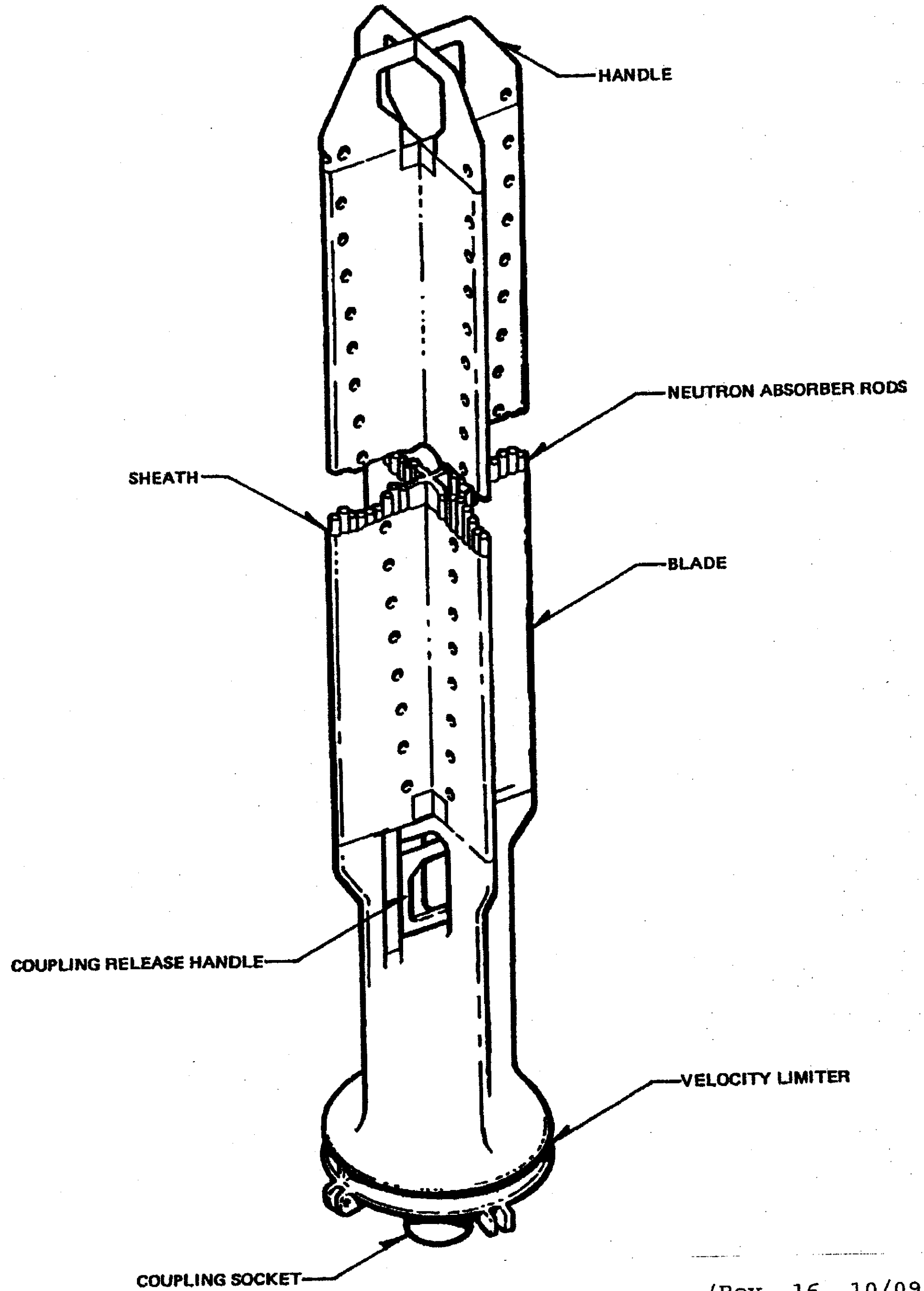
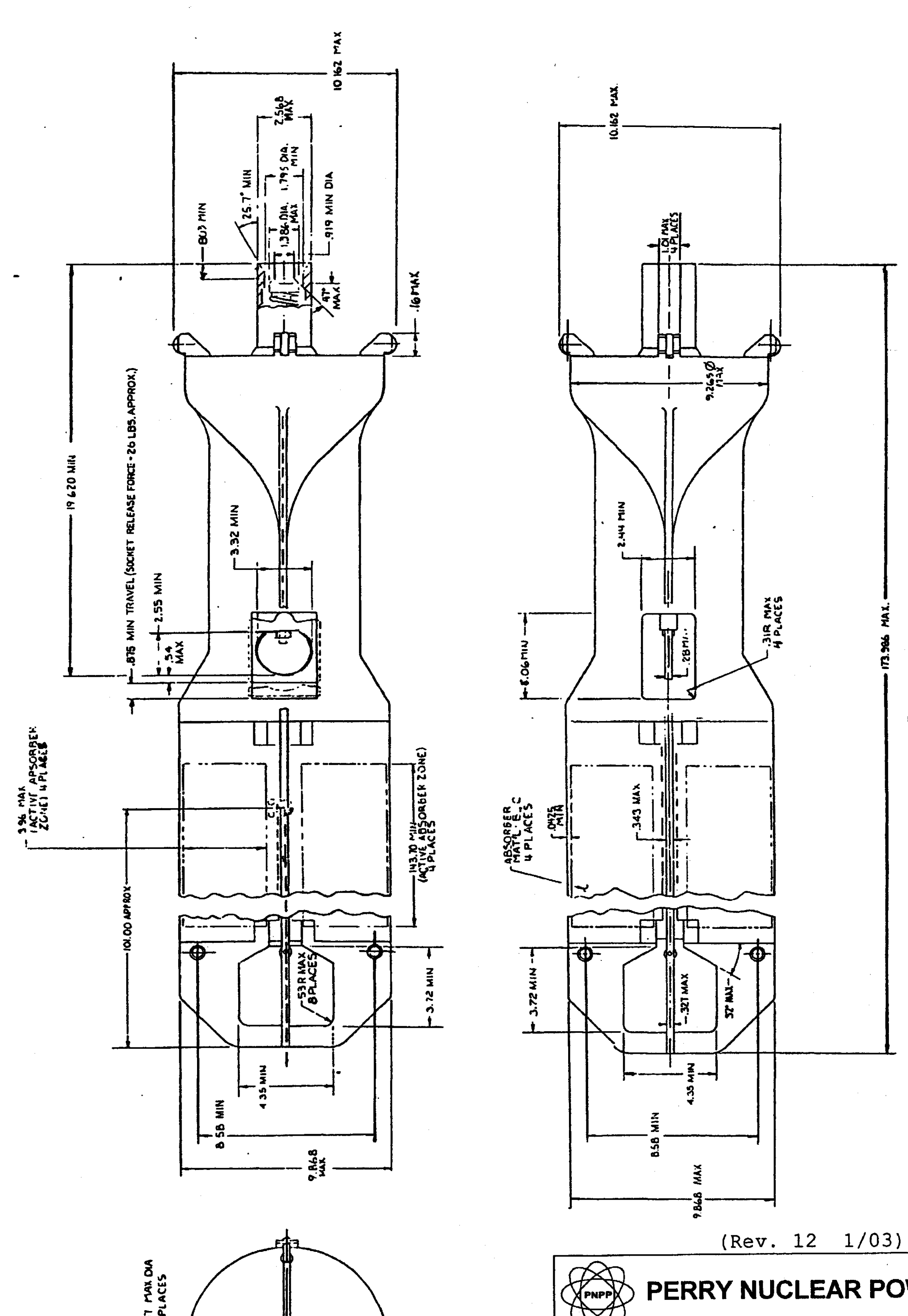


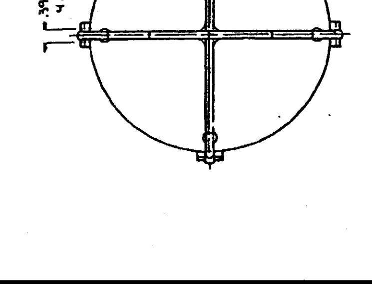
(Rev. 16 10/09)

PERRY NUCLEAR POWER PLANT

Control Rod Assembly
Original Equipment Design

Figure 4.2-1



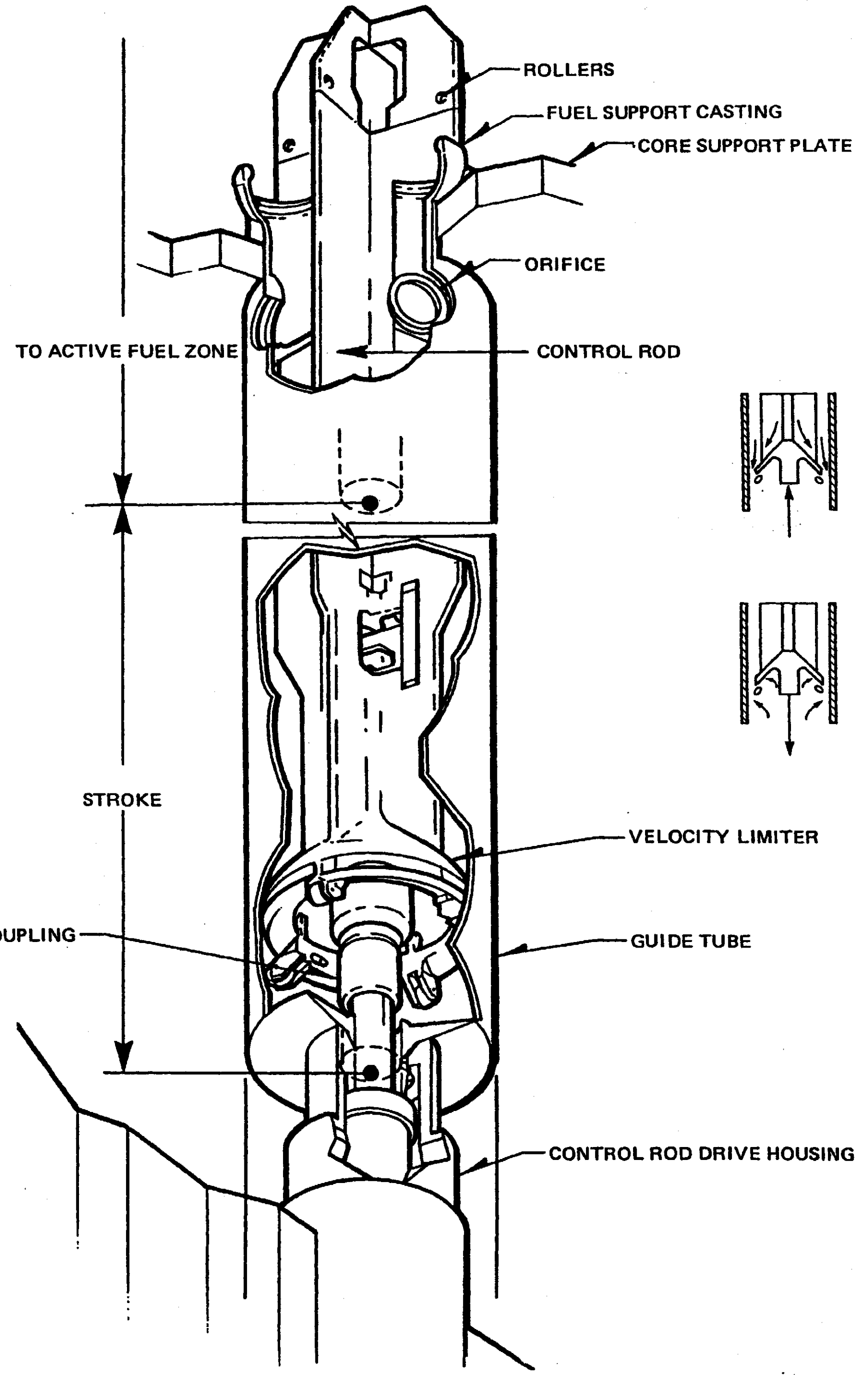


(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Control Rod Information Diagram
Original Equipment Design

