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**Hydropower Investment
Promotion Project (HIPP)**

SCHEDULING AND IMBALANCE SETTLEMENTS RECOMMENDATIONS FOR ELECTRICITY EXPORTS TO TURKEY

REPORT, JUNE 2012

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(HIPP)

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IN COLLABORATION WITH BLACK & VEATCH AND PIERCE
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1.0 INTRODUCTION

This report presents background information for consideration regarding transaction scheduling and financial settlement processes upon the completion of the Borcka-Akhaltshikhe Interconnection Line for electricity transactions with Turkey. The ideas included in this report are intended to assist the Government of Georgia (“GOG”) in dealing with the expectation of exporters (including private investors in new hydropower projects) for transactions with Turkish importers.

The USAID Hydropower Investment Program (“HIPP”) put forward a broad range ideas to encourage new competitively priced hydroelectric resources to enter the market. These ideas are described in detail in a HIPP’s report on “Georgian Electricity Market Model 2015 and Electricity Trading Mechanism”. Among these are:

- primary legislation that fully supports a competitive electricity market,
- clear and enforceable competitive market regulations that provide incentives for new competitively priced resources to enter the market,
- an enforceable contractual framework,
- competitive market operations including a clearing house,
- state-of-the art metering, communication, and data management system to handle the information needed for market operations,
- market monitoring and sanctioning of violations of market regulations,
- a competent energy regulator that will oversee and protect competition in the power market,
- standards of performance for network service providers enforced by the regular under clear license conditions,
- clear and cost-based tariff regulations for network service providers,
- a competent transmission system operator that provides a real time information system for power market participants and forecast the need for new resources in the next 5-10 years,
- a financial derivative market,
- a competent market operator, and
- a balancing market.

The scheduling and financial settlement processes described in this report provide background information for consideration as the GOG determines the changes that might be made to facilitate export transactions to Turkey. They may be useful for further discussions with counterparts in Turkey. They also represent initial steps that will assist in implementing some of the ideas listed above; namely (i) clear scheduling and settlement processes that provide incentives for new hydroelectric resources to enter the market, (ii) encouraging additional state-of-the-art metering communications, and data management system, and (iii) introduction of some of the concepts that can be used in a future balancing market.

The dispatch and settlement procedures in Georgia differ from those in Turkey. The Georgian State Electrosystem (“GSE”) dispatches generation with a focus on fulfilling monthly-settled direct contracts between generators and customers while maintaining system reliability. The Electricity System Commercial Operator (“ESCO”)

employs a balancing energy settlement approach that is based on monthly deviations from contracted volume in the direct contracts. The Turkish framework includes a day-ahead market and an hourly real time balancing market. The challenge is to adapt the Georgian processes as needed to fit with the Turkish processes to facilitate exports to Turkey.

The scheduling ideas presented in this report are intended to provide a timeline for scheduling export transactions in a manner that is consistent with the day ahead electricity market in Turkey. The settlements concepts are intended to account for the likelihood that there will be times when Georgian or Turkish dispatchers find it necessary to change the actual cross-border electricity flow from the scheduled amounts. We anticipate that the resulting imbalances will be settled at Turkish real time prices. These imbalance payments should be allocated fairly to those exporters and other generators and customers within Georgia who contribute to the imbalance.

