

Application Note



Is valve degradation your early warning indicator of subsea safety risks?

A subsea solution that provides an early indication of well valve degradation to support the safe and efficient operations of the subsea environment

Safety of Subsea Systems

Operating within a subsea environment adds a number of safety challenges for organizations. Subsea well valves form an important part of the subsea infrastructure, and are used to isolate or control the raw material flow through undersea pipelines.

Subsea valves are exposed to massive external pressure, salt-water corrosion and debris in the materials carried and therefore safe operation is critical. These valves can degrade and deteriorate over time that can adversely impact operational efficiency, and have the potential to effect the safety environment.

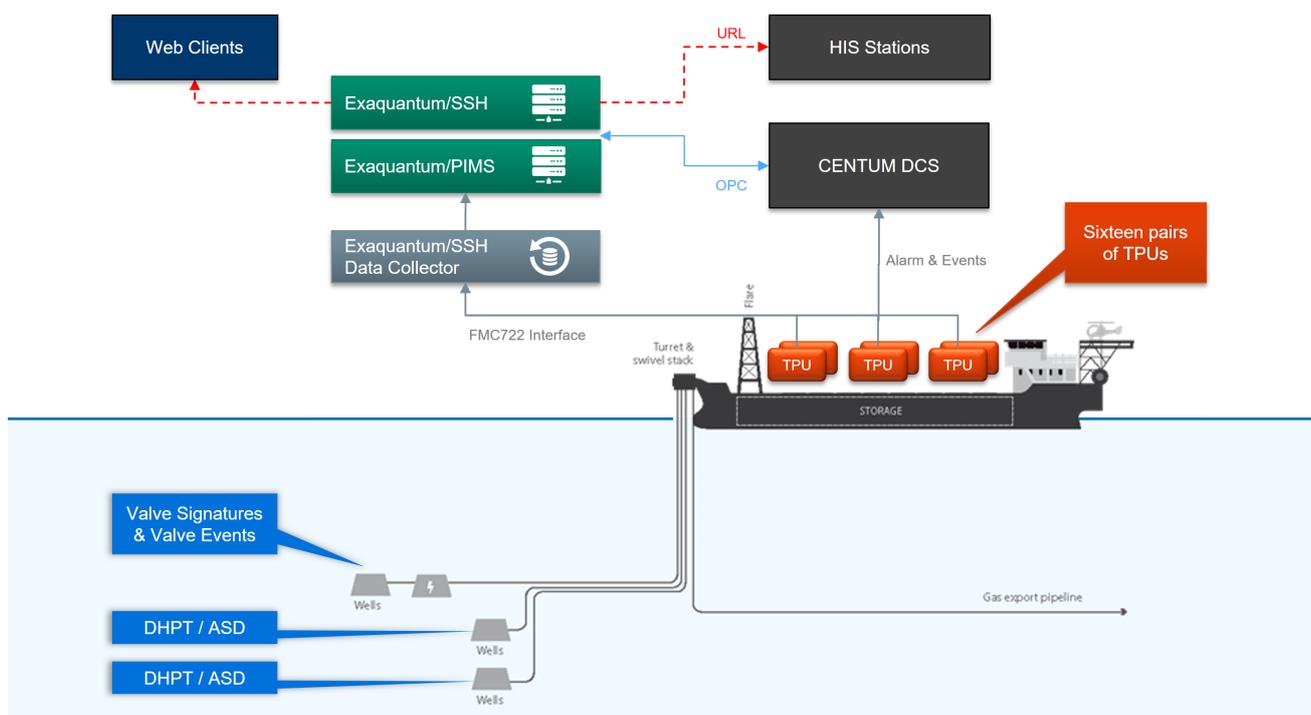
Operators require access to subsea valve data, and be made aware of changes to valve characteristics and signatures, to reduce potential issues or abnormalities from occurring.

Identifying Safety Risks

To support the safety and operations of the subsea environment, Yokogawa has developed a solution that notifies operators of the early signs of valve degradation by accessing valve signature data.

