TABLE 1 LPRM TO APRM ASSIGNMENTS

DET AND LPRM LOCATION	APRM CHANNEL A	B	C	D	UNIT NO.
20-61	B	C	D	A	1
28-61	C	D	A	B	2
36-61	B	C	D	A	3
44-61	C	D	A	B	4
52-61	B	C	D	A	1
12-53	D	A	B	C	1
20-53	A	B	C	D	4
28-53	D	A	B	C	3
36-53	A	B	C	D	2
44-53	D	A	B	C	1
52-53	A	B	C	D	4
60-53	D	A	B	C	3
04-45	B	C	D	A	4
12-45	C	D	A	B	3
20-45	B	C	D	A	2
28-45	C	D	A	B	1
36-45	B	C	D	A	4
44-45	C	D	A	B	3
52-45	B	C	D	A	2
60-45	C	D	A	B	1
04-37	A	B	C	D	2
12-37	D	A	B	C	2
20-37	A	B	C	D	3
28-37	D	A	B	C	4
36-37	A	B	C	D	1
44-37	D	A	B	C	2
52-37	A	B	C	D	3
60-37	D	A	B	C	4
04-29	B	C	D	A	3
12-29	C	D	A	B	4
20-29	B	C	D	A	1
28-29	C	D	A	B	2
36-29	B	C	D	A	3
44-29	C	D	A	B	4
52-29	B	C	D	A	1
60-29	C	D	A	B	2

TABLE 1 LPRM TO APRM ASSIGNMENTS (CONT'D)

DET AND LPRM LOCATION	APRM CHANNEL A	B	C	D	UNIT NO.
12-21	D	A	B	C	1
20-21	A	B	C	D	4
28-21	D	A	B	C	3
36-21	A	B	C	D	2
44-21	D	A	B	C	1
52-21	A	B	C	D	4
60-21	D	A	B	C	3
12-13	C	D	A	B	3
20-13	B	C	D	A	2
28-13	C	D	A	B	1
36-13	B	C	D	A	4
44-13	C	D	A	B	3
52-13	B	C	D	A	2
28-05	D	A	B	C	4
36-05	A	B	C	D	1
44-05	D	A	B	C	2

(NOTE 9)

TABLE 2 LPRM STRING ASSIGNMENT TO ATIP MACHINES

ATIP A		ATIP B		ATIP C	
POSITION #	LPRM LOC.	POSITION #	LPRM LOC.	POSITION #	LPRM LOC.
1	04-29	1	28-05	1	44-13
2	04-37	2	28-13	2	44-21
3	04-45	3	28-21	3	44-29
4	12-13	4	28-29	4	44-37
5	12-21	5	28-37	5	44-45
6	12-29	6	28-45	6	44-53
7	12-37	7	28-53	7	44-61
8	12-45	8	28-61	8	52-13
9	12-53	9	36-05	9	52-21
10	20-13	10	36-13	10	52-29
11	20-21	11	36-21	11	52-37
12	20-29	12	36-29	12	52-45
13	20-37	13	36-45	13	52-53
14	20-45	14	36-53	14	52-61
15	20-53	15	36-61	15	60-21
16	20-61	16	44-05	16	60-29
17	-	17	-	17	60-37
18	-	18	-	18	60-45
19	-	19	-	19	60-53
20	36-37	20	36-37	20	36-37

TABLE 3 POWER DISTRIBUTION

	120V AC DIVISIONAL UPS BUS A	B	C	D
DIVISION	I	II	III	IV
SRNM CH'S	A,E,J	B,F	C,G,L	D,H
APRM CH'S	A	B	C	D
	120V AC NON-DIVISIONAL UPS A	B	C	D
MRBM CH'S	A	B		
SRNM RECORDERS	A,E,J	B,F	C,G,L	D,H
APRM RECORDERS	A	B	C	D
MRBM RECORDERS	A	B	A	B

480V, 3ø 3kVA: ATIP DRIVE MECHANISMS

120V AC: ATIP INSTR. PANEL

LEGEND:

- ○ – LPRM DETECTOR ASM (52)
- + – CONTROL RODS (205)
- □ – SRNM DETECTORS (10)
- △ – NEUTRON SOURCES (5)
- [I] – SIGNAL ISOLATION
- ⟨A⟩ – COMPUTER INPUTS
- ⟨T⟩ – TRANSIENT TEST PANEL INPUTS
- ⟹ DATA TRANSMISSION [VIA OPTIC FIBER]
- ⟶ – SINGLE TRANSMISSION

ABBREVIATIONS:

RPS --- REACTOR PROTECTION SYSTEM
SRNM --- STARTUP RANGE NEUTRON MONITOR
LPRM --- LOCAL POWER RANGE MONITOR
APRM --- AVERAGE POWER RANGE MONITOR
ATIP --- AUTOMATED TRAVERSING INCORE PROBE
MRBM --- MULTI-CHANNEL ROD BLOCK MONITOR
UPS --- UNINTERRUPTABLE POWER SUPPLY
NMS --- NEUTRON MONITORING SYSTEM
RC&IS --- ROD CONTROL AND INFORMATION SYSTEM
MCRP --- MAIN CONTROL ROOM PANEL
PMCS --- PERFORMANCE MONITORING CONTROL SYSTEM
APRS --- AUTOMATIC POWER REGULATOR SYSTEM
MSV --- MEAN SQUARE VOLTAGE
ATLM --- AUTOMATED THERMAL LIMIT MONITOR
OPRM --- OSCILLATION POWER RANGE MONITOR
RTIS --- REACTOR TRIP AND ISOLATION SYSTEM

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

	MPL NO.
1. RECIRCULATION FLOW CONTROL SYS. IED	C81-1040
2. PMCS INPUT/OUTPUT LIST	C90-1080
3. PIPING AND INSTRUMENT SYMBOLS DIAGRAM	A10-3030
4. REACTOR PROTECTION SYS. IED	C71-1040
5. ROD CONTROL AND DEFORMATION SYS. IED	C11-1040
6. PMCS IED	C90-1040
7. MCRP SYSTEM IED	H11-1040
8. AUTOMATIC POWER REGULATOR SYS. IED	C62-1040
9. NEUTRON MONITORING SYSTEM IED	C51-1030
10. NEUTRON MONITORING SYS ARRGM'T	C51-1070

NOTES:

1. THIS DOCUMENT PRESENTS THE BASIC REQUIREMENTS OF FUNCTIONAL UNITS ALLOCATION OF THE NMS INSTRUMENTS. THEIR BASIC FUNCTIONS AND THEIR INPUT AND OUTPUT REQUIREMENTS TO OTHER SYSTEMS. IT ALSO INCLUDES REQUIREMENTS OF DETECTOR LOCATION ASSIGNMENTS IN CORE AS WELL AS THEIR ASSIGNMENTS TO DIFFERENT DIVISIONS.
2. ALL EQUIPMENTS, INTRUMENTS AND DISPLAY CONTROL SYSTEM INPUT SIGNALS ARE PREFIXED BY C51- UNLESS OTHERWISE NOTED. THE PART MEMBERS ARE LOCATED ADJACENT TO OR ON THE SIGNAL CONDITIONING EQUIPMENT PERFORMING THE FUNCTION INDICATED.
3. AN AREA RADIATION MONITOR IS RECOMMENDED TO BE INSTALLED IN THE TIP DRIVE MECHANISM ROOM, AND THE OUTSIDE OF THE PERSONNEL HATCH DOOR (TO THE DRYWELL).
4. REMOTE DISPLAY MEANS DISPLAY ON MAIN CONTROL PANEL. FOR DISPLAY DEVICE TYPE, REFER TO C51-5030.
5. REMOTE RECORDING DEVICE SHALL BE BASED ONT THAT SPECIFIED IN H11-4010
6. SRNM NON-COINCIDENT UPSCALE LEVEL TRIP IS ONLY ACTIVATED BY MANUAL SWITCH IN UPS.
7. THESE ARE SAFETY RELATED CORE PLATE DIFFERENTIAL PRESSURE (C81-DPT301A-D) SIGNALS OF THE RFCS ESSENTIAL CORE PLATE DIFFERENTIAL PRESSURE SIGNALS.
8. COMMAND AND CONTROL SIGNALS BETWEEN THE PLANT COMPUTER FUNCTIONS AND THE ATIP OTHER THAN ATIP MEASURED DATA ARE TRANSMITTED THROUGH THIS DATA ENTRY POINT.
9. DETECTORS SIGNALS ARE DISTRIBUTED TO FOUR UNITS, IN EACH DIVISION ACCORDING TO TABLE 1 ARRANGEMENT. THE UNIT ASSIGNMENT ONLY DEPENDS ON LPRM STRING LOCATION AND ARE IDENTICAL FOR ALL FOUR DIVISIONS.
10. THE DATA COMMUNICATIO FUNCTION (DCF) REFERS TO THE INPUT/OUTPUT FUNCTION OF THE SRNM AND THE APRM. THIS IED DOES NOT SPECIFY THE ACTUAL HARDWARE IMPLEMENTATION OF THIS DCF.
11. FOR DETAIL TRIP SIGNAL FUNCTIONAL INTERFACES WITH RCIS & RPS, REFER TO SUPPL. DOC. 9. THERE SHOULD BE A SEPARATE RCIS AND RPS TRIP LOGIC FUNCTION INDEPENDENT OF EACH INDIVIDUAL SRNM CHANNEL IN THE DIVISION. THE RTIS INTERLOCK SIGNAL IS THE "ATWS PERMISSIVE" SIGNAL.
12. THIS IED INCLUDES ALL MAIN INPUT/OUTPUT SIGNALS REQUIRED TO BE INLUDED IN THE INSTRUMENT DESIGN. FOR DETAIL BINARY TRIP SIGNALS, REFER TO NMS IBD. SUPPLEMENTAL DOCUMENT 9.
13. THE SIGNAL TRANSMISSION PATH CAN BE THROUGH DEDICATED CONDUCTORS.
14. TRIP SIGNAL FROM THE NMS TO THE PMCS SHALL BE TRANSMITTED VIA DEDICATED CONDUCTORS (E.G. METAL CABLE WITH PROPER ISOLATION) TO AVOID UNNECESSARY TIME DELAY FOR TRIP SEQUENCE RECORDING.
15. THE OPRM IS A FUNCTIONAL SUBSYSTEM OF THE APRM. IT RECEIVES THE SAME LPRM SIGNALS, THE APRM OF THE SAME DIVISION RECEIVES AS INPUT, AS SHOWN IN TABLE 1. THE OPRM LOGIC IS DISCRIBED IN SUPPL. DOC. 9.

