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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO AMENDMENT NO. 45 TO FACILITY OPERATING LICENSE NO. DPR-24 AND AMENDMENT NO. 50 TO FACILITY OPERATING LICENSE NO. DPR-27

WISCONSIN ELECTRIC POWER COMPANY

POINT BEACH NUCLEAR PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-266 AND 50-301

1.0 Introduction

By letter dated July 28, 1977 (Reference 1) Wisconsin Electric Power Company (WEPCO) submitted to the NRC plant specific analyses in support of the reactor vessel overpressure mitigating system (OMS) for Point Beach Units 1 and 2. The analyses were supplemented by letter dated October 28, 1977 (Reference 2) and other documentation submitted by WEPCO (References 3-6).

Staff review of all information submitted by WEPCO in support of the proposed overpressure mitigating system is complete and has found that the system provides adequate protection from overpressure transients. A detailed safety evaluation follows.

2.0 Background

Over the last few years, incidents identified as pressure transients have occurred in pressurized water reactors. This term "pressure transients," as used in this report, refers to events during which the temperature pressure limits of the reactor vessel, as shown in the facility Technical Specifications, are exceeded. All of these incidents occurred at relatively low temperature (less than 200 degrees F) where the reactor vessel material toughness (resistance to brittle failure) is reduced.

The "Technical Report on Reactor Vessel Pressure Transients" in NUREG 0138 (Reference 7) summarizes the technical considerations relevant to this matter, discusses the safety concerns and existing safety margins of operating reactors, and describes the regulatory actions taken to resolve this issue by reducing the likelihood of future pressure transient events at operating reactors. A brief discussion is presented here.

2.1 Vessel Characteristics

Reactor vessels are constructed of high quality steel made to rigid specifications, and fabricated and inspected in accordance with the time-proven rules of the ASME Boiler and Pressure Vessel Code. Steels used are particularly tough at reactor operating conditions. However, since reactor vessel steels are less tough and could possibly fail in a brittle manner if subjected to high pressures at low temperatures, power reactors have always operated with restrictions on the pressure allowed during startup and shutdown operations.

At operating temperatures, the pressure allowed by Apendix G limits is in excess of the setpoint of currently installed pressurizer code safety valves. However, most operating PWRs did not have pressure relief devices to prevent pressure transients during cold conditions from exceeding the Appendix G limit.

2.2 Regulatory Actions

By letter dated August 11, 1976, (Reference 8) the NRC requested that WEPCO begin efforts to design and install plant systems to mitigate the consequences of pressure transients at low temperatures. It was also requested that operating procedures be examined and administrative changes be made to guard against initiating overpressure events. It was felt by the staff that proper administrative controls were required to assure safe operation for the period of time prior to installation of the proposed overpressure mitigating hardware.

WEPCO responded (References 5 and 6) with preliminary information describing interim measures to prevent these transients along with some discussion of proposed hardware. The proposed hardware change was to install a low pressure actuation setpoint on the pressurizer air operated relief valves.

WEPCO participated as a member of a Westinghouse user's group which was formed to support the analysis effort required to verify the adequacy of the proposed system to prevent overpressure transients. Using input data generated by the user's group, Westinghouse performed transient analyses (References 9 and 10) which are used as the basis for plant specific analysis.

Plant specif' analyses for Point Beach Units 1 and 2 were submitted by WEPCO by letter dated July 18, 1977 (Reference 1) and supplemented by letter dated October 28, 1977 (Reference 2).

2.3.1 Design Criteria

Through this series of meetings and correspondence with PWR vendors and licensees, the staff developed a set of criteria for an acceptable overpressure mitigating system. The basic criterion is that the mitigating system will prevent reactor vessel pressures in excess of these allowed by Appendix G. Specific criteria for system performance are:

1) Operator Action: No credit can be taken for operator action for ten minutes after the operator is aware of a transient.

2) Single Failure: The system must be designed to relieve the pressure transient given a single failure in addition to the failure that initiated the pressure transient.

3) Testability: The system must be testable on a periodic basis consistent with the system's employment.

4) Seismic and IEEE 279 Criteria: Ideally, the system should meet seismic Category I and IEEE 279 criteria. The basic objective is that the system should not be vulnerable to a common failure that would both initiate a pressure transient and disable the overpressure mitigating system. Such events as loss of instrument air and loss of offsite power must be considered.

The staff also instructed the licensee to provide an alarm which monitors the position of the pressurizer relief valve isolation valves, along with the low setpoint enabling switch, to assure that the overpressure mitigating system is properly aligned for shutdown conditions.

2.4 Design Basis Events

The incidents that have occurred to date have been the result of operator errors or equipment failures. Two varieties of pressure transients can be identified: a mass input type from charging pumps, safety injection pumps, safety injection accumulators; and a heat addition type which causes thermal expansion from sources such as steam generators or decay heat.

