

TRTR Annual Conference 2026

The University of Texas at Austin · Austin, Texas

NUCLEAR INSTRUMENTATION FOR RESEARCH AND ADVANCED REACTORS

Mirion Technologies // Ewald Liebhart, Jörg von Loeben, John Portillo



MIRION
TECHNOLOGIES

proTK™

CoreVision

Advancing Radiation Safety.
Empowering Progress.

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Content

- Intro Mirion Technologies
- Overview Mirion's Portfolio for NFMS // proTK™ + CoreVision
- Executive Order 14301 – “Race to Criticality” / Mirion's contribution
- Neutron Flux Monitoring for SMR / ANR / RR

Mirion Introduction

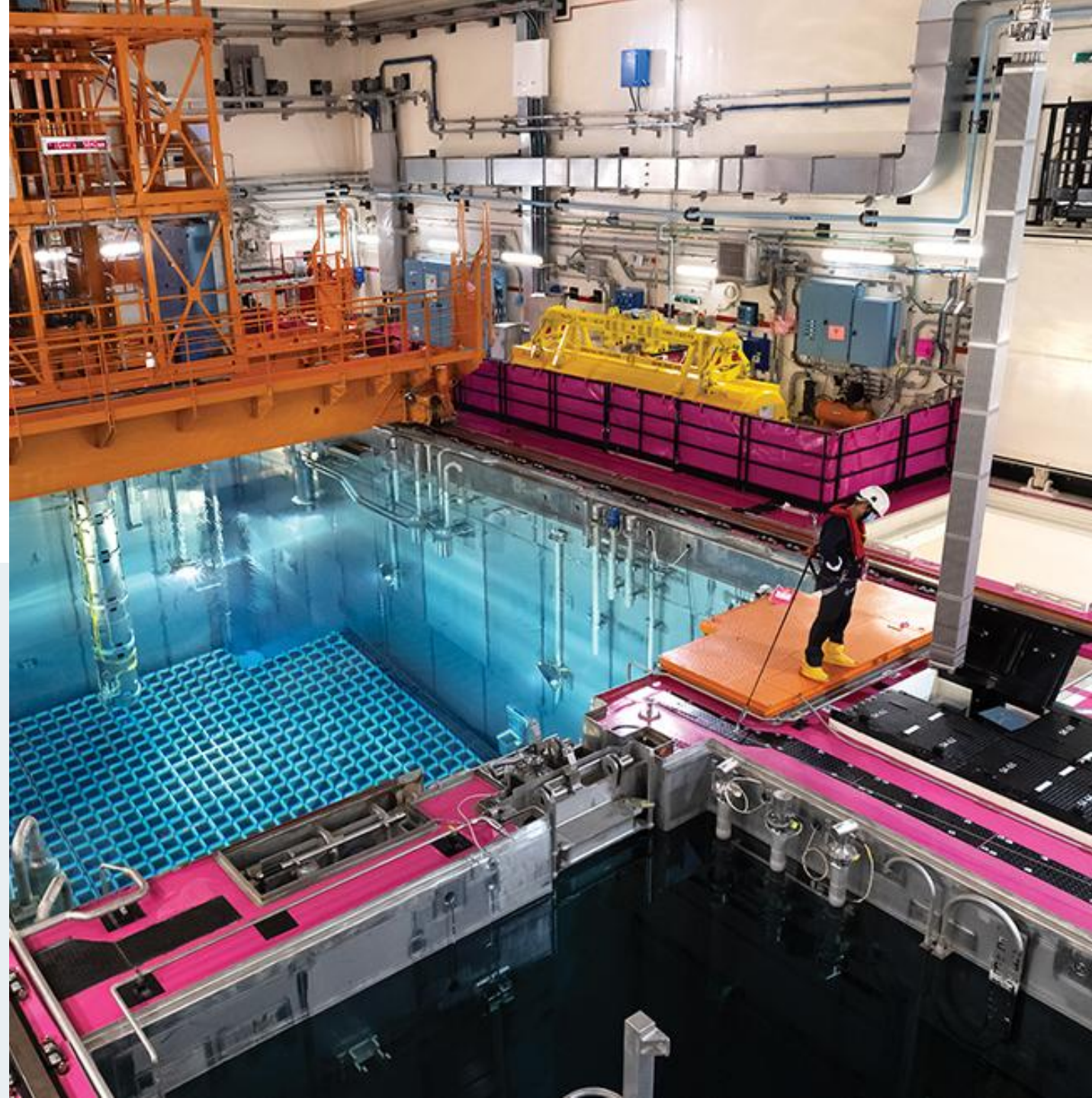


OUR MISSION

"TO HARNESS OUR
UNRIVALED KNOWLEDGE OF
IONIZING RADIATION FOR
THE GREATER GOOD OF
HUMANITY."



MIRION
TECHNOLOGIES



Mirion Solutions

Applicable Across Wide Array of Verticals

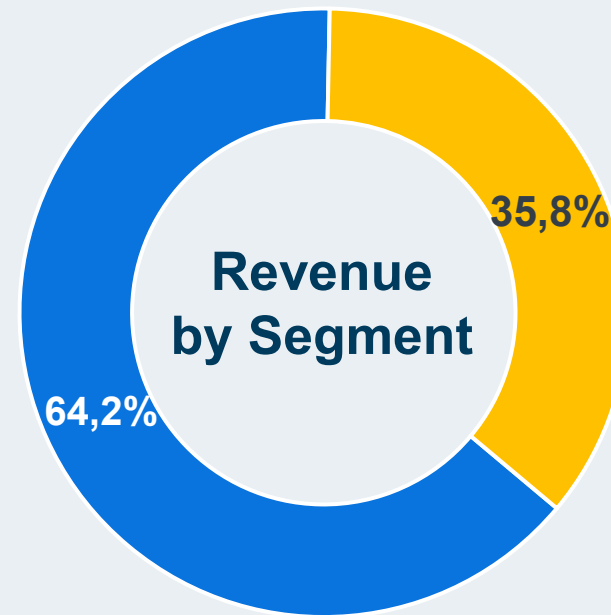
MIRION TECHNOLOGIES

Nuclear Power
Defense & Diversified
Labs & Research



MIRION MEDICAL

Radiation Therapy
Nuclear Medicine
Dosimetry Services



■ Technologies ■ Medical

Pie chart based on the nine months ended
September 30, 2024 (10-Q filing October 2024)



Mirion Technologies

130 Patents
700+ products

World leader since 70's

3000+ Employees

20+
Manufacturing sites globally
RMS and EPAs in France
NFMS in Germany and USA

>1.2 B revenue
Strong financial stability

Nuclear Power
(98 % of the reactors)

Defense

Research & Medical

KEY CATEGORIES

Instrumentation and control

- Radiation Monitoring Systems (70% of the world nuclear fleet)
- Neutron Flux Monitoring Systems (Analog and Digital)
- Safety related I&C platform (HIPS)
- Safety related electrical, mechanical and HVAC equipment
- Electrical Penetrations Assemblies (EPAs)
- Tritium monitoring solutions
- Radiation Tolerant Cameras
- Sensors
- Environmental qualifications

Spectroscopy & Scientific Analysis Systems

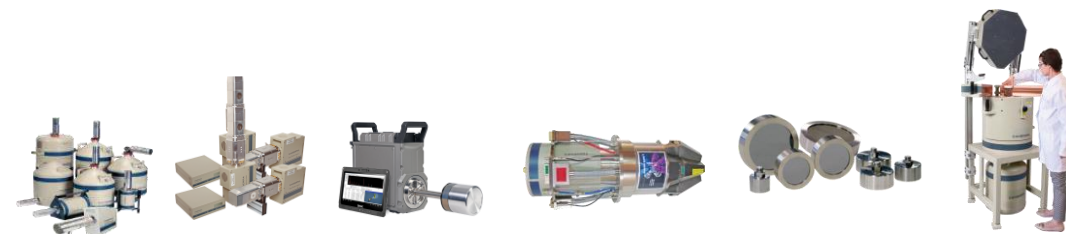
(Gamma, and Alpha spectroscopy, specialty detectors...)

