

# CATEGORY 1

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SUBJECT: Provides results of EPR testing & tensile specimen testing, expected schedules for submittal of fracture toughness testing results 7 evaluation of shroud fluence measurement results. Proprietary rept encl.

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 TITLE: GL 94-03 Intergranular Stress Corrosion Cracking of Core Shrouds in B

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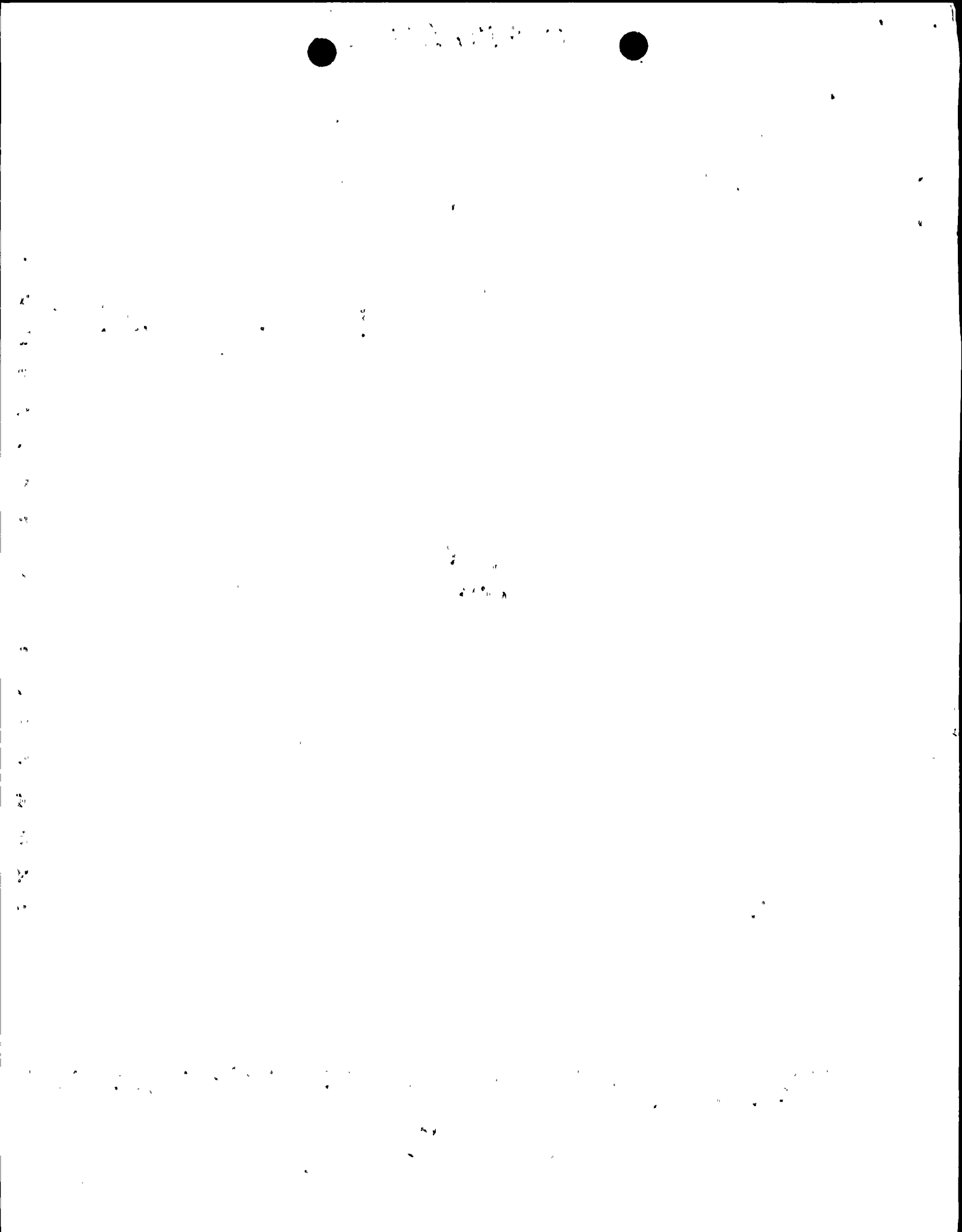
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February 27, 1998  
NMP1L 1290

