



NAUTILUS INSTITUTE

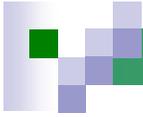
Overview of Project and Meeting Goals

David F. von Hippel

Nautilus Institute

Prepared for the Spent Fuel and Reduction of
Radiological Risk after Fukushima and Deep Borehole
and Spent Fuel in East Asia WORKING GROUP MEETING

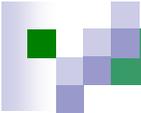
May 28-30, 2013, Beijing, China



OUTLINE OF PRESENTATION

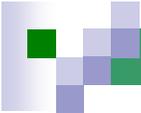
- **Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia**
- **Project Goals**
- **Introduction to Sessions 1 and 2**
- **Other Meeting Activities**





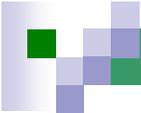
Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia

- **Key Project Question—Following on from last year, given the lessons of Fukushima, how do nuclear energy fuel cycle and nuclear materials management choices affect the vulnerability, resilience of nuclear facilities to radiation release due to accident or attack?”**
 - **How can the risk of radiation release be reduced in individual facilities (includes issues like “reciprocal risk” where spent fuel storage and reactor facilities are located together/share key systems)?**
 - **How can risks of radiation release be reduced in the nuclear energy system/energy sector overall?**



Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia

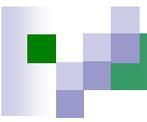
- **Continuing Project Funding from:**
 - **JOHN D. AND CATHERINE T. MACARTHUR FOUNDATION**, for “Spent Fuel and Reduction of Radiological Risk after Fukushima ”, funding the overall energy sector modeling, nuclear fuel cycle, and radiation consequences of accident portions of the project
 - **CARNEGIE CORPORATION OF NEW YORK**, for “Deep Borehole and Spent Nuclear Fuel in East Asia”, funding the elements of the project related particularly to the prospects of deep borehole disposal of nuclear materials in the region



Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia

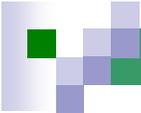
- **Key vulnerabilities—shared by many reactor systems worldwide—that were illustrated by the Fukushima accident include:**
 - **Having reactor cores and spent fuel-pools co-located, especially (but not necessarily) when in the same building, means that when radiation leaks that restrict access to one system typically also restrict access to the other**
 - **Interruptions in power/emergency power and/or water supplies affect both units**
 - **Common venting allows H₂ to build up and potentially explode to affect both systems**





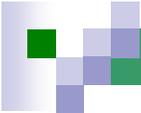
Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia

- **Additional “common-mode” or “reciprocal” risks:**
 - **Blocking of access roads and other site access avenues affects safety/security of both systems**
 - **Potential for unforeseen cascading events involving multiple systems to make the aftermath of an accident far worse**
- **Possibilities to consider: retrofitting and/or reorganizing reactor/spent fuel management systems so as to reduce risks of common-mode failure**



Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia

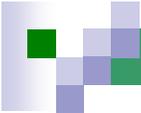
- **Options to address reciprocal risk (in existing and new reactors)**
 - **Build redundant systems**
 - **Separate spent fuel pools and reactors spatially, and provide with separate utilities and access roads**
 - **Use different forms of SF management**
 - **Harden existing/new structures against forces of nature/attack**
 - **Strengthen safety/security institutions**



Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia

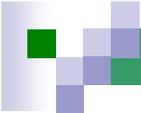
- **Addressing Project Question for East Asia nations involves cascading considerations:**
 - **How might the energy sectors of the nations evolve over the next few decades?**
 - **Within the energy sector, how will nuclear energy use evolve in each nation?**
 - **For a given level of nuclear energy development/use, how will the nuclear fuel cycle be developed/managed in each nation or regionwide--including choices for long-term storage/disposal of nuclear materials?**
 - **How do choices above affect risk, consequences of radiation releases due to accident or attack?**





Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia

- **To Address the Project Question this project again brings together**
 - **Energy futures modelers**
 - **Nuclear fuel cycle experts**
 - **Spent fuel storage/disposal experts**
- **Because the development of the nuclear energy sector has to be considered within the context of the economies and societies that it serves**



Project Overview: Spent Fuel and Reduction of Radiological Risk/Deep Borehole and Spent Fuel in East Asia

■ Project builds upon

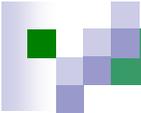
- **13+ years of collaborative consideration of energy futures and Energy Security in East Asia by Nautilus and colleagues, including many of the participants present today!**
- **“East Asia Energy Futures” Project**
- **“Asian Energy Security” Project**
- **“East Asia Science and Security” Project**
- **Nautilus DPRK work**
- **Common elements—collaborative use of “LEAP” energy futures modeling tool within broad energy security analysis methodology—seeking to identify “robust” policy strategies addressing multiple issues**



