Reactor Protection System (RPS)

304B Chapter 7.3

Objectives

1. **Identify the purposes of the Reactor Protection System (RPS).**
2. **Recognize the purpose function and operation of the following RPS components:**
   a. **Motor generator sets**
   b. **Alternate power supply transformer**
   c. **Power transfer switch**
   d. **One of two twice de-energized to function scram logic**
   e. **Scram reset time delay**
   f. **Scram air header**
   g. **HCU scram pilot solenoid valves**
   h. **SDV scram pilot solenoid valves**
   i. **Backup scram solenoid valves**
   j. **Alternate Rod Insertion (ARI) solenoid valves**

Objectives

3. **Recognize how a scram signal results in control rod insertion.**
4. **List the RPS setpoints which affect the following:**
   a. **Scram reset time delay**
   b. **Alternate Rod Insertion (ARI)**
5. **Describe the loss of power and loss of air fail-safe features of the system.**
6. **Given a scram signal, select:**
   a. **the reason for each**
   b. **the conditions which may bypass it**
   c. **the reason each bypass is allowed**

Objectives

7. **Explain how this system interfaces with the following systems:**
   a. **Control Rod Drive System**
   b. **Reactor Manual Control System**
   c. **Reactor Recirculation System**
   d. **Neutron Monitoring System**
   e. **Main Steam System**
   f. **Primary Containment System**
   g. **Reactor Vessel Instrumentation System**
   h. **Instrument Air System**

Purposes

- Monitor critical plant parameters during all plant operating modes and
- Initiate a reactor scram when a LSSS is reached such that:
  - fuel cladding integrity remains intact
  - the reactor coolant system pressure boundary remains intact
  - primary containment integrity remains intact
  - inadvertent criticality is avoided.

Overview

- Fail safe
- 2 independent trip systems
- Each trip system contains 2 channels
- Each channel receives independent sensor inputs
- One out of two taken twice de-energized to function logic arrangement

Overview

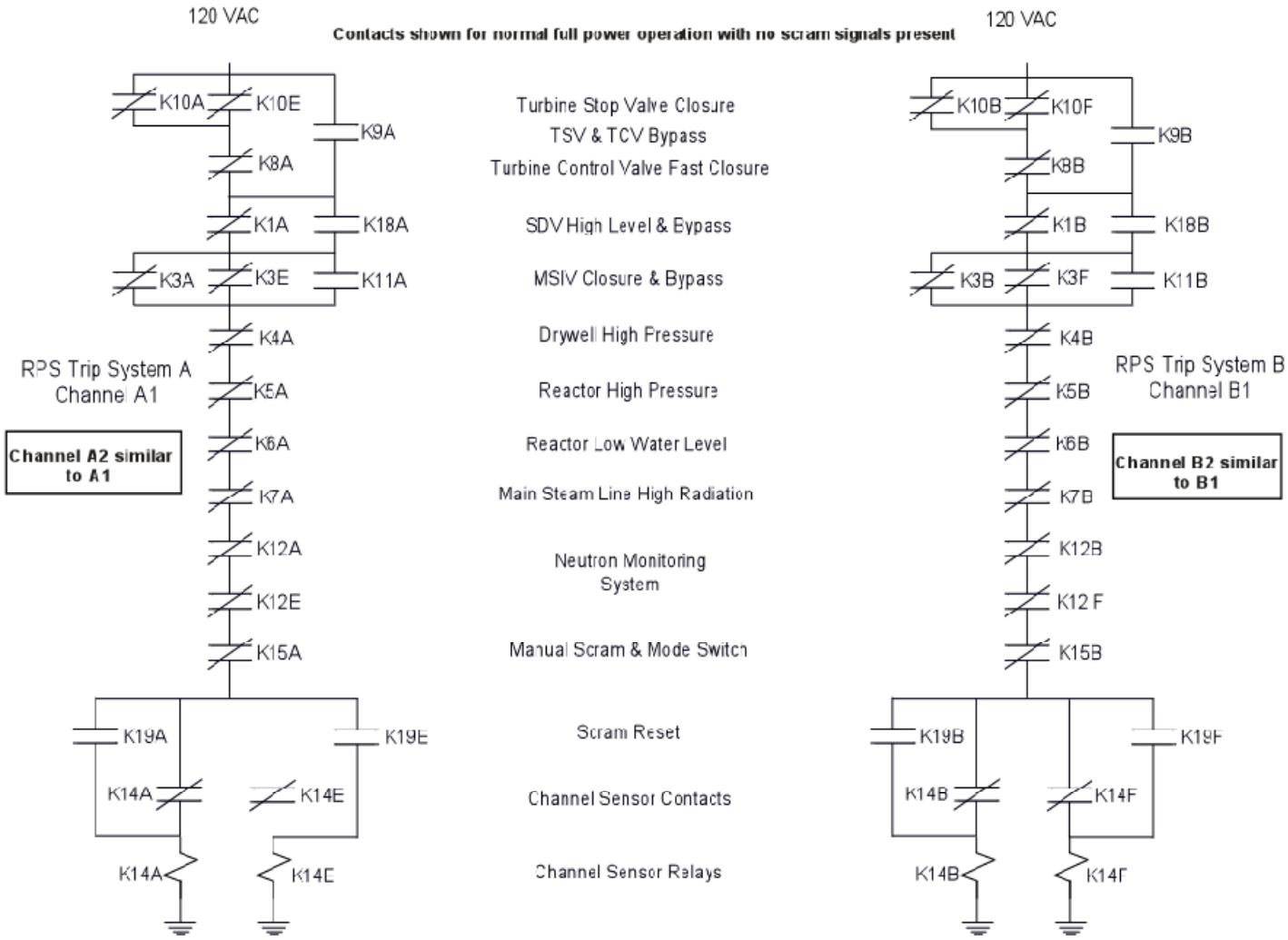
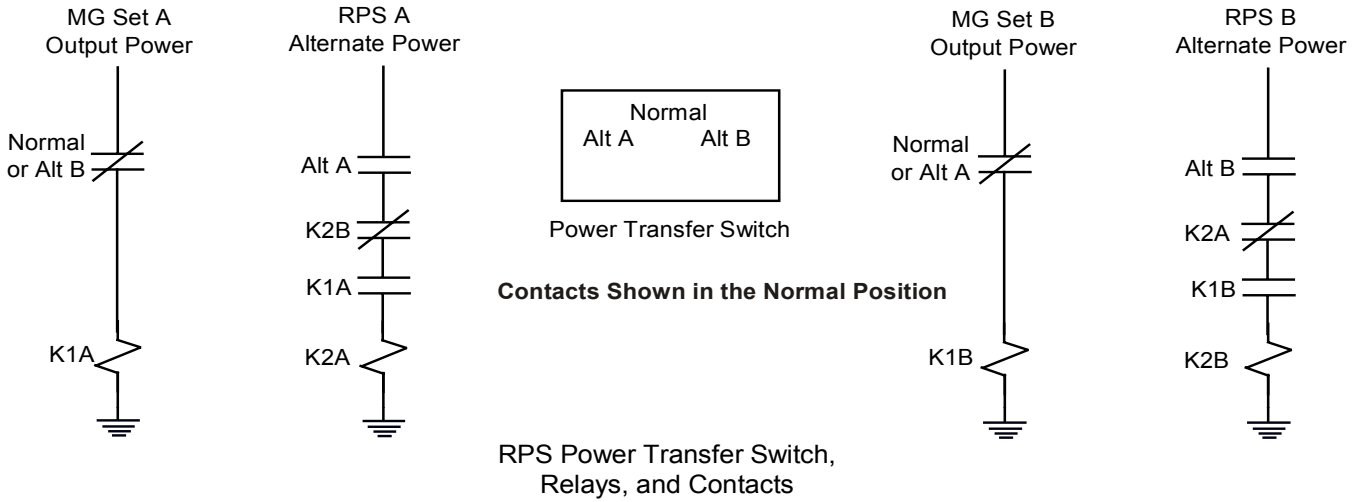


Figure 7.3-4

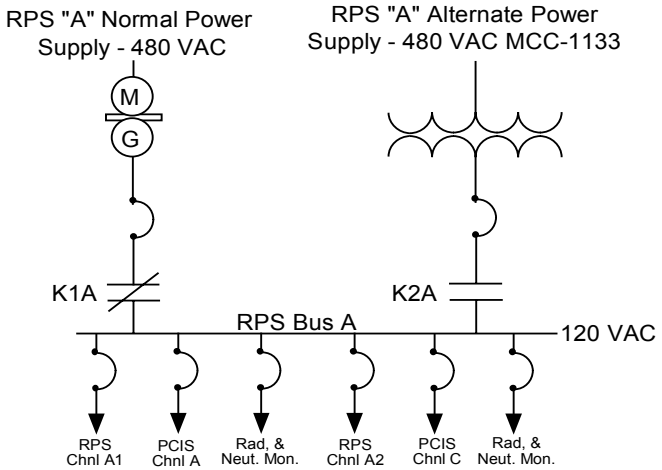
Major Components

- Motor Generator Sets
- Alternate Power Supply Transformer
- Power Transfer Switch
- Scram Logic
- Scram Air Header
- HCU Scram Pilot Solenoid Valves
- SDV Scram Pilot Solenoid Valves
- Backup Scram Solenoid Valves
- Alternate Rod Insertion (ARI) Solenoid Valves

