proTK™ RR

IGORR

Upgrade of neutron flux monitoring systems of research reactors with digital systems

June 2025

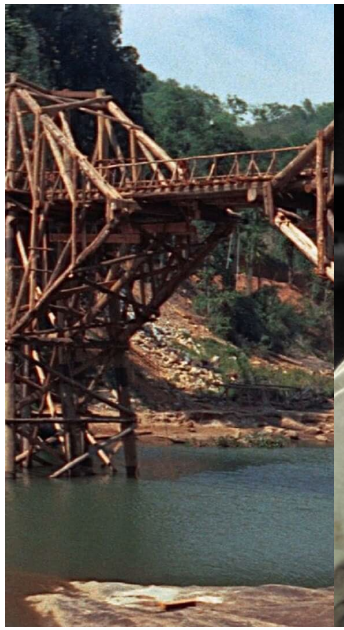
MIRION TECHNOLOGIES

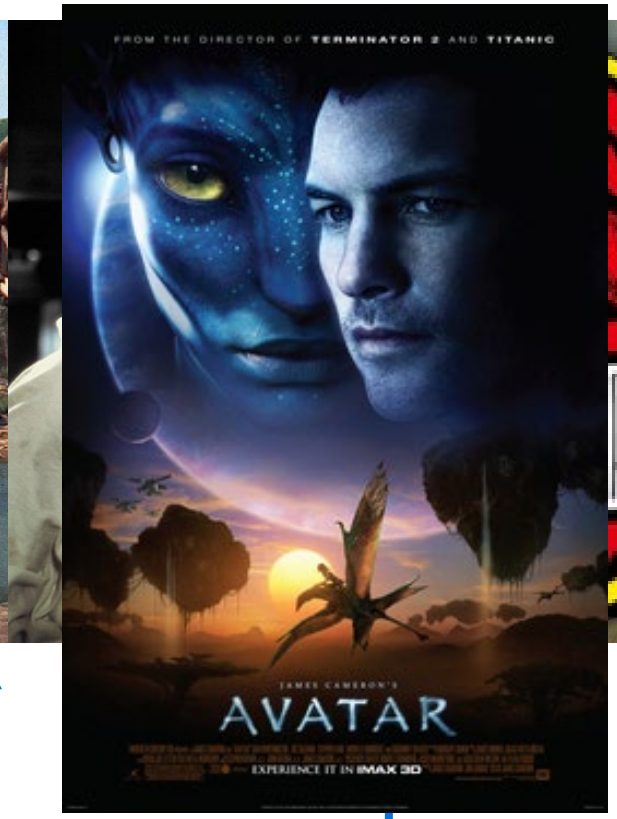
Table of Contents

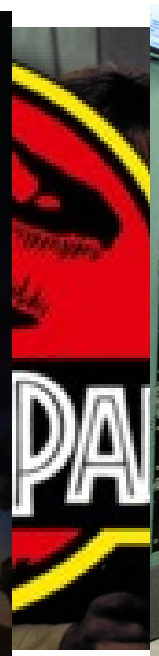
This presentation will focus on the connection between:

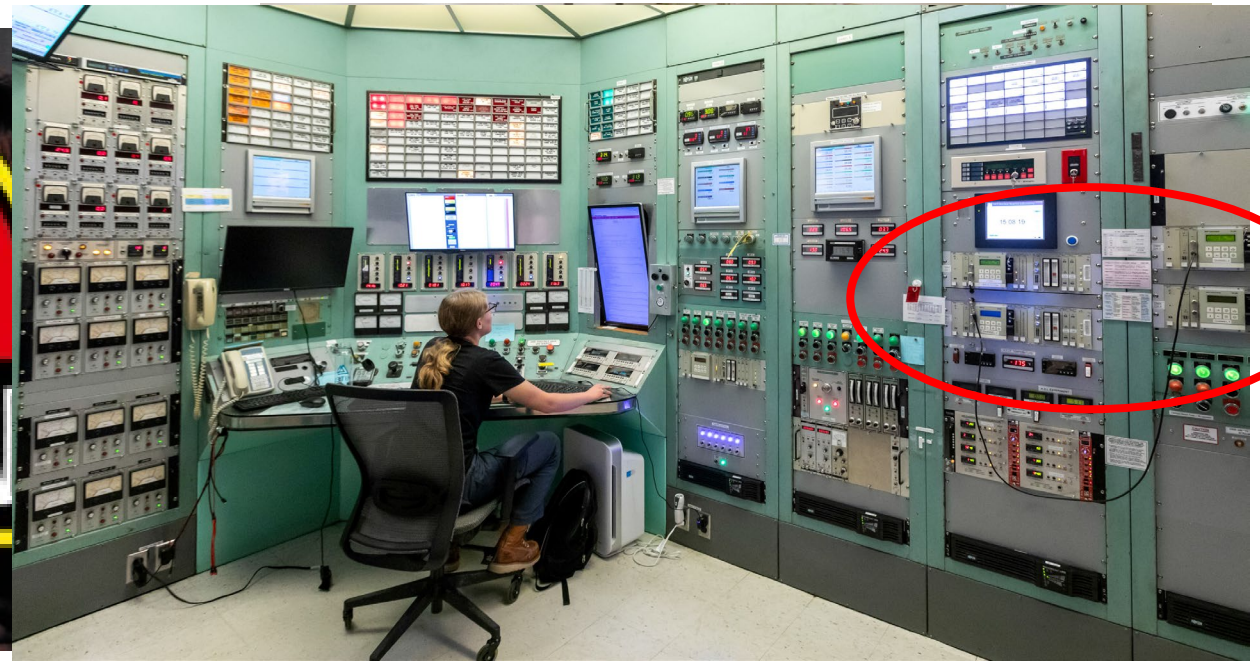
- the Oscars (Academy Award)
- lifecycle costs of NFMS systems
- Mirion proTK™ Neutron Flux Monitoring Systems

