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Report of the Steering Committee Black Sea Regional Transmission Planning Project

**Kyiv, Ukraine
March 29, 2007**

Ukrenergo hosted a meeting of the Steering Committee of the Black Sea Regional Transmission Planning Project in Kyiv, Ukraine on March 29, 2007. Participants included senior representatives of the Armenia Energy Institute, NEK of Bulgaria; GSE of Georgia; Moldelectrica of Moldova, Transelectrica of Romania; SO-CDU of Russia; TEIAS of Turkey; Ukrenergo of Ukraine; Energy Coordination Center of Belgrade (EKC); United States Agency for International Development and the United States Energy Association, World Bank, European Bank for Reconstruction and Development, and the Organization of Black Sea Economic Cooperation.

The purpose of the Steering Committee meeting was as follows:

- To reach agreement on the key technical findings of the Project Working Group related to the current capacity and technical constraints to trade and exchange of electricity in the Black Sea regional transmission network
- To approve the Project Final Report
- To assess the contribution of the project in building long term technical and institutional capacity for transmission cooperation at the national and regional levels
- To reaffirm the commitment of the participating transmission system operators (TSOs) to the goals and objectives of the project, and affirm their support for implementation of a follow-on phase
- To review and approve the Working Group's recommendations for potential activities for the second phase of the Project.

The following agenda items were discussed:

1. **Role of the Black Sea Regional Transmission Planning Project in the Context of the Energy Community of Southeast Europe:**

Dr. Robert F. Ichord, of the U.S. Agency for International Development discussed the Black Sea Transmission Planning Project in the context of the Energy Community of Southeast Europe Treaty Process. He noted that growing demand for electricity in the Energy Community market creates opportunities for increased exchange and trade with the Black Sea region. He noted that the Black Sea Regional Transmission Planning Project provides a platform to analyze the capacity of Black Sea network to enhance further east-west integration, as well as to identify priority investments necessary to improve regional system stability and facilitate electricity trade within the region and with neighboring regions.

2. **Report by Countries on Potential Impacts of Regional Cooperation on Domestic Networks of Black Sea TSOs:**

The Black Sea TSOs provided 10 minute updates on their networks and discussed the impact and potential benefits of strengthened regional cooperation on their domestic systems.

a) Armenia:

The Energy Institute of Armenia reported that the key principle Armenia's energy strategy is to ensure sustainable development of the energy sector. One of the fundamental conditions of sustainable development is a reasonable level of energy security. A special focus of this strategy is expanding the integration of Armenia into the regional electricity market.

Of significant interest is the project implemented by FICHTNER of Germany to study the potential for connecting Turkey, Georgia and Armenia through the construction of a direct current interconnection. A study related to the long term forecast of demand and supply has also been initiated and the first phase of this study is complete. The results confirm the availability of exports from Armenia in the medium term. However, for the long term it will be necessary to develop additional generation capacity.

Regional cooperation assumes special significance in the context of the development of the nuclear power sector of Armenia. This was discussed in a 2001 strategy paper developed in cooperation with TACIS, which provided a timeline for decommissioning the existing nuclear power plant pegged to the successful integration of Armenia in the regional electricity market.

b) Bulgaria:

ESO EAD of Bulgaria informed the participants about recent developments in the Bulgarian Power Sector, including a new interconnection line being constructed between Bulgaria and Macedonia (Cervena Moghila – Stip) and a new 2 x1,000 NPP to be built in cooperation with a Russian company.

c) Georgia:

GSE of Georgia reported that Georgia has participated in the Black Sea project from its inception. Two specialists from GSE were trained in the use of the PSS/E Steady State Load Flow Analyses Module as part of the Project. Presently, PSS/E software is used as the basic planning tool for GSE.

The GSE representative noted that the Working Group findings identified several weaknesses in the GSE power network and that additional detailed evaluation for the Caucasus sub-region is needed to develop optimal solutions for eliminating these weak points. As such, GSE proposed the following for the BSTP next phase:

- (i) Evaluate optimal solutions for the construction of a 220 kV interconnection between the Lajanuri HPP and the newly constructed 500 / 220 SS, up to the tie point with the 500 kV OHL to Imereti. Evaluate and model future expansion of 500 kV links, such as OHL Enguri – Akhaltsikhe, Zestaponi – Akhaltsikhe, Marneuli – Akhaltsikhe and Gardabani – Akhaltsikhe.
- (ii) Model alternate sites for 500 /400 substation, such as Lesa in western Georgia that might be preferable to currently proposed site at Akhaltsikhe. Model the optimization of connecting 500 kV OH lines, such as Enguri – Lesa, Zestaponi – Marneuli, Ksani – Marneuli and Gardabani – Marneuli.

