March 29, 2002

Mr. Gary Van Middlesworth
Site General Manager
Duane Arnold Energy Center
Nuclear Management Company, LLC
3277 DAEC Road
Palo, IA 52324-0351

SUBJECT: DUANE ARNOLD ENERGY CENTER - CLOSURE OF GENERIC LETTER 96-06, "ASSURANCE OF EQUIPMENT OPERABILITY AND CONTAINMENT INTEGRITY DURING DESIGN-BASIS ACCIDENT CONDITIONS" (TAC NO. M96808)

Dear Mr. Van Middlesworth:

On September 30, 1996, the U.S. Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," requesting information and actions regarding the following safety-significant issues:

1. Cooling water systems serving the containment air coolers may be exposed to the hydrodynamic effects of waterhammer during either a loss-of-coolant accident (LOCA) or a main steamline break (MSLB).

2. Cooling water systems serving the containment air coolers may experience two-phase flow conditions during postulated LOCA and MSLB scenarios.

3. Thermally induced overpressurization of isolated water-filled piping sections in containment could jeopardize the ability of accident-mitigating systems to perform their safety functions and could also lead to a breach of containment integrity via bypass leakage.

Your responses to GL 96-06 for the Duane Arnold Energy Center (DAEC) have been provided by letters dated October 30, 1996, January 28, 1997, June 30, 1998, and February 22, 2002. On the basis of your letter dated January 28, 1997, the NRC staff concluded in its letter of May 4, 1999, that your corrective actions for the above issue of thermally induced overpressurization of piping runs penetrating the DAEC containment have been completed and are acceptable.

The NRC staff has now completed its review of your evaluations of cooling water systems serving the containment air coolers to determine susceptibility to waterhammer and two-phase flow during postulated design-basis accidents. The enclosure is our safety evaluation concluding that the occurrence of a waterhammer event such as could affect plant safety as postulated in GL 96-06, is highly unlikely at DAEC and the DAEC containment air cooler design does not give rise to a safety concern involving two-phase flow. Therefore, and in view of the NRC staff's prior conclusions by letter dated May 14, 1999, regarding thermally induced

overpressurization of isolated water-filled piping sections in containment, you have provided the required evaluations, taken appropriate actions, and adequately addressed the issues raised in GL 96-06.

Accordingly, TAC No. M96808 is now closed. If you have any questions regarding this issue, please contact me at 301-415-3049 or by e-mail at dsh@nrc.gov.

Sincerely,

/RA/

Darl S. Hood, Sr Project Manager, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-331

Enclosure: Safety Evaluation

cc w/encl: See next page

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cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RESPONSE TO GENERIC LETTER 96-06

NUCLEAR MANAGEMENT COMPANY, LLC

DUANE ARNOLD ENERGY CENTER

DOCKET NO. 50-331

1.0 INTRODUCTION

On September 30, 1996, the U.S. Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," requesting information and actions regarding the following safety-significant issues:

1. Cooling water systems serving the containment air coolers may be exposed to the hydrodynamic effects of waterhammer during either a loss-of-coolant accident (LOCA) or a main steamline break (MSLB).

2. Cooling water systems serving the containment air coolers may experience two-phase flow conditions during postulated LOCA and MSLB scenarios.

3. Thermally induced overpressurization of isolated water-filled piping sections in containment could jeopardize the ability of accident-mitigating systems to perform their safety functions and could also lead to a breach of containment integrity via bypass leakage.

The licensee[1] has responded to GL 96-06 for the Duane Arnold Energy Center (DAEC) by letters dated October 30, 1996, January 28, 1997, June 30, 1998, and February 22, 2002. On the basis of the licensee's letter dated January 28, 1997, the NRC staff has previously concluded in its letter of May 4, 1999, that the licensee's information and corrective actions for the above issue of thermally induced overpressurization of piping runs penetrating the DAEC containment have been completed and are acceptable.

[1] The responses were provided by IES Utilities Inc., who has subsequently been succeeded by Nuclear Management Company, LLC (NMC and licensee), as the licensed operator of the DAEC. By letter dated October 5, 2000, NMC requested that the Commission continue to process and disposition licensing actions previously docketed and requested by IES Utilities Inc.

The NRC staff has now completed its review of the licensee's evaluations of cooling water systems serving the containment air coolers to determine susceptibility to waterhammer and two-phase flow during postulated design-basis accidents. GL 96-06 requests that licensees provide these evaluations and, if systems are found to be susceptible to these conditions, assess the operability of affected systems and take corrective action as appropriate. The NRC staff's evaluation regarding DAEC's susceptibility to waterhammer and two-phase flow during postulated design-basis accidents is given in Section 2.0 below.

2.0 EVALUATION

DAEC's containment structure is of the Mark I design by General Electric. The design includes a drywell containing the reactor vessel and recirculation loops and a suppression pool. Drywell cooling is provided by eight individual cooling units. DAEC's drywell air cooling system is a non-safety related system and is, therefore, not relied upon to mitigate any design-basis transient or accident. Cooling water is provided to the drywell air coolers by the well water system which takes supply from four independent wells. The cooling water is divided into two loops, each of which is provided with pneumatically operated containment isolation valves on the supply and return lines. The valves are located outside the drywell. A check valve located outside the drywell is provided on each supply line. The isolation valves are designed to close upon a triple low reactor water level signal, which would indicate the occurrence of a LOCA. The pneumatic isolation valves are designed to close even with the loss of offsite power.

The licensee's design-basis LOCA calculations indicate that the temperature within the drywell could reach a maximum of 340 °F. Therefore, the temperature of the water within the drywell air coolers could reach a maximum temperature of 340 °F following a LOCA. For steam to form within the drywell coolers, the internal pressure would have to exceed the set pressure of the relief valves. These valves have a minimum set pressure of 220 psig. The water temperature would have to exceed a temperature of 396 °F for steam to form at this pressure. Therefore, steam would not form within the drywell coolers following a LOCA unless additional failures, such as an isolation or relief valve sticking open, were to occur.

If well water flow were to be lost for a sustained period of time, the licensee has determined that, under certain single-failure conditions, the drywell coolers might drain. The licensee has revised DAEC's Abnormal Operating Procedures to ensure that waterhammer would not occur under these conditions when well water flow is being restored (i.e., operators are cautioned to restore well water in a slow and controlled manner to preclude the potential for waterhammer). Although two of the four well water pumps receive power from essential buses that are powered by diesel generators, the well water pumps do not start automatically. Therefore, operators are able to assess the possibility of the drywell cooler voiding before they manually start the well water pumps, and thereby avoid any potential waterhammer.

GL 96-06 also expressed concern regarding the occurrence of two-phase flow conditions within containment air coolers that might affect the assumptions used for heat removal during design-basis accidents. As noted earlier, the DAEC containment air coolers are not relied upon to mitigate design-basis accidents and would likely be isolated. Therefore, this aspect of the GL 96-06 does not give rise to a safety concern at DAEC.

3.0 CONCLUSIONS

On the basis of the above considerations, the NRC staff concludes that the occurrence of a waterhammer event such as could affect plant safety as postulated in GL 96-06 is highly unlikely at DAEC and the DAEC containment air cooler design does not give rise to a safety concern involving two-phase flow. Accordingly, and in view of the NRC staff's prior conclusions by letter dated May 14, 1999, regarding thermally induced overpressurization of isolated water-filled piping sections in containment, the licensee has provided the required evaluations, taken appropriate actions, and has adequately addressed the issues raised in GL 96-06.

Principal Contributor: W. Jensen

Date: March 29, 2002