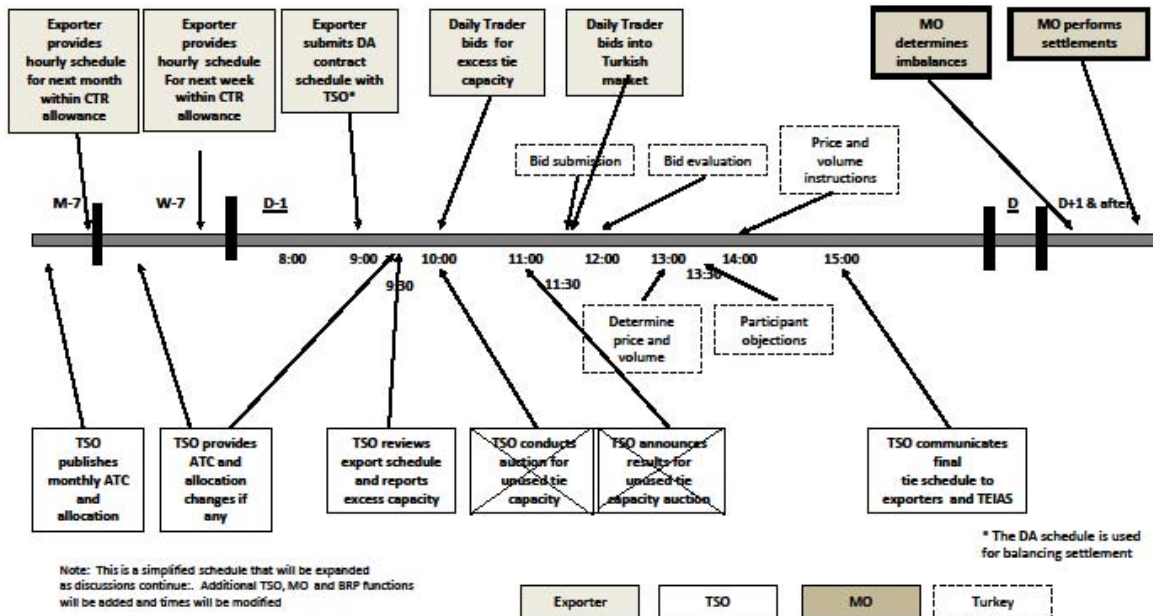
The report includes a discussion of scheduling, export imbalance settlements, and internal Georgian settlements as they relate to exports. The ideas presented in this report represent preliminary findings.

2.0 SCHEDULING

The scheduling process is important for new hydroelectric projects and particularly for run of river plants. These types of plants have less flexibility and are dependent on weather. Yearly and month ahead schedules can create liabilities that these projects cannot afford. A day ahead schedule obligation is a reasonable time frame and is consistent with the Turkish day ahead market. As a result, the time line shown in this section focuses on day ahead activities. Even day ahead liabilities can be large due to scheduling inaccuracies, but it will be necessary for the exporter and Turkish importer to agree on contract terms that address the volume deviation risk.

Our objective in the scheduling section of this report is to outline a timeline for scheduling activities that will enable Georgian exporters to sell into the Turkish day ahead market. We have had discussions with GSE and the Turkish Electricity Transmission Company ("TEIAS") to refine the time line. Based on those discussions, we offer the following ideas to assist in future scheduling and communications discussions between GSE and TEIAS.

Tie Scheduling with Day Ahead Transactions (Functions and Times are for Discussion Purposes Only)



The time line starts with GSE (or TSO) publishing the monthly Available Transmission Capacity (“ATC”) and the capacity allocation. We note that the 2013 monthly ATC values are expected to be available in August 2012 based on the draft Interconnection Operations Agreement between GSE and TEIAS. We are not aware of any 2013 transmission capacity allocations that GSE has made to date. We presume that GSE will publish the 2013 ATC values and invite potential exporters to apply for capacity allocations as soon as practical.

The boxes in the timeline show activities carried out by the exporter, GSE, ESCO, and TEIAS.

The timeline shows exporters providing an hourly schedule for the upcoming month (at M-7, or 7 days prior to the start of the month). The purpose of this schedule would be for planning purposes. We have also included a week-ahead schedule if GSE determines that it wants a more up to date schedule for planning. The time line includes provisions for GSE to modify the ATC values and allocations if required.

The timeline focuses around the day ahead schedule. The day ahead schedule would be the binding schedule for measuring imbalances in this scheduling timeline. This is consistent with the Turkish day ahead market procedures. The timeline shows the activities of each of the parties to enable exporters to bid in the Turkish day ahead market.

