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# Analog Neutron Instrumentations Solutions with CoreVision System

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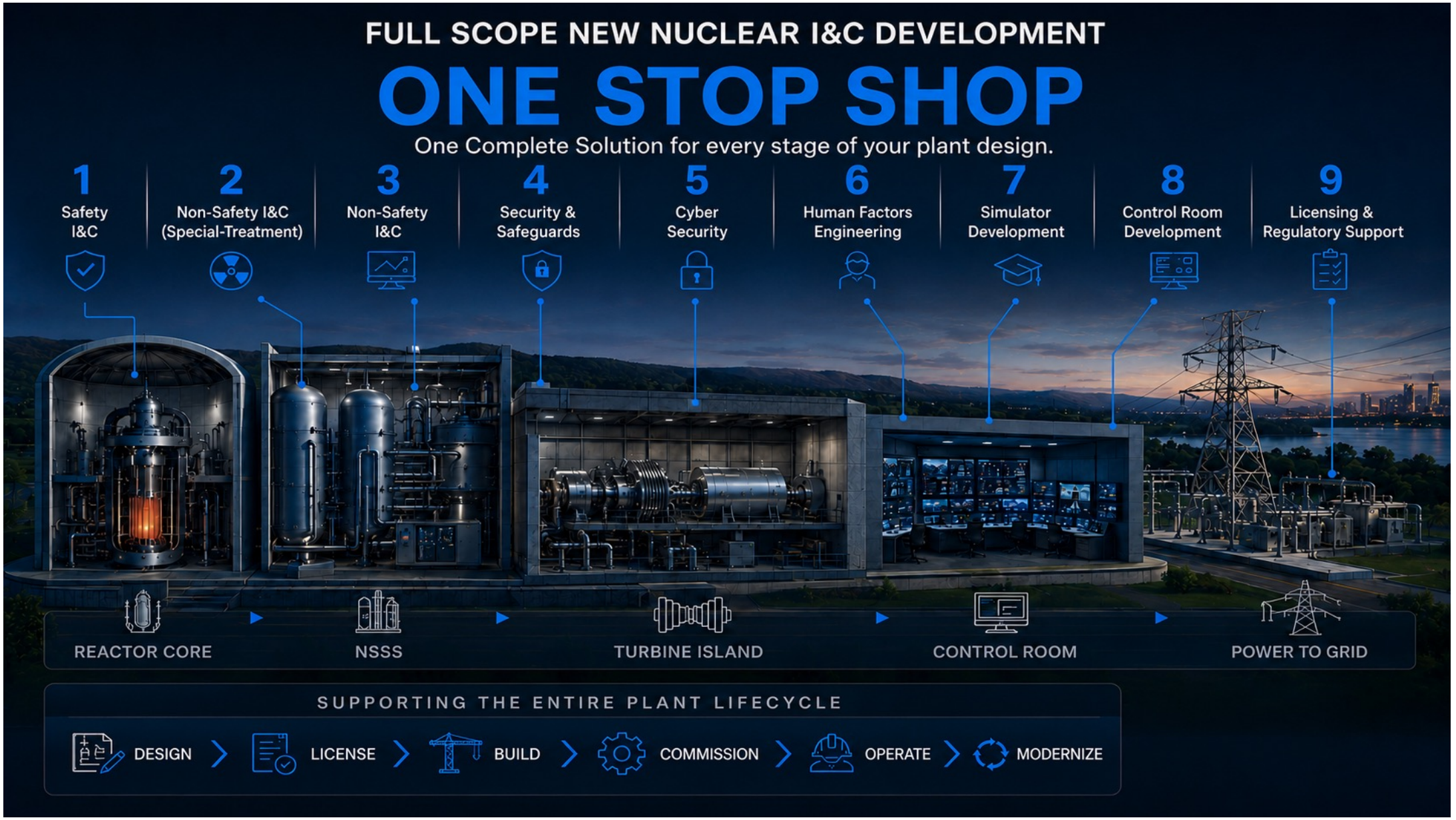
# Yvotte Brits

*Chief Reactor Technology Officer*



# Turnkey I&C Discipline Solution
## for New Nuclear Plant Life Cycle

One Integrated Solution. Delivered Across Every Stage.

