framatome

SECONDARY HEAT BALANCE MEASUREMENT SYSTEM

Dedicated I&C Acquisition System

Optimization of plant performance by accurate data acquisition of dedicated process variables

Challenge

Safety instrumentation and control (I&C) systems of nuclear power plants perform critical functions which monitor and control nuclear steam supply systems (NSSS). For the continued safe operation of such I&C systems, periodic calibrations are necessary to compensate for changing plant process conditions during the fuel cycle. In particular, Secondary Heat Balance (SHB) measurements performed at regular intervals during reactor operation, as well as at pre-defined stages of startup or shutdown, are required by plant operating regulations.

Accurate and reliable data acquisition of selected process variables is necessary to support the generation of calculated calibration factors, which are input to the related control loops of the NSSS.

Solution

Framatome SHB measurement solution offers a modular platform using a modern DataAcquisition (DAQ) system which employs robust, scalable and high performing equipment. The SHB measurement solution acquires the necessary measurement values and provides them to operators for the calculation of the calibration factors.

The SHB measurement system is implemented with FlatRACK DAQ hardware. The FlatRACK hardware employs powerful ARM-processor as chassis CPU, and FPGA's for input/output processing. The SHB measurement system is integrated into rugged and robust housing that can be located near to all related measurements within the plant unit.

Customer benefits

The state-of-the-art Framatome solution for Secondary Heat Balance measurement applications reduces downtime and improves plant power production, while increasing overall confidence in measurement integrity.

- With this precise DAQ-system and measurement process for measuring the signals and calculating the set-points, utilities may be able to produce up to an additional ~10 MWe depending on plant type and system configuration (based on German plant experience)
- Adaptable and customizable software (application program and Human-Machine Interface) makes operator training and operations easier
- Robust equipment diagnostic features produce highly accurate measurements with reduced complexity and downtime resulting in improved measurement reliability
- Multiple diverse mechanisms increase data integrity adding more certainty to operations
- Long-term product support of both hardware and software provides customers even more confidence in the system

FlatRACK chassis shown with four I/O modules

Technical information

Secondary Heat Balance measurement system specifications*:

- External power supply voltages in the range of: 24 VDC / 110 VAC @ 60 Hz / 240 VAC @ 50 Hz
- 130,000 hrs ≤ MTBF ≥ 540,000 hrs (module type specific)
- Supports the following types of signal* measurements:
  - Analog current input in the range of: 0 / 4 to 20 mA (Accuracy: ±12 µA @ 18-Bit resolution)
  - Analog voltage input in the range of: 0 to 10 Vdc (Accuracy: ±0,5 mV @ 24-Bit resolution)
  - Analog Resistive Temperature Device (RTD) measurement (Pt100) (Accuracy: ±0.2 °C @ 24-Bit resolution)
  - Serial data communication (RS-232 / 485) optional
- Fixed sampling rate at 10 ms (depending on signal type)

FlatRACK Software:

UEIPAC for hardware configuration of FlatRACK executing the Python application software

SHBMS operational conditions:

Plant room environmental conditions**:

Temperature, in the range of: +15 to +45 °C

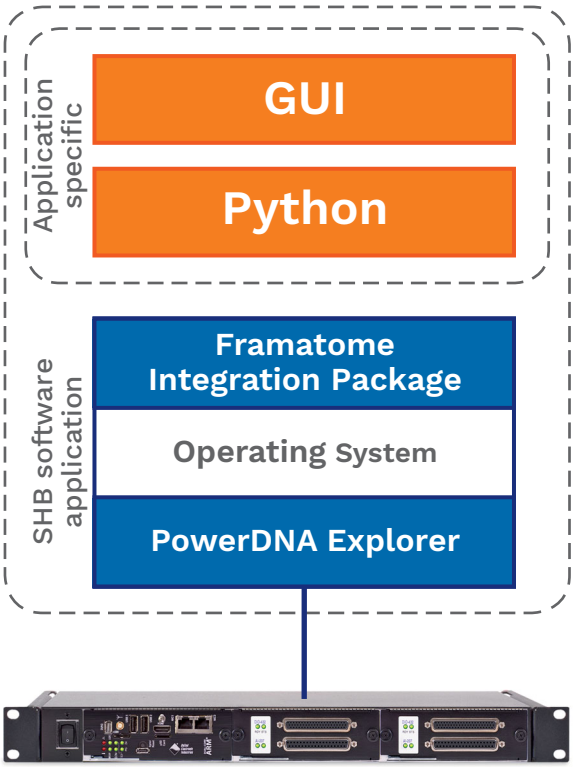
- Humidity, in the range of: +20 to +80 % Rh (non-condensing)
- Operational shock and vibration: 30 g (acc. IEC 60068-2-27) and 5 g (between 10 – 500 Hz) (acc. IEC 60068-2-6)

* Final system specifications and supported signal types may vary, depending on final system configuration

** Tougher environmental conditions in mild environments could be supported if needed

References

Testing applications using similar hardware and customized software for nuclear plants in Britain and Switzerland.



Additional features

- Customized data acquisition, adapted according to the constraints for data acquisition of the Nuclear Power Plant
- Signal count (I/O-signals) and specifications scalable and adaptable according to system requirements
- Low power consumption (<350 W depending on final system configuration)
- Secure data communication between system and remote operator ensured by LAN and secure data transfer protocols
- Reduced effort for recurring measurements (i.e., all equipment pre-installed, with remote PC connection optional)
- Cyber security ready
- Long-term product availability and support

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