Average Power Range Monitoring System (APRM)

304B Chapter 5.4

Objectives

1. Identify the purposes of the APRM system.
2. Recognize the purpose, function and operation of major system components:
   a) LPRM inputs
   b) count circuit
   c) averaging circuit
   d) slope and bias circuit
   e) trip units

Objectives (continued)

3. List the protective trips (scrams and rod blocks) generated by this system, the action caused by the trips, when the trips are bypassed and the reason for the trips.
4. Identify the assignment of LPRM detectors to the APRMs
5. Explain the system's interfaces with:
   a. Reactor Manual Control System
   b. Recirculation System
   c. Local Power Range Monitoring System
   d. Reactor Protection System
   e. Rod Block Monitoring System

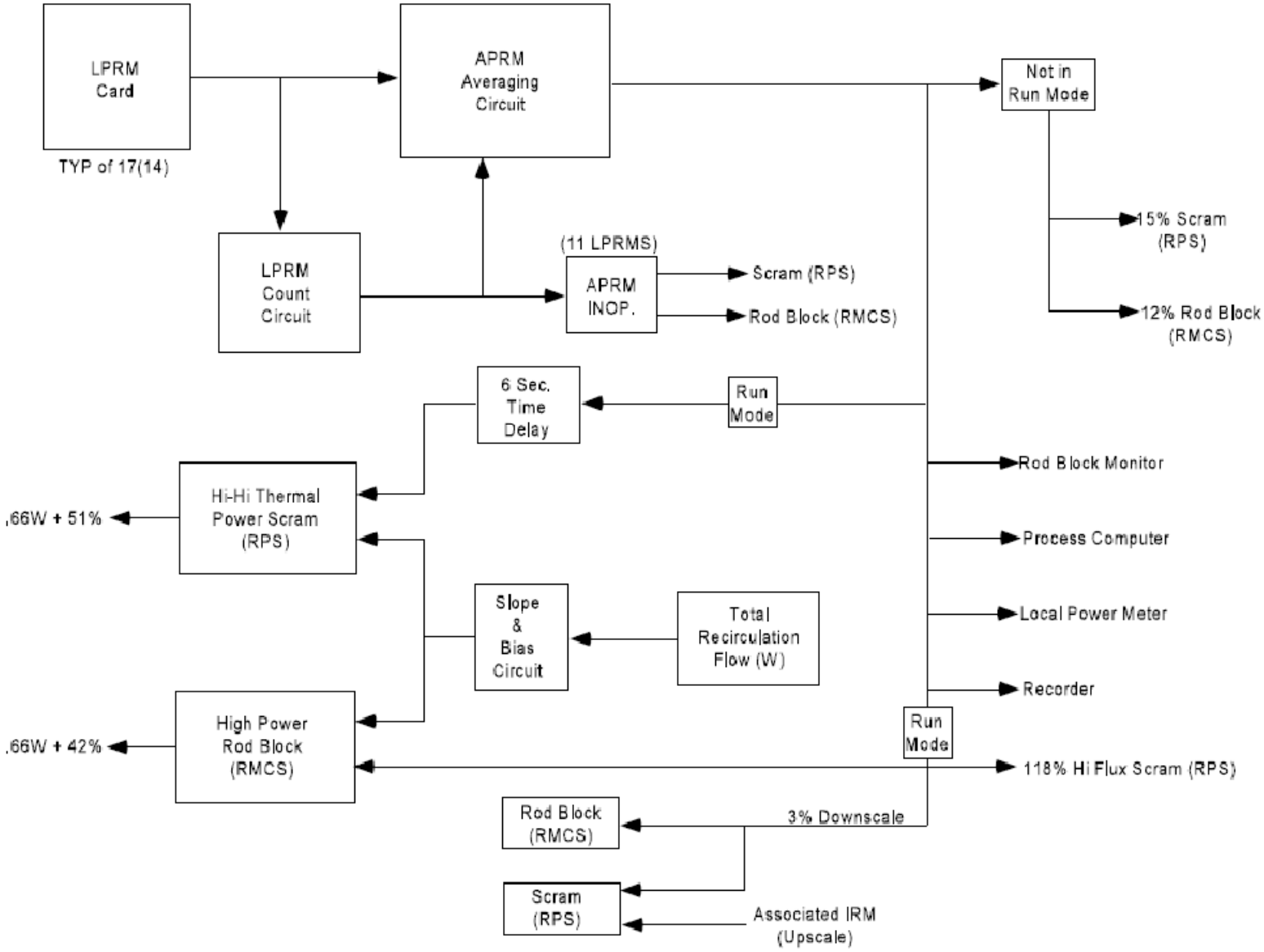
Purposes

The APRM system has two purposes:

