February 23, 2000

MEMORANDUM TO: Thomas L. King, Director
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

FROM: Michael E. Mayfield, Acting Director /RA/
Division of Engineering Technology
Office of Nuclear Regulatory Research

SUBJECT: REQUEST FOR COMMENTS ON DRAFT NUREG/CR-5632, "INCORPORATING AGING EFFECTS INTO PROBABILISTIC RISK ASSESSMENT-A FEASIBILITY STUDY UTILIZING RELIABILITY PHYSICS MODELS"

In your memorandum dated January 31, 2000, you requested that DET provide comments on the subject draft report developed by Idaho National Engineering and Environmental Laboratory (INEEL). Our general and specific comments are provided in the attachment.

This DRAA sponsored research program output provides for models, data and methodology for treatment of aging in long-lived passive components and structures, and the incorporation of aging effects into PRAs. A specific model pertaining to flow-accelerated corrosion (erosion-corrosion) has been developed to demonstrate and to prioritize potential aging-related damage (wall thinning). However, it is noted that the report is silent on the effectiveness of inspection, maintenance, refurbishment and replacement strategies that may limit the effects of aging on risk.

With regard to our thoughts on the scope for future extension of the research work the following suggestions are provided:

1. Suitable reliability-physics model(s) should be developed for the treatment of other prevalent aging mechanisms such as, radiation embrittlement and thermal aging associated with the reactor coolant pressure boundary components.

2. Develop appropriate reliability-physics model(s) and determine risk significance of cable aging in harsh environment within the scope of 10CFR Part 50.49. The cable types should include low-voltage I&C cables and power cables.

DET staff is available to provide insights into the deterministic engineering disciplines which may be involved in the follow on research effort for the above two items for the treatment of aging in long-lived passive components and structures, for the current license term of 40-years and for license renewal considerations

If you have and question with regard to our comments, please contact Jit Vora (JPV), at 415-5833.

Attachment: As stated

Distribution: .
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DATE	02 /22 /2000	02/22/2000	02/23/2000

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Attachment

INCORPORATING AGING EFFECTS INTO PROBABILISTIC RISK ASSESSMENT-A FEASIBILITY STUDY UTILIZING RELIABILITY PHYSICS MODELS

This research project attempts to utilize reliability physics models of long-lived passive components and structures, incorporating their aging effects into Probabilistic Risk Assessments (PRAs). The illustrative example focuses on failure caused by flow-accelerated corrosion induced wall thinning. In the process the researchers have identified relevant aging mechanisms, developed suitable model, and incorporated detrimental effects of aging in PRAs.

General Comments:

1. As a key element of the Aging Physics Model, it would be very useful to recognize and incorporate, how aging mechanisms and their detrimental effects are propagated over the service life of the component or structure? That is:

(a) determine significant Condition Indicator Parameter(s) (CIPs) relevant to the performance of the component or structure under study,

(b) how CIPs trend over the service life of the component or structure due to age-related degradation effects? (See Figure 1),

(c) establish acceptance criteria for the CIP value(s),

(d) prioritize potential age-related degradation effects, based on rate of change in CIP value(s) (See the 7 levels in Figure 1),

(e) establish probability of failures and uncertainties, based on time-trend of CIPs,

(NOTE: for a given component or structure under study there could be more than one CIP relevant to significant age-related degradation)

Specific Comments:

1. Page 6. Item 2. Aging Mechanisms. 1st Paragraph.

It would be useful to provide some examples of stressors and degradation mechanisms which have caused failures and raised questions about the continued safety and increased risk of the older nuclear power plants, attributable to structural integrity of the passive pressure boundary components and containment.

2. Page 20. Item 2.3 Field Experience Related to Aging Damage to Passive Components.

See General Comment and Figure1. It would be very useful to relate the seven levels of aging degradation in the context of wall thinning attributable to flow-induced corrosion and prioritize accordingly.

3. Page 49. Item 4. Incorporating Aging Effects into PRA Methodology.

Note that significant work related to the incorporation of aging effects into PRA methodology was done as a part of the Nuclear Plant Aging Research (NPAR) program. Reference to following NUREG/CR reports would be useful:

- NUREG/CR-4144, "Importance Ranking Based on Aging Consideration of Components Included in Probabilistic Risk Assessment."

- NUREG/CR-5378, "Aging Data Analysis and Risk Assessment-Development and Demonstration Study."

- NUREG/CR-5510, "Evaluation of Core Melt Frequency Effects Due to Component Aging and Maintenance."

- NUREG/CR-5587, " Approaches for Age-Dependent Probabilistic Safety Assessments with Emphasis on Prioritization and Sensitivity Studies."

