October 1, 2002

Mr. Mark A. Peifer
Site Vice President
Duane Arnold Energy Center
Nuclear Management Company, LLC
3277 DAEC Road
Palo, IA 52324-0351

SUBJECT: DUANE ARNOLD ENERGY CENTER - ISSUANCE OF AMENDMENT RE: ON-LINE BATTERY REPLACEMENT (TAC NO. MB3810)

Dear Mr. Peifer:

The Commission has issued the enclosed Amendment No. 247 to Facility Operating License No. DPR-49 for the Duane Arnold Energy Center. The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated December 19, 2001, as supplemented April 19, 2002.

The amendment extends the time for completing required action A.1 of TS 3.8.4, “Electrical Power Systems--DC Sources--Operating,” for restoring the 125 volt direct current (VDC) electrical power subsystem to operable status. The change, in effect, provides for replacement of 125 VDC batteries 1D1 and 1D2 while the plant is at power. The time is extended on a one-time basis, and for each battery division separately, from 8 hours to 10 days. The one-time change also requires that required features be declared inoperable when the associated 125 VDC source is inoperable and the redundant required features are also inoperable for at least 4 hours.

A copy of our safety evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

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

Docket No. 50-331

Enclosures: 1. Amendment No. 247 to DPR-49
2. Safety Evaluation

cc w/encls: See next page

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NUCLEAR MANAGEMENT COMPANY, LLC

DOCKET NO. 50-331

DUANE ARNOLD ENERGY CENTER

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 247
License No. DPR-49

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by the Nuclear Management Company, LLC, dated December 19, 2001, as supplemented by letter dated April 19, 2002, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-49 is hereby amended to read as follows:

   Technical Specifications and Environmental Protection Plan

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 247 , are hereby incorporated in the license. NMC shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days of the date of issuance. Prior to implementation, the licensee shall: (1) incorporate the committed actions and conditions as described in the December 19, 2001, application and the April 19, 2002, supplement, to be taken during the on-line replacement of 125 VDC batteries 1D1 and 1D2, into a procedure; and (2) change the Updated Final Safety Analysis Report to include a description of this and other relevant procedures. Implementation under this license amendment shall be on a one-time basis, with the replacement times for each of the two battery divisions separately extended from 8 hours to 10 days.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

L. Raghavan, Chief, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: October 1, 2002

ATTACHMENT TO LICENSE AMENDMENT NO. 247

FACILITY OPERATING LICENSE NO. DPR-49

DOCKET NO. 50-331

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

REMOVE	INSERT
3.8-17	3.8-17

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 247 FACILITY OPERATING LICENSE NO. DPR-49

NUCLEAR MANAGEMENT COMPANY, LLC

DUANE ARNOLD ENERGY CENTER

DOCKET NO. 50-331

1.0 INTRODUCTION

By application dated December 19, 2001, as supplemented by letter dated April 19, 2002, the Nuclear Management Company, LLC (NMC or the licensee) requested an amendment to the operating license to change the Technical Specifications (TSs) for the Duane Arnold Energy Center (DAEC). NMC's supplemental letter dated April 19, 2002, provided additional information in support of the initial application, did not change the scope of the application as originally noticed, and did not affect the U.S. Nuclear Regulatory Commission's (NRC's) original proposed no significant hazards consideration determination as published in the *Federal Register* on February 5, 2002, (67 FR 5329).

The proposed change would extend the time for completing Required Action A.1 of TS 3.8.4, "Electrical Power Systems--DC Sources--Operating," for restoring the 125 volt direct current (VDC) electrical power subsystem to operable status when the plant is in modes 1 (power operation), 2 (startup), or 3 (hot shutdown). The change, in effect, would provide for replacement of 125 VDC batteries 1D1 and 1D2 while the plant is at power. The time would be extended on a one-time basis, and for each battery division separately, from 8 hours to 10 days. The one-time change would also require that required features be declared inoperable when the associated 125 VDC source is inoperable and the redundant required features are also inoperable for at least 4 hours.

Specifically, the change would add the following note and additional Required Actions A.2.1 and A.2.2 to TS 3.8.4, Condition A:

"or Note: May be used on a one-time-only basis for each battery division.

