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The Case for Global Research & Development Following Fukushima

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Vice President & CNO

IAEA International Experts Meeting
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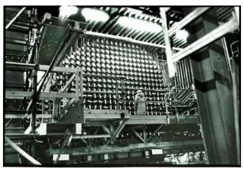
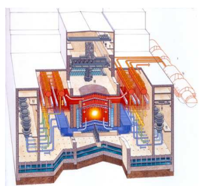
Looking Back…

- Early nuclear efforts were weapons program focused:
  - National security/pride/identity
  - Fast moving
  - High investment



- Consequences:
  - Many different designs/concepts
  - Diverse standards
  - Lessons not shared
  - Technology not fully understood?
  - Safety implications not comprehensively addressed?



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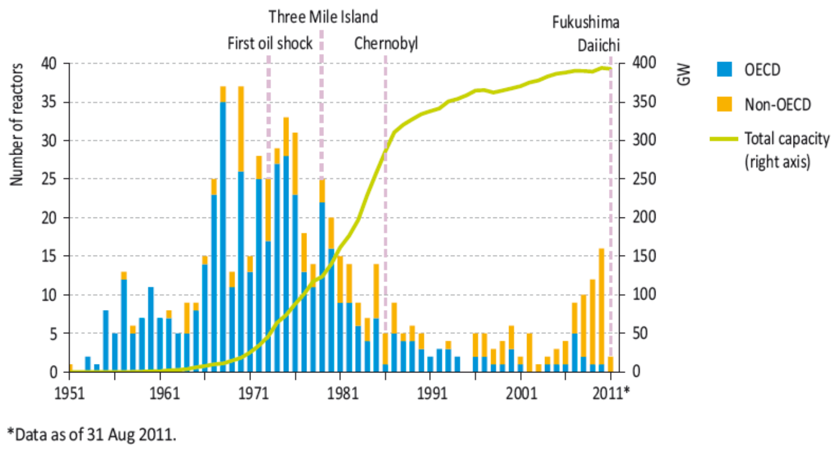
“Build Out” of the Industry…



Data Source: OECD/NEA

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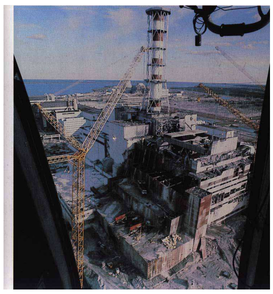
Accidents and Lessons…

- Significant events
- Tangible public impact
- Slow communication of events
- Significant clean-up costs
- Industry credibility damaged
- Safety issues still not fully understood?



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Follow Up …

- Increased global “coordination”
  - IAEA (1957)
  - INPO (1979)
  - WANO (1989)

- Focused research into causes of accidents
  - Thermal hydraulics
  - Accident management
  - Fuel
  - Safety systems
  - Human factors

Still national/technology focused…

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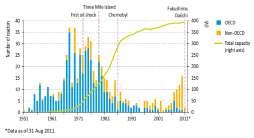
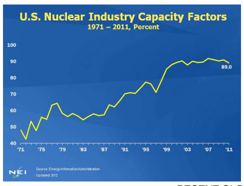
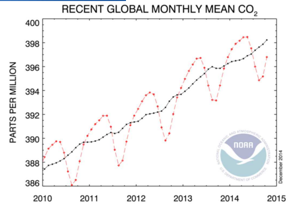
The “Nuclear Renaissance”



- Continued “build out” across the globe
- Improved operational performance
- Sharing of operating experience
- New designs developed
- Climate change discussion
- FUKUSHIMA….





A transformational event?

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Fukushima…What Was Different?

