Post-Fukushima WANO: The Safety Culture Challenge

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George Felgate
WANO Managing Director
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WANO

WANO Overview

- In 1986, the accident at Chernobyl occurred; in May 1989 WANO was formed
- The world's nuclear operators realised that an event at one plant would impact every plant
- Four Regional Centres and London office
  - Atlanta
  - Moscow
  - Paris
  - Tokyo
- Today every operator of a commercial nuclear plant is a member of WANO; 120 members

W A N O


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.
WANO
WANO mission

WANO Programmes

Four programmes define WANO member support:

1. Operating Experience
2. Peer Reviews
3. Professional and Technical Development
4. Technical Support and Exchange

WANO Programme Relationships

The programmes work together to drive **continuous performance improvement**

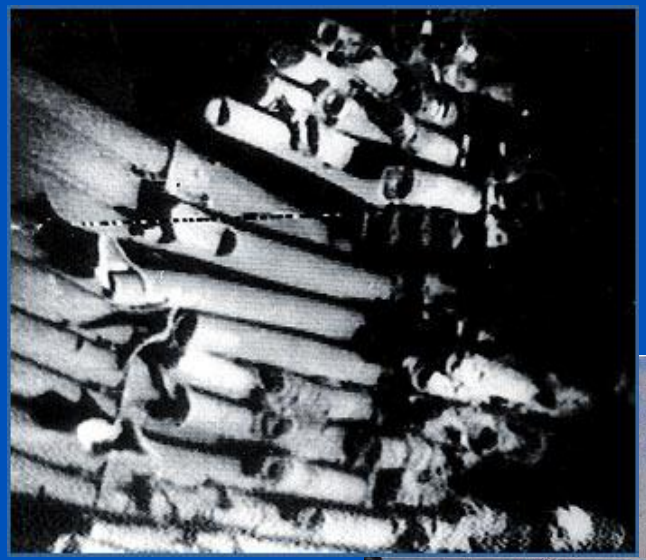
Unique Characteristics of Nuclear Energy

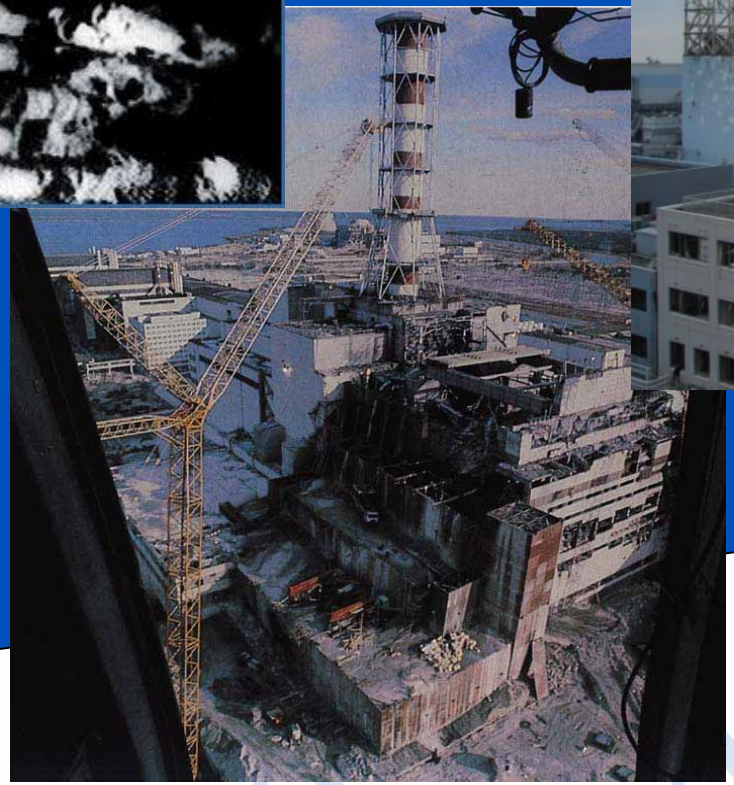
- Tremendous stored energy
- Decay heat is generated long after a reactor is shutdown
- Radioactivity and radioactive waste are byproducts

- These translate to our three nuclear safety functions:

- Controlling reactivity
- Core cooling
- Containment

Three (Five?) Major Core-Damaging Accidents in 32 Years





Compare

- Three Mile Island
  - PWR
  - New plant
  - Removal of decay heat
  - Core destruction
  - Nearly no release to the environment
  - No fatalities
  - Event initiator: Human performance
  - Root cause: Training
- Chernobyl
  - RBMK
  - New plant
  - Management of stored energy
  - Reactor destruction
  - Large release to the environment
  - Many fatalities
  - Event initiator: Human performance
  - Root cause: Safety culture
- Fukushima
  - BWR
  - Old plant
  - Removal of decay heat
  - Multiple reactor destruction / fuel pool damage
  - Large release to the environment
  - No fatalities
  - Event initiator: External event
  - Root cause: ??

