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Modeling Molten-Fuel-Moderator Interactions AYA DIAB, MICHAEL CORRADINI, University of Wisconsin-Madison — CANDU reactors are pressurized heavy-water moderated and cooled nuclear reactor designs. During commissioning of nuclear power plants a range of possible accidents must be considered to assure the plants' robust design. One must consider a complete channel blockage in the CANDU reactor. Such an extreme flow blockage event would result in fuel overheating, pressure tube failure, partial melting of fuel rods and possible molten fuel-moderator interactions (MFMI). The MFMI phenomenon would occur immediately following tube rupture, and involves a mixture of steam, hydrogen and molten fuel being ejected into the surrounding moderator water in the form of a high-pressure vapor bubble mixture. This bubble mixture would accelerate the surrounding denser water, causing interfacial mixing due to hydrodynamic instabilities at the interface. As a result of these interfacial instabilities, water is entrained into the growing two-phase bubble mixture with the attendant mass and heat transfer; e.g., water vaporization, fuel oxidation. A comprehensive model has been developed to investigate the complex phenomena resulting from a postulated complete flow blockage and pressure tube failure. This dynamic model will serve as a baseline to characterize the pressure response due to a pressure tube rupture and the associated MFMI phenomena.

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