

Date: April 21, 2021

To: Anna Bradford, Director of the Division of New and Renewed
Licenses

Subject: San Onofre Nuclear Generating Station Lessons Learned

Reference: Nuclear Regulatory Commission Letter to Eric Larson, Executive Chairman of
the Steam Generator Management Program (SGMP), dated August 13, 2014,
"San Onofre Nuclear Generating Station Lessons Learned, ML14206A841"
(copy attached)

Purpose: The purpose of this letter is to inform the NRC that SGMP's work regarding
in-plane fluid-elastic instability (IP-FEI) is complete.

Dear Director Bradford:

After the event at San Onofre, the SGMP began a test program to investigate the onset of IP-FEI. As requested in the reference letter, the SGMP provided updates to the NRC technical staff as the testing progressed. The latest update, provided October 28, 2020, contains the conclusions of the test program. No US operating steam generator is considered susceptible to IP FEI, and learnings from the tests are being incorporated into our guideline documents. SGMP also participated on an ASME Code committee to incorporate guidance in Section III, Appendix N for new SG designs.

If you have further questions, please contact me at michael.classe@duke-energy.com or (704) 719-0136.

Sincerely,



Michael Classe, Director of Fleet Engineering Components – Duke Energy
EPRI Steam Generator Management Program Executive Sponsor

cc: Steve Bloom

Attachment

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ADD
NRR

August 13, 2014

Eric Larson, Executive Chairman
Steam Generator Management Program
First Energy Nuclear Operating Company
PO Box 4
Shippingport, PA 15077-0004

Subject: San Onofre Nuclear Generating Station Lessons Learned

Mr. Larson:

The steam generator tubes at San Onofre Nuclear Generating Station (SONGS), Unit 3, became susceptible to in-plane fluid-elastic instability during the first cycle of normal operation. This phenomenon resulted in the steam generator tubes impacting each other in the U-bend region and causing tube wear. As a result of this wear, eight tubes failed to meet the steam generator performance criteria specified in the plant's technical specifications. The susceptibility of the tubes to fluid-elastic instability was attributed to aggressive thermal hydraulic conditions coupled with the ineffectiveness of the anti-vibration bars in mitigating in-plane motion of the U-bends. The anti-vibration bars are intended to provide out-of-plane support to the U-bend region of the tubes, although friction between the tube and the anti-vibration bar may provide some resistance to in-plane motion.

In a memorandum to the U.S. Nuclear Regulatory Commission (NRC) staff dated March 20, 2014 (ADAMS Accession No. ML14028A028), the Executive Director of Operations (EDO) tasked the NRC staff with performing an evaluation of the lessons learned from the SONGS tube degradation event. One of the eight topical areas of review outlined in the EDO memorandum was a steam generator (SG) technical review, which was to be performed by the Office of Nuclear Reactor Regulation. This letter addresses Item of Consideration (4) outlined under the SG Technical Review topical area of the EDO memorandum, which involves reviewing standards and criteria for SGs.

The events at San Onofre not only raise questions about industry standards for designing and fabricating steam generators, but also raise questions about the operation of existing steam generators. The issue could affect operating steam generators since steam generator secondary side thermal hydraulic conditions could change as a result of SG tube plugging, changes to reactor T_{hot} or T_{ave} , power uprates, and buildup of deposits on the secondary side of the steam generator. In addition, the support provided by anti-vibration bars may change (become ineffective) as a result of wear between the tubes and the anti-vibration bars, changing the tubes' susceptibility to fluid-elastic instability.

As a result of the steam generator event at San Onofre in 2012, the NRC staff is assessing whether any changes are needed to industry standards (e.g., Appendix N of Section III of the

E. Larson

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American Society of Mechanical Engineers Boiler and Pressure Vessel Code) and whether NRC review guidance (regulatory guides, standard review plan, and inspection procedures) should be modified.

Although there does not appear to be an immediate safety concern for the operating plants based on current operating experience, the events at San Onofre raise questions about whether the tubes may become susceptible to fluid-elastic instability as the steam generator operating conditions change. As a result, the NRC staff requests the industry discuss with the NRC staff specific actions planned or taken by the industry addressing the San Onofre operating experience, including any actions to add, develop, or modify industry design and fabrication standards/guidance and any actions to develop guidance on critical thermal hydraulic parameters to eliminate the potential for fluid-elastic instability.

We look forward to interacting with the industry on this issue.

Sincerely,

Patrick L. Hiland, Director /RA/
Division of Engineering
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission

cc: Kevin Ennis, ASME
Ralph Hill, ASME

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