



**Designed, Engineered and
Manufactured in South Africa**

Inspecta Automatic Purge System

A cost-effective ambient air purge system that requires neither compressed air nor an additional local power source to remove the fly ash build-up within the Inspecta pipe-sets.

Inspecta APS

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Instrotech, the company that designed the very successful Acoustic Steam Leak Detection Systems (Inspecta ASLD) have now developed a fully automatic purging system that is easily retrofitted to existing Inspecta installations.

The installation of this system will eliminate the requirement for routine manual purging of the pipe-sets and maintain the leak detection system at peak performance without manual intervention.

Inspecta ASLD systems are installed in most of the ESKOM power stations. Using acoustic detection technology, these systems can detect tube leaks less than 2mm in diameter in the large boiler structure.

However, as the coal used by ESKOM is very high in ash content, there is a considerable amount of fly ash remaining after combustion. This fly ash swirls inside the boiler and quickly blocks the 'listening' pipe-sets that contain the sensitive leak-detection microphones.

Unless the systems are frequently manually or automatically cleaned their ability to detect the leaks early, is significantly degraded.

Benefits of the Inspecta APS

- Complements the existing Inspecta ASLD system.
- Easily retrofitted to existing Inspecta ASLD plant sensor network. The Binder connector fitted, is compatible with Inspecta HA-3 sensor. An option exists to fit power station specific connectors if required.
- Significantly increases the effectiveness of the Inspecta ASLD system by automatically maintaining optimum performance levels.
- Improved early leak detection means that boiler outage times can be significantly reduced.
- Inspecta APS removes the routine maintenance human factor. It is automatic and does not require any human intervention to function.
- The system is purpose-designed to work in the extreme environmental conditions of a power station boiler house.
- As a complement to the Inspecta ASLD system, the Inspecta APS system cost can be recovered on the single early detection of a potentially damaging steam leak.
- AI-driven adaptive performance*

*Future planned enhancement.

Background

The literature on large boilers is extensive and agrees that boiler tube leaks are a major cause of boiler downtime.

EPRI Report RP1863 states that up to 6% plant availability is lost to boiler steam leaks, while other peer reviewed papers state that 60% of all boiler outages are caused by tube leaks.

The consequences of fast-progressing tube leaks, if left undetected for just a few hours, are serious resulting in significant secondary damage to surrounding tubes.

Typically, this secondary damage progresses at an exponential rate as each secondary leak can now cause further leaks.

This means that with certain leaks in critical areas, a few hours delay in identifying a tube leak and taking effective action, will result in increasing the boiler down time from a typical 2 days to more than 10 days, with associated loss of electricity production.

During 2020, South African main energy provider, ESKOM, had an Energy Availability Factor (EAF) of 67% with an Unplanned Capability Loss Factor (UCLF) of 22.9%. During this period, Eskom recorded 170 boiler tube leaks, which accounted for 9% of the UCLF.



The rate at which sound level deteriorates over time due to fly ash build-up

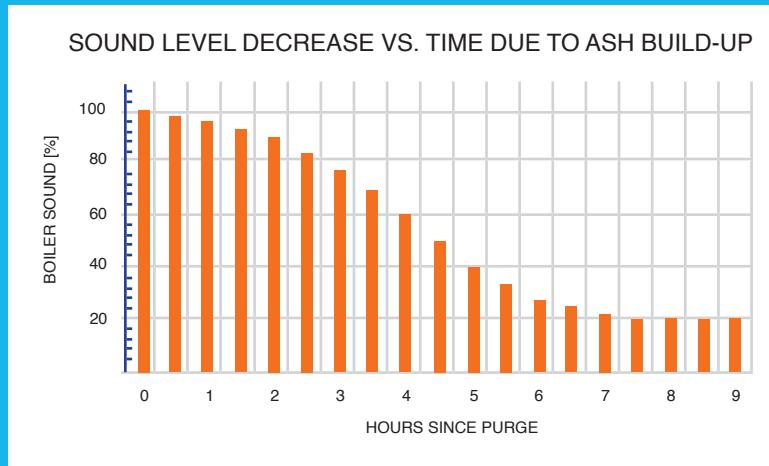


Figure 1 shows actual results of the attenuation of boiler sound over several hours in an **extreme case**.