REQUIRED ACTION		COMPLETION TIME
A.2.1	Declare required feature(s), supported by the inoperable 125 VDC source, inoperable when the redundant required feature(s) are inoperable.	4 hours from discovery of condition A concurrent with inoperability of redundant required feature(s)
	AND	
A.2.2	Restore 125 VDC electrical power subsystem to OPERABLE status.	10 days"

2.0 REGULATORY EVALUATION

NMC requested the proposed changes in accordance with Sections 2.101, "Filing of application," 50.59, "Changes, tests, and experiments," and 50.90, "Application for amendment of license or construction permit," of Title 10 of the Code of Federal Regulations (10 CFR) to assure continued compliance with 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 17, "Electric Power Systems." GDC 17 requires, in part, that "[t]he onsite electric power supplies, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure."

3.0 TECHNICAL EVALUATION

3.1 System Description and Licensee's Plans for Battery Replacements

As described in Section 8.3.2.1.1 of DAEC's updated final safety analysis report (UFSAR), the safety function of the DC power supply (including 125 VDC) and distribution system is to provide a source of reliable, continuous power for the control and instrumentation of engineered safety features (ESF) systems and for other loads required for normal operation and orderly shutdown. The 125 VDC system at DAEC consists of two batteries, each with its own battery charger. The batteries are sized to supply, without recharging, the control and essential instrumentation power for a minimum of 4 hours and the emergency motor loads for their required length of time. Each battery charger is sized to restore its battery to full charge after a 4 hour emergency discharge while carrying normal steady-state DC loads. Each charger receives alternating current (AC) power from a separate AC bus. One spare charger is supplied for either of the two 125 VDC batteries. As described in Section 8.3.2.2.3 of DAEC UFSAR, the 125 VDC buses are separate and redundant.

All of the normal loads connected to the plant battery system can be supplied by the battery chargers which can be powered from multiple sources of plant auxiliary power, including the plant standby diesel generator system. The aggregate system is arranged and powered such that the probability of system failure resulting in a loss of DC power is very low. Only the emergency motor loads require the capacity of the storage battery for their operation.

NMC stated that it decided to replace both 125 VDC batteries because of age-related degradation. According to NMC, the existing 1D1 (Division 1) 125 VDC battery required four battery cell replacements due to age-related degradation. All battery cells (C&D Technologies LC-17 lead calcium cells) will be replaced by C&D Technologies LCR-17 lead calcium cells. The existing 1D2 (Division 2) 125 VDC battery required one battery cell replacement due to age-related degradation. All 1D2 battery cells (C&D Technologies LC-17 lead calcium cells) will be replaced with C&D Technologies LCR-17 lead calcium cells. The new permanent batteries will be Class 1E, safety-related type. NMC has determined that a 10-day completion time is sufficient to remove the old battery and install and test the replacement battery (i.e., a 10-day replacement period is needed for battery 1D1 and a separate 10-day replacement period is needed for battery 1D2).

During the proposed on-line replacement, NMC will use a temporary non-seismic Class 1E battery (i.e., the associated DC bus will remain energized throughout the separate planned 10-day completion times by the associated existing battery charger and this temporary station battery). The temporary battery will be subjected to surveillance testing prior to being used to confirm its serviceability and will possess adequate capacity to fulfill the requirements of the associated 125 VDC bus. NMC states that the temporary battery will be assembled from safety-related Class 1E cells purchased for later use in another safety-related battery. Although the temporary battery will be qualified as safety-related Class 1E, it will not be placed in seismically mounted racks and will be located in the non-seismic turbine building. Thus, this temporary battery is expected to meet the same safety functions as the existing battery with the potential exception of functions associated with seismic, interaction with seismic, and vital area requirements.

To support the 10-day extended completion time, NMC states that it will implement the following actions and conditions:

1. The existing safety-related battery charger associated with the replaced station battery will be operable and connected to the DC bus in parallel with the temporary battery;

2. An existing swing backup safety-related battery charger will be available to be connected to the DC bus if needed;

3. The temporary and replacement batteries will be subjected to the applicable station battery surveillance tests before placing them into service;

4. The plant will be in a stable condition with no Required Actions in effect at the start of the battery replacement activity necessitating plant shutdown and no risk significant, planned maintenance or testing activities which could impact AC or DC normal or emergency electrical distribution sources;

5. Thorough plans will be prepared to minimize the duration of the battery replacement project through good coordination of work activities;

6. Pre-job briefings will be conducted to prevent worker error; and

7. Operations personnel will be refreshed on procedure AOP 302.1, “Loss of 125 VDC Power”.

NMC also states that during the actual conduct of the replacement project, the work will be closely controlled and supervised in accordance with plant administrative procedures.