JOHN T. CONWAY  
Vice President  
Nuclear Engineering

U. S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555

RE: Nine Mile Point Unit 1  
Docket No. 50-220  
DPR-63

*Subject: Generic Letter 94-03, "Intergranular Stress Corrosion Cracking (IGSCC) in Boiling Water Reactors"*

Gentlemen:

By letter dated April 8, 1997, and attached enclosures, Niagara Mohawk Power Corporation (NMPC) provided the NRC with root cause, corrective action and final design documentation which established the acceptability of the as-found Nine Mile Point Unit 1 (NMP1) vertical weld shroud cracking for a minimum of 10,600 operating hours (above 200 degrees F) after which the shroud was to be reinspected. That letter also indicated NMPC's plans for additional analyses to justify extension of the reinspection interval for the shroud vertical welds. As further stated in the letter, the analyses would rely, in part, on the results of boat sample metallurgical testing which was expected to establish the presence of IGSCC, the age of cracking, whether crack growth had arrested and assess the material properties of the shroud material. Boat sample test results were submitted to the NRC by letters dated September 30, 1997 and January 30, 1998.

NMPC stated in its letter to the NRC dated January 30, 1998 that the results of the core shroud boat sample electrochemical potentiokinetic reactivation (EPR) testing and tensile specimen testing would be submitted by February 27, 1998. NMPC also stated that the expected schedules for fracture toughness testing of the shroud materials and the completed evaluation of the shroud fluence measurement results would be provided by February 27, 1998. The purpose of this letter is to provide the following: 1) the results of the EPR testing (Attachment 1) and tensile specimen testing (Attachment 2), 2) the expected schedules for submittal of the fracture toughness testing results and the evaluation of the shroud fluence measurement results, and 3) technical justification for the application of the BWRVIP-14 disposition crack growth rate of 2.2E-5 inches/hour to the NMP1 shroud and for extension of the current NMP1 vertical weld inspection interval from 10,600 hours of hot operation to 14,500 hours of hot operation. Attachment 3 provides the technical justification for this extension request.

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etc. email  
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In accordance with 10CFR2.790, General Electric Company (GE) document GE-NE-523-b12-01869-113, Revision 0 (Attachment 3) is a proprietary document from GE and it is therefore requested on behalf of GE that this information be withheld from public disclosure. Attachment 4 is an affidavit supporting this classification signed by George B. Stramback, Project Manager Regulatory Services of GE. Attachment 5 is a non-proprietary copy of the GE report.

The NMP1 core shroud boat samples have undergone extensive testing and analysis. Attachment 6 summarizes the testing performed on the core shroud boat samples. The metallurgical results and the fluence measurement results were provided to the NRC by letters dated September 30, 1997 and January 30, 1998 respectively. This letter provides the results of the EPR testing and the tensile specimen testing. A final review of the fluence measurement results is planned after the completion of the re-evaluation of the reactor vessel material surveillance 210 degree vessel coupon dosimetry analysis. This evaluation will verify the applicability of the high energy neutron spectrum assumed in the boat sample fluence measurements. At this time, no significant change in the high energy neutron spectrum is anticipated which could affect the fluence measurement calculations. The results of this review are scheduled to be completed in April 1998. If any changes to the fluence measurement results are required they will be submitted on April 30, 1998. The expected submittal date for the fracture toughness testing results of the shroud materials is April 30, 1998. The fracture toughness testing is not required by the NRC Safety Evaluation Report (SER) or by the BWRVIP-01 for the application of linear elastic fracture mechanics (LEFM). The fracture toughness testing is being performed to obtain plant specific data and to increase the database of fracture toughness properties for 304 stainless steel material in the  $3E20$  n/cm<sup>2</sup> fluence range, since industry data is limited to higher fluence levels.

The depth of evaluation of the material condition of the NMP1 core shroud at the vertical welds as documented in the attached reports is unprecedented in the industry. The in-depth analyses of the core shroud material condition have enabled NMPC to complete a comprehensive review of the maximum potential crack growth rate applicable to the NMP1 core shroud during cycle 13 operation. Based on this evaluation, NMPC has concluded that the NMP1 core shroud can be safely operated in compliance with the required design and licensing basis safety margins for the entire scheduled fuel cycle 13 operating period. The next refuel outage 15 (RFO15) is planned to begin April 5, 1999.