A day ahead auction process for unused transmission capacity may be a valuable element for both exporters and for GSE to maximize use of the interconnection. We have put an X through those boxes to note that consideration should be given as to whether this should be included from the start or added at a later date. GSE will have more information to make this decision once ATC values are determined and potential exporters indicate their interest in daily transactions. The reason for not including a daily transmission auction at the start is that time is tight for all the activities that GSE has to perform in the mornings, auctions are complex to implement, and simpler approaches (first come first served or allocations) may be an easier way to begin if demand for unused daily capacity is not high.

The timeline above is a template that would be refined by GSE and TEIAS. It would be worthwhile to consider a follow up workshop to include GSE, TEIAS and other interested parties to refine the timeline and work out the many communication and scheduling details. The main concept that the timeline is intended to convey is that there should be sufficient time for exporters to bid into the Turkish day ahead market.

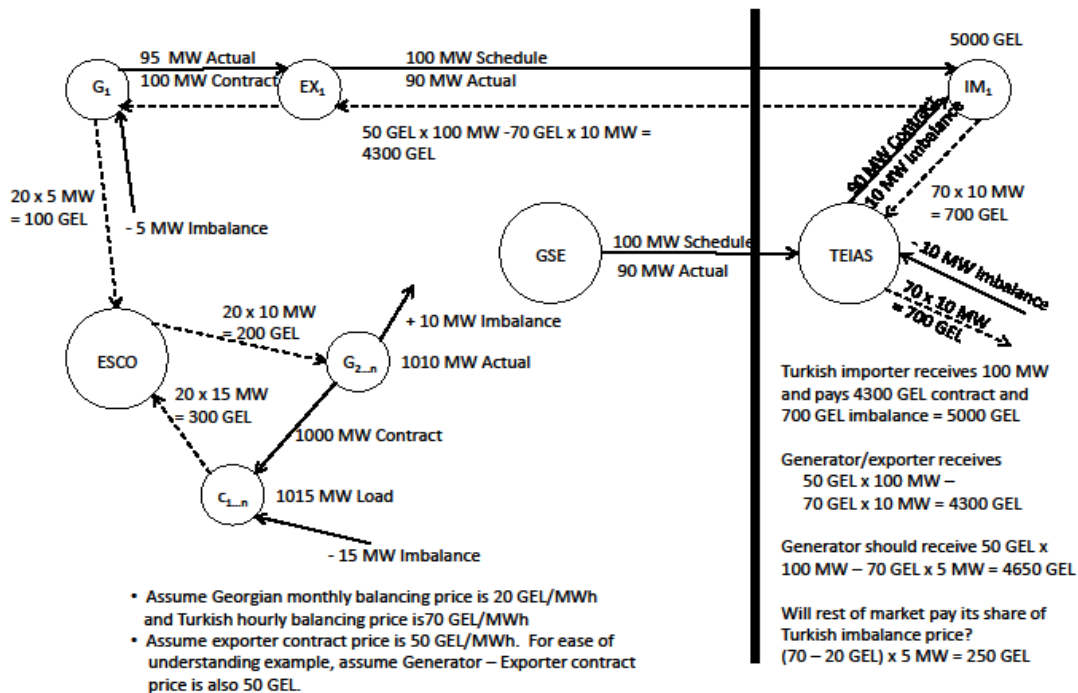
3.0 IMBALANCE SETTLEMENTS

3.1 STATEMENT OF ISSUES

By imbalance, we mean the difference between actual electricity flow in an hour and the day-ahead scheduled electricity flow for that hour. The question of whether imbalances will occur and how they will be settled is important because it represents a threshold question; is it necessary to modify Georgian settlement systems to address financial settlement at Turkish imbalance prices?

