3.0 LIMITING CONDITIONS FOR OPERATION

I. Recirculation System

1. Except as specified in 3.5.1.2 below, whenever irradiated fuel is in the reactor, with reactor coolant temperature greater than 212°F and both reactor recirculation pumps operating, the recirculation system cross tie valve interlocks shall be operable.

2. The recirculation system cross tie valve interlocks may be inoperable if at least one cross tie valve is maintained fully closed.

J. Average Planar LHGR

During steady state power operation, the average linear heat generation rate (LHGR) of all the rods in any fuel assembly, as a function of average planar exposure, at any axial location, shall not exceed the maximum average planar LHGR shown in Figure 3.5.1.

4.0 SURVEILLANCE REQUIREMENTS

I. Recirculation System

1. Once per month, when irriated fuel is in the reactor with reactor coolant temperature greater than 212°F and both reactor recirculation pumps operating, the recirculation system cross tie valve interlocks shall be demonstrated to be operable by verifying that the cross tie valves cannot be opened using the normal control switch.

2. When a recirculation system cross tie valve interlock is inoperable, the position of at least one fully closed cross tie valve shall be recorded daily.

J. Average Planar LHGR

Daily during power operation, the average planar LHGR shall be checked.

3.0 LIMITING CONDITIONS FOR OPERATION

K. Local LHGR

During steady state power operation, the linear heat generation rate (LHGR) of any rod in any fuel assembly at any axial location shall not exceed the maximum allowable LHGR as calculated by the following equation:

$$LHGR_{max} \leq LHGR_{d} \left[1 - \left(\frac{\Delta P}{P} \right)_{max} \left(\frac{L}{LT} \right) \right]$$

