CASE STUDY

Gas Field InFusion Enterprise Control System for Asset Performance Management

IPS
INVENSYS PROCESS SYSTEMS

BENEFITS

- **Fast payback for control system**
- **Improved gas production**
- **Equipment failure notification**
- **Realized return on previous technology systems investments**
- **Common view of disparate control systems**
- **Asset optimization information**

CUSTOMER CHALLENGE

An extremely competitive market and high-volume demand have forced midstream companies to push their transmission and gathering systems to full capacity. Pushing aging systems to maximum production causes a rise in system breakdowns and compressor failures. Balancing maximum production with minimum machine failure is essential to optimizing asset performance. A strict program of preventative maintenance including predictive maintenance and quick response corrective maintenance is needed to maintain maximum gathering system asset utilization. In other words, this company needed to get as much total running time out of its field equipment and reduce the mean time between failure or scheduled maintenance. The user knew that these two objectives – utilization and optimization – are functional opposites and requires new methods to determine the ideal mix for operations. A system was needed that combined both of these functions to provide real-time asset performance management was needed.

Currently, Maintenance management was just scheduling emergency repair with periodic service. In addition, the Operations group was reacting to machine failure as it happened without regard for planned production schedules. To run more efficiently from a gas production point of view and to minimize equipment failure and subsequent costs, operations needed to find a way to manage its assets for the greatest uptime with maximum utility.

If machine health and the time to failure could be estimated, Maintenance and Operations managers could utilize risk management tools to determine how to act. The challenge was getting machine condition restrictions into and out of the control strategy and applying them to the production schedule. When that was done, work flow and costs could be managed. This information and analysis would allow Maintenance and Operation managers to answer key questions such as: “Can the machine make it to the next scheduled PM?” and “Can I meet my production schedule with the machine in this condition?” Process operators could then manage their process and determine how to act to minimize losses and optimize economic benefits.

Another customer challenge came from the shear competitiveness of the market. Gas gathering and delivery is a commodity market requiring maximum throughput at maximum asset utilization and absolute low cost. Any technology upgrade must have a measurable ROI that is sustainable. Limited staffing to maximize profits has also put a strain on the maintenance organization which further complicated production efforts.

INFUSION

About This Company

A midstream company in the natural gas business has a large gathering network throughout the Southwest. The natural gas wholesaler deals in trading, marketing, transmission processing and distribution of both natural gas and electricity. It operates in the U.S., Canada and Europe.

"The theories of running assets 24x7 versus having them in an idle mode ready to be started up, are dramatically opposed. But developing a model which calculates the real-time cost to manage utilization versus availability provides a unique tool for management to help optimize their assets."

The customer had invested in data systems that are useful for condition monitoring, but had not closed the loop from data to diagnostics to maintenance planning to operations forecasting. They had the data, but the data was difficult to correlate across the many systems that were in the field. They also believed that there was a correlation between the mechanical data and the flow data (hosted on separate networks) with respect to sustainable flow for optimal operation. A system that would integrate all the different inputs to actually analyze and generate actionable results was a critical need. Again, technology without an operational benefit was of no value.

The challenge was to determine preventable downtime leading to lost opportunity from pipeline production. And they had to be able to estimate the production time they could recover from this improved use of the data.

EXISTING SITUATION

The system architecture consists of a radio telemetry data system that collects flow and pressure data from field meters on the pipeline and at well heads. This system operates on the Administration LAN because it is used primarily for accounting and contract reporting. This data is not available to Operations. The system brings in data via a variety of protocols:

- Multiple process unit types
- Rotating machinery, pipelines, distillation columns, heat exchangers
- Multiple data systems
- GE, Westinghouse, Allen Bradley, Caterpillar, Solar Turbines, WonderWare
- Various transmission protocols
- WINCCU, Suitelinks, Modbus Plus, OPC
- Separate LANs
- Administration, process
- Security firewalls

Failures that have been tracked:

- Bad valves led to a broken rod
- Crankshaft broken, engine destroyed and replaced
- Compressor valve leakage
- Engine combustion problem
- Condensate buildup in pipeline

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"The Invensys Predictive Maintenance Solution evaluates a variety of real-time input from the automation system. These data points are continually passed to algorithms that help deliver information for predictive failure."

