China's nuclear waste: management and disposal

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Talk outline

Section 1: Current status of post-Fukushima activities and implications

Section 2: China's current and future nuclear waste management

Section 3: Challenges of geological disposal of nuclear waste in China

Current status of post-Fukushima activities

- National Nuclear Safety Administration's nuclear safety plan called for higher safety standards and pushed on Gen III technologies
- The 2012 safety inspection report required 16 areas to improve by 2015.
- National Development Reform Commission set a new goal for China's Medium and Long-term Nuclear Power Development by 2020

Implications of post-Fukushima activities

- Only few Gen II+ projects which either were under construction or paired with existed units moved forward.
- Planned units switched to Gen III designs
- The Chinese nuclear industry already appears the urgency to develop domestic next generation technologies (ACPR1000, ACP1000, CAP1400)
- The main nuclear utilities are actively seeking overseas investment opportunities to make use of their financial resources

Potential impacts on spent fuel management

- The slower development pace of nuclear power program will decrease spent fuel generation
- R&D programs on on-site spent fuel storage safety
  - Deploying extra backup emergency power systems and portable pumps
  - Emergency coolant makeup system (passive coolant tank) and continuous water level monitoring system

Section 2 :
China’s current and future nuclear waste management

Low and Intermediate Level Waste

- Two existed LILW facilities
  - Beilong facility located in Guangdong
    - ~205,00 M^3 in total and 80,000 M^3 waste
    - Above ground

Cont'd

- Two existed LILW facilities
  - Yumen facility located in Gansu
    - ~200,000 M^3 in total and 60,000 M^3 waste
    - Under ground (10~20 meter)
- Three future facilities in plan
  - East coast area
  - Northeast area
  - Central area

High Level Nuclear Waste (HLW)

- China has a long-term reprocessing policy for its fuel cycle program and proposed a deep geological disposal method for high level nuclear waste since 1985
- Since China's nuclear industry is relatively young, China hasn't experienced any pressure from spent fuel and HLW storage
- R&D program is still at the early stage

Conceptual design

- The preliminary repository concept is a shaft-tunnel system, located in saturated zones in granite.
- The granite is considered as the most suitable host rock and bentonite is proposed as buffer and backfill material.

HLW R&D program

- The China Atomic Energy Authority (CAEA) is in charge of developing plans and projects for HLW disposal
- China National Nuclear Corporation (CNNC) is in charge of implementing R&D activities
- Beijing Research Institute of Uranium Geology (BRIUG) implements core research projects

The three-step plan in progress

- It is expected that China will finish the siting selection and build up an underground laboratory around 2020;
- On-site research activities at the underground laboratory should take place between 2020 and 2040;
- The actual HLW repository will be constructed around 2050.

Major research activities: 2006-2020

- Strategies, planning and management
- Site selection and site characterization
- Engineering Design
- Radiochemical studies for disposal
- Safety assessment

