

August 16, 2001
NG-01-0909

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station 0-P1-17
Washington, DC 20555-0001

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Response to Request for Additional Information (RAI) to Technical
Specification Change Request TSCR-042 – Extended Power Uprate.
(TAC # MB0543)

Reference: NG-00-1900, “Technical Specification Change Request (TSCR-042):
‘Extended Power Uprate’,” dated November 16, 2000.

File: A-117, SPF-189

Dear Sir(s):

On July 18, 2001, August 3, 2001 and August 6, 2001, conference calls were held with the NRC Staff regarding the referenced amendment request to increase the authorized license power level of the Duane Arnold Energy Center. In order to complete their review, the Staff requested additional information regarding our submittal. The Staff’s preliminary questions had been provided to us electronically on July 17th for the purpose of discussion in the July 18th call. No advanced questions were provided for the conference calls on August 3rd and August 6th. As a result of these calls, some of these questions have been clarified based upon our discussions and several were withdrawn. The Attachment to this letter contains the modified Request for Additional Information (RAI) and a partial set of responses. Our response to one item is not yet completed. We anticipate completion of that remaining item within a few days. We will provide that information as soon as it becomes available.

Please note that Attachment 1 contains information that the General Electric Company (GE) considers to be proprietary in nature and subsequently, pursuant to 10 CFR 9.17(a)(4), 2.790(a)(4) and 2.790(d)(1), requests that such information be withheld from public disclosure. The portion of the text containing the proprietary information is identified with vertical sidebars in the right margin. An affidavit supporting this request is provided as Attachment 2 to this letter. Attachment 3 is the redacted version of Attachment 1, with the GE proprietary material removed, suitable for public disclosure.

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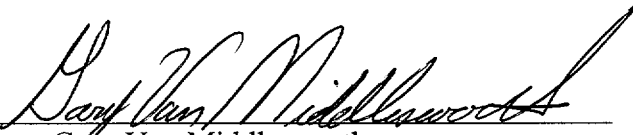
The following new commitment is being made in this letter:

The Supplemental Reload Licensing Report for the actual first cycle of operation at the Extended Power Uprate condition of 1912 MWt will be submitted to the NRC with the Core Operating Limits Report for that cycle.

Please contact this office should you require additional information regarding this matter.

This letter is true and accurate to the best of my knowledge and belief.

NUCLEAR MANAGEMENT COMPANY, LLC

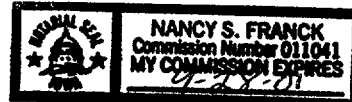
By 
Gary Van Middlesworth
DAEC Site Vice-President

State of Iowa
(County) of Linn

Signed and sworn to before me on this 16th day of August, 2001,

by Gary Van Middlesworth.


Notary Public in and for the State of Iowa



Commission Expires

Attachments: 1) DAEC Responses to NRC Reactor Systems Branch Requests for Additional Information Regarding Proposed Amendment for Power Uprate
2) General Electric Affidavit of Proprietary Information
3) Redacted Version of DAEC Responses to NRC Reactor Systems Branch Requests for Additional Information Regarding Proposed Amendment for Power Uprate

cc: T. Browning
R. Anderson (NMC) (w/o Attachments 1 & 2)
B. Mozafari (NRC-NRR)
J. Dyer (Region III)
D. McGhee (State of Iowa) (w/o Attachments 1 & 2)
NRC Resident Office
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Attachment 2 to

NG-01-0909

General Electric Affidavit of Proprietary Information

General Electric Company

AFFIDAVIT

I, **George B. Stramback**, being duly sworn, depose and state as follows:

- (1) I am Project Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.
- (2) The information sought to be withheld is contained in Enclosure 1 to letter GEDA-AEP-568, *Response to NRC RAI Regarding ATWS and SLC*, (GE Company Proprietary), dated August 10, 2001. The proprietary information is delineated by bars marked in the margin adjacent to the specific material in the *Enclosure 1 to Letter GEDA-AEP-568 GE Responses to NRC RAI Regarding ATWS and SLC*.
- (3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), 2.790(a)(4), and 2.790(d)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).
- (4) Some examples of categories of information which fit into the definition of proprietary information are:
 - a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;
 - b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

- c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of General Electric, its customers, or its suppliers;
- d. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, of potential commercial value to General Electric;
- e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in both paragraphs (4)a. and (4)b., above.