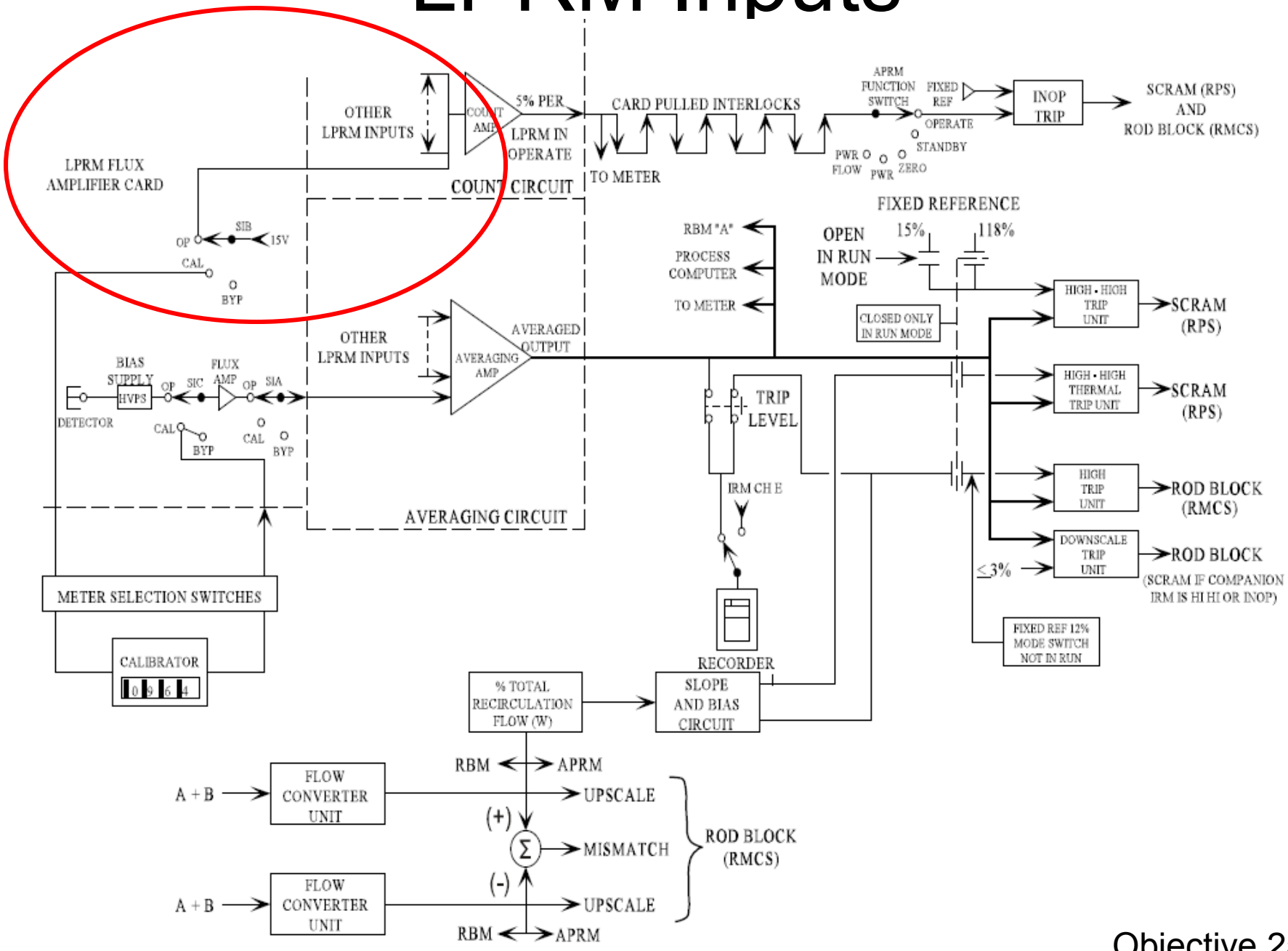
- Monitor the core thermal power level

- Provide reactor scram and control rod block signals to preserve fuel cladding integrity

Overview

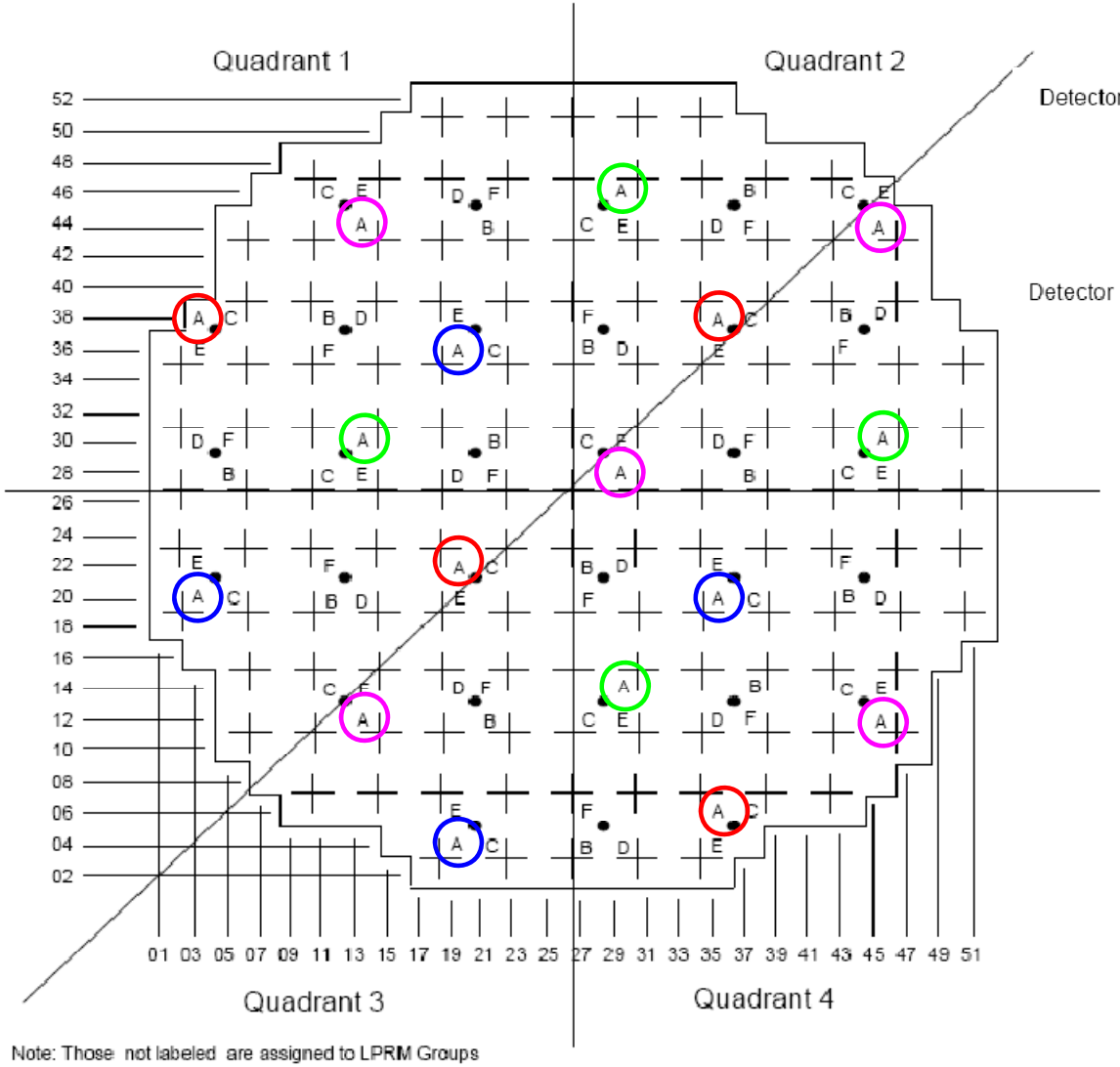

LPRM Card
TYP of 17(14)
APRM Averaging Circuit
Not in Run Mode
15% Scram (RPS)
12% Rod Block (RMCS)
LPRM Count Circuit
(11 LPRMS)
APRM INOP.
Scram (RPS)
Rod Block (RMCS)
6 Sec. Time Delay
Run Mode
Rod Block Monitor
Hi-Hi Thermal Power Scram (RPS)
,66W + 51%
Process Computer
Slope & Bias Circuit
Total Recirculation Flow (W)
Local Power Meter
Recorder
High Power Rod Block (RMCS)
,66W + 42%
Run Mode
118% Hi Flux Scram (RPS)
Rod Block (RMCS)
3% Downscale
Scram (RPS)
Associated IRM (Upscale)