On Westinghouse designed plants, the most common cause of the overpressure transients to date has been isolation of the letdown path. Letdown during low pressure operations is via a flowpath through the RHR system. Thus, isolation of RHR can initiate a pressure transient if a charging pump is left running. Although other transients occur with lower frequency, those which result in the most rapid pressure increases were identified by the staff for analysis. The most limiting mass input transient identified by the staff is inadvertent injection by the largest safety injection pump. The most limiting thermal expansion transient is the start of a reactor coolant pump with a 50 degree F temperature difference between the water in the reactor vessel and the water in the steam generator.

Based on the historical record of overpressure transients and the imposition of more effective administrative controls, the staff believes that the limiting events identified above form an acceptable bases for analyses of the proposed overpressure mitigating system.

3.0 System Description and Evaluation

WEPCO adopted the "Reference Mitigating System" developed by Westinghouse and the user's group. The licensee proposed to modify the actuation circuitry of the existing air operated pressurizer relief valves to provide a low pressure setpoint at 425 psig during startup and shutdown conditions. When the reactor vessel is at low temperatures, with the low pressure setpoint selected, a pressure transient is terminated below the Appendix G limit by automatic opening of these relief valves. A manual switch is used to enable and disable the low setpoint of each relief valve. The OMS will remain in service during heatup until the RCS temperature reaches a level corresponding to the value (approximately 370 degrees F) at which the inservice pressure test may be performed. Conversely during cooldown the OMS will be enabled when the RCS is depressurized to a pressure less than 425 psig (the OMS setpoint) and before the RCS temperature drops below the temperature at which the inservice pressure test may be performed (~370 degrees F). The staff finds the pressurizer relief valves with a manually enabled low pressure setpoint to be an acceptable concept for an overpressure mitigating system. Discussion and evaluation of the system proposed by WEPCO follows.

3.1 Air Supply

The power operated relief valves (PORVs) are spring-loaded-closed, air required to open valves, which are supplied by a control air source. To assure operability of the valves upon loss of control air, a backup air supply is provided. The backup air supply consists of a compressed gas bottle for each PORV. Each tank contains enough air for approximately 139 valve openings. The staff finds the backup air supply to be acceptable.

3.2 Electrical Controls

The PORV's are made operational for low-pressure relief by utilizing a dual setpoint where the low-pressure circuit is energized and de-energized, depending on plant conditions, by the operator with a key-lock switch. The logic required for the low-pressure setpoint is in addition to the existing PORV actuation logic and will not interfere with existing automatic or manual actuation of the PORV's.

The relief valves on the RHR system are available for pressure relief whenever the RHR system is connected to the RCS. The RHR system is normally connected to the RCS during plant conditions when overpressurization events have been most prevalent, i.e., during low-temperature and low-pressure conditions. The RHR-system relief valves can be considered a diverse relief system at Point Beach because the RHR system isolation valves do not automatically isolate the RHR system during a pressure transient, thereby making the relief valves available throughout the transient.

During plant cooldown and prior to the collapse of the steam bubble in the pressurizer, the operator acting under administrative procedure places the keylock switch in the "low pressure" position and connects the RHR system to the RCS. An alarm will alert the operator when the pressure is sufficiently low so that activation of the low pressure setpoint circuit will not inadvertently open a PORV. Placing the keylock switch in the "low pressure" position blocks the alarm indicating low pressure and enables the low-temperature high-pressure alarm.

During plant heatup, the operating procedure will identify the plant conditions for which low-pressure protection is no longer needed. The operator places the keylock switch in the "normal" position, thereby returning control of the PORV's to the operating high-pressure condition and avoiding inadvertent opening of the PORV's. Placing the keylock switch in the "normal" position removes or blocks the low-temperature high-pressure alarms and enables the low-pressure operation alert alarm.

We find the above design features acceptable.

3.3. Testability

Testability will be provided. WEPCO has stated that verification of operability of the OMS control system will be performed prior to entering water solid conditions. PORV testing will be performed during each refueling outage. Testing requirements will be incorporated in the Technical Specifications as discussed in Section 4.2 of this evaluation.

3.4 Appendix G

The Appendix G curve submitted by WEPCO for purposes of overpressure transient analysis is based on 32 effective full power years irradiation. The zero degree heatup curve is allowed since most pressure transients occur during isothermal metal conditions. Margins of 30 psig and 10 degrees F are included for possible instrument errors. The staff finds that use of this curve is acceptable as a basis for overpressure mitigating system performance.

3.5 Setpoint Analysis

The one loop version of LOFTRAN (Reference WCAP 7907) was used to perform the mass input analyses. The four loop version was used for the heat input analysis. Both versions require some input modeling and initialization changes were required. LOFTRAN is currently under review by the staff and is judged to be an acceptable code for treating problems of this type.

