



Incore Monitoring System

Chapter 7.0
B&W Cross-Training Course
R-326C

OBJECTIVES

1. List the purposes of the incore monitoring system.
2. Explain the operation of the self-powered neutron detectors (SPND).
3. Describe the construction of the detector assembly.
4. List the outputs provided by the detector assembly components.

Purposes

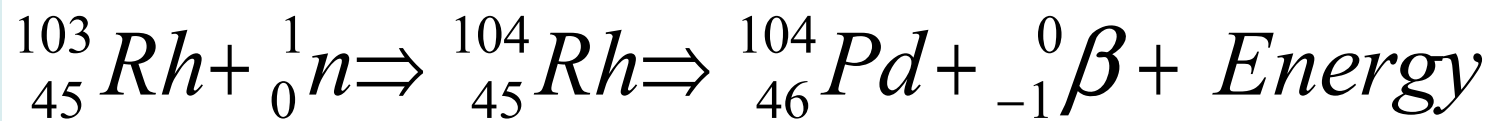
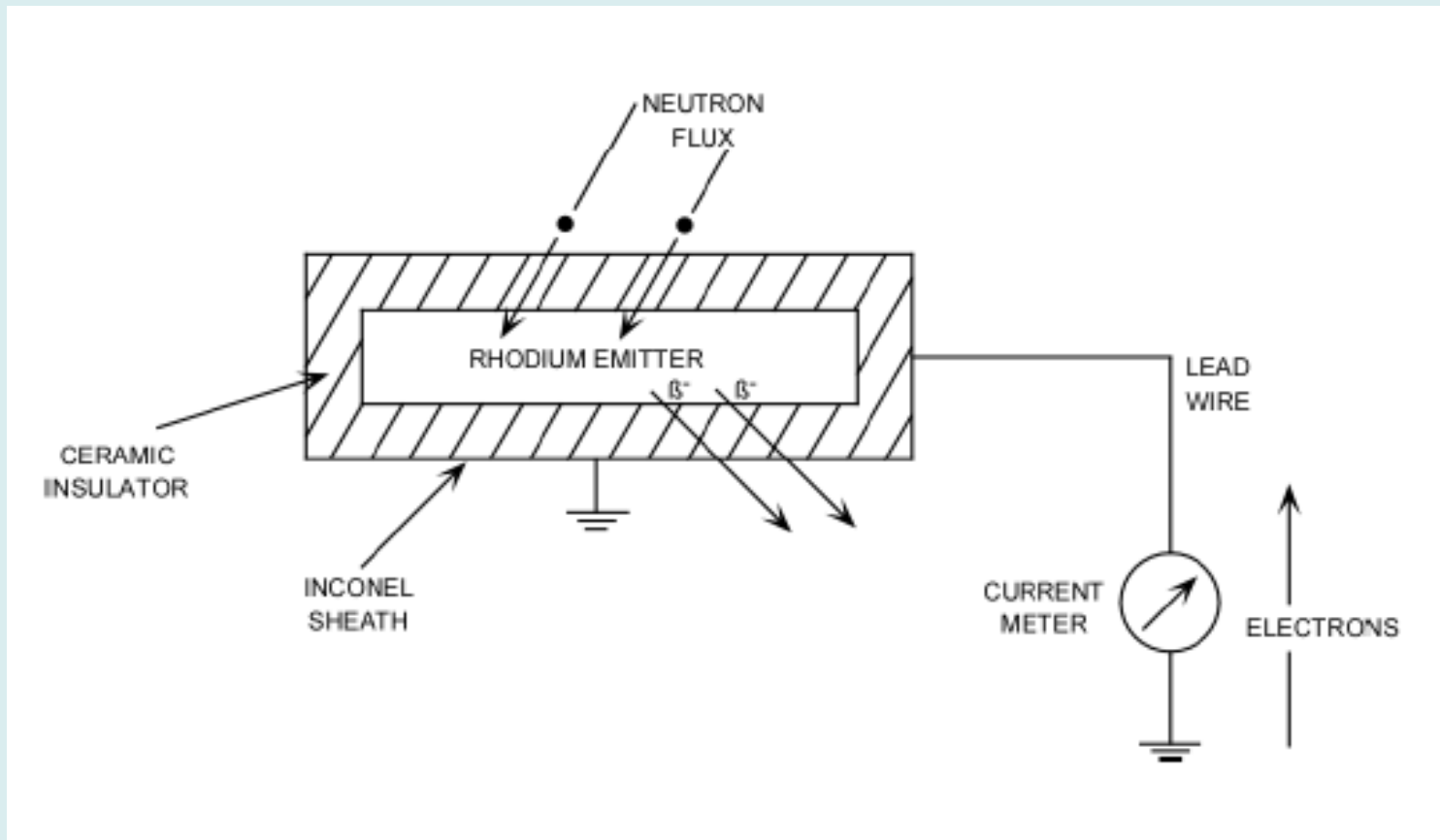
- Continuously monitors:
 - Local core neutron levels to provide information for calculation of:
 - axial power imbalance (API)
 - quadrant power tilt (QPT)
 - Heat Flux Hot Channel Factor ($F_Q(Z)$)
 - Enthalpy Rise Hot Channel Factor ($F_{\Delta H}^N$)

and

- Fuel assembly exit temperatures at the selected locations.