**Plant-Wide I&C Design & Licensing** → **Equipment Supply** → **Installation Support** → **O&M Support & Spares**

### PROJECT LIFE CYCLE

| DEFINITION PHASE<br>Define the right solution | | | | | | DEVELOPMENT PHASE<br>Design & engineer with confidence | | | | | | | | | EXECUTION PHASE<br>Build, commission & deliver | | | | | | UTILIZE<br>Operate & optimize | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Concept | Conceptual Design | | | | | Preliminary Design | | | | | Final Design I (System Level) | | Final Design II (Product Level) | | Construction | | | | Commissioning | | Operations | |
| Pre-Concept | C1 | C2 | C3 | C4 | C5 | B1 | B2 | B3 | B4 | B5 | D1 | D2 | D4 | D6 | R1 | R2 | R3 | R4 | R5 | R6 | U1 | U2 |
| Business objectives & initial I&C strategy | Regulatory framework & requirements | System architecture & boundaries | I&C technology selection | Vendor strategy & evaluation | I&C concept & validation | Architecture & system integration approach | Complete functional design | Detailed I&C specifications & standards | Interface & data management strategy | Verification & validation planning | System architecture & network design | Detailed engineering & I/O definition | Cybersecurity & functional safety analysis | Factory acceptance & test packages | I&C installation & preparation | Loop checks & pre-commissioning tests | System integration & functional testing | SAT & site acceptance | System commissioning & dynamic testing | Handover to operations | Performance monitoring & optimization | Lifecycle support & upgrades |

INTELLIGENT DESIGN

RELIABLE TECHNOLOGY

EXPERT INSTALLATION

SEAMLESS COMMISSIONING

LIFETIME SUPPORT

Safety & Compliance Built In | Proven Methodology & Standards | Integrated Team & Expertise | Risk Reduction & Schedule Confidence | Optimized Cost of Ownership

# Why Neutron Instrumentation Matters

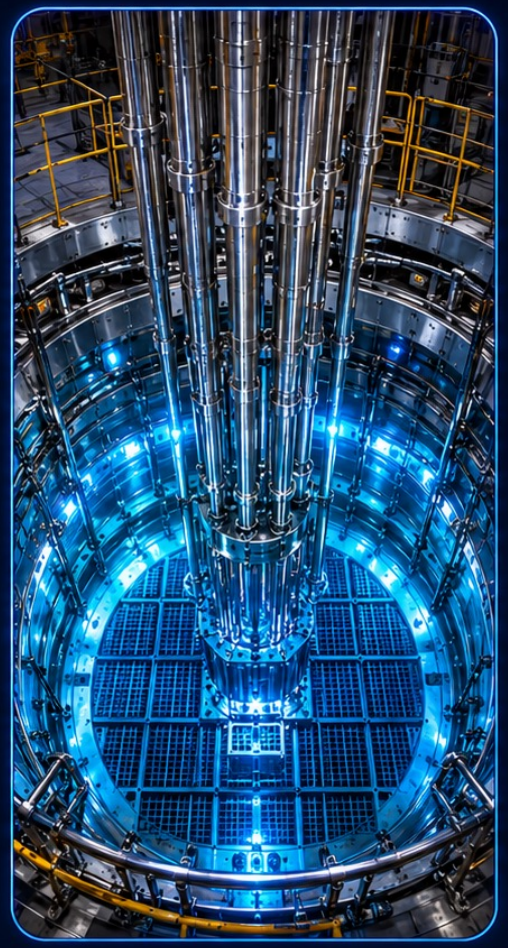
The neutron monitoring system is one of the few measurements tied directly to the reactor core.

