Final Grant Report

to U.S. Department of Energy
Oakland Operations Office

Final Narrative and Technical Report Regional Grid Connection Project Grant Number DE-FG03-02SF22537/A000

November 26, 2003

This document provides our Final Report for Grant Number DE-FG03-02SF22537, “Regional Grid Connection Project.” The original grant period was June 1, 2002 through May 31, 2003, and was extended until December 31, 2003.

This report consists of two sections. The first reports on the project deliverables. These reports are *given in italics*.

The second provides the detailed report on the regional grid workshop held in Vladivostok from September 29-October 4, 2003.

I. REPORT ON PROJECT OUTPUTS FROM GRANT PROPOSAL

- 6.1 Work with regional counterparts in a common analytical software framework for conducting national studies of the potential for regional grid connection in technical, economic, environmental and institutional terms.

The bulk of the quantitative and simulation activity was conducted in Excel. At this stage, it is premature to conduct studies in a software framework such as Matlab’s Power Toolbox. However, participants did settle on the dimensions for future comparative research including economic, technical, and environmental aspects of power trading.

- 6.2 Convene an annual regional grid connection workshop to gather and analyze country-specific data needed to analyze the potential for regional grid integration.

The 2003 Grid Workshop was convened in September-October 2003 in Vladivostok, Russia, and a full report is provided in section II below. A great deal of new technical and environmental data was provided by national presenters.

- 6.3 Initiate regional expert studies of the technical, economic and institutional feasibility of various grid connection configurations, especially linking the Russian Far East and the two Koreas.

These regional expert studies were initiated and presented at the workshop and are listed below in the workshop agenda. Copies of the presentations have been published on the project website. The primary focus of these papers is on the Russian Far East-DPRK-ROK network configuration, as called for in the project proposal.

- 6.4 Analyze specifically which grid connection and upgrade options would enable the safe operation of the two light-water reactors provided for in the 1993 KEDO-DPRK Agreed Framework.

After discussion with DOE HQ, this aspect of the original proposal was NOT pursued at the workshop as sufficient analysis had been conducted at earlier workshops and the interests of policymakers in addressing this issue has declined along with the KEDO LWR project and the Agreed Framework, rendering the issue largely moot. However, KEDO was represented at the workshop and the issue was discussed.

- 6.5 Compile results and provide annual reports to participants, and briefings to policy makers on the technical and economic merits of a regional electrical grid in Northeast Asia up to pre-feasibility study.

Such briefings were conducted in Washington DC to DOE HQ in June 2003, to the ROK National Security Council in September 2003, and to DOE HQ by provision of the workshop report and subsequent conversations with HQ officials in October 2003.

- 6.6 Disseminate widely the results to the public via the Web and listservs.

This has been achieved; see the project website at:
<http://www.nautilus.org/energy/grid/2003Workshop/index.html>

Please contact me if you have any questions or we may provide any further information.

Sincerely,

Peter Hayes

II. REPORT OF THIRD REGIONAL GRID CONNECTION WORKSHOP VLADIVOSTOK, SEPTEMBER 29-OCTOBER 4, 2003

Compiled by Nautilus Institute
October 4, 2003

1. What Happened?

From September 29-October 4, about 40 electric utility and ecological officials and experts met in Vladivostok Russia to discuss proposed regional electric grid inter-ties between the DPRK, ROK, Russia and China. Participants from the United States, KEDO and Mongolia also attended the workshop.¹ The participants spent two days deliberating and presenting analysis of the ecological dimensions of regional grid connection, especially between Russia-DPRK-ROK.

Workshop in session/delegates at hotel in Vladivostok

Posyett Bay

They then spent two days together on a field trip to inspect the most sensitive zone, the wetlands at the intersection of the Russian Far East, the DPRK, and China a regional tieline might traverse.²

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¹ A participant list, their bios, and the workshop agenda and list of papers presented is provided in the attachments to this report and are also available at www.nautilus.org at the project home page.