The results of this analysis are provided in terms of PORV setpoint overshoot. The predicted maximum transient pressure is simply the sum of the overshoot magnitude and the setpoint magnitude. The PORV setpoint is adjusted so that given the setpoint overshoot, the resultant pressure is still below that allowed by Appendix G limits.

WEPCO presented the following Point Beach Units 1 and 2 plant characteristics to determine the pressure reached for the design basis pressure transients:

SI Pump Flowrate	Flowrate versus pressure used in generic analysis (Ref. 10)
RCS Volume	6,900 ft^3
PORV Opening Time	2 sec
S G Heat Transfer area	44,000 ft^2
Relief Valve setpoint	425 psig

Westinghouse identified certain assumptions and input parameters as conservative with respect to the analysis. These include one PORV assumed to fail, conservative heat transfer coefficients, conservative modeling of stored energy of steam generators, and conservative interpolation schemes to obtain plant specific results from generic analyses.

The relief capacity of the RHR (990 gpm at 500 psig) has been conservatively neglected. In fact the relief capacity of the RHR will accommodate hypothesized mass injection from a single safety injection pump. It is a diverse as well as redundant subsystem.

3.5.1 Mass Input Case

The inadvertent start of a safety injection pump with the plant in a cold shutdown condition was selected as the limiting mass input case.

Westinghouse provided the licensee with a series of curves based on the LOFTRAN analysis of a generic plant design which indicates PORV setpoint overshoot for this transient as a function of system volume, relief valve opening time and relief valve setpoint. These sensitivity analyses were then applied to the Point Beach Units 1 and 2 plant parameters to obtain a conservative estimate of the PORV setpoint overshoot. WEPCO has taken credit for volumetric expansion of the RCS with increasing RCS pressure. This is calculated to reduce the pressure overshoot (P max - P setpoint) to 74% of the value calculated assuming no expansion. The calculations are documented in References 1 and 2. The staff finds this method of analysis to be acceptable.

The calculated pressure overshoot assuming inadvertent mass addition from a single safety injection pump is less than or equal to 94.5 psi. With an OMS low pressure setpoint of 425 psig, the highest predicted pressure for the worst case mass input is 519.5 psig. It has been assumed that only one PORV opens. No credit has been taken for the RHR system relief capacity. The 32 EFPY Appendix G limit of Units 1 and 2 at RCS temperatures greater than or equal to 109 F and 136 F respectively is greater than or equal to 520 psig. Use of an Appendix G curve applicable for less than 32 EFPY's would show additional conservatism. Hence the OMS setpoint is considered acceptable.

3.5.2 Heat Input Case

Inadvertent startup of a reactor coolant pump with a primary to secondary temperature differential across the steam generator, and with the plant in a water solid condition, was selected as the limiting heat input case. For the heat input case, Westinghouse provided the licensee with a series of curves based on the LOFTRAN analysis of a generic plant design to determine the PORV setpoint overshoot as a function of RCS volume, steam generator UA, initial RCS temperature, reactor coolant/steam generator ΔT, relief valve setpoint, and relief valve opening time.

WEPCO calculated the following values of the maximum pressure for the heat input transient for a fixed ΔT of 50 degrees F as a function of the initial RCS temperature.

RCS Temperature	Maximum Pressure
100	441
140	454
180	465
25[illegible]	490

In all these cases, for the given RCS temperature, the Appendix G limits are not exceeded.

The staff finds that the analyses of the limiting mass input and heat input cases show a maximum pressure transient below that allowed by Appendix G limits and is therefore acceptable.

3.6 Implementation

Unit 1

WEPCO installed interim hardware protection (a single control system, without redundant air supply) during the fall of 1976. Redundant control channels were installed during the October 1977 refueling. Redundant air supplies were installed on Unit 1 during the November 1979 refueling outage.

Unit 2

WEPCO installed interim hardware protection during the spring 1977 refueling. Redundant control channels and backup air supplies were installed on Unit 2 during the March 1979 refueling outage.

4.0 Administrative Controls

To supplement the hardware modifications and to limit the magnitude of postulated pressure transients to within the bounds of the analysis provided by the licensee, a defense in depth approach is adopted using procedural and administrative controls. Those specific conditions required to assure that the plant is operated within the bounds of the analysis will be enumerated in forthcoming Technical Specifications.

4.1 Procedures

A number of provisions for prevention of pressure transients have been incorporated in the plant operating procedures.

With respect to hypothesized mass addition transients, HPSI pump, HPSI isolation valve motors, and accumulator isolation valve motors are electrically isolated with circuit beakers locked in the open position.