Project Goals and Steps

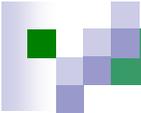
- 1. Update, expand, and add detail to existing LEAP “energy futures” models in China, Japan, and the ROK**
- 2. Revise and elaborate different nuclear energy scenarios for each nation, within the overall energy sector models, and taking into account recent and ongoing changes/potential changes in policies throughout the region (broader East Asia)**
- 3. Investigate and deepen understanding of existing and potential nuclear fuel cycle choices in each country**





Project Goals and Steps

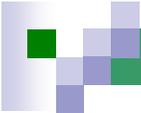
- 4. Estimate the implications of different energy/nuclear/nuclear fuel cycle scenarios/configurations in terms of locations and amounts of nuclear materials in storage over time**
- 5. At the same time, estimate and compare the costs and other energy security attributes (for example, greenhouse gas emissions) of different energy/nuclear scenarios**
- 6. Estimate/illustrate potential radiological risk of accident/attack on facilities where nuclear materials are stored under different scenarios**



Project Goals and Steps

- 7. Include in each step consideration not only of nuclear fuel cycle elements now existing or under development, but proposed technologies such as deep borehole disposal**
- 8. Use the overall results of analysis to identify both technical and policy approaches that offer the potential to reduce radiological risk and address other energy security issues**
- 9. Include consideration of options that involve the regional and international community—including updating/elaborating earlier scenarios of nuclear fuel cycle cooperation**

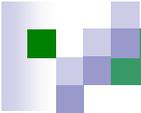




Project Goals and Steps

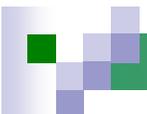
- 10. Include consideration of the impacts of national choices on broader regional security**
- 11. In the months following the meeting, complete LEAP analysis for each country, and compile/report results**
- 12. Update quantitative/qualitative analysis of nuclear fuel cycle cooperation scenario**
 - **See draft “Working Paper” prepared earlier this year as an example**





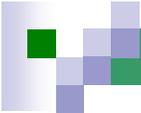
Project Goals and Steps

- 13. Complete overall report with chapters on energy sector analysis, nuclear energy, and deep borehole disposal prospects in each country, as well as analytical results above**
- 14. Complete reports to funders**
- 15. Publish project results as appropriate in each country and in international fora**
- 16. Prepare and deliver summaries of reports to key decisionmakers in NEA and elsewhere**



Introduction to Sessions 1 and 2

- **SESSION 1: Country Updates and Summaries**
 - Provide updates on key changes/trends in the energy sectors and energy policies of each nation
 - Provide updates on, description of next steps in overall energy sector modeling in each nation using LEAP model, including initial updated LEAP results
 - Republic of Korea: Dr. CHUNG Woo-jin, Korea Energy Economics Institute (KEEI) (with David von Hippel presenting Dr. KIM Hoseok's LEAP model)
 - Japan: Dr. Kae TAKASE, Governance Design Laboratory
 - China: Prof. WANG Yanjia and Prof. GU Alun, Tsinghua University



Introduction to Sessions 1 and 2

- **SESSION 2: Nuclear Energy and Nuclear Development**
 - Provide history of and updates on key changes/trends in the nuclear energy sectors and nuclear fuel cycle energy policies of each nation
 - Suggest scenarios for future developments in the nuclear energy/nuclear fuel cycle sectors in each nation
 - Japan: Ms. Tomoko MURAKAMI, Institute of Energy Economics, Japan
 - Republic of Korea: Dr. KANG Jungmin, Korea Advanced Institute of Science and Technology
 - China: Prof. LIU Xuegang, Tsinghua University



Other Meeting Activities

- In Session 2, there will be an opportunity for energy sector modeling and nuclear energy experts to meet to begin to coordinate on revising inputs to energy scenarios for LEAP
- Session 3, starting on the 29th, will focus on long-term nuclear materials storage and disposal, particularly deep borehole disposal of nuclear materials
 - Special case of nuclear fuel cycle management with potential for national use, regional cooperation
 - Will include comments by Dr. Neil Chapman of Chapman & Co Consulting, and discussions of how to integrate deep borehole and related approaches into analysis



Other Meeting Activities

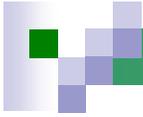
- **Session 4 will focus on the presentation, adaptation, and planning for the application of a methodology for assessing the radiological risk of attack on or accident at nuclear fuel cycle facilities**
 - **Presentation by David VON HIPPEL with a general introduction, and showing draft illustration of application of methodology to DPRK LWR**
 - **Presentation by Dr. Gordon THOMPSON providing a review of the methodology he has developed for the purpose, and case studies for US facilities**





Other Meeting Activities

- **Session 5: Working session to apply radiological risk methodology and related issues**
 - **With Gordon as a resource, make as much progress as possible on evaluating radiological risk for illustrative nuclear facilities in each country**
 - **Identify additional data needs and tasks to complete assessments**
 - **Finalize plans for next steps in project as a whole, including radiological risk and borehole disposal aspects, including preparing and reviewing analysis and publications, possible publicity approaches, and other project aspects**



THANK YOU!



NAUTILUS INSTITUTE

