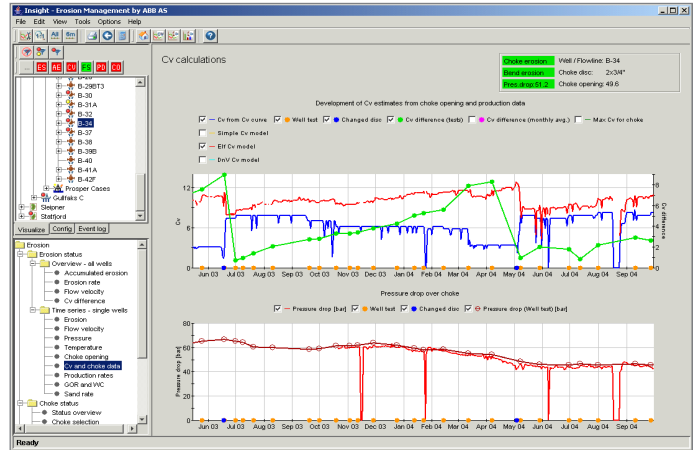


Condition Monitoring and Production Optimization Insight - Erosion Management System

Effective Sand Management strategies can result in significant production increase. Results documented by clients show additional 5.6 Mill bbls of oil in a year for two fields [SPE 94511].

Erosion Management is one of the technologies enabling these strategies. Insight - Erosion Management System from ABB is a proven solution managing erosion development in chokes and other critical flowline components.

The system enables operators to safely increase oil production, while organizing inspection and maintenance work more effectively.



Insight - Erosion Management System. Effectively monitoring erosion through advanced models.

Sand Management Strategy

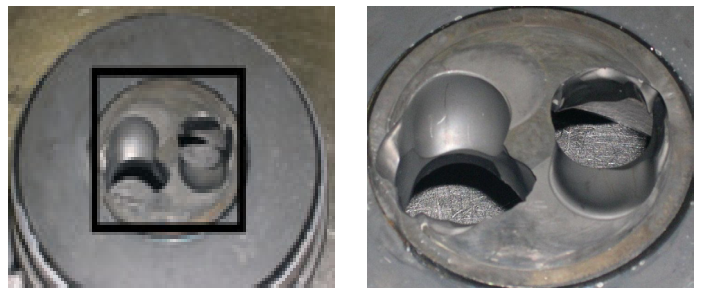
Sand production is an increasing problem in brownfields and may often lead to erosion damage of subsea and topside equipment such as chokes and pipelines. The most common first response to this problem is to reduce production. However, a far better approach is to address the problem with a change of Sand Management strategy. [See separate frame on Statoil's Sand Management project]. The main idea is that sand in the well flow can be allowed and managed effectively with the necessary tools in place to provide the needed decision support.

Erosion Management Functionality

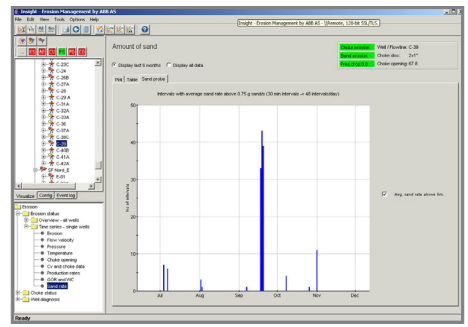
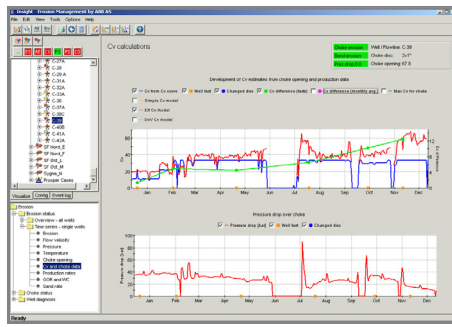
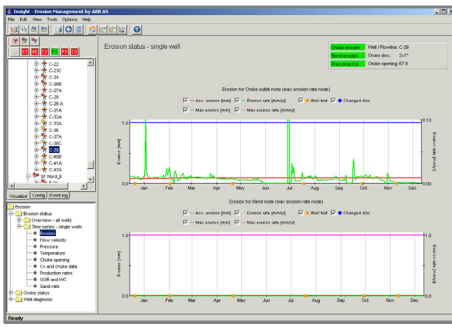
Insight – Erosion Management System provides a cross-platform, model-based approach to Erosion Management. It runs in online mode as a monitoring system, or offline mode proving what-if analysis. Through intuitive navigation and visualization on multiple levels (overview and drill-down trending) of both production data and model results, it provides a better understanding of the current situation. Furthermore, integrating event data (such as well tests and choke changes) with inputs and results, operational guidelines, status visualization, choke selection tools, sand data and QA mechanisms, it is an example of the value of Integrated Operations.