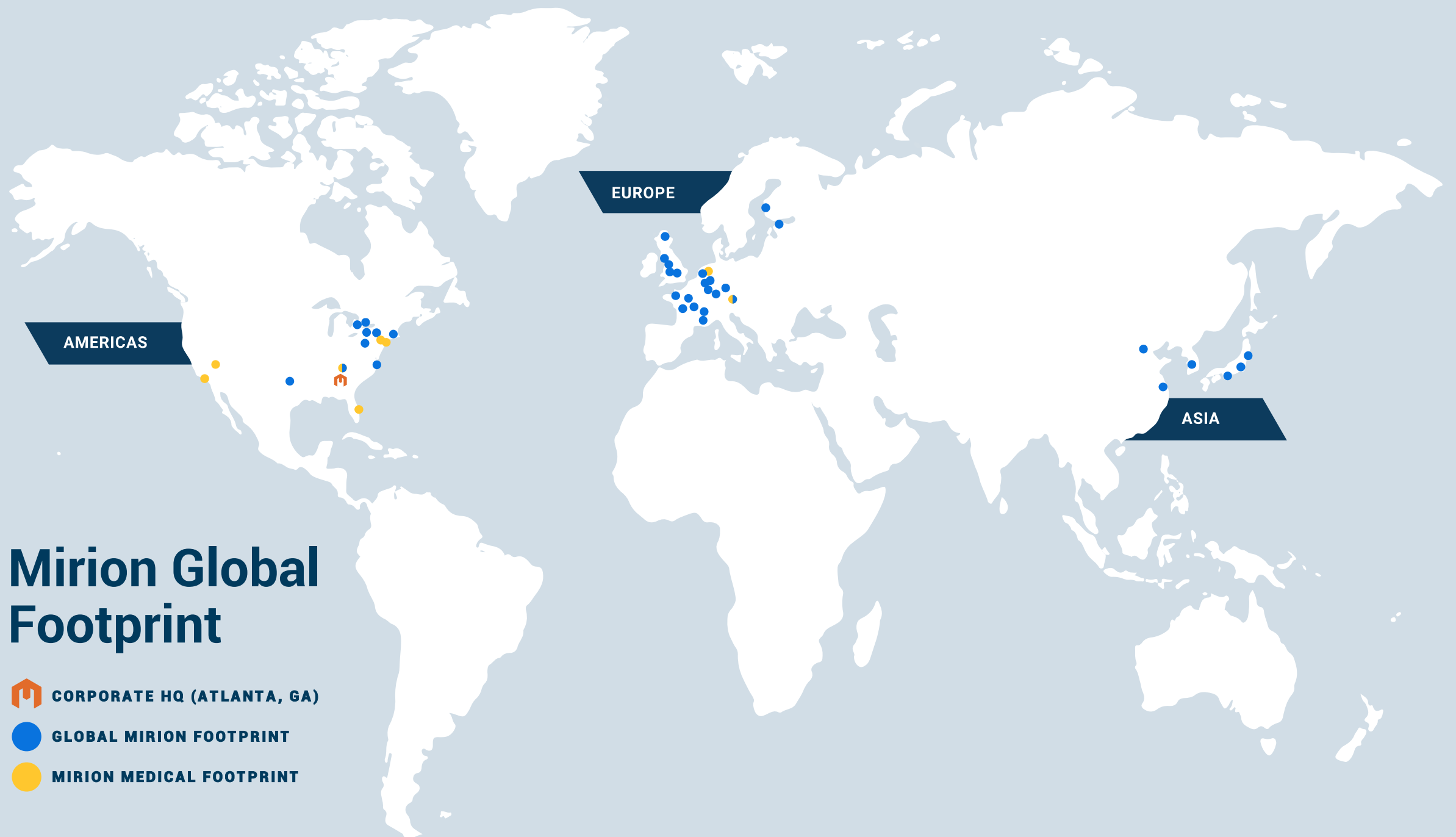
Health Physics

(Contamination and clearance, active and passive Dosimetry, hand-held instruments, defense...)

Characterization

(Waste monitoring, Waste characterization, decommissioning solution...)



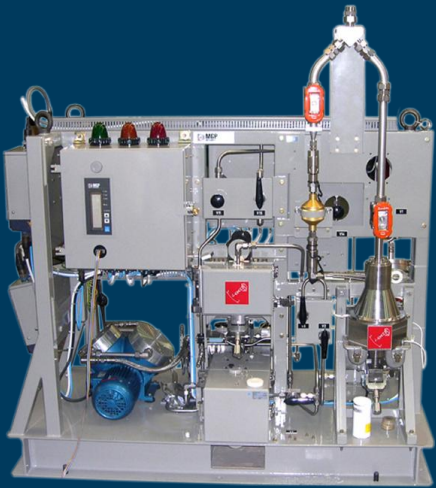




Reactor Instrumentation & Control

Our ultra-precise instruments help nuclear operators maintain reactor safety and peak operational performance.

- Radiation Monitoring Systems
- Neutron Flux Monitoring Systems
- In-Core & Ex-Core Detectors
- Nuclear Containment Seals
- Electrical Penetrations



A Portfolio of Trusted Brands

Full-service provider for Nuclear Instrumentation & Safety Systems

Horseheads

USA

- Ex-Core Detectors incl. Fission Chambers
- In-Core (Miniature Fission Chamber)
- Cabling + MI-Cables

Cambridge

CANADA

- In-Core Neutron Detectors & Reactor Feedthroughs
- Nuclear Service Sensors + MI-Cables
- Analog Measurement Channels

Buffalo & Fussy

USA · FRANCE

- Electrical Penetrations
- Nuclear Service Sensors

Munich

GERMANY

- Digital NFMS & Safety RMS (proTK)
- Ex-Core Detectors
- RMS Detectors & Safety Systems

Fort Worth, Texas

USA

- Safety I&C Platform (HIPS)
- Analog NFMS (CoreVision)
- Reverse Engineering & Commercial Grade Dedication / Qualification

End-to-End Coverage

From core to cabinet — engineered, qualified & delivered by Mirion



MIRION
TECHNOLOGIES





proTK™ Platform

Digital, modular, fast, reliable NIS

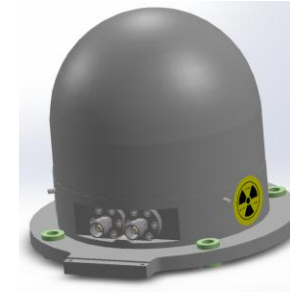
- Scalable 19" rack-mounted multiprocessor platform for Radiation and Process Monitoring and **Neutron Flux Measurement**
- Highly customizable to meet functional, normative and customer requirements
- Perfect for Retrofit, Advanced Nuclear, new Builds and Research Reactors
- Recently upgraded to modern μ Controllers



proTK™ Product Line

Safety First

- Modular, digital system for Radiation, Process and **Neutron Flux Monitoring**
- Highly customizable and extendable to meet functional, normative and application specific requirements
- Qualified up to highest safety standards for safety related equipment (class 1E, Cat A).
- Components from other vendors can be integrated (e.g. detectors), configurable as 100% “form fit function” compatible replacement
- proTK™ HW and SW is developed, customized, manufactured, qualified and tested in-house
- **Full-service provider for Radiation, Process and Neutron Flux Monitoring**



proTK™ – Main Features

- Fast response time due to a cycle time of **5 ms (2.5 ms power range)**
- **Adaptive signal filtering / time constant** over the complete dynamic range
- Signal processing and calculation of linear and/or **logarithmic neutron flux signal**
- Seamless determination of the **change rate**
- Isolated analog and binary output signals (SW configurable) for the reactor protection system
- **Up to 8 adjustable trip thresholds** (=safety alarms) for the RPS
- User **adjustable parameter**, locked by a key switch, non-volatile
- Elaborated testing concept based on
 - ✓ Remote controlled **test generators** in the input module, for both signal paths
 - ✓ **Simulation** of measurement values, analogue and binary outputs
- Operation and monitoring via serial interface, RS-232 or RS-485 (optional)
- Continuous functional **self-monitoring**



