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EVALUATION OF THE FUEL AND CORE COMPONENTS FOR KEWAUNEE

DRL:C&CTB:JHN RT-342

50-305

The functional performance requirements and design capability of the fuel and core components have been evaluated by J. Nicklas. The following comments are offered on the design with requests for additional information:

1. Provide an analysis of the fuel cladding stresses resulting from internal and external pressure, fuel swelling, and thermal cycling.

1.1 Show the values used for input data including the following parameters for internal pressure determination:

a. Design burnup for the maximum positioned fuel pin.

b. Value used for gas atoms produced per fissioned atom.

c. Axial volumetric temperature distribution in the fuel rod at the maximum radial exposure.

d. The gas release rate versus the axial temperature distribution based on 112% overpower.

e. Gas contribution to pressure by release of nitrogen, water vapor and other gases inherent in the pellet fabrication.

f. Free volume deemed available for gas containment.

1.2 Discuss the minimum gap or maximum interference fit between pellet and cladding at the maximum volumetric temperature as used is the analysis accounting for fuel swelling at the designed discharge exposure.

2. Integrity of the end plug welds is assured by standardization of the weld process based on radiographic and metallographic inspection of the welds. Discuss the methods used in sectioning the welds such as cross-sectioning for crack and void determination and longitudinal s sectioning for lack-of-penetration and tube wall thinning. Discuss

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the process capability study and lot-by-lot sampling. Since radiographic inspection is used for non-destructive examination of the welds discuss the lower limit of detection of voids in the weld and the number and size of voids that can be tolerated without reducing the weld strength. Discuss the justification for not performing dye penetrant inspection of the welds. It appears helium leak testing will detect cracks penetrating through the weld but not other cracks which may open in operation due to thermal cycling.

3. The absorber rods are made of cold worked 304 stainless steel cladding. Discuss why the cladding should resist stress corrosion cracking up to the design life.

3.1 Since the silver-indium-cadmium rods are unbonded to the stainless steel cladding show the effects of a breech in the cladding on the silver alloy.

3.2 Discuss why catastrophic corrosion of the cadmium alloy will not produce sufficient swelling the rod to prevent rod entry into the guide thimbles.

3.3 Provide an analysis showing the maximum temperature of the silver alloy at normal operating conditions, in transients, and in a LOCA.

3.4 Provide an analysis to show that the silver alloy will not flow hydraulically at the maximum temperature to swell the bottom end of the absorber rod. Consider long term flow due to the weight of the alloy and possible acceleration due to scram forces. Discuss the potential for swelling of the rod by hydraulic pressure alone and by differential thermal expansion emanating from normal thermal cycling and transients.

3.5 Discuss how leak tight integrity is established on the control rod welds similar to that requrested for the fuel rods.

4. Provide the calculations to show the flow induced vibrational amplitude and frequency of the mixing vanes installed in fuel assemblies that are free of RCC assemblies.

4.1 Discuss why the plug and mixing device in the fuel assemblies has a spring at its upper end that has uncaptured free ends. It would appear that the free ends should be captured as is done on the fuel assembly springs to prevent blocking of channels in the steam generator or fuel assemblies.

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5. In the LOCA, show the stresses produced on the RCC guide tube by the short time pressure reduction. This should be examined with the RCC assembly full out of the core and with the RCC out of the core 20 inches since this is the point of reduced diameter and the location of the flow holes in the guides tubes.

6. In an Uncontrolled RCCA Withdrawal at Power provide an analysis showing the fuel centerline temperature in the condition where scram is initiated by the overpower - overtemperature trip.

7. In a LOCA, where steaming above the core increases the pressure on the core barrel, provide an analysis to show bowing of the core barrel. If core barrel bowing does occur provision should be made to prevent the core barrel from covering the opening of the flooding nozzles.

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