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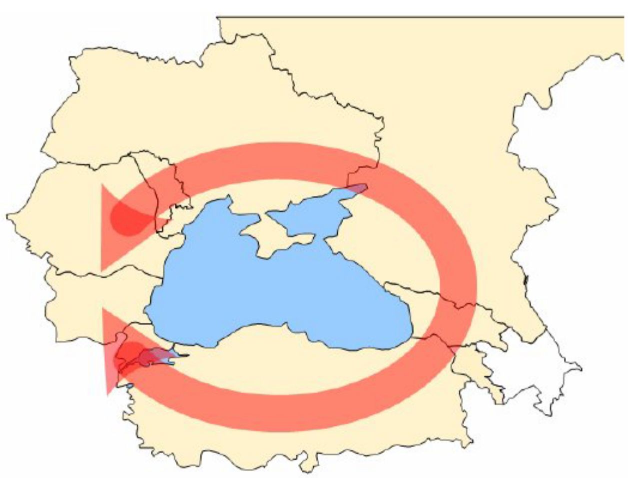
Black Sea Regional Transmission Planning Project

Executive Summary: Regional Model Development and Network Analysis Report

Results, Findings, Accomplishments, Next Steps



January 2007

BLACK SEA REGIONAL TRANSMISSION PLANNING PROJECT

PHASE ONE EXECUTIVE SUMMARY: RESULTS, FINDINGS, ACCOMPLISHMENTS, NEXT STEPS

INTRODUCTION

This report details the accomplishments, findings and recommendations of the Black Sea Regional Transmission Planning Project, which was established in 2004 to foster regional cooperation in transmission planning and analysis. Impetus for the Project results from a desire among the Transmission System Operators (TSOs) in the region to identify investments necessary to improve system security and to take advantage of the potential for east-west electricity trade with neighboring markets in Southeast Europe and the UCTE system.

Though integrated at the borders, the Black Sea electrical network is an amalgamation of three electric power systems, each employing distinct transmission planning software, methodologies and operational criteria. Communication between the TSOs within the system has been quite limited, restricted primarily to daily operational matters with little, if any, focus on longer term planning issues related to system expansion, security and the facilitation of trade and exchanges.

Within the context of this project, Armenia, Georgia, Moldova, Ukraine and Russia are members of the synchronous IPS/UPS system. Since the early 1990s national transmission system operators (TSOs) within IPS/UPS have operated relatively independently. Russia and Ukraine possess a strong institutional capacity for system planning and employ proprietary planning software for use in their national systems. Operating independently, the planning capacity in the smaller IPS/UPS systems of Armenia, Georgia and Moldova has diminished over time.

The Southeast European Black Sea nations of Bulgaria and Romania acceded to the European Union on January 1, 2007, are members of UCTE, and are signatories of the Energy Community of Southeast Europe Treaty. System operators in these countries have developed strong planning capabilities. They adhere to UCTE procedures and protocols and employ the Siemens/PTI Power System Simulator for Engineers (PSS/E) software, which is used in over 124 countries and was adopted in 2000 as the common planning platform for the Southeast Europe Coordination Initiative (SECI).

Turkey is the third element of the Black Sea electrical network and has applied for integration with UCTE and accession to the European Union. Its national system operator, together with UCTE, is conducting studies and tests to assess the technical feasibility of synchronous interconnection with the UCTE zone. It is constructing a high voltage line to connect with Greece. Like, Bulgaria and Romania, it employs the PSS/E software and has adopted planning protocols common to continental Europe.

The emerging electricity markets in the Energy Community of Southeast Europe and increasing demand in Central & Eastern Europe may present opportunities for increasing electricity exports from the Black Sea region. For example, the recently completed update of the Generation Investment Study (GIS) by the World Bank considers the potential for electricity imports from Ukraine. Likewise, the ongoing IPS/UPS – UCTE interconnection study designed to determine the technical feasibility of greater east-west electrical integration has significant technical and financial implications for all TSOs in the Black Sea network. Identifying and capitalizing on opportunities for further integration with the Energy Community and UCTE requires enhanced technical coordination, cooperative planning and institutional capacity to analyze of bulk power flows in the region and with neighboring regions.