LPRM Inputs

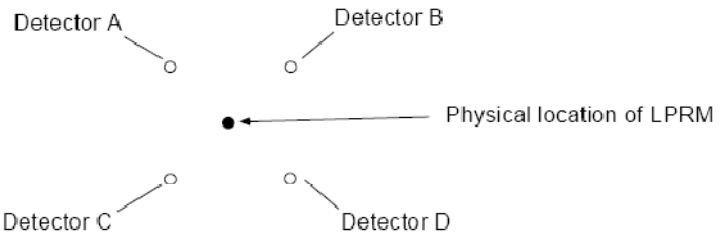


Objective 2a

LPRM Assignments



Note: Those not labeled are assigned to LPRM Groups

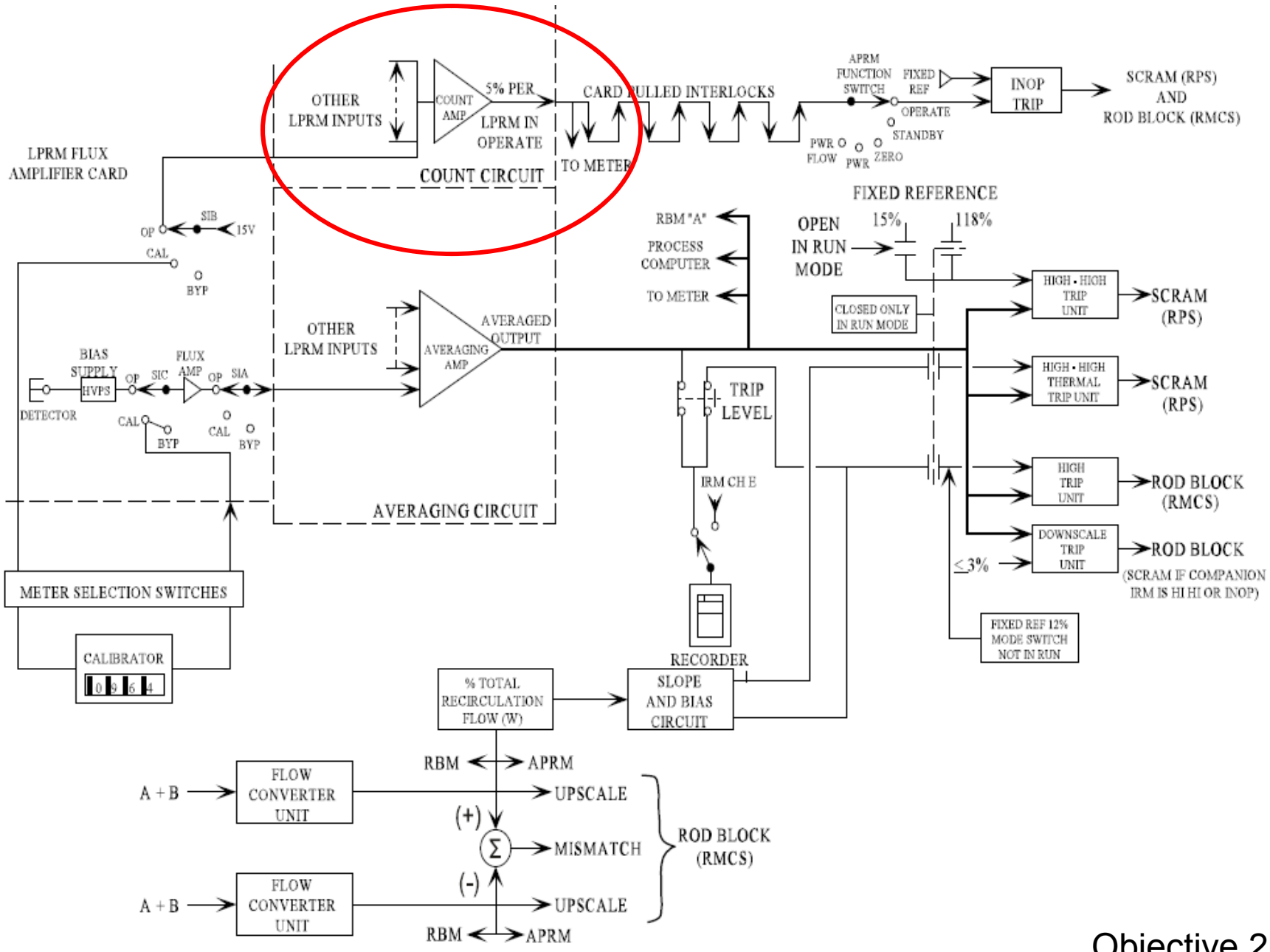


APRM Channel A:

- LPRM Detector Level D
- LPRM Detector Level C
- LPRM Detector Level B
- LPRM Detector Level A

