

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: The Material Properties Council (MPC) and Pressure Vessel Research Council (PVRC) Workshop on Residual Stresses
(20.06002.01.102)

DATE/PLACE: April 6-8, 2004
Savannah, Georgia

AUTHOR: Doug Gute

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BACKGROUND AND PURPOSE OF TRIP:

The purpose of the trip was to attend and participate in the Material Properties Council and Pressure Vessel Research Workshop on Residual Stresses. The workshop consisted of five half-day sessions encompassing (i) the practical implications of residual stresses generated within metallic structures during various fabrication processes; (ii) modeling techniques for approximating the magnitude and distribution of residual stresses and distortions caused by welding and post-weld heat treatments; (iii) residual stress and distortion mitigation techniques; (iv) fitness for service and design issues arising from residual stresses; and (v) pitfalls and current progress with regard to the measurement and repair of metallic structures with unacceptable residual stresses.

The highlights of the first session were overviews of the (i) origins and consequences of residual stresses in metallic structures; (ii) examples of failure incidence and avoidance under the action of residual stresses; (iii) critical parameters affecting fatigue damage; and (iv) residual stresses arising from various welding and thermal fabrication processes.

The second session focused on the current status of efforts to model residual stresses and distortions in welded structures by adapting multipurpose finite element programs. It was reported that consistent material property definitions (particularly as functions of temperature) are required to obtain reasonably acceptable approximations. Moreover, for certain types of steels, accounting for material phase changes during the weld cooling process in the analyses may be critical.

The third session presented some case studies of where weld residual stress modeling and measurements were used to minimize distortion and identify suitable heating conditions in local post weld heat treatments.

Fitness for service and design issues, covered in session four, emphasized the use of the American Petroleum Institute (API) 579 guidelines for incorporating residual stresses in Failure Assessment Diagram (FAD) procedures. This session also included a number of case studies where welding residual stresses were critical in assessing the onset of failure.

The final session consisted of an overview of the (i) residual stress related activities currently underway in Europe; (ii) measurement and validation of residual stress distributions in welded joints and behavior of creep cracks; (iii) residual stresses in repair welds and mitigation techniques; (iv) material properties for modeling stress relief and cracking; and (v) major research programs in the United States.

SUMMARY OF PERTINENT POINTS:

In summary, the workshop provided an excellent overview of what can be characterized as state-of-the-art in modeling, designing, repairing, and mitigating the effects of weld residual stresses. The handout compilation of overheads and papers presented at the workshop have been logged into the Center for Nuclear Waste Regulatory Analyses library.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

None.

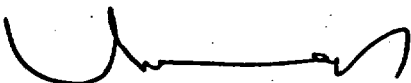
SIGNATURES:



Doug Gute
Senior Research Engineer

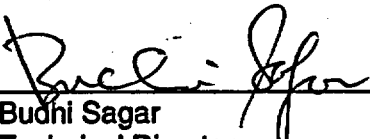
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