WHITE PAPER

NUCLEAR INDUSTRY NEW BUILD / NEW ENTRANTS

INTERNATIONAL SAFETY AND RELIABILITY STEERING COMMITTEE (ISRSC)

EPRI ELECTRIC POWER RESEARCH INSTITUTE

IAEA International Atomic Energy Agency
Atoms for Peace and Development

WANO
GLOBAL LEADERSHIP IN **NUCLEAR SAFETY**

The contributing organisations' input to this white paper is indicated in the relevant sections.

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WHITE PAPER : DECEMBER 2019

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INTRODUCTION

It is widely recognised that the commercial nuclear industry is experiencing significant change. Power reactors constructed in the latter part of the 20th century are approaching the end of their originally anticipated lives. Many are being extended into 'Long Term Operation', others are being shut down as they reach end-of-life, or for political or economic reasons. Rapid expansion is occurring elsewhere with many new units now under construction. The context in which these new units are being constructed around the world also presents novel challenges to regulators, operators and other stakeholders.

Some new operating organisations are starting up units in existing, established regulatory frameworks. Mature operating organisations are adding new units to established fleets. Increasingly, countries and areas that currently have no commercial nuclear power programmes are seeking to add a nuclear component to their national energy mix for the first time.

The new unit / new entrant environment is multi-faceted, requiring approaches tailored to the specific needs of each country or area, regulator and operator.

Constructing and starting up new nuclear plants safely is the key to them achieving high reliability over their planned lifetimes, which may be 60 years or even longer.

National governments and the whole nuclear power industry have a stake in this and have access to a significant amount of construction and operating experience that can be used to support all phases of new reactor projects. However, the complexity and thoroughness of the requirements for a nuclear power programme are best met with a concerted and coordinated global effort to make that support readily available.

This white paper is an initiative by members of the International Safety and Reliability Steering Committee (ISRSC), a group of international nuclear organisations supporting different constituent parts of the worldwide industry, to present an integrated picture of excellence at all stages of the new entrant journey. The paper sets out what the Electric Power Research Institute (EPRI), the International Atomic Energy Agency (IAEA) and the World Association of Nuclear Operators (WANO) provide in terms of support to new entrants to the industry. It also explains the benefits that new entrants gain by engaging with these organisations at the earliest appropriate point.

The nuclear industry has a long history of mutual support and collaboration. As it moves into a new phase of development and expansion, that legacy must also be carried forward into the future and our collective responsibility and experience shared with all those who are new to nuclear power technology.

Neil Wilmshurst

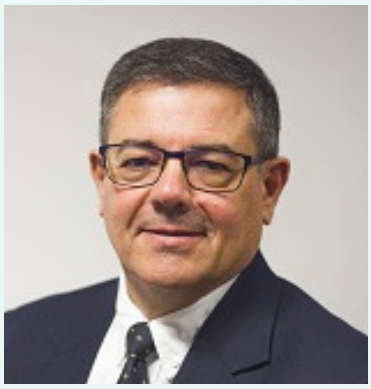
Vice President, Nuclear and Chief Nuclear Officer

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Peter Tarren

Head of the IAEA's Operational Safety Section

IAEA International Atomic Energy Agency
Atoms for Peace and Development



Peter Prozesky

Chief Executive Officer

WANO
GLOBAL LEADERSHIP IN NUCLEAR SAFETY

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[1] *The International Safety and Reliability Steering Committee (ISRSC) is comprised of the China Nuclear Energy Agency (CNEA), the Electric Power Research Institute (EPRI), the Japan Nuclear Safety Institute (JANSI), the Institute of Nuclear Power Operations (INPO), the International Atomic Energy Agency (IAEA), the Nuclear Energy Agency of the Organisation for Economic Cooperation and Development (OECD-NEA) and the World Association of Nuclear Operators (WANO). The ISRSC meets biannually to discuss emerging industry issues and trends and to agree on appropriate collaborative activities to support the various different constituent parts of the global nuclear industry.*

[2] *This paper has been co-authored by EPRI, IAEA and WANO only. None of the views expressed in this paper should be attributed to the other organisations represented on the ISRSC; they are the respective views of these three contributing organisations only.*

ELECTRIC POWER RESEARCH INSTITUTE (EPRI)

Introduction

The Electric Power Research Institute (EPRI) conducts research and development (R&D) relating to the generation, delivery, and use of electricity for the benefit of the public. An independent, non-profit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, affordability, health, safety, and the environment. EPRI members represent 90 percent of the electricity generated and delivered in the United States with international participation in 40 countries.

EPRI's Advanced Nuclear Technology (ANT) group performs R&D to address and improve every stage of deploying new nuclear power plants – siting, licensing, constructing, starting, and initial operations. ANT research supports organizations and countries with established nuclear programs and those new to nuclear power construction.
The program's technical products and tools target efficiency opportunities that minimize deployment and operational risks and uncertainties. Activities evaluate and address the challenges of deploying and operating plants of all generational designs – advanced large light-water reactors, small modular reactors, and non-light water, advanced reactor designs (i.e., Generation IV).

