WANO-MC safety improvement activities

global leadership in **nuclear safety**

WANO

WORLD ASSOCIATION OF NUCLEAR OPERATORS

M. Chudakov, WANO Moscow Centre, Moscow

Ninth International Scientific and Technical Conference
"Safety, Efficiency and Economics of Nuclear Power"
Moscow, 21-23 May 2014

WANO Organizational Chart

WANO GOVERNING BOARD

WANO PRESIDENT

WANO LONDON OFFICE

WANO CHAIRMAN

WANO PROGRAM DIRECTORS

HONG KONG CENTRE

WANO-AC GOVERNING BOARD

WANO-MC GOVERNING BOARD

WANO-PC GOVERNING BOARD

WANO-TC GOVERNING BOARD

WANO ATLANTA CENTRE

WANO MOSCOW CENTRE

WANO PARIS CENTRE

WANO TOKYO CENTRE

WANO

Region	Operating Units	Total capacity, MWe
North America	119	112060
Western Europe	118	113939
Asia – Far East	100	86848
Central and Eastern Europe	68	48528
Middle East and South Asia	25	6948
Latin America	6	4149
Africa	2	1860
Total	438	374 332

WANO

In 2013, WANO had 540 reactors, including operating reactors, reactors under construction and decommissioning, with 140 reactors affiliated to the Atlanta Center,

170 – Paris Center, 144 – Tokyo Center and

86 – Moscow Center.

WANO

- WANO members
  - 35 countries
  - 118 companies
  - 210 NPPs
  - 540 Units (operating Units, Units under construction and decommissioning)

- Nuclear industry changes
  - 69 Units under construction
  - Over 50 nuclear entrants

Plants under construction worldwide

Country	Units
China	28
Russia	10
India	6
The Republic of Korea	5
USA	5
Japan	2
Pakistan	2
Slovakia	2
United Arab Emirates	2
Other countries	7
Total	69

WANO Moscow Center

In 2013, WANO Moscow Center had 71 operating Units at 25 plants in 11 countries, with their total installed electrical power being over 50 GWe.

WANO Moscow Centre

Country	Operating Units	Operating plants
Armenia	1	1
Bulgaria	2	1
Hungary	4	1
India	1	1
Iran	1	1
China	2	1
Russia	33	10
Slovakia	4	2
Ukraine	15	4
Finland	2	1
Czech Republic	6	2
Total	71	25

25 WANO-MC commercial plants in 11 countries

Russia – 33 Units
1. Balakovo NPP - 4 Units
2. Beloyarsk NPP - 1 Unit
3. Bilibino NPP - 4 Units
4. Kalinin NPP - 4 Units
5. Kola NPP - 4 Units
6. Kursk NPP - 4 Units
7. Leningrad NPP - 4 Units
8. Novovoronezh NPP - 3 Units
9. Rostov NPP - 2 Units
10. Smolensk NPP - 3 Units

Ukraine – 15 Units
11. Zaporozhye NPP - 6 Units
12. Rovno NPP - 4 Units
13. Khmelnitski NPP - 2 Units
14. South Ukraine NPP - 3 Units

Czech Republic – 6 Units
15. Dukovany NPP- 4 Units
16. Temelin NPP- 2 Units

Slovakia – 4 Units
17. Bohunice NPP- 2 Units
18. Mochovce NPP- 2 Units

Hungary
19. Paks NPP - 4 Units

Bulgaria
20. Kozloduy NPP - 2 Units

China
21. Tianwan NPP- 2 Units

Finland
22. Loviisa NPP - 2 Units

India
23. Kudankulam NPP- 2 Units

Unit 2 has not reached commercial operation stage as yet

Armenia
24. Armenian NPP - 1 Unit

Iran
25. Bushehr NPP - 1 Unit

WANO Moscow Centre

14 WANO–MC Units under construction in 2013:

- Akademik Lomonosov-1&2
- Beloyarsk NPP-4
- Baltic NPP-1
- Leningrad NPP-2-1
- Leningrad NPP-2-2
- Mochovce NPP-3, 4
- Novovoronezh NPP-2-1
- Novovoronezh NPP-2-2
- Rostov NPP-3, 4
- Tianwan NPP-3, 4

WANO programs

WANO has four main programs in place to support its members:

1. **Operating experience (OE) program**
2. **Peer review program**
3. **Professional and technical development (P&TD) program**
4. **Technical support and exchange (TS&E) program**

