



WANO

GLOBAL LEADERSHIP IN NUCLEAR SAFETY

YEAR-END HIGHLIGHTS REPORT

2018

WANO.INFO
MEMBERS.WANO.ORG

WANO VISION AND MISSION STATEMENTS

WANO VISION

WANO AND ITS MEMBERS WILL BE WORLDWIDE LEADERS IN PURSUING EXCELLENCE IN OPERATIONAL NUCLEAR SAFETY FOR COMMERCIAL NUCLEAR POWER.

WANO MISSION

TO MAXIMISE THE SAFETY AND RELIABILITY OF NUCLEAR POWER PLANTS WORLDWIDE BY WORKING TOGETHER TO ASSESS, BENCHMARK AND IMPROVE PERFORMANCE THROUGH MUTUAL SUPPORT, EXCHANGE OF INFORMATION, AND EMULATION OF BEST PRACTICES.

FOREWORD

EXERCISING OUR COLLECTIVE RESPONSIBILITY FOR DELIVERING WANO'S MISSION TO MAXIMISE SAFETY AND RELIABILITY



Over the past year, the global nuclear industry has continued to see expansion with the emergence of new entrants in countries such as Turkey, Bangladesh and Egypt, together with new build projects in several countries, most notably China. In Japan, work and planning continues to return plants to service. Conversely, in other parts of the world there are plants facing life extension and decommissioning decisions. The World Association of Nuclear Operators (WANO) has continued to support plants through all stages of life, as well as work with members of reprocessing facilities to better integrate them into WANO programmes. With this in mind, WANO continued to fulfil its safety mission in 2018, while meeting the challenges emerging from this shift in the nuclear landscape.

INDUSTRY PERFORMANCE CONTEXT

Although this report details the activities WANO has undertaken in support of its members, it is appropriate to briefly review the performance of the members who make up the global nuclear power industry. This view on the state of the nuclear power industry serves as the backdrop against which the activities and priorities of WANO should be assessed.

The first numerical WANO Assessments commenced in October 2014 and have now become an embedded part of the peer review process. A WANO Assessment meeting follows every peer review and the plant is given a confidential numerical rating. At the end of 2018, approximately 95% of operating stations had received at least one WANO Assessment, and the remaining operating stations should receive an Assessment by the middle of 2019.

The fundamental premise of WANO is that, by consistently deploying its products and services, and with the receptive spirit of continuous improvement of its members, it should continue to see incremental improvements in performance

of the world's plants. Progress is reflected by the WANO performance indicators and WANO stands ready to support its members to meet both the agreed individual and industry performance targets.

The pursuit of excellence is continuous, and collectively the industry must advance nuclear safety and reliability despite these economic and market challenges. The pursuit of best practice demonstrably leads to improved overall performance and delivers a stronger business case, which is particularly important in these challenging times. Complacency is always a formula for declining performance. The industry must be prepared to address the rapid expansion of the industry in certain regions, the emergence of organisations that are new to the nuclear industry, and those plants facing life extension and decommissioning decisions. These areas will require WANO and its members to reinvigorate activities aimed at exercising collective responsibility for delivering the highest levels of safety and reliability of the world's nuclear fleet.

It is against this backdrop and the views of its members that WANO reviewed its strategic priorities in *Compass*, WANO's long-term plan, in October 2018. The objective of this annual strategic review was not to radically change the focus areas described in *Compass*, but to explore whether there was a need to adjust elements of the plan. As a result, a number of initiatives are being considered to help further support and promote improved member performance, in line with WANO's mission.

With limited resources and challenging economic pressures for many members, support activities must focus on the most significant safety and performance issues. In particular, they should be aimed at supporting those plants that are further away from excellence, as well as new entrants to the industry, and new units. This strategy recognises the need to continue to provide robust support to our members, and

to drive improvement through our traditional programmes and activities. It also recognises that WANO must engage earlier with new entrants and provide support to those plants preparing to start up.

