framatome

THE VALUE OF CERTAINTY

Nuclear Instrumentation and Control

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LEONI KERPEN

The Elements of Choice

Nuclear power plant Instrumentation and Control. As the plant's brain and nervous system, its function is unique. We understand that you face critical choices every day—choices that impact ongoing safety and reliable operations, as well as obsolescence and licensing issues that directly affect the lifetime of your nuclear assets. Every project, be it upgrade, maintenance, or new build, must be designed and engineered for the present—and the future—delivering safety, quality, licensability, reliability, seamless integration, cost-effectiveness, and more.

Choosing a project partner for this challenging journey is a multifaceted decision traditionally driven by two elements—information and judgement.

But we believe Framatome offers a third element. It adds strength to relationships fueled by truth and trust. It is a calculable difference that our unique combination of proprietary technology, business structure, collaborative process, industry position, and global experience brings to every project—a profound element that mitigates risk and ensures the project is completed on time and in full.

It is the value of certainty.

Our promise to you

We reliably complete projects by working closely with our customers and partners. Proven, state-of-the-art technology saves costs and extends the lifecycle of your plant. Innovative solutions provide safe and reliable operation.

Your performance
is **our** everyday **commitment**

Global Experience

The value of our experience is the combination of how much we have, what it has taught us, and how that can specifically benefit our customers.

At Framatome, I&C is a dedicated business unit with more than 1,400 employees. We have installed more than 300 comprehensive Instrumentation & Control systems in nuclear reactors of all types in more than 25 countries on five continents around the world. Our solutions range from safety automation systems to automation systems for normal operation; from nuclear instrumentation to lifecycle solutions; from simulators and global I&C engineering expertise to human-machine interface design and human factors engineering.

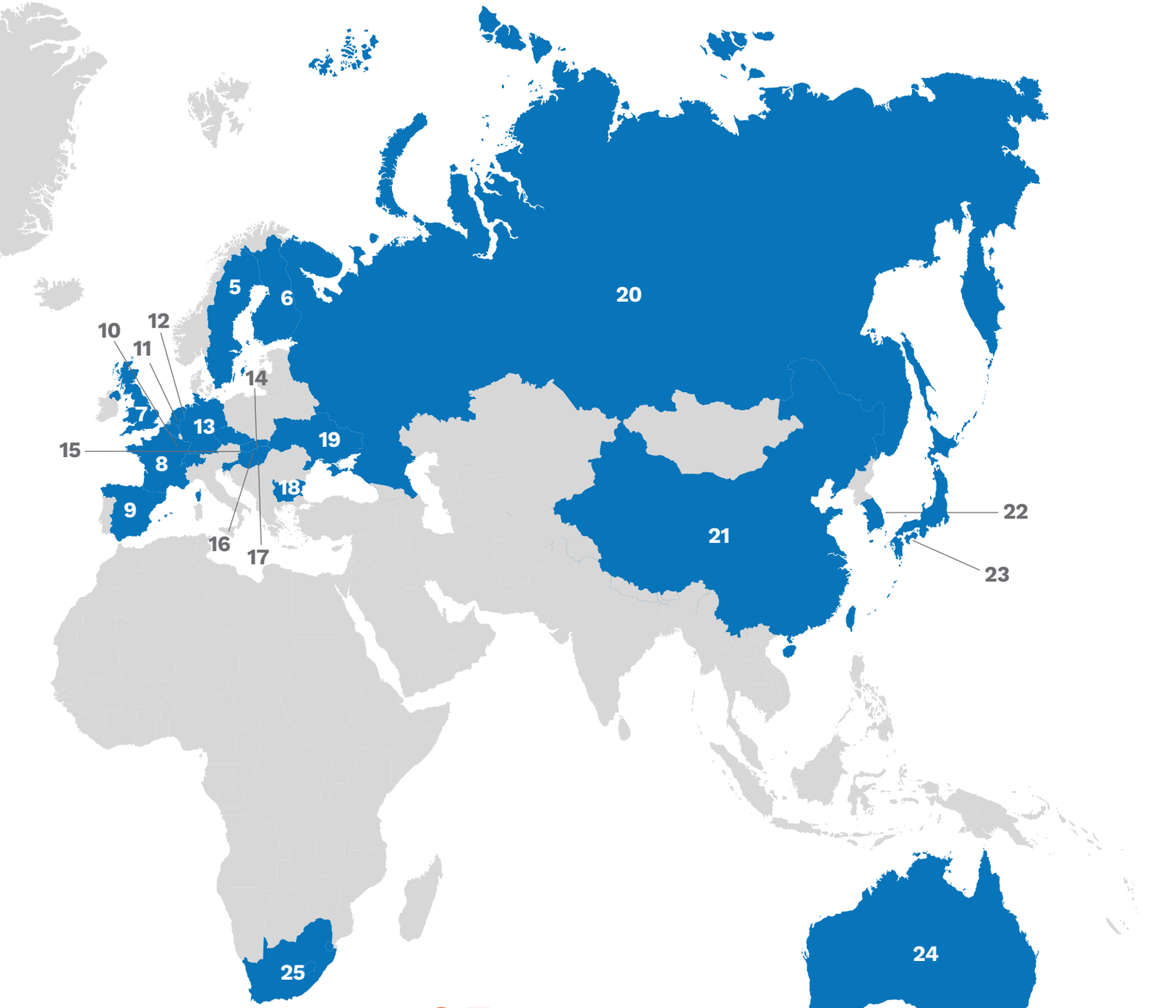
Our design, engineering, simulation, licensing, and installation experience is broad and deep. Among other things, our experience has taught us how challenges will appear in virtually any given project and how to integrate our lessons learned into new projects to solve problems before they become delays. As a result, we are able to promise our customers that we will own the success of their project, giving them the certainty they need to make a range of business decisions and pursue their broader future with greater confidence.

