



WANO

GLOBAL LEADERSHIP IN NUCLEAR SAFETY

YEAR-END HIGHLIGHTS REPORT

2017

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.

FORWARD

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



This 2017 Year-End Highlights Report details the key activities WANO has undertaken on behalf of its members. Over the past year, the global nuclear industry has continued to see expansion and emergence of new entrant members in some regions, and plants facing life extension and decommissioning decisions in other parts of the world. With this in mind, the World Association of Nuclear Operators (WANO) continued to fulfil its safety mission in 2017, while meeting the challenges emerging from this shift in the nuclear landscape.

Over seven years have passed since the events at Fukushima Daiichi were precipitated by the Great Eastern earthquake in March 2011. This seminal event for the nuclear power industry required a strong response. All organisations that operate or have oversight responsibilities for the nuclear power sector have carried out stress tests and other rigorous reviews to their plants. A wide range of improvement initiatives were implemented, from changes to physical plant designs, to radical overhauling of national regulatory arrangements and practices. There was also a fundamental shift in how the industry prepares for the unexpected. This has resulted in improvements to severe accident planning, emergency preparedness arrangements and availability of back-up equipment and services.

By the end of 2017, approximately 80% of stations had received at least one WANO Assessment. The Assessment is conducted after every peer review with the member given a confidential rating. The remaining stations should receive an Assessment in 2018. This is in keeping with the fundamental premise of WANO, which is by consistently deploying its products and services, and with the receptive spirit of continuous improvement of its members, we should continue to see incremental improvements in performance of the world's plants.

Based on the WANO performance indicator results, the industry demonstrated significant improvement in 2017. Progress was made for all the industry key indicators and most of the individual ones. However, there is still room for improvement in some areas, such as Forced Loss Rate (FLR) and Unplanned Total Scrams per 7,000 Hours Critical (US7).

Many factors influence the performance indicators. An example is the outages required to implement certain post-Fukushima modifications. It is important that these factors are understood and discounted, where necessary. Other issues relating to significant changes to electricity markets and generation mix should be reviewed and understood. Overall, the nuclear power industry is doing well, and it is in a more robust position than it was before March 2011.

Nevertheless, the pursuit of excellence is continuous and collectively we must advance nuclear safety and reliability - despite economic and market challenges. The industry must face issues such as the rapid expansion of the industry in certain regions and the emergence of organisations that are new to the nuclear industry. This is an area that will require WANO and its members to reinvigorate activities aimed at exercising collective responsibility for delivering the highest levels of safety.

It is against these insights and the views of its members that WANO established its strategic priorities in Compass, WANO's long-term plan. These will enable WANO and its members to provide more support to improve plant safety and performance, to support WANO's mission to maximise the safety and reliability of nuclear power plants worldwide. In particular, strong support must be provided for members that require help in addressing performance shortfalls to further improve plant safety and performance.

WANO must support its members to meet both the individual and industry agreed performance targets. With limited resources and challenging economic pressures for many members, support activities must focus on the most significant safety and performance issues. In particular, it should be aimed at supporting those plants that are further away from excellence, as well as new entrants and 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.

In 2017, WANO introduced a number of new services to meet the changing needs of its members, such as the establishment of Industry Working Groups to address issues of shared concern, and the development of informative industry performance analysis trend reports. The Performance Analysis programme completed the Significant Operating Experience Report (SOER) optimisation project to make service delivery more efficient. It also analysed global data for safety trends and identified six major areas for improvement: operator fundamentals, fire protection, new unit assistance, maintenance fundamentals, preventative maintenance and leadership.

WANO launched a new biannual Chief Nuclear Officer (CNO) Forum to strengthen sharing of information and best practices and to encourage networking and collaboration among member CNOs. The Training and Development programme introduced bilingual nuclear leadership training courses, with the successful inaugural course taking place in China.

The Peer Review programme introduced the crew performance optimisation initiative and new peer review key performance indicators. Within the Member Support programme, WANO developed New Unit Assistance modules

to support new units and new organisations. Furthermore, a Member Performance Improvement process began that replaces the Plant of Focus and Plant Assistance Prioritisation processes.

The Corporate Communications programme carried out a Member Engagement Survey, conducting interviews with the global membership to understand their experience of WANO's products and services and their perception of WANO overall. The results of this project were delivered to both the Executive Leadership Team and the WANO Governing Board and each of the programmes has built actions into their Compass transition map planning, to address feedback received through this survey.

Members committed additional support and resources to enable delivery of WANO's activities in recognition of the importance of our vision and mission. It is from these performance insights – guided by WANO's long-term plan Compass and the organisation's commitment to continuous improvement – that the best services can be provided to our members to promote excellence in safety and performance of their plants.