The following chart shows a simplified example of an imbalance caused in part by a generator that is under generating compared to its scheduled delivery to an exporter. The imbalance is also caused in part by customers using more than their contracted volumes.

**Generator and Customer Imbalance Example (Export Imbalance)
Summer Month with Low Georgian Balancing Price**



The various price assumptions are shown in the chart. For simplicity, we assume that there is one generator (G_1) with a 100 MW contract with one exporter (EX_1) to sell to a single importer in Turkey (IM_1). The importer will pay an imbalance charge for 10 MW at the Turkish balancing market price. The Turkish importer will also pay the Georgian exporter its contract price for the 100 MW minus the Turkish imbalance charge for the 10 MW shortfall (4,300 GEL).

The generator should expect to receive the contract price for the 100 MW contracted volume minus the Turkish imbalance cost for its 5 MW shortfall (4,650 GEL). The problem is that there is a shortfall in what the exporter and generator receive. They have been penalized for a 10 MW shortfall but are only responsible for 5 MW of that shortfall (receiving 4300 GEL and not 4650 GEL).

As a matter of fairness, the exporter should not be held financially responsible for that portion of the imbalance that it did not cause. One way to ensure that is not held responsible for imbalances it did not cause would be to design a settlement process that includes the impact of the Turkish imbalance cost, and to allocate those costs to the responsible parties within Georgia.

The imbalance question will become even more of an issue when Azerbaijan exporters use the Georgian transmission system for transit into Turkey. Larger imbalances are anticipated on electricity imports into Georgia since the Georgian and Azerbaijan systems operate synchronously and Georgia will have little control over the electricity flow into Georgia.

4.0 POTENTIAL IMBALANCE SETTLEMENT APPROACHES

There are a number of possible solutions to address imbalances with Turkey.

- **Allocate costs to the responsible parties**
It is possible to allocate imbalance costs to the responsible parties by knowing how much each party contributed to the imbalance. However, metering at all generators, distribution companies, and Direct Customers is required to make an exact allocation. If hourly metering is not available to determine each party's contribution to imbalances, then some hourly generation and load approximations would be needed. There was reluctance in discussions with ESCO about using approximations since that would lead to disputes that would not be easily resolved. Approximations would be minimized if hourly metering is available at all required locations.
- **Dispatch generation and disconnect customers if necessary to ensure the export schedule is met**
Dispatching generation to eliminate imbalances at the interconnection is certainly the preferred solution. If there is no imbalance at the interconnection, imbalances can be settled internally in Georgia. If there are hours when internal generation is not sufficient to meet the export schedule, disconnecting customers is a potential solution to maintaining an export schedule. However, financial settlement of imbalances is likely to be preferable to shedding load.
- **Add Turkish imbalance costs to ESCO's monthly settlement costs**
Socializing the cost of Turkish imbalance costs by adding those costs (that portion that are not directly attributable to exporters) to ESCO's monthly settlement costs is a potential solution to allocating imbalance costs. The question is whether the problems associated with this solution are more or less than the problems associated with allocating costs to responsible parties using some estimated values.
- **Volumetric Settlements**
The Turkish approach to imbalance settlements with Bulgaria and Greece is to repay imbalance MWh with energy rather than using financial settlements. If there are under deliveries to one country's electricity system, a MWh repayment schedule is established to bring the two countries into balance. There is a procedure in place to determine when MWh should be repaid so that one country does not under deliver in high cost hours and over deliver in low cost hours.

5.0 TURKISH IMBALANCE SETTLEMENT DISCUSSIONS

We had discussions with PMUM (TEIAS financial settlements subsidiary) and the energy market regulatory authority ("EMRA") in Turkey to understand their approach to cross border settlements. As noted above, the Turkish approach to imbalance settlements with Bulgaria and Greece is to repay imbalance MWh with energy rather than using financial settlements.