$LHGR_d$ = Design LHGR

= 17.5 kw/ft for 7x7 fuel

= 13.4 kw/ft for 8x8 fuel

$\left(\frac{\Delta P}{P} \right)_{max}$ = Maximum power spiking penalty

= 0.033 for 7x7 fuel

= 0.024 for 8x8 fuel

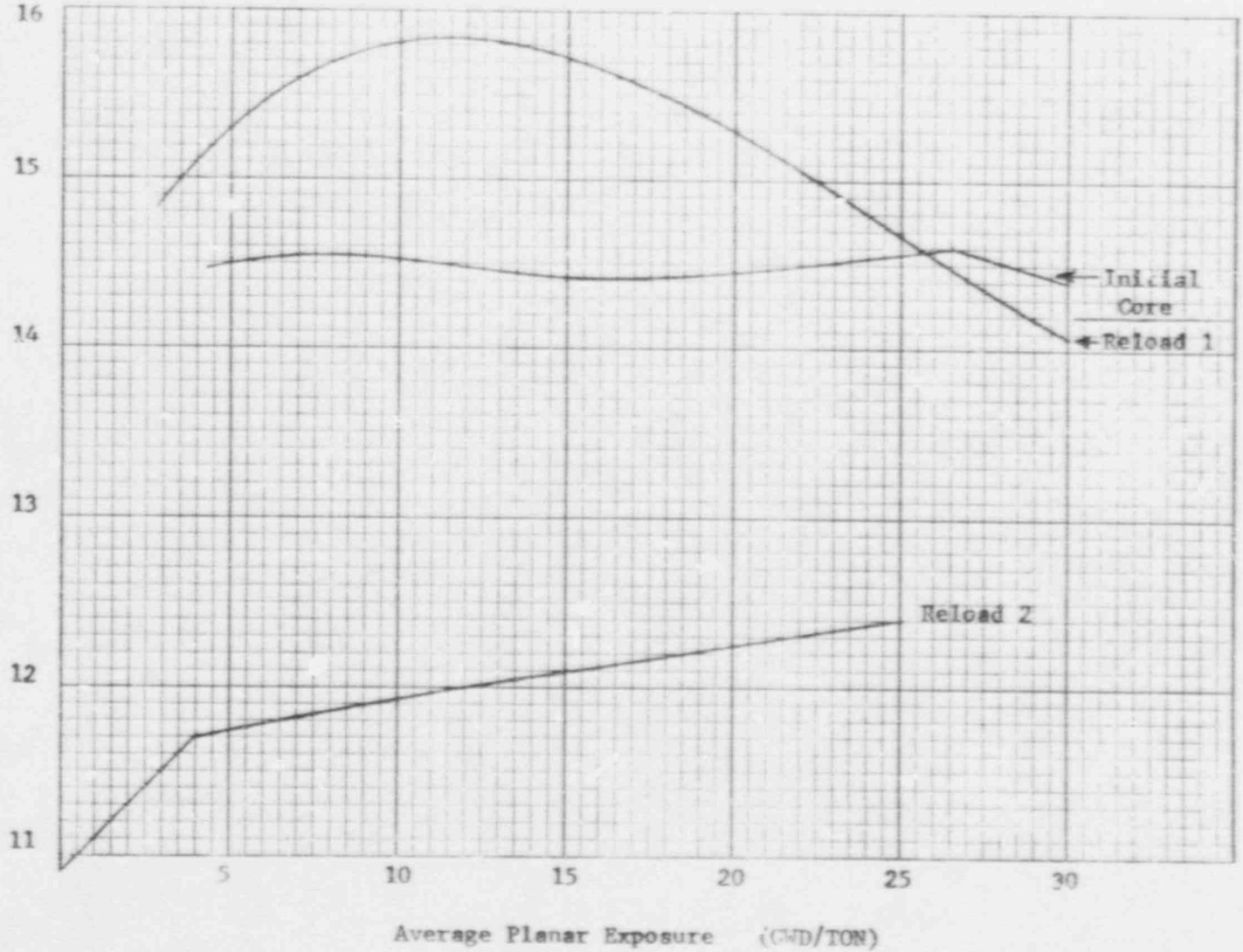
LT = Total core length = 12 ft

L = Axial position above bottom core

4.0 SURVEILLANCE REQUIREMENTS

K. Local LHGR

Daily during reactor power operation, the local LHGR shall be checked.



Maximum Average Planar LHGR (kw/ft)

Average Planar Exposure (GWD/TON)

Figure 3.5.1

Bases Continued 3.5:

J. Average Planar LHGR

This Specification assures that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the 2300°F limit specified in the Interim Acceptance Criteria (IAC) issued in June 1971 considering the postulated effects of fuel pellet densification.

The peak cladding temperature following a postulated loss-of-coolant accident is primarily a function of the average heat generation rate of all the rods of a fuel assembly at any axial location and is only dependent secondarily on the rod to rod power distribution within an assembly. Since expected local variations in power distribution within a fuel assembly affect the calculated peak clad temperature by less than $\pm$ 20°F relative to the peak temperature for a typical fuel design, the limit on the average linear heat generation rate is sufficient to assure that calculated temperatures are below the IAC limit.

The maximum average planar LHGR curves shown in Figure 3.5.1 were calculated for the various Monticello fuel types in the manner discussed in Section 4.3 of General Electric topical report, "GEGAP-III: A Model for the Prediction of Pellet-Cladding Thermal Conductance in BWR Fuel Rods", NEDO-20181, Revision 1, November 1973. These curves show the composite limitation based on the design LHGR of the fuel and the peak cladding temperature in the event of a LOCA. Calculations based on the AEC "Modified GE Model for Fuel Densification" attached to a December 5, 1973 letter from D J Skovholt (USAEC) to L O Mayer (NSP).

The possible effects of fuel pellet densification were: (1)creep collapse of the caldding due to axial gap formation; (2)increase in the LHGR because of pellet column shortening; (3)power spikes due to axial gap formation; and (4)changes in stored energy due to increased radial gap size. Calculations show that clad collapse is conservatively predicted not to occur currently or prior to September 1974. Therefore, clad collapse is not considered in the analyses. Since axial thermal expansion of the fuel pellets is greater than axial shrinkage due to densification, the analyses of peak clad temperature do not consider any change in LHGR due to pellet column shortening. Although the formation of axial gaps might produce a local power spike at one location on any one rod in a fuel assembly, the increase in local power density would be less than 2% at the axial midplane. Since small local variations in power distribution have a small effect on peak clad temperature, power spikes were not considered in the analysis of loss-of-coolant accidents. Changes in radial gap size affect

Bases Continued 3.5:

the peak clad temperature by their effect on pellet clad thermal conductance and fuel pellet stored energy. The pellet-clad thermal conductance assumed for each rod is dependent on the steady state operating linear heat generation rate and gap size. As discussed in NEDO-20181, Revision 1, the gap size was calculated with the assumption that the pellet densified from its measured value to 96.5% of theoretical density.

The curves used to determine pellet-clad thermal conductance as a function of linear heat generation are based on experimental data and predict with a 95% confidence that 90% of the population exceed the predictions.

K. Local LHGR

This Specification assures that the linear heat generation rate in any rod is less than the design linear heat generation even if fuel pellet densification is postulated. The power spike penalty specified is based on the analysis reported in NEDO-20181, Revision 1, and assumes a linearly increasing variation in axial gaps between core bottom and top, and assures with a 95% confidence, that no more than one fuel rod exceeds the design linear heat generation rate due to power spiking.

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ACKNOWLEDGED

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