UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

March 24, 1980

Mr. Robert Reid
Chief, Operating Reactors Branch No. 4
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Request for a change in the NBSR Technical Specifications
Docket No. 50-184

Dear Mr. Reid:

NBS respectfully requests a change to Section 6.3 of the NBSR Technical Specifications, License No. TR-5. The requested change is to delete the word "alloy" that describes the construction of the fuel plates in the last sentence of the section. This will enable NBS to use dispersion fabrication methods in the construction of fuel plates. Dispersion techniques are considered equal to or superior to alloy and utilize aluminide or oxide as the fuel matrix. Other than this fabrication change, all other conditions including the basis, will remain the same. A discussion in support of the requested change is enclosed.

Sincerely,

Robert S. Carter

Robert S. Carter
Chief, Reactor Radiation Division

Enclosure

Subscribed and Sworn to before me this 25th day of March 1980.
Frederick Co. Maryland
Jeannette S. Wells
Notary Public

My Commission Expires July 1, 1982

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Use of Dispersion Fabrication Techniques for Fuel Elements at the NBSR

1. Introduction

The NBS reactor (NBSR) has been using uranium-aluminum alloy fuel elements since start-up. They have given very satisfactory performance, but now they are no longer being produced by commercial manufacturers in the U.S. Therefore, it has become necessary for many research reactors, including the NBSR, to obtain fuel assembled using dispersion type fuel cores. The performance history of dispersion fuels has been excellent and dispersion fuel is generally considered equal to or superior to alloy fuels. For nearly 20 years, substantially more than 100,000 dispersion plates have been used with outstanding results and under conditions more severe than those existing at the NBSR. Among major reactors that have used, or are planning to use dispersion fuels are the HFIR, ATR, HFBR and ORR. The latter two with power levels of 40 and 30 Mw respectfully have been using alloy fuels similar to that used at the NBSR and are switching to dispersion for the same reasons as the NBSR.

2. General Considerations and Specifications

There are no basic differences in the overall specifications for dispersion elements to be used at the NBSR from alloy elements currently used. In all instances, dimensional, configuration, loading, fabrication control and quality assurance will be specified essentially the same for dispersion as they would be for alloy, with only minor adjustments to meet fabrication requirements. Because of generally better fabrication controls exercised by the dispersion manufacturers, a better, more uniform element is likely. This is confirmed by extensive past experience of several reactors where fewer rejects and very little or no failures were experienced. All considerations involving metallurgical and mechanical aspects of dispersion elements are equal to or superior to alloy elements.

3. Thermal Considerations

Since the dimensions and configuration of the dispersion plates can be made essentially identical to those made by the alloy process, there are no basic differences in the overall thermal performance relative to heat removal at the surface. Because of the better process control that can be exercised during the manufacture of dispersion fuel, these fuel cores are less likely to exhibit significant areas of non-bonding at the fuel-cladding interface than alloy cores. Measurements of the values of thermal conductivity for several dispersion cores showed them to be slightly higher than alloy cores for the same fuel loading.

4. Reactor Physics

No reactor physics changes will occur as a result of the conversion from alloy to dispersion fuel meat, since all other conditions and parameters remain virtually unchanged.

5. Physical Behavior Under Irradiation

Test results at ORNL and NRTS to burnups of 2.3×10^{21} fission/cm^3 and higher, indicate that dispersions perform quite well. Radiation swelling was found to be quite small and actually decreased with increased loading. Postirradiation examination showed no indication of blisters, core-cladding separation, matrix cracking, or other types of structural defects. Expected peak fission density at the NBSR will be less than 2.2×10^{21} fission/cm^3 (assuming 80% peak burnup and a maximum loading of 360g. U-235), which is below that achieved in tests or actual operation of reactors using dispersion fuel. In any event, the fission density would be the same for dispersion as for alloy.

Perhaps one of the major advantages of dispersion fuels is their great retention of fission products. Tests indicate that the fission product release from gross cladding failure would be considerably less in the case of dispersion than in the case of the alloy.

6. Conclusions

Based on the foregoing, it may be concluded that plate-type fuel assembled using U-Al_x or U_3O_8-Al dispersions is equal to or superior to U-Al alloy fuel and can be used at the NBSR without incurring any reduction in safety margins.

Bibliography

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