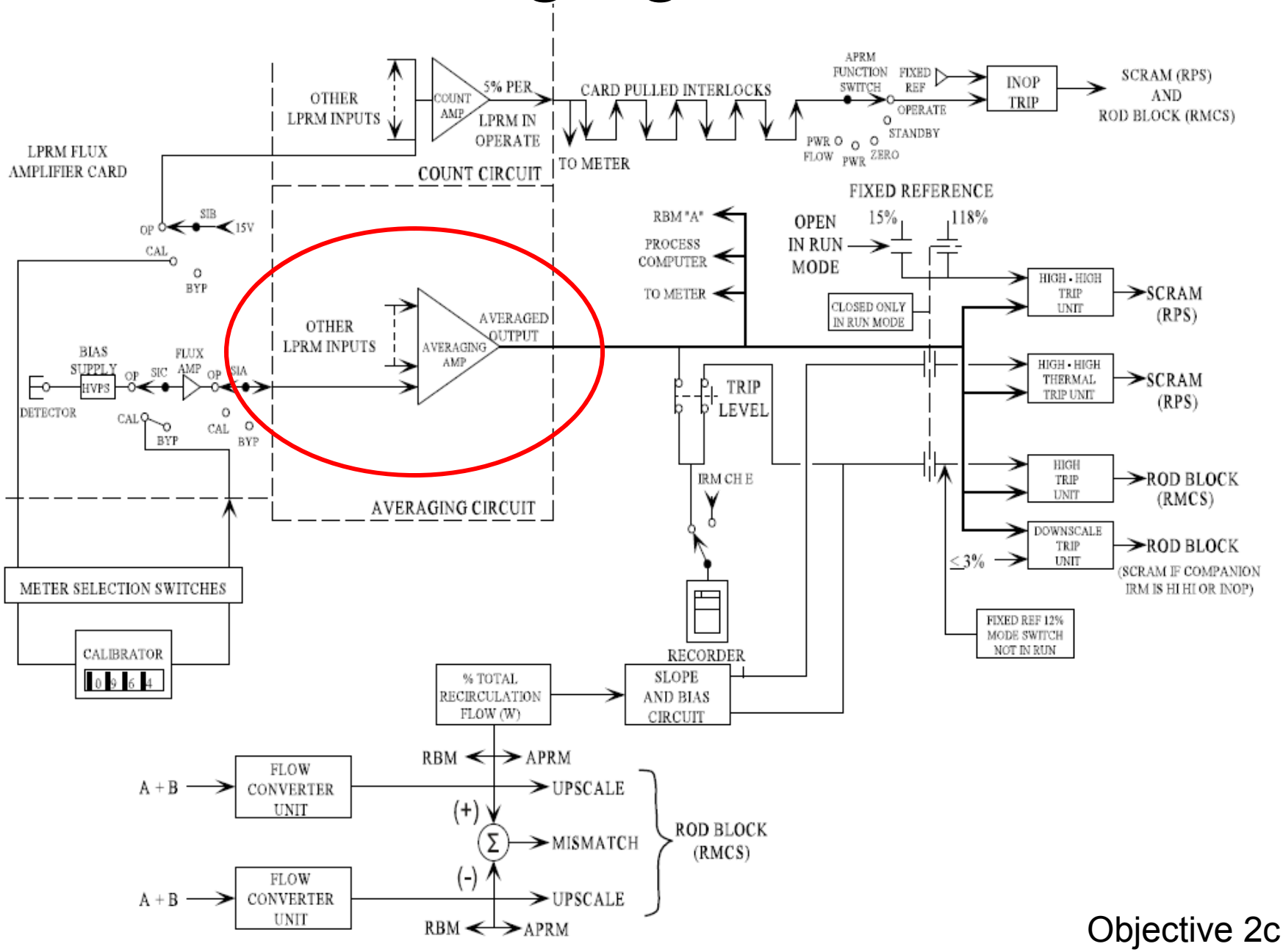
Objective 4

Count Circuit



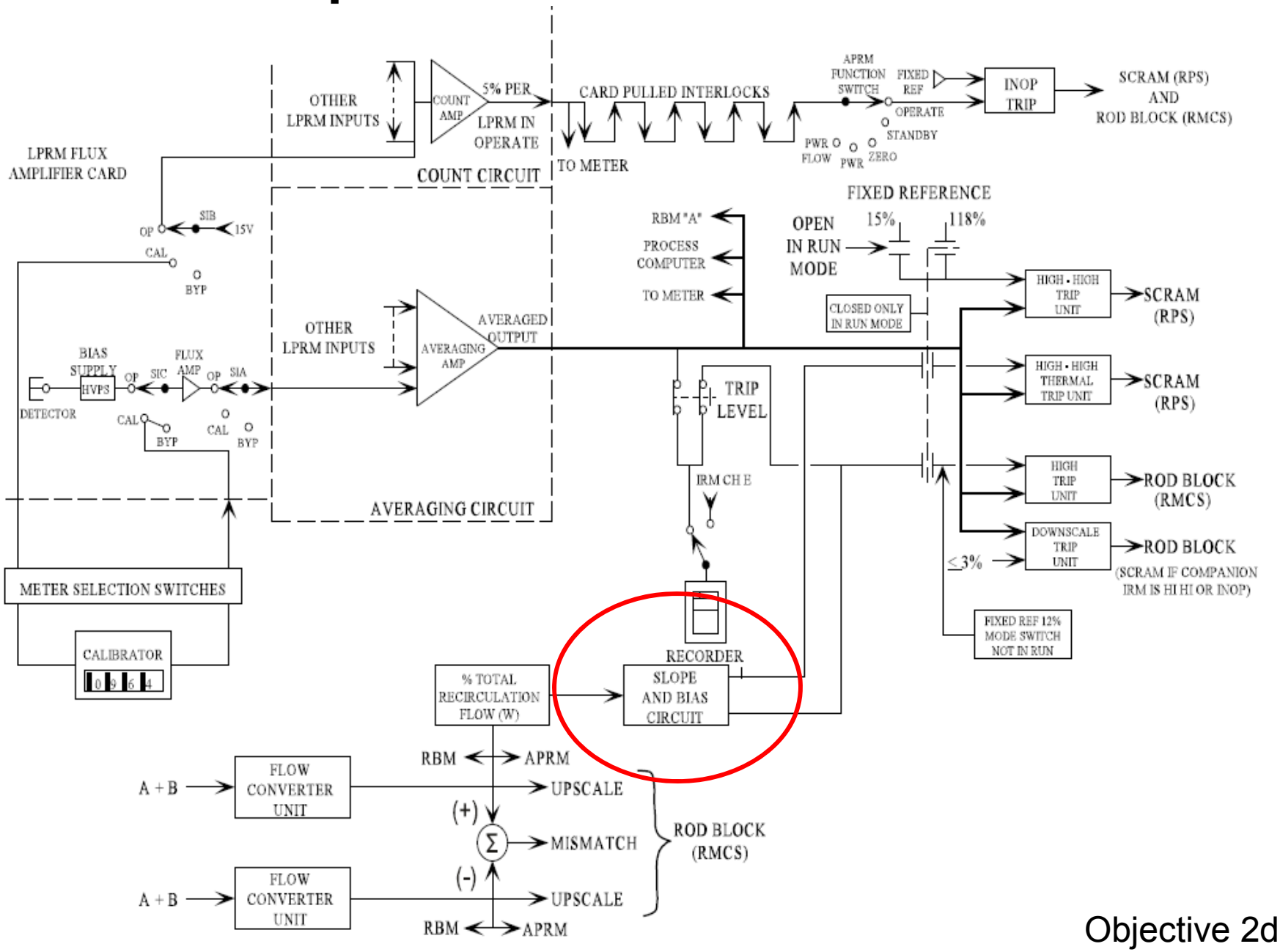
Objective 2b

Averaging Circuit



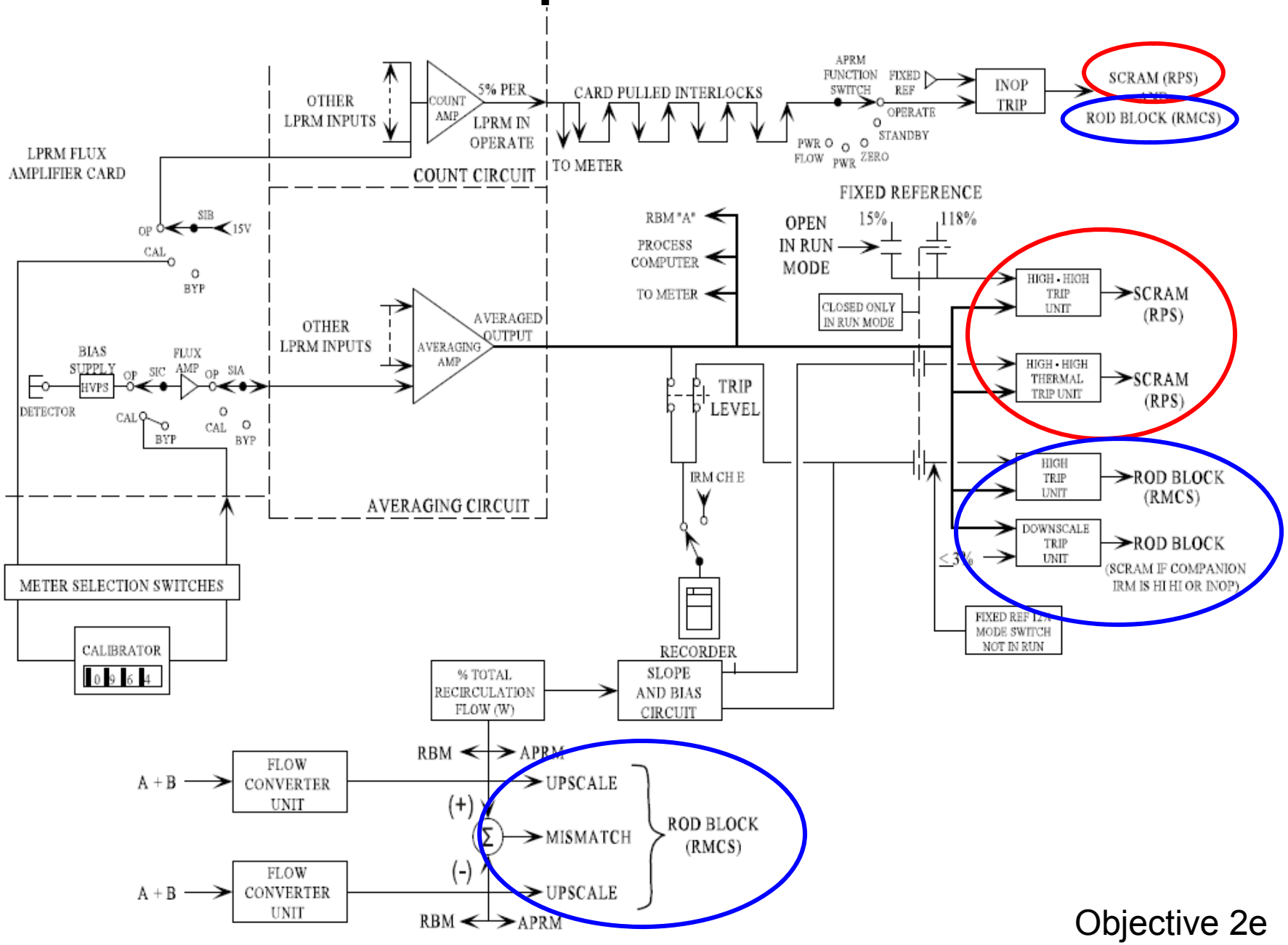
Objective 2c

Slope and Bias Circuit



Objective 2d

Trip Units



Objective 2e

Protective Trips

ALARM OR TRIP(1)	SETPOINT	APRM CHASSIS INDICATION	Panel 603 INDICATION	ANNUN-CIATOR	ACTION	AUTO BYPASS
APRM UPSCALE Neutron Trip	≤118% --- ≤15%	Neutron UPSCL (Red) (A-F)	UPSC Trip (A-F)	APRM UPSC or INOP	Scram	Mode switch not in RUN --- Mode switch In RUN
APRM UPSCALE Thermal Power Trip	≤.66w+51% (113.5% max)	Thermal UPSCL (Red)(A-F)	UPSC Trip or INOP (A-F)	APRM UPSC or INOP	Scram	Mode switch not in RUN