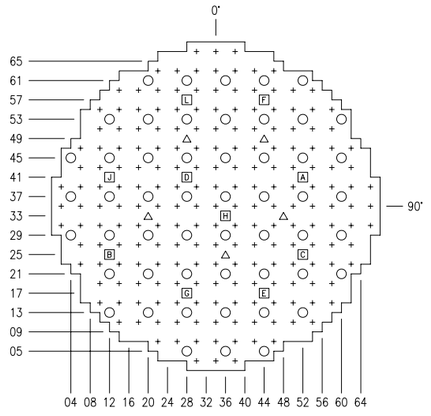


FIGURE 1: DETECTOR AND CONTROL ELEMENT ARRANGEMENT [TOP VIEW OF CORE]

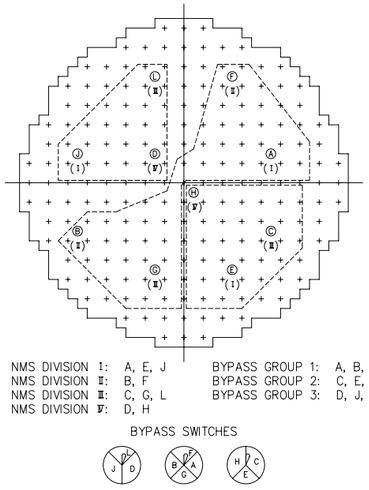


FIGURE 2: SRNM DIVISION & BYPASS GROUP ASSIGNMENTS

MPL NO. C31-1040

Figure 7.6-1 – Neutron Monitoring System IED (Sheet 1 of 4)

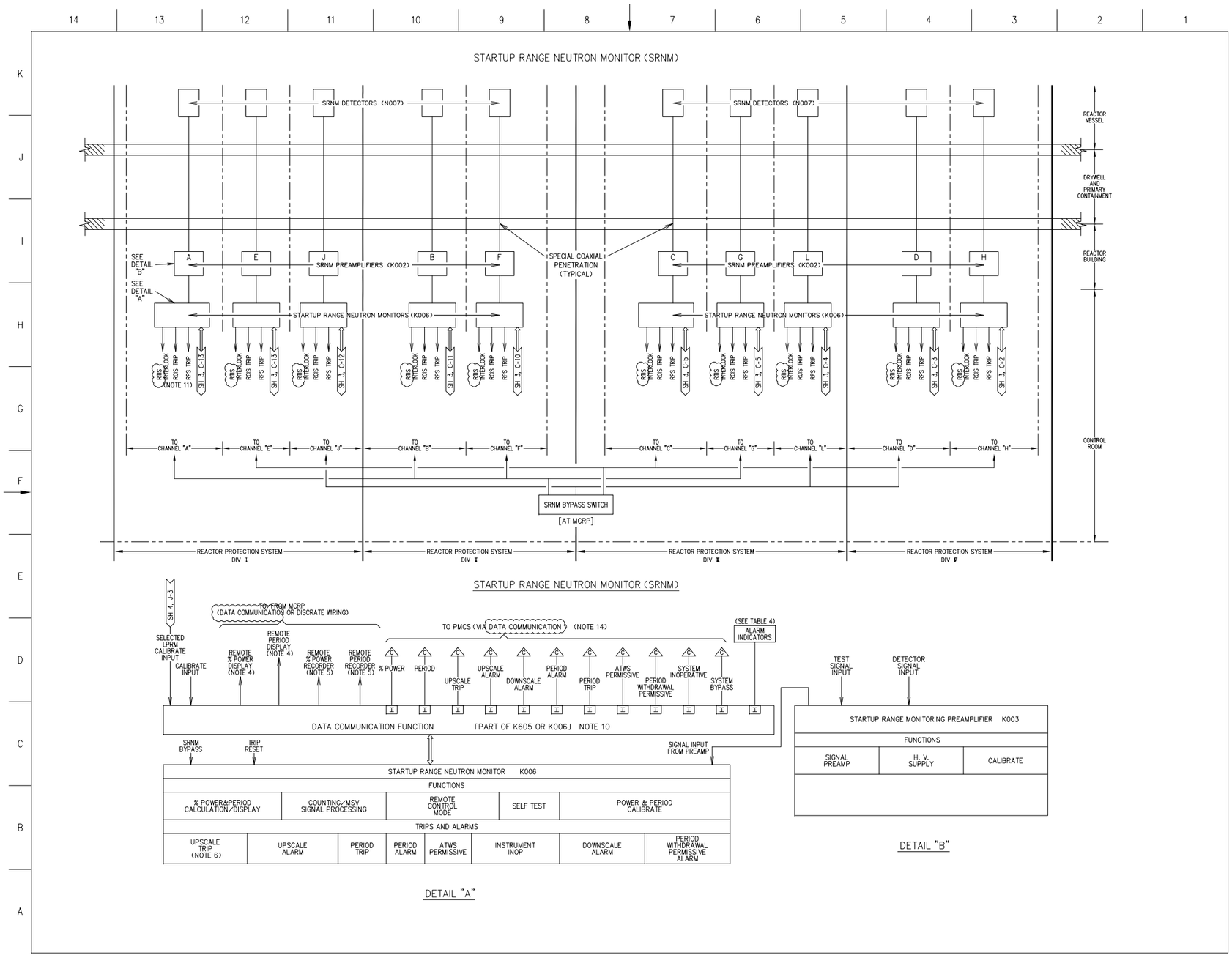


Figure 7.6-1 – Neutron Monitoring System IED (Sheet 2 of 4)

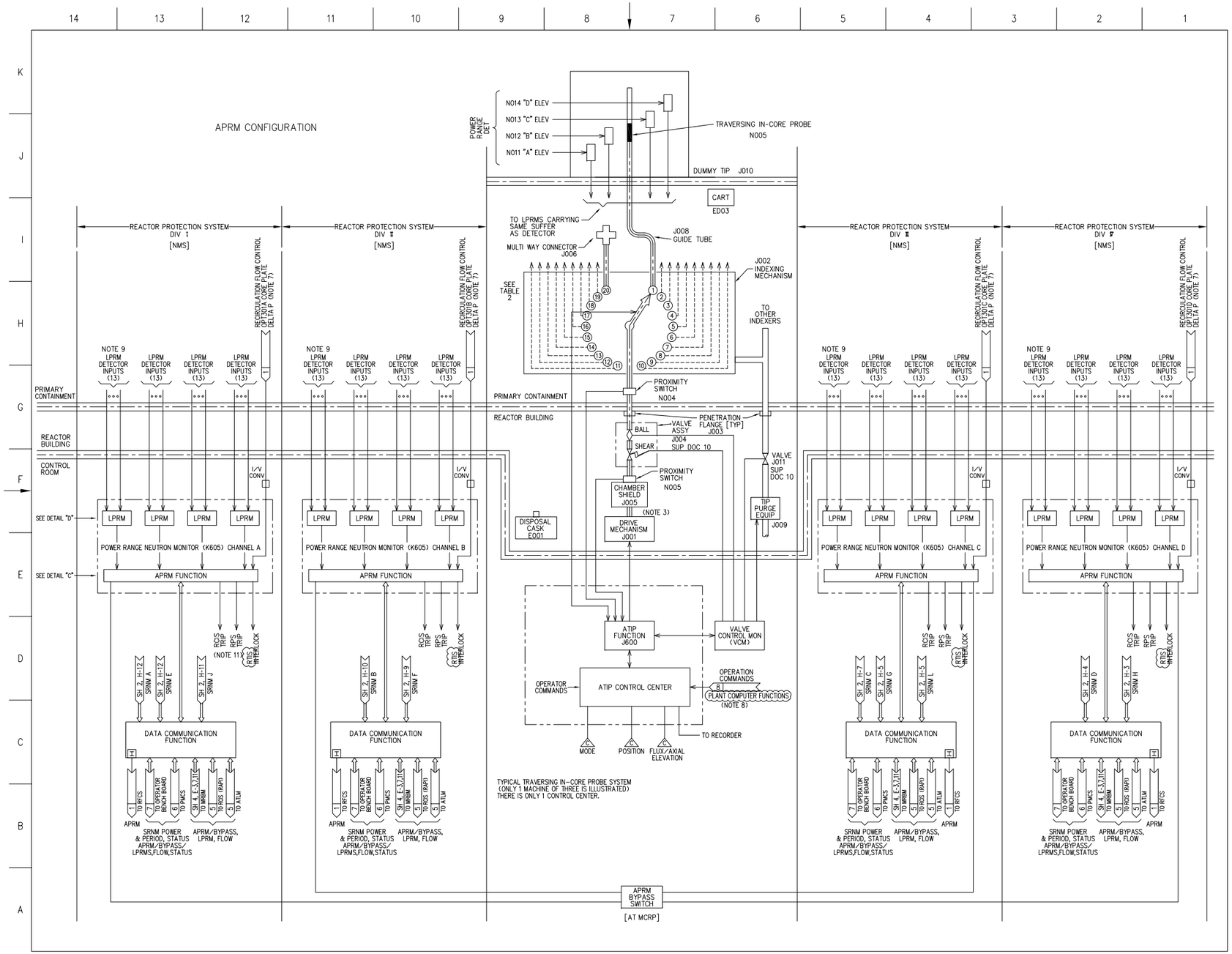


Figure 7.6-1 – Neutron Monitoring System IED (Sheet 3 of 4)