In response to these developments the Black Sea TSOs signed the Sofia Memorandum of Understanding in 2004. The MOU outlines the goals and objectives of the Project, provides a framework for Project governance and details the rights and responsibilities of participating organizations. Signatories of the Sofia MOU include:

- NEK of Bulgaria
- GSE of Georgia
- Moldelectrica of Moldova
- Transelectric of Romania
- SO-CDU of Russia
- TEAIS of Turkey
- Ukrenergo of Ukraine
- Black Sea Regional Energy Center
- United States Agency for International Development
- United States Energy Association

In the fall of 2005, the Steering Committee approved issuing an invitation to Armenia and Azerbaijan to join the Project. In 2006, the High Voltage Energy Network of Armenia executed the Memorandum, thereby expanding the Project to include the Caucasus portion of the IPS/UPS system. Azerbaijan signed the MOU in March 2006, but has not participated in the Working Group yet.

PROJECT GOALS & OBJECTIVES

The Sofia Memorandum of Understanding provided a basis for project organization and coordination detailing the Project methodology, timelines, schedules and deliverables, the rights and responsibilities of the TSOs, the role of Transelectrica as the Project Coordinator, the role of EKC as regional model integrator and the support provided by USAID and USEA.

The goals and objectives contained in the MOU are to:

- Promote regional cooperation on transmission planning among Black Sea TSOs
- Identify priority investments in transmission systems and interconnections to improve reliability of the regional power system
- Propose possibilities to enhance electric power trade in the Black Sea Region
- Harmonize transmission planning principles, methods and perhaps methodologies
- Create a working group with experts trained in transmission planning issues and very well informed about the characteristics of participating power systems
- Develop a common platform (common database, common software and consistent principles) for transmission system analysis among the TSOs in the Black Sea Region
- Provide training in the use of transmission planning software (PSS/E)
- Promote the results of the analysis to a wide audience of policy and regulatory authorities

PROJECT ORGANIZATION & STRUCTURE

The Sofia Memorandum of Understanding established a Steering Committee to oversee the Working Group and provide stakeholder guidance and ownership. The Steering Committee provides a mechanism for IFIs and regional organizations to provide input to the Project. The members of Steering Committee are representatives of:

- Armenia High Voltage Energy Network
- Black Sea Regional Energy Centre
- Georgian State Electrosystem
- Moldelectrica
- National Electric Company (Bulgaria)
- National Electric Company Ukrenergo
- System Operator-Central Dispatch Administration of the Unified Power System of Russia
- Transelectrica (Romania)
- Turkish Electricity Transmission Corporation
- Electricity Coordinating Center – EKC
- United States Agency for International Development
- United States Energy Association

Transelectrica is the Technical Coordinator of the project. The Electricity Coordination Center from Belgrade is the regional model integrator.

MILESTONES & TEAM BUILDING ACTIVITIES

The following Working Group meetings were conducted:

- July 2004 in Predeal, Romania – **PSS/E Training**
- July 2005 in Istanbul, Turkey -- **Review National Model Development**
- October 2005 in Bucharest, Romania – **Finalize National Models/Regional Integration**
- August 2006 in Chişinău, Moldova – **Finalize Regional Model/Commence Analysis**
- December 2006 in Sofia,Bulgaria**.— Finalize Analysis & Develop Recommendations**

Following the Kick Off meeting in Sofia, Bulgaria a Steering Committee meeting was conducted in Bucharest, Romania in October 2005 to monitor the progress of the Working Group.

KEY FINDINGS & RESULTS

The Project Working Group constructed a regional transmission simulation model for the forecast year 2010 incorporating the national generation and transmission network elements of each of the eight participating TSOs. For analytical purposes, the Working Group assumed the region is operating in synchronous operation through the existing interconnections, without pre-judging the technical feasibility of such synchronous interconnection. As a result, the findings of the Working Group should not be construed as a recommendation for synchronous interconnection. The goal was to evaluate such operation, since there is a possibility that Turkey and the IPS/UPS countries may connect to the UCTE main grid by 2010. As a result, the lines discussed in this report have significant potential to strengthen interconnections and support efforts to establish synchronous operation.

Using the model, the Project analyzed a set of nine trading scenarios to determine the grid's capacity to support increased trade of electricity within the region and with neighboring regions. In the base case scenario the Black Sea region is self sufficient with electricity exchanges limited to the confines of the Black Sea network.

In addition to the base case, the Working Group analyzed eight high trade scenarios in which a large increase in electricity trade, perhaps driven by the opening of electricity markets, results in energy-rich countries exporting significant quantities of electricity to energy deficit nations within the region and in neighboring regions.

