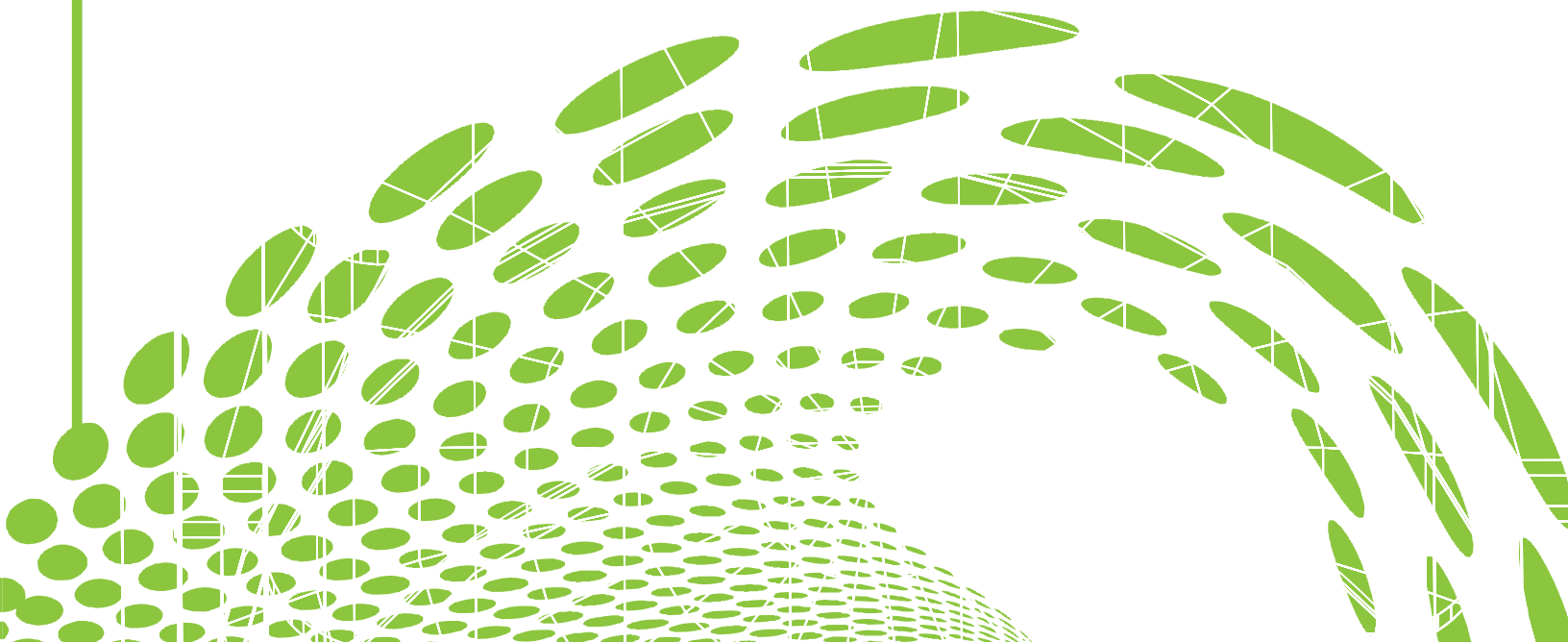
ASME STANDARDS TECHNOLOGY, LLC

STP-PT-095

LOCAL POST WELD HEAT TREATMENT: THERMAL GRADIENT STUDY



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Prepared by:

Erik Jensen Ph.D., Project Engineer
Cole Davis, M.Sc., Senior Engineer
Quest Integrity USA, LLC

ASME STANDARDS TECHNOLOGY, LLC

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FOREWORD

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EXECUTIVE SUMMARY

In 2016, ASME ST-LLC published a computational fluid dynamic (CFD) study of pipeline post weld heat treatment (PWHT) configurations (Phase I) with the intention of creating guidelines for the sizing of heated bands [1]. Many different combinations of nominal pipe diameter, pipe schedule, and heated band lengths were simulated, and while successful, this study also raised additional questions. In particular, the length of the heated band (HB) required to sufficiently PWHT was found to be too long for practical field applications. Therefore, ASME ST-LLC contracted Quest Integrity to perform this follow-up study (Phase II).

The goal of Phase II was again to provide guidelines for the sizing of heated bands, but differs from the previous study in two main ways:

1. The current study placed controlling thermocouples axially along the pipe in addition to circumferentially, and
2. The CFD model was calibrated and validated against two sets of experimental data on large diameter pipe rather than the small diameter pipes from the previous study.

This analysis was broken into two different parts. The first part focused on calibrating the CFD model to experimental results. PWHT thermocouple data was collected on a section of 26.029-inch P91 pipe using two different heating band configurations: three and five bands each with control thermocouples placed axially and circumferentially throughout the band configurations. This data was used to calibrate and validate the PWHT simulations using a conjugate heat transfer (CHT) CFD analysis performed using STAR-CCM+ [2] software.

In the second part, the calibrated model was used to analyze the through-wall temperature gradient in the soak band (SB) as measured at the 12 o'clock position along the pipe's circumference for pipe sizes ranging from nominal diameters of 6 to 30 inches and schedules 80 to 160. The heated band (HB) length was varied maintaining axial and circumferential control until all models obtained a 15 °F or less thermal gradient in the SB. These results were combined with results from Phase I, and the final data sets from these studies can provide evidence for refinement of the guidelines for PWHT of P91.