Aspen Mtell® Machine Learning Finds Cause of Compressor Failures at LNG Facility

aspentech | Case Study

49-51 days

of advance notice on equipment failures

CHALLENGE

Catastrophic failure of propane refrigerant compressors was occurring regularly, with an economic loss of over $40M USD per occurrence. To attempt to identify the cause of the failures, various inspections of the facility's three identical trains were undertaken without success.

SOLUTION

The company engaged with AspenTech to conduct a pilot using Aspen Mtell low-touch machine learning.

The initial Aspen Mtell agents were developed in just nine days, providing a solution that is readily scalable. The pilot confirmed that signatures could be successfully transferred to identical assets.

BENEFITS

The results were stellar. All objectives for the pilot were achieved:

- 49 days of lead time on one failure
- 51 days of notice on another failure
- Successful transfer learning with 61 days of lead time

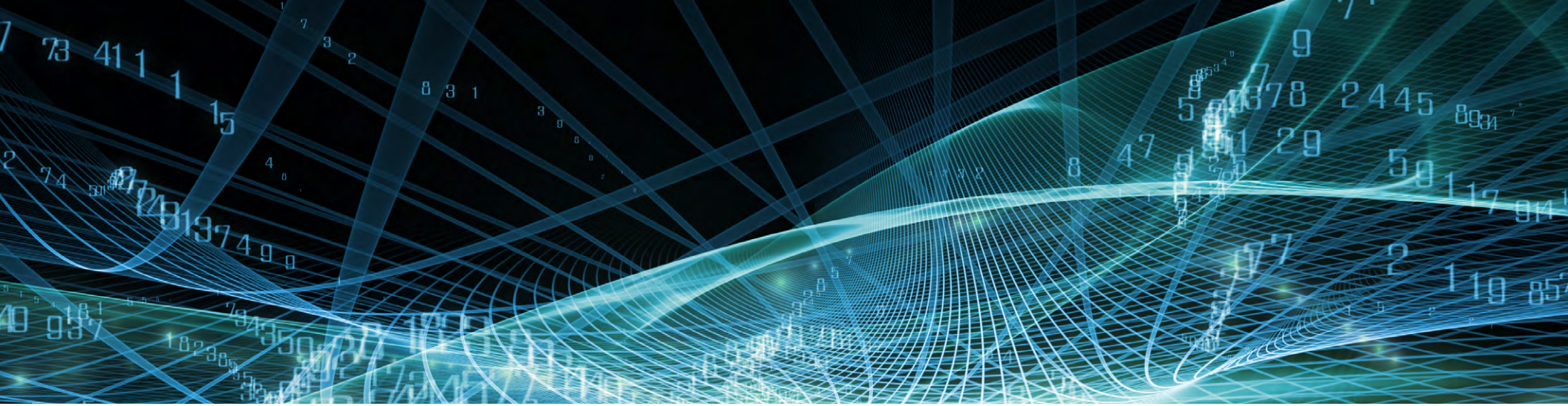
Overview

In this facility, three identical vast processing units, known as trains, can process and freeze 15.6 million metric tons of LNG a year.

Catastrophic failure of propane refrigerant compressors was occurring, with an economic loss of over $40M USD per occurrence. In processing, carbon dioxide and water was being extracted from the feed gas to ready it for cooling and the creation of the final product: almost 600 metric tons of LNG per hour at -162 C. The propane refrigeration system provided the first cooling.

The feed gas ran through the cooler on a separate circuit. The propane pressure was reduced in four stages — each time, some of it boiled quickly, and this “flash” cooled the feed gas. Because each flash was at a lower pressure, the propane had a lower boiling point, chilling the feed gas in stages to -40 C. The propane gas from each flash flowed back to the compressor through a knockout drum to repeat the cycle. The knockout drum was designed to remove any remnant propane liquid that could damage the compressor.

To attempt to identify the cause of the failures, various inspection efforts were undertaken without success. Operators had previously tried to retrofit the unit with a more rugged cone, but the unit still failed at a future point. They also had flows, temps and pressures on the various stages of the compressor.



The Solution: Low-Touch Machine Learning

The company engaged with AspenTech to conduct a pilot using Aspen Mtell low-touch machine learning. The pilot initially incorporated about 85 tags from the equipment — primarily providing asset condition data. Operators also needed to look upstream to get closer to the root cause and subsequently added about 500 upstream process tags (per train).

The results were stellar, and all objectives for the pilot were achieved:

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- Successful transfer learning with 61 days of lead time

The sensor ranking report gave some insights into the root cause of the failures. Thirty-seven sensors in the mixed refrigerant system upstream were rated highest on the ranking report. The highest sensors related to composition around Compressor 1.

The engineering team used the sensor ranking to attempt to identify the root cause, which seemed to be related to potential leaks in the heat exchanger tube, resulting in mixing of the materials.

Speed, Safety and Reliability

Failures of these compressors result in significant downtime and significant repair costs, and they also have the potential for injury and/or loss of life. Safety in LNG facilities is paramount. With Aspen Mtell, the plant now has significant warning of failures through a solution that was quick to implement — the initial pilot agents were developed in just nine days. Operators also have a solution that is readily scalable, as the pilot confirmed the claim that signatures could be successfully transferred to identical assets (as opposed to competing solutions that require a model of the asset behavior).

The agents also displayed their ability to detect and warn of failures up to 61 days in advance. That additional runway has enabled a more business-optimal approach than performing emergency maintenance.

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