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ANALYTICAL INSTRUMENTS

Reliable Online Monitoring of the Water-Steam Cycle in Nuclear Power Plants

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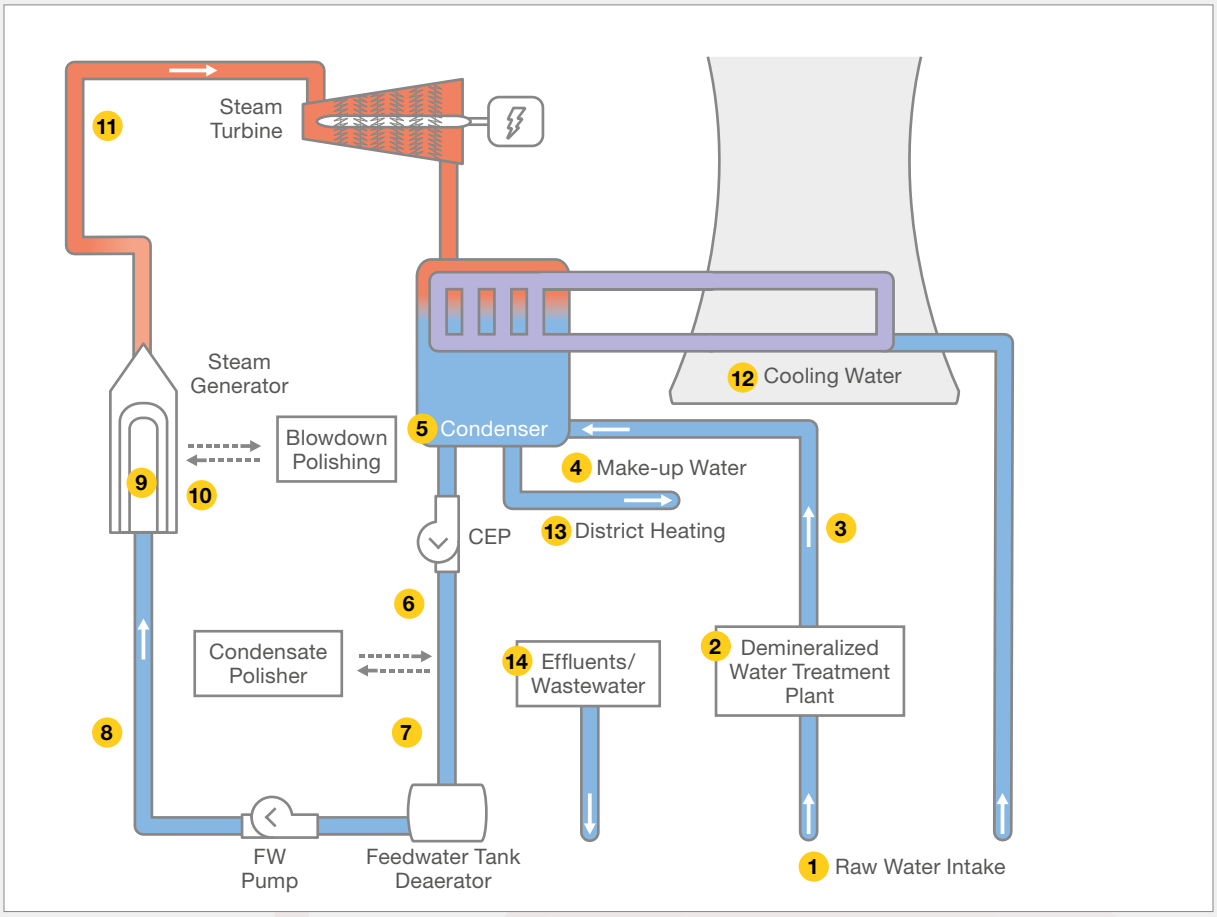