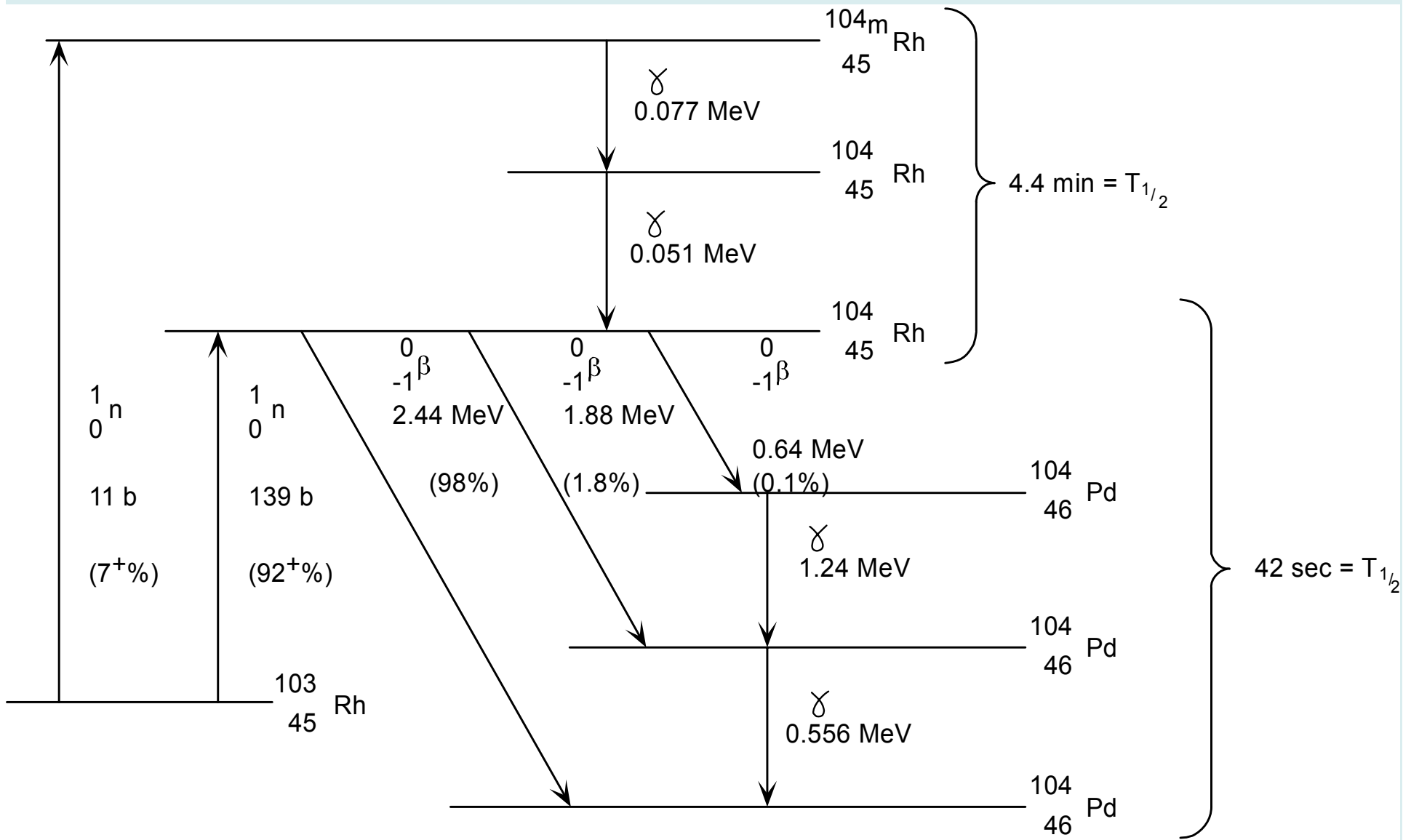
Description

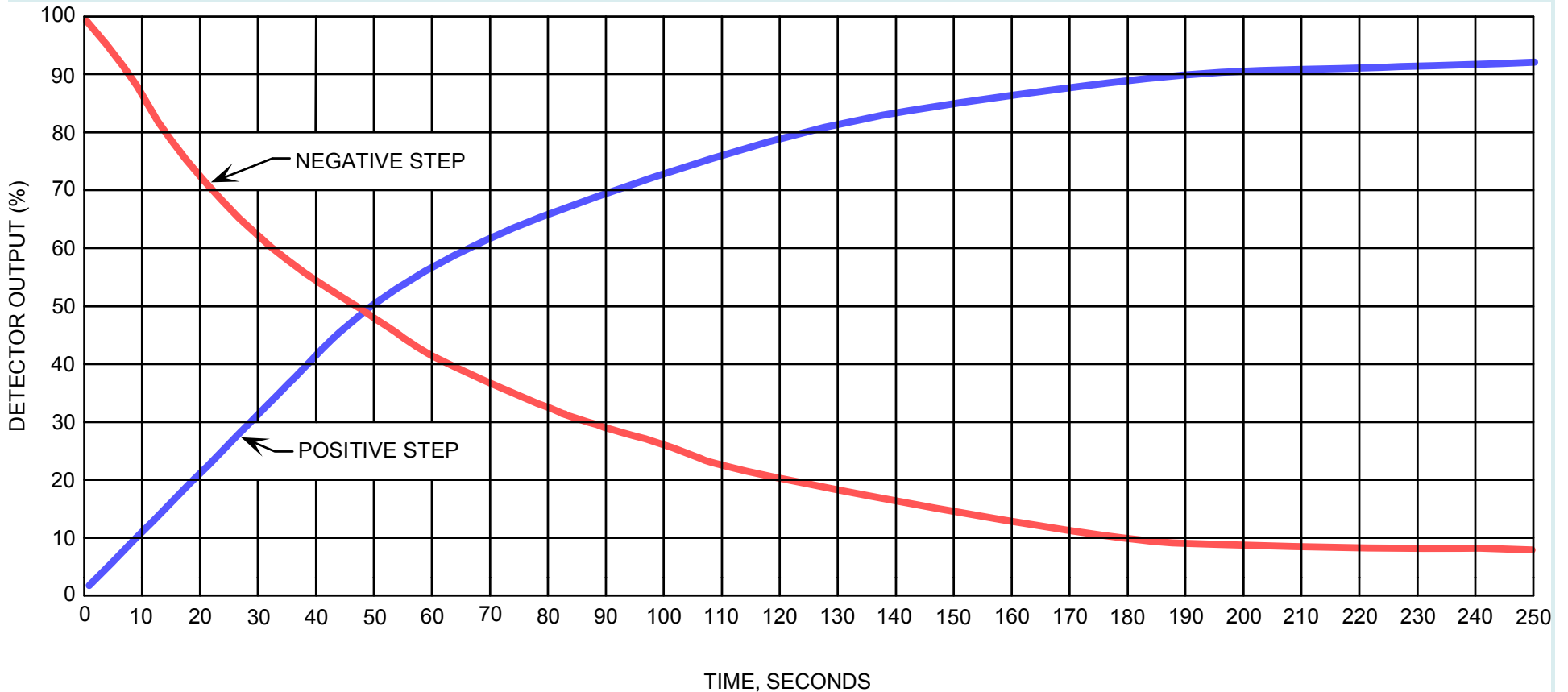
- The incore monitoring system uses 65 strings of self-powered neutron detectors (SPND) installed at pre-selected core locations (52 strings @ existing plants).
