visplore Hafslund Eco

User Success Story

How hydropower producer Hafslund Eco shortened the maintenance downtime of a Francis turbine by early detection of an overheating bearing - avoiding 1,1M Euro revenue loss.

Challenge

Reliability and plannability of renewable sources are key issues in enabling the energy transition. Hafslund Eco operates more than 80 hydropower plants that ensure Norway's clean electricity supply. Unplanned downtimes of plants come at a high cost, as the required power has to be produced elsewhere or purchased for high prices.

Engineers at Hafslund had observed suddenly increasing temperatures in a hydrodynamic journal bearing at one of their turbine generators. This happened after a longer standstill in summer and persisted also after multiple restarts of the turbine. The engineers had to assess years of equipment history, operation parameters and ambient conditions to determine if the change in temperature was in response to changing external conditions, or an early sign of failure leading to unplanned downtime - and therefore needed intervention.

Solution

Through Visplore's direct connectivity with process historians, the engineers could easily ingest 3 years of historical data for 31 sensors from their AVEVA PI system. The relevant historical reference for the incident were hundreds of six-hour periods following every startup of the turbine. Visplore's intelligent pattern search allowed the engineers to extract these startup events from the raw signals, and to overlay the patterns (see image on next page). This clearly showed that the temperature rise during startup was not only much faster than before the incident, but also reaching higher and higher levels over time. By correlation with other parameters, the engineers realized that the temperature of the bearing's cooling water did not heat up nearly as much as the actual bearing. This temperature difference indicated a technical problem rather than ambient conditions to be the root cause. From this insight, the engineers decided to repair the bearing as soon as possible.

Highlights

- 1,1 M Euro revenue loss avoided by performing a 50% shorter maintenance
- potential to transfer the approach to 80+ other turbines
- increased situation awareness for data driven decisions
- much more transparent for operators than "black-box" AI
- rapid access to years of historical operation data (startups, shutdowns, normal operation) enabling quick ad-hoc analysis with strong graphical interface

Results

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The planned maintenance following the discovery lasted 3 weeks and could be performed at a time where energy prices were relatively low. Without intervention, the engineers would likely have faced a much longer unplanned downtime of 6 weeks, in a time of significantly higher energy market price. Thus, the engineers shortened the duration of the non-market-ready downtime by 50%. For the 150GWh/year turbine at hand, the engineers estimated an avoided revenue loss of about EUR 1,1 million. After the repair, it was clearly evident from the data that the problem was solved (see picture below). Given that Hafslund Eco operates more than 80 turbines, this only scratched the surface of the value potential so far.

> **„Pattern anomaly detection and fast correlation with contextual data empowers the engineers to make data-driven decisions that save millions of EUR."**
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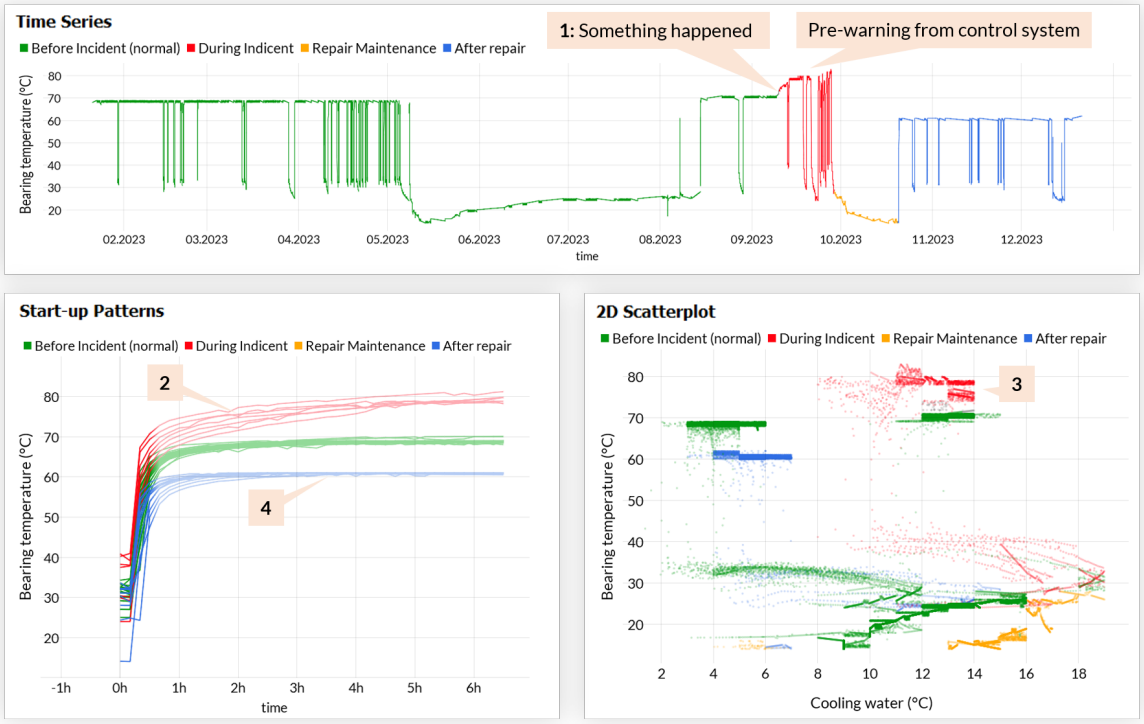
> — Thor Arne Hvam Bruun
> Turbine specialist, Hafslund Eco

The engineers feel empowered by the use of Visplore in their everyday operation. Existing control system warnings had not yet fired at the time where the first startup temperature curve in Visplore already showed the abnormal behavior. Two learnings were: (1) automation could benefit from more advanced pattern anomaly detection beyond simple thresholds, and (2) the engineer hugely benefits from tools to assess incident-specific context data quickly, to make difficult data-driven decisions like entering a 3-week maintenance right away. Having introduced Visplore less than 1 year ago at Hafslund Eco, the engineers were confident that their investment in self-service analytics had already more than paid off. (3) Learnings from this detection of anomaly can be set into "production" for other locations for very early detection.



(1) Sudden increase of bearing temperature is observed, rising further even after multiple restarts. (2) engineers compare historical start-ups to confirm incident as anomaly, and (3) quickly rule out ambient conditions as a "natural" explanation, as the internal cooling water is not nearly heating up as much. (4) After deciding for maintenance, the behavior is improved with a maximal temperature that is 10°C lower than before the problem occurred.