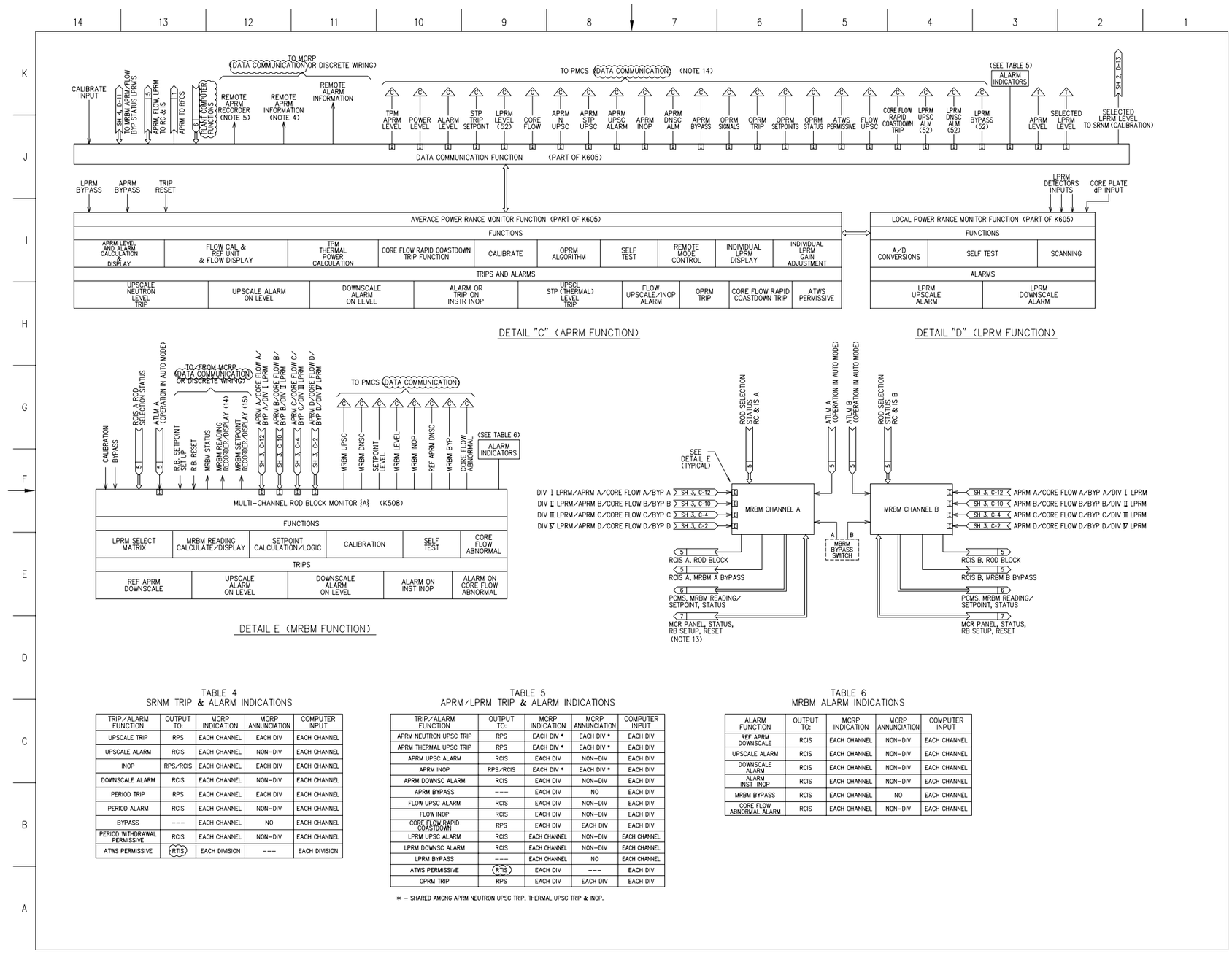


TABLE 4
SRNM TRIP & ALARM INDICATIONS

TRIP/ALARM FUNCTION	OUTPUT TO:	MCRP INDICATION	MCRP ANNUNCIATION	COMPUTER INPUT
UPSCALE TRIP	RPS	EACH CHANNEL	EACH DIV	EACH CHANNEL
UPSCALE ALARM	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
INOP	RPS/RCIS	EACH CHANNEL	EACH DIV	EACH CHANNEL
DOWNSCALE ALARM	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
PERIOD TRIP	RPS	EACH CHANNEL	EACH DIV	EACH CHANNEL
PERIOD ALARM	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
BYPASS	---	EACH CHANNEL	NO	EACH CHANNEL
PERIOD WITHDRAWAL PERMISSIVE	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
ATWS PERMISSIVE	(RTIS)	EACH DIVISION	---	EACH DIVISION

TABLE 5
APRM/LPRM TRIP & ALARM INDICATIONS

TRIP/ALARM FUNCTION	OUTPUT TO:	MCRP INDICATION	MCRP ANNUNCIATION	COMPUTER INPUT
APRM NEUTRON UPSC TRIP	RPS	EACH DIV *	EACH DIV *	EACH DIV
APRM THERMAL UPSC TRIP	RPS	EACH DIV *	EACH DIV *	EACH DIV
APRM UPSC ALARM	RCIS	EACH DIV	NON-DIV	EACH DIV
APRM INOP	RPS/RCIS	EACH DIV *	EACH DIV *	EACH DIV
APRM DOWNSC ALARM	RCIS	EACH DIV	NON-DIV	EACH DIV
APRM BYPASS	---	EACH DIV	NO	EACH DIV
FLOW UPSC ALARM	RCIS	EACH DIV	NON-DIV	EACH DIV
FLOW INOP	RCIS	EACH DIV	NON-DIV	EACH DIV
CORE FLOW RAPID COASTDOWN	RPS	EACH DIV	EACH DIV	EACH DIV
LPRM UPSC ALARM	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
LPRM DOWNSC ALARM	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
LPRM BYPASS	---	EACH CHANNEL	NO	EACH CHANNEL
ATWS PERMISSIVE	(RTIS)	EACH DIV	---	EACH DIV
OPRM TRIP	RPS	EACH DIV	EACH DIV	EACH DIV

* - SHARED AMONG APRM NEUTRON UPSC TRIP, THERMAL UPSC TRIP & INOP.

TABLE 6
MRBM ALARM INDICATIONS

ALARM FUNCTION	OUTPUT TO:	MCRP INDICATION	MCRP ANNUNCIATION	COMPUTER INPUT
REF APRM DOWNSCALE	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
UPSCALE ALARM	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
DOWNSCALE ALARM	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
ALARM INST INOP	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL
MRBM BYPASS	RCIS	EACH CHANNEL	NO	EACH CHANNEL
CORE FLOW ABNORMAL ALARM	RCIS	EACH CHANNEL	NON-DIV	EACH CHANNEL

Figure 7.6-1 – Neutron Monitoring System IED (Sheet 4 of 4)

7 6 5 4 3 2 1

NOTES:

1. THIS IBD PRESENTS THE BASIC FUNCTIONAL REQUIREMENTS OF THE NEUTRON MONITORING SYSTEM (NMS) OF THE APPLIED PROJECT. IT CONTAINS THE SUBSYSTEMS OF SRNM, APRM & LPRM, ATIP AND MRBM. IT DOES NOT NECESSARILY REFLECT THE ACTUAL PHYSICAL LOCATIONS OF LOGICS TO BE IMPLEMENTED TO THE HARDWARE OR SOFTWARE LEVEL. (FOR INSTANCE, THE LOCATION OF THE SRNM OR APRM CHANNEL BYPASS FUNCTION MAY BE AT DIFFERENT LOCATION OR MORE THAN ONE LOCATION AS SHOWN IN THIS IBD).
2. FAIL SAFE LOGIC: ALL OUTPUT CONNECTIONS FROM LOGIC UNITS EXCEPT ATIP AND MRBM IBD ARE DEFINED AS LOGIC "1" DURING NORMAL REACTOR OPERATION. THEY CHANGE TO LOGIC "0" UPON A TRIP CONDITION. ANY "LOSS OF SIGNAL" CONDITION WILL ALSO CAUSE THE STATE TO BE CHANGED TO "0".
3. ONE RESET SWITCH SHALL BE USED FOR EACH CHANNEL ON THE MCR BACK PANEL.
4. THE PRESENCE OF AN OPERATOR INPUT, SUCH AS RESET, BYPASS, AUTO CALIBRATION, ETC., IMPLIES LOGIC "1".
5. TIME CONSTANT REFERS TO THE FILTER TIME CONSTANT WHERE THE FILTERED SIGNAL IS LAGGED BEHIND THE ORIGINAL SIGNAL BY THIS TIME CONSTANT AFTER SIGNIFICANT TIME ELAPSE. THIS IS SHOWN IN THE LEGEND SECTION.
6. R - S FLIP FLOPS ARE SET AND RESET BY POSITIVE LOGIC.

TRUTH TABLE

R	S	OUTPUT
0	0	PREVIOUS STATE
0	1	1
1	0	0
1	1	0

7. FAIL SAFE LOGIC: EXCEPT ATIP AND MRBM IBD. THE OUTPUT OF THE COMPARATOR(S) IS DEFINED AS ZERO WHEN A TRIP OCCURS (FAIL SAFE LOGIC), I.E. WHEN THE COMPARISON EQUATION IS TRUE. OTHERWISE IT IS "1" DURING NORMAL CONDITION. HOWEVER, ALARMS, ANNUNCIATORS ARE ACTIVATED WITH LOGIC "1".
8. THE FAULT CONDITION RESULTED FROM A CHANNEL SELF-TEST IS LOGIC "0", SO IS THE CONDITION OF AN INSTRUMENT INOPERATIVE TRIP. THE SCOPE OF "CRITICAL SELF TEST" ITEMS IS TO BE REFERENCED IN NMS HARDWARE & SOFTWARE SYSTEM SPEC, C51-4010.
9. SETPOINTS FOR NMS LOGICS (NOMINAL) (I.E., SP 1 TO SP 22. MRBM AND SRNM PERIOD TRIP SETPOINTS) ARE INCLUDED IN AND SHALL BE GOVERNED BY THE NMS SYSTEM DESIGN SPEC, C51-4010.
10. CORE FLOW CONVERSION, FLOW REFERENCE LOGIC AND CORE FLOW RAPID COASTDOWN TRIP ALGORITHMS, MRBM CORE FLOW COMPARISON ALGORITHM AND OPRM TRIP ALGORITHM ARE DEFINED IN THE NMS HARDWARE AND SOFTWARE SYSTEM SPEC, C51-4010. ALSO THE TIME DELAY IN ATIP AUTO PARK LOGIC IS REFERENCED IN THIS DOCUMENT.
11. FOR ATIP IBD, IN DRIVE MECHANISM LOGIC,
    X = 1 INDICATES "MOVE" , X = 0 INDICATES "STOP".
    Y = 1 INDICATES "FORWARD" , Y = 0 INDICATES "REVERSE"
    Z = 1 INDICATES "FAST" , Z = 0 INDICATES "SLOW"
12. FOR ATIP IBD, THE DESCRIPTION OF AUTO MECHANISM IS PROVIDED.
13. STATUS INDICATORS CAN BE APPLIED BY ELECTRO LUMINESCENT TYPE OR CATHODE RAY TUBE DISPLAY, ETC., WHICH ARE INSTALLED ON THE UNITS. THE NOTE "LOCAL" REFERS TO CONTROL ROOM BACK BACK, THE NOTE "MCRP" REFERS TO MAIN CONTROL ROOM OPERATOR MAIN PANELS.
14. INDICATIONS IN MAIN CONTROL ROOM PANEL (MCRP) CAN BE PROVIDED USING THE NMS SIGNALS VIA THE PEREORMANCE MONITORING AND CONTROL SYSTEM (PMCS) OF THE PLANT COMPUTER FUNCTIONS OR DIRECTLY FROM THE NMS.
15. SRNM PERIOD WITHDRAWAL PERMISSIVE SIGNALS TO APRS ARE FOR INTERRUPT OF AUTOMATED CONTROL ROD WITHDRAWAL DURING AUTOMATED OPERATION.
16. THE OR GATE IS LOCATED IN THE MCRP SYSTEM.

