MIRION TECHNOLOGIES

Radiation. **Safety.**

Designing a Digital Control System for Purdue University

Roy Ray
August 25, 2016

18 Slides

MGPi H&B

Reactor Control System Replacement

Budget

- **DOE - Nuclear Energy University Programs Award of $1,276,812**
- Purdue University will replace its existing Instrumentation and Control systems with modern technology that will reduce unscheduled maintenance downtime, increase the availability and improve the safety of the reactor for use in its education, training, and research mission.

Basic Criteria

- Fully operational reactor control and reactor safety system cable of operating the reactor from 0% power (shutdown) to 100% power.
- Full control rod insertion from upper limit to lower limit in less than 1 second following a SCRAM signal by the operator or reactor protection system.
- Operational reliability at 99% up time.

proTK™ Neutron Flux Monitoring System

- 60 years of combined experience
- > 26 years of operational experience without any software failure in digital measuring channels
- Supplier of more than 1,000 installed safety system monitoring channels for NPPs and research reactors

✓ **Planning**	✓ **Production**
✓ **Design**	✓ **Training**
✓ **Engineering**	✓ **Maintenance**
✓ **Installation and Set up**	✓ **Onsite support**

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proTK™ Neutron Flux Monitoring System

Applications

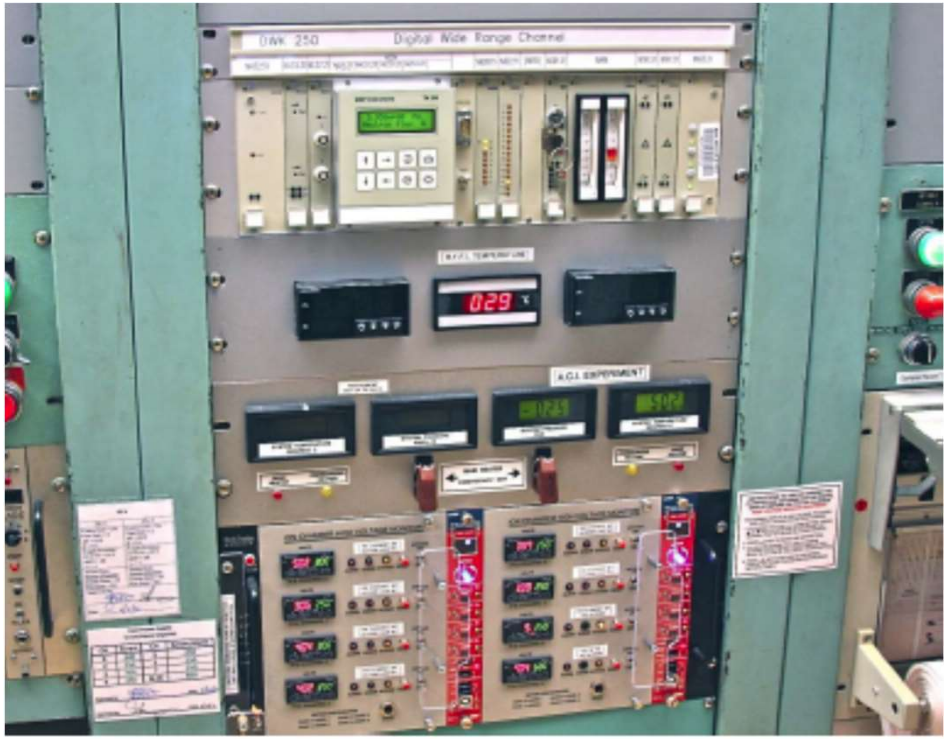
- Operational process monitoring
- Measurement and monitoring of neutron flux density including Start-up range, intermediate range and power range
- N16 power monitoring

Digital reliability!