Motor Generator Sets



RPS Power Transfer Switch, Relays, and Contacts



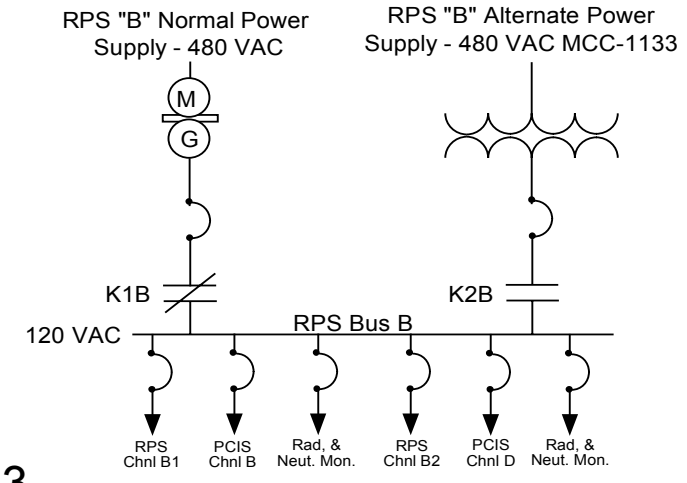


Figure 7.3-3

Objective 2a

Alternate Power Supply Transformer

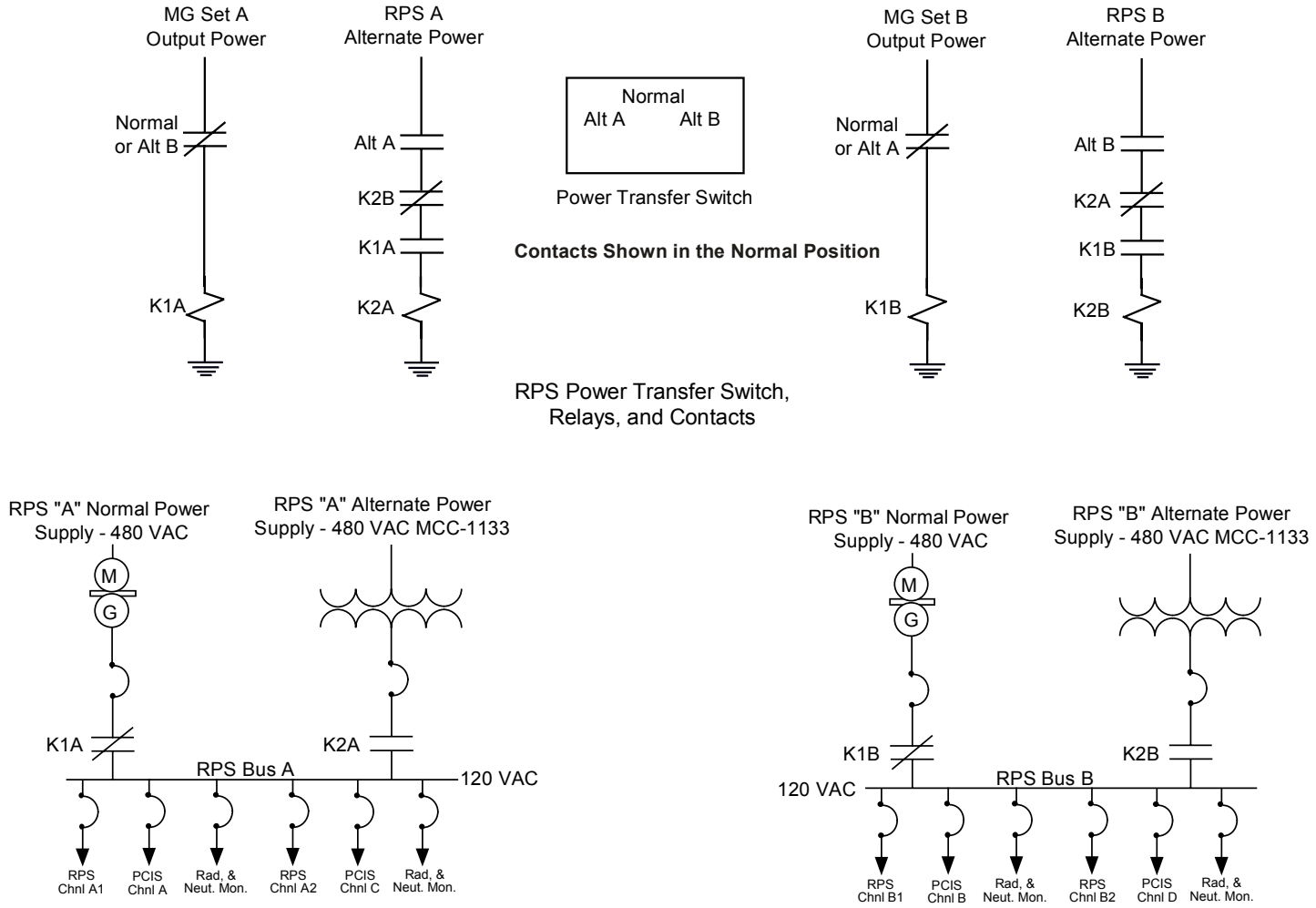
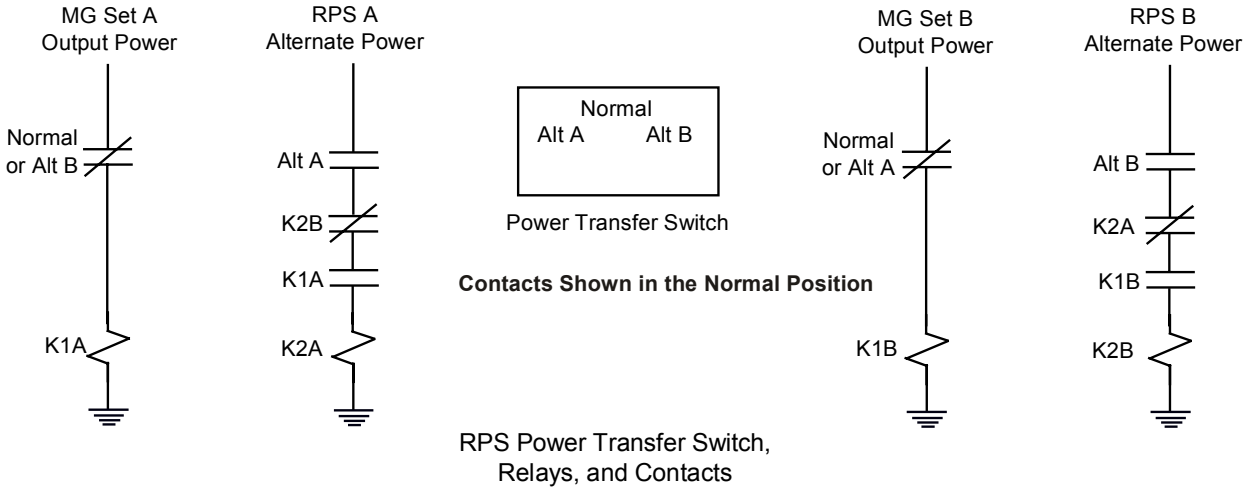


