Common Denominator for Condition Monitoring

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Abstract: Hydac has lately been focusing its CM-Expert condition monitoring system not only on its own sensors which determine water content in hydraulic media and the contamination itself, but also on all other process or system-related sensors to build up condition monitoring tools to pre-detect component failures and carry out the preventive maintenance. Designed either as a centralized or as a bus-system, the nucleus of the CM-Expert is a variety of microcontrollers or PLCs, using a broad spectrum of analogue and digital in- and outputs. The open system, compatible with all makes, has been well received because of its clear user interfaces and its ease of use. As a condition monitoring system, the CM-Expert pools process management data or condition monitoring data, regardless of the sensor manufacturer. Data memory and algorithms are available to be able to trace the course of damage over longer periods or to prove to customers that processes are free of errors. The presentation will include architecture of the system as well as several applications from different industrial branches.

Keywords: Condition monitoring, fluid sensor, particle counter

1. INTRODUCTION

The CM-Expert system, offers the user the freedom to integrate all types of sensor into the CM system – easily as well as quickly. No wonder therefore that users such as Airbus Industries and AMD have acted quickly and have found the system to be very satisfactory. Hydac CM systems have widely varying objectives. One manufacturer will be concerned with vibration analyses, another with the water or solid particle content of the oil, a third with the air quality in clean rooms. This list becomes endless when pressure sensors and expensive analysis systems are considered which, for example, examine hydraulic systems during and after flushing for residues and particles in aggressive cleaning media. In addition there are sensors to determine fluid level, flow rates and more.

If a user were to install the monitoring software from each of the relevant manufacturers onto his computer, it would very quickly become impossible to negotiate one's way round the screen. A lack of trust in the confused mass of displays and input screens is therefore a likely outcome. Above all, thanks to its excellent clarity, it is easy to learn how to operate the CM-Expert, and the program contains all the functionalities which are required for monitoring processes and systems, including easy integration of additional test points, adjustment of threshold values and multiple re-scaling of measurement transmitters of similar types.

Even though the system comes under condition monitoring at Hydac, it lends itself equally well to setting up a control room, without having to engage too deeply in atomization systems. In order to achieve the required capability for industry, it was decided to configure the industry PC itself, without all the bells and whistles which only get in the way of performance or stability.

But in return it provides an even wider connectivity in terms of the connection options of the sensors. Even with the basic version, sensors of similar or even different types can be connected to it.

The cost of monitoring the signals and upper and lower limits is less than most users think. A chip manufacturer uses the system, for example, to monitor 6 fluid sensors which are used on process media such as hydrofluoric acid, hydrogen peroxide, ammonia solutions or salt solutions, sometimes even in potentially explosive locations. Airbus on the other hand uses the system to monitor 37 fluid sensors and 75 flow rate controls. The main priority in their case is to prove and log the cleanliness of pipe systems, following assembly, by means of "turbulent flushing" of the hydraulic systems, before a component goes to final installation. Given that all types of sensors can be connected and when limits are exceeded or are not reached, messages can be displayed on screens or even alarm messages can be sent via email or to a mobile phone, a monitoring system can be set up with very little outlay.

One system oversees all the sensors, rather than numerous sensors working in isolation. The robust industry PC even supports the communication with the controls and has already been certified (software included) by a large German chemical company and an important pharmaceutical manufacturer. The user can therefore determine what should happen, for example, on the extruder of a plastic injection moulding machine, if the permissible temperature is

exceeded: first notify the master, or simultaneously switch off the machine before it produces faulty parts or even causes damage to the system. Other application examples are test rigs and wind turbine systems – and in the offshore sector. The developers of the system attach great importance to simple operation. This is the be-all and end-all because we do not wish to replace large process control systems or software for operation and display, but we want to establish a niche for ourselves alongside them.

Where large systems are used, CM-Expert is having a process-orientated role which is complementary to the system. The system complements exist control room systems in the best possible way, because, once implemented, it can easily be upgraded by the operator, thanks to its commonly-used interfaces, or can also be adapted if processes are changed in any way.

The CM-Expert can be used for example to monitor entire machine parks and only in the event of a breakdown would the main control room be informed with relevant details. If the production equipment department upgrades a machine with a further sensor, or if the machine park is extended by another machine, the CM-Expert can be adapted extremely simply. And if a problem should arise, the user does not have to waste time deciding which manufacturer should be contacted.