Some Personal Observations

- Two of three major industry events have been the result of failure to remove decay heat; in both cases core cooling was turned off by the operators
- WANO, and to some extent the industry, have been focused on prevention, and to a lesser degree on mitigation
- Sixteen of twenty-three core damaging events have been the result of human error; we must learn from Fukushima but we must not forget the lessons from TMI and Chernobyl
- We must not under-estimate the importance of a simulator that models every operating unit
- As an industry, we have not embraced the full value of operating experience.

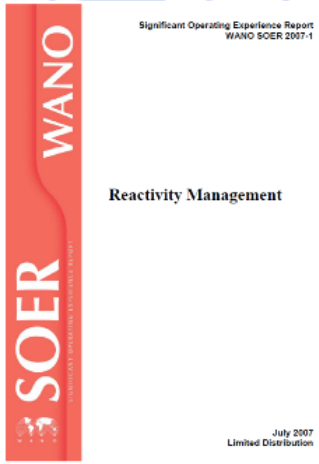
Previous Experience

- External Events
  - Hurricane—Turkey Point 1992, Waterford 2005
  - Flood—Blayais 1999, Cooper 1993
  - Windstorm—Hunterston 1998
  - Tsunami—Madras 2004
  - Earthquake—Kashawazaki-Kariwa 2007
  - Tornado—Browns Ferry 1974
  - Grid Blackout—US & Canada 2003, Brazil 1999
- Three Mile Island
  - Core cooling
  - Value of a simulator
  - Hydrogen

Fukushima Lessons

Significant Operating Experience Reports (SOERs)

- 2011-2: Fukushima Daiichi Nuclear Station Fuel Damage Caused by Earthquake and Tsunami
- 2011-3: Fukushima Daiichi Nuclear Station Spent Fuel Pool / Pond Loss of Cooling and Makeup
- 2011-4: Near-Term Actions to Address an Extended Loss of all AC Power
- 2011-2, Addendum 1
- 2012- X: Under Development (human performance and organizational issues)

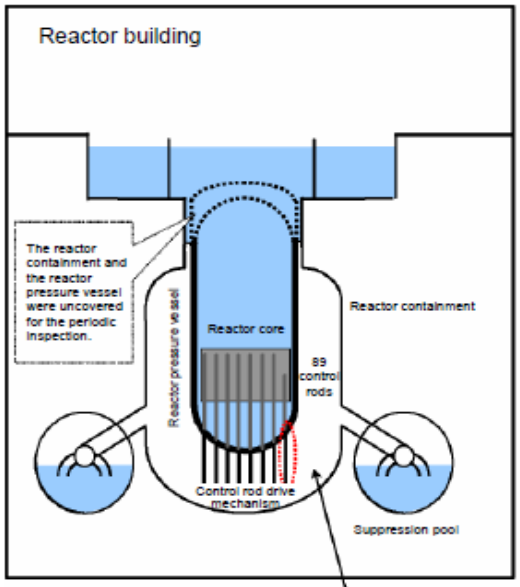


Fukushima SOERs

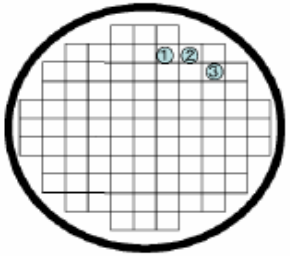
- For each SOER:
  - Urgent action required by every member
  - Report to WANO on actions taken and gaps found
  - Member reports analysed and analysis report sent to members (benchmarking)
  - Follow up to ensure closure of gaps
  - Inspect results during WANO peer reviews

Net result: Significant safety enhancements industry-wide

Shika NPP



Locations of the control rods



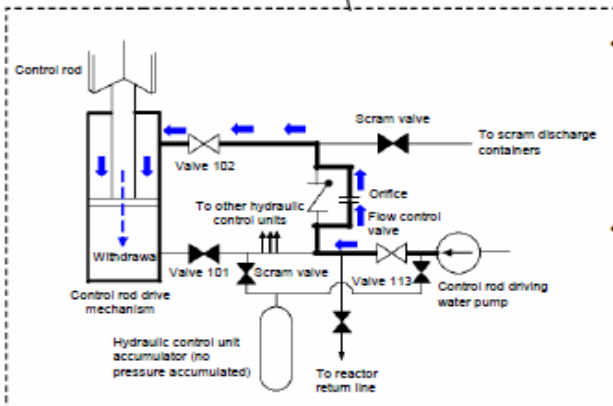
[Withdrawn control rods]

(1) Control rod [26-39]
Position 16 (withdrawn by about 1/3)

(2) Control rod [30-39]
Position 20 (withdrawn by about 2/5)

(3) Control rod [34-35]
Position 8 (withdrawn by about 1/6)

All the other control rods were completely inserted.