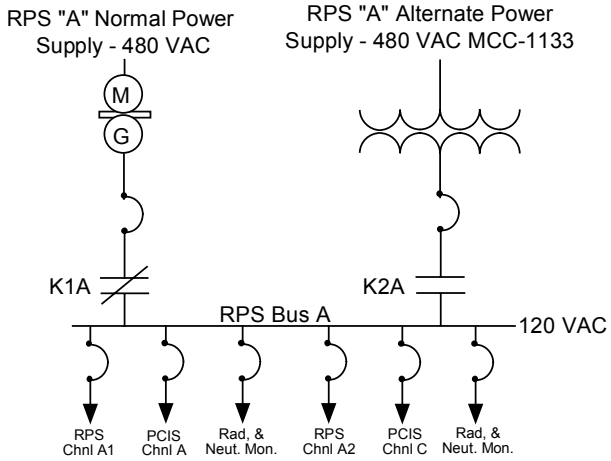
Figure 7.3-3

Objective 2b

Power Transfer Switch



RPS Power Transfer Switch,
Relays, and Contacts



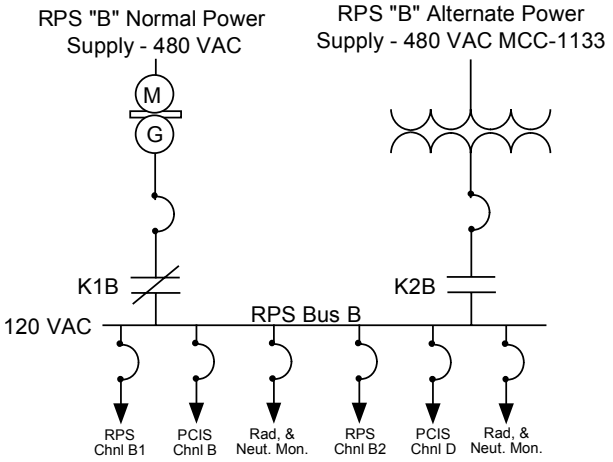


Figure 7.3-3

Objective 2c

Scram Logic

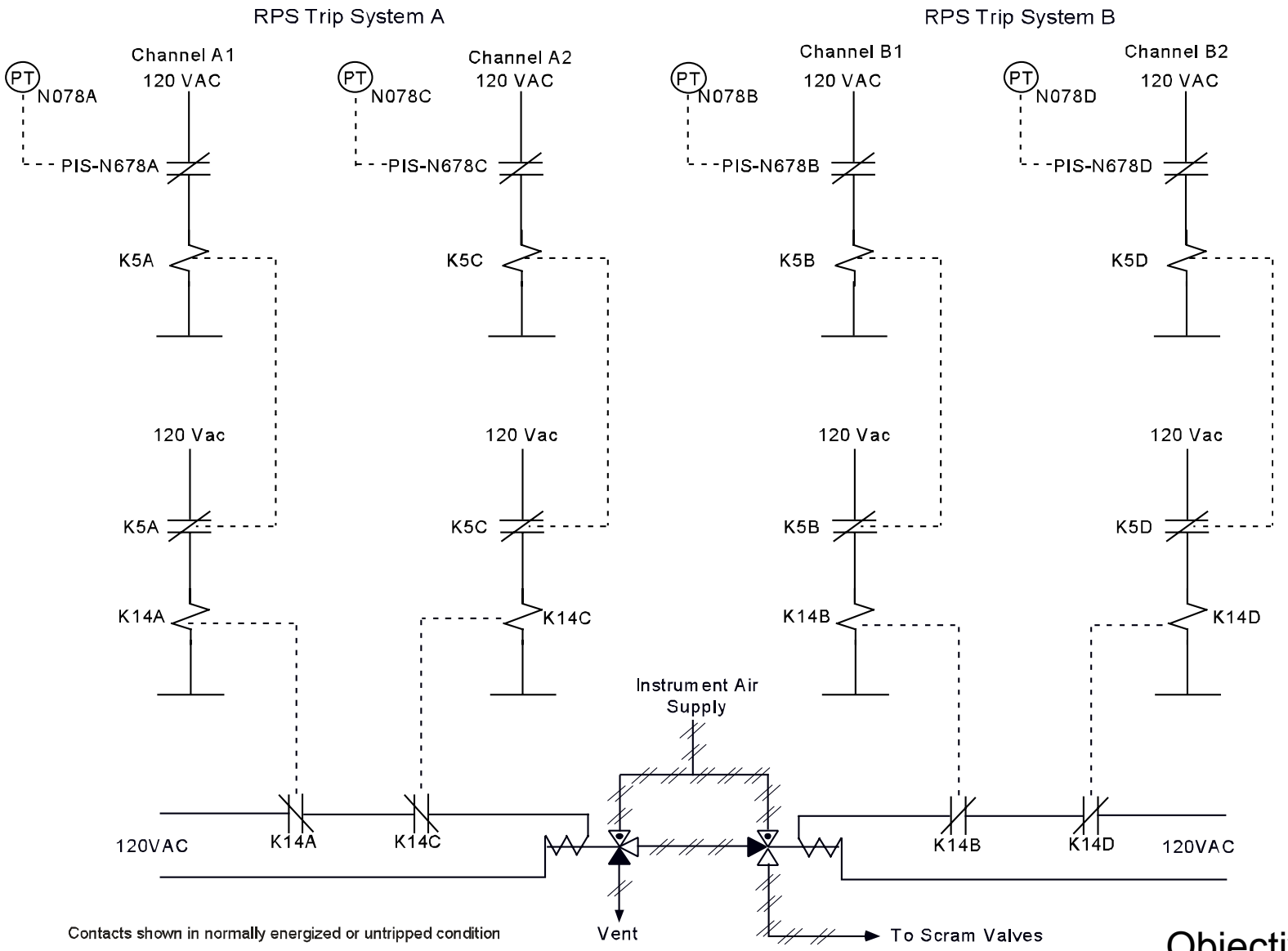


Figure 7.3-1

Objective 2d

Scram Logic

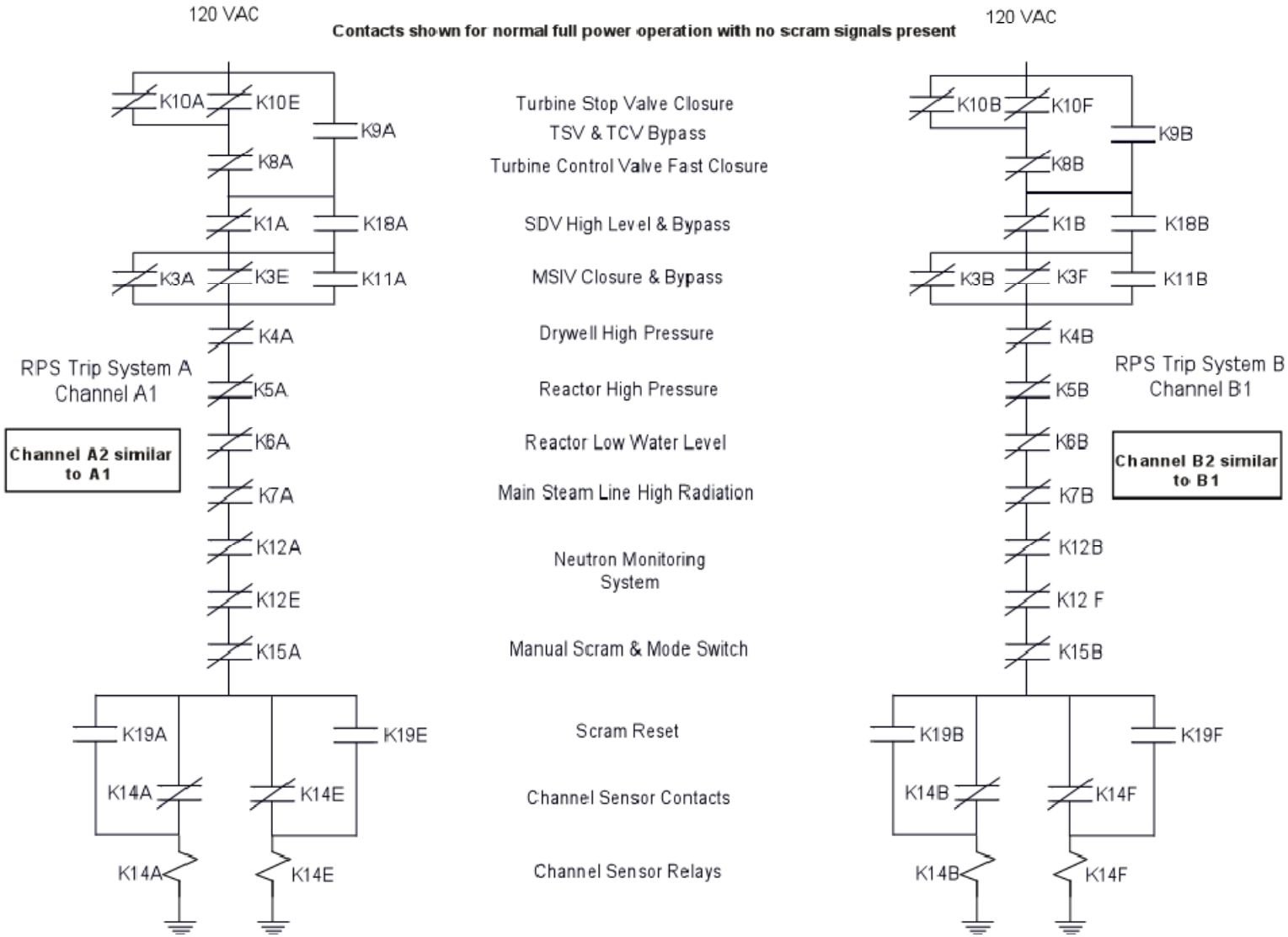


Figure 7.3-4

Objective 2d

Scram Air Header

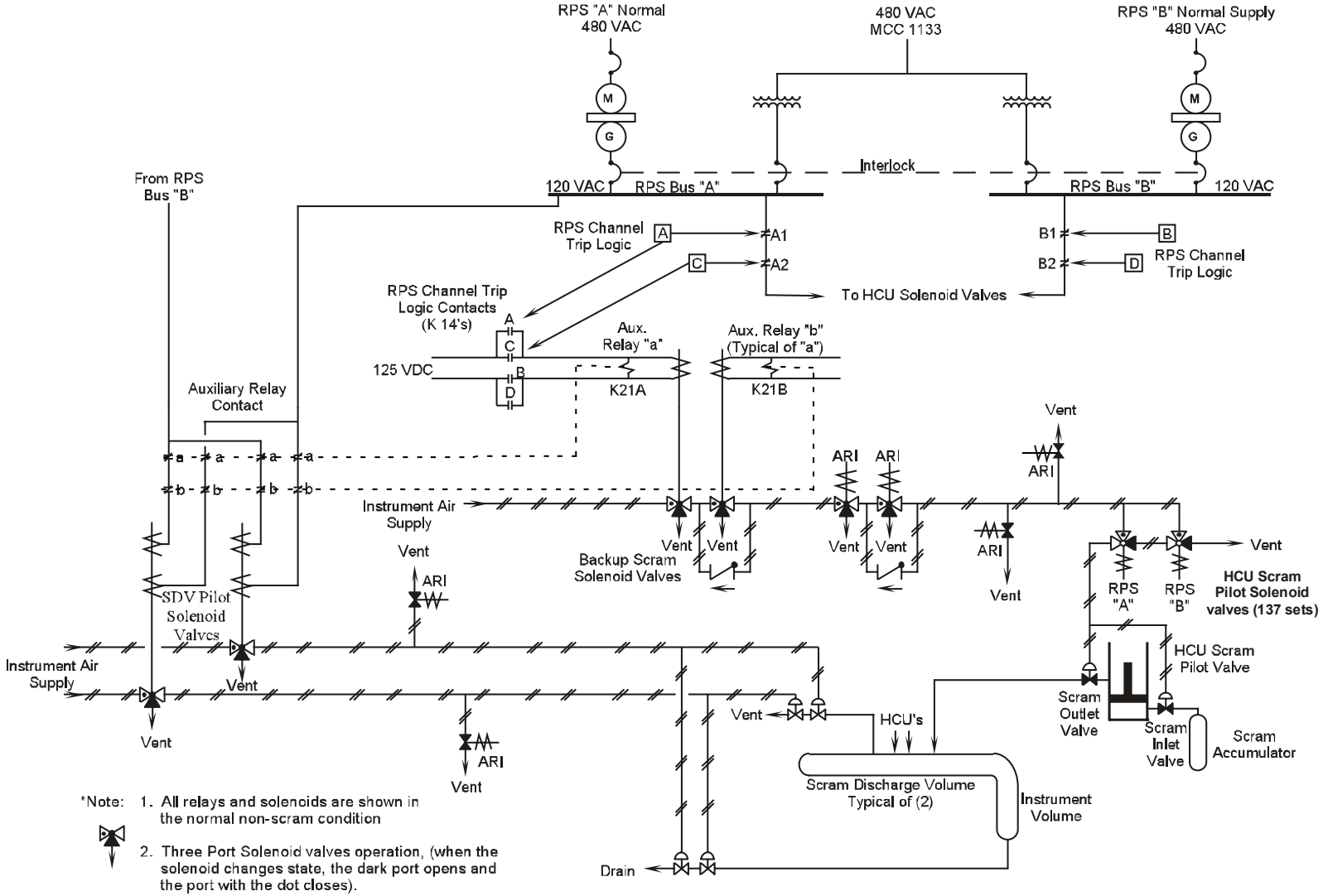


Figure 7.3-5

Objective 2f

HCU Scram Pilot Solenoid Valves