**Reactor Core**

**SOURCE RANGE**
**Startup / shutdown / refueling**
Low flux indication and count-rate based monitoring

**INTERMEDIATE RANGE**
**Approach to power**
Bridge between source and power-range operation

**POWER RANGE**
**Power operation / protection**
Flux signal for power indication, alarms, and trips



**1 Safety and Operations**
- Startup, power operation, shutdown and surveillance
- Clear reactor status across operating modes

**2 Protection Function Input**
- Interfaces to alarms, trips and protection logic
- Dependable, testable and understood by operators

**3 Lifecycle Impact**
- Aging NIS can drive outage and spare-parts risk
- Modernization must protect plant availability

# The Modernization Challenge

Customers need a practical path that reduces risk without turning NIS replacement into a new licensing project.

## Pressure on Existing Systems

- Obsolete components and limited spares
- Aging detectors, cabling and cabinets
- Vendor support gaps and repair delays
- Documentation and configuration drift

**CoreVision Pathway**

## What the Solution Must Do

- Preserve proven signal functions
- Reduce installation and outage impact
- Fit existing licensing basis where possible
- Provide long-term support and upgrade path

**Design intent**

Modernize neutron monitoring while preserving familiar, licensable and deterministic behavior.

# Why Analog Still Has a Place

Analog neutron instrumentation remains attractive because it is proven, deterministic, and familiar to operators and regulators.

**1**

## PROVEN

Operating history and established maintenance practices

**2**

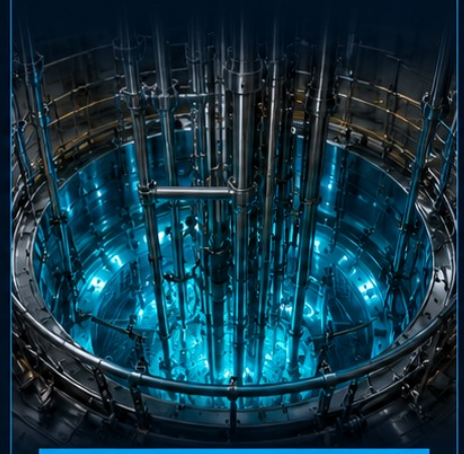
## DETERMINISTIC

Clear signal path and predictable behavior

**3**

## LICENSABLE

Maps well to existing safety basis and setpoint methods



**4**

## PRACTICAL

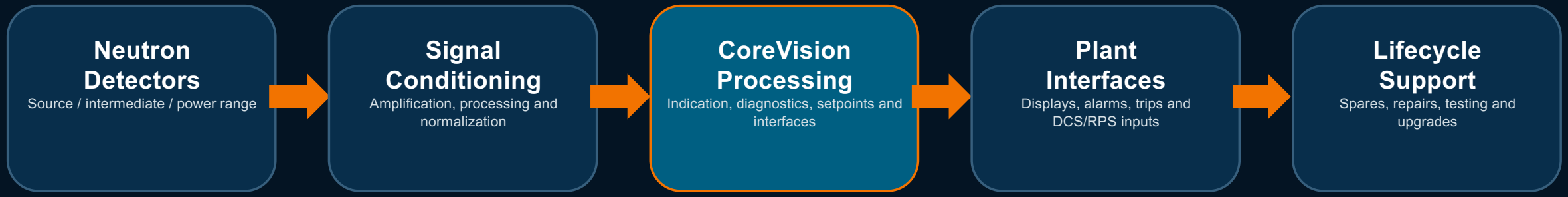
Suited for retrofits, spares and phased modernization

**Key message**

Not analog versus digital — choose the right architecture for safety, retrofit risk, licensing and lifecycle support.

# CoreVision System Positioning

CoreVision bridges proven neutron detection with the plant interfaces required for modern operation.




## A Safety interface

Trip signals and protection inputs
Surveillance and testability

## B Operator interface

Clear indication over the operating range
Alarm response and diagnostics

## C Plant interface

DCS/RPS integration
Cyber boundary considerations

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# Where Paragon Adds Value

The customer needs the equipment, the engineering basis, and the field execution path to make modernization successful.

**1 Requirements & architecture**

Safety classification, requirements and interfaces

**2 Equipment selection**

Detector, range, cabinet and channel strategy

**3 Licensing & documentation**

Basis, setpoints, qualification and coordination

**4 Testing & acceptance**

FAT/SAT, test procedures and configuration control

**5 Installation & commissioning**

Outage planning, field support and turnover

**6 Lifecycle support**

Spares, repairs, obsolescence and upgrades

**Outcome**

A lower-risk modernization path: proven technology, clear licensing basis, executable installation plan and long-term support.

