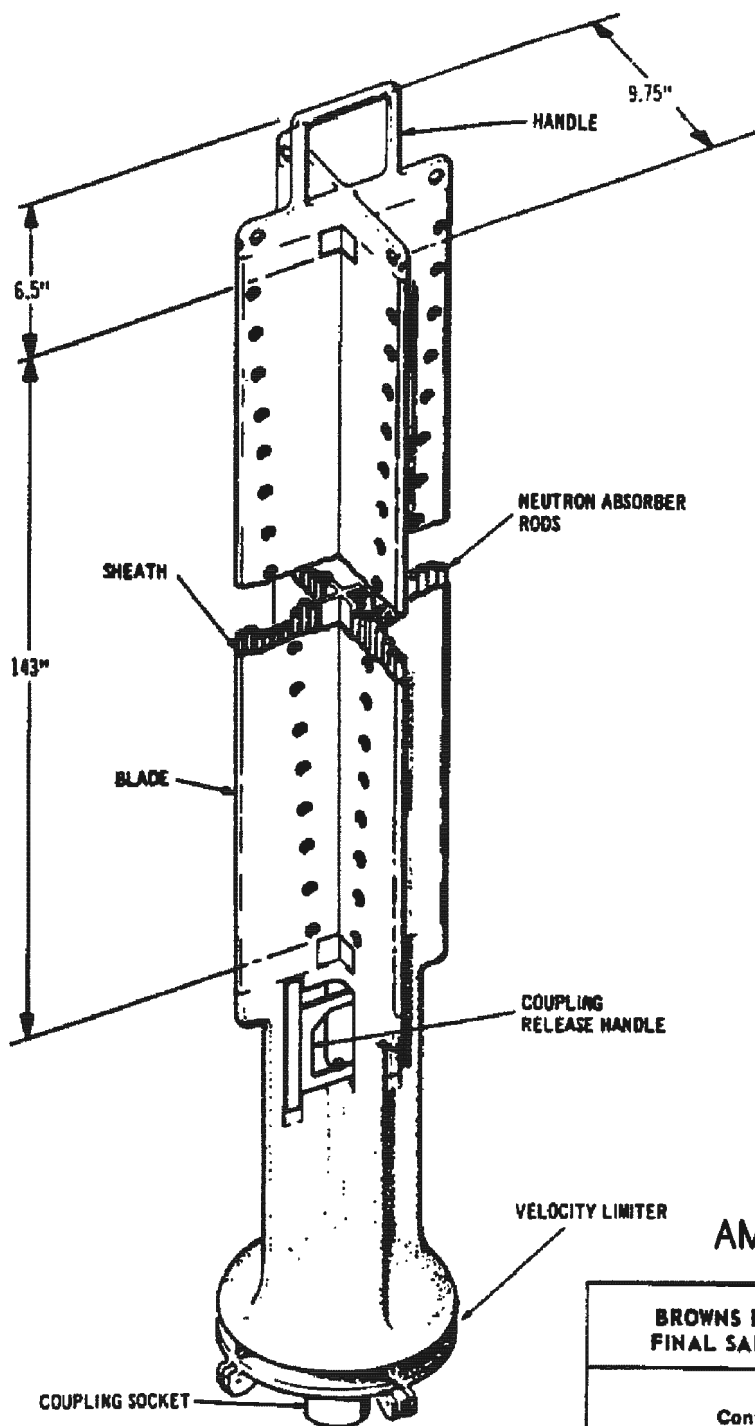


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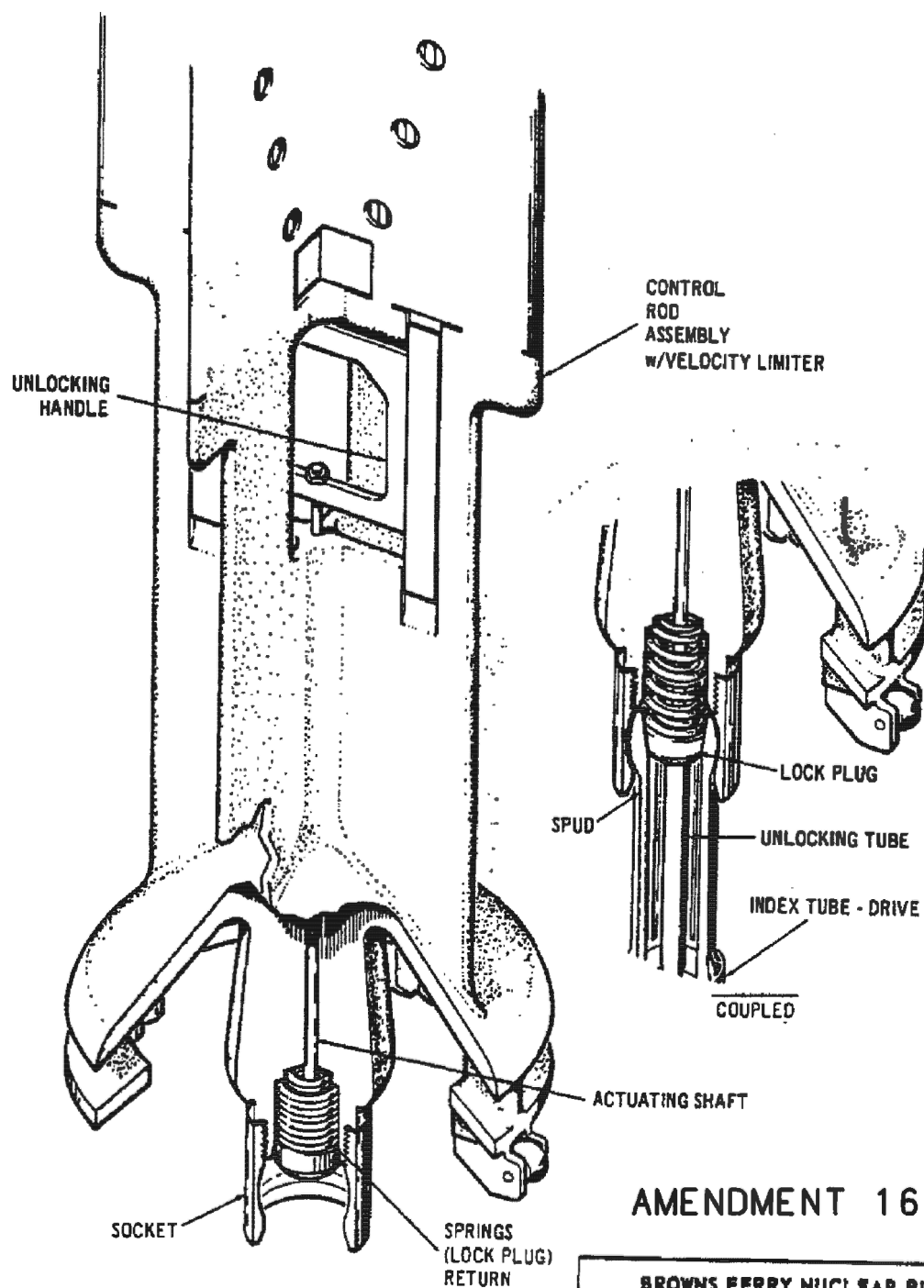
Control Rod - Isometric
FIGURE 3.4-1



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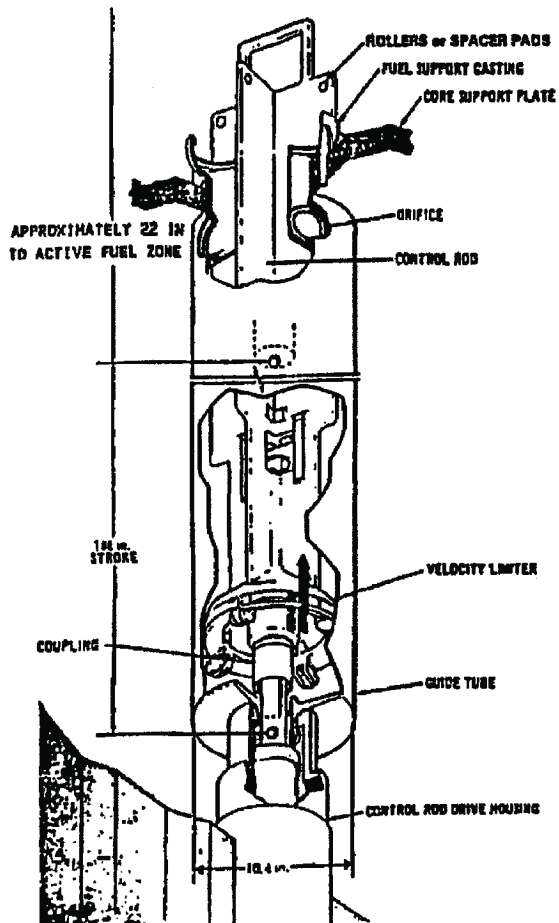
Control Rod - Isometric
FIGURE 3.4-2



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Control Rod to Control Rod Drive Coupling -
Isometric
FIGURE 3.4-3

