

Long term performance of Alloy 690 and associated weldments in a PWR environment

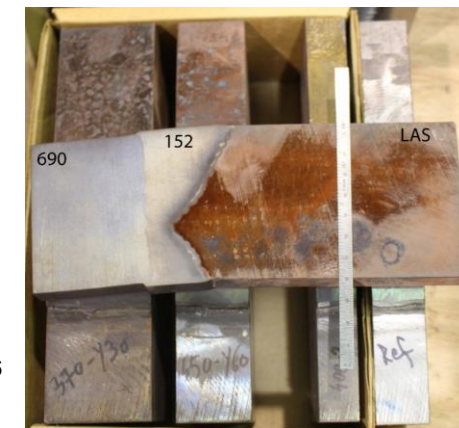
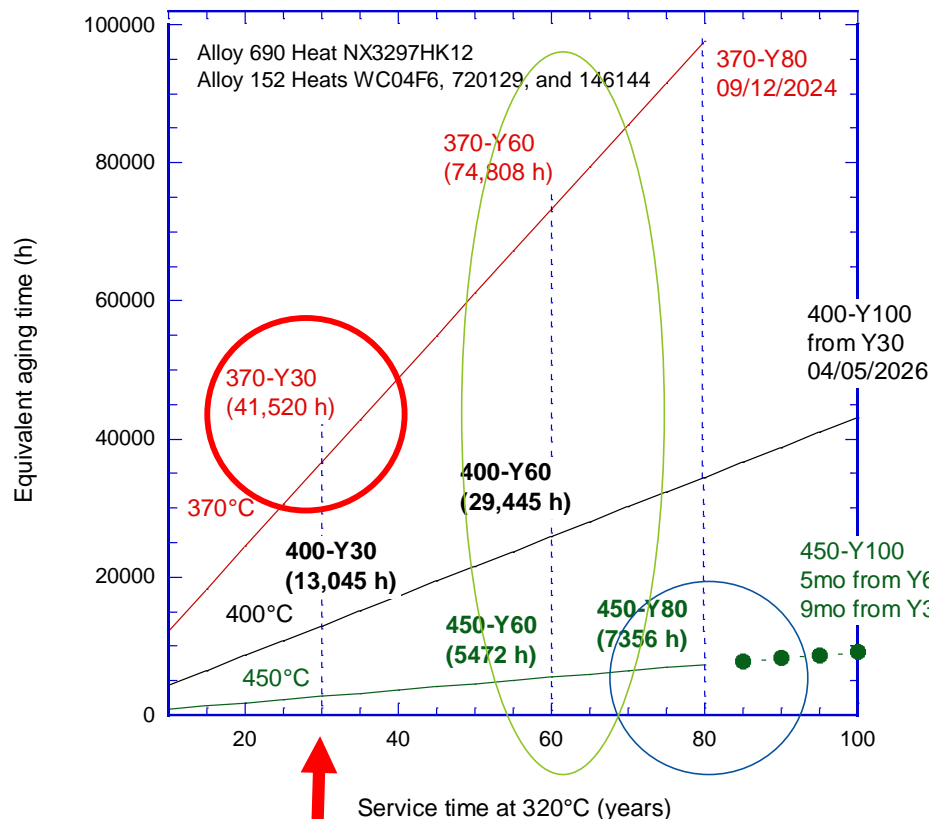
Objectives:

1. Develop an understanding of the microstructural changes in base Alloy 690, associated weldments, weld HAZ, and weld interfaces occurring during long term operation
2. Quantify the effects of aging on performance

Approach:

Use pedigreed materials aged long term in sufficient quantities to quantify long-term performance

1. A prototypical Alloy 152 weldment joining Alloy 690 and low alloy steel - identical to that used in the US NRC research program – that has been aged for over the last decade to 30, 60 and 80-year service equivalents. Continuing to 100-year, some 100-year available
2. Others (80, 100-years)