- (5) The information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.
- (6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.
- (7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.
- (8) The information identified in paragraph (2), above, is classified as proprietary because it contains further details regarding the GE proprietary report NEDC-32980P, *Safety Analysis Report for Duane Arnold Energy Center Extended Power Uprate*, Class III (GE Proprietary Information), dated November 2000, which contains detailed results of analytical models, methods and processes, including computer codes, which GE has developed, obtained NRC approval of, and applied

to perform evaluations of transient and accident events in the GE Boiling Water Reactor ("BWR").

The development and approval of these system, component, and thermal hydraulic models and computer codes was achieved at a significant cost to GE, on the order of several million dollars.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

- (9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

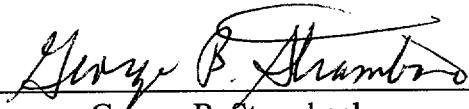
The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

STATE OF CALIFORNIA)
) ss:
COUNTY OF SANTA CLARA)

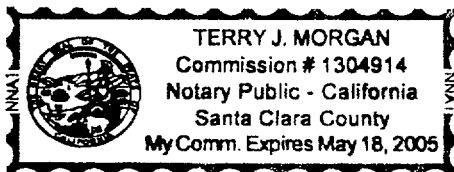
George B. Stramback, being duly sworn, deposes and says:

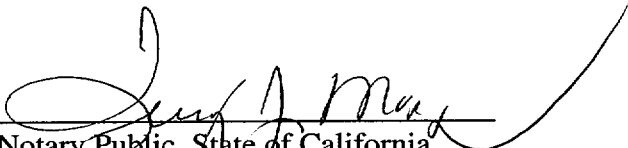
That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 10th day of August 2001.


George B. Stramback
General Electric Company

Subscribed and sworn before me this 10th day of August 2001.




Notary Public, State of California

**Redacted Version of
DAEC Responses to NRC
Reactor Systems Branch Requests for Additional Information
Regarding Proposed Amendment for Power Update**

1. Core Operating Licensing Report (COLR):

- (a) Provide the COLR and the supplemental reload licensing report for the updated cycle.

DAEC Response:

a) The COLR and supporting Supplemental Reload Licensing Report for the full updated cycle have not yet been prepared. It is anticipated that the DAEC will require at least an additional reload cycle beyond the current cycle (Cycle 18) to achieve the full updated condition of 1912 MWt. Thus, we will provide the requested information when it becomes available in the future.

2. Maximum Extended Load Line Limit Analysis (MELLLA):

- (a) Discuss the specific analyses needed to verify the safety of operation within the MELLLA domain in the power flow map. Indicate which MELLLA were not performed, if any, as part of the EPU safety analysis process and why. Also, provide a cross-reference to the section in the submittal where the analyses are discussed.
- (b) Added per August 3, 2001 conference call: Confirm that the ARTS program was considered in conjunction with the MELLLA, where applicable.

DAEC Response:

a) [LATER]

b) As stated in PUSAR Section 1.3.2, all existing "performance improvement features," which would include the ARTS program as shown in Table 1-2, were incorporated into the EPU safety analyses. The ARTS program is made up of two major components: the application of power- and flow-dependent multipliers for fuel thermal limits to account for off-rated conditions in lieu of thermal peaking factor setdowns on the Average Power Range Monitor (APRM) setpoints; and, second, the conversion of the Rod Block Monitor (RBM) system from flow-biased to power-dependent setpoints for mitigating a Rod Withdrawal Error (RWE) event.

PUSAR Section 2.2 for the fuel thermal limits states that the ELTR-1, Section 5.7.2 was followed, which describes the application of the ARTS program for determining the power and flow-dependent fuel thermal limits. Second, PUSAR Section 5.3.5 discusses the evaluation of the power-dependent RBM setpoints for EPU. As shown in PUSAR Table 5-1, no changes in the RBM were required for EPU. The evaluation of the RBM to mitigate the

RWE event is provided in PUSAR Table 9-2. Thus, the ARTS program was re-evaluated at the EPU conditions.