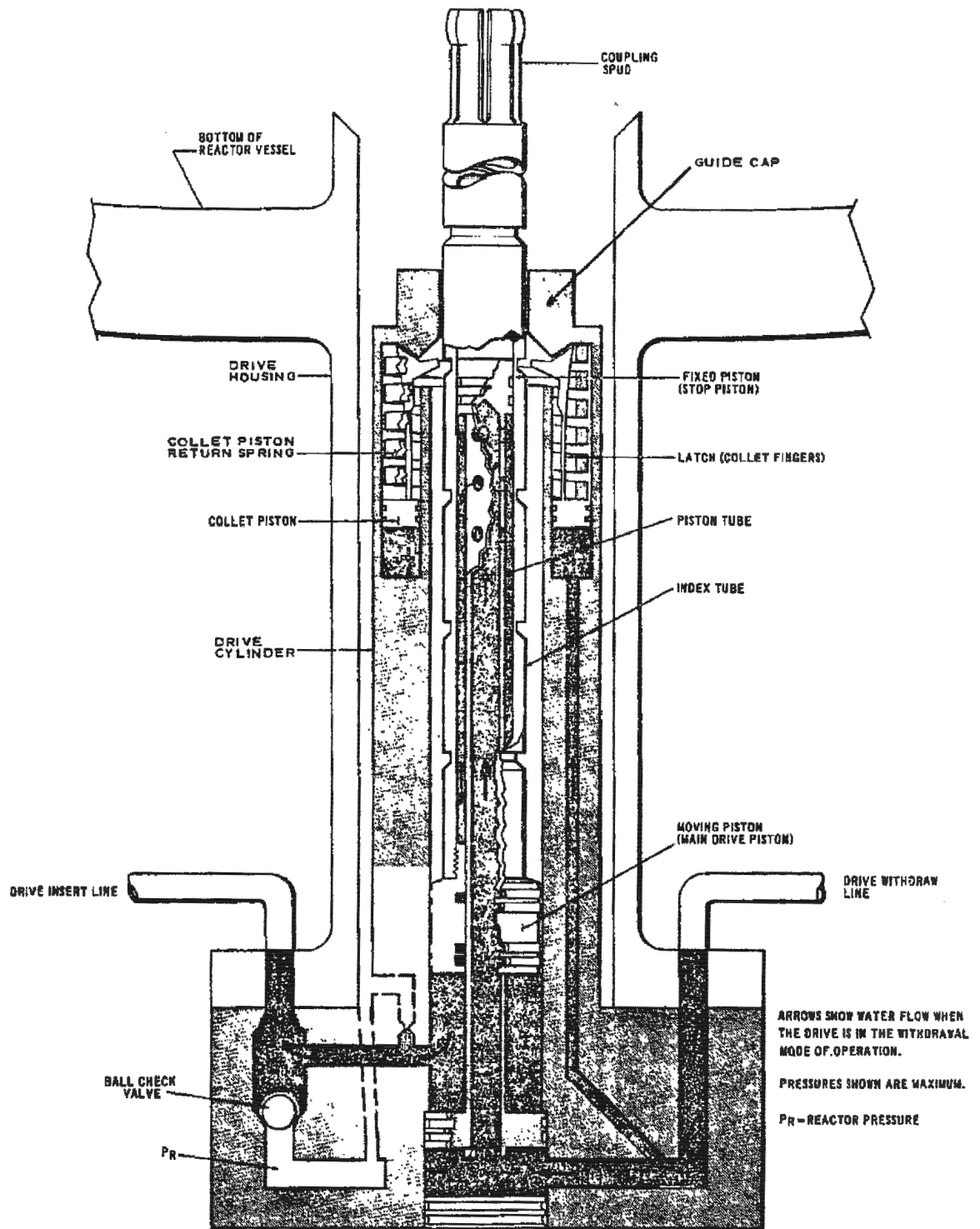


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CONTROL ROD VELOCITY LIMITER-
ISOMETRIC

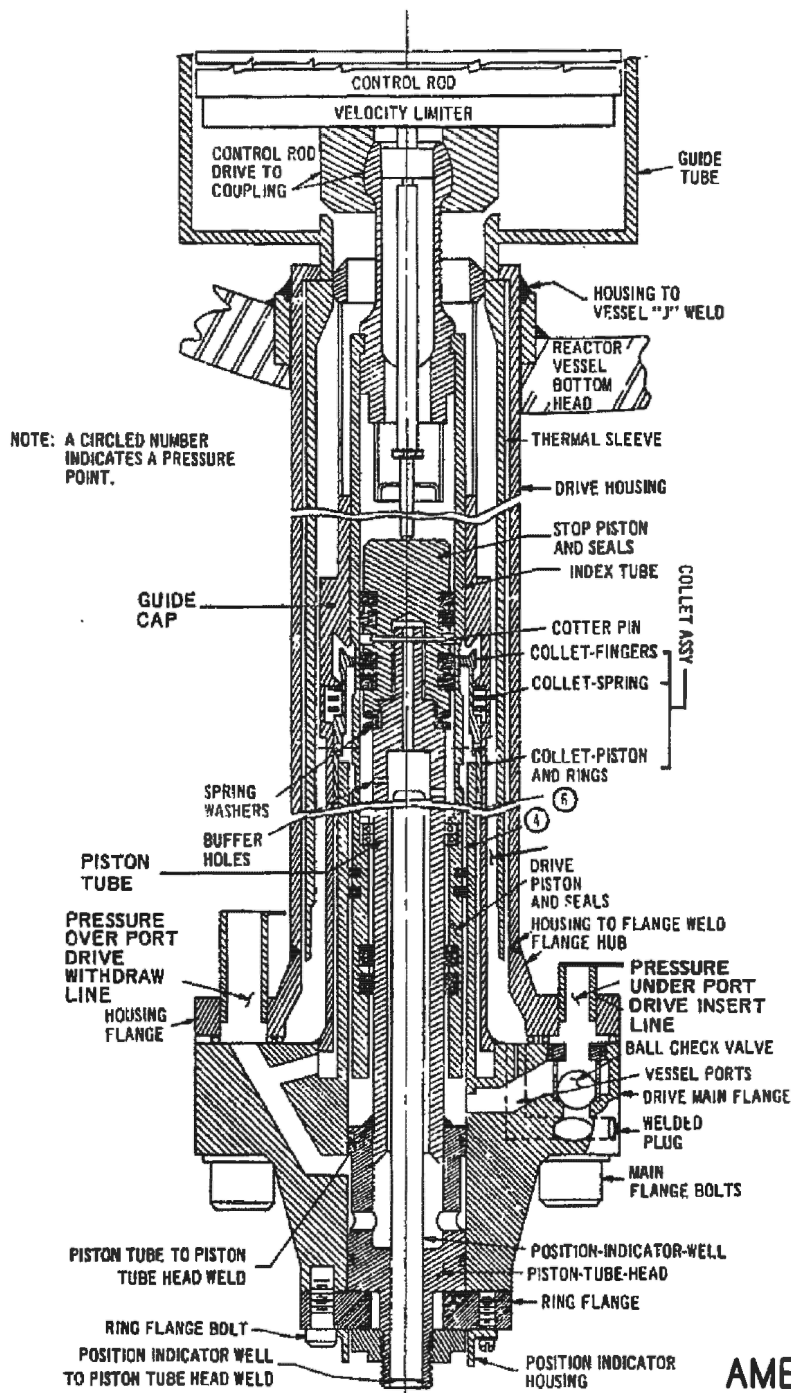
FIGURE 3.4-4



**BROWNS FERRY NUCLEAR PLANT
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Control Rod Drive, Simplified
Component Illustration
FIGURE 3.4-5

