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Subject: Response to Additional Information Request Regarding the Seismic Questions for the Clinton Power Station Individual Plant Examination For External Events (IPEEE)

Dear Madam or Sir:

By letter dated February 25, 1998, from Jon B. Hopkins, the NRC requested additional information regarding the Clinton Power Station (CPS) Individual Plant Examination of External Events (IPEEE) submittal in the seismic and fire areas. In letter U-602986 dated April 27, 1998, Illinois Power (IP) committed to respond to the two seismic related questions in the February 25, 1998, request for information by the end of the third quarter 1998.

The purpose of this letter is to provide responses to the two seismic questions contained in the February 25, 1998, request for additional information. The responses to the subject seismic questions are contained in Attachment 1 to this letter.

Sincerely yours,

Walter G. MacFarland

Walter G. MacFarland, IV
Senior Vice President and
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Attachment

cc: NRC Clinton Licensing Project Manager
NRC Resident Office, V-690
Regional Administrator, Region III, USNRC
Illinois Department of Nuclear Safety

SUBJECT: Response to Additional Information Request Regarding the Seismic Questions for the Clinton Power Station Individual Plant Examination For External Events (IPEEE)

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* Associated Corrective Action Document N/A

Responses to NRC Questions Pursuant to Seismic Evaluation for IPEEE at CPS

NRC Question 1:

According to the Individual Plant Examination of External Events (IPEEE) submittal, the preferred success path for the Clinton Power Station (CPS) relies on the reactor core isolation cooling (RCIC) system, and RCIC alone, for reactor coolant system (RCS) inventory control. The RCIC system, which uses a turbine-driven pump, is a single train system with only moderate reliability. According to EPRI NP-6041, "the use of single-train systems with recognized poor availability" should be "treated with caution" (for non-seismic-caused component or system unavailability). EPRI NP-6041 further states that "one should have reasonable assurance that the plant level non-seismic system unavailability is no more than about 0.01 [per demand]" and RCIC is cited as an example of systems with poor non-seismic failure probabilities. For Clinton, the independent failure probability of the RCIC system used in the Individual Plant Examination (IPE), as indicated in some of the Level 1 core damage sequences (from the IPE analyses), is 0.0546 per demand, higher than that specified in EPRI NP-6041 (i.e., about 0.01). The failure prol bility may increase for IPEEE application because of the longer mission time required f ie IPEEE (72 hours for IPEEE versus 24 hours for IPE). The use of generic data from JREG-1150 for turbine-driven pumps (3E-2 per demand for failure to start, 5E-3/ho or failure to run, and 1E-2/demand for unavailability due to test and maintenance) would yield a higher failure probability for a 72-hour mission time. The reliance on RCIC alone would yield a higher failure probability for a 72-hour mission time. The reliance on RCIC alone for high pressure injection in the preferred success path is therefore questionable. To address this issue, the high pressure core spray (HPCS) system is also required in the IPEEE for some other BWR6/Mark III plants as a back-up to the RCIC system. In these IPEEEs, although either the RCIC system or the HPCS system can satisfy the success criteria for high pressure injection, both systems are included in the safe shutdown equipment list (SSEL) for seismic evaluation. Please provide additional basis for the use of RCIC alone in the preferred success path for RCS inventory control and discuss the seismic capacity of the HPCS system.

Response:

In order to respond to the question of the seismic capacity of the High Pressure Core Spray (HPCS) System, a seismic walkdown of the HPCS system was performed. This walkdown included not only the HPCS injection system but also the HPCS support systems. The walkdown was conducted according to the guidance given in EPRI NP-6041.

This extensive walkdown for HPCS and support systems negates the need to provide additional basis for the use of RCIC alone in the preferred success path. The seismic walkdowns of the HPCS and support systems are of the same level of diligence that was used in the walkdowns performed for the original CPS IPEEE submittal.

The HPCS and support systems walkdowns provide the basis for use of HPCS as a backup to the RCIC system as other BWR 6 plants with Mark III Containments have done. The HPCS and the support systems are all classified as Division 3, which is divisionally separate from RCIC.

To this end, a safe shutdown equipment list (SSEL) was prepared, the seismic evaluation walkdown sheets (SEWS) for each component developed, walkdowns conducted, and results evaluated.

Support systems walked-down include the following Division 3 systems:

Shutdown Cooling Water (SX)
SX Pump Room Cooling (VH)
HPCS Room Cooling (VY)
Diesel Generator Room Cooling (VD)
Essential Switchgear Cooling (VX)
Instrument Power System (IP)
Diesel-Generator (DG)
Diesel Oil Storage System (DO)
Auxiliary Power System (AP)
DC Power System (DC)

After developing the SEWS forms for the SSEL components, the Seismic Walkdown Team from the original walkdowns was re-assembled. The qualifications of the Seismic Review Team (SRT) remain the same as in the September 1995 submittal with the addition of more years of experience. A pre-job briefing was conducted to re-familiarize the team with the objectives and methodology of the seismic walkdowns, lessons from the SQUG Walkdown Screening and Seismic Evaluation Training Courses, and the SEWS documentation forms.

