

PN. ACM-193

110152

**REPORT ON SUSPECTED DIVERSION OF  
PURCHASED ENERGY  
GEORGIA ELECTRIC AND NATURAL GAS REFORM**

*Prepared for:*

The United States Agency for International Development  
under Contract LAG-I-00-98-00005-00, Task Order 15  
"Georgia Electricity and Natural Gas Sector Reform Program"

*Prepared by:*

Hagler Bailly Services, Inc.  
1530 Wilson Boulevard  
Arlington, VA 22209  
703-351-0300

*Contact:*

Dean White  
Joellyn Murphy

March 27, 2000

The reproduction or distribution for sale of any portion of this report without the express written consent of Hagler Bailly Services, Inc. is prohibited. Any other reproduction, publication, distribution or use of the material contained herein must include this acknowledgement and prohibition.

A

## Introduction

The following presents the results of Hagler Bailly's review of the circumstances surrounding the suspected diversion of power purchased by AES Telasi, the privatized electricity distribution company in Tbilisi, Georgia, from the Republic of Armenia. The intent of this review was to independently determine the extent of the losses, if any, and to identify the control weaknesses permitting the diversion.

## Summary

AES purchased the Tbilisi electricity distribution system in January 1999, forming AES Telasi. Initially, all power purchases were made through Sakenergo, however Sakenergo was unable to supply adequate energy to enable AES Telasi to serve its customers. To supplement its energy supply, AES Telasi in late 1999 signed two contracts for additional power with Armenergo, the entity responsible for dispatch and wholesale power transactions for the Republic of Armenia. Armenergo is owned by the Armenian Ministry of Energy, the party that conducted the negotiations with AES Telasi.

The first contract covered the period December 30, 1999 through January 7, 2000. The second covered January 25, 2000 through February 26, 2000. Each contract called for 100 MW (2.5 GWh) per day, priced at \$0.027 per kWh for the first contract and \$0.025 per kWh for the second. A third contract was also signed in February, to be effective April 1, 2000. Payments for the power are made directly to Armenergo. In all cases, the contract provides for the two parties to split losses.

Deliveries under the contracts with Armenergo are first measured at 220 kV inside the Armenian border at the Alaverdi Substation owned by the High Voltage Electric Network Enterprise (or ArmTrans, the Armenian transmission company owned by the Ministry of Energy). The power is routed through an isolated 220 kV busbar at the Gardabani generating station in Georgia, then, still at 220 kV, to the Navtlugi Substation (owned by Sakenergo) for the second and final metering. Isolation is necessary as the Armenian system is not synchronized with the Republic of Georgia. The power is stepped down to 110 kV at the Navtlugi Substation, prior to metering. AES Telasi assumes control of the energy at this metering point.

Subsequent to the start of receiving energy under the contracts with Armenergo, semi-public statements were made by AES Telasi management to the effect that 40% of their power was being diverted. These statements were interpreted by various parties as being applicable solely to the energy purchased from Armenia. At this point Hagler Bailly was brought in as a neutral party to perform a review of the situation. Through discussion with the General Director during the course of this review, it was learned that the statements were not intended to apply solely to the Armenian power purchases; rather that the concern related to the overall system losses of 40%, including technical and commercial, currently being suffered by AES Telasi. Losses on the energy purchased from Armenia were averaging 8.2%.

In conjunction with AES Telasi personnel, Hagler Bailly examined the reports maintained by AES Telasi on its energy purchases and consumption, reviewed diagrams

and schematics demonstrating the flow of power through the system and the system interconnection points. Plans were developed and implemented to observe the metered and nonmetered interconnection points for a two-day period to determine whether there was actual energy diversion or facilities tampering, or whether there were metering issues that indicated losses not actually incurred. Finally, the metering equipment at the Navtlugi substation was examined.

### ***Conclusion***

The result of the review was that there had not, in fact, been any diversion of energy or intentional tampering with equipment. The agreement ultimately reached with the General Technical Director of AES Telasi was that the apparent losses were the result of system overload at the Navtlugi Substation, causing meter misreads. The overloaded current transformer used for metering was causing consistent underreads, spiking when deliveries rose.

### **Recommendations**

No recommendation is made here regarding the original issue, as AES Telasi will work with Sakenergo to resolve the metering issue. In addition, AES Telasi will review the other 83 system interconnection points to identify similar problems that most likely exist. However, it would not be unreasonable to follow-up with both parties to ensure that the matter is satisfactorily resolved. The item of concern here for all parties is that losses are appropriately recognized and dealt with in the future. While there is no accurate data on actual energy deliveries and losses for the period examined due to the metering issues, care must be taken to ensure that parties are not required to compensate for losses not actually incurred.