proTK™ - Neutron Flux Measurement Channels

Class 1 systems that perform Category A functions acc. to IEC 61226

HW and SW is developed, designed, produced, tested and qualified in-house

Digital, modular, accurate, fast, testable and reliable

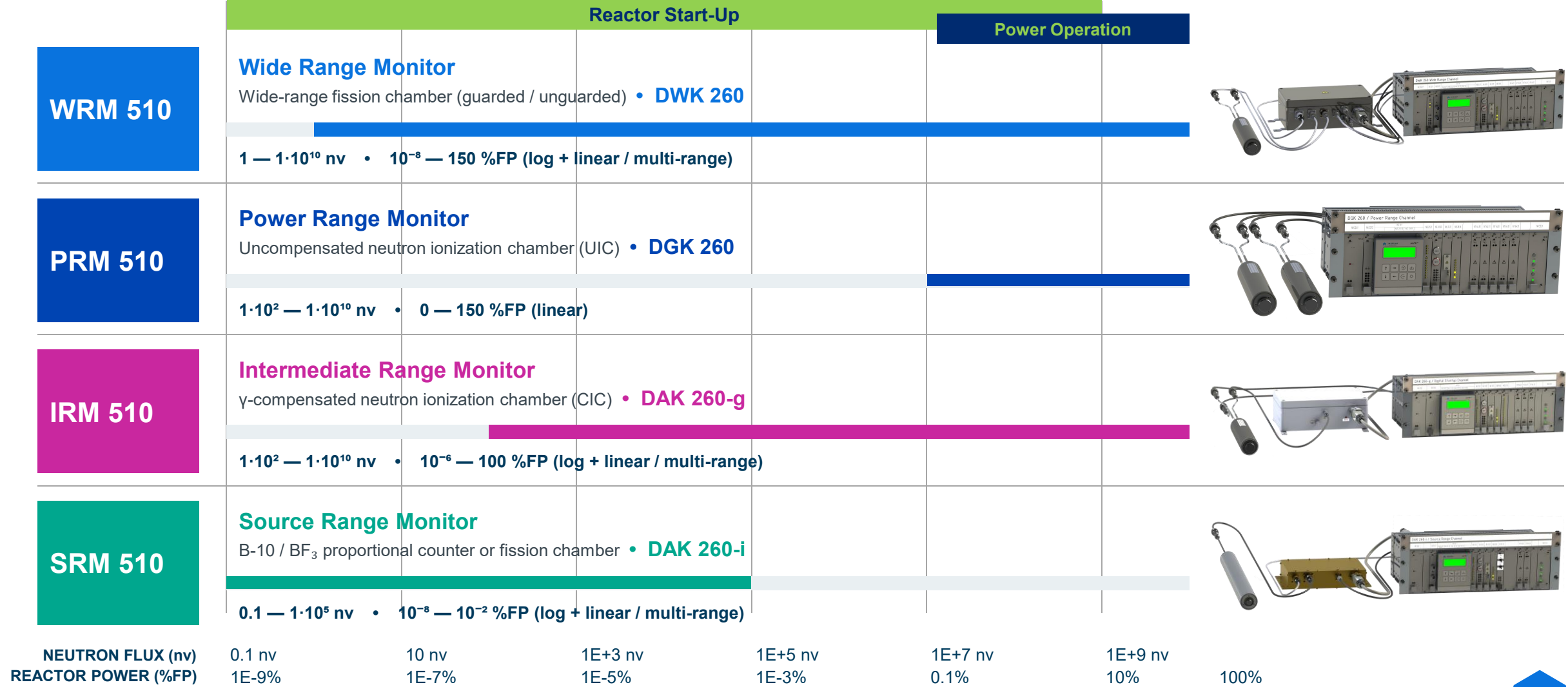
Qualified to highest safety standards such as IEC 61513/IEEE 603, IEC 60880/IEEE 7.4.3.2, IEC/IEEE 60780-323, IEEE/IEC 60980-344

DAK 260-i	Pulse/Startup Channel (source range, for counter tubes and pulse FCs)
DAK 260-g	Intermediate Range Channel (DC current measurement, CICs and UICs)
DGK 260	Power-Range Channel (linear channel, UICs)
DWK 260	Wide-Range Channel (guarded or non-guarded fission chambers)



Reactor Power and Neutron Flux Ranges

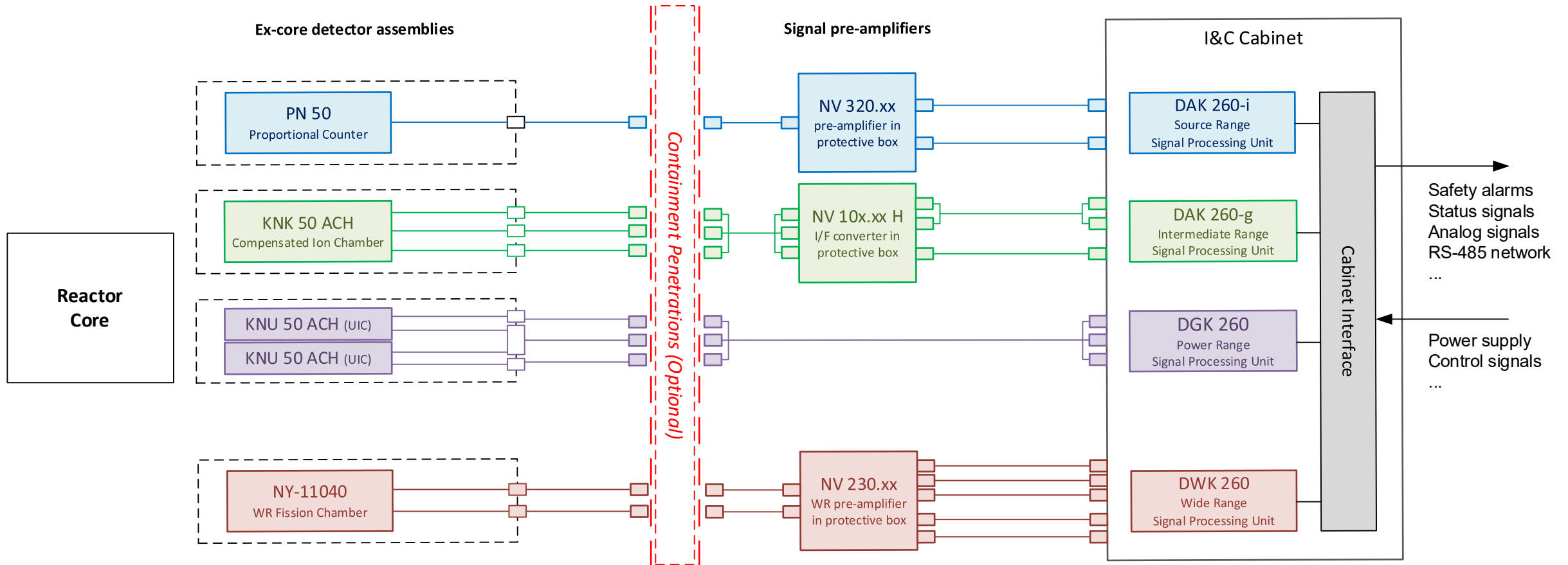
Complete coverage from reactor start-up to full power — four monitors, one integrated proTK™ solution