2. APPLICATION EXAMPLE

Condition Monitoring on the High Seas

A drilling ship (Figure 1) equipped with the Condition Monitoring (CM) system is 228 m long, 42 m wide and can drill down to a depth of 10 000 meters. The wave compensation system can compensate against waves of up to 7.6 m with full drilling power with the positioning of the drilling ship being controlled by “Dynamic Positioning” GPS-controlled software. The main hydraulic system has a total oil volume of 90 000 litres, out of which 16 000 litres is in the piping system and in drilling tower cylinders. The cylinder stroke is 24 m with a normal moving speed of 1.5 m/s and 2.5 m/s in fast action when the 29 hydraulic pumps give a flowrate of up to 33 000l/min.

Operating at sea requires special specifications from the hydraulic system, especially from the service and reliable spare parts availability point of view. A stoppage in the drilling work because of a failure in the hydraulic system could cause enormous costs; it is therefore important that the CM expert system controls the hydraulic system parameters 24/7/365.

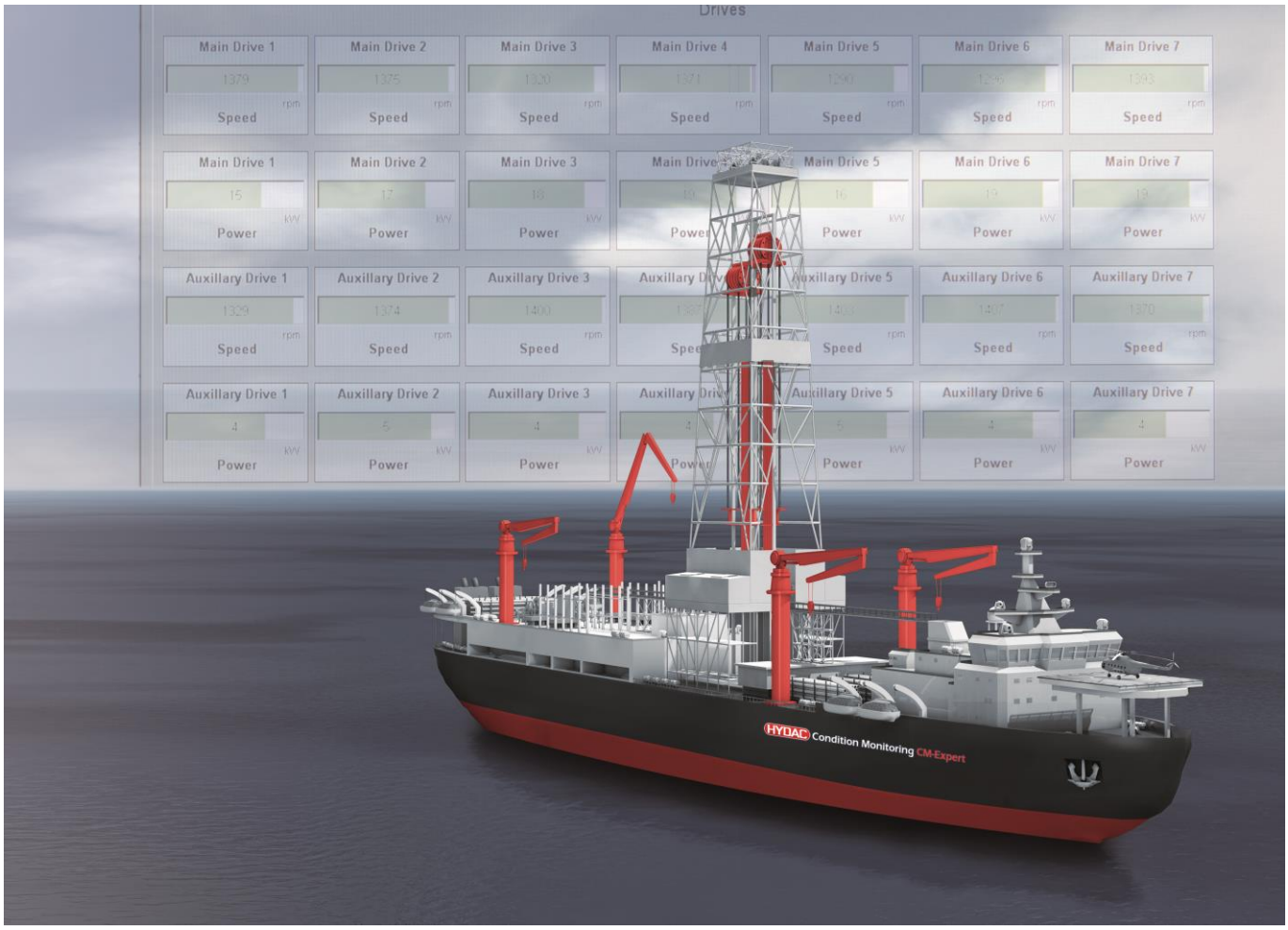

Fig. 1. Drilling ship is ideal object for the Condition Monitoring System.

