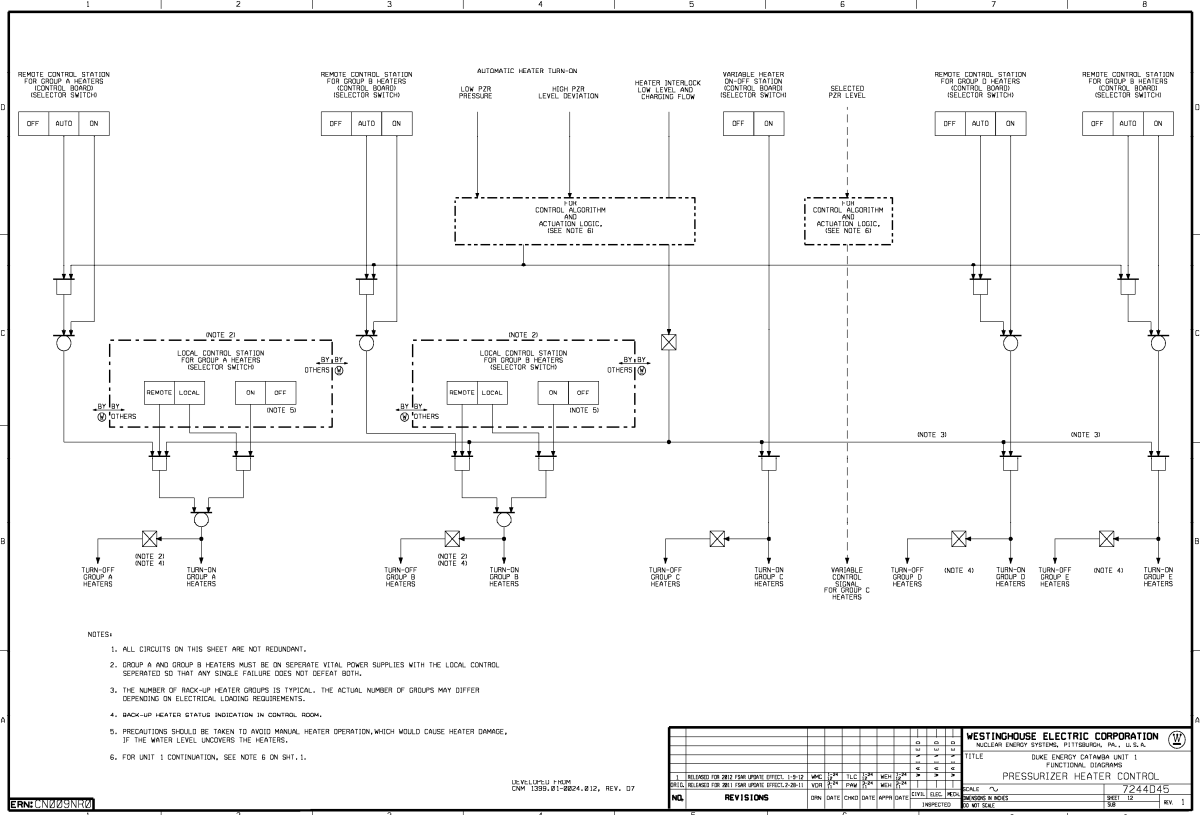


Pressurizer Heater Control

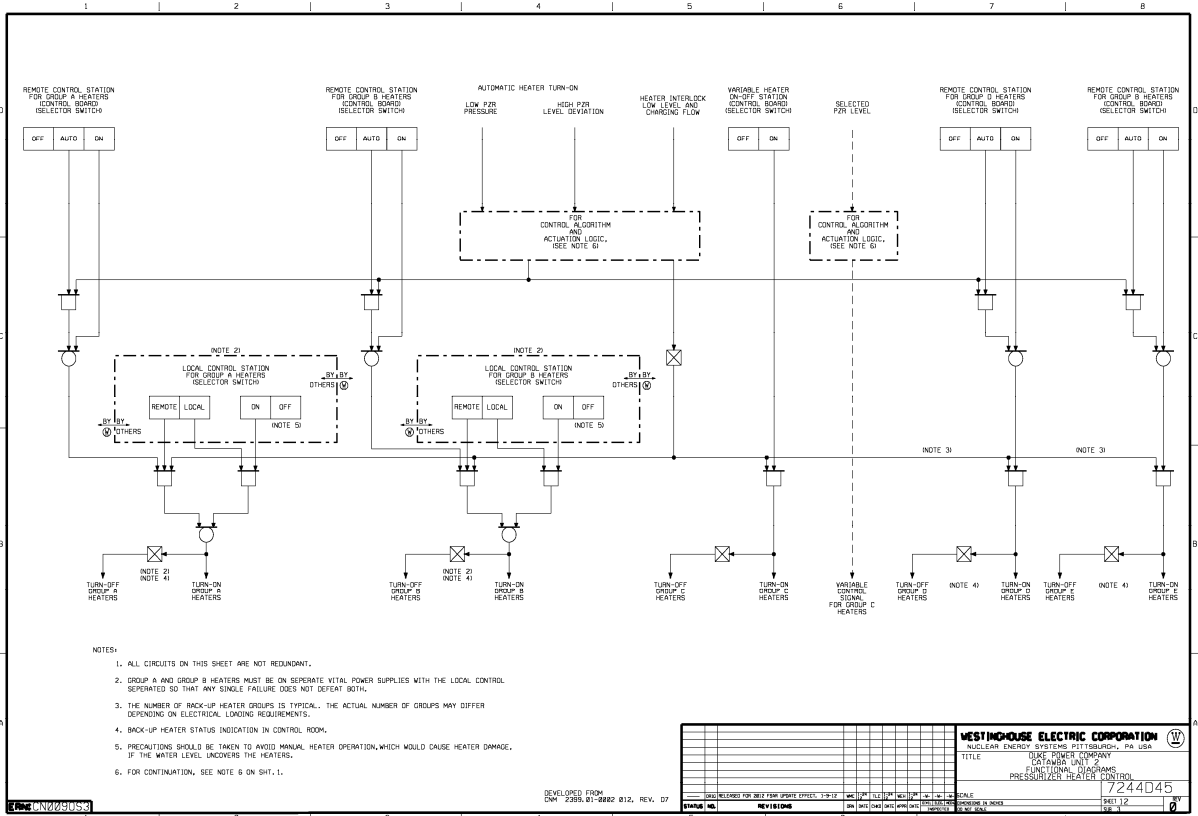


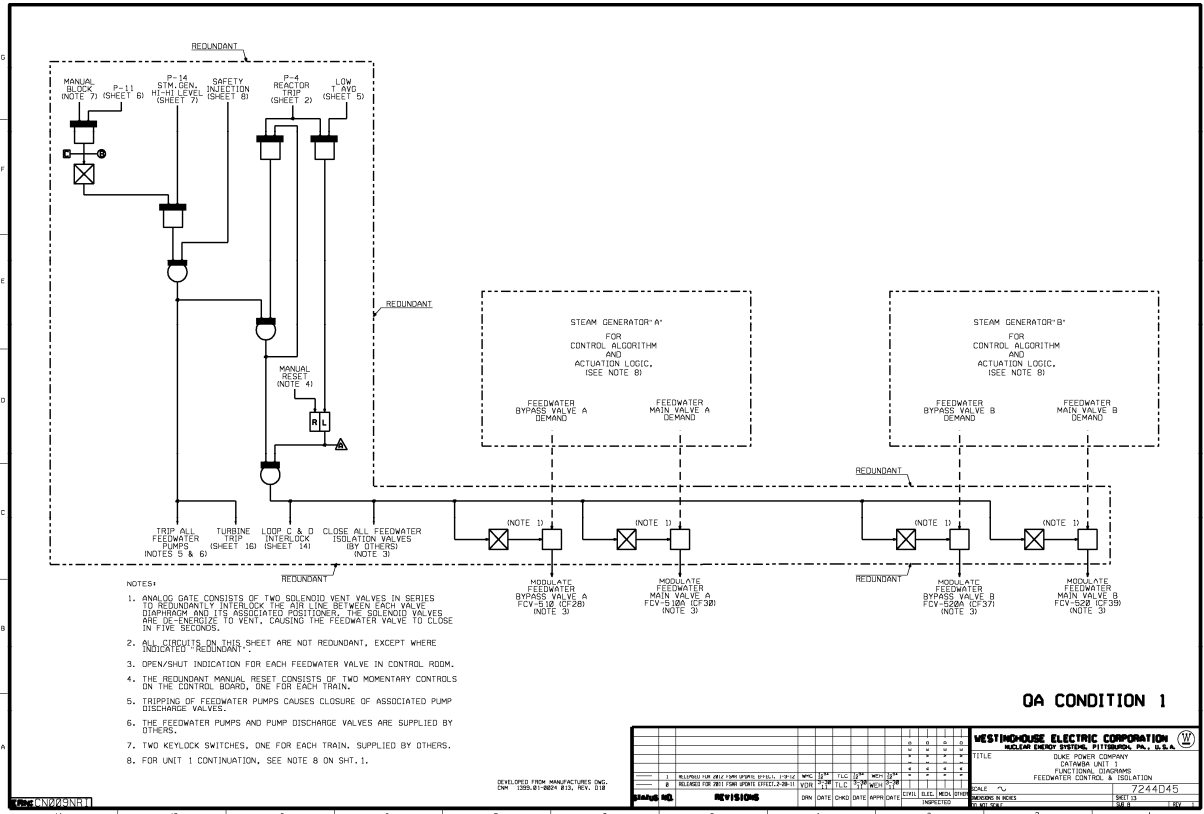
- NOTES
1. ALL CIRCUITS ON THIS SHEET ARE NOT REDUNDANT.
  2. LOCAL CONTROL OVERRIDES ALL OTHER SIGNALS. LOCAL OVERRIDE ACTUATES ALARM IN CONTROL ROOM.
  3. NOT USED
  4. OPEN/SHUT INDICATION IN CONTROL ROOM.
  5. A LIGHT SHOULD BE PROVIDED IN THE CONTROL ROOM FOR EACH SPRAY VALVE TO INDICATE WHEN IT IS NOT FULLY CLOSED.
  6. NOT USED
  7. NOT USED
  8. FOR CONTINUATION, SEE NOTE 6 ON SHIT. 1.