- Because valve 101 was closed with the flow control valve opened and the valve to the reactor return line closed, the pressure represented by arrows was brought about, and the control rods were withdrawn unexpectedly.
- Though the reactor went critical and a reactor automatic shutdown signal was generated, they were not with urgency reinserted because valve 101 was closed, and no pressure was accumulated in the hydraulic control unit accumulator.

Davis Besse

Paks Chemical Cleaning Vessel

The Cleaning vessel located in the pit

Kori Unit 1

- February 8, 2012 - 29th refueling outage
- Loss of offsite power due to human error
  - EDG B failed to start; EDG A out of service for maintenance
  - Loss of all AC for 12 minutes; loss of cooling for 19 minutes
  - Hot leg temperature increased from 37 C to 58.3 C
  - Emergency Alert was not declared
- Station manager concealed the event from the regulator and from corporate
- Results of safety culture survey in May 2012: “Relatively few (23.2%) of plant staff provided positive response to whether safety culture is regarded as the overriding priority in performing any activity.” [IAEA Report]

WANO Post-Fukushima

- Established in April 2011, the Post-Fukushima Commission was charged with determining changes which should be implemented within WANO, based on lessons from the event at Fukushima Daiichi.
- Five recommendations to strengthen WANO and its focus on nuclear safety emerged:
  - Expand the scope of WANO's activities
  - Develop a worldwide integrated event response strategy
  - Improve WANO's credibility, including important changes to WANO's peer review process
  - Improve visibility and transparency
  - Improve internal consistency
- WANO's Governing Board approved the recommendations in October 2011. At the 2011 BGM in Shenzhen, China, WANO members unanimously supported the Board's decision.

Commission Members

- Tom Mitchell—Ontario Power Generation (chair)
- Allan Kupcis—Former WANO President
- John Herron—Entergy Nuclear
- Vladimir Asmolov—Rosenergoatom
- Yuriy Nedashkovsky—NNEGC
- Vladimir Hlavinka—CEZ
- Dominique Miniere—EDF
- GAO Ligang—CGNPC
- Phillipe van Troeye—Electrabel
- Jörge Michels—EnBW
- H K Park—KHNP
- Hideki Toyomatsu—Kansai Electric
- Takeo Fujie—JANTI
- William Coley—Former British Energy CEO

Important WANO Changes

1. Add EP to the scope of WANO activities
2. Add severe accident management to the scope of WANO activities
3. Add on-site fuel storage to the scope of WANO activities
4. Add some aspects of design to the scope of WANO activities
5. Implement an integrated emergency response strategy
6. Improve visibility and transparency

Important WANO Changes

7. Implement a real-time event reporting process
8. Address equivalency of INPO, JANTI, IAEA and other peer reviews
9. Conduct a corporate review of every member within six years
10. Increase peer review frequency to every four years
11. Add an assessment or grading process
12. Conduct internal assessment of each WANO Region and London

Other WANO Challenges

- Concerns in Asia
  - 48 Japanese units shutdown
  - Safety culture
- Rapid growth of our industry despite Fukushima
  - Aggressive programmes to build new units
  - New entrants to the nuclear community
  - Multi-national owners/operators
- Fukushima distraction
- Aging, life extension and power uprates
- Turnover in workforce
- Safety focus during nuclear program phase-out (Germany, others?)
- Expanding the size and scope of WANO – improving credibility and effectiveness
- Moving from prevention to prevention and mitigation

Key Points You Should Take Away

- Fukushima will offer important industry lessons; but we should not forget TMI and Chernobyl
- Human performance (safety culture) is still the leading cause of core damaging events
- Our industry must shift its mindset from “prevention” to “prevention and mitigation”
- If you do not use operating experience you are destined to repeat it
- Our industry (and WANO) will emerge from the Fukushima event with an even stronger commitment to nuclear safety

Questions to Consider in Your Working Groups

- What is the “root cause” of the Fukushima disaster?
- Did WANO fail?
- Why do we not learn from operating experience? What are the barriers?

W A N O

Questions?