The EPR testing of the V9 and V10 weld material resulted in measured values of EPR that are consistent with and support the assumptions used in Attachment 3. The results are also consistent with the qualitative evaluation of material sensitization based on the V9 and V10 micrographs which were documented in our September 30, 1997 submittal. Both evaluations concluded that the material exhibited mild sensitization consistent with that typical of 304 stainless steel core shroud welds.



The tensile specimen testing results demonstrate that the NMP1 core shroud material retains excellent ductility. This establishes that the existing NMP1 LEFM analyses for the V9 and V10 welds, which is the basis for the existing core shroud NRC SER dated May, 1997, are conservative and that the limit load analysis is applicable. The limit load analysis for these welds demonstrate additional margin compared to the LEFM.

The analysis provided in Attachment 3 demonstrates that the BWRVIP-14 disposition crack growth rate is applicable to the NMP1 core shroud vertical welds. The analysis shows approximately a factor of 10 margin of safety on predicted actual crack growth rate. The Attachment 3 analysis has concluded that the cracking is consistent with cracking that initiated early in the plant history, growing in depth over the early years of plant operation when the coolant conductivity was significantly higher and the cumulative fluence low. The proposed continuous operating period through April 5, 1999 represents a maximum hot operating period of 14,500 hours due to the unplanned three month Emergency Condenser forced outage in late 1997. This is approximately an additional 5 months continuous operation above the currently approved vertical weld inspection interval of 10,600 hours.

Consistent with the core shroud analyses approved by the NRC in the May 1997 SER, NMPC implemented EPRI action level 1 operating restrictions. The EPRI action level 1 guideline has an upper limit of  $0.3 \mu\text{S}/\text{cm}$ . The NMPC crack growth evaluation has concluded that the cycle average normal reactor water chemistry, when maintained below  $0.1 \mu\text{S}/\text{cm}$ , establishes an equivalent factor of approximately 10 conservative margin regarding crack growth rate. The cycle average conductivity for each of the last 4 operating cycles and for the current cycle to date has been maintained below  $0.1 \mu\text{S}/\text{cm}$ . The upper limit of reactor water conductivity which ensures that NMP1 would not exceed the  $2.2\text{E-}5$  inches/hour crack growth rate has been determined to be  $0.19 \mu\text{S}/\text{cm}$ . Consistent with the 14,500 hot operating hours proposed operating period, NMPC will implement the EPRI action level 1 requirements if reactor water conductivity exceeds  $0.19 \mu\text{S}/\text{cm}$ . In addition NMPC will continue to operate in a manner which maintains best achievable reactor water conductivity below  $0.1 \mu\text{S}/\text{cm}$  to preserve the factor of 10 margin.

The existing fracture mechanics analysis defined an available ligament, to allow for crack growth, of 0.53 inches. Using this available crack growth ligament, and the NMPC proposed BWRVIP-14 disposition crack growth rate, the allowable hot operating hours prior to reinspection as defined by the equation,  $0.53 \text{ inches} \div 2.2 \text{ E-}5 \text{ inches/hour}$ , equals 24,000 hours. Since the available crack growth ligament of 0.53 inches is unchanged, the existing fracture mechanics analysis which is the basis for the existing core shroud NRC SER will remain unchanged.





NMPC has also completed a supplemental review of the fracture mechanics analysis which is the basis for the existing core shroud NRC SER dated May, 1997. The results of this review conclude that additional margin exists based on the evaluations of uncracked ligament on the V9 and V10 welds confirmed by dual inspection techniques, both ultrasonic testing and enhanced visual examination (EVT-1) which were not credited in the April 1997 analysis. Additional fracture mechanics analyses have also been performed assuming the vertical welds are fully cracked, crediting only the inspected regions of the horizontal welds, and assuming no credit for the clamping load supplied by the tie rods. These analyses have demonstrated that structural integrity is maintained. Additional analyses have also been performed for the V4 weld for which inspection data was limited due to inspection tool access restrictions. These analyses credited the BWRVIP-03 qualification of the GE inspection for far side detection capability which was not credited in the April 1997 analysis. The additional coverage achieved extends the V4 inspection coverage. These analyses are currently undergoing third party engineering review. These supplemental analyses demonstrate that additional margin exists above that required to satisfy the BWRVIP-01 required safety margins. These analyses are not required to support the 14,500 hour hot operating period since the existing analyses remain bounding assuming the BWRVIP-14 disposition crack growth rate.