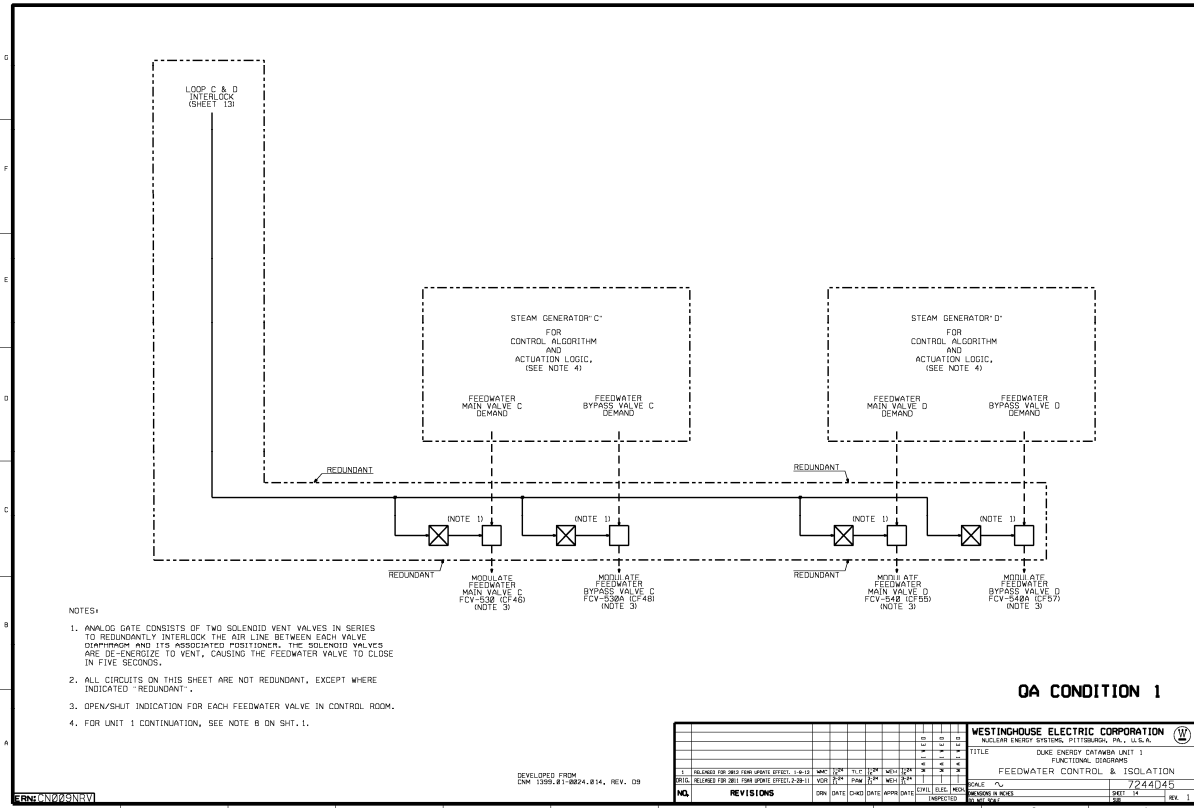
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NUCLEAR ENERGY DIVISION, P.O. BOX 217, PITTSBURGH, PA. 15224	
TITLE: UFSAR POWER DISTRIBUTION	
CATAWBA UNIT #1	
FUNCTIONAL DIAGRAMS	
PRESSURIZER PRESSURE & LEVEL CONTROL	
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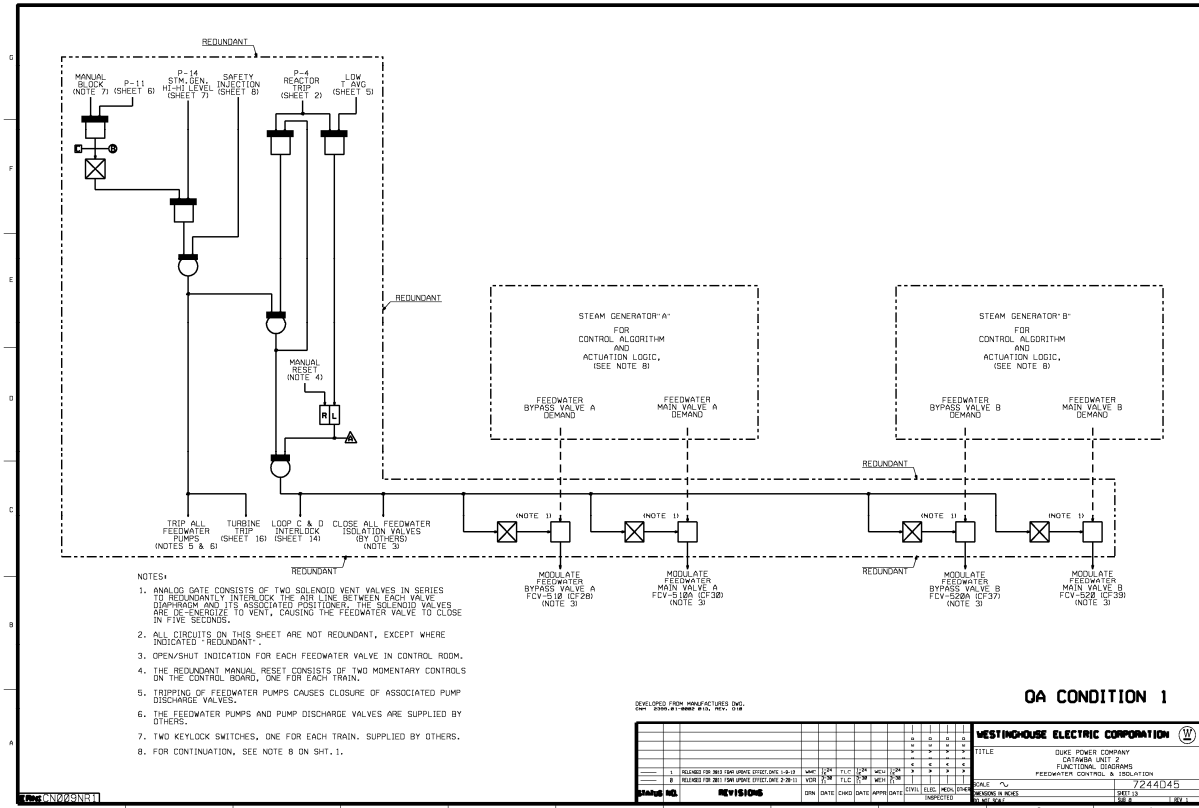


Pressurizer Heater Control









- NOTES:
1. ANALOG GATE CONSISTS OF TWO SOLENOID VENT VALVES IN SERIES TO REDUNDANTLY INTERLOCK THE AIR LINE BETWEEN EACH VALVE DIAPHRAGM AND ITS ASSOCIATED POSITIONER. THE SOLENOID VALVES ARE DE-ENERGIZE TO VENT, CAUSING THE FEEDWATER VALVE TO CLOSE IN FIVE SECONDS.
  2. ALL CIRCUITS ON THIS SHEET ARE NOT REDUNDANT, EXCEPT WHERE INDICATED "REDUNDANT".
  3. OPEN/SHUT INDICATION FOR EACH FEEDWATER VALVE IN CONTROL ROOM.
  4. THE REDUNDANT MANUAL RESET CONSISTS OF TWO MOMENTARY CONTROLS ON THE CONTROL BOARD, ONE FOR EACH TRAIN.
  5. TRIPPING OF FEEDWATER PUMPS CAUSES CLOSURE OF ASSOCIATED PUMP DISCHARGE VALVES.
  6. THE FEEDWATER PUMPS AND PUMP DISCHARGE VALVES ARE SUPPLIED BY OTHERS.
  7. TWO KEYLOCK SWITCHES, ONE FOR EACH TRAIN, SUPPLIED BY OTHERS.
  8. FOR CONTINUATION, SEE NOTE 8 ON SH1.1.

DEVELOPED FROM MANUFACTURER'S INFO.  
DATE: 03/01/00 BY: JLV, DTG

METHENHOUSE ELECTRIC CORPORATION										
DUKE POWER COMPANY										
DATA/UNIT 2										
FUNCTIONS, DIAGRAMS										
FEEDWATER CONTROL & ISOLATION										
72241045										
SCALE: 1/2"										
SHEET NO. 18 OF 18										
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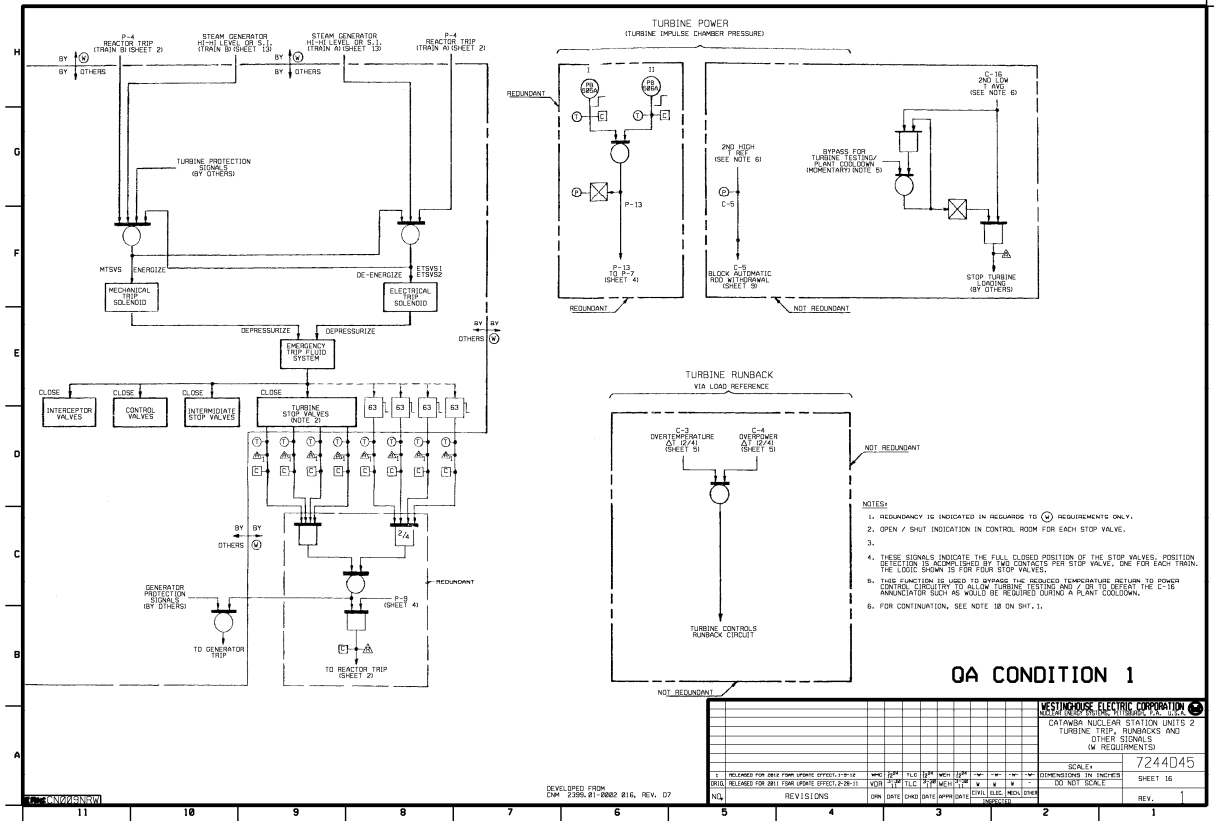