300+

Comprehensive I&C Systems

(including TELEPERM XS, TRICON and SPEC200) in different reactor designs across the world, including:

- Pressurized Water Reactors
- Boiling Water Reactors
- Pressurized Heavy Water Reactors
- Research Reactors



100+

Complete nuclear instrumentation systems
in operation worldwide

190+

Full-scope power plant simulators

delivered over the last 28 years

25

Countries

1. Canada
2. United States
3. Brazil
4. Argentina
5. Sweden
6. Finland
7. United Kingdom
8. France
9. Spain
10. Switzerland
11. Belgium
12. Netherlands
13. Germany
14. Czech Republic
15. Slovenia
16. Slovakia
17. Hungary
18. Bulgaria
19. Ukraine
20. Russia
21. China
22. South Korea
23. Japan
24. Australia
25. South Africa

Supply Chain Dependability

The fact that we are a large international company is only of value to our customers in terms of how our organization is structured to benefit them.

From design and engineering to manufacturing, testing, construction, and installation, we own outright the vast majority of the products and services required to complete and support any I&C project from start to finish and beyond. For the few products we do not own, we have long-term agreements in place securing their availability. Virtually everything resides under the Framatome umbrella, an organizational structure that provides two very valuable benefits to our customers.

Project Efficiency and Control.
By mitigating the risk of shortage and delay, schedules are better kept and budgets are more secure.

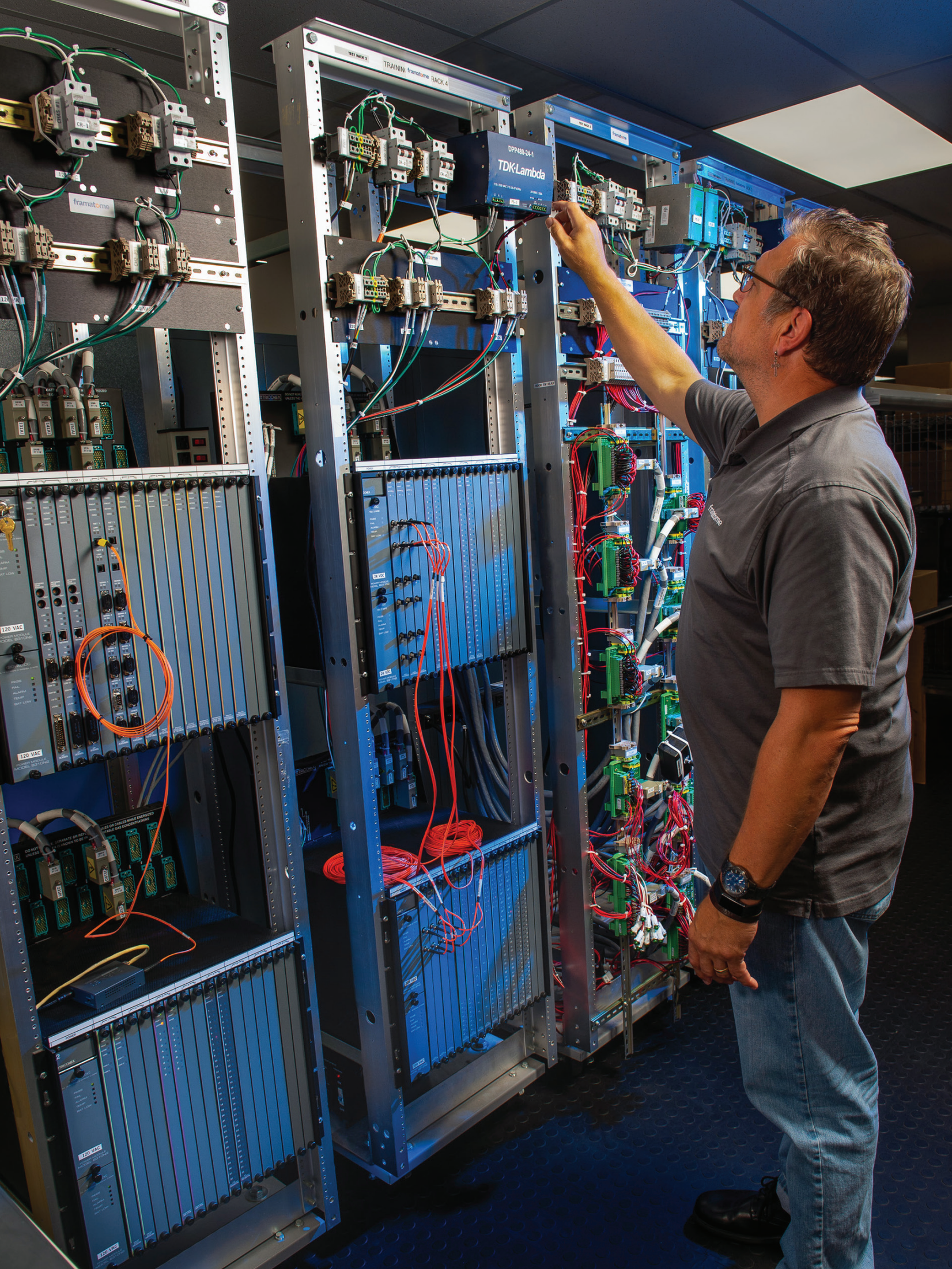
Long-Term Support.
From spare parts to expert support to complete training, our commitment to full customer support adds value over the long term.

Mitigation of risk in the present.
Security for the long term.
Valuable benefits now and into the future as far as you can see.

Unyielding Commitment to Your Future

No two nuclear power reactors are precisely the same, even among reactors of the same type. Parameters like age, location, size, type of output, position within its lifecycle, and more all contribute to the individuality of each reactor and support required throughout its lifecycle.

We have a proven track record of continually updating our technology and training services, making sure they meet the industry's and our own ever-evolving standards. Consequently, we can support legacy systems, update those systems as desired by our customers, and bring the latest technology available to new systems. We are uniquely positioned to mitigate obsolescence by having one foot in the past and one in the future, keeping product evolution available to all.
This commitment is an integral part of our supply chain mastery, bringing long-term certainty to the lifetime of your plant.