² A map of the region visited in the field trip is provided in Vladimir Karakin's presentation. The delegations traveled into the sensitive border zone, accompanied by a representative of the Russian Border Guard. Photographs of the areas visited including the border village are provided in the attached trip reports.

Border between DPRK (left), Russia (foreground), China (right) looking South along Tuman River

Xacan Border Town, Russian Far East

Lotus Lake, north of Xacan Town, state reserve

At this, the third such regional workshop, national delegations were of a higher and more consistent quality than in the past. The DPRK and ROK especially sent high-level and high-quality delegations with specific briefs.

Kraskino Village, Chinese-Russian Hotel

The workshop and the field trip at close quarters including a bus and shared accommodations offered many opportunities for intensive interaction between participants, both formal and informal, and group and individual. In particular, the friendly and open communication between the North and South Korean participants was striking, as was the frank and specific discussion about potential for inter-Korean grid cooperation and statement of fears and anxieties about the risks involved in embarking on such cooperation.

On the topic of the workshop—ensuring that regional grid connections are maximally “green” and minimize ecological damage and preferably generate net environmental gains in terms of global, regional and local environmental impacts of providing electricity service—the discussion clearly articulated the imperative that in this region, utilities might strive for and achieve global standards of environmental performance.

Tuman River Wetlands, globally significant, north Xacan town to coast

Russian, North Korean and Mongolian engineers and officials all noted the importance of improving their performance and the shortfalls in current practice relative to both global standards explained at the

workshop, and in the specific challenge of not irreversibly degrading the sensitive and globally important wetlands, migration corridors and ecosystems of the Russian Far East south of Vladivostok and reaching to the DPRK and Chinese borders. North Koreans stated their avid desire to obtain more information on grid standards and practices, for study tours and training, and reflecting the critical and urgent situation arising from the collapse of the DPRK grid, their desire to move quickly from "more talk" to action.

In conclusion, there is clearly great potential to continue the dialogue and to take small, incremental, fast and affordable steps to foster "green" grid inter-ties, with important spillover for inter-Korean and geopolitical cooperative outcomes provided that the nuclear confrontation and related tensions ease over the coming months and year. There is a strong case for convening a fourth regional grid workshop, optimally in Shenyang to enable China to host the event, and to shift the focus from RFE-DPRK-ROK inter-ties to RFE-PRC inter-ties with side-ties to DPRK-ROK as an alternate baseline to the RFE-DPRK-ROK tieline—especially if the KEDO LWRs project is indefinitely postponed or terminated (which eases the urgency of considering an east coast RFE-ROK tieline that would support the KEDO LWRs). This fourth workshop should be combined with a study tour in either or both of the ROK and southern China on HVDC technology and implementation; and the compilation and exchange of required data for regional analysis of the technical, economic, environmental, and institutional analysis of regional grid connection options. In this regard, it is critical that the ROK and China take regional leadership with US backing and support.

It would be optimal if a first effort were made to compile such a database, at least for simplified grid data, to allow a commissioned expert study of the stability of connected national grids at a regional level to be presented at the next workshop, and for this to serve as a training opportunity in a common software framework to initiate national level studies for presentation at subsequent regional events and exchanges.

Other options for follow-up are provided in the next section of this report.

2. Summary of Next Steps Discussed at Third Regional Grid Connection Workshop Vladivostok, September 29-October 4, 2003

The Working Group deliberations included the following possible steps and implications for follow-up:

1. Conduct additional bilateral and concerted bilateral studies and discussions of inter-tie concepts, especially between the DPRK and the ROK, and under the rubric of the Working Group on Regional Grid Connection. In particular, clarify a common base-line concept of regional connection so that consistent assumptions and similar designs are used in separate studies so that they are comparable in technical, economic, and ecological parameters. Possible hosts for the meeting who either indicated that they would be willing to serve or might be approached include Ministry of Electricity, Mongolia; State Power Corporation/Liaoning Provincial Utility in Shen Yang; and Ministry of Electric Power and Coal, Pyongyang.
2. Select and utilize methods to analyze the regional distribution of ecological costs-benefits arising from grid connection; and