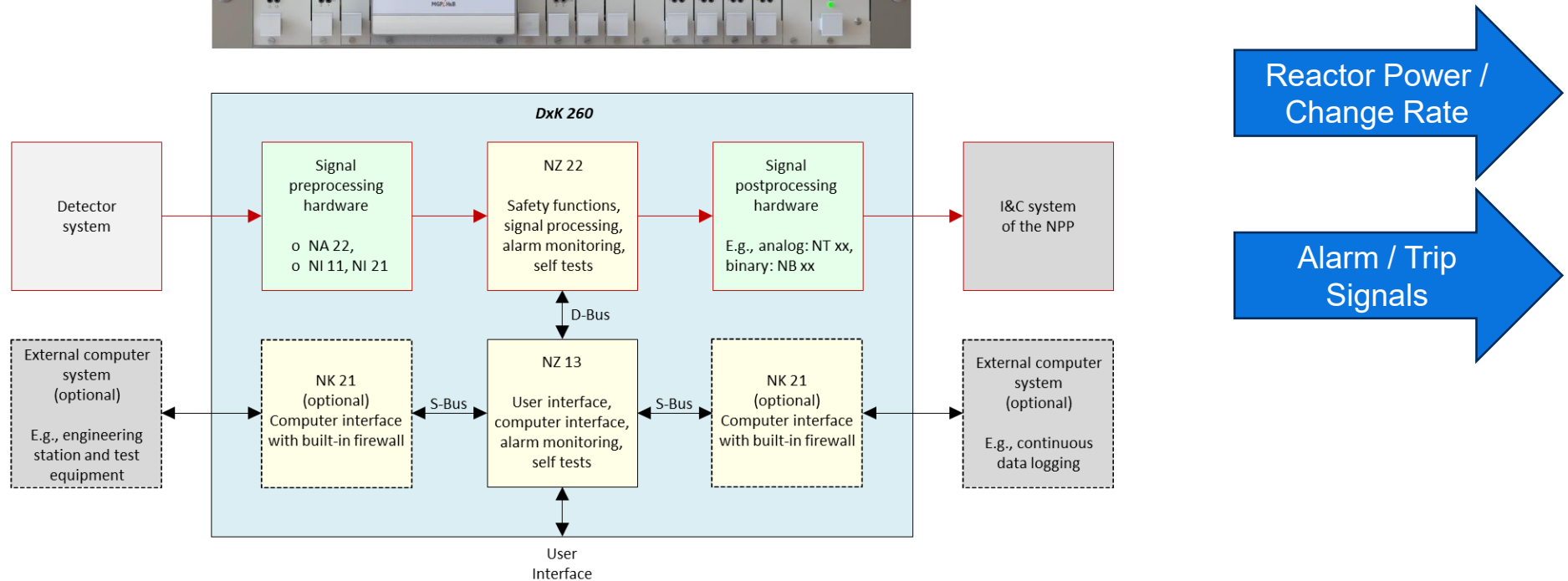
proTK™ - Typical Implementation

Reactor Building / Containment

Electrical Building



proTK™ - Basic Architecture



Legend

Equipment performing safety functions

Processor board performing safety functions (NZ 22)

Signal pre-processing hardware

Detector system

 External NPP I&C systems performing safety functions (not part of the DxK 260)

Equipment not performing safety functions

Processor board without safety function (mandatory)

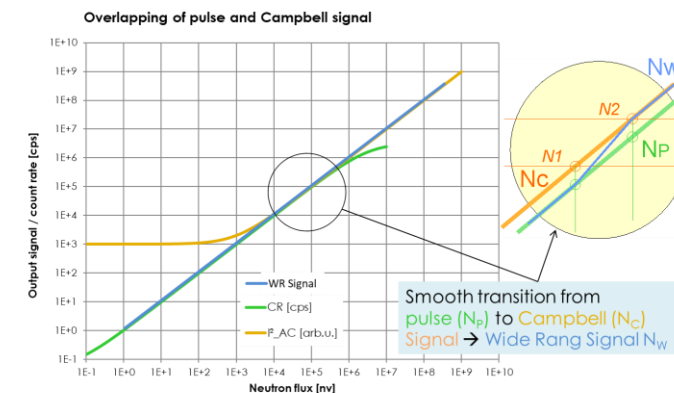
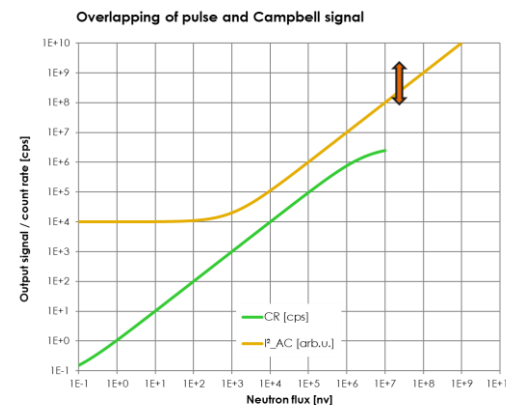
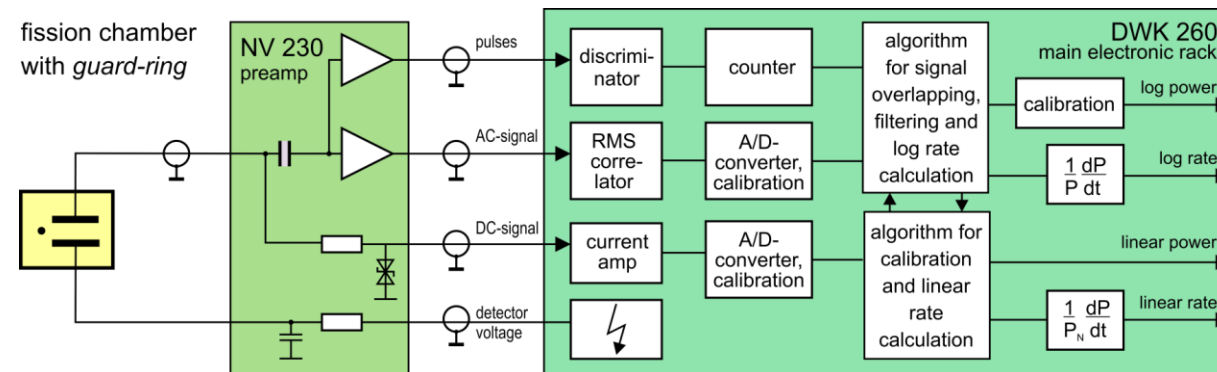
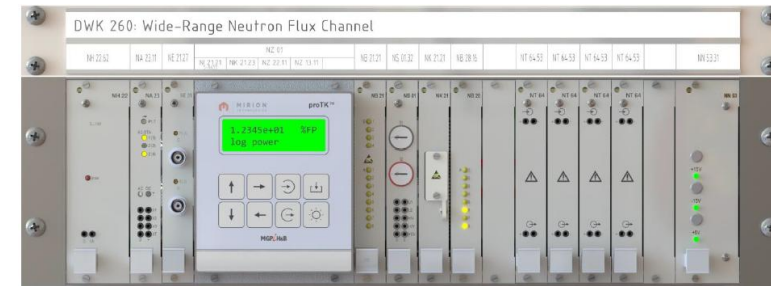
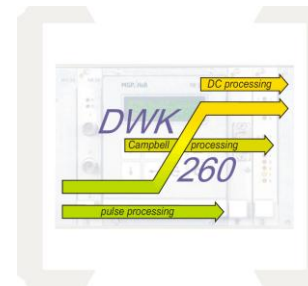
 Processor board without safety function (optional)

 External systems that are not part of the DxK 260 (optional)



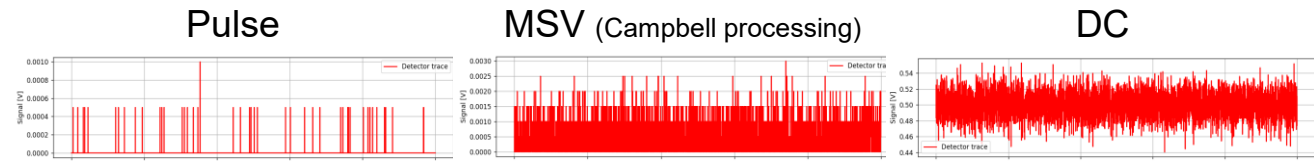
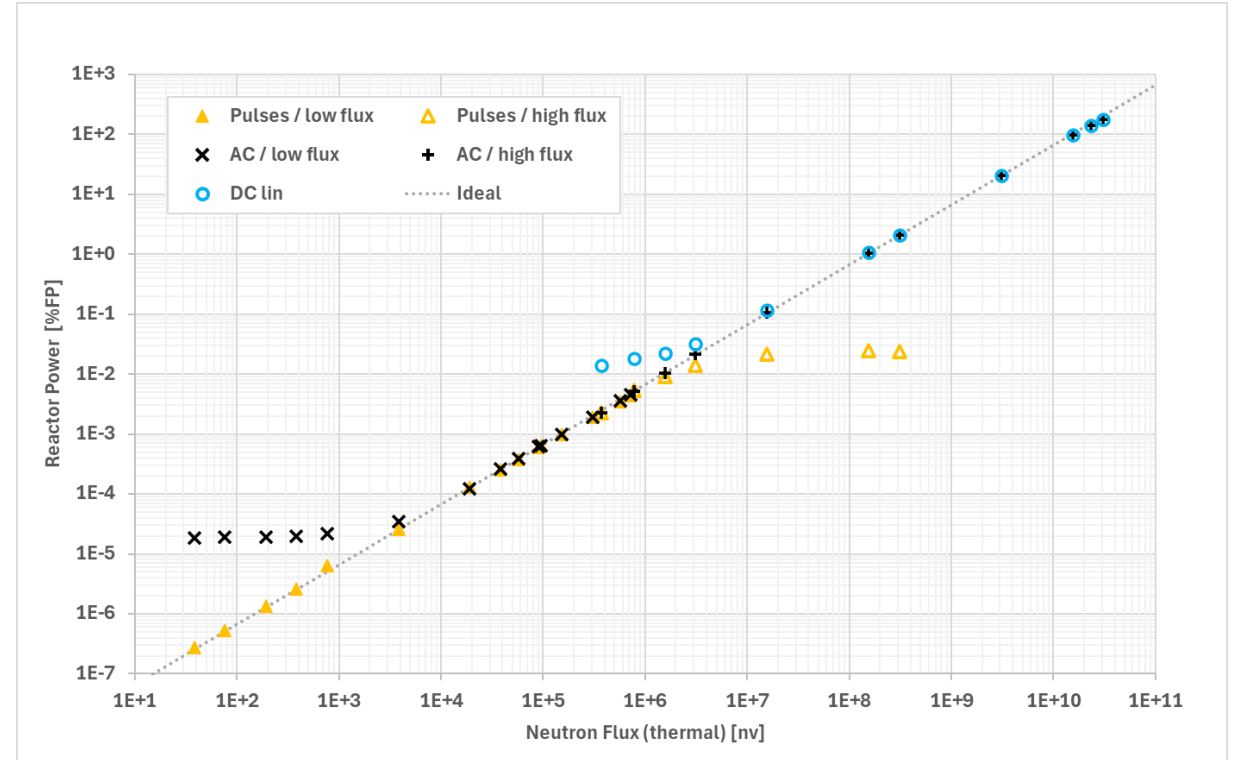
Wide Range Channel DWK 260