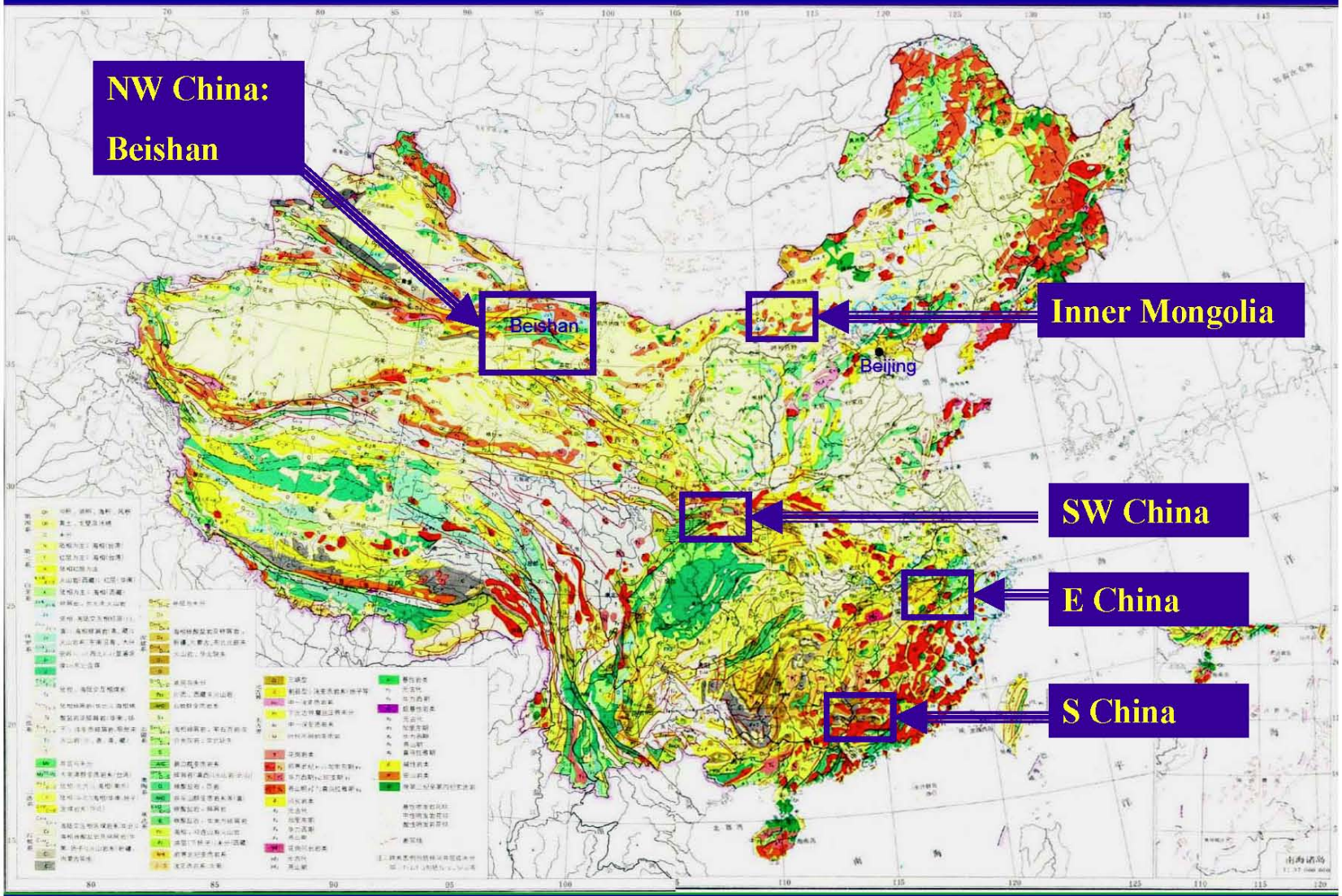
Current status

- The early projects include studies of regional geological setting, seismic safety, geological and hydrogeological features, rock mass quality investigation, geophysical survey, borehole drilling and borehole tests.
- China has not finalized the permanent location and is still conducting researches in Xinjiang and Inner Mongolia areas.
- Five potential sites are chosen, studied and compared and the most promising one is the Beishan area.

Current status (Cont'd)

- 16 boreholes were drilled at three sub-areas in the Beishan area during the period of 2000–2011.
- Designs of the underground laboratory and the repository passed the expert panel evaluation