Existing technologies from inside and outside the industry are also reviewed to evaluate and adapt technologies for use. The ANT program also performs R&D to optimized performance for new plant designs – during and after construction – and endeavours to codify the research by working with standards organizations.

What are the technical focus areas of ANT?

ANT has four technical focus areas to support near- and long-term deployment of nuclear power plants – Advanced Reactors, Engineering and Construction Innovation, Advanced Manufacturing and Materials, and Commissioning and Initial Operations.

Advanced Reactors (ARs): Some countries new to nuclear have expressed interest in the growing support of the next generation of design technologies for nuclear power production. There are many advanced, non-light water nuclear generation technologies and designs that take advantage of new nuclear fuels and fuel cycles, lower pressures, higher temperatures, inherent safety features, and advanced energy conversion technologies.
This focus area builds the technical foundation that can inform decisions for new nuclear generation options.
It includes scouting and engagement of promising advanced nuclear generation options, understanding capabilities and status, and disseminating that information to stakeholders. Two additional areas of focus include strategic analysis and technology assessment and responding to owner-operator needs for advanced nuclear generation options. A country new to nuclear often finds the scalability and flexibility of advanced reactor designs to be appealing, and ANT research provides the prospective owner a clearer understanding of technologies that may be suitable for their needs.

Engineering and Construction Innovation (ECI): Whether for the existing or future generation of reactor designs, the value of enhancing and improving engineering, procurement, and construction activities for nuclear power plants is substantial. First, by developing collaborative engineering design, tools and processes, the industry can leverage and standardize repeated tasks to support licensing, developing, and constructing nuclear plants. Second, research in this area supports supply chain quality to ensure equipment and labor meets the high-standards of the nuclear industry. Third, ANT continues to research advanced materials and processes to increase efficiency and reduce costs of construction. This supports the civil and non-civil aspects of building nuclear power plants, and should be considered first for a country new to nuclear. It informs decisions on where a nuclear power plant should be sited and provides information for seismic-structural design; developing specifications and supply-chain; and activities related to concrete, reinforcing steel, modular construction, and automated inspection.

Advanced Manufacturing and Materials: This area focuses on materials, degradation mechanisms, inspection requirements, and manufacturing of components – piping, valves, heat exchangers, and pumps. Research activities address advanced manufacturing and fabrication of components using additive manufacturing (3D printing), electron beam welding (EBW), and powder-metallurgy hot-isostatic pressing (PM-HIP), advanced cladding processes, and other advanced technologies. ANT also supports new builds by researching risk-informed approaches to improve material performance and inspection, which can reduce the frequency and scope of inspections for materials and welds, and evaluates advanced inspection methods, such as real-time non-destructive evaluation (NDE) during fabrication. ANT works with the experts in EPRI's chemistry program to improve components' environment to reduce the proclivity toward equipment degradation from various mechanisms such as stress corrosion cracking. Adjustments to the component environment and improvements to materials ensures high performance and reliability. Overall, this area reduces capital costs for component fabrication and long-term operational costs.

Commissioning and Initial Operations: This focus area evaluates lessons learned and technical challenges associated with commissioning, start-up, and initial operations. ANT develops "how-to" guidance related to materials, engineering, maintenance, and equipment reliability, supporting the final stages of nuclear construction through initial operations. Entities involved in new construction are also provided with ideas on how to engage with the site representatives about EPRI products that will support longer-term operations.

How do specific ANT research topics help support a country new to nuclear power?

In the Advanced Reactor area, ANT assesses the long-term strategic view of nuclear plants for Generation IV deployment including economic assessment. This work is generally done in collaboration with multiple government and industry stakeholders to analyse the economics of construction and identify related research needs, including what technologies may be economically advantageous. Generation IV also activities include the development of an owner-operators requirements guide for non-light water reactors. This guide is similar to the EPRI Utility Requirements Document (URD), which was developed by ANT was developed in collaboration with the U.S. Department of Energy for light water reactors. It provides an understanding of technology- and mission-based expectations for nuclear energy production.

For light-water reactors, EPRI's URD provides a comprehensive set of plant-functional requirements developed over the last 20 years to inform the efficient design, siting and licensing and optimize construction, operational performance, safety, and economics.

ANT also performs research to resolve specific technical challenges. One example is a large-scale experiment studying aerosol deposition behaviour for small modular reactors in accident scenarios.

This information was used to benchmark EPRI's Modular Accident Analysis Program (MAAP) so ANT members could determine the appropriate size for emergency planning zones. MAAP simulates the deposition of radioactive particles in large and small light-water reactor designs for postulated accident and related release scenarios.