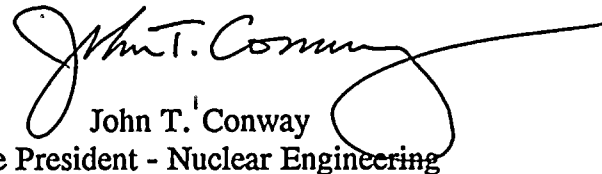
NMPC, in its April 30, 1997 letter, committed to provide the NRC with reinspection plans for the core shroud and stabilizer assemblies three months prior to the end of the proposed operating cycle of 10,600 operating hours. Since this request seeks to extend the operating cycle to 14,500 operating hours, NMPC is providing the following information on reinspection plans. The preliminary plans for the core shroud inspection during the RFO-15 are to complete a 100% reinspection of all the accessible vertical welds and selected accessible horizontal welds. The intent of the reinspection will be to confirm that the actual NMP1 crack growth experienced during cycle 13 operations is very low. The results of this inspection will establish the future inspection interval for the vertical welds assuming no repair is implemented. An inspection interval consistent with a 24 month cycle based on the BWRVIP-14 disposition crack growth rate will be validated. The detailed core shroud tie rod inspection plans are being developed. The augmented inspections of the tie rods as discussed in the May 1997 NRC SER will be performed during RFO-15. The NMP1 analysis and the May 1997 NRC SER for the tie rods established that operation for a complete 24 month fuel cycle was justified.

NMPC is developing a contingency vertical weld repair. At this time the installation of a vertical weld repair is not required and is not anticipated to be needed for RFO-15 due to the fact that our analyses predict an actual crack growth rate that is practically negligible. NMPC is evaluating mitigation measures for reactor internals cracking including the application of hydrogen water chemistry and the use of noble metals technology.



NMPC has concluded that continuous operation for a period of 14,500 hours is justified based on the boat sample results, water chemistry controls, and a thorough analysis of the crack growth behavior of the core shroud. The boat sample results have eliminated uncertainty regarding the cause of the shroud cracking, the degree of sensitization of the V9 and V10 weld heat affected zone material and the impact of the neutron fluence experienced. The NMP1-specific modeling of the potential crack growth has bounded the maximum crack growth rate to be below the BWRVIP-14 disposition crack growth rate of 2.2E-5 inches/hour. Operating practices will ensure that approximately a factor of 10 additional margin regarding crack growth rate will be maintained.

Very truly yours



John T. Conway  
Vice President - Nuclear Engineering

JTC/TRE/lmc  
Attachments

xc: Mr. H. J. Miller, Regional Administrator, Region I.  
Mr. S. S. Bajwa, Director, Project Directorate I-1, NRR  
Mr. B. S. Norris, Senior Resident Inspector  
Mr. D. S. Hood, Senior Project Manager, NRR  
Records Management



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ATTACHMENT 4

AFFIDAVIT (GE)



ATTACHMENT 4

AFFIDAVIT (GE)





# 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 the GE proprietary report GE-NE 523-B13-01869-113, *Assessment of Crack Growth Rates Applicable to Nine Mile Point-1 Vertical Weld Indications*, Revision 0, Class III (GE Nuclear Energy Proprietary Information), dated February 1998. The proprietary information is delineated by bars marked in the margin adjacent to the specific material.
- (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;



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- 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 detailed results of analytical models, methods and processes, including computer codes, which GE has developed and applied to perform evaluations of indications in the core shroud for the BWR.



The development of the crack growth methodologies that are used to evaluate BWR Core Internal components was achieved at a significant cost, on the order of one million dollars, to GE.

The development of the evaluation process contained in the paragraph (2) document 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.



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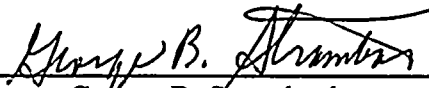
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ss:


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

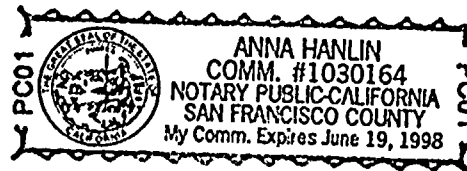
That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 26<sup>th</sup> day of February 1998.

  
\_\_\_\_\_  
George B. Stramback  
General Electric Company

Subscribed and sworn before me this 26<sup>th</sup> day of FEBRUARY 1998.

  
\_\_\_\_\_  
Notary Public, State of California





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ATTACHMENT 1

RESULTS OF THE EPR TESTING