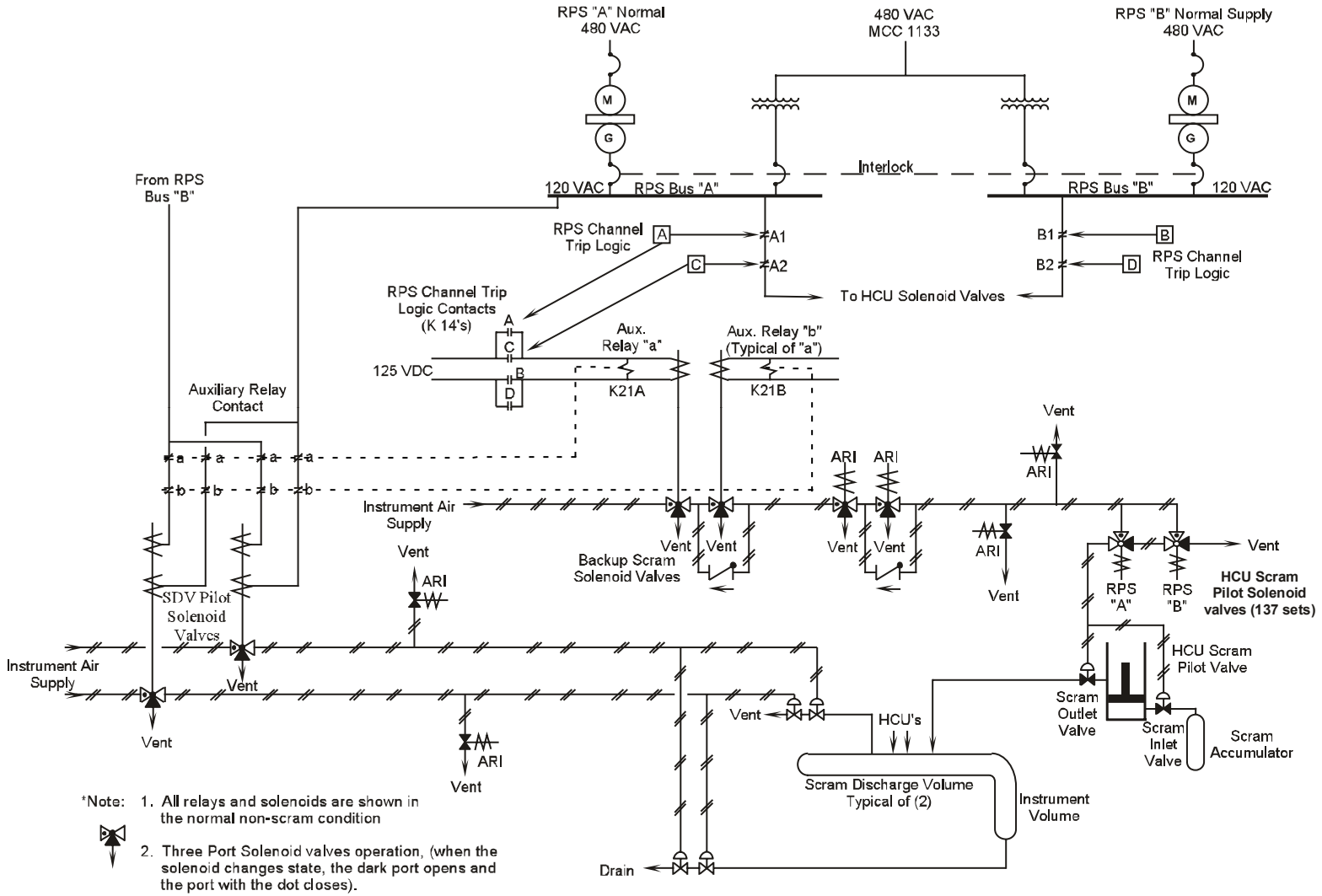


Figure 7.3-5

Objective 2g

SDV Scram Pilot Solenoid Valves

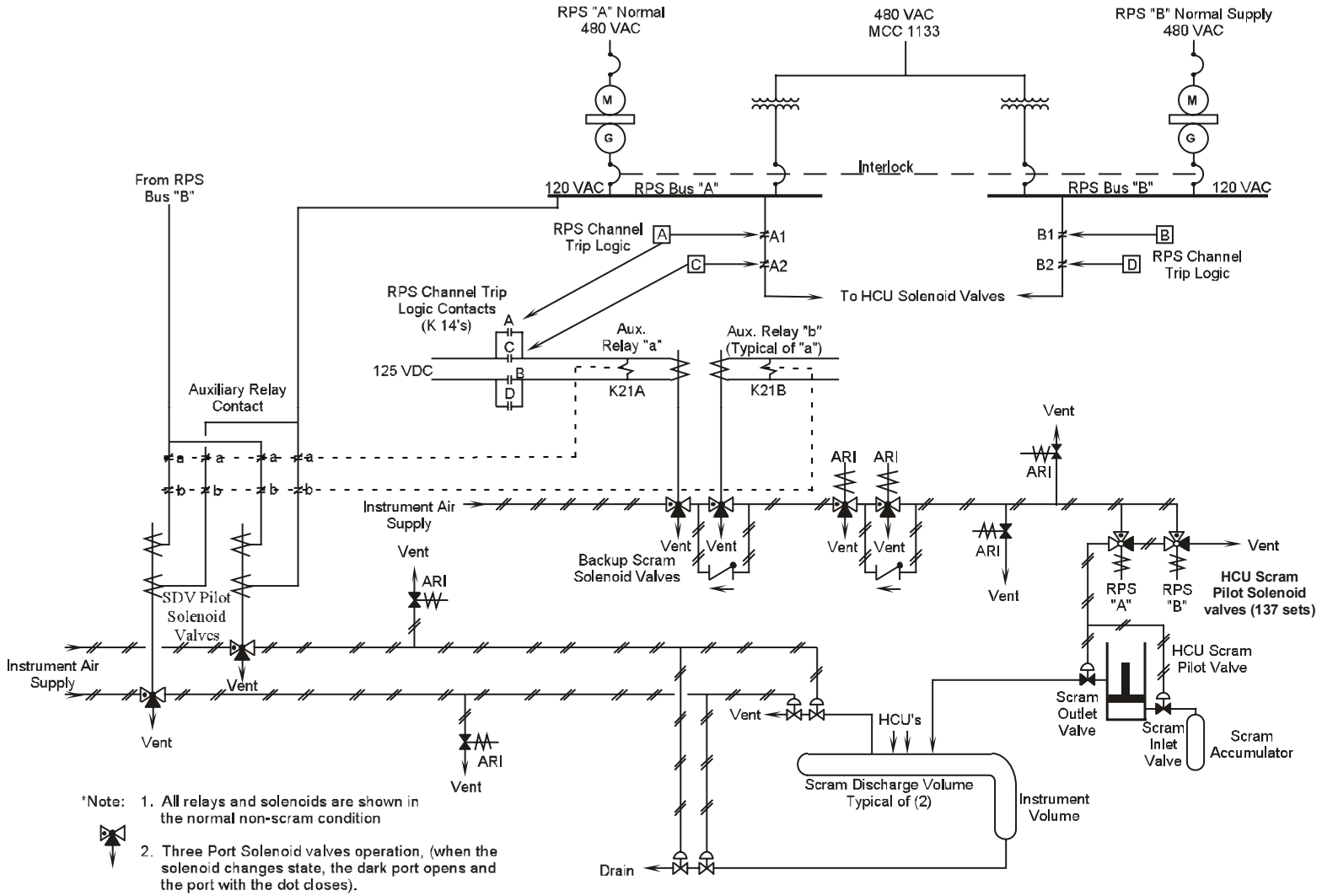


Figure 7.3-5

Objective 2h

Backup Scram Solenoid Valves

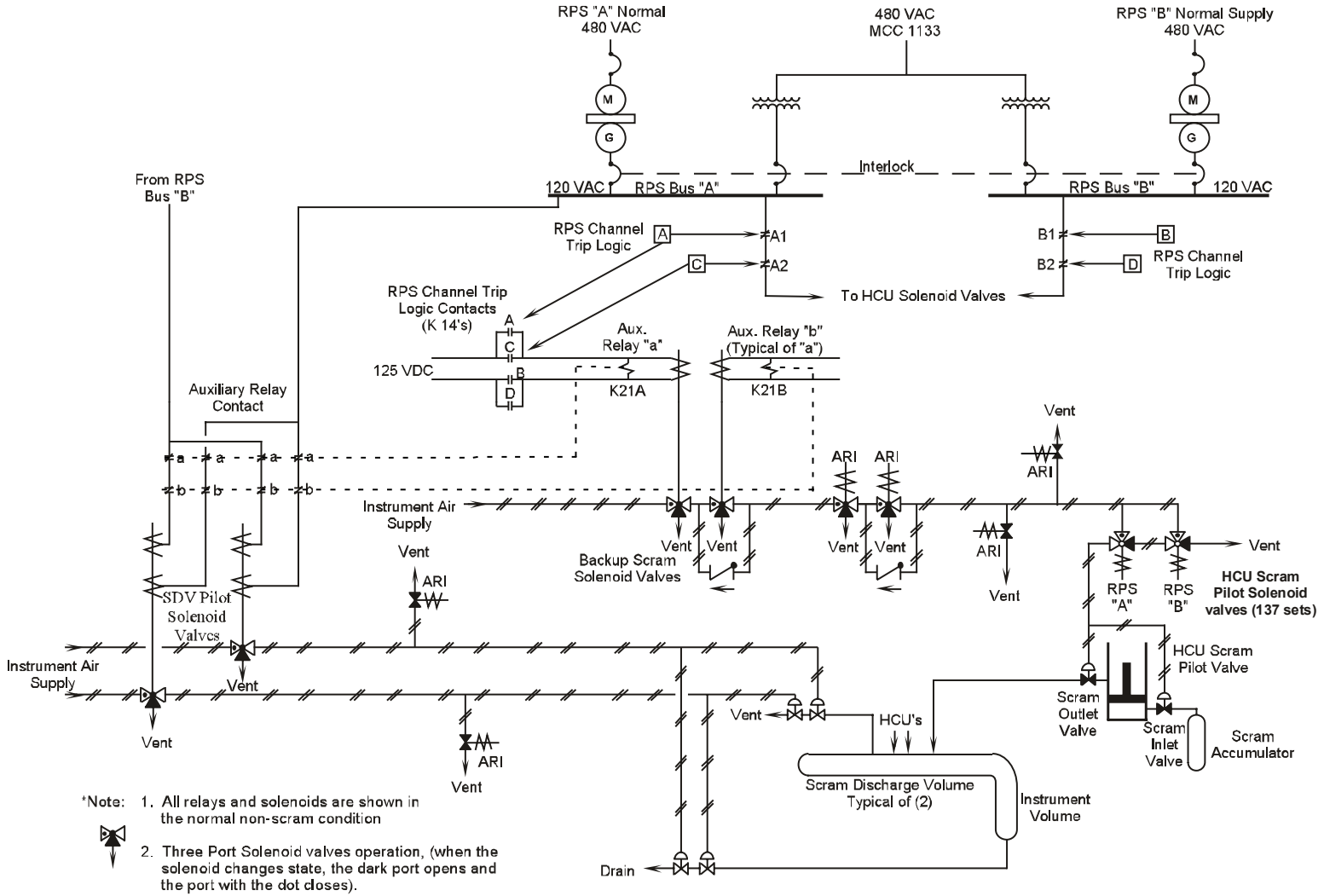


Figure 7.3-5

Objective 2i

Alternate Rod Insertion (ARI) Solenoid Valves

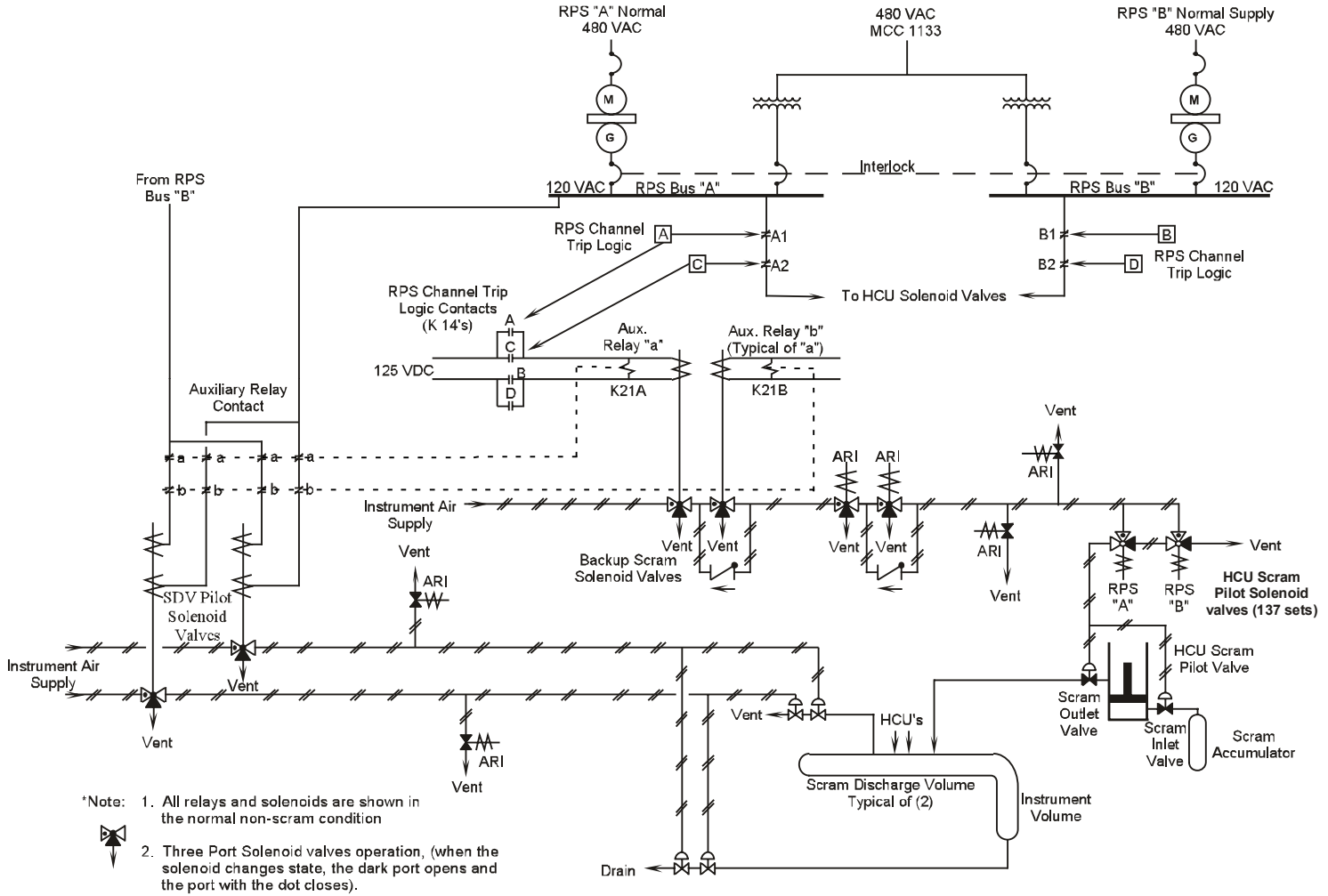


Figure 7.3-5

Objective 2j

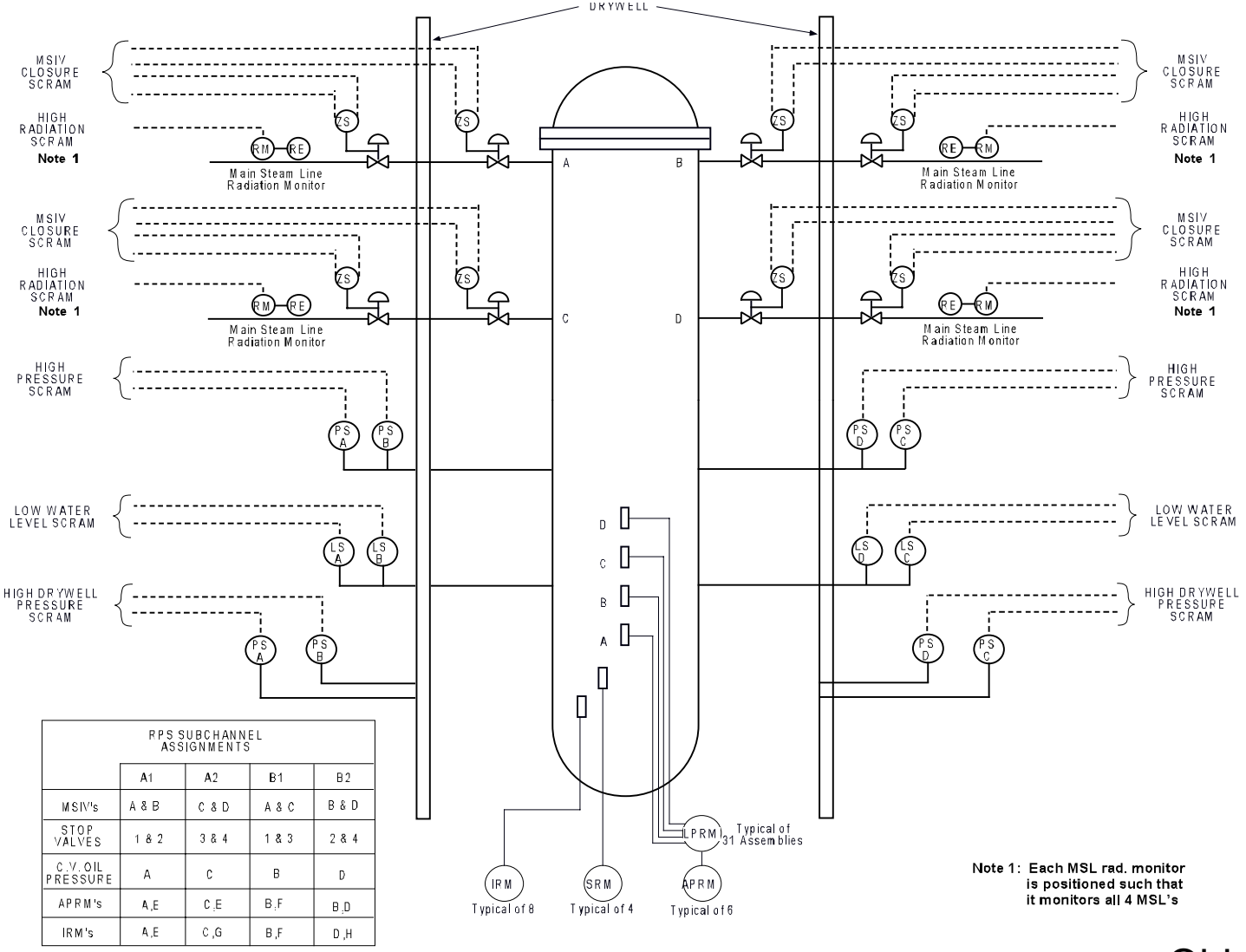
Scram Functions and Bases

Table 7.3-1

- Reactor Mode Switch in Shutdown