- For **WR fission chambers** (guarded / non-guarded)
- **10+ decades** of neutron flux with one WR FC
- Processes **pulses, AC / MSV (Campbell), DC**
- Generates **combined WR signal** over full range
 - > seamless transition pulse / MSV
 - > continuous rel. change rate (%/s, DPM, ...)
- In-/ex-core fission chambers available with different sensitivities and configurations, e.g. connectorized or with integral MI cable
- Compatible and tested with high temperature fission chambers (e.g. Exosens CFUC06, CFUC16)

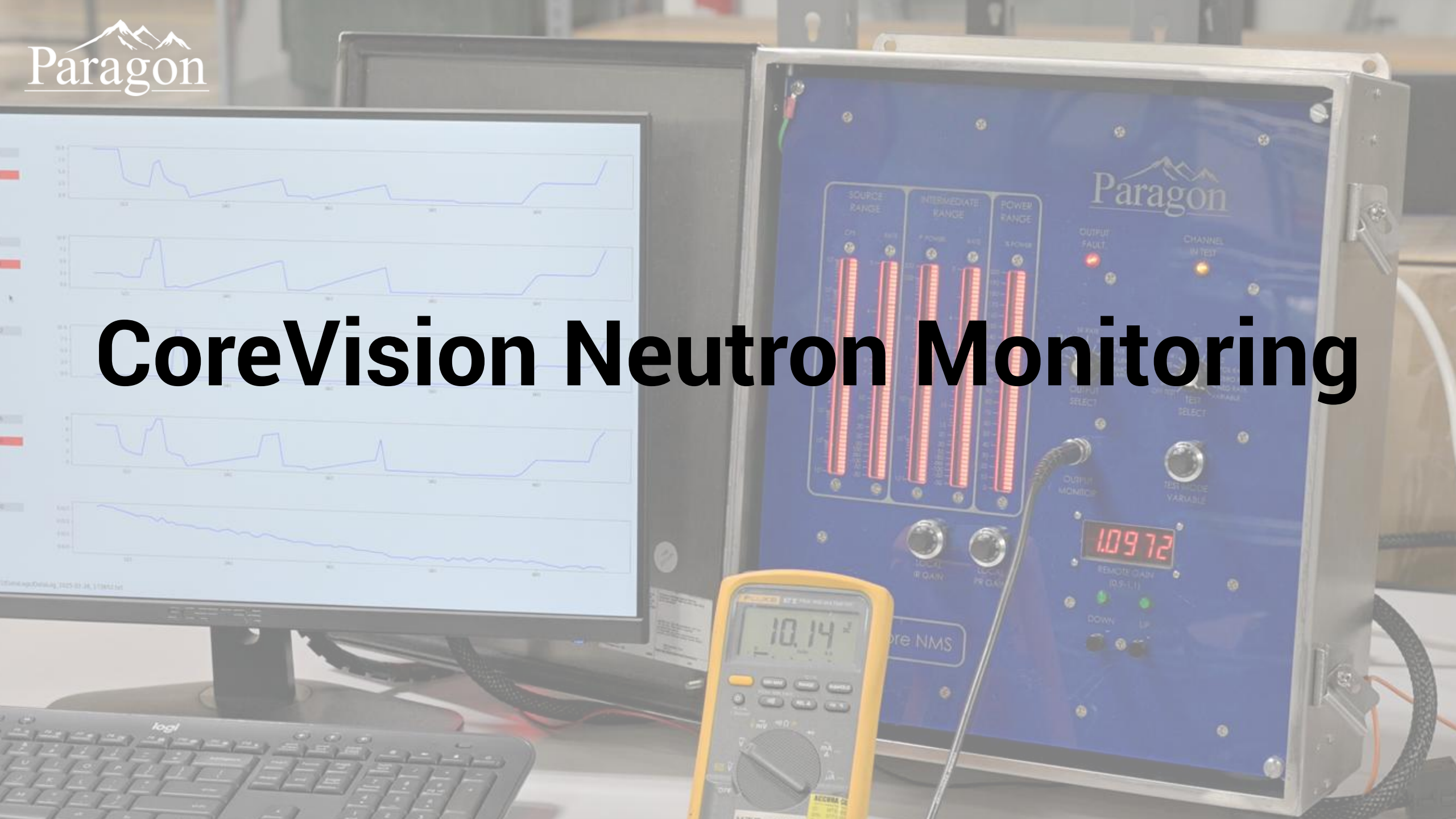


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CoreVision Neutron Monitoring



CoreVision — Overview

Complete NIS portfolio backed by turnover engineering

New NFMS

New nuclear neutron flux monitoring systems

Legacy NFMS

Legacy neutron flux monitoring systems

Spare Parts

NFMS spare parts and replacements

On-Site Service

System evaluations and repairs in the field



Turnover Engineering

NRC licensing prep · System design specs · Equipment selection & evaluation

From new builds to legacy modernization — Paragon delivers complete neutron flux monitoring system solutions

CoreVision for SMRs & Advanced Reactors

Purpose-built for next-generation designs – scalable, cyber-secure, and analog-reliable

Analog architecture

Meets NRC cybersecurity requirements (10 CFR 73.54) by design

Safety Class 1E

Qualified for harsh post-accident environments as required by 10 CFR 50 App. A

Built-in test

Built-in test generators

Fiber Optic Remote Gain

Flux-to-thermal matching without physical access – critical for unmanned or remote SMR sites

Display

2 multi-digit displays + 2 or 5 vertical bar graphs (NUREG-0700)



Compact Enclosure

24"x16"x10" wall-mount fits the constrained control room footprint of SMRs

CoreVision[®] for Advanced Nuclear

Compact, fully analog electronics — built for advanced reactors

Source Range



Detector compatibility

B-10 / BF3 / He-3 proportional counters · Fission Counter

Neutron flux range

0.1 ... 1E5 nv

Typical output / scaling*

Log count rate: 0.1 ... 1E6 cps

Log count period: -3 s... +30 s

Output options: 0...10 V, 4...20 mA, RS-485

Trip Functions

Multiple trip outputs per flux measurement channel

Class 1E

Wide Range



Detector compatibility

Wide Range Fission Chambers

Neutron flux range

1E2 ... 1E10 nv

Typical output / scaling

Log count rate: 0.1 ... 1E6 cps

Reactor Power: 10E-8 ... 200 % (log) | 0 ... 200 % (lin)

Log Period: -3 s ... +30 s (count rate and wide range)