3. Section 2.4 Stability:

Provide discussions on the following topics to facilitate responding to the ACRS concerns and ensuring that implementation of MELLL and 20% power uprate will not reduce protection against core wide mode instability.

(a) GE submitted a 10 CFR Part 21 report (EN 38104) stating that stability reload licensing calculations may be potentially nonconservative for plants that implemented the stability detect and suppress trip systems. DAEC had implemented the long-term solution Option I-D and GE reported that the MCPR safety limit protection from the flow-biased APRM flux trip may be inadequate for plants that implemented the Option I-D. Please provide the evaluation of the impact of the GE Part 21 on the DAEC EPU stability analysis.

(b) ACRS Question:

Describe the inputs into the stability on-line monitoring system (SOLOMON) and the accuracy of the system. Discuss how the system detects and alerts the operators of pending instability. Include in your discussion the conditions that will occur and whether the inputs used in the stability monitoring system can sufficiently detect the instability condition. Explain if the operators will be able to avoid operation in the instability regions.

DAEC Response:

a) With respect to the recent GE Part 21 report on the error in their thermal-hydraulic stability methodology (J. Post (GE) to USNRC, MFN 025-01, June 29, 2001), we have reviewed this report and determined that the DAEC power uprate submittal does not require revision as a result. The conclusion that the flow-biased APRM scram provides adequate protection of the MCPR Safety Limit remains valid.

As stated in Section 2.4 of our PUSAR (NEDC-32980P), the DAEC is an Option I-D stability solution plant. Per the Part 21 notice, the "figure of merit" for Option I-D plants to be used to determine whether the plant-specific analysis remains valid is the "core average power-to-flow ratio following a simulated flow runback on the rated rod line to approximately 30% of rated core flow." This figure of merit is a Power/Flow (P/F) ratio $< 66 \text{ MWt/Mlbm/hr}$.

For the DAEC at uprated conditions, the "rated rod line" is essentially the MELLLA boundary as depicted in Figure 2-1 of the PUSAR. The MELLLA boundary is actually the 100.6% rated rod line, so it is a bounding value for this evaluation. Thus, a recirculation flow runback would end up at State point A on that figure. At that point, the thermal power is $(47.5\%)(1912 \text{ MWt}) = 908.2 \text{ MWt}$ and the core flow is 14.2 Mlbm/hr (28.9% rated core flow, corresponding to "approximately" 30% core flow cited in the Part 21 notice). Thus, the

P/F ratio is $(908.2 \text{ MWt}) / (14.2 \text{ Mlbm/hr}) = 63.96$ or $\sim 64 \text{ MWt/Mlbm/hr}$. Thus, we satisfy the figure of merit and our EPU analysis remains valid.

b) The SOLOMON system is basically the on-line version of the ODYSY computer code. A basic description of which (GE-NE-523-A038-0495) was provided to the Staff in support of DAEC license amendment #215 (G. Kelly (USNRC) to L. Liu (IES Utilities), Amendment #215 to Facility Operating License No. DPR-49, Duane Arnold Energy Center (TAC No. M94313), dated August 7, 1996). The ODYSY code was recently re-reviewed by the Staff as a replacement for the FABLE/BYPSS code in reload licensing calculations (Ref. S. Richards (USNRC) to J. Klapproth (GENE), Review of NEDC-32992P, ODYSY Application for Stability Licensing Calculations (TAC No. MB0373), MFN-01-016, dated April 20, 2001). This document elaborates on the accuracy of the ODYSY code to predict an instability condition.