TRAINING framatome RACK 4
framatome
DPP400-24-1
TDK·Lambda
120 VAC
120 VAC
24 VDC
24 VDC
150 VAC
120 VAC

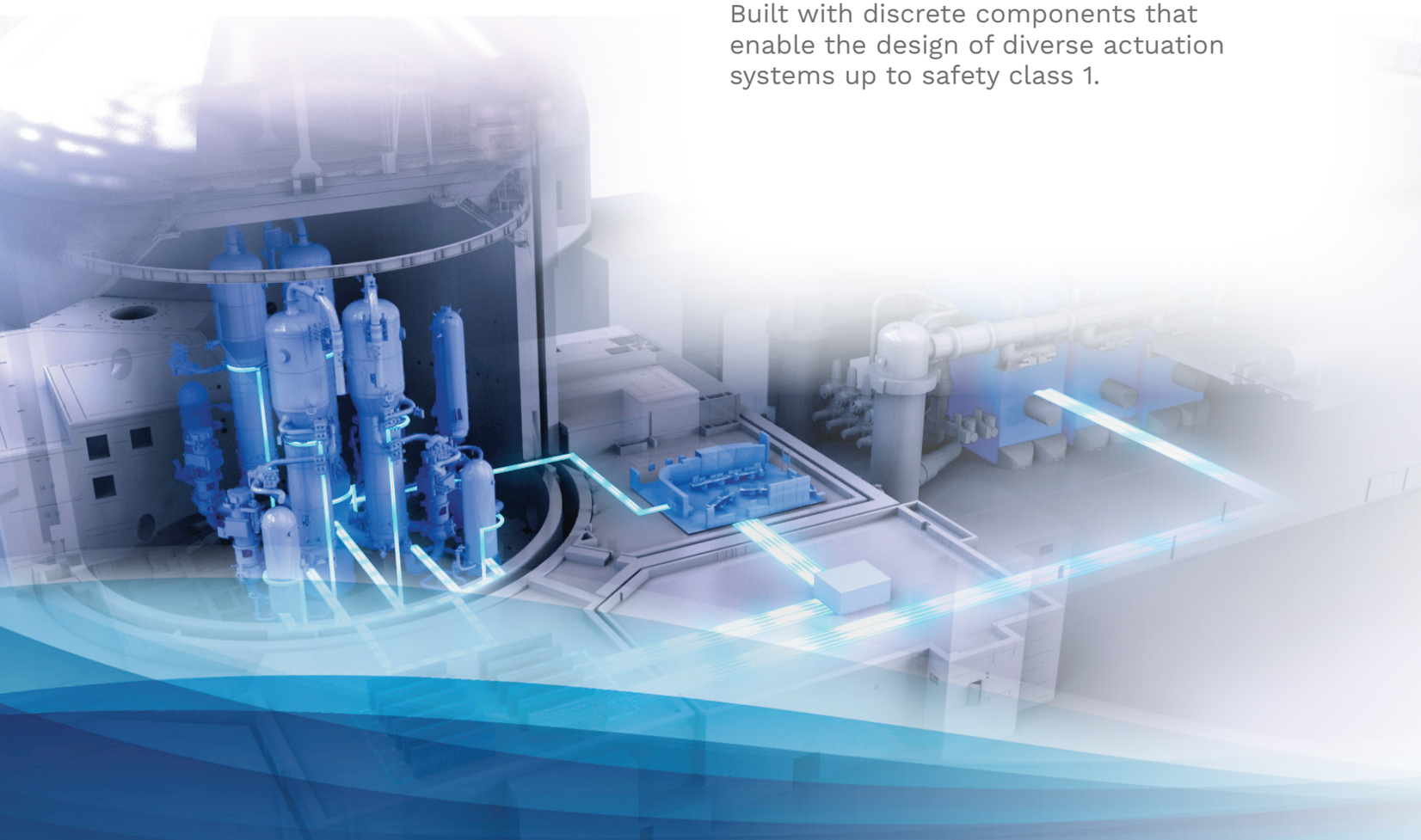
Products and Solutions

At Framatome, we have developed the world's broadest offering of I&C products, solutions, systems, and services available that address the needs of new build, upgrade, and modernization projects. We are constantly expanding every aspect of this global product and solutions portfolio.

New Plant Solutions
Safe, cost-effective automation and instrumentation solutions that meet all safety and performance requirements.

Analog to Digital Upgrades
Opt for:
- Complete digital system
- Analog system
- Optimized combination of both

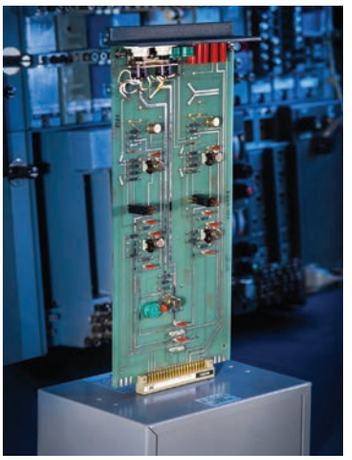
Non-Computerized Solutions
Built with discrete components that enable the design of diverse actuation systems up to safety class 1.



Automation Solutions
Our portfolio includes well-known brands like:

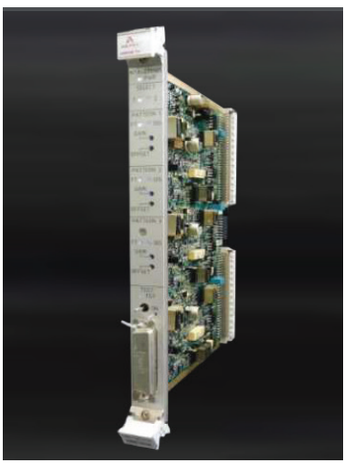
TELEPERM XS
Flexible and modular system platform for Category A functions for Safety I&C. More than 80 installations worldwide.

