CAMPBELL SCIENTIFIC, INC.

MEASUREMENT & CONTROL SYSTEMS

Dam Safety

Benefits of Our Systems

1. Systems provide real-time data on critical dam safety parameters.
2. Nearly every available sensor can be used—analog, resistive bridge, pulse, vibrating wire, 4-20 mA, SDI-12, etc.
3. Systems operate reliably in harsh environments.
4. Systems control external devices, such as audio or visual alarms, based on measured conditions.
5. Software supports data retrieval and display, datalogger programming, and override control capability.
6. Low current drain allows long-term, unattended operation from batteries and solar panels.
7. Systems can report conditions or sound alarms by calling out to pagers, radios, or phones.
8. Systems support long-term, unattended data storage and transfer.

The CR10X is a versatile, rugged datalogger capable of long-term, unattended operation.

From water level to structural integrity, our systems provide continuous, stand-alone monitoring of parameters critical to dam safety.

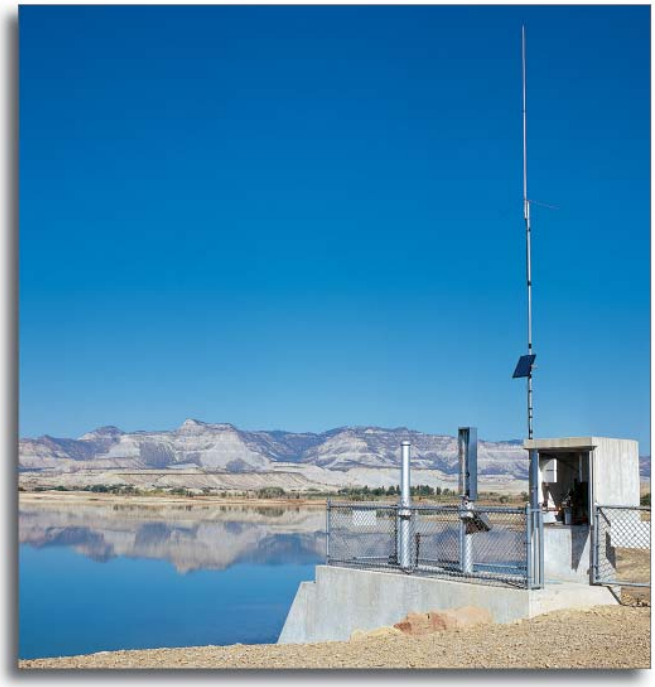
Campbell Scientific data acquisition systems provide real-time data for dam safety applications. Our systems are versatile, rugged, and powerful—factors that make them ideal for long-term, unattended monitoring. Integrators, consultants, and organizations overseeing their own monitoring programs use our instrumentation to identify and warn of common causes of dam failures, such as overtopping, structural or stability failures, or piping. Our systems provide reliable solutions for all types of dams—embankment and concrete, new and existing. Applications include monitoring of:

- Reservoir levels
- Watershed inflow
- Crack size
- Slope stability
- Rock mass deformation (TDR)
- Tilt and inclination
- Erosion
- Thermal gradients

Dam safety monitoring can include monitoring the dam itself, the foundations holding the dam in place, and the water in the reservoir.

- Dam monitoring can include measuring cracks and joints, tilt, inclination, stress, strain, deformation, and seepage flow.
- Foundation monitoring may include measuring pore pressure, slope stability, subsurface water table, regional versus local tilt measurements, and subsurface rock mass deformation.
- Water level monitoring can consist of single stations or large-scale monitoring networks.

For example, the Sacramento Municipal Utility District in California has a network of over 60 monitoring stations that measure water levels, rainfall, and weather parameters at dams and rivers. The network provides data used for forecasting and managing the operation of hydropower plants. Systems can also perform control functions (such as opening or closing a gate) based on monitored conditions.



Low-power use, battery power, telecommunications, and reliable instrumentation allow long-term, remote operation.

Communications

There are multiple communications options for retrieving, storing, and displaying data. Telecommunication options include short-haul, telephone (landline, voice-synthesized, cellular), radio frequency, meteor burst, multidrop, satellite, and the Internet. Onsite options include direct connection to a PC or laptop, PC card, storage module, PDA (specifically Palm brand), and datalogger keyboard/display. Telecommunication and onsite options can be mixed in the same network and multiple stations measuring different parameters can be monitored from a single laptop or desktop computer. Our OPC client/server software application allows data to be used with third-party software.

Sensors

Our dataloggers are compatible with nearly every commercially available sensor, so you can use the sensors that best meet your application. Typical sensors for dam safety applications include: vibrating wire gauges, Carlson strain meters, foil strain gauges (set up in quarter, half, or full bridge strain configurations), inclinometers, crack and joint sensors, and tilt sensors, as well as piezoresistive, piezoelectric, capacitive, borehole, and servo force balance accelerometers. Because our dataloggers have many channel types and programmable inputs, all of these sensor types can be measured by one datalogger. Channel types include analog (single-ended and differential), pulse counters, switched excitation, continuous analog output, digital I/O, and anti-aliasing filter. Using switched or continuous excitation channels, our dataloggers provide excitation for ratiometric bridge measurements.

Monitoring systems at the Long Park Dam (Daggett Co., Utah) helped identify and prevent an imminent dam failure.

Dataloggers

The measurement and control features of our dataloggers allow them to be used as a more functional alternative to PLCs or RTUs. The same datalogger can be used in a variety of applications, commonly at the same time. For example, a CR10X Measurement and Control System can be used for slope stability, water level, or crack monitoring. Scan rates can be programmed from a few hours to 100,000 times per second, depending on the datalogger model. Measurement types, processing algorithms, and recording intervals are also programmable. Onboard processing instruction sets allow data reduction in the field.

The control functions of our dataloggers combined with their programmability allow them to sound alarms, actuate electrical devices, or shut down equipment based on time or measured conditions. Systems can also call out to phones, pagers, radios, and other devices to report site conditions. Voice-synthesized modems are available, so the system can actually call and tell you what is happening.

Low power drain allows our data acquisition systems to be powered by solar panels and batteries. Non-volatile data storage and battery-backed clock ensure data capture and integrity.

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