The walkdowns were conducted during June of 1998.

Inclusion of HPCS as a Backup to RCIC in the Preferred Safe Shutdown Path

For the preferred shutdown path, HPCS is considered a backup to the RCIC system. This path assumes that a loss-of-offsite power (LOOP) occurs with the Review Level Earthquake (RLE).

If RCIC fails, then HPCS is available as a backup inventory control system. The HPCS system starts automatically on low reactor water level 2. The system stops injecting on high reactor water level 8 and restarts on level 2. Thus, no manual actions are necessary for HPCS to start and inject and maintain reactor water level between level 2 and level 8. There are no other changes to the preferred path system operating description. Safety Relief Valves (SRV) will be used for pressure control and the Suppression Pool Cooling mode of Residual Heat Removal (RHR) system train "A" will be used when the pool temperature increases. This path places the plant in hot shutdown.

When a RLE occurs, the Reactor Protection System (RPS) will provide a SCRAM signal if necessary, and the Control Rod Drive (CRD) system will provide motive force for driving in control rods for reactivity control. If a loss of offsite power (LOOP) occurs coincident with the RLE, the RPS will initiate a reactor SCRAM. Control room operators verify that the reactor is shut down following the SCRAM signal. To verify shutdown criteria are met, if non-safety power is available, the Rod Control and Information System (RCIS) display is used. If non-safety power is lost, the RCIS display is also lost and operators utilize a back panel in the main control room (MCR) to verify that the "all rods in" LED is lit on either Division 1 or 2 of the Rod Gang Control Cabinets (RGCC).

During the few minutes required for an operator to verify all rods in if the RCIS display is lost, other operators will utilize alternate means to determine whether significant rod movement occurred. Since non-safety power is lost, the main steam isolation valves (MSIVs) would close and the number of SRVs lifting would be indicative of whether the reactor was on a decay power trend or still at power. The Safety Parameter Display System (SPDS) power indication and suppression pool heatup rate would also indicate if the reactor was still at power. These alternate indications would give operators immediate indication of not meeting shutdown criteria while an operator is verifying the "all rods in" LED on the RGCC.

The next step in this scenario would be pressure control by the SRVs in response to closure of the MSIVs because of loss of solenoid power. Division 1 actuation and control logic of the SRVs is the preferred success path front line system for the reactor pressure control function. If no operator action occurs, the SRVs will lift on their set pressure. Otherwise, operators could control reactor pressure manually by controlling the SRVs. This action occurs in the MCR horseshoe and Automatic Depressurization System (ADS) valves are used during this event though non-ADS valves may be available. Depressurization of the reactor pressure vessel (RPV) is not required for this preferred success path because both RCIC and HPCS are high pressure injection systems.

The RCIC System will automatically start on a low reactor water level signal (Level 2). In accordance with operating procedure, operators will verify that the RCIC system is operating and providing inventory makeup. RCIC stops injecting on high water level (Level 8) to prevent water carry over to the RCIC turbine. No manual actions are required for restarting injection since the system will automatically restart injection on low water level (Level 2). However, the operators will manually control RCIC in accordance with Emergency Operating Procedures (EOPs) to prevent the cycling of RCIC injection. This operator action is performed from the "at the controls" area in the MCR and would not have to occur for RCIC to respond successfully in this scenario.

In the event that the RCIC system is lost, the HPCS system is used for inventory control. HPCS is capable of injecting water to the reactor vessel at a much higher flow rate than RCIC. The HPCS system will also start automatically on a low reactor water level signal (Level 2) and isolate on a high water level signal (Level 8). While RCIC is the preferred system because it is more easily controlled, HPCS is an alternate source of high pressure injection to the vessel. There are no operator actions required to operate this system.

The next action in this path is to start Residual Heat Removal (RHR) train "A" in the Suppression Pool Cooling mode to remove decay heat from the suppression pool and thus protect the containment. This is performed manually in accordance with EOPs when the suppression pool temperature increases. Suppression pool temperature will increase as a result of discharge from the RCIC turbine and/or the SRVs.

Operators placing RHR into Suppression Pool Cooling mode are required to use the MCR's controlled operating procedure, and would have sufficient time to properly place the system into operation before cooling is required. There is a self-checking system in place at CPS to minimize operator errors. There are also other members of the operating crew in the "at the controls" area of the MCR to assist in peer-checking. The shift manager has oversight responsibilities.