Monitoring Points and Key Parameters

	pH	SC	CACE	DCACE	Na	SiO_2	DO	H2	N_2H_4	TOC	UV_{254}	TURB	DISF	ORP
1 Raw Water	○	○									○	○	○	
2 Demineralized Water Treatment Plant	○	○			○	○				○	○	○	○	
3 Demineralized Water Outlet		●			○	○				○				
4 Make-up Water		●			○	○								
5 Condenser Hotwell			●		○									
6 Main Condensate downstream Pump	●	●	●	○	●		●		○			○		
7 Condensate Polisher Outlet		○	●		●	○								
8 Feedwater	●	●	●				●	○	○			○		○
9 Steam Generator Water	●	●	●	○	●	○						○		
10 Steam Generator Blowdown Demineralizers Outlet		○	●		●	○								
11 Main Steam			●	○	●	○		○						
12 Cooling Water for Condenser	●	●										○	●	
13 District Heating	○	●	○											
14 Effluents / Wastewater	●	●					○					●	○	

SC = Specific Conductivity
CACE = Conductivity After Cation Exchange
DCACE = Degassed Conductivity After Cation Exchange
H_2 = Dissolved Hydrogen
DO = Dissolved Oxygen

pH = pH Value
ORP = Oxidation/Reduction Potential
PO_4 = Phosphate
SiO_2 = Silica
Na = Sodium
N_2H_4 = Hydrazine

TOC = Total Organic Carbon
UV_{254} = Organics Material
TURB = Turbidity
DISF = Disinfectant

● = Required parameter by guidelines and standards
○ = Optional parameters depending on water quality, water treatment process, power plant configuration, operation mode, metallurgy and chemical treatment applied

Conductivity (Acid)

AMI Powercon A

Conductivity after cation exchange (CACE)

- Temperature compensation for strong acids
- Integrated, easy to replace cation exchanger with automatic deaeration
- Option for second pre-rinsed cation exchanger to allow fast replacement of exhausted cation resin

Acid Conductivtiy
0.055-1000 µS/cm

Conductivity (Specific/Acid)

AMI Deltacon Power

Conductivity before and after cation exchange (CACE) with conventional resin columns

- Calculation and display of pH and alkalizing reagent concentration by differential conductivity measurement (VGB-S-010-T-00)
- Automatic monitoring of cation resin consumption with alarm
- Selectable temperature compensations (for all common alkalizing agents and strong acids)

Specific Conductivity
0.055-1000 µS/cm
Acid Conductivity
0.055-1000 µS/cm
pH Range
pH 7.5-11.5
Alkalizing Agent
Concentration in ppm
(e.g ammonia 0.01-10 ppm)

AMI-II CACE

Conductivity before and after cation exchange (CACE) with EDI module for automatic and continuous resin regeneration

- No resin columns needed:
  - no resin exchange
  - no chemicals for regeneration
  - reduced maintenance
  - reduced operation costs
- Uninterrupted measurement of CACE: No gaps and no high CACE values caused by exhausted resin column
- Available version as separated transmitter and module for system integration

Specific Conductivity
0.055-1000 µS/cm
Acid Conductivity
0.055-1000 µS/cm
pH Range
pH 7.5-11.5
Alkalizing Agent
Concentration in ppm
(e.g ammonia 0.01-10 ppm)

Conductivity (Degassed Acid)

AMI Deltacon DG

Specific conductivity, CACE and degassed CACE according to ASTM D4519 via sample reboiler

- Atmospheric pressure measurement for automatic boiling point compensation if air pressure changes, to ensure reproducible measurements
- Safe operation due to automatic shutdown function of sample heater if sample flow is low
- Integrated sample cooling system: cooling water supply not necessary

Conductivity (Specific, Acid, Acid Degassed)
0.055-1000 µS/cm
pH Range
pH 7.5-11.5
Alkalizing Agent
Concentration in ppm
(e.g ammonia 0.01-10 ppm)

AMI-II CACE DG

Specific conductivity, CACE and degassed CACE according to ASTM D4519 via sample reboiler with EDI Module for automatic and contious resin regeneration.

- Sample heater with continuous heating point determination based on atmospheric pressure
- Effective and stable CO_2 removal from sample
- Efficient sample cooling with incoming sample: no hot drain.
- Continuous operation with automatic regeneration of the cation exchange resin by electrodeionization (EDI)
- Minimal sample flow, panel size and electrical power consumption

Conductivity (Specific, Acid, Acid Degassed)
0.055-1000 µS/cm
pH Range
pH 7.5-11.5
Alkalizing Agent
Concentration in ppm
(e.g. ammonia 0.01 to 10 ppm)

Conductivity (Specific)

