November 18, 1991

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MEMORANDUM FOR: Edward G. Greenman, Director
Division of Reactor Projects, Region III

FROM: John A. Zwolinski, Assistant Director
for Region III Reactors
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

SUBJECT: REQUEST FOR TECHNICAL ASSISTANCE - CLARIFICATION OF ALTERNATE DECAY HEAT REMOVAL REQUIREMENTS - AIT #0128 / TAC #M76379

In a memorandum dated March 15, 1990, the Region III Division of Reactor Projects requested technical assistance regarding the alternate decay heat removal (DHR) requirements for Boiling Water Reactors (BWRs). The Office of Nuclear Reactor Regulation has reviewed your request and is enclosing the response to your concerns. In addition, we have enclosed a copy of the request for assistance and its attachments as background information. Please note that NRR is currently evaluating shutdown risks as a generic issue. Dr. Murley has directed the staff to refrain from making any plant-specific resolutions until the staff has fully evaluated the risk and established an official NRC policy statement regarding plant operations while shut down. Most technical evaluations are scheduled to be complete by December 31, 1991 and any new requirements which may result from the staff's evaluation are expected by June 1992. The enclosures should assist in your evaluation of these shutdown issues and indicate to you which areas are currently under staff consideration.

Should you have any questions, feel free to contact me or Anthony T. Gody, Jr. at (FTS)492-1335 or (FTS)492-1387 respectively.

/s/
John A. Zwolinski, Assistant Director
for Region III Reactors
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

Enclosure: As stated
cc: w/Enclosure

LA/PDIII-3	PM/PDIII-3	BC/SRXB*	PD/PDIII-3
11/ /91	11 /15 /91	11 /14 /91	11/15/91
P.Kreutzer	A.T.Gody, Jr.	R. Jones	J.N.Hannon

AD/DRPW
/ /91
J. Zwolinski

* See previous concurrence

Edward G. Greenman, Director
Division of Reactor Projects, Region III

cc:

Charles W. Hehl, Division of Reactor Projects, Region I
Luis A. Reyes, Division of Reactor Projects, Region II
Hubert J. Miller, Division of Reactor Safety, Region III
L. Joe Callan, Division of Reactor Safety, Region IV
Roy P. Zimmerman, Division of Reactor Safety and Projects, Region V
Philip G. Brochman, Senior Resident Inspector, Clinton Power Station

Enclosure 1

ALTERNATE DECAY HEAT REMOVAL REQUIREMENTS

DESIGN BASIS:

Many Boiling Water Reactors (BWRs) have only one common shutdown cooling suction line from the reactor to the residual heat removal (RHR) system. An alternate shutdown cooling (ASC) method was identified to satisfy the requirements of General Design Criterion 34 (GDC-34) "Residual Heat Removal." The ASC function is provided by pumping water from the suppression pool through an RHR heat exchanger and discharging water into the reactor via the low pressure coolant injection (LPCI) discharge flow path. A cooling loop is established with the reactor pressure vessel (RPV) by returning vessel water to the suppression pool via the main steam line safety relief valves (SRVs) and their discharge piping. This alternate method uses safety grade and seismically qualified equipment and can withstand a loss of off-site power (LOSP) event.

The General Electric Company (GE) performed generic tests for the ASC method to demonstrate that it is feasible to use the SRVs for decay heat removal (DHR). Individual licensees were required to review the generic tests and perform analyses to verify that their plant-specific design is capable of performing the ASC function while shutdown. The ASC method described above is not a preferred method, principally due to potential damage to SRVs from water passing through them and poor reactor cooling flow control, and obviously cannot be utilized after the reactor vessel head is removed, the main steam lines are blocked, and the cavity is flooded for core refueling.

The use of ASC does not constitute an unreviewed safety question and is in the licensing basis of the plant. Due to a number of inconvienient operating characteristics with the ASC method, although this safety-grade method of removing decay heat meets the requirements of GDC-34, licensees normally choose to utilize alternate decay heat removal (ADHR) methods. ADHR methods not in the licensed design-basis of the plant need to be specifically reviewed by the licensee under 10 CFR 50.59 to determine whether their use constitutes an unreviewed safety question when Technical Specifications (TS) require alternate DHR.