- explore the possibility that regional traded prices reflect the net environmental gains arising from a regional grid inter-tie.
3. Analyze the avoided costs arising from grid inter-tie such as avoided nuclear reactor construction, operation, maintenance, decommissioning and waste storage and disposal in South Korea by connecting DPRK reactors and/or Russian hydropower to ROK grid.
  4. Develop a policy constituency for the Northeast Asia Grid Interconnection Concept by briefings to each of the relevant governments and utilities; and to the international agencies such as the World Bank, Asian Development Bank, and in global or regional fora such as the Environmental Rights of Way Management Conference in New York, September 2004; the Northeast Asia Economic Forum meeting in Niigata, 2004; and in APEC Energy Working Group meetings.
  5. Monitor and communicate results of other events related to regional inter-tie concept in Northeast Asia such as the APERC October 29-30, 2003 and June 2004 grid connection study workshops; the Korea Electrotechnology Research Institute April 27-28, 2004 regional grid workshop under the NEAREST project.
  6. Promote increased communication of information and analysis between the various national, bilateral, and regional studies and investigations of regional grid connection via listserv, linked websites, and exchange of materials on CD-ROMs.
  7. Compile global and institutional standards, methods, assessment procedures for grid inter-tie projects such as World Bank and ADB standards on a CD-ROM and exchange to participants.
  8. Create a regional database, compile national grid data (technological, economic, environmental, institutional, a who's who contact profile) and exchange by WWW and by CD-ROM.
  9. Conduct a regional grid stability analysis using simplified network grid data for each country in an affordable and common software package such as MATLAB Power Systems Toolbox as first step to defining possible configurations of regional inter-tie that is consistent with and supportive of national utility development plans for electricity generation and transmission grids.
  10. Review alternate corridors for a regional inter-tie, especially the Russia-DPRK-ROK inter-tie that avoids ecological damage to valuable ecological assets such as the Tumen River wetlands and other critical habitat in this region, especially the possible trilateral grid inter-tie between Russian Far East-Southern China linked to DPRK-ROK inter-tie; examine co-location of grid inter-tie with natural gas pipeline corridors from Russian Far East to DPRK-ROK, including via China.
  11. Conduct training and study tours of national high voltage direct current (HVDC) technology and practices, especially in China, USA, and the ROK.
  12. Investigate possibility of a GEF "state of the art" environmentally sustainable grid inter-tie project with global replicability using net greenhouse gas reduction, engineering,

corridor selection, habitat offset and other innovative approaches to achieving sustainability.

For a summary of Deliberations, see Attachment F2. For observations on ROK-DPRK Interactions, see Attachment F1.

2. Key Points Made by DPRK Delegation at Third Regional Grid Connection Workshop, Vladivostok, September 29-October 4, 2003

The DPRK delegation made two presentations (see attached pdf files) and made a number of substantive interventions and asked questions at the workshop. Their presentations provided basic views on the inter-tie concept and their plans for high voltage grid construction. However, in private dinner and public comments at the workshop, they emphasize that their plans were just that, and could be revised to accommodate regional grid connection design requirements and standards. Lacking HVDC experience, they emphasized their relative ignorance of the engineering and design challenges (which is sobering considering that they have negotiated a 500 KV system integration with KEDO for the two LWRs and appear willing to abandon this understanding should it prove necessary for a regional inter-tie). They openly admitted their lack of knowledge or past concern about environmental aspects of grid connection, and admitted that their existing grid is prone to starting forest fires when it droops due to overload and heating of lines (they were going to present on this topic but the agenda ran out of time). They specifically requested training and study tours to enable their engineers to become conversant with the required standards for eventual World Bank, ADB or bilateral financing of a grid inter-tie (without which such a project will never occur).

