Digital monitoring in the district heating network
Innovative and future-proof
Advantages of continuous digital monitoring

Responsibility for monitoring a district heating network is associated with many challenges. Problems in the network can often only be identified once cost-intensive damage has resulted. In addition, the losses in power and heat that occur in the meantime will reduce the supplier’s profits. According to figures from the AGFW (German Heat & Power Association), an average of 0.12 incidents of damage per km section each year are caused by:

- System damage due to material fatigue caused by frequent load changes, improper workmanship and extreme weather-related situations
- Third-party damage, e.g. due to earthworks and welding

Early detection and localisation of leaks increases the efficiency of the pipe network, reduces down time and saves on repair costs. Continuous monitoring (24/7) also makes it easier to clarify responsibilities and liability issues in the event of third-party damage.

Who are SAE IT-systems?

As a manufacturer of telecontrol and substation control and monitoring systems, SAE IT-systems can draw on more than 45 years of experience in the application areas of electricity, water, gas and infrastructure. Today, the company offers expert knowledge while being a leading innovator in the supplier environment. Our customers include energy suppliers and public utilities as well as industrial groups and major system integrators. Our products are used wherever intensive monitoring of physically distributed or remote properties is required, and wherever they may also need to be controlled in cases of doubt. In addition to requirements-based hardware and software products, SAE also offers all key services, from project planning to system commissioning, with 85 employees at our Cologne site. Our stated goal is to always provide comprehensive solutions for our customers' tasks – “Solutions in Mind”!

The new district heating concept from SAE IT-systems is at the heart of this: the system supplier has expanded its established telecontrol and transmission technology to include special measuring components for application in district heating networks. The modular system enables continuous monitoring of district heating pipes in accordance with DIN EN 14419.

SAE IT-systems has been an official supporting member of the AGFW since June 2019.

Brief profile of the SAE concept

The application range includes

- Nordic system (copper)
- NiCr

It is based on the established FW-5 telecontrol unit

- Reliable and secure transmission of measured data direct to an existing control centre or any workstation (e.g. district heating management)
- Wireless or cable transmission
- Modular and can be expanded
  - Up to 24 section/48 pipes per FW-5
  - Extensive range of extension boards to complete additional tasks

Monitoring and measuring are performed by the ISO-1 and PIT-1 extension boards

- Loop measurement
- Insulation measurements in the insulating foam of the plastic sheath pipes
- Water ingress measurements for slots and temperature measurement in the flow and return circuits
Adjustment options for warning and alarms in the setIT configuration software

Plastic sheet pipes (up to 2 sections respectively 4 pipes per ISO-1)

Control centre

Operation management district heat

Workstation with visualisation

SAE connection concept for district heating management and control centre

Individual components and complete solutions

The product variants FW-5-GATE-4G (LTE) or FW-5-GATE-450 (CDMA 450 MHz radio) with their integrated modems make a simple and convenient wireless connection possible. If required, we can also provide complete, ready-for-connection systems in the cabinets or in a compact industrial housing, with the right IP protection class depending on the installation location (e.g. in structures of section fittings or in above-ground junction boxes).

SAE Solution
FW-5-GATE and ISO-1 (up to 12 units per FW-5)

Firewall integrated

SAE Solution FW-5-GATE-4G (with integrated modem for direct LTE-connection) and ISO-1

Alternative communication

Plastic sheet pipes (up to 2 sections respectively 4 pipes per ISO-1)

Configuration via Ethernet, USB or from remote

Encryption

Configuration via Ethernet, USB or from remote

VPN Encryption

VPN Router

Operation management district heat

Workstation with visualisation

Control centre

The FW-5 telecontrol unit with ISO-1 and PIT-1 extension boards

Complete, ready-for-connection solutions from SAE IT-systems
Connection concept for ISO-1 to plastic sheath pipes
For each ISO-1 extension board, up to four loops with a length of max. 10,000 m for Cu and 1,500 m for NiCr can be monitored. The measuring range for the insulation measurement is between 1 kΩ and max. 60 MΩ. For the loop measurement, it is between 10 Ω and max. 12 kΩ.

Adjustment options in the setIT configuration software
In setIT, the measured values are transferred consistently. Notification thresholds for warnings and alarms for the measured insulation are freely adjustable, just like the measurement cycle.

