



nodes in the active core region give adequately accurate power and temperature predictions and computation times that satisfy the requirements of continuous on-line data validation, plant state verification, and fault identification.

From the point of view of operational safety, it is desirable to terminate a transient before sodium boiling is initiated in the core. Thus, only the preboiling phase of core transients is modeled in Ref. 1.

The TREAT/TS-1C experiment<sup>2</sup> was a simulation of a transient overpower event driven by a slow reactivity insertion of 5  $\text{¢}/\text{s}$ . It was performed upon a single FFTF fuel pin (outside diameter = 0.005842 m, length = 0.9144 m) surrounded by a flow tube. Coolant temperatures were measured at different heights of the pin channel by eleven thermocouples welded to the outside of the flow tube. The reactor power and the sodium flow in the flow tube during the transient, as well as the axial power distribution of the pin are shown in Fig. 1.

The material properties used in the analysis (density, conductivity, specific heat, coefficient of thermal expansion) were functions of material temperature and were those used for the analysis of the same experiment with SAS4A.<sup>3</sup> At low gap conductance values the heat transferred from the fuel to the coolant during a transient is strongly dependent on the gap conductance. This property was allowed to vary axially and was computed from the modified Ross-Stoute model<sup>4</sup> of SAS4A.

For the analysis of the TS-1C experiment the model of Ref. 1 was used with two nodes. The sodium temperatures predicted by this model at the different axial locations of the flow tube are shown in Fig. 2 (distance from pin bottom in m: A=0, BC=0.229, D=0.432, E=0.508, F=0.584, G=0.686, H=0.762, I=0.838, JK=0.914). Fuel melting started at 17 s. At 25 s 14% of the pin fuel had melted and at 32.2 s the pin failed (cladding breached). The present

modelling extends up to fuel melting initiation (there is no distinction between molten and solid fuel). As Fig. 2 shows, the agreement between model predictions and measurements is very good up to fuel melting initiation. After this time the difference between predictions and measurements increases as the molten fuel fraction increases. The maximum difference between predictions and measurements in the pre-fuel-melting phase is  $\sim 7.5$  K.

In summary, the analysis of the <sup>TREAT</sup>/TS-1C experiment shows that the model of Ref. 1 gives adequately accurate temperature predictions with only two spatial nodes in the active core region. As discussed in Ref. 1, for fast loss-of-flow and transient overpower events, this small number of nodes leads to computation times that are about 1/20 and 1/25, respectively, of the real transient time per thermal-hydraulic channel.

#### REFERENCES

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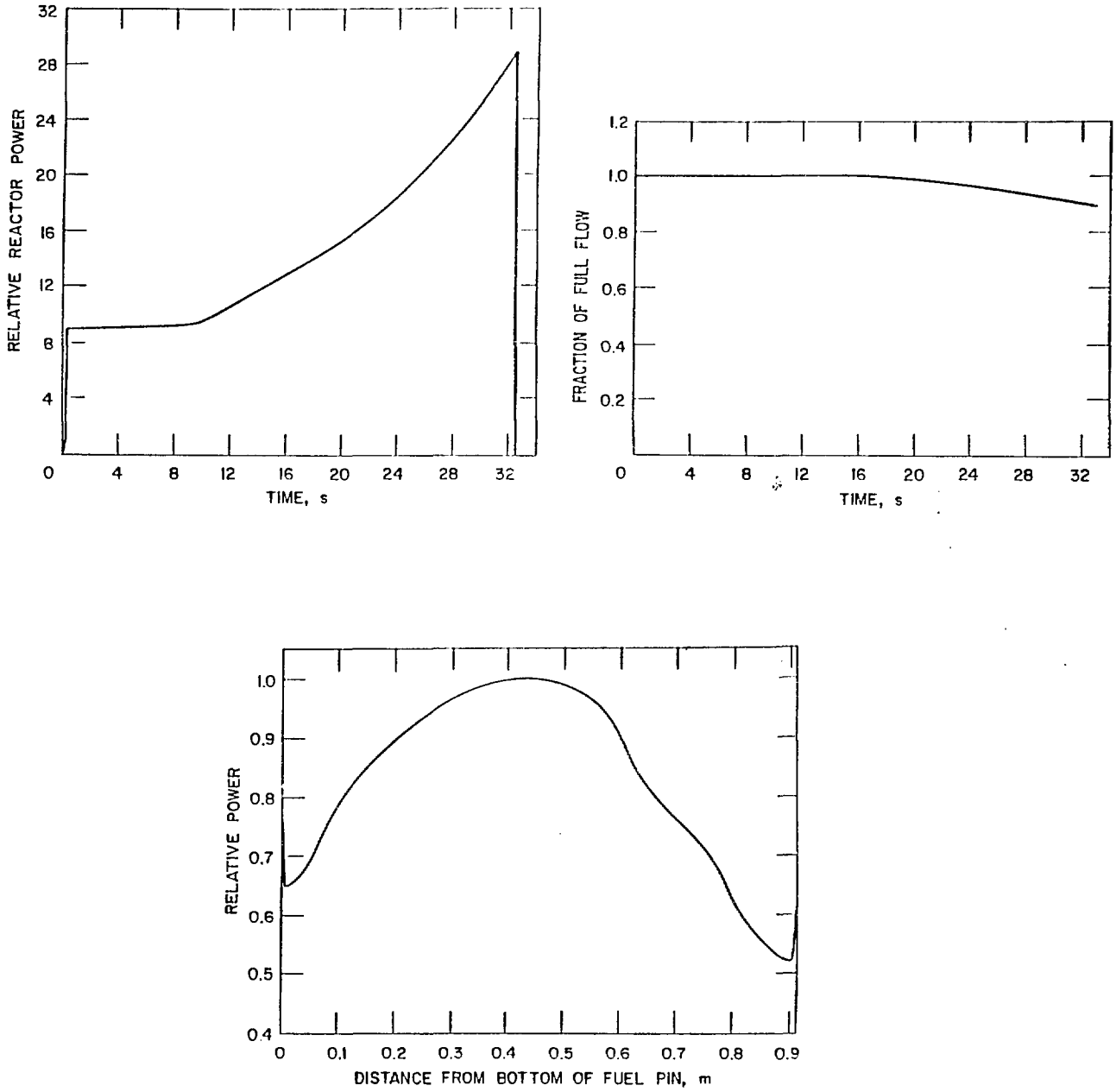


