SFEN Young Generation
First & second Generation Reactors

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Chairman of WANO
October, 14 2010
ENSTA, Paris

“Feedback on 50 years of nuclear reactor operation”
Introductory Remark
Nuclear Safety Responsibility

Support:
- WANO
- INPO
- JANTI
- CAEA
- ...

1st Responsible: Operator

Control:
- National Safety Authority
- IAEA
- Euratom
- ...

...
SFEN Young generation

WANO MISSION
WANO ORGANISATION
WANO PROGRAMMES
EXPERIENCE FEEDBACK
WANO CHALLENGES
CONCLUSION
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.
1979 : TMI → INPO

Key factors:
- CEO engagement
- Focus on nuclear safety
- Support from the nuclear industry
- Accountability
- Independence
1986 : Chernobyl → WANO

After the 1986 Chernobyl accident, the world’s nuclear operators realised that an event at one plant impacted every plant and that international cooperation was needed to ensure such an accident could never happen again.

WANO was formed in May 1989. Today, every nuclear operator in the world is a member.
● Current WANO membership
  ➤ Thirty-one countries (or areas)
  ➤ Company Members : 100
  ➤ Nuclear stations – 210
  ➤ Operating nuclear units – 436

● Changes to the Industry
  ➤ 57 new units under construction
  ➤ 60+ countries have announced interest in nuclear
WANO ORGANISATION
Geographical distribution
Regional Centres are responsible to their respective Regional Governing Boards for the delivery of high-quality activities within their regions.

Regional Centres are responsible to the London office for implementing policies and programmes set forth by WANO's Main Governing Board.

Each Regional Governing Board is represented in the WANO Governing Board.

ELT Executive Leadership Team
(WANO Managing Director + Regional Centre Directors)
WANO ORGANISATION
Governing Board

Managing Director
George Felgate
Company Secretary
Bob Cockrell

Chairman
L. Stricker

President
HE Yu

W.A.C
W.P.C
W.M.C
W.T.C

Most Influential Utility in Region
J. Ellis
H. Proglio
S. Obozov
M. Shimuzu

Regional Chairman
D. Hawthorne
J. Bongers
I. Pnacek
Jong Shin Kim

CEO Nominated by Region
G. Gates
B. Guthoff
Y Nedashkovsky
SK Jain
SFEN Young generation

WANO MISSION

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WANO PROGRAMMES

Operating Experience

Peer Reviews

Technical development, Support and Exchanges
The programmes work together to drive continuous performance improvement
The objectives are:

- to report events promptly with a plant analysis valuable to WANO members
- Alert members to events so they can take actions to prevent similar events at their own plants
  - Using operating experience is a proven method to improve plant performance by applying the applicable lessons learned from past events
WANO PROGRAMMES
OE: Events Reported to WANO (2000-2009)
SER – an analysis of significant events to identify and communicate the lessons learned

- SERs contain:
  - Event description
  - Causes
  - Analysis
  - Lessons learned
  - ‘Prevent events’

- Training presentation also provided on members’ web site

- There are currently 33 WANO SERs dating back to 1999
SOER – written to address significant events or trends, including recommendations requiring WANO members to identify and implement appropriate corrective actions.

There are currently 12 WANO SOERs dating back to 1998.
SOER 2010-1 (Shutdown Safety)
SOER 2008-1 (Rigging, Lifting and Material Handling)
SOER 2007-2 (Intake Cooling Water Blockage)
SOER 2007-1 (Reactivity Management)
SOER 2004-1 (Managing Core Design Changes)
SOER 2003-2 (Reactor Pressure Vessel Head Degradation at Davis-Besse NPS)
SOER 2003-1 (Power Transformer Reliability)
SOER 2002-2 (Emergency Power Reliability)
SOER 2002-1 (Severe Weather)
SOER 2001-1 (Unplanned Radiation Exposures)
SOER 1999-1 (Loss of Grid) inc 2004 Addendum
SOER 1998-1 (Safety systems status control)
Created in 2006, the CEO updates describe important events and trends that utility CEOs are encouraged to discuss with their nuclear executives and oversight organisations.

