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MEMORANDUM TO: Brian Thomas, Division Director
Division of Engineering
Office of Nuclear Regulatory Research

FROM: Edward O'Donnell, Acting Chief */RA/ E. O'Donnell*
Regulatory Guidance and Generic Issues Branch
Division of Engineering
Office of Nuclear Regulatory Research

SUBJECT: INITIAL SCREENING RESULTS FOR GI-016, PROPOSED
GENERIC ISSUE ON THE POTENTIAL LOSS OF TURBINE
DRIVEN PUMPS DUE TO DEPENDENCE ON ELECTRIC
POWER

On October 29, 2014, the Nuclear Regulatory Commission (NRC) staff in Office of Nuclear Reactor Regulation (NRR) submitted a proposed generic issue (GI) relating to auxiliary feedwater turbine control system dependency on electrical power to support turbine operation. This proposed issue has been entered into the Generic Issues Management Control System as PRE-GI-016 for tracking purposes. The GI staff have performed a cursory initial review of the proposed issue and determined that it meets the seven screening criteria.

Description of Proposed Issue

The original steam driven auxiliary feedwater pumps used in pressurized water reactors (PWRs) and boiling water reactors (BWRs) were manufactured to use mechanic (hydraulic) speed control systems. These governors did not require electric power to operate. In order to increase the pump's performance reliability, some licensees have changed to electronic governors in order to achieve better speed control. However, this change out has induced a dependency on DC power for the steam driven pump to be capable of performing its safety function.

The permanent loss of both AC and DC power is currently not a design basis accident for nuclear power plants. This type of accident would be classified as "beyond design basis." Such a situation occurred internationally during the catastrophic event at Fukushima, Japan, March 11, 2011. The NRC staff is currently evaluating actions to mitigate the effects on nuclear plants in the United States from such catastrophic events. There are no current regulations requiring a licensee to maintain operation of a steam driven auxiliary feed water pump in the event of the

CONTACT: Stanley Gardocki, RES/DE/RGGIB
301-251-7409

Arthur Cunanan, RES/DE/RGGIB
301-251-7457

loss of both AC and DC power. The most applicable regulation is Title 10 of the Code of Federal Regulations (10 CFR) Part 50.63, "Loss of all alternating current power." It requires the licensee to be capable of withstanding a specific duration and recover from a station blackout (total loss of AC power).

Initial Safety Review

The staff in NRR reviewed the proposed issue and determined that there was no immediate safety concern that would require immediate actions to be taken by NRC staff or licensees. The circumstances surrounding the proposed issue involve a scenario that is beyond the current design basis of current nuclear power plants. The probability of such a beyond design basis event may be possible, but is not very probable in the near future. Therefore, there should not be a significant increase in risk upon current operations of nuclear power plants during the time this proposed issue is being evaluated in the GI Program.

Initial Screening Results

This memorandum documents the GI Program staff's initial screening of this proposed generic issue has been completed. The GI Program addresses only those issues that meet all the seven screening criteria specified in NRC Management Directive and Handbook 6.4, "Generic Issues Program." The GI Program staff determined that the proposed issue may meet all the seven screening criteria. Refer to Enclosure 1 for the results of their initial screening assessment.

During their initial review, the GI Program staff noted that NRC staff are working on the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, which may possibly address this issue. The NRC staff in the Mitigating Strategy Division under NRR is evaluating every licensee's response plan to meet the NRC Order EA-12-049. Every licensee is required to have installed permanent plant equipment to initially mitigate a loss of an all AC power event. This equipment is required to operate until temporary equipment can be installed to sustain the function. There is currently no additional regulatory requirements instituted outside Order EA-12-049 relevant to a loss of all AC power event. Current rule making activities have proposed a draft of a new regulatory requirement. Note: this is only draft and not approved. The rule will require licensees to have capabilities to maintain or restore core cooling similar to the following draft specifications:

Integrated response capability. Each applicant or licensee shall develop, implement, and maintain an integrated response capability that includes:

(1) Mitigation Strategies for Beyond-Design-Basis External Events.