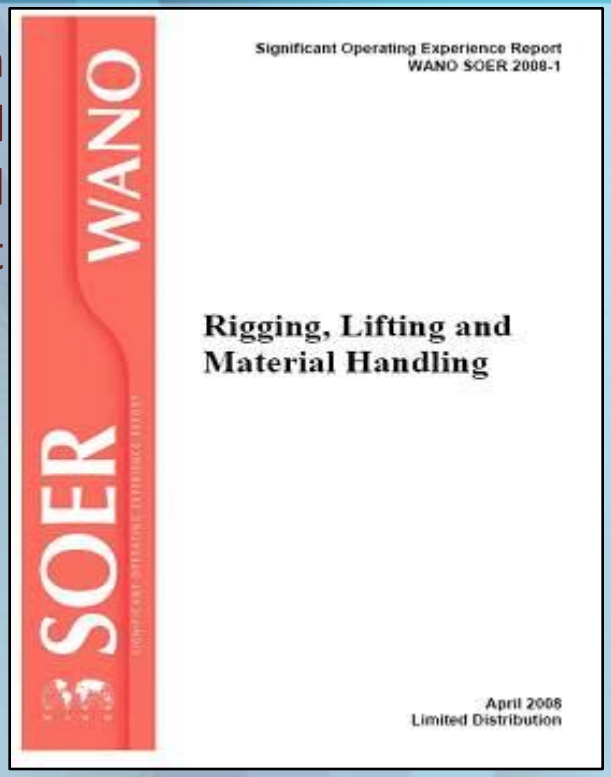
OE program

Objectives:

- To ensure information exchange among WANO members on plant events and event analysis
- To focus WANO members' attention on events to take preventive actions
  - Use of operating experience is a proved method of enhancing operational safety through learning lessons from events

SOER
Significant Operating Experience Reports

- SOER – Addressed to WANO members to get them familiar with significant events or trends and recommendations whereby WANO members shall identify and implement corrective actions to prevent recurrence
- In addition to the detailed analysis, the reports include the following:
  - Summary
  - Training materials
  - Training presentations
  - Recommendations
- 17 SOERs have been issued since 1998

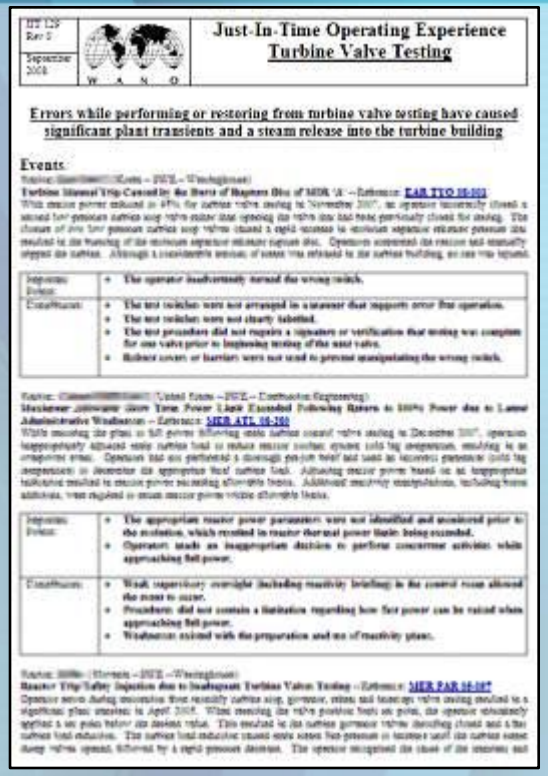


SER
Significant Event Reports

- SER – encompasses a significant event analysis and exchange of lessons learned
- SERs contain the following:
  - Event description
  - Causes
  - Analysis
  - Lessons learned
  - Preventive actions
- Training presentations attached
- 38 WANO SERs have been issued since 1999

Just-In-Time OE Reports

- JIT – to be used by managers to get their staff prepared for possible errors
  - Each JIT contains 3-4 event analyses
  - Cause analysis
  - Questions that give the staff an idea of actions to prevent an event
- JITs are intended to be used as pre-job briefings



Just-In-Time Operating Experience
Turbine Valve Testing

Errors while performing or re-storing from turbine valve testing have caused significant plant transients and a steam release into the turbine building

Events

OE program

In total, WANO-MC received 102 event reports from 71 operating Units in 2012, with each Unit sending at least one report.

The year 2013 saw 176 event reports.

There are no longer “silent” Units in the WANO Moscow Center.

Peer review program

Objectives:

- **To compare the operational level of a plant against WANO standards through an in-depth analysis of the plant performance by a WANO international independent peer review team**
- **To identify plant opportunities to fulfill performance objectives at a higher quality level: Can each specific job be done better?**

Peer review program

Main peer reviews (PR):

1. Full-scale PRs
2. Pre-start-up PRs
3. Corporate PRs
4. Follow-up PRs

Peer review program (new PO&C)

Fundamental review areas:

- ❑ Nuclear professionals
- ❑ Leadership

Functional review areas:

- ❑ Operation
- ❑ Maintenance
- ❑ Chemistry
- ❑ Engineering support
- ❑ Radiation protection
- ❑ Training

Each peer review involves peers from other WANO Regional Centers

Peer review program

Cross-functional review areas:

- ❑ Overriding operational targets (“operational focus”)
- ❑ Work management
- ❑ Equipment reliability
- ❑ NPP (design condition) configuration management
- ❑ Radiation safety
- ❑ Performance improvement
- ❑ Operating experience
- ❑ Organizational structure efficiency
- ❑ Fire protection
- ❑ Emergency preparedness

Peer review program

- Since 2012, preliminary visits (pre-visits) have been arranged prior to each full-scale peer review.
- To follow the WANO-MC long-term plan and Post-Fukushima Commission recommendations, all WANO-MC plants will switch over to 4-year cycle peer reviews by 2015.
- Pre-start-up peer reviews shall be carried out by a WANO team prior to plant operation to evaluate its preparedness for safe operation.
- All utilities shall undergo corporate peer reviews before 31.12.2017.