Figure 4.2-2

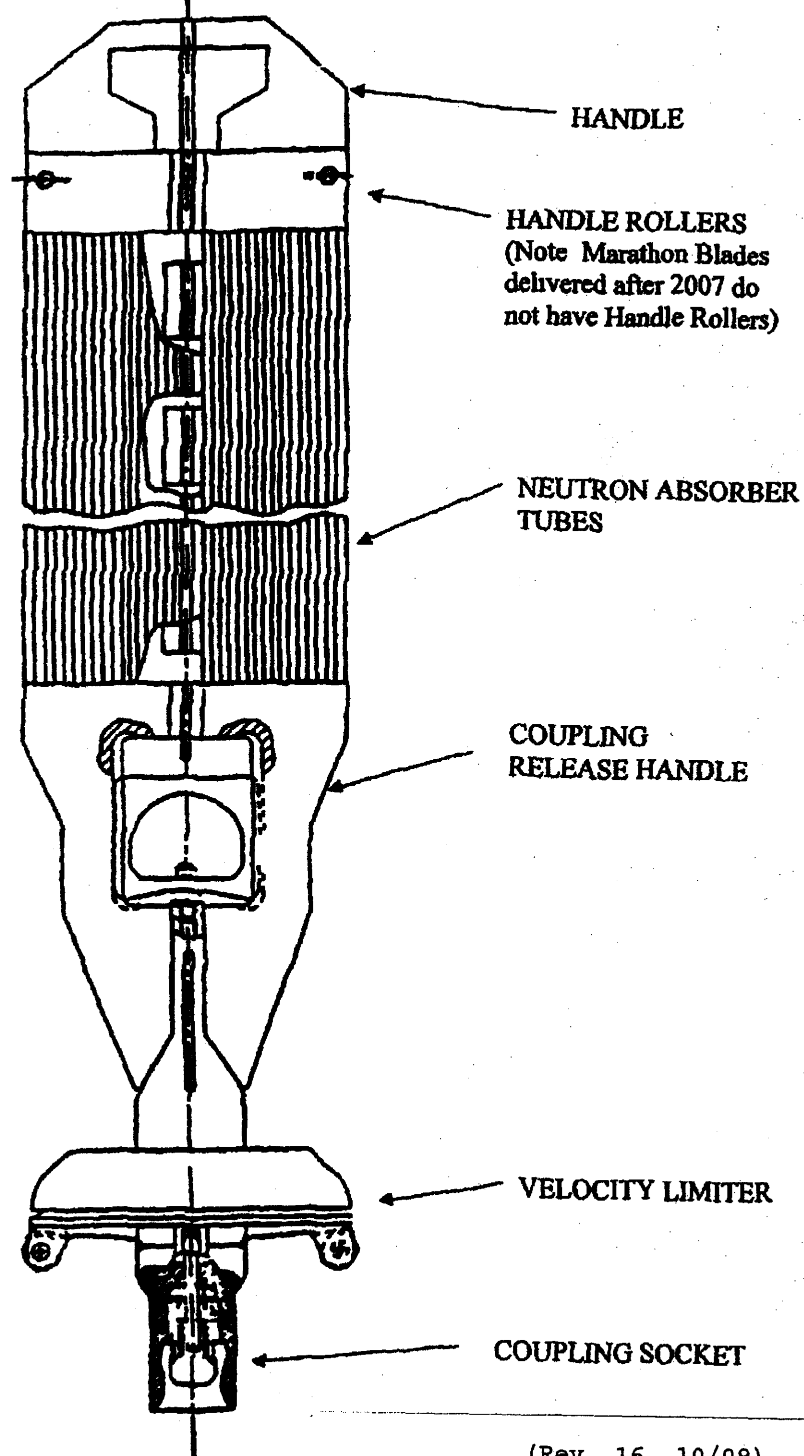


(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Control Rod Velocity Limiter

Figure 4.2-3

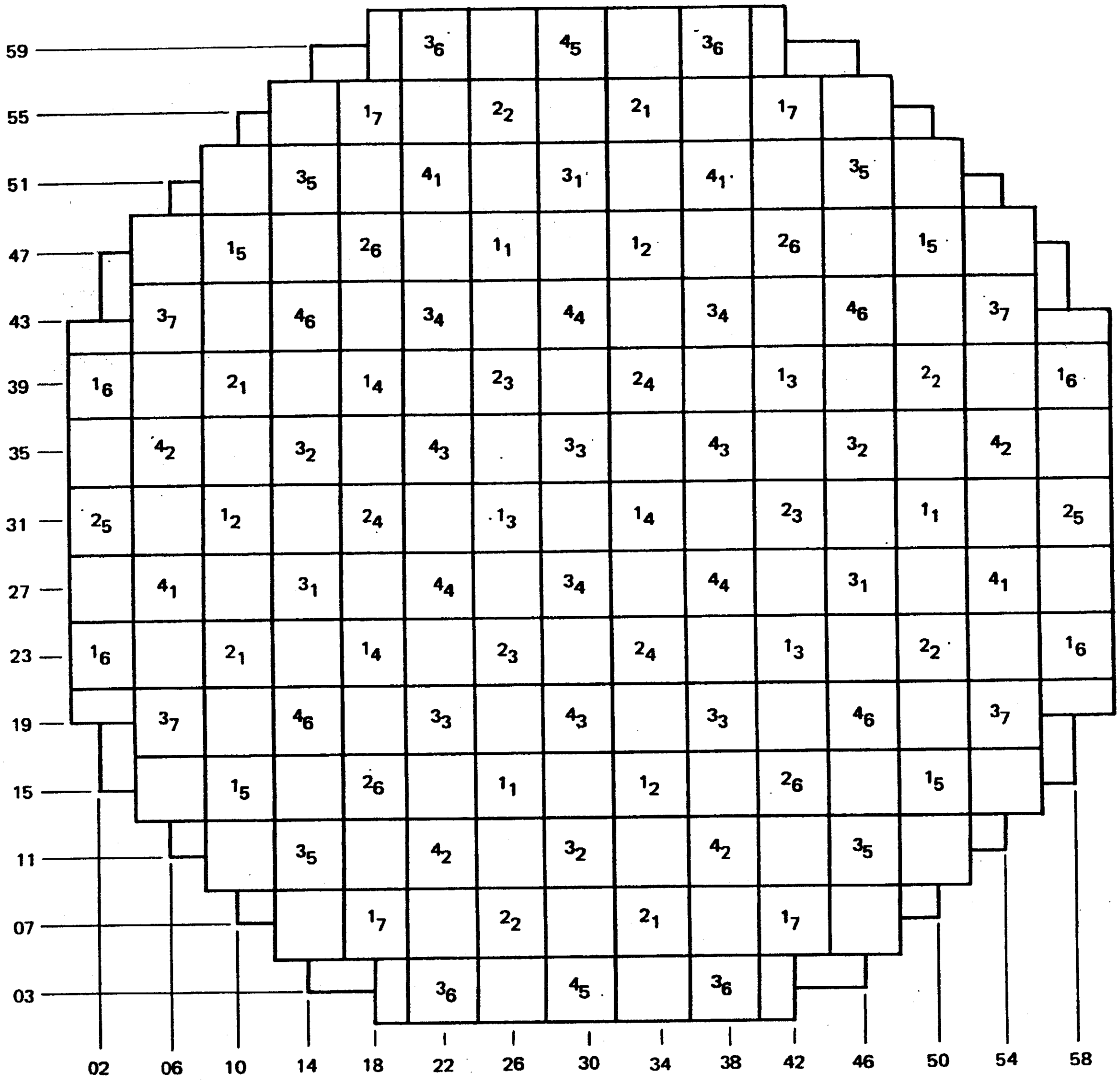


(Rev. 16 10/09)

PERRY NUCLEAR POWER PLANT

Control Rod Assembly
Marathon Design

Figure 4.2-4



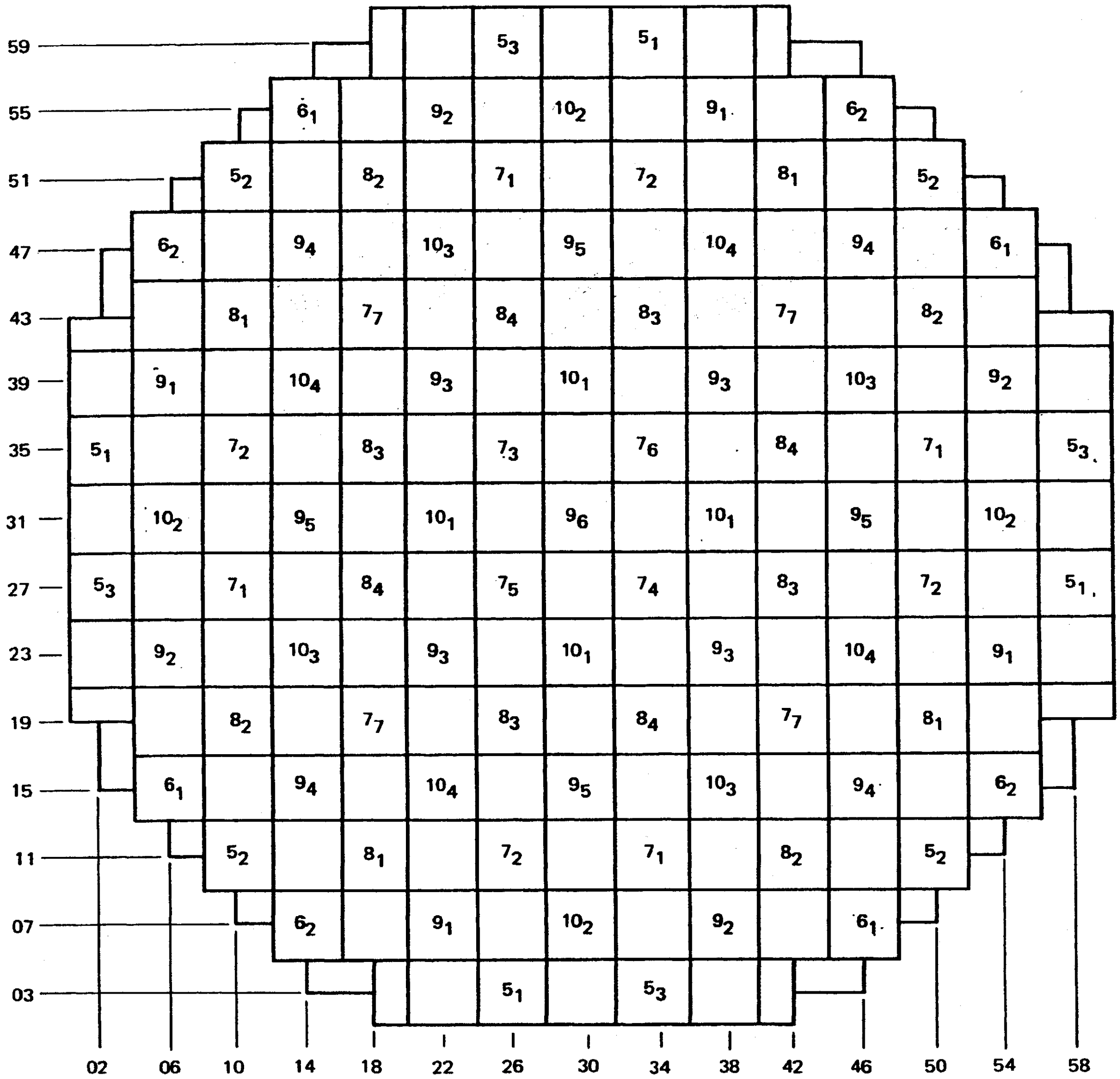
N_M N = GROUP
M = SUBGROUP (GANG)

(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Banked Position Withdrawal
Sequence RPCS, Groups 1 Through 4,
Sequence A (238-748)

Figure 4.3-4



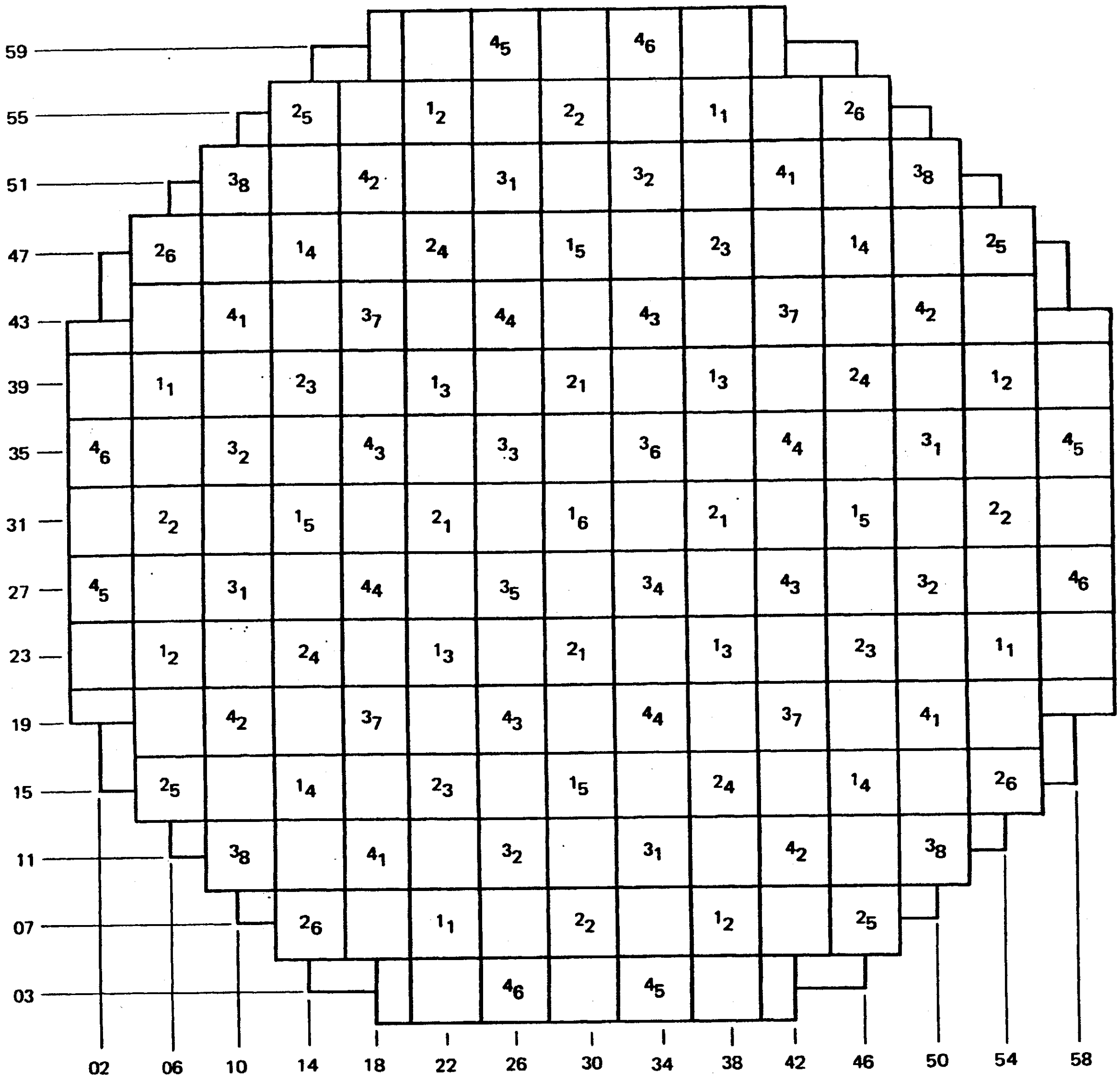
N_M N = GROUP
M = SUBGROUP (GANG)

