



WANO

GLOBAL LEADERSHIP IN NUCLEAR SAFETY

YEAR-END HIGHLIGHTS REPORT

2021

WANO.INFO
MEMBERS.WANO.ORG

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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.



TOM MITCHELL
Chairman



INGEMAR ENGVIST
Chief Executive Officer



**DR. NIKOLAY
SOROKIN**
President

Although the global impact of the COVID-19 pandemic continued to be felt throughout 2021, WANO and its members made significant strides on the road to worldwide performance improvement through the industry initiative Action for Excellence – Shaping the Nuclear Future (AfE). There is growing member interest and engagement in the initiative, with several members having volunteered to be a part of the pilots and others engaged in the initiative through different forums.

In addition, several members have placed specific targets in their business plans related to AfE. WANO continues to encourage and support this development.

In 2021, several member plants worldwide started pilots for AfE, with support provided from WANO. They included Borssele 1 in the Netherlands, Qinshan II 1&2 in China, Armenia 1 in Armenia, and Kori 3&4 in South Korea, reflecting the truly global commitment of the industry to this initiative.

Borssele was the first pilot to commence in July 2021, with Qinshan pilots starting shortly after. Armenia and Kori started towards the end of 2021. All pilots were scheduled to be completed by Q2 2022.

In November 2021, WANO attended United Nations Climate Change Conference (COP26) which was held in Glasgow, Scotland. The WANO CEO, Ingemar Engkvist participated in a panel discussion with industry leaders looking at the critical contribution of nuclear to a net zero future. This IAEA side event was led by IAEA Director General, Ambassador Rafael Grossi, and was titled 'Nuclear Innovation for a Net Zero World'. Mr Engkvist emphasised the unique contribution of WANO and its members in sharing knowledge and supporting one another, with a shared goal and willingness to make the global industry safer and more reliable.

Although this report is a reflection on the work that took place in 2021, WANO cannot look to the future of the industry without acknowledging the significant impact of the conflict currently taking place in Ukraine. WANO and its members continue to offer their full support to all commercial nuclear power facilities, and supports the IAEA seven fundamental pillars for nuclear safety.

Now, more than ever, the industry must come together and, while being sensitive to the significant challenges some of our members are facing – and ensuring they are provided with the support required – the industry will continue to aim for the goals of Action for Excellence.

KEY ACHIEVEMENTS

- Several member plants worldwide started pilots for Action for Excellence (AfE), with support provided from WANO.
- WANO developed an operational/organisational model and a transition principles document in support of AfE and the industry goals.
- An Operator Fundamentals Task Force was established to sustainably improve operator performance.
- WANO supported members in successfully starting up new units in Belarus, China, Finland, India, Pakistan and the UAE.
- WANO took innovative measures during the pandemic to enable continued implementation of products and services, with the highest regard for member and WANO staff safety.
- WANO issued several key Operating Experience and Performance Analysis documents in 2021.
- WANO hosted the industry's first ever virtual Global Chief Nuclear Officers (CNO) Forum.
- An AfE CNO Advisory Committee was established to evaluate the progress of the initiative.
- WANO launched the AfE Resource Centre on the WANO member website.
- The WANO Chairman and CEO held a series of regional meetings with member CEOs and executives to maintain a strong connection with WANO members in lieu of the postponed 2021 Biennial General Meeting.
- The WANO Shanghai Office was officially opened in November 2021.



WANO SERVICES



The COVID-19 pandemic continued to challenge all aspects of WANO's operations in 2021. WANO responded through a variety of innovative measures in conduct of operations. These innovative measures allowed continued implementation of products and services, with the highest regard for member and WANO staff safety, and achievement of high quality and effective results.

PEER REVIEW

One of WANO's key services are Pre-startup Peer Reviews (PSURs). PSURs provide an important review of new units to help ensure their readiness for unit startup. They are typically conducted by a team that visits the plant site prior to start-up. COVID restrictions made site visits more difficult to arrange.

WANO developed several alternative compensatory measures (ACMs) to allow effective PSURs during this challenging time. This included use of thorough self- assessments and evaluation of detailed advanced information packages provided by the plant. In addition, WANO arranged PSUR teams consisting of qualified in-country WANO staff, who could conduct the site visit with minimal travel restrictions.

As part of the review of operator readiness, Crew Performance Observations (CPOs) were conducted. In some cases the CPO was managed internally by simulator training staff or by qualified CPO reviewers from other organisations within the same country who could access the site. The scenarios for the CPOs were agreed by WANO, and the results shared with the WANO team.

Arrangements for each PSUR were carefully made and tailored to the needs of the plant and member organisation.

These arrangements helped ensure a high quality, effective and timely PSUR for new plants in 2021.

MEMBER SUPPORT

Member Support Missions (MSMs) were similarly affected by pandemic restrictions.

For performance monitoring of plants, the scope remained largely unchanged with missions performed virtually and onsite by WANO Representatives globally.

Throughout 2021, Member Support continued to utilise remote MSMs, with new tools such as webinars developed for a number of topics. However, there were key challenges with remote MSMs. They are a temporary solution, and were only deployed if there were no alternatives.