All of the above includes important research used by the industry during the early regulatory stages of licensing a future power plant. Eventually, components and structures are designed, fabricated, and built. To support these efforts, ANT also assesses seismic design practices for embedded structures to inform potential changes in global structural design codes. It also engages in international collaboration for civil/structural research affecting applicable codes on the efficient design and placement of concrete and reinforcing steel, including mass concrete, self-consolidating concrete, and high-strength reinforcing steel to improve constructability of nuclear structures. Organization can take advantage of the advanced manufacturing research to reduce costs of component fabrication. Advanced manufacturing research results and techniques, including PM-HIP, EBW, diode laser cladding, and additive manufacturing, can be used at new and existing nuclear power plants, for equipment installation and replacement. For example, ANT recently released additional updates on the use of PM-HIP for the fabrication of near-net-shape components and its ability to eliminate dissimilar metal welds in plant components, which would reduce fabrication costs and help mitigate common degradation mechanisms.

A demonstration project is currently underway that will likely support a 40 percent reduction in the cost of a reactor pressure vessel and a reduction in manufacturing time from years to months.

For a new plant project, fabrication and construction activities often occur in parallel with the digital design. Digital configuration research results include adaption of modern digital technologies for new nuclear plants (including data-centric configuration management), data interoperability standards, equipment schema, and data handover processes that plant owners can implement to achieve effective configuration management.

Continuing research and the future

ANT is also evaluating the performance and implementation of augmented reality, indoor positioning systems, and automated chemistry. It has completed an assessment of technologies available for full automation of chemistry in new light water nuclear plants, assessing the current state of the art and gaps to be overcome.

Looking to the future, ANT is evaluating global markets for non-electric products and missions which improves cost models used for new nuclear construction. Specific to advanced reactors (Generation IV), ANT is mining information for novel design attributes relative to increased flexibility, resiliency, and competitiveness. It is developing guidance on designing structures to safely reduce the duration of construction time. This includes seismic-isolation and modular construction technologies for assembling structures, systems, and components. Progress is being made in advanced manufacturing, where ANT remains focused on PM-HIP, EBW, additive manufacturing, and adaptive feedback welding, which has the potential to significantly increase the use and improvement of automated welding. All of these technical areas support global organizations interested and pursuing nuclear energy generation.

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

Introduction

The International Atomic Energy Agency is the world's central intergovernmental forum for scientific and technical co-operation for all peaceful applications of nuclear technology, including nuclear power. Its statute came into force in 1957 with one of its objectives being 'to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world'. Among other things, the Agency is authorized to make provision for services to meet the development and practical application of atomic energy for peaceful purposes, including the production of electric power, and to establish or adopt standards of safety for protection of health and minimization of danger to life and property and to provide for the application of those standards. These two elements (the application of standards and the provision of services) can be broadly categorised as IAEA 'assessment' and 'assistance'.

As of mid-2019, 30 IAEA Member States have operational nuclear power plants, with approximately 450 reactors in operation and more than 50 reactors under construction. The safety of nuclear installations is entirely a national responsibility and 'must rest with the person or organization responsible for the facilities and activities'. To that end the IAEA's Nuclear Power related programmes support those Member States with existing nuclear power plants as well as those countries building new nuclear plants. The IAEA's support focusses on ensuring safety and enhance the efficient and reliable performance of these valuable assets.

IAEA Safety Standards

Since its inception the IAEA has created and maintained a comprehensive set of safety standards for a wide range of nuclear facilities and activities including the siting, design, regulation and operation of nuclear power plants. The IAEA Safety Standards are published once a consensus has been reached with Member States and are often incorporated into national regulations or practices. Their structure ranges from fundamental safety principles through safety requirements that demonstrate the achievement of an acknowledged high level of safety, and on to safety guides illustrating good examples and practices seen across the global nuclear industry. They are all available to download, free of charge, on the IAEA's website.

Application of the IAEA Safety Standards

The IAEA can, on request, review Member States' application of the safety standards using 'safety review services'. These take the form of international peer reviews. They typically result in the identification of areas where the host organization can further enhance its activities that influence safety and capture good practices to be shared across the nuclear power industry. The IAEA encourages Member States to make the results of these reviews publicly available, enhancing the transparency and openness of the industry to stakeholder scrutiny. For nuclear power these reviews include site selection and assessment (SEED), design safety (DSR), review of national regulatory framework (IRRS) and on to operational safety (OSART), including the preparatory phase before a new nuclear power plant is commissioned and starts operating (Pre-OSART).

Additional services cover emergency preparedness (EPREV), radioactive waste and spent fuel (ARTEMIS). They ensure that significant safety matters are well in hand as a new nuclear power programme proceeds through procurement, construction, commissioning and initial operation. Taken together they offer Member States a comprehensive set of safety reviews. In those Member States that have agreed structured assistance programmes with the IAEA, any safety reviews requested are integrated into those programmes.