WANO has continued to support its members through facilitating the industry working groups (WG), which were introduced to meet the changing needs of its members.

There are seven formal long-term industry WGs in place:

- International Equipment Reliability
- Independent Oversight
- Human Performance
- Performance Indicators
- New Unit Assistance
- Digital Control System (closed in May 2019)
- Transition to Decommissioning

An eighth industry WG was formed in 2018 to focus on a specific task; the development of a set of universal nuclear leadership attributes. It will be closed once the project is finished.

The WG participants are industry experts, led by industry chairs and supported by executive sponsors who are usually chief nuclear officers (CNOs) of WANO members. The WANO London Office provides the secretariat to the WGs. Industry issues are the focus of the WGs, with the aim of developing and publishing best practice guidelines in each subject.

Additional senior-level engagement has been achieved through the CNO Forum which was initially launched in 2017. It was refined to strengthen sharing of information and best practices and to encourage networking and collaboration among member CNO-level executives.

Increasing geopolitical influences and implementation of export controls by many national governments have challenged WANO's ability to conduct missions in some areas. WANO has been working to minimise the impact on its ability to deliver its services. Although some progress has been made toward recognition of WANO's unique nuclear role, this remains an issue that will warrant the attention of all WANO members.

Considerable progress has been made during the past year in developing the conditions and framework that will lead to a decision to open a potential fifth WANO regional centre in China. This work culminated in approval by the WANO Governing Board to convene a member vote at an Extraordinary General Meeting early in 2019, in order to proceed with a phased implementation of actions leading to a Branch Office and subsequently a Support Centre in China.

With these performance insights and in the context of this environment, guided by WANO's long-term plan *Compass* and the organisation's commitment to continuous improvement, WANO provides services to its members to promote excellence in the safety and performance of their plants.



TOM MITCHELL
Chairman



PETER PROZESKY
Chief Executive Officer



SIMONE ROSSI
President



WANO PROGRAMMES

TO ACHIEVE ITS
MISSION, WANO
OFFERS MEMBERS
A SERIES OF HIGH
QUALITY SERVICES
THROUGH FIVE
PROGRAMMES

PEER REVIEW

Peer reviews help members compare themselves against standards of excellence through an in-depth, objective review of their operations by an independent team from outside their organisation.

In 2018, 54 plant peer reviews (PRs) and 40 PR follow-up visits were conducted across the regions. The London Office continued to observe PRs and PR follow-ups in line with its oversight role and was able to confirm consistent process adherence, disseminate areas for improvement (AFIs) and efficiency opportunities to the regional centres and share best practices for emulation with the PR peer group.

In addition, WANO conducted eight pre-startup PRs (PSURs). The number of startup-related AFIs began to show a decreasing trend as new units had taken proactive actions to improve operating crew performance, utilising lessons learnt from previous PSURs.

As 2018 came to a close, 70% of all station PRs included crew performance observations, with full implementation anticipated by the end of 2020. The results of this initiative are already showing their merit. PR teams are now able to provide greater insight into important training and teamwork performance gaps.

A WANO Assessment meeting follows every peer review and the plant is given a confidential numerical rating. At the end of 2018, approximately 95% of operating stations had received at least one WANO Assessment, and the remaining operating stations should receive an Assessment by the middle of 2019.

The Assessment is critical not only for providing the station with an overall level of performance compared to their global peer group, but also allows WANO to focus resources where they can provide the greatest benefit. An effectiveness review will be completed in the third quarter of 2019 to look for ways to further improve the process and provide even greater value to members.





PERFORMANCE ANALYSIS

The Performance Analysis programme collects, screens and analyses operating experience and performance data, providing members with lessons learnt and industry performance insight reports. Fundamental to its success is the willingness of WANO members to openly share their operating experience (OE) and performance data for the benefit of other nuclear operators throughout the world.