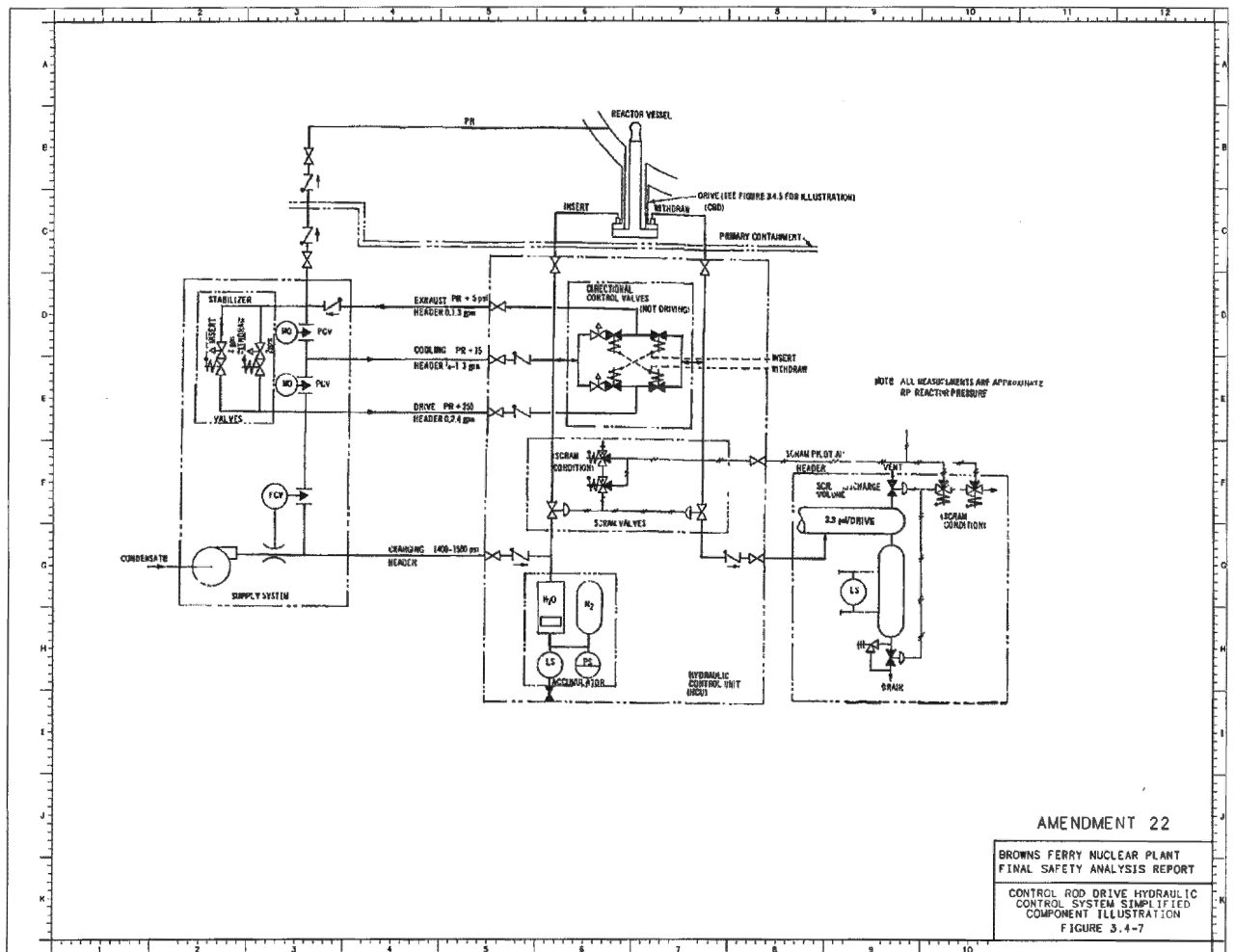
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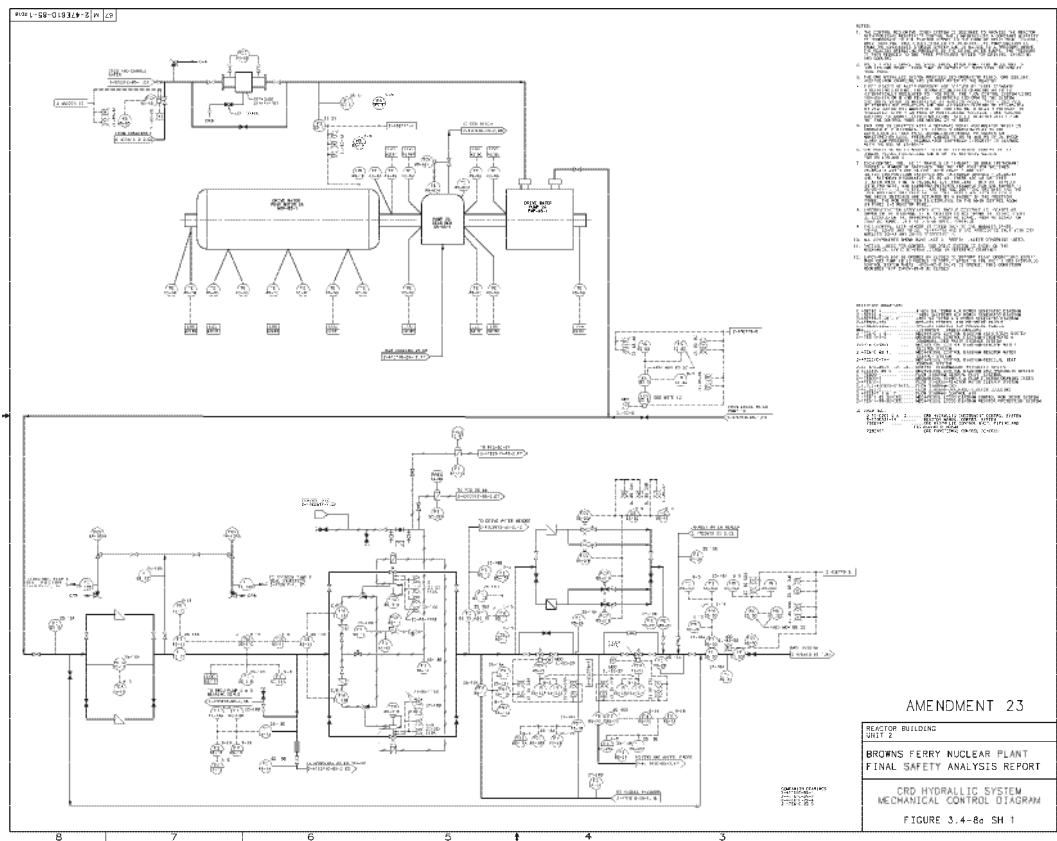


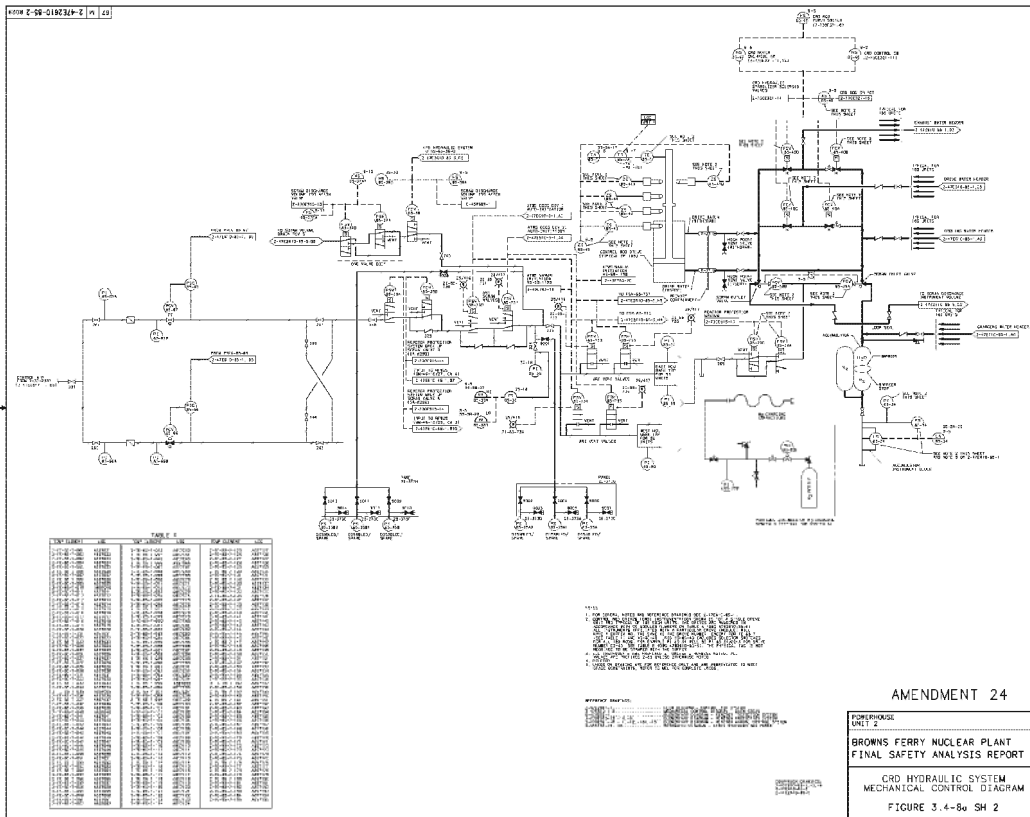
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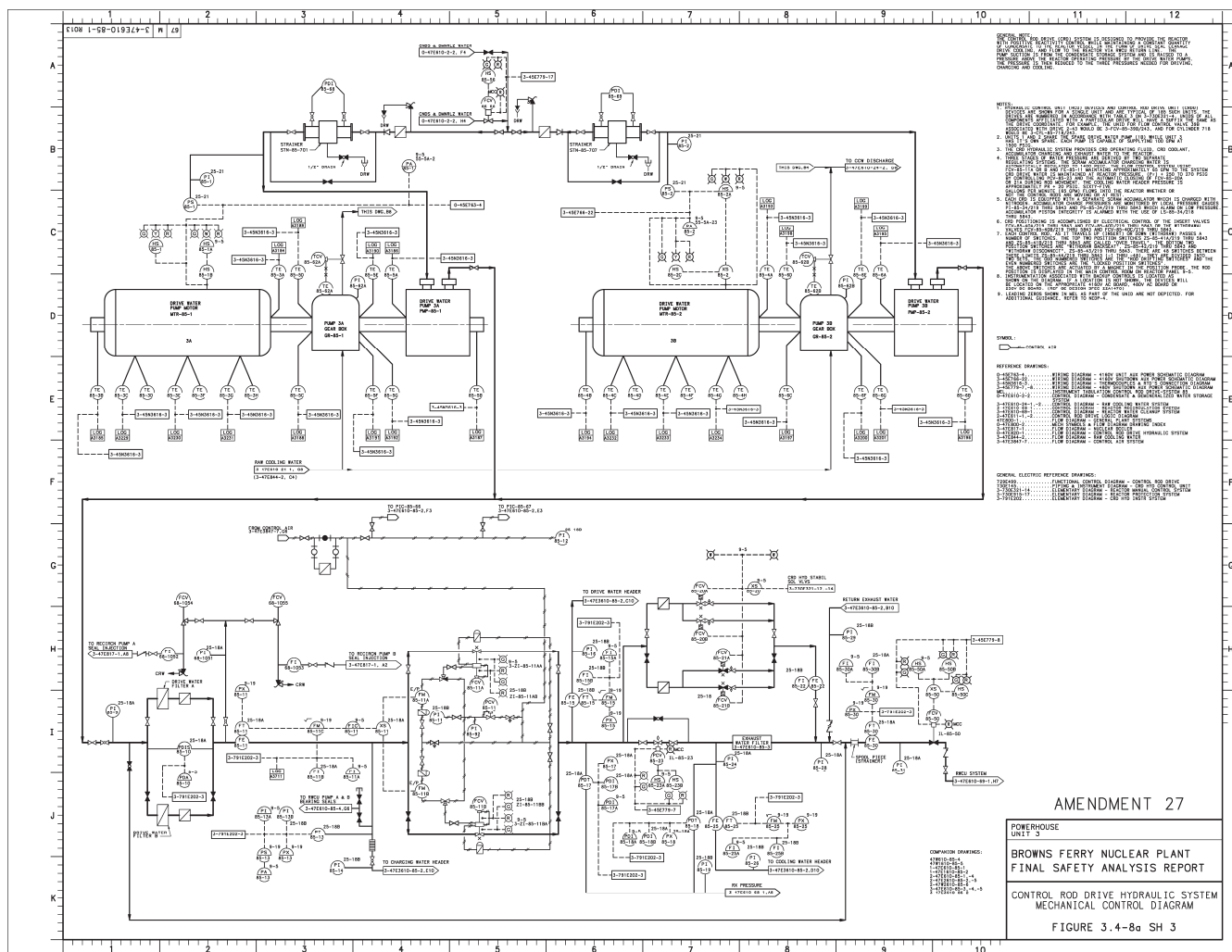
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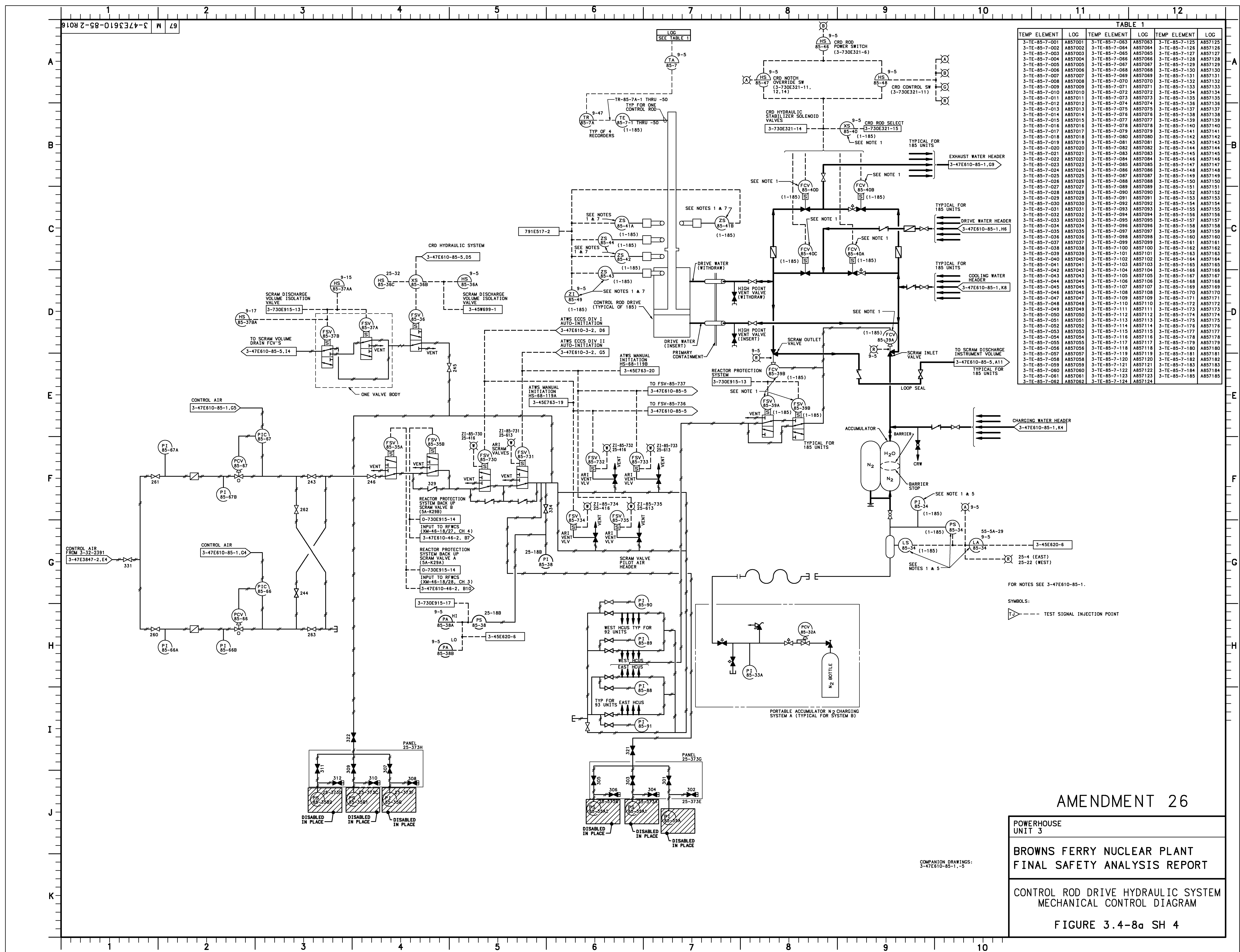
Control Rod Drive, Schematic Diagram
FIGURE 3.4-6