The CM system consists of 31 optical particle counters (Figure 2), 31 pressure transducers, 26 flowmeters and 4 multifunctional oil condition sensors with the main function of the system being to monitor the condition of the hydraulic pumps. The system gives an alarm of pump failures, reports the operating time of pumps and gives information about the overall pump condition by comparing the current actual measured values to the measured values of a new pump, enabling advanced planning of condition-based and time-optimized maintenance. Based on the real time measuring data and alarms from the hydraulic system, the CM system sends an automatic report of immediate service needs to the service personnel, thus preventing expensive damages and additional failures and increasing the utilization rate. Service and maintenance operations can be optimized and the lifetime of components in a hydraulic system is increased.

Fig. 2. Particle counter assembly.

The sensor data is collected in a router in the hydraulic room for data processing and transferred to the main unit, which is installed in an isolated marshalling cabinet. The main unit consists of an industrial PC and condition monitoring software to process and visualize the measurement data. The user interface is a touch screen panel installed on the main unit, which can be individually tailored to meet each customer's needs. The visualization and naming of the pump groups is done according to customer specifications and names like "spare pump", "main pump 1", "main pump 2", "servo pump" etc. are used in the user interface. The sensor values, alarm limits and alarms are shown for each pump group. When the limit values have been reached or exceeded, the system sends an automatic message to the operator informing which sensor and in which measuring location triggered the alarm. Furthermore, the alarm will show up in "traffic lights" located in the hydraulic room or service centre. The stored measuring curves and limit values of each measuring point can be easily checked afterwards. Condition of the hydraulic system and necessary service actions can be easily and quickly defined based on the measuring data and easy switching between online data and history data helps to compare the values.

The user interface display (Figure 3) can show the actual measured values both in numerical and graphical forms and the alarm and message system allows the user to find, define and compare the alarms and history data of each sensor. The alarm log shows always-open alarms and messages and in addition the colour coding shows the condition of each group, which helps to find active alarms and messages. All alarms are stored in the alarm log and can be read at a later date (for example after a shift change, the next shift can check alarms, messages and comments during the previous shift).

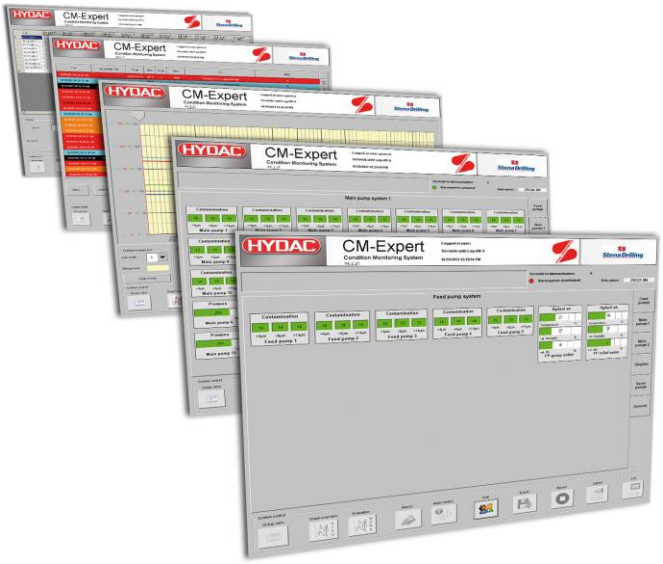

Fig. 3. CM-Expert condition monitoring system user interface.

A reliable condition monitoring system needs calibrated sensors, so there is a calibration test bench installed in each ship to ensure reliable and long sensor operation. A supplier's specialized service technician maintains the system and calibrates all sensors once a year. The CM-Expert condition monitoring system can be installed to most applications and sensors, for example in steel mills, paper factories, power plants, machine tools, mining and mobile applications.

Features of the condition monitoring system:

- Constant monitoring of the production media.
- Automatic messaging of maintenance-relevant limits have been reached.
- Immediate alarm when the limits are exceeded.
- Early detection of the faults and prevention of "emergencies".
- Optimization of service intervals.
- Reduction of maintenance and repair costs.
- Prevention of the operation downtime and consequential damage.
- Customer tailored user interface and operation.

REFERENCES

Application example drilling boat published in Maintworld_2013-3_hydac condition monitoring on the high seas.pdf

More info about CM-Expert: http://www.hydac.com/de-en/service/fluid-engineering/condition-monitoring/product-program/monitoringcontrol.html