And the Oscar goes to….









Late 1950s

1970s

1990s

2010s

2020s

Time to go digital worldwide !

Situation at customer site

Most research reactors were commissioned in the 1950s - 1960s.

- **Now – System:**
  - High costs to maintain systems (time, spare parts, human resources)
  - High efforts necessary to make measurements reliable
  - High efforts for adjustment of measurements
- **Now – Environment:**
  - Slight advancements in information technology
  - Different control systems
  - Change in nuclear regulations and standards
  - Advancements in (nuclear) safety systems
  - Government budget are tighter on nuclear
  - Availability of trained engineers

Closer look at analog NFMS systems

One of the major issues analogue systems must overcome is the **obsolescence** of analogue components.

- Functions become more complex and sometimes impossible to integrate in an analogue system.
- Confusing number of knobs, switches, buttons, meters and jacks.
- Oxidation of rarely used potentiometers and switches.
- Important functions like e.g. logarithmic characteristic, threshold or time constant are subject to drift and must be periodically tested.
- Time costly periodic tests, full loop tests are necessary.
- Only hardware qualification necessary.

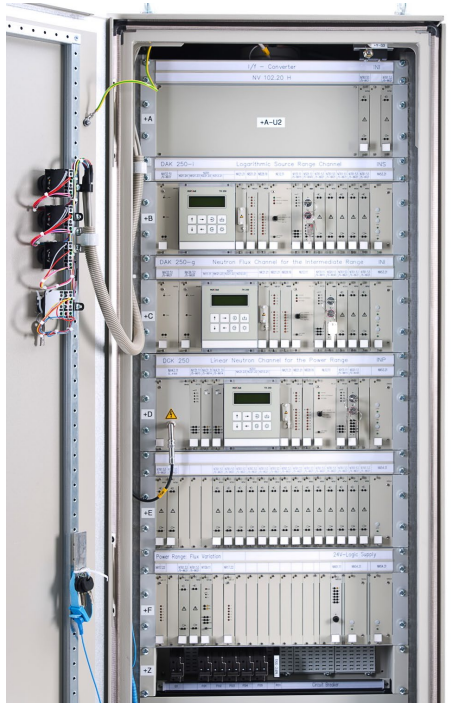
"Over the lifecycle, 80% of the TCO (Total Costs of Ownership) are operational costs."

(T. Menze, ARC Advisory Group)

Mirion proTK™ platform - digital processing systems

It has been shown that digital I&C has a series of advantages compared to its analogue predecessors :

- increased performance
- better adaptability
- higher flexibility
- higher functionality
- improved safety and reliability
- reduced risk of human error by providing an intuitive interface
- simplified periodical testing
- and as a consequence, **its overall "life cycle" costs are lower**.