Trip Functions

10 trip functions: CR, WR Level/Rate, Power Range

RG 1.97



The I&C Lab

15 Technician Stations
for Repair

5 Stations for Reverse
Engineering

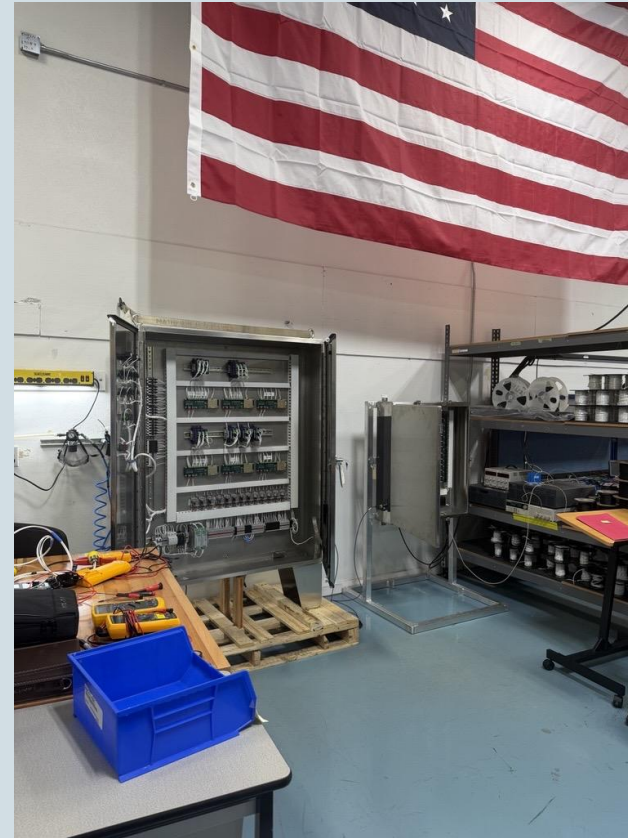
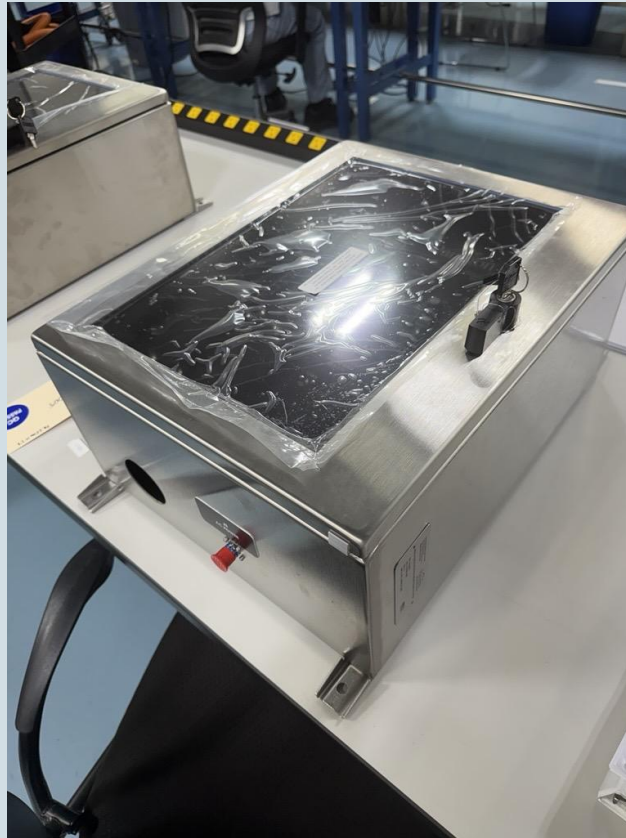
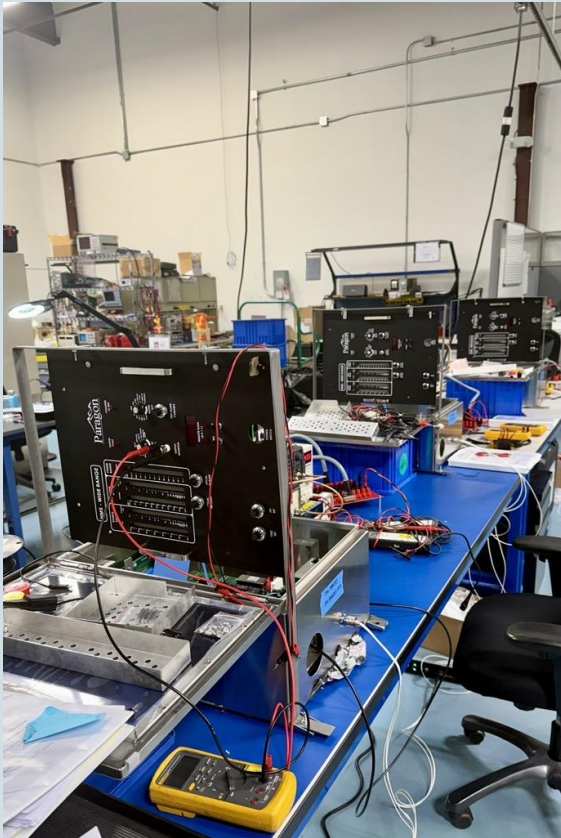
20 Dedicated I&C
Engineers

Over 500 Lines
Shipped in 2025

Over 50 Expedites in
2025

4th of July Reactors

Reactor Trip System with Analog Neutron Monitoring System



A New Pathway for Advanced Reactors

DOE Reactor Pilot Program – Executive Order 14301 (May 2025)

11

companies selected for the
Reactor Pilot Program

3

criticalities targeted by
July 4, 2026 (EO 14301 goal)

1

GOAL

Achieve criticality in at least 3 test reactors, outside the National Laboratories, by July 4, 2026 – using DOE's own authorization process rather than NRC licensing.

2

SCOPE

11 advanced reactor projects initially selected in August 2025, spanning sodium-cooled, heat-pipe, HTGR, MSR, and PWR concepts.

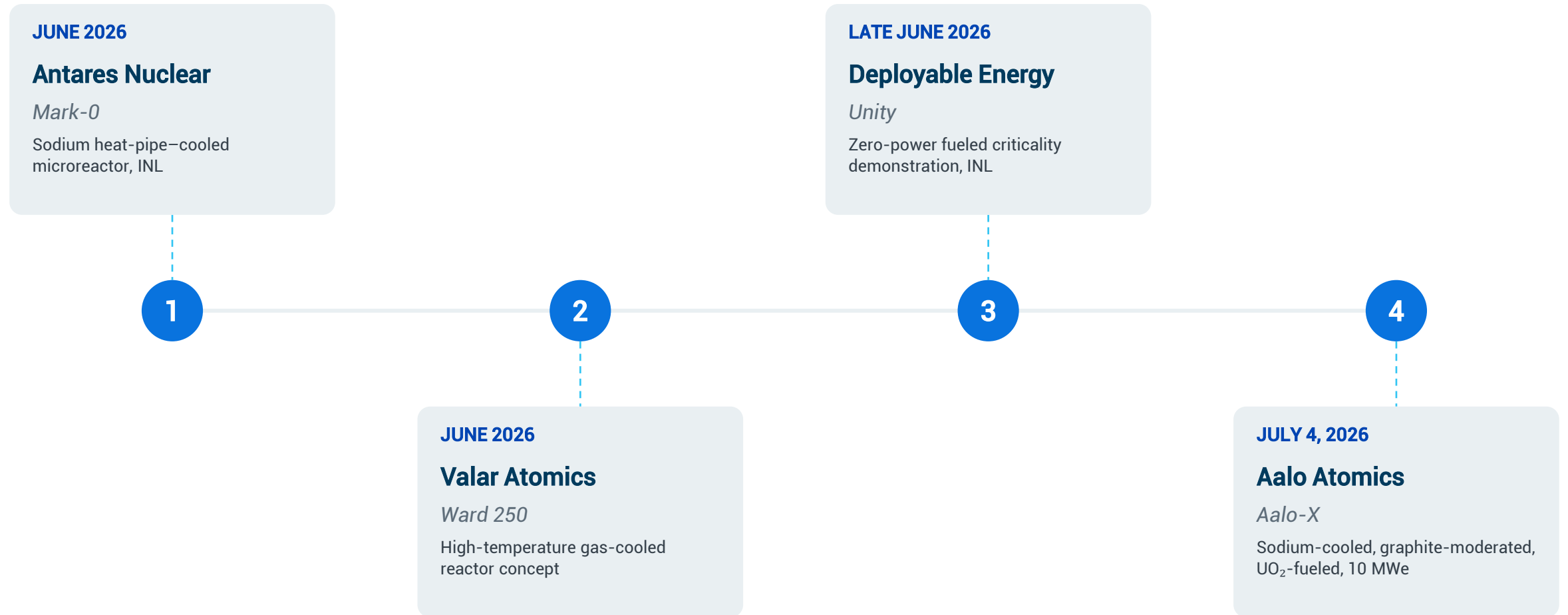
3

APPROACH

Each company self-funds design, construction, and operation; DOE authorization is intended to fast-track a future path to commercial NRC licensing.