AMI Powercon S

Specific (total) conductivity for high purity water

- Selectable temperature compensations for different sample qualities and alkalizing agents
- Automatic zero verification with integrated high precision resistor
- Two-electrode titanium conductivity sensor with high precision cell constant, integrated Pt1000 temperature probe
- Patented slot lock sensor design for easy installation and release

Specific Conductivtiy
0.055 µS/cm-30 mS/cm

Disinfectants

AMI Solicon4

Specific (total) conductivity for surface water, cooling water and effluents

- Selectable temperature compensation with absolute (none), linear coefficient or non-linear function
- Insensitive to fouling due to 4-electrodes principle. No measuring errors due to polarization effects
- Measurement of concentrations (for NaCl, NaOH and acids in %), salinity and TDS possible
- Optional deltaT sensor for flow detection

Specific Conductivity
0.1 µS/cm - 100 mS/cm
Salinity (as NaCl)
0-4.6%
TDS (Coefficient)
0.0 mg/l - 20 g/l

AMI Codes-II

Colorimetric measurement (DPD-method) of free chlorine and other disinfectant concentrations

- No interference with sea water and effluents, or additives like corrosion inhibitors and antiscalants
- High accuracy and reproducibility due to automatic zero-value calibration before each measurement
- Reduced maintenance with optional cleaning module and high tolerance against fouling

Free Chlorine
0-5 ppm
Chlorine Dioxide, Bromine
0-6 ppm
Ozone
0-1 ppm

AMI Codes-II CC

Colorimetric measurement (DPD-method) of free, bound and total chlorine

- Determines free available and total chlorine, and calculates monochloramine, dichloramine and combined chlorine
- Freely adjustable measuring intervals for optimized use of reagents
- Fast and easy to use verification with user-friendly solid state standard

Free Chlorine
0-5 ppm
Bound Chlorine
by calculation
Total Chlorine
0-5 ppm
Monochloramine
by calculation
Dichloramine
by calculation

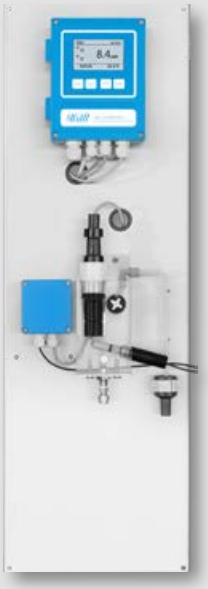
AMI Codes-II TC

Colorimetric measurement (DPD-method) of total chlorine and dichloramine

- Determines total chlorine and calculates dichloramine
- Continuous, automatic monitoring of main instrument functions (dirty photometer, sample flow, reagents level)
- Integrated pH measurement with temperature compensation available as option

Total Chlorine
(standard mode)
0-5 ppm
Total Chlorine
(extended mode)
0-10 ppm
Dichloramine
by calculation

Dissolved Hydrogen



AMI Hydrogen QED

Measurement of trace dissolved hydrogen for corrosion monitoring

- Faraday electrode for automatic or manual verification by electrochemically generated hydrogen concentration in the ppb-range
- Automatic sensor self-regeneration at configurable intervals
- Long-life amperometric hydrogen sensor

Dissolved Hydrogen (H_2)
0-800 ppb
Saturation
0-50%

Dissolved Oxygen

AMI Oxytrace

Amperometric measurement of trace dissolved oxygen concentrations

- Sensor with 3 electrode set-up (gold cathode, silver anode and silver guard) and temperature sensor. Faster initial response time after maintenance due to silver guard
- Automatic temperature and air pressure compensation for simple calibration using ambient air
- Automatic surveillance of electrolyte
- Available on a compact sized panel (280 x 180 mm)

Dissolved Oxygen
0-20 ppm
Saturation
0-200%

AMI Oxytrace QED

Measurement of trace dissolved oxygen including integrated auto-verification

- Faraday electrode setup for automatic or manual verification by electrochemically generated oxygen concentration in the ppb range
- Monitoring of electrolyte and membrane integrity through faraday verification
- Easy to handle membrane and electrolyte exchange, sensor cap for up to 24 months of operation
- Available on a compact sized panel (400 x 420 mm)

Dissolved Oxygen
0-20 ppm
Saturation
0-200%

Hydrazine/ Carbohydrazide

AMI Hydrazine

Membrane-free, amperometric three electrode system for determination of hydrazine or carbohydrazide