Figure 7-4. Typical ESF Test Circuits

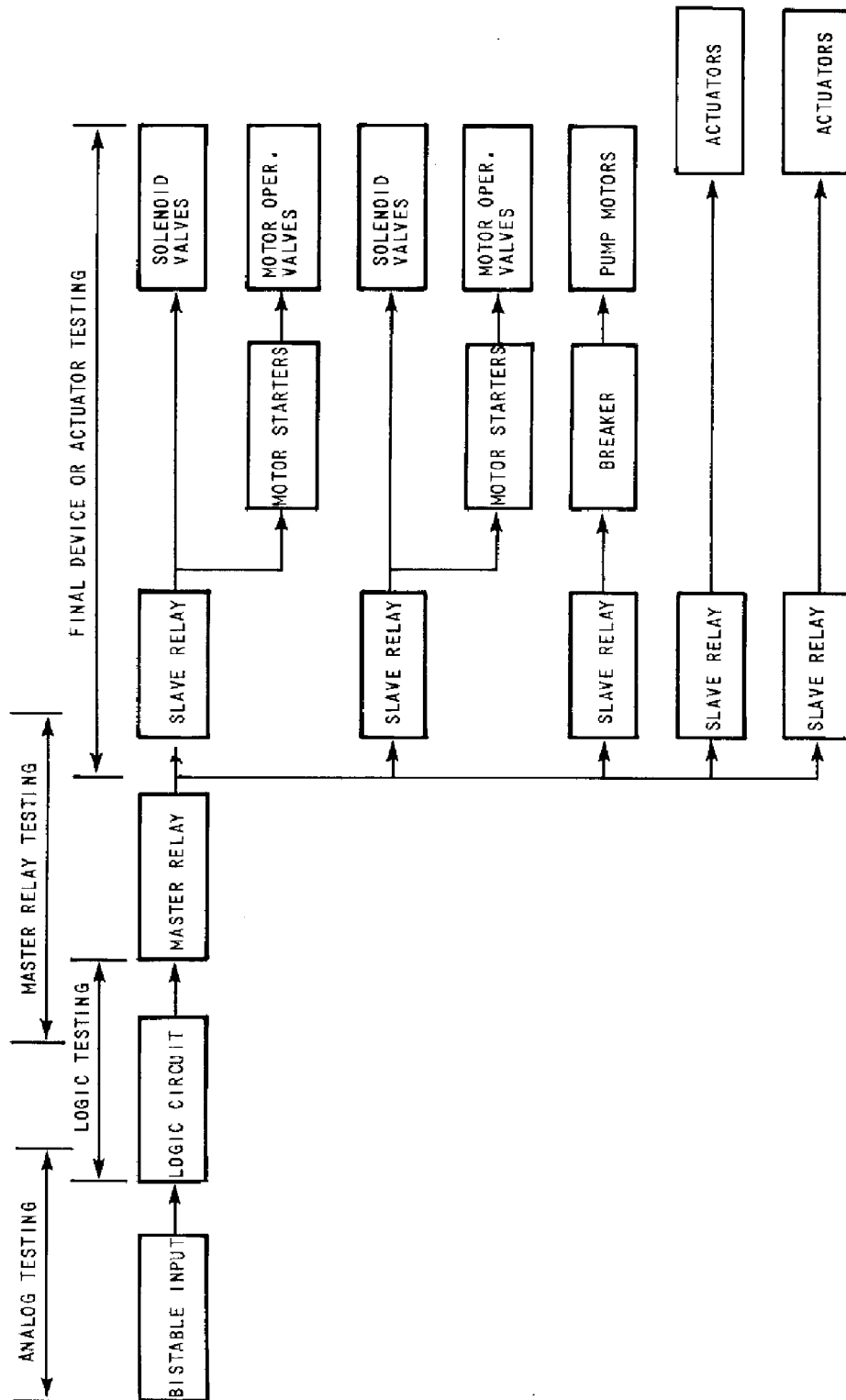




Figure 7-6. Motor-Driven Auxiliary Feedwater Pump Alignment to NSW Logic Diagram

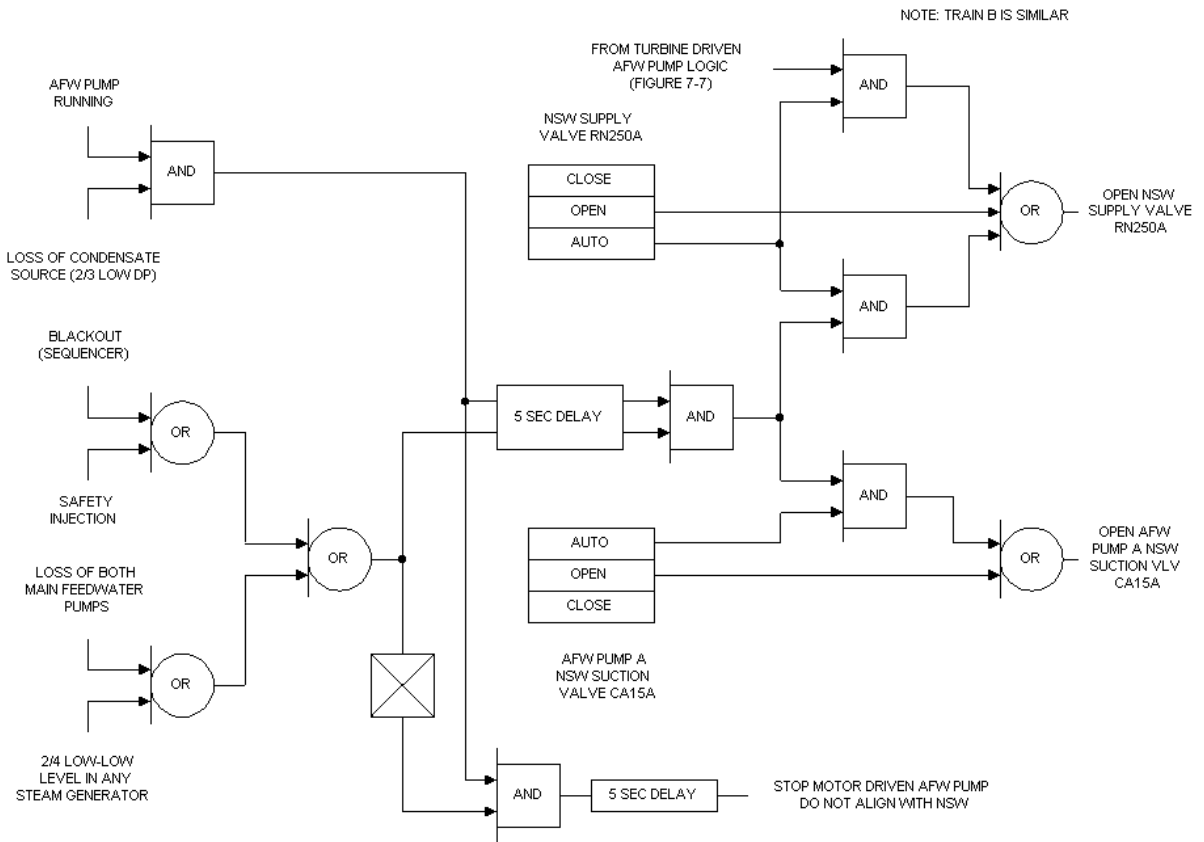
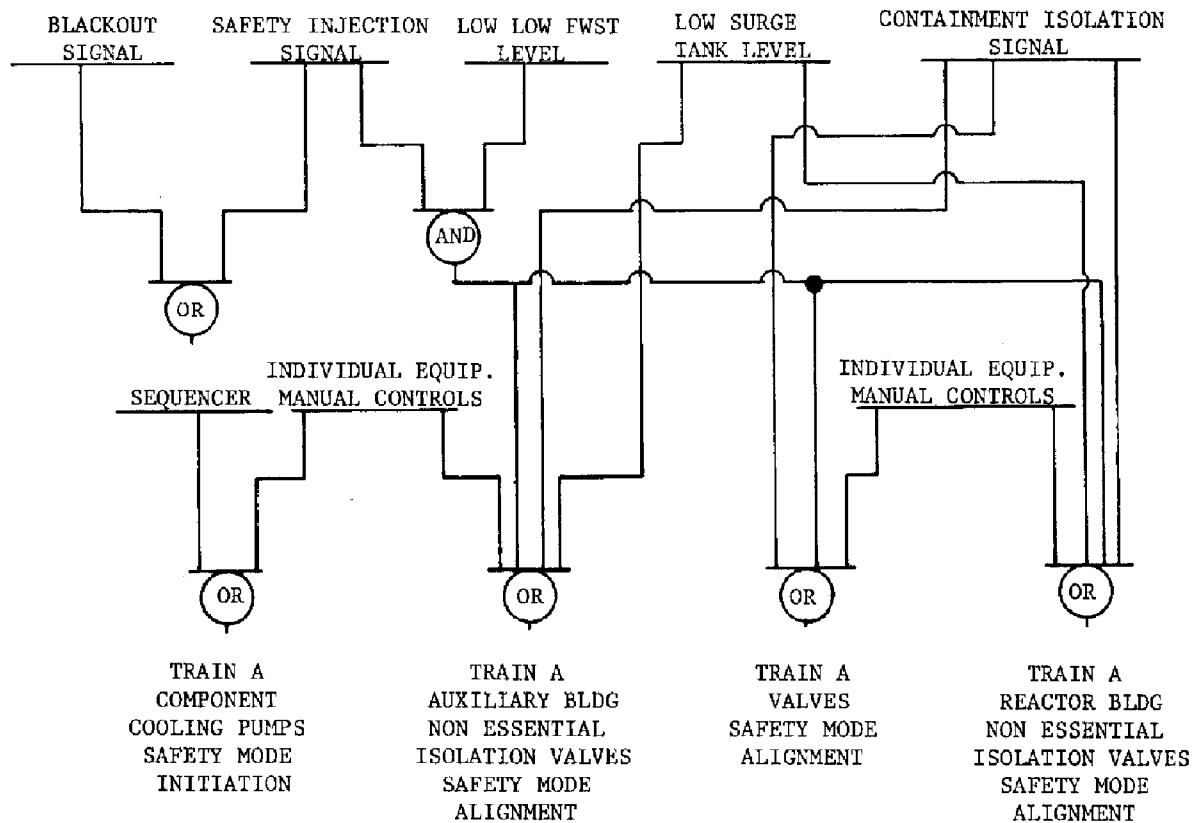






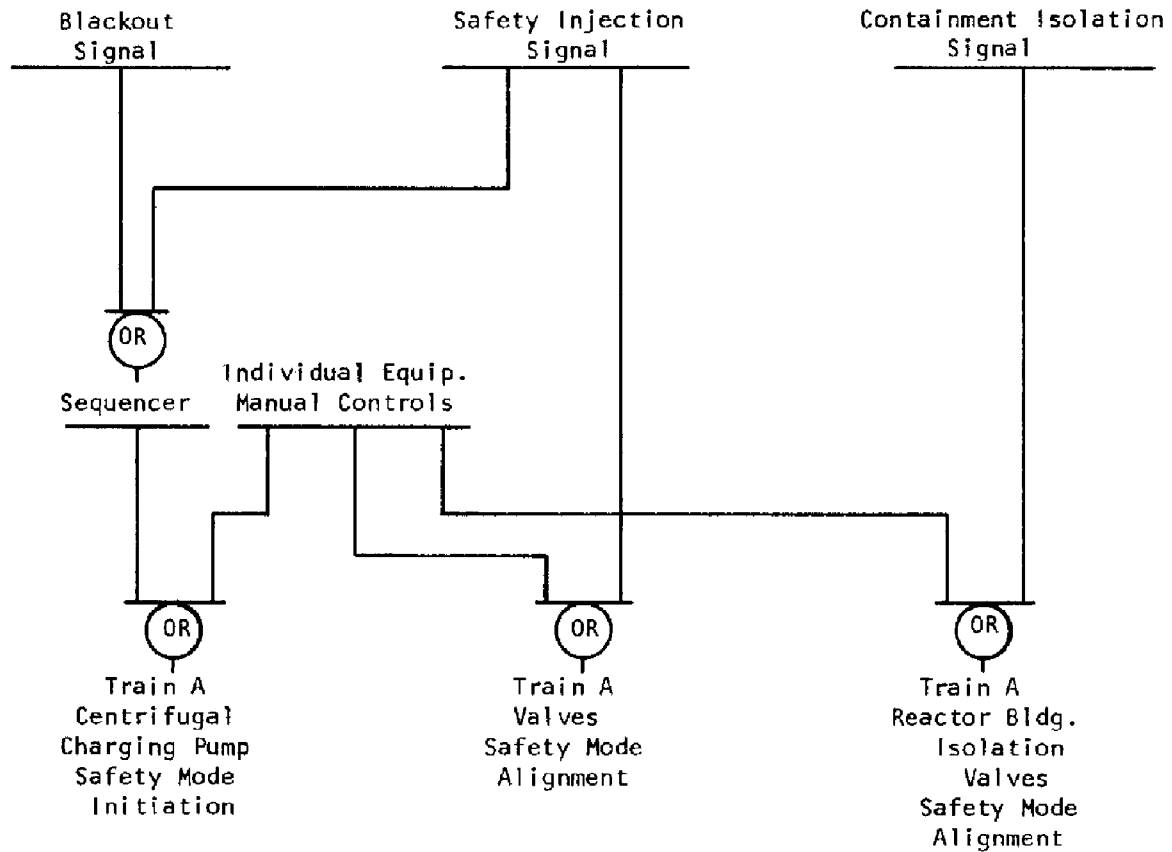
Figure 7-8. Component Cooling Water System Logic Diagram



(TRAIN B SIMILAR)

NOTE: A separate manual control switch is provided for each pump and valve which receives a safety injection or containment isolation signal. Each such device is controlled independently of any other in the manual mode. Capability for simultaneous manual actuation of all devices by a single control switch is not provided or implied.