Corporate Peer Reviews

Plant safety largely depends on the interaction between the plant and utility

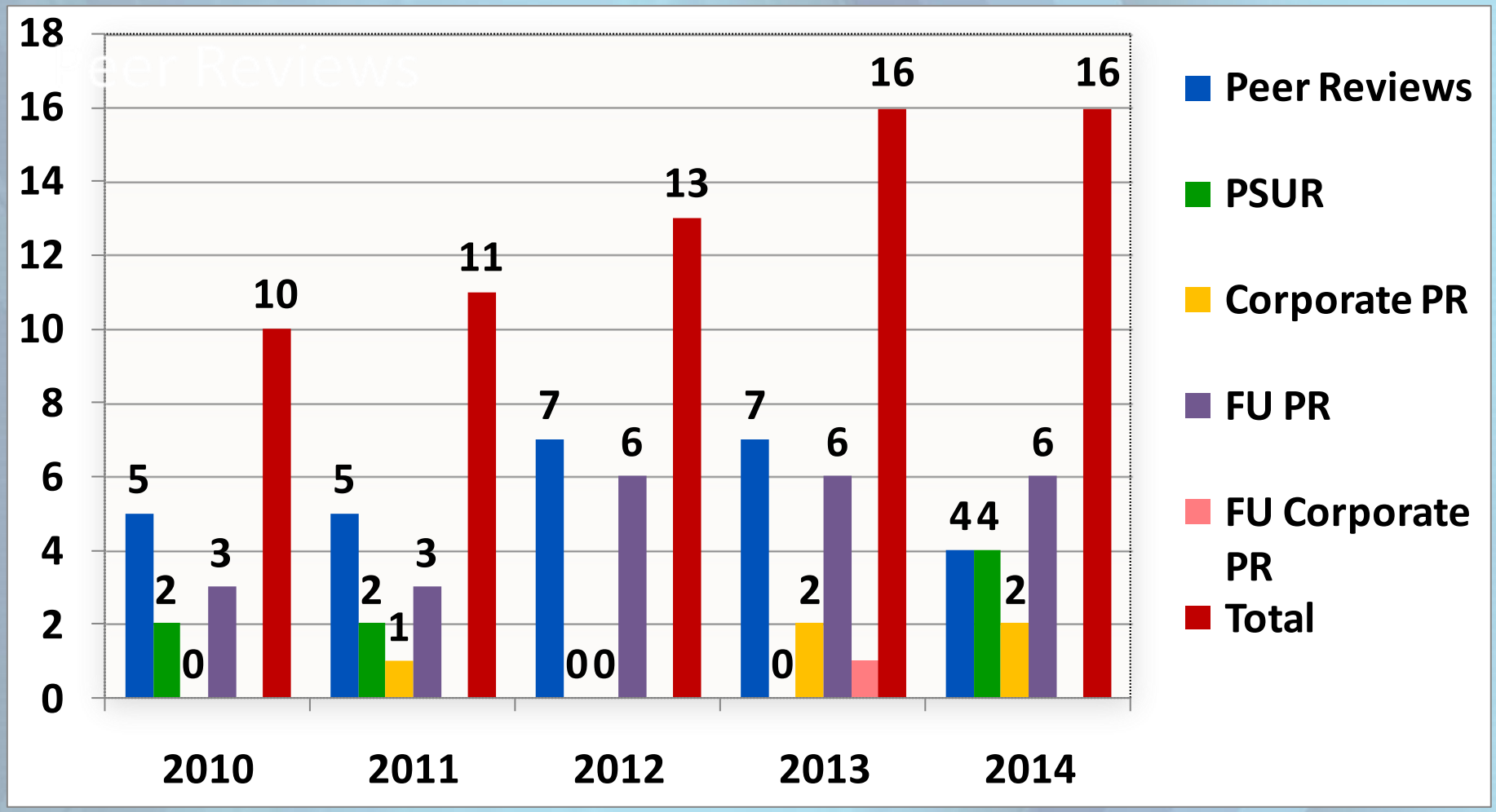
- How the utility sets concepts, tasks and objectives
- How the utility provides resources, including human and financial resources, technical support, etc.
- How the utility ensures nuclear safety oversight

Corporate peer reviews give a critical judgment of the interactions and their impact on plant operational quality and reliability.