Nuclear Tricon
1E Safety Evaluation Report (SER) approved and Triple Modular Redundant. More than 60 installations globally.



SPEC200
Analog control system in operation for more than 40 years. Installed in more than 100 nuclear plants globally and 70% of nuclear plants in the U.S.

Foxboro DCS
This long-performing non-safety system by our partner Schneider Electric is operating in more than 20 nuclear plants worldwide.



UNICORN
A modular analog Safety Class 1 platform designed for customer-specific applications in all types of nuclear power plants, from small-scale solutions to main automation systems.

Stand-Alone Solutions
We provide cost-effective solutions for stand-alone systems such as:
- HVAC
- Refueling machines
- Auxiliary systems
- Lifting devices

All safety and non-safety applications include all hardware and software components required for engineering, testing, commissioning, and maintenance, from spare part supplies to custom-designed, comprehensive systems.

Products and Solutions

Incore and Excore Instrumentation and Measurement Systems
We offer the full range of nuclear instrumentation solutions:

- Incore Temperature Measurement: Based on thermocouples, our solutions include the sealing assembly, full connecting lines (organic or mineral technology) and conditioning, for all reactor types.

- Incore Flux Measurement: We have solutions to cover a large range of reactor types. Our movable and fixed incore detector systems are individually designed solutions to support safe reactor operations with measurements from inside the core. Our offer includes complete mechanical parts, sealing devices, acquisition chains, and processing solutions.

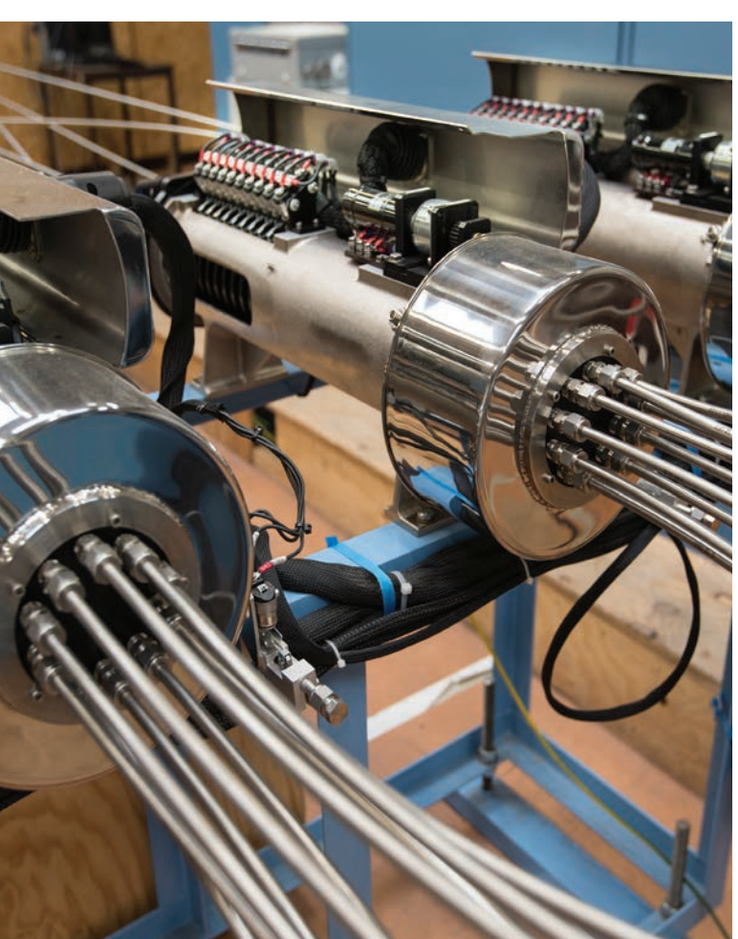
- Excore Flux Measurement: We combine a high level of expertise and manufacturing capability to deliver a complete safety-classified solution from zero power physical testing, including source range to power range channels.

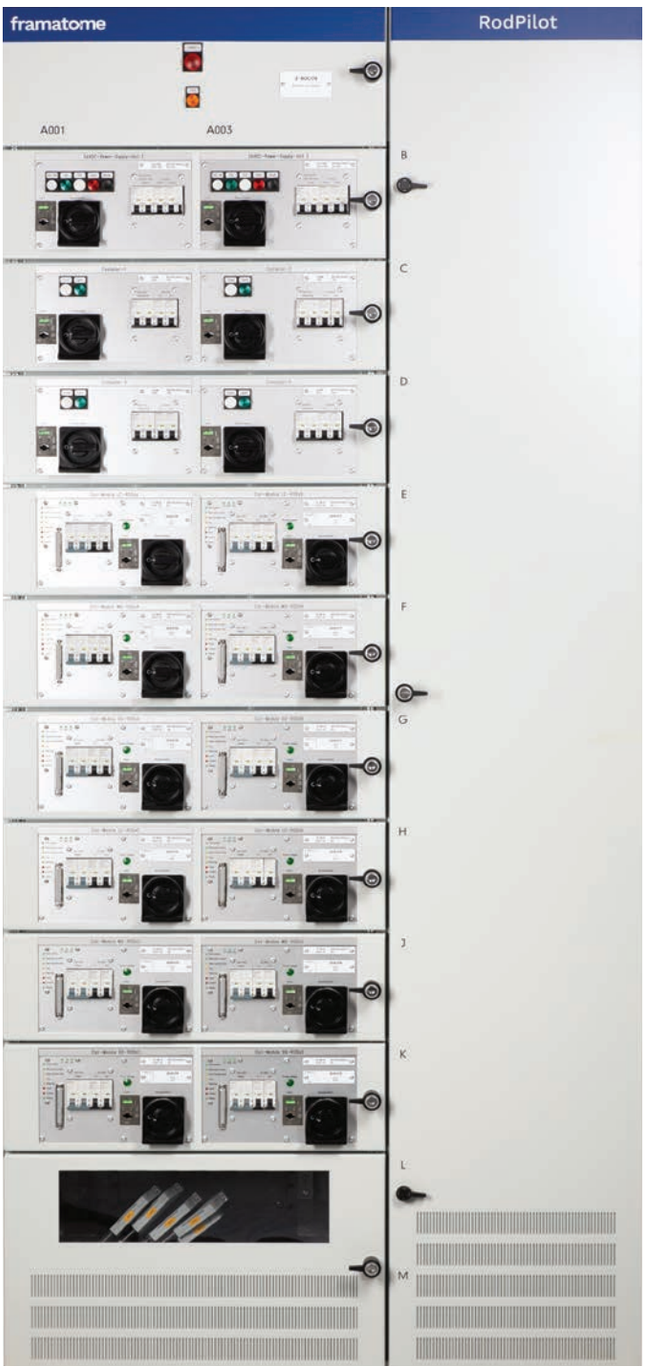
All our solutions are safety classified and qualified according to IEEE, IEC, and KTA standards.

