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June 16, 2006

Mr. Stewart Rubin
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738
Phone: 301-415-7480
E-mail: sdr1@nrc.gov

Subject: Structural Integrity Evaluation of Advanced Reactors

Dear Mr. Rubin,

This is a follow up to our discussion, including Dr. Don Griffin, on structural integrity of advanced reactors and operation at elevated temperatures. Attached is a copy of my paper presented at the ANS conference by Tim McGreevy of ORNL that you requested.

You may be aware of the O'Donnell-Porowski Bounds for creep ratcheting which are used worldwide in the design of high temperature reactors. We also developed the creep strain limits for membrane, membrane plus bending, and peak local strains in both base metal and weldments used in the ASME Code for Elevated Temperature Nuclear Components. We have done extensive work in the design of advanced reactors worldwide subjected to cyclic thermal loading, with operating conditions limited by creep-fatigue/creep rupture damage.

My background and that of our firm includes reactor engineering, nuclear fuel design, safety analysis, nuclear reactor loop designs, and the design of facilities for testing irradiated materials and fuels. O'Donnell consulting Engineers, Inc. (O'Donnell) is currently design "zero leak" test containment vessels for the Knolls Atomic Power Laboratory. We are also designing the largest chemical reactor in the world for Dow Chemical Company, requiring special gaskets and sealing for gases which pose extreme hazards. Dr. Porowski has patents on special seals for safety related applications.

Our unique experience includes consulting on structural integrity and cracking issues in the Russian, German, Japanese and U.S. advanced reactors over the past thirty five years. Materials and design features tend to get locked-in early, and cannot subsequently be corrected easily. This leaves only the operating conditions to be corrected. Past "lessons learned" require that we develop and apply allowable strain, fatigue, rupture damage and tensile instability limits specific to the design of advanced reactors.

We can provide the benefit of 35 plus years of experience in the design and analysis of elevated temperature nuclear components to set structural integrity acceptance criteria including the following:

1. Allowable limit for biaxial creep strains. Dr. O'Donnell solved the creep tensile instability problem for NASA and the solutions can be applied to general biaxiality conditions to provide the stress/strain limits needed to avoid creep tensile instability cracking.

2. Material damage under cyclic loading using finite element results for cyclic loads in the creep regime with repeated application of primary creep, creep recovery and hardening.

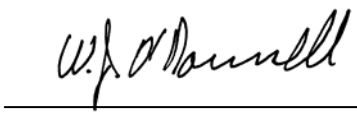
3. Limits for nominal and local strains, and creep rupture damage.

4. Evaluation of welding and other fabrication induced damage and residual stress effects in of critical regions with and notches in advanced reactors.

Early Regulatory guidance can quantify "how safe is safe enough" in concrete terms, prior to designers getting "locked in" on design concepts and configurations which may make it impossible to meet safety objectives.

Please feel free to call if you have questions. We believe that we can be of real help in your Program because of our extensive experience in elevated temperature structural integrity and advanced reactors. Dr. Janek Porowski, P.E.; Dr. Don Griffin; Dr. Behzad Kasraie, P.E.; Dr. Thomas P. O'Donnell, P.E. and others in our firm have shared in this experience.

Cordially,



William J. O'Donnell Ph.D., P.E.

cc: "NRC and ACRS Technical Issues Relating to Clinch River Breeder Reactor (CRBR)," by William J. O'Donnell
CV for William J. O'Donnell
List of Relevant Publications