- Each string consists of 7 SPNDs, a background detector, and a thermocouple.



Self-Powered Neutron Detector (Fig. 7-1)

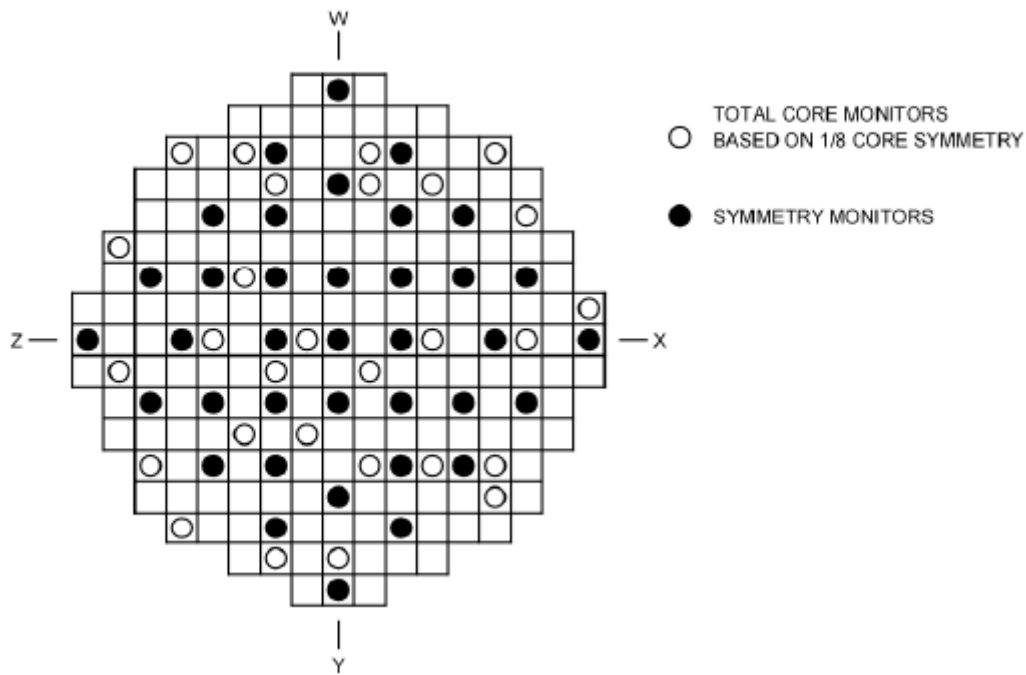
Rhodium Decay Scheme (Fig. 7-2)