Pre-start-up Peer Reviews

- Overview of all necessary factors to start safe plant operation.
- Inclusion of the plant into the international nuclear society, establishment of interactions.
- Support to the plant under construction to ensure a high quality of installation and further operation.

Peer Reviews



Professional and technical development

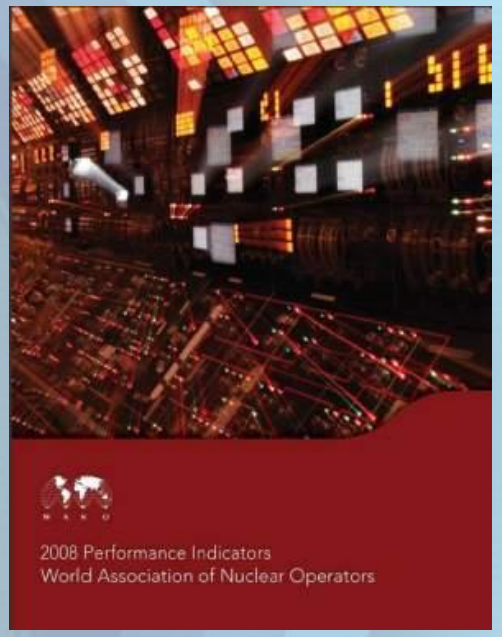
Components:

- ❑ **Workshops and conferences**
- ❑ **Training**
- ❑ **Information dissemination**

Technical support and exchange

Technical support and exchange program encompasses the following activities:

- ❑ **Technical support missions**
- ❑ **Performance indicators**
- ❑ **Guidelines and good practices**



Technical support and exchange

Technical support missions

- Technical support missions aim to support WANO members in finding better ways of addressing performance issues, enhancing safety and reliability. These missions are conducted on a voluntary basis, when requested by the customer – plant
- Duration ranges from two days to two weeks
- Various plant issues are areas of focus during these missions

Technical support missions

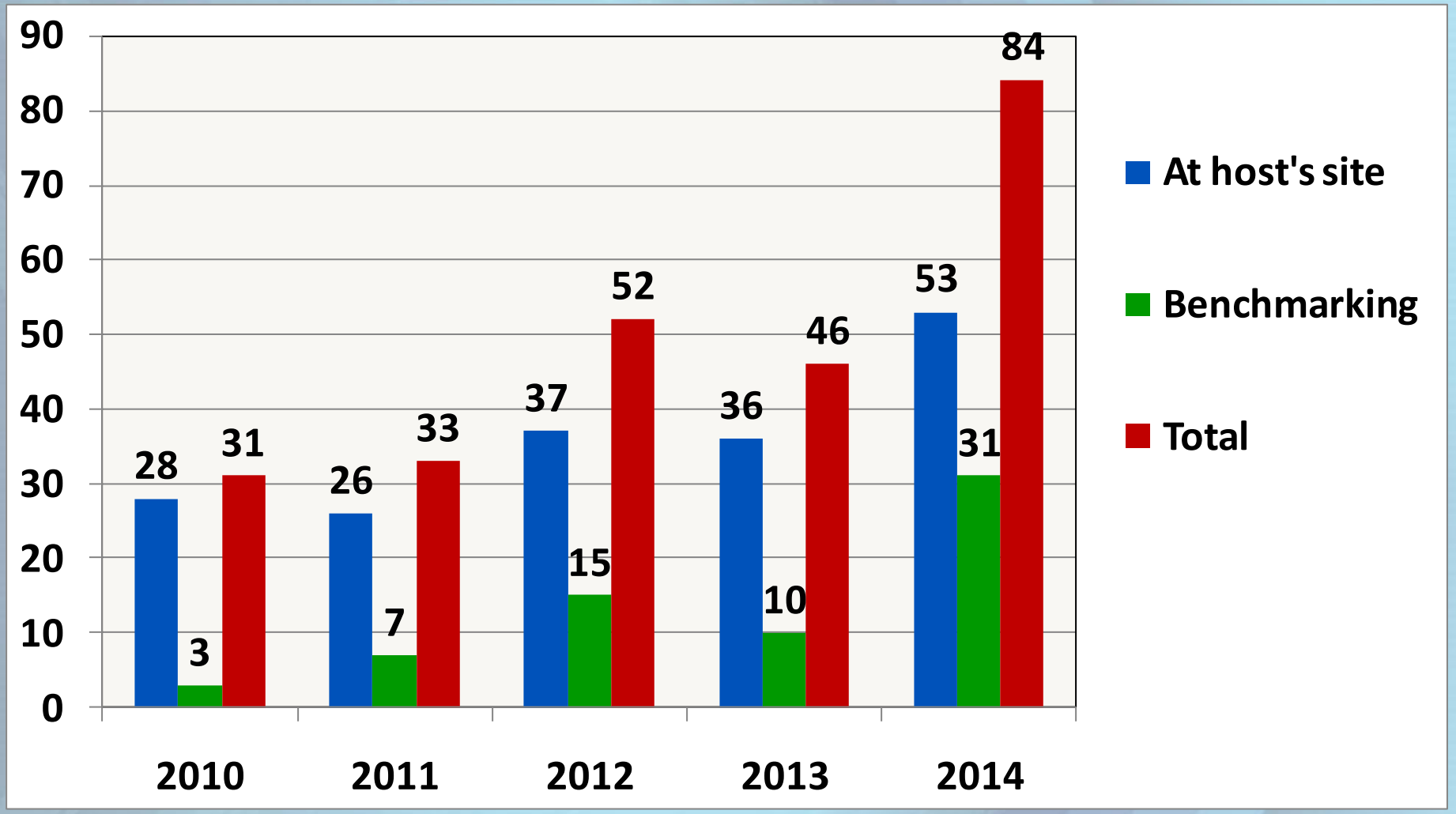
1) Expert (exchange of information and world best practices)