Other peripheral issues arose during the course of the review that merit attention, including:

- Sakenergo continues to wheel power across AES Telasi's wires on a gross basis, with no provision for technical losses. This results in AES Telasi bearing the burden of these losses.
- Metering practices and capabilities at Sakenergo facilities need to be improved to attain adequate commercial business practices.
- It was brought out during one meeting that dispatchers still practice accepting payments in order to maintain power. This was reported by one individual having personally observed such a transaction.

## **Listing of Appendices**

The following appendices are integral components of this report:

- Appendix I Summarized Chronology of Significant Contacts and Activities
- Appendix II AES Telasi Metering Differences (chart)
- Appendix III Shipments per Alaverdi (chart)
- Appendix IV Listing of Contributors

Additional information gathered and available but not incorporated into this report includes:

- Map of the Transcaucasian Power System
- Detailed schematics of the energy system interconnection points
- Photographs of the meters located at the Navtlugi Substation

Appendix I

**Summarized Chronology of Significant Contacts and Activities**

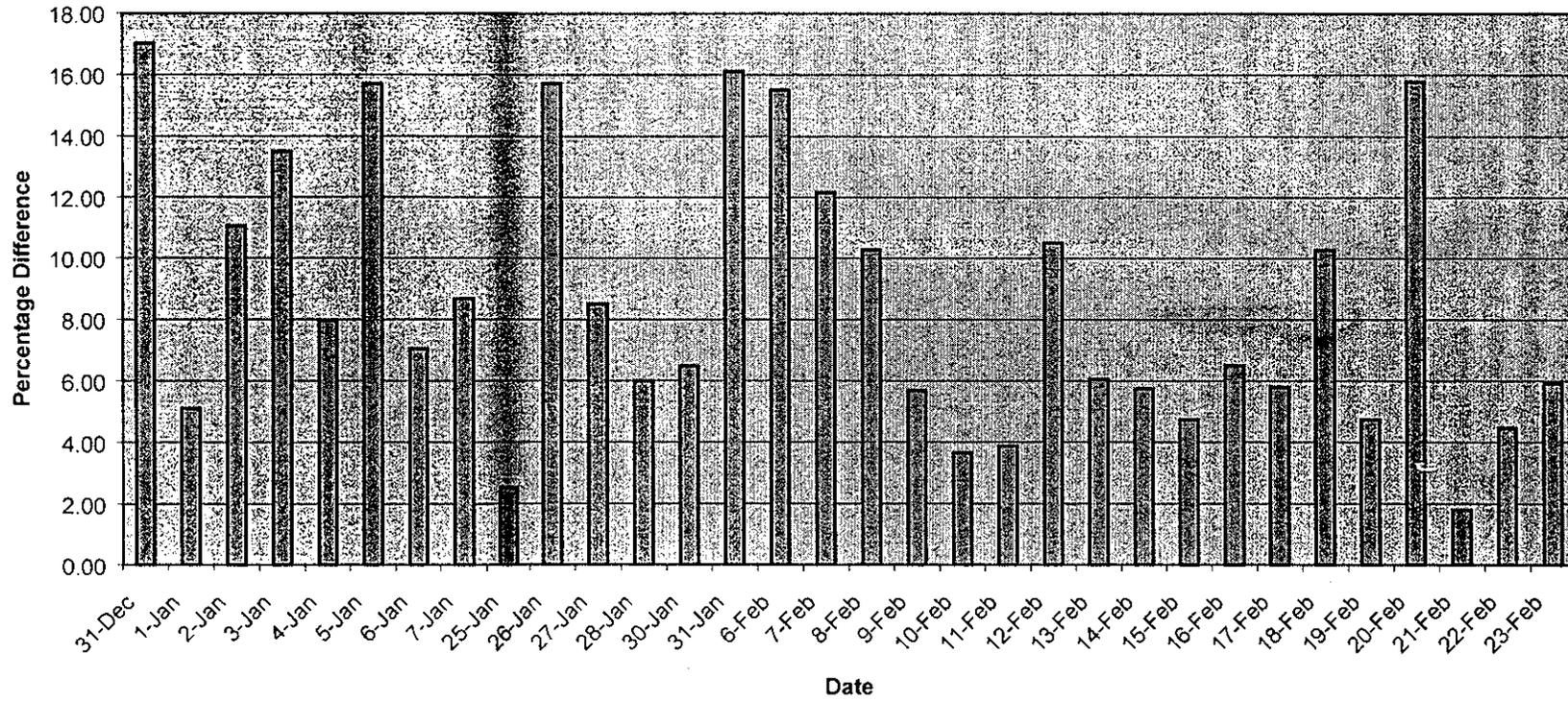
<p>February 17</p>	<p>Discussed background with Hagler Bailly's Chief of Party and Deputy Chief of Party. Received high level briefing on the Georgian power system and the interconnection with Armenia. Identified possible scenarios for consideration, including actual theft by tampering with equipment, interim line taps for energy diversion, or no theft occurring.</p>
<p>February 18</p>	<p>Accompanied by Hagler Bailly's Chief of Party, met with AES Telasi's General Director and General Technical Director to discuss the basis for the concerns. At this meeting it was learned that the 40% figure for diverted energy originally believed was actually the approximate total system losses for AES Telasi. Losses on the purchased Armenian power were averaging 8.2% of deliveries. AES Telasi's calculations indicated actual technical losses should run between 1.5 and 2.5%. The Armenian power grid is not synchronized to Georgia, so the purchased energy is delivered only to isolated portions of the Tbilisi system. The General Director provided a copy of the daily report</p>
<p>February 19</p>	<p>Received and reviewed files and data available on the market structure and rules, in addition to notes from meetings held with market personnel and AES Telasi.</p>
<p>February 21</p>	<p>Met with AES Telasi's General Technical Director, Dispatch Director and the Head, Electricity Purchases and Quality Control Department for the purpose of obtaining contract data and detailed power system information. The General Technical Director delineated the terms for of the contracts, including the parties involved, delivery schedules and pricing. There are currently two contracts involved, each providing for 100 MW, 2.5 MWh per day. The first contract (December 30 through January 7) was priced at 2.7 cents per kWh, the second (January 25 through February 26) at 2.5. The contracts were negotiated with the Armenian Ministry of Energy, although Armenergo is signatory as the supplier. Payments are made directly to Armenergo. The contracts call for losses to be split between the two parties.</p> <p>Discussed the various diversion scenarios for consideration of the possibility for each. Detailed system diagrams were presented and reviewed, with the General Technical Director identifying the power routing and metering points. It was agreed it would be difficult, if not impossible, to steal power between Alaverdi and Gardabani. The most likely causes were limited to either misreading the meters or switching off the meters at the Navtlugi Substation. Meters at both Navtlugi and Alaverdi are read daily. AES Telasi had previously requested that</p>