This approach is carried out by agreements between TEIAS and the transmission system operators in the neighboring countries. Their logic is that system operators are responsible for imbalances in synchronous connections and they should settle imbalances between themselves. If there are under deliveries to one country's electricity system, a MWh repayment schedule is established to bring the two countries into balance. There is a procedure in place to determine when MWh should be repaid so that one country does not under deliver in high cost hours and over deliver in low cost hours.

It was clear in discussions with TEIAS, EMRA, and PMUM that there were multiple views on the applicability of volumetric settlements with Georgia. The fact that the interconnection with Georgia will be asynchronous led some of those we spoke with to believe that financial settlements was a more appropriate way to handle the imbalances. Others supported a volumetric settlement for some +/- percentage band width and then financial settlements outside that band. The logic was that small imbalances were immaterial but larger imbalances should result in payments.

6.0 VIEWS ON IMBALANCES

We had a number of discussions with ESCO and GSE reviewing imbalance settlement issues. One meeting was a joint working session between GSE, ESCO and HIPPT. There were two major points of discussion: (i) if changes are made in the financial settlement processes, what is the preferred approach, and (ii) are potential imbalances a large enough issue to justify changes in existing settlement processes.

There was a general sense that an imbalance approach should fairly allocate imbalance cost to the responsible parties. The difficulty is that none of the potential solutions is fully acceptable and may lead to legal disputes.

- The lack of hourly metering on the commercial metering points needed to construct hourly loads for distribution companies makes it impossible to precisely know the extent to which each party is responsible for hourly imbalances.
- Adding Turkish imbalance costs to the ESCO monthly settlements would spread the cost over all customers, but would not target those responsible for the imbalances.

Hourly imbalance cost allocation to responsible parties would be more viewed more favorably if appropriate metering was in place to measure hourly imbalances more precisely.

The question of whether imbalances are a large enough problem to justify changes to existing settlement procedures is based on the following:

- Imbalances may be infrequent. GSE believes that the HVDC back to back interconnection will provide a high degree of power flow control that will minimize or eliminate inadvertent flow.
- There will be times when dispatchers in Georgia or Turkey will order changes to the delivery schedule due to operating conditions on their system. However, GSE believes that there is a strong capability within the Georgian

system to react to internal problems and quickly get back to scheduled deliveries.

- Imbalances caused by TEIAS will need to be handled in the contract between the Georgian exporter and Turkish importer. GSE would not be involved in how these contracts address this matter.
- GSE will have a provision in its Transmission and Dispatch Agreements (“TDA”) with project developers that will compensate the developer in the event that GSE is responsible for reductions in exports.

However, there was a clear recognition that the import of electricity from Azerbaijan for transit to Turkey is still an open issue. There is less control over the synchronous interconnection than there would be if it were an HVDC back to back interconnection. To date there is no commercial contract for balancing, no transit tariff, and no agreement on the transmission line. GSE stressed that these are major items that need to be resolved. The upcoming workshop in Sophia, Bulgaria is expected to be a good forum to discuss these matters with representatives from Azerbaijan.

7.0 POTENTIAL IMBALANCE SETTLEMENTS SOLUTIONS

There was general agreement that there will be imbalances on the interconnection with Turkey. At this time, the number of times that this will happen and the level of the imbalance cost is not known. However, the fact that imbalances will occur makes argues for having a mechanism in place to settle those imbalances.

Without a settlement mechanism in place, there will likely be cases where exporters are penalized more than they should be for imbalances. The only recourse that exporters would have is to claim that the imbalance was caused by GSE and try to collect under the compensation provision in the TDA. If GSE disagrees (and indeed there will be many cases where imbalances are caused by generators tripping or other factors that are not GSE’s fault), then the exporter will have nowhere to turn except to the courts. A financial settlement process, even if not exact, is likely to be preferable to imposing more of a share of imbalance costs on exporters than they are responsible for.