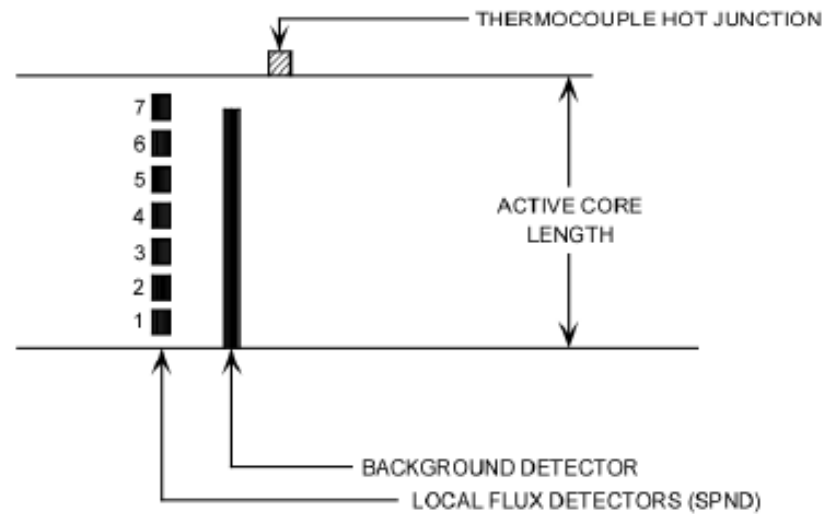


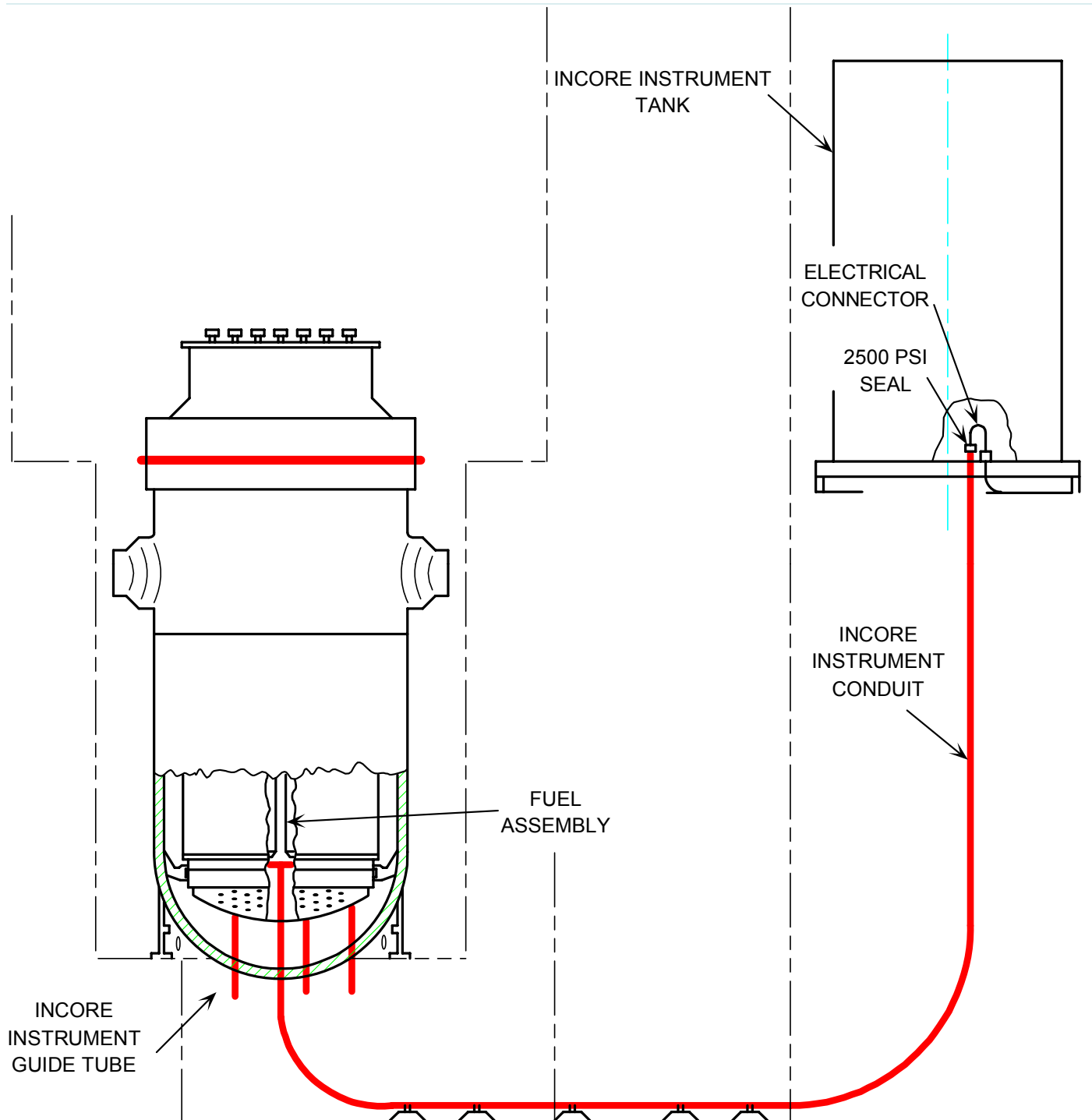
It takes almost 5 minutes for the output of the SPND to reach a new level after a step change in power has occurred.