2) Review of plant specific performance areas (assist visits)

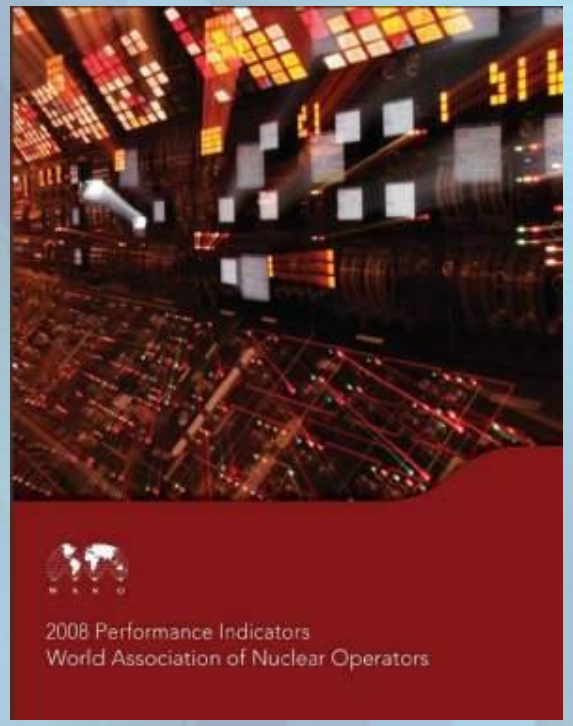
3) Training

4) Experience exchange visits (benchmarking)

Technical support missions



- Performance indicators
  - Illustrate another method of supporting plants to compare their performance indicators against those of other plants and to identify areas for improving plant operation
  - Indicators are also used to identify advanced industry-wide companies to exchange good practices or to prepare for WANO peer reviews



WANO: 12 performance indicators falling into 4 categories

1. **Коэффициент готовности энергоблока**
   UCF – Unit Capability Factor
2. **Коэффициент неготовности энергоблока**
   UCLF – Unplanned Capability Loss Factor
3. **Коэффициент вынужденных потерь электроэнергии**
   FLR – Forced Loss Rate
4. **Неплановые автоматические аварийные остановы реактора в критическом состоянии**
   UA7 – Unplanned Automatic Scrams per 7,000 Hours Critical
5. **Неплановые аварийные остановы реактора в крит. сост. (автоматическое + ручное)**
   US7 – Unplanned Scrams per 7,000 Hours Critical (automatic + manual)
6. **Коэффициент недовыработки по причинам, связанным с работой энергосистемы**
   GRLF – Grid Related Loss Factor

Production

7. **Работоспособность систем безопасности (САОЗ ВД, САПВ, Авар.ЭС)**
   SSPI - Safety System Performance (SP1, SP2, SP5 – EAC)

SS reliability

8. **Коллективная доза радиационного облучения**
   CRE – Collective Radiation Exposure
9. **Показатель надежности ядерного топлива**
   FRI – Fuel Reliability
10. **Химический показатель**
    CPI – Chemistry Performance Indicator

Radiation, fuel, chemistry

11. **Показатель потерь рабочего времени в результате несчастных случаев персонала АЭС**
    ISA – Industrial Safety Accident Rate
12. **Показатель несчастных случаев у персонала подрядных организаций**
    CISA – Contractor Industrial Safety Accident Rate

Personnel safety

WANO Post-Fukushima Commission

The WANO Post-Fukushima Commission established in April 2011 in response to the Fukushima event was charged with determining the changes WANO should implement based on the lessons learned from the event to help prevent or mitigate a similar occurrence in the future, and to close the gaps in WANO performance.

Mr. Mitchell, Chairman of the Post-Fukushima Commission,

Ontario Power CNO

2011 BGM

WANO Post-Fukushima Commission Report

…nuclear industry had changed unalterably, and to go forward, WANO must be much stronger and have "teeth" with its members. … if this could not be accomplished, WANO should close its doors and relinquish the role of champion and proponent of international nuclear safety.

