



System 1* Extender Rightrax Corrosion and Erosion Monitoring

Introduction

GE's Corrosion and Erosion System 1 Extender detects and reports on wall thickness, enabling you to trend and mitigate degradation from corrosion and erosion. Managing wall thickness, loss of critical piping, and other fixed assets—whether due to corrosion or erosion—presents a costly challenge to most plants. The high operating safety and environmental risks associated with these assets typically drive the highest annual maintenance costs, which can be mitigated only by time-based inspection methods.

Integrating the most critical piping and other fixed assets into a condition-based maintenance program can typically produce a one year ROI based on moving time based inspection costs to an online condition monitoring infrastructure and management program. This solution is now enabled using the Bently Nevada* Asset Condition Monitoring (BNACM) System 1 platform.

The System 1 Platform and the Rightrax Online Solution

Critical measurement areas are often located in difficult and/or expensive to access locations such as offshore production platforms, buried pipelines, under insulation, or in hazardous areas.

Manual inspection and monitoring techniques for critical assets are:

- Expensive due to the inspection frequency and support logistics
- Uncertain and provide questionable accuracy due to measurement repeatability and reproducibility
- Questionable if not trended and correlated with other process measurements

For applications between 0° and 120° C, integrating the Rightrax M2 wall thickness measurement, data collection and communications technology into System 1 software enables online wall thickness data collection to solve these problems. See Figure 2. Currently the Rightrax M2 sensor is available with ATEX Zone II hazardous area approval and the data collection device is available with ATEX Zone I or II approval when installed in a suitable enclosure.

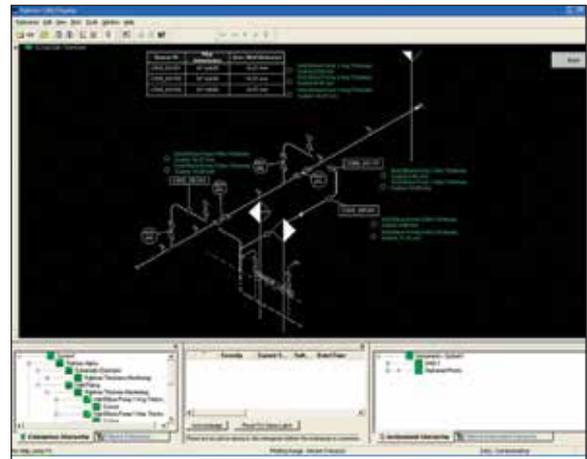


Figure 1. System 1 with Rightrax

Failure Modes and Consequences

A population of critical piping and other fixed assets will require online measurement and condition monitoring to effectively manage risk and availability when a Reliability Centered Maintenance approach is used for Plant Asset Management.

The most predominant failure mode for piping is leaks, due to total failure of wall integrity. The consequences of failure or even the slightest leakage for a critically ranked asset can lead to a total production outage or to an unacceptable safety and environmental risk.

The System 1 Platform and Rightrax Application

Since wall thickness loss is expected and typically gradual, a wall thickness monitor is a key measurement to manage maintenance of piping and vessel assets. Rightrax, with the System 1 platform, provides online wall thickness measurements that enable correlation of wall thickness with other process and ambient parameters that can be used to manage and measure the effectiveness of a corrosion inhibitor program and minimize the damaging effects of corrosion and erosion. For more information on this application of the System 1 platform, please refer to Specifications and Ordering document 174590.

Application Examples

Upstream Oil & Gas Production

In this operating environment, managing erosion in piping from the wells to general corrosion on all other production piping and vessels is challenging. Considering the well risers carry an unpredictable flow and mix of oil, gas, sand and water, it is difficult to determine the best inspection frequency to study the erosion impact, especially from sand.

For oil & gas production fields with higher corrosive gas content, (i.e., H2S) and therefore higher environmental risks, more frequent inspections are expensive and the time spent getting the data to an expert reduces the effectiveness and overall value of manual inspection.

The System 1 solution enables online, repeatable data collection with correlation tools and remote access to immediate expert attention.

Midstream Oil & Gas Distribution

Most pipelines are buried and extend hundreds of miles. Internal inspection using instrumented "pigs" generally covers only about 50% of the pipeline due to piping design obstacles and pressure raising production stations.