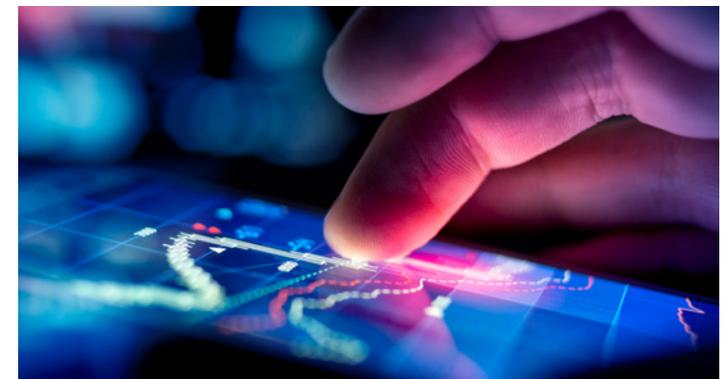
JACQUES RÉGALDO
Chairman



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

1. PEER REVIEW

Peer reviews help members compare their operational performance against standards of excellence through an in-depth, objective review of their operations by an independent team from outside their organisation. This includes plant peer reviews, pre-startup peer reviews and corporate peer reviews.

In 2017, there was a similar level of Peer Review programme activity as there was in the previous year. Throughout the year, WANO conducted 46 plant peer reviews and 39 peer review follow-up visits worldwide. The London Office continued to observe peer reviews and follow-ups in line with its oversight role, and confirmed consistent process adherence across regions.

After Fukushima, the important role the corporate organisation can play in nuclear safety was also recognised. Consequently, WANO's Post-Fukushima Commission recommended all Category 1 and 2 members should receive at least one corporate peer review within the six-year period, from January 2012 to December 2017. With careful oversight and monitoring, WANO conducted 16 corporate peer reviews and six follow-ups in 2017. As a result, WANO has met its six-year target and completed all 77 corporate peer reviews by the end of 2017.

Efforts to optimise peer review team sizes continued throughout the year. Benchmarking and sharing of best practice techniques for conducting peer reviews have resulted in incremental reductions of team size and time onsite, with no effect on peer review quality.

These steps, along with additional improvements in scheduling methods to optimise available resources, have allowed the regional centres to apply peer review resources to other important activities, such as conducting crew performance observations. This has improved the insights developed during peer reviews, without any corresponding increases in staffing.

A notable milestone reached by the Peer Review programme was the integration of the Design Informed Review (DIR) methodology by the four regions during the year. DIR is completed by the Peer Review teams using basic design, plant information and analysis. In conjunction with other peer review activities, it has been used to identify where areas for improvement have an impact on safety functions and to determine the significance of the impact.



2 . PERFORMANCE ANALYSIS

The focus of the Performance Analysis programme is on industry performance analysis and identification of trends, in addition to the screening of event reports and the processing of performance indicator data. High quality and sufficient quantity of operating experience (OE) reports are vital to ensure meaningful statistical analysis.

Over several years, the number of events reported to WANO has increased substantially. However in 2017, the WANO Performance Analysis programme saw a slight decline in the number of events reported. Members shared 3,306 event reports in 2017 compared to 3,419 in 2016, a decrease of 3%. The total number of event reports available in the OE database was 26,222 by the end of 2017. There remains vast differences in the number of events reported by individual members.

There were 167 Significant and Noteworthy events reported in 2017 compared to 168 in the previous year. This figure represents only 5% of all events reported to WANO for the year and the percentage has remained fairly constant over the last four years.

In 2017, 35% of these events were related to Significant Operating Experience Report recommendations. Although this percentage is still high, there has been a continual declining trend over the last five years from the 57% figure reported in 2012. This is a positive and welcome trend, which may indicate more effective member use of SOER recommendations.

WANO's message to members to focus more attention on reporting Significant and Noteworthy events, should not be misinterpreted as an instruction to members to report fewer events overall. In addition, the imbalance of reporting level across regional centres is still important. The quality of information reported has improved but requires greater attention, especially with the new analyses performed by the Performance Analysis group.

In 2017, the Performance Analysis programme analysed global data for safety trends and has identified six major areas for improvement: operator fundamentals, fire protection, new unit assistance, maintenance fundamentals, preventative maintenance and leadership.



3. MEMBER SUPPORT

WANO's support does not end once a peer review team leaves a site. Member Support Missions (MSMs) are carried out at the request of a plant or utility and provide a means for WANO members to assist each other in addressing identified issues or problems. A team of peers is selected on the basis of their expertise in the applicable area. The team reviews issues identified during peer reviews or other problems and helps to identify potential solutions.