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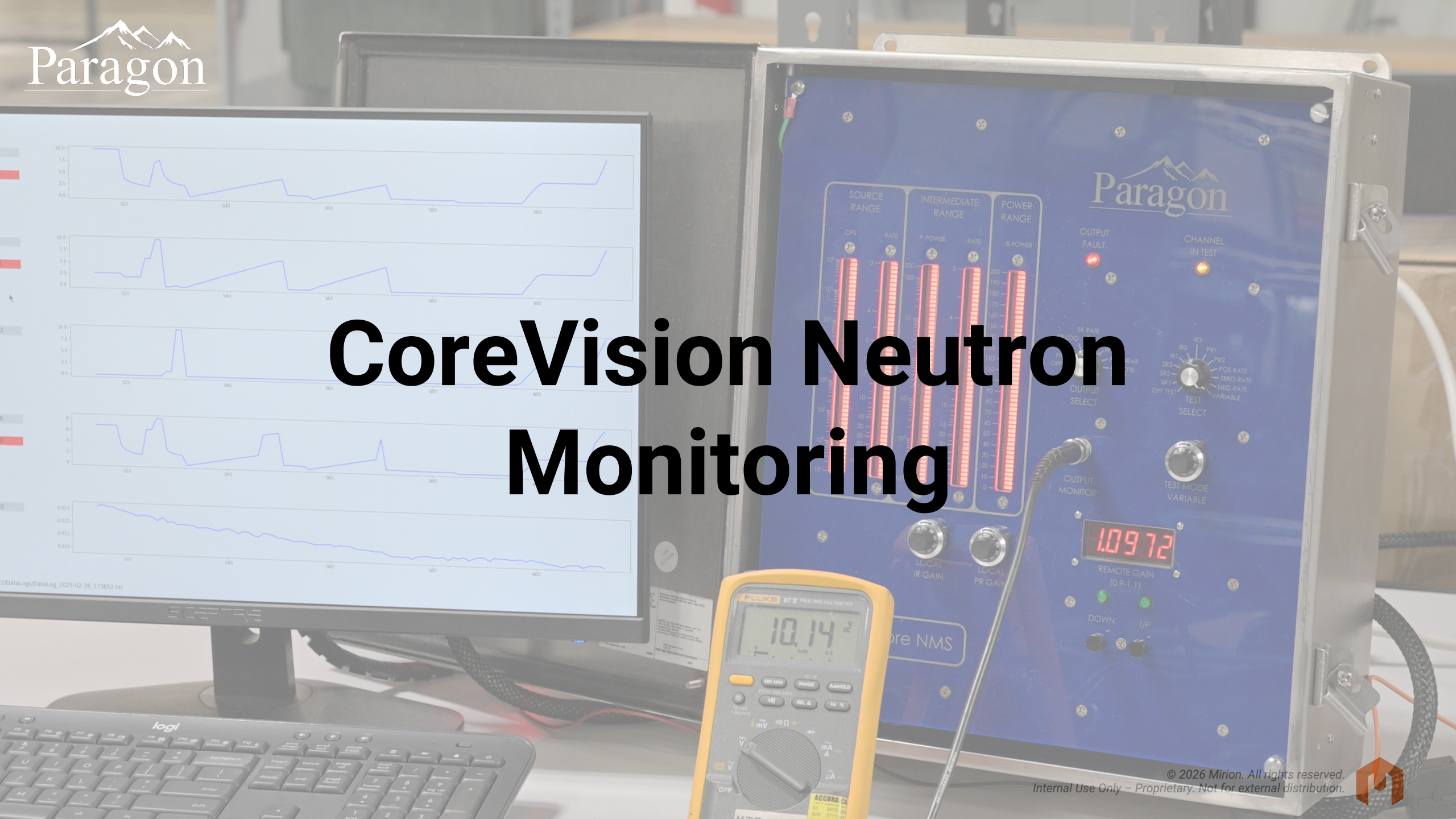
# John Portillo