[3] *Current data available from the IAEA Power Reactors Information System, https://pris.iaea.org/PRIS/home.aspx*

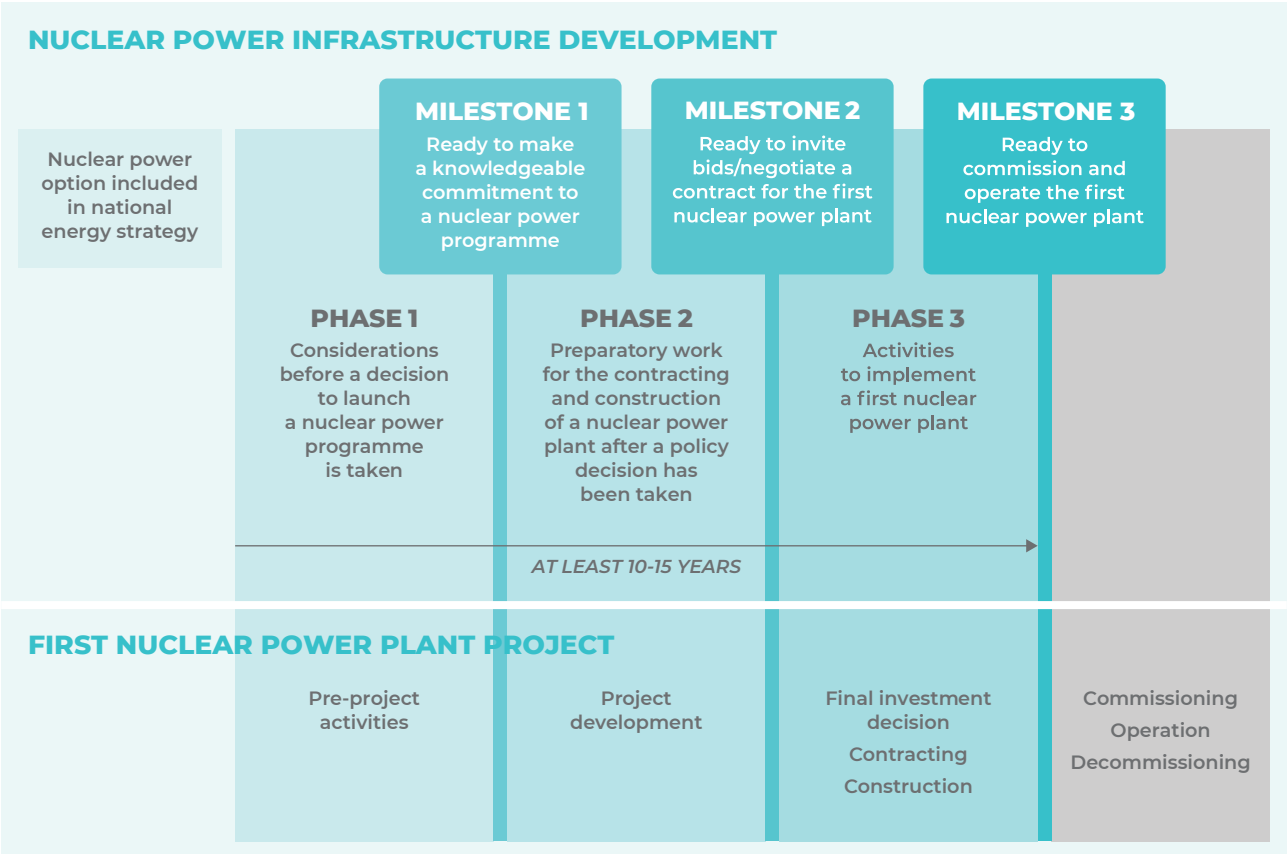
[4] *SF1: Fundamental Safety Principles [IAEA; 2006]*

Developing Nuclear Safety Infrastructure

The licensing of a nuclear power plant requires a sound regulatory framework upon which to build the nuclear safety infrastructure that supports the safe design, construction, commissioning and operation of the plant. In 2012 the IAEA published a Specific Safety Guide which provides a roadmap for the deployment of IAEA Safety Standards when developing the safety infrastructure for a nuclear power programme. This guide is complementary to IAEA guidance related to other national nuclear infrastructure requirements (**see below**) and clearly identifies the safety-related activities needed during the first three phases of developing a nuclear power programme.

These activities ensure the timely development of a suitable regulatory framework, support the selection and safety evaluation of the site and ensure that the plant's design meets safety requirements, is constructed to the highest standards and that a comprehensive commissioning process has been completed before the start of operation.

The Agency has also developed a self-assessment methodology and tool that helps Member States to review the development of their nuclear safety infrastructure against the roadmap at critical stages and establish an action plan for addressing the rest of the programme until commissioning.