APRM UPSCALE Alarm	≤.66w+42% (108% max) --- ≤12%	APRM UPSC (Amber) (A-F)	UPSC Alarm (A-F)	APRM UPSCL Alarm	Rod Block	Mode switch not in RUN --- Mode switch in RUN
APRM DNSC	≥3%	APRM DNSC (Amber) (A-F)	DNSCL	APRM DNSC	Rod Block & Scram if associated IRM upscale	Mode switch not in RUN
APRM INOP	-2		UPSC Trip or INOP	APRM UPSC or INOP (A-F)	Scram and Rod Block	
APRM Flow Bias Not Normal	108% or △Flow 10%				Rod Block	
APRM Bypass	(3)	Bypass (White Light) (A-F)	Bypass (A-F)			

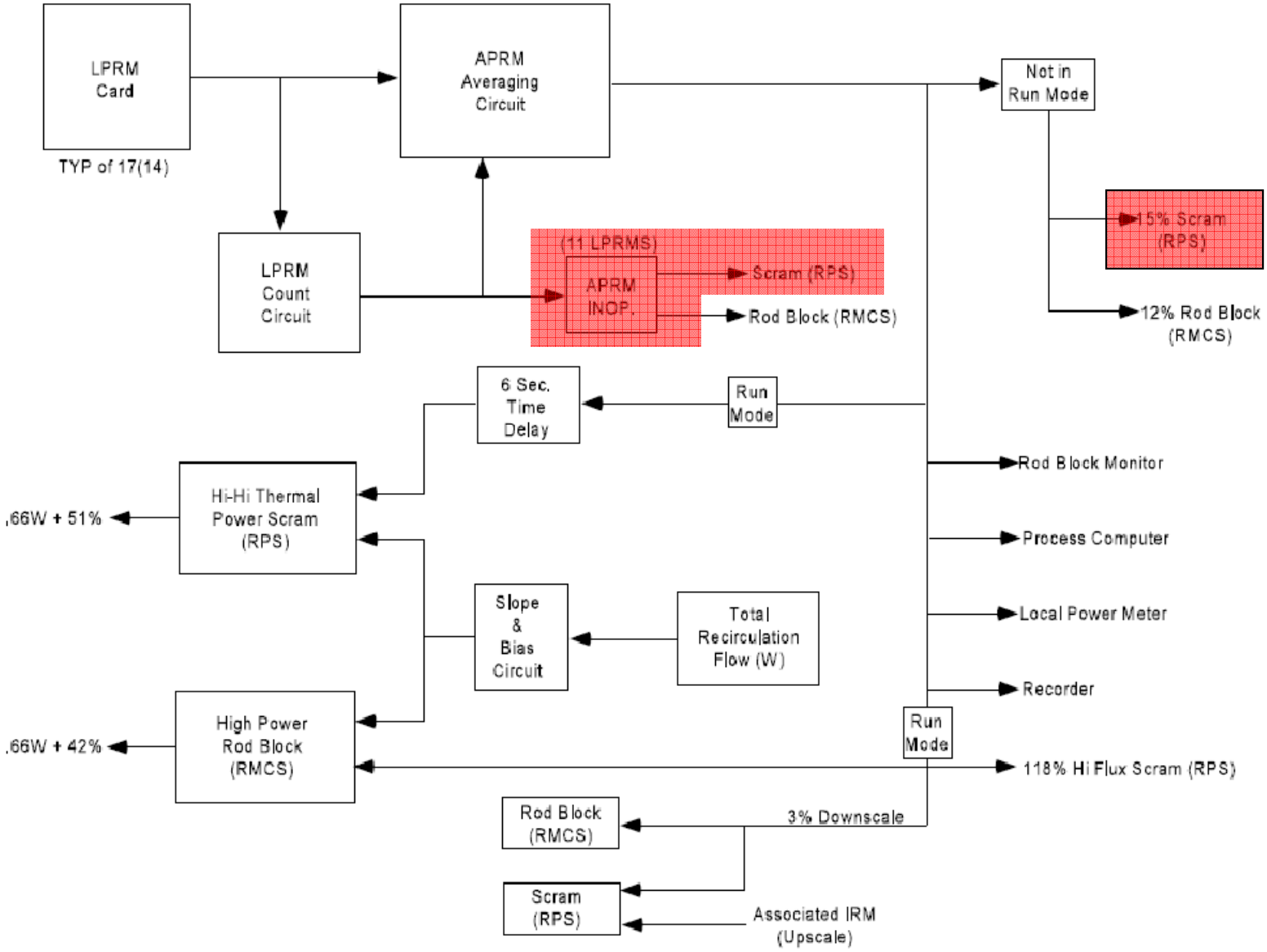
1. All trips automatically reset when the trip condition is cleared. Trip indicators on the APRM chassis must be manually reset.

