Intelligent Measuring Technology
For The Future

CHRIS BOLD, GWF EXPORT SALES MANAGER

- 16 years in utility metering industry
- Previously with Sensus International in South Africa and Germany
- Joined GWF in Switzerland in 2004
- MID Certified Verification officer
- Currently manages exports of meter systems to Europe, Middle East, North American and China
- Leading Aqua Promotion Group
AGENDA

- Introduction to GWF….Swiss, Smart, Simple
- Thermal Energy Systems and Thermal Metering Market Overview (Europe)
- European Metering Standards
- Thermal Metering 101
- GWF Thermal products and complete metering solutions
- FAQs and Best Practices
Introduction to GWF

GWF - MISSION

GWF Facilitates sustainable energy usage. We offer trendsetting Smart Metering system solutions based on precision measuring instruments with the patented GWFcoder®-Technology and interoperable M-Bus communication.
<table>
<thead>
<tr>
<th>Business entity</th>
<th>Joint-stock company (Family owned)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Founded</td>
<td>1899 in Lucerne</td>
</tr>
<tr>
<td>Employees</td>
<td>approx. 155</td>
</tr>
<tr>
<td>Turnover</td>
<td>47 MCHF, 39 MEUR, 56 MCAD</td>
</tr>
<tr>
<td>Encoder Licences</td>
<td>Elster, Sensus, Badger Meter, Metron Farnier, Apator Metrix</td>
</tr>
<tr>
<td>Quality System</td>
<td>ISO 9001, ISO 14001, OHSAS 18001</td>
</tr>
<tr>
<td>Directives EU</td>
<td>MID 2004/22/EC B+D, ATEX 1994/9/EG Encoder</td>
</tr>
<tr>
<td>Verification center</td>
<td>Gas, Water and Heating according to ISO/IEC 17020, and ISO/IEC 17025</td>
</tr>
</tbody>
</table>
R&D: OUR VISION FOR THE FUTURE

\[ N[k+1] = A*B[k] + C*U[k] \]
Thermal Energy Systems and Thermal Metering Market Overview (Europe)

1. High Energy Costs….why?
   - Europe has embarked reducing carbon emissions
   - Limited resources for energy – Coal, Nuclear, Gas are not preferred - Renewable

2. Need for Environmental Regulations and need for energy efficiency

3. High population density

4. Deregulation/Privatization of utilities

= Need for submetering of all utilities
CLIMATE CHANGE / RISING ENERGY DEMANDS
Driving Factors

IPCC- Climate report*: 1.4 to 5.6 Degrees warming this century

**EU** commitment in light of the 2005 put into force Kyoto Protocol, to lower CO2-Emissions until 2020 by 20% (Basis: 1990) IPCC

_Energy Efficiency Directive – use energy more efficiently at all stages of the energy chain - December 2014_

**USA** Obama Energy Policy: Reduce greenhouse emissions 80% by 2050

* Intergovernmental Panel on Climate Change (World climate summit Geneva)
EUROPEAN SOLUTION
Thermal Metering Systems

1. Abundant?
   - Extensive deployment due to regulatory measures

2. Economically viable?
   - Lower input (variable) costs and lower maintenance provide excellent ROI

3. Minimal environmental impact?
   - Efficient Plants and/or use of geothermal reduces carbon emissions produced

Resulted in massive growth of district and building heating and cooling systems….

And the need for submetering of thermal energy
Thermal Metering

1. Low quality equipment gave the industry a bad reputation and resulted in a lack of confidence in thermal energy measurement
2. Standards not consistent across Europe and created trade barriers
3. Needed economies of scale to make the meters cost effective

= Need for meter standardization led to MID and EN1434
European Metering Standards
EUROPEAN UNION – HEAT METERING
STARTING POSITION

- Approval vs. Type examination
  - Up to now, **country specific approvals** were needed to sell measuring instruments in EU
  - For the future, there would be only **one type examination certificate needed** acc. the new **Measuring Instrument Directive (MID)** for the EU
Goal

- The main goal for the definition and introduction of the new measuring instrument directive was the **reduction of trade barriers** within the European countries.
- More stringent testing for First Type Approval to conform to improved measuring technology.