(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Banked Position Withdrawal
Sequence RPCS Groups 5 Thru 10,
Sequence A (238-748)

Figure 4.3-5



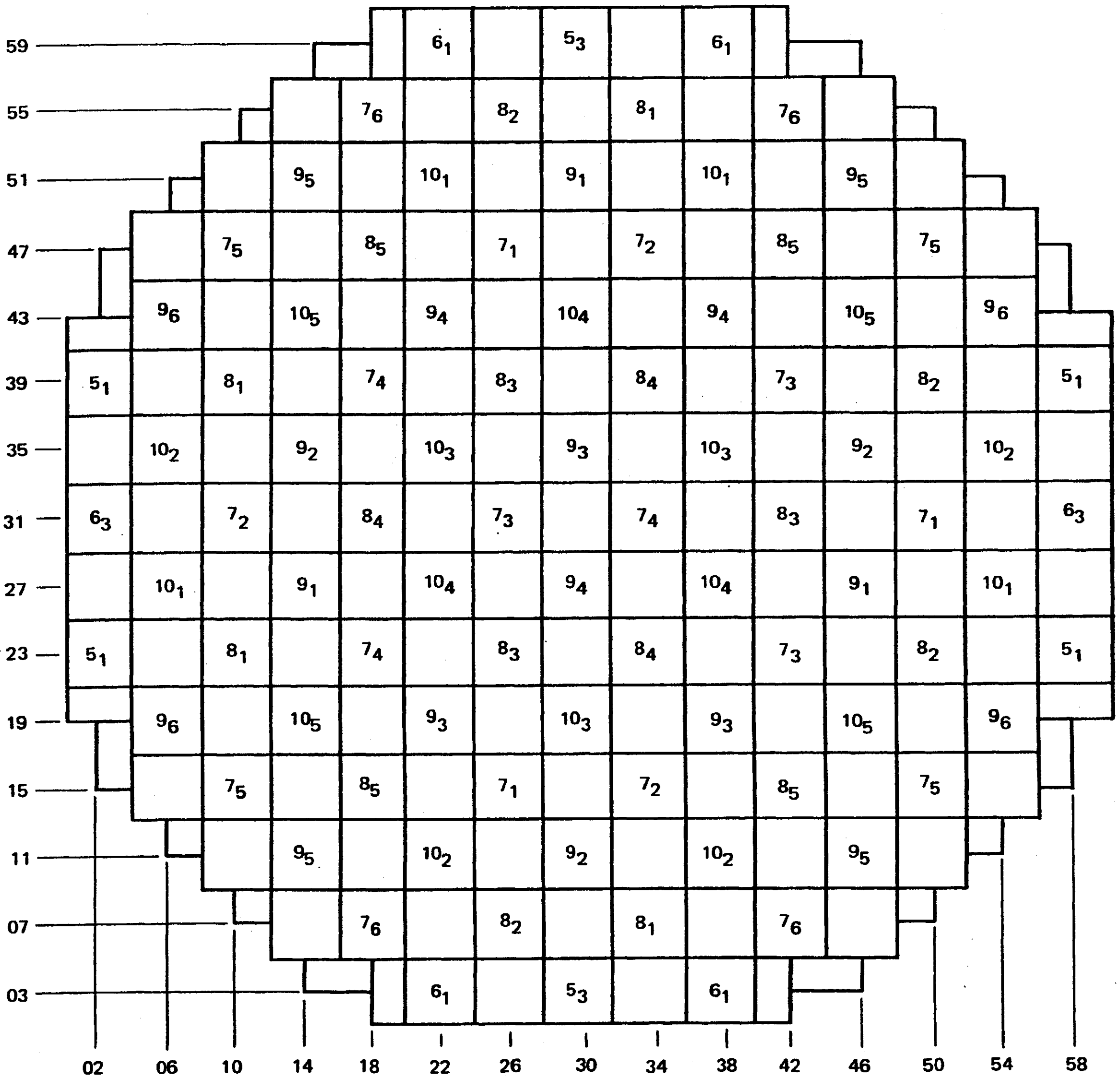
N_M N = GROUP
M = SUBGROUP (GANG)

(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Banked Position Withdrawal Sequence, RPCS Groups 1 thru 4, Sequence B (238-748)

Figure 4.3-6



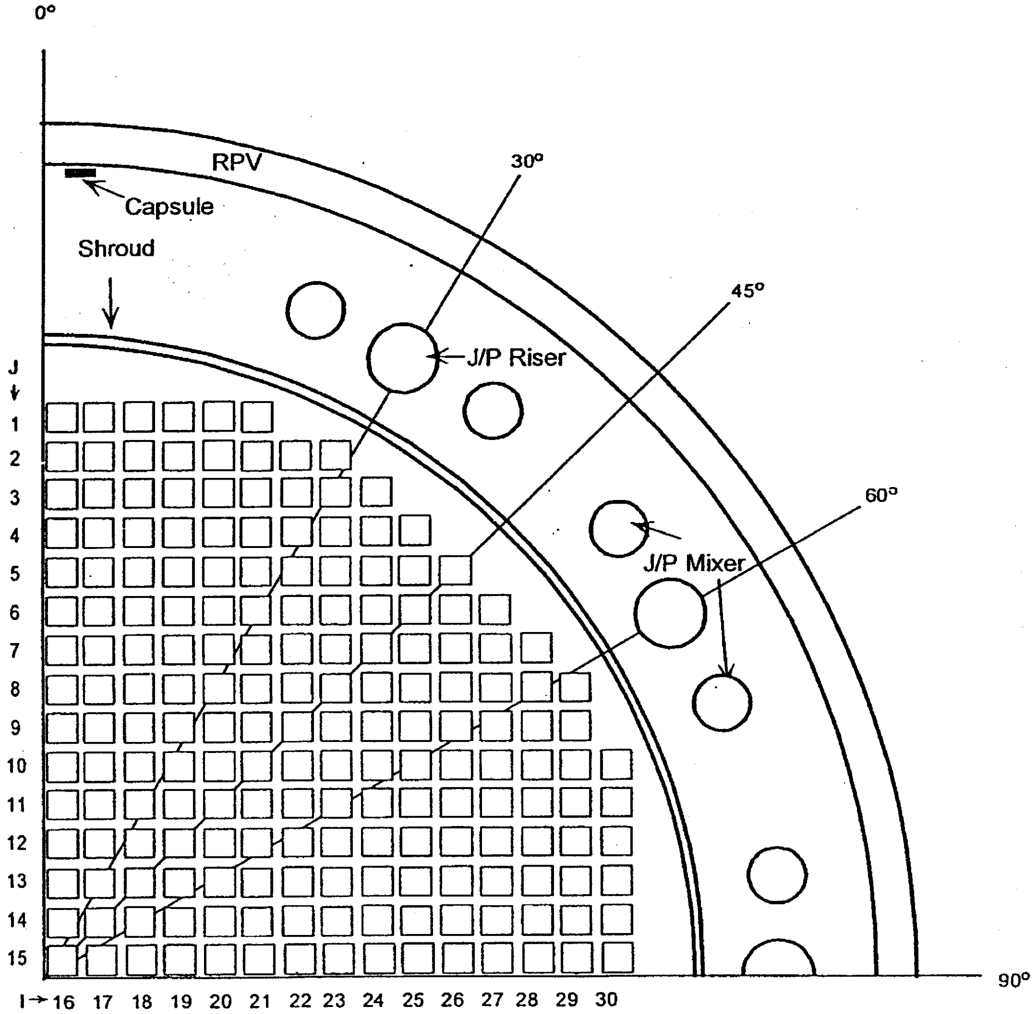
N_M N = GROUP
M = SUBGROUP (GANG)

(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Banked Position Withdrawal
Sequence RPCS Groups 5 thru 10,
Sequence B (238-748)

Figure 4.3-7

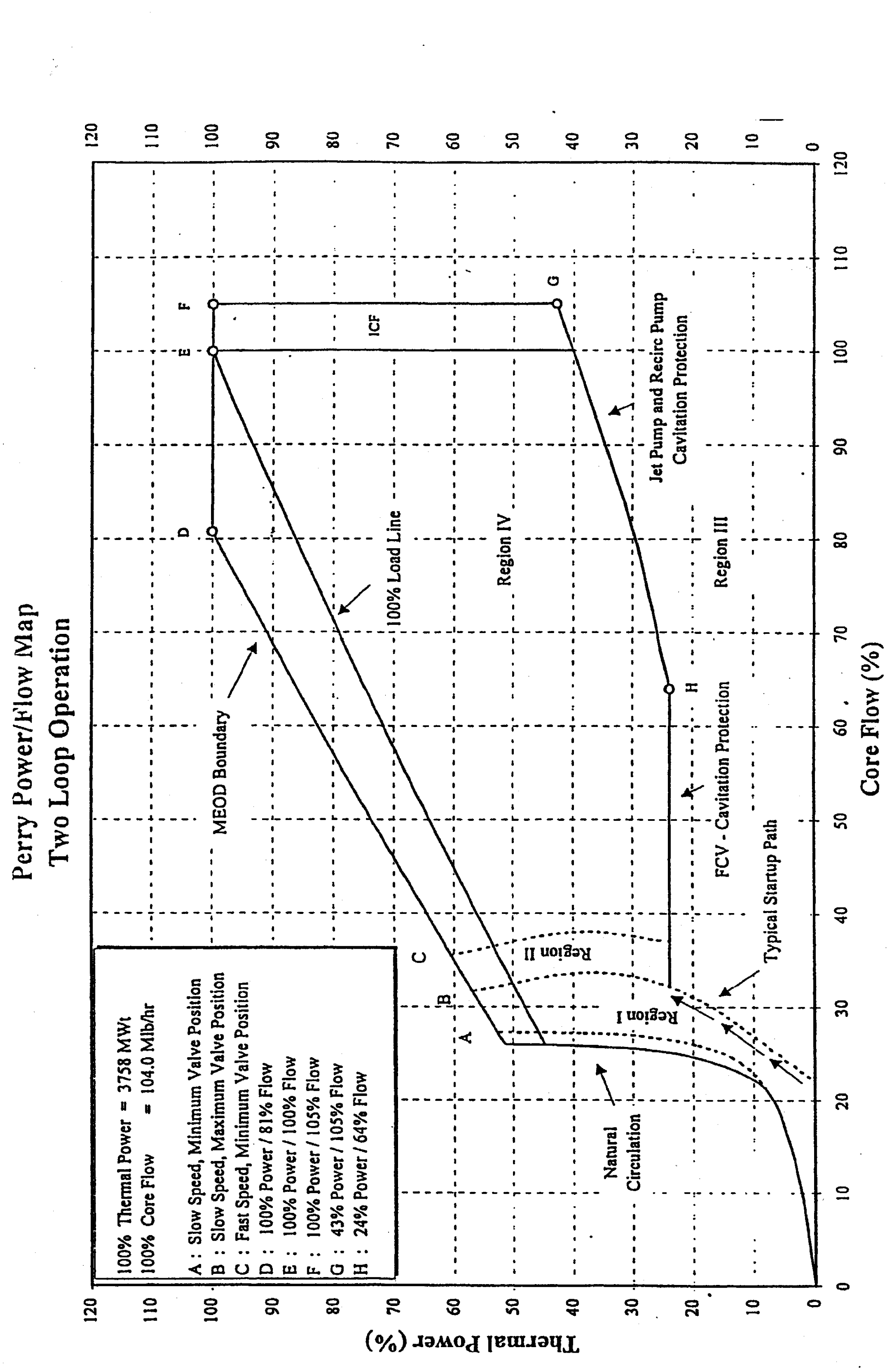


(Rev. 13 12/03)

PERRY NUCLEAR POWER PLANT

Model for Neutron
Transport Analysis
of Vessel Fluence, Unit 1

Figure 4.3-9

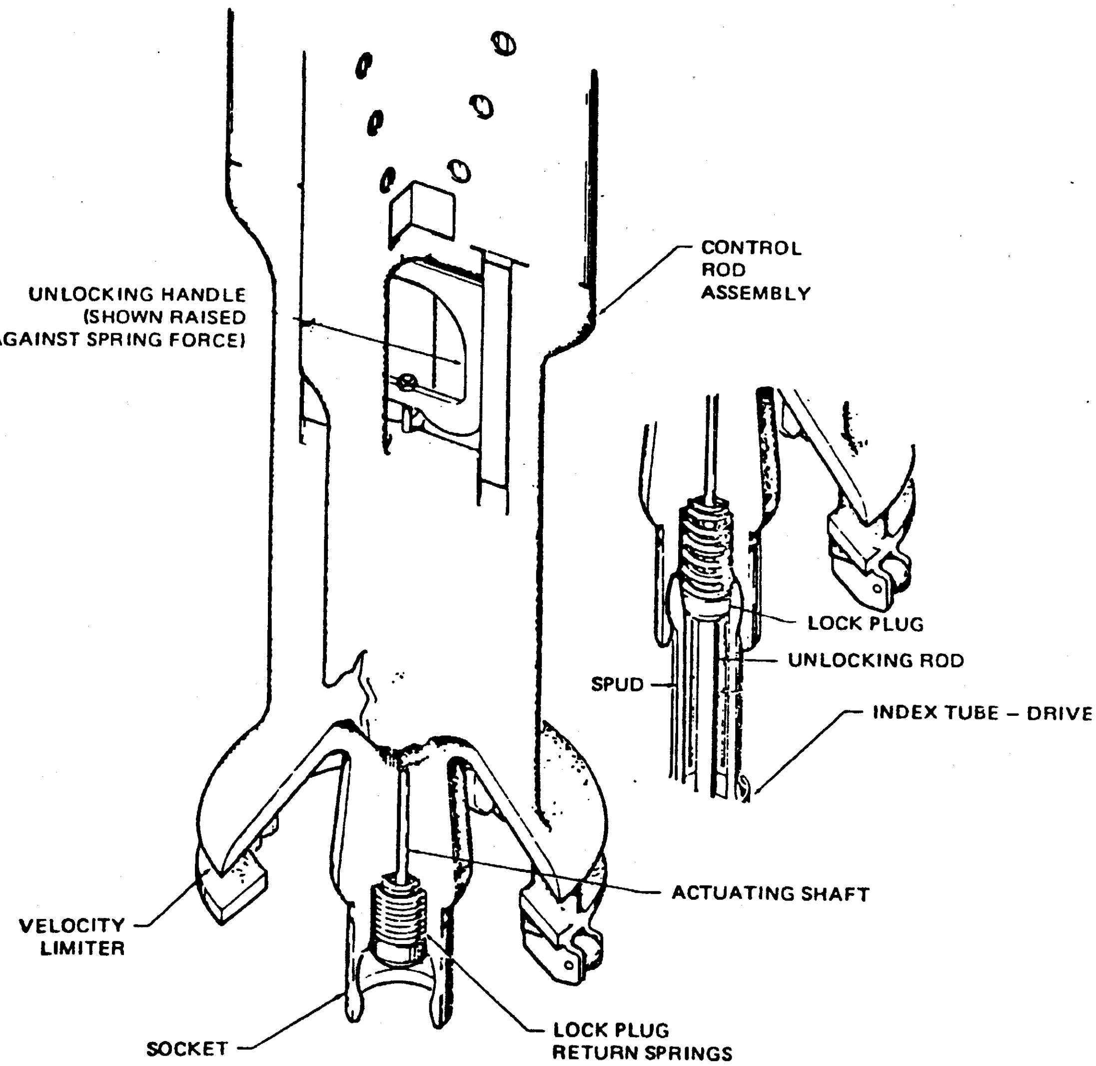


(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Standard Power-Flow
Operating Map
(Typical)

