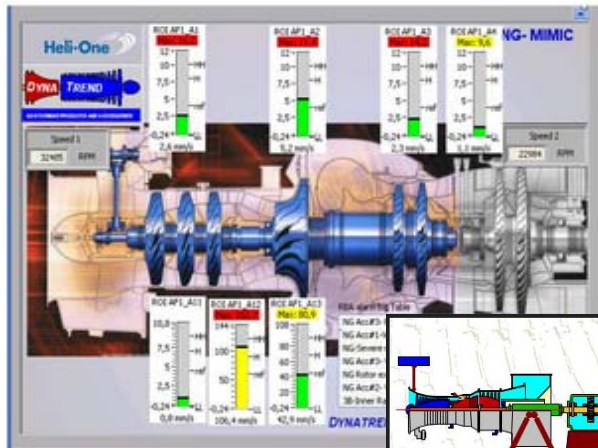


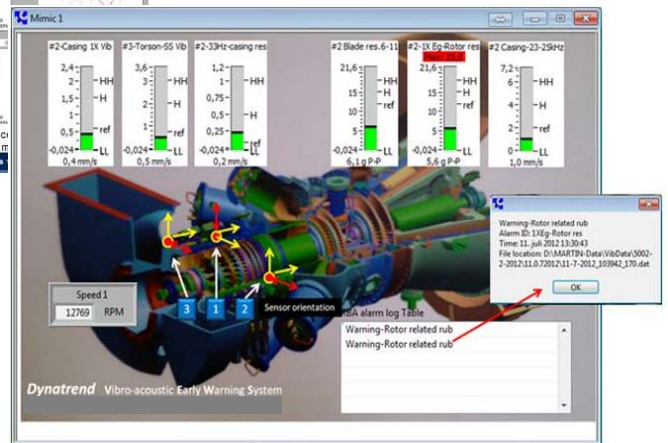
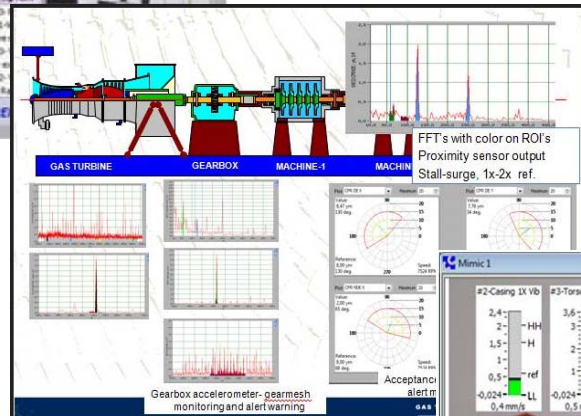
ADVANCED VIBRATION ANALYSIS



AVIATION

POWER
INDUSTRY

OIL&GAS



OEM

NEW TECHNOLOGY
NEW METHODOLOGY
BIG POTENTIAL

NON INTRUSIVE SENSOR SYSTEM



VEWS *Vibro-acoustic Early Warning System*

Smart solutions to a range of pitfalls

The **Vibro-Acoustic Early Warning System, VEWS, Online monitoring**, is capable of revealing crucial information from critical machinery which is yet not commonly known and implemented by the industry.

The VEWS monitoring system is designed to obtain, process and interpret information to provide features such as:

Automatically processed diagnostics --- Instant alerts --- Real time feedback to operator

There are a range of pitfalls that goes under the radar for most operators. The VEWS monitoring system offer smart solutions to these challenges. A small selection of VEWS system features is listed below:

Gas Turbine, and Power Turbine.

- Resonances and rotor thermal bow problems. Casing bow problems.
- Rolling element bearing condition data.
- Blade rub and rotor rub data, ranging; light, medium and heavy contact.
- Providing rub control during start up of semi hot gas generator, preserving power, and preserves turbine reliability. Faster start up as rub problems can be navigated away from.
- Providing Break Away rub control during start up of semi hot power turbines, preserving power.
- Determining need for waterwash by vibro-acoustic feedback.
- Accessory gearbox bearing and gearmesh data.
- Axial compressor 1stage blade Mid Span Damper fretting wear.
- Axial compressor flow instability over individual blade rows. VSV drift off. Stall-surge detection.