The high trade scenarios modeled by the Working Group include the following:

- (1) Russia to Turkey
- (2) Romanian to Turkey *and* (3) Turkey to Romania
- (4) Russia and Ukraine to Georgia, Armenia and Turkey
- (5) Black Sea Region to CENTREL zone of UCTE (Poland, Hugary, Czech, Slovakia)
- (6) Black Sea Region to Southeast Europe
- (7) UCTE to Turkey *and* (8) Turkey to UCTE

The Working Group's analysis reveals a set of strong interconnections within the Black Sea system, including the following links:

- Ukraine and Russia – Over 3000 MW of capacity in both winter and summer
- Romania and Ukraine – Over 2500 MW of capacity in both winter and summer

These links provide ample capacity for east-west flows of electricity.

The analysis also reveals the following weak points, which threatens overall system security, limiting the potential for cross border exchange and trade:

- Georgia and Turkey – only 200 MW of capacity in both winter and summer
- Turkey and Bulgaria – only 600 MW of capacity in winter
- Romania and Moldova – approximately 600 MW in winter and summer;
- Russia and Georgia – between 600 - 700 MW in winter and summer

System stability is the factor most limiting the capabilities of the Black Sea network to facilitate trade and exchange. Preliminary analysis indicates that the Southern Caucasus is the weakest region and most unstable on the Black Sea network.

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 Project's network analysis reveals that if the Black Sea system were operated synchronously, a natural load flow loop of up to 300 MW will be triggered in the direction of Russia → Ukraine → Romania → Bulgaria → Turkey → Georgia → Russia. This is a natural phenomenon of the behavior of electricity that loads existing network capacity, and as such, limits the possibilities of additional electricity trade in the region and with neighboring regions.

The weakest point discovered by the Working Group to date is located in the connection between Turkey and Georgia, which at present is a 220 kV single circuit OHL between Hopa (TR) – Batumi (GE). The loop flow identified by the Project will undoubtedly cause a strain in the Georgia-Turkey connection, threatening the overall security of the regional network.

The Project identified the following options to remedy this:

- **Constructing a new 400 kV OHL between Borcka (TR) and Akhaltske (GE). This line will increase the transfer capacity between Turkey and Georgia to at least 600 MW in both directions, creating enough reserve for unexpected and unplanned load flows;**
- **In case of asynchronous interconnection between Georgia and Turkey, constructing a "Back-to-Back" station in Georgia is an option. Such a connection will improve system security by providing system operators with control options of the load flows on this border, and increase overall transfer capacity between Georgia and Turkey.**

Further sub-regional analysis of these options is necessary to determine the optimal solution.

- **The Project also identified strengthening the internal 500 kV network in Georgia as a means of improving overall system security in the Caucasus. This entails building new lines from the Akhaltske Substation to existing substations at Gardabani and Zestafoni.**

The U.S Trade and Development Agency is currently funding a feasibility study on both the 400 kV line to Turkey and the internal lines in Georgia. This study will prepare preliminary design and cost estimates, review financing options, and prepare tender documentation.

The Project also recommends further sub-regional analysis on the Moldova-Romania connection to improve system security. One of the proposals is installing phase shift transformers (instead of planed LTC transformers) in substations Balts and Vulcanesti. This would give transmission operator of Moldova ability to control power flows in 400 kV and 330 kV network, and therefore increase transfer capacities of the network.

The Black Sea TSOs are actively developing new projects to improve system stability and security. Provided below is a list of current projects compiled by the TSOs and grouped by the status of the proposed project.

PLANNED NETWORK REINFORCEMENT PROJECTS

TYPE	SUBSTATION1		SUBSTATION2		VOLTAGE LEVEL kV/kV	CAPACITY A or MVA	DATE OF COMM	STATUS
				BULGARIA				
OHL	BG	C.Mogila	MK	Stip	400	1890	2008	construction
OHL	BG	M.East	GR	Nea Santa	400	1890	-	Feasibility study
OHL	BG	Zlatitsa	BG	Plovdiv	400	1890	2007	Feasibility study
				GEORGIA				
SS	GE	Qsani			500/400	3X267	2009	Feasibility study
OHL	GE	Qsani	AM	TPP Hrazdan	400	1100	2009	Feasibility study
OHL	GE	Mukharani	AZ	AZ TPP	330			existing
SS	GE	Akhaltske			500/400			Feasibility study
BB	GE	Akhaltske			400			Feasibility study
OHL	GE	Akhaltske		Marneuli	500			Feasibility study
OHL	GE	Marneuli		Gardabani	500			Feasibility study
OHL	GE	Akhaltske		Menji	500			Feasibility study
OHL	GE	Menji		Kudoni	500			Feasibility study
OHL	GE	Akhaltske		Zestaponi	500			Feasibility study
OHL	GE	Akhaltske	TR	Borcka	400			Feasibility study
OHL	GE	Enguri	RU	Centralna(Sochi)	500			Idea
MOLDOVA								
OHL	MD	Balti	RO	Suceava	400			Idea
SS	MD	Chisinau			400/330			Idea
OHL	MD	Chisinau	RO	Iasi	400			Idea
OHL	MD	Balti	UA	Dnestrovska HPP	330			Idea
OHL	MD	Balti	MD	Straseni	330			Idea