Figure 4.4-2

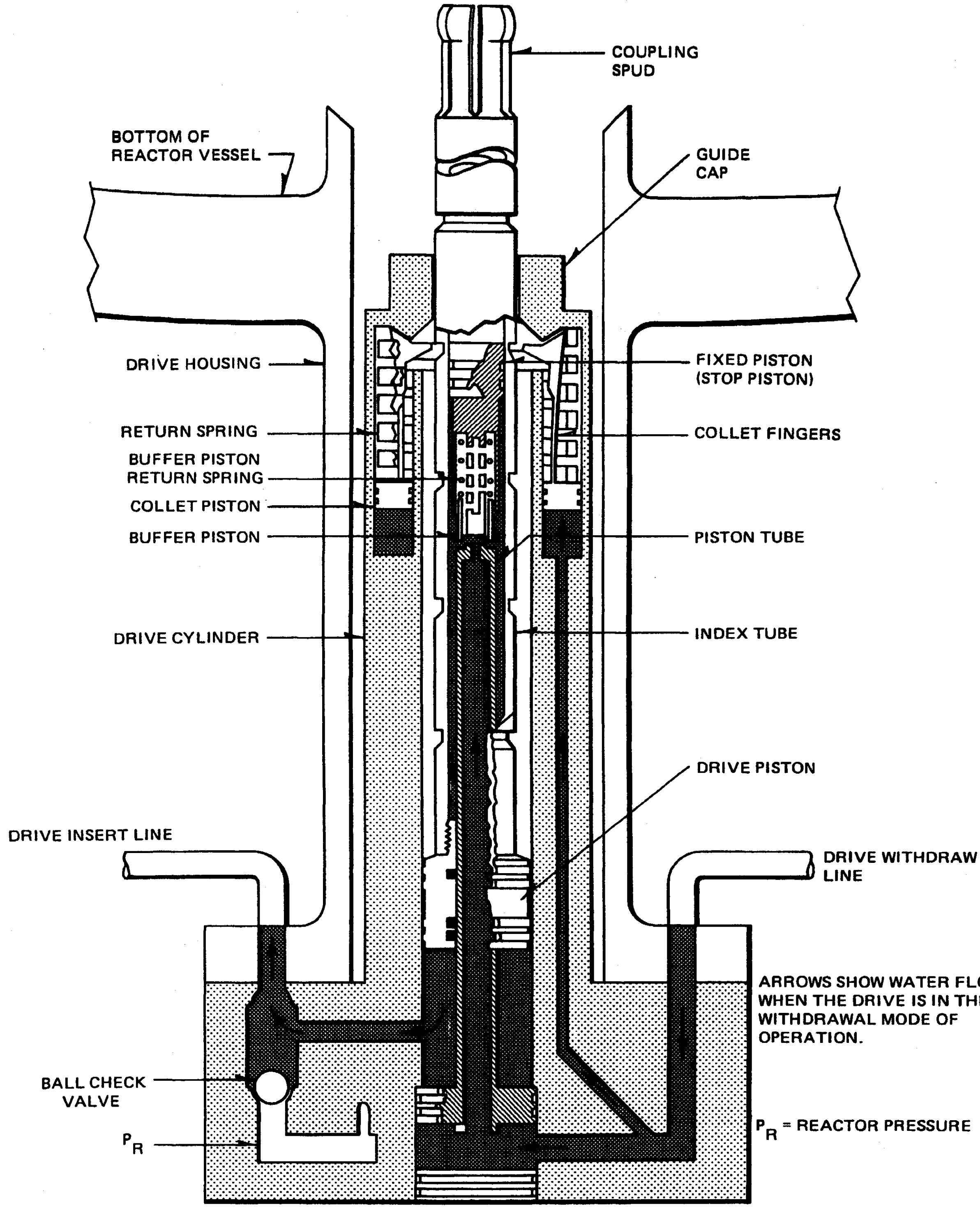


(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Control Rod to Control Rod Drive Coupling

Figure 4.6-1

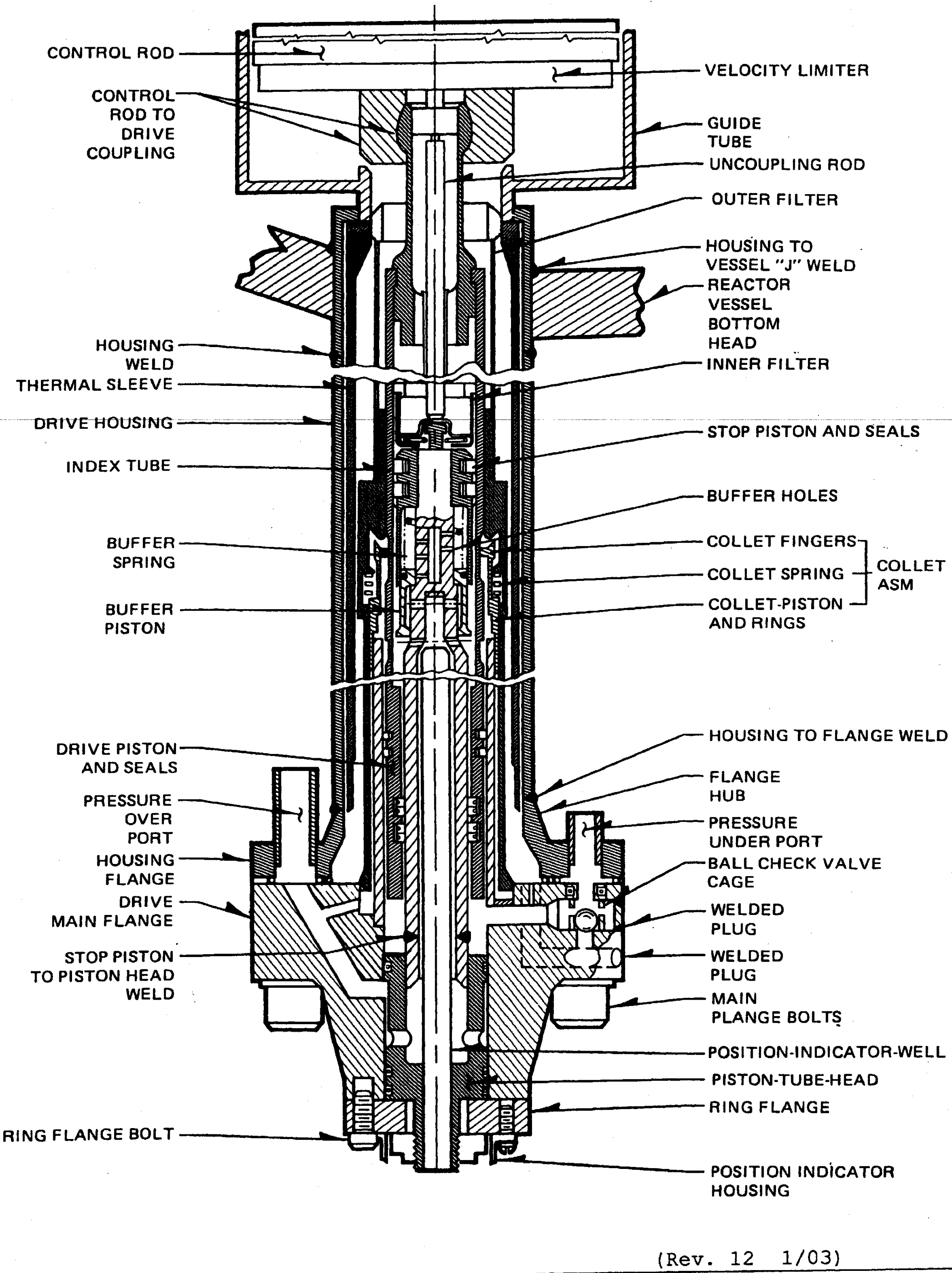


(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Control Rod Drive Unit

Figure 4.6-2



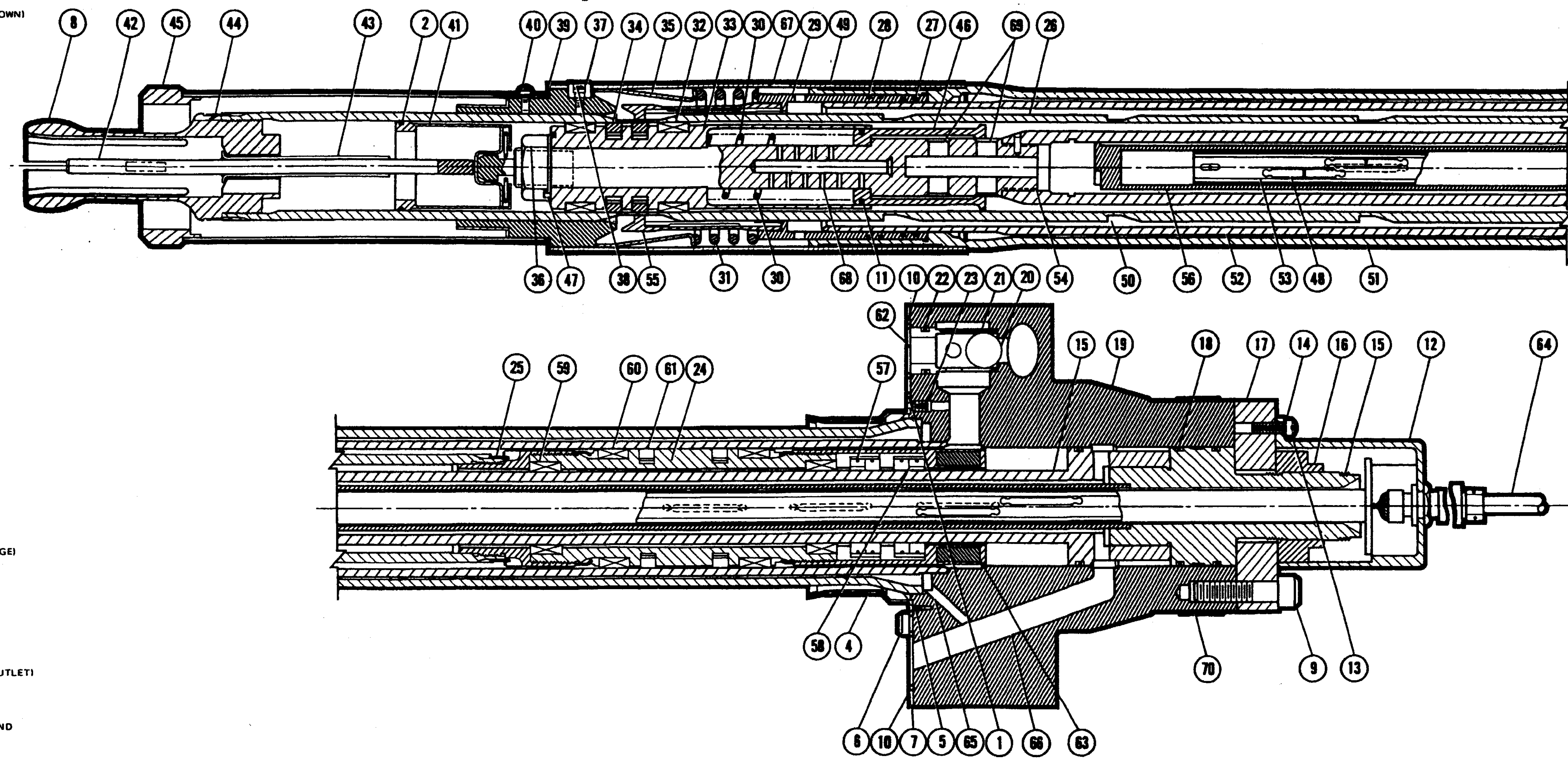
(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Control Rod Drive Schematic

