VBR TURBINE PARTNERS
support beyond expectation

Data driven predictive maintenance information to enhance human decision making in gas turbine operation & maintenance

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Welcome …

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Decision making in Gas Turbine Operation & Maintenance

Every day gas turbine plant managers, operators, maintenance engineers and procurement officers face many decisions on how to run their plant in the best possible way.

The profitability of a gas turbine operation depends largely on the quality of the day-to-day decision making by all these people involved

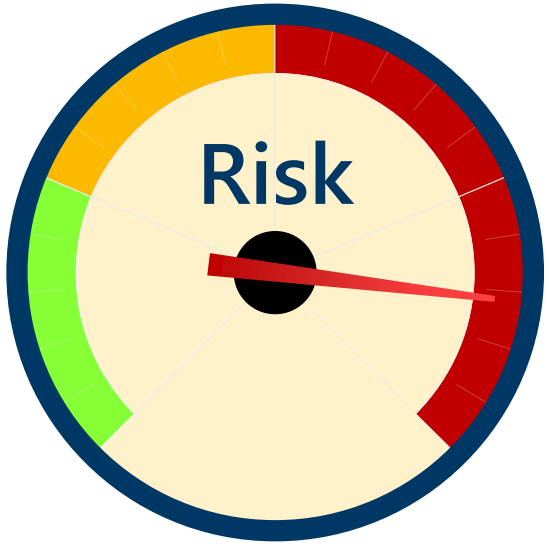
Heavily increased focus on cost reduction

The heavily increased focus on cost reduction in gas turbine operation & maintenance over the past years has resulted in less specialized gas turbine plant managers, operators & maintenance engineers on-site and in often unnoticed negligence of routine daily maintenance.

Increased risk of technical error and human error

This situation has increased the risk of technical error & human error in gas turbine operation & maintenance.

Mitigating this increased risk requires reducing both the technical error and the human error in a simultaneous way.



Simultaneous reduction of technical error and human error

Most common causes of technical error

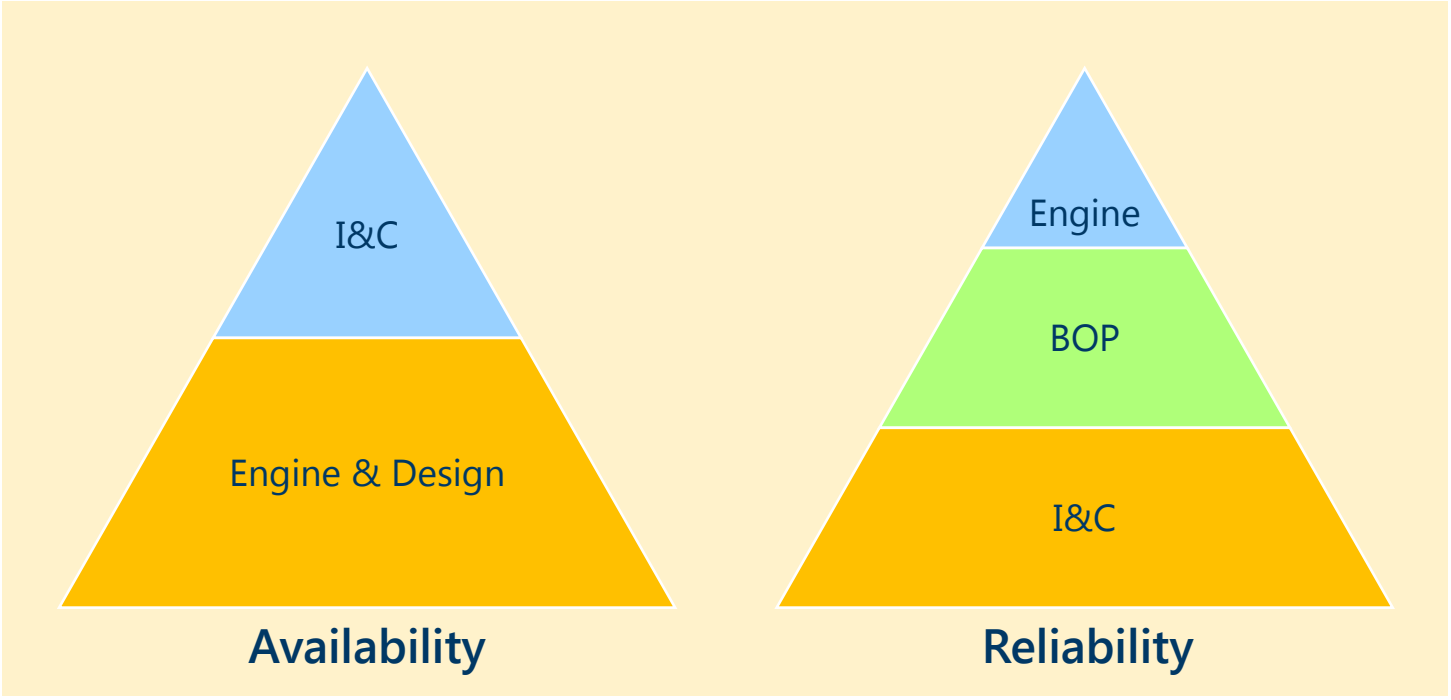
- Maintenance overdue or postponed (corrective and preventive)
- Used parts installed without proper overhaul
- Lack of adequate tools on-site
- Manuals and drawings not up to date
- Spare parts management not effected

