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DATE July 23, 1968

TO A. R. Maguire/A. P. Vinther

FROM J. P. Hamric, Supervisor
Process Physics Unit

SUBJECT PERSONNEL EXPOSURE REDUCTION

References: 1) DUN-4256, "Spline Savings,"
by R.V. Skinner, May 9, 1968,
(Secret)

2) Personal Communication -- DE Hanson
and RM Fulsaa

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Process Physics Unit has investigated in our sphere of responsibility the changes in reactor operating methods which would result in lower personnel radiation exposure. Reduced spline usage is the only innovation I can suggest for reducing personnel radiation accumulation.

Studies show that reduced turnaround levels would be preferable to power cut-back turnarounds. The power cut-back turnaround method does save several splines per turnaround, but the increased risk of cycle resulting from a non-optimum rod configuration or from a bad flux distribution either before or after the cut is probably not worth it. The penalty for lower turnaround levels is increased non-equilibrium startup losses. For a turnaround level reduction of 600 Mw at C Reactor and 1200 Mw at the K Reactors, startup losses would probably double. For normal turnaround levels with the existing loads, the startup losses would average about 0.15 full power days per startup. The splines saved per 100 Mw of power level per startup are estimated below for an average case:

C Reactor	-- Minimum outage:	4.4
	-- Infinite outage:	3.0
K Reactors	-- Minimum outage:	4.0
	-- Infinite outage:	2.5

Assuming 25 startups per year, we currently have about 3.75 full power days of non-equilibrium losses per year. By turning around 600 Mw lower at C Reactor and 1200 Mw at the K Reactors, the startup losses would be about 7.5 full power days per year, and splines saved would be about 475 per year at C Reactor and about 800 per year at the K Reactors. These numbers are best estimates, since the varying

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number of total control splines required at startup preclude a simple multiplication of splines saved per 100 Mw and per 100's of Mw of turnaround power level reduction.

Another method of reducing spline usage is to reduce the spike inventory to the point at which just enough operational control is required in the samarium dip to ensure operation through the dip. We strive for this delicate balance currently, but routinely calculate the spike requirements conservatively. The reason for this is that failure to operate through the dip as a result of inadequate excess reactivity just once per year would more than negate the personnel exposure saved from decreased spline requirements resulting from decreased spike enrichment. For this reason we would like to continue our present method, but with increased effort to reduce the spike inventory when feasible. The personnel exposure reduction would probably be very small for this case, since the splines required are inserted while the reactor is shut down.

In conclusion, lower turnaround levels can be used to reduce splining operations while the reactor is operating, but the penalty for this exposure (and spline) savings would be a significant increase in startup losses.

JPH:vb

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