In its letter of April 19, 2002, NMC provided the following additional information:

1. The backup battery will be tested in accordance with the DAEC TS surveillance test. Specifically, the temporary battery will have been subjected to a modified performance test at the vendor’s facility prior to shipment to DAEC. After assembly, the battery cells parameters (electrolyte level, float voltage and specific gravity) are verified. Average electrolyte temperature of representative cells will be verified to be within limits. The battery will be verified to be operable by verifying the required terminal voltage, no visible corrosion at terminals and connectors, or verifying connection resistance, and verifying cell plates and racks show no physical indication of physical damage.

2. In addition to the testing described in item 1 above, the new battery will be given a full charge using the temporary battery charger before connection to the DC bus.

3. The cable between the temporary battery and the DC bus will be safety-related, Class 1E, 350 MCM or equivalent, with 600 Volt insulation.

4. The temporary battery will not be installed in the immediate proximity of high-energy steam lines. It will be located about 35 feet away from the feedwater lines, which include the feedwater regulating valves at that location. The battery will be located perpendicular to the plane of rotation of the main turbine shaft so that turbine missiles should not be a concern.

5. The temporary battery will be located in the power block where the access is always controlled and limited. Augmented security measures will be in place.

Prior to implementing the replacement activities, the licensee will (1) incorporate the committed actions and conditions as described in December 19, 2001, application and the April 19, 2002, supplement, to be taken during the on-line replacement of 125 VDC batteries 1D1 and 1D2, into a procedure, and (2) change the UFSAR to include a description of this and other relevant procedures. Accordingly, changes to the procedures, if any, including the committed actions and conditions described therein, shall be evaluated in accordance with 10 CFR 50.59, “Changes, tests, and experiments.”

On the basis of the above information regarding DAEC’s 125 VDC system design and NMC’s proposed process and actions for accomplishing the battery replacements, the NRC staff finds that reasonable assurance exists that the proposed replacement activity would not prevent the plant from mitigating a Design Basis Accident or shutting down due to events that could result in the loss of power from the temporary battery. Except for seismic considerations, the temporary battery is functionally similar to the safety-related battery being replaced. In the unlikely event of a seismic event during either 10-day replacement period, the redundancy and

independence in the 125 VDC design ensures that the remaining DC power would be available to support accident mitigation and/or plant shutdown. Because of system design, the limited duration of the replacement activity, the small likelihood of a significant seismic event occurring during this limited extended replacement time, and NMC's planned implementing contingency actions, the NRC staff concludes, with reasonable assurance, that the DC bus will be continuously supplied by either the temporary battery and/or the battery charger throughout the duration of the replacement activities. Accordingly, the NRC staff concludes that, during either 10-day online replacement period, the 125 VDC system will continue to have sufficient independence, redundancy, and testability to perform its safety functions assuming a single failure in accordance with GDC-17. Therefore, the proposed TS change is acceptable.

The proposed one-time change to DAEC's TSs also adds a requirement that required features be declared inoperable when the associated 125 VDC source is inoperable and the redundant required feature or features are also inoperable for at least four hours. The NRC staff finds that this addition to the TSs provides increased assurance that a loss of onsite power, during the period that a 125 VDC source is inoperable, would not result in a complete loss of safety function of critical systems. This proposed addition is, therefore, acceptable.

3.2 Probabilistic Risk Assessment

3.2.1 Tier 1

For the replacement of Division 1 and Division 2 batteries on a one-time basis at power, NMC computed the total increase in annualized core damage frequency (Delta CDF) for both activities to be 9.6E-8/yr. The total increase in annualized large early release frequency (Delta LERF) was computed by NMC to be 4.9E-9/yr. Both of these values are very small according to the guidelines of Regulatory Guide (RG) 1.174 (less than E-6 and less than E-7, respectively).

NMC computed the Incremental Conditional Core Damage Probability (ICCDP) for two ten day on-line battery outage periods (one for Division 1 and another for Division 2) to be 9.6E-8 and 4.8E-9, respectively. These are well within the RG 1.177 guideline value of 5E-7 for ICCDP.

The NRC staff finds the above values of Delta CDF, ICCDP, and Delta LERF to be reasonable and acceptable. There is also an unquantified risk reduction due to not replacing the batteries at shutdown.