Flexible and precise – adjustment options in setIT
 Slot monitoring with PIT-1

Thanks to the connection option for two PT-100 temperature sensors (0..150°C) and four active inputs for float switches/low point and moisture sensors (JOLA-compatible), the PIT-1 extension board enables monitoring of slots and structures of section fittings for water ingress and temperature changes. The PIT- can also be used for access control.

Monitoring options with the PIT-1
Direct link to control centres

Next to the increased safety requirements, it is more and more frequently the case that consistent and direct provision of information to central control centres is requested.

A key driver of this trend is IT security, which can be more effectively safeguarded through the standardisation of communication structures. At the control centre the information and measured values which are received are prepared and visualised in an appropriate way for the operator. In the opposite direction, control and adjusting commands can be output into the network. In this process, communication takes place according to standard protocols, such as IEC 60870-5-101, IEC 60870-5-104 or Modbus RTU/Modbus TCP. As these are standard telecontrol protocols, you can also benefit from the expertise provided through our core business here. Our customer relationships with more than 500 energy suppliers stretch back many years and we are proud of our high level of customer satisfaction.

Control centre-independent visualisation

With SAE, it is not just the provision of data to control centres that becomes possible. Thanks to its high degree of flexibility, the system offers various options relating to control centre-independent management according to individual requirements. In general, there are not restrictions on the design of the visualisations. You may prefer a map-based representation of your district heating network or a tile view with branches to deeper hierarchical levels. Your requirements are easy to implement with the SAE system. If necessary, we are also happy to take on the complete creation of the visualisation in accordance with your requirements. You will receive a complete system that is ready for operation.
Location in theory and practice

The automatic location function for stationary monitoring units makes them more complex and expensive, but does not necessarily offer any practical benefits. For example, depending on the measurement procedure, multiple errors may not be detected and this may distort the location values. As these location values also need to be “interpreted” together with the pipe network plans, the network documentation must be up to date, but this cannot always be guaranteed in daily business. For this reason, before exposing the district heating pipe, the exact location of a leak is generally measured at the relevant pipe sections by gradually shortening the loop. This is why SAE consciously avoids using a costly location function and focuses on the measurement and reporting of leaks and their continuous transmission.

Limited usefulness: Incorrect information on the damage location due to multiple errors

Limited usefulness: Undocumented new connection
Remote and automatic loop disconnection

The service mode makes loop disconnection possible remotely (from control centre or operation management workstation) and directly at the ISO-1 module on-site. If necessary (e.g. for extension work), this removes the need for manual physical disconnection and subsequent reconnection. If the measuring technology is not disconnected from the network before starting welding work, this can cause considerable damage to measuring devices. The ISO-1 service mode can be configured in a way that the sensitive measuring unit of the module automatically protects itself in these cases by disconnecting fully from the pipe system.

Remote loop closure for mobile fault detection measurement

Service mode (configurable)
Loop can be closed from remote for mobile fault detection measurement

Automatic decoupling to protect the measurement core
With the classification of large-scale district heating network as “critical infrastructure”, the operators of these networks are now required by law to implement and verify their protection measures for company IT systems. District heating is therefore gradually becoming subject to the same requirements as the electricity sector, which is the core market for SAE since many years. For example, the recently introduced industry-specific BSI safety standard for district heating networks (B3S) largely overlaps with the IT security requirements for electricity networks and is a standard task for SAE.

### Basic concepts of IT security

Four aspects are key here:

1. **Confidentiality**  
   Unauthorised persons may not read data

2. **Integrity**  
   Unauthorised persons may not change data

3. **Authenticity**  
   Data really does come from the assumed source

4. **Availability**  
   Access to data must be guaranteed for authorised persons

In order to verify the effectiveness of our ongoing improvements in the area of IT security, we have our telecontrol systems checked by external specialists at regular intervals. We have also made the proactive and voluntary decision to seek ISO 27001 certification. Successful initial certification is expected by the beginning of 2020.

### Some important security features of the SAE solutions

- Secure encryption and hash algorithms, e.g. for encrypting project files with AES-256
- User profiles with individual role based access control (RBAC)
- VPN tunnel from the station (end-to-end encryption with IPSec IKEv1/IKEv2 or OpenVPN protocol)
- Secure file transfer via FTPS (File Transfer Protocol over SSL), e.g. for station updating
- Secure web communication with HTTPS (HyperText Transfer Protocol Secure)
- Accesses and services such as USB port, USB Ethernet and web server can be disabled
- Integrated firewall (whitelist concept)
- Syslog for central logging of operational messages and processes