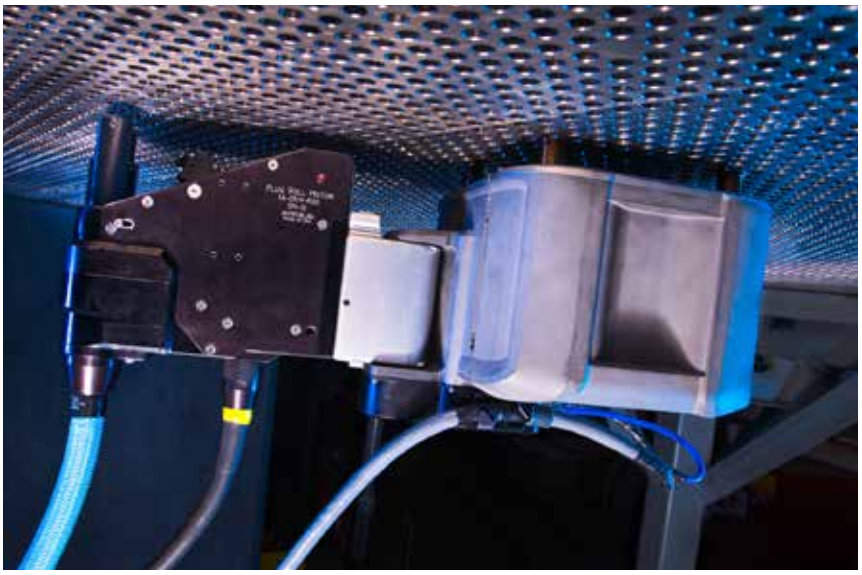
framatome

Tube Plugging and Stabilization Systems

Qualified to the highest industry standards, Framatome's tube plugging and stabilization systems, methods and repair hardware are suited to a wide variety of tube sizes, stabilization needs and plant operating conditions.



Challenge

Improved tube materials on modern steam generators (SG) have reduced, but not eliminated, the need for repairs. Availability of repair capabilities during tube inspections is still essential. Shorter outage schedules and even shorter windows for SG primary side activities make it critical to have fast, reliable tube plugging and stabilization systems.

Solution

Fast and reliable, the Framatome tube repair system has a simple setup with a small footprint. In a single visit to the tube, the system can perform both stabilizer and plug installation, a unique feature for this repair process with the highest accuracy, efficiency and quality in the industry.

Customer benefits

- Fast setup and installation time shortens project schedule
- Stabilizers of various lengths to address operability assessments
- Plugs are ASME qualified for the life of the SG
- Plug and stabilizer insertion and roll expansion in one tube visit shortens schedule
- Independent tube ID verification ensures correct application
- Most process steps performed by remote control, minimizing platform support and dose
- All process steps can be performed with the shield doors closed, minimizing dose

Mechanical Rolled Plugging

When installed in open ends of a tube to be removed from service, the rolled plug forms the pressure boundary between the primary and secondary sides of the SG. The plug is mechanically roll expanded against the surrounding tube, forming the pressure boundary and providing a structural seal. As opposed to a traditional leak-limiting approach, Framatome's design includes a nickel band in the expanded region which enhances seal tightness.

Designed to remain in place for the design life of the SG under all operating conditions, the plugs are designated as safety related and qualified in accordance with ASME boiler and pressure vessel code requirements.

The plugs are manufactured from Alloy 690 bar stock, ASME SB-166 UNS-N06690 annealed and thermally treated material. The plug design, fabrication, and inspection meet the requirements of ASME Section XI, Class 1 Subsection NB.
The plug qualification process is overseen and validated by engineers and subject matter experts ensuring an independent evaluation to the highest possible standards.

Plug Features:

- Designed for repair scopes of all sizes
- Nickel band enhances seal tightness
- Installation into any SG tube coordinate (no access limitations)
- Designed for use with or without a stabilizer
- Allows for easy visual inspection in subsequent outages
- Removable without damage to tube
- Minimal extension beyond tube end

Rapid Plugging System

At the core of the rapid plugging system is the innovative design of a hollow spindle plug rolling tool. This universal tool is designed to couple with the ZR100 robot and control all aspects of the mechanical plugging installation and removal process. The plug and plug expander are delivered remotely through the hollow spindle tool. This unique design reduces tooling costs, cycle-time, platform setup time and dose, and overall schedule. The plug rolling tool is designed with an electric motor as its power source, providing several improvements. Electric motor computer control allows for torque, variable speed, rotational position and data logging capabilities. This ensures a very precise and repeatable process and a qualified installation.

Another innovation in the plugging process is a rapid plug loader with several features that increase plugging production rates. The advanced features include a torque-controlled plug locking station, video verification of plug-to-roll position, encoder position and torque feedback for the pusher station.

Calibration of the system is performed both mechanically and electrically. A mechanical torque system is used to produce a known calibrated torque and the electrical calibration is inherent to the electric motor's manufacturing data.

The rolling process is computer controlled and provides a visual image of the process parameters. Data collected from the electric motor control system is displayed as torque vs. time, torque vs. angle of rotation, and RPM vs. time; all of which are available for display and evaluation in various graph and chart formats. In addition to verifying the installation parameters of each individual plug, the information can be used for process enhancements.