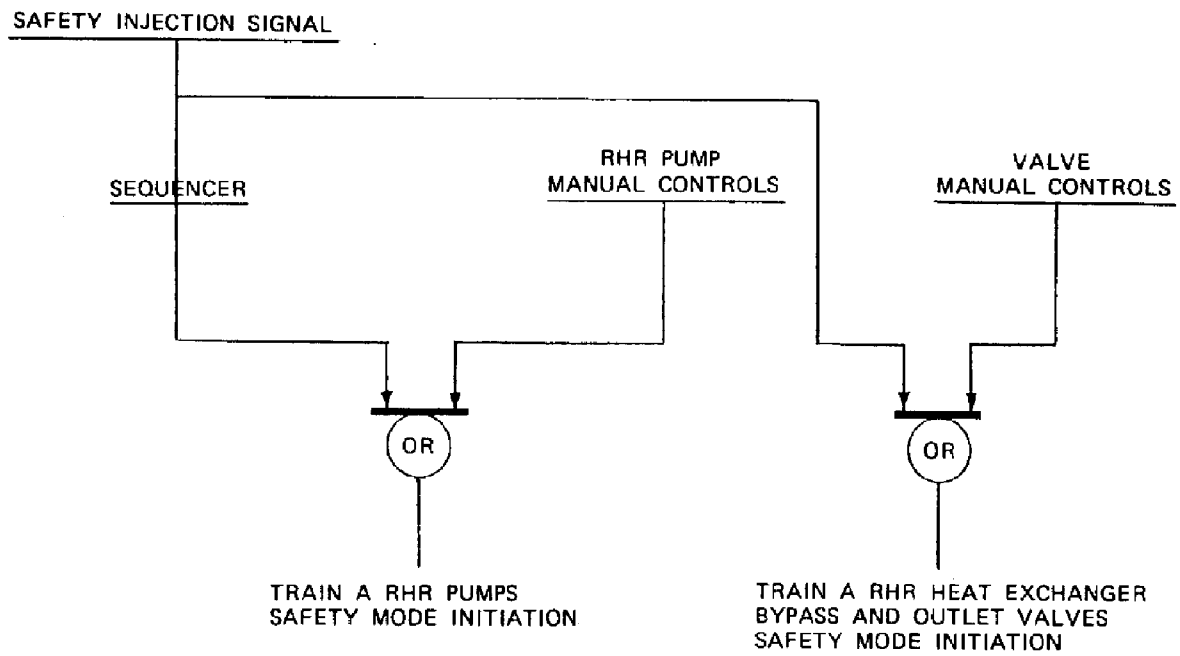
Figure 7-9. Chemical and Volume Control System Logic Diagram



(Train B Similar)

NOTE: A separate manual control switch is provided for each pump and valve which receives a safety injection or containment isolation signal. Each such device is controlled independently of any others in the manual mode. Capability for simultaneous manual actuation of all devices by a single control switch is not provided or implied.

Figure 7-10. Residual Heat Removal Pump Logic Diagram



**Figure 7-11. Deleted Per 1991 Update**

**Figure 7-12. Deleted Per 1993 Update**

Figure 7-13. Cold Leg Accumulator Isolation Valves Control and Alarm Logic

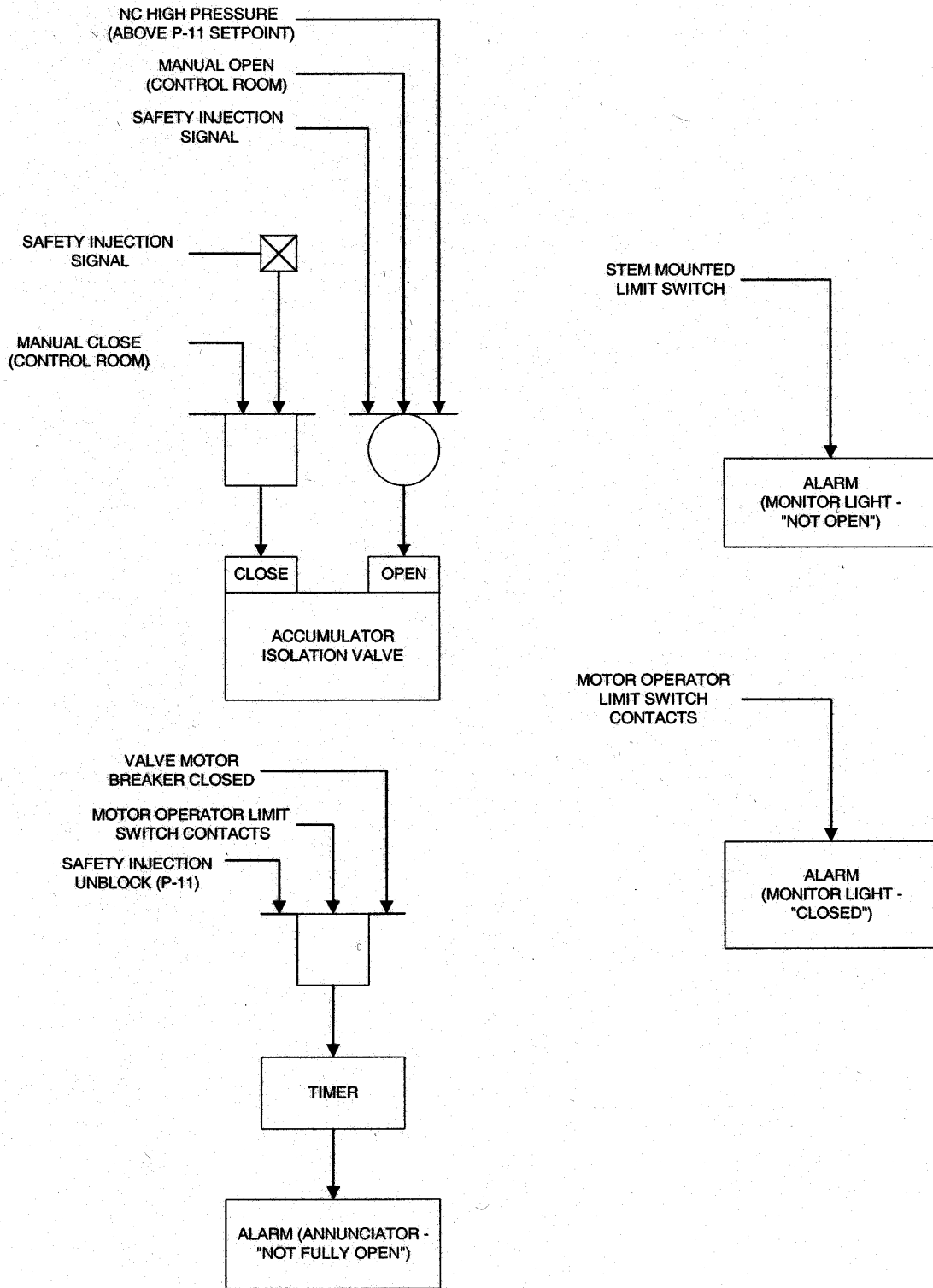


Figure 7-14. Containment Pressure Control System Logic

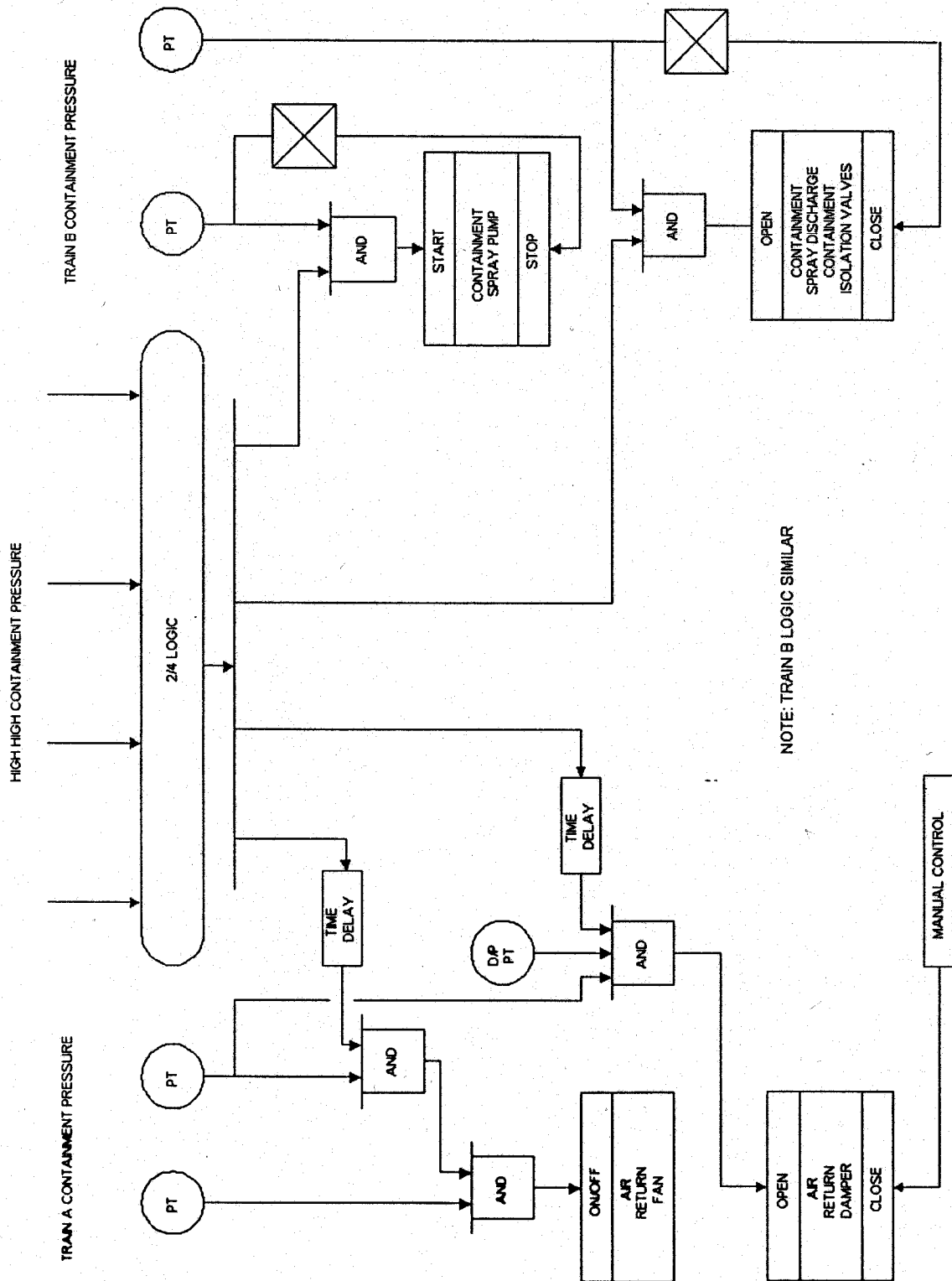


Figure 7-15. RWST Level Signal for Safety Injection System Recirculation Sump Isolation Valves