- Manual Scram
- High Drywell Pressure
- Low Reactor Vessel Water Level
- High Reactor Pressure
- Main Steam Line High Radiation
- Turbine Stop Valve Closure
- Turbine Control Valve Fast Closure
- Scram Discharge Volume High Level
- Main Steam Isolation Valve Closure
- APRM High-High Fixed (15% and 118%)
- APRM High-High Flow Biased Thermal
- APRM Inop
- IRM High-High
- IRM Inop
- IRM High-High or Inop with companion APRM downscale
- SRM High-High
- SRM Inop

Objective 6

Scram Functions and Bases

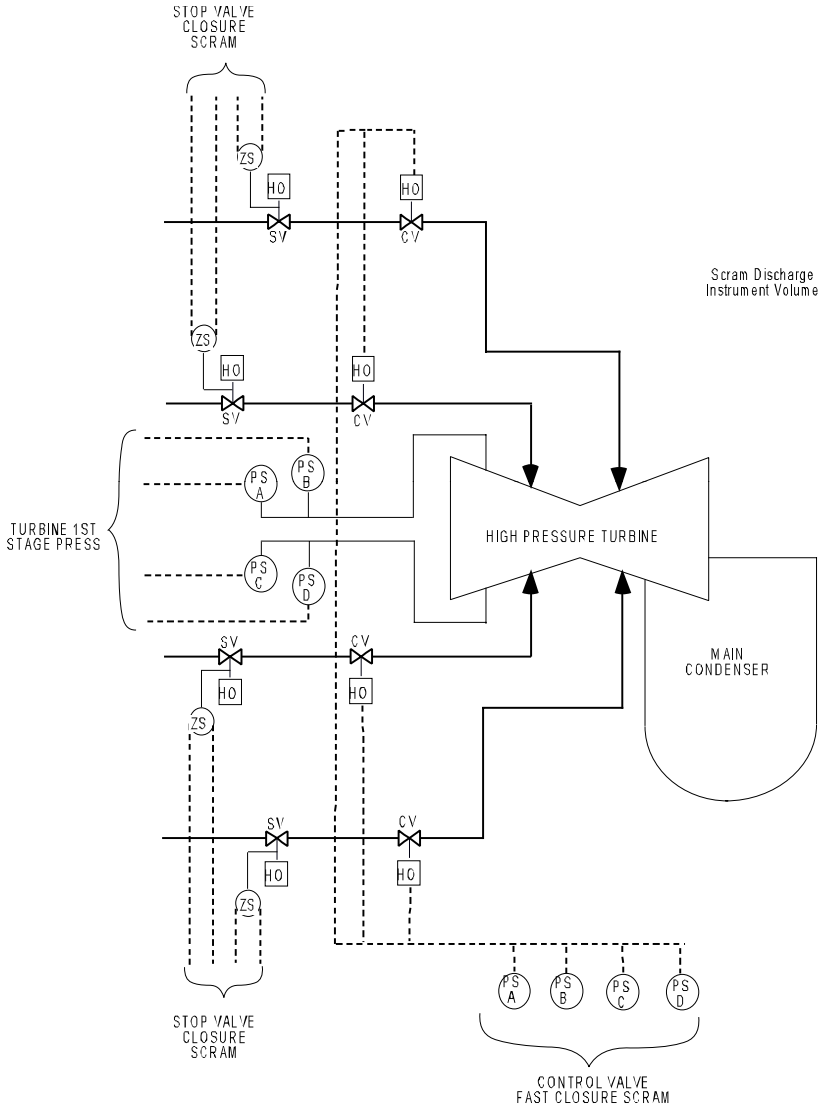


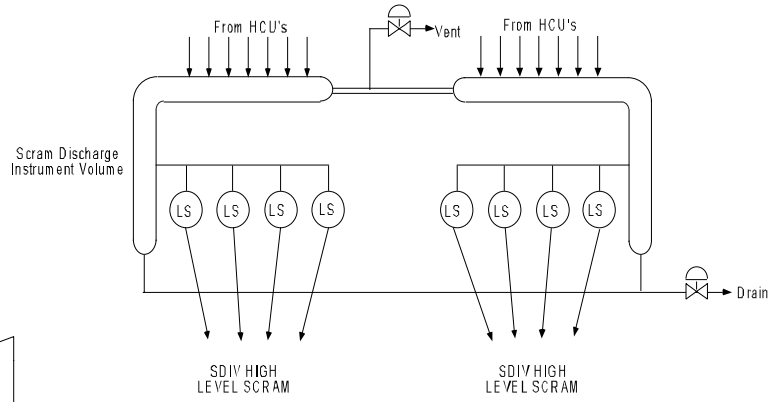
RPS SUBCHANNEL ASSIGNMENTS				
	A1	A2	B1	B2
MSIV's	A & B	C & D	A & C	B & D
STOP VALVES	1 & 2	3 & 4	1 & 3	2 & 4
C.V. OIL PRESSURE	A	C	B	D
APRM's	A,E	C,E	B,F	B,D
IRM's	A,E	C,G	B,F	D,H

Figure 7.3-2

Objective 6

Scram Functions and Bases





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STOP VALVES	1 & 2	3 & 4	1 & 3	2 & 4
C.V. OIL PRESSURE	A	C	B	D
APRM's	A,E	C,E	B,F	B,D
IRM's	A,E	C,G	B,F	D,H

