SAXTON NUCLEAR EXPERIMENTAL CORPORATION

DOCKET NO. 50-146
LICENSE DPR-4

- - - - - - - - - - -

CHANGE REQUEST NO. 28

- - - - - - - - - - -

Applicant hereby submits Change Request No. 28 in compliance with paragraph 3B of License DPR-4 for change of the Technical Specifications to be authorized by the Commission as provided in 10 CFR 50.59.

SAXTON NUCLEAR EXPERIMENTAL CORPORATION

By /s/ R. E. Heidig
President

1. Description of Change

In Supplement No. 1 to Technical Specifications, add the following Test Fuel Assembly to Item F.2.

Test Fuel Assembly XVIII

One 9 rod subassembly of standard pitch and array shall contain the following:

a. Two burnable poison test rods containing borosilicate (Pyrex) glass tubing (0.388 nom. O.D. x 0.251 nom. I.D.) sealed in type 304 stainless steel clad (0.4315 nom. O.D. x 0.019 nom. wall thickness) will be suspended in a type 304 stainless steel RCC thimble guide tube (0.519 nom. O.D. x 0.4945 nom. I.D.). The borosilicate glass is annular in cross section (Figure 1) and is supported on the inner side by a type 304 stainless steel tube (0.245 nom. O.D. x 0.007 nom. wall thickness. The composition of the borosilicate glass is shown in Table 1. These rods may contain a 0.02 inch diameter Al-Co alloy tracer wire sealed in a 0.035 inch diameter titanium tube suspended in the central void from an attachment to the inner surface of the top end plug.

b. The four corner positions and the center position of the subassembly contain dummy fuel rods of the same size and configuration as standard Saxton fuel rods, but contain no fuel. The five dummy rods are orificed at the top and bottom end plugs to permit filling of the rod internal volume with primary coolant.

c. The remaining two rods will be any combination of the following:

   1. Zircaloy-4 clad rods containing Zircaloy-4 encapsulated stress relaxation test specimens described in Change Request No. 24.

   2. Internally pressurized Zircaloy-4 clad rods containing 17.4% enriched UO_2 fuel pellets described in Change Request No. 22.

   3. Internally pressurized 304 SST clad rods containing 5.7% enriched UO_2 fuel pellets described in Change Request No. 22.

The test subassembly may be located in one of two peripheral core positions, either the N-3 position or the N-5 position. When the subassembly contains 17.4% enriched fuel rods it may be operated at reactor power levels up to 23.5 MWt, otherwise it may be operated at power levels up to 35 MWt.

2. Purpose of Change

The purpose of this change is to permit insertion of Test Fuel Assembly XVIII into the core in order to:

a. Verify mechanical performance of a burnable poison material and rod configuration in a power reactor environment. Approximately 6400 megawatt days of exposure is expected, at the end of which approximately 50% of the B_{10} in the pyrex glass will be consumed. Dimensional inspection of the rods will be conducted before and after exposure to demonstrate the absence of large clad strains or diametral changes as a result of the elevated temperature and depletion of B_{10}.

b. Continue the in-pile testing of internally pressurized rods and stress relaxation test specimens described in Change Requests 22 and 24 respectively.

3. Safety Considerations

The burnable poison rods will simulate the mechanical and hydraulic configuration of prototype rods and will be statically positioned in RCC thimble tubes in the same manner as the test elements in the RCC test assembly (Change Request No. 10). The rods have been designed in accordance with the standard Westinghouse APD fuel rod design criteria, i.e., the cladding is free standing at reactor operating temperature and pressures and sufficient cold void volume has been provided within the rods to limit internal pressure release of all helium generated in the B_{10} n,α reaction.

The calculated stresses in the cladding for the expected beginning of life temperature and pressure condition is given in Table 3. The maximum stress is compressive and occurs at beginning of life because of the larger differential pressure. The large void volume required to contain the helium generated has been obtained by using glass of an annular cross-section (tubing) to provide a central void along the length of the poison rods.