*Vice President, Global New Nuclear*




# CoreVision Neutron Monitoring

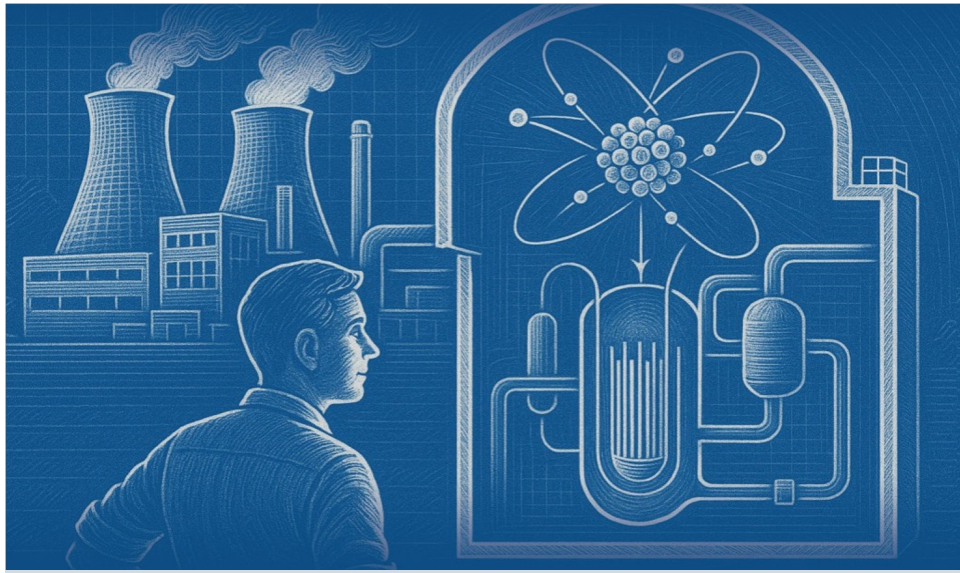
Paragon
A MIRION TECHNOLOGIES COMPANY

CoreVision

# Neutron Monitoring System

## Paragon Provides Complete NIS

- *New Nuclear Analog Neutron Flux Monitoring Systems (NFMS)*
- *Legacy Gamma Metrics Neutron Flux Monitoring Systems*
- *NFMS spare parts and replacements*
- *On-site system evaluations and repairs*
- *Detectors manufactured at the Mirion Horseheads, NY facility, including MI cable manufacturing*