Figure 7.3-2

Objective 6

Integrated operation

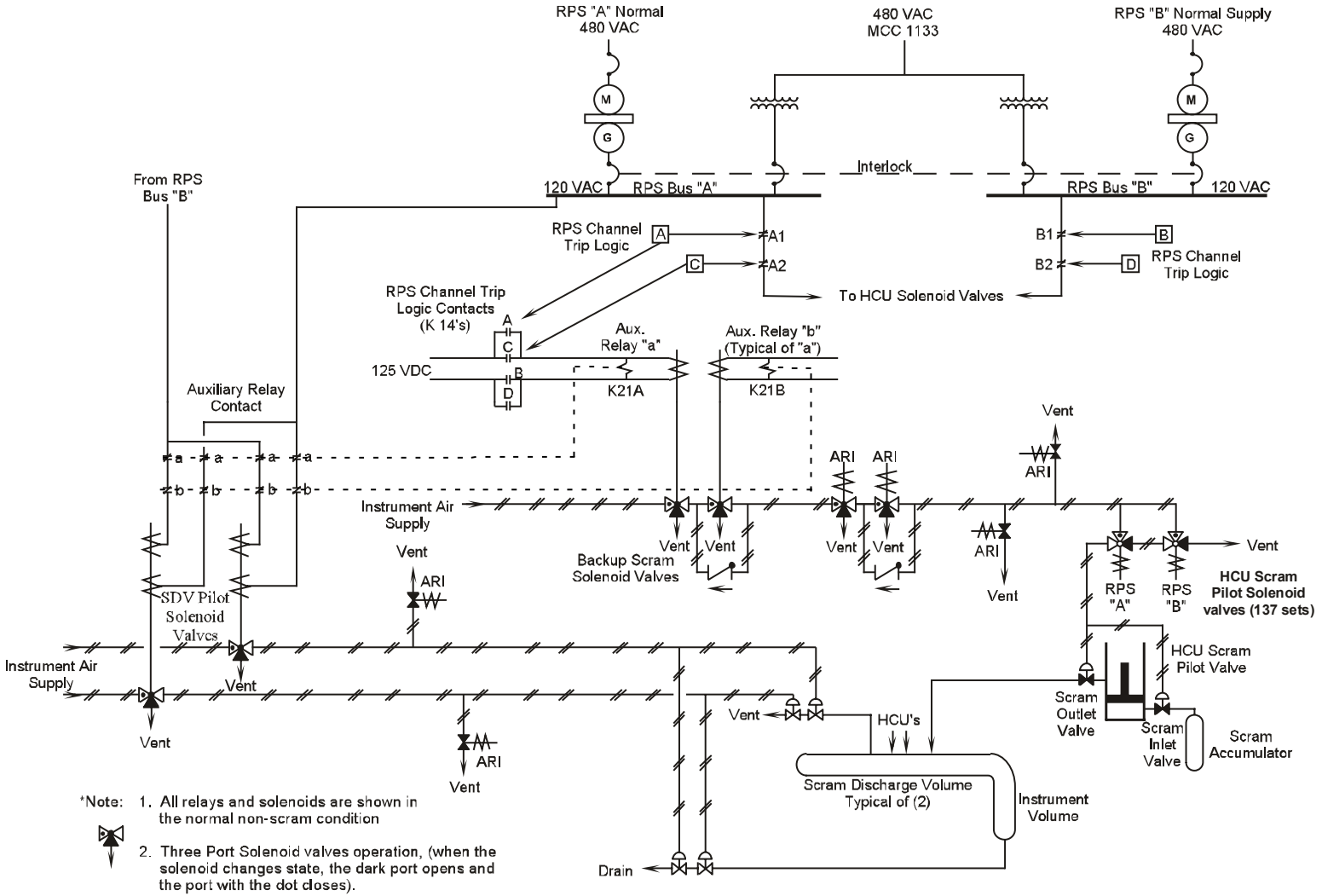
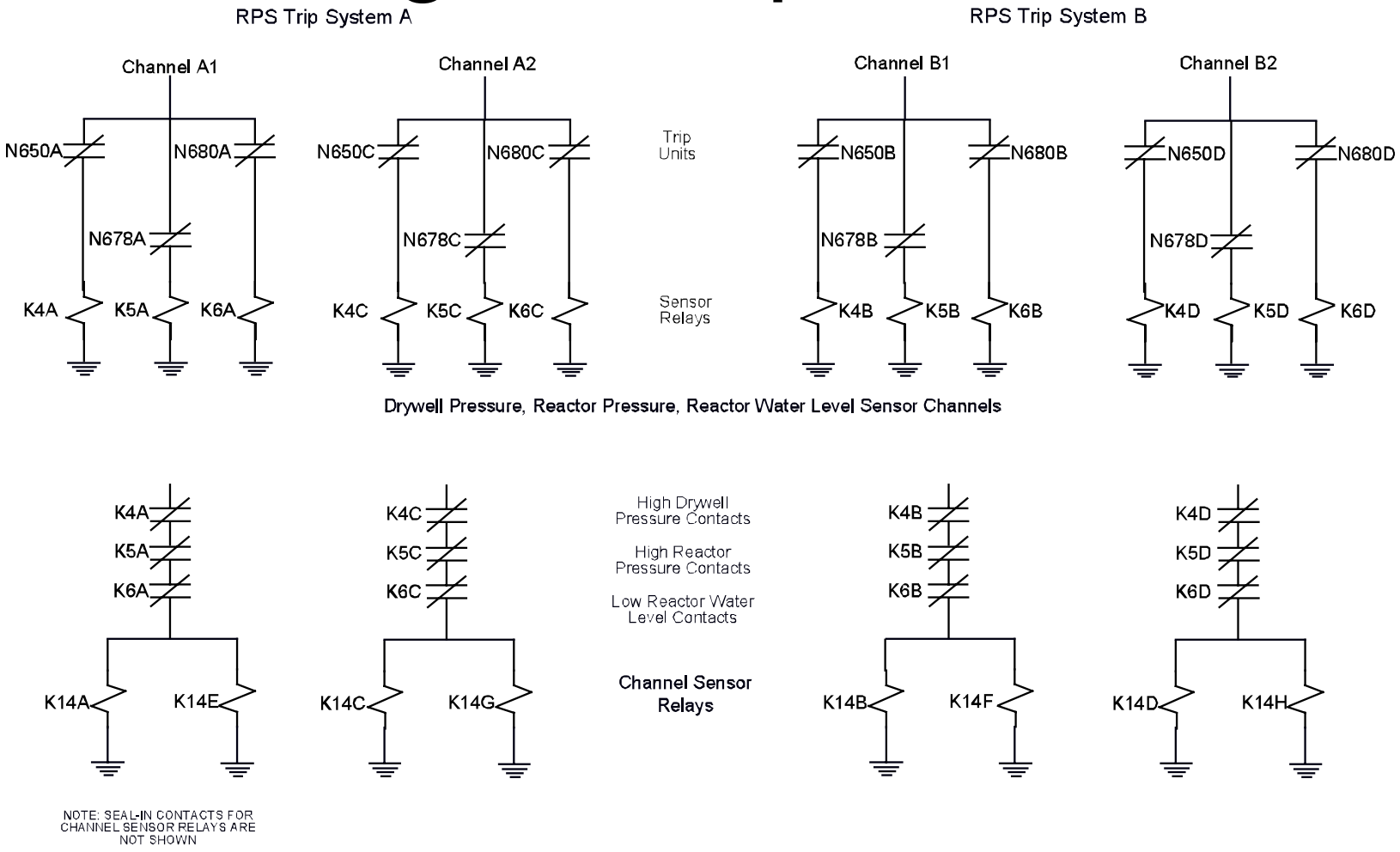