It seems clear that there are no ideal solutions at this time. However, we offer the following ideas for GOG consideration:

- Completing the installation of hourly metering as soon as practical would permit Turkish imbalance costs to be allocated to the responsible party with minimal approximations.
- ESCO could consider an interim approach of incorporating Turkish imbalance costs that are not attributable to exporters in its monthly settlement calculations. This could be replaced with a more accurate cost allocation to the responsible parties once hourly metering installations are complete. The alternative to not having an interim settlement solution in place is to expose exporters to potentially large penalties that are not their responsibility.
- There is agreement on the assessment of the situation with Azerbaijan. Much work needs to be done to begin transactions and time is short.

8.0 INTERNAL GEORGIAN IMBALANCE SETTLEMENTS RELATED TO EXPORTS

It is likely that in most hours, actual exports to Turkey will match scheduled amounts. At the same time, there are likely to be many hours where there are imbalances internal within Georgia that involve exporters. In that case, exporters will fulfill their export commitments using, in part, energy from the Georgian balancing market.

Georgian imbalances are settled on a monthly basis by ESCO. Actual monthly volumes are compared to contracted volumes and market participants pay or are paid based on their deviations from contract volumes. The rates that are used in the calculation are based on administratively set tariff prices.

The difference between the monthly framework of the Georgian market and the hourly framework of the Turkish market leads to potential challenges. It is a common practice to arbitrage¹ between markets. There is a clear incentive, especially in months where Georgian imbalance prices are low (typically summer months when imbalance prices can be 1-2 tetris/KWh) when it would be more economic for Georgian exporters to buy from the balancing market than to buy from Georgian generators. This could harm other market participants in Georgia who would sell into the balancing market to supply the exporter at low prices. Under the current market structure, GSE will need to monitor generation schedules and actual output to ensure that exporters do not abuse the low cost balancing market by intentionally under producing to buy from the balancing market.

When Azerbaijan imports into Georgia are included, the situation gets more complicated. Since the interconnection with Azerbaijan is synchronous, GSE anticipates that imbalances will be a matter of concern since the flow at the interconnection cannot be closely controlled. We presume that Georgia would not want to give Azerbaijan exporters full access to its monthly balancing market. The incentives would be too high for Azerbaijan to reduce the thermal generation associated with its exports in order to buy from the low cost Georgian balancing market in the summer. Therefore, we assume that negotiations between parties in Georgia (GSE, ESCO, other balancing responsible party?) and Azerbaijan will include the question of who provides balancing energy and at what price. This situation would be eased if there was a market based balancing market in Georgia.

Additionally, in the event that there are exports from Turkey into Georgia, the arbitrage issue comes into play again. How will Georgia control the use of its balancing market by Turkish exporters? This may not be a big issue at this time since the vast majority of transactions will be exports from Georgia to Turkey. But it is worthwhile to think through all scenarios when modifying market rules.

An hourly balancing market would change the export dynamics and would permit an exporter to seek the lowest cost supply available for its exports, including supply from the balancing market. This would encourage additional economically efficient exports. If an exporter can find market priced power that is lower cost than its alternative supply, this will increase the attractiveness of exports and assist GOG in achieving its goals.

¹ The simultaneous purchase and sale in different markets to profit from unequal prices.

9.0 CONCLUSION

This is a historic time for the electricity sector in Georgia and we appreciate the opportunity to provide our input to the GOG. We also greatly appreciate the courtesy and engaging discussions we have had with ESCO and GSE. We hope that the ideas we have presented on scheduling and export imbalance settlements will help to further Georgia's progress toward establishing an enabling environment for hydropower development and facilitate exports to Turkey.

Our focus in this report was on the immediate needs for establishing a scheduling framework that enables Georgian exporters to sell into the Turkish market and for settling cross border imbalances in an equitable manner. However, the ideas presented in this report also represent initial steps in implementing some of the concepts contained in the Georgian Electricity Market Model 2015 and Electricity Trading.

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