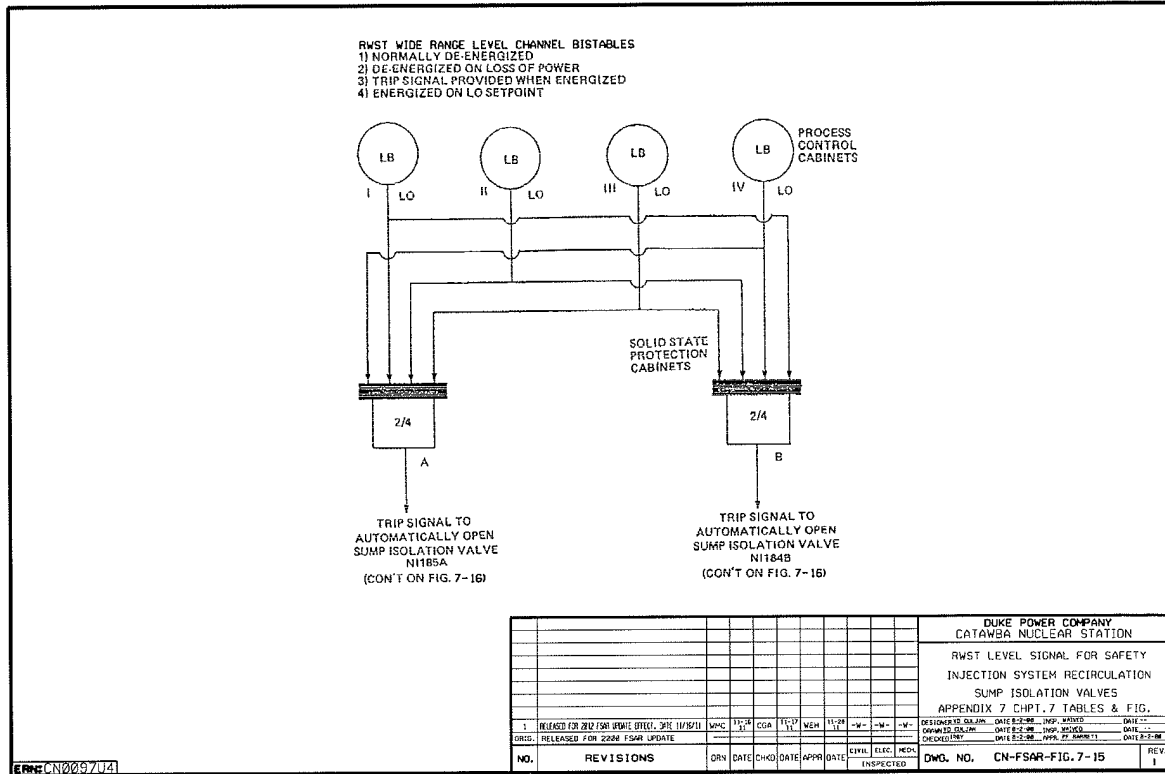
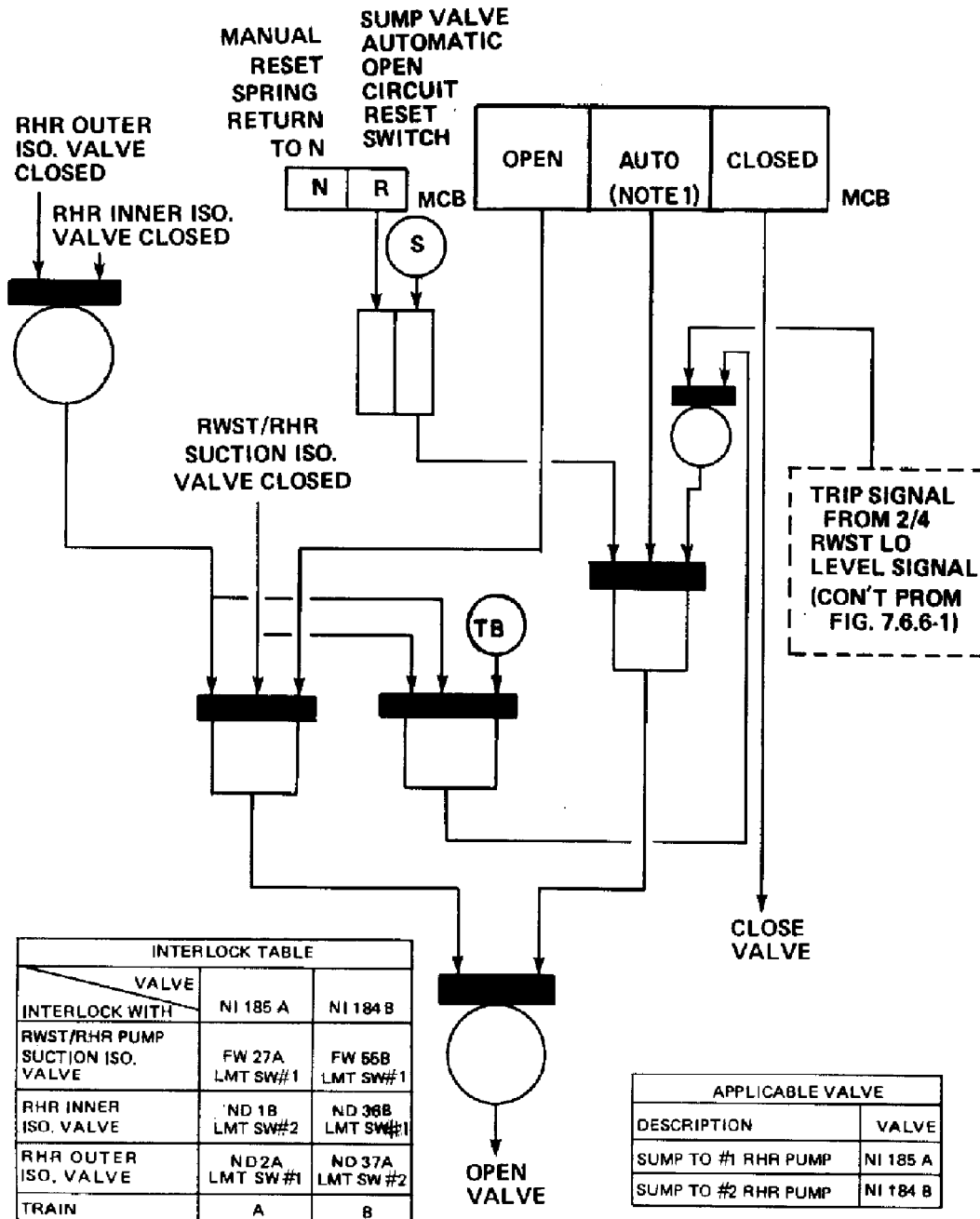


Figure 7-16. Safety Injection System Recirculation Sump Isolation Valves



LIMIT SWITCH #1 IS THE NORMAL POSITION SIGNAL AND IS USED FOR POSITION SIGNALS BETWEEN VALVES ASSIGNED TO THE SAME TRAIN.

LIMIT SWITCH #2 IS THE STEM MOUNTED POSITION SWITCH AND IT IS USED FOR POSITION SIGNALS BETWEEN VALVES ASSIGNED TO OPPOSITE TRAINS.

TB - TEST BUTTON (LOCATED ON WESTINGHOUSE SAFEGUARDS TEST CABINET)

S - SAFETY INJECTION SIGNAL

NOTE 1: THIS IS A TWO POSITION CUTLER-HAMMER (E30JY5) MOMENTARY OPEN/CLOSE PUSHBUTTON. THERE IS NOT AN AUTO BUTTON, BUT WHEN THE SWITCH IS NOT IN THE OPEN OR CLOSE STATE IT IS IN THE AUTO MODE.



Figure 7-17. Reactor Coolant System Overpressure Protection System for Low Pressure/Temperature Water Solid Conditions Logic Diagram