VEWS can typically read and correlate additional data from:

- Torque meters- (for exact performance monitoring)
- Oil debris monitoring (correlated to VEWS bearing diagnostics)
- GG RECOUP trust balance correlated to GG trust bearing acoustic feedback.

Step up gearbox

- Gearmesh energy, and tooth contact surface condition

Process compressors

- Short spike stall and/or surge
- Liquid carry over spikes and shock.
- Impeller sidewall material loss
- Misalignment, shaft cracking and coupling problems
- Rub between rotating and stationary parts

Power generator

- Short spike shaft torsional feedback problems from grid
- Movement of rotor mass. (windings, etc)
- Misalignment, shaft cracking and coupling problems

System output

- -Remotely accessible
- -Real time logging of events and event triggered alarms
- -Routine summary of pat events at optional intervals (e.g. monthly)
- -Export of triggers machine control systems for integration to logics for protection.

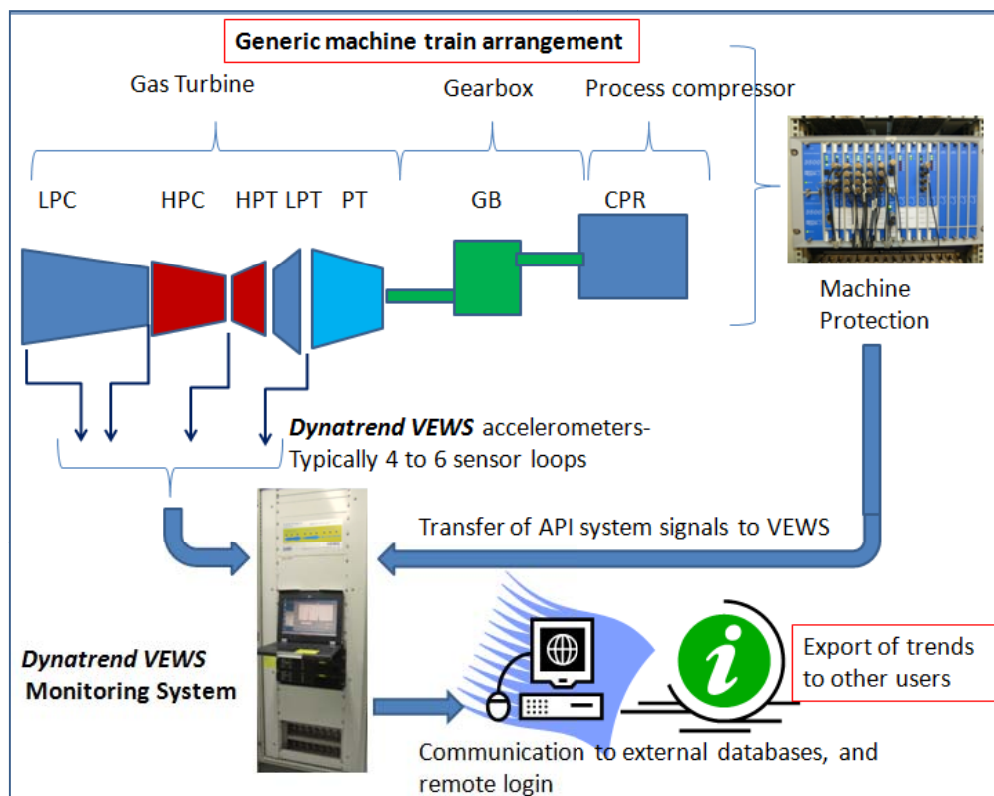


Fig: Typical arrangement of a monitoring setup

DYNATREND Vibro-acoustic Early Warning technology and methodology

LOW COST

By the use of non intrusive seismic sensor systems, an extremely cost effective solution is available for “visualizing” interaction between mechanical components in critical machinery.