Reducing technical error

Technical error can be reduced by executing a technical audit and executing the recommended improvement program.

Technical failures will always result in lower:

- Availability
- Reliability

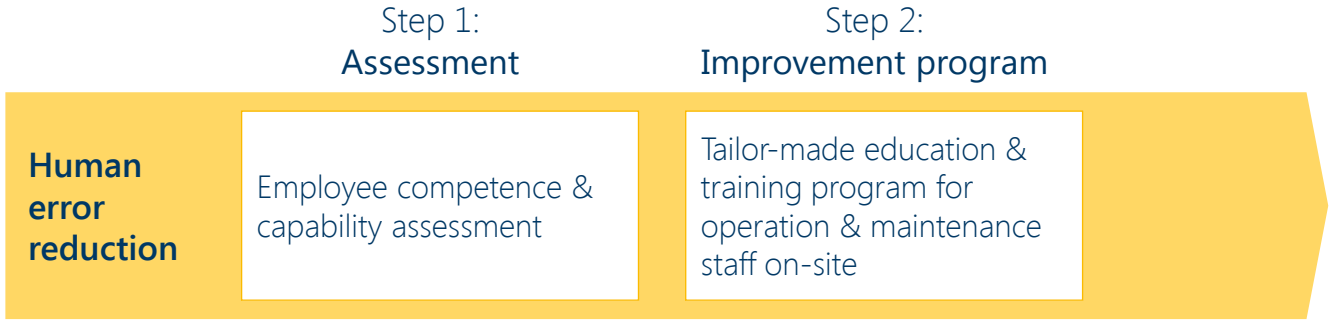


Most common causes of human error

- Limited education & training
- Limited experience
- Limited on-the-job guidance & support
- Procedures not up-to-date
- Manuals & drawings not up-to-date

Reducing human error

Human error can be reduced
by executing a competence & capability audit and
by executing the recommended education & training program



Case study Oil & Gas operator in Europe

Step 1 – audit/assessment
Executed a technical audit and a employee competence & capability assessment.

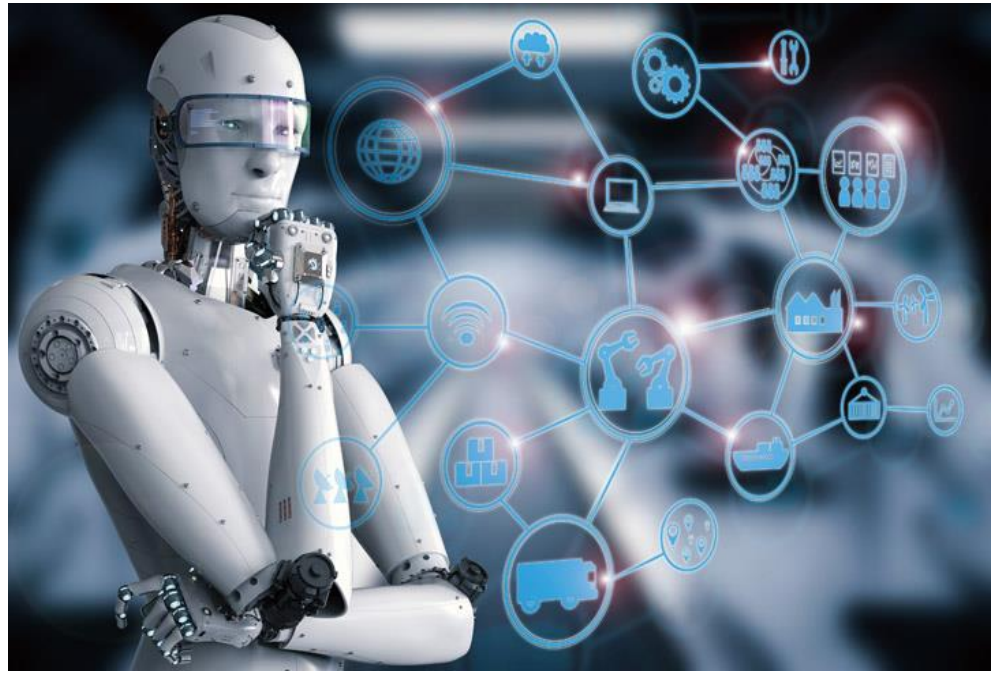
Step 2 – improvement program
Executed a technical improvement program in conjunction with a tailor-made education & training program for the operation & maintenance staff on-site.