Trial remote MSMs have been delivered in all regional centres with very positive feedback. The first remote Operational Readiness Assistance mission was delivered in June 2021. A set of remote materials have been developed in regional centres to support such MSMs. Video meetings of the Member Performance Assessment committee allowed wider participation of Senior Plant Managers and the involvement of observers from other regional centres.



INDUSTRY LEARNING & DEVELOPMENT

New ways of learning were developed and implemented, with both internal training and external seminars being conducted using remote training platforms.

Tokyo Centre and Paris Centre expanded use of a learning management system to conduct or supplement various courses and seminars. London Office conducted several Covid-19 related forums using video conferencing technology.

PERFORMANCE ANALYSIS DOCUMENTS

Several WANO Performance Analysis documents were published in 2021, which are available on the WANO member website. This included guidelines and manuals, Chief Nuclear Officer Updates on the number of events being reported to WANO across the global industry, notable trends emerging from WANO event reporting, as well as expectations of senior industry executives. It also included the Performance Analysis Annual Report, which reviews the main activities of the programme, and provides some notable statistics and trends observed in the industry. Analysis Reports were developed and distributed based on analysis of events, as well as Peer Review areas for improvement (AFIs) and other information important to members.



Despite the impact of the pandemic still being felt around the world, WANO was able to ensure members were engaged and supported either physically or virtually through several meetings, groups and forums in 2021.

MEDICAL OFFICERS' FORUM

A Medical Officers' Forum was created in 2020 in response to the pandemic and at the request of WANO members. The objective of this forum was to facilitate the exchange of information and experience between members in managing the challenges posed by the pandemic, and to protect nuclear power plant workers.

The forum was attended by doctors and representatives working for WANO's members onsite or corporate offices, and representatives from the regional centres and the London Office.

The forum took place once every quarter, and the representatives agreed to continue the forum in 2022.

WANO INTERFACE OFFICER (WIO) FORUMS

In December, WANO Paris Centre conducted its first Action for Excellence (AfE) WIO Forum, with fourteen representatives from Paris Centre members.

GLOBAL CHIEF NUCLEAR OFFICER (CNO) FORUM

WANO hosted a Global CNO Forum in June 2021, bringing together CNOs from around the world to share experiences. Due to pandemic restrictions, the Forum was conducted as a virtual event and featured streamed videos, as well as live presentations.

CHIEF NUCLEAR OFFICER (CNO) ADVISORY COMMITTEE

An AfE CNO Advisory Committee was established to engage in and evaluate the progress of the initiative. The committee supported WANO in communicating this initiative and engaging with WANO members, with two CNOs from each region, as well as the WANO Shanghai Office.



YOUNG GENERATION

WANO created a Young Generation programme to develop future leaders in safe, reliable operation of nuclear power plants, through the sharing of knowledge and experience and professional development within the WANO membership.

WANO Moscow Centre conducted the Third International Young Generation Forum with the topic Young Generation Movement – Course to Excellence. The forum was attended by representatives from nine countries. Due to pandemic restrictions, it was hosted virtually by Kola NPP.

WANO Paris Centre conducted a number of activities, such as the Paris Centre leadership initiative, Young Generation seminar with Moscow Centre, and an Industry Working Group on Small Modular Reactors.

WANO Tokyo Centre conducted a Plant Managers and Young Generation meeting to discuss Action for Excellence. About 80 representatives attended the meeting.

REGIONAL CEO MEETINGS

During 2021, the WANO Chairman and CEO held a series of regional meetings with member CEOs and executives. The purpose of the meetings was to discuss the results of member self-assessments of Significant Operating Experience Report (SOER) recommendations and Leadership Area For Improvement (AFIs) recommendations, and to review the status of the Action for Excellence industry performance improvement initiative.

GOVERNANCE AND STRUCTURE

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

WANO's success is highly dependent on its ability to balance the varied interests and perspectives of its members with the common goal of maximising safety and reliability at each of its member's nuclear power plants. 'One WANO', expressed locally in each region tries to capture the dynamic of WANO.

WANO governing board members are critical to ensuring the organisational alignment of WANO and a strong worldwide spirit of cooperation. In particular, they are responsible for ensuring the alignment of the WANO governing board and each regional governing board.

The Board comprises WANO President, Chair, CEO, and member representatives from all four Regional Centres who are accountable for the overall direction and success of the association.

In November, the WANO Shanghai Office was officially opened with a ceremony attended by senior leaders from the Chinese nuclear industry, as well as officials from the city of Shanghai.

2021 prepared the qualification of the first 11 Peer Review Lead Reviewers. Regional centre feedback and coaching were key in the decision to qualify the reviewers. Multiple WANO regional centres contributed to the evaluation of trainee performance.



MEMBERSHIP

WANO: GROWING TO MEET THE NEEDS OF AN EXPANDING INDUSTRY

MEMBERSHIP BY CATEGORY

Category 1: 48 members

Category 2: 62 members

Category 3: 11 members

Category 4: 4 members

Category 5: 2 members

TOTAL MEMBERS

127



There were few membership changes in 2021, and overall the membership remains stable.