LIST OF ATTACHMENTS

ATTACHMENT A. AGENDA AND PAPERS PRESENTED AT THIRD REGIONAL GRID CONNECTION WORKSHOP VLADIVOSTOK, SEPTEMBER 29-OCTOBER 4, 2003

ATTACHMENT B. PARTICIPANTS LIST

ATTACHMENT C. PARTICIPANT BIOS (PARTIAL, NOT ALL LISTED ATTENDED)

ATTACHMENT D. BACKGROUND TO THIRD REGIONAL GRID CONNECTION WORKSHOP

ATTACHMENT A. Agenda and Papers Presented at Third Regional Grid Connection Workshop Vladivostok, September 29-October 4, 2003
(note: copies of most papers are already posted at www.nautilus.org on the project home page; five papers delivered on the web site will be posted shortly).

REVISED DRAFT WORKSHOP PROGRAM

EVENING OF 29th September, 2003

<u>6:30-9:00</u>	<u>Registration and Reception (Hotel Gavan)</u>	<i>Scott Bruce, Nautilus Institute Anton Lozinsky, FEB-WWF, Valentina Buldakova, ERI</i>
6:30-7:00	Registration	
7:00-9:00	Informal Reception Dinner	

DAY ONE - 30 SEPTEMBER, 2003

<u>9:00-9:45</u>	<u>Opening Ceremony (Workshop Venue, Hotel Gavan)</u>	
	Welcoming Remarks	<i>Representatives from FEB-WWF, ERI, and Local Government</i>
	Opening of the Workshop, Summary of Project Background, and Presentation of Workshop Objectives	<i>Peter Hayes, Nautilus Institute</i>
	Presentation of Workshop Schedule & Logistics	<i>D. Von Hippel and Scott Bruce, Nautilus Institute, with FEB- WWF./ERI Counterparts</i>

<u>9:45- 11:40</u>	<u>National/International Updates on Grid Development and Grid Interconnection Investigations</u>	
	<i>Brief presentations on any major power grid developments (transmission and generation) in each country in the last year, including both infrastructural and institutional developments that might affect international grid interconnections, and report on any discussions underway regarding grid interconnections (20 minutes each, including questions)</i>	
	<i>The Development and Status of the Electrical Grid, and Discussions on International Cooperation for Grid Integration, in the Russian Far East</i>	<i>V. Kalashnikov and A. Ognev (RFE)</i>
	<i>The Development and Status of the Electrical Grid, and Discussions on International Cooperation for Grid Integration, in the Democratic People's Republic of Korea</i>	<i>Representative (DPRK)</i>

**10:25-
10:40**   **Break**

The Development and Status of the Electrical Grid, and Discussions on International Cooperation for Grid Integration, in the Republic of Korea
The Development and Status of the Power Grid in China, and International Cooperation for Grid Integration in Northeast Asia
Outcomes of UN ESCAP Meeting of Senior Officials on Energy Cooperation in North-East Asia

H-Y. Kim (ROK)

X. He (China) [To be presented by Colleague]

Attendee from UN ESCAP Meeting (or informal discussion)

**11:45-
12:30**

Environmental Issues for Regional Power Systems in Northeast Asia. A summary of the generic environmental impacts and potential impacts, both positive and negative, of power line construction, operation, including an overview of existing analysis, and a summary of what needs to be learned for the proposal under study. [30-35 minutes plus questions]

D.. Von Hippel and J. Williams, Nautilus Institute

**12:30-
1:45**   **Lunch**

1:45-4:30   **Possible Environmental Impacts and Benefits of Regional Power Grid Interconnections**

Speakers from Each Country will Present:

- Discussion of power-plant-level impacts and other fuel-cycle impacts avoided or created by use of interconnection
- Discussion of impacts related to construction and operation of transmission line in the speaker's country
- Technical opportunities to reduce power line impacts
- Other topics relating to the environmental performance of power lines

Environmental Impacts and Benefits of Regional Power Grid Interconnections for the Republic of Korea

J-Y. Yoon (ROK)

Environmental Impacts and Benefits of Regional Power Grid Interconnection for the Russian Far East: Generation and Fuel-Supply-Related Impacts
Environmental Problems of Power Transmission
Between Russia and the Korean People's Democratic Republic