OHL	MD	Straseni	MD	Chisinau	330			Idea
OHL	MD	Balti	MD	Ribnita	330			Idea
SS	MD	Balti			400/330			Idea
SS	MD	Moldovskaya			400/330			Idea
ROMANIA								
SS	RO	Portile de Fier II			220/110	2*200	2008	Feasibility study
OHL	RO	Portile de Fier II	RO	Cetate	220	875	2008	Feasibility study
OHL	RO	Portile de Fier II	RO	Portile de Fier I	220	875	2008	Feasibility study
CSS	RO	Nadab		-	400			Feasibility study
OHL	RO	Oradea	RO	Nadab	400	1997		Feasibility study
OHL	RO	Arad	RO	Nadab	400	1997		Feasibility study
OHL	RO	Nadab	HU	Bekescsaba Border	400	1750	2008	Feasibility study
OHL	HU	Bekescsaba Border	HU	Bekescsaba	400	1750	2010	Feasibility study
SS	RO	Suceava			400/110	250	2010	Feasibility study
OHL	RO	Suceava	MD	Balti	400	1750	2014	Feasibility study
SS	RO	Bacau			400/220	400	2014	Feasibility study
SS	RO	Roman			400/220	400	2014	Feasibility study
OHL	RO	Suceava	RO	Roman	400	1700	2014	Feasibility study
OHL	RO	Roman	RO	Bacau	400	1700	2014	Feasibility study
OHL	RO	Bacau	RO	Gutinas	400	1700	2014	Feasibility study
SS	RO	Iasi			400/220		2010	Feasibility study
OHL	RO	Iasi	MD	Chisinau	400		2010	Feasibility study
SS	RO	Resita			400/220	400	2014	Feasibility study
SS	RO	Resita			400/110	250	2014	Feasibility study
OHL	RO	Portile de Fier I	RO	Resita	400	1997	2014	Feasibility study
SS	RO	Timisoara			400/220	400	2014	Feasibility study
OHL	RO	Timisoara	RO	Resita	400	1997	2014	Feasibility study
OHL	RO	Timisoara	RO	Arad	400	1997	2014	Feasibility study
OHL	RO	Timisoara	CS	Vrsac	400	1750	2014	Feasibility study
DC	RO	Constanta			400	600	?	Feasibility study
SK	RO	Constanta	TR	Pasakoy	400	600	?	Feasibility study
OHL	RO	Constanta	RO	Medgidia	400	1800	2014	Feasibility study
RUSSIA								
OHL	RU	Sotchi	GE	Enguri	500			Idea
SS	RU	Rostov			500			Feasibility study
OHL	RU	Rostov		Sahti 30	500			Feasibility study
OHL	RU	Rostov		Frolovskaya	500			Feasibility study
OHL	RU	Rostov		R 20	220			Feasibility study
SS	RU	Krimskaya II			500			Feasibility study
OHL	RU	Krimskaya II		Tihoreck	500			Feasibility study
SS	RU	Senaya		Senaya	220			Feasibility study
OHL	RU	Krimskaya II		Senaya	220			Feasibility study
OHL	RU	Krimskaya II		Slavyansk	220			Feasibility study
OHL	RU	Slavyansk		Senaya	220			Feasibility study
SS	RU	Nevinomysk			500			Feasibility study
OHL	RU	Nevinomysk		Volgodonskaya	500			Feasibility study
SS	RU	Mozdok			500			Feasibility study
OHL	RU	Nevinomysk		Mozdok	500			Feasibility study
SS	RU	Alagir			330			Feasibility study
OHL	RU	Nalcik		Alagir	330			Feasibility study
OHL	RU	V2		Alagir	330			Feasibility study
SS	RU	Kizljar			330			Feasibility study
SS	RU	Grozniy			330			Feasibility study
SS	RU	Artem			330			Feasibility study
OHL	RU	Mozdok		Artem	330			Feasibility study
OHL	RU	HP Irganskaya		Artem	330			Feasibility study
OHL	RU	Derbent		Artem	330			Feasibility study
OHL	RU	Derbent	AZ	Apsheron	330			Feasibility study
TURKEY								
SS	TR	Afyon	-	-	400/150	250	2006	construction
SS	TR	Agri	-	-	400/150	250+150	2006	construction
SS	TR	Baglum	-	-	400/150	2x250	2006	construction
SS	TR	Beykoz GIS	-	-	400/33	2x125	2006	construction
SS	TR	Davutpaşa GIS	-	-	400/150	250	2006	construction
SS	TR	Davutpaşa GIS	-	-	400/33	125	2006	construction
SS	TR	Erzurum	-	-	400/150	250	2006	construction
OHL	TR	Erzurum		Horasan	400		2006	construction

