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China's Nuclear Safety Regulatory System: Current Status and Challenges

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China's Current Nuclear Program

- 14 nuclear reactors in operation (12 GWe)
  - Qinshan Phase I, II III (5 reactors - indigenous & Canada)
  - Daya Bay (2 reactors - France)
  - Ling Ao Phase 1 (2 reactors - France)
  - Tianwan (2 reactors - Russia)
  - Ling Ao Phase II (2 reactors - localized CPR-1000)
- 27 reactors under construction (29.5 GWe)
- Nuclear power target: 60-70 GWe by 2020

China's Reactions to Fukushima

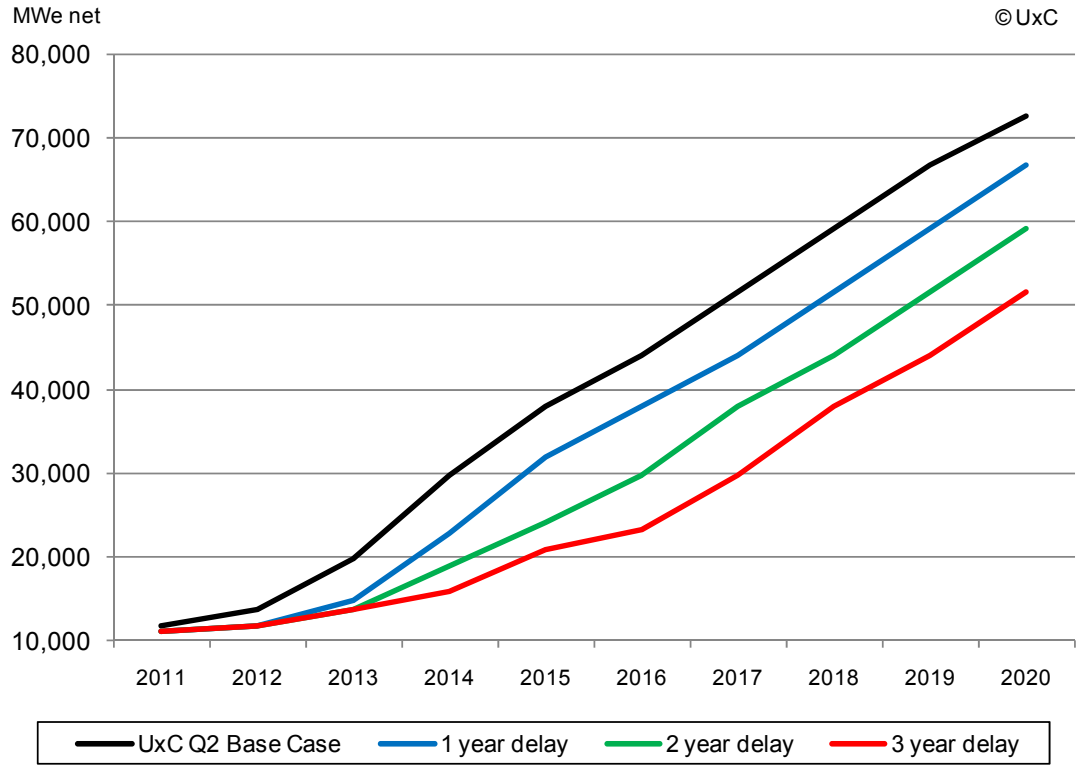
- Response from the State Council on nuclear safety and development in March (four guidelines)
- Premier's speech on China's continuing nuclear energy development policy and call for international cooperation in May
- Safety inspections on reactors in operation and under construction
- Release of new safety standards/plans
- Renewed push on China's atomic energy law
- Temporary adjustment of NPP development pace

Reasons Behind China's Reactions

- China sees the shortcomings of Gen II designs from Fukushima accidents and China has 25+ Gen II reactors planned
- China needs more time to see how the first AP1000 projects develop
- China realizes it still has an incomplete regulatory system
- China's government is more risk-averse now considering public safety and opinions

