AEOD TECHNICAL REVIEW REPORT*

UNIT: Callaway Plant, Unit 1 TR REPORT No. AEOD/T501

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LICENSEE: Union Electric Company EVALUATOR/CONTACT: R. Freeman

NSSS/AE: Westinghouse/Bechtel

SUBJECT: FAILURE OF AUTOMATIC PROTECTION FOR BORON DILUTION EVENT AT CALLAWAY UNIT 1

REFERENCES: (1) Licensee Event Report 84-021, Union Electric Company, Docket No. 50-483, dated August 17, 1984.

(2) NUREG-0933, "Nuclear Reactor Regulation Report on the Prioritization of Generic Safety Issues," dated December 1983.

SUMMARY

On July 19, 1984, at 1:00 pm, with Callaway Unit 1 at cold shutdown, while performing engineered safety feature actuation system (ESFAS) testing, train A of the solid state protection system (SSPS) was placed in the inhibit mode and the slave relay circuitry used to actuate ESF equipment in train B of the SSPS was placed in the test mode. This rendered all automatic actions of the ESFAS inoperable, including the boron dilution mitigation system (BDMS). Train B of the SSPS was still available to provide high flux alarms, source range high flux trip, and the source range flux doubling alarm. This event was caused by the licensee's failure to recognize that the BDMS is made inoperable when performing surveillance testing for the ESFAS. Due to the licensee's lack of understanding concerning the operation of the BDMS when testing the ESFAS, the BDMS was made inoperable inadvertently. Deficient surveillance procedures contributed to the event. Instrumentation and alarms available to the operators on the plant's status during the event provided adequate indication to mitigate a boron dilution event. Thus, no safety concerns were identified which warranted corrective actions.

Discussion

The source range flux doubling circuitry acts to automatically realign the suction for the charging pumps from the volume control tank to the refueling water storage tank (RWST) when neutron flux doubles in nine minutes or less. This automatic action serves to mitigate the consequences of a boron dilution accident. Callaway and Byron are the only operating plants to date that have this new protection feature called the Westinghouse Boron Dilution Mitigation System.

*This report supports ongoing AEOD and NRC activities and does not represent the position or requirements of the responsible NRC program office.

The Westinghouse SSPS circuitry is composed of an analog portion and a digital portion. The analog portion consists of between two to four redundant channels per parameter or variable to monitor various plant parameters. Most of these signals are processed in the analog protection system and result in bistable outputs if predetermined safety limits are exceeded. Other signals such as oil pressure switches on the turbine, auxiliary contacts on circuit breakers, and limit switches on valves, are derived directly from the process sensor by way of contacts in the sensor, and these signals are input directly into the logic section of the SSPS. The digital portion of the SSPS circuitry consists of two redundant logic trains which receive inputs from the analog protection channels, or directly from the process sensor, and perform the logic needed to actuate the engineered safety feature equipment required. Placing train A of the SSPS in the inhibit mode prevents the ability of train A to cause a reactor trip or actuate ESF equipment. Placing train B of the SSPS slave relay tester in the test position prevents only the ability of train B to actuate ESF equipment. The loss of both trains of the SSPS to actuate ESF equipment prevents the automatic actions of realigning the suction of the charging pumps suction to the RWST, which occurs on an ESFAS signal and upon a source range flux doubling signal.

During the event train B was still available to provide all nuclear instrumentation alarms, indications, and trips, including the source range flux doubling alarm. Also the licensee stated that the reactor trip breakers were open, no positive reactivity changes were being made, and the reactor makeup water system was isolated from the charging pump suction. This eliminated the possibility of a boron dilution accident. Other sources of information used in the detection of a boron dilution event available to the operator included: indication of boric acid and blended flow rates, chemical volume control system and reactor makeup water system pump status lights, deviation alarms if the boric acid or blended flow rates deviate by more than 10 percent from the preset valves, indicated source range neutron flux count rates, and audible source range neutron flux count rate.

The Final Safety Analysis Report (FSAR) takes credit for having the automatic source range flux doubling feature operable in mitigating a boron dilution event when the plant is in modes 3, 4 and 5. It was found that there was no direct reference to the source range flux doubling circuitry as being part of the source range neutron flux reactor trip instrumentation in the Technical Specifications. Plants which do not have the source range flux doubling design rely on the source range high flux trip, and strict administrative procedures to mitigate a boron dilution event.

CONCLUSIONS

Because of the licensee's lack of understanding concerning the operation of the BDMS when testing the ESFAS, the BDMS was made inoperable inadvertantly. Deficient surveillance procedures contributed to the event. This event was determined not to be significant because: (1) a boron dilution event is a very slow transient, (2) instrumentation and alarms available to the operators on the plant's status during the event provided adequate protection against a boron dilution event comparable to plants which do not have the Westinghouse Boron Dilution Mitigation System, (3) NRR concluded that boron dilution events do not constitute a significant risk to the public and dropped this generic issue that could have required licensees to install special instrumentation to detect and stop a boron dilution event (reference 2), and (4) Callaway and Byron are the only operating plants to date with the Westinghouse Boron Mitigation System design. NRR is aware and is correcting the Technical Specifications for Callaway and Byron to include explicit requirements for the Boron Dilution Mitigation System. No further actions by this office are deemed necessary.