In 2018, members shared 2,829 event reports compared to 3,306 in 2017, 3,419 in 2016 and 3,083 in 2015. The total number of event reports available in the OE database was 29,050 by the end of 2018.

The Performance Analysis team issued two Analysis Reports and three Hot Topics, providing important lessons for the industry. One Just-In-Time report was published, providing workers and contractors at nuclear power plants with practical, timely operating experience for pre-job briefings.

The Performance Analysis team continues to issue monthly summaries of the main events reported to WANO. This summary is posted on the WANO member website to highlight events of potential significance to other members that may provide meaningful lessons learnt.

WANO Performance Indicators is a part of the Performance Analysis programme. A set of performance indicators has been developed to enable members to exchange information and assess the performance of their plants objectively. At the end of 2018, industry and individual unit performance against the targets was stable. WANO publishes a separate Performance Indicator trifold which carries more detailed information on these trends.



MEMBER SUPPORT

The Member Support programme works with members to improve safety and reliability.

In 2018, 244 member support missions (MSMs) were conducted. There is no strict target for MSM numbers since fundamentally they are conducted based upon plant needs and requests. The regional centres prioritise assistance to focus MSMs on helping members resolve areas for improvement (AFIs) identified during peer reviews (PRs). A target of 60% of MSMs being focused on resolving PR AFIs has been established to concentrate MSM resources on issues with the most relevance to safety and reliability. The average performance for this target across WANO was 77% for operating units in 2018.

In 2018, 45 new unit assistance (NUA) activities were conducted, including training missions, workshops, seminars and other WANO missions. Support to new units is based on a graded approach to ensure that a new company in a newcomer country receives focused assistance. A set of NUA modules is used to align support activities through construction and commissioning phase.

The Member Performance Improvement process was established which is a revision of the former plant assistance prioritisation and plant of focus. Changes were considered after feedback from members, and resulted in a cross-regional effort to enhance the support provided to members as they strive to meet the WANO performance objectives.

The WANO Representative (WANO Rep) process was further strengthened in 2018. WANO Reps have been assigned in all regions to improve interaction between the plant and regional centres and support WANO programme activities. A WANO Rep workshop was organised and hosted by the Paris Centre in November 2018 to plan and conduct programme reviews, support discussion and coherent implementation of the process, and maintain continuous alignment and exchange of information. The workshop will be organised annually.

In addition, three Guidelines and 16 Good Practices were published.



TRAINING AND DEVELOPMENT

The Training & Development (T&D) programme provides a forum for WANO members to enhance their professional knowledge and skills. The T&D programme has three main focus areas; workshops and seminars, leadership training, and new build support.

There were 78 workshops, seminars and other activities completed during 2018 compared to 61 in 2017. Each regional centre provides assistance through different kinds of activities, based on analysis of peer review trends or member requests

The two most common types of T&D activities in 2018 were workshops and seminars. Workshops are more interactive and are designed to facilitate members to work together to identify solutions; whereas in seminars, the information is usually delivered to the attendees (similar to a lecture or presentation).

A focus for T&D was leadership development for mid-level managers, shift managers and plant managers. The new Nuclear Leadership programme was successfully run for Paris

and Atlanta Centre members. Moscow Centre continued to deliver an existing training programme and Tokyo Centre presented a shorter leadership seminar.

Recognising that shift managers are key in ensuring excellence in plant operation and operational focus, the newly developed Shift Manager Development Programme was launched in 2018, with delegates from Atlanta, Moscow and Paris centres. It proved to be a great success and plans are currently underway to expand its roll out to the regional centres in 2019/20.

WANO continues to collaborate with OPG/EDF Energy on the International Senior Nuclear Plant Managers programme, with two conducted in 2018. WANO supplied mentors, speaker and facilitators, and supported the marketing of the programme.

Tokyo Centre held the Emergency Preparedness and New Unit Assistance working group meeting in June 2018.



