

# Power Generation

Perspectives in Pure Water Analytics



# 9 News

**THORNTON**

Leading Pure Water Analytics

## EDF Puts THORNTON Cation Conductivity Know-How to the Test!

**THORNTON participated in the qualification program for cation conductivity meters held at the test laboratory for chemical analysis equipment (YAC) at the EDF nuclear power station in Chinon, France.**

### EDF, one of Europe's leading energy providers

EDF (Électricité de France) operates 19 nuclear power stations inside France with annual revenue of over €8 billion. The Product Engineering Division of EDF maintains an Expertise and Inspection Department for Manufacturing and Operation (CEIDRE) which promotes continuous improvement of operational safety and competitiveness in the field of power generation. The Center is situated at the Chinon nuclear power station in the Loire Valley in France.

In 1988, a laboratory for the testing of continuous, online chemical analysis systems used in nuclear and thermal power plants was set up at Chinon with the objective of establishing technical qualification criteria

for individual process analysis systems and for carrying out tests for each relative parameter under representative operating conditions. The findings in each case are described in a final report made available to all EDF equipment centers.

### Measurement of cation conductivity

Mettler-Toledo Thornton was invited to take part in the latest series of tests for securing approval of cation conductivity measurement instruments (range 0.05 to 0.5 to 5  $\mu\text{S}/\text{cm}$ ). The assessment tests were carried out in the period Q4 2006 to Q1 2007. Cation (acid) conductivity is the most critical measurement parameter for control of the water/steam cycle chemistry in a nuclear power plant. This measurement is carried out to control and con-



**METTLER TOLEDO**

sequently inhibit corrosion and scaling within the plant, aimed at reducing downtimes and assuring best possible protection of costly components such as boilers, turbines and condensers.

The EDF strategy relative to online analysis systems focuses on replacing frequent single (offline) measurements with precise and reliable continuous automatic measurements to enable optimization of

the plant cycle chemistry. In this case, it meant achieving reliable measurement results in the three important plant component areas mentioned above, in the presence of wide sample temperature fluctuations.



#### Mettler-Toledo Thornton solution

Mettler-Toledo Thornton placed a complete conductivity measurement system at the disposal of the test laboratory, consisting of

- 770MAX Transmitter
- Smart 230-211 Conductivity sensor (cell constant 0.1 cm<sup>-1</sup> with titanium electrodes and temperature compensation)
- Flow housing 1000-30 of type 316SS stainless steel

#### Strengths of the measurement system

In order to take part in the test, the equipment had to comply with a requirements specification. The instruments supplied by Mettler-Toledo Thornton fully satisfied all the set criteria. The 770MAX transmitter covers the required measurement range, 0.05 to 0.5 to 5 µS/cm, and is equipped with a 4 to 20 mA analog output that could be scaled logarithmic over 2 decades. Together with the sensor and flow housing, this transmitter forms a fully certified, commercially available industrial measurement system. The sensor includes an integrated temperature sensor with NIST traceable calibration. The transmitter provides selectable temperature compensation algorithms including one specifically for cation conductivity samples.

#### THORNTON's temperature compensation algorithm confirmed most accurate

Reliability and accuracy of measurement for this important parameter was the highest priority. The tests showed that the algorithm developed by THORNTON for temperature compensation in the measurement of cation conductivity fully met EDF expectations.

THORNTON conductivity sensors all have cell constants and temperature sensors calibrated and certified individually based on ASTM and NIST traceable standards. Compared to competitors' products, THORNTON's instruments were proven to provide better and more accurate measurements for both cation and specific conductivity.

Mettler-Toledo Thornton has an unrivalled algorithm for cation conductivity temperature compensation which has been the subject of several publications. Relevant articles can be downloaded from the "know-how list" on the website [www.mt.com/thornton](http://www.mt.com/thornton). «Practical application of specific and cation conductivity measurement».

#### Final approval report

Following the test series and the approval of Mettler-Toledo Thornton conductivity measuring equipment, we are now able to respond to all calls for tenders for cation conductivity measuring equipment for existing and future EDF power stations. The final test approval report will be published on the internet portal of the YAC so that the data can be easily accessed by EDF centers and power stations interested in gaining a technical performance overview before considering purchase.

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## THORNTON Dual Channel Transmitter Saves Time and Improves Accuracy

**A UK waste management company has improved measurement accuracy and reduced cleaning downtime after installing a Mettler-Toledo Thornton system.**

### DO and conductivity measurements in the condensate return line

The company, which has a power station using waste as a fuel source, was using old dissolved oxygen (DO) and cation conductivity instrumentation on the condensate return line downstream of the turbines. The application required one DO sensor and one conductivity sensor on each return line. Each turbine has its own condensate return line as well as its own control panel and the site runs 4 turbine sets and 1 'house' (standby) set. However operators found the equipment was unreliable and required frequent cleaning and maintenance.

