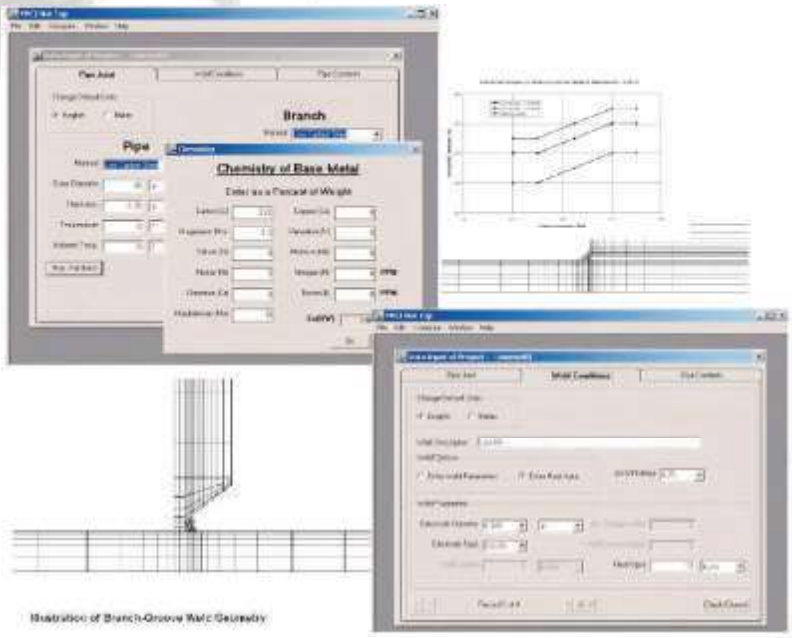
THERMAL ANALYSIS MODEL FOR HOT-TAP WELDING



PRCI Thermal Analysis Model for Hot-Tap Welding

There are two primary concerns with welding onto in-service pipelines. The first is for welder safety during welding, since there is a risk of the welding arc causing the pipe wall to be penetrated allowing the contents to escape. The second concern is for the integrity of the pipeline following welding, since welds made in-service cool at an accelerated rate as the result of the ability of the flowing contents to remove heat from the pipe wall. These welds, therefore, are likely to have hard heat-affected zones (HAZ) and a subsequent susceptibility to hydrogen cracking. The model allows burn-through risk to be controlled by limiting inside surface temperature and hydrogen cracking risk to be controlled by limiting weld-cooling rates.

Background

The Edison Welding Institute (EWI) developed the PRCI Thermal Analysis Model for Hot Tap Welding V4.2 for PRCI. The model is intended to provide welding engineers with guidance for establishing safe parameters for welding onto in-service pipelines (hot-tap welding).

The use of this software model is not a substitute for procedure qualification. The model provides guidance for establishing safe parameters, but provides no means for demonstrating that these parameters are practical under field conditions. To demonstrate that the parameters are practical, a welding procedure based on these predictions should be qualified under simulated conditions. (1) A brief history of cooling rate prediction methods for welds made onto in-service pipelines is given in Appendix A of the user manual.

Software Description

The PRCI Thermal Analysis Model for Hot-Tap Welding is a stand-alone, user-friendly Windows application based on a complex finite element mathematical model. The model uses a proprietary finite-element solver developed at Edison Welding Institute (EWI). Mesh generation capabilities include sleeve, branch, and bead-on-pipe geometries, the latter for buttering layers and weld deposition repairs. Heat-sink capacity values can also be predicted for comparison with field-measured values. The multi document user interface (MDI) allows multiple cases to be run and heat input selection curves to be generated. The model was designed and developed to meet the requirements of API 1104, API 1107, ASME Section IX, BS4515, BS6990, and CSA Z662.

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