

P-T Curve Analysis

INTRODUCTION

Pressure-Temperature (P-T) operating curves are required to ensure safe operation of pressure vessels. The regulations governing the calculation of P-T curves for nuclear power plants are found in the Code of Federal Regulations (CFR), the ASME Boiler and Pressure Vessel Code, and Nuclear Regulatory Commission (NRC) Regulatory Guides. The fracture toughness requirements for the pressure vessel for testing and operational conditions are specified in Section IV of 10 CFR 50, Appendix G. This appendix requires implementation of the acceptance and performance criteria of Appendix G to Section III of the Code. Appendix G to 10 CFR 50 requires that the effects of neutron irradiation on the nil ductility reference temperature of the vessel beltline materials must be included in the P-T curve calculations. Surveillance capsules are periodically pulled and analyzed to monitor neutron damage to the vessel. In most cases, the P-T curves must be updated after the capsule analysis has been completed.

P-T CURVE SOFTWARE

MPM has developed PT Curve™ v2.0 to perform the calculations required to determine the allowable loadings on the reactor pressure vessel during heat up, cool down, and leak/hydro testing. PT Curve™ v2.0 has been Quality Assurance (QA) verified in accordance with 10 CFR 50, Appendix B under the MPM Nuclear Quality Assurance Program. The calculations and models of PT Curve™ v2.0 are based on years of experience obtained by MPM and the result is accurate and conservative P-T curves which have been approved by the Nuclear Regulatory Commission (NRC) in numerous submittals. The key features of the model are summarized below:

- Limiting adjusted nil-ductility reference temperature in accordance with NRC Regulatory Guide 1.99
- Thermal transient heat transfer analysis to determine thermal loads
- Instrument errors are accounted for in a conservative manner
- If it is beneficial, Code Case N-640 (approved by ASME in 1997), which allows K_{Ic} to be used in place of K_{Ia} as the reference fracture toughness, can be implemented
- If applicable, Code Case N-588 can be used. This code case allows for the assumption of circumferential cracks if considering weld metal in a



circumferential weld. This code case is beneficial to the final P-T curves primarily if the limiting material is in a circumferential weld.

FOR MORE INFORMATION

If you would like a price quotation or additional information concerning MPM's services or products, please contact us at the below listed address:

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