### THORNTON 2000 transmitter simplifies measuring situation

As a result they consulted a number of suppliers with a view to upgrading the equipment. METTLER TOLEDO UK suggested the dual channel 2000 transmitter which provides an input for both DO and conductivity sensors. This meant that only one transmitter was required per control panel whilst still providing analog output signals for both the conductivity and DO to a chart recorder.

### Product benefits pass the "litmus test"

The THORNTON system was selected because of the benefits it offered and the equipment has now been incorporated into the company's production processes.

The new DO and cation conductivity instrumentation provides information on impurities and oxygen content of the condensate. This is vitally important as ultimately it can cause corrosion of pipework and boiler which would result in costly downtime and repair work.

### The result: Improved process control and less maintenance

Since the equipment was installed the company has been able to obtain accurate conductivity and DO readings without having to clean the equipment as frequently as before. It also improves monitoring

of the condensate cycle, providing a better warning of potentially expensive unplanned shutdowns.

### The win-win situation paired with confidence leads to further orders

The company has also recently placed an order for a further THORNTON 2000 meter and two conductivity sensors for use in monitoring at its deairators.

[www.mt.com/transmitter](http://www.mt.com/transmitter)

### Important facts about the THORNTON 2000

Measurements of pH, specific & cation conductivity, ORP and dissolved oxygen ensure that proper levels of phosphate, ammonia/amine and/or oxygen scavenger are maintained, to minimize corrosion. The THORNTON 2000 can be used to measure and display a pair of values on a single sample stream on one instrument. It can compute pH based on specific and cation conductivity measurements.

### Key benefits of the THORNTON 2000 transmitter:

- Single instrument model for broad choice of measurements – all configurable in the field
- Wide conductivity/resistivity range-ability enables sensor calibration in

ASTM standard solutions even for high purity applications

- Variety of pH/ORP preamp connections enable wide choice of sensors

### Key Features:

- NIST & ASTM traceable factory calibration
- Plug-in NIST traceable calibrators for field calibration
- Two 4-20mA outputs scaled linear or bi-linear
- Accurate 3-wire temperature measurement-no startup calibration required
- Selectable, application-specific temperature compensation
- USP <645> and EP compatibility with non-compensated measurement

## Advanced Fusion Research Requires Ultrapure Water

**THORNTON instrumentation has been used for many years to monitor ultrapure water treatment at the Cadarache research facility in southern France. Research there will be expanding to develop an experimental fusion reactor – holding great promise for clean, safe energy in the future.**

### Cadarache research facility

Cadarache is a research center of the CEA (Commissariat à l'énergie atomique) and one of the largest technological R&D centers for energy in Europe. The activities of the CEA research center of Cadarache are focused on the areas of nuclear energy (fission and fusion), and also new technologies for energy and studies on the effects of radiation on plant life.

### Ultrapure water contributes

To sustain these major R&D projects Cadarache has many support systems in its facilities, including ultrapure water production. To monitor and control water treatment, THORNTON 770MAX and 200CR instrumentation has been used to measure conductivity/resistivity, pH and ORP. pH and ORP are used in pretreatment stages to assure proper conditioning ahead of membrane processes including reverse osmosis. Resistivity is used to monitor final water quality at various points, with the same type of equipment used in pure water treatment for power plants.

### New fusion project

R&D efforts will be expanding considerably since the representatives from six nations and the European Union came to a €10 billion (\$12.8 billion) agreement to build an experimental nuclear fusion reactor at Cadarache. The EU, the U.S., India, China, Japan, South Korea and Russia are all participating in the International Thermonuclear Experimental Re-

actor (ITER) project. It is another step toward developing the potential of fusion as a cleaner, safer and ultimately, lower cost energy source. While fossil fuels are being depleted, a fusion reactor would run on isotopes of hydrogen which are plentiful since they can be extracted from water.

Nuclear fusion represents a practically unlimited source of energy. Under extremely high pressures and temperatures, the isotopes of hydrogen (deuterium and tritium) come together, or fuse, producing enormous amounts of energy. A prime example is the Sun, where huge gravitational pressure allows fusion to take place at about 10 million degrees Celsius. At the gravitational pressure on Earth, higher temperatures are required to generate fusion, and to date only tokamak-type reactors are capable of reaching the 100 million degree Celsius threshold where energy can be produced.

