Innovative Solutions for Dam Safety Monitoring

KISTERS
Empowering decisions of tomorrow

Evidence-based decisions for the safety of dams

Knowledge about the condition and behavior of dam structures lies in long-term recorded data. Interrelationships, trends and changes become visible early on when these data are routinely observed and evaluated.

The data recorded at each dam for short-term operational control by a control system provides an excellent foundation for evaluation and analysis. Interrelationships and changes clearly emerge when all hydrometeorological variables (temperature, precipitation, dam height, inflow and outflow volume), displacement and deformation variables and further hydrometric and stress variables are assessed together over long periods of time.

This is exactly what WISKI is for. This software solution is the ideal supplement to the dam's control/operating system and supports dam operators in making data-based and well-founded decisions – especially with regard to dam safety.

Your benefits

Effectiveness, efficiency and lower costs for monitoring dams.
While the strength of a control system lies in the management of the current situation, WISKI is the specialist for long-term data evaluations: Archive and merge data, derive defensible information and insights to support decisions and actions. With WISKI you discover changes over longer periods of time, cause-effect relationships and trends.

You benefit from:
— Better and more reliable information about the condition and safety of structures
— Risk minimisation through early detection of changes
— Well-founded results from professional analysis of a large, quality-assured data pool.
— Improved legal basis due to comprehensive and traceable archived information, e.g. for safety reports.
— Cost-effective monitoring of multiple sites in one central system thanks to simple data integration

Data ➤ **Insights** ➤ **Expertise** ➤ **Decision** ➤ **Action**
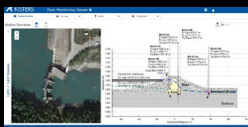
Our software solution for dam operators

Central information portal for all dam data (pages 4 and 5)

Long-term archive as a supplement to the daily operational data (pages 4 and 5)

Interfaces to control systems, forecasting and simulation models (pages 4 and 5)

Scalable with optional tools (pages 6 and 7) such as
— Digital recording of inspection results in the structure (FieldVisits)
— Alarming (AlarmManager)
— Optimisation and simulation
— Precipitation forecasts (HydroMaster)
— Water quality analysis (physical-chemical and biological)

Sensor technology to fill in measurement networks (page 8)

Applications

WISKI displays dam data live, archives it long-term and provides holistic analyses, e.g. for

— Structural monitoring
— Floods and dry periods
— Hydro-meteorology and water balance at the structure and in the catchment area
— Hydropower generation and Optimisation
— Water quantity and water supply
— Equipment management and support for operations
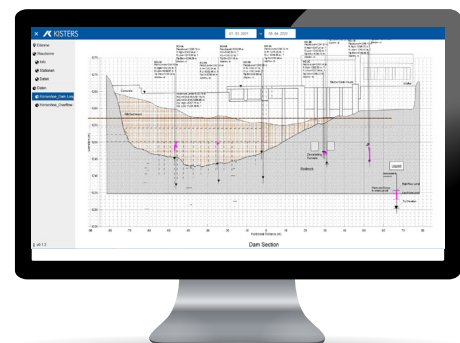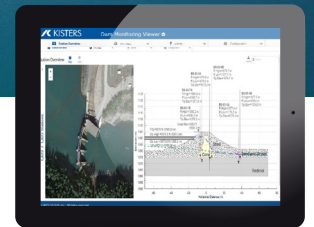
⚡ WISKI dam monitoring made simple and efficient

Long-term archived (structural) data contain all the knowledge about the condition and changes of a dam. WISKI makes this knowledge visible and helps the dam operator to make the right decisions on structure and water management. The information used is defensible and complements the user's experience-based decisions because it is derived directly from the dam's historical data.

The larger the database, the more information it contains. In most cases, this information is only revealed when all the data collected are analysed together, rather than individually. That's why WISKI brings together the most diverse types of data, checks their plausibility and evaluates the data pool as a whole. The information that supports the right decisions for the long-term safety and water management of the dam is just a few clicks away.

⚡ WISKI features

WISKI supports dam operators in the management, evaluation and visualisation of their data:
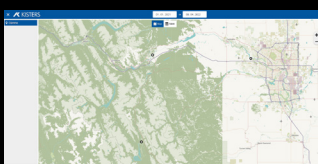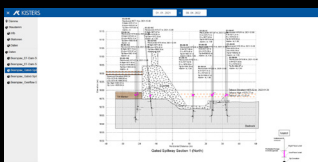
— **Time-unlimited, site-specific archive for measured values**
  – Pressure sensors of all kinds
  – Settlement and displacement variables
  – Water level, volume, discharge
  – Meteorological measurements
  – Energy production and consumption
  – Rating curves (e.g., water level/volume, water level/flow, formulas for weirs)

— **Data transfer between the archive and other data sources**
  – Operational data from control systems
  – Data from automatically measuring loggers and other data bases
  – Data from manual measurements of control walks

– Integration with simulation and forecasting models
– Integration of open and licensed third-party data (e.g., forecast data)

— **Professional and technically sound data management**
  – Customizable meta data management
  – Automated data validation
  – Alerting of threshold exceedances
  – Primary and extreme value statistics

— **User-friendly data display and editing** (various graph and chart types, tables, arithmetic, correlations, etc.)