Model-based approach offers flexibility

State of the art erosion models is provided through a close cooperation with DNV (Det Norske Veritas). The model-based approach offers full flexibility as opposed to hardware sensors and probes, since erosion development can be modelled anywhere in the production system without any hardware investments or installation costs. However, if sensors are already present, data from these can be visualized in Insight and further strengthen the analysis.



Insight - Erosion Management System monitors the impact of sand in the production on e.g. chokes on Statoils Gullfaks and Statfjord fields in the North Sea.



Real life example: Actual choke erosion detected with Insight on the Statfjord well SFC-39. Using three erosion indicators (erosion models, Cv difference and sand rate), the choke was inspected (see picture) and erosion found.

Insight - Erosion Management System - main features:

- **Monitoring:** Online, automated operation, accessible in the office domain.
- **Complete overview:** Calculates erosion on all pre-defined erosion nodes in the entire system.
- **Model-based approach:** No hardware investments.
- **Multiple erosion indicators:** Erosion models, choke Cv analysis and sand data/sand trap visualization.
- **Decision support:** Status flagging for multiple operation criteria and guidelines.
- **What-if analysis tool:** Predict future conditions.
- **Navigation and Visualization:** Cross-platform navigation, overview and drill-down trending.
- **Guidelines:** Operational guidelines integrated.
- **Choke selection tools:** Choke recommendations based on operating conditions.
- **Integration and QA:** Integrating production data, well tests and events improves quality assurance.

Statoil's Sand Management Project

Increasing sand production is a common problem in maturing fields, resulting from declining reservoir pressure and increasing amounts of water. Sand production has an impact on both production and safety, because sand causes erosion of production equipment. In some cases, increasing sand production triggers premature shut down of production wells.

Statoil has more than 400 sand producing wells in the North Sea. The sand producing reservoirs with the lowest formation strength are located in the Gullfaks field. (The reservoir rock disintegrates when it is squeezed between the fingers). As a result, Gullfaks was the first field to systematically enhance sand management through investments in knowledge and technology.

Cooperation between Statoil and DNV was established, and a systematic review of the erosion phenomena was conducted. The major break-through of the sand management project reached surface in 2001, which made it possible for Statoil to control the oil production according to an Acceptable Sand Rate (ASR) instead of a Maximum Sand free Rate (MSR). As a direct consequence, the oil production from the Gullfaks field has increased.

The Insight - Erosion Management System software (ABB) was installed on the Gullfaks field, and is today keeping track of the actual wall thickness reduction due to the sand production in chokes and other erosion nodes. Besides from an increased production and improved safety situation, the software provides an economical gain due to condition based inspection and maintenance operation. Based on the experiences from the Gullfaks field, the system is now also in operation on the Statfjord field, which has seem similar results (SPE 94511)

Source: Norwegian Petroleum Directorate (www.npd.no)

For more information, please contact:

ABB AS
 Ole Deviks vei 10
 N-0666 Oslo
 Email: io@no.abb.com

www.abb.no/oilandgas

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