We manufacture these solutions built on a foundation of true technological expertise. This provides a high level of industrial independence, ensuring lifelong product management and support.

We also offer a large portfolio of field instrumentation solutions and services. We rely on a group of industry-leading, qualified suppliers and provide significant added Framatome value in terms of performance, evaluation, qualification, integration into a complete system design, and functional testing.

We also provide in-house manufacturing and high expertise for the following instrumentation systems:
- Boron measurement
- Level measurement
- Primary pump speed measurement
- Rod position indication
- Tubing
- Signal conditioning





I&C for Rod Control
Our complete systems combine modern components, state-of-the-art logic, and proven electronic rod drive control principles to provide enhanced reliability, higher availability, and lower maintenance costs. Our solutions are operating in pressurized water reactors, boiling water reactors, and heavy water reactors worldwide.

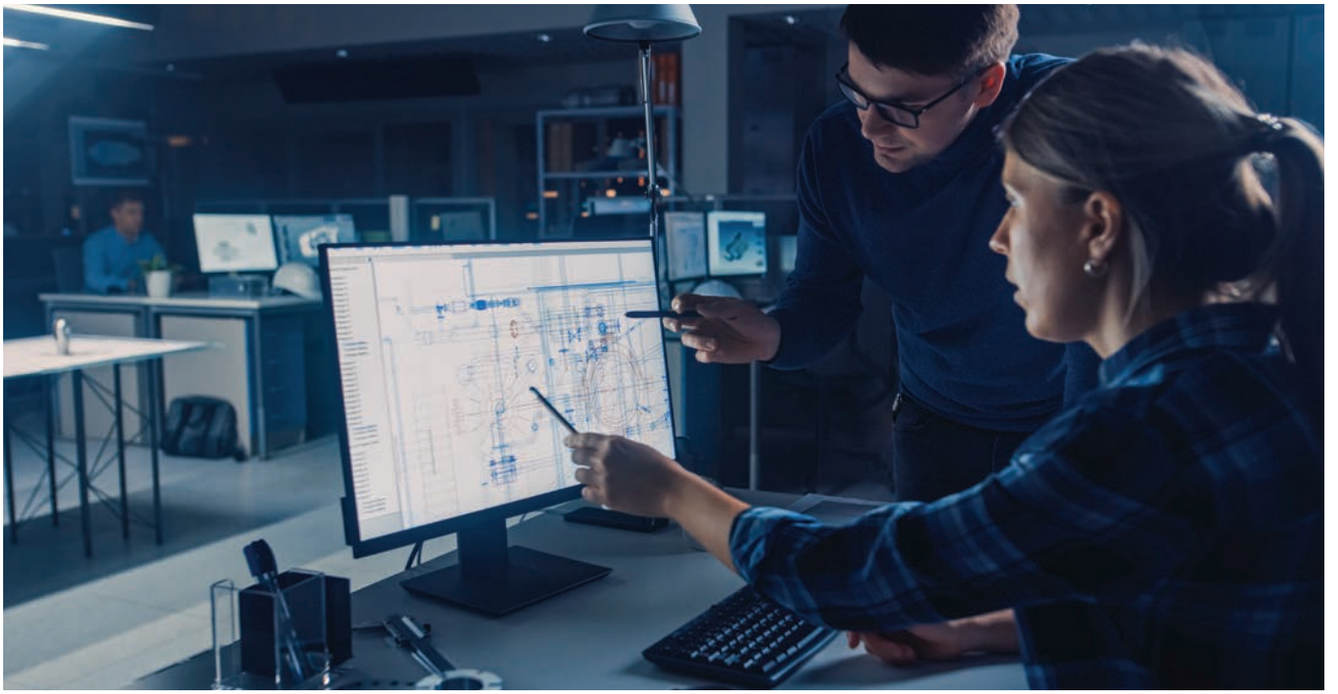
Products and Solutions

I&C Engineering
We listen to our customers and deliver reliable and predictable I&C engineering solutions. Our solution-based approach incorporates years of industry, system, SRO, and plant start-up experience.

We have decades of plant design and modification experience across a broad spectrum of nuclear plant designs. Our highly experienced engineers provide comprehensive design solutions and licensing support for resolution of obsolescence issues and plant life extension.

Our design phase builds from conceptual evaluation and solid scope definition, then incorporates industry operating and station experience, in addition to constructability, a robust Human Performance program and lessons learned, allowing Framatome to deliver total plant engineering solutions.

These project components merge to foster a culture of safety, continuous learning, and continuous improvement—all crucial elements in the delivery of sustainable, predictable, reliable results.