S. Podkovalnikov (RFE)

N. Gamolya (RFE)

3:10-3:25   **Break**

Environmental Impacts and Benefits of Regional Power Grid Interconnections for China
Environmental Impacts and Benefits of Regional Power Grid Interconnections for the Democratic People's Republic of Korea

F. Zhu (China)

Representative (DPRK)

4:30-4:35   **Short Break**

**4:35-5:30 Discussion of Environmental Aspects of NE
Asia Power Grid Interconnections**

Possible Topics Include:

- Specific questions regarding presentations from each country
- Issues regarding the relative environmental impact of power lines in the region as a whole
- Opportunities for improving environmental benefits
- Linkages between environmental benefits of interconnection and financing options
- Elaboration and specification of the key unknowns to fully evaluate the environmental impacts of interconnection alternatives
- Other questions relevant related to project environmental performance

Discussants:

Representative (ROK)
Representative (RFE)
Representative (DPRK)
D. Von Hippel
(Nautilus) and/or
Russian Co-host

**5:30-5:35 Review of day's activities & outline for
the next day**

D. Von Hippel, Scott
Bruce, FEB-WWF
Representatives

5:35 *Close of Day 1*

6:00-7:30 *Banquet*

7:30-8:30 *[Possible Organized Touristic Activity]*

DAY TWO – 1ST OCTOBER, 2003

8:00-9:30 Environmental Impacts of Grid Interconnections: Special Topics
Environmental Characteristics of HVDC
Overhead Transmission Lines

L. Koshcheev,
presented by A.
Gerasimov (RFE)
J. Kang (ROK)

Environmental Impacts and Benefits of
Regional Power Grid Interconnections for
the Republic of Korea: Potential Impacts
on Nuclear Power Generation and Nuclear
Waste Production
International Best Practices for
Assessing and Reducing the Environmental
Impacts of High-Voltage Transmission
Lines

James Williams (USA)

9:30-9:45 *Break*

**9:45-
11:40 Codes, Laws, and Practices Related to the Environmental
Performance of Power Lines in the Countries of Northeast Asia**

Environmental, Technical and Safety Laws,
Regulations and Standards Related to
Power Line Construction in China
Environmental, Technical, and Safety
Codes, Laws, and Practices Related to
Power Line Construction in the Democratic
People's Republic of Korea

Representative
(DPRK)

Environmental, Technical, and Safety
Codes, Laws and Practices Related to
Power Line Construction in Russia

A. Gerasimov (RFE)

	Codes, Practices, and Regulations for Major Power Line Construction and Operation in the Republic of Korea, with a Focus on Environmental Protection	C. Suhmoon (ROK)
11:40 - 11:45	<i>Short Break</i>	
<u>11:45-12:15</u>	<u>Regional Perspectives on NE Asia Grid Interconnections</u>	
	Northeast Asia Grid Interconnections from the Perspective of Energy Modeling Work at APERC	Y. Wang (China/APERC) and J. Skeer (USA/APERC)
12:15-1:15	<i>Lunch</i>	
<u>1:15-2:45</u>	<u>The Environment, Ecology, and Wildlife of the Russian Far East and of the RFE/DPRK/China Border Region</u>	
	The Environment of, and Environmental Regulations in, the Russian Far East (RFE)	A. Sheingauz (RFE)
	Migratory Bird Issues Related to Grid Transmission Line Siting	H. Healy (USA)
	Main Ecological and Resource Issues of the Russian Part of the Tumen River Area	V. Karakin (RFE)
	Priorities of Biodiversity Conservation in the Area Adjacent to the Russian-DPRK-Chinese Border	Y. Shibaev (RFE)
2:45-3:15	Discussions:	[FEB-WWF or other Vladivostok-area Moderators to be determined]
	• Additional experience of local researchers with environment of the region • Impacts to-date of development in the area • Conservation efforts now underway • National/International institutional structures needed to ensure adequate mitigation • Other topics?	
3:15-3:30	Break	
<u>3:30-4:15</u>	<u>Preliminary Discussion on Organization of Future Work on Grid Integration</u>	
	Open Discussion	Open discussion Moderator: P. Hayes
	• Potential overall "Next Steps" in the study of environmental and other effects (benefits and impacts) of power line interconnections • Discussion and elaboration of overall study goals • Discussion of institutions to be involved including their roles of each institution • Discussion of tasks in the study and proposed timing	