Based on available data on properties of the pyrex glass and on nuclear and thermal design calculations for the rod, the glass is not expected to melt or undergo gross cracking or swelling during operation. However, as insurance against possible slumping of glass into the central cavity and the resulting redistribution of the poison material during operation, the glass is provided with a thin wall stainless steel tube as an inner liner.

The wall thickness of the inner liner is sized to provide inner support for the glass in the event of possible melting or slumping due to softening but to

collapse locally before rupture of the exterior cladding if swelling or large volume changes due to cracking of the glass should occur. The inner liner is open at the top end to receive the helium which will diffuse out of the glass.

Because the assembly is to be irradiated at a peripheral location in the Saxton reactor where the thermal neutron flux is lower than required for the desired burnup of the B_{10} in the poison rods, a flux trap has been designed into the assembly. The increased moderator volume necessary to produce the flux peak has been obtained without an increase in bypass coolant flow by the use of the dummy fuel rods.

Although the flux peaking produced in the vicinity of the poison rods provides the desired poison depletion, the maximum heat rate in the fuel rods in the surrounding 9 x 9 fuel assembly (10.2 kw/ft @ 35 MWt) will still be well below the heat rate in the peak rods of the core. The peak heat rate in the fuel rods within the test assembly under design conditions would be as follows:

a. Zircaloy clad 17.4 w/o enriched rods........12.4 kw/ft @ 23.5 MWt

b. Stainless clad 5.7 w/o enriched rods........10.2 kw/ft @ 35 MWt

To eliminate the possibility of the higher enriched zircaloy clad rods exceeding the current limit on peak heat rate, the reactor power will be limited to 23.5 MWt with these rods in the burnable poison test assembly. The heat rate in the stainless clad rods is sufficiently below the limit to present no problem even at 35 MWt reactor operation. The calculated internal pressure and maximum clad stresses for the internally pressurized rods at design conditions are listed in Table IV.

4. Health and Safety

It is our opinion that the health and safety of the public is not endangered by this change.

TABLE 1

COMPOSITION OF BOROSILICATE GLASS

$Si\ O_2$	80.5 wt%
Al_2O_3	2.2
Na_2	3.8
K_2O	0.5
B_2O_3	12.9

TABLE 2

BURNABLE POISON ROD OPERATING CHARACTERISTICS

Heat Generation Rate (includes (n,α) and λ heating)

at 35 MWt	0.628 kw/ft
at 23.5 MWt	0.421 kw/ft

Maximum Pyrex Temperature (°F)	35.0 MWt		23.5 MWt	
	Air Fill	He Fill	Air Fill	He Fill
Maximum Gap (7 mil)	910	690	780	640
Nominal Gap (5.5 mil)	860	670	750	630

Pyrex Glass Annealing Temperature	1050°F
Pyrex Glass Softening Temperature	1520°F

Internal Pressure at end of exposure assuming total He release - 870 psi

B-10 depletion after 6400 megawatt days of operation - 50%

TABLE 3

TOTAL POISON ROD CLAD STRESSES AT BEGINNING OF LIFE
(OVAL CLAD)

Component	Minor Axis		Major Axis	
	I.D.	O.D.	I.D.	O.D.
Direct	-24735	-24735	-24735	-24735
Bending	+8461	-8461	-8461	+8461
Thermal	-526	+526	-526	+526
TOTAL	-16800	-32670	-33720	-15750

TABLE 4

FUEL ROD CLAD STRESSES AND INTERNAL PRESSURES

	Peak Clad Stress psi	Internal Pressure, psia
Zircaloy Clad Rods (23.5 Mwt operation)	24,300	5200
Stainless Clad Rods (35 Mwt operation)	45,200	5450

SKETCH SHEET
FORM 28577

WESTINGHOUSE ELECTRIC CORPORATION

Docket No. 50-146
DPR-4
Technical Specifications
Change Request No. 28
Page 8 of 8 Pages