INNOVATIVE TECHNOLOGY

Traditionally, only rotor vibration is used for key information of the mechanical condition in turbo machinery. However, new and more important is the feedback from the internal component interaction related to clearances, component touching, resonances, breakages.

Since energy in vibro-acoustic form is extremely easily transferred through metal, crucial information is revealed by using the machine housing as the source of information. This method is possible by applying our knowledge, patents and technology.

As an example, this can be “demonstrated” by listening onto the rail-way while a train is arriving. Through the rails, the train can be heard miles away by a human ear. However, this is only audible, and cannot be felt as vibration. The train need to be close to actually feel the vibration.

-Thinking of the train synonymous to a turbo machine, we could provide early warning of its arrival, long time before the rails start to vibrate

By using sensitive sensor systems, diagnostics of a locked up wheel which is dragged along the rails would be announced, and instantly alerted. Then a spare wheel can already be made available prior to arrival.

Automatic diagnostics will open up a time window for dealing with a problem at an earlier stage compared to waiting until vibration is detected. Early warning potentials are creating valuable tools for enhancing availability.

IMPLEMENTATION TO END USER

Several patents, long term developed know-how, and strong IP has created the ability to open up a very wide window into mechanical related fault predictions towards complex machinery.

The simplicity in hardware and software, the low cost sensors and easy attachments to any machinery makes it an available tool for all user categories in the turbo machinery industry.

For the gas turbine segment it spans all the way from small helicopter gas turbines to heavy industrial units.

WHAT IS Vibroacoustic Early Warning System-VEWS

VEWS is a ultra fast vibration/transient analysis system which is specially equipped and configured to identify imbalance problems, rolling element bearing problems, blade rub problems, rub towards rotor, resonance phenomena, and more. Not limited by this, the system and technology is more than sufficient to monitor gearboxes, process compressors, or any type of rotating equipment. Among several outstanding abilities, the system also includes monitor flow instability issues over individual blade rows in axial compressors by vibro-acoustic feedback.

VEWS CAPABILITY

VEWS is capable of predicting and trending a wide range of early stage anomalies compared to conventional systems.

VEWS is typically remotely connected to Customer data network via CITRIX .

For end users or OEM's with already existing infrastructure for handling condition related data, the VEWS information can easily be embedded to databases and overall logging systems, thereby enhancing the predictive ability.

VEWS do have a very strong side by using rulebase diagnostics which is built up case by case. Cases are typically endorsed by the end user before integration. All embedded faults will be automatically announced if occurring, and this is reducing the need for transferring data over the net as the diagnostics are done at the plant. It also offload the organization for not working on diagnostics that have been done before.

NEW TECHNOLOGY

Limiting and preventing blade tip clearance loss

The latest module added to the VEWS system, is a tool and method able to reduce the tip clearance related power degradation commonly seen in axial flow gas turbines. Some installations require all the power that can be delivered from the Gas turbine, and by limiting the power loss, large assets can be saved.

Availiability increase

Obvious benefits when applying this technology is that both operators and OEM's can extract information describing the gas generator internal component degradation at a much more detailed level than conventional analysis systems can provide. This is very useful for enhancing availability figures

Maintenance planning

General benefits increase when knowing more about the machine behavior compared to today's standards. This will aid making every decision related to the machine condition easier as condition based parameters can be added to the commonly used time-based evaluations. This will make the work for engineers and staff more interesting as it will be easier to know more details about the condition. For maintenance planning, more freedom is generated as a more useful data related to the machine condition is available.

Business case

The business case for limiting power loss at a full load gas turbine is formidable. For one typical platform, Dynatrend Power preservation program can conservatively calculated contribute to avoid losing export volumes in the value of 30-to 50 MUSD. over a 3 year running period. Further, enhanced diagnostics will aid to reduce unplanned outages, contributing to increased availability figures.