Operational results

Remote monitoring & diagnostics

Many companies have tried to improve their operational results by implementing remote monitoring & diagnostic systems that promise immediate improvement of GT operation & maintenance.

Operators who have worked with these systems have experienced that they do not always bring the value they had expected from them.



Remote monitoring & diagnostics vs. remote decision support

Remote monitoring & diagnostics
often focus on:
data presentation

Remote decision support chooses
the perspective of:
human operator understanding

Key factors for effective remote decision support

The value that remote decision support can bring will depend largely on two factors:

quality of input data

usability of output data

Usability of output data

For many operators and maintenance managers the preferred way of working is:

- to have 24-7 overviews of the overall status of their operation
- to receive timely and correct signals when something is about to happen
- to receive easy-to-understand practical recommendations how to act on these signals in the most effective way.

The right decision at the right time

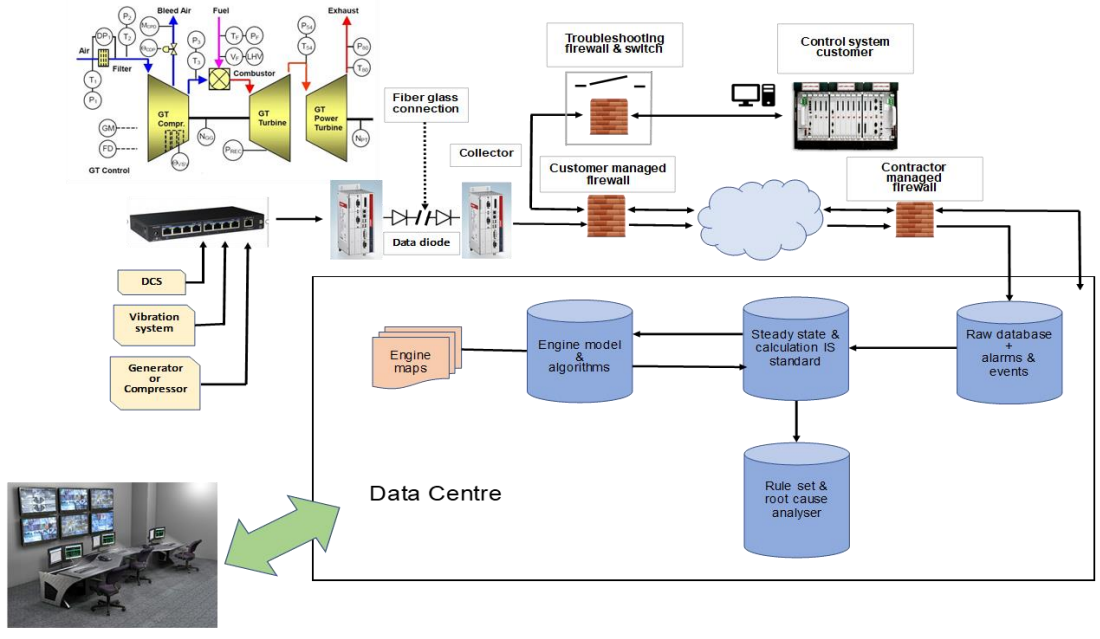
Effective decision support enables Gas Turbine operators & maintenance managers to take

- the right decision at the right time
- **every time again**

Effective decision support – four steps

The **four process steps** of effective decision support are:

1. **Connect & collect** all relevant engine data.
2. **Automated analysis** & **intelligent diagnostics** to transform raw engine data into useful information & smart alarm management.
3. **Professional interpretation** to draw conclusions from the information & insights gained.
4. **Feedback to customers** by **recommendations**, easy to understand dashboards & periodic reports.