TEST ASSEMBLY CROSS-SECTION

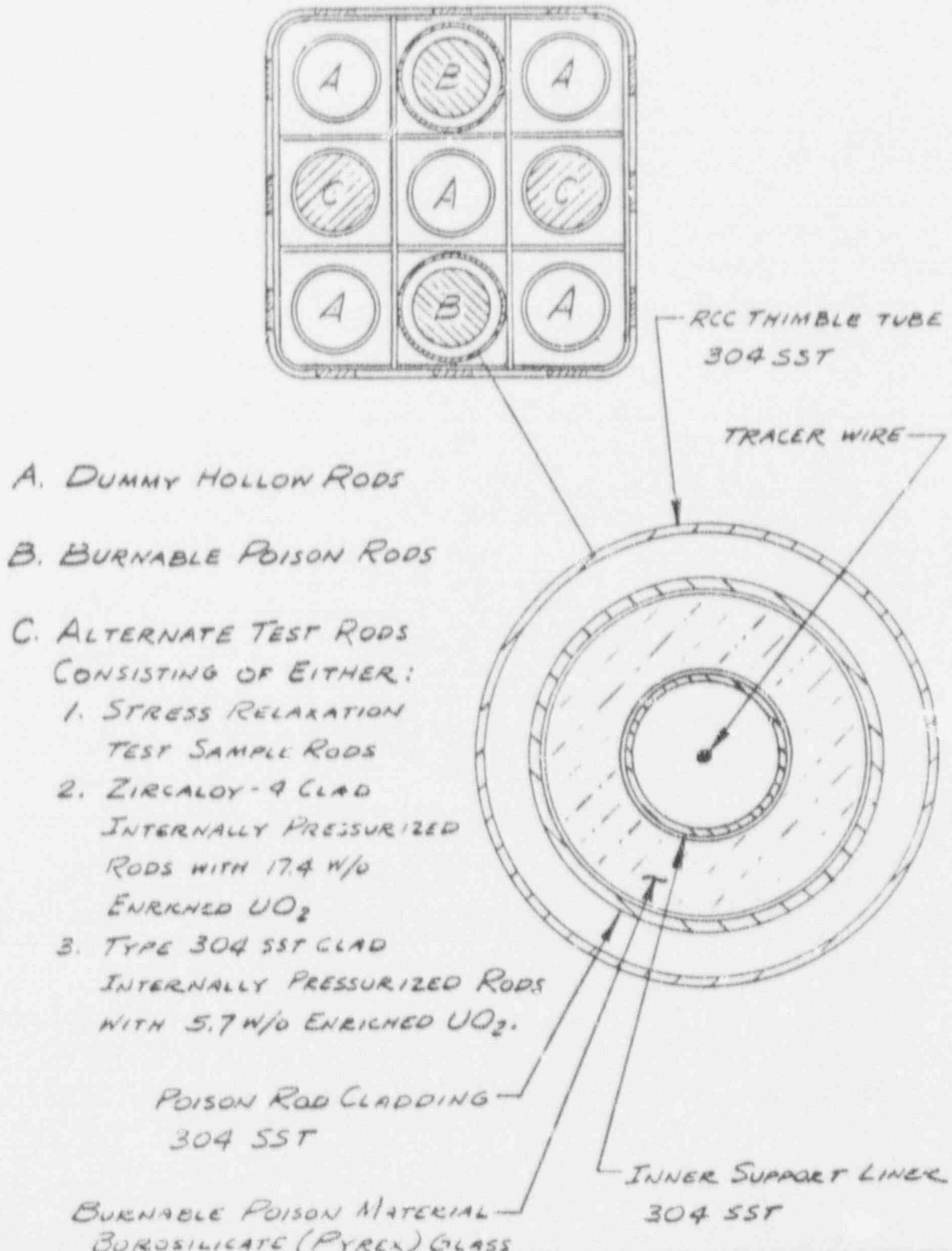

FIGURE 1. SAXTON BURNABLE POISON TEST ASSEMBLY.