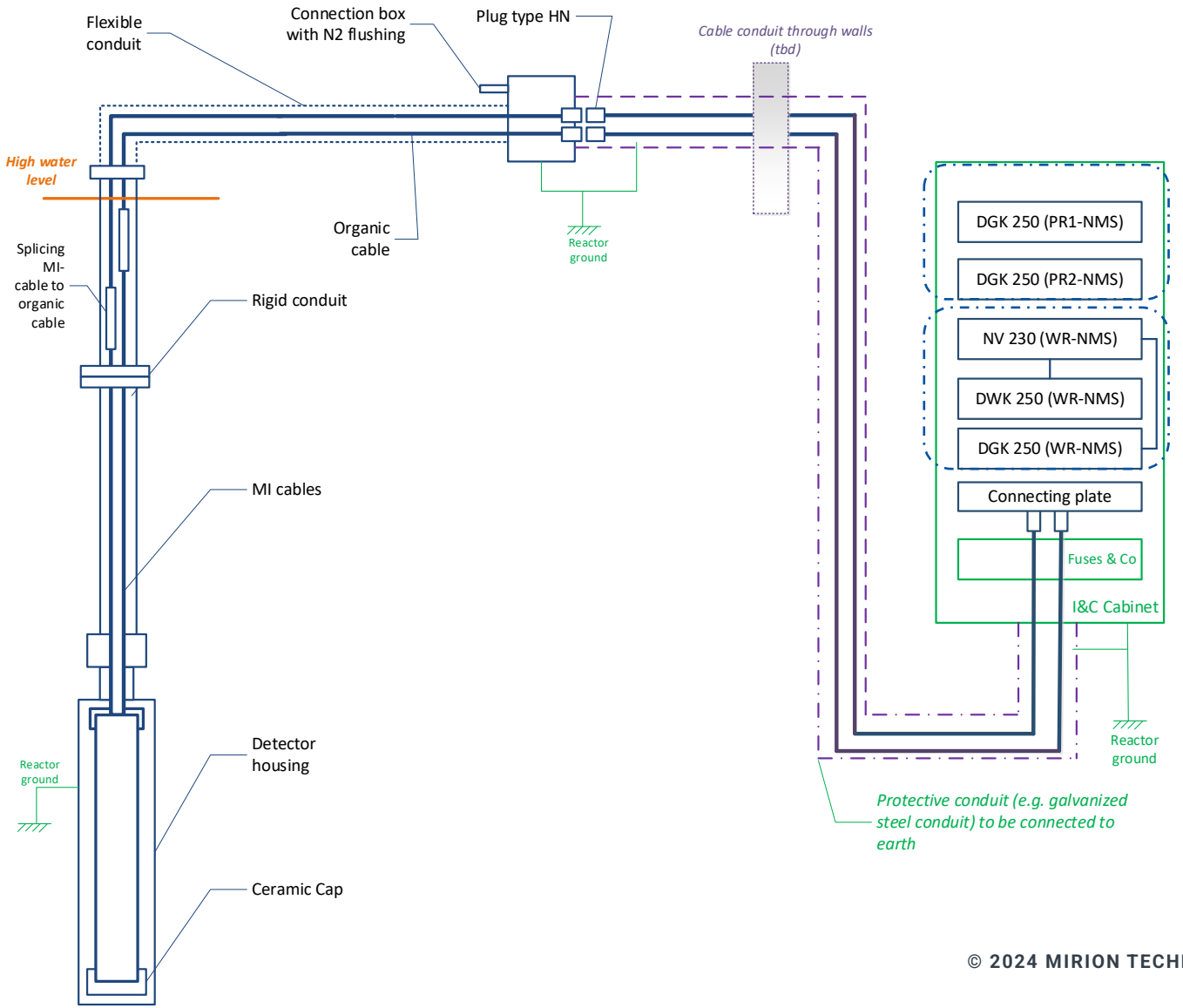


The digital signal processing channels of the proTK™ platform offer all the advantages of a digital signal processing system and has a proven reliability through more than 4000 operation years, achieved with more than 400 installed channels.

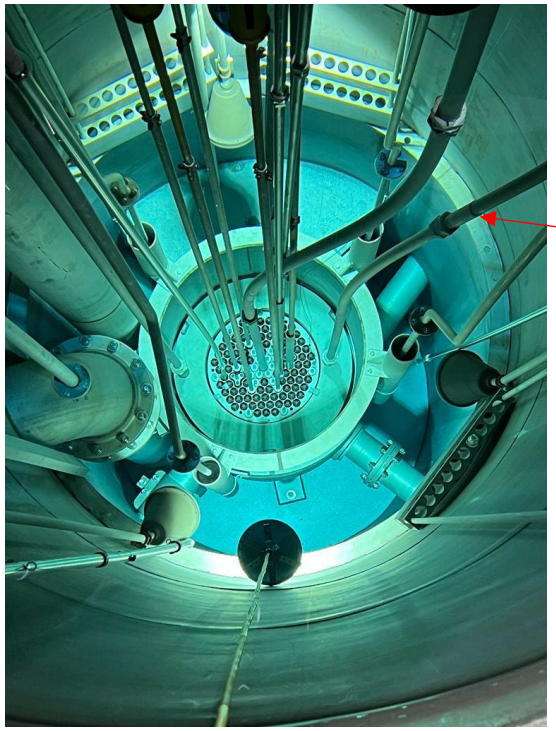
Application in BTRR : Neutron Measurement System (NMS)