— **Reports and dashboards**

— **Integration of web cameras**

WISKI information portal in the web browser

Simple and intuitive to use: All information can be viewed and analysed at any time via a web browser on any computer, tablet or smartphone. The interactive web interface displays all relevant data in near real-time, as well as cross-sections and 3D geographical visualisations with live data, information and hydrographs in maps, charts, graphs and tables. All data can be exported in standard file formats.

Each user of the WISKI portal can create their own dashboard (home page) and customise it to suit their workflow and individual preferences. For this purpose, WISKI provides an extensive selection of small graphical building blocks (widgets) with specific functions. This makes working particularly efficient and convenient.

WISKI interfaces

WISKI enables the easy integration of data streams from sources, such as operations management and control systems, making it the ideal central measurement data management system.

— Connection via OPC Unified Architecture (OPC UA), a platform-independent standard for data exchange that is frequently used in control system environments.

— Web services for simple and fast integration of internal and external (third party) applications

— Defined REST API for direct bi-directional communication with third party software

— Data converter and scheduler to import data from loggers of numerous brands
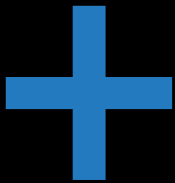
# **Additional components** for a solution that meets your needs
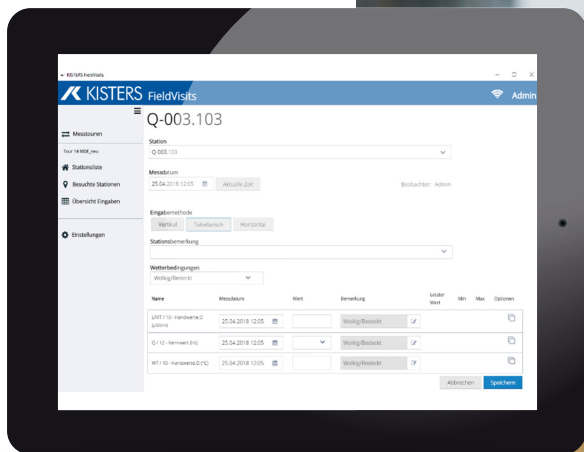
⟁ FieldVisits
+ On-site digital data recording

Daily inspection rounds by dam inspectors form the backbone of the safety assessment process. Our FieldVisits application supports the inspectors with digital data collection during their rounds. The app guides them through the pre-configured steps of the inspection process on a laptop, tablet or smart phone. It allows the collection of sensor data and visual observations right on-site (dam elevation, water level, seepage weir leaching, surveys, expansion and joint measurements, pendulum readings, inclinometer, jointmeter, piezometer, compass, ground anchor, settlement meter, temperature, and many others).
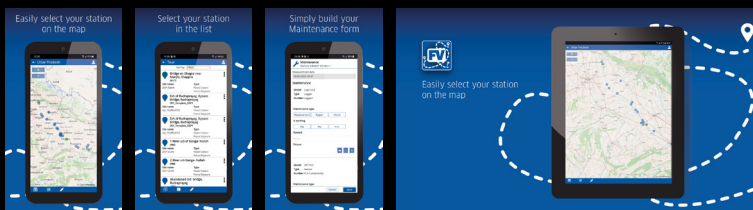

KISTERS FieldVisits supports QR codes and barcodes as point identifiers and can also capture photos. Its digital data acquisition and storage works without a data connection. The data is then transferred to the KISTERS WISKI database via direct synchro- nisation as soon as a wireless connection is established. It is then available to all users of the WISKI information portal. KISTERS FieldVisits is available as a mobile application in the Google Play Store and the Apple App Store.