This powerful monitoring tool also detects abnormal operating conditions for temperature, pressure and sand in the subsea system, presenting data to operators to quickly isolate problems and take corrective actions.

By accessing data directly from the Topsides Processing Units (TPUs) via Exaquantum, operators are informed of anomalies like wear, drift and valve stiction and are able to pinpoint areas of concern before affecting production. With a reliable and dependable data historian, past data can be used for comparison and analysis helping to maintain system performance over time.



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This information can also assist with maintenance schedules and priorities that help reduce risk by highlighting valve deviations that could ultimately lead to failures in the future.

Alarm notifications from the DCS are displayed alongside valve signatures in SSH for rapid identification of problems and an integrated view of the subsea system performance. The SSH valve information displays can also be integrated with the DCS for viewing on HIS screens in the control room. Additionally, SSH can trigger DCS alarms when identifying abnormal valve operations.

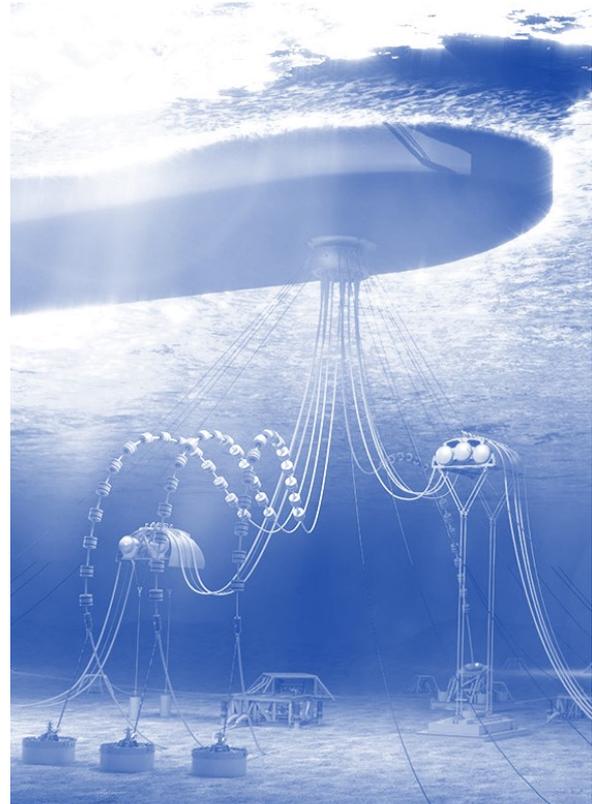
What are the benefits?

- Reduces safety risks and enhances the environmental protection of the subsea system by detecting valve degradation and providing an early warning indicator for operators.
- Unexpected operational issues can be reduced with a continuous health check of the subsea system having constant access to data direct from the TPUs. Operators have access to the best available information and are notified rapidly of any potential issues enabling informed decisions to be actioned quickly.
- Increases the situational awareness of operators putting them in a position to make better decisions in response to abnormal conditions. Using the main process historian without a dedicated vendor specific subsea system historian allows for a unified access to information and a more inclusive view of the data.
- Maintenance programs and schedules can be improved for operational efficiencies that help ensure a safer working environment.

How to monitor and analyze data from subsea wells

Yokogawa was contacted by an existing customer regarding a problem being able to monitor and analyze data from subsea wells connected to one of their floating deep water platforms. Having already worked on a partial solution across a number of their installations worldwide, Yokogawa was selected to provide a solution that fulfilled the following criteria:

Interface directly with multiple TPUs - Measuring and monitoring data from subsea well valves and sensors is important operational requirement that provides an insight into valve characteristics and identifies areas of concern.



Provide redundant data collection services -

Accessing, storing, analyzing and presenting this data is a very real problem, due to the location and environment of the well valves and sensors.

Deliver valve signature deviation alarming - Data analysis enables early warning for operations giving the change or preventative maintenance before failure.

All of the above requirements would need to be accessible via an intuitive web user interface with client access to all collected data.