Major attributes

- Modular construction
- Versatile applications
- Robust and reliable
- Proven by operational experience
- Use extensive detector
- Design and manufacturing
- Highest level of safety and reliability
- Type test qualified and proven through excellent operational experience.
- Reactor protection system in accordance with IEC 61225 cat A

Recent Installations



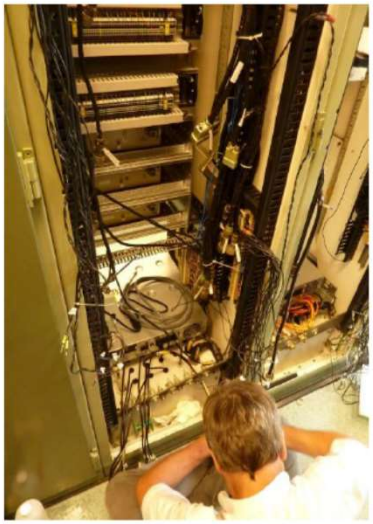
MIT Nuclear Reactor Laboratory

SANDIA Laboratory

Control Room Prior to Upgrade at University of Delft, Netherlands

Existing Equipment to be Replaced

Schedule of Installation

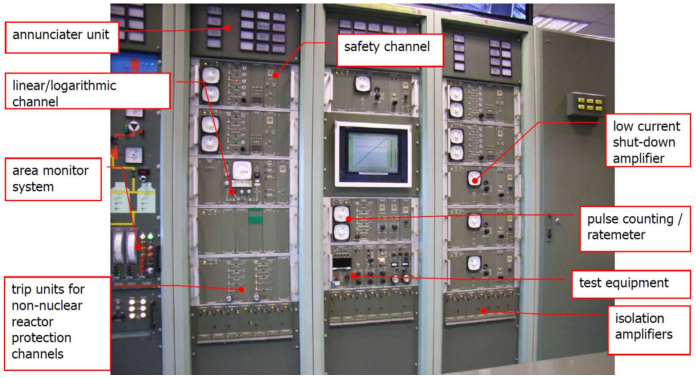

Start Removing Old equipment → 4 weeks → Site Acceptance Test

Reactor Institute Delft
Faculty of Applied Sciences

TU Delft

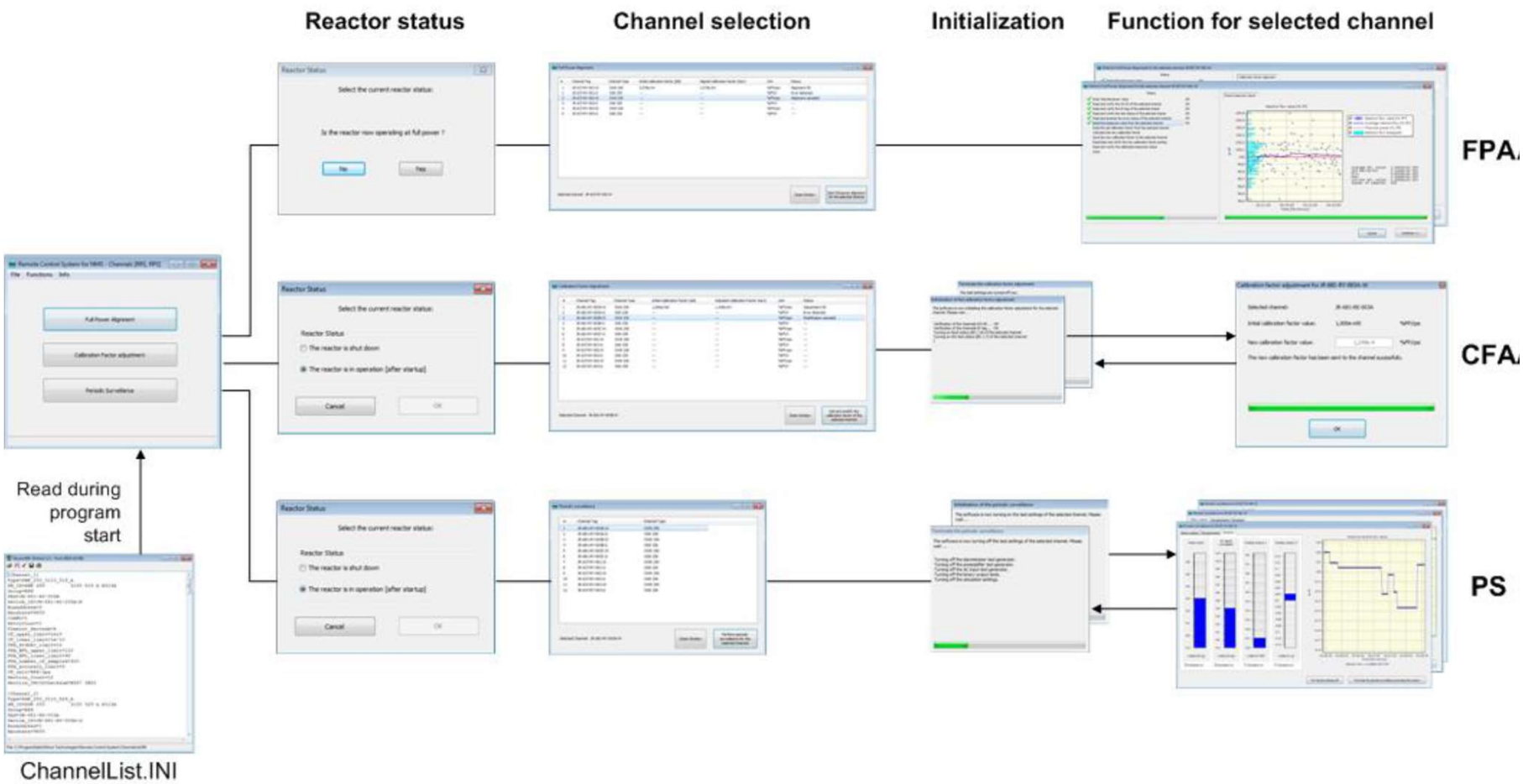
Functioning System at University of Delft, Netherlands