“Four by the Fourth”

The goal was three — four demonstration reactors reached criticality ahead of the July 4, 2026 deadline



The Common Thread: Nuclear Instrumentation

Mirion Technologies and Paragon Energy Solutions have, between them, supplied most of the nuclear instrumentation for all four successful startups

4 / 4

successful demonstration
reactors instrumented by
Mirion & Paragon

Two companies each supplied nuclear
instrumentation for two of the four reactors

1

Mirion Technologies

proTK™ digital signal processing platform, including the wide-range DWK 260, paired with a portfolio of neutron flux detectors — wide-range fission chambers and proportional counters. In addition, Mirion also supplied radiation monitoring system (RMS).

2

Paragon Energy Solutions

CoreVision analog neutron flux monitoring system, providing proven, field-tested reactivity and flux monitoring for first-of-a-kind cores. In addition to NFMS, Paragon also supplied reactor trip systems.

The Common Thread: Nuclear Instrumentation

*Mirion Technologies and Paragon Energy Solutions have, between them, also supplied most of the nuclear instrumentation for **new advanced reactor designs***

2

Channel Types

Wide Range Channels
supported by
Source Range Channels

1

Wide Range Channels

2-4 redundant safety channels with the digital WR signal processing unit DWK 260 or the equivalent CoreVision channel, paired with guarded or un-guarded wide range fission chambers

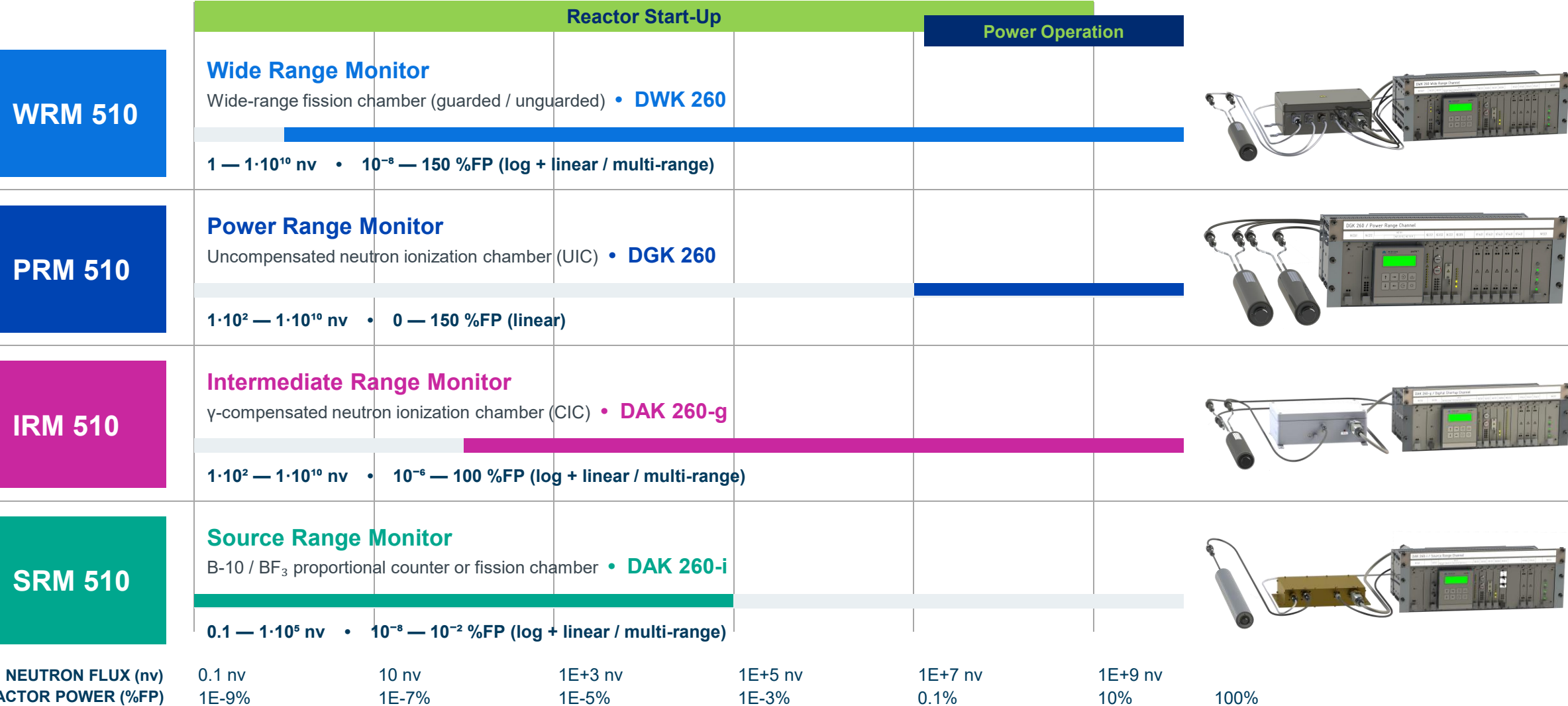
2

Source Range Channels

1 - 2 complementary Source Range Channels with the digital start-up signal processing unit DAK260-i and Proportional Counters, e.g. for improved performance at low neutron flux levels.

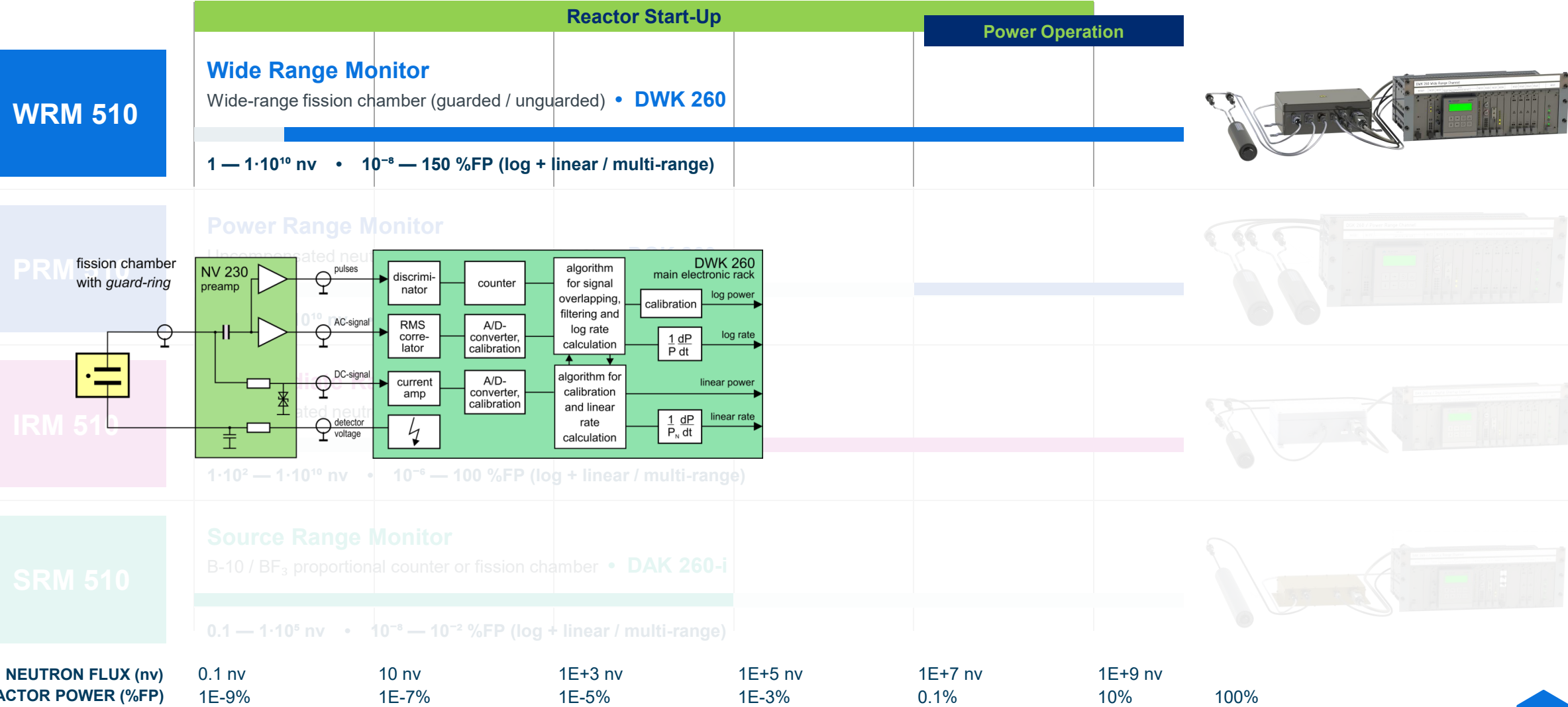
Reactor Power and Neutron Flux Ranges (recap)