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

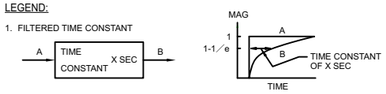
	MPL NO.
1. AUTOMATIC POWER REGULATOR SYS. IBD	C82-1030
2. ROD CONTROL & INFORMATION SYS. IBD	C11-1030
3. REACTOR PROTECTION SYSTEM. IBD	C71-1030
4. RECIRCULATION FLOW CONTROL SYS. IED	C81-1040
5. ROD CONTROL & INFORMATION SYS. IED	C11-1040
6. NEUTRON MONITORING SYSTEM. IED	C51-1040
7. LEAK DETECTION AND ISOLATION SYS. IBD	E31-1030
8. SAFETY SYSTEM LOGIC & CONTROL SYSTEM IBD	C74-1030

SUPPORTING DOCUMENTS

	MPL NO.
1. INTERLOCK BLOCK DIAGRAM (IBD) STANDARDS	A10-1030

LEGEND:

1. FILTERED TIME CONSTANT



ABBREVIATIONS

NMS-NEUTRON MONITORING SYSTEM
RPS-REACTOR PROTECTION SYSTEM
SRNM-STARTUP RANGE NEUTRON MONITOR
LPRM-LOCAL POWER RANGE MONITOR
APRM-AVERAGE POWER RANGE MONITOR
ATIP-AUTOMATED TRAVERSING IN-CORE PROBE
MRBM-MULTI CHANNEL ROD BLOCK MONITOR
RC&IS-ROD CONTROL & INFORMATION SYSTEM
MCRP-MAIN CONTROL ROOM PANEL
PMCS-PERFORMANCE MONITORING CONTROL SYSTEM
ATCF-AUTOMATED TIP CONTROL FUNCTION
OPRM - OSCILLATION POWER RANGE MONITOR
ATWS - ANTICIPATED TRANSIENT WITHOUT SCRAM
UPSC-UPSCALE
INOP-INOPERABLE
DNSC-DOWNSCALE

MPL NO. C51-1030

Figure 7.6-2 – Neutron Monitoring System IBD (Sheet 1 of 28)

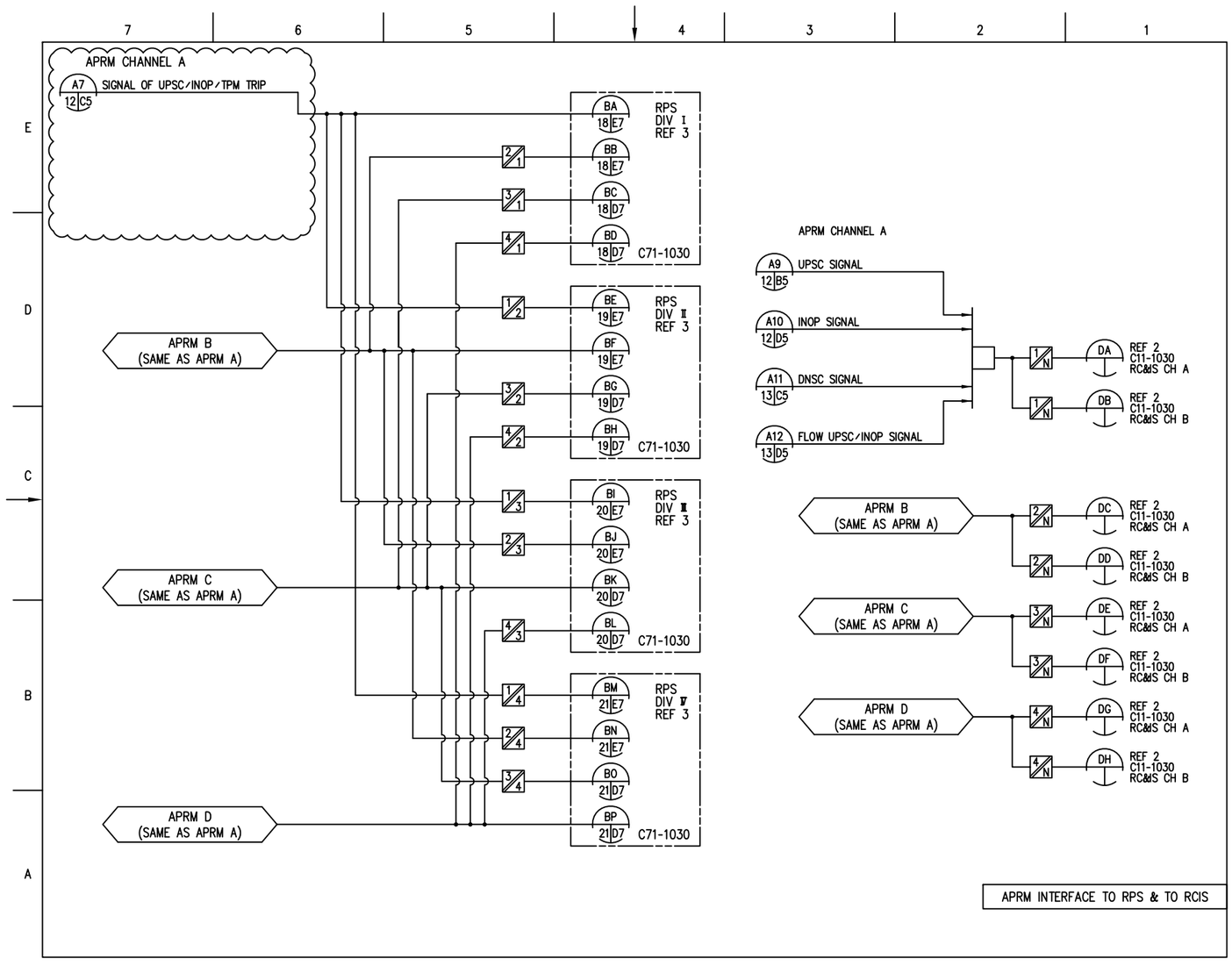


Figure 7.6-2 – Neutron Monitoring System IBD (Sheet 9 of 28)

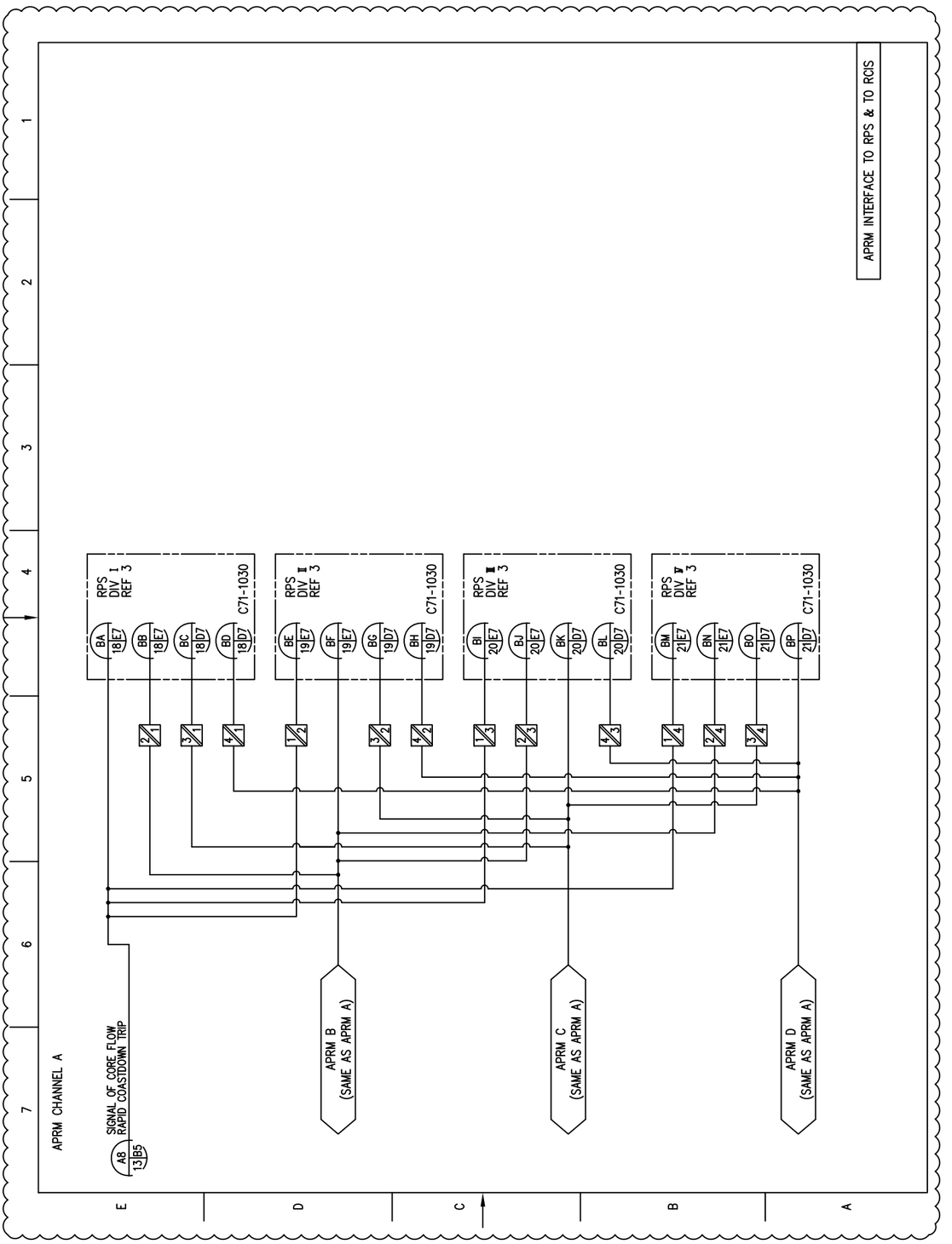


Figure 7.6-2 – Neutron Monitoring System IBD (Sheet 9a of 28)

