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FUEL ELEMENT - SUPPORT BLOCK FRICTION
(EML-43)
(Title Unclassified)

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1.0 INTRODUCTION

Differential thermal expansions between the fuel elements and cluster support blocks will occur during reactor startup. Since damage to these components could result during startup if high bonding forces developed, tests were performed to measure the breakaway friction forces required to produce relative motion under simulated reactor conditions.

2.0 TEST DESCRIPTION

The movable test specimens used in the tests were machined from coated fuel element ends and support blocks. In order to keep the contact area constant during the tests, coated solid graphite plates were used as the stationary specimens. The specimens were sized to develop an average contact pressure of 150 psi under a normal force of 20 lb.

The tests were performed in the hydrogen friction test furnace shown in Figures 1 and 2. Changes were made in the original furnace components to permit specimen contact pressures larger than those for which the furnace was originally intended.

The furnace heating element is an electrical resistance heated graphite tube with a rectangular slot cut through its center as shown in Figure 3. The high furnace temperatures occur locally in the slotted area of the tube. The stationary specimen was placed at the bottom of this slot. The movable specimen was locked on the surface of a graphite push rod located in the center of the heater tube so that the test surface of the movable specimen rested on the test surface of the stationary specimen. A 10 lb weight was mounted at each end of the push rod in order to obtain the desired contact pressure between the test specimens. One

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end of the push rod was connected through a load transducer to a drive rod which entered the furnace through a packing gland. The load transducer was protected from the furnace heat by an insulated aluminum heat shield. The drive rod was cycled with a motor driven eccentric.

A hydrogen environment was maintained around the specimens throughout the test by flowing hydrogen through the furnace. The gas leaving the furnace was burned to avoid any danger of hydrogen concentrations in the test area.

3.0 RESULTS

The breakaway friction forces measured indicated that when the specimens were held in contact at the test temperature for 10 min, bonding of the specimens began to develop at about 4100°R and become fairly strong at 4500°R . However, when the specimens were exposed to 4500°R for only a short period of time, such as was the case in testing immediately after heating from ambient to the test temperature in 3 min, significant bonding was not observed. The static coefficient of friction developed in producing relative motion at 4500°R was approximately 3.7 after a 10 min exposure to the test temperature, but dropped to about 1.5 when the specimens were tested immediately after heating up to 4500°R in 3 min.

4.0 CONCLUSIONS

The results of these tests indicate that the breakaway friction forces that will be developed between the fuel elements and cluster support block during reactor startup should not be high enough to cause damage of these components. However, in long-life reactor tests where the fuel element-support block interface will be exposed to high temperatures for an extended period of time, relatively strong local

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bonding could develop. This bonding could cause coating damage if for any reason relative motions between the elements and block were forced to occur during reactor shutdown and restarting.

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FIGURE 1

FRICTION TEST FURNACE

FIGURE 2
FRICTION TEST FURNACE AND RECORDING EQUIPMENT

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FIGURE 3
FURNACE WITH OUTER CYLINDER AND
UPPER INSULATION ASSEMBLY REMOVED

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