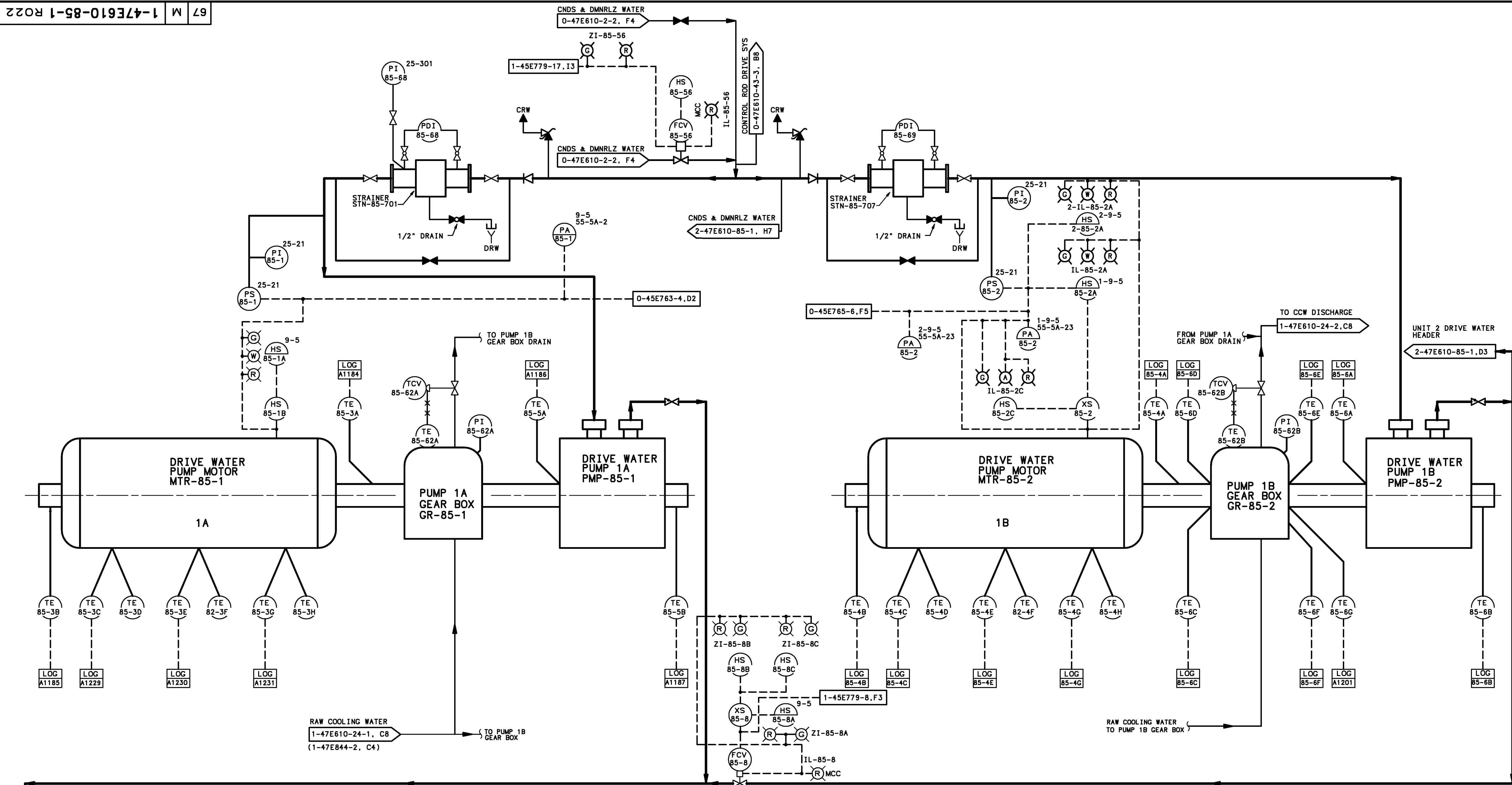












GENERAL NOTE:
THE CONTROL ROD DRIVE (CRD) SYSTEM IS DESIGNED TO PROVIDE THE REACTOR WITH POSITIVE REACTIVITY CONTROL WHILE MAINTAINING A CONSTANT QUANTITY OF CONDENSATE TO THE REACTOR VESSEL IN THE FORM OF DRIVE SEAL LEAKAGE. CONDENSATE IS FROM THE CONDENSATE STORAGE SYSTEM AND IS AT A PRESSURE ABOVE THE REACTOR OPERATING PRESSURE BY THE DRIVE WATER PUMPS. THE PRESSURE IS THEN REDUCED TO THE THREE PRESSURES NEEDED FOR DRIVING, CHARGING AND COOLING.