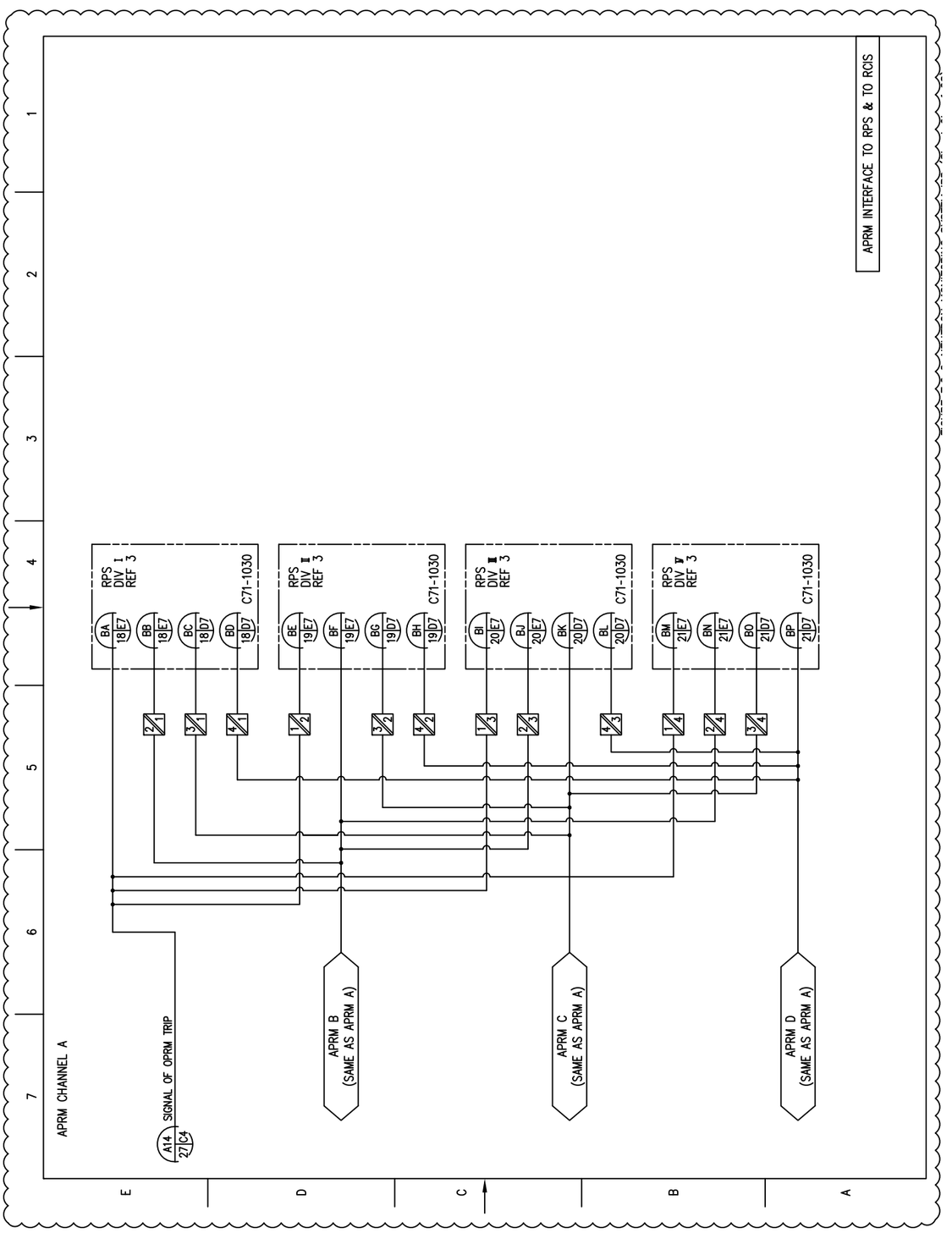


Figure 7.6-2 – Neutron Monitoring System IBD (Sheet 9b of 28)

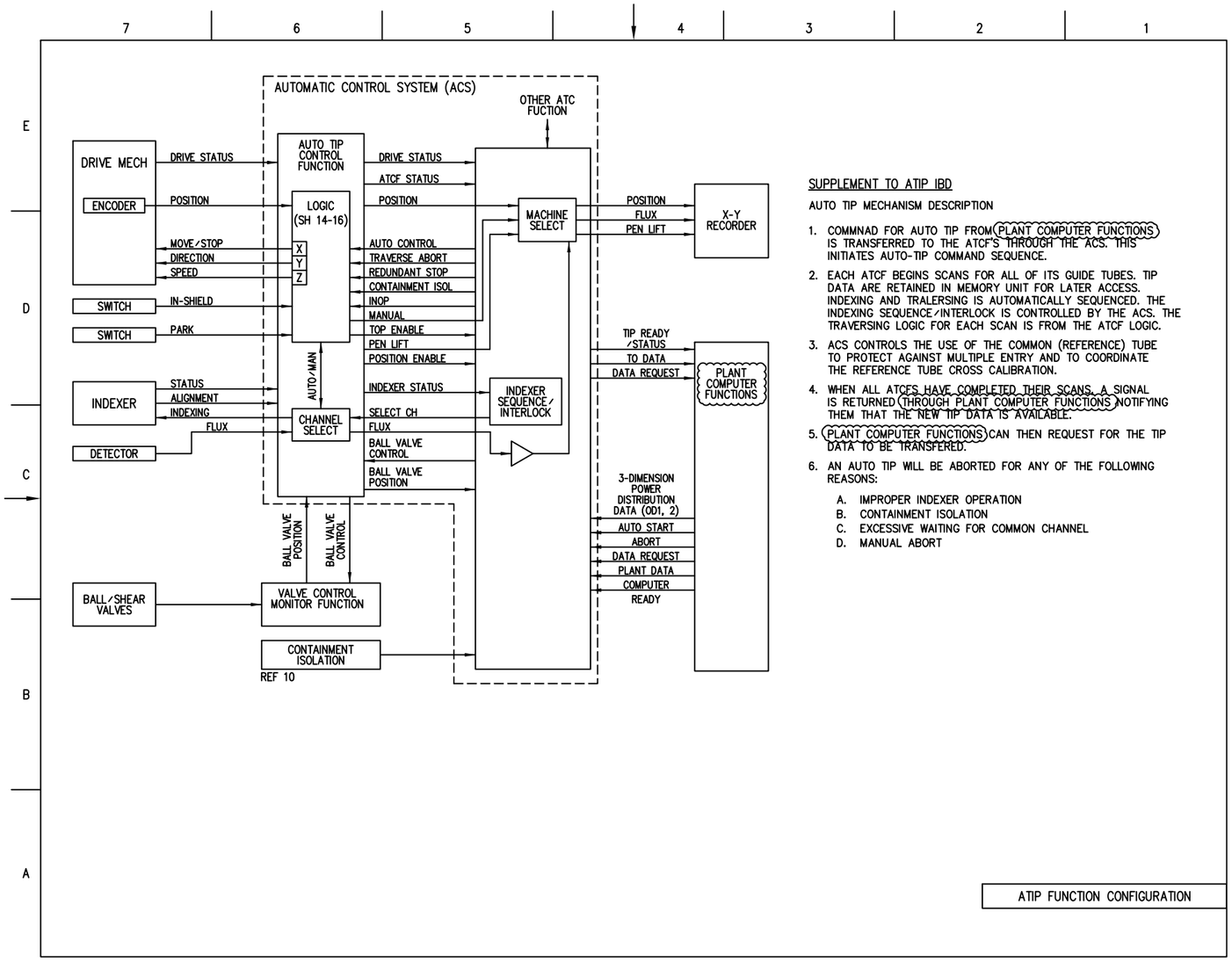


Figure 7.6-2 – Neutron Monitoring System IBD (Sheet 14 of 28)

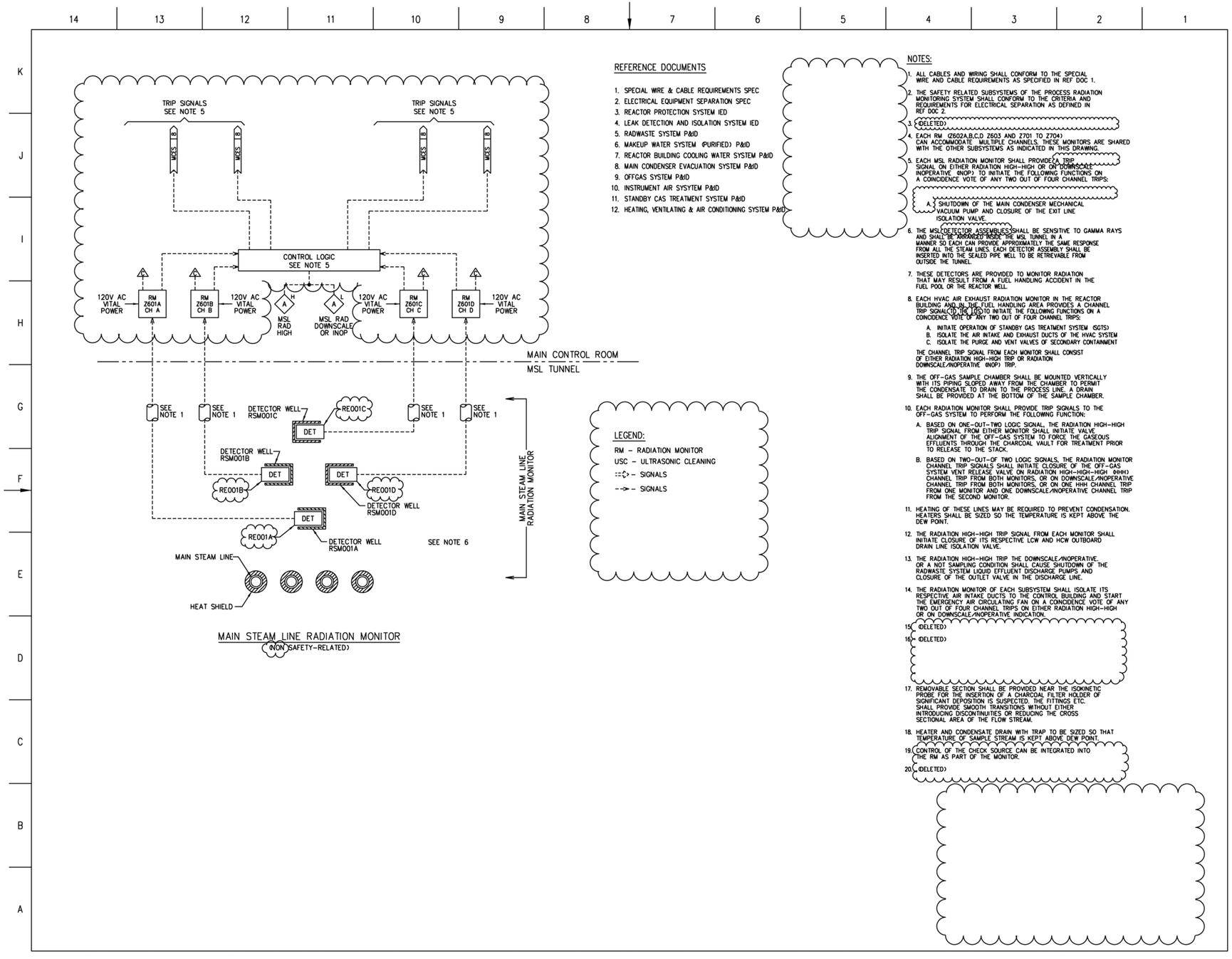


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 1 of 11)