Because some activities essential to the safety of a new nuclear power have long lead times the IAEA offers assistance from early in the process of developing the nuclear safety infrastructure. Although these activities may be well understood and documented they can, because of their focus on culture and behaviours, take considerable time to establish and become effective. One example is bringing about an effective learning culture that identifies errors and events, finds the underlying causes and implements corrective actions that prevent recurrence. Another is the achievement of an effective safety culture during construction, commissioning and early operation so that, when a new project becomes a truly 'nuclear' site the appropriate behaviours and attitudes are not only understood but embodied by leaders and regarded as normal conduct by plant personnel. This helps an organization to avoid significant events in the first place.

Developing National Nuclear Infrastructure

Around 30 additional countries are considering, planning or actively working towards the addition of nuclear power to their national energy mix and the IAEA has been providing integrated support to these 'embarking countries' for over a decade. This support has been formalized in IAEA guidance document 'Milestones in the Development of a National Nuclear Infrastructure for Nuclear Power', recently revised in 2015. Comprising three phases, the Milestones Approach supports IAEA Member States in understanding and preparing for the commitments and obligations associated with developing a safe, secure and sustainable nuclear power programme. The Milestones Approach identifies 19 nuclear infrastructure issues and three progressive phases of nuclear power programme development. Taken together these address the main responsibilities of three key organizations in particular: the government, the regulatory body and the owner/operator (or operating organization). The Milestones Approach can also be applied to nuclear infrastructure development in countries that are expanding their nuclear power programmes. This comprehensive support to countries embarking on or expanding their nuclear power programmes also represents 'assessment' and 'assistance'.

[5] *SSG 16 – Establishing the Safety Infrastructure for a Nuclear Power Programme*

The assessment component was initiated in 2009, when the IAEA launched the Integrated Nuclear Infrastructure Review Service (INIR). This service supports Member States in assessing the status of a nuclear power programme based on the requirements set out in the Milestones Approach and helps ensure that the nuclear infrastructure required for the safe, secure and sustainable use of nuclear power has been developed and implemented. INIR Missions and INIR Follow-Up Missions can be conducted in each of the phases of programme development, and 27 INIR Missions to 20 Member States have been conducted since the service was launched.

The assistance component comprises several tools such as the 'Nuclear Infrastructure Bibliography' on the IAEA web site which lists the key guidance publications for each of the above-mentioned infrastructure issues. The IAEA has also created several competence-building tools to help embarking countries develop a roadmap and satisfy the requirements for a safe and sustainable nuclear power programme. Following the Milestones Approach, the 'Nuclear Infrastructure Competency Framework' database covers competences, roles and responsibilities of the Government, the Regulatory Body and the Operating Organization throughout the phases of the programme.

The IAEA also provides a set of introductory E-learning modules aimed at nuclear newcomers. Moreover, the Agency offers numerous opportunities for embarking Member States and those with existing nuclear power programmes to come together and exchange knowledge and share experience on relevant topics concerning nuclear power infrastructure development. As well as technical meetings and conferences, the Agency, together with experienced donor states, organizes inter-regional, regional or national capacity building and training workshops on the development of nuclear infrastructure.

Moving to Operations

Around three months prior to the important step when nuclear fuel is loaded into a new reactor for the first time the IAEA offers a comprehensive pre-operational safety review, known as 'Pre-OSART'. These reviews have similarities to WANO's Pre-Start Up Reviews, and are conducted in a similar time frame, so the two organizations cooperate closely to minimise the burden on the operating organization. This cooperation includes the timing of the reviews and, in some cases, sharing reviewers between the review missions. A notable feature of these IAEA missions is the desire that the reports be used to help the whole industry and enhance the openness and transparency of the industry. To this end, OSART mission findings, once derestricted by the host Member State, are made available to other operators within nuclear power industry for learning purposes.

Supporting the Safety of Existing or Expanding Nuclear Programmes

The Agency also provides engineering, operation and maintenance support to Member States that currently operate nuclear power plants, as well as those expanding existing programmes. Relevant areas include contracting and the supply chain, construction readiness, instrumentation and control, and operation and maintenance optimization. In addition to engineering support, the Agency also develops guidance and shares good practices with Member States in areas such as human resource development; training; stakeholder involvement; management systems; and leadership.

In those Member States expanding their nuclear power programmes, the Agency has initiated a focused effort to understand and respond to the unique challenges facing these countries. In late 2019, a Technical Meeting will be held to further discuss common challenges and identify opportunities to support the Member States through existing or newly developed IAEA guidance. In this context the IAEA also offers its Member States a 'Construction Readiness Review service' that provides a comprehensive review of the strategic elements associated with the implementation of nuclear power plant construction projects.