Validation period

- Instruments approved before 30th October 2006 may continue to be sold for up to 10 years.
- New meters have to comply as from 30th October 2006.
MEASURING INSTRUMENT DIRECTIVE

- Regulation field
  - The Measuring Instrument Directive **regulates**…
    - ...general requirements for measuring instruments (i.e. EMC requirements, etc.)
    - ...specific requirements for measuring instruments (i.e. MI-001, etc.)
    - ...requirements up to initial operation
    - ...the labelling of the measuring instruments
    - ...responsibilities between legislator, producer and user

  - The Measuring Instrument Directive **doesn’t regulate**…
    - ...obligatory calibration and calibration period
    - ...requirements after initial operation
    - ...operational error limit
STANDARDS – THERMAL METERS

- EN1434: Heat meters
  - EN1434-1 = General requirements
  - EN1434-2 = Constructional requirements
  - EN1434-3 = Communication interfaces
  - EN1434-4 = Pattern approval tests
  - EN1434-5 = Initial verification tests
  - EN1434-6 = Installation, operational monitoring and maintenance

- OIML R75, main specifications identical to EN1434
  - OIML R75-1 = General requirements
  - OIML R75-2 = type approval and initial verification tests requirements
  - OIML R75-3 = test report format (approval and initial verification)
EVERY METER TO FULFILL MAXIMUM PERMISSABLE ERROR (MPE)

\[ \varepsilon (\%) \]

Heated water

Cold water

Cold water

Heated water

EVERY METER TO FULFILL MAXIMUM PERMISSABLE ERROR (MPE)
BENEFITS OF METERING

Where meters are installed, with greater control and transparency of consumption and charging, they allow consumers to:

- Decide *when to use their heating* (and cooling) systems and at what temperature to heat their homes (and businesses);
- **accurate measurement of what energy** they use and encourages consumers to identify and reduce wasteful consumption;
- **Avoid the subsidization** of abnormally high usage by lower energy consumers. For example, in multi-apartment buildings, where flat-rate charges can distort individual heat consumption variances.

On a system-wide basis:

- Building-level meters help to highlight the heat provided to a building as a whole, and those heat distribution networks that are poorly performing at a system-wide level. This will enable heat network operators to identify system inefficiencies and remedy accordingly.
Thermal Metering 101

CORE PRODUCTS

Meters

YOU MUST HAVE:

- SIMPLE
- ACCURATE
- RELIABLE
- LONG LASTING
- DATA DRIVEN
- MIGRATABLE

CASH REGISTERS
(Meters)
FUNDAMENTAL PRINCIPLE

What is thermal energy?

1 gram of water

$1 \, ^{\circ}C$ temperature increase

Required energy:

1 Calory

= 4.18 Joule

= 0.00116 Wh
GENERAL PRINCIPLE
The thermal energy meter has always 3 parts

To be measured:
- water volume —> flow meter
- temperatures —> temperature sensors

To be computed:
- energy —> calculator
OPERATING PRINCIPLE
Energy measurement and calculation

\[ E = V \times (T_s - T_r) \times k \]
BUILDING ARCHITECTURE

- Metering system architecture has changed over the years
  - Vertical systems > Heat cost allocators
  - Horizontal systems > Heat meters
- Water Meters are always required (Irrespective of building architecture)
- Vertical and Horizontal Architecture Worldwide
  - Trend to Horizontal Systems

Vertical Piping Systems
- Built in the 80's/90's
- Found in most buildings in this period
- Difficult to regulate heat exchange point

Horizontal Pipe Systems
- Built as of middle 80's/90's
- Energy transfer at just one point
- Easy to manage and regulate heat exchange point
CORRECTION FACTOR $k$

Density of water ($\rho$):

\[
\begin{align*}
4°C & \quad 1,0 \\
\rho & \quad [\text{kg/dm}^3]
\end{align*}
\]

Specific heat capacity ($c_p$):

\[
\begin{align*}
\text{kJ} / (\text{kg*K}) & \quad T [°C]
\end{align*}
\]

The factor $k$ compensates:
- dependence of density from temperature
- dependence of heat capacity from temperature
- Respecting flow meter position (return/supply)

New calculation of „$k$“ following operation conditions with each temperature acquisition
GWF Thermal Products and Complete Metering Solutions
CORE PRODUCT FOR CANADIAN MARKET
ULTRAMAXX-V
Ultrasonic principle:

- Ultrasonic measurement = no turning parts
- not sensitive for deposits / dirty medium
CORE PRODUCTS
Ultrasonic Principle

