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HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

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TITLE

ANALOG SIMULATION OF V3R
WITHDRAWAL RATES

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Classification Cancelled and Changed To**DECLASSIFIED**By Authority of RM OttenCGPR-2 3-1-94By J E Savely 3-30-94Verified By SL Hanson 3-30-94

R. A. Harvey, Supervisor
Systems Research
Hanford Laboratories Operation
3707-C Bldg., 300 Area

ANALOG SIMULATION OF VSR WITHDRAWAL RATES

In order to up-date the bases for standards which govern the rate of removal of the VSR's, an analysis of various reactor transients during a cold startup is needed. In particular, we would like to know what reactor power and uranium temperature transients would result if the reactor were to become critical before all of the VSR's had been withdrawn. Under these conditions a Beckman trip would be initiated when the reactor power reached a given level. This will then, after an appropriate delay time, cause the safety rods which are out of the pile to be reinserted. Therefore, the scram strength of the rods will be equal to the amount of reactivity which was added as the rods were withdrawn.

This is an analysis which has been needed for some time, and we would appreciate its completion as soon as possible.

Pertinent reactor data which will be needed are attached. If you have any further questions or need any data which has been omitted, R. E. Tiller is available to assist you.

Roy Nilson
Supervisor, Reactor Physics
Process & Reactor Development Sub-Section
Research & Engineering Section

R Nilson:nmd

Attachment

$$100 - 166 = -66$$

$$L_{eff} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \dots} \approx \frac{1}{\frac{1}{100} + \frac{1}{100}} = 50$$

$$N^2 = \frac{1}{1 - 0.166} = 1.197$$

$$1000 = 1000$$

1000 = 1000

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The test conditions (relaxation and temperature) for the test should be maintained as constant as possible. The test should be run at a constant rate of 1000 Hz. The test should be run at a constant rate of 1000 Hz. The test should be run at a constant rate of 1000 Hz.

The test should be run at a constant rate of 1000 Hz. The test should be run at a constant rate of 1000 Hz. The test should be run at a constant rate of 1000 Hz. The test should be run at a constant rate of 1000 Hz.

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$$T_{1/2} = \frac{h\nu}{i} = \frac{.6731}{\lambda}$$

4-7-61
R-10

Delayed Neutron Data

U235 Thermal

λ	β_i	λ_i	α_i	β_i	$\lambda_i/\beta_i = .015$
1	55.72	.01244	.000	.000211	
2	22.72	.030504	.01	.001401	$\nu = 2.47$
3	3.22	.0043	.17	.001355	
4	1.30	.30135	.395	.002521	
5	.610	.77542	.115	.000707	
6	.230	3.0135	.040	.000267	

Pu239 Thermal

λ	β_i	λ_i	α_i	β_i	$\lambda_i/\beta_i = .0061$
1	55.72	.01277	.005	.00007	
2	22.72	.03048	.090	.000605	$\nu = 2.31$
3	5.60	.1377	.011	.000403	
4	2.13	.3054	.305	.000661	
5	.611	.77575	.005	.000170	
6	.257	4.767	.000	.000020	

Pu239 Fast

λ	β_i	λ_i	α_i	β_i	$\lambda_i/\beta_i = .001$
1	24.81	.01313	.010	.00010	
2	11.25	.01313	.107	.00015	$\nu = 2.1$
3	5.37	.03062	.10	.00050	
4	1.30	.30712	.30	.00010	
5	.60	.7445	.00	.00001	
6	.172	4.0427	.00	.00001	

Where:

α_i = Fraction of delayed neutrons which will decay to λ_i

λ_i/β_i = total number of delayed neutrons per prompt neutron

ν = number of prompt neutrons per fission

For the equivalent group, for all of the isotopes:

$$\beta_i = \frac{\sum_j f_j \nu_j \beta_{ji}}{\sum_j f_j \nu_j}$$

$$\lambda_{1,2} = \frac{\sum_j f_j \nu_j \beta_{ji} T_{1/2i}}{\sum_j f_j \nu_j \beta_{ji}} = \frac{\sum_j f_j (\frac{\lambda}{F})_j a_{ji} T_{1/2i}}{\sum_j f_j (\frac{\lambda}{F})_j a_{ji}}$$

$$0.11 = 11 \times 10^{-3} = 11 \times 10^{-3}$$

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[REDACTED]

$$= 3037.41504 \text{ gm/sec}$$

Page 5

Mass Flow Rate of Water = $\frac{24.157 \text{ lbs./hour}}{3600}$ (1 tube)
(held this constant during runs)

Lattice Constants

$$\gamma = 355 \text{ cm}^2$$

$$L^2 = 290 \text{ cm}^2$$

$$r = .002$$

$$D_f^2 = 31.3 \times 10^{-6} \text{ cm}^2$$

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Flow Distribution - Front to Rear

Grains distributed approximately to zero at 171 inches from each end of the fuel column. ^{fuel column is} 720.5472 cm long

43.434 cm

Grains per inch	
1.5	1.5
3.5	10.0
4.0	2.0
4.0, 8.0	6
4.0, 8.0	1
4.0	1

For Front view H₂O is
same as width of unburned
propellant bed at 171 in

For Rear view H₂O is
same as width of unburned
propellant bed at 171 in

For Front view H₂O is
same as width of unburned
propellant bed at 171 in

[REDACTED]

DATE

FILMED

6 / 27 / 94

END