Requesting Assistance

An IAEA Member State considering requesting assistance for their nuclear power programme should, in the first instance, contact their National Liaison officer for the IAEA, who will contact the Agency through established channels. For those countries embarking on a new nuclear programme this will result in a response from the Agency's Nuclear Infrastructure Development Section, which coordinates and harmonizes IAEA efforts related to the integration of such programmes.

At the end of the three phases, and shortly before first criticality, WANO provides operational readiness assistance missions (ORA), pre-startup peer reviews (PSURs) and crew performance observations (CPOs), to help members determine their asset's and crews' readiness to safely operate the new unit.

WORLD ASSOCIATION OF NUCLEAR OPERATORS (WANO)

Introduction

An organisation solely focused on maximising commercial nuclear safety and reliability, and with no advocacy remit, WANO supports new entrants and new build in the nuclear industry with its New Unit Assistance (NUA) service. NUA is a suite of 18 modules that are provided to future operating companies at various points along the design, construction and commissioning timeline. The service also includes support for the first fuel cycle, including preparation for the plant's first refuelling outage.

Along the timeline of a new unit's journey to start-up, WANO provides support in all areas of plant operations from nuclear safety culture, operator fundamentals, emergency planning, fuel and reactor management, leadership, and turnover for operations. This support is delivered by teams of experts from across the global nuclear industry.

How does New Unit Assistance work?

Provision of the NUA modules can be tailored to a unit or company's specific needs, and the delivery methods are varied to ensure the member receives the right information for them at the right point in time - via training materials, sharing of best industry practises, benchmarking, use of operating experience (including construction-phase operating experience (OE) and information about events obtained from contractor organisations), targeted support missions and training.

The focused support provided by the NUA service helps members to build-up an appropriate operational mindset through three key phases of the overall project timeline [**see pages 18 & 19**].

Support is provided at the first stage of the project predominantly through learning and development opportunities, such as seminars, workshops and training alongside other WANO members. During the second phase, learning and development opportunities are supplemented by support missions on various subjects relevant to the stage of the project and considering the needs of the company as it builds the capacity of its operating organisation. The third phase of the NUA timeline allows for more tailored support missions at the request of the plant, in response to particular issues of concern or areas of specific interest for the member. At the end of the three phases, and shortly before the first criticality, WANO provides operational readiness assistance missions (ORA), pre-startup peer reviews (PSURs) and crew performance (CPOs), to help members determine their asset's and crews' readiness to operate the new unit safely.

Who can access NUA support?

The NUA service supports all new nuclear power plants, whether they are in newcomer or expanding countries or areas. In order to provide the most appropriate support, WANO seeks to engage with new entrant companies and countries/areas using a graded approach according to the type of project and familiarity the company has with the industry:

1. Monitoring: provided to new unit(s) at an existing site in a country or area with a mature nuclear infrastructure and regulator.
2. Increased assistance: to a new nuclear company in a country or area where other nuclear companies already exist and with a mature nuclear infrastructure.

3. Focused assistance: provided to a new company in a newcomer country or area, where the regulatory framework is growing in parallel with the new build.

Why is early engagement with WANO so important?

Full and effective engagement with the NUA programme can significantly reduce the risk of a delay to start-up or a setback during the construction phase. Lessons learnt from PSURs have been incorporated into the NUA modules, to enable WANO members to learn from past challenges and ensure their construction and commissioning projects are as successful as possible.
To benefit from WANO's expertise to ensure they start up safely and on time, new nuclear units and entrants should join WANO as soon as the contracts for main works are signed. By becoming a member of WANO before construction begins and several years before initial criticality, new units will gain the maximum value from their membership.

WANO members are also encouraged to share operating experience (OE) events from the construction and commissioning phase, which allows each member to benefit from access to thousands of OE reports from plants across the world.

These exist to provide information on how to spot and prevent common problems, enabling WANO members to become more efficient, reliable and safer.
WANO also supports the industry's NUA working group, comprised of new entrants and experienced operators alike. Their objective is to provide comprehensive peer support and guidance to any operator starting up a new nuclear unit.

FENNOVOIMA: HANHIKIVI NPP (FINLAND)