Ultrasonic principle
- \( q > 0 \Rightarrow \text{Time 1} < \text{Time 2} \)
- runtime difference to measure the flow

Transducers

Reflectors (Stainless steel)
TEMPERATURE MEASUREMENT

Principle T-Sensor types

Pocket sensor (PS)

Direct immersion sensor (DS)
GWF COMBINED HEATING AND COOLING METER

- DN15-1200
- Versions qp0,6-qp9000
- ultrasonic flow measurement
- removable calculator
- Pt100, Pt500,
- 2/4-wire technology (CF55)
- plug & play com-options
- plug & play power supply
- datalogger (CF55)
- tariff functions (CF55)
WHAT IS M-BUS (METER BUS)?

Why M-Bus?
- In the past, each European country had its own standards with its own advantages and disadvantages. These standards were incompatible to each others.

Why is M-Bus a good choice?
- The European commission has combines the know-how of each country holistically
  The M-Bus is a well established platform which has been in the market for over 22 years

M-Bus is used by more than 50 countries including:
- Europe (Germany, France, Great Britain, Poland, Italy, Spain, Russia, …)
- Middle East (Saudi Arabia, UAE, Qatar, …)
- Asia (China, Malaysia)
WHAT IS M-BUS (METER BUS)?

- M-Bus network powers thermal & water meters
- Meter sends header information plus register read upon request from Master
- Wireless technologies available (radio modules, bridges, etc.)
- Numerous options for remotely accessing and reading M-Bus system
  - TCP/IP
  - GSM/GPRS
  - Wireless M-Bus
- Modular design for easy scalability
METER BUS SYSTEM ABSOLUTE DATA

M-Bus-Meters, Interface over Absolute Passive Encoder Interface

All meter end points do not need batteries – Power over the Bus

- Cold Water Consumption
- Warm Water Heating + Consumption

<table>
<thead>
<tr>
<th>UNICOcoder MP</th>
<th>ULTRAMaXX MT… coder MP</th>
<th>Commercial / Industrial</th>
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</table>

August 17, 2016
Video of Encoder Register
M-BUS MASTER EXAMPLE
M-BUS TECHNOLOGY
BETTER RETURN ON INVESTMENT

CUSTOMER SATISFACTION
thanks to absolute meter reading – never a deviation, and highly reliable proven technology

MINIMIZE INSTALLATION COSTS
thanks to plug & play installation (wired, wireless)

LOWER OPERATIONAL COSTS
thanks to process automation, no manual readings, opportunity costs of staff, no adjustment with meter reading deviation (pulse)

ROI =

Revenue - Operational costs

Capital investment

SECURE INVESTMENT
Thanks to interoperability and open standards (M-Bus)
FAQs and Best Practices
POTENTIAL AREAS FOR ERRORS

Flow meter should be installed in return pipe

Supply sensor in hot pipe

Immersion depth of sensors

Configuration of calculator (position, pulse weight)

Straight length (Inlet / outlet)

Return sensor in cool pipe

Flow meter should be selected by qp
POTENTIAL AREAS IMPACTING ACCURACY

- Installation of meter components well done?
- Installation compliant to meter configuration?
- Combination of components (sub-assemblies) well done?
- On site sealing respected?
- System conditions / water quality.
INSTALLATION OF T-SENSOR – COOLING!

- Risk of condensation
- Avoid condensation between pipe and isolation
- In case of head sensors:
  - protect the cable clamps against humidity
  - or use potted head sensors
- Installation downwards
  - avoid water remaining in the pocket
- Cable positioning “drop down”
  - avoid water moving to calculator
WRONG INSTALLATION

WRONG!
GOOD INSTALLATION

Good!
BAD EXAMPLE
Cooling meter installed in intermediate ceiling

Searching for the meter....
BAD EXAMPLE

Cooling meter installed in intermediate ceiling

Flow meter and calculator found…

T-sensor found…
BAD INSTALLATION OF T-SENSOR
Temperature sensor installed in “dead zone”
BAD INSTALLATION OF T-SENSOR
Direct sensor installed in pocket
STRONG PARTNERS

- QMC Metering Solutions represents GWF in Canada
  - Canada-wide support of submetering systems
  - Measurement Canada laboratories and verification teams
  - Shared values of GWF/QMC:
    - continuous improvement, commitment to quality, open protocols and non-proprietary systems