CLINTON POWER STATION (CPS) TECHNICAL SPECIFICATIONS:

In Mode 4 (Reactor Average Coolant Temperature ≤ 200°F), TS require two RHR loops to be operable, and, unless a recirculation pump is in operation, at least one RHR loop be operating (i.e one RHR pump and one RHR heat exchanger in operation). If one RHR loop is out of service, the licensee must demonstrate the operability of at least one ADHR method (recall that ASC qualifies) within 1 hour and at least once per 24 hours thereafter. If two RHR loops are out of service and no recirculation pump is available, the licensee has 1 hour to establish reactor coolant circulation by an alternate method. In addition, the licensee must monitor reactor coolant temperature and pressure at least once per hour.

With the plant in Mode 5 (Reactor Average Coolant Temperature ≤140°F) and fuel in the reactor vessel with the head closure bolts less than fully tensioned, the REFUELING OPERATIONS TS control the RHR system operation. Prior to flooding the vessel to 23 feet above the top of the RPV flange, TS require both RHR loops to be operable with at least one loop operating. Once the vessel is flooded to 23 feet above the RPV flange, TS require only one RHR loop to be operable and operating.

Once fuel is removed from the vessel, the DHR requirements of the fuel are met by the spent fuel pool cooling system and associated backup systems.

TS 3.8.1.2, applicable in Modes 4 and 5 and whenever irradiated fuel is being handled within the secondary containment, requires diesel generator 1A or 1B to be operable. In addition, diesel generator 1C is required to be operable when the high pressure core spray (HPCS) system is required to be operable.

TS 3.5.2 requires that at least two of the Emergency Core Cooling Systems (ECCS) be operable during Modes 4 and 5. ECCS is not required to be operable, however, when the reactor head is removed, the cavity is flooded, the reactor cavity steam dryer pool gate is open and water level in the upper containment pools is maintained within the limits of TS 3 9.8 and 3.9.9.

SRV operability is not specified in the TSs for Modes 4 and 5. Valves F008 and F009, containment isolation valves in the common suction header for RHR, do not have operability requirements for operational conditions 4 and 5.

Generally, when a plant does not satisfy the limiting condition for operation (LCO) for a particular TS, the ACTION statement is entered. The licensee shall take appropriate corrective action to ensure the ACTION statement is implemented and exited as soon as practicable.

ALTERNATE DECAY HEAT REMOVAL:

ADHR methods are typically established by licensees well in advance of the need for them to be utilized for core decay heat removal. Verification or checking the adequacy of design as required by Appendix B typically includes an engineering evaluation of equipment availability, heat removal capability, electric power availability, and decay heat requirements of the core, and may even include a test of the systems' capabilities.

In developing ADHR methods, licensees must ensure the ADHR method can adequately transfer the heat from the core to some form of ultimate heat sink. Ultimate heat sink capacity must be sufficient to accommodate the current decay heat rate in the core. Additionally, the flow rate through the core must be sufficient to remove the decay heat and transfer this heat to the ultimate heat sink.

Licensees should not utilize nonsafety-grade methods for an unlimited time under normal circumstances. The alternate DHR method should be used only during exigent situations and unavoidable maintenance related circumstances and should be limited to a minimum period of time. It is not appropriate for the licensee to intentionally disable both loops of RHR, violating TSs, and depend totally on nonsafety-grade equipment for long term DHR.

Intentionally disabling all the required loops of RHR while in Mode 4 or 5 to perform elective maintenance and shorten outage duration may not be an acceptable practice without ensuring a safety-grade method of removing core decay heat is operable. Many BWR licensees choose to take both loops of RHR out of service to facilitate timely maintenance on the feedwater system during plant outages. However, most licensees take credit for the ASC method described above (or another safety-grade system) by ensuring the system is operable prior to removing all the loops of RHR from operation. The staff, in its shutdown risk effort, is evaluating this practice to determine if it is acceptable.

Although the TSs are clear on the requirements of RHR operability, there are some situations where entering the TS Limiting Condition for Operation (LCO) is necessary. An example of this type of situation is when the RHR suction containment isolation valves (F008 and F009) require maintenance. Removing this section of piping from service for maintenance on these valves disables both trains of RHR. Many licensees schedule maintenance on these valves during plant conditions when decay heat can be efficiently removed with other available systems. For example, while the plant is being cooled down and still generating steam, decay heat can be removed via the main steam lines. Some licensees ensure several safety-grade systems are available for backup in the event of an emergency. Another typical window of opportunity for maintenance on these valves (F008 and F009) occurs when the decay heat load is very low, the head is removed, the cavity is flooded, and TS require only one train of RHR. Although TSs require one or both trains of RHR to be operable at all times, licensees are sometimes forced into disabling both loops of RHR for

special situations such as this. The Individual Plant Evaluation may help identify the best time to perform this type of maintenance when it is complete.