Effective decision support – step 1

Step 1

Connect & collect all relevant engine data by means of **cyber secure 100% one-way acquisition** of engine data.

Effective decision support – step 2

Step 2

Automated analysis & intelligent diagnostics to transform raw engine data into useful information & smart alarm management.

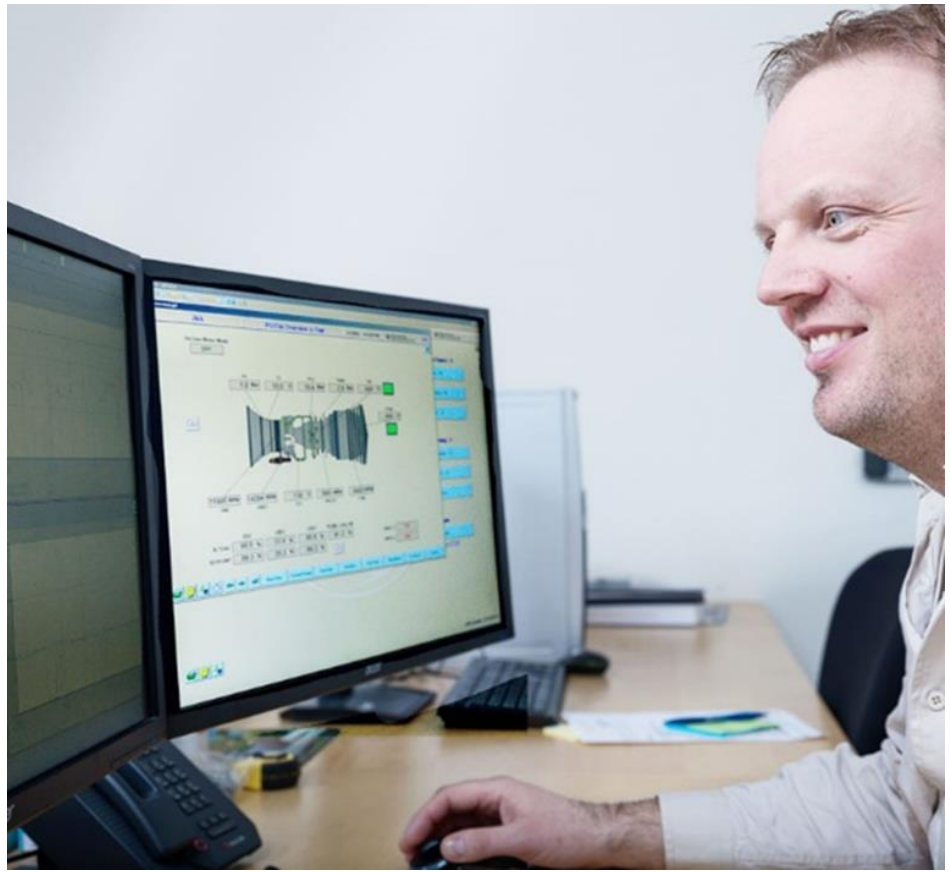
Acquired engine data are compared with the outcomes of a tailor-made **digital engine model** (**digital twin**) to detect deviations from the ideal operation modus.

Effective decision support - step 3

Step 3

Professional interpretation to draw conclusions from the information & insights gained.