Complete coverage from reactor start-up to full power — four monitors, one integrated proTK™ solution



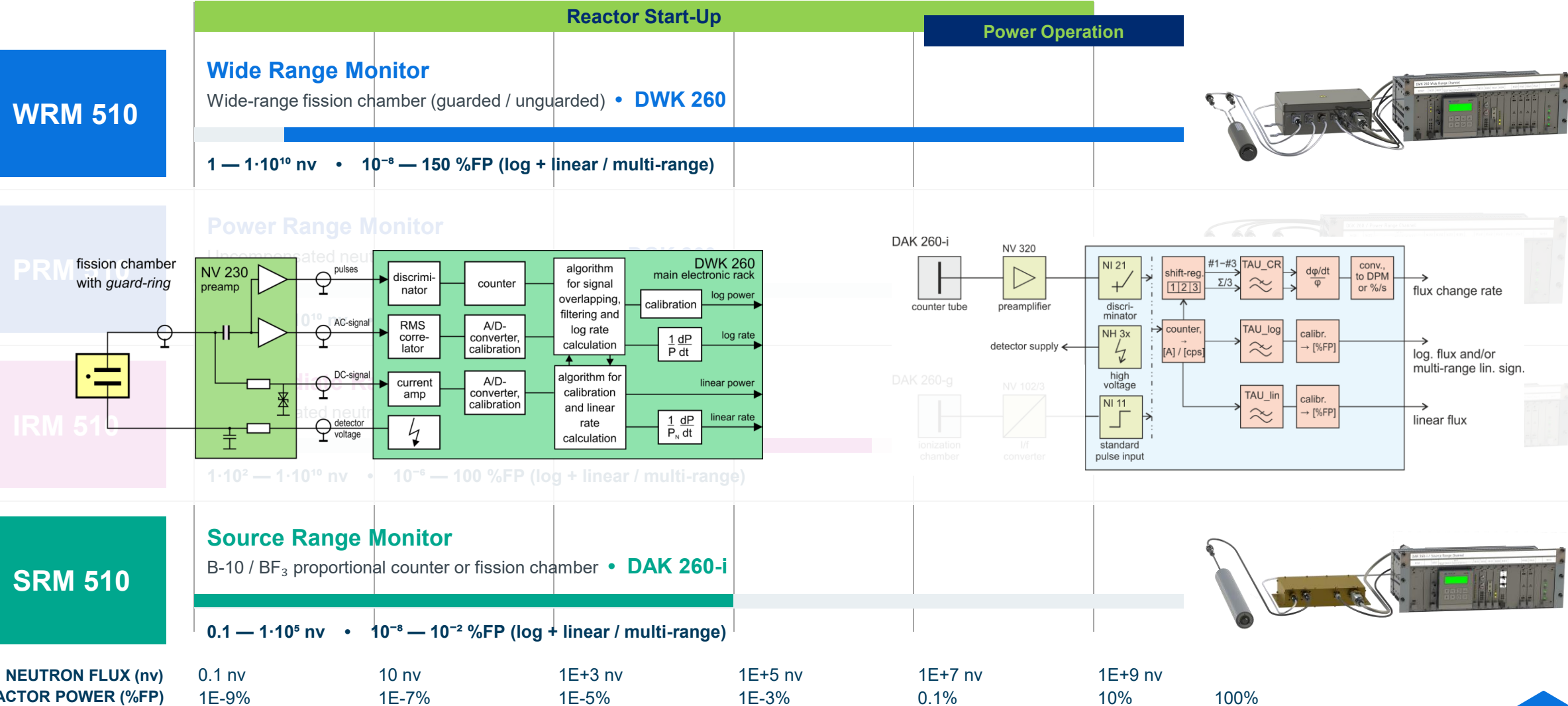
Reactor Power and Neutron Flux Ranges for SMR / μ R / ANR -> WR

Complete coverage from reactor start-up to full power — four monitors, one integrated proTK™ solution



Reactor Power and Neutron Flux Ranges for SMR / μ R / ANR -> WR + SR

Complete coverage from reactor start-up to full power — four monitors, one integrated proTK™ solution



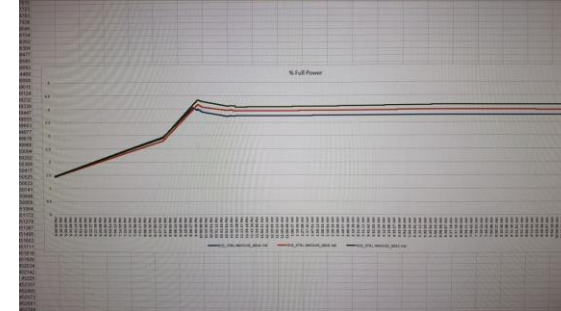
Example: Valar Atomic's Ward 250 (HTGR) / WR and SR Channels

Reached zero-power criticality before July 4 deadline

- June 18, 2026:
Moments ago, Valar Atomics took Ward 250 critical for the first time. This fulfills President Trump's EO 14301, which called for 3 advanced reactors to go critical by July 4th.
- June 22, 2026:
Last night at 8:51pm Mountain Time, the Valar Atomics Nuclear Operations team brought Ward 250 to 10kW thermal output. We held this power level throughout the night.
- July 1, 2026:
Valar Atomics became the first nuclear startup to make electricity by powering an NVIDIA Spark.

Source of messages: Valar on X

Source of pictures: Valar Atomics



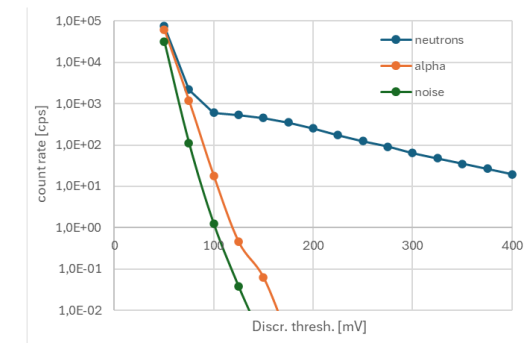
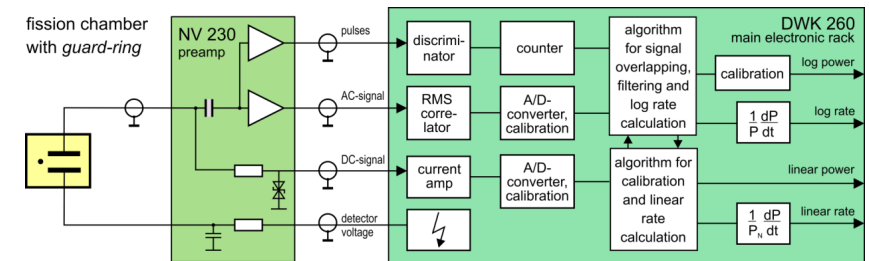
Wide Range Channel for High Temperature Fast Reactors

Mirion Partnering with Exosens for Advanced Reactor Solutions

After successfully implementing Exosens (Photonis) fission chambers into proTK™ based neutron flux monitoring systems for many decades, Mirion has also successfully tested and integrated the Exosens high temperature fission chamber technology for advanced reactors and applications that require temperatures sensors that function at up to 600 °C or even higher.

Typical set-up

- Digital Wide Range Signal Processing Unit DWK 260 wide range channel with application specific configuration incl. Detector HV supply, pulse discrimination, AC correlator, DC amplifier, signal filtering, trip generation, etc.
- WR pre-amplifier NV 230 for pulse, AC/MSV and DC
- High Temperature Fission Chamber, e.g. the CFUC16 (an improved CFUC06) with integral MI cables
- Other: field cables, connectors, detector support, I&C cabinet, pre-amplifier field enclosure, ...



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