

Power Generation

Perspectives in Pure Water Analytics



7 News

THORNTON

Leading Pure Water Analytics

THORNTON Multiparameter Measurement Helps to Power South Africa

Over the years, Mettler-Toledo Thornton instrumentation has safe-guarded the steam-water cycle chemistry, makeup water treatment, and generator-cooling systems of many of the plants powering South Africa. The unique multiparameter capability of the 770MAX transmitter offers on-line monitoring of all critical parameters and thus ensures water quality and saves costs.

Eskom, the primary electric company

South Africa has been a technological leader in energy production, from extensive development of synthetic fuels to innovative power plant configurations and operating techniques. Eskom is the primary electric company in South Africa with the responsibility to provide reliable, low-cost power throughout the country and beyond. It is one of the largest electric utilities in the world with over 35,000 MW of generating capacity. Eskom's power plant chemistry innovations are particularly noteworthy.

South Africa has an abundance of coal in its northeast region, above Johannesburg although it is of a low grade. As a result, large 6-unit power stations are built next

to the mines in that area to minimize coal transportation costs. However, water is in short supply in that region. To minimize water consumption, some of the plants are designed with dry cooling systems. There is no evaporation in the cooling towers which operate more like automobile radiators than conventional towers. Because of the constraints on these condensers, there are additional limitations on the cycle chemistry water treatment which raises the importance of reliable monitoring instrumentation.

THORNTON conductivity and ORP selected

Over a decade ago, Eskom was refurbishing cycle chemistry sample panels at the Lethabo Station. About the same time, THORNTON had introduced the 200CR



METTLER TOLEDO



Eskom Majuba Station.



Eskom Matla Station.

conductivity instrument with the flexibility and accuracy needed in power industry applications – especially the accuracy of temperature compensation. Its value was recognized by Eskom personnel who evaluated and then specified it for Lethabo. The successful performance at this station was recognized and over several years the 200CR was included in upgrades at Kendal, Majuba, Matimba and Matla stations. They were also used in some of the makeup water treatment systems and in special portable modules used to verify on-line instruments.

When some of the units were converted to oxygenated treatment, THORNTON 200 instruments for ORP were installed to monitor the conversion. They helped identify the changing conditions in the system as oxygen scavenger was discontinued and internal surfaces were transitioning from magnetite to hematite, finally helping to

identify the point where oxygenation levels could be raised safely to secure the hematite layer. After the oxygenation conversion was completed, it was found that ORP stabilized at a higher level and was no longer very responsive. Dissolved oxygen became the more sensitive parameter and ORP measurement was discontinued. The flexibility of the ORP instruments allowed them to be redeployed for pH measurement.

Advanced stator coolant treatment

Eskom has been quite innovative in the operation of their generator stator cooling systems. They have fully addressed the strong influence of pH, as well as dissolved oxygen and conductivity, on copper corrosion. Many other plants around the world have considerable difficulty with copper corrosion products plugging the narrow passages of the stator bars due to uncontrolled pH and dissolved oxygen levels. This is no longer a problem within Eskom.

Eskom developed a specialized ion exchange polishing system to control pH on the alkaline side near 8.5 where copper

solubility is near its minimum. At the same time, dissolved oxygen is monitored and controlled, either

very low (< 30 ppb) or high (> 2000 ppb) to avoid the rapid corrosion rates that occur between those limits. Conductivity is also maintained at a low value by the ion exchangers.

To simplify sensor maintenance and to maximize reliability when monitoring those parameters, at Lethabo station an evaluation was made of pH calculation based on specific and cation conductivity – the same technique that is increasingly accepted for alkaline cycle chemistry pH determination. The result of the evaluation was that Eskom chose the THORNTON 770MAX Multiparameter Analyzer/Transmitter to measure specific and cation conductivity, calculated pH and dissolved oxygen. Its multiple inputs and outputs allow monitoring and re-transmitting all parameters using a single instrument. This system is now being duplicated in other plants.

Dissolved oxygen upgrade

The evaluation of dissolved oxygen equipment within Eskom also led to upgrades of cycle chemistry instrumentation using THORNTON dissolved oxygen at Kendal and Matimba stations. To match the existing 200CR conductivity transmitters with virtually identical menus, display, enclosure and operation, the THORNTON 2000 series DO transmitters were chosen. This choice minimized requirements for new documentation, operator training and spare parts inventory as well as providing a consistent panel appearance.

In measurement applications from makeup water, to cycle chemistry, to stator coolant, THORNTON instrumentation has proven its capabilities for long-term fulfillment of power plant requirements in South Africa and around the world.