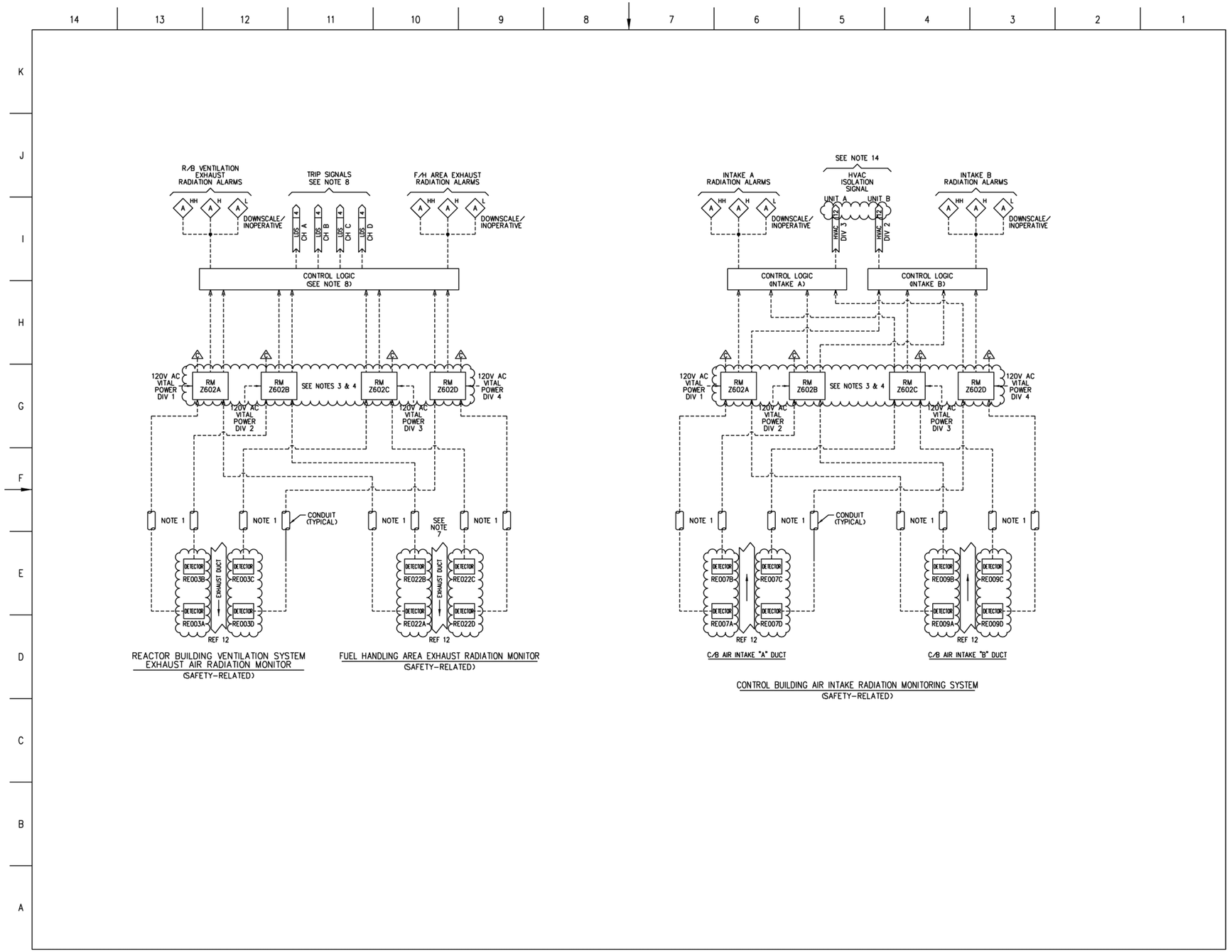


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 2 of 11)

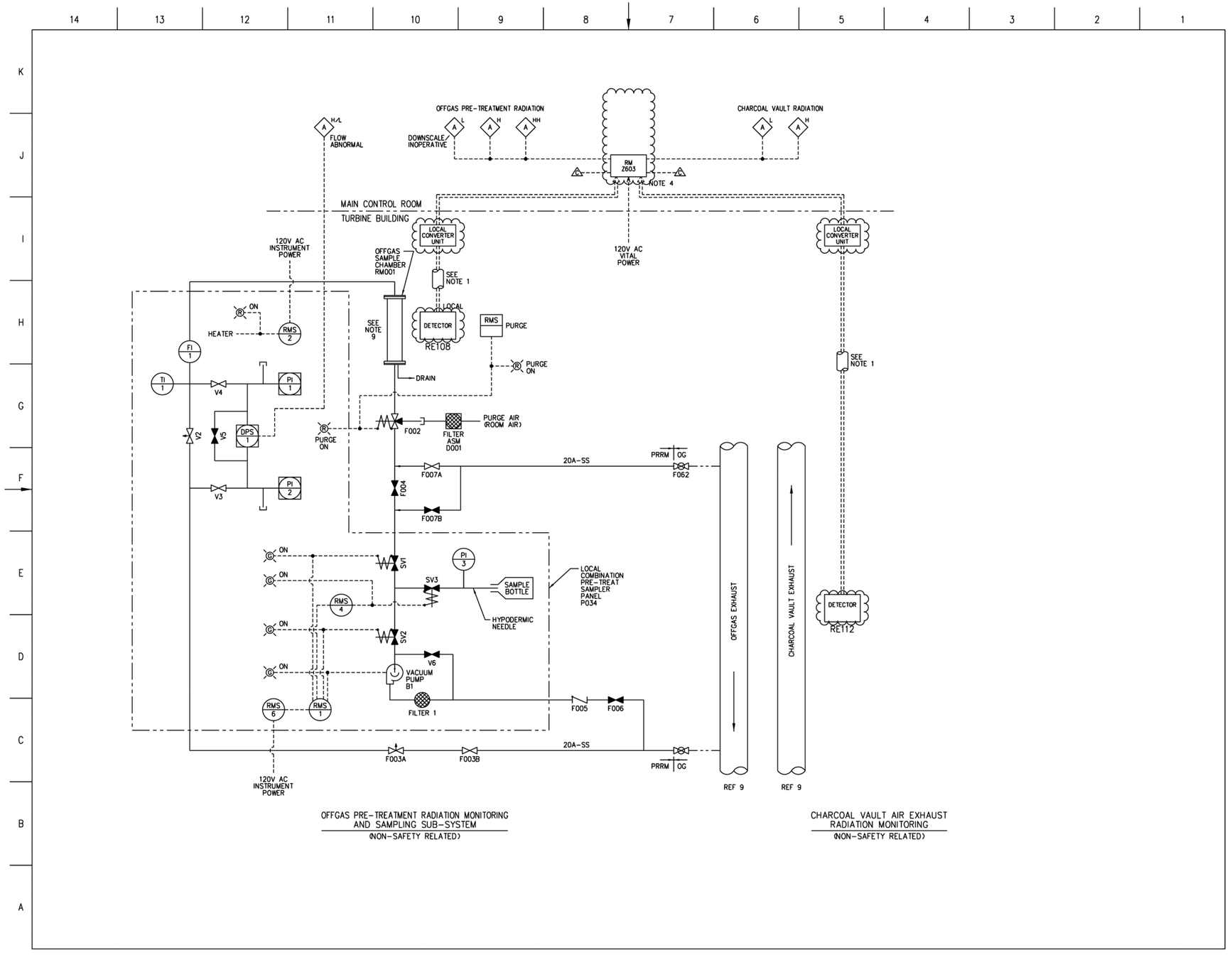


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 3 of 11)

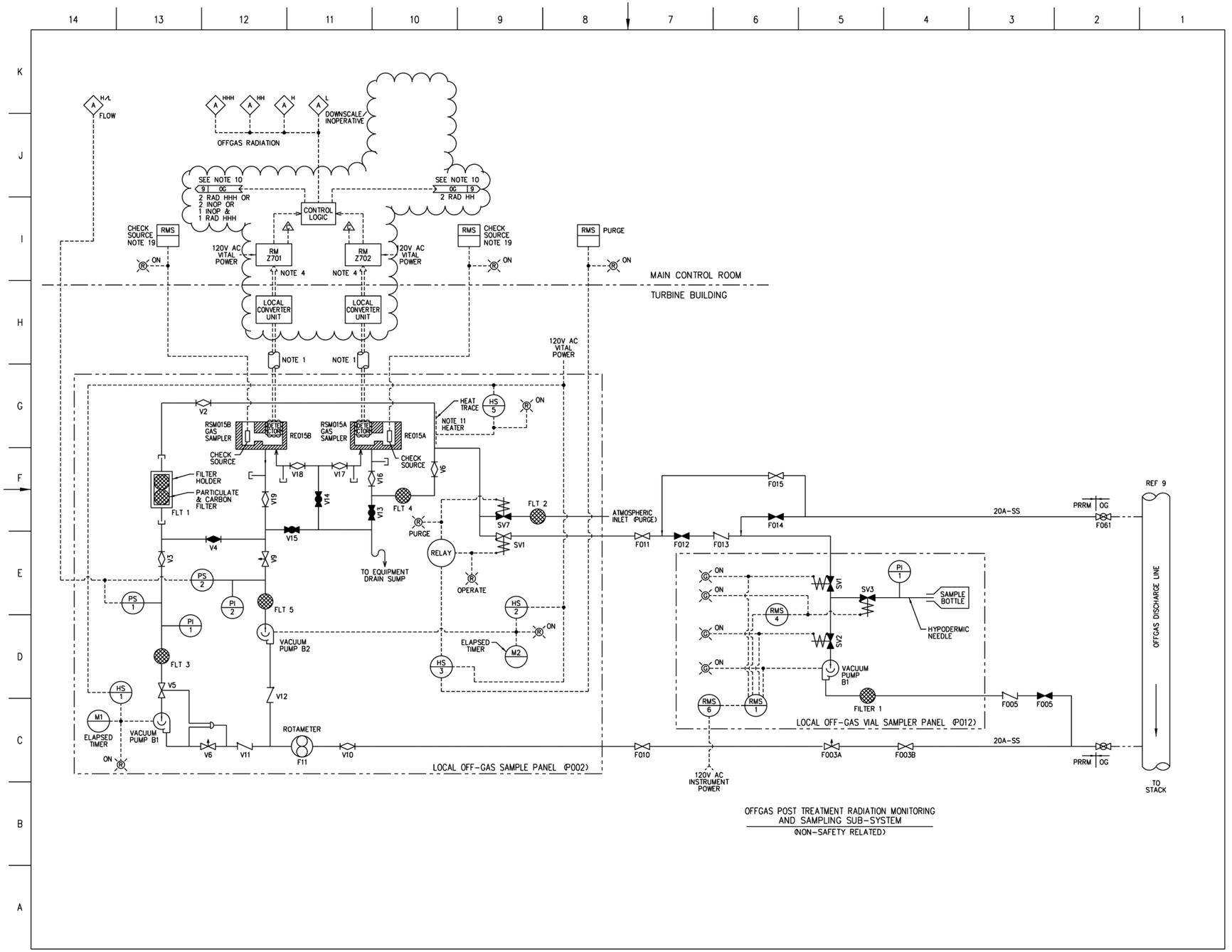


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 4 of 11)