WANO Post-Fukushima Commission recommendations

WANO Post-Fukushima Commission formulated 5 recommendations

1 To extend the scope of WANO to design and accident management

2 To set up an event response strategy

3 To increase WANO credibility (stronger internal control)

4 To increase WANO transparency (WANO regular reports accessible to public)

5 To increase internal consistency between the 4 Regional Centers

WANO Post-Fukushima Commission recommendations

WANO Post-Fukushima Commission projects to respond to post-Fukushima actions:

Project	STATUS
1. Self-assessment (LO)	Completed*
2. Emergency planning (AC)	Completed
3. Severe accident management (MC)	Completed
4. On-site fuel storage (TC)	Completed**
5. Emergency response planning (LO)	In progress
6. Design bases (PC)	In progress
7. Corporate peer reviews (LO)	Completed
8. Equivalency of other organizations' peer reviews (LO)	Completed
9. Early notification strategy (LO)	Completed
10. Visibility and transparency (LO)	In progress
11. Increasing frequency of WANO peer reviews (LO)	Completed
12. Assessment process (LO)	In progress

*Self-assessment is completed, follow-up self-assessment is under way
**SOER is developed, implementation of recommendations is initiated

Support

global leadership in nuclear safety WANO

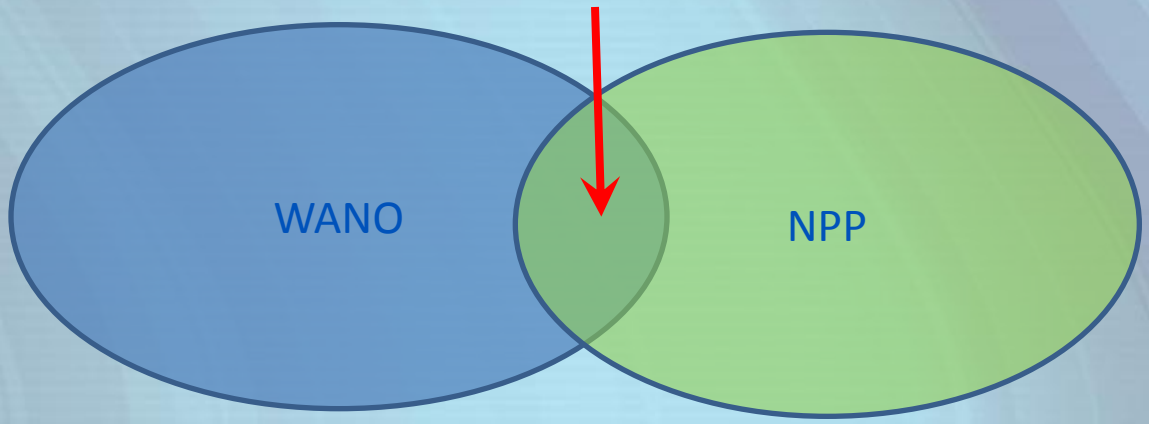
WANO-MC support

- Dissemination of OE materials, including SER, SOER, JIT
- Familiarization with good practices of other plants
- Dissemination of WANO guidelines
- Technical support missions
- Benchmarking visits
- Topical workshops, meetings and training courses
- Requests for additional information to address problematic areas to other plants and Regional Centers
- Participation in plant self-assessments
- Assist visits