As described in the above documents, SOLOMON is basically the on-line version of the ODYSY code. It is a module within the 3-D Monicore software package which does the core monitoring function. SOLOMON is not a stand alone software package; it gets its input from 3-D Monicore to do its calculations. SOLOMON does not directly monitor the core for instability conditions. It does a predictive calculation of the core and channel decay ratios at the actual operating power and core flow condition. The results of the calculation are presented to the Operator as being within one of three categories – Instability Expected, Reduced Stability Margin, and Large Stability Margin. It does not provide the Operator with an alarm that an actual instability condition exists. The Operators rely on their safety-related in-core neutron monitors to provide the detection and alarm on an instability event. The primary purpose of SOLOMON is to allow operation within the Stability Buffer Zone and is considered a backup function only.

The attached Figure-1 is a typical plant startup power ascension path, as depicted on the EPU power-to-flow map. While there is a reduced operating window during the initial startup period between the Stability Buffer Zone and the Low Feedwater (FW) Protection line, it will be possible to maneuver around the Buffer Zone, if the Operators so desire. Again, reactor operation within the Buffer Zone is allowed, provided the SOLOMON system is available.

4. Shutdown Cooling Mode:

- (a) The submittal stated that the EPU decay heat is increased proportionally, thus, increasing the time to reach shutdown temperature by 10.5 hours. Provide the total time required to reach the shutdown temperature for operation at the uprated condition.

DAEC Response:

- a) First a point of clarification, the “shutdown temperature” alluded to is not the Technical Specification requirement of $\leq 212^\circ\text{F}$ (i.e., MODE 4). It refers to the design requirement of achieving a bulk reactor temperature to allow for refueling operations, as stated in PUSAR

Section 3.9.1. This value is $\leq 125^{\circ}\text{F}$. Thus, at EPU conditions, the total time estimated to reach the 125°F design value is 27.1 hours¹.

5. Standby Liquid Control System (SLCS) and Anticipated Transients Without Scram (ATWS):

- (a) What ATWS events were analyzed at the EPU condition?
- (b) Confirm that for all limiting ATWS events, the SLCS will be able to inject at the assumed time without the lifting of the SLCS relief valves. For example, will the SLCS be able to inject the required flow rate at the assumed time for the ATWS LOOP event without reaching the rated SLCS relief valve setpoint?
- (c) Added per conference call on August 3 and August 6, 2001, what are the limiting event(s) for each of the five acceptance criteria in Section 9.3.1?
- (d) Added per conference call on August 3 and August 6, 2001, confirm that the Operator response to an ATWS event is not being modified from those described in Section L.3.2 of ELTR-1.

DAEC Response:

a) As stated in PUSAR Section 9.3.1, the limiting events for ATWS, as defined in Section L.3 of ELTR-1 were analyzed. These are 1) Closure of all Main Steamline Isolation Valves (MSIVC), 2) Pressure Regulator Failure Open-Maximum Steam Demand (PRFO), 3) Loss of Offsite Power (LOOP), and 4) Inadvertent Opening of one Relief Valve (IORV).

b) [[General Electric Proprietary Information Redacted]]

It is concluded that the potential for the SLCS relief valve lifting is negligible for the ATWS events at DAEC. The SLCS can deliver a constant boron injection rate to the reactor vessel for all the ATWS events.

c)

ATWS Acceptance Criteria	Limiting Event	Cycle Exposure
Peak Vessel Pressure - Bottom Head	PRFO	BOC*
Peak Clad Temperature	PRFO	EOC**
Peak Clad Oxidation	***	
Peak Suppression Pool Temperature	MSIVC	EOC
Peak Containment Pressure	MSIVC	EOC

* Beginning of Cycle

** End of Cycle

*** Peak Clad Temperature was $< 1800^{\circ}\text{F}$, so no cladding oxidation calculation was necessary.

¹ As stated in NG-01-0738, some power uprate analyses are potentially impacted by the issue raised in SIL-636, Rev. 1, "Additional Terms Included in Reactor Decay Heat Calculations." The formal evaluation of the SIL impact on this specific EPU analysis is not yet complete.

d) As stated in our RAI Response dated May 10, 2001 (Ref. NG-01-0637), the basic strategies and operator responses in the Emergency Operating Procedures (EOPs) were not changed as a result of EPU. Given that our EOPs are currently consistent with the ELTR-1, Section L.3.2 actions, they will continue to be consistent with implementation of EPU.