Response of Rhodium Detectors (Fig. 7-3)



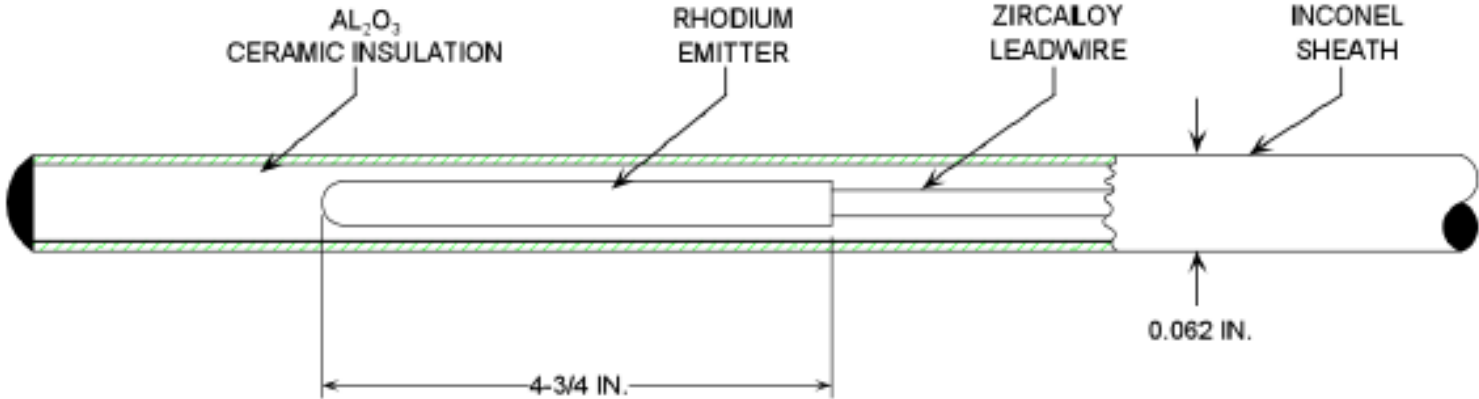
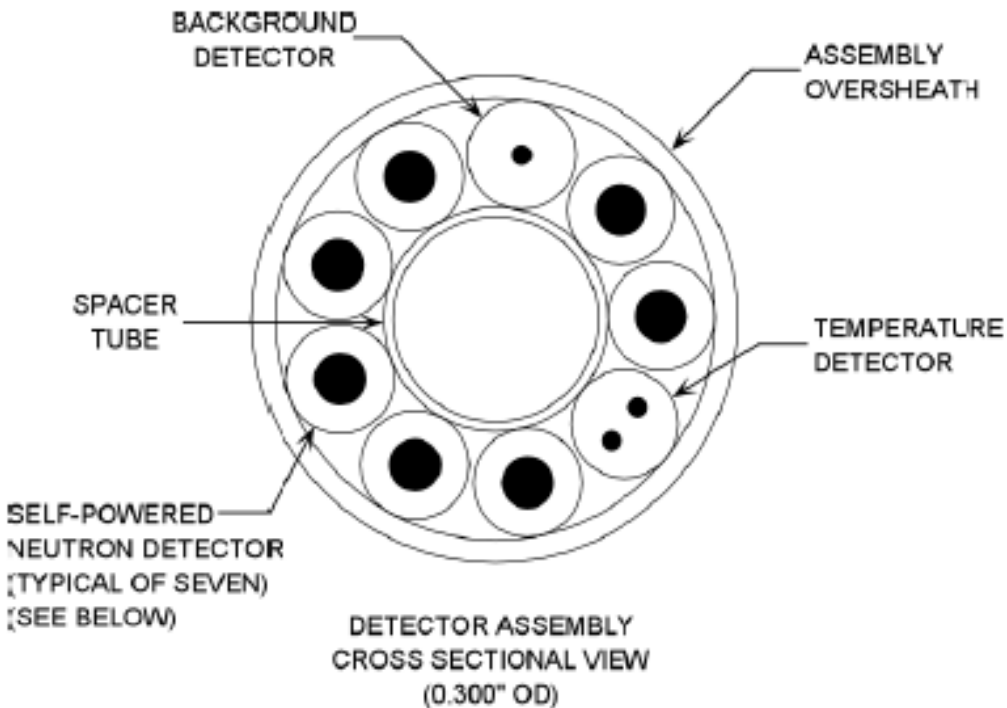
Incore Detector
Arrangement
Fig. 7-4