- Outputs of the study and dissemination of results

4:15-4:30   Review of Day's activities, and Discussion of Logistics for Field Trip to Border Region   *Nautilus and FEB-WWF*

4:45   *Departure by Bus for Border Region*

~6:00   *Stop for Dinner in Route to Border Region*

~10:00   *Arrive at Hotel Yuitun at Border Region*

DAY THREE - 2ND OCTOBER, 2003

9:30   Board Bus at Yuitun Hotel in Border Region for Field Trip

Vist to Khafanskii Nature Park   *Hosted by FEB-WWF and other RFE colleagues*

12:00-1:30   *Box Lunch at Nature Park*

1:30-5:30   Continue Vist to Khafanskii Nature Park; Visit to State Forest and Marine Reserve or to Kedrovaya Bad Nature Reserve   *Hosted by FEB-WWF and other RFE colleagues*

~5:30-6:30   *Transit to Yuitun Hotel at Border Region*

7:00   *Dinner at Yuitun Hotel*

DAY FOUR - 3RD OCTOBER, 2003

9:30   Board Bus at Yuitun Hotel

9:30-12:00   Return Drive To Vladivostok

12:00-1:30   *Stop for Lunch in Route to Vladivostok*

1:30-4:30   Return Drive to Vladivostok, End of Workshop

6:30   *Informal Dinner for Participants Staying Overnight in Vladivostok*

ATTACHMENT B. PARTICIPANTS LIST

*The Working Group on Regional Power Grid Interconnection
World Wildlife Fund Russia, The Far Eastern Branch
Economic Research Institute of the Far Eastern Branch, Russian Academy of Sciences
Third Workshop on the Northeast Asia Power Grid Interconnection
September 30-October 3, 2003, Hotel Gavan*

Attendee List and Contact Information

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Research Fellow

ATTACHMENT C. Participant Bios (partial, not all listed attended)

A t t e n d e e B i o g r a p h i e s

C h i n a

H E , X i n

L I N , C h u n g - Y a n g

Chung-Yang LIN is a team leader of Asia Pacific Energy Research Centre (APER C), Chung-Yang's work with APER C has centered around deregulated power market and at present he is studying a project of market for interconnections in the APER C. He also has been with Taiwan Power Company for 18 years since his graduation from the graduate school of Agriculture Engineering, National Taiwan University. During his employment with this company, he developed a number of projects and systems such as, the trading strategy of electricity under power deregulation. The knowledge management of Taiwan Power Company. The regional call center of Taiwan Power Company. The establishment of energy data base system. The decision support system of energy. Ocean thermal energy conversion project. Coal handling system of Taichung thermal power plant, etc.

W A N G , Y a n j i a

W E B E R - L I U , K o s i m a

Z H A O , Y o n g

Dr. Yong Zhao, an associate professor of the Energy Environment Economy Institute of Tsinghua University, Beijing, China. Yong has ten-year experience in the power sector of China before moving to the university, working on power planning, energy strategy, energy policy and economics, being the project manager of Sino-Canada Southern China Strategic Energy Planning Project sticking to the analysis of interconnections among provinces in southern China for seven years. Yong is involved in intensive research activities and authored or coauthored a number of publications in the fields of energy strategy and long-term planning, global climate change, power restructuring, environmental protection in power sector, optimization models and game theory. He holds Ph.D. degree in Management Science and Engineering and M.A. and B.S. degrees in Hydropower Engineering from the Tsinghua University.