6. Station Blackout (SBO):

The EPU submittal stated that the plant's response and coping capabilities for an SBO event are affected slightly for operation at the uprated power level, due to the increased decay heat. But there won't be any change in the systems and equipment used to respond to an SBO and the coping time will also not change. The EPU submittal also stated that the condensate storage requirement is increased, however, the current condensate storage tank design ensures that adequate water volume is available.

- (a) Currently, 63,800 gallons of condensate is required for four hour coping duration and the condensate storage tank is required to maintain 75,000 gallons. What would be the condensate inventory required to provide core coverage and decay heat removal at the EPU condition for the four hour SBO coping time? Discuss whether sufficient water level will be available to provide the necessary NPSH and to prevent vortexing of the HPCI pumps.
- (b) Added per conference call on August 6, 2001, provide additional details regarding the change in SBO assumptions on the condensate storage tank temperature to a "more realistic" value.

DAEC Response:

a) The 4 hour coping analysis for EPU determined that approximately 66,750 gallons of condensate storage tank (CST) inventory would be used². This remains within the 75,000 gallon minimum requirement for CST inventory. Thus, adequate core coverage is assured, accounting for the additional makeup required by the increased decay heat due to EPU.

Adequate Net Positive Suction Head (NPSH) is assured through the physical design of the system. Per UFSAR Section 6.3.2.2.1, the physical arrangement of the High Pressure Coolant Injection (HPCI) pump is at an elevation below that of the CST, such that the static head and piping size are sufficient to provide the required NPSH. This is irrespective of CST level.

The CST has level switches that transfer the HPCI pump suction from the CST to the suppression pool if CST level drops to the level where air entrainment (i.e., vortexing) could become a concern. The Technical Specification (TS) Allowable Value (Reference TS Table 3.3.5.1-1, Item 3.d) ensures that the suction transfer occurs before the vortexing limit is reached.

² As stated in NG-01-0738, some power uprate analyses are potentially impacted by the issue raised in SIL-636, Rev. 1, "Additional Terms Included in Reactor Decay Heat Calculations." The formal evaluation of the SIL impact on this specific EPU analysis is not yet complete.

b) The original SBO analysis used an “assumed ambient” temperature for the CST of 90 °F. However, the design basis for the Reactor Core Isolation Cooling (RCIC) system assumes that CST water temperature for injection is 100 °F (Ref. UFSAR Figure 5.4-10). Because RCIC is the assumed source for reactor makeup during the SBO coping period, its design basis temperature was assumed for the EPU analysis.

7. Single Loop Operation:

This question was added per the August 3, 2001 conference call. Per PUSAR Section 3.4, the nameplate rating of the recirculation pumps is being exceeded “by a small amount” under EPU conditions. This is stated as being an operational concern only and not a safety issue. However, a recirculation pump seizure event is an analyzed event in the DAEC’s UFSAR. In addition, Section 10.4.3 states that although the pump speed is being increased “slightly,” startup vibration testing will not be performed. With respect to these issues, please address the following:

- (a) Confirm that the recirculation pump seizure event was analyzed for Single Loop Operation (SLO) at the EPU condition, as it is not listed as one of the required events to be analyzed in ELTR-1, but, it is required to be evaluated by UFSAR Section 15.3.4 for each reload cycle.
- (b) Provide additional justification for not performing the vibration testing of the recirculation pumps at the EPU conditions.

DAEC Response:

- a) Consistent with the DAEC’s licensing basis, the SLO recirculation pump seizure event was analyzed due to the introduction of GE14 fuel, which is a part of the EPU program. As stated in UFSAR 15.3.4, this is done to ensure that this event is evaluated for the Operating Limit Minimum Critical Power Ratio (MCPR) for each cycle.
- b) The recirculation pumps are permanently instrumented with vibration monitors, which provide an alarm in the main control room. Thus, during power ascension from current rated power to the EPU conditions, the vibration of the reactor recirculation pumps will be monitored. Thus, there is no need to perform special testing.

Figure 1
Typical Startup Path