SS	TR	Germencik	-	-	400/150	2x250	2006	construction
SS	TR	Hilvan	-	-	400/150	250	2006	construction
SS	TR	Hilvan	-	-	400/33	125	2006	construction
OHL	TR	Horasan		Agri	400		2006	construction
OHL	TR	HPP Borçka-Deriner		HPP Yusufeli	400		2006	construction
OHL	TR	HPP Oymapinar		Varsak	400		2006	construction
OHL	TR	HPP Yusufeli		Erzurum	400		2006	construction
OHL	TR	Karabiga-Çan		TPP Soma	400		2006	construction
SS	TR	Manisa	-	-	400/150	2x250	2006	construction
SS	TR	TPP Iskenderun	-	-	400/150	250	2006	construction
OHL	TR	TPP Unimar		Babaeski	400		2006	construction
K	TR	Yildiztepe		Davutpasa	400		2006	construction
SS	TR	Zekeriyakoy GIS	-	-	400/150	250	2006	construction
SS	TR	Zekeriyakoy GIS	-	-	400/33	125	2006	construction
SS	TR	Hatay	-	-	400/150	250	2007	construction
SS	TR	Hatay	-	-	400/33	125	2007	construction
OHL	TR	Hatay		Erzin	400		2007	construction
SS	TR	Mersin	-	-	400/150	250	2007	construction
SS	TR	Mersin	-	-	400/33	125	2007	construction
OHL	TR	Mersin		TPP Iskenderun	400		2007	construction
OHL	TR	Seydişehir		HPP Oymapinar	400		2007	construction
SS	TR	Umraniye	-	-	400/150	2x250	2007	construction
SS	TR	Borçka	-	-	400/150	250	2010	Feasibility study
OHL	TR	Borcka	GE	Akhaltske	400			Feasibility study
OHL	TR	Babaeski	GR	N.Santa	400		2010	F.study
DC	TR	Pasakoy			400	600 MW		Idea
SK	TR	Pasakoy	RO	Constanta	400	600 MW		Idea
UKRAINE								
OHL	UA	Pivdenoukrainskaya	RO	Isaccea	750	4000 A	2015	Feasibility study
SS	UA	Kyivska			750/330	1000 MVA	2008	Construction
OHL	UA	Rivnenska NPP	UA	Kyivska	750	4000 A	2008	Construction
OHL	UA	Zahidnoukrainska	UA	Bogorodchani	330	1670 A	2010	Construction
OHL	UA	Dnistrovska PSHPP	UA	Bar	330	1670 A	2007	Construction
OHL	UA	Novoodeska	UA	Artsyz	330	1670 A	2007	Feasibility study
OHL	UA	Adgalyk	UA	Usatovo	330	1670 A	2007	Feasibility study
OHL	UA	Zarya	UA	Mirna	330	1380 A	2008	Construction
OHL	UA	Simferopol	UA	Sevastopol	330	1670 A	2007	Feasibility study
OHL	UA	Dgankoj	UA	Melitopol–Simferopol	330	1380 A	2006	Construction
OHL	UA	Pivnichnoukrainska	UA	Kyivska	750	4000 A	2015	Feasibility study
OHL	UA	Zaporizka NPP	UA	Kahovska	750	4000 A	2015	Feasibility study
OHL	UA	Lutsk Pivnichna	UA	Ternopil	330	1670 A	2010	Feasibility study
OHL	UA	K.Podolska	UA	Ternopil	330	1670 A	2012	Feasibility study
OHL	UA	HPP Dnistrovska	MD	Balti	330	1670 A	2012	Idea
ARMENIA								
SS	AM	Hrazdan TPP			400/220	2x5x200	2009	Feasibility study
OHL	AM	Hrazdan TPP	IR	Tavriz	400	2x1800	2010	Feasibility study
OHL	AM	Hrazdan TPP	GE	Ksani	400	1100	2009	Feasibility study

PROPOSED NEXT STEPS & RECOMMENDATIONS

Building on the results and findings of the technical assessment and the institutional and technical accomplishments cited above, the Project recommends the following next steps:

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 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.