- Low maintenance device without need for membrane or electrolyte exchange
- Highly reliable measurement with stable zero-point, sample conditioning without measurement interference
- Long-life sensor due to automatic sensor cleaning and continuous monitoring of cleaning efficiency

Hydrazine
0-600 ppb
Carbohydrazide
0-600 ppb

Organics (UV_{254})

AMI SAC254

Measurement of UV absorption at 254 nm (SAC254) for organic carbon trending

- Insensitive to fouling of the optical components due to dynamic measurement at multiple path lengths
- Integrated grab sample function
- Correlation to DOC, TOC and other paramaters via calibration or manual configuration of the correlation parameters
- Integrated turbidity correction at 550 nm per DIN 38404-3

UV Absorption
UVA 0-300 m^{-1}
UV Transmission
0-100%
DOC, TOC
Concentration ppm

pH/Redox Potential

AMI pH-Redox QV-Flow

Potentiometric determination of pH value or redox potential for low conductivity samples

- pH or redox electrode with liquid electrolyte reference sensors, and Pt1000 temperature probe
- Automatic temperature compensations models for pH measurement, for high purity water
- Straightforward calibration procedure without sensor disassembling
- Economical operation of the instrument due to refillable liquid electrolyte

pH Range
pH 1-12
Redox Potential (ORP)
-500 to +1500 mV

AMI pH-Redox M-Flow

Potentiometric measurement of pH value or redox potential for surface water, cooling water and effluents

- pH or redox combined electrode with gel electrolyte, with a Pt1000 temperature probe
- Automatic temperature compensation for pH measurement according to Nernst
- Easy calibration without sensor disassembling
- Minimized maintenance with optional spray nozzle for sensor cleaning

pH Range
pH 1-13
Redox Potential (ORP)
-400 to +1200 mV

Silica

AMI Silica

Colorimetric measurement of reactive silica in the water steam cycle and demineralized water production

- Detection limit of 1 ppb
- Automatic zero prior to each measurement
- Selectable measurement interval for low reagent consumption
- Easy to use, integrated grab sample capability
- Optional 2nd sample channel, or automatic sample sequencer up to 6 sample streams

Silica
0-5000 ppb

AMI Silitrace

Determination of trace concentrations of silica

- Detection limit of 0.5 ppb
- Automatic sample heating and regulated reaction time features for highest precision
- Automatic zero verification (daily)
- Programmable, automatic calibration
- Easy to use, integrated grab sample capability
- Optional 2nd sample channel, or automatic sample sequencer up to 6 sample streams

Silica
0-1000 ppb

Sodium

AMI Sodium P

Dissolved sodium for samples with pH≥7

- Detection limit of 0.1 ppb
- Reliable alkalization reagent addition system for diisopropylamine or ammonia, with continuous pH-monitoring and alarm
- Automatic temperature compensation and simple two-point calibration
- Easy to use, integrated grab sample function
- Optional 2nd sample channel, automatic sample sequencer up to 6 sample streams, and automatic regeneration of sodium electrode
- Available on a compact sized panel (375 x 700 mm)

Sodium
0-10000 ppb

Total Organic Carbon

AMI Sodium A

Dissolved sodium measurement for samples with pH≥2 and pH<8

- Detection limit of 0.1 ppb
- pH controlled alkalization reagent addition for diisopropylamine with maintenance-free air pump
- Optional 2nd sample channel, or automatic sample sequencer up to 6 sample streams

Sodium
0-10000 ppb

AMI Soditrace

Measurement of trace sodium concentration in high purity water

- Lowest available detection limit for sodium ion concentrations of 0.001 ppb
- pH controlled alkalization reagent addition for diisopropylamine to a pH 12, via maintenance-free air pump
- Programmable automatic three-point known addition calibration in ppb-range (detection limit for sodium remains: 0.001 ppb)
- Programmable automatic regeneration of sodium electrode

Sodium
0-10000 ppb

AMI-II LineTOC

Online monitoring for Total Organic Carbon (TOC) in high purity water

- Reagent-free monitoring system using conductivity differential prior to and after UV-oxidation
- Reaction time below 2 minutes, for fast trend identification without costly lab analysis
- Easy to use, integrated grab sample function
- Available on a compact sized panel (700 x 450 mm)