Final Installation

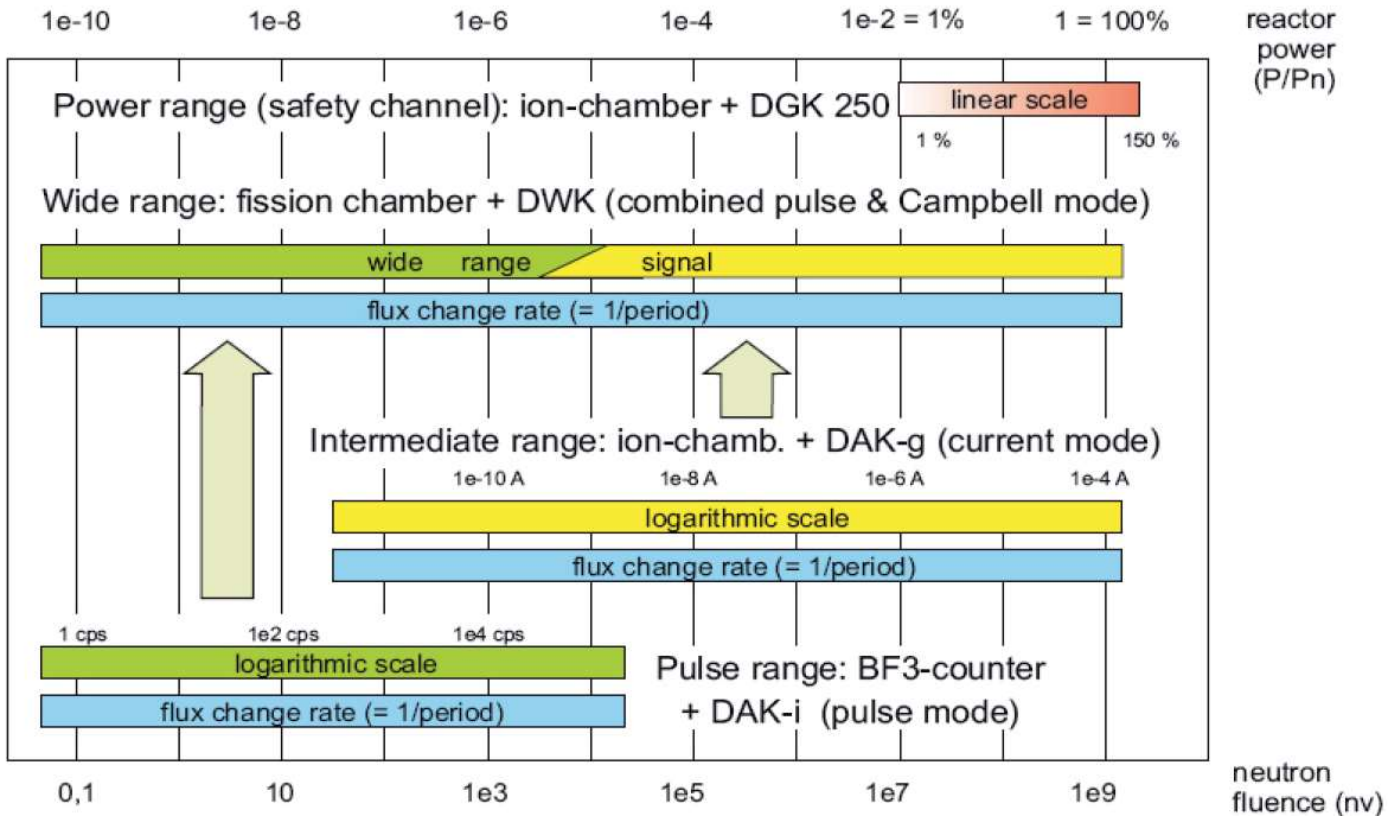


Replaced Equipment

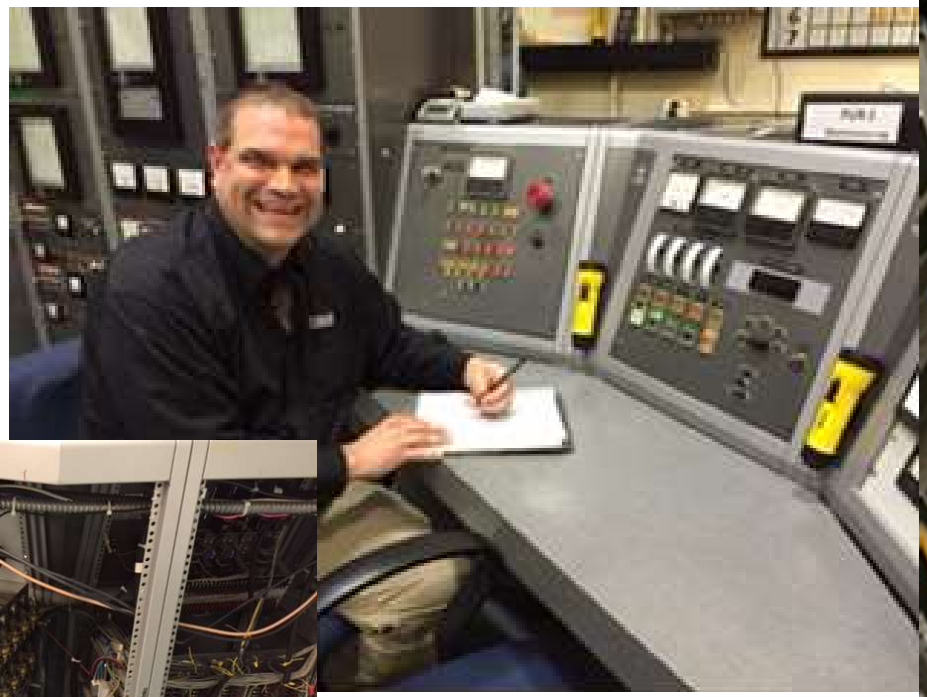
Software Structure - HMI

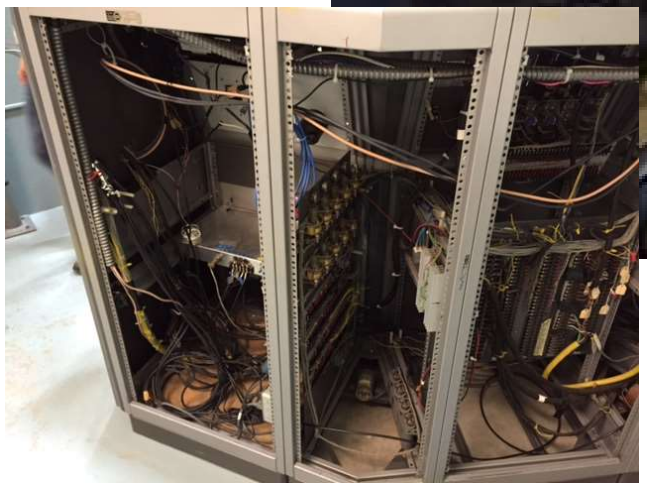


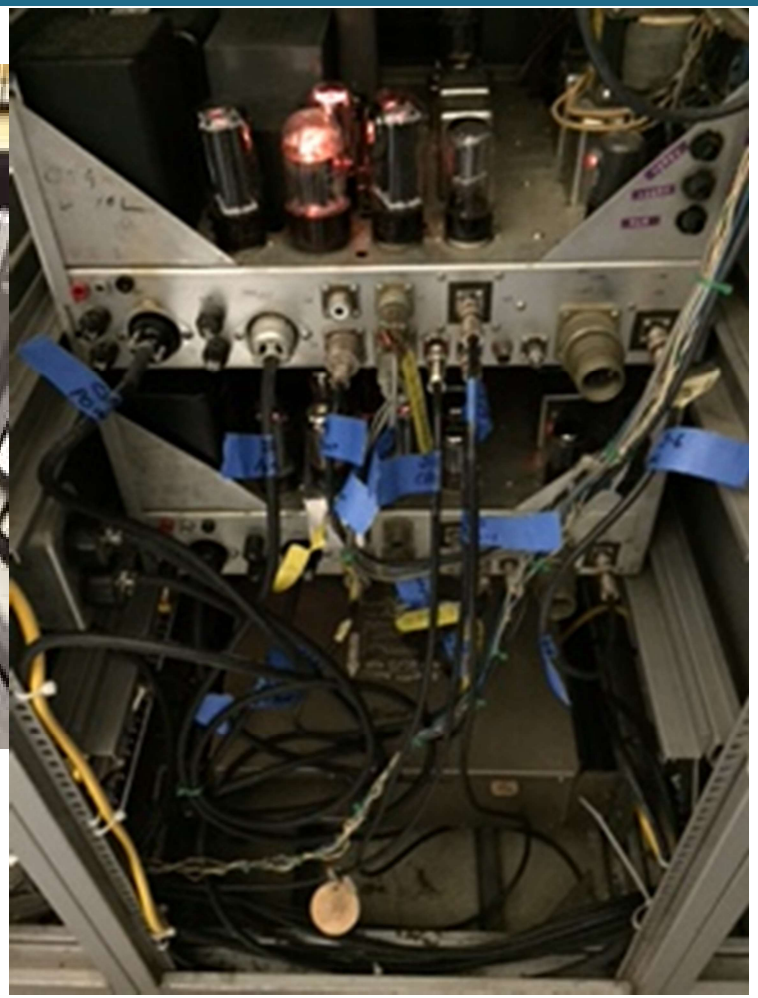
Comprehensive Detection



Purdue University – Current System