4. Page 104. 2nd Paragraph.

We agree with the statement made by the authors with regard to the need for developing reliability physics models for long-lived passive electrical component such as "cable." In this regard, aging mechanisms associated with the polymeric insulating materials are well known within the nuclear industry and for applications in transmission and distribution systems. When integrated with the results of ongoing research work the existing database on polymers would be useful for developing reliability physics model(s) for cables, as a follow-on research activity.

Aging Physics Model

Based on
One-Condition Indicator Parameter
(Time Trend)

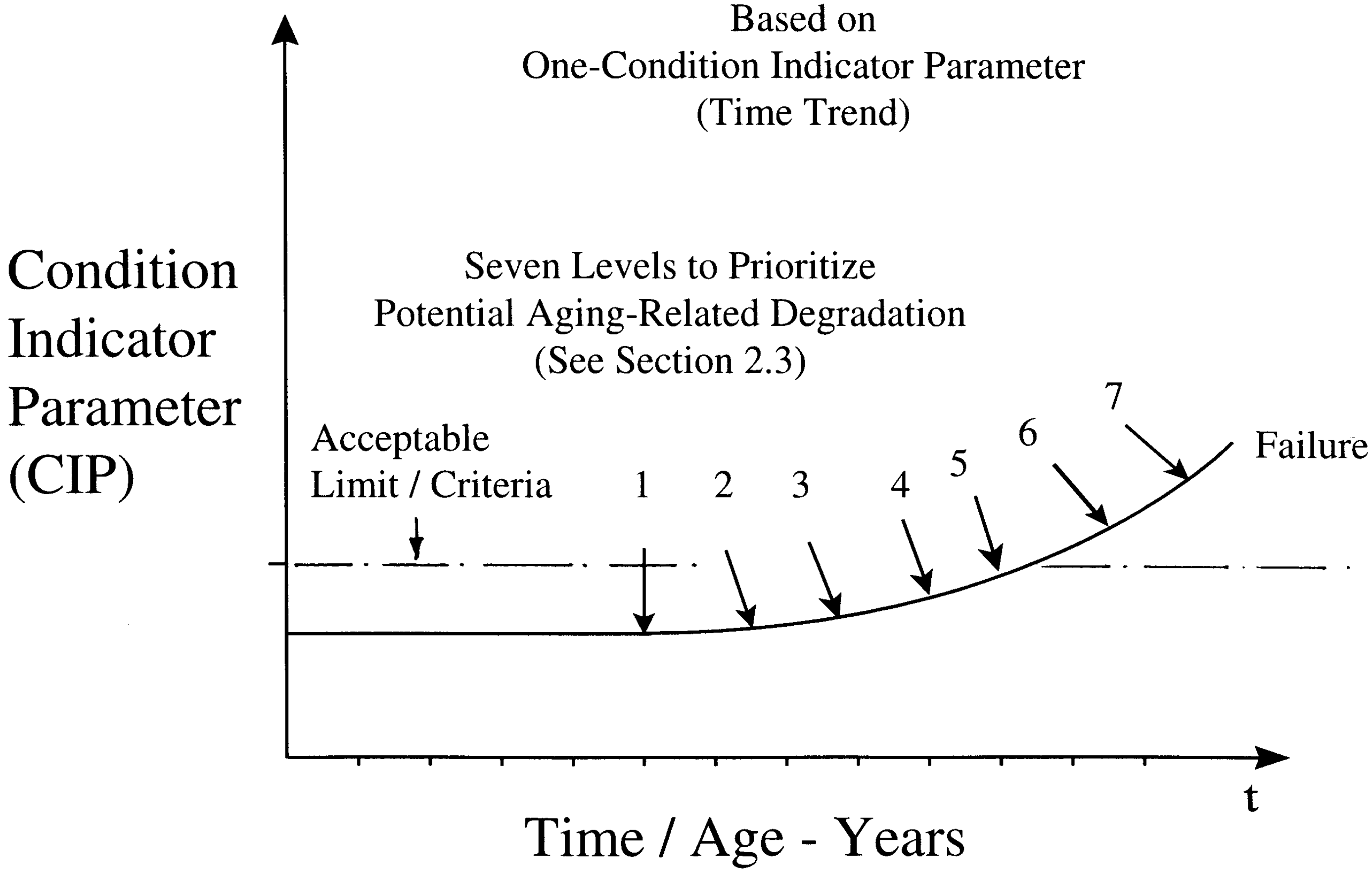

Figure 1

Jit Vora 2/15/00