Performance monitoring
Interaction categories

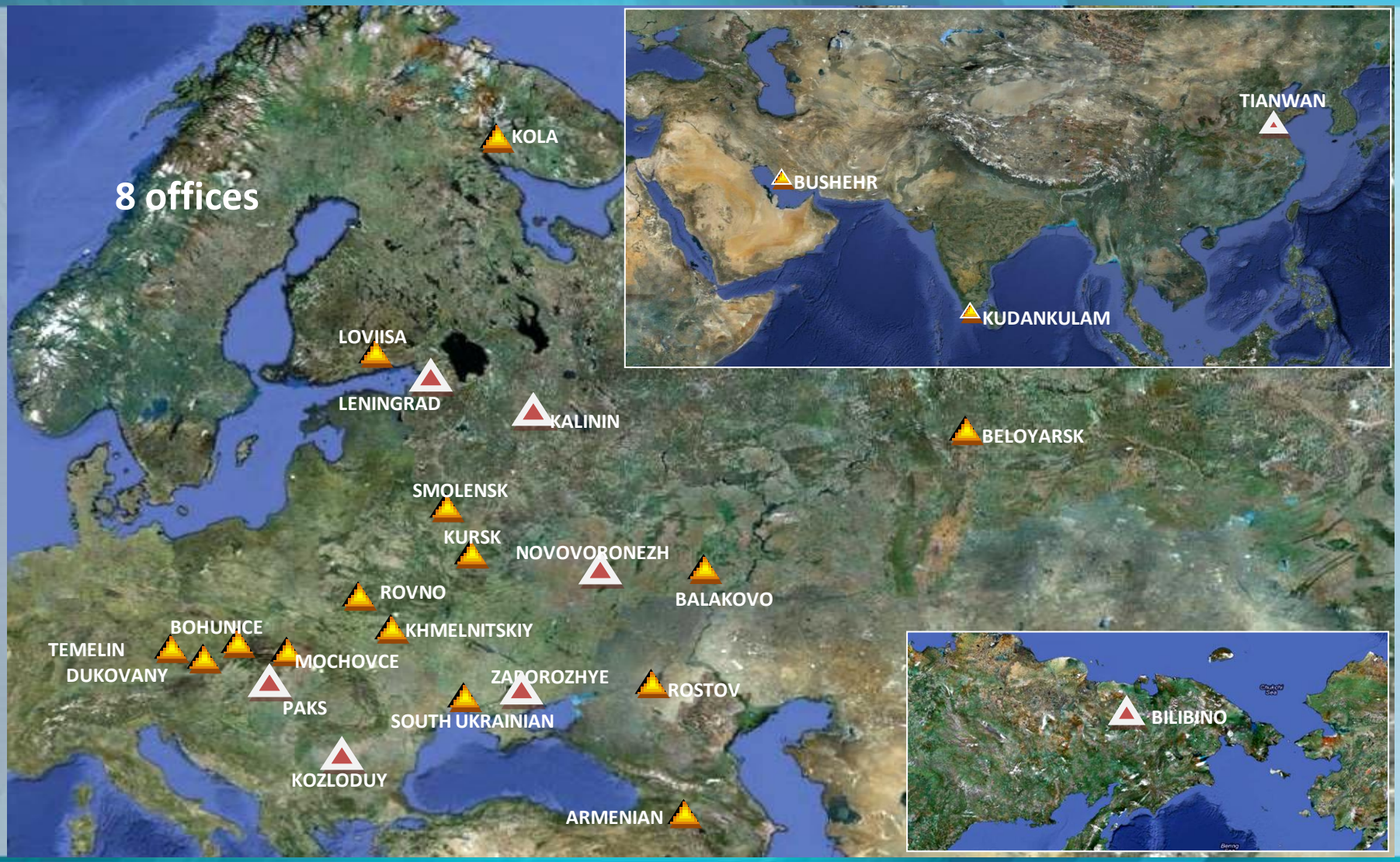
WANO has established its representative offices practically at all WANO-MC sites.

WANO-MC on-site representative



Five interaction categories (A B C D and E) have been proposed

On-site Representative Offices. 09. 2012



On-site Representative Offices. 2014

Severe accident management project

WANO Post-Fukushima Commission:

The full focus of WANO since its formation has been accident prevention, and no procedures were in place to address nuclear response or mitigation

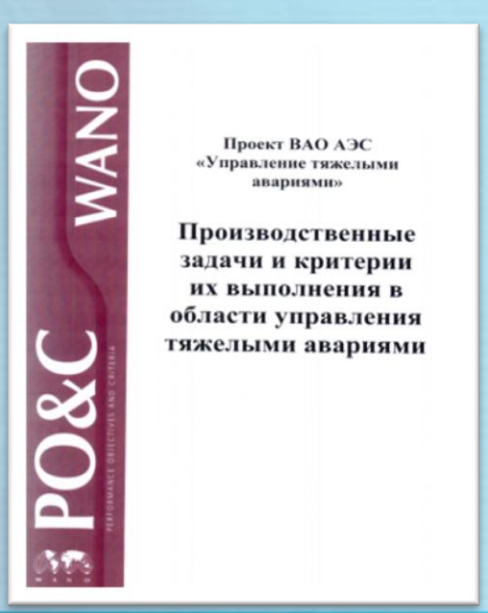
Therefore, WANO should both focus on accident prevention and mitigation, and should not confine itself with the accident prevention only

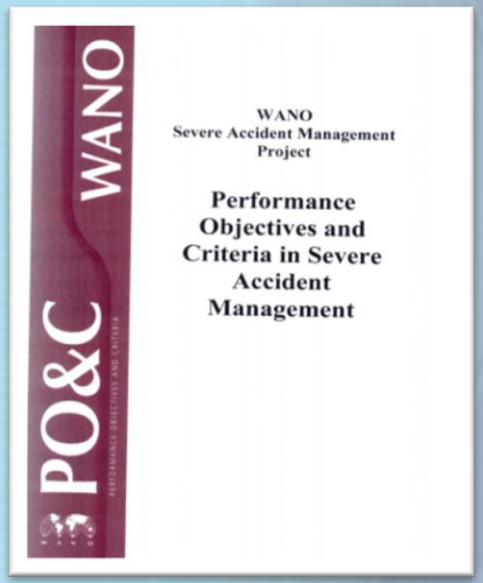
Severe accident management project

- One of the Post-Fukushima Commission recommendations was to extend the scope of WANO programs, including, inter-alia, severe accident management (SAM)
- WANO-MC assumed overall responsibility for the SAM project to complete the project on December 26, 2012