- Instantaneous communications
  - Global awareness of issues and response
  - Public debate on nuclear power
  - Challenge to future
- Multi-unit impact
- Safety procedures ineffective
- External event paradigm challenged

Recognition that all plants and operators MUST stand together…

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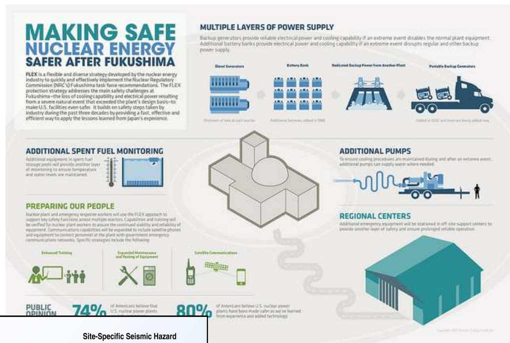
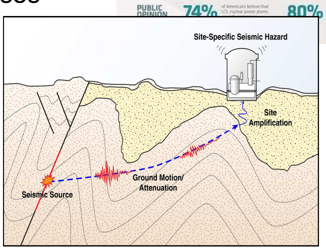
Global Response

- Immediate and extensive
  - Stress tests
  - Portable emergency equipment
  - Seismic re-evaluations
  - Emergency exercises
  - Plant shutdowns





Sharing, collaboration and benchmarking

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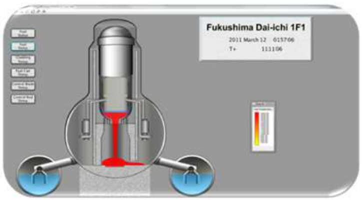
Global R&D Collaborative Successes

- Two examples of success:
  - The "Zorita Project"

  - Modular Accident Analysis Program (MAAP)



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Success: Jose Cabrera "Zorita" Plant

- Unique opportunity to extract highly irradiated reactor internals material
- To understand fluence effects:
  - *Mechanical properties*: tensile strength, fracture toughness, crack initiation and growth
  - *Microscopic properties*: grain boundary chemistry and size, void formation, and hydrogen and helium production
- Support ongoing operation of current fleet

Jose Cabrera NPP "Zorita"
Westinghouse design
1968 – 2006 (~26 EFPY)

Collaboration between global utilities and regulators; managed by EPRI

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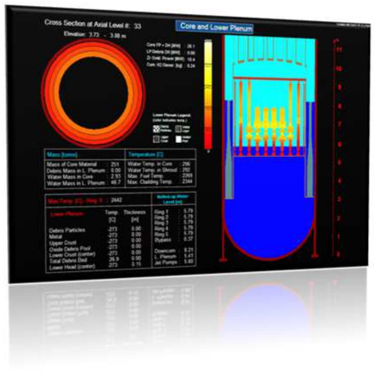
Success: MAAP

- Fast running code to simulate/ predict severe accident progression
- Initial development in 1980s
- Predicts timing of key events
- Evaluates effects of operator actions
- Predicts magnitude and timing of fission product release

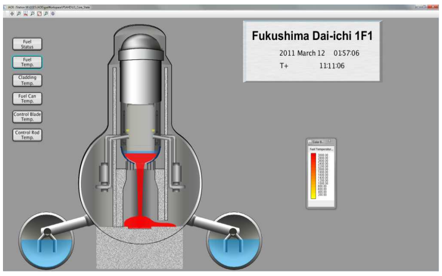


Global effort: 17 countries, 70 organizations

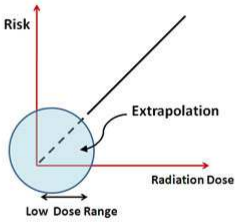
Current Applications of the MAAP Code

- Probabilistic Risk Assessment (PRA)
- License Renewal/Power Uprates
- Design & Design Certification for Advanced Light Water Reactors
- Severe Accident Guidelines (1992)
- Severe Accident Simulators

- Fukushima Root Cause Evaluation
- Severe Accident Guidelines
- Filter and Venting Strategies
- Stress Tests
- Restart Analysis in Japan
- Portable Equipment/FLEX
- Spent Fuel Pool Analyses
- Real-Time Event Evaluations



Global R&D Opportunities



- Low dose health effects
- Accident tolerant fuels
- Long term storage of spent fuel
- Decommissioning technologies
- External events analysis
- Shared use of specialized facilities
- Gen IV and beyond

Many continuing needs…

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Conclusions

- The nuclear industry continues to be important to the global community
- Despite decades of progress there is still much to do
- The era of massive state funded R&D is past
- Collaboration across borders and across technologies will help assure the ongoing success of nuclear

"Success is not final, failure is not fatal: it is the courage to continue that counts."

Winston Churchill

No single country can do everything…

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Together…Shaping the Future of Electricity

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