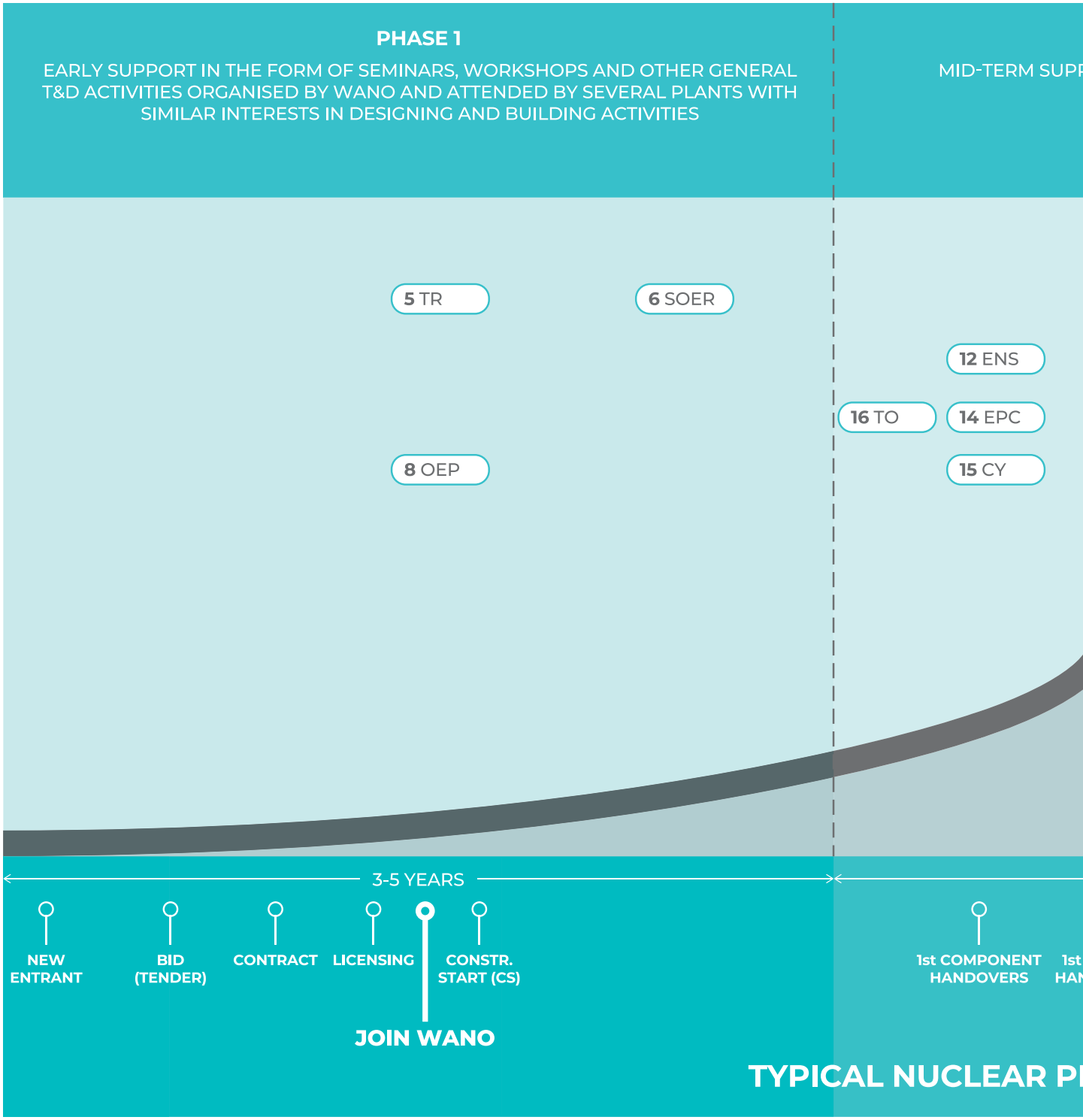
Early engagement with WANO

Fennovoima has recognised the value of cooperation with WANO since its very beginning. CEO of Fennovoima, Toni Hemminki, says that nuclear safety is a key priority for all Fennovoima employees.
"Gathering and utilising lessons learned from different channels is important in the development of the future plant design and practices.

"One channel to get the information about lessons learned is WANO member support missions (MSM). WANO benchmark visits are carried out at the request of a member plant or utility. Experts from the requesting plant/organisation draft recommendations and suggestions to address an issue after focused observations and interviews performed at a well performing plant/organisation.

