September 1, 2005

MEMORANDUM TO: Andrea D. Lee, Chief
Corrosion and Metallurgy Section
Materials Engineering Branch
Division of Engineering Technology, RES

FROM: William H. Cullen, Sr. Materials Engineer ***/RA/***
Corrosion and Metallurgy Section
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SUBJECT: MEETING SUMMARY WITH ELECTRIC POWER RESEARCH INSTITUTE, SOUTHERN NUCLEAR OPERATING COMPANY AND WESTINGHOUSE ON MITIGATION OF PRIMARY WATER STRESS CORROSION CRACKING

On August 25, 2005, Nuclear Regulatory Commission (NRC) staff met with representatives of the Electric Power Research Institute (EPRI) Materials Reliability Program (MRP), Southern Nuclear Operating Company and Westinghouse Electric Company in a public meeting at NRC headquarters in Rockville, Maryland. A list of meeting attendees is provided in Attachment 1 of this memorandum. At this meeting, MRP representatives presented a review of the status of industry research and testing on the subject of mitigation of primary water stress corrosion cracking (PWSCC) of nickel-base alloys typically used as vessel penetrations and piping component butt welds. Representatives of Southern Nuclear Operating Company (SNC), supported by engineers from Westinghouse Electric Company (WEC) presented their plan for experiments to assess whether additions of zinc to their primary coolant at the Farley Unit 2 system successfully suppressed nucleation of PWSCC in their vessel head penetrations, most of which have been fabricated from a heat of Alloy 600 that has cracked in four other domestic plants.

Dana Covill and John Wilson, representing the EPRI/MRP Alloy 600 Issue Task Group and the Mitigation Working Group, presented a status review of the research programs addressing various approaches to mitigation of PWSCC. These approaches include (a) chemical methods to alter the environment, or the films that form on the surfaces of nickel-base alloy components, (b) mechanical methods to alter stress, specifically the Mechanical Stress Improvement Process (MSIP), and (c) the replacement of susceptible materials, referring principally to the replacement of Alloy 600 components welded with Alloy 82 or Alloy 182 filler, with Alloy 690 components welded with Alloy 52 or Alloy 152.

The principal, mitigative chemical methods are the addition of soluble zinc compounds (usually zinc acetate), thereby altering the constitution of the tightly adherent spinel films, or the extra dosing of PWR coolant with dissolved hydrogen, thereby lowering the electrochemical potential at the exposed nickel-base alloy surfaces. The principal, mitigative mechanical methods, besides MSIP, include preemptive weld overlays, and surface peening, using a variety of

advanced techniques, including cavitation peening with ultra-high pressure water jets, pulsed water jet peening, and fiber laser peening. MSIP is a mature technology, accepted by the NRC for use on non-flawed components, or those with detected flaws less than 30% throughwall. The underlying technology for each of these processes was described during the course of the presentations.

Mason Dove, of SNC, supported by Dr. Richard Jacko of the WEC Science Center, presented plans for laboratory experiments to assess the PWSCC resistance of small specimens fabricated from the control rod drive mechanism nozzles of the Farley Unit 2 vessel head upon its permanent removal this Fall. Farley Unit 2 has been utilizing zinc treatment for about fourteen years. The Farley Unit 2 reactor pressure vessel head contains 61 penetrations fabricated from B & W Tubular Materials Alloy 600 Heat M3935, the heat of material that has exhibited PWSCC in all four of the other vessel heads containing CRDM tubes made from that heat. The stub ends of two of those 61 tubes will be removed from the inside diameter of the vessel head. From these sections, oxide film analyses will be completed and small, four-point, bend beam specimens will be fabricated. Some beam specimens will be stripped of the zinc-containing films, and others will be left intact. Side-by-side PWSCC comparison tests, i.e., of zinc-containing vs. stripped specimens, will be conducted in the Westinghouse laboratory at 325°C, over a series of stress levels ranging from just below to just above yield.

The NRC staff asked detailed questions during the MRP and SNC presentations. Generally, the staff questions were intended to elicit more technical details, the mechanistic bases for the chemical mitigation methods, or information about project completion dates. The staff was encouraging to the industry participants to continue their efforts, and to keep the NRC staff informed of progress, observations and conclusions. The public was provided several opportunities to ask questions.

The meeting was adjourned at 2:15 pm.

Attachments: List of Attendees

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List of Attendees
Mitigation of Primary Water Stress Corrosion Cracking Meeting
NRC Headquarters
August 25, 2005

Leslie Spain	Dominion Generation
Kawaljit Ahluwahlia	EPRI
Daniel Horner	McGraw-Hill
Edward Andruszkiewicz	NRC
Ganesh Cheruvenki	NRC
Kazohiko Kishioka	Japan Atomic Power Co.
Kazunobu Sakamoto	JNES
Deann Raleigh	LIS, Scientech
Bart Fu	NRC
Cayetano Santos	NRC
Don Naujock	NRC
Bin Kao	Taiwan, AEC
Kuo-Jung, Chang	Taiwan, AEC
Barry Elliot	NRC
Brian Beley	AEA Technology
Richard Croteau	NRC
Dana Covill	Progress Energy
Mark Richter	Constellation Energy
Louise Lund	NRC
Carolyn Lauron	NRC
Eric Reichelt	NRC
Jay Collins	NRC
Keith Wichman	NRC
Bob Hardies	NRC
Cynthia Pezze	Westinghouse
Bob Martin	NRC
Pete Riccardella	Structural Integrity Assoc., Inc.
Edward Ray	Westinghouse Electric
Allen Hiser	NRC
Anne Demma	EPRI
John Wilson	Exelon Nuclear Corp.
Andrea Lee	NRC
Mason Dove	Southern Nuclear Corp
Richard Jacko	Westinghouse Electric
Nick Liparulo	Westinghouse Electric
Mike Stinson	Southern Nuclear
Doug McKinney	Southern Nuclear

Terence Chan	NRC
Todd Mintz	NRC
Hipolito Gonzalez	NRC
Simon Sheng	NRC
Ken Chang	NRC
Makuteswara Srinivasan	NRC
Kris Parczewski	NRC
Charles Brinkman	Westinghouse Electric
Bill Koo	NRC
John Tsao	NRC