International Association for the Properties of Water and Steam

# IAPWS Technical Guidance Document on Instrumentation and Control

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# In Memoriam Geoff Bignold

In 2008, IAPWS started the production of cycle chemistry Technical Guidance Documents (TGDs) and Geoff became an inaugural member of the Task Group charged with driving forward this new initiative. In 2009, Geoff took the lead on developing a Technical Guidance Document on “Instrumentation for Monitoring and Control of Cycle Chemistry for the Steam-Water Circuits of Fossil-Fired and Combined-Cycle Power Plants”. This was published at the IAPWS Annual meeting in The Netherlands in September 2009.

# Introduction

## Some Trivial, but Important Statements !

- **Safe, reliable operation of Power Plants depends upon the establishment of chemical conditions throughout the steam-water circuit.**

- **The chosen chemical treatments and instrumentation will depend upon the details of plant type, circuit design, metallurgy, physical parameters and intended operational mode of the plant (base, medium or peak load operation).**

# Trivial Statements, but Important

**In all cases it is essential to be able to measure the <u>key chemical parameters</u> and to take action on the basis of these measurements to ensure that chemical targets are achieved.**

**➔ For all systems there is a Minimum Key Level of Instrumentation !!!**

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- So what are those key parameters and key instruments ?
- What is the scientific background for those ?
- Where those shall be measured ?
- Why those shall be measured ?
- How those shall be measured ?
- How those shall be indicated ?
- Is an alarm necessary ?
- Recording ?
- What about so called Off-line batch (grab) and confirmatory analyses ?
- What parameters are really worth to be taken into consideration as additional option ?

# IAPWS Technical Guidance Document on Instrumentation and Control

- **Quickly has become International Standard**
  - Minimum Key Level of Instrumentation and Optional Additional Instrumentation for Every Plant/CC combination
- **Not just chemical monitoring, but also Reliability**
  - Must all be alarmed for operator use
  - Provides sensitivity to identify defect instrument
  - and security for the operators
- **Consolidates locations and introduces new terminology**
  - Conductivity after Cation Exchange (CACE) (cation conductivity)
  - Conductivity (specific conductivity)

# Minimum Key Level of Instrumentation for HRSG Drum Units with All-ferrous Metallurgy

## Feedwater AVT (O) and No Solid Alkali added to Evaporators

| Parameter | Sample Location |
|---|---|
| CACE | CPD, FW, Each BD in multi-pressure system, SS or MS or RH |
| Conductivity | Makeup, FW, Each BD in multi-pressure system |
| pH | Each BD in multi-pressure system |
| Sodium | CPD, FW, SS or MS, or RH |
| Dissolved Oxygen | CPD, FW |

Air in-leakage should be monitored on daily basis. Drum carryover conducted every 6-12 months

Sodium may not be required on CPD for units with ACC. Main steam or reheat steam preferred over saturated steam

# Minimum Key Level of Instrumentation for HRSG Drum Units with All-ferrous Metallurgy

## Feedwater AVT (O) and Evaporators on Caustic Treatment (CT)

| Parameter | Sample Location |
|---|---|
| CACE | CPD, FW, Each BD in multi-pressure system, SS or MS or RH |
| Conductivity | Makeup, FW, Each BD in multi-pressure system |
| pH | Each BD in multi-pressure system |
| Sodium | CPD, FW, SS or MS, or RH |
| Dissolved Oxygen | CPD, FW |

Air in-leakage should be monitored on daily basis. Drum carryover conducted every 6-12 months

Sodium may not be required on CPD for units with ACC. Main steam or reheat steam preferred over saturated steam

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| Location \ Parameter | | DC | CC | pH | DO | Na | $PO_4$ | ORP | Degas | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Make-up water upstream mixing with condensate | | X | | | | | | | | |
| Condensate storage tank | | | X | | | | | | | |
| Condensate at condensate pump discharge header | | O | X | O | X | X | | | O*) | |
| Condensate at condensate polisher plant outlet | | O | X | | | X | | | | |
| Feedwater upstream deaerator | | | | | O | | | | | |
| Feedwater downstream deaerator | | | | | O | | | | | |
| Feedwater at economizer inlet | | X | X | X | X | | | X | | |
| Boiler water | AVT treatment | X | X | X | | | | | | O |
| | Phosphate treatment | X | X | X | | O | X | | | O |
| | Caustic treatment | X | X | X | | | | | | O |
| | Once-through | X | X | | | | | | | |
| Steam upstream of superheaters | all drum boilers | | X | | | X | | | | |
| Steam downstream of superheaters | all boilers | | X | | | X | | | | |
| Steam downstream of reheaters | all boilers | | X | | | X | | | | |

**DC:** direct conductivitiy
**CC:** Cation conductivity
**pH:** pH-value
**DO:** solved oxygen
**Na:** Sodium

**$PO_4$:** Phosphate
**ORP:** Oxidation/ reduction potential
**Degas:** Degassed conductivity
**$SiO_2$:** Silica

**X:** minimum key parameter

O: optional addtional online instruments

# Resources for all Areas of Water and Steam

- **Freely available and downloadable on IAPWS website**
  - **www.IAPWS.org**

- **Please give full attribution to IAPWS**