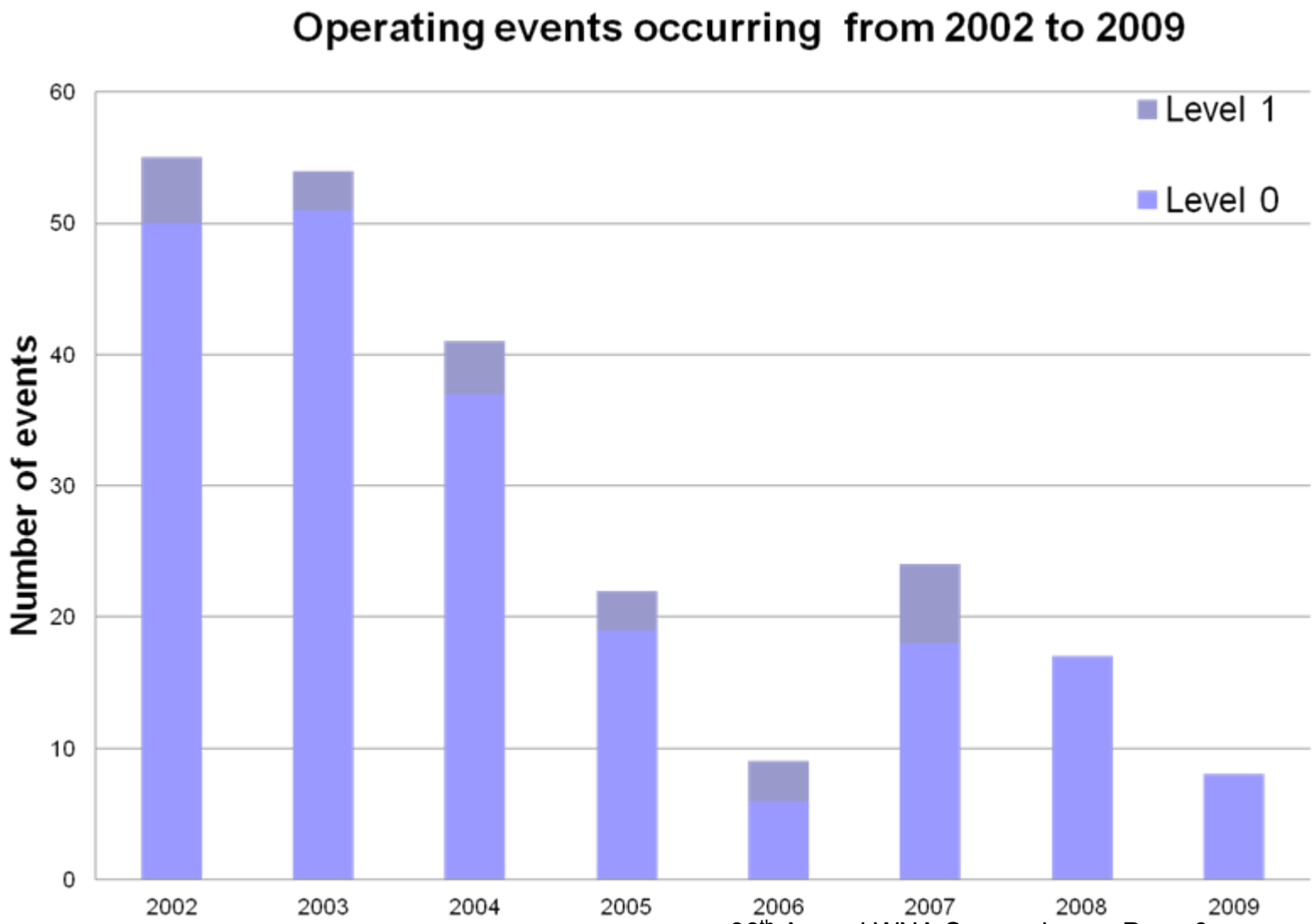
Post-Fukushima Growth Scenarios

- 1 year delay: 66.7 GWe by 2020 (6.0 GWe less than UxC Q2 Base case)
- 2 year delay: 59.1 GWe by 2020 (13.6 GWe less than UxC Q2 Base case)
- 3 year delay: 51.6 GWe by 2020 (21.1 GWe less than UxC Q2 Base case)



