Enclosure
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SAFETY EVALUATION REPORT (SER)

FINAL DESIGN AND IMPLEMENTATION OF SAFETY-GRADE ANTICIPATORY REACTOR TRIP (ARTS) ON TURBINE TRIP OR LOSS OF MAIN FEEDWATER

DAVIS-BESSE NUCLEAR STATION, UNIT 1

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I. INTRODUCTION

The licensee, Toledo Edison Company, in its submittals of September 8, 1981, November 17, 1981, January 5, 1982, March 25, 1982, and April 14, 1982, forwarded the information necessary to complete our safety evaluation of their final design and implementation of the safety-grade anticipatory reactor trips (ARTS) on turbine trip or loss of main feedwater. These ARTS are intended to provide additional protection beyond that provided by the existing Reactor Protection System (RPS). We previously approved the licensee's preliminary design for upgrading this system in our SER of December 20, 1979. We also requested additional information on the final design.

II. EVALUATION

In performing our evaluation, we reviewed the information in the recent licensee submittals of September 8, 1981, November 17, 1981, January 5, 1982, March 25, 1982, and April 14, 1982, and their previous submittals of May 21 and October 3, 1979, relating to this system.

Our review of the preliminary design and the final design drawings for installation of the safety grade anticipatory reactor trips indicates that the licensee has incorporated the previously approved logic design

concept into the ARTS design for Davis-Besse Unit 1. For the most probable causes of turbine trip or loss of main feedwater, these anticipatory trips will operate in advance of the reactor coolant system (RCS) high pressure reactor trip to reduce the peak RCS pressure and thus reduce challenges to the power operated relief valve. This will alleviate these concerns as reported in NUREG-0560.

Our review included the final drawings of the inputs, outputs, and logic of the new trip functions and their integration into the existing RPS. The new ARTS sensors monitor the hydraulic oil pressure associated with control of the main turbine and main feedwater pump turbine control valves. The ARTS logic is designed such that a trip will occur due to low hydraulic pressure for the main turbine control valves or low hydraulic pressure to the control valves of both MFWP turbines.

The ARTS design utilizes four redundant and independent sensor channels to monitor the main feedwater pumps and the main turbine for trip conditions. In addition, the existing steam and feedwater rupture control system (SFRCS) provides an input to the ARTS sensor channels to provide a diverse means to initiate reactor trip. Each of the four sensor channels provides an input to each of the four logic channels via isolation devices to maintain the independence between sensor and logic channels. The logic channels initiate a trip based on a specific two-out-of-four logic for each input parameter, with the exception of the main feedwater pump sensor channels which provide a trip input to the logic channels based on loss of both main feedwater pumps. Each logic channel operates to remove power from a separate reactor trip breaker undervoltage coil to effect a reactor trip. These breakers are configured in a one-out-of-two logic taken twice to initiate a reactor trip.

Additional circuits are included to provide testing capability, operating and maintenance bypasses, and manual actuation of the reactor trip breakers. An automatic inhibit is included in the sensor channels to prevent reactor trip on turbine trip below 20% power levels.

The only ARTS interfaces with the existing RPS are the new relay contacts added to the control rod drive trip strings. All ARTS signals are isolated and independent from each other and the RPS. Thus, the previous conclusion of the RPS failure analysis, performed by the licensee, that any single failure in the RPS will not prevent performance of its protection action when required, is still valid.

The new ARTS logic is similar to the existing Safety Features Actuation System (SFAS) logic currently used for Davis-Besse Unit 1. As such this cabinet-mounted logic is designed in accordance with the design basis of the SFAS and will conform with the acceptance criteria and design requirements of the SFAS as described in Section 7 of the Davis-Besse Nuclear Station FSAR. We did, however, identify one area of the new ARTS circuitry that does not meet the existing requirements (IEEE-279-1971) as stated in the FSAR. The local manual block for each ARTS logic channel has no associated block indication in the control room. As such, this system block may be activated and left in that state which would render the system inoperable (until locally reset) and the control room operator would not have information indicating this condition. The staff concluded that this aspect of the design does not meet the requirements for indication of bypasses found in paragraph 4.13 of IEEE-279-1971. Additionally, the existing SFAS logic circuitry for Davis-Besse (prior to ARTS) provides indication for similar manual blocks in the control room. In response to this concern, the licensee indicated by letter

dated April 14, 1982, that the local block feature performs no required function and therefore will be electrically disabled. Based on this modification, we find this aspect of the design is acceptable.

The licensee's submittal of September 8, 1981, states that the seismic and environmental qualification summary report will not be completed until early 1982. The licensee's submittal of November 17, 1981, states that the ARTS design permits a channel functional test which includes the operability of the new pressure sensors. The licensee has not provided a description of the test procedures and therefore the staff's evaluation of the licensee's monthly channel functional tests will be performed during review of revised Technical Specifications covering ARTS.

III. CONCLUSION

Based on our review of the design of anticipatory reactor trips of main turbine trip or loss of main feedwater, we conclude that the design of the ARTS satisfies the RPS safety requirements and criteria for redundancy, independence, testability, and single failures. We conclude that the upgraded RPS will provide a greater degree of protection beyond that provided by the existing RPS.

Dated: May 14, 1982

The following NRC personnel have contributed to this Safety Evaluation: F. Burrows.