Walkdowns

Per the guidance in EPRI NP-6041, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin", Appendix D, "Sampling Guidelines" page D-3, commodities installed in bulk such as piping, cable trays, HVAC ducting, electrical conduit, and instrument lines can usually be screened generically subject to walkdown verification of inclusion rules. Since this was performed during the walkdowns of the original CPS IPEEE submittal, and design and installation practice of these items at CPS have been consistent and are included in the plant's quality assurance program, generic screening was not performed for these walkdowns.

HPCS AND SUPPORT SYSTEM AREAS WALKED-DOWN BY THE SRT

HPCS Pump Room and associated piping areas (Fuel Bldg 712, 737, & 755 foot elevations)
HPCS Diesel Generator (DG) Room (Diesel Generator Bldg 737 foot elevation)
HPCS DG Day and Storage Tank Rooms (Diesel Generator Bldg 712 & 737 foot elevations)
HPCS DG Ventilation Area (Diesel Generator Bldg 762 foot elevation)
HPCS Electrical Equipment Room (Control Bldg 781 foot elevation)
Div 3 Battery Room (Control Bldg 781 foot elevation)
Div 3 SX Pump Room (Screenhouse 699 foot elevation)
Main Control Room (Control Bldg 800 foot elevation)

The above areas contain the necessary active equipment to operate the HPCS pump, given a loss-of-offsite power event. Ventilation systems for the HPCS pump room, associated DG room ventilation, the Shutdown Service Water (SX) system pump room ventilation and the ventilation for the HPCS electrical equipment room were also included in these walkdowns.

Piping was walked down in accordance with the EPRI Seismic Margin Assessment (SMA) methodology which included a review of the following considerations:

- Non-ductile joints
- Cast iron pipe
- Branch lines flexibility
- Piping connections for excessive nozzle loadings
- Adequate clearance for valves to avoid seismic interactions
- Multiple support failure issues
- Vibration isolation on equipment
- Piping across seismic gaps
- Seismic interaction

The piping systems in these safety-related systems have been qualified for the Clinton SSE level earthquake of 0.25g. No weaknesses were identified during the walkdowns, therefore the seismic capacity should well exceed the RLE of 0.3g

Ductwork and dampers associated with the HPCS and support systems were also walked down and found to be acceptable for an RLE of 0.3g.

The HPCS pump room is located at the lowest elevation of the power block (excludes the service water pump house). The effects of seismic amplification are minimized at this level in the power block. The pump, piping, and valves were found to be adequately restrained by seismically qualified hangers, restraints, and snubbers. Branch lines and valves were found adequate for items mentioned above from the EPRI SMA methodology.

Certain HPCS motor operated valves (MOVs) were walked down and screened from further investigation during the walkdowns performed for the initial submittal of the CPS IPEEE. These MOVs received a walkby to confirm that each valve's configuration and potential interaction sources had not changed since the previous walkdowns. No problems were noted and all MOVs in this category were screened from further evaluation.

The HPCS pump room also included the room cooling coils, fans, and cabinets. This equipment was judged adequate to survive an RLE based on the EPRI SMA guidance.

The DG system was also walked down. The associated air start compressors and air receiver tanks were included with the DG as well as the fuel oil storage and day tanks, fuel oil pump and the ventilation for these areas. The guidelines of the EPRI SMA methodology for these types of components were followed and no outliers were found; therefore, these systems were screened from further review.

The electrical equipment area of the HPCS system walkdown included the switchgear panel, motor control centers (MCCs), battery and charger, distribution panel, and room ventilation equipment. All the equipment was found to be adequate for an RLE.

There were no additional MCR panels needed for the instruments and controls of these systems than what was included in the original CPS IPEEE submittal. The MCR panels did receive a walkby to confirm seismic configuration and to verify that no new problems had emerged.

The Division 3 SX pump room contains the SX pump, strainer, valves, MCC, and room ventilation equipment. The shaft of the SX pump could not be inspected below the floor of the pump room. Drawings were used to determine the location and adequacy of the seismic restraints on the pump shaft. The SRT found these to be adequate. The MCC and HVAC panels were inspected and passed the initial screening as did the air handling equipment. The valves, exposed piping, and SX pump all passed the initial screening for the respective equipment categories.

For the SX buried structures, penetrations were checked for flexibility but the analyses performed as part of the original CPS IPEEE submittal for the buried piping and electrical runs seismic distortions were not re-performed. The soils analyses from the original IPEEE submittal were reviewed and considered appropriate for demonstrating the adequacy of buried equipment that supports HPCS.

<u>Summary</u>

There were no outliers found during the course of the walkdowns. All of the HPCS and support systems components were screened from further evaluation. The addition of the HPCS and support systems to the preferred shutdown path does not change any of the conclusions of the original CPS IPEEE seismic submittal. These walkdowns serve to add credibility to CPS as a plant that has sufficient seismic margin to successfully withstand an RLE of 0.3g.