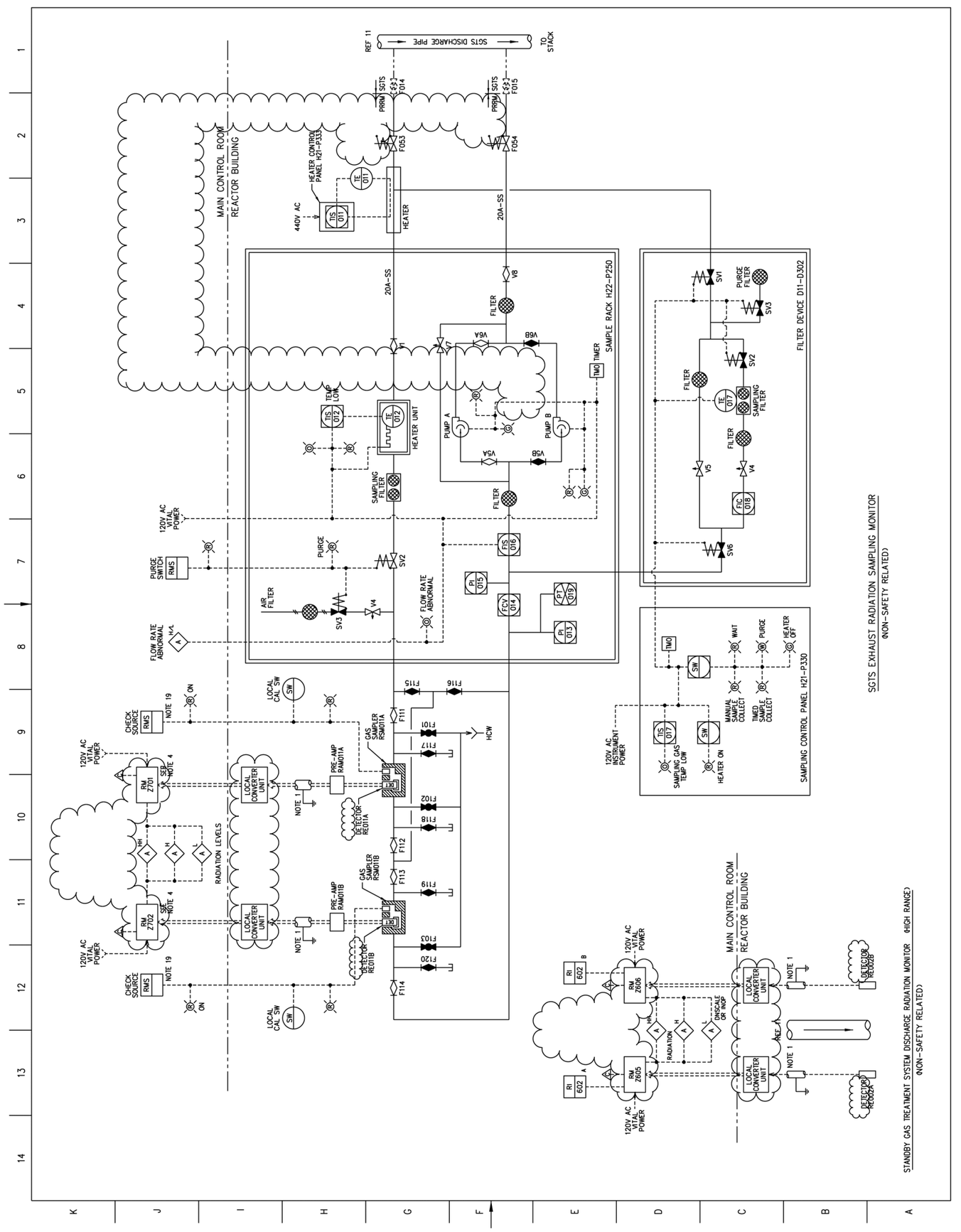


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 5 of 11)

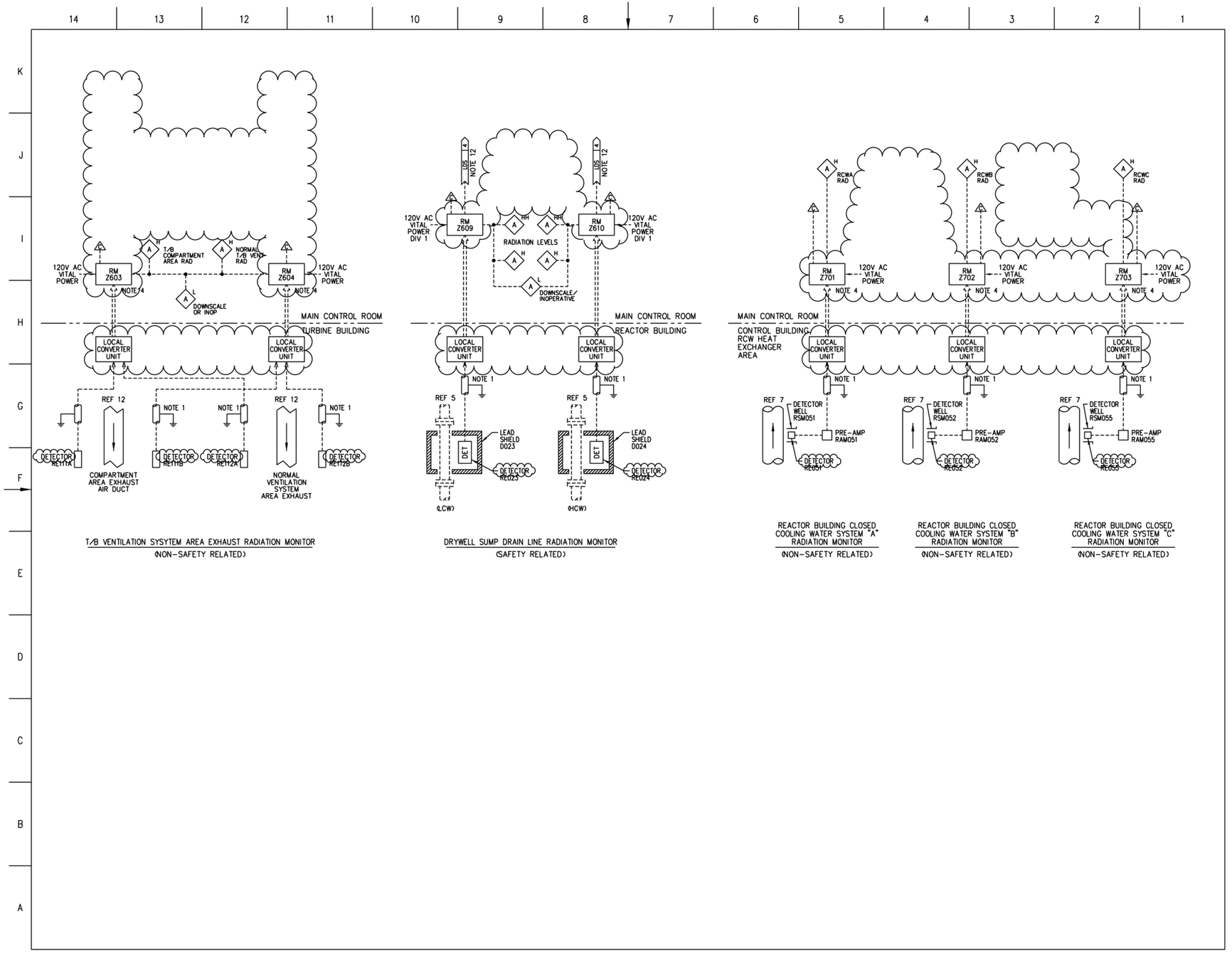


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 6 of 11)

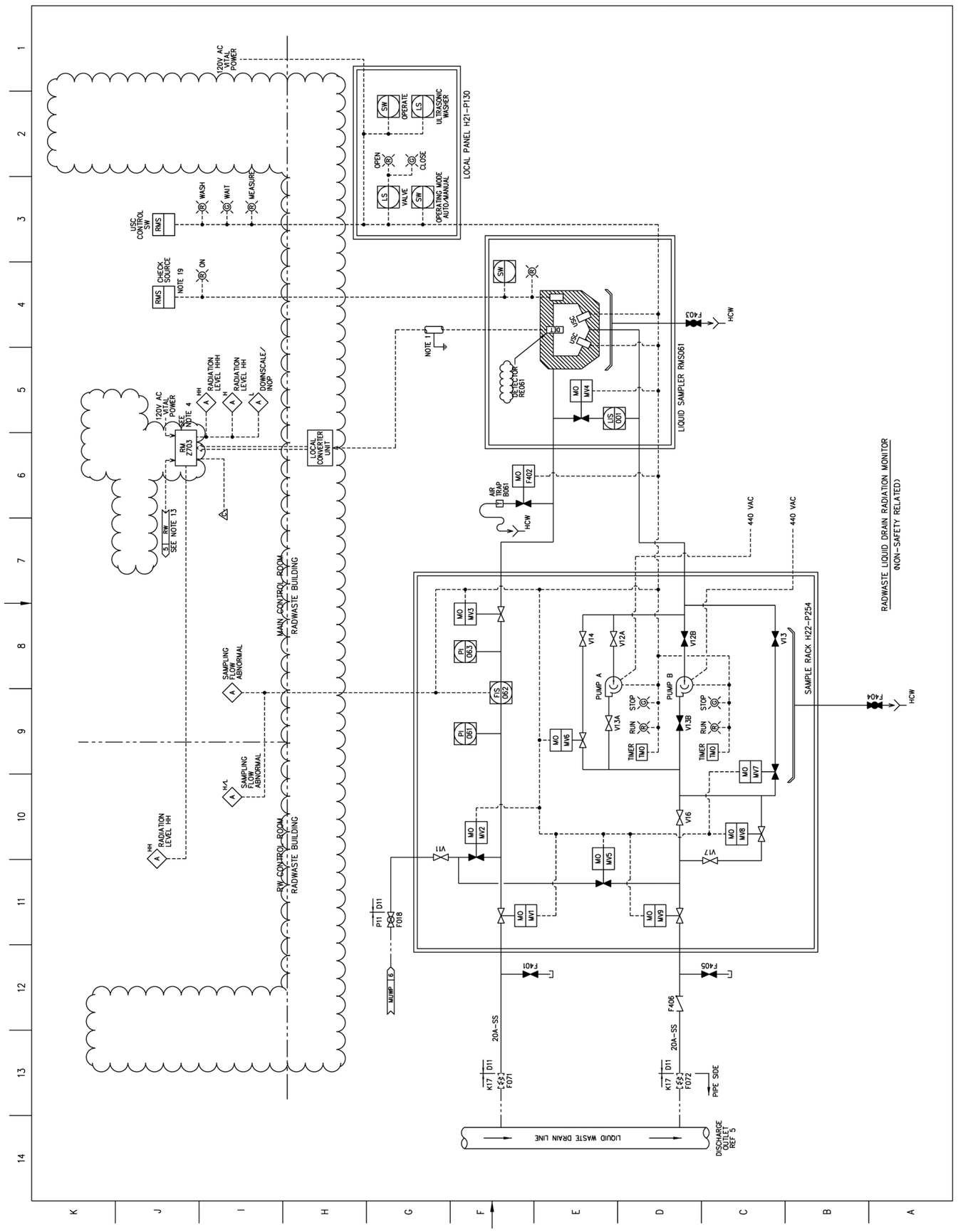


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 7 of 11)