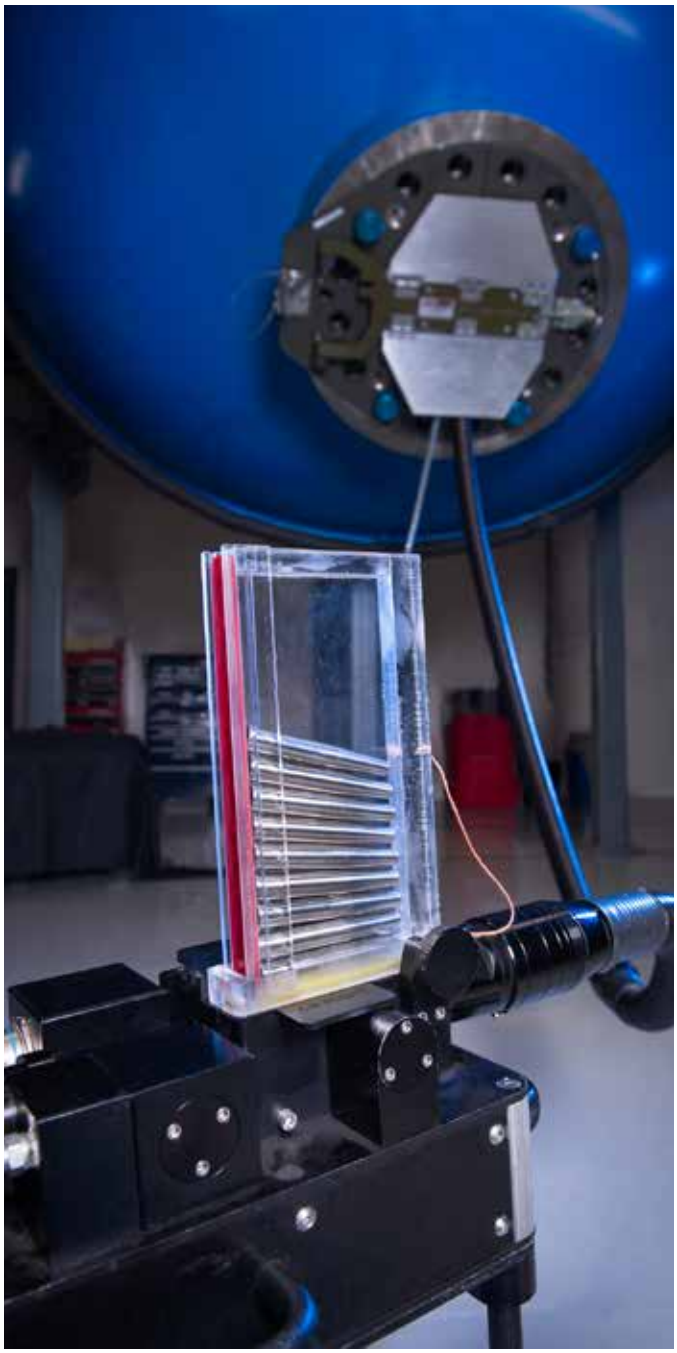
System diagnostics for bus power, circuit integrity and other electrical measures can be checked and displayed as well. The plug qualification process is overseen and validated by engineers and subject matter experts ensuring an independent evaluation to the highest possible standards.

Tube Stabilizers

The stabilizer protects the structural integrity of the out-of-service tube by providing additional stiffness and dampening flow-induced vibration (FIV). In addition, the stabilizer's size achieves a fill factor that prevents the out-of-service tube from contacting and damaging adjacent in-service tubes. The stabilizer is designed to prevent long-term degradation of the tube over the design life of the steam generator.

The tube stabilizer uses a commercially available stainless steel wire rope with specific parameters of size, winding pattern, stiffness and length. Field experience, engineering expertise and testing determines the best configuration for the wire rope, installation process and tooling, resulting in a fast and easy stabilizer insertion method.

Framatome engineers have extensive experience and knowledge specifically related to stabilizers, requirements based on tube defects and steam generator design, and associated installation methodology and tooling. The tube stabilizer is qualified by analysis and testing. Analyses were performed to determine the damping requirements of the stabilizer based on SG tube properties and FIV analysis. Testing was performed to determine the frequency and damping ratio.



Stabilization System

A flexible tube stabilizer is installed into the tube using a stabilizer pusher unit located on the platform near the manway. Using the ZR-100 robot, a section of conduit is positioned at the tube. The conduit is then routed from the ZR-100 to the stabilizer pusher unit. The manway shield door can remain closed during the installation of the stabilizer and only opened for tool changes. Installation speed was a major factor in determining the appropriate technique, cable attributes and tooling. Our system is designed to install stabilizers of any length and minimize the handling of the stabilizer by the platform technician.

Stabilizer Key Features:

- Flexible cable stabilizer designed for rapid installation
- PC-based controls and software
- Field-proven installation process for both U-bend and once-through style SGs
- Stabilizer pusher apparatus allows stabilizer and plug installation in one tube visit
- Pusher unit is powered by industrial electric motor assembly, providing torque, RPM and travel distance control and feedback
- Installation process requires minimum interaction from platform technician

Your performance
is **our** everyday **commitment**

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