Determining Potential Scope of Supply

Budget

Digital Front End – Neutron Flux Monitoring

Analog vs Digital for Reactor Control & RPS – Back End

Hybrid System

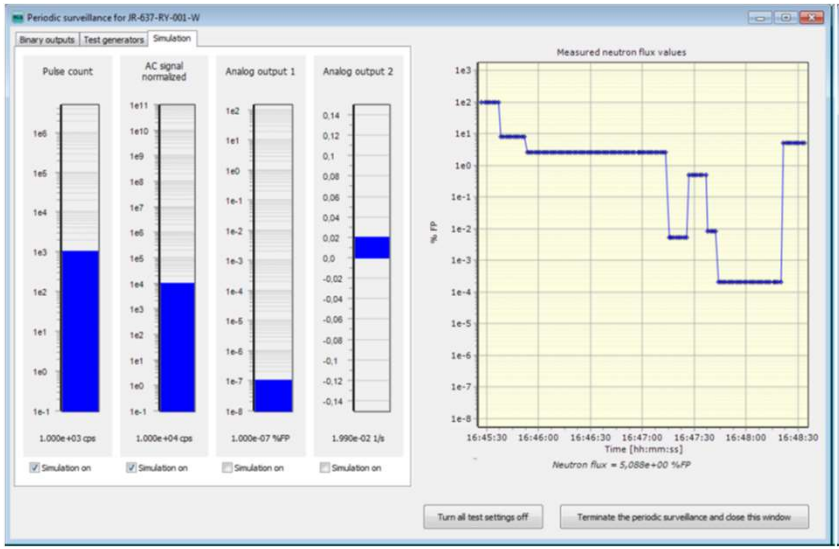
Partner

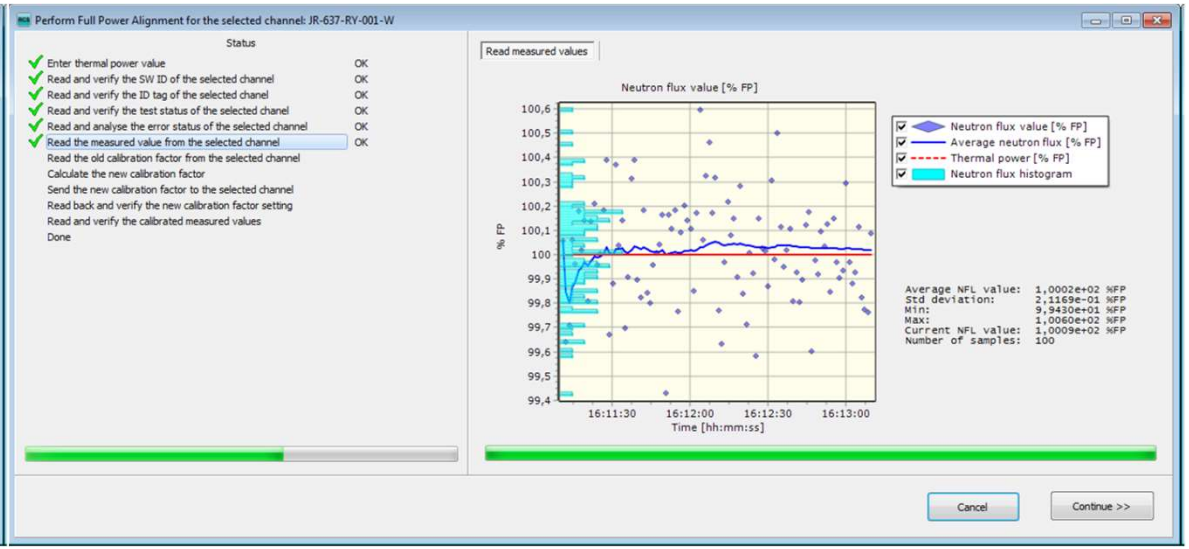
System Design and Development Processes

- Existing System Reengineering
- System Functional Requirements Definition
  - Technical Specifications
  - Safety Analysis Report
- Detailed Hardware Design
  - Qualification safety or non-safety related
- Detailed Software Design
  - Qualification safety or non-safety related
- System Implementation
- System Testing
- Installation
- Site Acceptance Testing

