#37373 Mechanical Failure Risk Management for In-Service CSP Nitrate Hot Tanks

Post-weld heat treatment proposed for Gen2 hot storage tanks susceptible to stress relaxation cracking.

1. Impact

Previous research shows that weldments of 347H stainless steel (SS) on Gen2 hot tanks are potentially susceptible to stress-relaxation cracking (SRC), particularly in the heat-affected zone at operating temperatures above 540ºC when no post-weld heat treatment (PWHT) is performed. If left untreated, this could lead to tank failure.

2. Project Goal

Optimize cost-effective, thickness-dependent, localized PWHT procedures at commercial scale for hot tanks in Gen2 CSP using 347H SS.

3. Method(s)

Experimentally demonstrate PWHT effects on improved ductility while avoiding SRC.

Evaluate phased array ultrasonic testing to detect microcracks.

Perform cost-benefit analysis of PWHT.

4. Outcome(s)

Work in progress. Plan to submit results to the American Society of Mechanical Engineers (ASME) and engage in discussions about best practices for PWHT in 347H SS thick-section welds for high temperature operation.

5. Conclusion/Risks

Early results show that PWHT will be compromise between meeting temperature gradient restrictions during localized PWHT versus access to welds, cost of applying insulation, and time required for PWHT on commercial scale tanks.

6. Team

Lead organization: National Renewable Energy Laboratory (NREL) (Judith Vidal, PI)

Partners:

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Advisian – Worley Group, Inc. (Ryan Bowers)

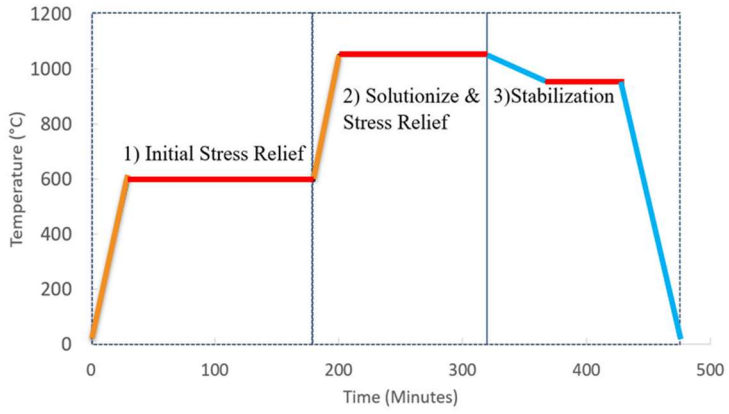

Fig. 1. Example PWHT to mitigate SRC

- PWHT variables: 1) heating rates (HR), 2) soak temp and time, 3) cooling rates (CR)
- Fast HR may reduce crack susceptibility but limited by thermal gradient control
- Fast CR desired (ex. air cool) also limited by temperature gradient control

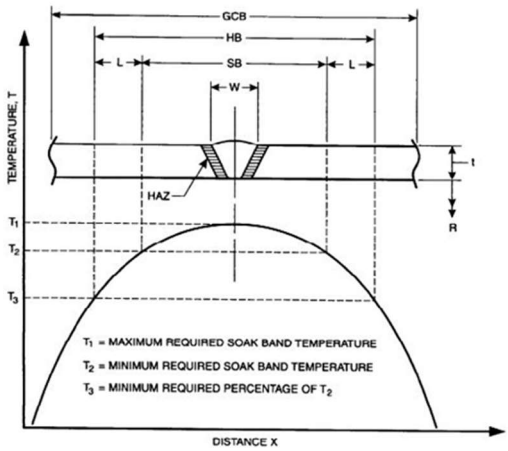

Fig. 2. The area to be heated must account for target temps during PWHT and thermal gradients near weld