9 CEO Updates were issued:

- **Use of Industry Operating Experience**
- **Rigging, lifting and material handling**
- **Control of high risk outage activities**
- **Reactivity management**
- **Flow accelerated corrosion**
- **Importance of control rods**
- **Transformer failures**
- **Intake cooling water blockage**
- **Availability of emergency AC power**
● JIT briefings – help planners, workers and supervisors apply lessons learned for specific plant activities
  ➔ Each JIT includes 3-4 events
  ➔ Frequent or common causes are discussed
  ➔ Open questions are provided to the workers for them to consider what defences are available

● JIT reports are specifically designed for use during pre-job briefings
  Over 200 JIT reports available
WANO PROGRAMMES

Operating Experience

Peer Reviews

Technical development, Support and exchanges
The purpose of a WANO Peer Review is to compare the operational performance of a station to standards of excellence through an in-depth, objective review by an independent team.

WANO Peer Reviews are performance-based and ask the question, ‘How can this be done better?’
The functional areas of Peer Reviews are:

- Organisation and administration
- Operations
- Maintenance
- Engineering support
- Radiological protection
- Operating experience
- Chemistry
- Training and qualification
- Fire protection

Each peer review includes at least one industry peer from each Regional Centre.
The cross-functional areas of Peer Reviews are:

- Safety culture
- Human performance
- Self evaluation
- Industrial safety
- Plant status & configuration control
- Work management
- Equipment performance and condition
WANO PROGRAMMES
Peer Review

- Station Peer Review
  - Six-year frequency by full team to assess performance

- Pre-startup Peer Review:
  - Conducted either by WANO or IAEA prior to startup to assess startup readiness

- Corporate Peer Review
  - To assess effectiveness of management and corporate support
Pre Start-Up Peer Review:
- 60 reactors under construction
- Dedicated Pre Start-Up Team (French Team leader)

Look at everything needed to operate safely at the beginning of commercial operation

Review the important transition from a construction culture to an operating plant with nuclear safety the top priority
A corporate peer review takes a critical look at the interactions between the plant and its corporate organisation and how they impact performance and reliability.

How does the Head of the Company:

- develop a strong nuclear safety culture?
- set vision, goals, objectives?
- provide resources, including human, financial, engineering, etc.?
- exercise nuclear oversight?

British Energy, Ontario Hydro, EDF, TEPCO, EOn, Rosenergoatom, Slovenske Elektrarne
WANO PROGRAMMES

Operating Experience

Peer Reviews

Technical development, Support and exchanges
Information exchange forum,

Specific activities including workshops, seminars, expert meetings and training courses,

Technical Support Missions,

Supporting documents, …
WANO PROGRAMMES
Technical development, support and exchanges

[Bar chart showing the number of TSMs from 1999 to 2009, with a significant increase over the years.]
EXPERIENCE FEEDBACK
Health of Nuclear Safety

- No Chernobyl-like accident
- Trend in performance
- Safety culture is widely discussed
- Transparency – reporting of operating experience
- International benchmarking
- Margin management
- Improved investigative techniques
- Corporate peer reviews
EXPERIENCE FEEDBACK
Past Nuclear accidents

29 September, 1957
USSR – Siberia - Mayak
Pyroradiological explosion - 75 tonnes TNT equivalent (INES level 6)
7 October, 1957
U.K.
Partial Fuel damage at Windscale
(INES level 7)
22 February, 1977
Bohunice - Czechoslovakia
Partial core meltdown of 150 MWe experimental reactor
(INES : level 4)
EXPERIENCE FEEDBACK
Past Nuclear accidents