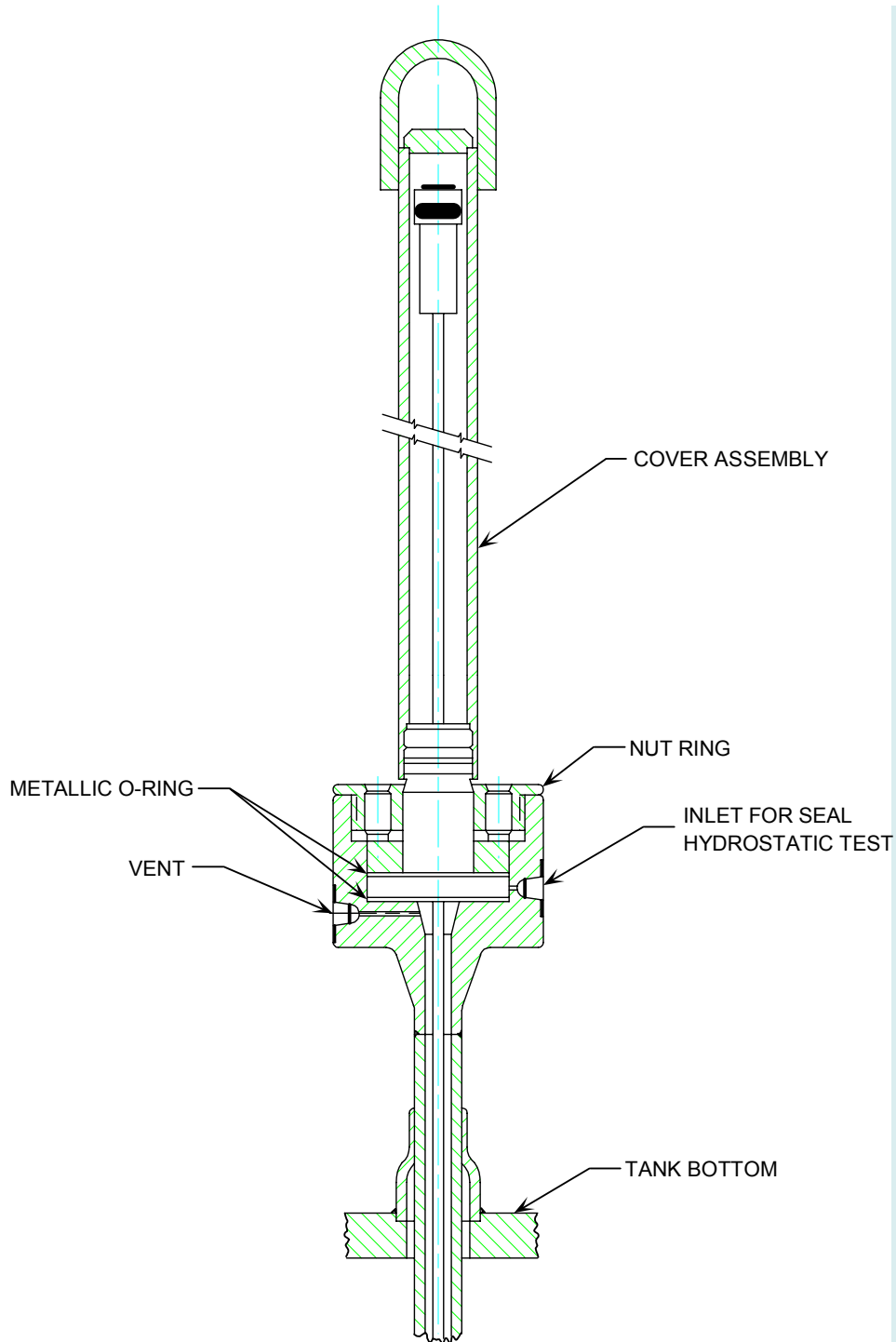




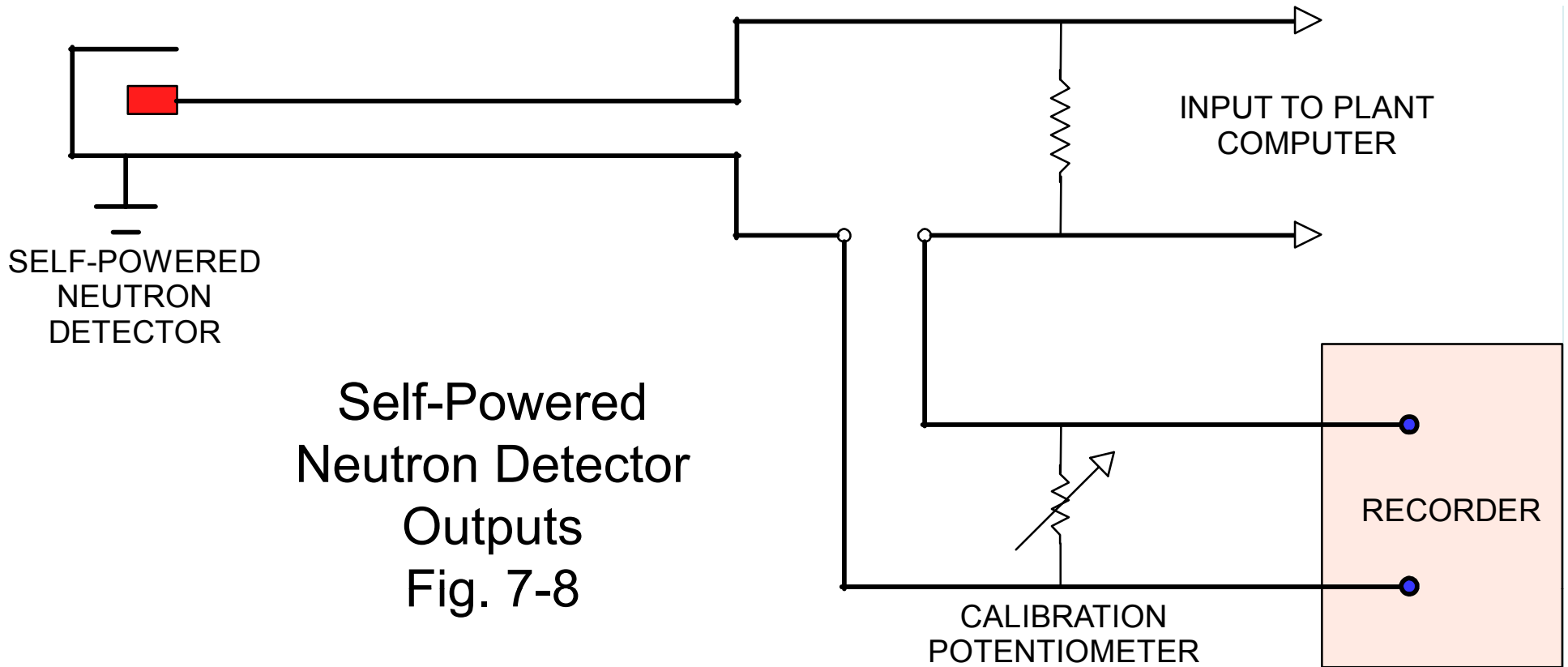
Incore
Detector
Assembly
Installation
Fig. 7-5