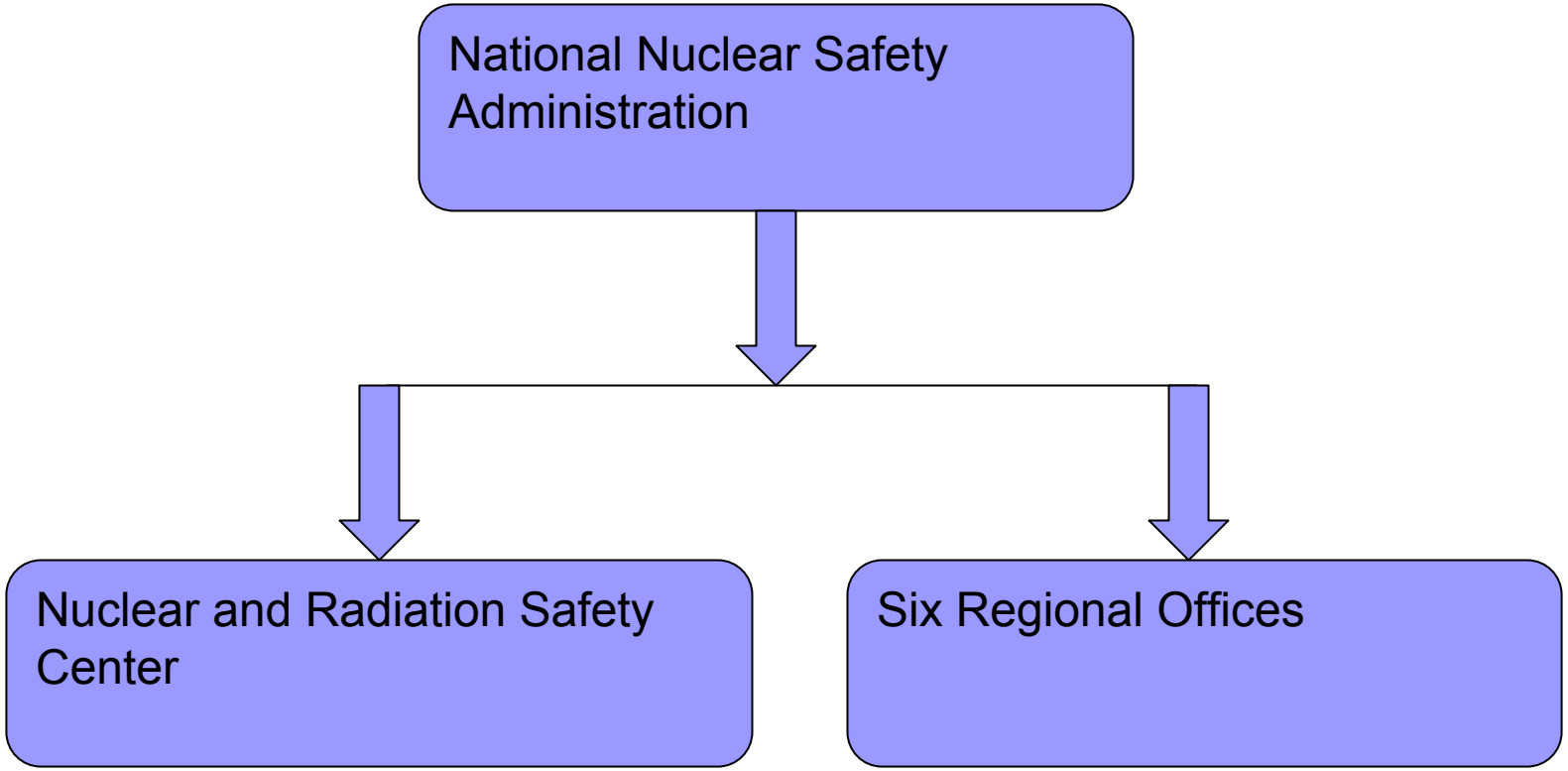
Key Uncertainties:
1)Start of new approvals
2)Future of CPR-1000
3)NPP siting

