

# WANO Post-Fukushima Severe Accident Management Project

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International Experts' Meeting on Severe Accident Management in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant

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# What is WANO

## World Association of Nuclear Operators (WANO)

- Established in 1989 in response to Chernobyl.
- Four Regional Centers + WANO London.
- Not for profit: every commercial operator is a member (about **440 nuclear units**).
- Four major programmes:
  - ➔ peer reviews
  - ➔ technical support and exchange
  - ➔ operating experience
  - ➔ professional and technical development



# WANO Mission

To maximize 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.



# WANO SAM Project: Background

## WANO Post-Fukushima Commission:

- established in April 2011
- to determine what changes WANO needs to implement
- representatives highly placed in the industry
- chaired by Tom Mitchell, CEO of Ontario Power Generation, Canada

WANO Post-Fukushima Commission developed five recommendations which were approved by the WANO Governing Board during the 11th BGM conducted in October 2011 in Shenzhen, China



# WANO PFC Recommendations

1. Expand the scope of WANO programmes to include emergency preparedness, severe accident management, on-site fuel storage, design fundamentals, multiple unit effects.
2. Implement a world-wide nuclear event response strategy.
3. Improve WANO's credibility including important changes to WANO's peer review process.
4. Improve WANO's transparency and visibility.
5. Conduct periodic internal peer reviews.

WANO launched 12 Post-Fukushima Projects to implement these recommendations.



# WANO SAM Project: Background

## 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”.*

We have to shift from a focus on accident prevention to a focus on both prevention and mitigation.

- Recommendation No.1 resulted in the launching of the **SAM Project**.
- **Overall responsibility** for the SAM Project was delegated to the **WANO Moscow Centre**.



# WANO SAM Project: Background

The **SAM Project Team** was established in April 2012.

The Project Team included 17 members from 10 countries: Canada, the Czech Republic, Finland, India, Japan, Russia, Slovakia, Spain, the UK, Ukraine.

They were WANO staff from the Regional Centers and the London Office and industry experts from each WANO Regional Centre.





# Purpose of the WANO SAM Project

## The purpose of the SAM Project was to:

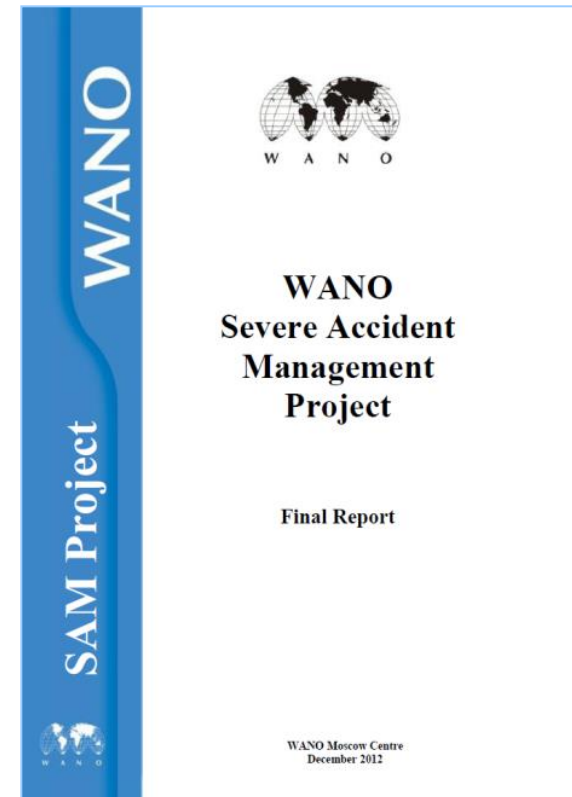
- expand the scope of WANO programs to include severe accident management, and
- establish a worldwide standard for performing station and corporate assessments in the area of severe accident management.



# WANO SAM Project Deliverables

The first stage of the WANO SAM Project was completed on December 26, 2012 with the following Project deliverables:

- SAM Performance Objectives and Criteria for station peer reviews;
- SAM-related additions to performance objectives and criteria for corporate peer reviews;
- A “How to Review SAM” guidance for peer reviewers.