3.2.2 Tier 2

NMC plans to implement several actions and conditions, as identifed above, to support extending the present completion time of 8 hours to 10 days for Division 1 and 10 days for Division 2. These take into account the Probabilistic Risk Assessment (PRA) analysis and minimize risk associated with the occurrence of a seismic event.

3.2.3 PRA Quality

NMC developed Level 1 and Level 2 PRA models as part of the Individual Plant Examination (IPE) submitted to the NRC in November 1992 in response to Generic Letter 88-20. NMC has maintained these PRA models to conform to plant configuration and operating procedure

changes subsequent to the original development, i.e., it is a "living PRA". The Individual Plant Examination for External Events (IPEEE) was submitted to the NRC staff by the DAEC licensee in November 1995. Subsequent to that submittal, a stand-alone, external events PRA model was developed to provide enhanced capability to assess risk from seismic and fire initiators. In 2001, both the internal event and external event PRA models were converted from the Reliability Engineering Building Block Environment for Computer Analysis (REBECA) PRA development and quantification platform to Electric Power Research Institute's (EPRI's) Risk and Reliability Workstation Computer Aided Fault Tree Analysis (CAFTA). NMC performed a rigorous comparison of REBECA and CAFTA cutsets to ensure that the conversion was performed appropriately. A revision to the Level 1 and Level 2 PRA models is currently being carried out by NMC to incorporate various model enhancements and to update it for extended power uprate applications and conditions.

Because of its ongoing use as a licensee decision-making tool, NMC's PRA has been through a peer review as part of the Boiling Water Reactor (BWR) Owners' Group PRA certification program. NMC states that the PRA review team concluded that all of the graded elements are of sufficient detail and quality to support a risk significance determination supported by deterministic insights. The review team also commented, according to NMC, on DAEC's excellent PRA documentation and very consistent quality level across all elements of the certification.

The seismic portion of the external events PRA model was used by NMC to calculate increase in CDF for this proposed TS change (one-time extension of the allowed outage time from 8 hours to 10 days per Division). Since the external events model was created after performance of the PRA peer review, it was not included in the scope of the review. However, it contains modeling elements (system fault trees, component failure data, etc.) from the Level 1 PRA model, which were included in the review, and is judged by NMC to be of sufficient quality and detail for use in this application. The seismic model employs a bounding approach to the quantification of CDF, according to NMC, and is therefore considered to overestimate actual risk from seismic events.

On the basis of the NRC staff's review of the above , the NRC staff concludes that the quality of NMC's PRA is adequate for the application being reviewed.

3.2.4 External Events

NMC's IPEEE considers accidents in six categories: Seismic events, fires, high winds and tornadoes, external floods, transportation and nearby facility hazards, and other plant-unique external events.

Seismic Events

A PRA model was developed for DAEC in 1997 that is explicitly designed for calculating the contribution to CDF from both seismic and fire events. This is known as the external events PRA model. NMC states that the approach used in the development of the model for seismic events is consistent with guidance provided in the PRA Procedures Guide (NUREG/CR-2300).

The seismic-induced CDF analysis involves the construction and quantification of seismic event trees. A unique event tree is developed for each of nine seismic magnitude intervals. These

event trees are supported by modified system fault trees. The base seismic event tree quantification results in an estimate of CDF for a full spectrum of earthquake intensities of 6.99E-7 per year. The NRC staff finds this result to be acceptable.

Fire

In the PRA-based model for fires, NMC assessed 18 fire areas, including areas from the reactor building, the control building, and safety-related portions of the pump house. The estimated total CDF from fires was 3.1E-6 per year, which is approximately 20% of the total CDF from internal and external events. The NRC staff finds this result to be acceptable.

High Winds and Tornadoes

The extreme wind risk evaluation for DAEC employs a bounding approach recommended in NUREG-1407, "Procedural and Submittal Guidance for the IPEEE for Severe Accident Vulnerabilities".

DAEC is located in the upper Midwest, a region of the country that has exhibited relatively high tornado activity. As such, Class 1 structures at DAEC are designed to withstand the strongest tornado believed to be credible (i.e., 300 mph rotational wind speed and 60 mph translational wind speed). Since safety-related trains and components are located within Class 1 structures, the probability of tornado-induced damage (considering both wind pressure and missile impact effects) to this equipment is very low. Other structures, including the turbine building where the temporary batteries will be located, are designed to a wind speed of 105 mph. Although higher speeds can be achieved by straight winds, the primary impact of straight winds on CDF is from loss of offsite power. This is appropriately accounted for in the internal events PRA.