NRC Question 2:

It is stated in the submittal that "Operators use existing procedures to operate all of the systems in both of the success paths and are trained extensively on the use of these procedures in an on-going operator training program," but no details are provided. Since operator actions following a review level earthquake (RLE) are crucial for the successful shutdown of the plant, please discuss in more detail the types of operator actions needed, the locations where they have to be performed, the time available for these actions, and the estimated failure rates (e.g., obtained from IPE). Please also provide a discussion concerning the anticipated effects of the RLE on rates of operator errors which may impact the integrity of the preferred and the alternate success paths, as well as a more detailed discussion of the on-going operator training program and its effect on the IPEEE.

Response:

Following a RLE, operators would follow the directions given in CPS procedure 4301.01, "Earthquake." There are no "Immediate Operator Actions" in this procedure. "Subsequent Operator Actions" include the following:

Within 8 (eight) hours, a walkdown inspection of plant accessible equipment, piping, and the Clinton Lake dam should be made. Safety-related equipment should be checked first. These activities should have no effect on the availability of the preferred or alternate shutdown paths.

If the non-safety-related and non-seismically qualified systems such as Feedwater (FW) that are used in a normal plant shutdown are lost, operators would use equipment reviewed during the SMA. The discussion of operator actions during the preferred and alternate safe shutdown paths follows.

Preferred Path

The inventory and pressure control systems in the preferred path can operate without operator intervention. The safety relief valves (SRV) operate on set pressure and deadband reset pressure. The SRV's can be controlled manually to lower reactor vessel pressure to values lower than the SRV's would control when operating in automatic based on set pressures. Manual control of the SRV's occurs in the MCR. The SRV's are designed to control reactor vessel pressure automatically.

The RCIC system operates automatically between levels 2 and 8. Operators could take manual control of the system to adjust pump flow, but this action would occur only when time and circumstances allow. This operator action is intended to control reactor water level within tighter bands and avoid multiple cycles on the RCIC system. However, if the operators do not take this option, RCIC is designed to maintain reactor water level automatically.

The Suppression Pool Cooling mode of RHR train "A" would be used when the Suppression Pool increases in temperature. This operator action is performed from the MCR with a controlled copy of the operating procedure. The Suppression Pool Cooling mode of RHR has been used periodically at CPS during normal operation to maintain the suppression pool temperature within allowable limits. As a result, operators are experienced in this manual operation. The RLE should not affect this action since it is not a time-critical task and self-checking and peer-checking would help in minimizing human errors.

Alternate Path

To reduce reactor vessel pressure, ADS or operator action is needed to bring the pressure within the limits of a low pressure injection system. One consideration of the effects of an RLE is that an operator may not be able to perform manual actions immediately. In this scenario, the ADS system will automatically actuate upon completion of the initiation logic permissives and timer. A low pressure injection system will automatically inject when reactor pressure decreases to below the system pressure.

After reactor water level is stabilized and pressure is reduced below the shutdown cooling (SDC) setpoint, operators procedurally place RHR 'B' in SDC mode.

Operators undergo periodic training on manual control of SRVs, RCIC, HPCS, Shutdown Cooling, and Suppression Pool Cooling. The on-going operator training program is conducted in accordance with 10CFR55.59, "Requalification." The CPS licensed operator training program is an NRC approved systems approach to training program and is accredited with the Institute of Nuclear Power Operations.

Since there are no operator actions required to complete the actions associated with reactor vessel pressure and inventory control, there is no discussion on the anticipated effects of the RLE on rates of operator errors. There are operator failure rates associated with placing RHR in Suppression Pool Cooling mode and Shutdown Cooling mode. The rates used in development of the IPE are 1.6E-3 for RSPCOOLSWW, "Failure to Initiate Suppression Pool Cooling," and 3.0E-3 for RSDCOOLSWW, "Failure to Manually Start Shutdown Cooling." The RLE should not significantly affect these actions since they are not time-critical tasks and self-checking and peer-checking help in minimizing human errors.

Licensed operators practice earthquake, off-normal, and emergency scenarios in the CPS plant specific simulator. Because of participation in these scenarios, human errors are anticipated to be minimized. Procedure adherence is stressed, not only during simulator earthquake scenarios but at all times. Procedural adherence expectations have resulted in precise and clear procedures which help to minimize human errors.

Conclusion

There are no immediate operator actions required for reactor vessel pressure and inventory control as a result of the RLE since those systems are designed for automatic operation. Subsequent operator actions are performed from the MCR, are proceduralized and trained upon, and are not time-critical.

The self-checking and peer-checking programs in place at CPS help to minimize the number of operator errors. The on-going operator training program re-enforces these error reduction techniques.