In less than 5 hours, 50% of the sounds are blocked and in less than 8 hours 80% are blocked.

This means that to maintain a steam leak detection system at optimum performance, the 'listening' pipe-sets should be cleared every 1.5 to 2 hours!

Figure 1

Cost Savings Case Study

The proven Inspecta ASLD 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 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.

Referring to Figure 1 above, to optimise effective leak detection operation, the pipe-sets, located in particularly the combustion areas of the boiler, should be cleared of fly ash build up every 1.5 to 2 hours! It is not practical to reliably achieve this using a manual purging system.

If the fly ash is allowed to build up, over a period of 5 to 6 hours, this will result in a serious degradation in the leak detection sensitivity of the Inspecta ASLD. Under these degraded conditions, tube leaks may only be detected after progressing for some time. The resulting delay in detecting a tube leak may well result in extensive secondary tube damage and significantly extend the downtime to repair the damaged boiler.

The literature shows that if there is a delay in the detection of a fast-progressing tube leak by just a few hours, that the downtime to repair the boiler may increase by more than 5 times compared to a leak that is detected earlier.

Installing the Inspecta APS onto a boiler will ensure that the pipe-sets are automatically kept clear of fly ash, and ensuring that the sensitivity of the Inspecta steam leak detection system is not compromised. This, in turn, will enable the system to reliably detect small tube leaks at a very early stage.

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.

If the Inspecta APS installation reduces the downtime to repair a leak in a large generation unit by only one day, due to earlier leak detection, the savings in electricity production loss will pay for the cost of the system more than ten times over!

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 APS retro fitting

The Inspecta APS system can be installed into the current Inspecta ASLD configuration by simply replacing the existing Inspecta pipe-set with an APS enabled one. All existing plant wiring remains the same. Either battery-fitted or battery-less APS units can be fitted depending on the cable loop resistance between the APS PSU and the microphone location. Some minor wiring changes will be required either in the Control Room or at the JB locations

The APS units come in two variants. With and without built-in battery. Which unit is installed depends on the cable loop resistance between the APS power supply and microphone locations.

Specifications

Category	Parameter	Battery Unit	Battery-less Unit	Remarks
Operations	Purge cycle interval	30 to 480 minutes	30 to 480 minutes	Trim Pot adjustment. Default 60 minutes
	Purge cycle period	15 to 60 seconds	15 to 60 seconds	Trim Pot adjustment. Default 30 seconds
Environment	Ambient operating temperature	0°C to 65°C	0°C to 65°C	Ambient temperature should not exceed 60°C for more than 15% of operating time
	Storage temperature limits	-40°C to 70°C	-40°C to 70°C	
Voltage	Input voltage	24V nominal	24V up to 29V	Up to 12 Ohm cable loop resistance for battery units. Cable loop resistance must be <=4 Ohm for battery-less units
	Absolute max input voltage	30 V	30V	
	Min input voltage	21V	21V	Assumes a maximum 12 or 4 Ohm cable loop resistance between Inspecta APS unit and 24V power supply depending on APS variant used
Current	Input current	250 mA typical	2A max	
Maintenance	Routine maintenance	None	None	
	Periodic maintenance	2 years or 20 000 purge cycles **	2 years or 20 000 purge cycles **	Whichever occurs first.
Additional power supply	Installation location	Control Room	Inspecta JB locations	

** Instrotech offers a fixed-price refurbishment option for this product

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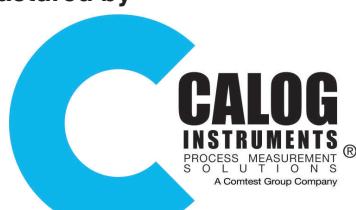
Reference List

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