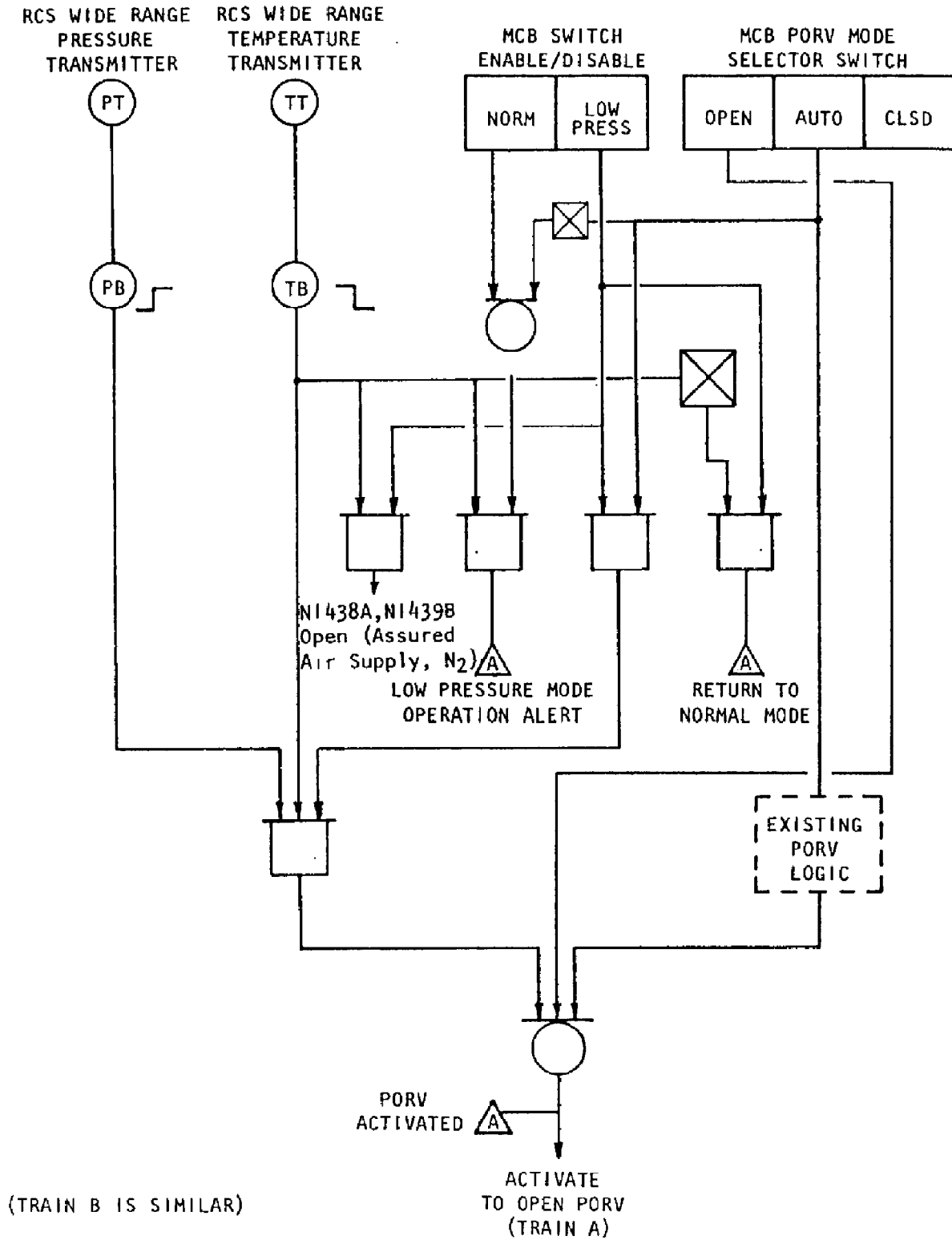


Figure 7-18. Rod Control System Block Diagram

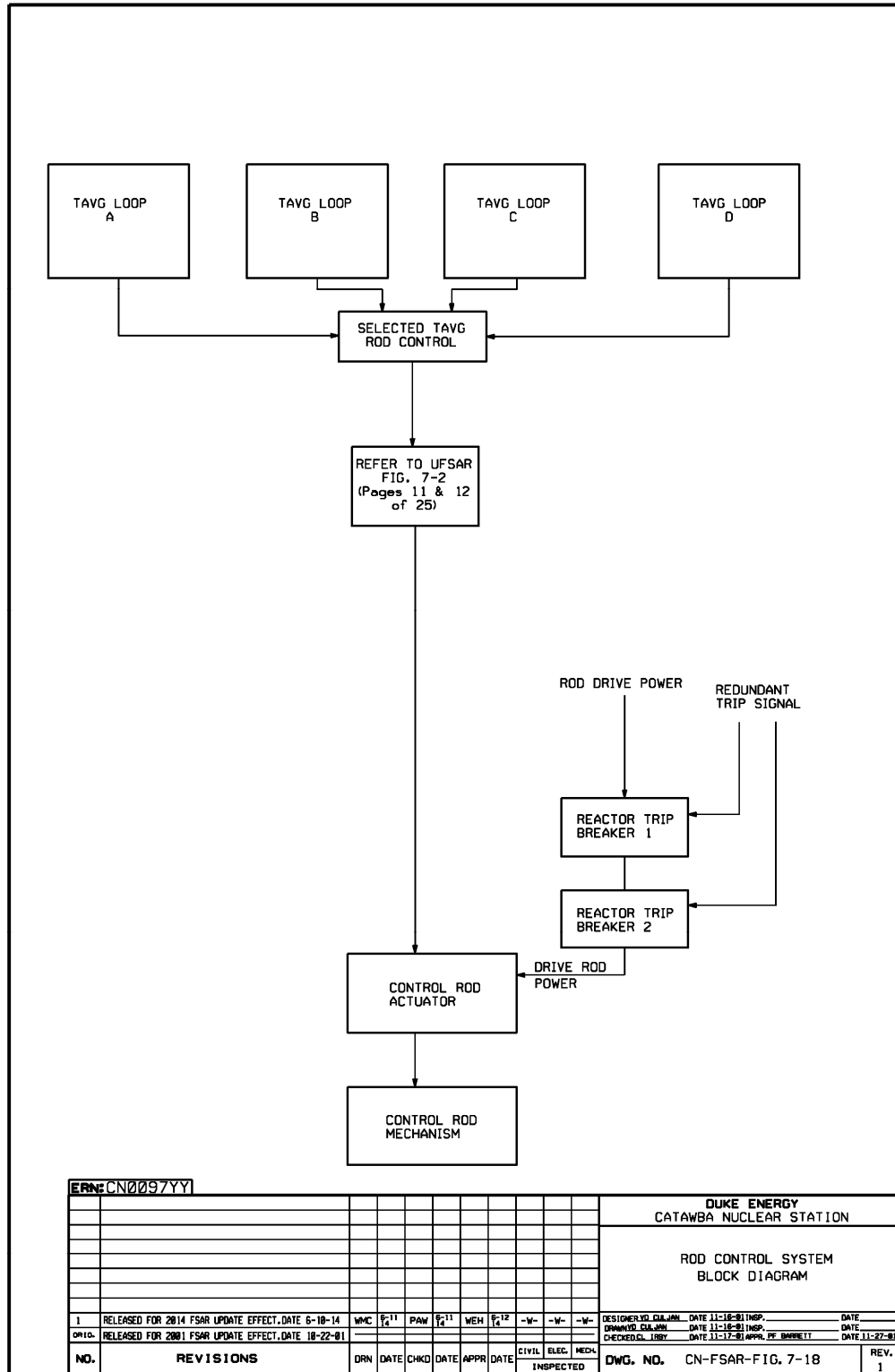
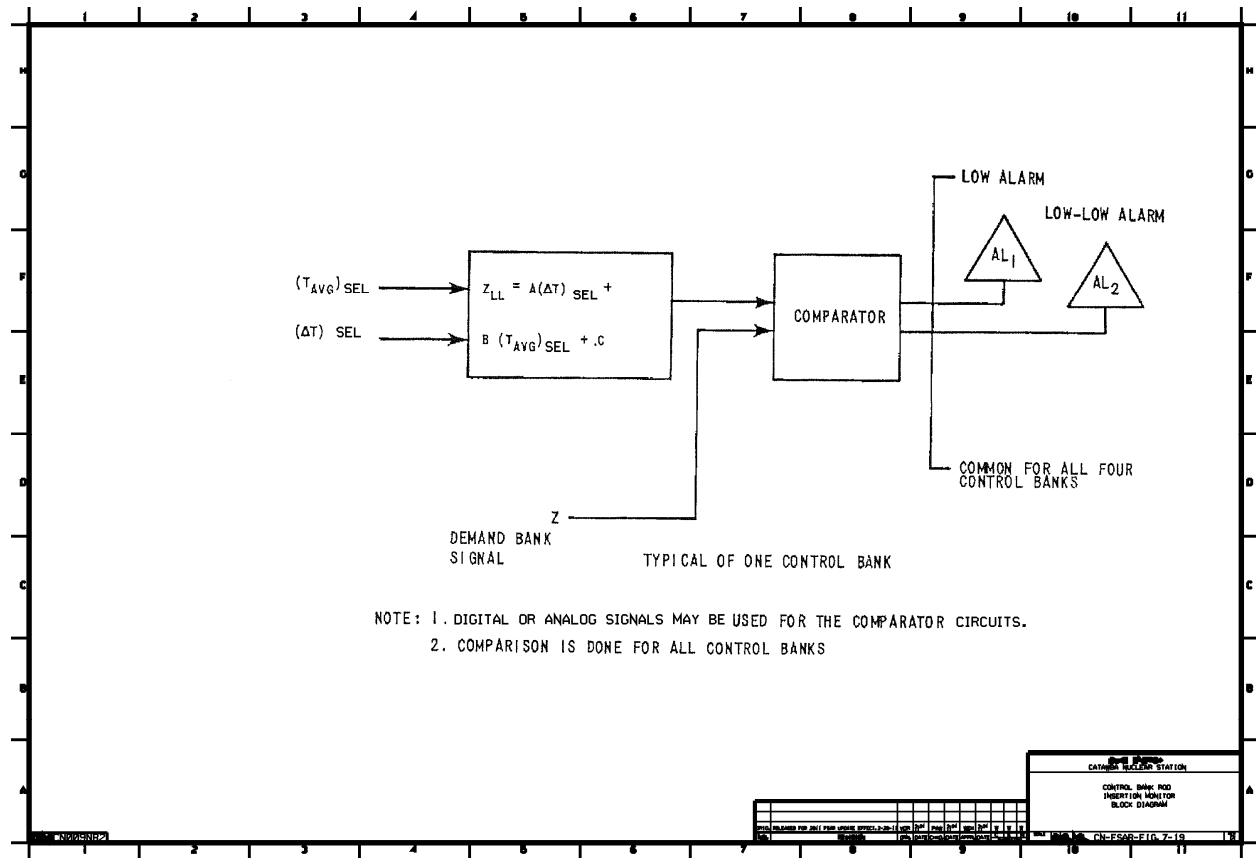
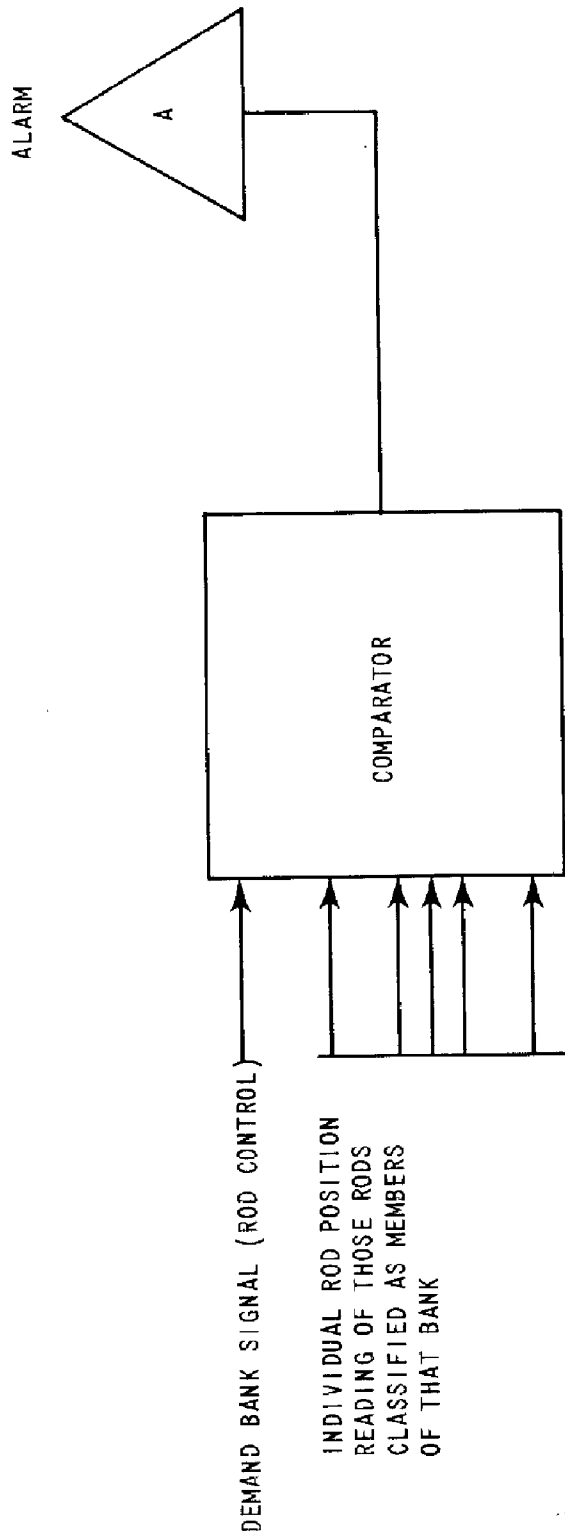


Figure 7-19. Control Bank Rod Insertion Monitor Block Diagram



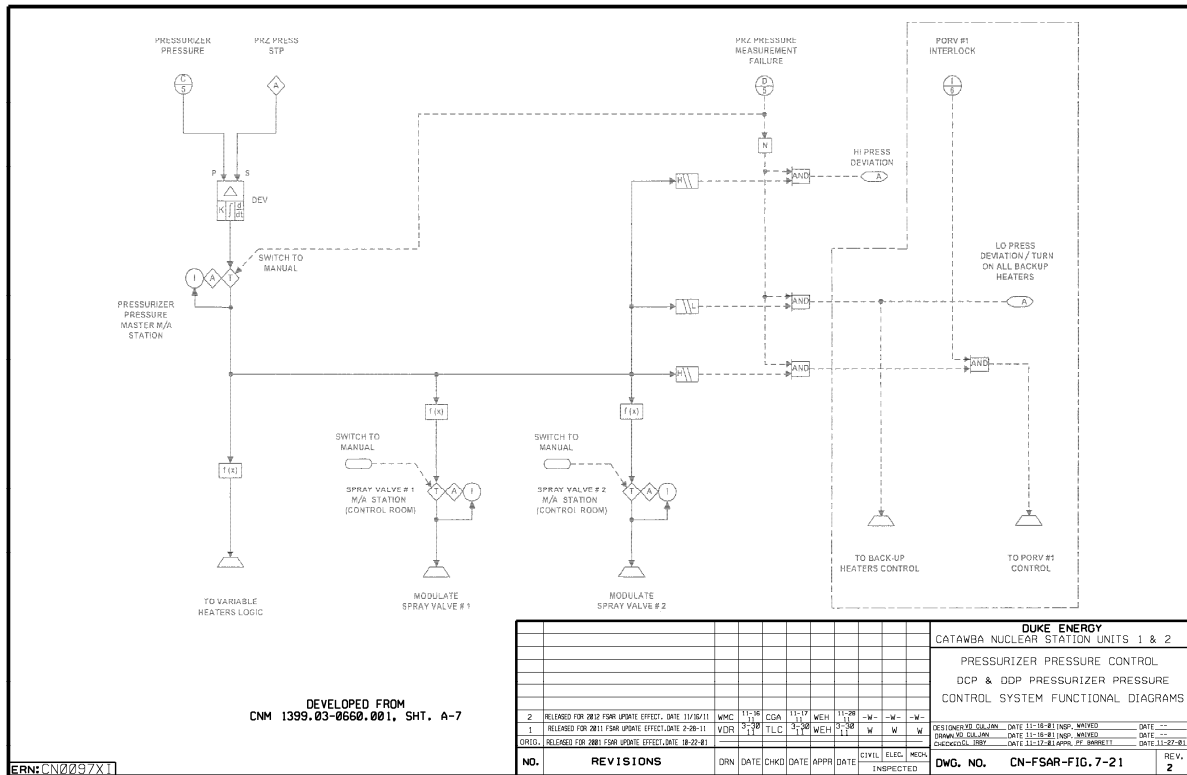
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Figure 7-20. Rod Deviation Comparator



- NOTE: 1. DIGITAL OR ANALOG SIGNALS MAY BE USED FOR THE COMPARATOR COMPUTER INPUTS .
2. THE COMPARATOR WILL ENERGIZE THE ALARM IF THERE EXISTS A POSITION DIFFERENCE GREATER THAN A PRESET LIMIT BETWEEN ANY INDIVIDUAL ROD AND THE DEMAND BANK SIGNAL .
3. COMPARISON IS INDIVIDUALLY DONE FOR ALL CONTROL BANKS .