2. Produced by:
   (1) <11 operable LPRM inputs
   (2) APRM mode switch not in operate
   (3) Module unplugged
   (4) Flow unit mode switch not in operate

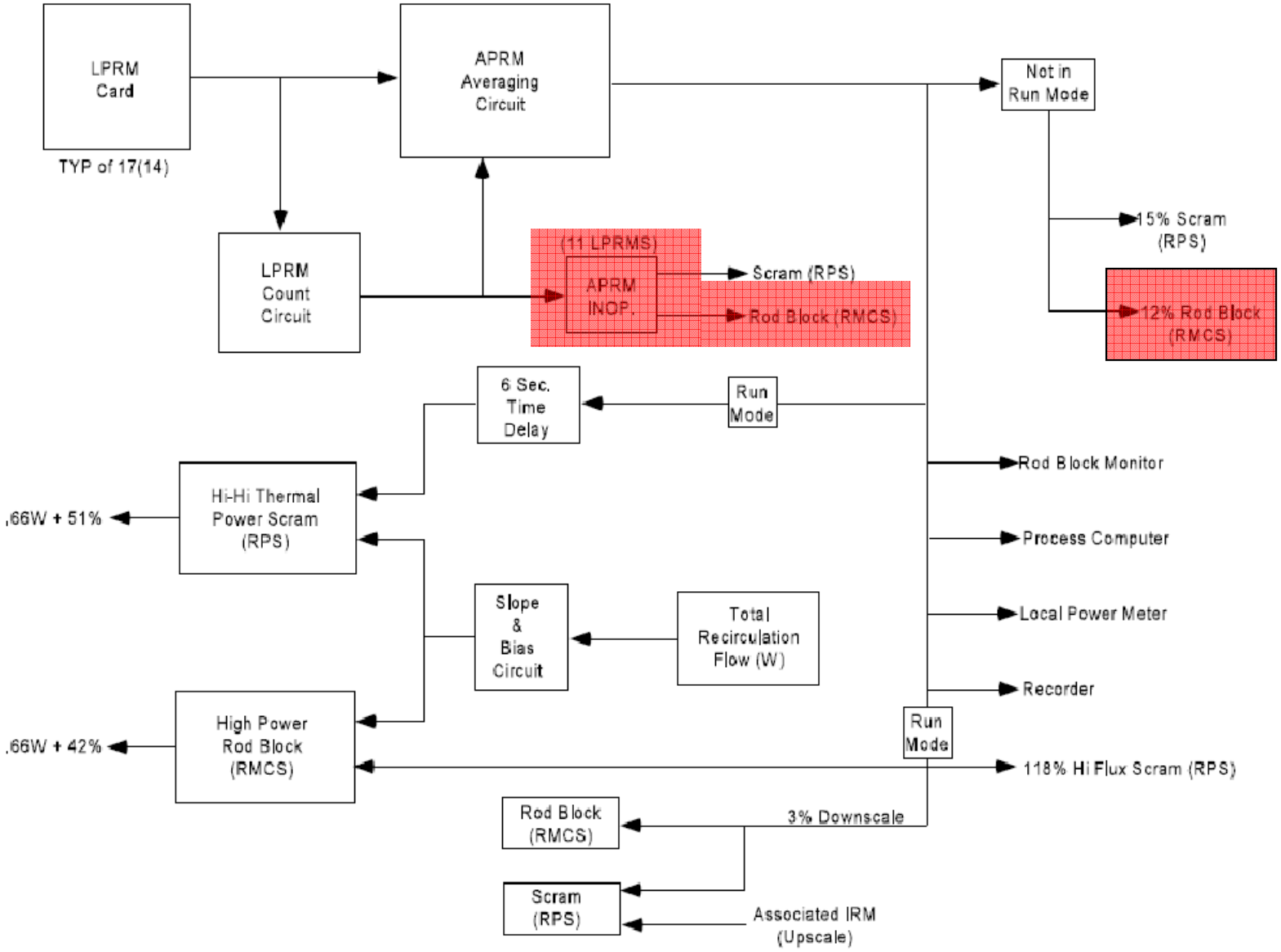
3. Bypassed by corresponding bypass selector switch.