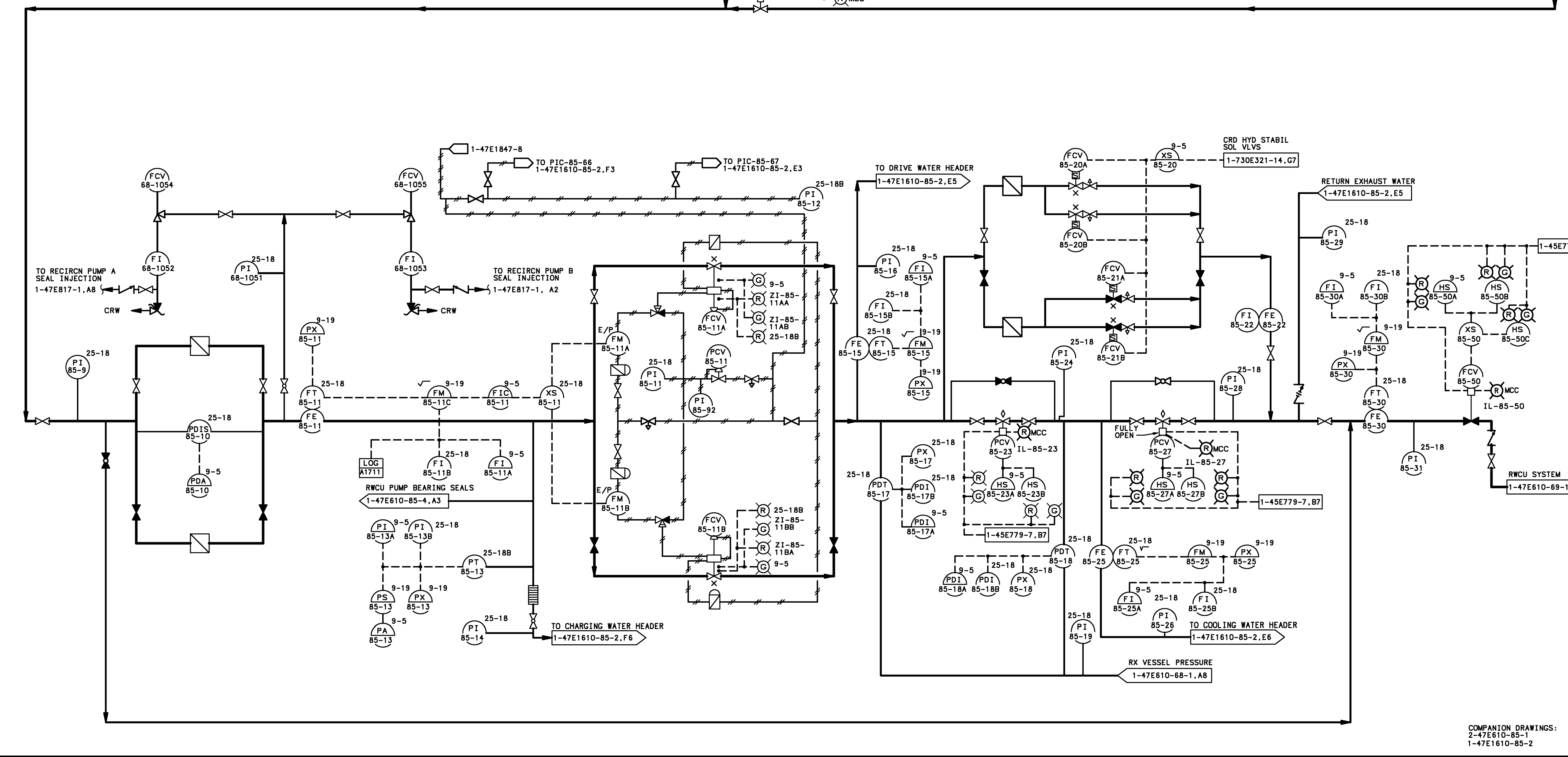
- NOTES:
1. THE CRD HYDRAULIC CONTROL UNIT (HCU) DEVICES AND CONTROL ROD DRIVE UNIT (CRDU) DEVICES ARE SHOWN FOR A SINGLE UNIT AND ARE TYPICAL OF 185 SUCH UNITS. THE DEVICES ARE NUMBERED IN ACCORDANCE WITH TABLE 3 ON 1-730E321-1. UNITS OF ALL COMPONENTS AFFILIATED WITH A PARTICULAR SYSTEM ARE PREFIXED THE SAME AS THE DRIVE COORDINATE. FOR EXAMPLE, THE UNIT FOR FLOW CONTROL VALVE 388 ASSOCIATED WITH DRIVE 2-43 WOULD BE 1-FCV-85-388/2-43. AND FOR CYLINDER 718 WOULD BE 1-CYL-85-718/2-43.
 2. UNITS 1 AND 2 SHARE THE SPARE DRIVE WATER PUMP (1B) WHILE UNIT 3 HAS ITS OWN SPARE. EACH PUMP IS CAPABLE OF SUPPLYING 100 GPM AT 1500 PSIG.
 3. THE CRD HYDRAULIC SYSTEM PROVIDES CRD OPERATING FLUID, CRD COOLANT, ACCUMULATOR CHARGING AND EXHAUST WATER TO THE REACTOR.
 4. THREE STAGES OF WATER PRESSURE ARE DERIVED BY TWO SEPARATE REGULATING SYSTEMS. THE SCRAM ACCUMULATOR CHARGING WATER IS AUTOMATICALLY REGULATED TO 1400 PSIG. THE FLOW CONTROL SYSTEM USING FCV-85-11A OR B AND FCV-85-11A MAINTAINS APPROXIMATELY 65 GPM TO THE SYSTEM. CRD DRIVE WATER IS MAINTAINED AT REACTOR PRESSURE, (P) + 250 TO 270 PSIG BY CONTROLLING P + 25 PSIG. SIXTY-FIVE GALLONS PER MINUTE (45 GPM) FLOWS INTO THE REACTOR WHETHER OR NOT THE CONTROL RODS ARE MOVING OR AT REST.
 5. EACH CRD IS EQUIPPED WITH A SEPARATE SCRAM ACCUMULATOR WHICH IS CHARGED WITH NITROGEN. ACCUMULATOR CHARGE PRESSURES ARE MONITORED BY LOCAL PRESSURE GAUGES P1-85-34/219 THRU 5843 AND PS-85-34/219 THRU 5843 WHICH ALARM ON LOW PRESSURE. ACCUMULATOR PISTON INTEGRITY IS ALARMED WITH THE USE OF LS-85-34/219 THRU 5843.
 6. CRD POSITIONING IS ACCOMPLISHED BY ELECTRICAL CONTROL OF THE INSERT VALVES FCV-85-40A/219 THRU 5843 AND FCV-85-40B/219 THRU 5843 OR THE WITHDRAWAL VALVES FCV-85-40B/219 THRU 5843 AND FCV-85-40C/219 THRU 5843.
 7. EACH CONTROL ROD, AS IT TRAVELS UP (INSERT) OR DOWN (WITHDRAW) PASSES A NUMBER OF SWITCHES. WITHDRAWAL SWITCHES AT LS-85-42/219 THRU 5843 AND INSERT SWITCHES AT LS-85-41/219 THRU 5843. THE TOP TWO POSITION SWITCHES 25-85-41A/219 THRU 5843 AND 25-85-41B/219 THRU 5843 ARE CALLED "OVER TRAVEL". THE BOTTOM TWO POSITION SWITCHES 25-85-41C/219 THRU 5843 AND 25-85-41D/219 THRU 5843 ARE CALLED "LIMIT SWITCHES". THE 16 POSITION SWITCHES ARE DIVIDED INTO TWO SECTIONS. THE 8 POSITION SWITCHES (LS-85-41A/219 THRU 5843) ARE THE "LIMIT SWITCHES" AND THE 8 POSITION SWITCHES (LS-85-41B/219 THRU 5843) ARE THE "LIMIT SWITCHES". THE 16 POSITION SWITCHES ARE ACTUATED BY A MAGNET IN THE POSITION PROBE. THE ROD POSITION IS DISPLAYED IN THE MAIN CONTROL ROOM ON REACTOR PANEL 9-5.
 8. INSTRUMENTATION ASSOCIATED WITH BACKUP CONTROLS IS LOCATED AS SHOWN IN THE DIAGRAM. IF A LOCATION IS NOT SHOWN, THE DEVICES WILL BE LOCATED ON THE APPROPRIATE 4180V AC BOARD, 480V AC BOARD OR 240V DC BOARD. (REF. GE DESIGN SPEC 22A1470)
 9. UNITS ON DRAWING ARE FOR REFERENCE ONLY AND ARE ABBREVIATED AS SHOWN. IN THE EXAMPLE TO MEET SPACE CONSTRAINTS, REFER TO MEL FOR COMPLETE UNITS. ALL UNITS ARE IN UNIT 1 UNLESS OTHERWISE NOTED. LEADING ZEROS SHOWN IN MEL AS PART OF THE UNIT ARE NOT DEPICTED. FOR ADDITIONAL GUIDANCE REFER TO NEOP-4.
- EXAMPLE: MEL UNIT BFN-1-51A-85-0707 DRAINING UNIT 21N-85-707
BFP-1-1-21-85-008A Z1-85-8A

REFERENCE DRAWINGS:

MEL	DESCRIPTION
0-47E600-224A-224A	CRD INSTRUMENT TABULATION
0-47E610-2-2	RPS-CRD CONTROL AIR PRESSURE PANELS
0-47E610-24-10	CONTROL DIAGRAM-CONDENSATE
2-47E610-24-10	CONTROL DIAGRAM-RAW COOLING WATER
1-47E610-68-1	CONTROL DIAGRAM-RECIRCULATION SYSTEM
1-47E610-69-1	CONTROL DIAGRAM-RWC SYSTEM
2-47E610-69-1	CONTROL DIAGRAM-CHARGE WATER
1-47E610-85-2	CONTROL DIAGRAM-CRD HYD
2-47E610-85-2	CONTROL DIAGRAM-CRD HYD
0-47E600-1	FLOW DIAGRAM-GENERAL PLANT SYSTEMS
0-47E600-1	MECHANICAL SYMBOLS & FLOW DIAGRAM DRAWING INDEX
0-47E647-1 THRU -3	FLOW DIAGRAM-CONTROL AIR
0-47E647-1	4180V UNIT AUX POWER SCHEMATIC DIAGRAM
2-45E779-7	480V SHUTDOWN AUX POWER
1-47E611-85-SERIES	MECHANICAL LOGIC DIAGRAM CONTROL ROD DRIVE SYSTEM
2-47E611-85-SERIES	MECHANICAL LOGIC DIAGRAM REACTOR PROTECTION SYSTEM
0-47E610-43-3	MECHANICAL CONTROL DIAGRAM SAMPLING & WATER QUALITY SYSTEM

GE DRAWINGS:
1-730E321-14, 3 REACTOR MANUAL CONTROL SYSTEM
1-731E201-2, 3 CRD HYD INSTR SYSTEM

SYMBOL:
[Symbol] CONTROL AIR



AMENDMENT 26

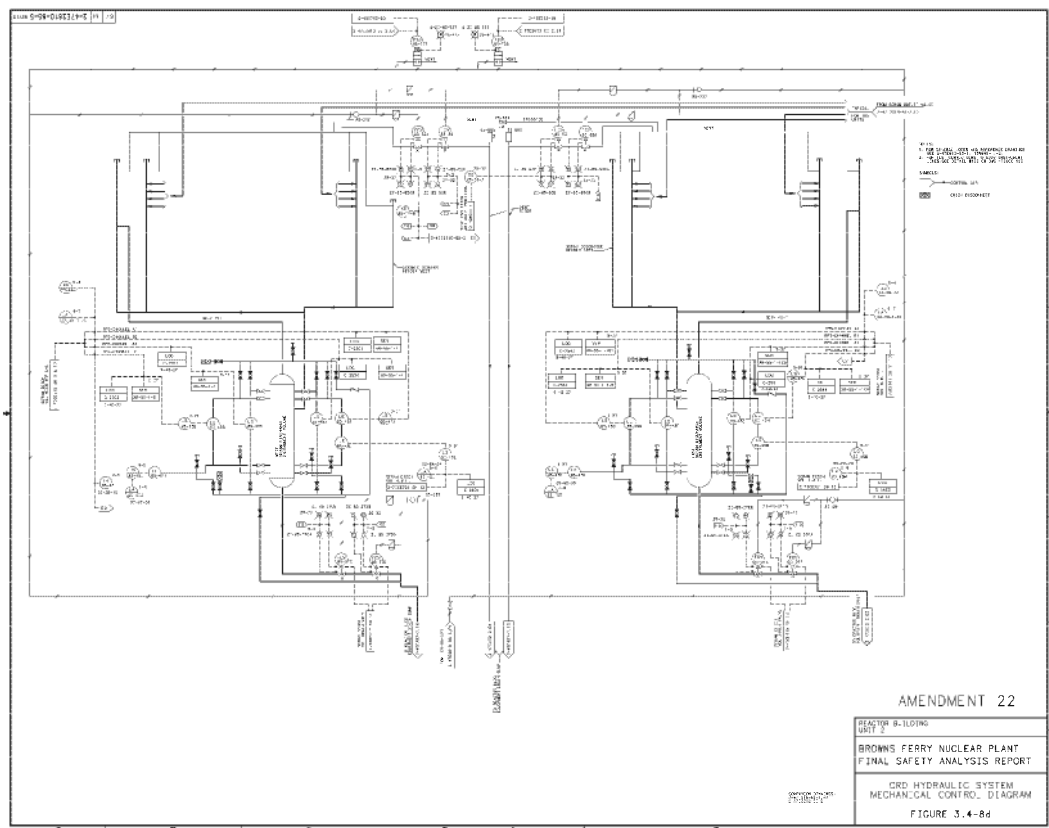
REACTOR BUILDING
UNIT 1

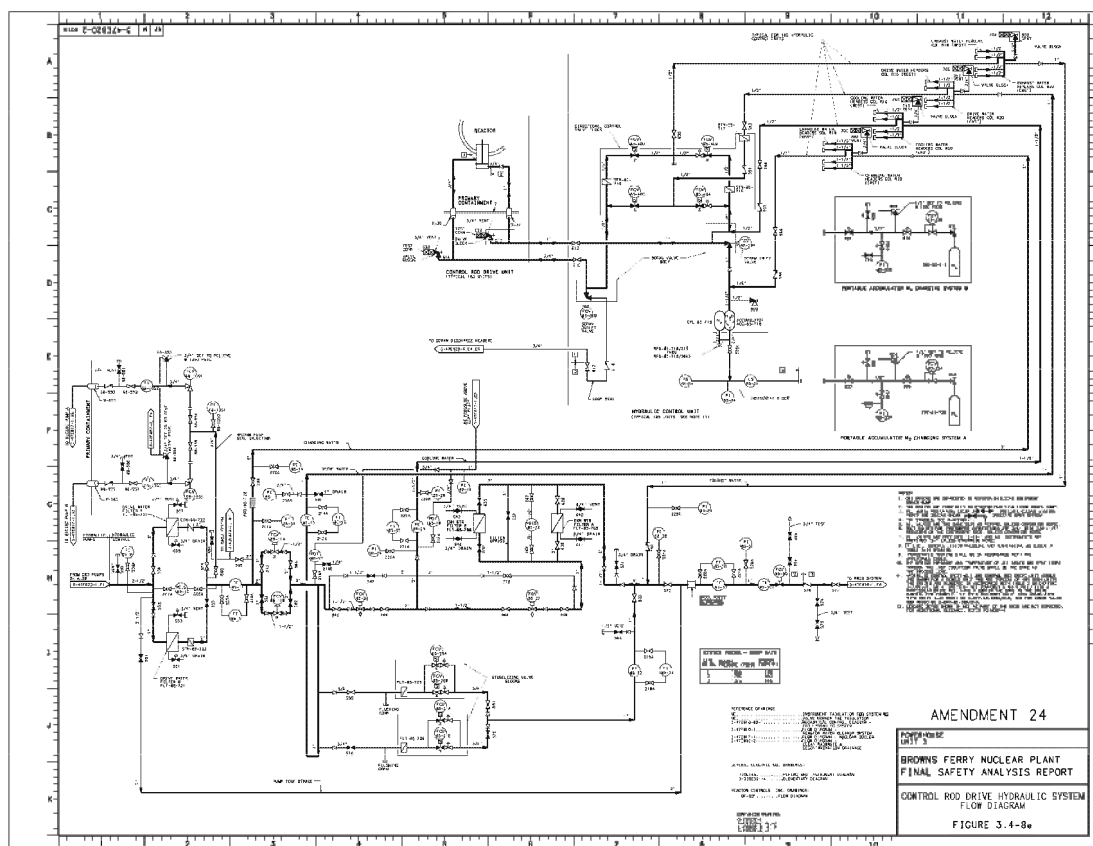
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FINAL SAFETY ANALYSIS REPORT