CORPORATE COMMUNICATIONS

Work continued at the end of 2018 on the member engagement survey. WANO is committed to seeking a broad range of views and feedback from its members on an ongoing basis.

Members have expressed a lack of engagement amongst WANO nuclear communicators. They identify the need for peers to share best practices in order to promote excellence within their organisation as a whole, and information on how the communications function provides added value to their strategic operations. WANO will address these needs in the coming years as part of its existing member communications strategy. As part of the latter, and through Communications Expert Group Meetings which are being run in every region, WANO will be engaging with communications peers to build a worldwide network of nuclear communicators to tackle the above issues to strengthen WANO members' capabilities and assist them with capacity building in the area of communications.

The member website was further developed with a number of member-facing and technical improvements taking place to provide a better user experience.

A new WANO public website was launched including better language capability for Inside WANO, individual pages for WANO regions, and resources including videos and downloadable documents. Following its launch in July 2018, it won 'Website of the Month' from the platform vendor.

WANO's relationship and engagement with the global nuclear trade media was strengthened and social media was harnessed to build engagement with key influencers through LinkedIn and Twitter, where it now has over 5,500 followers, an increase of approximately 40% on the previous year.

The SVP & PM Conference in Bucharest was an overall success according to event feedback. The WANO Biennial General Meeting 2019 registration site was launched in January 2019.

GOVERNANCE AND STRUCTURE

WANO CONSISTS OF
A WANO GOVERNING
BOARD, A CENTRAL
OFFICE IN LONDON
AND REGIONAL
CENTRES IN ATLANTA,
MOSCOW, PARIS AND
TOKYO, EACH WITH
THEIR OWN REGIONAL
GOVERNING BOARDS

There were four changes to the WANO Governing Board in 2018.

Mr Gaëtan Thomas, President and CEO of New Brunswick Power, took over as Chairman of the Atlanta Centre Regional Governing Board on 1 January 2018, replacing Mr William D Johnson, President and CEO of Tennessee Valley Authority, who continued to sit on the WANO Governing Board.

On 21 June 2018, Mr Oleksandr Shavlakov, First Vice-President of NNEGC "Energoatom", replaced Mr Yuriy Nedashkovsky, President of NNEGC "Energoatom"; Dr Erwin Fischer, CNO and Member of the Management Board of PreussenElektra, took over as Chairman of the Paris Centre Regional Governing Board, replacing Mr Bertrand de L'Épinois, Senior Vice President – Safety Standards of Orano; and Dr Jae-hoon Chung, President and CEO of Korea Hydro & Nuclear Power Co, Ltd replaced Mr Syed Yusuf Raza, CNO of Pakistan Atomic Energy Commission.

The WANO reorganisation project to establish a fifth regional centre in Shanghai to support the major growth in China reached a critical milestone at the end of 2018. At the WANO Governing Board meeting in November 2018, the final issues were resolved in order to satisfy member concerns around financing, independence and internationality, and the WANO Governing Board approved convening an Extraordinary General Meeting (EGM) in February 2019.

In October 2018, a review of the strategic priorities in Compass was carried out. The objective was to explore whether there was a need to revise the long-term plan based on the rapidly changing external environment. A number of initiatives are being considered to help further improve member performance, such as agreeing clear and simple industry targets, developing arrangements that can detect early decline in member performance, and revising the role of the Training & Development Programme to better support member performance improvement.



MEMBERSHIP

WANO: GROWING TO MEET THE NEEDS OF AN EXPANDING INDUSTRY

MEMBERSHIP BY CATEGORY

Category 1: 48 members

Category 2: 60 members

Category 3: 15 members

Category 4: 4 members

OTHER ORGANISATIONS
AWAITING AFFILIATION: 2

129

TOTAL MEMBERS



At the end of 2018, there were 129 members in WANO's four membership categories. There were minimal membership changes in 2018, some of which were administrative. Membership reflects the broader trend of a shift within Europe and North America for the nuclear industry.