	<p>Sakenergo test the meters at Navtlugi, but this has not been done. In addition, there is a breaker at Gardabani that is out of service that AES Telasi has asked to be repaired (this was accomplished during the course of these efforts).</p> <p>AES Telasi proposed to develop a plan to secure and monitor both metering facilities for a twenty-four hour period beginning the following night, in addition to observing activities at the Gardabani generating station. The intent was to ensure accurate meter readings and eliminate the possibility of equipment tampering at the three facilities. If the loss percentages remained high, AES Telasi would bill Sakenergo under the assumption Armenia was delivering all power scheduled.</p>
<p>February 22</p>	<p>Reviewed the proposed monitoring plan with the General Technical Director. Subsequent to discussion and revision, including extending the monitoring period, the plan was accepted and scheduled for implementation in the evening. Two individuals would be placed at each of the three locations, with monitoring scheduled to begin at 9:00 PM. Personnel clearances have been obtained for all locations.</p>
<p>February 24</p>	<p>Met with AES Telasi's General Technical Director, Dispatch Director and the Head, Electricity Purchases and Quality Control Department to review the interim results of the surveillance. The effort had started and proceeded as planned; based on the hourly readings, the previous day's losses were reported at 5.4%. Today's information is still being processed. Monitoring will stop with tonight's 8:00 PM readings. There was no evidence of any tampering with metering equipment.</p> <p>The current probably cause is preliminarily identified as problems with the circuitry at the Navtlugi Substation. It now appears that the current transformer used to step down the amperage for metering may be overloaded. This will be examined during a site visit scheduled for the following day.</p>
<p>February 25</p>	<p>Accompanied by AES Telasi's General Technical Director, traveled to the Navtlugi Substation for the purpose of examining the metering facilities. This visit revealed that:</p> <ul style="list-style-type: none"> <li>• Circuit schematics for the facility were inaccurate.</li> <li>• Metering facilities were improper and inadequate. It was noted that at least one meter was "pegged" meaning that system load was greater than the meter capacity.</li> <li>• The current transformer (600A, 5A secondary) was overloaded, with three meters connected, in addition to relay protection equipment. Further, the current circuit was not in compliance with standards.</li> </ul>