Rather than utilize the ASC method to remove core decay heat when both trains of RHR must be removed from service at the same time, licensees typically use alternate DHR methods (e.g., spent fuel pool cooling, reactor water cleanup system). Licensees prefer alternate DHR methods over the ASC method for the following reasons: (1) the ability to assure a higher quality of water entering the core; (2) the potential for SRV degradation due to water passing through these valves; and (3) better core coolant flow control.

When the reactor decay heat rate decreases to a low enough value, some licensees choose to stop DHR system flow until the reactor coolant temperature increases to a pre-determined value, the licensee must perform an engineering analysis to demonstrate that this is an acceptable method. This is done sometimes to reduce wear on pumps when decay heat is low and is allowed by TSs. During this period, cooling is provided by natural circulation within the vessel with heat removal provided by natural convection to the surroundings. Under these conditions, natural circulation is considered an acceptable method. Nevertheless, during this time, the TS require DHR equipment (RHR) to be operable and, in the case of CPS, the system is only allowed stopped for a maximum period of 2 hours for every 8.

TSs require that when alternate DHR methods are used, operability of the selected method must be ensured. "Demonstrate the operability" means to verify, through testing and/or analytical methods, that each individual component is capable of performing its intended function or verify that the system as a whole can perform its function through testing.

In the proposed new BWR Standard TS, the staff requires the licensee to demonstrate that a safety grade alternate DHR is operable when both RHR loops become inoperable. The licensee can still choose to use the non-safety grade alternate DHR systems for decay heat removal but must ensure the safety grade equipment is operable. Other TS that may need to be considered are those associated with the emergency diesel generators (EDGs), emergency core cooling system (ECCS), safety relief valves (SRVs), and containment isolation valves F008 and F009.

Contact: Anthony T. Gody, Jr.
(FTS) 492-1387

Enclosure 2

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

MAR 15 1990

MEMORANDUM FOR: Gary M. Holahan, Acting Director, Division of Reactor Projects III/IV/V and Special Projects, NRR

FROM: Edward G. Greenman, Director, Division of Reactor Projects, Region III

SUBJECT: REQUEST FOR TECHNICAL ASSISTANCE - CLARIFICATION OF ALTERNATE DECAY HEAT REMOVAL REQUIREMENTS - AIT #0128

Clinton Technical Specifications 3.4.9.1, 3.4.9.2, 3.9.11.1, and 3.9.11.2 require that two loops of residual heat removal (RHR) be OPERABLE for shutdown cooling in OPERATIONAL CONDITIONS 3, 4, and 5 except that only one train is required when the head is removed from the reactor and more than 23 feet of water is over the vessel flange. ACTION statements for the above Technical Specifications permit the licensee to utilize alternate methods capable of decay heat removal (DHR) for each required shutdown cooling mode loop of RHR that is not OPERABLE.

Technical Specifications require that the licensee demonstrate the operability of these alternate DHR methods within one hour and once per 24 hours thereafter. In addition, the ACTION statements require the licensee to establish reactor coolant circulation by an alternate method when no RHR or recirculation pumps are in operation. No time limits are specified for reliance on the ACTION statements for alternate DHR or alternate coolant recirculation. Several questions regarding Technical Specifications have been raised by the Clinton resident staff.

1. What are the requirements of "alternate methods of decay heat removal" with regard to the use of safety grade equipment, seismic qualifications, ability to withstand a loss of offsite power accident, margin of excess heat removal capability, etc.?

2. Does the alternate DHR method have to include the capability to transfer the heat all the way to an ultimate heat sink or just remove it from the core?

3. What is meant by "demonstrate the operability?" Would this be expected to include physically proving all components will operate by, for instance, actually opening safety relief valves (SRVs) and passing water through them when that is the method being used for alternate DHR? Current NRC philosophy seems to lean towards not putting water past the SRVs due to industry problems with foreign material contaminants interfering with their operation. Does the licensee have to actually measure heat removal capacity during each

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demonstration, just show that flow can be established through the system, or merely perform an analysis that shows that the decay heat rate is within the capacity of the alternate system? Can the licensee rely on previous demonstrations or generic evaluations (BWR Owners Group)?

4. No time limits are specified in the Technical Specification for dependance on alternate DHR methods. What time limits would be appropriate, or can the licensee utilize nonsafety grade methods for an unlimited time? Is it appropriate for the licensee to intentionally disable both loops of RHR at the same time and depend totally on nonsafety grade equipment for long term decay heat removal?