GSE reported that its participation in the Project has helped it to interact with its counterparts in the region and to gain a better understanding of the neighboring systems. GSE expressed its appreciation for the support the BSTP has provided in advancing regional collaboration to improving crossborder

transmission planning and coordination.

d) Moldova:

Moldelectrica of Moldova reported on the positive impact of employing PSS/E software for the analysis of its power network and expressed its appreciation for the creation of a common technical language among the countries participating in the project. Moldelectrica representatives expressed their support for the project and pledged continued support for its follow-on phases.

e) Transelectrica of Romania reported the following positive impacts as a result of the project:

- Development of a team and a team spirit among the specialists from the TSOs in the Black Sea area.
- Development of a network model and common data format
- Information exchange among the TSOs on new project development.
- Information exchange among the TSOs on the potential for import/export in the area.
- Improved understanding of the technical characteristics of the area, including the direction and amplitude of load flows, voltage levels at peak and low load, and the transfer capacities of the regional network.
- Development of the basis for a future electricity market in the area.

f) SO CDU (INTER RAO) of Russia noted that the Black Sea area has significant importance to it because the company owns major power plants in almost all the countries in the eastern part of the region, including Ukraine, Georgia, Armenia and of course, Russia. In these conditions SO CDU looks forward to supporting this project in the next phase.

SO CDU expressed great interest in the development of the network model for transient stability analyses.

g) TEIAS of Turkey reported the following:

- Located at the transit point of the continents, Turkey has significant opportunities regarding the interconnections
- Turkey is already involved in long term international projects, including the MEDRING in addition to the Black Sea Project
- Interconnection of the regional networks must be achieved on a step by step basis
- Synchronous interconnection of the Turkish Power System to UCTE is of the highest priority for TEIAS and is a prerequisite for the realisation of other projects
- The studies / activities for the synchronous interconnection of the Turkish power system to UCTE is proceeding successfully based on the decision of UCTE Steering Committee
- Following the interconnection of the Turkish power system with UCTE, TEAŞ supports the MEDRING and BSTPP, provided they:
 - Are technically and economically feasible;
 - The participating countries affirm their commitment to the realisation of these projects; and they
 - Are approved by UCTE
- During this transition period until the time of synchronous connection with UCTE, the interconnections outside of UCTE will operate as follows:
 - Isolated region method
 - Unit direction method
 - Asynchronous connection

h) Ukrenergo of Ukraine reported the following positive impacts of the project:

- Development of a network model for the entire Black Sea and the promotion of PSS/E format as common data format
- Improved understanding of the technical characteristics of the power systems in the area, including the direction and amplitude of load flows, voltage levels at peak and low load, and the transfer capacities of the regional network; especially as they relate to Ukraine's understanding of the countries in the UCTE area

For the next phases of the project Ukrenergo expressed its interest in developing the network model for transient stability analyses.

3) Report on the Development of the Regional Model

Snezana Mijailovic of the Electricity Coordination Center of Belgrade presented the process by which the Black Sea Regional Transmission Planning model was developed. She explained how Project Working Group participants were trained in the use of the Power System Software for Engineers (PSS/E), which was selected as the common planning platform for the project. She explained how eight national transmission planning models were developed using PSS/E, how the Working Group integrated their national models into the first regional model of the Black Sea network, and how the model was used to calculate network stability and to calculate the capacity of the network to facilitate trade in the region and between the region and neighboring regions. *She noted that an important accomplishment of the project was the development of a corps of transmission planning specialists well versed in the use of the model that provides the region with an institutional capacity for transmission planning that did not exist prior to the project.*

4) Analysis of the Regional Network

Dan Preotescu of Transelectrica, in his capacity as Project Manager, discussed the Working Group's analysis of the Black Sea network. He explained that the model made certain assumptions, among them that the IPS/UPS, UCTE and Turkish systems will operate synchronously in 2010. Given these assumptions, he noted that the analysis of the system indicates that stability appears to be limiting factor in increasing trade within the region and with neighboring regions. The Southern Caucasus region appears to be the weakest and most unstable element of the network and within this subregion, the connections between Turkey and Georgia are the most troubling. However, it must be noted that Azerbaijan has not been modeled and that net transfer calculations have not been completed for Armenia. As a result, further analysis of the Southern Caucasus network is required to gain a better understanding of the effects this region may have on the overall Black Sea network.

The analysis also revealed that further sub-regional examination of the Romania-Moldova-Ukraine interconnections must be conducted to identify priority investments that will facilitate trade and greater system stability.

5) Discussion of the Findings & Analysis

Participants engaged in a dialogue to discuss the findings and analysis of the report. The following summarizes the key points of their discussion:

- Mr. Nenko Gamov proposed to improve the network model by merging the Black Sea model with the SECI model. According to the discussion this action is feasible and can be completed in the next phases of the project. Mr. Gamov also proposed to include a training session on economic analysis of regional transmission projects during the next phase of the project. Mr. Preotescu has underlined the importance of this aspect for the companies from the IPS / UPS area.

- Mr. Tigran Gnuni emphasised the need to perform the steady state load flow analyses for Armenia in the next phase. He also supported the training for economic analyses proposed by Mr. Gamov.
- Dr. Robert Ichord underlined the importance of the Greek power system model for the quality of the analyses. He proposed the integration of this model in the next phase of the study. Regarding this subject, Mr. Trajce Cerepnalkovski informed the participants that the SECI model includes the Greek power system model and it is possible to provide this information to the Black Sea project.

