Summary of Final Resolution of Loss-of-Coolant Accident Unreviewed Safety Questions for the Advanced Test Reactor

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Unreviewed Safety Questions (USQs) were resolved by a combination of analysis revision and plant design modifications while under interim restrictions on operation. The effort involved many parallel path activities, culminating in updated analytical models, updated accident analyses, identification, design, and completion of plant modifications to support the updated analyses, and revision of facility Technical Safety Requirements and associated procedures.

A late-heatup phenomenon during design-basis loss of coolant accidents (LOCAs) was identified that had not been discovered while updating the Advanced Test Reactor (ATR) Updated Final Safety Analysis Report (UFSAR). Identification of the late-heatup phenomenon constituted a USQ for new information and an interim limit reducing the allowable reactor power level by 50% was imposed in order to meet the ATR Plant Protection Criteria in the approved UFSAR. The initial approach taken to resolve the late heatup USQ included demonstrating that the primary coolant pumps (PCPs) would continue to provide flow when PCP net positive suction head (NPSH) fell below 50 ft and to model that degraded flow with the PCP in cavitation. Some flow from the PCP is required to prevent the late heatup after the initiation of a design-basis LOCA. The original UFSAR analysis had assumed the PCP output dropped to zero when NPSH dropped below 50 ft.

A second phenomenon was identified when the PCP cavitation model was applied to the design-basis LOCA analyses. Continued operation of the PCP would result in very low primary coolant system (PCS) pressures. For some analytical cases, pressures were so low that the air volume in the PCS surge tank expanded into the PCS piping creating concern for potential degradation of flow from the operating emergency coolant pump. The surge tank provides damping of pressure variations during normal operation. This evaluation concluded that the potential for surge tank draining during a design-basis LOCA under the interim effective-fuel-plate-power limits also constituted a USQ for new information. Interim resolution was developed based on a manual trip of the PCPs after a LOCA and tightened controls on surge tank level.

For final resolution of the USQs, the low-pressure actuation setpoint for the emergency firewater injection system was raised, surge tank operating levels were restricted, and a new Engineered Safety Feature (ESF) to trip the PCPs nominally 65 seconds after the Plant Protective System tripped on low vessel inlet or outlet pressure was designed and installed. Probabilistic risk assessment was used to evaluate the new ESF reliability and the risk-significance of the facility modifications. An increased vulnerability to heavy load drops was identified that required

relocation of emergency coolant pump power conduits as part of the final resolution. The effort resulted in a return to full power operation to achieve needed irradiation capability.