The total contribution to CDF from extreme winds is conservatively estimated at 1.4E-7 per year. Use of a conservative bounding approach to quantification is consistent with NUREG-1407 methodology. NMC estimates that if more realistic assumptions were used, the overall extreme wind risk contribution would be approximately an order of magnitude lower, which would place it at less than one percent of the total CDF from internal and external events.

The 125 VDC batteries will be temporarily relocated from the Class 1 designed control building to the non-Class 1 turbine building. In this location, they will be somewhat more vulnerable to damage from extreme winds. However, the overall impact on CDF is judged by NMC to be very low for the following reasons: (1) The annual exceedance probability for wind speeds greater than 105 mph is only 5.5E-3 per year; (2) Division 1 and Division 2 battery replacement activities will be performed separately, and (3) Battery replacement activities will not be initiated under conditions of impending severe weather.

On the basis of its review, the NRC staff concludes that the impact on risk from extreme wind is acceptable.

External Floods

Vulnerability to external flooding events was evaluated in NMC's IPEEE using NUREG-1407 methodology. In accordance with this methodology, if DAEC met the criteria of the 1975 Standard Review Plan, flooding could be screened from further analysis. This was found to be

the case for DAEC. Therefore, the estimated CDF due to flood-related causes was assumed to be below 1E-6/yr.

DAEC is located adjacent to the Cedar River in Eastern Iowa. The design flood level is elevation 767 feet, which is ten feet above ground level for most site buildings. Actual flood levels have never approached this height. Nonetheless, the site maintains contingency plans that are invoked when river water level is expected to rise above normal levels. These plans include installation of barriers at the doorways of buildings to prevent water intrusion into areas containing safety-related equipment.

The temporary 125 VDC batteries will be located in the turbine building on the same level (elevation 757 feet) as the permanent batteries in the adjacent control building. Risk from external flooding is judged by NMC to be the same with the batteries in either location because the two areas communicate with one another via a non-waterproof doorway.

On the basis of its review, the NRC staff concludes that the impact on risk from external flooding is acceptable.

Transportation and Nearby Facility Hazards

Vulnerability to transportation and nearby facility-related events was evaluated in the DAEC IPEEE using methodology contained in NUREG-1407. There are no nearby military or industrial facilities within 5 miles of DAEC. The area is rural, with only smaller retail establishments within this distance from the plant. For this reason, no credible hazard to safe operation could be identified in relation to nearby facilities.

The IPEEE analysis also considered transportation accidents relating to aviation, ships or barges, railroads, and trucks. These classes of transportation hazard were considered for their impacts due to potential hazardous material releases and plant damage related to explosions or fires, as well as their potential for impact damage. Transportation related hazards were judged not to be a significant contributor to risk for DAEC.

Risk from transportation and nearby facility hazards is judged by NMC to be unchanged by the proposed battery replacement activity. The NRC staff agrees with NMC's judgment and finds it acceptable.

Plant Unique External Events

In addition to the previous five categories assessed in DAEC IPEEE, other external risks were screened for their potential impact on plant safety. A list of potential events to include in this category was compiled by NMC from a variety of industry documents. Criteria used for screening events on the list included whether:

1. The event was included in the definition of another event,

2. The event could occur close enough to the plant to affect it,

3. The event could result in worse consequences than analyzed events with similar frequencies and uncertainties,

4. There is sufficient time to provide an adequate response to the event, and

5. The event has damage potential similar to events for which the plant has been designed.

No events were identified in this process that were not already included under one of the previously considered external event categories. The proposed battery replacement activity is judged by NMC not to change the conclusion of this review.

3.2.5 Conclusion

On the basis of the above, the NRC staff concludes that NMC's requested TS change to allow a one-time, on-line replacement of safety-related 125 VDC batteries 1D1 and 1D2, in the manner proposed, does not adversely affect the current licensing requirements and meets GDC 17. The NRC staff also concludes that the impact on plant risk of the proposed replacement is very small for both internal and external events. Therefore, the proposed TS change is acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Iowa State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration and there has been no public comment on such finding (67 FR 5329). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: S. Saba
M. Wohl

Date: October 1, 2002