6) Perspectives of the Donor Community and NGOs

Members of the donor and NGO community shared their perspectives on enhancing regional grid trade and cooperation among transmission system operators, as well as relevant programs/funding opportunities.

a) The World Bank reported that the most significant issues regarding regional electricity trade potential in the Black Sea Region are as follows:

- Electricity trade in the Black Sea Region declined in recent years to a very low level
- The region has three power grids which are unable to exchange electricity
- The WB study analyzed three market scenarios:
 - **Scenario A** – No change in the current level of electricity trade; each country invests in generation to meet its incremental demand
 - **Scenario B** – Open electricity market within the Black Sea region; increasing electricity trade to upper limits on import penetration
 - **Scenario C** – High electricity trade including energy transit (gas and/or electricity) from the Caspian region to the UCTE zone

According to the World Bank, the most interesting is the **Scenario B**.

- Key features of scenario B:
 - Significant increase in electricity exports from Russia (up to 150 TWh by 2020)
 - Required transmission investments estimated at about \$1.7 billion, i.e. about 12% of the BSR transmission system needs in the next 10 years
 - Net reduction of 19 Mt CO₂ emissions by 2015
 - Cost savings diminish by increasing price of gas in Russia and practically vanish at \$150/mcm
- Issues and constraints:
 - Investments in power transmission not yet adequately studied (e.g. UCTE connection)
 - Impact of increasing electricity imports on security/ diversity of energy supply
 - Environmental impacts of increasing electricity trade – requirements and opportunities
 - Compatibility of energy market reforms (“standard market design”)
 - Financing infrastructure for cross-border trade

b) The EBRD reported that it has a long and fruitful collaboration with Ukrenergo regarding the development projects in the Power System of Ukraine.

A new contract was signed in 2005 involving the installation of up to 600 MW in 2 stages. The first stage of ~ 300 MW will be used for steel production. The second stage of ~ 300 MW it is planned to be used in the electricity market.

c) The Organization of Black Sea Economic Cooperation expressed its interest in the development of an energy market in general, and an electricity market in particular. Its energy sector programs have been guided by the agreements derived in the following meetings:

- Baku Declaration – 2003
- Alexandropoulos Declaration – 2005
- Sochi Statement – 2006

d) KfW Development Bank has expressed its interest in supporting activities in the Black Sea Project. KfW is also interested in financing development projects in the area.

7) Recommendations of the Steering Committee of Next Steps

Participants reviewed the following recommendations of the Working Group for a second phase of the project:

Analyses of Subregional Constraints and Optimization and Investment Requirements

Further analysis of the impact of new interconnections on the transfer capacity for the constrained borders identified in the first phase of the project. Specific focus areas could include:

- a) Calculation of net transfer capacities for the Armenian network;
- b) Development of a network model and net transfer calculations for Azerbaijan;
- c) Analysis of system improvements on the Turkey-Georgia interconnection; and
- d) Analysis of options for upgrading the Moldova – Romania interconnection.

Development of Criteria For Economic And Financial Analysis Of Proposed Network Connections

The Project recognizes that the Southeast Europe Cooperation Initiative (SECI) Transmission Planning Project is developing financial and economic criteria for analysis of projects in Southeast Europe. The Black Sea Project may work in cooperation with SECI to extend and apply these criteria.

Development of Dynamic Model

As system stability is the most limiting factor for the overall capability of the network, further analysis of the regional network in dynamic mode is necessary to both confirm the network capacity and identify additional stability limiting factors. The current regional model would be upgraded to allow for dynamic modeling and short circuit analysis. Further training on the use of PSS/E software in dynamic mode will be necessary to support the model upgrade.

Developing Proposals For Harmonizing System Planning Norms And Standards Among The Black Sea TSO

Building on the development of the corps of transmission specialist trained for this project, the Working Group would begin developing commonly accepted transmission planning criteria for grid reliability and safety on a regional basis.

GIS Update and Interaction with the Energy Community Process

The World Bank Generation Investment Study conducted by the World Bank for Southeast Europe would be expanded and updated taking into account prospective increased trade with the Black Sea region.

Institutional Development & Local/Regional Capacity Building

Additional training could be conducted to support the economic analysis of proposed regional transmission projects

Development of Common Grid Codes

As a precursor to the development of trading rules, the Working Group would develop an outline of a grid code for the Black Sea region.

The Steering Committee agreed to recommend the following for the second phase of the Project, subject to the availability of funding:

- a) Training on Dynamic Modeling**
- b) Development of Dynamic Model**
- c) Analyses of Subregional Constraints and Optimization and Investment Requirements**
- d) Analysis and Prioritization of Proposed Transmission System Projects**
- e) Harmonization of Transmission Planning Criteria on a Regional Basis**
- f) Institutional Development & Local/Regional Capacity Building**

Upon final agreement of the objectives and activities, the next phase of the project will be memorialized through a new Memorandum of Understanding designed to reaffirm the commitment of each TSO. The MOU will outline the goals, objectives, timelines and deliverables of the second phase, as well as the rights and responsibilities of the participants.