Figure 4.6-3

1 O-RING (FLANGE FACE)
2 SEAL RING (INNER FILTER)
3 SCREW, FLAT HEAD (O-RING SPACER MOUNTING NOT SHOWN)
4 STRAINER
5 SCREW, FLAT HEAD (STRAINER)
6 DOWEL PIN (DRIVE ALIGNMENT)
7 O-RING SPACER
8 SPUD (COUPLING)
9 CAP SCREW (RING FLANGE)
10 "O" RING (INSERT AND WITHDRAW PORTS)
11 SEAL RING (BUFFER PISTON)
12 POSITION INDICATOR PROBE
13 SCREW (POSITION PROBE)
14 WASHER (FOR P13)
15 PISTON TUBE
16 NUT (PISTON TUBE RETAINER)
17 RING FLANGE
18 O-RING (PISTON TUBE HEAD)
19 CYLINDER, TUBE AND FLANGE
20 BALL (CHECK VALVE)
21 BALL RETAINER
22 O-RING (BALL RETAINER)
23 SET SCREW PLUG (COOLING ORIFICE)
24 DRIVE PISTON
25 BAND
26 INDEX TUBE
27 SEAL RING (COLLET PISTON INTERNAL)
28 SEAL RING (COLLET PISTON EXTERNAL)
29 COLLET AND 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 RETAINER)
37 PLUG (GUIDE CAP MOUNTING)
38 SCREW, FILLISTER HEAD (GUIDE CAP)
39 GUIDE CAP
40 DRILLED FIL HD SCREW (OUTER FILTER)
41 INNER FILTER
42 ROD (UNCOUPLING)
43 TUBE
44 BAND (SPUD)
45 FILTER (OUTER)
46 BUFFER PISTON
47 WASHER, LOCK
48 POSITION INDICATOR SWITCHES
49 COLLET HOUSING (PART OF OUTER TUBE)
50 INDEX TUBE NOTCH
51 OUTER TUBE (PART OF CYLINDER TUBE AND FLANGE)
52 INNER CYLINDER (PART OF CYLINDER TUBE AND FLANGE)
53 LOCATION OF THERMAL COUPLE (NOT SHOWN – PART OF POSITION INDICATOR PROBE)
54 BUFFER SHAFT
55 COLLET FINGER (PART OF COLLET AND PISTON)
56 INDICATOR TUBE (PART OF PISTON TUBE)
57 INNER SEALS (DRIVE PISTON – DRIVE UP SEALS)
58 INNER SEALS (DRIVE PISTON – DRIVE DOWN SEALS)
59 INTERNAL BUSHING (DRIVE PISTON)
60 EXTERNAL BUSHING (DRIVE PISTON)
61 OUTER SEALS (DRIVE PISTON)
62 INSERT PORT (INSERT AND SCRAM INLET/WITHDRAW OUTLET)
63 RING MAGNET (PART OF DRIVE PISTON)
64 CABLE (POSITION INDICATOR)
65 PORT TO COLLET PISTON (WITHDRAW PRESSURE TO COLLET PISTON)
66 WITHDRAW PORT (WITHDRAW INLET/INSERT OUTLET AND SCRAM DISCHARGE)
67 WATER PORTS IN COLLET HOUSING
68 BUFFER ORIFICES IN BUFFER SHAFT
69 FLOW PORTS IN BUFFER SHAFT
70 NAMEPLATE

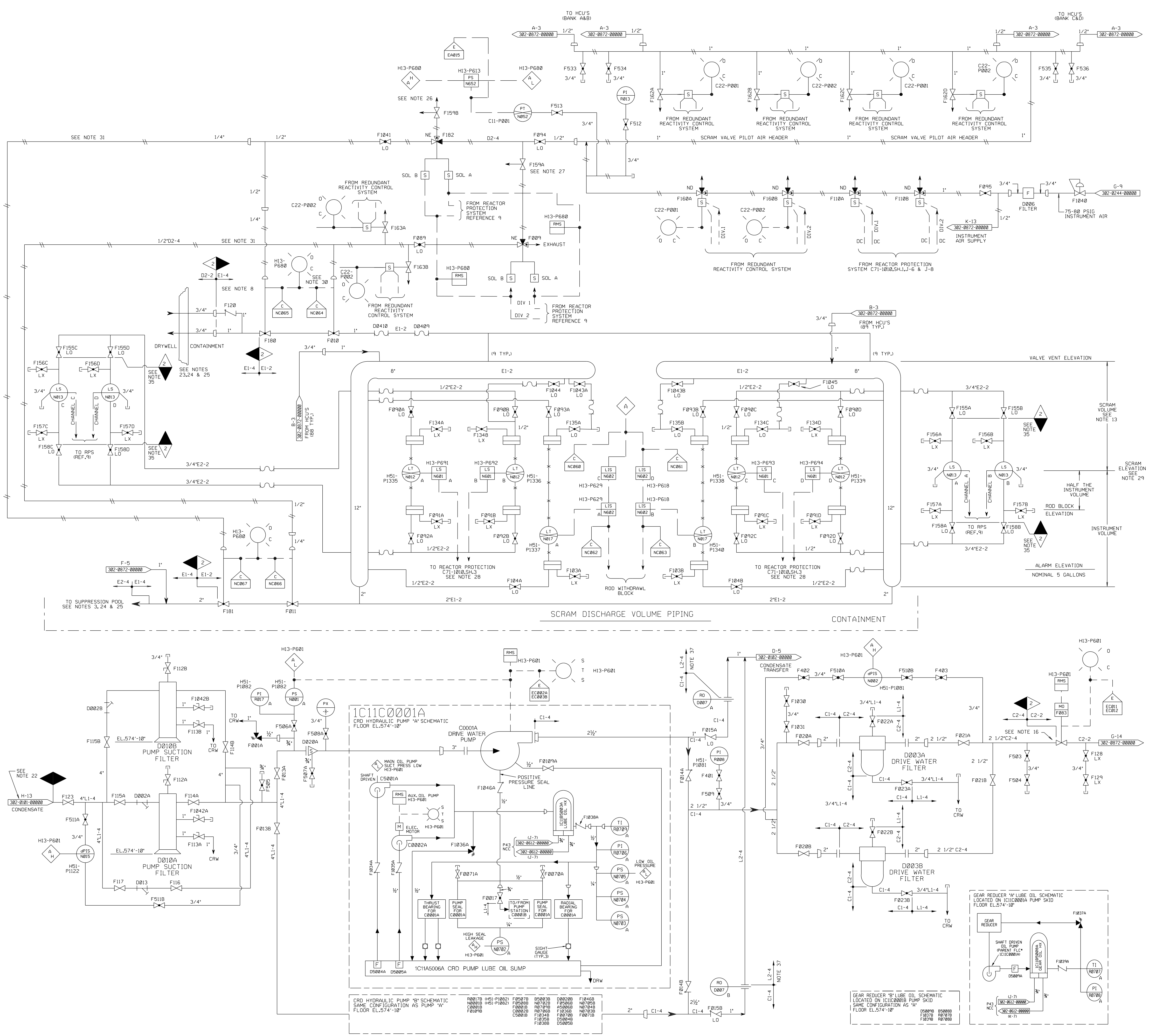


(Rev. 12 1/03)

PERRY NUCLEAR POWER PLANT

Control Rod Drive Unit (Cutaway)

Figure 4.6-4



NOTES:

1. ONE STABILIZING VALVE OF STABILIZING VALVE ASSEMBLY (F007) CLOSES ON WITHDRAWAL SIGNAL PER ONE DRIVE OPERATION. TWO STABILIZING VALVES OF STABILIZING VALVE ASSEMBLY (F007) CLOSE ON INSERT SIGNAL PER ONE DRIVE OPERATION. FOR GANGED ROD DRIVE OPERATION,AN APPROPRIATE NUMBER OF STABILIZING VALVES SHALL BE OPERATED.
2. PROVISION FOR CONTAINMENT ISOLATION TO BE IN ACCORDANCE WITH CURRENT LICENSING REQUIREMENTS.
3. SCRAM DISCHARGE DRAIN MUST BE SUBMERGED DUE TO POTENTIAL RELEASE OF STEAM LEAK-OFF AND RADIOACTIVE NON-CONDENSIBLES.
4. PROVIDE VENT VALVES WITH CAP ON DISCHARGE SIDE AT ALL SYSTEM HIGH POINTS. F101 IS THE VENT VALVE FOR THE INSERT LINE AND F102 IS THE VENT VALVE FOR THE WITHDRAW LINE. THE FIRST "X" FOLLOWING THE F101/F102 CORRESPONDS TO THE NUMBER OF TIMES THE ALPHABET WAS USED TO ENCOMPASS ALL 177 HCU'S. THE SECOND "X" REPRESENTS THE RESPECTIVE ALPHABET LETTER.
5. PROVIDE DRAIN VALVES WITH CAP ON DISCHARGE SIDE AT ALL SYSTEM LOW POINTS.
6. EXHAUST FLOW FROM MOVING DRIVES IS DISPERSED VIA THE HCU'S OF ALL OTHER NON-MOVING DRIVES TO REACTOR VESSEL.
7. AVAILABLE FOR TEMPORARY CONNECTION FOR DRIVE TESTING AND FLUSHING. NO PERMANENT PIPING CONNECTIONS TO BE MADE TO THIS VALVE.
8. VACUUM BREAKER VALVE (F120) AND VENT VALVES (F010 & F180) TO BE ON HIGH POINT OF VENT LINE. VACUUM BREAKER VALVE SHALL OPEN ON A DIFFERENTIAL PRESSURE SETTING OF NO GREATER THAN 1.0 PSI. THE LOCATION OF THE VACUUM BREAKER SHOULD CONSIDER THE POTENTIAL RELEASE OF RADIOACTIVE NON-CONDENSIBLES, WATER AND STEAM THAT COULD OCCUR IF THE VACUUM BREAKER VALVE WERE TO FAIL IN AN OPEN POSITION WHEN THE VENT SYSTEM PIPING IS PRESSURIZED.
9. EXCEPT AT POINTS OF CONNECTION WITH NED SUPPLIED EQUIPMENT OR PIPING, THE PIPING DESIGNER SHALL SIZE PIPES IN CONFORMANCE WITH THE SYSTEM SPECIFICATION AND PROCESS DIAGRAM.
10. FOR LOCATION AND IDENTIFICATION OF INSTRUMENTS, SEE INSTRUMENT DATA SHEET LISTED IN MPL FOR EACH INSTRUMENT.
11. CRD NITROGEN AND AIR LINES SHALL BE OF A NON-CORRODING MATERIAL.
12. MULTIPLE ORIFICES CONNECTED IN SERIES AS SHOWN IN PURCHASE PART DRAWING OF ORIFICE D008. THE PRESSURE DROP ACROSS EACH ORIFICE IS 250 PSI AT PUMP RUN-OUT CONDITION. SEE MPL FØR THE QUANTITIES OF ORIFICES. VALVE F034 SUPPLEMENTS THE ORIFICES D008 FOR THE REQUIRED PRESSURE DROP.
13. THE SCRAM DISCHARGE VOLUME ARRANGEMENT SHOWN IS FOR REFERENCE ONLY. FOR REQUIREMENT, SEE CRD DESIGN SPEC. REFERENCE 10.
14. DELETED
15. FLUSHING CONNECTIONS SHALL BE PROVIDED IN ACCORDANCE WITH REFERENCE 7. TEMPORARY STRAINER SCREENS SHALL BE PROVIDED ON THE SUCTION SIDE OF ALL PUMPS IN ACCORDANCE WITH REFERENCE 7.
16. ISOLATION VALVES SHALL BE LOCATED AS CLOSE AS PRACTICABLE TO THE CONTAINMENT PENETRATION.
17. CONTINUOUS FLOW TO THE REACTOR SAMPLE STATION SHOULD BE 1 LITER/MINUTE MAXIMUM SHALL BE 2 LITER/MINUTE.
18. VENT PORT TO CONFORM WITH SAE INTERNAL STRAIGHT THREAD BOSS DIMENSIONS FOR .50 TUBE STRAIGHT THREAD FITTING (3/4-16UNF-2B) AND DEPTH OF .50 MINIMUM EFFECTIVE THREAD TO BE COMPATIBLE WITH THE INSTRUMENT USE FOR TESTING.
19. A PORTABLE NITROGEN CHARGING SYSTEM SHALL BE PROVIDED TO MEET THE REQUIREMENTS OF THE HCU. SEE REFERENCE 15 FOR SPECIFIC ACCUMULATOR CHARGING REQUIREMENTS. IT SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH GOOD INDUSTRY PRACTICE AND SHALL HAVE THE APPROPRIATE SAFETY DEVICES,GAGES, AND VALVES. A PRESSURE RELIEF VALVE SHALL BE INSTALLED DOWNSTREAM OF THE CHARGING STATION PRESSURE REGULATOR WHICH SHALL PREVENT PRESSURIZATION ABOVE SYSTEM REQUIREMENTS.
20. DELETED
21. DELETED
22. SOURCE OF CRD SYSTEM WATER SHALL BE NORMALLY FROM CONDENSATE TREATMENT SYSTEM. CONDENSATE STORAGE TANK IS THE ALTERNATE SOURCE IF CONDENSATE TREATMENT SYSTEM IS NOT IN OPERATION. FOR DETAILED DESIGN REQUIREMENT FOR SOURCE AND QUALITY OF WATER, SEE REFERENCE 10.
23. THE SCRAM DISCHARGE VOLUME VENT LINE SHALL BE ROUTED VIA A DEDICATED LINE TO A NON-SUBMERGED DISCHARGE. THE VENT SYSTEM PIPING SHOULD NOT CONTAIN SIGNIFICANT FLOW RESTRICTIONS WHICH COULD INHIBIT VENTING OF THE SCRAM DISCHARGE VOLUME TO THE EXTENT OF LIMITING THE SCRAM DISCHARGE VOLUME DRAIN RATE. THE DESIGN OF THE NON-SUBMERGED VENT DISCHARGE MUST CONSIDER THE POTENTIAL FOR THE RELEASE OF RADIOACTIVITY DUE TO THE DISCHARGE OF NON-CONDENSIBLES, WATER, AND STEAM WHICH MAY OCCUR DURING THE PERIOD AFTER SCRAM PRIOR TO VENT VALVE CLOSURE AND UPON SCRAM RESET WHEN THE VENT VALVES ARE REOPENED WITH THE SCRAM DISCHARGE VOLUME PRESSURIZED.
24. TO PREVENT LOOP SEALS FROM OCCURING IN RELATIVELY SMALL DIAMETER LINES OF THE SCRAM DISCHARGE VOLUME VENT AND DRAIN SYSTEM, A CONTINUOUS DOWNWARD PITCH AWAY FROM THE SCRAM DISCHARGE VOLUME VENT AND DRAIN VALVES MUST BE MAINTAINED. THERMAL EXPANSION EFFECTS SHOULD BE ADDRESSED IN THE DESIGN OF THE VENT AND DRAIN SYSTEMS.
25. THE DESIGN OF THE SCRAM DISCHARGE VOLUME, ASSOCIATED VENT, AND DRAIN SYSTEM PIPING AND COMPONENTS MUST CONSIDER THE POTENTIAL PRESSURE, TEMPERATURE, AND TRANSIENT LOADING WHICH MAY RESULT FROM: (A) THE DISCHARGE TO THE SCRAM DISCHARGE VOLUME AND DOWN THE VENT AND DRAIN LINE DURING A FULL SCRAM PRIOR TO VENT AND DRAIN VALVE CLOSURE. (B) THE PRESSURIZATION OF THE SCRAM DISCHARGE VOLUME TO REACTOR VESSEL PRESSURE FOLLOWING VENT AND DRAIN VALVE CLOSURE, AND (C) DEPRESSURIZATION OF THE SCRAM DISCHARGE VOLUME UPON SCRAM RESET AND OPENING OF THE SCRAM DISCHARGE VOLUME VENT AND DRAIN VALVES.
26. THE F159B VALVE SHALL BE ADJUSTED SO THAT THE F180 VALVE AND THE F181 VALVE FULLY CLOSE AT LEAST FIVE (5) SECONDS AFTER THE F010 AND F011 VALVES, RESPECTIVELY, DURING A FULL CORE SCRAM. *
27. THE F159A VALVE SHALL BE ADJUSTED SO THAT THE F010 AND F011 VALVES START TO OPEN AT LEAST FIVE (5) SECONDS AFTER THE F180 AND F181 VALVES, RESPECTIVELY, UPON THE RESET OF A FULL CORE SCRAM. *
28. INSTRUMENT LOW POINT PIPING TAP LOCATION SHOULD BE 12 INCHES ABOVE THE SCRAM DISCHARGE INSTRUMENT VOLUME REFERENCE DATUM ELEVATION.
29. THE ELEVATION WITHIN THE SCRAM DISCHARGE INSTRUMENT VOLUME CORRESPONDING TO THE SCRAM INITIATION SET POINT SHALL BE ≥ 8 1/2 INCHES BELOW THE LOWEST ELEVATION OF THE HORIZONTAL SCRAM DISCHARGE VOLUME ELEVATION.
30. SCRAM DISCHARGE VOLUME VENT AND DRAIN VALVE CONTROL ROOM INDICATORS SHALL INDICATE OPEN WHEN BOTH VALVES ARE OPEN AND SHALL INDICATE CLOSED WHEN EITHER VALVE IS CLOSED.
31. THE PNEUMATIC PIPING FROM NEEDLE VALVE F159B AND SOLENOID VALVE F009 TO THE VENT AND DRAIN VALVES F181. F011, F180, F010 SHALL BE ROUTED AND SUPPORTED TO MINIMIZE THE POSSIBILITY OF PIPE CRIMP AND ALSO IT SHOULD BE ADEQUATE PIPE THICKNESS AND MATERIAL TO MINIMIZE THE CONSEQUENCES OF PIPE CRIMP.
32. HCU MPL NUMBERS CORRESPOND TO CORE GRID CONTROL ROD NUMBERING DESIGNATION.
33. LS 129 MPL NUMBERS CORRESPOND TO N (HCU NUMBER) A. PS 130 MPL NUMBERS CORRESPOND TO N (HCU NUMBER) B. PI 131 MPL NUMBERS CORRESPOND TO R (HCU NUMBER).
34. FLOW ELEMENTS 1C11N5840A/B ARE INSTALLED TO MONITOR RECIRCULATION SEAL PURGE FLOW STABILITY. THESE ELEMENTS MAY BE CONNECTED TO TEMPORARY M&TE FOR DATA COLLECTION.
35. INSTRUMENTATION CONNECTED TO VALVES 1C11F0155A/B/C/D AND 1C11F0158A/B/C/D IS INSTALLED AS SAFETY RELATED, NON-ASME. VENT AND DRAIN VALVES 1C11F156A/B/C/D AND 1C11F157A/B/C/D WERE PROCURED TO ASME SECTION III, CLASS 2 REQUIREMENTS.
36. THE MANUFACTURE, PROCUREMENT, FABRICATION AND INSTALLATION OF PIPING AND COMPONENTS SHOWN AS (▷) IS SAFETY RELATED. MATERIALS ARE ASME SECTION II PER GE DESIGN SPECIFICATION 22A4168 REV.2.
* FOLLOWING PROPER ADJUSTMENT THE VALVE (F159A/B) SHALL BE LOCKED INTO POSITION TO MAINTAIN ADMINISTRATIVE CONTROL.
37. THE L2-4 PIPING BETWEEN THE RESTRICTING ORIFICE 1C11D007A/B AND VALVE 1P11F0506 IS SCHEDULE 80 SEAMLESS PIPE.