Incore Instrument Assembly Fig. 7-6



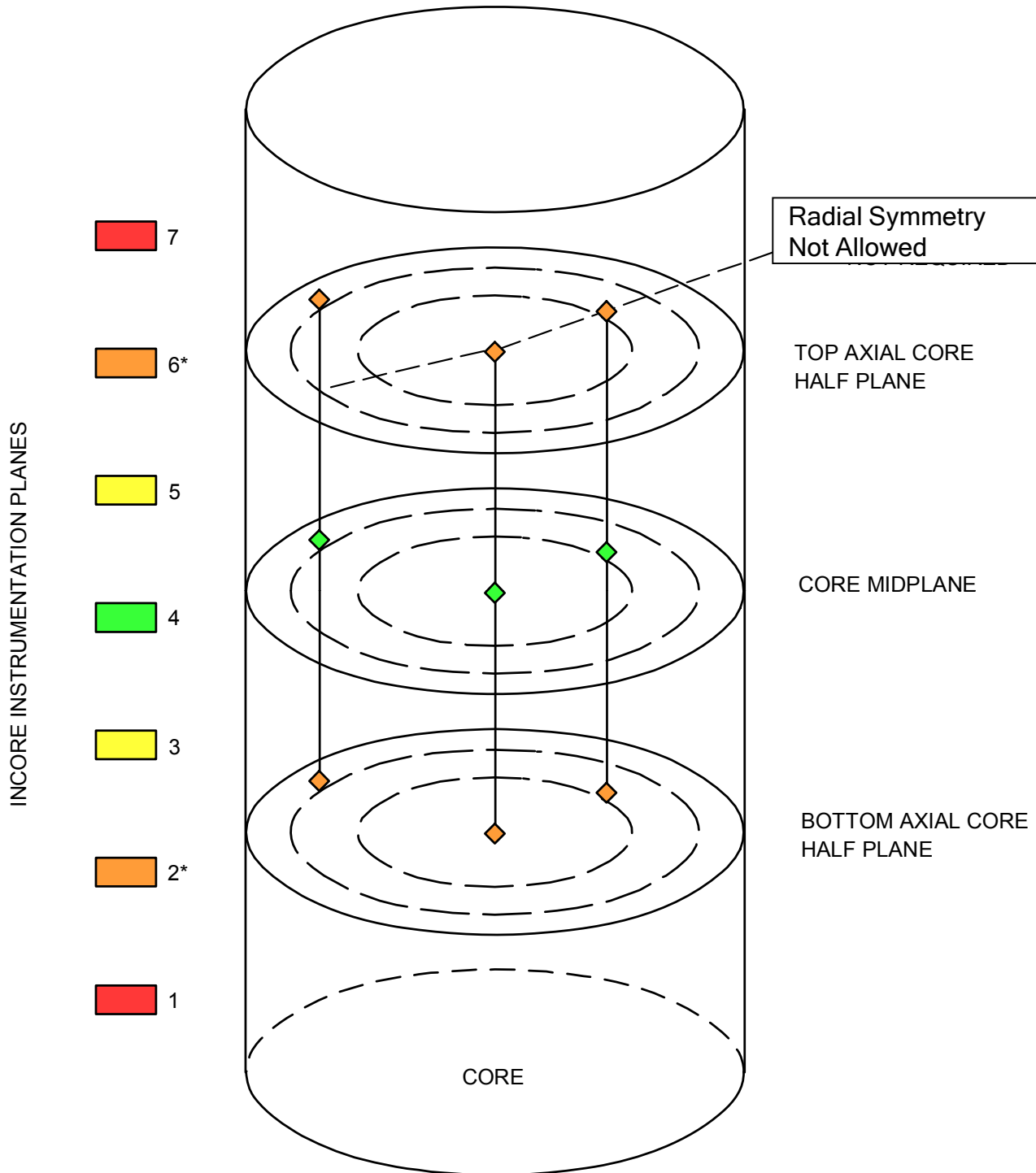


High Pressure
Closure Assembly
Fig. 7-7



Self-Powered
Neutron Detector
Outputs
Fig. 7-8

- The SPND outputs go to the plant computer and a recorder.
- The calibration potentiometer on the recorder is used to adjust for burnup of each detector to display power level.