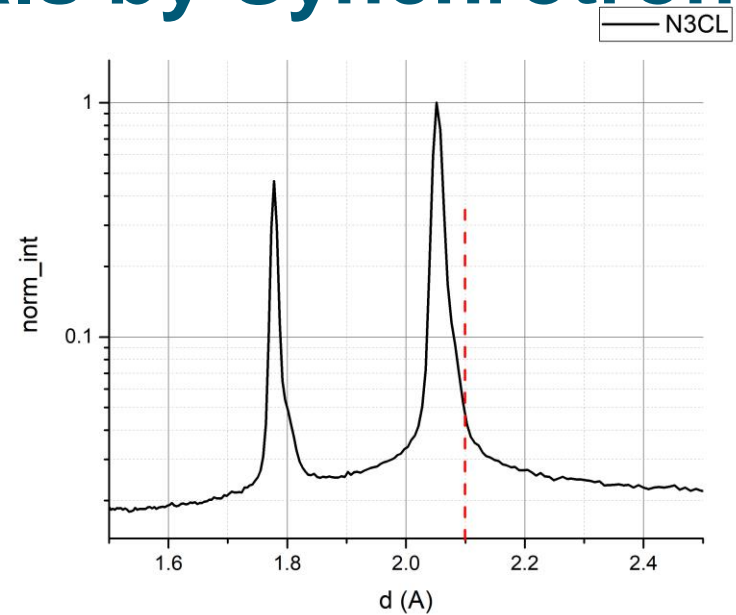
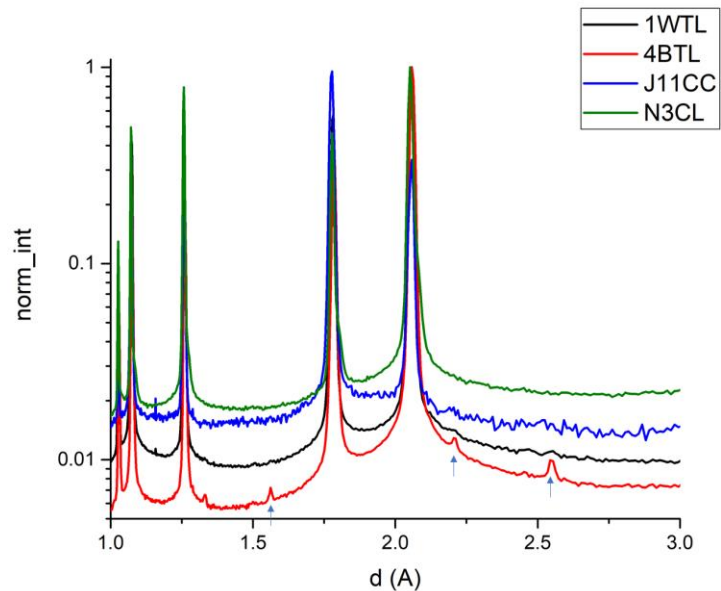
Can be compared with current plant materials

Examination of field materials by Synchrotron XRD



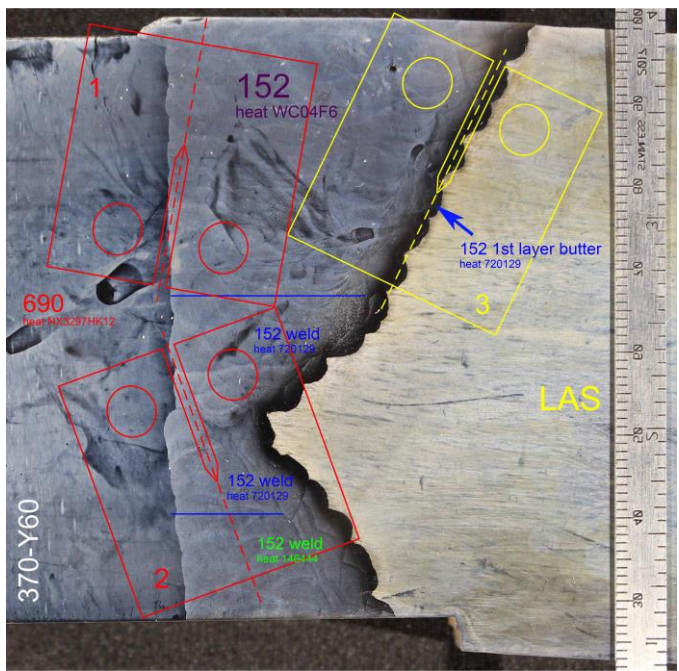
- Was “ordering” a culprit in the SCC observed in the field? SRO was proposed as a mechanism for SCC in Alloy 600
- Encapsulation method with Kapton tubes was devised to allow potentially-radioactive specimens to be analyzed by Synchrotron XRD
- Specimens of Interest: V.C. Summer Alloys 82 (1WTL) and 182 (4BTL) and Davis-Besse Alloy 182 weldment from nozzle #11 (J11CC) and Alloys 600 CRDM nozzle #3 (N3CL) from the original head of Davis-Besse (15.78 EFPY, 24 chronological years)

Examination of field materials by Synchrotron XRD



- Alloys of interest: V.C. Summer Alloys 82 (1WTL) and 182 (4BTL) and Davis-Besse Alloy 182 weldment from nozzle #11 (J11CC) and Alloys 600 CRDM nozzle #3 (N3CL) from the original head of Davis-Besse. For specimen 4BTL blue arrows are pointing to Nb(N,C) phase.
- Alloys 600 CRDM nozzle #3 (N3CL) from the original head of Davis-Besse. Location where SRO phase with a d-spacing of 2.1 Å would occur is indicated in the figure.
- No ordering – SRO or LRO – was found

SCC Testing 100-year equivalent service: 370-Y60 + 40-year additional aging



- CT Specimens tested in the program in the 60-year aged condition received additional aging to 100 years
- Alloy 152 Weld heat (1) WC04F6, (2) 720129 and 146444 successively, and (3) 720129 as 1st layer butter
- Alloy 690 370-Y60