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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?



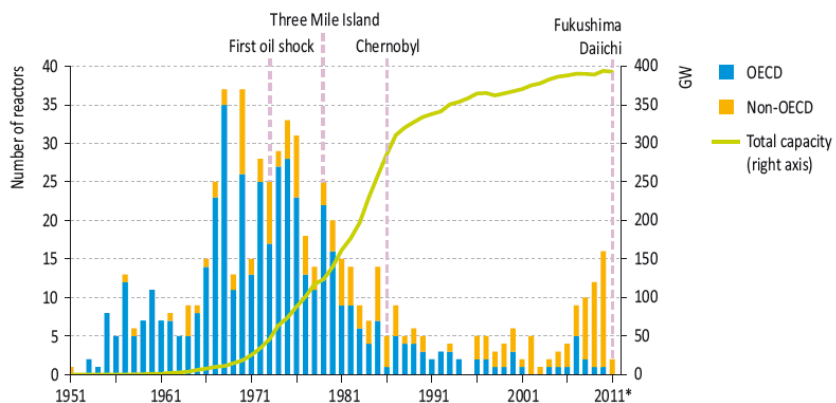



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“Build Out” of the Industry...



*Data as of 31 Aug 2011.

Data Source: OECD/NEA

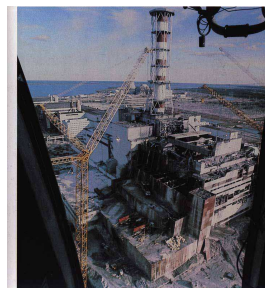
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Accidents and Lessons...

- 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...

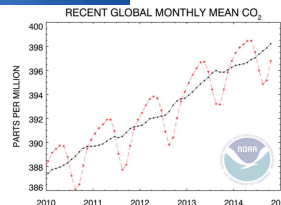
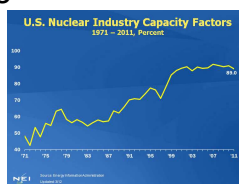
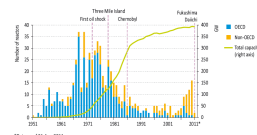
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The “Nuclear Renaissance”

- 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

MAKING SAFE NUCLEAR ENERGY SAFER AFTER FUKUSHIMA

MULTIPLE LAYSERS OF POWER SUPPLY
Backup generators provide electrical power and cooling capability if an extreme event disables the normal plant equipment. Additional battery banks provide electrical power and cooling capability if an extreme event disrupts regular and other backup power supply.

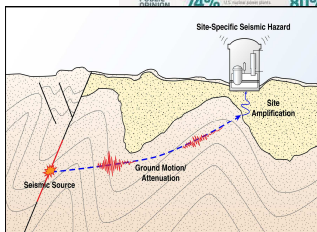
ADDITIONAL SPENT FUEL MONITORING
Additional equipment to spot fuel temperature and pressure anomalies and monitor fuel levels are installed.

PREPARING OUR PEOPLE
Additional equipment to spot fuel temperature and pressure anomalies and monitor fuel levels are installed. Additional equipment to spot fuel temperature and pressure anomalies and monitor fuel levels are installed.

ADDITIONAL PUMPS
To ensure cooling operations are maintained during and after an extreme event, additional pumps are installed where needed.

REGIONAL CENTERS
Additional emergency response is provided in off-site support centers to ensure timely repair of safety and emergency equipment operation.

PUBLIC EDUCATION 74% of consumers believe that nuclear power is safe. 80% of Americans believe U.S. nuclear power plants have been made safer as a result of new regulations and better technology.



Sharing, collaboration and benchmarking

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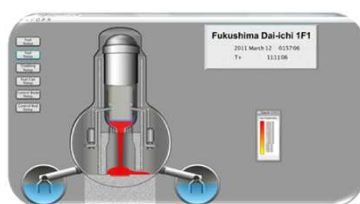
Global R&D Collaborative Successes

- 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

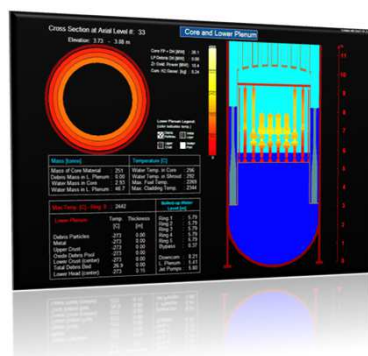
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Success: MAAP

- 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

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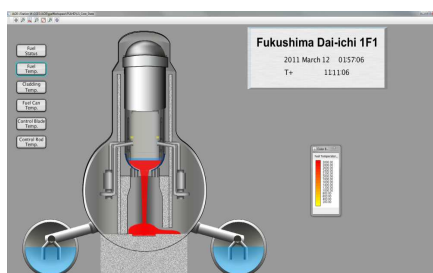
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Current Applications of the MAAP Code



- 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



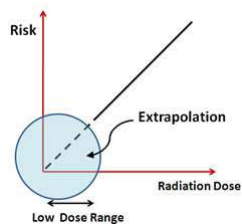
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Global R&D Opportunities

- 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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