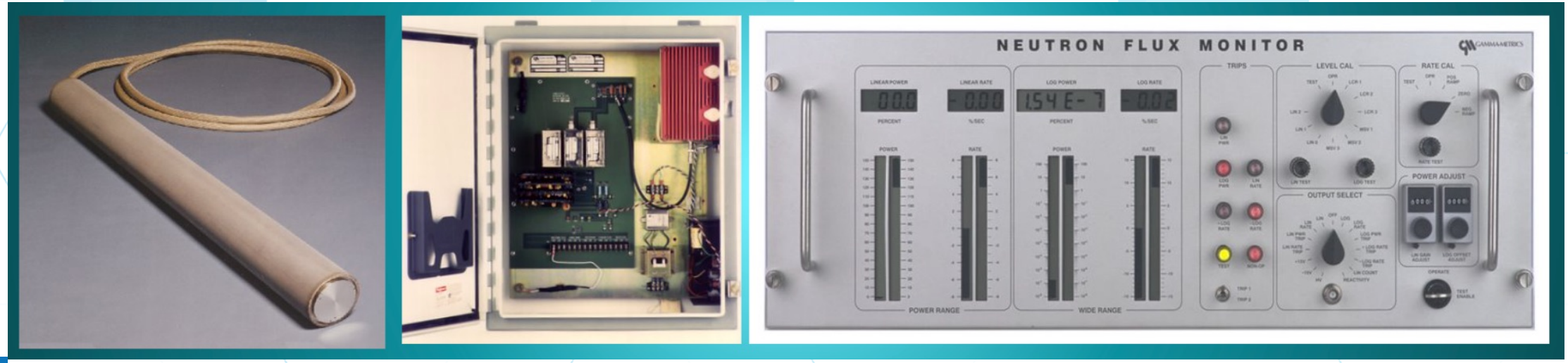


Paragon

CoreVision

# Thermo Fisher Gamma Metrics IP Acquisition

- **December 2023** – *Paragon entered into a license agreement for Thermo Fisher's Gamma Metrics Neutron Flux Monitoring production line. This is an exclusive, perpetual, worldwide license to use, make, have made, import, export, sell, or offer for sale.*
- *Paragon is the sole source supplier of this product line for any and all applications related to power level monitoring and control of nuclear reactors.*
- ***Paragon has supported the product line extensively since the agreement, keeping the industry running and monitoring.***



# Thermo Fisher IP Acquisition

## Legacy NFMS – Now Exclusively Owned & Supported by Paragon

**Installed in 70+ PWR & BWR fleet plants**
*Backbone of commercial NPP and TRTR in the US & internationally for decades*

**Continued Support**
*Spares, upgrades, services, and new systems for the legacy install base*

**System Upgrades**
*Modernization of existing TFS installations*

**Full Support Services Available**
*Licensing, replacement detectors, spares & new systems*


**Source Range**
0.1 – $10^6$ CPS | BF3, B-10, He3 & fission chamber detectors | Start-up & shutdown monitoring

**Intermediate / Wide Range**
$10^{-11}$ – $10^{-3}$ A (CIC) or $10^{-8}$ – 200% power (FC) | CIC & fission chamber detectors | Full start-up overlap

**Power Range**
0 – 120% full power | Uncompensated ion chamber (UIC) or fission chamber | Upper/lower axial deviation detection

*130+ NMS systems supported*

*3 continents served*

*40+ years of TFS heritage*



*Advancing Radiation Safety. Empowering Progress.*

# 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*



*Advancing Radiation Safety. Empowering Progress.*

# 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*

## 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**

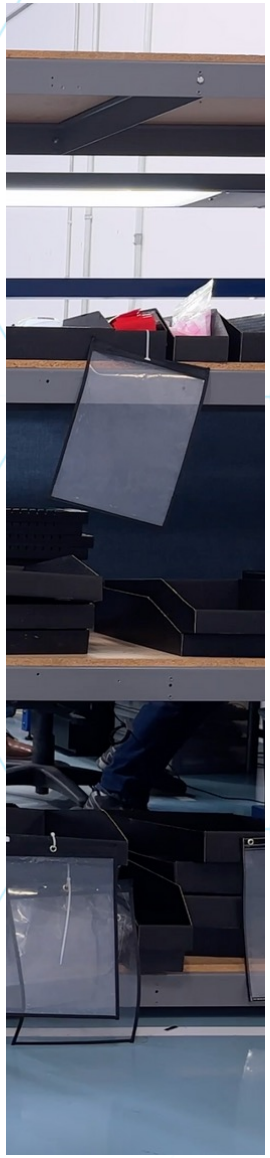
10 trip functions: CR, WR Level/Rate, Power Range