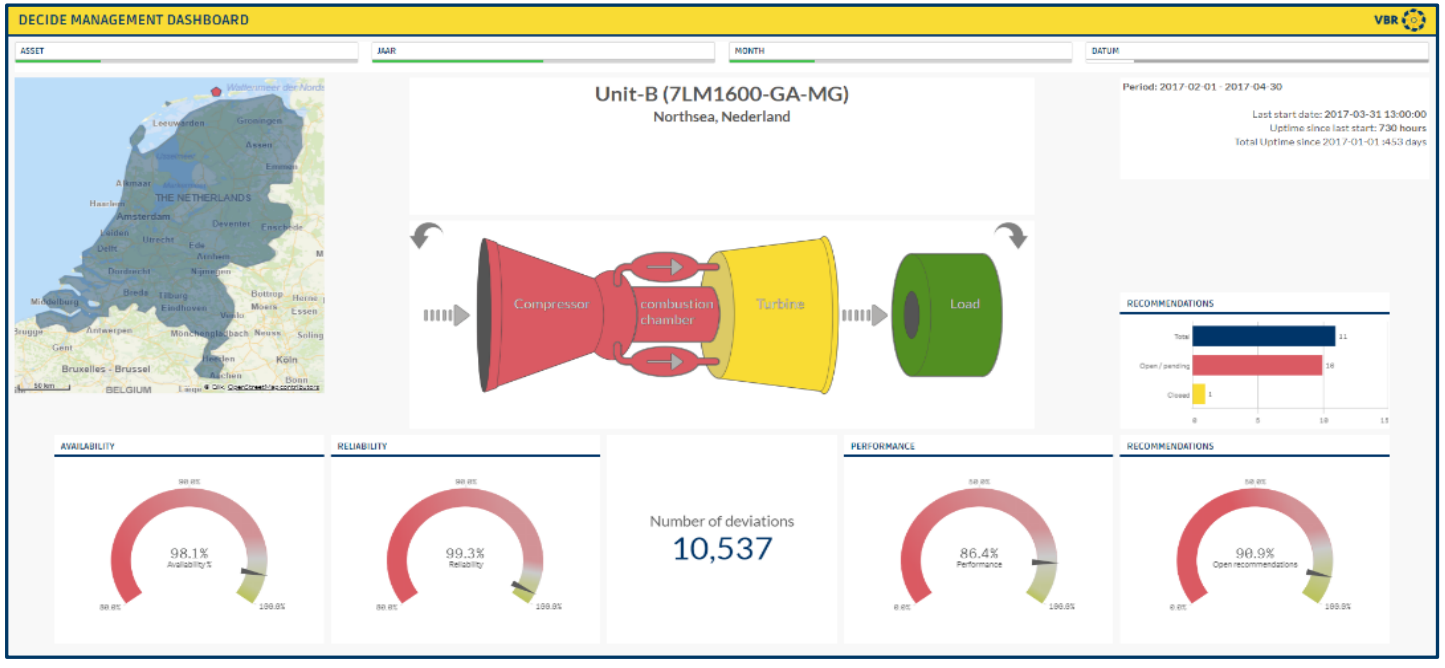
Experienced engineers draw conclusions from the enriched engine data, automated analysis and smart alarm management info.



Effective decision support - step 4

Step 4

Feedback to operators and maintenance managers in the form of **recommendations**, easy to understand dashboards & periodic reports.



Case study remote decision support 1: temperature deviations in thermocouples

Customer: Oil & Gas operator North Sea.

Monitored: small temperature deviations in two thermocouples not indicated on the HMI.

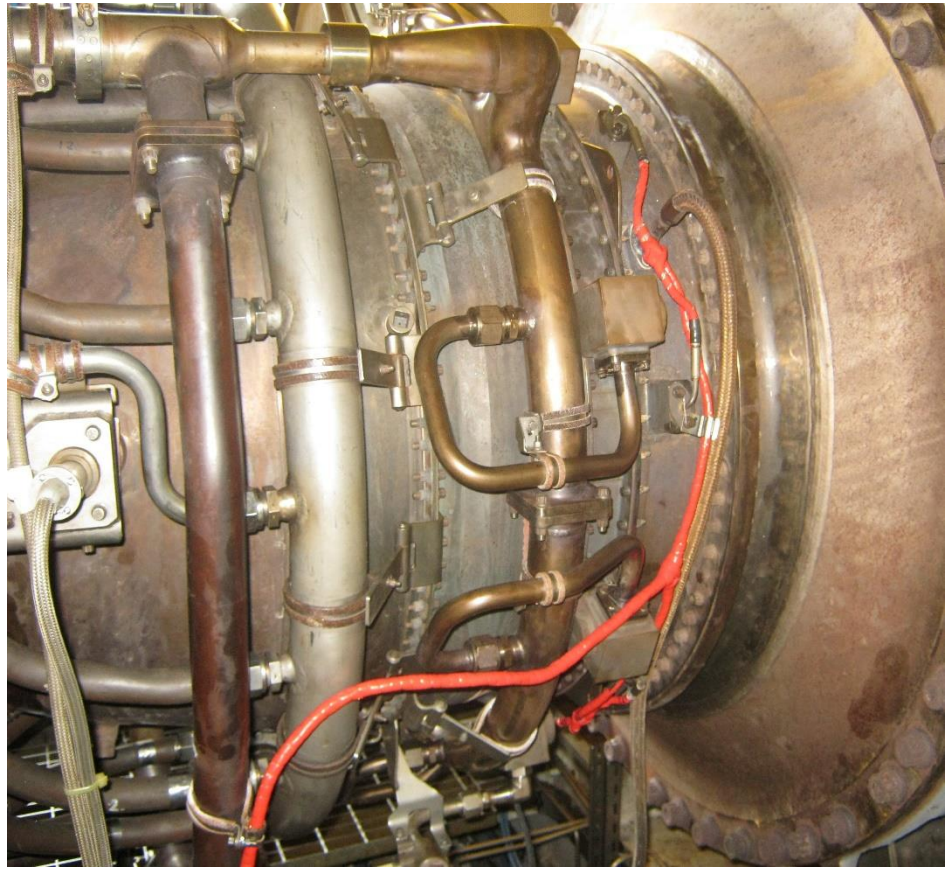
Assessment: potential issues with fuel lines and fuel nozzles.