REFERENCES:

1. 302-0606-00000 NUCLEAR BOILER SYSTEM B21
2. 302-0601-00000 REACTOR RECIRCULATION SYSTEM B33
3. 302-0101-00000 CONDENSATE SYSTEM N21
4. 302-0612-00000 NUCLEAR CLOSED COOLING WATER SYSTEM P43
5. 302-0950-00000 NITROGEN SUPPLY SYSTEM P86
6. 302-0772-00000 REACTOR PLANT SAMPLING SYSTEM P35
7. A62-4140 CLEANING OF PIPING AND EQUIPMENT
8. C11-1020 CONTROL ROD DRIVE HYDRAULIC SYS. PROCESS DIA.
9. C71-1010 REACTOR PROTECTION SYSTEM IED
10. C11-4010 CONTROL ROD DRIVE HYDRAULIC SYS. DESIGN SPEC.
11. 302-0872-00000 CONTROL ROD DRIVE HYDRAULIC SYSTEM DIAGRAM
12. C11-1030 CONTROL ROD DRIVE HYDRAULIC SYSTEM FCD
13. 302-0102-00000 CONDENSATE TRANSFER AND STORAGE SYSTEM P11
14. A62-4240 WATER SAMPLING
15. C11-D001 HCU OUTLINE DRAWING
16. A62-1010 GROUP CLASS 8 CONTAINMENT ISOLATION DIAGRAM
17. C11-1050 ROD CONTROL AND INFO SYSTEM
18. 302-0671-00000 REACTOR WATER CLEANUP SYSTEM G33

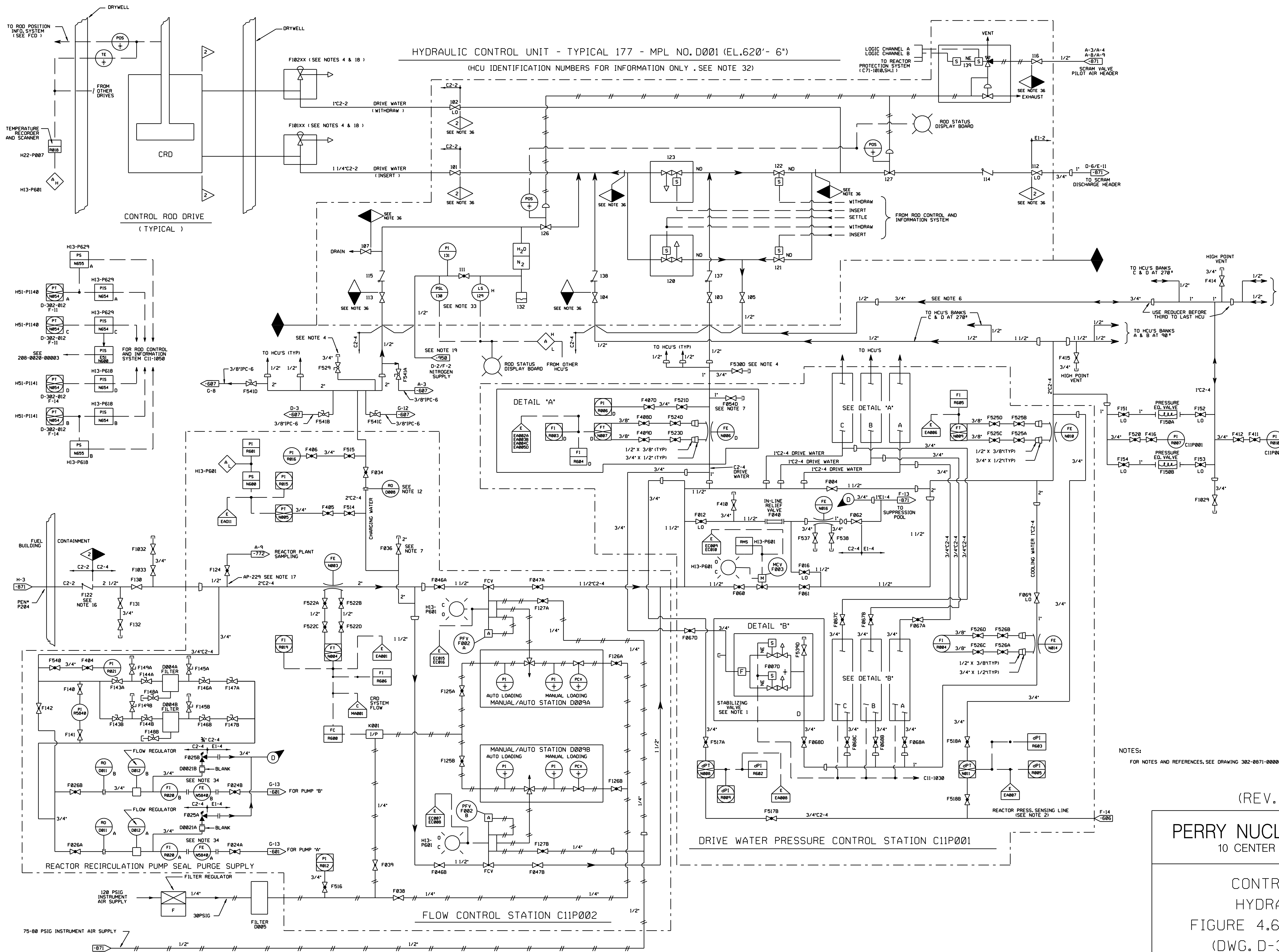
(REV. 20 10/2017)

PERRY NUCLEAR POWER PLANT
10 CENTER RD., PERRY, OHIO 44081

CONTROL ROD DRIVE HYDRAULIC SYSTEM

FIGURE 4.6-5 (SHEET 1 OF 2)

(DWG. 302-0871-00000)



NOTES:

FOR NOTES AND REFERENCES, SEE DRAWING 302-0871-00000.

(REV. 22 10/2021)

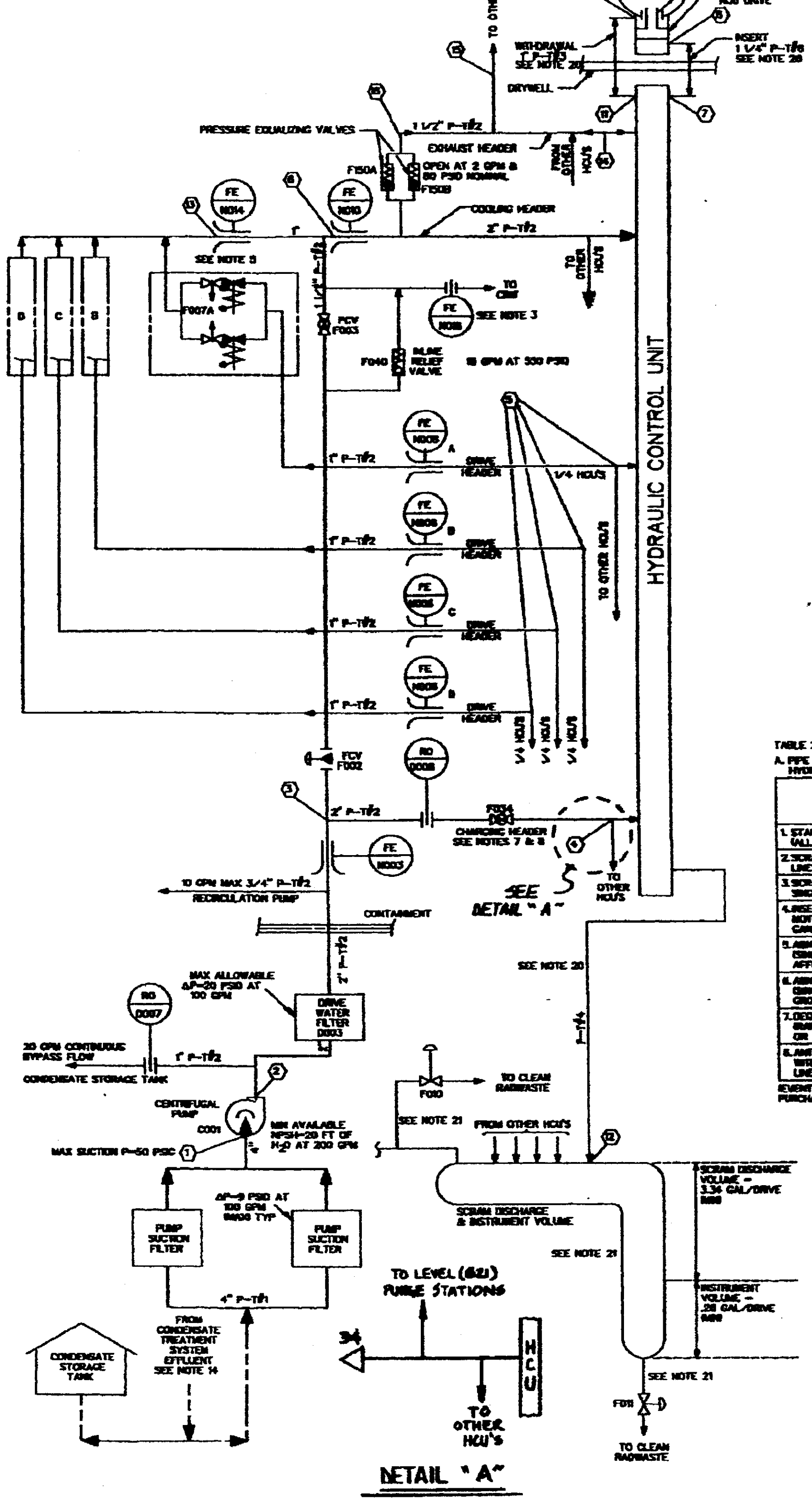
PERRY NUCLEAR POWER PLANT
10 CENTER RD., PERRY, OHIO 44081