Figure 7.3-5

Objective 3, 5

Integrated operation



Contacts shown with no scram condition present

Reactor Protection System Channels

Figure 7.3-8

Objective 3, 5

Integrated operation

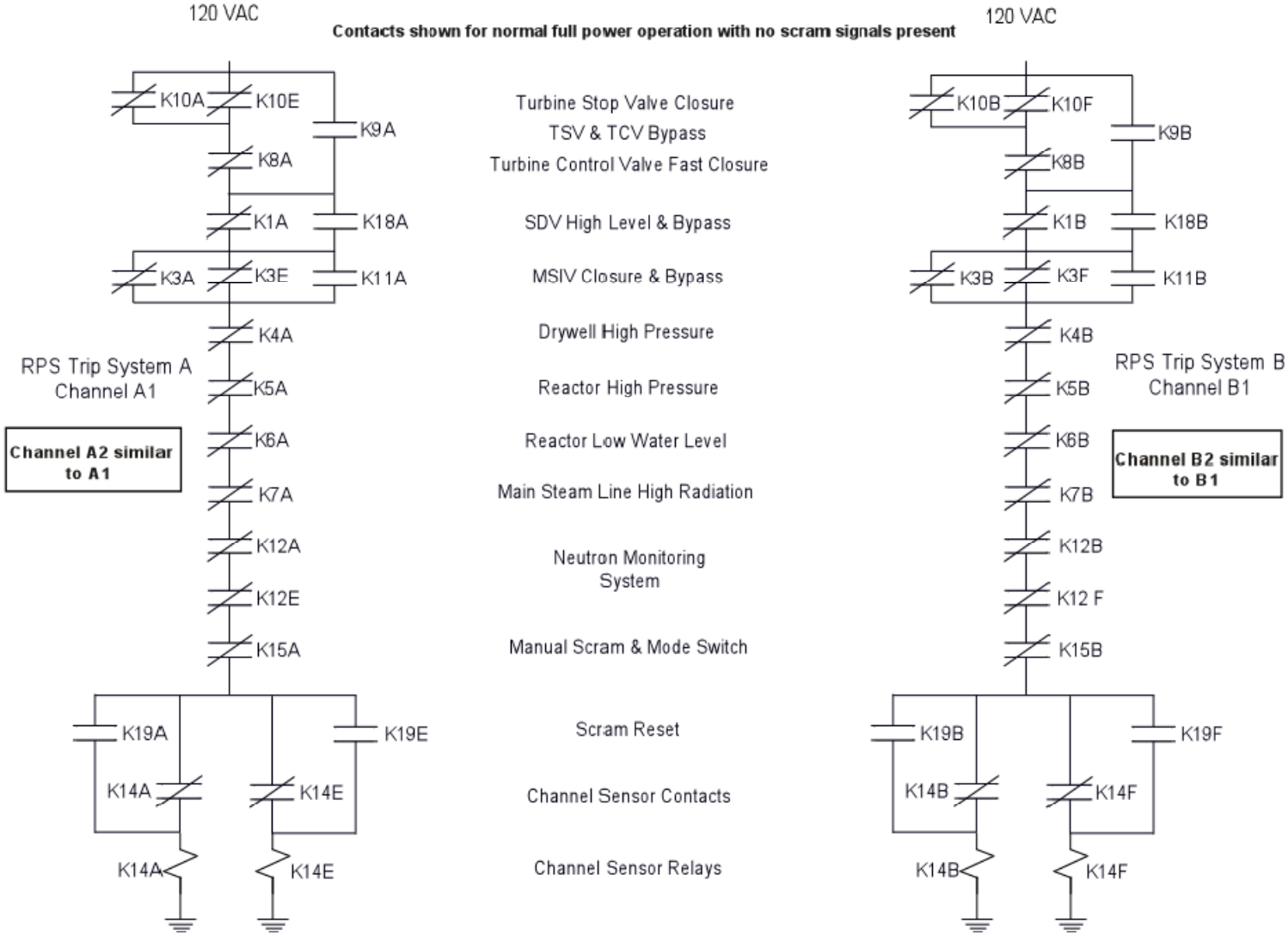


Figure 7.3-4

Objective 3, 5

Integrated operation

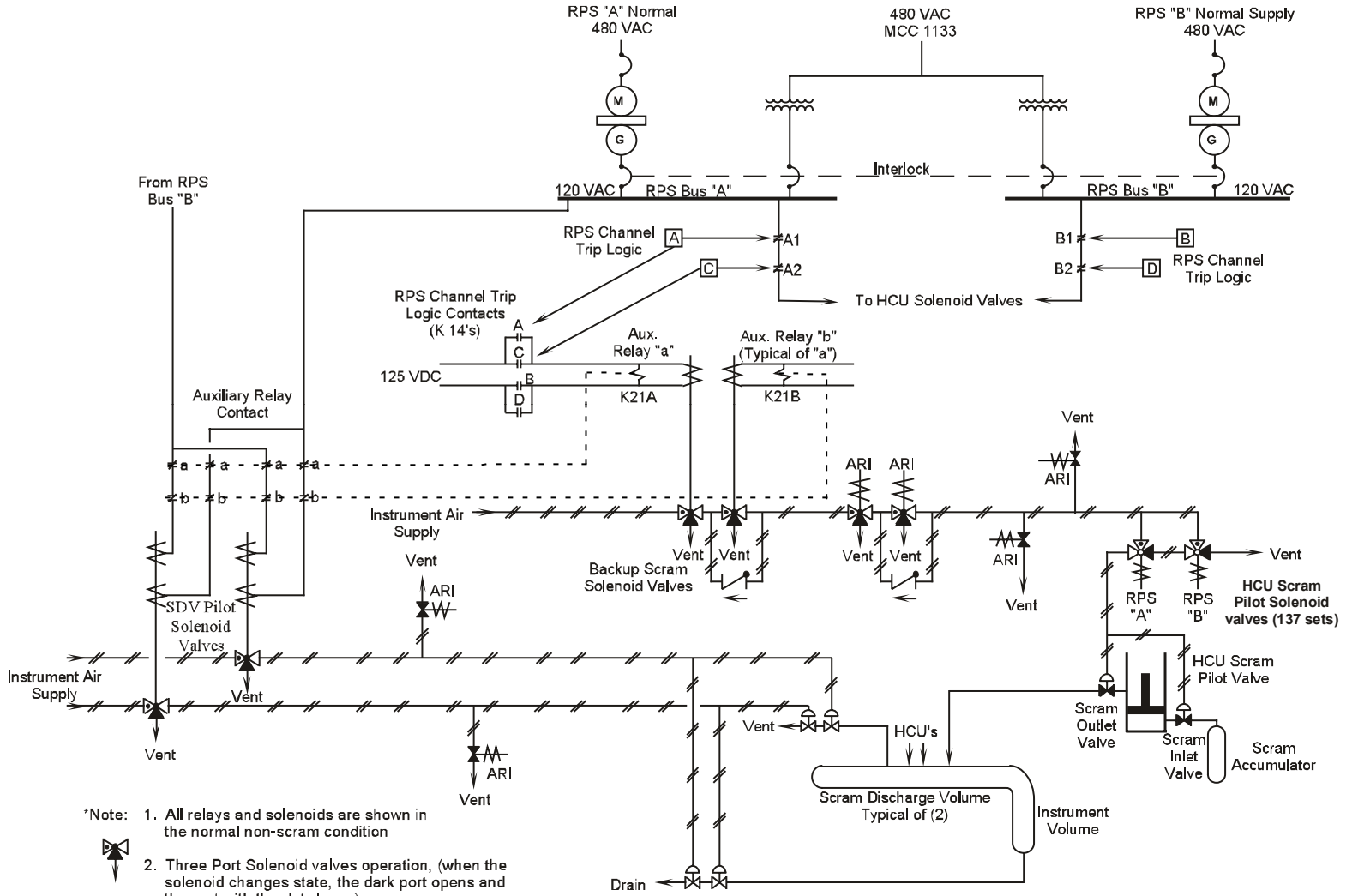


Figure 7.3-5

Objective 3, 5

Integrated operation

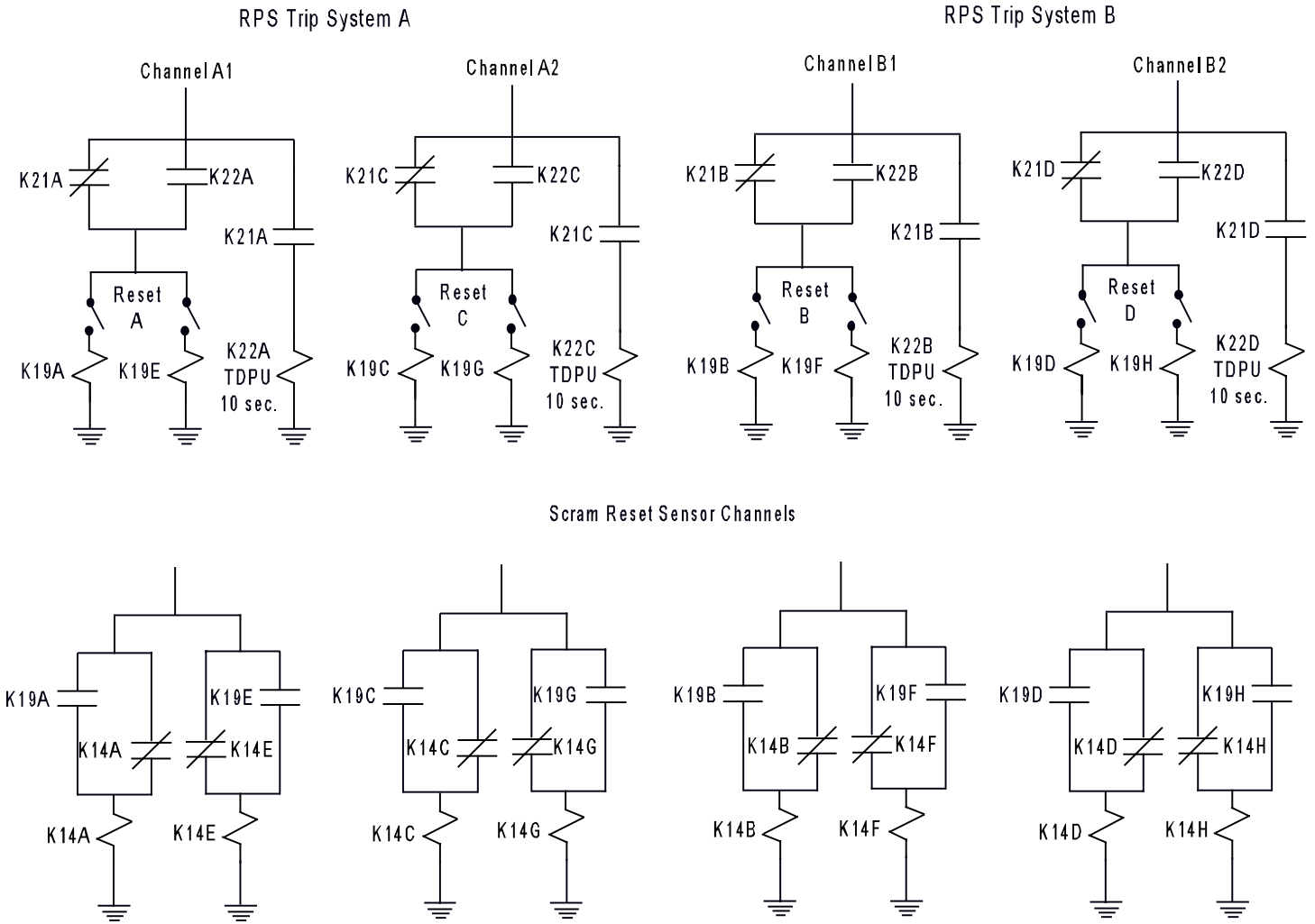


Figure 7.3-7

Objective 2e, 4

System Interfaces

Control Rod Drive System
Reactor Manual Control System
Reactor Recirculation System
Neutron Monitoring System
Instrument Air System
Main Steam System
Reactor Vessel Instrumentation System
Primary Containment System

Objectives

1. **Identify the purposes of the Reactor Protection System (RPS).**
2. **Recognize the purpose function and operation of the following RPS components:**
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3. **Recognize how a scram signal results in control rod insertion.**
4. **List the RPS setpoints which affect the following:**
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5. **Describe the loss of power and loss of air fail-safe features of the system.**
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7. **Explain how this system interfaces with the following systems:**
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   - » **Reactor Manual Control System**
   - » **Reactor Recirculation System**
   - » **Neutron Monitoring System**
   - » **Main Steam System**
   - » **Primary Containment System**
   - » **Reactor Vessel Instrumentation System**
   - » **Instrument Air System**

Are there any questions?