Recent missions have covered areas as diverse as stream analysis, work management, human performance, equipment reliability, radiation protection, operations, outage management and organisational effectiveness. The main challenges for the Member Support programme were increasing the efficiency of support in order to maximise the safety and reliability of nuclear power plants worldwide, achieving consistency of regional centre activity, and staffing for the New Unit Assistance (NUA) and WANO Representative processes.

In 2017, WANO conducted 246 MSMs, which is 15% higher than in previous years. Atlanta Centre, Moscow Centre, Paris Centre and Tokyo Centre conducted 45, 95, 54 and 50 MSMs respectively, and London Office conducted two further MSMs, which were supported by the regional centres. There is no strict target for MSM numbers since fundamentally they are conducted based upon plant needs and requests.

WANO is increasingly focusing MSMs to help members resolve Areas for Improvement (AFIs) identified during peer reviews. A target of 60% of MSMs should be focused on resolving peer review AFIs, in order to focus MSM resources on issues with the most relevance to safety and reliability. The average performance for this target across all WANO was 72% for operating units in 2017. This indicator does not take into account missions conducted for new units, because such missions are focused more on plant requests and safety issues common for new WANO members.



4. TRAINING AND DEVELOPMENT

The purpose of the WANO Training and Development (T&D) programme is to assist members in improving performance and reducing events primarily using training, workshops and seminars. T&D activities are intended to support multiple members – this is accomplished through workshops, seminars, expert meetings, training and conferences. These address industry issues common to multiple stations.

Throughout 2017, WANO conducted a wide range of courses, seminars and workshops in all four regions. There were 61 T&D activities conducted, which were attended by 2,089 people. This is an increase from 53 activities held in 2016. Across WANO, 66% of all T&D activities were selected due to observed performance issues identified from peer review results or plant events. A detailed list of all activities can be found on the WANO member website.

Each regional centre provides assistance through different kinds of activities. The two most common types of T&D activities are workshops and seminars. Two key areas identified from peer reviews have been leadership and operator performance. In 2017, there was a strong emphasis on leadership-related activities. However, more emphasis on operator performance is warranted, and action plans are now in place to increase emphasis on this area during 2018.

WANO upgraded the existing nuclear leadership course for mid-level managers to reflect current training approaches. In 2017, this course was piloted in Paris and then delivered to a mixed group of Chinese members in English and Chinese in Shenzhen.

Feedback from this course was very positive and demonstrated that bilingual courses can be delivered effectively and can reach a broader audience than English-only courses.

T&D has been working with the New Unit Assistance (NUA) group to assist new units in establishing their training organisations. This will be done in two parts – first to work with the members executives and project management to understand the need to begin working on training early in the process; then later, to work with line managers and the training staff to understand key concepts and their roles in developing and implementing the training programmes. The NUA module for Training was drafted and piloted in late 2017.



5. CORPORATE COMMUNICATIONS

The Corporate Communications programme was restructured in 2017 to deliver support and expertise in corporate events, internal communications, member engagement and external relations. This will help strengthen and refocus WANO's global activities and help it deliver greater value to the membership.

For corporate events, WANO facilitated seven industry working group meetings, and hosted the inaugural Chief Nuclear Officer (CNO) Forum in Paris – where CNOs exchanged information and best practices on nuclear safety. Small Group CEO Meetings took place in Mumbai, Shanghai and Bucharest. Corporate Communications also worked with WANO Tokyo Centre and Korea Hydro and Nuclear Power to deliver a successful Biennial General Meeting in South Korea.

A series of WANO publications were produced throughout the year, including the 2017 WANO Review, This is WANO trifold, 2016 Year-End Highlights Report and the 2016 Annual Report. Paris Centre's internal newsletter, Flash, continued to be popular and a version of it was adopted in Tokyo and Moscow Centres.

In 2017, the Corporate Communications team began checking and cleaning contact data for member communications teams. This will enable the team to distribute targeted newsletters with relevant, topical and useful content. The Paris and Tokyo Centres held a Communications Expert Group meeting with communications professionals at member organisations, to enable members to gain greater value from their membership.

Corporate Communications assumed control of the member website and launched a major project to improve the website's search functionality and library for members. A series of planned updates will improve search capability and general functionality in 2018. Work also began on creating a member resources section, to help members communicate the value and purpose of WANO inside their organisation.

Corporate Communications increased its external relations capability in late 2017 to drive greater awareness of WANO, its expertise and services with members, the wider nuclear industry and the public. By raising awareness of the organisation, its heritage and expertise, WANO will raise favourability of its brand as a leader in nuclear safety. Greater awareness of WANO's work will help members gain greater value and benefit from their membership.