Z H U , F a h u a

D P R K

7 M e m b e r D e l e g a t i o n

J a p a n

N A K A Z A W A , N o r i o

Norio has been an adviser to Japanese trade policy to Korea, study group of Korea Japan Free Trade Agreement, analysis on Korean Economy and circumstances, lectures in Ewha University Post graduate school of Interpreter, lectures for Samsung Electronics Training Course. in the power sector he has worked with the ODA arrangement of following projects : Masinloc Coal Power Plant, Calaca Power Coal Plant, Bataan Limay Gas turbine Power Plant, Tiwi MacBan Geothermal Power Plant (rehabilitation), Sucat Oil Power Plant (rehabilitation). Hew has worked on other consulting projects on National Power Corporation privatization, Leyte-Luzon Submarine Interconnection, Rural Electrification Project.

M o n g o l i a

B A T H Y A G , S o d o v

**Statement of Background and Goals for the
Third Workshop on Power Grid
Interconnection in Northeast Asia**

**September 30 to October 3, 2003,
Vladivostok, Russian Federation**

Co-hosted by:

**The Far Eastern Branch of WWF Russia (Vladivostok,
Russian Federation),
and the Economic Research Institute of the Far
Eastern Branch, Russian Academy of Sciences
(Khabarovsk, Russian Federation)**

**Background to the Northeast Asia Regional Grid
Project**

Initiated in 2001, the Northeast Asia Regional Grid Project, organized by Nautilus Institute with collaborating institutions and individuals in Northeast Asia, aims to examine the feasibility of grid interconnection among the countries of the region on a real and practical level, taking full account of the energy, economic, political, and environmental situations in the countries of the region. To date, the Regional Grid Project has included two workshops, the first in Beijing, China in May, 2001, and the second in Shenzhen, China, in May of 2002. Summaries of the activities carried out at these workshops, as papers and other materials prepared for the workshops, can be found on the Nautilus Institute World-wide Web site at <http://www.nautilus.org/energy/grid/index.html> and <http://www.nautilus.org/energy/grid/2002Workshop/index.html>, respectively. The September 30 to October 3, 2003 Workshop on Northeast Asia Power Grid Interconnection, which will be held in Vladivostok, the Russian Federation, and co-hosted by the Far Eastern Branch of WWF-Russia (FEB-WWF) and by the Economic Research Institute (ERI) of the Far Eastern Branch, Russian Academy of Sciences, is thus the third in the series of Grid workshops.

Overall, the Northeast Asia Regional Grid Project has as its goals to establish collaborations between energy policy researchers, power system experts, engineers, and environmental experts from the Northeast Asia region and elsewhere to identify the potential benefits of, constraints to, and barriers in implementing, electric power grid interconnections in the Northeast Asia region. Through these collaborations, the project hopes to establish open means of communication and a clear understanding between national researchers in the region, Nautilus researchers, and others, in order to assist the process of collaborative work for the regional grid interconnection. The collaborative work will include development and sharing of consistent scenarios for electricity supply and demand in each of the countries of the region and in the region as a whole, and evaluation of these scenarios to establish the range of costs and benefits of

potential regional grid integration. The costs and benefits of grid integration are defined broadly to include economic, environmental, and security impacts.

Summary of the First and Second Workshops on Power Grid Interconnection in Northeast Asia

The First Regional Workshop on Power Grid Interconnection in Northeast Asia focused on providing general background on grid interconnection issues in a number of areas, including exploring the motivations for grid interconnections from the perspective of existing international grid arrangements, economic and environmental issues associated with interconnections, grid stability issues, issues related to the use of nuclear reactors within small power grids, and grid financing. Presentation of the status of power grids and interconnection investigations in each of the countries of the region were also included.