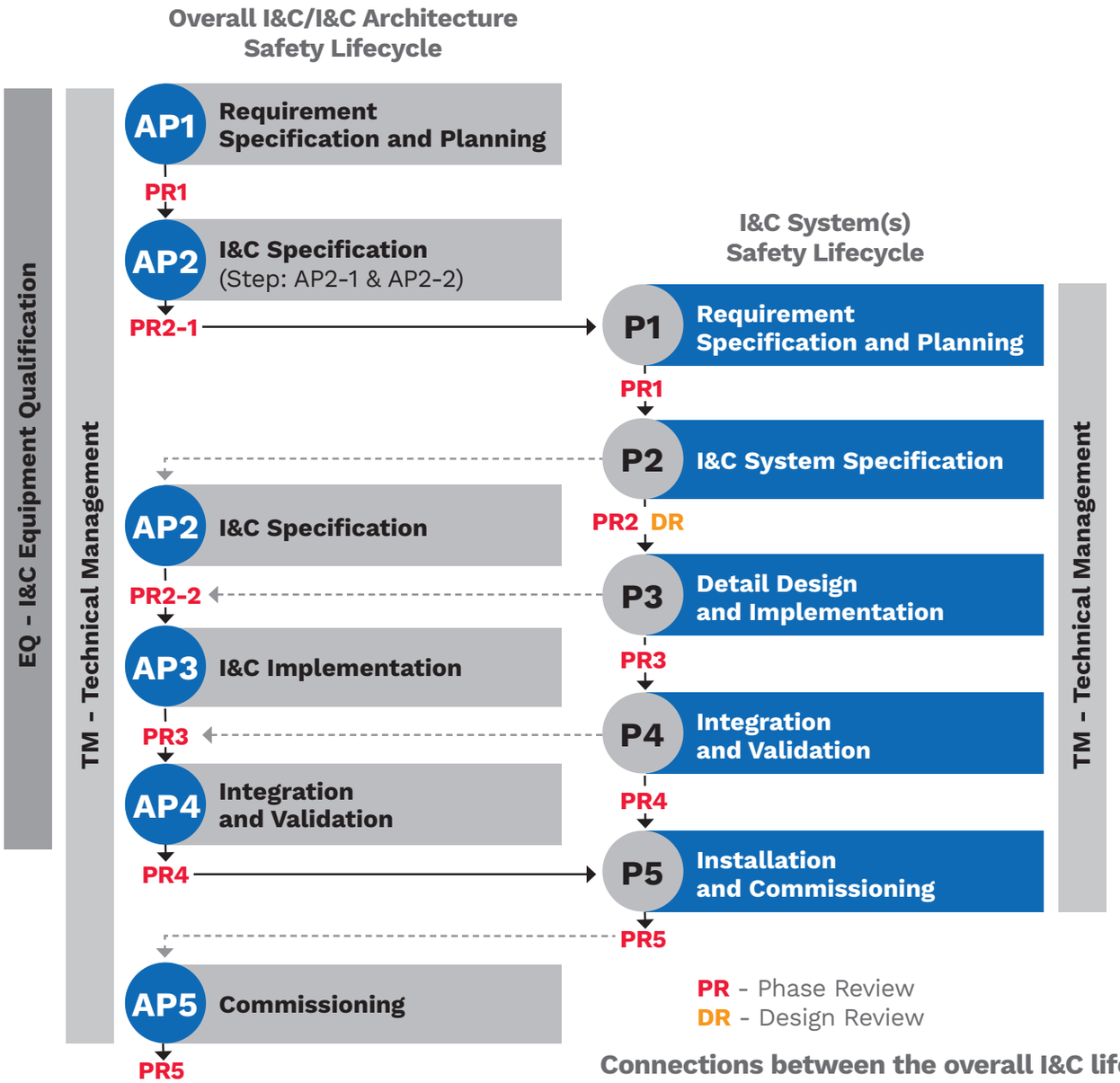


I&C Architecture

Framatome has designed, engineered and developed I&C solutions for most reactor types operating worldwide. From overall I&C architecture to stand-alone systems design, count on Framatome to support licensing, qualification, verification and validation, cybersecurity, and human factors engineering throughout the entire lifecycle of your plant. Through the combination of our experience and our proprietary, qualified safety products, we offer unmatched technical expertise, comprehensive customer support, and cost-effective solutions.

Our ability to integrate third-party systems rests on profound OEM and non-OEM experience from many nuclear power plants built worldwide. This helps optimize collaboration among all stakeholders by sharing all relevant technical and operational information, helping guarantee optimum I&C systems performance.

Our proven processes, incorporating the latest rules and standards and many years of operational experience, are key to the successful completion of every project. We provide a complete set of capabilities for overall I&C architecture design, as well as for I&C system architecture design, including country-specific licensing and qualification know-how.

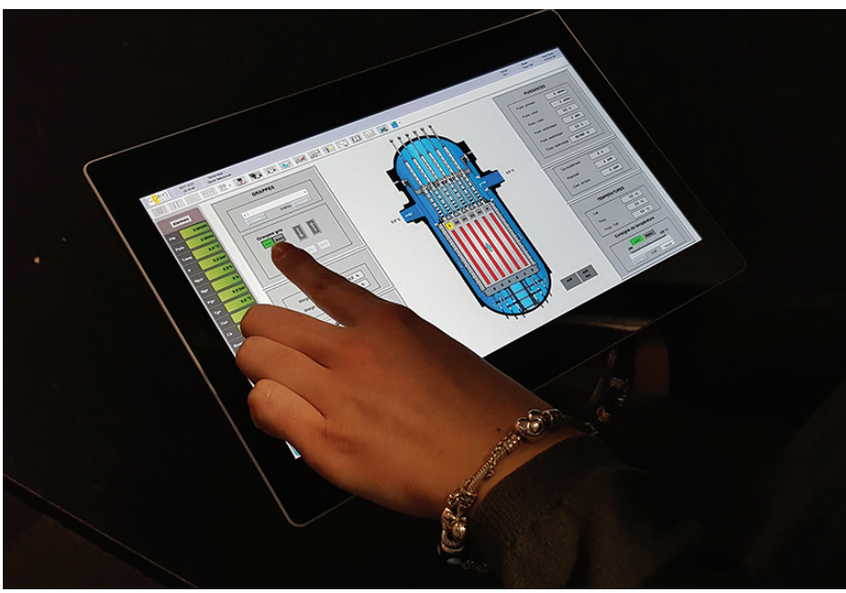


Connections between the overall I&C lifecycle and the safety lifecycles of the individual I&C systems—following IEC 61513 (2011)

Products and Solutions

Full Training Solutions
With more than 40 years of training experience, our full training portfolio includes courses on virtually every aspect of nuclear power plant construction and operation. We also design training programs and courses to suit our customers' specific requirements. Our long-standing relationships with utilities, authors, and institutions around the world also give us valuable insights into nuclear safety policy and procedures, no matter where our customers are located.