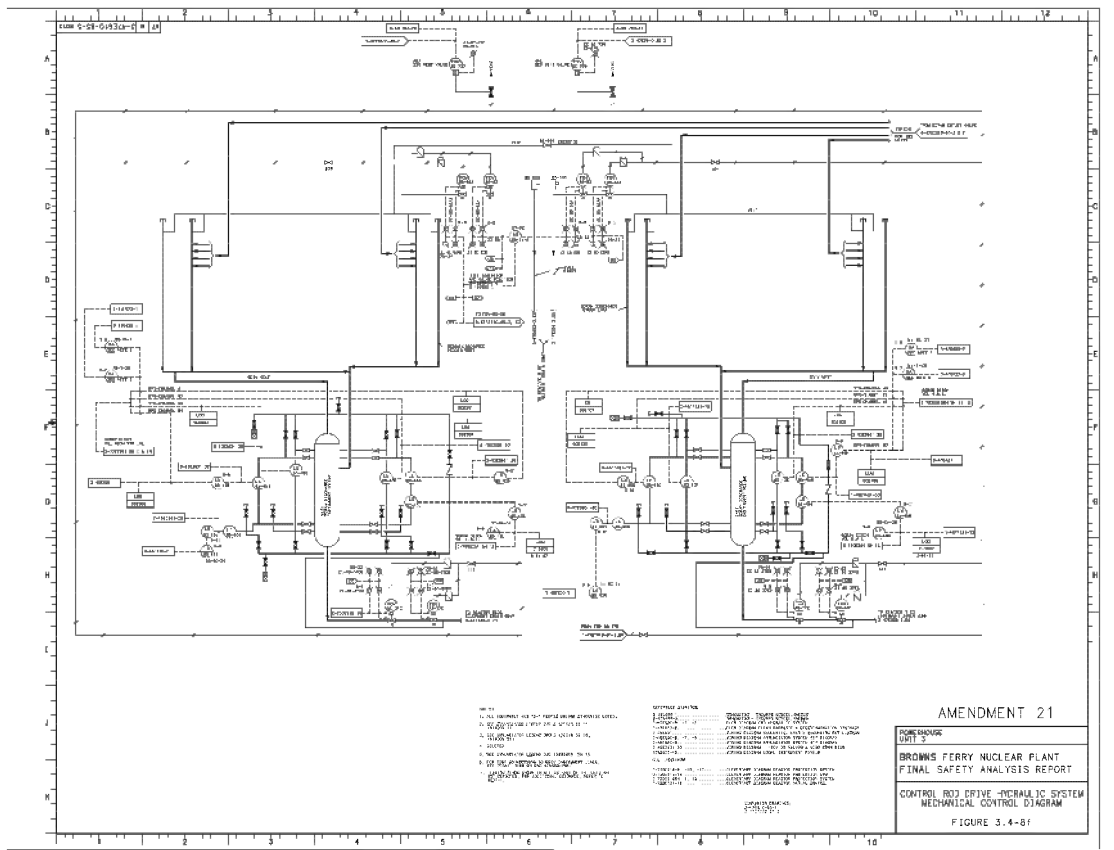
CRD HYDRAULIC SYSTEM
MECHANICAL CONTROL DIAGRAM

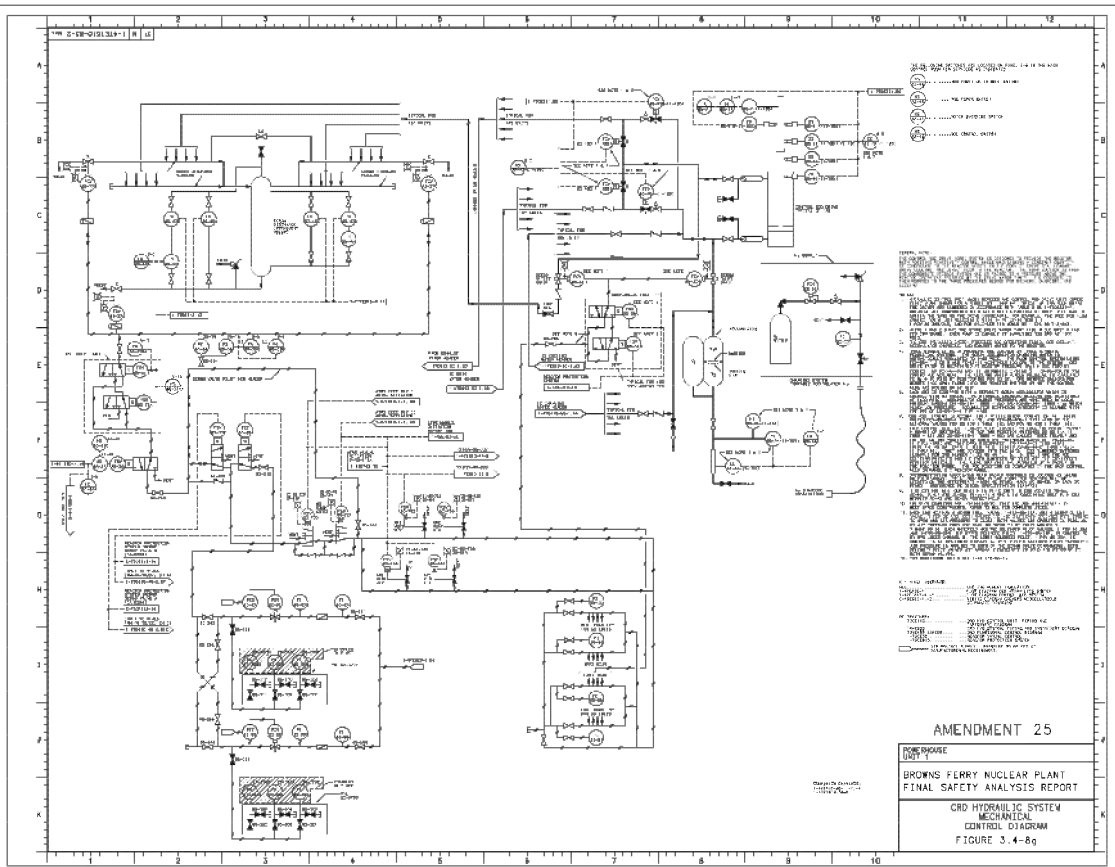
FIGURE 3.4-8a SH 5

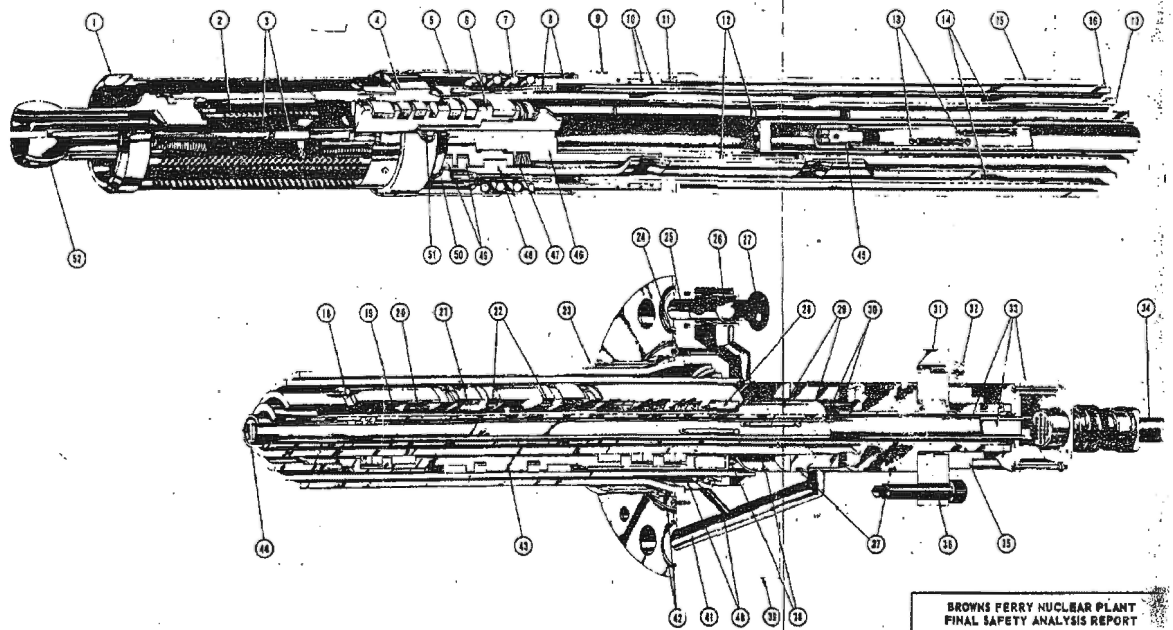
COMPANION DRAWINGS:
2-47E610-85-1
1-47E610-85-2











1. EXTERNAL FILTER ASSEMBLY
2. INTERNAL FILTER ASSEMBLY
3. UNCOUPLING ROD ASSEMBLY
4. GROUND CAP
5. BARREL
6. STOP PISTON
7. COUPLER SPRING
8. COUPLER AND COUPLER PISTON
9. COUPLER INSULATING PAD (of cylinder, tube and flange)
10. COUPLER PISTON SEALS
11. SPACER (of cylinder, tube and flange)
12. BUFFER BRIDGES (typical)
13. POSITION INDICATOR SWITCHES (Typical)
14. LOCKING GROOVE (typical)

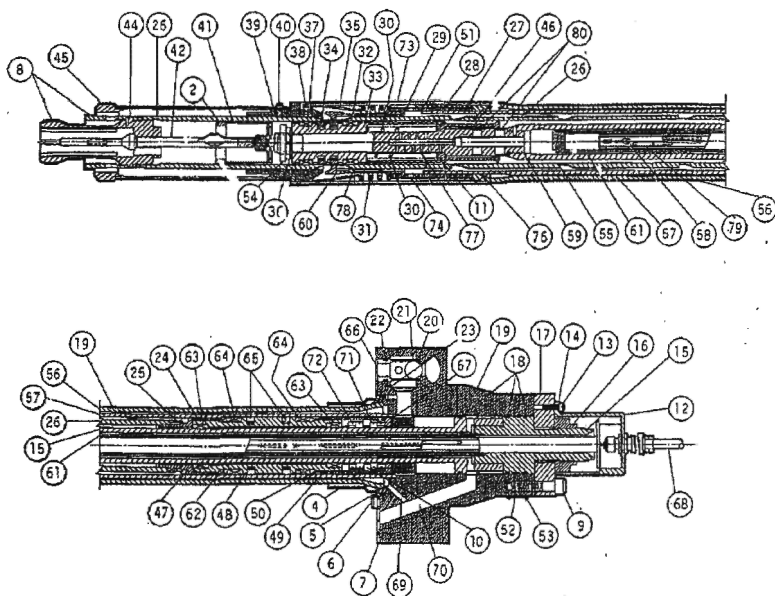
15. OUTER TUBE (Part of cylinder, tube, and flange)
16. CYLINDER TUBE
17. INNER TUBE
18. LOCKING BAND (typical)
19. INTERNAL PISTON SEAL RINGS (typical)
20. INTERNAL PISTON INSURINGS (typical)
21. EXTERNAL PISTON BUSHINGS
22. EXTERNAL PISTON SEALS
23. STRAINER
24. COUPLER WATER OUTLET
25. DRIVE INLET WATER INLET (Steam and water driven water inlet)
26. BALL-SHUTTLE VALVE
27. REACTOR WATER INLET (Through drive housing)