CONTROL ROD DRIVE
HYDRAULIC SYSTEM
FIGURE 4.6-5 (SHEET 2 OF 2)
(DWG. D-302-0872-00000)

TABLE I

PLANT SIZE	NO. OF DRIVES	Q1–Q2	Q3	Q6
238–732	177	60 / 90	50 / 60	50 / 60

LEGEND
SLASH(/) = MIN DRIVE COOLING FLOW CONDITION / MAX DRIVE COOLING FLOW CONDITION



MODE A NORMAL OPERATION–SIZES COOLING WATER HEADERS

LOCATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FLOW, GPM	Q1	Q2	Q3	0	0	Q6	.28/.34	.28/.34	.28/.34	0	8	0	16	0	0	0
PRESSURE, PSIG.		TDH=1800 PSI MIN			PR+250 (MIN)	>PR	>PR	>PR	PR	PR	PR	0	SEE NOTE 12 & 13	PR	PR	PR
		MAX LINE LOSS 60 PSID														

CONDITIONS:
1. DRIVES LATCHED.
2. MIN/MAX COOLING FLOW TO DRIVES.
3. PRESSURE OF REACTOR (PR) AT 1060 PSIG MEASURED IMMEDIATELY ABOVE THE VESSEL CORE PLATE.

MODE B GANGED ROD INSERTION–SIZES THE DRIVE WATER HEADERS

LOCATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FLOW, GPM	Q1	Q2	Q3	0	4	SEE NOTE 4	4	4	13	.7	.7	0	0	.7	2.8	0
PRESSURE, PSIG.		TDH=1800 PSI MIN					PR+91	PR+90	PR	PR+15	PR+12	0		<PR+10	<PR+10	<PR+10
															SEE NOTE 17	

CONDITIONS:
1. 4 DRIVES INSERTING AT 3 INCHES/SECOND.
2. EACH DRIVE HEADER FEEDING FLOW TO 1 DRIVE (MAX).
3. PRESSURE OF REACTOR (PR) AT 1060 PSIG.

MODE C SCRAM–SIZES INSERT & WITHDRAW LINE

LOCATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FLOW, GPM	50	50	20	0	0	20	125	125	5	37	37	37	0	0.1	18.9	20
PRESSURE, PSIG.						SEE NOTE 15	104 PSID MIN, 168 PSID MAX LINE LOSSES		PR	41 PSID MIN, 68 PSID MAX LINE LOSSES		SEE NOTE 18				300
														SEE NOTE 16		

CONDITIONS:
1. DRIVES SCRAMMING.
2. FLOWS BASED ON ROD VELOCITY OF 120 INCHES PER SECOND.
3. PRESSURE OF REACTOR (PR) AT 1060 PSIG.

MODE D SCRAM COMPLETED–SIZES THE PUMP SUCTION LINE

LOCATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FLOW, GPM	200 MAX	200 MAX	170	150 MAX	0	20	SEE NOTES 7 & 8			SEE NOTE 16		0	0	0.1	18.9	20
PRESSURE, PSIG.	TDH=1475 MIN					SEE NOTE 15			PR	65 MAX	65 MAX	65 MAX		SEE NOTE 16		
										SEE NOTE 15						

CONDITIONS:
1. SCRAMMING OF DRIVES COMPLETED.
2. MAXIMUM CRD SUPPLY PUMP FLOW.
3. PRESSURE OF REACTOR (PR) AT 0 PSIG.

MODE E GANGED ROD WITHDRAWAL–SIZES EXHAUST HEADERS

LOCATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FLOW, GPM	Q1	Q2	Q3	0	2	SEE NOTE 4	2.3	2.3	2.17	2.0	2.0	0	8	2.3	9.2	0
PRESSURE, PSIG.		TDH=1800 PSI MIN						PR+110	PR	PR+230		0		PR+15 (MAX)	PR+15 (MAX)	PR+15 (MAX)
															SEE NOTE 17	

CONDITIONS:
1. 4 DRIVES WITHDRAWING AT 3 INCHES/SECOND
2. EACH DRIVE HEADER FEEDING FLOW TO 1 DRIVE
3. PRESSURE OF REACTOR (PR) AT 1060 PSIG.

TABLE 2: THERMAL CYCLES FOR SAFETY RELATED PIPES AND PIPE SUPPORTS

A. PIPE SECTION–WITHDRAWAL LINES (3), (4) & (6), (CRD FLANGE TO HYDRAULIC CONTROL UNIT)

EVENT	PRESSURE (psig)	TEMPERATURE (°F)	EXPECTED FREQUENCY PER PLANT LIFE (9)	DURATION PER EVENT
1. STANDBY OPERATION (ALL LINES AFFECTED)	1250 (2)	CONSTANT TEMP 45 MIN(7)/150 MAX	N/A	40 YEARS
2. SCRAM (ALL OR SINGLE LINES AFFECTED)	1250 (2)	AMBIENT TO 280(2)	300	20 MINUTES
3. SCRAM–COLD (ALL OR SINGLE LINE AFFECTED)	0	AMBIENT	300	20 MINUTES
4. INSERT AND WITHDRAWAL MOTION (SINGLE LINE OR GANGED GROUPS AFFECTED)	(PR + 300)	CONSTANT TEMP 45 MIN(7)/150 MAX	31000	<1 MINUTE
5. ABNORMAL SYSTEM CONDITION (SINGLE OR GANGED GROUPS AFFECTED) (8)	(PR + 300)	(a) AMBIENT TO 45 (8) (b) AMBIENT TO 150	<40	N/A
6. ABNORMAL SYSTEM CONDITIONS (SINGLE LINES OR GANGED GROUPS AFFECTED) (4)	1880 MAX	AMBIENT TO 150(8)	<25	20 MINUTES
7. DEGRADED SYSTEM CONDITIONS (RANDOM SINGLE LINES OR ALL LINES AFFECTED) (3)	1250	AMBIENT TO 500(3) MAX	<25	<10 HOURS
8. ANTICIPATED TRANSIENT WITHOUT SCRAM (ALL LINES AFFECTED)	1500 (PASSIVE)	AMBIENT TO 400	<1	<30 SECONDS

(EVENT #8 ONLY APPLICABLE TO THOSE PROJECTS THAT PURCHASED THE ATWS 3A OPTION)

TABLE 2: (CONTINUED)

B. PIPE SECTION–SCRAM DISCHARGE VOLUME (8) & (3), (HYDRAULIC CONTROL UNITS TO THE SCRAM DISCHARGE VOLUME VENT AND DRAIN VALVES)

EVENT	PRESSURE (psig)	TEMPERATURE (°F)	EXPECTED FREQUENCY PER PLANT LIFE (9)	DURATION PER EVENT
1. STAND–BY OPERATION	0	AMBIENT	N/A	40 YEARS
2. SCRAM	1250(2)	AMBIENT TO 280(2)	300	20 MINUTES
3. DEGRADED SYSTEM CONDITIONS	1250	AMBIENT TO 450(3) (MAX)	<20	20 MINUTES
4. ANTICIPATED TRANSIENT WITHOUT SCRAM	1500 (PASSIVE)	400	<1	<30 SECONDS

(EVENT #4 ONLY APPLICABLE TO THOSE PROJECTS WHICH PURCHASED THE ATWS 3A OPTION)

TABLE 2 (CONTINUED)

C. PIPE SECTION–INSERT LINES (5) & (3), (CRD FLANGE TO HYDRAULIC CONTROL UNIT)

EVENT	PRESSURE (psig)	TEMPERATURE (°F)	EXPECTED FREQUENCY PER PLANT LIFE (9)	DURATION PER EVENT
1. STANDBY OPERATION (ALL LINES AFFECTED)	(PR+10)	CONSTANT TEMP 45 MIN(7)/150 MAX	N/A	40 YEARS
2. ABNORMAL SYSTEM CONDITION (ALL LINES AFFECTED) (8)	(PR+10)	(a) AMBIENT TO 45 (8) (b) AMBIENT TO 150	<40	N/A
3. SCRAM (ALL OR SINGLE LINES AFFECTED)	1890 MAX	CONSTANT TEMP 45 MIN(7)/150 MAX	600	<1 MINUTE
4. INSERT AND WITHDRAWAL MOTION (SINGLE LINE OR GANGED GROUP AFFECTED)	(PR+300)	CONSTANT TEMP 45 MIN(7)/150 MAX	31000	<1 MINUTE
24MAY1985	24 MAY 1985	24 MAY 1985	24 MAY 1985	MAY 1985

NOTES FOR TABLE 2

1. PIPE SUPPORT INTEGRITY SHOULD BE MAINTAINED FOR THERMAL EXPANSION CONDITIONS.

   THIS MAY BE DEMONSTRATED BY VISUALLY INSPECTING THE PIPE SUPPORTS FOR DAMAGE FOLLOWING ANY OF THE FOLLOWING RARE EVENTS AT HOT REACTOR CONDITIONS:
   –MULTIPLE MANUAL SCRAMS (SINGLE OR FULL CORE) WITH NO TIME BETWEEN SCRAMS FOR PIPE COOL DOWN.
   –FAILURE TO ISOLATE THE SDV FOLLOWING A SCRAM
   – LEAKING SCRAM VALVE FOR AN EXTENDED PERIOD OF TIME (WITHDRAWAL LINES ONLY).
2. DESIGN PRESSURE AND TEMPERATURE CONDITIONS. HOT REACTOR CONDITIONS ASSUMED.
3. THE PIPING SHOULD BE SIZED AS A MINIMUM TO SCHEDULE 80.
4. THIS EVENT INCLUDES: STUCK CRD MAINTENANCE, AND PRESSURE CONTROL VALVE CLOSURE.
5. INSERT AND WITHDRAWAL PIPING SHOULD BE DESIGNED FOR HYDRODYNAMIC LOADS AS A RESULT OF A NORMAL SCRAM AT ZERO AND NORMAL REACTOR PRESSURES, SHORT STROKE AND FULL STROKE SCRAMS, AND A SCRAM WITH A FAILED CRD BUFFER. PLANT LOAD COMBINATIONS SHOULD INCLUDE CONSIDERATION OF THESE SYSTEM HYDRODYNAMIC LOADS.
6. THE SCRAM DISCHARGE VOLUME (SDV) AND WITHDRAWAL PIPING DESIGN SHOULD CONSIDER THE HYDRODYNAMIC LOADS WHICH MAY OCCUR DUE TO 1) SDV ISOLATION AND 2) SDV VENTING AND DRAINING FOLLOWING SCRAM COMPLETION.
7. FOR DESIGN OF CRD PIPING 45°F MIN. IS REFLECTIVE OF THE MINIMUM CONDENSATE STORAGE TANK (CST) TEMPERATURE AND CAN BE REVISED TO AGREE WITH CST ENVIRONMENTAL CONDITIONS OR MINIMUM CRD PIPING AMBIENT CONDITIONS WHICH EVER IS LIMITING
8. CRD PUMP SUCTION FROM EITHER A COLD CONDENSATE STORAGE TANK OR HOT CONDENSATE TREATMENT SYSTEM.
9. THE EVENT FREQUENCIES GIVEN ARE NOT REFLECTIVE OF THE NUMBER OF STRESS CYCLES ASSOCIATED WITH EACH EVENT.
10. DESIGN PRESSURE AND TEMPERATURE CONDITIONS. HOT AND COLD REACTOR CONDITIONS ASSUMED.