Severe accident management project

- It is recommended that all plants should undertake a SAM self-assessment by late 2015
- PO&C in SAM and “How to review SAM” guideline which WANO developed and submitted to the utilities/plants make up the basis for the self-assessment



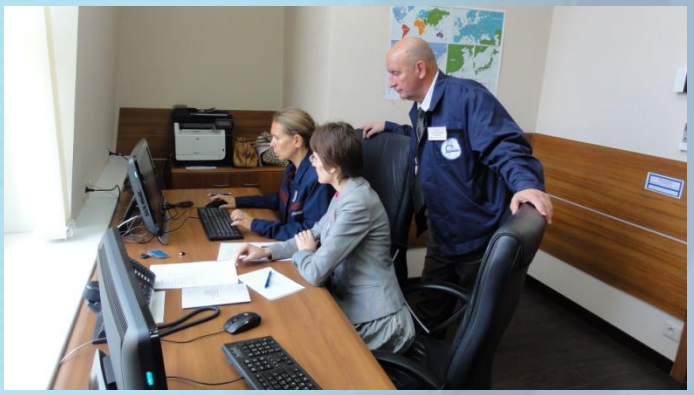


Regional Crisis Center

- Another WANO Post-Fukushima Commission recommendation is to: **Develop an international event response strategy**
- On August 30, 2011, the WANO-MC plant stress test workshop decided to establish a VVER Regional Crisis Center (RCC) to render assistance in the decision making process in case of severe accidents

RCC tasks and objectives

- Support to affected plants
- Dissemination of information on plant safety significant events among the RCC members
- Establishment of the single information and expert space



RCC operating principles

Principle 1: Continuous readiness

Principle 2: Optimization of information flows

Principle 3: Early notification

Principle 4: Confidentiality

Principle 5: Expert support

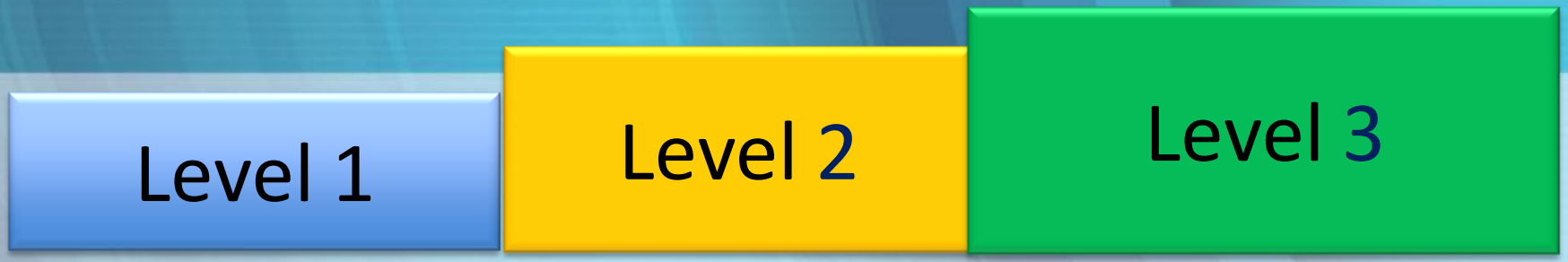
Principle 6: Logistical support

Principle 7: Use of accumulated knowledge

Principle 8: Exercises and drills

Principle 9: Voluntariness

RCC participation levels



Participants: all 11 WANO-MC operating organizations

Level 1 Finland, Czech Republic, Slovakia, Hungary, Ukraine, Bulgaria

Level 2 Iran, China

Level 3 Russia, Armenia

No decision **India**

Regional Crisis Center (RCC)

- RCC started on **14 March 2013.**
- RCC agreements were concluded with nine WANO-MC utilities.
- RCC regulations… were approved by the WANO-MC Governing Board in October 2012.
- RCC regulations on information exchange between the RCC and VVER RCC members and procedure for RCC operation were developed.
- RCC participated in the international integrated emergency exercises with a simulated initiating event at:
  - ✓ Loviisa NPP on 14 March 2013 (Finland)
  - ✓ Kalinin NPP on 18-20 September 2013

RCC plans

- Conclusion of RCC agreements with Slovenske Elektrarne (Slovakia) and Kudankulam NPP (India).
- RCC participation in 3 emergency exercises at Kola NPP, Mochovce NPP and Kozloduy NPP.
- Accumulation of RCC operating experience and increase of OO/NPP participation level in the RCC.
- Sharing information within the RCC framework per RCC regulations and information exchange regulations.
- Other efforts per RCC 2014 Action Plan.

Спасибо за внимание!

Thank You for Your Attention!