770MAX configured for specific & cation conductivity, calculated pH and dissolved oxygen measurements.

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THORNTON 770MAX – the Ideal Verification Instrument System Platform

On-line analytical instruments in today's power plant are expected to operate reliably and accurately. But this requires proof. Verification of measurements can take a number of forms, from checks with known standard solutions, to electrical calibrations of instruments, to returns for factory traceable re-calibration, and more.

On-line verification is optimized

One of the most comprehensive verification methods is to use a complete duplicate on-line measuring system that has proven accuracy. A portable on-line system eliminates several of the pitfalls of comparison measurements. It connects directly to the sampling point to prevent sample contamination, time delays and temperature changes which are inherent in laboratory samples. The best on-line instruments can be set for accurate application-specific high purity temperature compensation which is not available in most laboratory equipment. On-line verification also avoids the routine use of standard solutions which cannot be made reliably in the high purity ranges where most of the measurements are made.

An on-line system to verify many parameters can entail high cost and complexity, with individual instruments for each measurement. Each additional parameter is a major increment to the system and it can become unwieldy. For these reasons, a number of plant chemists have chosen to build their portable verification systems around the Thornton 770MAX platform which can fit onto a panel mounted on a two-wheeled hand truck. With the 770MAX Multi-parameter Analyzer/Transmitter, four analytical parameters plus temperature can be monitored simultaneously in one unit. All parameters can be displayed

and sent to analog or serial digital outputs for local or remote data acquisition.

The single 770MAX provides identical operator interface with straight-forward menus for all parameters. Its compact size



770MAX portable verification system measuring conductivity, pH, dissolved oxygen and TOC with local data acquisition.

and light weight contribute to the portable system design. It has full flexibility in the choice of parameters and even allows adding or changing parameters in the field, with appropriate sensor changes.

Sensors support portable verification system performance

Of course, every measurement depends first on the sensor for consistent, reliable results. The 770MAX instrument, whether for portable or permanent installation, is complemented by an array of sensors designed specifically for high purity measurements.

Conductivity sensors are provided with individually-certified, ASTM and NIST traceable cell constant and temperature calibration. Specific and cation conductivity temperature compensation algorithms are the most accurate available. Where both specific and cation conductivity are measured, the calculation of pH from these values is available in the 770MAX to provide a highly reliable check on pH readings.

For electrode pH measurement, the pHure Sensor™ includes a pressurized flowing gel reference electrode and differential measuring circuit that assure excellent stability and matching of calibration in traceable buffer solutions. In addition, measurement can be confirmed by the abovementioned calculated pH value.



770MAX portable verification system measuring specific and cation conductivity and pH. Dissolved oxygen has since been added to this system.

High performance dissolved oxygen measurement to the lowest ppb levels is provided by a probe with guard ring electrode that promotes rapid downscale response. It also employs a reinforced membrane for long life and stability. The membrane is part of a cartridge that makes replacement extremely easy and low cost.

Verification system doubles as a troubleshooting tool

Where cycle chemistry or makeup water treatment systems experience upsets and where on-line measurement is not available, a portable system such as described here can be put into service at any point. It can be used as a diagnostic tool to monitor trends and help resolve problems. The output signals are a key capability for this purpose.

Organic contamination finding its way through a makeup water treatment system can be a real threat to operation. But because of the cost of total organic carbon analyzers, they are seldom installed permanently. However, a single TOC measurement in a portable system can be used to diagnose problems at many points of makeup water treatment. Thornton provides the simplest, the fastest responding, the most compact and the lowest cost TOC measurement available. The convenient 5000TOC Sensor connects to the 770MAX like other sensors. It requires no reagents and has no moving parts, making it ideal for portable use. It provides thorough surveillance of makeup water integrity, including both inorganic (conductivity) and organic (TOC) detection.

With greater importance being placed on reliable on-line analyses, a portable verification and trouble-shooting system is becoming an essential tool for successful power plant chemistry management.



Hand-carried 770MAX system measuring specific and cation conductivity, dissolved oxygen and pH.



770MAX with 5000TOC Sensor detects inorganics (conductivity) as well as organics (TOC).

770MAX Provides Reliable Multiparameter Monitoring for Cycle Chemistry

To assure reliable operation of aging power plants, on-line instrumentation must be upgraded periodically. The THORNTON 770MAX Multiparameter Analyzer/Transmitter, used with up to four analytical sensors with Smart Sensor technology, makes upgrades especially easy. Its compact size, its greater functionality and accuracy make the changeover a true upgrade.