Strategies and guidelines to mitigate beyond-design-basis external events from natural phenomena that result in an extended loss of all ac power concurrent with either a loss of normal access to the ultimate heat sink or, for a nuclear power plant for which the Final Safety Analysis Report references Appendix D or E to 10 CFR Part 52, a loss of normal access to the normal heat sink. These strategies and guidelines must be capable of being implemented site-wide and must include:

- (i) Maintaining or restoring core cooling, containment, and spent fuel pool cooling capabilities; and
- (ii) The acquisition and use of offsite assistance and resources to support the functions required by paragraph (b)(1)(i) of this section.

(2) Extensive Damage Mitigation Guidelines (EDMGs).

Strategies and guidelines to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under the circumstances associated with loss of large areas of the plant due to explosions or fire, to include strategies and guidelines in the following areas:

- (i) Firefighting;
- (ii) Operations to mitigate fuel damage; and
- (iii) Actions to minimize radiological release.

(3) Severe Accident Management Guidelines (SAMGs).

Strategies and guidelines for mitigating actual or imminent damage to fuel in the reactor vessel or spent fuel pool and minimizing its consequences to support actions intended to:

- (i) Arrest the progression of fuel damage,
- (ii) Maximize the duration for which containment capability is maintained, and,
- (iii) Minimize radiological releases.

Conclusion

Therefore, the GI Program staff recommends that the proposed generic issue concerning the loss of electric power to the steam driven emergency feedwater pump continue in the GI Process in accordance with Management Directive 6.4. The GI Program Manager concurs with the GI Program staff's finding that this proposed issue should continue forward. The next step as directed in MD 6.4 is to form a Generic Issue Review Panel (GIRP) to conduct a detailed review of the seven screening criteria to determine whether the proposed issue warrants further regulatory action in the GI program.

Enclosure 1:

Initial Review of the Seven Screening Criteria

- (i) Maintaining or restoring core cooling, containment, and spent fuel pool cooling capabilities; and
- (ii) The acquisition and use of offsite assistance and resources to support the functions required by paragraph (b)(1)(i) of this section.

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OFFICE	RES/DE/RGGIB	RES/DE/RGGIB	RES/DE/RGGIB (A)	RES/DE
NAME	A. Cunanan	S. Gardocki	E. O'Donnell	B. Thomas
DATE	12/19/14	12/19/14	12/19/14	12/23/14

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Initial Review of the Seven Screening Criteria

1. The issue affects public health and safety, the common defense and security, or the environment. For issues that are not amenable to quantification using risk assessment, qualitative factors may be developed and applied as necessary to assess safety/risk significance.

The issue identified in the proposed GI-0016 centers around the vulnerability of the steam driven emergency feedwater pump to a loss of AC power. Many nuclear power plants rely on the steam driven emergency feedwater pump as a diverse means for heat removal in the event of a design basis accident coincident with a single failure, or in the event of a beyond design basis event. The submitter identified that several licensees of nuclear power plants have changed the mechanical governor speed control system to an electronic governor. In the event the governor loses its supply of electric power, the steam driven pump would cease to provide its safety function, leaving the reactor core without an adequate heat removal mechanism, which would lead to core damage. Therefore, the proposed issue identifies an increase in safety/risk to the nuclear power plant with electronic governor control systems. This increase in safety/risk may present adverse effects to public health and safety.

- Therefore, the proposed issue would meet screening criteria #1.

2. The issue applies to two or more facilities and/or licensees/certificate holders, or holders of other regulatory approvals.

Almost all nuclear power plants rely on a steam driven emergency feedwater pump for reactor decay heat removal to prevent core damage during a design basis accident. The pressurized water reactor types rely on steam driven auxiliary feedwater pumps to supply water to the steam generators with the normal feedwater system is inoperable. The boiling water reactor types rely on steam driven high pressure core injection (HPCI) pumps, and reactor core injection (RCIC) pumps. There are a few nuclear power plants that have diesel driven pumps instead of steam driven pumps. The submitter states that there are many licensees which have convert their mechanical governors to electronic governors. Therefore, the proposed issue would apply to two or more facilities.