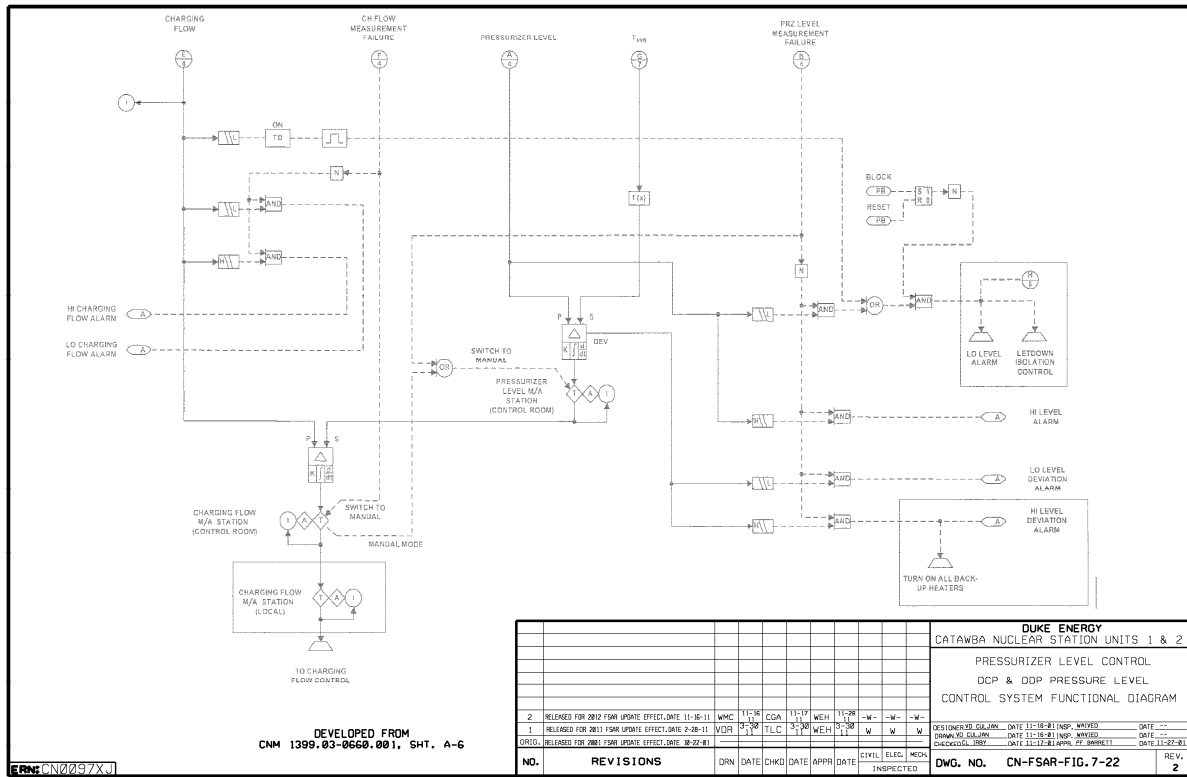
Figure 7-21. Pressurizer Pressure Control



DUKE ENERGY													
CATAWBA NUCLEAR STATION UNITS 1 & 2													
PRESSURIZER PRESSURE CONTROL													
DCP & DDP PRESSURIZER PRESSURE													
CONTROL SYSTEM FUNCTIONAL DIAGRAMS													
2	RELEASED FOR 2012 FSW UPDATE EFFECT. DATE 11/30/11	WMC	TC-36	COA	TC-17	WEH	TC-28	-W-	-W-	DESIGNER: JLM DATE 11-18-11 INSP. MANUED DATE ---			
1	RELEASED FOR 2011 FSW UPDATE EFFECT DATE 2-26-11	VDR	TC-36	TLC	TC-17	WEH	TC-28	W	W	DRWING: JLM DATE 11-18-11 INSP. MANUED DATE ---			
0	ORIG. RELEASED FOR 2001 FSW UPDATE EFFECT DATE 10-22-01									CHECKED: JBY DATE 11-17-01 APPR. ZJ 08/08/11 DATE 11-27-11			
NO.	REVISIONS	DRN	DATE	CHKD	DATE	APPR	DATE	CIVIL	ELEC.	MECH.	DWG. NO.	CN-FSAR-FIG. 7-21	REV.
													2

**Deleted Per 2012 Update**

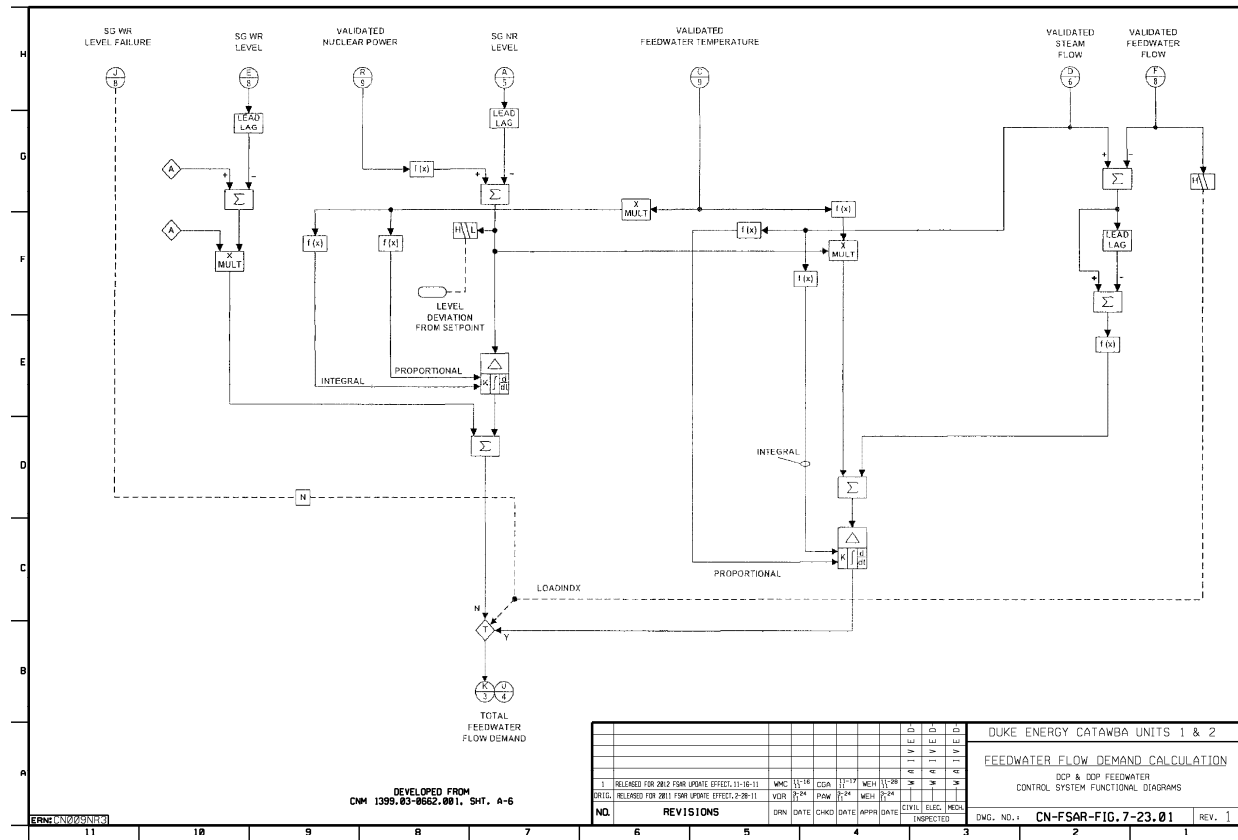
Figure 7-22. Pressurizer Level Control System Block Diagram



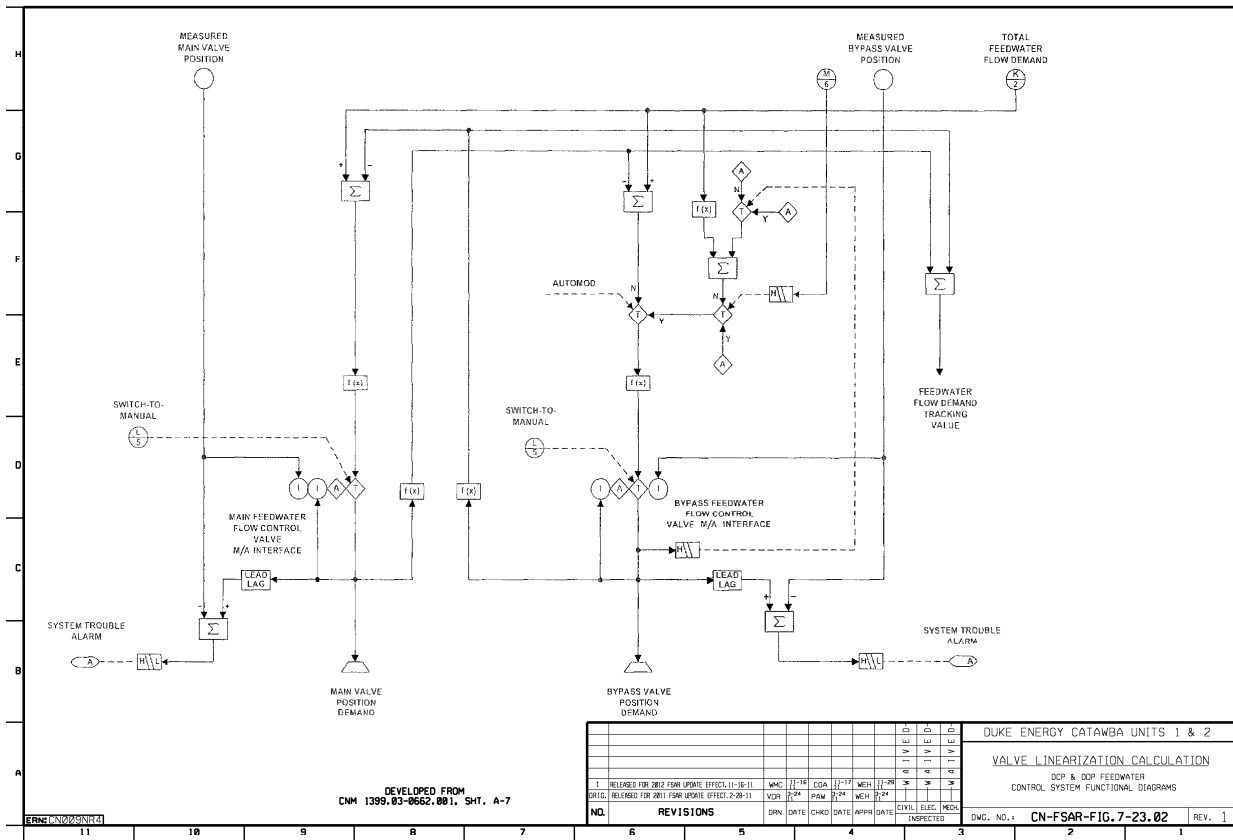


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Figure 7-23. Steam Generator Level Control