5. What are the requirements of "establishing reactor coolant circulation by an alternate method" with regard to flow rate, use of safety grade equipment, seismic qualification, ability to withstand a loss of offsite power accident, etc.? Would natural circulation be considered an acceptable method?

6. The Clinton Updated Safety Analysis Report (USAR) does not discuss alternate DHR methods except for use of SRVs to cool the reactor and RHR in the suppression pool cooling mode to transfer the heat to the ultimate heat sink. This accident analysis starts at 102% power and is terminated when cold shutdown is reached. The USAR does not analyze a loss of decay heat removal accident which occurs during cold shutdown conditions. Would the use of alternate DHR methods in cold shutdown constitute an Unreviewed Safety Question in accordance with 10 CFR 50.59?

7. Does 10 CFR 50, Appendix A, "General Design Criteria For Nuclear Power Plants," apply to alternate DHR and coolant circulation methods? For example, Criterion 34 states, in part, "A system to remove residual heat shall be provided...to assure that for onsite electrical power system operation (assuming offsite power is not available)...the system ~~safety~~ function can be accomplished, assuming a single failure."

Background Information:

Clinton has used several methods of alternate DHR in the past to meet the requirements of the Technical Specifications. Among the methods used have been circulation of the reactor refueling pool through the fuel pool cooling heat exchangers with the reactor head removed, circulation of reactor coolant through the reactor water cleanup system using the non-regenerative heat exchanger to remove heat, draining reactor coolant to the condenser through the main steam line drains while making up with water from other sources, draining reactor coolant through the SRVs with no method to remove the heat from the suppression pool but a calculation showing that the pool would not heat up excessively in the time that RHR was not available, and most recently, draining reactor coolant through the SRVs with suppression pool heat removal accomplished by circulating water through the spent fuel pool heat exchangers

using the suppression pool cleanup pumps. In one case, the licensee depended on one such alternate DHR method for a 24 day period and depended on two alternate methods for 8 days of that time when both RHR loops were inoperable.

All of the above alternate DHR methods utilize nonsafety grade equipment for at least part of the DHR chain. None of the methods would be able to perform fully during a loss of offsite power accident. Clinton, as well as most other BWRs, routinely disables RHR loops for preventative and corrective maintenance and has no completely safety grade alternate DHR method available. In light of recent generic communication and TI inspection requirements regarding PWR loss of DHR incidents and long term decay heat removal capabilities, Region III is concerned about a BWR plant's ability to remove decay heat with RHR loops disabled during a loss of offsite power accident, seismic event, or other accident or failure. We believe that the Technical Specifications should be more prescriptive regarding acceptable methods of alternate DHR and coolant circulation and should contain time limits for operations with one or two RHR loops inoperable. Current Specifications would allow both loops of RHR to be inoperable for an unlimited period of time.

Regarding the issue of "demonstrating the operability" of the alternate systems, Clinton currently does a one-time test to verify flow rates and heat removal capability of the systems and then simply depends on a record review to meet the 1 hour and once per 24 hour demonstration requirements. They conduct an informal review of system status and tagout files to determine that the system would still work if called upon. This review is logged in the control room log. If the alternate system is being taken credit for but not physically being used to remove decay heat, they do not normally even keep it lined up in standby. In the case of using the fuel pool cooling system to cool the suppression pool, it took about seven hours to line up the systems to put it in operation. When using emergency core cooling system injection and SRVs as the alternate DHR system for the reactor, they do not do any kind of a test. However, there are existing periodic surveillance requirements for these individual systems. We do not know of any test done at Clinton to verify the heat removal capability of the SRVs when passing water.

Region III realizes that a completly safety grade alternate DHR system is not always possible. We would prefer hat the Technical Specifications establish a reasonable time limit for inoperability of one of the required loops of RHR and not allow the intentional disabling of both loops of RHR. We request resolution of these issues before Clinton enters the next refueling outage in September 1990. These issues are also relevant to other BWRs so a generic response would appear to be appropriate. We have been told that the BWR Owners Group is in the process of preparing some kind of submittal concerning alternate DHR.

If you have any questions, please contact Richard Knop (FTS 388-5547) or Philip Brochman (217-935-9521).

Edward G. Greenman

Edward G. Greenman, Director
Division of Reactor Projects

cc: J. B. Hickman, NRR
P. G. Brochman, SRI-Clinton