ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 11, 1976

Mr. Lee V. Gossick
Executive Director for Operations
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: REPORT ON STRESS CORROSION IN BOILING WATER REACTORS

Dear Mr. Gossick:

The ACRS ended its letter of February 8, 1975, "Report on Cracking in Boiling Water Reactor Piping," with the sentence:

> "The Committee wishes to review the programs in the preceding paragraph when the ongoing studies reach a suitable stage."

The cited preceding paragraph (7), entitled, A longer range solution should be sought by programs of research and development contained the seven issues indicated:

> "Specific examples where additional information is desirable, several of which are being reviewed or where programs are underway, include such items as: (1) development of quantitative techniques for detecting and measuring residual stresses; (2) determination of the combined role of cyclic and static stresses on SCC; (3) response of piping to SCC as a function of degree of sensitization; (4) assessment of the reliability and sensitivity of NDE techniques such as ultrasonic testing when applied to piping systems; (5) better methods for measuring and controlling both oxygen and other impurities in the coolant immediately adjacent to regions of potential failure; (6) role of internal surface finish on the initiation phase of SCC; and (7) selection of alloys not susceptible to SCC, which can be used to replace limited components in operating reactors (e.g., bypass loops), or which might be used for the piping systems in future reactors. Such alloys must meet ASME Section III Code requirements of design, mechanical properties, fabricability and weldability, and have a minimal effect on plant operability. Examples of the last requirement could include coupling of dissimilar metals, relative degree of "crud" formation of replacement alloys compared to current alloys, and possible mechanism for controlling "crud" formation, to establish tradeoffs. Examples of alloys with substantial promise include the low carbon stainless steels (304L),

stabilized stainless steels (347), low alloy steels (2-5 chromium), and austeno-ferritic alloys (17)."

The Committee reviewed NUREG-75/067, "Technical Report - Investigation and Evaluation of Cracking in Austenitic Stainless Steel Piping of Boiling Water Reactor Plants," in the context of the issues cited in the ACRS letter. In addition the Committee had the benefit of discussions with the NRC Staff. References stated in the following paragraphs pertain to specific pages and headings in the NUREG Report.

Inservice Inspection

The extent and scheduling of inservice inspections cited on pages 13-14 under G-1 "Inservice Inspection" appear appropriate; however, the potential limitations of ultrasonic testing cited by the ACRS in item (4) "assessment of the reliability and sensitivity of NDE techniques such as ultrasonic testing when applied to piping systems" are not addressed. The Committee is aware of the EPRI efforts to establish a better understanding of the usefulness and limitations of NDE when used to examine austenitic stainless steels. The ACRS plans to continue to monitor progress of these programs on an ad hoc basis. The Committee recommends that NRC provide a positive input into these efforts.

Leak Detection Systems

The ACRS concurs with the Staff position cited in G-2 on page 14.

Modifications of Existing Piping

The NRC position in G-3 strongly advises replacement, when necessary, with piping material significantly less susceptible or immune to intergranular stress corrosion. This position is in accord with item (7) "selection of alloys not susceptible to SCC, which can be used to replace limited components in operating reactors (e.g., bypass loops), or which might be used for the piping systems in future reactors." The alternate, replacement with the same material (304SS), should be scrutinized closely to assure that fabrication procedures minimize sensitization in line with item (3) of the ACRS letter.

Modification of Plant Operational Practices

The suggested actions under G-4 items a through h are considered responsive to the ACRS concerns in item (5) "better methods for measuring and controlling both oxygen and other impurities in the coolant immediately adjacent to regions of potential failure."

Modifications for BWR Plants Under Construction Permit Review or Those Being Constructed

The suggestions cited under G-5 represent good preventative engineering practice and should be implemented.

The ACRS letter also touched on a few other items; namely,

(1) "development of quantitative techniques for detecting and measuring residual stresses;" item (1).

(2) "determination of the combined role of cyclic and static stresses in SCC;" item (2).

(3) "role of internal surface finish on the initiation phase of SCC;" item (6).

Items (1) and (2) above are discussed extensively in Section 6.0 of NUREG-75/067 and in NEDO-21000, "Investigation of Cause of Cracking in Austenitic Stainless Steel Piping." The Committee believes that quantitative data now exist on both stress levels and the role of vibration so that its questions have been answered.

With regard to the item pertaining to internal surface finish, the ACRS is unaware of definitive work responding to this concern. Although the Committee considers this item of secondary priority, it deserves attention.

The ACRS expects that there will be additional cases of intergranular stress corrosion cracking in the future in addition to those occurring in the past few months; however, the steps taken to monitor, to better understand the problem, and to take corrective actions should minimize the impact of such cases of IGSCC. The Committee urges positive action in future plants to minimize the frequency of IGSCC.

Sincerely yours,

Dade W. Moeller

Dade W. Moeller
Chairman

<u>References</u>

1. ACRS letter to W. A. Anders, "Report on Cracking in Boiling Water Reactor Piping" dated February 8, 1975.

2. Nuclear Regulatory Commission report NUREG-75/067, "Technical Report, Investigation and Evaluation of Cracking in Austenitic Stainless Steel Piping of Boiling Water Reactor Plants" dated October 1975.

3. General Electric Company topical report NEDO-21000, "Investigation of Cause of Cracking in Austenitic Stainless Steel Piping" dated July 1975.