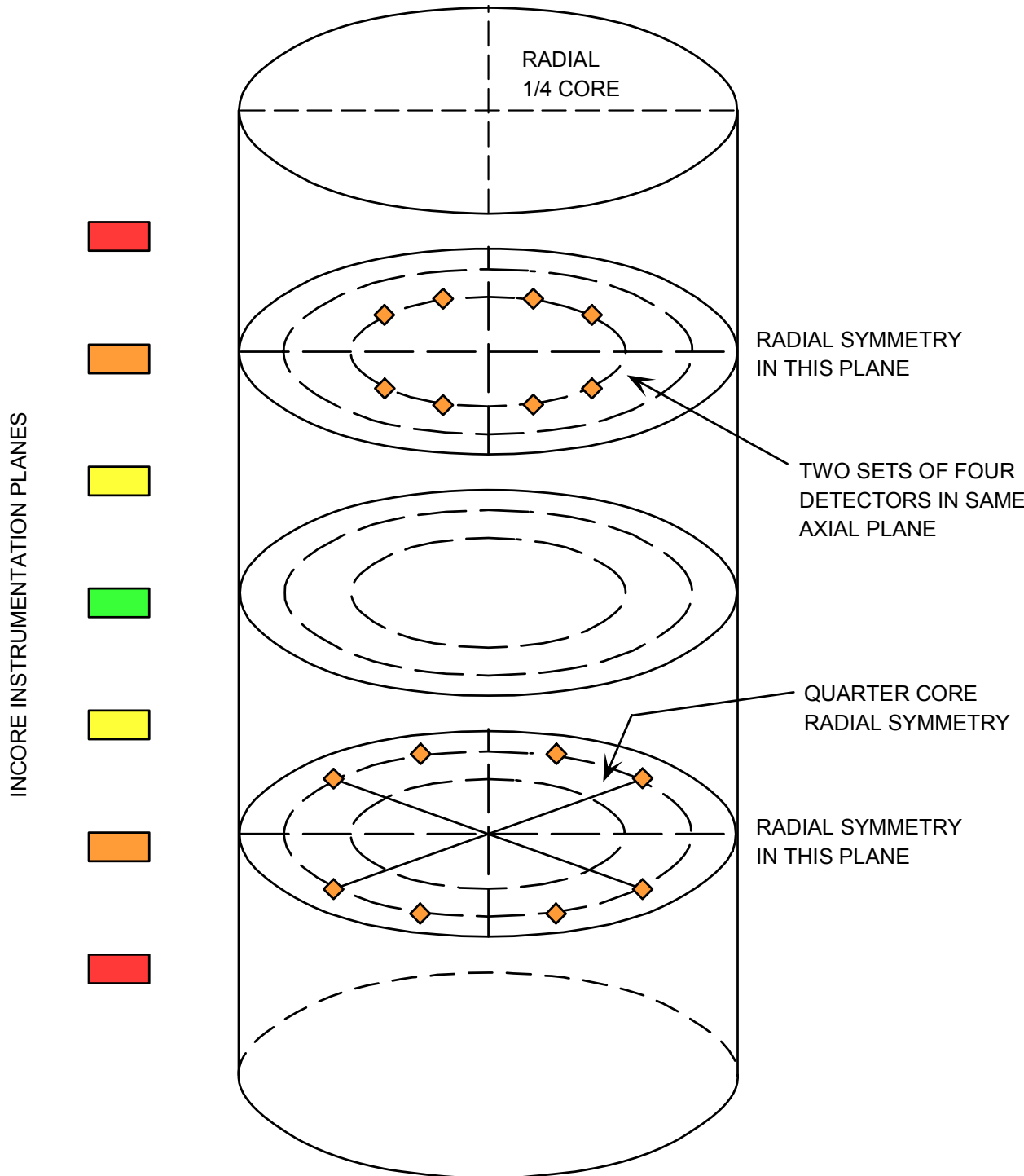


3 measurement system choices for API:

- Full Incore System: (at least 75% of all detectors in each quadrant operable)
- Excore detector system.
- Minimum Incore System

Minimum Incore System for Axial Power Imbalance Measurement

Fig. 7-9



QPT Full Incore System measurement:

- At least 75% of each core quadrant's detectors must be operable,
- AND
- The specific set of 16 detectors needed for the QPT Minimum Incore System measurement.

Minimum Incore System for Quadrant Power Tilt Measurement
Fig. 7-10

Fuel Exit Temperature

- Chromel-alumel thermocouple at top of each detector assembly.
- Gross power distribution core map generated by plant computer.
- Used in EOPs to determine:
 - Proper natural circulation
 - Inadequate core cooling (ICC).