+ Platform for prediction models

All forecasts at a glance in the same system:
The model-independent platform brings together existing hydrological, hydraulic and reservoir operations models and presents the results together in real time. In addition, WISKI provides the long-term baseline data to feed the models and writes the forecast results back into the database. One central data hub for all models.
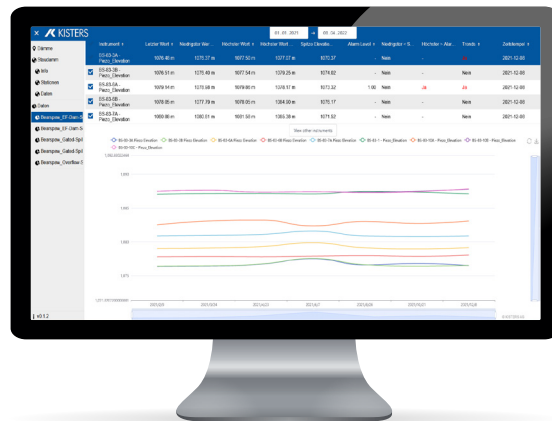

+ Modeling (Hydrostatic Season Time Model, HST)

The Hydrostatic Season-Time (HST) model allows you to analyse the behaviour of dams based on data history. It describes, for example, the functional relationship between the deformation of a dam and its height, the seasonal influence and irreversible long-term deformations. The model calculations are continuously updated with incoming data. An alarm system informs in case of anomalies.

+ Optimisation

Realtime Optimisation (RTO) for reservoirs, hydropower plants and dams provide the dam operator with decision-making aids to optimally manage his dam under all boundary conditions – for example, with the objectives of maximum profit/energy generation, particularly high efficiency and/or minimum operating expense. Scenarios with different boundary conditions can be simulated using a detailed model of the dam system, known as a 'digital twin', which provides a realistic representation. By connecting to the control system, a high degree of automation can be achieved, allowing the optimisation results to guide daily operations.
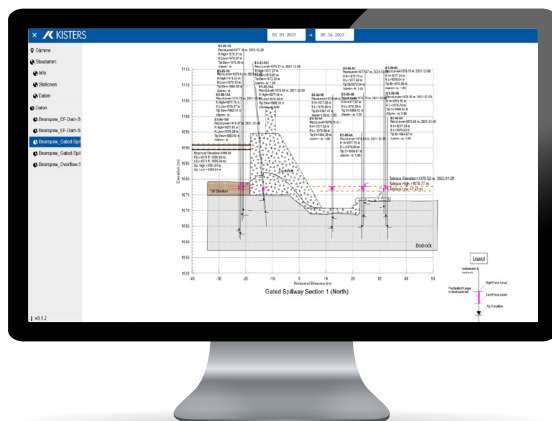
⚡ ProCoS
+ Control system

The KISTERS SCADA and process control system ProCoS supports dam operators in managing their operations: It offers functions such as leak and pipe burst monitoring, trend line monitoring of levels, water optimisation and pump control, as well as extensive options for remote alarming and remote access for location-independent control system operation. This ensures safe operation of the respective monitored systems or processes at optimal cost.

Sensors and Measuring Stations

Metrological monitoring of dams and reservoirs

KISTERS offers sensors, data loggers and data transmission technologies for a wide range of hydrometeorological measurement and voltage variables. Our sensors can be configured easily and efficiently, and communicate via the proven LoRaWAN radio transmission standard to form (together with existing sensors) a dense measurement network. This increases the database for evaluations and thus results in more meaningful insights.

All measuring devices are characterised by robustness, reliability, accuracy, low maintenance requirements, low power consumption, and easy installation.

Sensors

KISTERS' portfolio includes robust and accurate sensors for:

— Water level (surface and groundwater): Radar sensors, pressure sensors with temperature compensation, float-operated absolute angle encoders, desiccant-free compressed air ('bubblers')
— Seepage: tipping bucket flow meters (suitable for very small quantities)
— Precipitation: tipping bucket rain gauges, weighing rain gauges, piezo and photoelectric rain gauges, hail sensors

Data logger

Our reliable low-power data loggers transmit data via ModBus, cellular or LoRaWan. Their functionalities include data acquisition, processing and storage, control of limit values and alarming. For the operation of LoRaWAN monitoring stations is the low-cost IoTa SensorNode particularly suitable - it can operate on single battery charge autonomously for several years.

Please ask us for details about our devices.

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About KISTERS

Using water and energy more sustainably, mitigating the effects of climate change and counteracting them preventively – that is our passion and our motivation. We develop digital solutions to advance the monitoring and forecasting of water and the environment, so environmental managers have salient information to plan for and face difficult decisions about flooding and drought as well as ensuring the delivery of clean water. Our goal is to develop sustainable and efficient software solutions, including databases or forecasting and decision support systems, based on state-of-the-art technology and a thorough understanding of our customers' requirements. Our solutions are used for a variety of purposes, including dam operation and safety, surface and groundwater monitoring, meteorology, flood warning, water quality, and urban drainage. They are employed by hundreds of customers worldwide, with several thousand licenses in use. KISTERS is a medium-sized IT company with 750 employees, headquartered in Aachen (Germany) and numerous national and international subsidiaries.

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