Our training solutions focus on:
- Certified, experienced instructors and experts in all fields of nuclear technology
- Competent advice and support regarding your intended training goals
- Practical courses with applied training on real-life systems
- Courses tailored to your needs
- Experience evaluation and individual transfer to custom courses, specific to your needs
- Modern training facilities or on-site training worldwide
- High-quality training materials customized for each course and customer



Simulators for Training & Engineering
CORYS is our subsidiary for developing complete simulation environments.

This includes:
- A full-scale engineering simulator providing a virtual view of the dynamic system in full operating range and with changing conditions
- More than 190 power plant simulators for customers worldwide

Products and Solutions

Human Factor Engineering
By identifying issues early on in the engineering process, we are able to maximize human performance in the control room, through optimal design of:
- Digital displays
- State-of-the-art main control room layout
- Efficient operating procedures

This is how we reduce project risks, enhance human reliability, increase usability, and meet plant safety requirements.

Cybersecurity
Protection against unauthorized access is paramount to your plant's safety. We offer cybersecurity solutions that cover your needs while complying with regulations.

Your plant will benefit from:
- Cybersecurity expertise and knowledge
- Systematic approach for cyber risk minimization
- Worldwide experience in cybersecurity for NPPs
- International codes and standards (e.g., IEC 62645, NRC RG 5.71) compliance

Lifecycle Solutions

We keep a close eye on the entire lifecycle of all I&C solutions. Our experienced specialists ensure long-term operation with services that go far beyond the standard scope. Outage and operation support, maintenance, spares and spare parts management, obsolescence service and training—we provide it all. With Framatome, your plant is in the best hands for the long run.

With our long history of experience in designing, building and maintaining every type of nuclear reactor, we support customers at each stage of their plant's lifecycle, and provide a wide range of services, including:

- Planning and performance of tests on digital and non-digital I&C systems, as well as on safety and non-safety related I&C systems
- Consultation regarding maintenance intervals for equipment and maintenance strategies
- Outage support and support of modernization projects
- Supply of spare parts, repair activities, and proactive obsolescence management on all I&C components

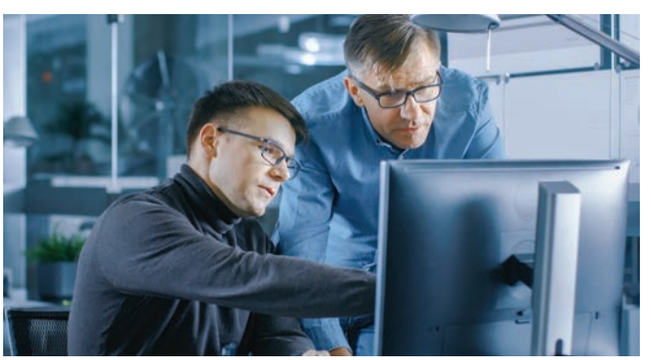
Collaboration in the Pursuit of Excellence

Throughout much of industrial design and engineering history, teams have tended to work in isolation from each other—compartmentalized—focusing on their own task, with a limited view of the total project.

At Framatome I&C, however, collaboration is a core element in how design and engineering teams work together that provides significant value to our customers. For example, by standardizing our processes for documentation, simulation, validation, verification and more, we ensure that all teams are always "speaking the same language," allowing them to work together cohesively. This approach is constant, it is conscious, and it leads to the exchange of ideas, observations, and data as they occur and provides a far more efficient and effective design and engineering process.

Systems engineering has been a key initiative within Framatome for several years. It aims to improve and streamline the engineering and production processes behind our I&C solutions to better understand and meet the requirements of each customer, particularly for the most complex projects. To achieve this understanding, it is essential to begin at the very earliest stage of the project, ideally even before the contract is signed. This makes it possible to more clearly understand customer needs and make our recommended solutions as sound and on-target as possible.

We have also invested in simulation technology to identify problems and validate solutions from the earliest phase of the development cycle. This mitigates the risk of costly and time-consuming revisions during the construction and commissioning phase.



Collaboration that leads to excellence that leads to savings. Therein lies significant value.

Anticipating the Future

Framatome is a leading participant in various international organizations engaged with the nuclear power industry. They include the International Atomic Energy Agency, World Nuclear Association, International Electrotechnical Commission, and Institute of Electrical and Electronics Engineers. We also regularly communicate with representatives from regulatory bodies and safety authorities around the world. Our goal is to advance global cooperation and standardization by understanding the needs of all national safety authorities. We believe these efforts will lead to greater cost efficiency for all projects.

How does that benefit our customers?

For example, our impact on the licensing process on behalf of our customers is significant. We provide substantial support including training, tests, qualification, inspection, operating technical specifications, documentation, licensing studies, interfacing with regulatory bodies, and more to make sure every aspect of the licensing process runs smoothly.

As nuclear power utilities consider the opportunities and challenges they face, we provide valuable counsel by helping clarify what we see coming for design, engineering, construction, installation, licensing, and more and how those trends can impact their projects and their business. Adding greater clarity to their planning process helps our customers approach their decision-making with greater confidence about what the future may hold.