	<p>The General Technical Director was satisfied with the conclusion that there had, in fact, been no theft or diversion of energy purchased from Armenia, and that the alleged losses were caused by improper utilization of equipment. This was further supported by overlaying the chart of energy deliveries by day to percentage losses by day, indicating the loss percentages would spike when deliveries were higher. AES Telasi will now proceed to review the metering facilities at the other connection points with Sakenergo.</p>
--	---

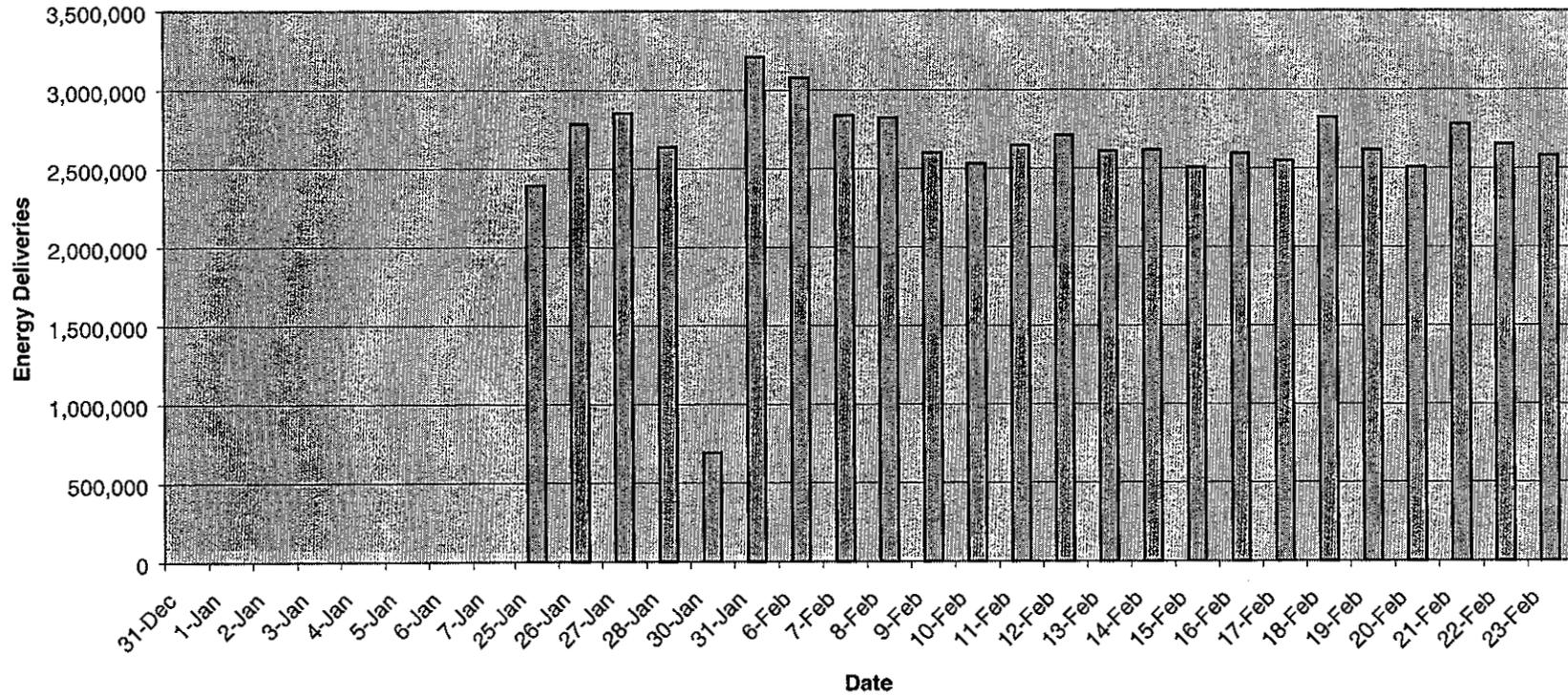
Appendix II

AES Telasi Metering Differences



Appendix III

Shipments per Alaverdi



note: Delivery data was not obtained for the first contract.

Appendix IV

**Listing of Contributors**

<b>Name</b>	<b>Position</b>
<b>AES Telasi</b>	
Michael Scholey	General Director
Alexey Tutaev	General Technical Director
Malkhaz Broladze	Dispatch Director
Jamal Koniashvili	Head of Electricity Purchases and Quality Control Department
<b>Hagler Bailly</b>	
Joellyn Murphy	Chief of Party
Murman Margvelashvili	Deputy Chief of Party
Nino Shanidze	Specialist
Larry Jensen	Auditor and Financial Advisor