Implementation

Implementing intelligent diagnostic systems with human interaction normally requires altering the mind set for how to operate the rotating equipment, going from only to keep the machines running, to be able to conserve efficiency and power, and to enhance reliability. Implementation requires a close cooperation between Dynatrend and the operational teams for taking out the full potential.

The VEWS system is the right tool, and is already proven at multiple Oil & Gas installations and test-cells.

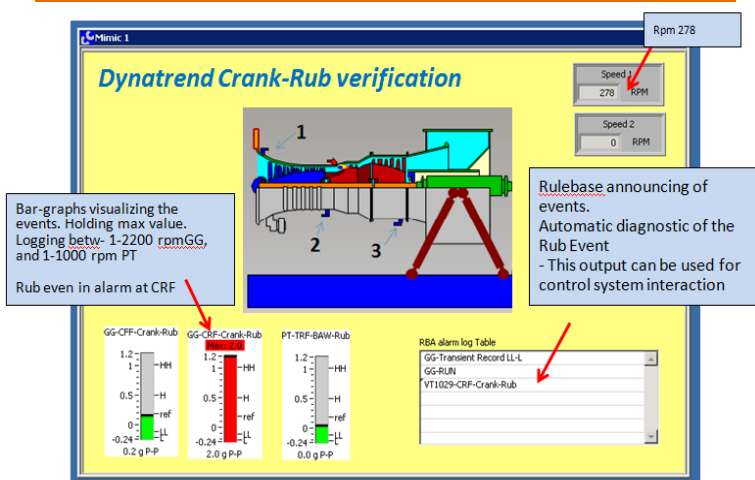


Fig: Typical arrangement of rub feedback from an GE-LM2500PE- Power Preservation tool.

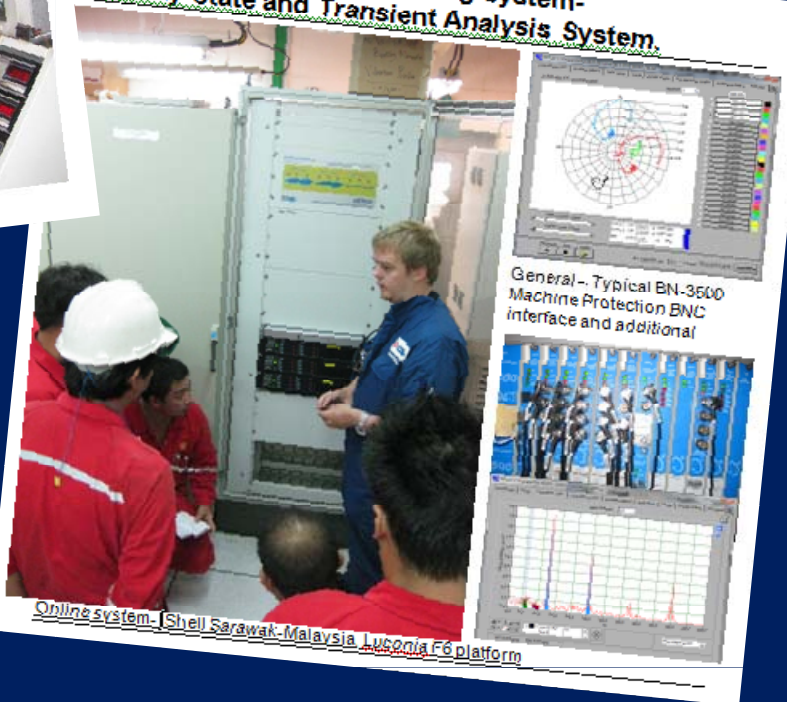
AVIATION & OEM

Testcell application



HeliOne - Turbomeca Makila A1A testcell at Forus-Stavanger - Norway

Dynatrend -Online Monitoring System-
Steady State and Transient Analysis System



General - Typical BN-3500
Machine Protection BNC
interface and additional

Online system - (Shell) Sarawak - Malaysia, Luconia F6 platform

TAILOR MADE APPLICATIONS FOR DEMANDING TASKS

OIL&GAS



Portable systems- testcell applications etc

OEM

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