AEP Appalachian Power Company Clinch River Station in Virginia

The AEP Appalachian Power Company Clinch River Station in Virginia has three coal-fired 235 MW units built in the early 1960s. They are highly efficient for plants of that vintage. Various modifications to those units have been implemented over the years to maintain that high performance. A recent change replaced the deteriorating sampling equipment and analytical instrumentation monitoring Unit #3.

770MAX combines with Smart Sensor technology

Despite the use of other instrumentation on the other two units, for this upgrade the plant chemist chose the THORNTON 770MAX because of the Smart Sensor technology, convenient menu-driven operation and compact four-channel design. The need to replace equipment for conductivity, dissolved oxygen and pH was matched very well by 770MAX capabilities which allowed the measurements to be configured in the most straight-forward combinations.

4 Multiparameter analyzer measure 16 channels

A total of 4 dissolved oxygen, 2 pH and 10 conductivity measurements on 4 - 770MAX instruments were designed into a very compact panel that fit into the available space. The sensors were designed specifically for high purity measurements on

power plant samples. The high performance dissolved oxygen sensor can withstand very hot samples in case a cooler should fail and uses a simple, low cost, drop-in membrane cartridge that minimizes maintenance time and expense. The compact pHure Sensor™ provides accurate pH measurements in low conductivity samples without cumbersome electrolyte reservoirs or other refilling requirements. Conductivity sensors are individually factory calibrated with NIST traceability and are used with exceptionally accurate specific and cation conductivity temperature compensation algorithms in the 770MAX.

Reliability overcomes skepticism

Early in the project, plant chemical technicians were skeptical of having new, unfamiliar instrumentation specified for Unit #3. However, after just a few weeks of operation, they began recognizing the ease of operation and reliability of the 770MAX measuring system which is making their jobs easier to obtain consistent data on water and steam quality. The data, in turn, is helping the Clinch River Station to comply with the high company standards for monitoring and controlling cycle chemistry conditions.



Four 770MAX instruments measure 16 channels of conductivity, dissolved oxygen and pH on sample panel by Waters Equipment.



Dissolved oxygen and pH sensors for critical cycle chemistry sample points.

Training and Technical Services

On-site instrument operation and calibration training workshops

THORNTON's Operator Training Courses are tailored to each customer's requirements. The course is conducted in a classroom setting where interaction between instructor and participants is encouraged. Each attendee is supplied with material detailing the course content. Instruments are provided for hands-on participation. The areas covered in this training program focus on THORNTON instrumentation, calibration, and maintenance specific to your facility. Additional technical topics may be added or substituted as requested.

Traceable instrument calibration

THORNTON offers instrument calibration and validation services traceable to national standards, industry guidelines

and/or regulatory requirements. Services using factory-trained technicians are available at our facilities in Bedford, Massachusetts or on-site at your location. Each calibrated/validated instrument is supplied with the appropriate calibration documents.

Specialized conductivity calibrations

Choose one of seven unique conductivity calibrations to fit your application needs, from standard calibrations to customer-specified temperature and ASTM verification points. System calibrations are also available where the instrument and sensors are calibrated together optimizing system accuracy.

Service and calibration contracts

A THORNTON representative will provide on-site service for items covered under the agreement. These services include, but are not limited to:

- Calibration/validation of instrument and sensor system
- Issuance of appropriate documentation
- Identification and verification of all software revisions
- Minor repairs or adjustment of instruments
- Installation and validation support services
- TOC test services
- On-Site System Suitability Testing

Tradeshows	Location	Dates July to December 2006
POWER		
Southwest Chem. Workshop	Page, AZ USA	July 18 – 20
Aquatec – Europe	Amsterdam, NL	September 26 – 29
IWC – Pittsburgh	Pittsburgh, PA	October 22 – 25
Scientech/NUS	Clearwater, FL	November 15 – 17

Tradeshows	Location	Dates July to December 2006
SEMI		
SEMICON West	San Francisco, CA USA	July 10 – 14
UPW Asia	Singapore	July 12 – 14
SEMI – Taiwan	Taipei, Taiwan	September 11 – 13
Aquatec – Europe	Amsterdam, NL	September 26 – 29
UPW (formally Portland)	Austin, TX	November 7 – 8
SCIENTECH (NUS)	Clearwater Beach, FL	November 14 – 17
SEMI – Japan	Tokyo, Japan	December 6 – 8

Tradeshows	Location	Dates July to December 2006
PHARMA		
UPW Asia	Singapore	July 12 – 14
Aquatec – Europe	Amsterdam, NL	September 26 – 29
ISPE – Boston	Foxboro, MA USA	October 18

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