Of particular concern is the conduct of the loss of A.C. simultaneous with Safety Injection test which may be performed with the RCS in a water solid condition. During this test which simulates loss of A.C. power and startup of emergency diesel generators both safety injection pumps and safety injection isolation valves receive command signals. The OMS is not designed to mitigate mass addition from both safety injection trains. Additional steps will be incorporated in the plant operating procedures to check that Safety Injection Isolation Valves, MOV866A and B are closed, and circuit breakers providing power to the valve motor operators are open and tagged, prior to performing this test.

With respect to heat addition hypothesized transients, RCP starts are minimized, RCS/SG differential temperatures are checked prior to RCP starts. In addition RCP starts during solid water conditions are performed with minimized charging flow rates and maximized letdown flow rates.

With respect to any scenario, additional, redundant, relief capacity is provided by insuring that the RHR system is aligned prior to taking the plant solid.

The staff finds that the procedural and administrative controls described are acceptable.

4.2 Technical Specifications

To assure proper operation of the overpressure mitigating system, WEPCO submitted, by letter dated November 2, 1978, proposed Technical Specifications for Staff review. The proposed specifications were reviewed against the following criteria.

1. The OMS is to be operable when the RCS temperature is below the value at which inservice pressure testing may be performed. The OMS setpoint is to be incorporated in the Technical Specifications. Operability requires that the system is enabled, upstream isolation valves open and backup air supply charged. Should one redundant train (control circuitry and associated relief valve) be inoperable for more than seven days either a vapor bubble is to be established in the pressurizer or the primary system depressurized and vented to the atmosphere within eight hours. Should both redundant trains be found inoperable either a vapor bubble is to be established in the pressurizer or the primary system depressurized within eight hours.

2. Suitable surveillance requirements are to be proposed consistent with the need for use of the OMS.

3. Electrical isolation of HPSI pump and isolation valve motors and the reinstation of electrical power to these components is to be incorporated in the Technical Specifications.

4. Surveillance requirements consistent with the assumption that the RCS/SG differentialtemperature is less than or equal to 50 degrees F are to be proposed. It is noted that calculations based on a RCS/SG ΔT of 50 degrees F result in ample margins to the Appendix G curves. Should WEPCO chose to demonstrate that larger values of RCS/SG ΔT are acceptable with respect to violations of the Appendix G curves corresponding relaxation of surveillance requirements will be accepted.

5. Operation of the OMS (PORV's and/or RHR relief valves) to relieve a pressure transient is to be reported.

Our review of WEPCO's submittal indicated that some modifications and additions were required to ensure compliance with the Staff's criteria. These changes have been discussed with and agreed to by the WEPCO Staff. With the inclusion of these changes, the Staff finds the proposed Technical Specifications conform to our criteria and are, therefore, acceptable.

5.0 Conclusions

The administrative controls and hardware changes proposed by Wisconsin Electric Power Company provide protection for Point Beach Units 1 and 2 from pressure transients at low temperatures by reducing the probability of initiation of a transient and by limiting the pressure of such a transient to below the limits set by Appendix G. The staff finds that the overpressure mitigating system meets the criteria established by the NRC and is acceptable as a long term solution to the problem of overpressure transients. However, any future revisions of Appendix G limits for Point Beach Units 1 and 2 must be considered and the overpressure mitigating system setpoint adjusted accordingly with corresponding adjustments in the license.

Environmental Consideration

We have determined that the amendments do not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendments involve an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR §51.5(d)(4), that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of these amendments.

Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendments do not involve a significant increase in the probability or consequences of accidents previously considered and do not involve a significant decrease in a safety margin, the amendments do not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of these amendments will not be inimical to the common defense and security or to the health and safety of the public.

Date: MAY 2 0 1980

REFERENCES

1. W.E. letter (Burstein) to NRC (Case), July 18, 1977.

2. W.E. letter (Burstein) to NRC (Case), October 28, 1977.

3. W.E. letter (Burstein) to NRC (Rusche), September 3, 1976.

4. W.E. letter (Burstein) to NRC (Rusche), October 14, 1976.

5. W.E. letter (Burstein) to NRC (Rusche), March 2, 1977.

6. W.E. letter (Burstein) to NRC (Rusche), April 18, 1977.

7. "Staff Discussion of Fifteen Technical Issues listed in Attachment G November 3, 1976 Memorandum from Director NRR to NRR Staff." NUREG-0138, November 1976.

8. NRC letter (Lear) to W.E., (Burstein), August 11, 1976.

9. "Pressure Mitigating System Transient Analysis Results" prepared by Westinghouse for the Westinghouse user's group on reactor coolant system overpressurization, July 1977.

10. "Supplement to the July 1977 Report, Pressure Mitigating Systems Transient Analysis Results," prepared by Westinghouse for the Westinghouse user's group on reactor coolant system overpressurization, September 1977.

11. W.E. letter (Burstein) to NRC (Denton), November 2, 1978.