At pipeline pressure raising stations, the compression or pumping machine trains are typical applications for System 1 condition monitoring software. Combining critical piping wall thickness measurements with the data from other critical production assets enables production availability to be managed more effectively. The System 1 solution offers open communications capabilities

Rightrax to System 1 Architecture

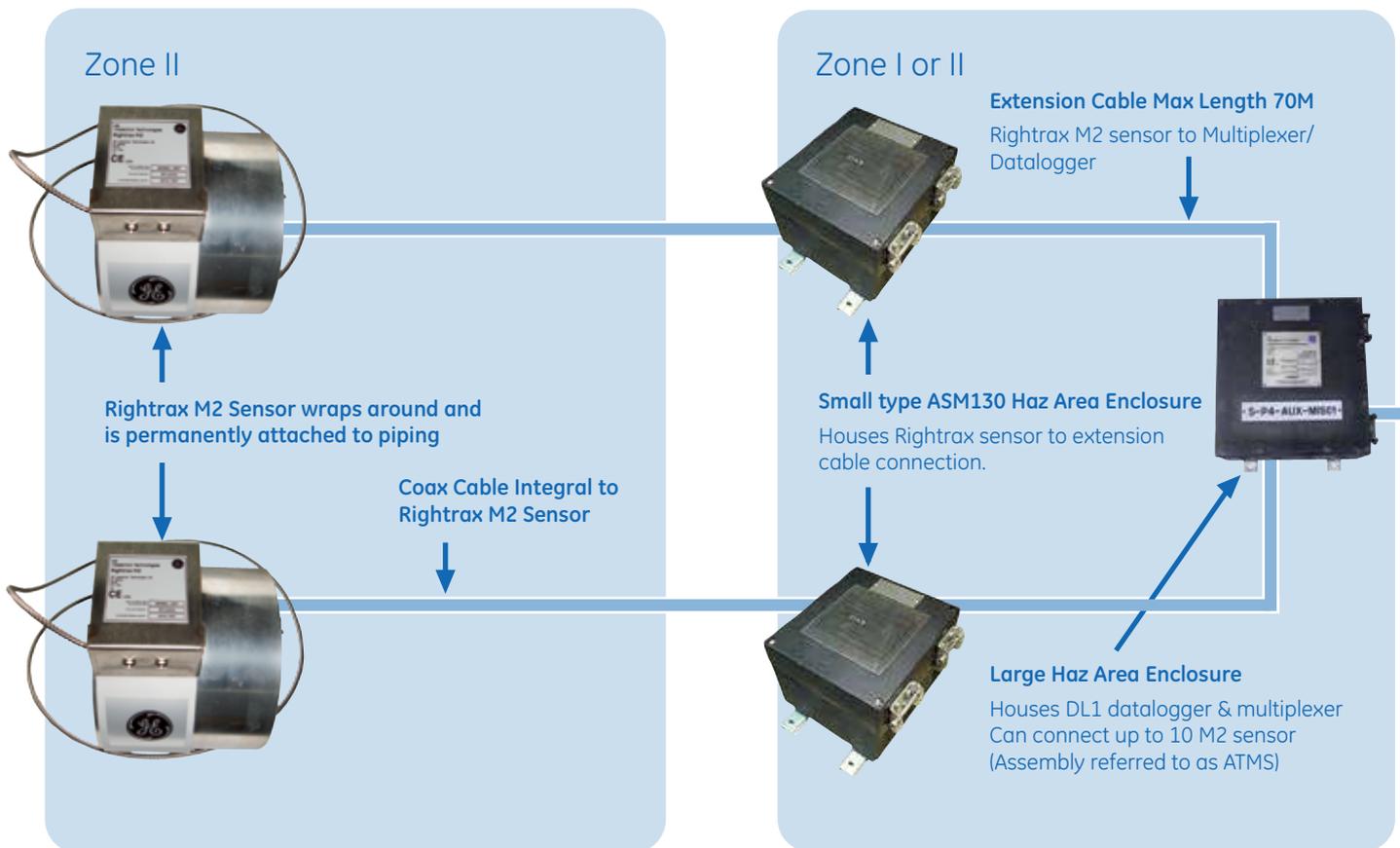


Figure 2. System Architecture

that leverage existing pipeline communications infrastructure, enabling remote access data collection and data viewing options. Transferring data to the expert is generally considered a more cost-effective and efficient methodology for critical and semi-critical assets than manual alternatives.

Downstream Oil & Gas Processing

Within refineries and other downstream hydrocarbon processing plants there are miles of piping that differ in criticality depending on their impact to safety, the environment, and production.