### Fusion brought down to earth

In the last several years, considerable technological progress has been made in fusion research, leading to high expectations for the ITER. With this reactor, studies done on the feasibility and functioning of a nuclear fusion-based center of electricity production can be brought to a successful conclusion, and the groundwork can be laid for the first prototype commercial fusion reactor. Up to this point energy-producing nuclear reactors have used fission, rather than fusion, to gener-

ate energy. Fusion reactors would have huge advantages: power stations would be inherently safe because “meltdown” or “runaway reactions” could not occur, and these reactors would not generate long-lasting radioactive waste. Fusion reactors would not emit greenhouse gases, and the basic fuels – hydrogen and lithium – are abundant and available everywhere.

The energy production of ITER will be unprecedented: a single gram of deuterium fused with one and a half grams of tritium can produce ten million times as much energy as a gram of oil. The successful launch of these new technologies in the ITER reactor would set the stage for the successful use of fusion as an inexhaustible and sustainable energy source. The first plasma test with the reactor is scheduled for 2016.

THORNTON instrumentation will continue to contribute to the support systems for energy research just as it has done for years in existing power plants through out the world. Where cutting edge performance and measurement accuracy are essential, THORNTON instrumentation is the first choice.

 [www.mt.com/thornton](http://www.mt.com/thornton)

## New! – High Performance Transmitter for the Power Industry

The M300 transmitter series for Conductivity, pH/ORP and Dissolved Oxygen measurements combines robustness and ease of use. High versatility and reliability make this instrument the ideal choice for most applications.

### M300 – a multiparameter transmitter

The new M300 transmitter line has been designed to measure pH/ORP, conductivity, dissolved oxygen, dissolved ozone and flow. Besides a single channel unit there is also a dual channel version available with multi-parameter capability. A large, 4 line backlit display with menus in 5 languages simplifies the installation and configuration of these instruments. The transmitters feature a USB port for ease of configuration, data logging and downloading software upgrades.

### M300 – the right choice for pure and ultrapure water detection

These benefits make the Mettler-Toledo Thornton brand transmitters the first choice for applications in the power and pure water treatment industries. In addition, they include application-specific high purity temperature compensation of conductivity and pH, and computation of pH from specific and cation conductivity measurements.

Fig. 1: Clear, backlit display



### Features, designed according to industry requirements

The hallmark of a modern measurement system should be the practicality of its hardware combined with an intuitive, self-explanatory user interface. This enables the complete system to be set-up and operated without prolonged study of operating manuals or costly personnel training. The information shown on the display should be clearly legible and easy to understand. In addition, continuous monitoring of pH electrodes via integrated diagnostic functions must provide continuous checking on the status of the electrode, so that in the event of failure, the situation can be rectified as soon as possible. Likewise, the time needed for maintenance and calibration should be reduced to an absolute minimum through clear user prompting by the transmitter. These important points were fully implemented in the development of the M300 Transmitter Line.

### Highlights of the M300 Hardware

All transmitters – ½ or ¾ DIN case size – are equipped with a universal power supply for operation from 20 to 30 VDC or 100 to 240 VAC. Two different measurement values shown on the backlit display are clearly legible from a distance of 3-5 m. The attractively priced multiparameter version is freely configurable for two channels of pH, conductivity and/or dissolved oxygen sensors.

### Software

A specially developed “Quick Setup” routine for startup guarantees error-free, basic configuration. The menu logic, for pH, ORP, dissolved oxygen and conductivity, is self-explanatory and available in five languages.

### Data Logger

Via the USB connection the data logger is able to transfer data to a notebook PC which can be very helpful in troubleshooting a system.

### PID Controller

The M300 Transmitter is equipped with a non-linear PID controller for rapid control of extreme values as well as for exact control near the set point. In practice, this allows savings in reagent usage, faster treatment, and a lowering of overall costs.

### Maintenance and calibration

The continuously operating diagnostics provide information about the sensor status and, where necessary, display what maintenance work is needed. When calibrating the electrode, automatic buffer recognition reduces service time and improves accuracy.

[www.mt.com/transmitter](http://www.mt.com/transmitter)

# 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 2007
<b>Semiconductor</b>		
SEMICON West	San Francisco, CA USA	July 17-19
SEMI - Taiwan	Taipei, Taiwan	Sept 12-14
UPW - USA	Austin, TX USA	November 7-8
SEMI - Japan	Tokyo, Japan	December 5-7

Tradeshows	Location	Dates 2007
<b>Power Generation</b>		
South West Chemical	Page, AZ USA	July 16-19
AEP BRO	Columbus, OH USA	August 14-16
IWC Pittsburgh	Pittsburgh, PA USA	October 21-25
SCIENTECH (NUS)	Clearwater Beach, FL USA	November 13-15

Tradeshows	Location	Dates 2007
<b>Pharma UPW</b>		
ISPE - Boston	Foxboro, MA USA	October 17
ISPE - Annual USA	Lake Buena Vista, FL USA	November 4-7