28. PISTON ACTUATING MACHINERY (Part of drive piston)
29. PISTON TUBE ASSEMBLY
30. DRIVE WITHDRAWN PORTS AND ANNULES (Also drive water)
31. RING FLANGE
32. POSITION INDICATOR PROBE
33. POSITION INDICATOR CABLE
34. PISTON TUBE NUT
35. CAP SCREW (typical)
36. O-RING SEAL
37. DRIVE INLET PORTS AND ANNULES
38. DRIVE FLANGE (Part of cylinder, tube, and flange)
39. UNLOCKING FORCE AND ANNULES

40. DRIVE WITHDRAWN WATER INLET (Also water inlet for screw water)
41. METAL O-RING SEAL (driven to housing)
42. DRIVE PISTON
43. INDICATOR TUBE (Part of actuator)
44. THERMOCOUPLE (Part of position-indicator probe)
45. STOP PISTON SEAL RINGS (typical)
46. STOP PISTON SEAL RINGS (typical)
47. COUPLER SPRING
48. COUPLER PISTON
49. COUPLER PISTON
50. COUPLER PISTON
51. COUPLER PISTON
52. COUPLER PISTON
53. COUPLER PISTON
54. COUPLER PISTON
55. COUPLER PISTON

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Control Rod Unit Drive - Outway
Illustration
FIGURE 3.4.9



- 2 - SEAL RING (INNER FILTER)
- 3 - FLAT HEAD SCREW (O-RING SPACER MOUNTING)
- 4 - STRAINER
- 5 - FLAT HEAD SCREW
- 6 - DOWEL PIN
- 7 - O-RING SPACER
- 8 - SPUD & CYLINDER
- 9 - SOCKET-HEAD CAP SCREW (RING FLANGE MOUNTING)
- 10 - SEAL CUP (PART OF DRIVE PISTON ASSEMBLY)
- 11 - SEAL RING (BUFFER PISTON)
- 12 - POSITION INDICATOR PROBE
- 13 - FILLISTER-HEAD SCREW (POSITION INDICATOR PROBE MOUNTING)
- 14 - LOCKWASHER (FOR PART 13)
- 15 - PISTON TUBE ASSEMBLY
- 16 - NUT (PISTON TUBE)
- 17 - RING FLANGE
- 18 - O-RING (PISTON TUBE)
- 19 - CYLINDER, TUBE, AND FLANGE
- 20 - BALL (CHECK VALVE)
- 21 - BALL RETAINER
- 22 - O-RING (BALL RETAINER)
- 23 - COOLING WATER ORIFICE
- 24 - DRIVE PISTON ASSEMBLY
- 25 - LOCKING BAND
- 26 - INDEX TUBE
- 27 - SEAL RING (COLLET PISTON - INTERNAL)
- 28 - SEAL RING (COLLET PISTON - EXTERNAL)
- 29 - COLLET & PISTON
- 30 - BUFFER SPRING
- 31 - COLLET SPRING
- 32 - SPLIT BUSHING (STOP PISTON)
- 33 - STOP PISTON
- 34 - SEAL RING (STOP PISTON)
- 35 - BARREL
- 36 - NUT (STOP PISTON)
- 37 - PLUG (GUIDE CAP)
- 38 - FILLISTER-HEAD SCREW (GUIDE CAP PLUG MOUNTING)
- 39 - GUIDE CAP
- 40 - DRILLED FILLISTER-HEAD SCREW (OUTER FILTER MOUNTING)
- 41 - INNER FILTER
- 42 - UNCOUPLING ROD
- 44 - LOCKING BAND
- 45 - OUTER FILTER
- 46 - BUFFER PISTON
- 47 - PISTON HEAD (PART OF DRIVE PISTON)
- 48 - PISTON COUPLING (PART OF DRIVE PISTON)
- 49 - MAGNET HOUSING (PART OF DRIVE PISTON)
- 50 - LOCKING BAND (ON DRIVE PISTON)
- 51 - COLLET HOUSING (PORTION OF OUTER TUBE)
- 52 - NAMEPLATE
- 53 - DRIVE SCREW
- 54 - LOCKING CUP
- 55 - INDEX TUBE NOTCH
- 56 - OUTER TUBE (PART OF CYLINDER, TUBE, AND FLANGE)
- 57 - INNER TUBE (PART OF CYLINDER, TUBE, AND FLANGE)
- 58 - THERMOCOUPLE (PART OF POSITION INDICATOR PROBE)
- 59 - BUFFER SHAFT
- 60 - COLLET FINGER (PART OF COLLET RETAINER, AND PISTON)
- 61 - INDICATOR TUBE (PART OF PISTON TUBE)
- 62 - LOCKING BAND (ON DRIVE PISTON)
- 63 - INTERNAL BUSHING (DRIVE PISTON)
- 64 - EXTERNAL BUSHING (DRIVE PISTON)
- 65 - OUTER SEALS (DRIVE PISTON)
- 66 - INSERT PORT (INSERT & SCRAM INLET/WITHDRAW OUTLET)
- 67 - RING MAGNET (PART OF DRIVE PISTON)
- 68 - CABLES (POSITION INDICATOR)
- 69 - PORT TO COLLET PISTON (WITHDRAW PRESSURE TO COLLET PISTON)
- 70 - WITHDRAW PORT (WITHDRAW INLET/INSERT OUTLET & SCRAM DISCHARGE)
- 71 - INNER SEALS (DRIVE PISTON - DRIVE DOWN SEALS)
- 72 - INNER SEALS (DRIVE PISTON - DRIVE-UP SEALS)
- 73 - WATER PORTS IN COLLET HOUSING
- 74 - WATER PORTS IN COLLET PISTON
- 75 - VESSEL-WATER PORTS
- 76 - SHOULDER (PART OF CYLINDER, TUBE AND FLANGE)
- 77 - BUFFER ORIFICES IN PISTON TUBE ASSEMBLY
- 78 - COLLET RETAINER (HOLES COLLET FINGERS)
- 79 - POSITION INDICATOR SWITCHES
- 80 - BUFFER SHAFT PORTS

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MODIFIED CONTROL ROD
DRIVE (BWR/G)

FIGURE 3.4-9a

BFN-16

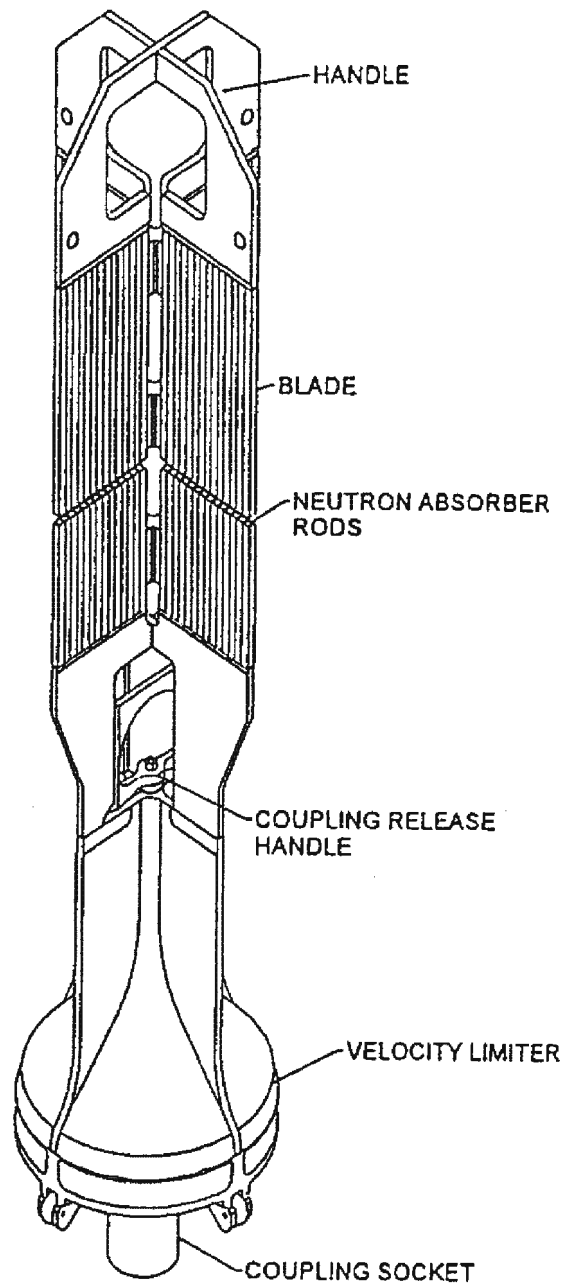
Figure 3.4-10

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BFN-22

Figure 3.4-11
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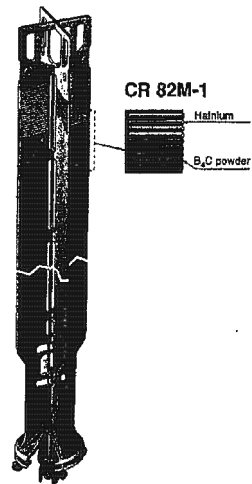
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Marathon Control Rod — Isometric
FIGURE 3.4-12



ADMENDMENT 20

BROWNS FERRY NUCLEAR PLANT
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WESTINGHOUSE
CR-82M-1
CONTROL ROD

FIGURE 3.4-13