NOTES:

1. ESTIMATED LINE SIZES ARE FOR INFORMATION ONLY. ACTUAL LINE SIZES AS DETERMINED BY PIPING DESIGNER SHALL MEET THE PROCESS DATA HYDRAULIC REQUIREMENT.
2. THE TERM PR IS DEFINED AS THE REACTOR PRESSURE IMMEDIATELY ABOVE THE CORE PLATE.
3. ORIFICE SHALL BE DESIGNED TO MEASURE A FLOW OF 18 GPM FOR IN-LINE RELIEF VALVE TEST.
4. COOLING WATER FLOW IS DECREASED DURING ROD MOVEMENT IN ORDER TO DIVERT FLOW TO THE SELECTED CONTROL ROD DRIVE (OR DRIVES IN THE CASE OF GANGED ROD OPERATION).
5. TOTAL FLOW IS THE SUM OF EQUAL FLOWS THROUGH EACH OF 8 STABILIZING VALVES. FLOW/VALVE IS SELECTED TO MINIMIZE PRESSURE CHANGE AT 5 WHEN INSERTING OR WITHDRAWING DRIVES. FLOW/VALVES ESTIMATED AT 2 GPM.
6. SCRAM VENT VALVE F010 AND DRAIN VALVE F011 CLOSE WITH A SCRAM SIGNAL.
7. PUMP RUNOUT CAPACITY OF 200 GPM SHALL NOT BE EXCEEDED. ORIFICE D008 AND VALVE F034 REDUCE THE PRESSURE AT THE INSERT LINE SO THAT NO GREATER THAN A TOTAL OF 150 GPM WILL LEAK THROUGH ALL THE DRIVES WHEN PR=0 PSIG. FLOW AT LOCATION 7 AND 8 IS EQUAL TO 150 ÷ NO. OF DRIVES.
8. D008 IS COMPOSED OF MULTIPLE ORIFICES CONNECTED IN SERIES. SEE MPL FOR THE QUANTITIES OF ORIFICES. THE PRESSURE DROP AT EACH ORIFICE IS 200 PSID AT 200 GPM. VALVE F034 SUPPLEMENTS THE ORIFICES D008 FOR THE REQUIRED PRESSURE DROP.
9. THE MAXIMUM OPERATING TEMPERATURES WILL NOT EXCEED 150°F FROM LOCATION 1 THROUGH 16 WITH THE FOLLOWING EXCEPTIONS.

		LOCATION	MAX TEMP °F
MODE A		9	200
MODE A	(LEAKING SCRAM DISCHARGE VALVE)	9	550
		10	500
		11	500
		12	280
MODE D		9	475
		10	475
		11	475
		12	450

IT MAY BE ASSUMED THAT THE TEMPERATURES OVER 280 °F OCCUR LESS THAN 1% OF THE OPERATING LIFE OF THE SYSTEM.

10. DESIGN PRESSURE & TEMPERATURE GIVEN BELOW IS FOR INFORMATION ONLY AND IS THE BASIS FOR DESIGN OF BWROD SUPPLIED EQUIPMENT.

PT INDEX

PT#	DESIGN TEMP (F)	DESIGN PRESS (PSIG)
1	140	150
2	150	2000
3	280 (500 PEAK)	1250
4	280 (450 PEAK)	1250
5	400	1250
6	150	2000

11. SEE TABLE 1 FOR VALUES OF Q1, Q2, Q6.
12. SYSTEMS NOT HAVING GANGED ROD CAPABILITY SHALL USE THIS PROCESS DIAGRAM AS A DESIGN BASIS EVEN THOUGH VALUES GIVEN AT SOME POINTS WILL BE DIFFERENT DURING ACTUAL OPERATION.
13. FOR NON-GANGED ROD PLANTS FLOW IS 4 GPM.
14. LINE FROM CONDENSATE TREATMENT SYSTEM SHALL BE SIZED TO MAINTAIN A FLOW RATE APPROXIMATELY TWICE NORMAL MODE A) CRD SYSTEM FLOW RATE. SURPLUS FLOW WILL BE DIVERTED TO THE CONDENSATE STORAGE TANK (CST). CST WILL PROVIDE AN ALTERNATE SOURCE OF WATER FOR THE CRD SYSTEM IF THE CONDENSATE TREATMENT SYSTEM IS NOT AVAILABLE.
15. THIS VALUE APPLIES IMMEDIATELY FOLLOWING COMPLETION OF SCRAM. PRESSURE WILL SUBSEQUENTLY EQUALIZE WITH REACTOR PRESSURE.
16. DURING SCRAM THIS FLOW WILL BE DIRECTED INTO THE SCRAM DISCHARGE VOLUME. FOLLOWING SCRAM THIS FLOW WILL DECLINE AS VALVE F002 CLOSES AND AS THE SCRAM VOLUME PRESSURE RISES TO EQUAL REACTOR PRESSURE. AFTER THE SCRAM VOLUME & REACTOR VESSEL PRESSURES HAVE EQUALIZED, FLOW WILL BE DIVERTED TO THE REACTOR VESSEL, VIA THE CRD WITHDRAW LINES AT A FLOW RATE DEPENDENT ON THE REACTOR PRESSURE.
17. COMBINED EXHAUST FLOW FROM 4 CRD'S (GANGED MODE).
18. LINE LOSSES BETWEEN HCU & SCRAM DISCHARGE VOLUME HEADER SHALL BE ≤25 PSID AT 37 GPM.
19. ALL EQUIPMENT AND INSTRUMENTS ARE PREFIXED BY SYSTEM NUMBER C11 UNLESS OTHERWISE NOTED.
20. INSERT AND WITHDRAWAL PIPING SHALL BE DESIGNED FOR HYDRODYNAMIC LOADS AS A RESULT OF A NORMAL SCRAM AT ZERO AND NORMAL REACTOR PRESSURES, SHORT STROKE AND FULL STROKE SCRAM, AND A SCRAM WITH A FAILED CRD BUFFER. PLANT LOAD COMBINATIONS SHOULD INCLUDE CONSIDERATION OF THESE SYSTEM HYDRODYNAMIC LOADS.
21. THE SCRAM DISCHARGE VOLUME (SDV) AND ITS VENT AND DRAIN PIPING DESIGN SHALL CONSIDER THE HYDRODYNAMIC LOADS WHICH MAY OCCUR DUE TO 1) SDV ISOLATION AND 2) SDV VENTING AND DRAINING FOLLOWING SCRAM COMPLETION AT REACTOR OPERATING PRESSURE.

SUPPLEMENTAL DOCUMENTS UNDER THE FOLLOWING IDENTITIES ARE TO BE USED IN CONJUNCTION WITH THIS DRAWING:

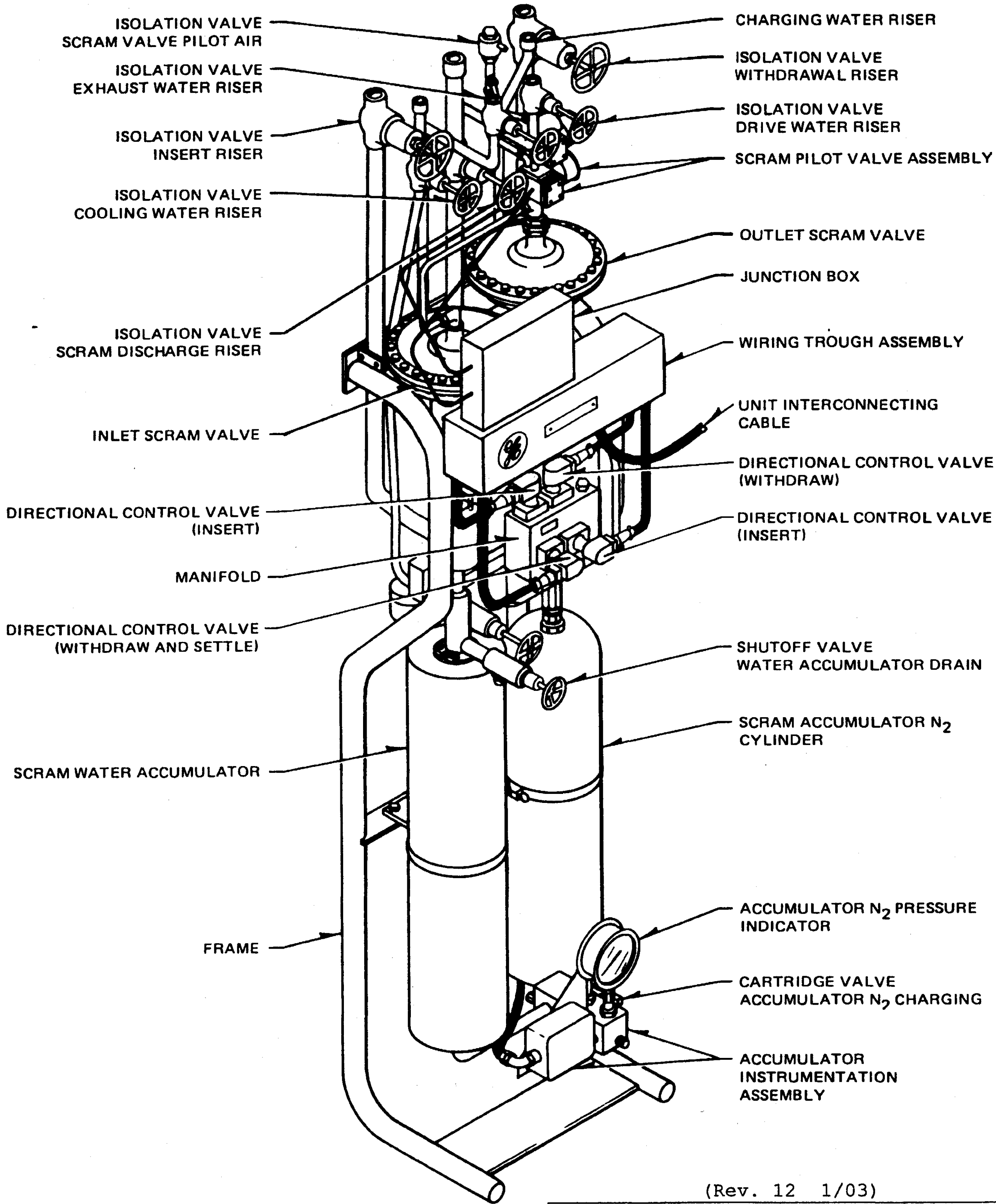
	REFERENCE DESIGNATOR
1. PIPING & INSTRUMENTATION SYMBOLS	A42–1010
2. DESIGN PRESSURE FOR PIPING SYSTEMS	A82–4410

(Rev. 13 12/03)

PERRY NUCLEAR POWER PLANT

Control Rod Drive Hydraulic System

Figure 4.6-7



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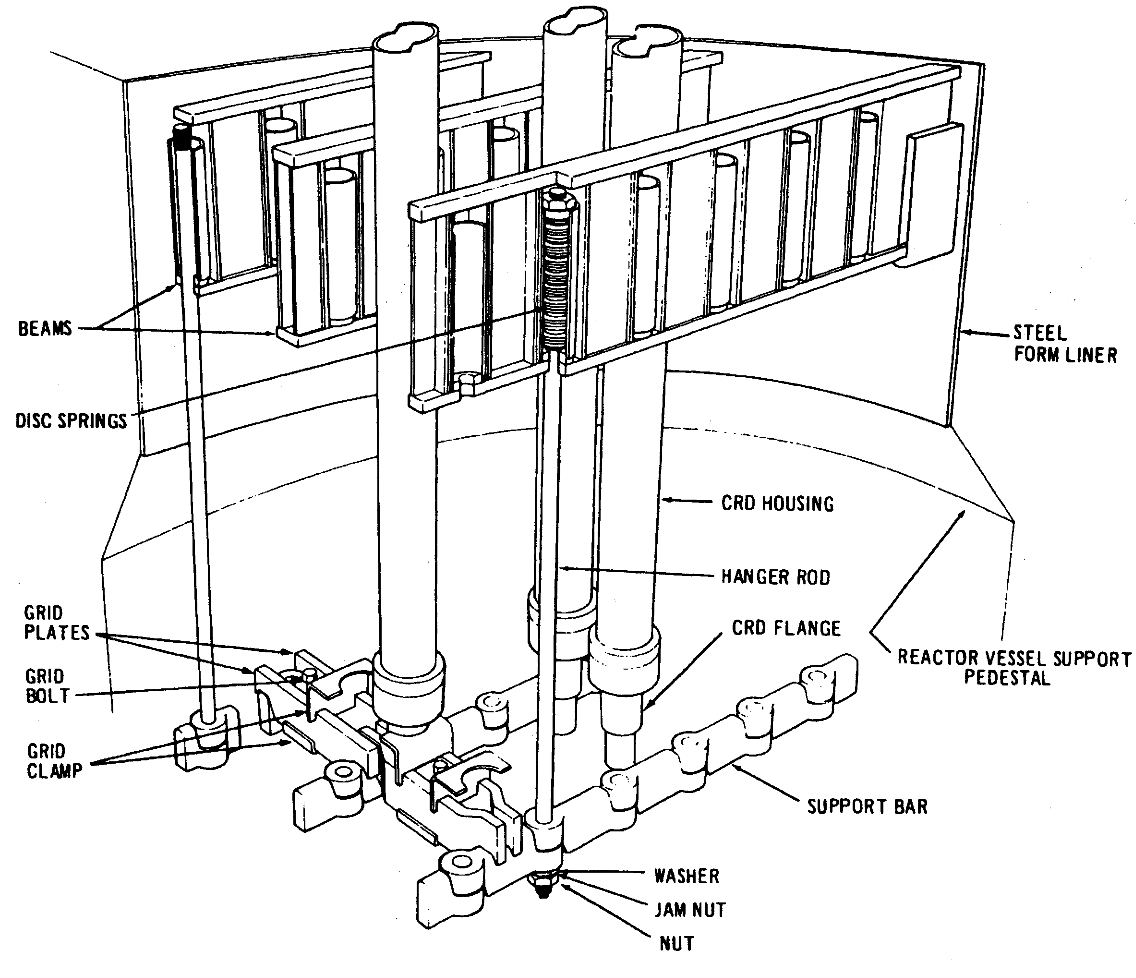
PERRY NUCLEAR POWER PLANT

Control Rod Drive Hydraulic Control Unit

Figure 4.6-8



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PERRY NUCLEAR POWER PLANT

Control Rod Drive Housing Support

Figure 4.6-9