Steam Generator Level Control



DEVELOPED FROM  
CNM 1399.03-0662.001, SHT. A-7

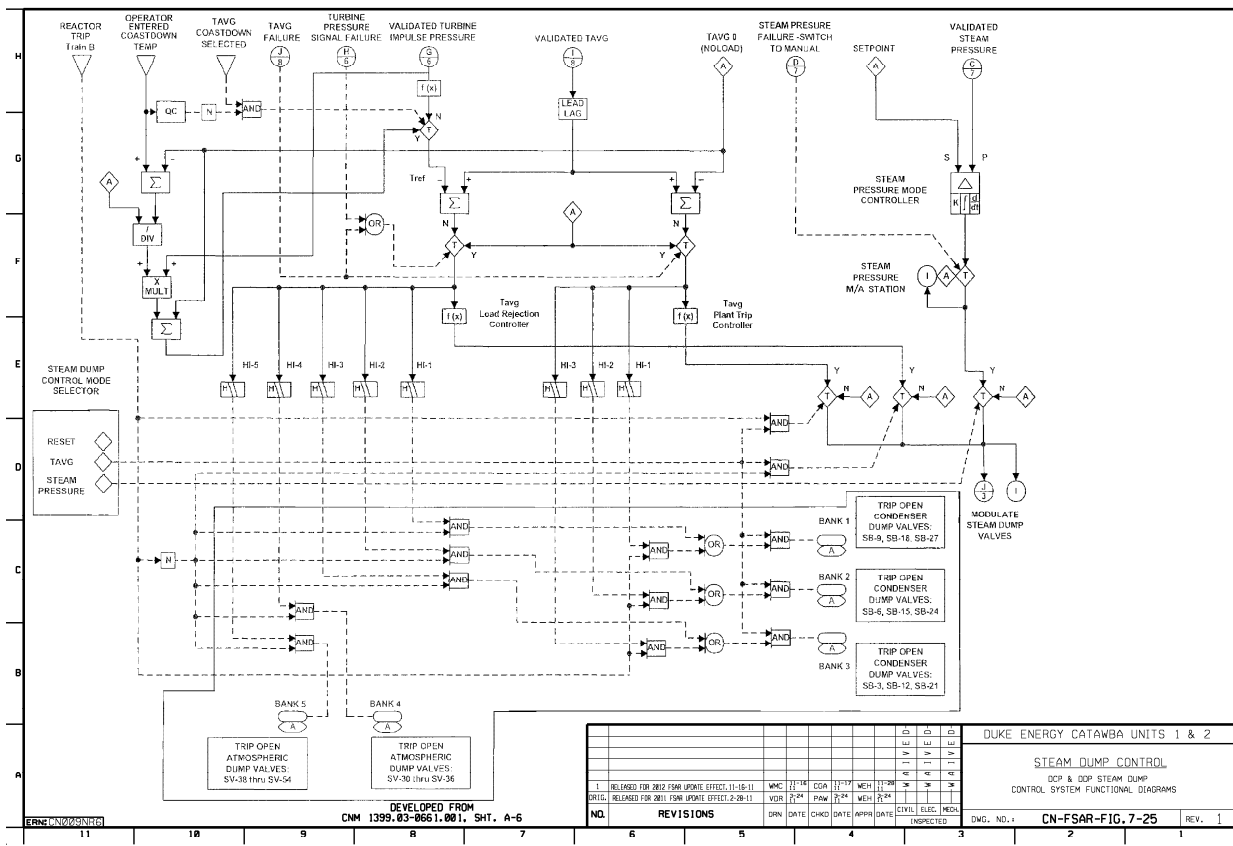
DUKE ENERGY CATAWBA UNITS 1 & 2										
VALVE LINEARIZATION CALCULATION										
DCP & DDP FEEDWATER CONTROL SYSTEM FUNCTIONAL DIAGRAMS										
NO.	REV.	DATE	BY	CHKD	APPV	DATE	CIVIL	ELEC	MEDIA	INSPECTED
1		08/12/89	WMC	JLH	COA	11/11/89				
2		02/15/90	WMC	JLH	COA	02/15/90				
3		02/15/90	WMC	JLH	COA	02/15/90				
4		02/15/90	WMC	JLH	COA	02/15/90				
5		02/15/90	WMC	JLH	COA	02/15/90				
6		02/15/90	WMC	JLH	COA	02/15/90				
7		02/15/90	WMC	JLH	COA	02/15/90				
8		02/15/90	WMC	JLH	COA	02/15/90				
9		02/15/90	WMC	JLH	COA	02/15/90				
10		02/15/90	WMC	JLH	COA	02/15/90				
11		02/15/90	WMC	JLH	COA	02/15/90				
Dwg. No. 1 CN-FSAR-FIG. 7-23.02 REV. 1										

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**Deleted Per 2012 Update.**

Figure 7-25. Steam Dump Control System



DEVELOPED FROM  
 CNM 1399.03-0661.001, SHT. A-6

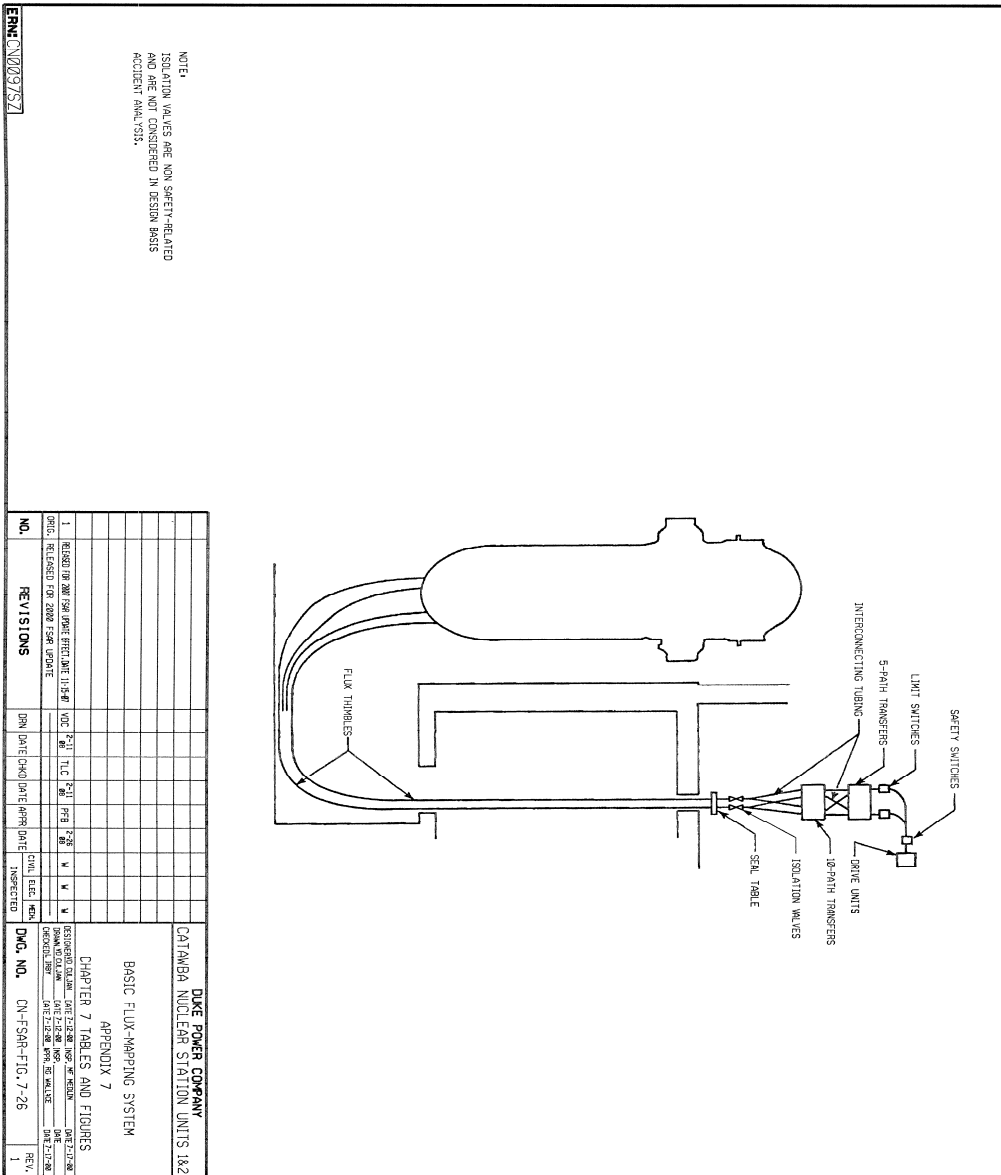
NO.	REVISIONS	DRN	DATE	CHKD	DATE	APPR	DATE	CIVIL	ELEC	MEDIA	INSPECTED
1	RELEASED FOR 2012 FSAR UPDATE EFFECT 11-16-11	WMC	11/16/11	COB	11/17/11	MEH	11/20/11				
2	DRG. RELEASED FOR 2011 FSAR UPDATE EFFECT 2-28-11	YOR	2/24/11	PSM	2/24/11	MEH	2/24/11				

DUKE ENERGY CATAWBA UNITS 1 & 2  
 STEAM DUMP CONTROL  
 DCP & DDP STEAM DUMP CONTROL SYSTEM FUNCTIONAL DIAGRAMS  
 CN-FSAR-FIG. 7-25 REV. 1

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Figure 7-26. Basic Flux-Mapping System



NOTE:  
ISOLATION VALVES ARE NON-SAFETY-RELATED  
AND ARE NOT CONSIDERED IN DESIGN BASIS  
ACCIDENT ANALYSIS.

ENR 000975Z

DUKE POWER COMPANY CATAMBA NUCLEAR STATION UNITS 1&2										
CHAPTER 7 TABLES AND FIGURES										
APPENDIX 7										
BASIC FLUX-MAPPING SYSTEM										
DESIGNED BY: DATE: 2-28-80										
DRAWN BY: DATE: 2-28-80										
CHECKED BY: DATE: 2-28-80										
APPROVED BY: DATE: 2-28-80										
PROJECT: 000975Z										
REV. 1										
NO.	REVISIONS	DN	DATE	CHKD	DATE	APPR	DATE	CHG	DATE	CHKD
1	ISSUED BY THE FSAR PROJECT TEAM	YOC	7-21-80	TLC	8-11-80	FRB	7-28-80	W	8-11-80	W
	RELEASED FOR 2007 FSAR UPDATE									

**Figure 7-27. Deleted Per 1990 Update**

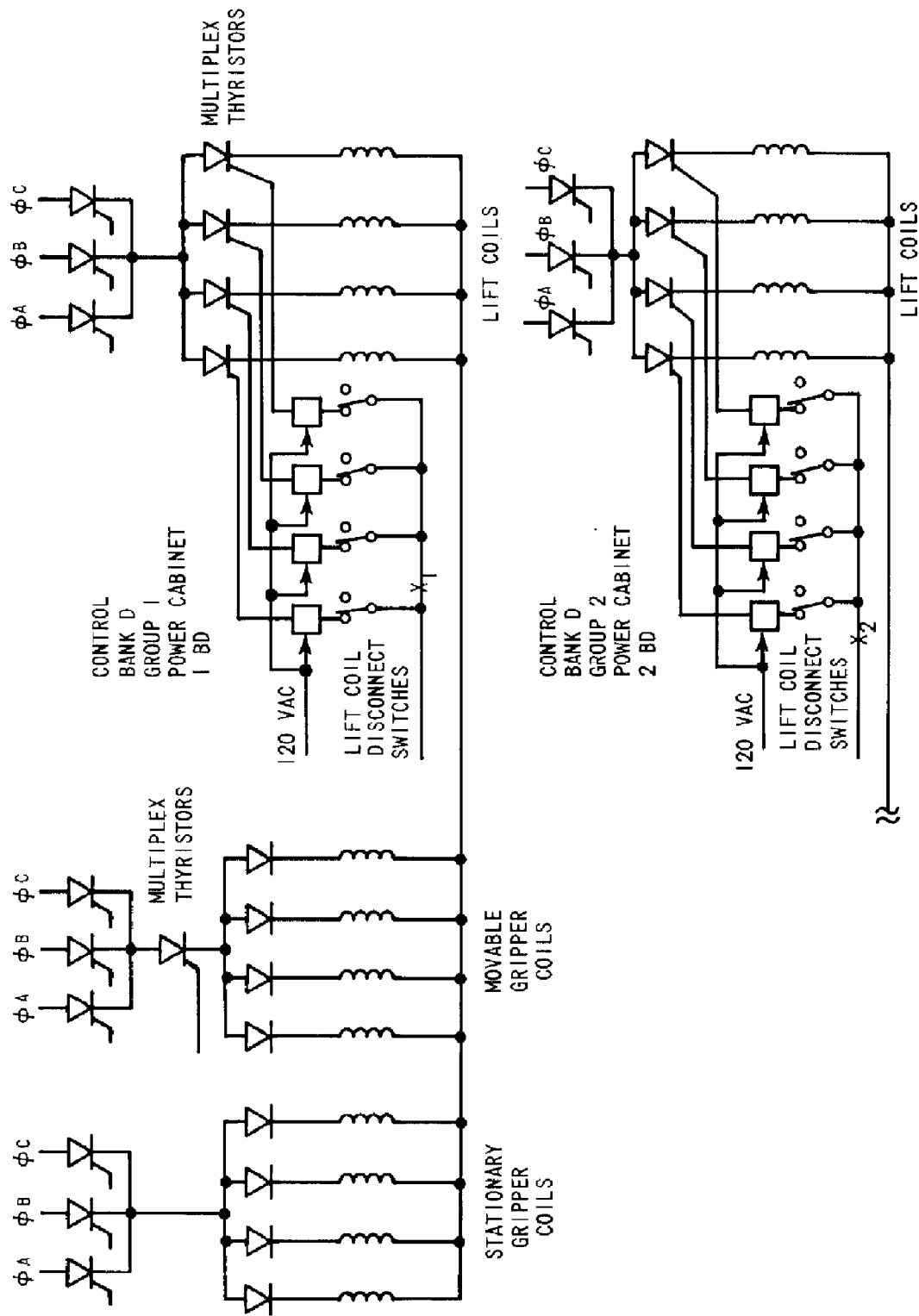
**Figure 7-28. Deleted Per 1990 Update**

**Figure 7-29. Deleted Per 1990 Update**

**Figure 7-30. Deleted Per 2000 Update**



Figure 7-32. Control Bank D Power Cabinets 1BD and 2BD Partial Schematic Diagram



**Figure 7-33. Deleted Per 1995 Update**