# What are WANO PO&Cs?

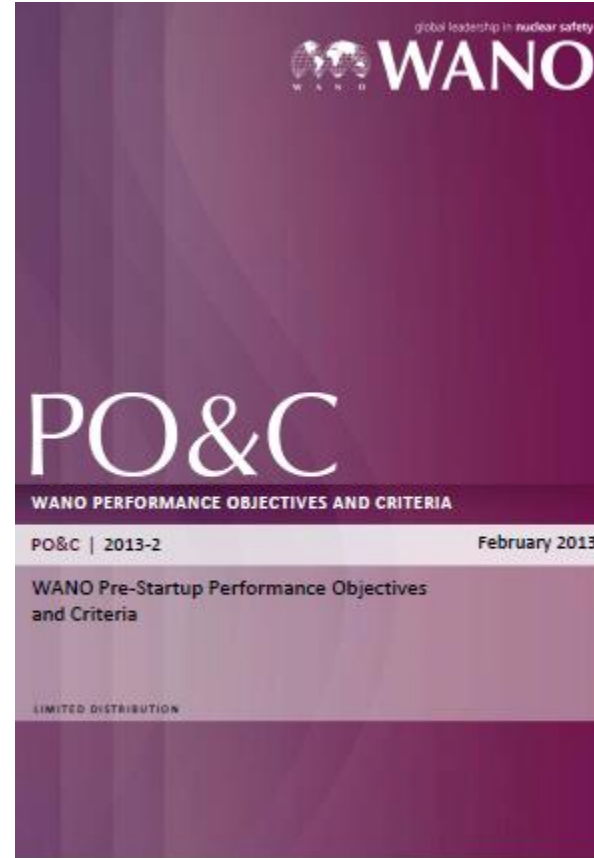
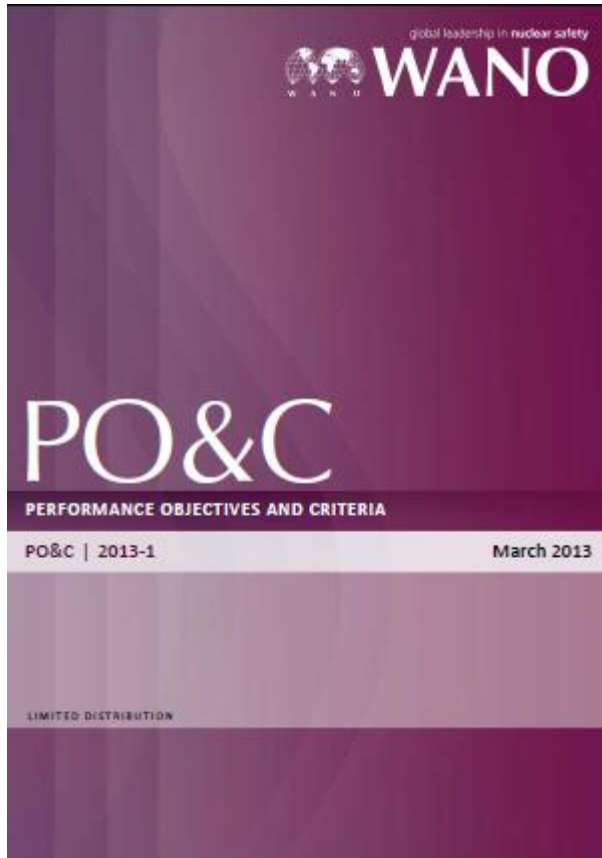
- WANO Performance Objectives and Criteria are intended to help in assessing station/utility performance during peer reviews.
- Generalized standards of excellence reflecting best industry performance for nuclear power plants.
- A description of a perfect, excellently performing nuclear power station, something for the member stations to strive for.
- PO&Cs can also be used by the member stations/utilities for self-assessment.



# What are WANO PO&Cs?

Currently, WANO uses two sets of PO&Cs:

- for station/corporate peer reviews;
- for pre-startup peer reviews of new plants.



