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Japan Nuclear Technology Institute

Caution 2007-1

Prevention of Control Rod Withdrawal Event at BWR while the Control Rod Drive Is Operating in Non-return Mode

It was revealed that, during the fifth annual outage in 1999 of Shika Unit 1, three control rods came off and caused the reactor to reach a state of criticality. This incident took place as workers were preparing for the confirmation tests after the reactor shutdown function reinforcement work, when they isolated the hydraulic control unit (HCU) while the CRD was operating in non-return mode, which contributed to a gradual pressure increase in the CRD system.

It was also confirmed that similar control rod insertion or withdrawal events had occurred at other BWR plants when attempting to isolate and restore the HCU while the CRD was operating in non-return mode.

Based on technical lessons learned from these cases, in order to ensure the prevention of such control rod withdrawal events during reactor shutdown, the Japan Nuclear Technology Institute decided to issue this Call for Attention, requesting operators of any BWR with a hydraulically-driven CRD to report their plans and implementation of recurrence prevention measures.

1. Problems with Shika Unit 1 during the Event

(1) Isolating many HCU modules while the CRD is operating in non-return mode brings about the pressure increase in the CRD, which may cause some control rods to come off inadvertently. In spite of this risk, the plant workers did not take measures to prevent the rise of pressure in the CRD.

(2) Due to the lack of close communication with the HCU isolation crews, the operation crews were not fully aware that the HCU was being isolated and therefore did not take necessary actions such as monitoring the CRD hydraulic fluid flow rate and the CRD coolant head pressure.
Moreover, at that time, the “Reactor/CRD Coolant Header Pressure Difference High/Low” alarm was deliberately cut off to prevent unnecessary and frequent actuations by the decreased pressure difference.

(3) The HCU isolation crews and the individuals that planned and confirmed the isolation were not sufficiently aware of the risks associated with the HCU isolation procedure and the HCU isolation itself.

2. Recurrence Prevention Measures

With a few exceptions, control rod withdrawal events similar to the case in Shika Unit 1 occurred at other BWR plants when attempting to isolate or restore the HCU while the pressure in the CRD was high. As with the case of Shiga Unit 1, inadequate inspection procedures and monitoring contributed to such events.

The electric power companies operating any BWR in Japan have individually taken measures to prevent recurrence. Nevertheless, to ensure that such measures are fully implemented and to reinforce safety, we request the relevant companies to examine the need for the following measures in view of the situation at their nuclear power stations:

(1) Place the CRD in return mode before isolating the HCU to prevent an excessive increase of the CRD pressure.

(2) While the HCU is isolated, ensure that the reactor/CRD coolant header pressure difference is monitored using indicators and alarms, and that the control rod position is also monitored. In addition, clearly display the CRD operation status (return mode, non-return mode or CRD pump not working) in the main control room.

(3) Describe in procedure documents and the like the control procedures to be followed during the HCU isolation and the procedures to be followed when a relevant alarm is activated. In addition, ensure that the operation crews and the HCU isolation crews are familiar with these procedures and educated about the risks associated with the HCU isolation.

(4) When isolating the HCU, ensure that close communication is kept between the HCU isolation crews in the field and the operation crews in the main control room. The operation crews in the main control room should perform proper monitoring while being well aware of the activities in the field.

By June 15, each electric power company that owns any BWR with a hydraulically-driven CRD must send us (Japan Nuclear Technology Institute) a report on their review of their own recurrence prevention policy and plan for implementing recurrence prevention measures.

The principle of heat generation in a nuclear power plant is nuclear fission. To extract energy from nuclear fission in a stable and safe manner, it is essential to properly control the criticality of the reactor. Each electric power company in Japan should learn from the recent reports on control rod withdrawal events, renew their awareness of this basic requirement, and improve the training of their operation crews on operation procedures to be followed when responding to a critical state that deviates from the normal control range