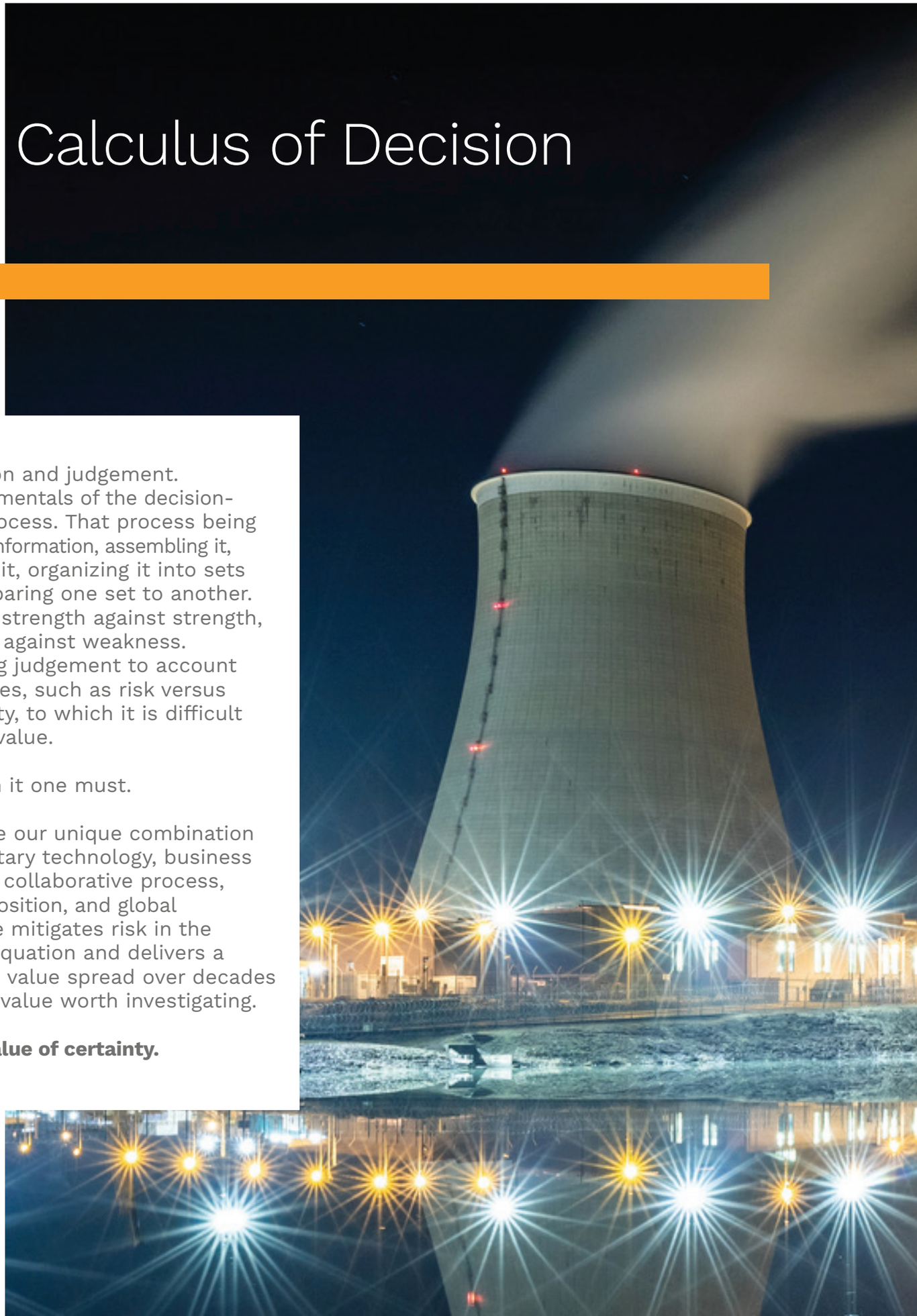
Unequivocal Stability

Along with our business structure of owning our supply chain and technology, the structure of our corporate ownership also mitigates risk for our customers.

EDF Group, which is primarily owned by the French state, owns controlling interest (75.5%*) in Framatome. This presents certain realities regarding our long-term stability, one of which is our confidence in making an unequivocal commitment to the long-term support of our projects, our technologies, our solutions and, more importantly, our customers. Though our size may not be unique, the stability of our ownership unquestionably is. There is simply nothing more certain than that.

* The balance of ownership is held by Mitsubishi Heavy Industries (19.5%) and Assystem (5%).

The Calculus of Decision



Information and judgement.
The fundamentals of the decision-making process. That process being gathering information, assembling it, assessing it, organizing it into sets and, comparing one set to another. Balancing strength against strength, weakness against weakness.
Then using judgement to account for variables, such as risk versus opportunity, to which it is difficult to assign value.

But assign it one must.

We believe our unique combination of proprietary technology, business structure, collaborative process, industry position, and global experience mitigates risk in the decision equation and delivers a calculable value spread over decades of time. A value worth investigating.

It is the value of certainty.

An Invitation
Your project is unique and will present its own set of challenges and opportunities. To learn more about the Value of Certainty and how we can bring it to your project, please contact us at your convenience via email at ic@framatome.com. Together, we will begin to discover the pathway to success.

Your performance
is **our** everyday **commitment**

Framatome is an international leader in nuclear energy recognized for its innovative solutions and value-added technologies for the global nuclear fleet. With worldwide expertise and a proven track record for reliability and performance, the company designs, services and installs components, fuel, and instrumentation and control systems for nuclear power plants. Its more than 14,000 employees work every day to help Framatome's customers supply ever cleaner, safer and more economical low-carbon energy.

Visit us at: www.framatome.com, and
follow us on Twitter: @Framatome_
and LinkedIn: Framatome.

Framatome is owned by the EDF Group (75.5%), Mitsubishi Heavy Industries (MHI – 19.5%) and Assystem (5%).

Scan the QR code to browse our solutions by market area.

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