Major activities: Site selection and site characterization

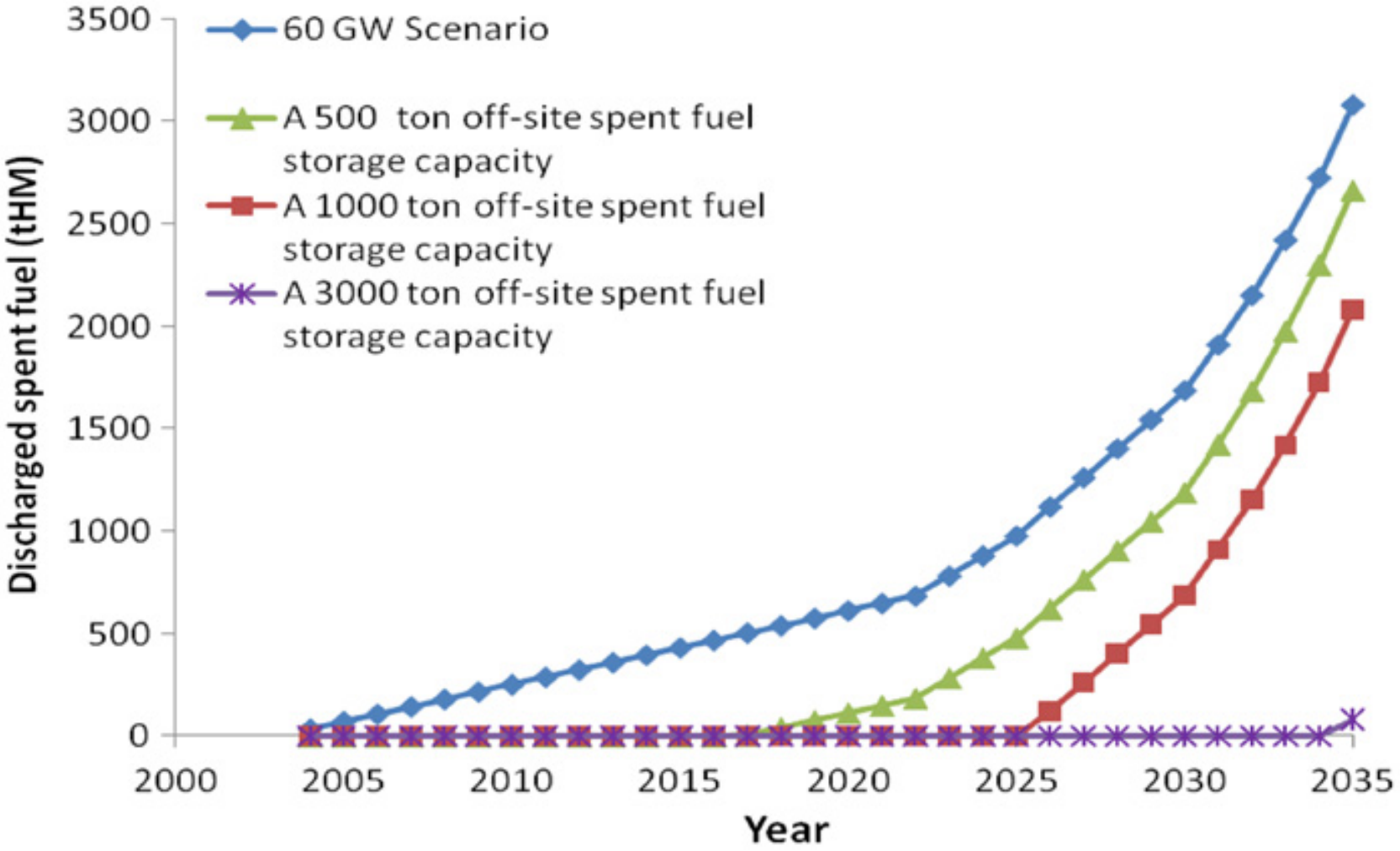


5 Pre-selected regions for China's HLW repository since 1986

drilling sites at BS01, BS02, BS03, BS04 boreholes

Section 3 :
China’s nuclear waste disposal: Future scenarios and Challenges

Future spent fuel management



Future spent fuel management (cont'd)

Offsite storage space (tons)	Estimate of when the storage will reach full capacity
500	2017
1000	2025
3000	2035

China will experience very little pressure to reduce the burden of storing spent fuel.

China’s current fuel cycle program

- The reprocessing pilot site will be in operation after safety modifications (50 tons/year)
- The China’s experimental fast reactor connected to the grid (20 MWe)
- A potential commercial reprocessing site is under plan (Areva tech or domestic tech)
- A 200 tons/year demo project is under development
- A MOX pilot site is under construction

Future scenarios

- Due to less pressure from spent fuel storage and China's ongoing R&D program on reprocessing, China will not view the deep geological disposal as a spent fuel storage tool in the near term.
- China will continue to generate HLW from its reprocessing R&D activities
- The potential commercial reprocessing site might not be in operation in the next 15 years.

Potential deep borehole disposal

- In China, deep borehole disposal was not considered as an option for HLW management and has not been studied closely
  - China has reprocessing policy for spent fuel
  - High level nuclear waste will be disposed next to the reprocessing site
- Commercial drilling technologies in China allow a 4km depth and mainly focus on mining exploration
- In 2005, China's national drilling R&D project fulfilled a 5km deep borehole

Problems & Challenges

- An Incomplete regulatory system to regulate all nuclear activities
  - China needs an Atomic Energy Law to regulate all nuclear related activities
  - Currently, there is not any law to regulate nuclear waste management, disposal and spent fuel disposal fund imposition

Cont'd

- Insufficient attentions and financial supports on nuclear waste disposal R&D activities.
  - The budget on HLW R&D activities was relatively low comparing to other national energy projects
  - The HLW R&D program never been listed as a key national R&D program
  - An independent and specialized agency needed to plan and manage the program

Cont'd

- Insufficient public participation
  - the Chinese public seems to accept and embrace nuclear technologies before Fukushima for several reasons.
  - In the past, the Chinese public has not been an integral part of nuclear energy decision-making. This situation is changing.
  - The Chinese government will have to improve public participation to make the decision making system more transparent and enforce the regulatory system more effectively.

Cont'd

- Limited international cooperation on nuclear waste management and disposal
  - Participating international R&D projects
  - Communicating and collaborating with other nuclear states on geological disposal R&D