**Class 1E** **RG 1.97**



*Advancing Radiation Safety. Empowering Progress.*

Paragon



# The I&C Lab

*15 Technician Stations for Repair*

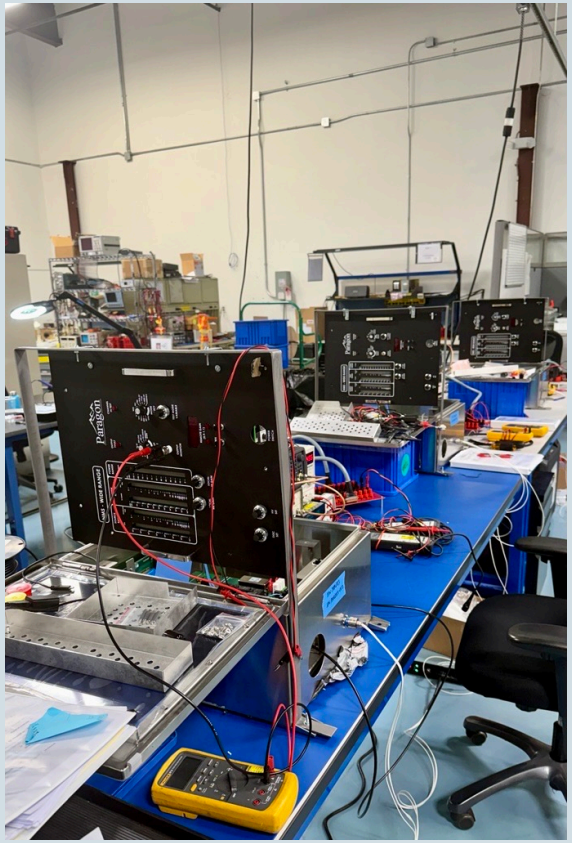
*5 Stations for Reverse Engineering*

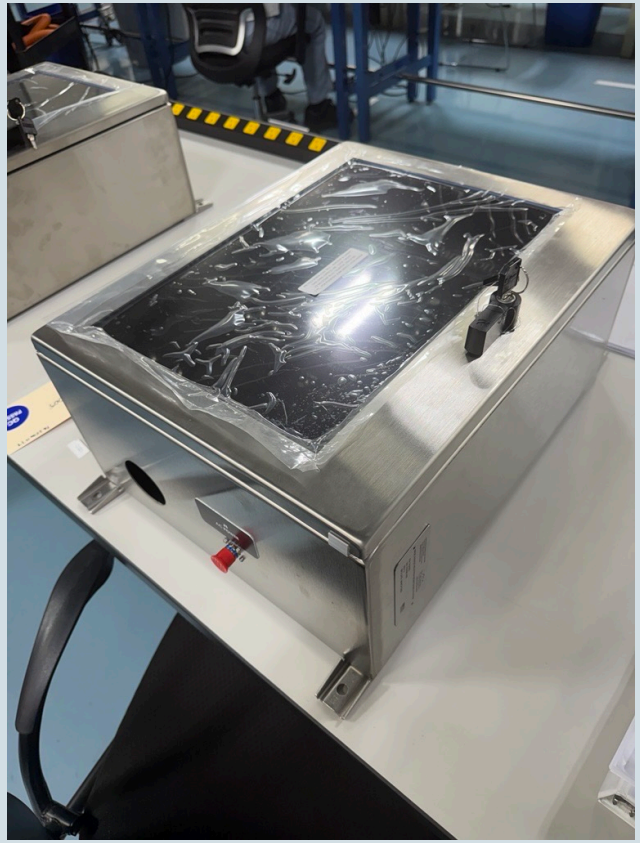
*20 Dedicated I&C Engineers*

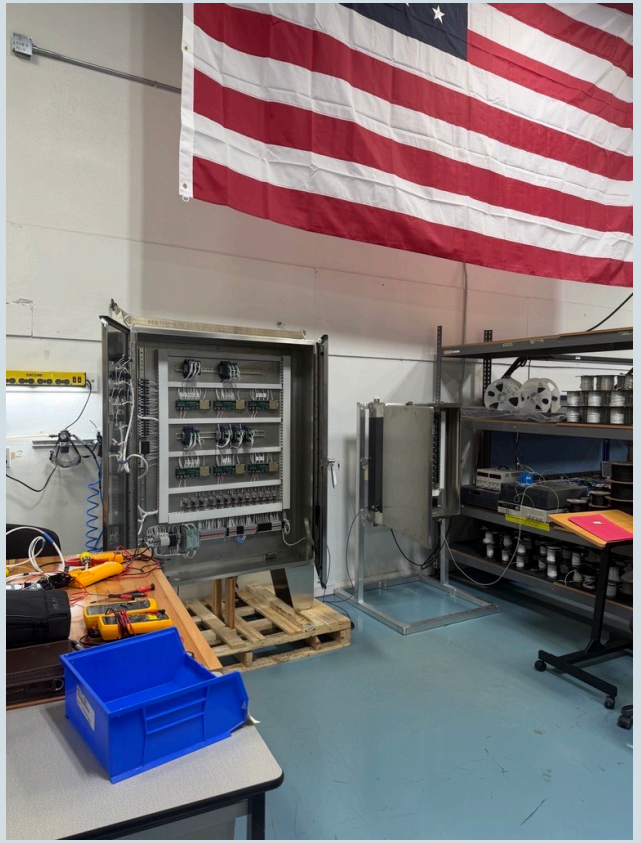
*Over 500 Lines Shipped in 2025*

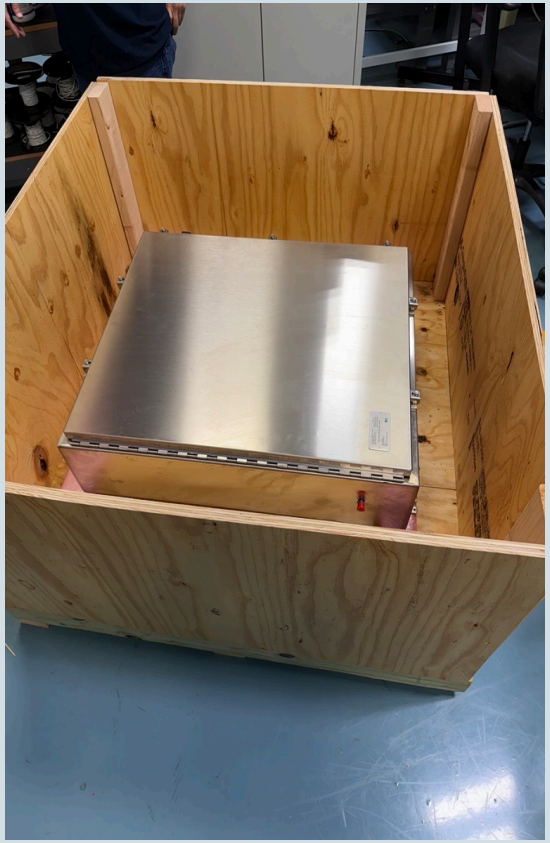
*Over 50 Expedites in 2025*

# 4th of July Reactors
# Reactor Trip System with Analog Neutron Monitoring System









# You're Invited

## Join Us for a Pre-NECX Open House

Paragon, Certrec, and Mirion Technologies—the companies behind Mirion Nuclear Solutions—invite you to an open house at Paragon's Fort Worth headquarters ahead of the NECX opening reception in Dallas.

Join us for:

- Facility tours showcasing advanced capabilities and innovation, including seismic testing tables, loss-of-coolant accident (LOCA) simulation, electromagnetic interference and radio-frequency interference (EMI/RFI) testing, and a real-time reactor simulation environment
- A hands-on look at solutions supporting today's operating fleet and advanced reactors, including MCCs, plantwide modernization, digital upgrades, HVAC systems, and radiation monitoring technologies
- Insights into I&C repair and reverse engineering as a bridging solution
- Licensing support services
- Conversations with the Mirion Nuclear Solutions team on unified I&C approaches and the future of nuclear operation
- Lunch and refreshments

| | |
|---|---|
| **WHAT** | **An Open House before NECX** |
| **WHERE** | **Paragon Headquarters**<br>7410 Pebble Drive, Fort Worth, TX |
| **WHEN** | **Monday, August 24**<br>Drop in between 10:00 a.m – 4:00 p.m. |
| **RSVP** | Scan QR code to **register by August 7th** |

Transportation between the Hilton Anatole (NECX headquarters in Dallas) and Paragon will be available throughout the day.

**SHUTTLE SCHEDULE**

Departure times from Hilton Anatole to Paragon: 9:30 a.m.; 11:30 a.m.; 1:30 p.m.

Departure times from Paragon to Hilton Anatole: 12:30 p.m.; 2:30 p.m.; 4:00 p.m.

**MIRION NUCLEAR SOLUTIONS**

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# Your Voice Matters

*2026 Customer Satisfaction Survey*

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