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

In November 2017, Simone Rossi, Chief Executive Officer of EDF Energy was elected as WANO President, succeeding Kwansup Lee, former President and CEO of Korea Hydro and Nuclear Power Co, Ltd. Simone Rossi has the responsibility for organising the next WANO Biennial General Meeting (BGM) in London, in October 2019.

One new governor joined the WANO Governing Board in 2017. In November 2017, Jaroslav Holubec, Generation Director and Member of the Board of Directors of Slovenské elektrárne, a.s. replaced János Tóth, Nuclear Safety Advisor of MVM Paks Nuclear Power Plant Ltd as a WANO Governor and Chairman of Moscow Centre Regional Governing Board. Gaetan Thomas, President and CEO of New Brunswick Power, took over as Chairman of the Atlanta Centre Regional Governing Board, replacing William D. Johnson, who continues to sit on both the Atlanta Centre and WANO Governing Boards.

One significant governance change was initiated during 2017 and will be finalised in 2018. This involves a revision to WANO Policy Document 5, Membership. The executive leadership team (ELT) is working to revise the current policy to enable a means of accommodating new entrant members earlier, in addition to clarifying the fee structure guidance. Approval will be sought from the WANO Governing Board in 2018.

In response to a request from WANO's Chinese members, the WANO reorganisation project was undertaken to recognise and support the major growth in China. The WANO ELT developed a roadmap for conducting the study of WANO reorganisation which was subsequently approved by the WANO Governing Board. A working group under the leadership of the London Office was formed with representation from all the regional centres to undertake this extensive study. It included consideration of establishing a fifth WANO regional centre in China.

A business case based on proposals to reorganise WANO was presented to the ELT and WANO Governing Board for review in 2017. Discussion surrounding the legal registration and funding for the branch office and support centre phases also continued throughout the year.



MEMBERSHIP

WANO: GROWING TO MEET THE NEEDS OF AN EXPANDING INDUSTRY

MEMBERSHIP BY CATEGORY

Category 1: 48 members

Category 2: 59 members

Category 3: 15 members

Category 4: 4 members

OTHER ORGANISATIONS AWAITING AFFILIATION: 3

129

TOTAL MEMBERS



At the end of 2017, there were 129 members in WANO'S four membership categories. There were several membership changes in 2017, some of which were administrative. Membership reflects the broader trend of a shift within Europe and North America, and growth within Asia for the nuclear industry.

In June 2017, the WANO governors approved three new applications for membership. A Category 1 membership application was submitted by Sellafeld (a previous Category 2 member).

A Category 2 membership application was submitted by Lufeng Nuclear Power Co, Ltd. A Category 3 membership application was submitted by JSC Rusatom Automated Control Systems (RASU).

In October 2017, the WANO governors approved one new application for membership. A Category 2 membership application was submitted by Nawah Energy Company.

WANO MEMBERS*

*MEMBER DATA AS OF 31 DECEMBER 2017

ATLANTA

Ameren Missouri
Arizona Public Service
Bruce Power
CANDU Owners Group
Centrala Nuclearelectrica Cernavoda
China Huaneng Group
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
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.



POINT LEPREAU NUCLEAR POWER PLANT

WANO MEMBERS*

*MEMBER DATA AS OF 31 DECEMBER 2017

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 OKB "Gidropress"

JSC Rusatom Automated Control
Systems (RASU)

Kozloduy NPP Plc

MVM Hungarian Electricity Private
Limited Company

MVM Paks II. Nuclear Power Plant Ltd

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 Nuclear
Power Production and Development
Company of Iran



LOVIISA NUCLEAR POWER PLANT

WANO MEMBERS*

*MEMBER DATA AS OF 31 DECEMBER 2017



PARIS

AREVA (Now Orano)

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

Eletróbrás Termonuclear -
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

Magnox Ltd

N.V. elektriciteits -
Produktie maatschappij Zuid -
Nederland (EPZ)

Nuclear Decommissioning Authority

Nuclenor, S.A.

Nucleoeléctrica Argentina S.A. (NA-SA)

Nuklearna Elektrarna Krško

PreussenElektra

Ringhals AB

RWE Power AG

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)



FORSMARK NUCLEAR POWER PLANT

WANO MEMBERS*

*MEMBER DATA AS OF 31 DECEMBER 2017



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 Atomic Energy Agency

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



FUQING NUCLEAR POWER PLANT



WANO

GLOBAL LEADERSHIP IN NUCLEAR SAFETY

ATLANTA
LONDON & HONG KONG
MOSCOW
PARIS
TOKYO

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