In February 2018, the WANO Governing Board approved a change to RWE Power AG Category 2 membership, which was transferred to a new subsidiary RWE Nuclear GmbH.

In June 2018, the WANO Governing Board approved a new application for membership, and a Category 2 membership application was submitted by EDF Energy on behalf of NNB GenCo.

The WANO Governing Board also received a request from Vattenfall to withdraw the Category 3 membership held by its subsidiary Swedish Nuclear Fuel and Waste Management co, SKB effective as of 1 January 2019.

WANO MEMBERS*

*MEMBER DATA AS OF 31 DECEMBER 2018

ATLANTA

Ameren Missouri

Arizona Public Service

Bruce Power

CANDU Owners Group

Centrala Nuclearelectrica Cernavoda

China Huaneng Group Co., Ltd

Comision Federal de Electricidad

Dominion Energy

DTE Energy Corporation

Duke Energy Corporation

Emirates Nuclear Energy Corporation

Energy Northwest

Entergy Nuclear

Eskom Holdings SOC Limited

Exelon Corporation

FirstEnergy Corp.

Haiyang-Shandong Nuclear Power
Company

Horizon Nuclear Power Limited

Huaneng Shandong Shidao Bay
Nuclear Power Co., Ltd

Indiana Michigan (formerly AEP)

Institute of Nuclear Power Operations

Luminant

Nawah Energy Company PJSC

Nebraska Public Power District

New Brunswick Power

NextEra Energy, Inc.

Ontario Power Generation

PG&E Corporation

Public Service Enterprise Group, Inc.

SCANA Corporation

Southern Nuclear Operating Company

State Nuclear Power Demonstration
Plant

State Power Investment Corporation

STP Nuclear Operating Company

Talen Energy

Tennessee Valley Authority

WANO Atlanta Centre

Wolf Creek Generating Station

Xcel Energy Inc.



WANO MEMBERS*

*MEMBER DATA AS OF 31 DECEMBER 2018



MOSCOW

"Haykakan Atomayin
Electrakayan" CJSC

CEZ, a.s.

Concern Rosenergoatom

Federal State Unitary Enterprise of
Atomic Fleet (FSUE "Atomflot")

Fortum Power and Heat Oy

Ignalina Nuclear Power Plant

Jiangsu Nuclear Power Corporation

JSC "Atomenergoremont"

JSC "Atomtechenergo"

JSC "Atomtechexport"

JSC OKB "Gidropress"

JSC Rusatom Automated Control
Systems (RASU)

Kozloduy NPP Plc

MVM Hungarian Electricity Private
Limited Company

MVM Paks II. Nuclear Power Plant
Development Private Company Limited
by Shares

MVM Paks Nuclear Power Plant Ltd

NNEGC "Energoatom"

Nuclear Power Corporation of India
Limited (S)

Nuclear Power Production and
Development Company of Iran

Republican Unitary Enterprise
"Belarusian Nuclear Power Plant"

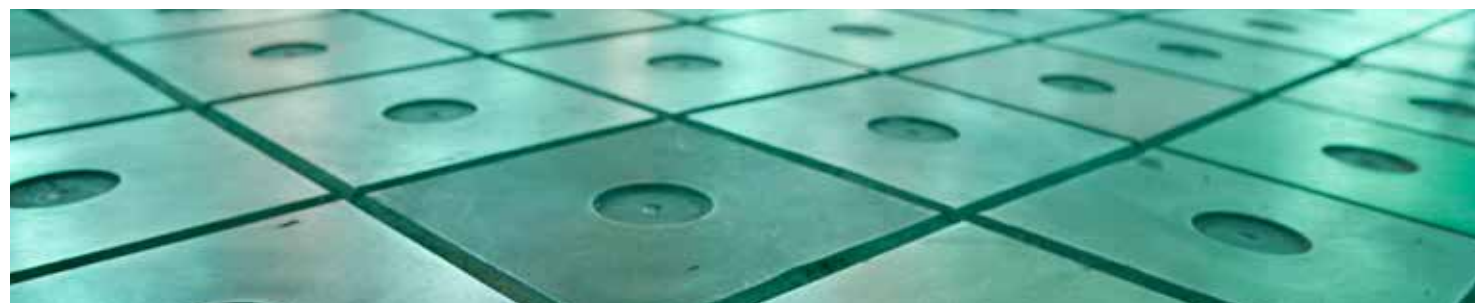
Slovenské elektrárne, a.s.