- Therefore, the proposed issue would meet screening criteria #2.

3. The issue is not being addressed using other regulatory programs and processes; existing regulations, policies, or guidance.

In response to the nuclear accident at Fukushima Japan, the NRC staff conducted a systematic and methodical review of its own processes and regulations. On July 12, 2011, the NRC's Near-Term Task Force released its report, "Recommendations for Enhancing Reactor Safety in the 21st Century." In order to address the short-term recommendations, the NRC issued three orders in March 2012 that require nuclear power plants to implement measures related to lessons learned from the Fukushima accident. The third order states, "Nuclear power plants must be capable of responding to multiple simultaneous events and ensuring that reactors and spent fuel pools remain cooled. The order specifies a three-

phase approach involving use of installed on-site resources, use of portable on-site equipment, and indefinite use of off-site resources.”

The NRC staff is reviewing actions being taken by all licensees in response to the order. As part of this review, the staff is ensuring that all licensees can adequately respond to a loss of electric power to the steam driven emergency feedwater pumps that rely on electric power speed control system. Also the staff is verifying that the licensee maintains accessibility for personnel directly to the pump controls. Even though the licensee is doing all these modifications and actions, the staff does not see a current regulatory requirement mandating these actions. Therefore, there may be a need to modify existing regulations or create a new regulatory requirement to maintain this level of safety.

- Therefore, the proposed issue would meet screening criteria #3.

4. The issue can be resolved by new or revised regulation, policy, or guidance.

In the event the staff determines that the proposed issue presents an undo increase in safety/risk to a nuclear power plant, then the staff can propose new regulation or revise existing regulations to licensees to take actions to mitigate the consequences of this type sequence of events. Additional analysis of the risk or safety impact would provide sufficient additional information to properly characterize the issue and its potential impact. The regulatory office has authority to take appropriate regulatory action as necessary to protect the public health and safety and the environment. Depending on the outcome of the additional analysis, and industry initiatives to address any safety issues, the regulatory office could address this issue through one or more actions involving regulation, policy, or guidance.

- Therefore, the proposed issue would meet screening criteria #4.

5. The issue’s risk or safety significance can be adequately determined in a timely manner (i.e., it does not involve phenomena or other uncertainties that would require long-term study and/or experimental research to establish the risk or safety significance).

The proposed issue identifies a risk of losing the steam driven emergency feedwater pump due to a coincidental loss of electrical power to the steam driven pump while the other electric motor driven pump are also unavailable. Currently, the staff can calculate a probability of core damage due to loss of all heat removal mechanisms. The staff can focus on the cause factors that result in the loss of the steam driven pump and calculate the increase in risk from loss of electric power to the governor system.

- Therefore, the proposed issue would meet screening criteria #5.

6. The issue is well defined, discrete, and technical.

The proposed issue specifically identifies a risk of losing the steam driven emergency feedwater pump due to a coincidental loss of electrical power to the steam driven pump. If the other electric motor driven pump are also unavailable, the reactor core will not have an

adequate means of decay heat removal, which would lead to core damage. The issue assumes that electrical power is lost to the steam driven pump's speed control electronic governor.

- Therefore, the proposed issue would meet screening criteria #6.

7. Resolution of the issue may involve review, analysis, or action by the affected licensees, certificate holders, or holders of other regulatory approvals.

Some plants may be identified as having a vulnerability to loss of their steam driven emergency feedwater pump that needs to be addressed to maintain adequate safety margins. Determining the plant's margins and potential need for actions to maintain adequate margins, could involve regulatory actions (e.g., requests for information from plant licensees, reviews, additional analysis, mitigation actions, physical enhancements, administrative controls, etc.) for some plant licensee holders, or could involve actions by industry stakeholders.

- Therefore, the proposed issue would meet screening criteria #7.