

High-precision wall thickness monitoring in nuclear power plant

In-service, high-temperature, high-precision wall loss monitoring of steam piping circuit in a nuclear power plant



Key deliverables

- Significant direct cost savings from reduced inspections, with the largest savings coming from minimizing the need for scaffolding and lagging removal and re-installation.
- Optimized operations through high-frequency, high-quality data, enabling safe plant operation between outages and better maintenance planning, reducing unplanned shutdowns and maximizing uptime.
- Increased personnel safety by limiting exposure to hazardous environments through use of wireless data collection methods.

Overview

A European nuclear power plant (NPP) faced a critical challenge with its high-pressure steam lines near the electricity-generating turbines. Previously, the plant had replaced assets due to wall loss caused by steam condensate erosion at piping T-junctions. However, concerns were rising that the rate and location of wall loss were accelerating due to changing process conditions, prompting the operator to seek a more proactive monitoring solution. To address this, the operator needed a system that could collect data at increased frequency, allowing them to correlate wall loss with specific process parameters. Additionally, they were advised that the greatest wall loss could occur within the first year of operation for new piping, making it critical to act quickly. The challenge was compounded by the need to monitor non-standard steel 21" and 25" NPS diameter steam lines, with surface temperatures exceeding 230 °C. These lines were located across multiple levels, up to 30 m high, in an area restricted to personnel during operation. The solution required a system that could be quickly deployed, reliable, and capable of capturing precise data to stay ahead of the issue — that could be installed immediately.

The Challenge

There were a number of challenges around the deployment which required a flexible monitoring solution.

- A high-temperature wall thickness monitoring solution was required which could operate over 230 °C continuously.
- The pipe geometry was non-standard and the monitoring locations were distributed around two T-sections.
- The piping is lagged, and the location is inaccessible during normal operation.
- The wall loss was thought to be process dependent, requiring a high-frequency of measurements.
- Wireless/RF systems are restricted in proximity to sensitive electricity generating plant.
- The equipment needed to be installed very short notice before the end of a shutdown as subsequent access would not be possible.

The Solution

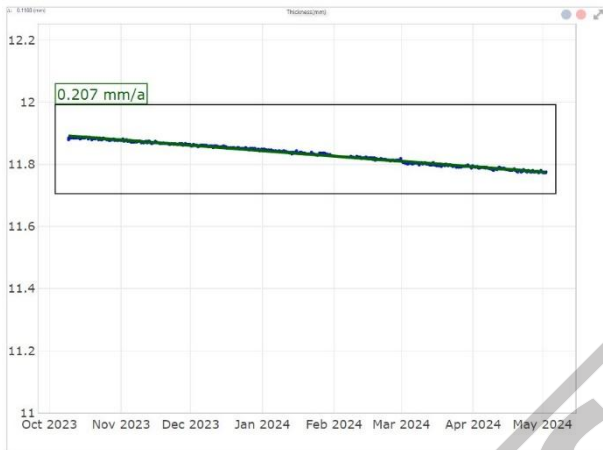
- 16 x HotSense 380 sensors were deployed around each T-junction to provide a sensor which could operate continuously above 230 °C and provide a stable and reliable thickness measurement.
- The HotSense strap deployment system allowed for fast installation during the limited shutdown and offered flexibility to place sensors in the expected pattern to detect wall loss.
- Sensors were connected to WirelessHART CALIPERAY ultrasonic nodes, for automated, high frequency data collection to provide high-precision wall loss trending.
- The CALIPERAY automated monitoring system was inspected by the local electrical engineering team and the radio output approved for safe operation at the site.
- A remotely accessible Field Deployment Logging Kit (FDLK) allowed simple implementation and data collection.



Execution

- To meet the scheduled turnaround, the full system was successfully deployed within 2 months of initial enquiry.
- The installation was carried out by an Ionix-trained partner and the plant maintenance team, with on-site supervision from Ionix experts.
- Within 24 hours of equipment delivery, high-precision measurements (+/- 0.005mm) enabled rapid detection of areas with accelerated wall loss, against areas where no wall loss was detected.

- The system, operating remotely from locations with limited access and high-temperature pipes, provides live, continuous, and reliable wall thickness data.
- Implemented and monitored by the service provider, the data is used to report wall loss to the customer.



Rapid, high-precision measurement of areas with accelerated wall loss from steam condensate erosion



Comparison of areas where no wall loss was detected