Refining lower quality crudes is now the norm through the increased use of sour crudes, with a higher Total Acid Number (TAN), presenting a greater challenge in managing the corrosive

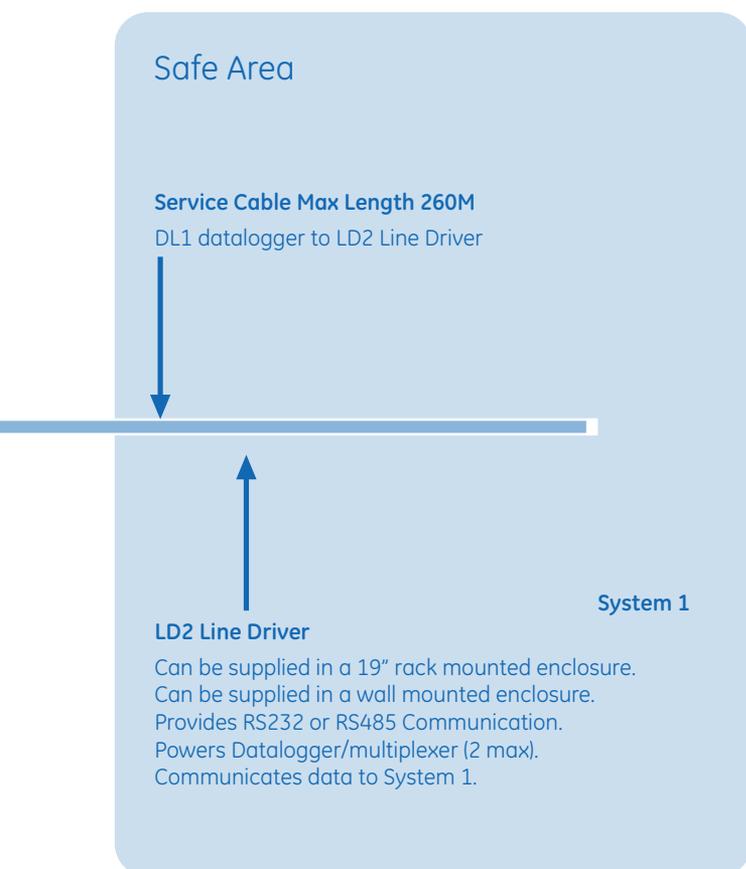
impact on piping. At elevated process temperatures, the problem compounds and rates of wall thickness can change much faster. It is essential to correlate the wall thickness removal rates with TAN variations and the impact of corrosion inhibitors.

Moreover, corrosion rates in high-risk areas (desalters, overhead condensers, furnace lines) cannot be measured effectively with manual inspection, due to data resolution, access, and repeatability. This creates the need for a permanently installed sensor and online condition monitoring.

For high temperature applications up to 500°C, we offer an alternative System 1 integration infrastructure that is not covered in this application overview. Please ask your salesperson for additional details on this option.

System 1 Extender/Rightrax Benefits

- **Increased Reliability.** The consequences of leaks or piping failure with toxic, erosive, high temperature or high-pressure piping is an environmental, health, and safety risk that can be better managed by incorporating Rightrax System 1 extender messages and alerts into your overall program plan for staying within today's plant EHS operating limits.
- **Increased Availability.** Online condition monitoring permits data to be collected frequently enough to gage the accuracy and establish trends with much greater accuracy than walk-around inspections. Trending and observing trends, predicting when they will increase risk and managing those risks are all actions that enhance overall plant availability.
- **Decreased Lost Production Revenue.** Inspection-based maintenance alone can lead to missed failures if not performed regularly. As the risk increases, so does the required interval of inspection, making maintenance costs for critical fixed assets predominantly high among other mechanical assets. Investing in an online condition monitoring program for critical assets can usually be justified within 12 to 18 months.



The System 1 Extender/Rightrax Solution Package

Whether System 1 software already exists at site, or is being newly installed, GE supplies all necessary project management and system integration services to get your Rightrax measurements up and running on time and on budget. Our Bently Nevada Asset Condition Monitoring (BNACM) team works hand-in-hand with our Sensing & Inspection Technology (S&IT) team to ensure a trouble-free deployment that is installed, configured, and documented properly.

A typical Rightrax project includes the following steps:

- Site visit to inspect piping and/or vessel infrastructure
- Review of plot plan drawings, P&IDs, and selection of Rightrax sensor locations
- Hardware scope, design, and installation plan to match your EHS and condition monitoring requirements
- Factory Acceptance Testing at S&IT manufacturing plant; sensor-to-software integration test
- Site installation, commissioning, and integration of Rightrax measurements and System 1 software

All Bently Nevada products, including System 1 software, come with a Technical Support Agreement (TSA) for phone-, web-, and email-based technical support. Platinum-, Gold-, and Silver-level TSAs are available to provide the desired level of support. A platinum-level TSA is complimentary for the first year and can be renewed thereafter at any level.