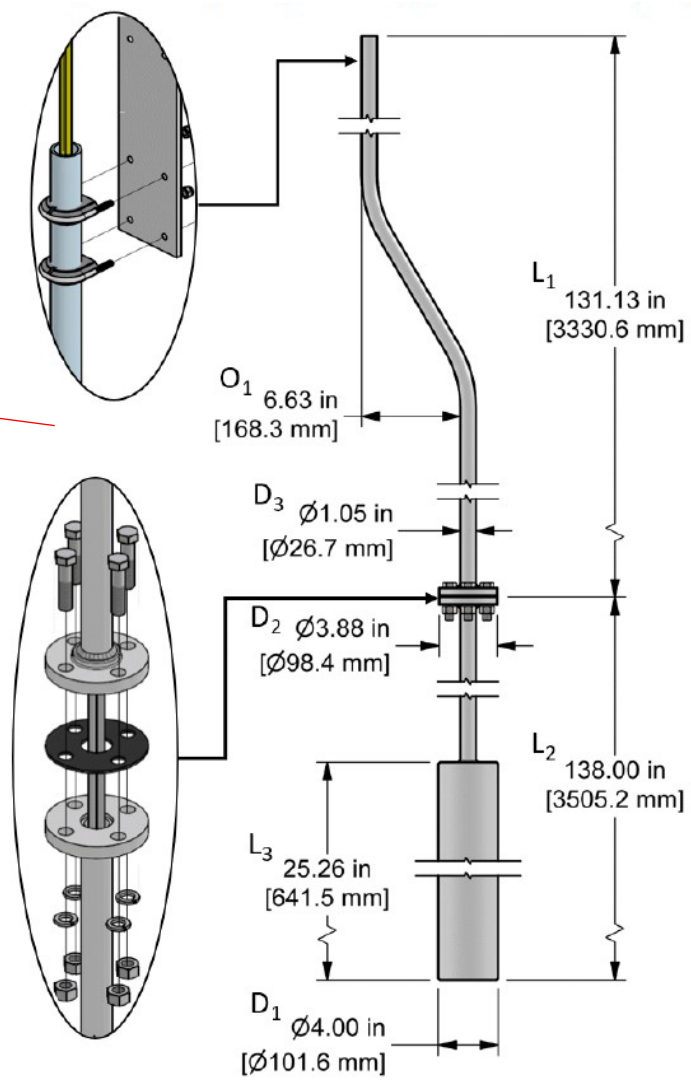
- **BAEC TRIGA Research Reactor (BTRR)**
- 3 MW TRIGA Mark-II Research Reactor in Bangladesh
- Existing Neutron Measurement System (NMS) has been modernized.
  - One (1) wide-range neutron monitoring system (**WR-NMS**), with 1 x wide-range fission chamber (WR FC)
  - Two (2) independent linear power-range neutron monitoring systems (**PR-NMS**) with signals from two uncompensated neutron ionization chambers (UIC)

Application in BTRR : Schematic



Application in BTRR : Detector assemblies solution





- ✓ Mechanical components for mounting and positioning detectors in suitable locations around the reactor core.
- ✓ Watertight housing from aluminum alloy 6061, delivered in two (2) sections (joined using a gasket and stainless-steel fasteners).
- ✓ For Ion Chamber, Fission Chamber or Proportional Counter (BF_3 filled or B-10 lined) suitable.