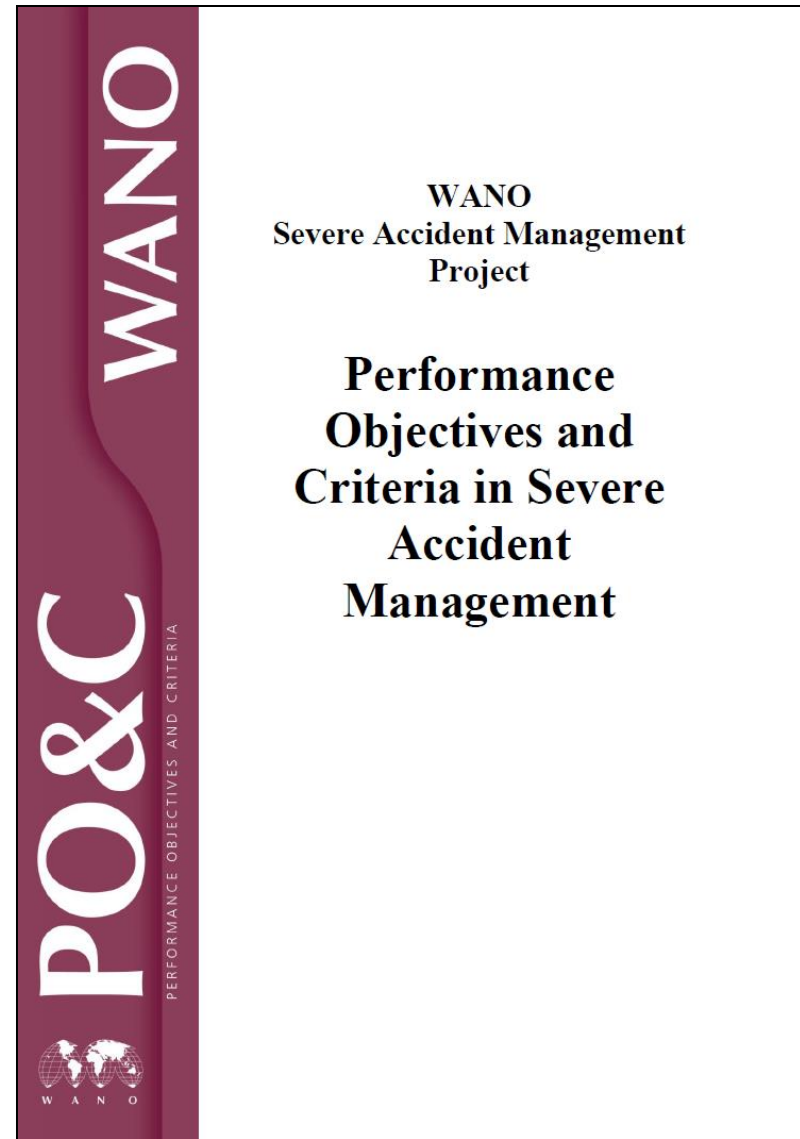
# Structure of the proposed SAM PO&Cs

## Three performance objectives:

SAM.1 SAM Management and Leadership

SAM.2 Severe Accident Management Program

SAM.3 Severe Accident Response



# Structure of the proposed SAM PO&Cs

## **SAM.1 SAM MANAGEMENT AND LEADERSHIP**

The station organization is prepared to effectively manage on-site actions and interface with off-site organizations to prevent or to mitigate the consequences of a severe accident and to achieve a long-term safe stable state.

**+ 8 supporting criteria**



# Structure of the proposed SAM PO&Cs

## SAM.2 SEVERE ACCIDENT MANAGEMENT PROGRAM

The SAM program has been developed and is implemented to provide appropriate resources, facilities, equipment and documentation for activities that are conducted by trained and knowledgeable personnel to manage severe accidents in an efficient and reliable manner.

- ➔ Objectives of the SAM program
- ➔ Development and implementation of SAM strategies
- ➔ Documentation
- ➔ Staffing, Qualification and Training
- ➔ Facilities and Equipment

**+ 40 supporting criteria**



# Structure of the proposed SAM PO&Cs

## **SAM.3 SEVERE ACCIDENT RESPONSE**

Severe accident response activities are efficiently conducted by skilled, trained and knowledgeable personnel to prevent or to mitigate the consequences of a severe accident and to achieve a long-term safe stable state.

**+ 10 supporting criteria**





# Structure of the proposed SAM PO&Cs

**Each performance objective is supported by a number of criteria to provide depth and breadth to the objective.**

Several example criteria in SAM.2, “Severe Accident Management Program”:



# Example criteria in SAM.2

## Objectives of the SAM program

1. The SAM program considers all internal and external initiating events that potentially lead to nuclear fuel damage and large radioactive releases including, but not limited to, external beyond-design-basis impacts, indirect initiating events, multi-unit accidents, loss of all AC and/or DC power and/or loss of ultimate heat sink.



# Example criteria in SAM.2

## Objectives of the SAM program

2. The station's organization provides adequate capabilities to accomplish the main SAM objectives:

- avoid or mitigate core damage or spent fuel damage;
- terminate the progress of core damage and/or spent fuel damage once it has started;
- maintain the containment integrity for as long as possible;
- prevent or minimize significant releases of radioactive products into the environment;
- achieve a long-term safe stable state.



# Example criteria in SAM.2

## Development and Implementation of SAM Strategies

3. Strategies have been developed and are implemented and maintained for the prevention and mitigation of severe accidents potentially arising from beyond-design-basis events. These strategies are coordinated with the emergency preparedness and emergency response under which they would be deployed if beyond-design-basis events occurred.



# Example criteria in SAM.2

## Staffing, Qualification and Training

24. The personnel involved in SAM are clearly defined; they are trained and qualified, and have sufficient capabilities to perform specified SAM functions and responsibilities in a wide range of events, including multi-unit events, in a reliable manner. The composition of groups involved in severe accident response takes into account different skills, experience and expertise to enhance teamwork.



# Example criteria in SAM.2

## Facilities and Equipment

36. Facilities, equipment, instrumentation and supplies to be used for SAM are identified; they are routinely monitored, tested and maintained to ensure their readiness for use during severe accidents; compensatory actions are implemented as necessary when those facilities and equipment are out of service.



