ENCLOSURE

SEQUOYAH NUCLEAR PLANT
UHI INJECTION RATE NOT
IN ACCORDANCE WITH DESIGN
NCR MEB 78-4
FINAL REPORT

Description of Deficiency

During preoperational testing of the Upper Head Injection (UHI) System on Unit 1, the accumulators injected water in excess of design allowables. This occurred at blowdown rates equivalent to those which would be experienced during a large LOCA.

The UHI system basically consists of two large accumulators connected in series, one filled with borated water and the other filled with compressed nitrogen. The water filled accumulator is connected to the reactor vessel head by two lines (which branch to four lines before connection to the vessel head). Check valves in the lines prevent the tanks from experiencing the high reactor system pressures. Should there be a LOCA, the pressure in the reactor vessel drops according to the size of the LOCA. (A rapid pressure drop with a large LOCA and conversely a slow pressure drop with a small LOCA). As the pressure drops, it falls below that of the accumulator tanks. The check valves then open and the compressed nitrogen in the nitrogen accumulator forces the borated water out of the water accumulator and into the reactor vessel. (For a more detailed description of UHI operation see FSAR Section 6.3.2.2.)

The amount of borated water injected must be maintained within certain tolerances in order to validate the ECCS analysis. Too little water provides inadequate cooling, too much water subcools the upper head region and delays reflood. To insure the correct injection volume, four hydraulically operated valves are provided to terminate the injection. The signal to trip these valves originates from four differential pressure sensors which are installed in four standpipes connected to the water accumulator. Each standpipe is connected at the top and the bottom of the accumulator and one instrument was installed in each standpipe. It was assumed in the original design that as the level in the water accumulator fe the level in the standpipe would fall correspondingly and e injection would be terminated at the correct time. This assumption proved correct only for small breaks. For these, the injection rate would be slow and the instruments would track the level accurately. However, the preoperational tests found that if the LOCA was large, the injection from the accumulator would be at such a high rate the level in the standpipes would lag behind (i.e., record a level higher than actual) the level in the tank. Thus excessive amounts of water would be injected into the reactor vessel before the signal was received to close the valves.

Safety Implications

The ECCS is designed to cool the reactor core as well as to provide additional shutdown capability following initiation of a spectrum of postulated NSSS accidents including loss of coolant accident. (See FSAR Section 6.3.1.1.)

During blowdown of the reactor coolant system after the LOCA, the reactor core is uncovered and hence subject to damage from excess fuel temperatures. To prevent this from occurring, the UHI system injects about 950 cubic feet of borated water into the reactor vessel during the first seconds of the blowdown. This quantity of water serves to quench the core and to maintain safe tempertaures during the early stages of the accident. Once the injection is terminated and the core adequately quenched, some of the UHI water remains in the upper head region of the vessel. This water must drain through the core before the steam in the core region can vent through the break and the core can once again be flooded with water. If the injection is as designed, the residual water in the upper head region will be very hot when UHI flow terminates. It will flash into steam and rapidly drain out of the way, allowing core reflood to proceed. However if too much water is injected, the residual water in the upper head region will be subcooled. Should this be the case the reflood will be delayed and unacceptable core temperatures may occur.

Since the test simulates a depressurization more severe than the largest postulated LOCA and the instrumentation setpoint is verified during testing, it is unlikely that an instrument setpoint would be established which would result in too much water being injected to the vessel. If the deficiency had gone uncorrected, it is likely that the instruments would be set to deliver the correct water volume for only the largest LOCA and hence something less for smaller accidents. Since the UHI system was added expressly for the large LOCA, it is not clear that this is an unacceptable condition. It is however an unevaluated situation and has the potential to result in core damage.

Corrective Action

To correct the standpipe lag time, the standpipes have been removed and the level instruments have been installed directly into the accumulator tank. Retest of the Unit 1 accumulators have shown the problem to have been corrected. Watts Bar Nuclear Plant UHI system is presently being evaluated to determine if it also is deficient. If corrective action is required at Watts Bar, it will be performed before obtaining an operating license for the plant.