

Steam Generator Mechanical Cleaning

Technologies for Efficient Hard and Soft Sludge Removal

Long-term integrity and high performance of major plant systems and components, such as steam generators are essential for ensuring safe and reliable operations.

Challenge

During their operational lifetime, the construction materials of nuclear steam generators (SG) are subject to an aging process based on degradation mechanisms.

Particles in the form of ferrous oxide are produced in the secondary feed water system. These particles, also known as sludge, accumulate and contribute to forming local aggressive conditions. It is the main reason for SG tube failure, creating negative effects to the integrity of the SG during operation.

Effective methods of deposit removal are required to prevent further accumulation and significantly decrease the risk of corrosion damages and performance losses.

Solution

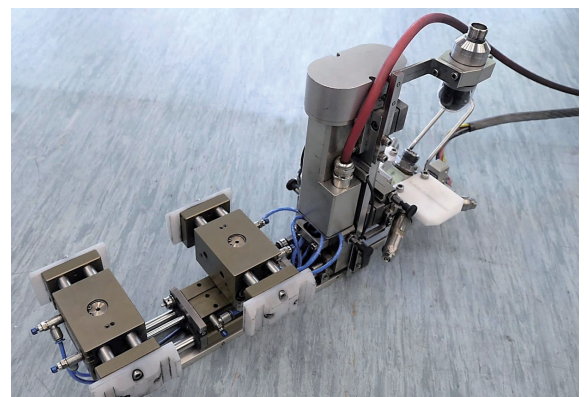
Framatome provides different technologies for efficient hard and soft sludge removal, as part of our integrated steam generator service:

- Standard Sludge Lancing (SL) removes deposits and soft sludge by means of hydraulic impact using remotely operated manipulators or static lances.
- Inner Bundle Lancing (IBL) is an automated, remote-controlled process, designed to clean tube bundle areas and tube plates, freeing them from hard sludge.
- High pressure water jet stream (200 bar) with continuous movement in vertical and horizontal direction ensures proper removal of soft and hard sludge on top of the tube sheet.

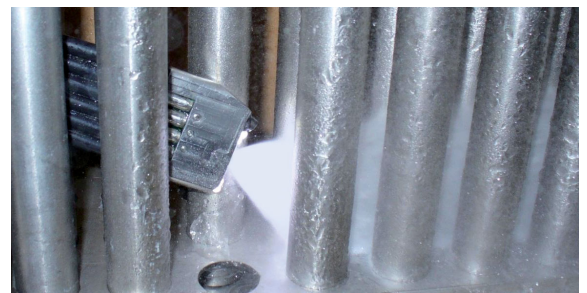
The increased/variable height of the nozzle head allows accessibility to remaining soft sludge behind hard deposits.

Dedicated remote-operated tooling is available for various steam generator types including CANDU and VVER SG.

For optimized hard sludge removal of hard deposit accumulated over long periods of time Framatome provides a combined mechanical and chemical cleaning solution. It was first applied in 2017 and produced excellent cleaning results.



New sludge lancing manipulator



Inner bundle lancing

Customer benefits

- Time saving thanks to rapid and highly reliable performance
- Steam generator integrity
- Maintaining required thermal SG performance
- Significant decrease of corrosion risk, damages and performance losses
- Outage optimization / cost saving
- Support to component lifetime extension programs
- Field service worldwide

Technical information

Standard Sludge Lancing

- Applied from the tube lane in 30°/90°/150° to flush the complete tube sheet
- Pneumatic remote controlled stepping manipulator or static lance
- Automated process control
- Controlled rotating multi-nozzle head
- Nominal operating pressure: 220 bar, overall flow rate up to 229 l/min
- Flexible location of process equipment inside or outside the containment

Inner Bundle Lancing

- Automated, remote-controlled operation
- High effective jet impact at tube shadow areas
- Operating pressure at nozzle outlet: 220 bar
- Removal of hard sludge from tubes and tube sheet
- Applied in 30°, 90° or 150° directly in the tube bundle



VVER SG cleaning manipulator with camera

Key figures

More than **40** years of experience in steam generator services

About **880** successful SG secondary side mechanical cleaning applications worldwide

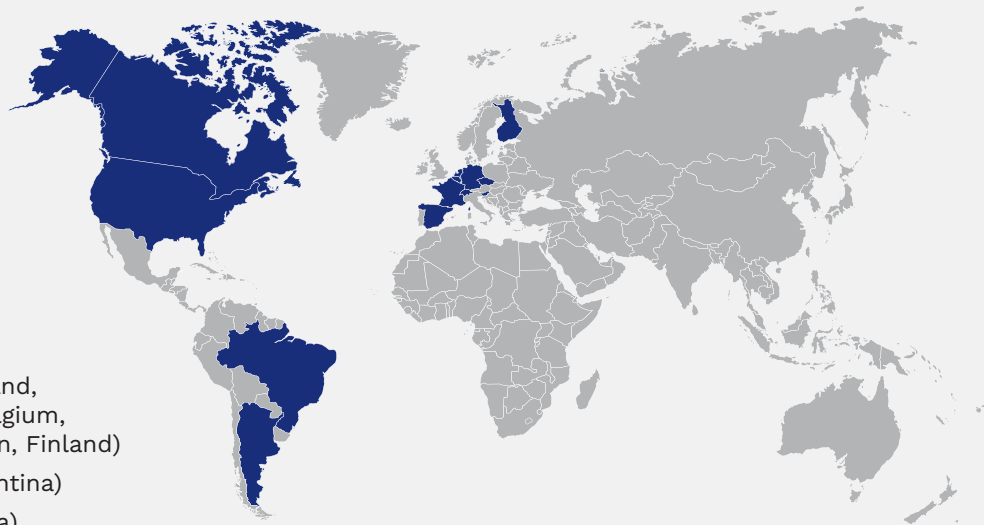
References

Reactor types / designs:

- KWU PWR
- Framatome PWR
- Westinghouse PWR
- VVER
- CANDU

NPPs in:

- Europe (Germany, Switzerland, Czech Republic, France, Belgium, Netherlands, Slovenia, Spain, Finland)
- South America (Brazil, Argentina)
- North America (USA, Canada)



Steam generator secondary side mechanical cleaning is applied regularly as part of our recurrent outage services, but also on specific customer demand.

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

Contact: outage@framatome.com
www.framatome.com

It is prohibited to reproduce the present publication in its entirety or partially in whatever form without prior written consent. Legal action may be taken against any infringer and/or any person breaching the aforementioned prohibitions.

Subject to change without notice, errors excepted. Illustrations may differ from the original. The statements and information contained in this publication are for advertising purposes only and do not constitute an offer of contract. They shall neither be construed as a guarantee of quality or durability, nor as warranties of merchantability or fitness for a particular purpose. All statements, even those pertaining to future events, are based on information available to us at the date of publication. Only the terms of individual contracts shall be authoritative for type, scope and characteristics of our products and services.