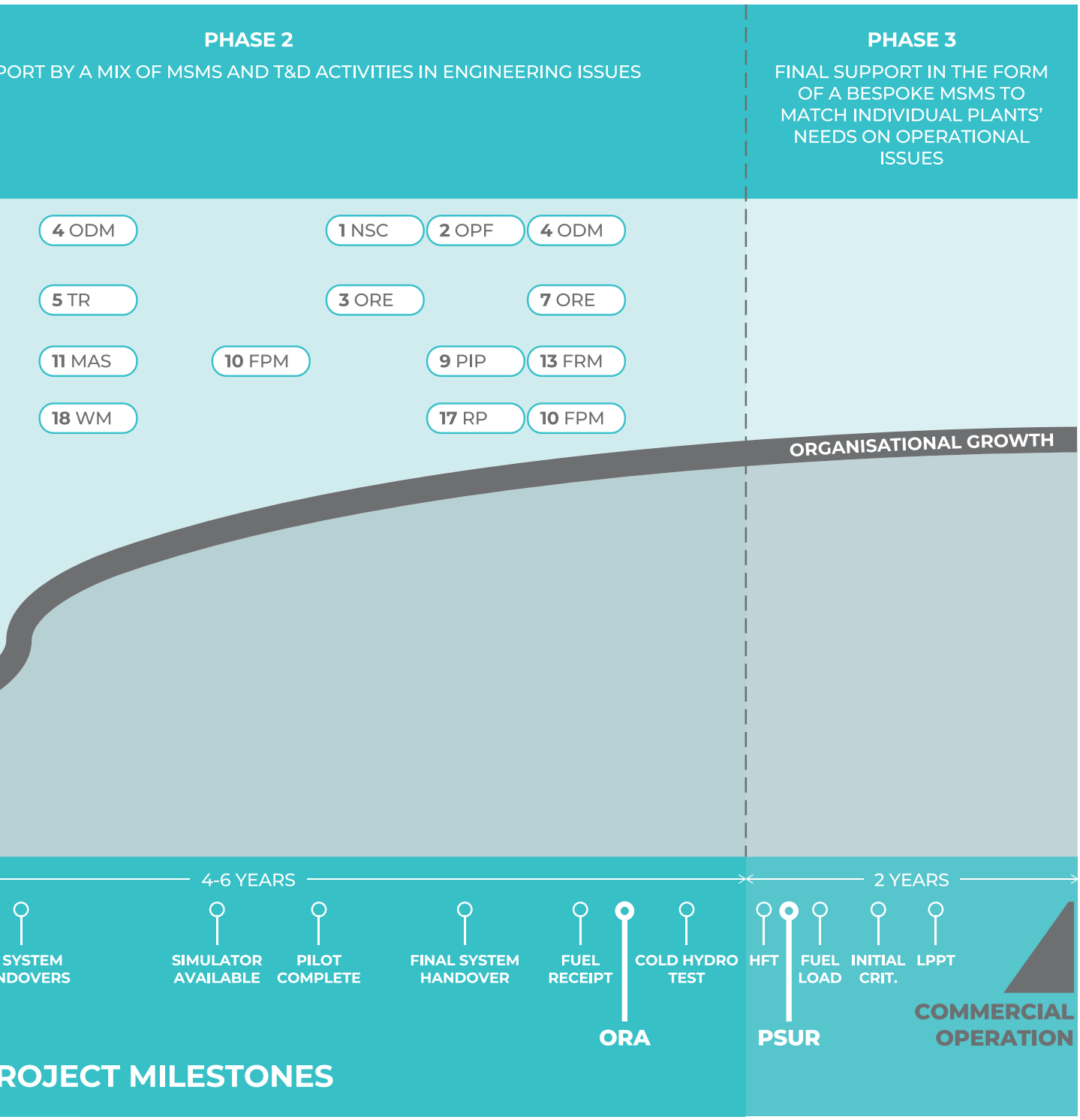
"Fennovoima requested a member support mission in December 2018 to discuss commissioning lessons from Flamanville 3. The purpose of the meeting was to obtain best practices and lessons learned that should be adopted at the commissioning preparation/ company development stages of Fennovoima and the Hanhikivi 1. In summary, 70 unique lessons were identified, with 8 deemed critical."

WANO SUPPORT UNTIL OPERATION



WANO (MODULES) SUPPORT

1 NSC (NUCLEAR SAFETY CULTURE - OR.1)
2 OPF (OPERATOR FUNDAMENTALS, CREW PERF & TEAMWORK - OP.1)
3 ORE (ORG EFFECTIVENESS & OVERSIGHT - OR.2)
4 ODM (OPERATING DECISION MAKING - OP.1)
5 TR (TRAINING - TQ.1)
6 SOER (SOER - OE.1)
7 EPM (EMERGENCY PLANNING MANAGEMENT & LEADERSHIP - EP.1)
8 OEP (OE PROGRAMME - OE.1 OE.2)
9 PIP (PERFORMANCE IMPROVEMENT PROCESSES - OE.1)
10 FPM (FIRE PROTECTION MANAGEMENT & LEADERSHIP - FP.1 FP.4)
11 MAS (MAINTENANCE STRAGTEGIES - MA.1)



12	ENS	(ENGINEERING STRATEGIES - EN.1)
13	FRM	(FUEL & REACTOR MANAGEMENT - EN.5)
14	EPC	(EQUIPMENT PERFORMANCE & CONDITION - EQ.1)
15	CY	(CHEMISTRY - EQ.1)
16	TO	(TURNOVER FOR OPERATIONS EQ.1)
17	RP	(RADIOLOGICAL PROTECTION - RP.1)
18	WM	(WORK MANAGEMENT WM.1)

MSMS	MEMBER SUPPORT MISSIONS
ORA	OPERATIONAL READINESS ASSISTANCE
PSUR	PRE-START UP REVIEW
T&D	TRAINING AND DEVELOPMENT

WANO

GLOBAL LEADERSHIP IN **NUCLEAR SAFETY**

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