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Validation of Advanced Metallic Fuel Models of SAS4A using TREAT M-Series Overpower Test Simulations

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The SAS4A safety analysis code has been extended to include mechanistic and physics-based models of U-Pu-Zr and U-Zr metallic fuel pins. The simulation of various phenomena such as metal fuel component migration, fission gas behavior, clad wastage formation, gas swelling induced axial fuel expansion, in-pin and ex-pin molten fuel relocation, and clad failure models has been significantly enhanced. The integrated code is validated through analyses of eight metal fuel TREAT M-Series overpower experiments. In this study, the SAS4A calculated fuel reactivity and clad failure data are compared with the corresponding experimental data. The results show that the code satisfactorily predicts solid fuel axial expansion, molten fuel in-pin relocation, cladding loss due to rapid eutectic penetration, cladding creep fracture and molten fuel ejection to the coolant channel. The study shows that the uncertainties in transient response tend to be higher for the lower burnup fuel.

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