



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

DAVIS-BESSE NUCLEAR POWER STATION, UNIT 1

DOCKET NO. 50-346

FAILURE MODE EFFECTS ANALYSIS

ON THE INTEGRATED CONTROL SYSTEM

NUREG-0737, ITEM II.K.2.9

Following the Three Mile Island Unit 2 event, the staff expressed concern regarding the response of Babcock & Wilcox (B&W) design reactors to transients. Since the staff did not perform a detailed review of failure modes and potential interactions within the Integrated Control System (ICS), it was unsure of the role the ICS might play in initiating or exacerbating transients. Therefore, the staff required a failure mode and effects analysis (FMEA) of the system. In August 1979, B&W submitted a report, BAW-1564, "Integrated Control System Reliability Analysis", which provided the results of a FMEA and an operating history review for the ICS installed at all operating B&W plants. BAW-1564 was endorsed by the licensee as applicable to Davis-Besse Nuclear Power Station, Unit 1.

The staff completed its review of BAW-1564 through a technical assistance contract with Oak Ridge National Laboratory (ORNL). As a result of this review, both the staff and ORNL concluded that the ICS itself had a relatively low failure rate and did not appear to initiate a significant number of plant upsets. However, there were aspects of the plant control system and related components outside the ICS for which improvements should be investigated. In BAW-1564, B&W recommended six actions aimed at improving system performance. In November 1979, the licensees with

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B&W plants (except Three Mile Island Unit 1) were requested to address the B&W recommendations. Responses were received from the licensees including Toledo Edison and reviewed by the staff.

Toledo Edison letter dated January 9, 1980, provided the licensee's position on the B&W recommendations as requested by the staff. Additional information concerning final resolution on each recommendation was provided in a letter dated March 25, 1982. A summary of the response on each recommendation is as follows;

- 1) The staff asked the licensee to address the B&W recommendation to improve the reliability of the Non-Nuclear Instrumentation (NNI)/ICS power supply. Toledo Edison completed a study of power supply reliability and identified several modifications which have either been completed or will be completed in the 1982 refueling outage to minimize the effects upon the plant of power supply failures.
- 2) The staff asked the licensee to address the B&W recommendation to improve the reliability of the input signal from the Nuclear Instrumentation/Reactor Protection System to the ICS - specifically, the Reactor Coolant flow signal. The licensee will provide a separate flow signal for the ICS to separate the flow signal used for control from that used for the Reactor Protection System. This modification will be performed during the refueling outage in 1983.

- 3) The staff asked the licensee to address the B&W recommendation to improve ICS/Balance of Plant tuning, particularly the interaction between the feedwater condensate systems and the ICS controls. The staff further asked that the licensee address any particular operational problems experienced with the ICS, procedures used by the operator to take manual control of ICS functions, and ICS training provided for the operators. Toledo Edison indicated that problems related to ICS tuning during initial plant startup are summarized in the initial startup report. Guidance is given to operators for the use of hand auto stations in the station unit startup and shutdown procedures. Reactor operator training includes simulator sessions where ICS failures are simulated and operator response observed.
- 4) The staff asked the licensee to address the B&W recommendation to improve the main feedwater pump turbine drive minimum speed control. Toledo Edison indicated that main feedwater pump turbine drive minimum speed control is not a problem at Davis Besse. The licensee plans no modifications to this function.
- 5) The staff asked the licensee to address the means of preventing or mitigating the consequences of a stuck-open main feedwater startup valve. Toledo Edison indicated that the effects of a stuck-open main feedwater startup valve are bounded by the analysis of "Excessive Heat Removal Due to Feedwater System Malfunction" in the Davis-Besse Final Safety Analysis Report, Chapter 15. No plant modifications are planned.

- 6) The staff asked the licensee to address the means of preventing or mitigating the consequences of a stuck-open turbine bypass valve. Toledo Edison indicated that Davis-Besse Nuclear Power Station Unit 1 has a safety grade steam and feedwater rupture control system which will, if necessary, isolate the main steam line should a low pressure occur as a result of a stuck-open turbine by-pass valve.

In May, 1981, subsequent to the review of the responses from the licensees on the B&W recommendations, the staff held a meeting with Duke Power Company to discuss the Duke response on the Oconee units. The meeting was held not only to review the specific Duke response to the B&W recommendations, but also to provide the staff with an opportunity to better understand the details of the ICS design and its effect on plant safety. B&W representatives were in attendance at this meeting to give a presentation on the functions of the ICS and respond to staff questions on the effects of failures in the ICS. The basic contention was that plant transients caused by ICS failures will be terminated by the Reactor Protection System prior to exceeding any plant safety limit.

Based on the meeting with Duke Power Company and reviews to date, the staff has identified no specific control system failures or actions which would lead to unacceptable consequences nor any control system design feature on B&W designed plants which violates any Commission regulation. The staff has concluded that little more can be gained by pursuing the issue of control system failures on a plant by plant basis for operating plants, but, rather intends to pursue the issue on a broader basis which will include all vendor designs and all control systems that

could affect plant safety. The Commission has designated the "Safety Implications of Control Systems" (USI A-47) as an Unresolved Safety Issue (see NUREG-0705, "Identification of New Unresolved Safety Issues Relating to Nuclear Power Plants, Special Report to Congress" dated March 1981). The purpose of this Unresolved Safety Issue is to perform in-depth evaluations of control systems that are typically used during normal plant operation and to evaluate the adequacy of current licensing requirements.

In summary, the staff has reviewed the Reliability Analysis of the ICS (BAW-1564) and the licensee's response to the six recommendations contained in BAW-1564. Based upon these reviews, the staff believes that the Davis-Besse Nuclear Power Station Unit 1 design meets all current regulatory requirements. In addition, since the staff has not identified any specific control system failures or actions that would lead to unacceptable consequences, the staff does not believe that any additional immediate licensing action is warranted at this time. However, for the longer term, USI A-47, which was begun in December 1980, has as its principle task, the assessment of the adequacy of current regulatory requirements for control systems. Resolution of A-47 will determine whether it will be necessary to impose additional and more stringent requirements on control systems in the future.

The following NRC personnel contributed to the preparation of this Safety Evaluation Report: Charles Rossi.

Dated: April 5, 1982