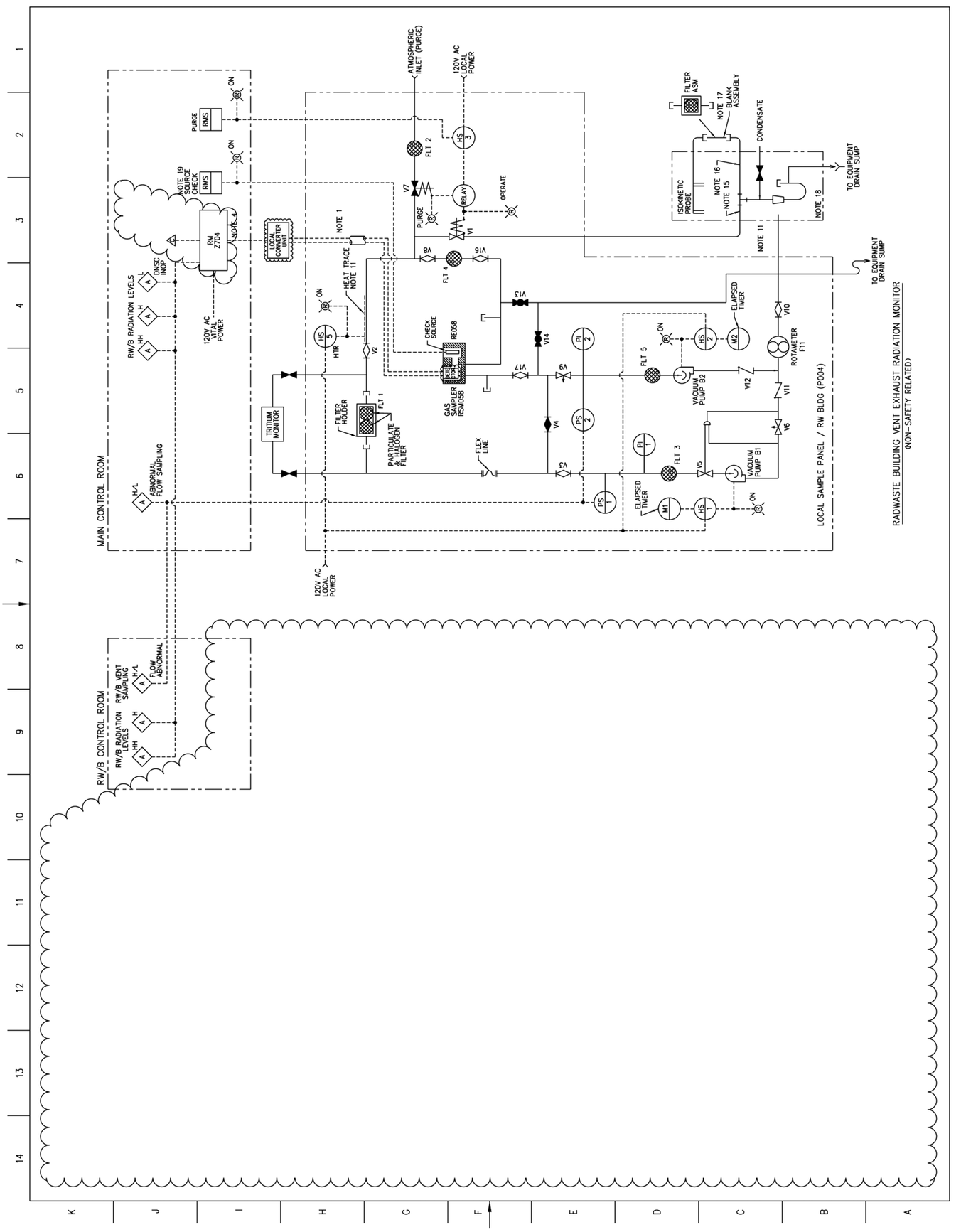


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 8 of 11)

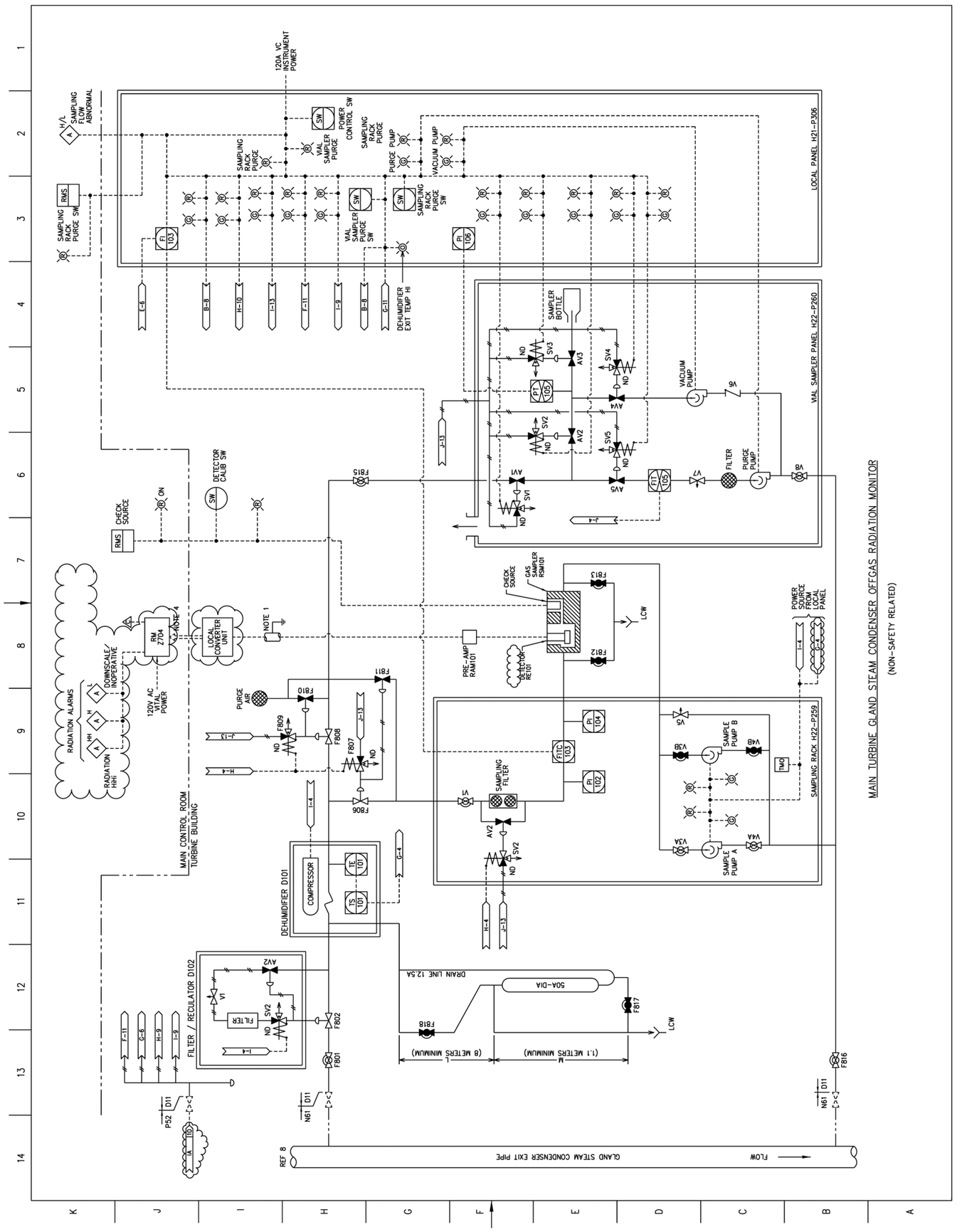


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 9 of 11)

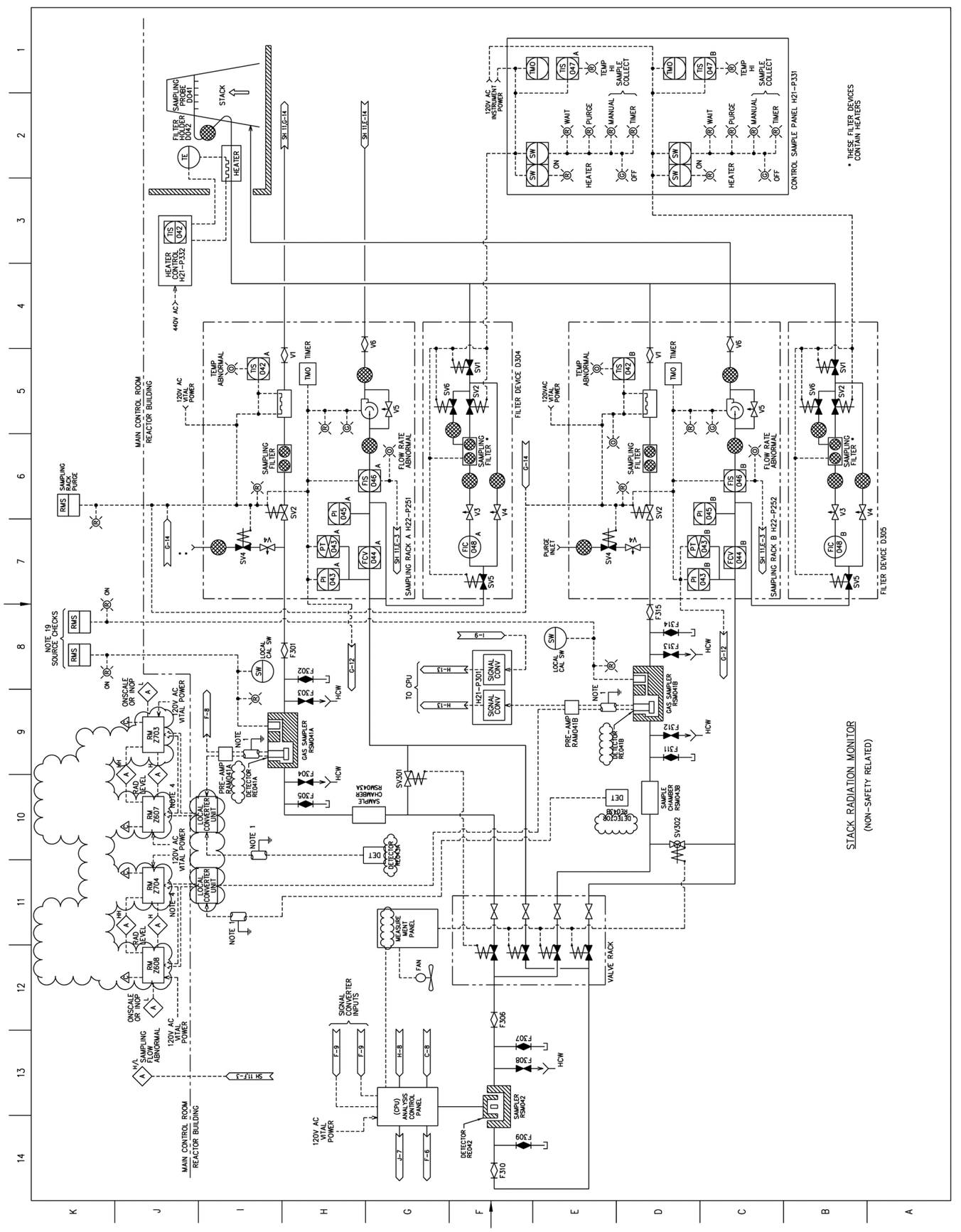


Figure 7.6-5 – Process Radiation Monitoring System IED (Sheet 10 of 11)