INSTITUTIONAL & TECHNICAL ACCOMPLISHMENTS

The first phase of the Project concluded in December 2006. In addition to its analysis of the regional network, the Project was instrumental in developing a sustainable institutional capacity to expand cooperation among Black Sea TSOs. Among its accomplishments are the following:

Capacity Building & Training -- Establishing a Sustainable Transmission Planning Working Group
The project established the Black Sea Transmission Planning Working Group comprised of a corps of 14 planning specialists from the eight participating TSOs. Trained together in the use of the project software and methodologies, they cooperated to analyze bulk power flows on the regional network. Five Working Group meetings were hosted by participating TSOs over the course of the Project. Through their cooperation, Working Group members established confidence in their capabilities, agreeing to timetables, procedures and deliverables for each Working Group meeting. As a result, formal and informal communication among them has improved, proving the basis for both regional and bilateral cooperation.

Developing a Regional "Lingua Franca" – Selecting a Common Regional Planning Platform
Participating TSOs adopted by consensus, the PSS/E software as the common planning platform for the development of an integrated regional system simulation model. The platform provides the TSOs of the region with a "Lingua Franca.", with which to analyze the regional network.

Exchanging System Data – Constructing & Distributing National & Regional Models
Black Sea TSO constructed national databases and system models detailing generation and transmission elements in their national networks. The models were subsequently incorporated into an integrated regional network model for the forecast year 2010. Containing system specific databases for each national network, this model has been distributed freely among the participating TSOs. As a result, system operators have an improved understanding of the structure and operations of their neighboring national systems and an ability to analyze proposed network changes in terms of regional reliability, security and trade potential.

Harmonizing Protocols – Adopting UCTE Methodologies
The Working Group adopted and was trained in the UCTE procedures for calculating Total and Net Transfer Capacity on international tie-lines among bordering TSOs. These calculations identify for system operators and traders, the maximum capacity for safely transferring electricity on high voltage transmission lines between countries. By adopting UCTE procedures for these calculations, the Black Sea TSOs have harmonized the practices of the entire region with the Energy Community of Southeast Europe and UCTE.

Analyzing the System -- Identifying Network Capabilities and Weak points
The Working Group analyzed nine potential electricity trading scenarios among the Black Sea TSOs and neighboring systems. Using the regional model, they calculated total and net transfer capacities and analyzed the network to identify transmission bottlenecks that may threaten system security and prevent regional trade.

ACKNOWLEDGEMENTS

USAID and USEA wish to acknowledge the invaluable contributions of all participating organizations to the success of the Project. The successful completion of this phase of the project would not be possible without the tremendous collaborative effort contributed by both the senior management and technical staff of the TSOs and resource organizations involved. The dedication to the objectives of the project by all involved is illustrated by the countless hours of volunteer labor contributed as a cost share to the project.

The TSOs graciously contributed the pro-bono labor of skilled system planners who worked diligently to develop their national models, spent countless hours coordinating with their counterparts by phone and email, and collaborated so effectively at the five two-day regional Working Group meetings. In addition to their labor contributions, they are to be recognized for sharing the cost of travel to the Working Group meetings by funding airfare and other expenses.

A special acknowledgement goes to Transelectrica, which volunteered to serve as Technical Project Coordinator in 2004. Since then, Transelectrica’s Bogdan Popescu Vifor and Dan Preotescu have served as the Project Coordinator, deftly leading the Working Group and Steering Committee through seven meetings. Thanks to Transelectrica’s excellent management, the Project has produced a sophisticated regional transmission planning model and system analyses.

The Electricity Coordination Center of Belgrade, is to be recognized for its professionalism and technical support in the development of the eight national models, the creation of the regional model, training on PSS/E and UCTE calculations, and the system analysis calculations. The assistance provided by EKC was “above and beyond” all expectations.

A special debt of gratitude must be paid to TEIAS, who on a pro-bono basis worked with its Georgian colleagues to create a sub-regional model for Turkey and Georgia.

Finally, to GSE for graciously volunteering to host and conduct a one week training course on the use and application of PSS/E for its colleagues from Armenia, Russia and Ukraine.