LOFT TECHNICAL REPORT LTR 1111-44

JULY 27, 1978

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LPWR FUEL ASSEMBLY CHARACTERISTICS

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LOFT TECHNICAL REPORT
LOFT PROGRAM

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SUMMARY

The purpose of this LTR is to document the LPWR fuel assembly characteristics from which the LOFT fuel bundle material and dimension design choices were derived.

LPWR FUEL ASSEMBLY CHARACTERISTICS

TABLE I

LPWR FUEL ASSEMBLY CHARACTERISTICS

Item	Trojan ^[a] (Westinghouse)	Millstone No. 1 ^[a] Combustion Eng.)	Davis-Besse ^[a] Babcock & Wilcox
1. Materials			
a. Fuel: Material	UO ₂	UO ₂	UO ₂
Density	94, 92, and 91	92.15	93.5
b. Fuel pin cladding: Material	Zircaloy-4	Zircaloy-4	Zircaloy-4
UTS (650°F)	[b]	[b]	70,000 nom ^[c]
YS (650°F)	[b]	[b]	50,000 nom ^[c]
% Elong. (650°F)	[b]	[b]	15 nom ^[c]
c. Fuel pin filler gas	Helium	Helium	Helium
d. Skeleton top and bottom end box	304 ss	[d]	Cast ss
e. Skeleton support tubes	Zircaloy-4	[d]	Zircaloy-4
f. Spacer grids	Inc. 718	Zircaloy-4	Inc. 718
g. Skeleton fasteners	Inc. 600	[d]	[d]
h. Skeleton springs	Inc. 718	[d]	[d]
i. Control rod clad tube	304 ss	N ₁ CrFe Alloy	304 ss (cold-worked)
j. Poison	B ₄ C	B ₄ C	Cd/In/Ag
k. Control rod spider assembly	Stainless Steel	Stainless Steel	Stainless Steel GR. CF 3m
l. Sources: Primary (init startup)	Po Be	[d]	[d]
Secondary	Sb Be	[d]	[d]
2. Dimensions and Envelopes			
a. Fuel pin array	15 x 15	14 x 14	15 x 15
b. Fuel pins per assembly	204	176	208
c. Fuel pin pitch - in.	0.563	0.580	0.568
d. Fuel: Geometry	Pellet	Pellet	Pellet
End Configuration	Both ends dished	Both ends dished	Both ends dished
OD (in.)	0.3669	0.3815	0.370
Length: Pellet (in.)	0.600	0.600	0.700
Pellet stack (in.)	144	137	144

[a] Unless otherwise noted, information is from Preliminary Safety Analysis Reports.

[b] This information was solicited from reactor designers. No information was returned for these items.

[c] Intercompany correspondence from B. A. Mong (B&W) to H. L. Coplen (INC) dated June 29, 1970.

[d] Information not yet solicited.

TABLE I (contd.)

Item	Trojan ^[a] (Westinghouse)	Millstone No. 1 ^[a] (Combustion Eng.)	Davis-Besse ^[a] Babcock & Wilcox
e. Fuel pin cladding: ID (in.)	0.3734	0.3880	0.377
Thick (in.)	0.0243	0.0260	0.0265
f. Fuel pin void-fuel volume ratio	[b]	[b]	0.105
g. Fuel pin length (total)(in.)	[b]	147.4	153.1
h. Fuel pin diameter	0.422	0.440	0.430
i. Fuel assy. outside dim	8.426	7.980	3
j. Fuel assembly - pitch	8.466	8.180	8.587
k. Spacer grid axial space	16.87 - 20.75 Ave. 18.33	[d]	[d]
l. Control rod clad tube dia	0.4395 in. OD	0.44 in. OD	0.440 in. OD
m. Control rod clad tube thickness	0.024	0.040	0.021
n. Guide tubes: Upper section	0.546 OD x 0.512 ID	[d]	[d]
Lower section	0.489 OD x 0.455 ID		
o. Source: Locations	Inside control rod guide tube	[d]	[d]
3. Operating Conditions and Parameters			
a. Pellet stack holddown spring force (lb)	[b]	[b]	0 (RT), 70 max operating temperatures ^[c]
b. Linear ht/rate (kW/ft): Avg	7.0	5.9	5.8
Max (nom)	[b]	14.18	17.2
(design)	18.8	18.2	17.8
c. Fuel temp (°F): Avg	[b]	[b]	1560
Avg at hot spot:			
(nom)	[b]	[b]	2720 ^[c]
(design)	[b]	[b]	2760 ^[c]
£ at hot spot:			
(nom)	[b]	[b]	4030 ^[c]
(design)	4140	4110	4120 ^[c]

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TABLE -- (contd.)

Item	Trojan ^[a] (Westinghouse)	Millstone No. 1 ^[a] (Combustion Eng.)	Davis-Besse ^[a] Babcock & Wilcox
d. Fuel pin internal pressure (psi):			
initial	[b]	[b]	Atmos ^[c]
EOL design	2250 max	2285 max	3300 max ^[c]
e. Sources: a. Primary	2	[d]	[d]
b. Secondary	4	[d]	[d]
f. Source strengths:			
a. Primary at startup (curies)	200	[d]	[d]
(nvt)	5 x 10 ⁸	[d]	[d]
b. Secondary	[d]	[d]	[d]
c. Neutron flux at detector at startup (nvt)	[d]	[d]	[d]

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