Mirion - Scope of Supply – Digital Front End

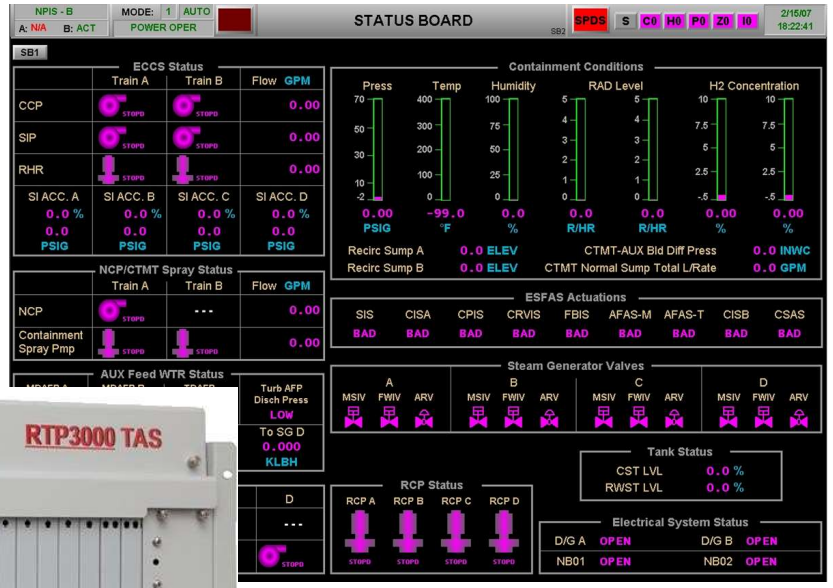
- DWK 250 Startup Range Monitoring using FC, also used as wide range monitor
- DAK 250 Intermediate Range Monitoring using CIC
- DAK 250 Intermediate Range Monitoring using UIC with linear range switching
- DGK 250 Power Range Monitoring using UIC

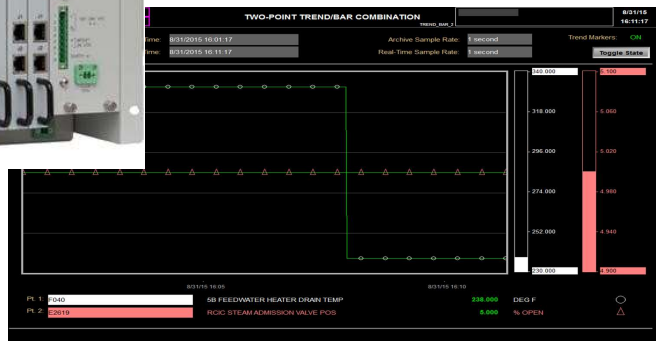




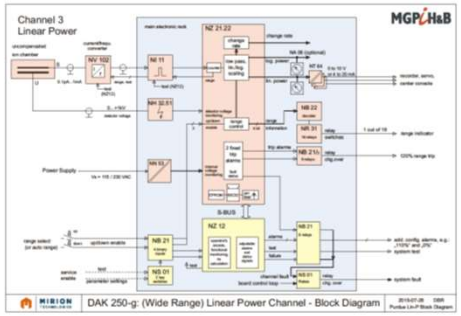
Curtiss-Wright/Scientech Scope of Supply – Back End

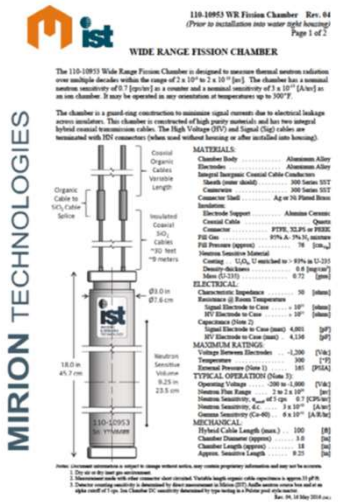
- RTP 3000 TAS System, Reactor Protection
- Drive Assembly Interface Electronics
- RMS System Interface
- HVAC System Interface
- Makeup Water System Interface
- Equipment Rack Electronics
- Operator Console HMI
- Trend Recorders
- Annunciator
- Elapsed Time Meter
- Indicator Lights
- Display Workstations
- Networking Hardware