THE SOLUTION

The InFusion ECS provides a number of benefits to this customer. Perhaps the most important element that yields real asset performance benefits is the use of real-time process data. The InFusion ECS components include:

1. Real-time process data from the field sent to the DCS and 'objectized' for use by other InFusion applications
   - DAServers and protocol drivers bring in data from multiple devices
   - Central database – Galaxy – holds multiple data points for distribution
2. InFusion Historian captures all input data, calculations and specifications, results, and reports
3. SuiteVoyager® publishes specific reports or windows to the web or LA
4. ActiveFactory® delivers trend analysis
5. Invensys Predictive Maintenance Solution to identify patterns in the real-time data
6. Real-time asset performance
7. Avantis® software publishes real-time predictive maintenance information for work order creation

THE INVENSYS PREDICTIVE MAINTENANCE SOLUTION

IPMS takes inputs from a variety of real-time measurements from plant floor devices. A key element to the solution is its ability to model typical machine behavior through all operating conditions and generate alerts that identify the deviation of failing components from normal operation. An incident alarm, based on multiple sensor condition rules, defines the machine condition and provides diagnostics for failure mode analysis. The sensor alert tolerances incident alarm rules are defined by the user.

On the previous page, the example of the problematic valve, a variety of red 'X's are shown within each individual sensor on the input graphs. These 'X's indicate that the sensor has deviated from the normal operating band determined by the model. The blue diamonds indicate that the individual sensor is a part of a machine condition incident that may include the deviation of multiple sensors (failure modes defined in the user rule base).

Real-time Asset Performance

Real-time asset performance data can be obtained frompredictive maintenance 'Watch List' report. The 'Watch List' can output two critical asset performance information: Potential Cost and Confidence. The potential cost element can define the overall monetary loss including equipment loss and process downtime costs. The Confidence element identifies the probability of failure or process impact of the current incident.

This customer had a requirement to monitor the Engine Combustion. The InFusion ECS, using predictive maintenance technology, identified that there was an ignition failure on the left side of the crossover turbo charged engine from the 'Watch List' report. Rules were previously generated that identified the combination of Alerts and Alarms and their cost impact. In this case, the cost impact was $16K. So, the condition was determined to be allowable and it was monitored and repaired during scheduled maintenance. Without knowing the cost impact, it was possible that the engine might have been shut-down for repair causing significant downtime costs.

Another example was bad valves led to a broken rod when sticky valves developed in cylinder 6 on the engine. A performance problem was indicated by the cylinder temperature, the exhaust and converter temperature delta and the oxygen levels. The InFusion ECS determined that the valve problem would shortly cause the engine rod to break which would have resulted in a $220K loss from downtime and engine repair. The valve was immediately repaired.

"Predictive failure analysis, when combined with the InFusion ECS, creates Asset Performance Management information to drive corrective maintenance procedures."

In both of these cases, the InFusion ECS was able to deliver a Dynamic Performance Measurement that linked real-time process control data to the combination of utilization and optimization with an economic impact estimate. This delivered real information to the operators upon which they could act to optimize their plant based on the asset performance.

Predictive Maintenance versus Corrective Maintenance Benefits

A threshold was set for each of the devices being examined. If the Cost element and corresponding Confidence element exceeded a threshold, a report was generated that automatically alerted the Maintenance engineers of the situation. In the beginning, the Maintenance engineers manually generated a work order. As their confidence grew with the InFusion ECS, the reports were automatically passed to the Avantis software, via the InFusion object technology in the InFusion Engineering Environment. From Avantis, work orders were automatically generated for the Maintenance Department to handle according to the severity of the problem.

The Avantis product was engineered to take Asset Optimization into consideration. In this case, plant operations needed to determine whether the piece of equipment had to be repaired or if the piece of equipment could wait to be repaired based on the cost impact to the business.

THE CONCLUSION

The company was doing all they could to manage the inputs from the sensors and to subsequently make educated decisions based on their process knowledge. However, the InFusion Enterprise Control System allowed the user to take the real time control information and push it through. Ultimately the InFusion ECS functioned in a truly collaborative method.

1. Real-time process control data brought in critical measurements.
2. Multiple protocols and multiple devices were easily configured by the InFusion DCS layer using the InFusion Engineering Environment.
3. Real time process measurement were fed into Avantis software, Invensys' asset intelligence system, to predict critical and non-critical failures.
4. Dynamic Performance Measures were generated from a 'Watch List' which created an Asset Optimization result.
5. Corrective maintenance activities were acted upon based on a financial impact basis.
6. Work orders were automatically delivered to Maintenance Engineers.

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INVENSYS PROCESS SYSTEMS

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