The Second Workshop on Power Grid Interconnection in Northeast Asia included discussions on:

- The current status of economic and technical issues associated with potential power grid interconnections in each of the countries represented, and review of the findings of an analysis of a Russia-DPRK-ROK interconnection route prepared by Dr. Sergei Podkovalnikov and his colleagues from the Energy Systems Institute of the Siberian Branch of the Russian Academy of Sciences.
- The analytical methodologies that might be used in an ongoing joint pre-feasibility study of grid interconnection, along with potential data sharing mechanisms, including the sharing of data for use in software tools for network stability analysis.
- The creation of a pre-feasibility working group of Russians, North Koreans, South Koreans and Chinese to work specifically on preliminary quantitative analysis of interconnection options.
- Specific safety and grid stability issues related to the Korean Peninsula Energy Development Organization (KEDO) Light Water Reactor (LWR) nuclear power plant currently under construction in the DPRK, and how those issues intersect with incentives and options for construction of international power grid interconnections on the Korean peninsula.

During and subsequent to the Second workshop, participants provided ideas for the scope and organization of collaborative research on grid interconnections. These ideas will be addressed, and, it is hoped, moved forward during the discussions to be held during the upcoming Third workshop.

Emphasis and Goals of the Third Workshop on Power Grid Interconnection in Northeast Asia

In addition to the technical and economic implications and considerations of the interconnection of electrical grids in Northeast Asia that have been discussed in previous Grid workshops, grid interconnections will have environmental impacts as well. These environmental impacts—including both costs and benefits—of grid interconnection range from emissions (and avoided emissions) of air and water pollutants from power generation, to the land use impacts in both transmission line and power plant construction, to the environmental impacts associated with the location of new, large transmission lines in sensitive ecological areas. Vladivostok provides an excellent venue for the discussion and direct observation of the potential environmental impacts and benefits of grid integration in Northeast Asia. During the

Third Workshop on Power Grid Interconnection in Northeast Asia, participants and co-hosts will work together to gain a better understanding of range of environmental ramifications of potential grid interconnections.

While it is intended that the main theme of this Workshop be the environmental implications of electric power grid interconnections, other aspects (technical and economic for example) of potential grid interconnections between the countries of Northeast Asia will also be discussed, building on the work of the first and second Grid workshops. As in previous workshops, participants from several Northeast Asian nations (the DPRK, the ROK, Russia, China, and Japan) have been invited to attend, thus the Workshop is expected to provide an excellent opportunity for the informal exchange of views on topics related to grid interconnection.

In brief, the overall goals for this Third workshop are:

1. Offer opportunities for researchers from different countries to candidly discuss issues related to grid interconnections, both within and outside of the workshop structure.
2. Identify and explore the potential environmental benefits of and barriers to power line interconnections in the region, and summarize those barriers and benefits for future reference and use.
3. Build on the work of previous workshops and other initiatives to further identify and elaborate the "Next Steps" in the analyses of Northeast Asia power grid interconnections, and begin the process of organizing and identifying the resources, agencies and institutions needed to move forward with those analyses.

In order to work toward these goals, the main elements of the workshop agenda includes:

- A session on "National/International Updates on Grid Development and Grid Interconnection Investigations", in which participants from the different countries will bring workshop attendees up to date on grid-related developments in their countries (and in international organizations).
- A presentation of a generic outline of environmental issues associated with grid integration, followed by presentations from each country summarizing initial research on the "Possible Environmental Impacts and Benefits of Regional Power Grid Interconnections". This session will be followed by an open discussion of the topic.
- A session on special topics related to the environmental aspects of grid interconnection.
- A session on "Codes, Laws, and Practices Related to the Environmental Performance of Power Lines in the Countries of Northeast Asia".
- A session on "Regional Perspectives on NE Asia Grid Interconnections", including presentations from regional organizations and others.
- A session of presentations and discussions focusing on "The Environment, Ecology, and Wildlife of the Russian Far East and of the RFE/DPRK/China Border Region".
- A concluding open discussion session in which further steps in the collaborative evaluation of the technical, economic, and environmental impacts of grid integration will be addressed.

Following these presentations and discussions, workshop participants will be guided on a study tour of the Russian Federation/DPRK/China border region through which a power grid interconnection might pass, providing an opportunity to learn about the ecology and environmental sensitivity of this unique and important region.

ATTACHMENT E: DPRK PRESENTATIONS

SEE TWO ATTACHED PDF DOCUMENTS