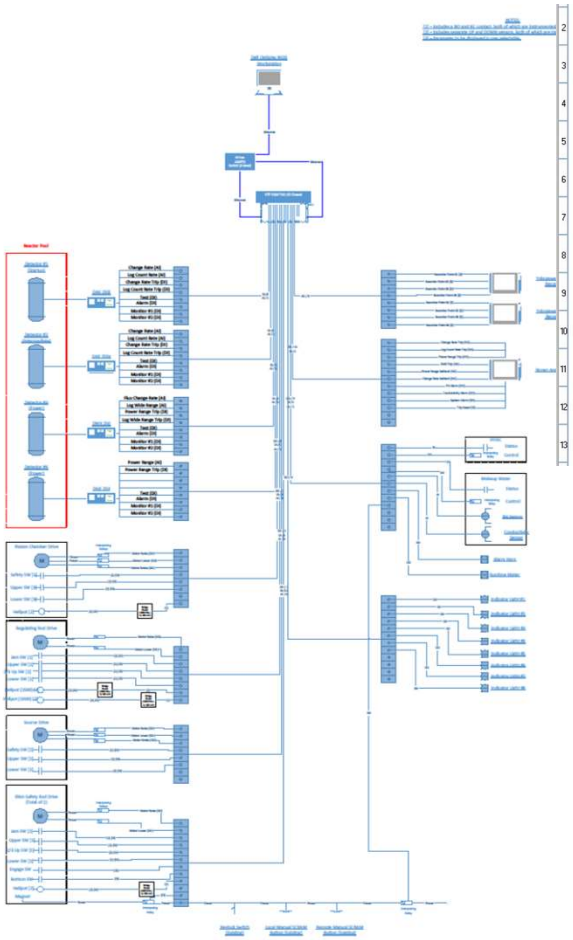


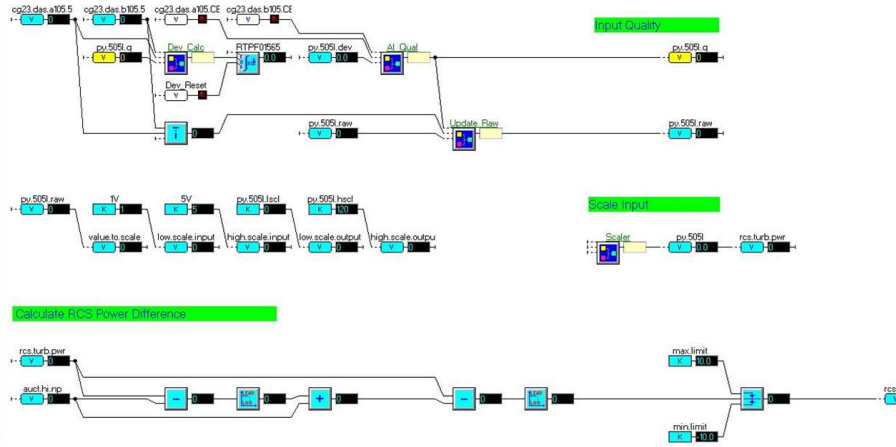


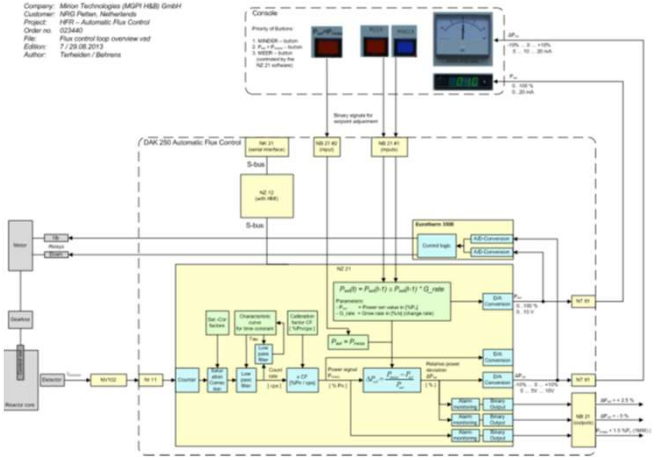
Configuration & Logic Diagrams











Current Status

- **Digital Front End – Mirion equipment shipped to Idaho Falls, Scientech**
- **Integration of Digital Front End & Hybrid – Back End, July 25, 2016**
- **Factory Acceptance Testing (FAT) August 27, 2016**
- **Project tracking within budget and on schedule**

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