28 March, 1979
Three miles Island - USA
Partial core meltdown
(INES : level 5)
13 March, 1980
Saint-Laurent des Eaux - France
Partial meltdown of fuel elements
(INES : level 4)
26 April, 1986
Chernobyl - USSR
Nuclear core explosion
(INES : level 7)
24 November, 1989
Greifswald unit 5 – East Germany
10 fuel element damage, 24 days after commercial operation
21 September 2001
Toulouse - France
AZF (30 deaths)
EXPERIENCE FEEDBACK
Non Nuclear accidents

15 December, 2005
Taum Sauk dam
Missouri - USA
17 August, 2009
Sayano-Shushenskaya Dam – Russia
(75 deaths)
7 February, 2010
Gas electrical generation plant
Kleen Energy, Middletown
Connecticut – USA
EXPERIENCE FEEDBACK
Non Nuclear accidents

July, August 2010
BP DEEPWATER HORIZON
OIL SPILL
Mexican Gulf, USA
EXPERIENCE FEEDBACK
Non Nuclear accidents

4 October 2010
Toxic Red Mud Spill from Aluminum Plant
Hungary
EXPERIENCE FEEDBACK

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EXPERIENCE FEEDBACK
Trend in Performance

Unit Capability Factor

Unplanned Automatic Scrams per 7,000 Critical Hours

Unplanned Capability Loss Factor
EXPERIENCE FEEDBACK
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- Loss of Primary circuit pressure
- Criticity
- Loss of electric grid
- Hydrogen explosion
- Loss of safety functions: reactivity, cooling.
During an outage, the control rods were pulled up making the reactor critical while the containment and the reactor pressure vessel were open.
2002 : Reactor pressure vessel head corrosion
Undetected leak of boric acid in control rod drive mechanism. Problem was
discovered by ultrasonic inspection when the metal layer was only few mm
thick. (cavity of 15 cm wide in RPV)
It could have occurred a LOCA of 5 inches.

In 2010, lack of in-depth periodic ultra-sonic controls led to discover new
cross-over cracks and leakages.
Inadequate cooling of the fuel elements, which were heated due to the radioactive decay of short-lived fission products. These were kept cool by water circulated by a submerged water pump. The incident led to 30 fuel element cladding broken.
EXPERIENCE FEEDBACK

Transparency – OE : Barriers to Using Operating Experience

- Language barrier
- Our technology is different, therefore the event does not apply to us
- Cultural – we would never operate that way
- Workload – other higher priority work
- Leadership does not place high value on the use of operating experience
EXPERIENCE FEEDBACK
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WANO CHALLENGES
Challenges to Nuclear Safety

- Dramatic growth in our industry
- Ageing of the current fleet
- Complacency
- Shutdown safety
- Reporting / use of operating experience
- Workforce experience
When an event occurs, what questions do you, should you ask as engineers, leaders or experts?

- What is the root cause?
- Was there operating experience available that could have prevented this event? If so, why wasn’t OE used?
- Does this event need to be shared with the nuclear community?
No nuclear safety issue should remain if the solution exists elsewhere in the World.
If we do not use operating experience, we are destined to repeat events: Use OE

Transparency is fundamental in nuclear safety

We are only as strong as our weakest link – “hostages of one another”

One single accident anywhere in the world may jeopardise the whole nuclear industry.

The transfer of operating experience to the next generation of operators represents one of the greatest challenges we face.
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CONCLUSION
An individual responsibility

but also …

A collective responsibility
Thank you for your attention

Don’t forget to visit our website: www.wano.info
Member Obligations

- “Accept their individual responsibility for nuclear safety, and accept their collective responsibility”
- Actively participate in the governance of WANO
- Safeguard WANO confidential information
- Support WANO with membership fees and human resources
- Host peer reviews and technical support missions (TSMs)
- Share operating (and construction) experience
- Provide “experts” for workshops, seminars, other member’s peer reviews and TSMs
- Strive for EXCELLENCE in all aspects of plant operation
- Take timely action to correct performance weaknesses