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Manufactured in South Africa**

Inspecta III

www.instrotech.co.za

Inspecta Acoustic Steam Leak Detection

An advanced acoustic leak detection system designed for the early detection and progressive monitoring of steam leaks within coal fired boilers and subsequently minimising boiler outage and repair time.



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Inspecta Acoustic Steam Leak Detection

The Inspecta III Acoustic Steam Leak Detection System (Inspecta ASLD) was designed to detect boiler steam leaks in large thermal coal fired boiler installations ranging between 200MW to 900 MW but customizable to be used in smaller facilities to detect tube leaks at an early stage (1mm to 2mm in diameter). The Inspecta III's extensive diagnostic features enable maintenance to be planned and scheduled appropriately.



Features and benefits of the Inspecta III

- Very early detection of steam leaks and trend analysis of the potential tube leak progression, assisting in scheduling when best to plan a boiler shutdown.
- Complete capture and logging of all field sensor data, enabling post-event analysis.
- Strong system access security through a sub-system of various user levels; System Administrator, Supervisor and Operator. Each of these has a dedicated list of allowed operations.
- Standard 19" rack mechanical equipment practice.
- Modular expansion of up to 64 field sensor channels per system.
- The Inspecta III system makes use of industry standard communications protocols to communicate to utility information and control systems and networks.
- The standard communications output is serial RS-232. As an alternative output option, Modbus RS-485 may be utilised instead, please contact supplier for more information.
- Recording of Trend progress for potential steam leak monitoring and analysis.
- Backward compatibility connecting to existing sensor networks and plant facilities using the purpose designed Inspecta Plant Interface (PIU).
- Digital inputs to enable relevant power station conditions to be input to Inspecta (e.g. soot blowing)
- Digital outputs for audible alarm conditions such as critical (steam leak) and low level alarms.

Cost saving case study

The Inspecta ASLD system has been shown to reliably detect steam tube leaks less than 2mm. To achieve this accuracy, the system must be correctly calibrated and the 'listening' pipe-sets kept clear of any obstruction that will reduce the sensitivity of the system. Experience has shown that if there is any obstruction such as fly-ash that reduces the sensitivity by more than 10%, it will result in a measurable degradation of the Inspecta ASLD and a delay in the detection of a tube leak.

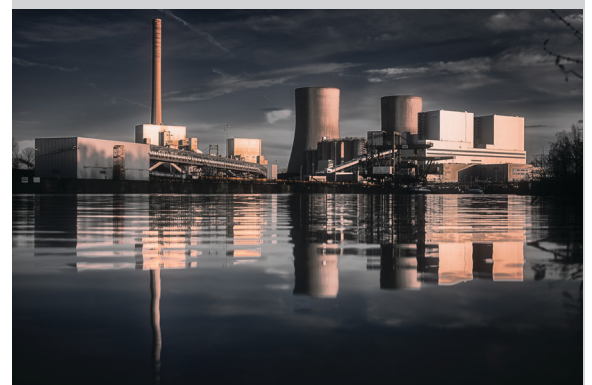
Early leak detection gives operational management staff time to consider and evaluate different options so that effective action can then be taken to minimise boiler downtime and loss of electricity production.

Case 1: Early Detection of Tube Leak

In this case the tube leak was detected promptly, and the boiler shut down before significant secondary tube damage had occurred. From the literature (EPRI, 2003), this resulted in an outage time of 2 days before the boiler was brought back onto line.