Yokogawa has developed a subsea solution that enables subsea data to be collected directly from the TPU containing the subsea well valves and sensors using the FMC722 protocol for monitoring, analysis and visualization. This provides the customer with a reliable data stream and storage mechanism that is used to aid analyzing, identifying and correcting areas of concern.

What were the key deliverables?

Yokogawa was contacted by an existing customer regarding a problem being able to monitor and analyze data from subsea wells connected to one of their floating deep water platforms.

Having already worked on a partial solution across a number of their installations worldwide, Yokogawa was selected to provide a solution that fulfilled the following criteria:

TPU Data Collection

- Support connection up to 16 TPU pairs
- Collect valve signature data
- Collect fast scan data
- Store data collected
- Support redundancy using paired TPUs
- Handle high volume data spikes from TPUs
- Prevent data loss from TPUs
- Record health status of TPUs
- Raise TPU health status alarms
- Record messages received from TPUs
- Automatically remove expired data received from TPUs

Valve Data Management

- Collect valve signature data from primary and secondary data collectors
- Determine best valve signature data from primary and secondary data collectors to use
- Recovery of data after periods of downtime
- Store valve signature data collected from redundant data collectors
- Detect valve signature deviations
- Raise valve signature deviation alarms

User Interface

- View KPIs for data collectors and valve signatures
- View valve signatures
- View fast scan data
- View data collection status
- Control data collection process

Additional Features

Some additional features were also incorporated that further enhanced the value for the customer, including:

- A new user-friendly web design
- Data collection redundancy at the data collection points
- The ability to manually or automatically switch data routes when underlying systems were unavailable

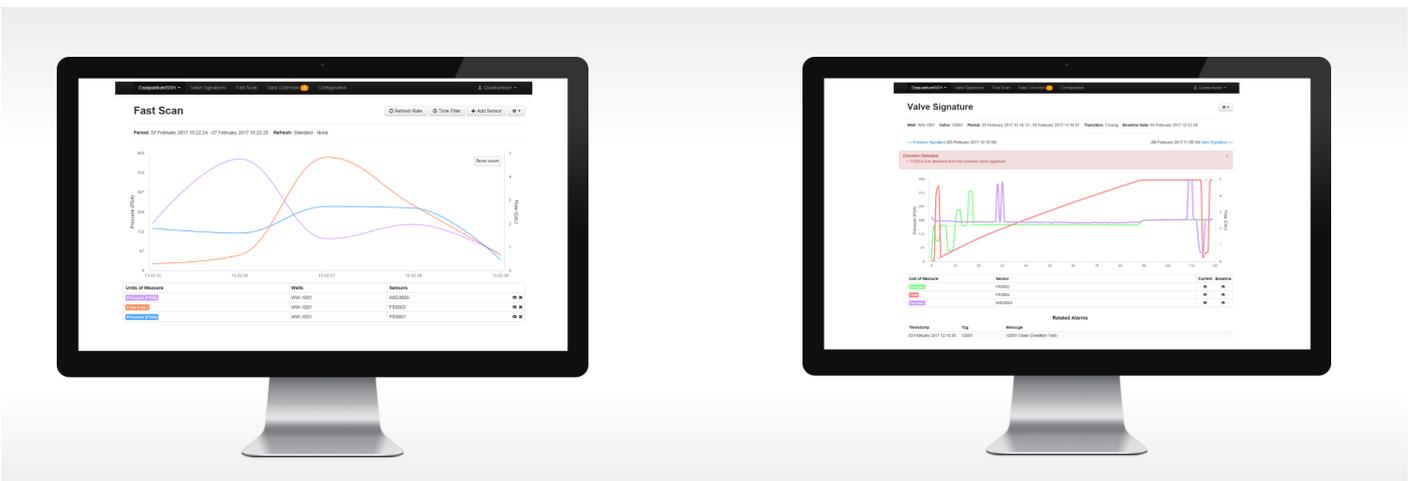
A Packaged Solution

Yokogawa worked with the customer to provide a total packaged solution that included the following:

- Specification and Design
- Proof of Concept consultancy
- Functional Specification document
- Product Development including:
 - * Subsea Historian collecting data from an FMC TPU using the FMC722 protocol
 - * Data transfer to the Exaquantum Historian
 - * Data display and analysis through the web interface
- Factory Acceptance Test (FAT) and Site Acceptance Test (SAT) specification documents
- FAT and SAT support
- Technical consultancy throughout the project

All the Data in a Single Web Interface

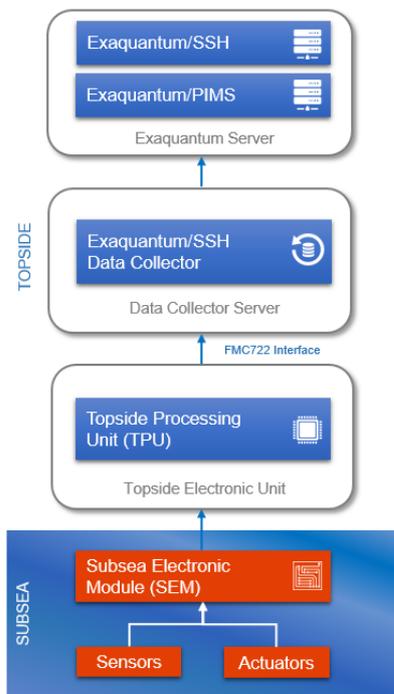
By collecting data direct from the TPUs, all subsea system data was accessible. This enabled development of a user-friendly interface that displays not only valve signatures but also Down Hole Pressure and Temperature (DHTP) and Acoustic Sand Detection (ASD), separated into individual screens for intuitive operation and analysis.



System Architecture

The Subsea solution consist of a number of systems and servers.

- Valve and sensor data is generated from sensors located at subsea well centers.
- TPUs collect data from valve movements and sensors.
- The data collectors interface with the TPUs to request data for the valves and sensors configurations.
- The data server stores the redundant data from multiple TPUs in short term storage, typically 30 days.
- Redundancy is provided both at the TPU level and with two data servers interfacing with the redundant TPUs.



The Data Historian collects data from the data collectors. Data collection is usually from the primary data collector but can automatically or manually switch to the redundant secondary data collector if the primary server is unavailable. Valve Signature data is stored in data server database. Downhole Pressure and Temperature (DHPT) and Acoustic Sand Detection (ASD) data is stored in the Exaquantum database.

The Data Historian in the configuration also contains the Web Server that provides the user interface for operators.

Key Takeaways

Collaboration and Co-innovation

This project built upon a good working relationship with the customer, providing a solution that enhanced a pre-existing installation. It helps maintain the safety and environmental protection of subsea well valves by identifying early signs of valve degradation. It enables operators to quickly isolate problems and take corrective actions.

Monitoring and Analysis of subsea data

Monitors valve signatures by continuously receiving updated subsea valve information from FMC Technologies subsea systems. Operators are provided with a visual display of valve signature deviations from the current baseline for each valve signature, helping to easily identify wear, drift and sticking valves to pinpoint areas of concern before they affect production. This assists preventative maintenance activities that can be undertaken before failures which reduces risk. Trend analysis can help determine the health of the wells for both Downhole Pressure and Temperature (DHPT) and Acoustic Sand Detection (ASD).

Integration of Information

By leveraging data directly from the TPU, Exaquantum is used for secure and reliable data collection, providing unified access to information with an inclusive view of data. By using the main process historian for this data, a dedicated vendor specific subsea system historian is not required. This enables DCS integration where valve signatures can be displayed on a HIS station via a URL link from the Face Plate for rapid identifications of problems. Abnormal valve operation can trigger DCS alarms, and these alarm notifications can be displayed alongside valve signatures for an integrated view of valve performance.

References

- Exaquantum Plant Information Management System
- Exaquantum Subsea Historian
- Exaquantum Historical Data Manager
- Yokogawa delivers subsea control solutions for Shell deepwater projects ([Success Story](#))

Source Information

For more information, please contact sales@ymx.yokogawa.com