Objective 3

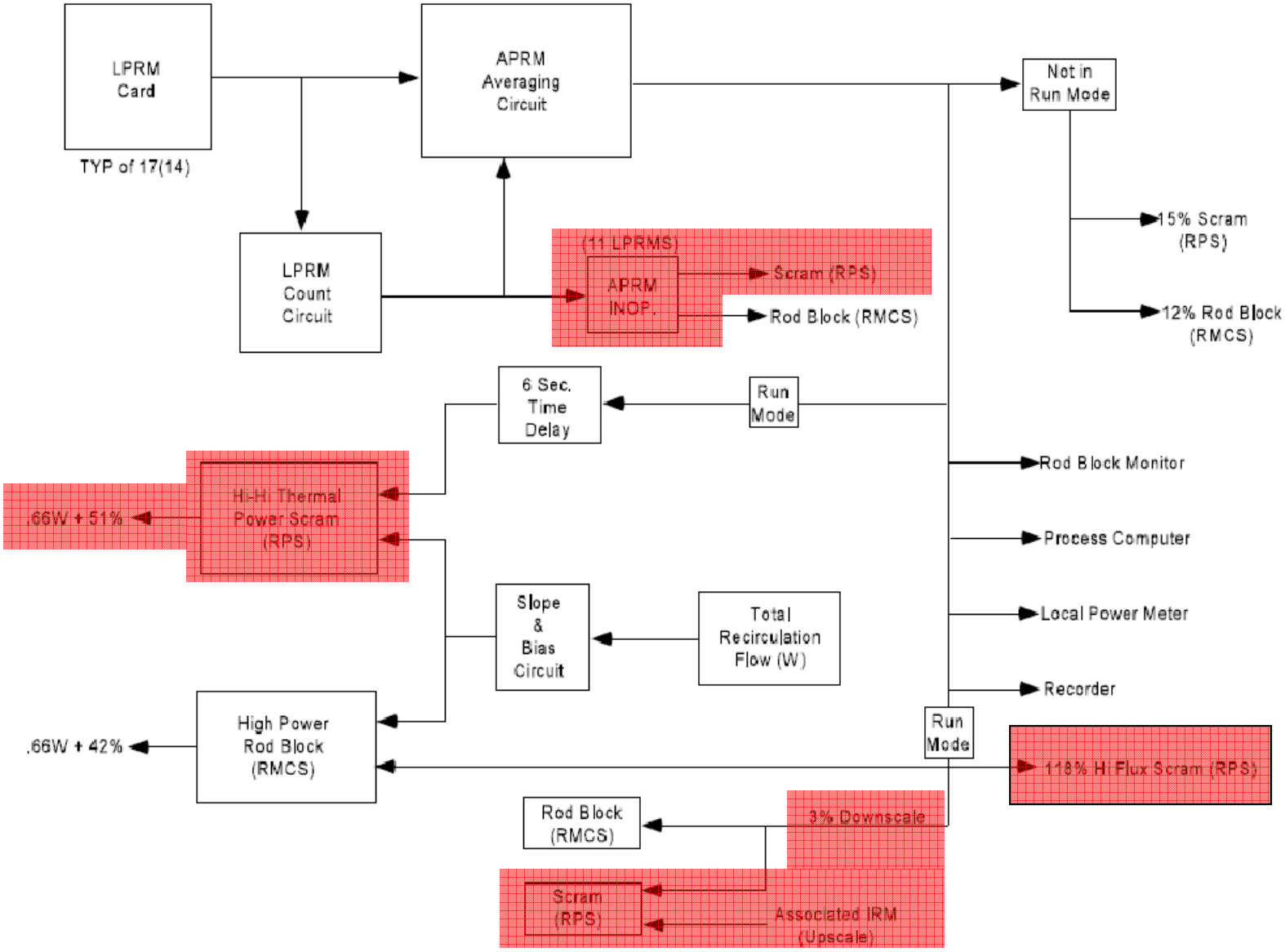
Scram Signals NOT in Run



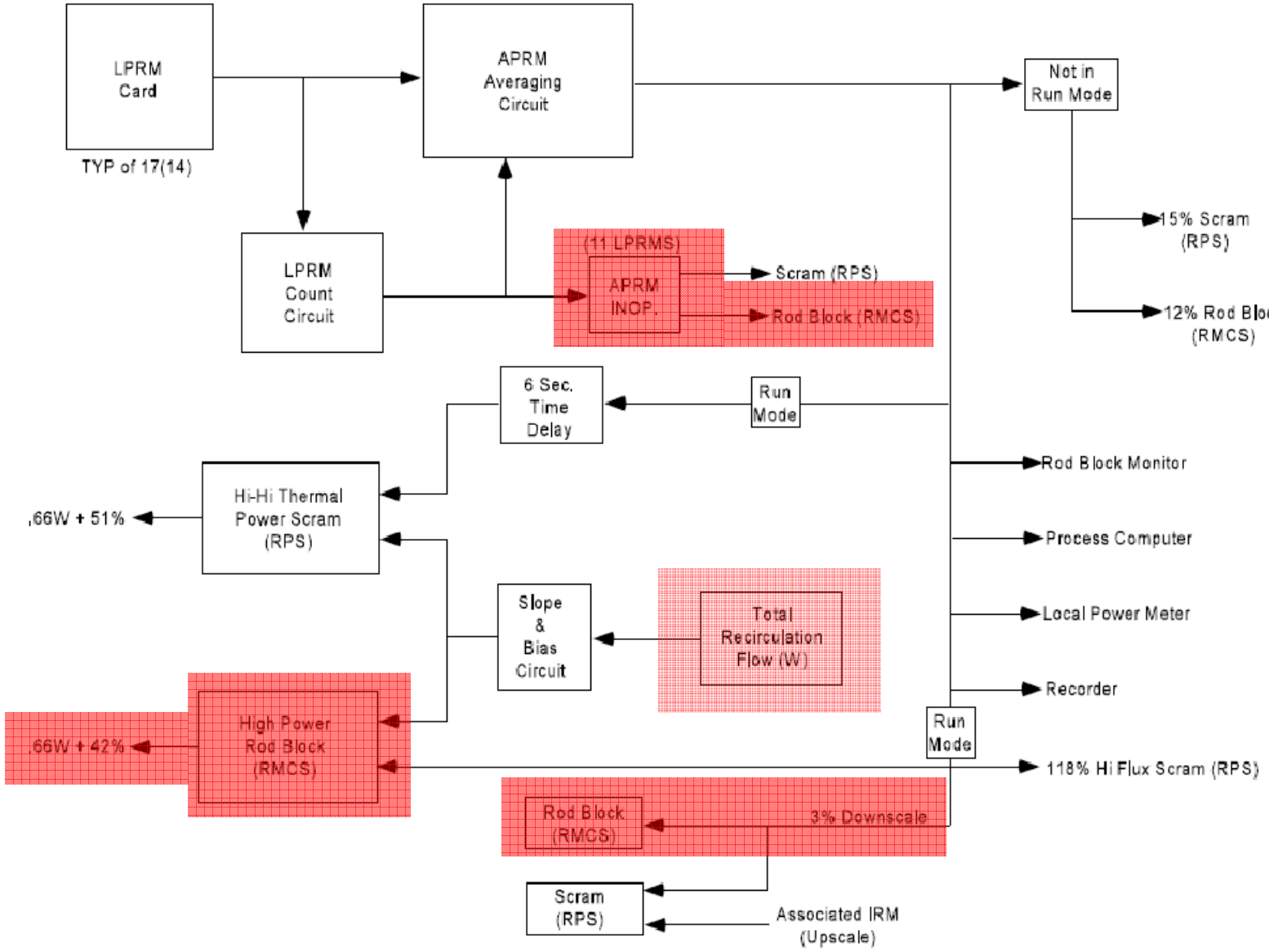
Rod Block Signals NOT in Run



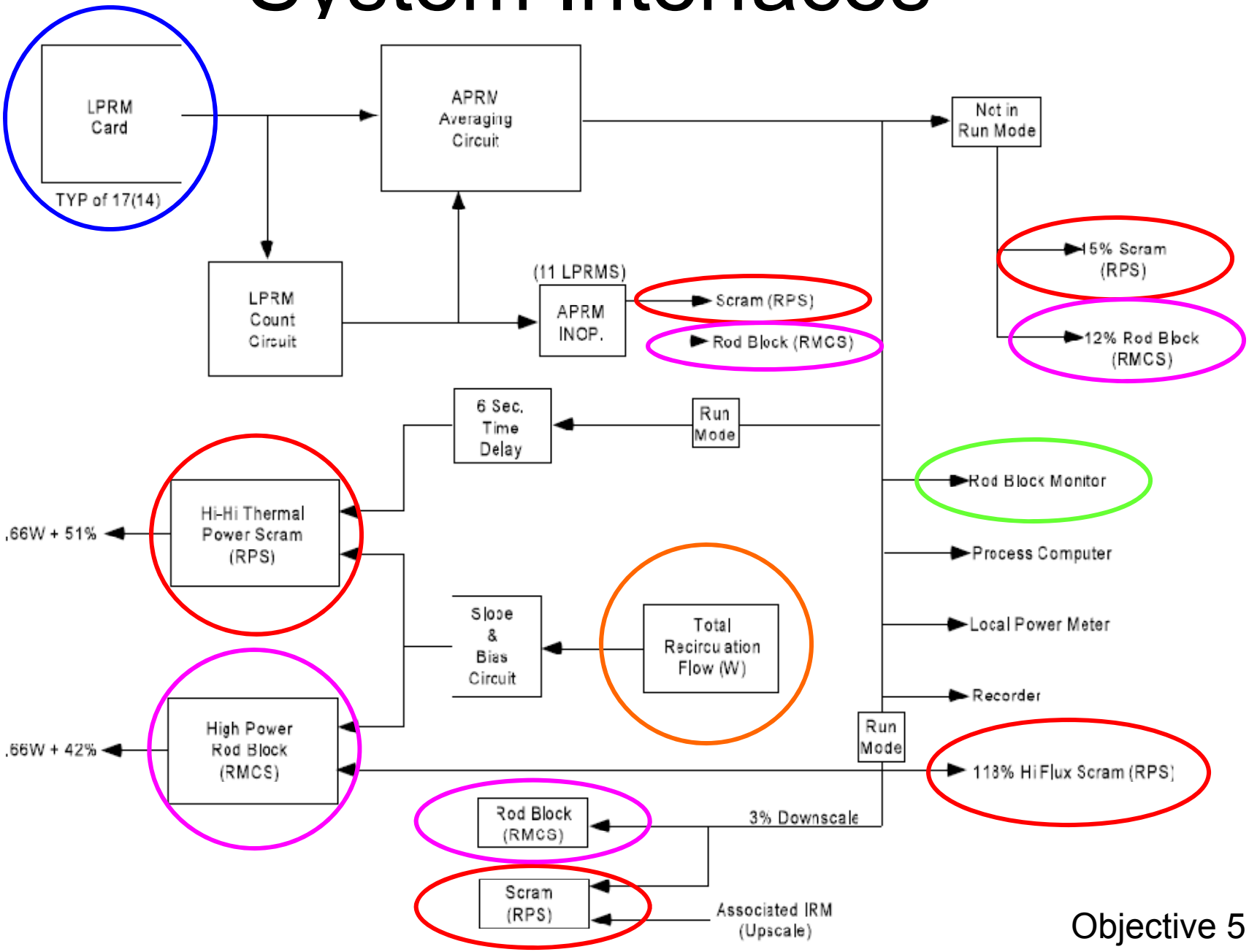
Scram Signals in Run



Rod Block Signals in Run



System Interfaces



Objective 5

Review Objectives

1. Identify the system's purposes.

o Monitor the core thermal power level

o Provide reactor scram and control rod block signals to preserve fuel cladding integrity

Review Objectives

2. Recognize the purpose, function and operation of major system components:
   a) LPRM inputs – each APRM channel receives 14 or 17 inputs from LPRM detectors at diverse axial and radial locations in the reactor core
   b) count circuit – determines the number of operable LPRM inputs to an APRM channel and provides a rod block signal on fewer than 11
   c) averaging circuit – averages the inputs of operable LPRM detectors

Review Objectives

2. Recognize the purpose, function and operation of major system components:
   d) slope and bias circuit - adjusts APRM control rod block and reactor scram trip setpoints based on total recirculation flow when the reactor mode switch is in Run