State Specialized Enterprise
"Chernobyl NPP"

VNIIAES

WANO Moscow Centre

(S) = Secondary Affiliation



WANO MEMBERS*

*MEMBER DATA AS OF 31 DECEMBER 2018



PARIS

Asociación Nuclear Ascó -
Vandellós II, A.I.E. (ANAV)

Axpo AG

BKW Energie AG

CC.NN. Almaraz-Trillo, A.I.E.

CGN Lufeng Nuclear Power Co., Ltd

China General Nuclear Power
Corporation (CGN)

Daya Bay Nuclear Power Operations
and Management Co., Ltd

EDF

EDF Energy

Eletronuclear S.A. -
Eletrobrás Termonuclear

EnBW Kernkraft GmbH

Engie Electrabel

Forsmarks Kraftgrupp AB

Fujian Ningde Nuclear Power Co.

Guangxi Fangchenggang Nuclear
Power Co., Ltd (FCGNP)

IBERDROLA Generación Nuclear, S.A.

Kernkraftwerk Gösgen-Däniken AG

Kernkraftwerk Leibstadt AG

Liaoning Hongyanhe Nuclear
Power Co., Ltd

Magnox Ltd

NNB GenCo.

N.V. elektriciteits -
Produktiemaatschappij Zuid -
Nederland (EPZ)

Nuclear Decommissioning Authority

Nuclenor, S.A.

Nucleoeléctrica Argentina S.A. (NA-SA)

Nuklearna Elektrarna Krško

Orano

PreussenElektra

Ringhals AB

RWE Nuclear GmbH

Sellafield Ltd

Swedish Nuclear Fuel and Waste
Management co. SKB

Swissnuclear

Sydkraft Nuclear Power AB

Taishan Nuclear Power
Joint Venture Co. Ltd

Teollisuuden Voima Oyj (TVO)

Vattenfall AB

VGB PowerTech e.V.

WANO Paris Centre

Yangjiang Nuclear
Power Co., Ltd (YJNP)



WANO MEMBERS*

*MEMBER DATA AS OF 31 DECEMBER 2018



TOKYO

China National Nuclear Corporation

Chubu Electric Power Company, Inc.

Electric Power Development Co., Ltd

Fujian Fuqing Nuclear Power Company Ltd

Hainan Nuclear Power Co., Ltd

Hokkaido Electric Power Company Inc.

Hokuriku Electric Power Company Inc.

Japan Nuclear Safety Institute

Japanese Nuclear Operators (JNO)

Korea Hydro & Nuclear Power Co., Ltd.

Kyushu Electric Power Company, Inc.

Nuclear Power Corporation of India Limited

Nuclear Power Qinshan J.V.C., Ltd

Pakistan Atomic Energy Commission

Qinshan Nuclear Power Company Ltd

Sanmen Nuclear Power Company Ltd

Shikoku Electric Power Company, Inc.

Taiwan Power Company

The Chugoku Electric Power Company, Inc.

The Japan Atomic Power Company, Inc.

The Kansai Electric Power Company, Inc.

Third Qinshan Nuclear Power Company, Ltd

Tohoku Electric Power Company, Incorporated

Tokyo Electric Power Company Holdings, Inc.

WANO Tokyo Centre





WANO

GLOBAL LEADERSHIP IN NUCLEAR SAFETY

ATLANTA
LONDON & HONG KONG
MOSCOW
PARIS
TOKYO

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