# Expected prospects: Incorporation of SAM into WANO programs

How we see incorporation of severe accident management into all four WANO programs:



# Expected prospects: Incorporation of SAM into WANO programmes

As the main deliverable, the SAM Project Group has developed Performance Objectives and Criteria for SAM. This would contribute to incorporation of SAM into all four WANO programmes in the following way:

- **Peer reviews:**  
Severe accident management issues will be reviewed on WANO peer reviews.





# Expected prospects: Incorporation of SAM into WANO programs

## ➤ Technical Support and Exchange:

Stations would host **Technical Support Missions** based on issues and weaknesses identified in the SAM-related AFIs. Besides, **operator exchanges** could be arranged to assist WANO members in meeting the SAM-related performance objectives and criteria. Furthermore, strengths and beneficial practices in SAM observed during peer reviews could be disseminated to WANO members as **Good Practices**.



# Expected prospects: Incorporation of SAM into WANO programs

## ➤ Operating Experience:

Whenever applicable, SAM-related SOERs, SERs, JITs and Hot Topics might be used by stations to improve their preparedness to deal with severe accidents.

## ➤ Professional and Technical Development:

Based on SAM-related AFIs, strengths and beneficial practices identified during peer reviews, WANO Regional Centres would arrange **workshops, conferences, seminars, expert meetings and training courses** for WANO members to enhance their professional knowledge and skills in severe accident management.



# Expected prospects

The SAM PO&Cs have been reviewed by WANO-MC to identify overlaps with the Emergency Preparedness PO&Cs.

The review indicates that where overlap exists it is limited in scope and the SAM PO&C document provides augmented information.



# Expected prospects

WANO Regional Centers are expected to review the proposed SAM PO&Cs and provide their comments for resolution in March 2014.

Upon approval by the RCs, the SAM PO&Cs will be considered a separate document from WANO PO&Cs for a certain period of time.



# Expected prospects

The separate SAM PO&C document will be used for industry self-assessments.

Later on, an evaluation will determine whether the proposed SAM PO&Cs should be included in the next revision of WANO PO&Cs.



# Expected prospects

## WANO Governing Board:

- Utilities/stations should carry out self-assessments in the area of SAM by October 2015.
- The SAM PO&Cs should be used by stations\utilities to perform the self-assessment.




# Some issues to be resolved

- proper alignment between EP and SAM;
- whether SAM should be merged with EP or be a stand-alone review area in the new PO&Cs;
- addition of SAM experts to peer review teams;
- changes to WANO programs which might be necessitated by the new SAM PO&Cs.



# WANO Moscow's initiatives in SAM

October 2013, the Board of WANO-MC Station/Corporate Technical Directors (Chief Engineers):

- Implementation of the station SAM programs should be reviewed during station peer reviews using the proposed SAM PO&Cs .
- EP reviewers on WANO Moscow's peer review teams are assigned to review  area of SAM in addition to EP.





# WANO Moscow's initiatives in SAM

The latest WANO-MC Governing Board Meeting in October 2013:

- Self-assessments in SAM should be conducted at all nuclear power plants in the WANO Moscow Region by January 1, 2015.
- As the basis for the self-assessment, our member utilities will use the proposed SAM PO&Cs and the EP section from the new WANO PO&Cs.



# WANO Moscow's initiatives in SAM

**March 18–20, 2014, WANO-MC will arrange a workshop on “Severe Accident Simulation Models for Plant Full Scope Simulators”:**

- Severe Accident Simulation (SAS) modules for Full Scope Simulators (FSS)
- Integrating SAS modules into the existing FSSs.
- Display systems for SAS model visualization during training.
- SAM simulator training / emergency drill scenarios.
- Examples of FSS application during integrated emergency drills.



# WANO Moscow's SAM activities in 2013

- WANO-MC Workshop, ***“SAM Guidelines development, implementation and training at WANO-MC Member Plants”***: 25-28 March 2013, Kiev (Ukraine), 28 participants from 10 operating organizations of WANO-MC.
- WANO-MC Workshop, ***“Corium Retention Following a Severe Accident on a VVER Reactor”***: Kozloduy NPP (Bulgaria), 36 participants from 9 operating organizations of WANO-MC, managers and specialists representing scientific companies, 8 - 12 July 2013.



# WANO Moscow's SAM activities in 2013

- **Board meeting of the WANO-MC Technical Directors/Chief Engineers** (1–3 October 2013, Budapest, Hungary). 45 participants from all 11 WANO-MC member utilities.
- **The topics for discussion included:**
  - Content of SAM Guidelines including multi-unit effects, entrance criteria, I&C for SAM, full scope simulator upgrades for SAM,
  - WANO SAM Project,
  - In-vessel retention and ex-vessel cooling/stabilization of corium following a severe accident on a VVER reactor.



**THANK YOU!**

**СПАСИБО!**

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