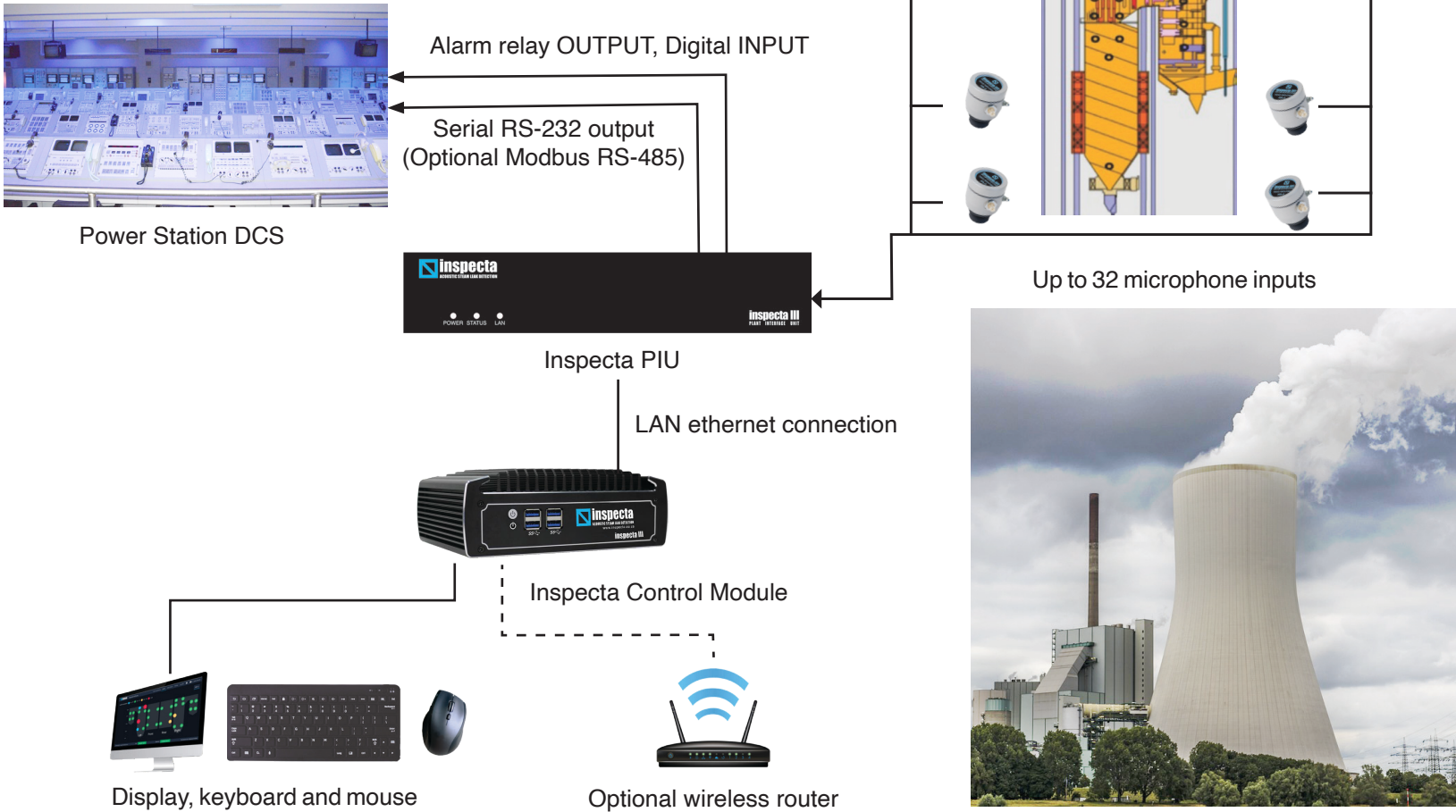
Case 2: Delayed Detection of Tube Leak

The tube leak was detected, and the boiler shut down 2 hours after case 1. In this case, it is assumed that a tube leak has occurred and rapidly created significant secondary damage so that upwards of 40 tubes have been damaged, (similar to the case described in Combined Cycle Journal, 2020) . From EPRI information (EPRI, 2003), the boiler outage time increases steeply as secondary damage increases. From this information, the time taken to repair the boiler was 11 days, which means 11 days of lost electricity production.



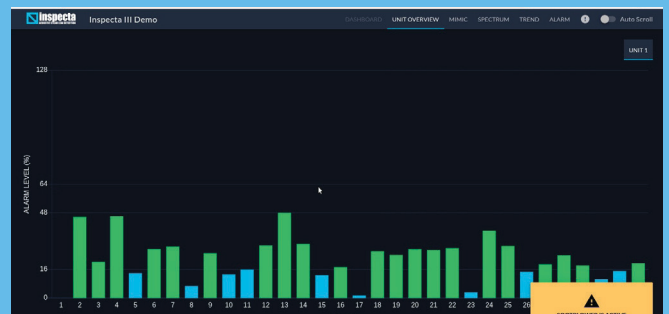
Inspecta III System Setup in Power Station

The Inspecta III system is connected to the coal-fired boiler in the field and the power station's Distributed Control System (DCS) in the following arrangement:



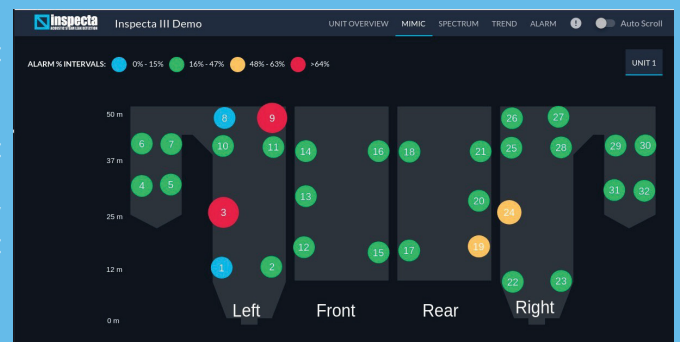
Unit overview

Indicates the alarm level % for all channels of the Inspecta system. Up to 32 field sensors can be displayed as bar graphs on the same screen in order to provide an overview of the system's condition. Each bar level is 0-100% indication of the processed audio spectrum. When the sound is at a normal background pattern, the bar will remain in the green zone, 16-47%. Should one or more inputs increase in volume and change their pattern to indicate an abnormal condition, the bar will then rise into the yellow/amber zone, 48-63%. As the leak increases the bar will rise into the red zone, 64-128%. If the bar remains in the red zone for longer than a pre-set time (default is 1min), an output relay is initiated which, if connected, is able to activate remote alarms at the Power Station control panel. The blue zone, 0-15%, indicates that the relevant field sensor is not working. This may be due to fly-ash blocking the stub pipe or no sensor is connected.



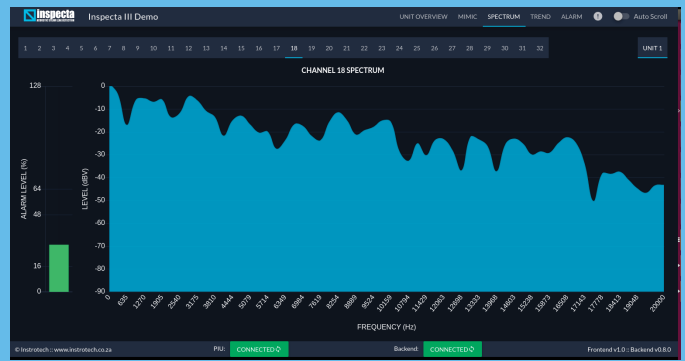
Mimic view

The Mimic view indicates to the plant operator the physical position of each Sensor point on the boiler. The numbered input points (shown as circles) are sized according to alarm severity and change colour as the alarm Bar Graph increases. Once a danger level has been exceeded and timed out, the point will pulsate in red. An abnormally low level will pulsate in blue to signify a system malfunction. During initial commissioning, the boiler plant layout showing the position of the sensors should be designed and uploaded to the new Inspecta system.



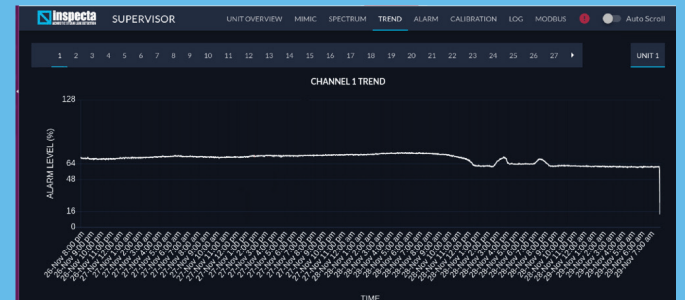
Spectrum view

Displays the frequency spectrum for each selected channel as well as the alarm % level for that channel. On the Audio Spectrum display, the sound level is indicated as decibels vs. frequency. Inputs are sampled at least once every five seconds and digital averaging is incorporated into the programme to allow for any spurious noise. This sound signature has a particular shape for the normal background sounds such as burners, induced draft and forced draft fans. The background sound patterns can be saved for future comparison against the patterns generated by steam leaks. When a steam leak occurs, the patterns alter and are displayed in the form of an alarm on the Unit Overview. The Spectrum Display also shows the time & date, boiler and sensor number.



Trend view

By using the Trend view, operators are able to visually interpret the alarm % level for a selected channel over a 32 hour period. The Trend view is useful for analysing the progression of possible steam leaks over time. This vital information assists the boiler maintenance staff in making crucial decisions regarding when to shutdown and action the repair work within the boiler.



Inspecta III retro fitting

The Inspecta III acoustic steam leak detection system is BACKWARD COMPATIBLE with all existing Inspecta sensor networks and plant facilities. If an Inspecta FFT Muxbox(s) is being used, it is simply replaced with the purpose designed 19" rack-mount Plant Interface Unit (PIU) which is plug & play. All existing plant wiring remains the same. Some minor wiring changes within the Control room may be required.

Reference List

- Combined Cycle Journal. (2020, April 20). Some issues affecting HRSGs. Retrieved from Combined Cycle Journal: <https://www.cj-online.com/some-issues-affecting-hrsgs-conventional-boilers-have-common-solutions/>
- ESKOM. (2020). ESKOM Integrated Report 31 March 2020: Restoring Trust. Johannesburg: ESKOM.
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