Mirion proTK™ Neutron Flux Monitoring Systems

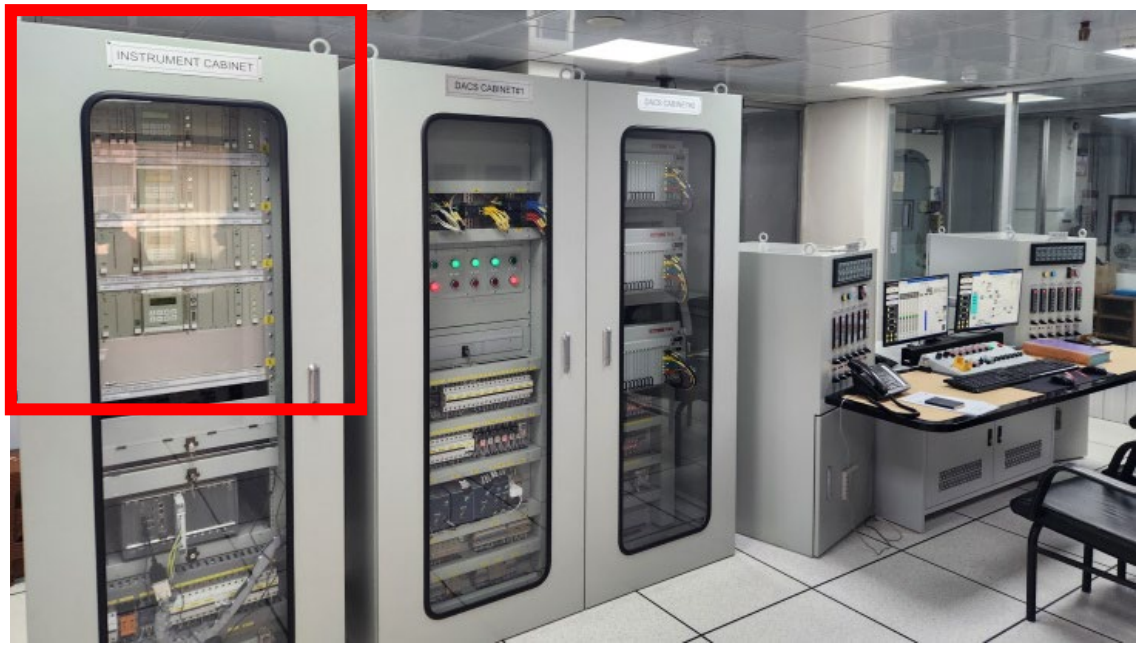
The **proTK™** for **Neutron Flux Monitoring Systems** combines long term experience in design and manufacturing of both detectors and digital signal processing electronics.

This equipment has the **highest level of safety relevance** and reliability and is qualified by several type tests and field-proven by excellent operational experience.

Main characteristics proTKTM digital systems:

- Modular, multi-microprocessor system → Simple and clear
- Cycle time of signal processing starting with 5 ms → Deterministic and Fast
- Low heat C-MOS technology → Safe
- Software fixed in EPROM, efficient self monitoring → Reliable
- Remote signal generators and signal simulation → Testable
- Qualified according to international standards → independent V&V and certifications

Application in BTRR : Key benefits of Mirion solution



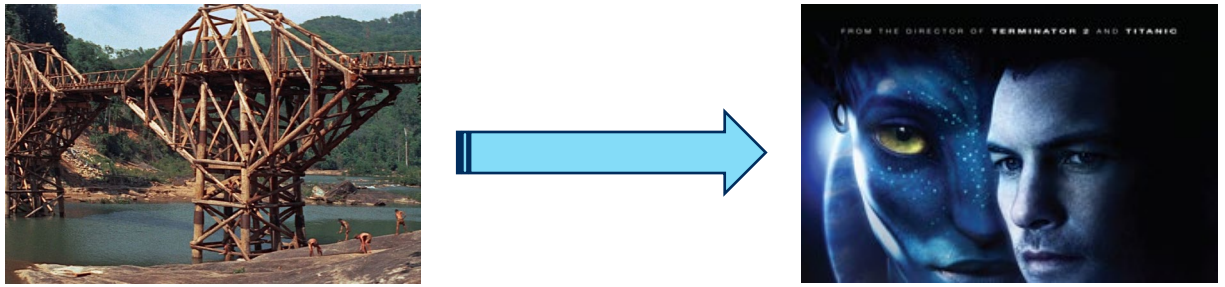
Press release WNN : KAERI completes upgrade of Bangladeshi research reactor - World Nuclear News

The designed solutions provide the following benefits to BTRR:

- **Delivery of a turn-key solution** (detector, cables, signal processing) with a user friendly and easy to operate human-machine interface due to the digital processing
- Software-based, modular design allows both systems:
- **Ease of calibration and maintenance**
- Possibility for easy future upgrades if desired by the owner/user.

Key Take-aways

- Don’t built and destroy : Digitize, be future proof, and save money and time !



- Mirion’s proTK™ provides **essential equipment for neutron flux monitoring** and other safety-critical applications in nuclear power plants & research reactors.
- The **modular proTK™ channels** with micro-controller-based signal processing enable efficient, customized safety functions, **ensuring comfortable, safe, and economical reactor operation**.

Isabelle Güldner

Deputy Director Sales & Project Management

E-Mail: igueldner@mirion.com

Your contact at
Mirion Technologies (MGPI H&B) GmbH (Munich, Germany)

MIRION
TECHNOLOGIES