Recommendation: inspect fuel lines and nozzles at next scheduled stop and bring sufficient replacement parts on-site.

Outcome: nozzles damaged, lines clogged.

Decision: perform required repairs on the spot.

Benefit: trip on temperature spread prevented.



Case study remote decision support 2: deviations in actuator positions

Customer: Oil & Gas operator North Sea.

Monitored: small deviations in actuator positions not indicated on the HMI.

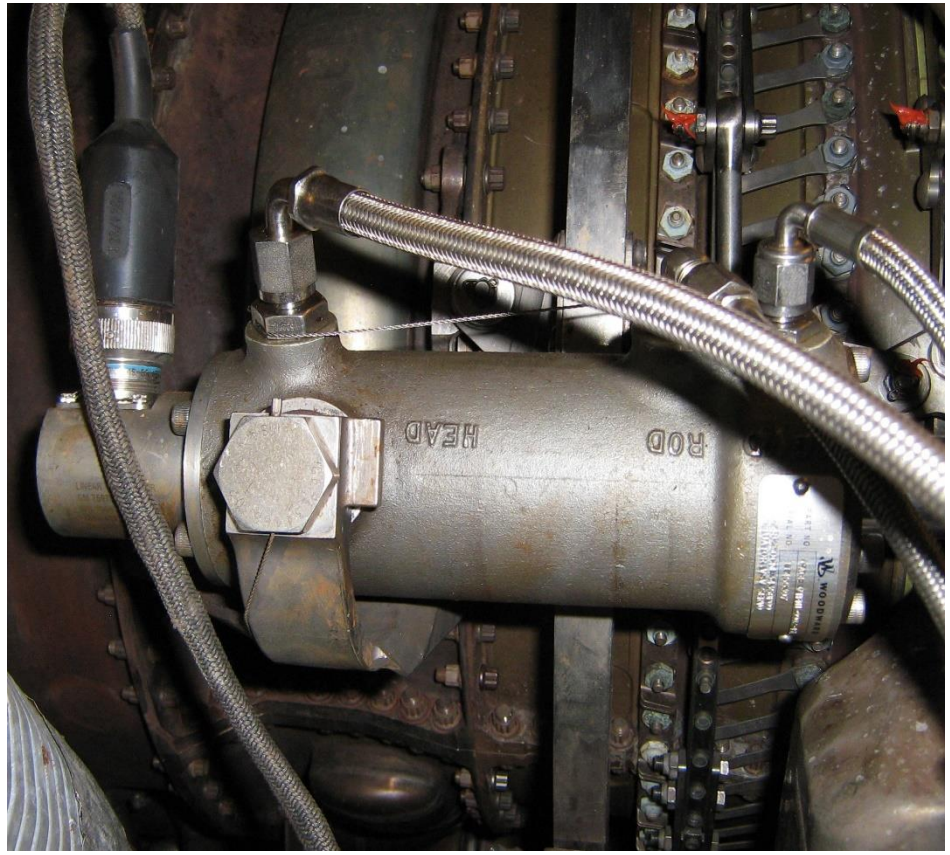
Assessment: potential actuator damage.

Recommendation: inspect deviating actuators at next scheduled stop and bring sufficient replacement parts on-site.

Outcome: actuators damaged.

Decision: perform required repairs on the spot.

Benefit: failed start on actuator problems prevented.



Summary

Human decision making in GT operation & maintenance can be effectively enhanced by implementing user-friendly decision support solutions based on predictive maintenance information.

The entire GT operation needs to be in a good and reliable technical condition to provide reliable input data for the initial engine health condition monitoring.

Questions?

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Thank you for your attention!

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