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DISCUSSION

R. L. Miller[1] *(written discussion)*—The author is to be congratulated on his application of existing corrosion data to the prediction of oxide film thickness on irradiated fuel pins. This subject is very timely from the standpoint of predicting the materials properties and the behavior of fuel pins during steady-state operation and to transient conditions such as would occur during a loss-of-coolant accident. Several questions arise in regards to your presentation, namely, your predictions of oxide film thickness were about a factor of two less than those observed on the Shippingport fuel pins. To what do you attribute this discrepancy? What algorithm was used to evaluate the original experimental data? What algorithm was used to predict the oxide thickness on the fuel pins? Does your model predict the axial distribution of oxide film thickness on the fuel pins?

E. Hillner (author's closure)—The longterm out-of-reactor (autoclave) Zircaloy-2 corrosion data of Kass [7] were employed to derive an empirical relationship equating the post-transition (linear) corrosion rate constant with an exponential function of the reciprocal of the absolute temperature of the corroding surface. The accelerated corrosion performance of Zircaloy in a neutron irradiation environment has been reported by many investigators; however, since previous evaluations of the corrosion behavior of the Shippingport fuel rods appeared to indicate fair agreement with the just-mentioned ex-reactor empirical relationship, it had been postulated that Zircaloy corrosion acceleration would not take place in the highly reducing environment of the PWR coolant. The large discrepancy between measured and predicted oxide film thicknesses in the current examination is assumed to be indicative of the excess corrosion associated with the fast neutron irradiation exposure, even in the presence of a highly reducing environment. Examination of the data in Table 1 shows that the axial distribution of oxide film thicknesses on the fuel rods is predicted by the ex-reactor empirical equation due, primarily, to the predicted surface temperature gradients derived from measured bulk coolant temperatures, crud thicknesses, and axial heat flux values. The measured oxide film thicknesses at each axial location of a fuel rod appears to be an approximate constant excess quantity above the corresponding predicted values from the ex-reactor correlation, indicating that the predicted and measured oxide film thickness gradients are very similar.

[1]Senior engineer, Engineering Division, Aerojet Nuclear Company, Idaho Falls, Idaho 83401.

Mr. Miller's suggestion that these corrosion data (500 to 550°F) may be applied to transient conditions such as would occur during a loss-of-coolant accident (~2000°F) is not supported by this author; the technical literature is replete with experimental studies of the Zircaloy corrosion performance under the unique very short time and very high temperature conditions associated with a typical loss-of-coolant accident.