In November 2020, Taiwan Power Company requested to withdraw Chinshan Nuclear Power Plant and the two units from WANO membership effective 31 December 2021 due to the units being decommissioned.

In March 2021, the WANO Governing Board approved a new Category 2 membership application for CNNP Guodian Zhangzhou Energy Co., Ltd., with affiliation to WANO Tokyo Centre.

In April 2021, the WANO Governing Board approved a new Category 2 membership application for CGN Huizhou Nuclear Power Co., Ltd. and CGN Cangnan Nuclear Power Co., Ltd., with affiliation to WANO Paris Centre.

In May 2021, a letter was received from Category 3 members JSC OKB Gidropress and JSC RASU notifying WANO of their request to withdraw from WANO membership effective 27 May 2021.

It is also worth mentioning that since the last report EUSAŞ International Incorporated Cell Company Türkiye Şubesi has been affiliated to the WANO London Office. Their Category 5 membership application was approved by the WANO Governing Board in July 2020.

WANO MEMBERS*

*MEMBER DATA AS OF JULY 2022



ATLANTA CENTRE

Ameren Missouri
Arizona Public Service Company
Bruce Power
CANDU Owners Group
Centrala Nuclearelectrica Cernavoda
China Huaneng Group Co., Ltd
China Nuclear Energy Association (CNEA) (S)
Comision Federal de Electricidad
Constellation Energy Corporation
Dominion Energy
DTE Energy Corporation
Duke Energy Corporation
Emirates Nuclear Energy Corporation

Energy Harbor Nuclear Corp.
Energy Northwest
Energy Nuclear
Eskom Holdings SOC Limited
Exelon Corporation
Haiyang Shandong Nuclear Power Company (SDNPC)
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.
Southern Nuclear Operating Company
State Nuclear Power Demonstration Plant (SNPDP)
State Power Investment Corporation
STP Nuclear Operating Company
Talen Energy
Tennessee Valley Authority
Wolf Creek Generating Station
Xcel Energy Inc.

(S) = Secondary Affiliation



WANO MEMBERS*

*MEMBER DATA AS OF JULY 2022



MOSCOW CENTRE

“Haykakan Atomayin
Electrakayan” CJSC

Akkuyu Nukleer Anonim Sirketi

CEZ, a.s.

China Nuclear Energy Association
(CNEA) (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”

Kozloduy NPP Plc

MVM Energy Private Limited
Liability Company

MVM Paks Nuclear Power Plant Ltd

Nuclear Power Corporation
of India Limited (S)

Nuclear Power Production and
Development Company of Iran

Paks II. Nuclear Power Plant Private
Company Limited by Shares

Republican Unitary Enterprise
“Belarusian Nuclear Power Plant”

Slovenské elektrárne, a.s.

VNIIAES

(S) = Secondary Affiliation



WANO MEMBERS*

*MEMBER DATA AS OF JULY 2022

PARIS CENTRE

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

Axpo AG

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

CGN Cangnan Nuclear Power Co., Ltd.

CGN Huizhou Nuclear Power Co., Ltd.

CGN Lufeng Nuclear Power Co., Ltd

China General Nuclear Power
Corporation (CGN)

China Nuclear Energy Association
(CNEA) (S)

Daya Bay Nuclear Power Operations
and Management Co., Ltd

EDF

EDF Energy

EDF UK – Hinkley Point C

Eletronuclear S.A. -
Eletronuclear S.A.

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

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

NNEGC “Energatom”

Nuclear Decommissioning Authority

Nuclenor, S.A.

Nucleoeléctrica Argentina S.A. (NA-SA)

Nuklearna Elektrarna Krško

Orano

PreussenElektra

Ringhals AB

RWE Nuclear GmbH

Sellafield Ltd

State Specialized Enterprise
“Chernobyl NPP”

Swissnuclear

Sydkraft Nuclear Power AB

Taishan Nuclear Power Joint
Venture Co. Ltd

Teollisuuden Voima Oyj (TVO)

Vattenfall AB

VGB PowerTech e.V.

Yangjiang Nuclear Power Co., Ltd
(YJNP)

(S) = Secondary Affiliation



WANO MEMBERS*

*MEMBER DATA AS OF JULY 2022



TOKYO CENTRE

China National Nuclear Corporation

China Nuclear Energy Association
(CNEA) (S)

Chubu Electric Power Company, Inc.

CNNP Guodian Zhangzhou Energy
Co., Ltd

Electric Power Development Co., Ltd

Emirates Nuclear Energy
Corporation (S)

Fujian Fuqing Nuclear Power
Company Ltd

Hainan Nuclear Power Co., Ltd

Hokkaido Electric Power Company Inc.

Hokuriku Electric Power Company Inc.

Japan Nuclear Fuel Limited (JNFL)

Japan Nuclear Safety Institute (JANSI)

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.

(S) = Secondary Affiliation





WANO

GLOBAL LEADERSHIP IN NUCLEAR SAFETY

ATLANTA
LONDON & SHANGHAI
MOSCOW
PARIS
TOKYO

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