Figure 1. Reactor Power, Coolant Flow, and Axial Pin Power Distribution

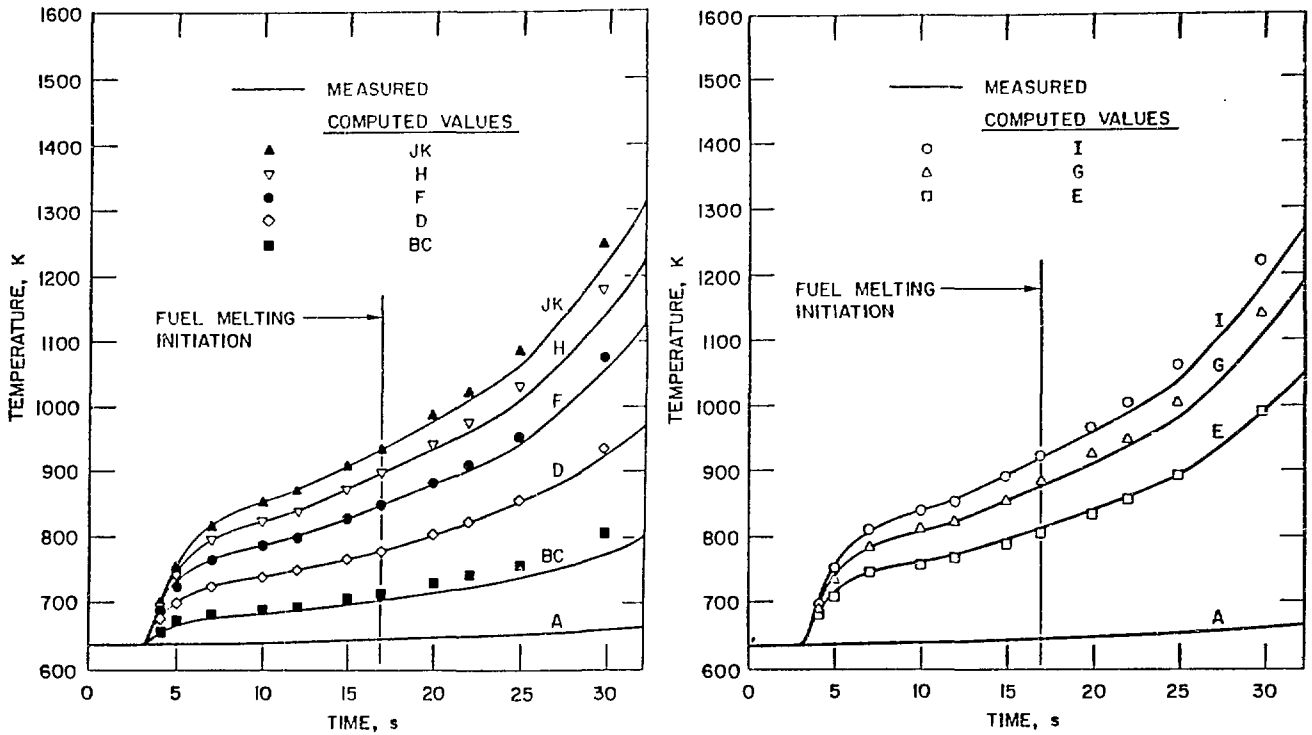


Figure 2. Coolant Temperature Predictions and Measurements

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