

# Mechanical Stress Improvement Process

## Background

Pressurized water reactor (PWR) plants have experienced primary water stress corrosion cracking (PWSCC) since the 1980s. PWSCC occurs in Alloy 82/182 welds as well as Alloy 600 components. Left untreated, PWSCC can compromise the operations and economics of light water reactors.

Westinghouse has teamed with NuVision Engineering Inc. (formerly AEA Technology Engineering Services Inc.) to provide the Mechanical Stress Improvement Process (MSIP®) – a long-term solution to PWSCC in reactor vessel hot- and cold-leg welds, pressurizer nozzles and other small and large bore welds.

MSIP is a NuVision Engineering-patented mechanical process that prevents and mitigates PWSCC in piping by minimally contracting the pipe on one side of the weldment, replacing residual tensile stresses with compressive stresses. This removal of as-welded tensile stresses is an effective and permanent means to prevent or mitigate PWSCC.

## Description

MSIP is a long-term solution that can be applied to welds with and without PWSCC. Analyses and tests confirm the applicability of MSIP for pressurizer and reactor vessel nozzle welds and other large and small bore welds. The PWR Owners Group has performed generic engineering for reactor vessel outlet nozzle dissimilar metal welds, and equipment is available and qualified for applying MSIP to these nozzles. MSIP is the preferred PWSCC mitigation option with respect to schedule, dose and cost. MSIP is ready for implementation to protect nozzle welds against PWSCC.

## Benefits

- Is a PWSCC long-term mitigation and solution
- Is more economical than replacement and weld repair options

- Arrests existing cracks; inhibits new crack development
- Has 100-percent success rate; no adverse indications found after MSIP
- Is a proven solution in boiling water reactors



Application of MSIP to 12-inch pipe

(BWRs) (applied to 49 units worldwide)

- Is a proven solution in PWRs (14 applications since 1995)
- Is accepted by the U.S. Nuclear Regulatory Commission (NUREG 0313, Rev. 2).
- Westinghouse and NuVision Engineering are the only providers of this proven preventive/mitigation solution

## Deliverables

Westinghouse and NuVision Engineering provide a total solution:

- Process demonstration
- Equipment design
  - Site-specific engineering
  - MSIP tooling and qualification

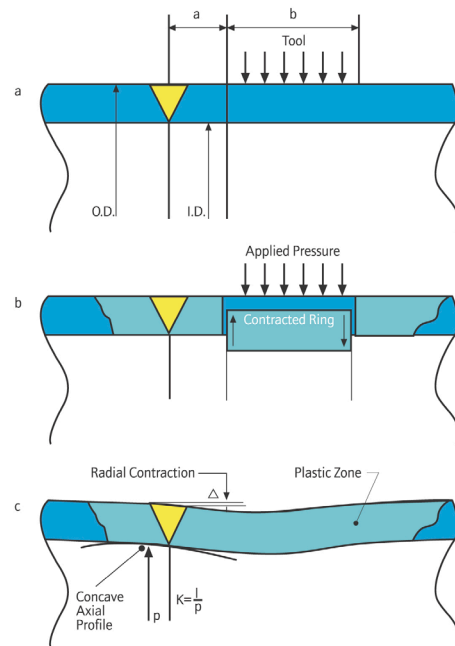
- Installation equipment design and qualification
- Pre-outage planning and procedures
- Pre- and post-MSIP non-destructive examination of welds
- Steam generator and reactor coolant pump shimming evaluation and advisory services
- Reactor coolant system piping analysis

## Experience

- Successfully applied to more than 1,500 welds, including more than 500 nozzle and safe-ends, in both BWR and PWR units in the United States.
- Successfully applied to more than 6,000 welds worldwide with no rework.
- Successfully applied to eight hot- and cold-leg reactor vessel nozzles in March 2010.
- Successfully applied to four safety injection system nozzles in May 2010.
- Successfully applied to six pressurizer nozzles and eight hot-and cold-leg reactor vessel nozzles in July and November of 2010.
- Successfully applied to three reactor vessel hot leg nozzles in October 2010.
- Successfully applied to four safety injection system nozzles and two charging system nozzles in January 2011.
- Successfully applied to eight hot- and cold-leg reactor vessel nozzles in March 2011.



MSIP equipment for reactor vessel nozzles



MSIP process and equipment

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