China's Nuclear Incident History



China's Nuclear Regulatory System

- Organization Chart



China's Nuclear Regulatory System

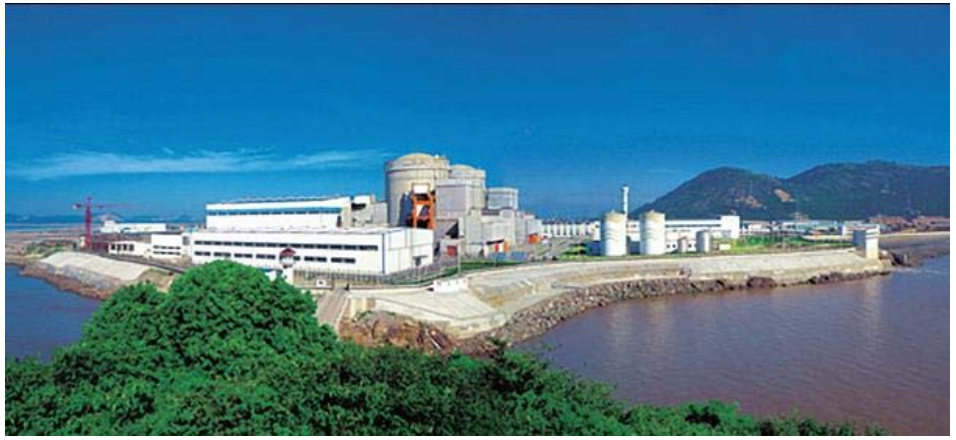
- National Nuclear Safety Administration (NNSA)
  - Ensure the supervision and management of radiation and nuclear safety
  - 12 sub-divisions with 30-40 staff members
- Nuclear and Radiation Safety Center
  - NNSA's technical support and assurance body
  - Technical assessment and evaluation
  - 200+ staff members
- Regional Offices
  - NNSA's supervising and enforcement body
  - Daily supervision activities
  - 6 offices with 331 staff members

Current Practices & Enforcement

- New nuclear project licensing process includes three stages and two major permits
  - Siting and feasibility study stage: Project Approval needed from the National Development and Reform Commission (NDRC)
  - Construction stage: Construction Permit (CP) and First Fuel Loading Permit (FFLP) issued by the NNSA
  - Commissioning stage: Operation Permit (OP) issued by the NNSA

Current Practices & Enforcement

- Case 1:“Welding Defects” at primary loop connection pipes at Qinshan Phase II Unit 2
  1. Deficiencies in quality assurance
  2. Inadequate nuclear safety culture at the utility company and supplier
  3. Insufficient experiences of Regulator to make judgment and resolution
  4. Regulator’s strict attitudes on regulation enforcement



Current Practices & Enforcement

- Case 2: “Control rod drop time” non-compliance at Daya Bay plant
  1. Design Defects from the vendor
  2. Regulator’s strict attitude to nuclear safety
  3. Insufficient R&D capabilities at NNSA to assess licensee’s technical responses or solutions

Current Practices & Enforcement

- Overall, NNSA fulfills the functions of supervision and enforcement
- NNSA treats safety as a top priority in practice
- No compromise on detected problems
- Good understanding of state-of-art nuclear safety regulation development in other countries, e.g. IAEA, NRC, ASN, etc.
- Ambitious program to improve NNSA technical competency

Problems & Challenges

- Insufficient nuclear regulatory professionals and expenditures
- Insufficient R&D capability to identify potential technical issues and approve and assess new designs
- Issues remain on safety culture and quality assurance
- **Lack of nuclear emergency planning and exercise**
- **Incomplete integration into international safety regime**
- Insufficient public participation
- **Potential issues with utility operators and supplier quality assurance that could have safety impacts**

Conclusions

- Overall, China's nuclear safety regime is on par with global standards
- **Some past incidents have** highlighted critical shortcomings (e.g. technical depth)
- **Government and Industry need to work together to ensure that a large nuclear power program can be built and operated safely**
- Current new construction delays may be significant, but this should result in improved safety standards with positive long-term outcomes in public opinion