   e) trip units – provides rod block signals to RMCS and scram signals to RPS

Review Objectives (continued)

3. List the protective trips generated by the APRM system

ALARM OR TRIP(1)	SETPOINT	APRM CHASSIS INDICATION	Panel 603 INDICATION	ANNUN-CIATOR	ACTION	AUTO BYPASS
APRM UPSCALE Neutron Trip	≤118% --- ≤15%	Neutron UPSCL (Red) (A-F)	UPSC Trip (A-F)	APRM UPSC or INOP	Scram	Mode switch not in RUN --- Mode switch in RUN
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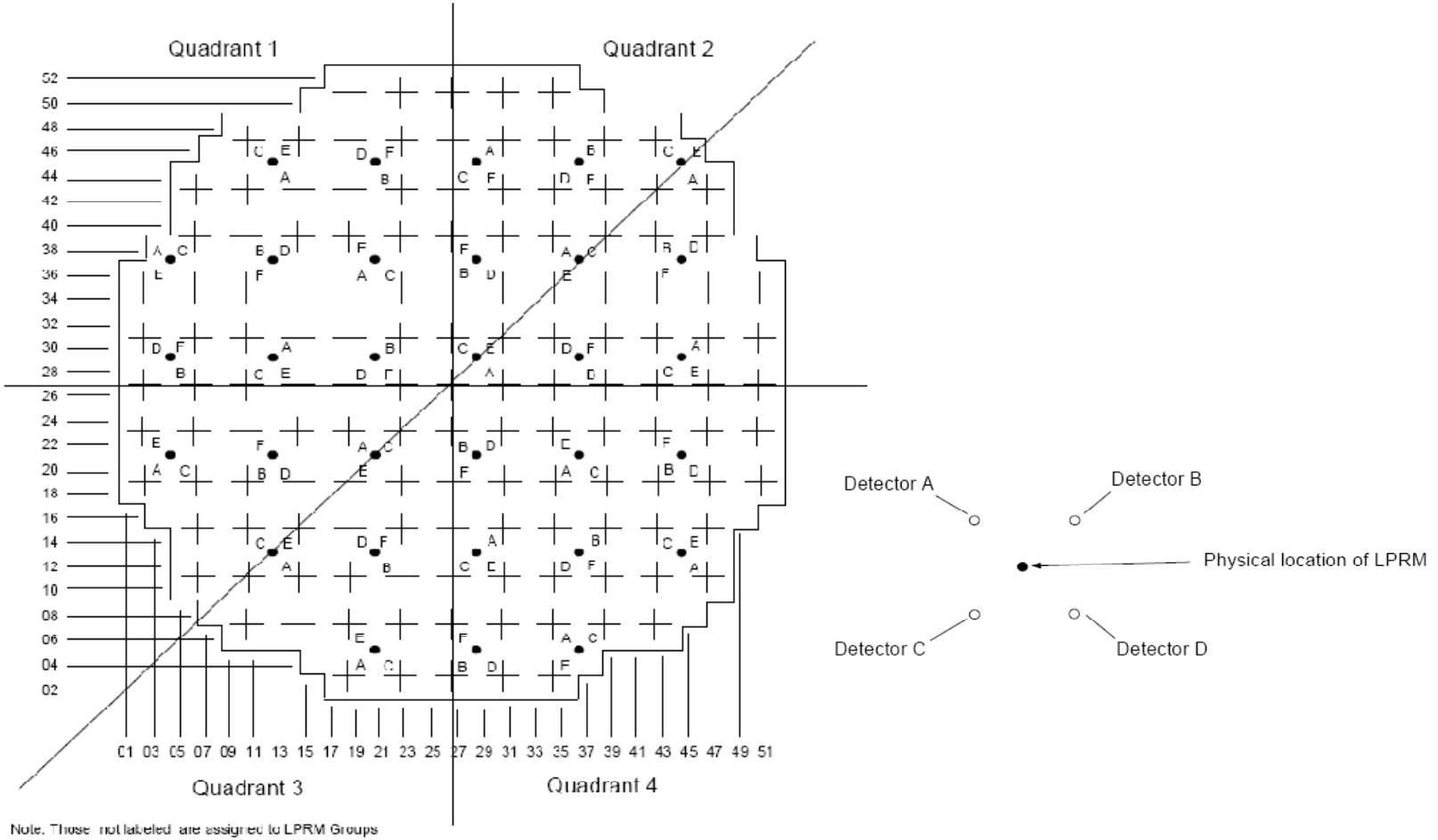
APRM INOP	-2		UPSC Trip or INOP	APRM UPSC or INOP (A-F)	Scram and Rod Block	
APRM Flow Bias Not Normal	108% or △Flow 10%				Rod Block	
APRM Bypass	(3)	Bypass (White Light) (A-F)	Bypass (A-F)			

Review Objectives (continued)

4. Identify the assignment of LPRM detectors to the APRMs



Review Objectives (continued)

5. Explain the system's interfaces with:
   a) reactor manual control system
   b) recirculation flow control system
   c) local power range monitoring system
   d) reactor protection system
   e) rod block monitoring system

Are there any questions?