Total Organic Carbon (TOC)
0-1000 ppb

Turbidity

AMI Turbiwell Power

Contact-free turbidity measurement for corrosion product trend monitoring

- LED light source for long life and stable measurement, heated optics to prevent condensation effects
- Automatic or manual draining of the measuring chamber for cleaning
- Non-contact design avoids fouling of optical surfaces and analyzer drifting: calibration-free

Turbidity
0-200 FNU/NTU

AMI Turbiwell 7027/W/LED

Contact-free measurement of turbidity in raw water, water treatment plant, cooling water and effluents

- AMI Turbiwell W/LED as per US EPA 180.1
- AMI Turbiwell 7027 as per ISO 7027 (infrared red LED)
- Heated optics prevent measurement errors and condensation
- Integrated constant head for continuous sample flow into the measuring chamber
- Fast and easy verification with primary and secondary standard
- No consumables, no wearing parts, no maintenance costs
- Optional deltaT flow meter, and sample degasser to avoid the formation of interfering bubbles in the sample

Turbidity (ISO)
0-200 FNU/NTU
Turbidity (EPA)
0-100 FNU/NTU

Portable Instruments

AMI Inspector

Portable quality assurance (verification) of existing online measurements. Available for conductivity, hydrogen, oxygen and pH measurements

- USB data logger interface for lifelong data storage at a selectable interval
- Rechargeable battery for more than 24 hours of stand-alone operation
- Recertification by Swan possible

Conductivity
0.055-1000 µS/cm
Hydrogen
0-800 ppb
0-50 % Saturation
Dissolved Oxygen
0-20 ppm
0-200 % Saturation
pH Range
pH 1-12

Options

AMI Sample Sequencer

Complete system for the automatic, continuous multiplexing of up to six sample streams to one process analyzer

- Complete system including control unit, back pressure regulator and needle-valve for each stream, and flow measurement
- Signal outputs for indication of active sample stream and flow alarm
- Optional module to use conjointly with these monitoring systems:
  - AMI Sodium P
  - AMI Sodium A
  - AMI Silica
  - AMI Silitrace
  - AMI Phosphate HL

Cleaning Module

Reliable accurate measurements ensured by counteracting bio-growth inside the flow cell and photometer

- Automatic cleaning with addition of one or two cleaning solutions (e.g. 2.5% hypochlorite solution and/or diluted sulfuric acid 2.5%)
- Individual programmable cleaning interval
- Automatic reagent level monitoring
- Optional module to use conjointly with these monitoring systems:
  - AMI Codes-II
  - AMI Codes-II CC
  - AMI Codes-II TC
  - AMI Phosphate-II
  - AMI Phosphate HL
  - AMI SAC254

Swan AMI Monitor Concept

Swan instruments are delivered as fully functional, ready-to-use instruments. This ensures easy system integration as well as user-friendly operation and maintainability.

Highest standards in development and production assure the instrument quality expected by our customers.

MADE IN SWITZERLAND

Full System Integration

- Complete panel-mounted systems with fluidics connections preconfigured for quick start up
- Various communication possibilities with Profibus, Modbus, HART-Protocol, USB-interface and analog output
- Simple process engineering with regulation functions (P, PI, PID or PD), relay or analog output

Easy Maintenance

- Uniform menu navigation for easy operation and maintenance – one platform for all instruments
- Clearly arranged setup of instruments, good accessibility of all components for efficient operation and maintenance
- Self-explanatory maintenance procedures can be easily performed by the operating company

Highest Quality Assurance

- Every analyzer is wet bench tested and factory calibrated prior to delivery
- Automatic instrument alarms and self-diagnostic such as reagent level and sensor functions for validated results
- Integrated sample flow control for measurement check available for all analyzers

Swan Customers Service and Maintenance

Expert Training and Maintenance

- Flexible on-demand or scheduled maintenance services
- Expert re-calibration and re-certification options
- Comprehensive product trainings to boost your team's expertise

After-Sales Support

- Skilled engineers ready to assist with any technical request
- Scheduled maintenance visits to prevent downtime
- Fast, reliable service — on-site or remote

Genuine Parts and Repairs

- On-demand service including delivery of spare parts and consumables
- Authentic Swan sensors, reagents, and components
- Convenient send-in repairs at regional Swan workshops

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ANALYTICAL INSTRUMENTS

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- Swan Subsidiaries
- Distributors

We make water safe.