INSTRUCTOR LESSON PLAN

Lesson Title: INCORE NEUTRON MONITORING SYSTEM	Date: March 9, 1986
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9.0 OBJECTIVES

9.1 OUTPUTS

1. Axial flux
2. Radial flux (quadrant power tilt)
3. Fuel assembly exit temp
4. Core differential press.

9.2 SELF_ POWERED NEUTRON DETECTOR (SNPD)

Fig. 10.2-1

A. Operation

~~62~~ 65 assemblies (7detectors/assembly)--- ~~434~~ 455 total

activation of Rh (subsequent B decay)

Rh insulated from elec. ground---B decay represents charge deficiency ∝ # $_{0}n^{1}$ interactions

Rh material connected---measure charge deficiency through current meter

No external power source necessary

Fig. 10.2-2

B. Response time

proportional to Rh-104 decay to Pallidium

effected by 2 half-lives (decay chains)

93% --- 42 sec
7% --- 4.4 min

Fig. 10.2-3

important during changing flux levels

after step change in power level:
5 min to obtain new equil. value for output

precludes use in RPS (too slow of response)

Fig. 10.2-5

9.3 INSTALLATION

A. Rx vessel

physically pushed through conduit from instrument tank to vessel bottom

guide tubes (inside Rx vessel)---
mech. interface between conduit & fuel assembly guide tube

RCS pressure boundary

Fig. 10.2-7

B. Closure assembly

plug

Notes	Lesson Plan (Continuation Sheet)
	O rings (Ag plated) surround seal assembly as nut ring is tightened, o rings are deformed to form the seal nut ring C. Instrument tank refueling: incores withdrwan (25' inside conduit) little exposure (detector still inside condui replacement: requires shielding can flood tank (from spent fuel system)
Fig. 10.2-4	9.4 ARRANGEMENT assemblies inserted in fuel assembly inst. tubes detectors positioned between fuel assembly spacer grids
Fig. 10.2-6	A. Each assembly (Inconnel sheath): 7 detectors background detector TC (chromel - alumel) Al_2O_3 insulation B. Detector corrections (done by computer) 1. sensitivity factor (manufacture error) provided by manufature (X-ray) 2. background (gamma reaction in detector & leadwi 3. Burnup (Rh depletion) 4. leakage (insulation resistance change)
Fig. 10.2-8	C. Detector outputs recorder --- displays selected incore levels cal. pot. -- compensates recorder input detector burnup 1. core exit temperature 2. core differential pressure central spacer tube open at top (RCS press) open to outside of outer sheath (bottom) 3. neutron flux --- computer calculations F

Notes	Lesson Plan (Continuation Sheet)
	F^N_Q --- nuclear heat flux hot channel factor
	F^N_H -- nuclear enthalpy rise hot channel factor
	* offset --- axial flux distribution
	* quadrant power tilt --- radial flux distribution
	9.5 MINIMUM DETECTOR REQUIREMENTS
Fig. 10.2-9	A. Axial Power Imbalance (offset)
	~~1. 75% detectors operable in each quadrant~~
	2. 3 assemblies with 3 detectors per assembly: one detector in upper core half one detector in lower cor half one detector at core mid-plane
	3. Axial planes in each core half MUST be symmetrical about core mid-plane
	4. the 3 detectors shall not have radial symmetry
Fig 10.2-10	B. Quadrant Power Tilt (radial flux)
	1. 75% detectors operable in each quadrant
	2. 2 sets of 4 detectors shall lie in each half (8 detectros / half)
	3. Each set of detectors shall lie in the same axial plane. The 2 sets in each half MAY lie in the same axial plane
	4. Detectors in the same plane shall have quarter core radial symmetry
	$QPT = 100\left(\frac{\text{power in a core quad.}}{\text{ave. power in all quad.}} - 1\right)$