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ACRONYMS

AC	Alternative Current
GEDF	Georgian Energy Development Fund
GoG	Government of Georgia
GSE	Georgian State Electrosystem
HV	High Voltage
kV	Kilovolt
MoU	Memorandum of Understanding
MVA	Megavolt-ampere
MW	Megawatt
OHL	Overhead Line
USAID	United States Agency for International Development

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INTRODUCTION

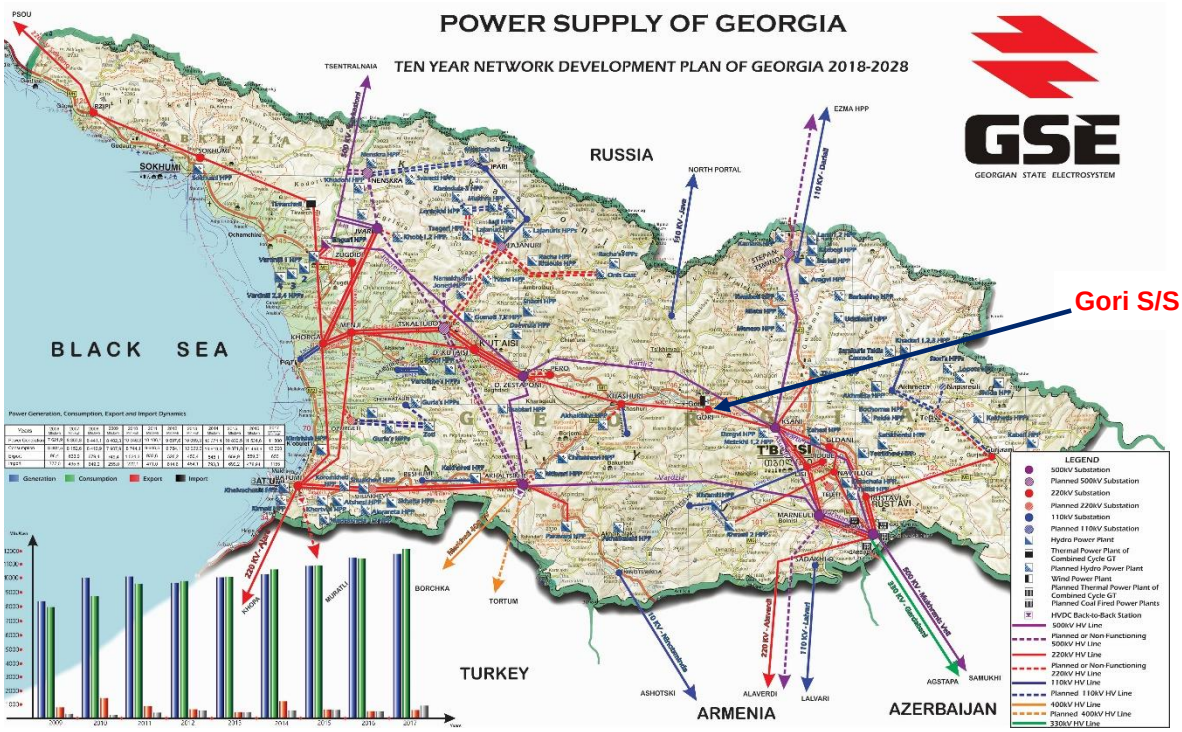
USAID Energy Program is a three-year project aimed at facilitating the development of Georgia's electricity and natural gas markets that enhance further expansion of renewable energy projects and improve the security of supply. Task Three supports immediate development of 50 MW of non-hydro renewable energy with the intent of creating an enabling environment for sustainable development of non-hydro renewable energy. USAID Energy Program will support up to ten proposed non-hydro renewable energy projects to reach its target of 50 MW with financial closure and reach commercial operation.

The Georgian Energy Development Fund (GEDF) and Çalik Energy (Turkey) have signed a Memorandum of Understanding (MoU) with the Government of Georgia (GoG) to develop a 50 MW wind power farm near Gori. GEDF requested the USAID Energy Program to assist them in the development of the plant. The first issue to support the Wind Farm development is the evaluation of the Gori Substation's ability to connect to the proposed wind farm.

The following analysis and preliminary findings examine the ability of the new GEDF- Çalik 50 MW wind farm to be connected to the Gori Substation. These findings were based on a quick visit to the substation and review of high-level single-line diagrams of the nearby network.

USAID Energy Program visiting GSE substation Gori 220kV

Fig. 1 Electricity Transmission Map of Georgia



TECHNICAL OVERVIEW OF THE GORI SUBSTATION

Structure: The substation is situated 3 km western from the city of Gori on the left bank of river Mtkvari, and it is constructed on area about 25 000 m^2. The control room is quite large constructed with a metal roof. The substation has two outdoor switchgears for 220 kV and 110 kV. There are two concrete roads for switchgears 220 kV and 110 kV. Power transformers are mounted on rails on the top of concrete foundations. Under the transformers there are oil pits filled out with gravel. All electrical wires and electrical apparatus are installed on iron-lattice pillars and portals. The switchgear yards are protected with metal fences with height of 2m. The lighting protection is mounted on the top of iron-lattice pillars.

Electrical Facilities: The substation includes two outdoor switchgears 220 kV and110kV with two transformer bays for power transformer 220/110 kV. The transformer No. T1 is with capacity 125 MVA. The bay for the transformer T2 is empty. There are two outdoor three-phase busbar systems 220 kV and 110 kV. The 220 kV busbar system is a non-sectional single busbar system with instrument voltage transformers, connected to the busbar system, and used for relay protection and electricity metering. The 110 kV busbar system is non-sectional single busbar system (H scheme), with instrument voltage transformers connected to the busbar system, used for relays protection and electricity metering. To the 110 kV busbar system are connected two power transformers T3 and T4, 110/35/10 kV with capacity 25 MVA and 40 MVA. The distribution of the electricity is performed through medium voltage (35kV and 10kV) switchgear cubicles. The Qartli Wind Farm is connected through 3 HV cables plus one for reserve to the 35kV switchgear cubicle. The 110 kV outdoor switchgear includes 110 kV “Siemens” SF6 circuit breakers, ABB reclosers, and “Trench” instrument current transformers. All equipment has been operational for about 5 years.

Control systems: Operations control room – automated operations control center with computer control of the electrical apparatus. The relay protection systems are organized in single operational house situated in the area between first and second transformer (T1 and T2.) The protection system is steady state microprocessor systems for 220 kV protection and for 110 kV protection.

Electricity metering: Electricity metering is performed through steady state automated electricity meters situated in relay protection houses. The data is measured on 5 minutes and it is distributed through communicational canals to Alpha Center of Georgian State Electrosystem (GSE).

Fig. 2 Single line diagram of the substation Gori 220/110/35/10kV

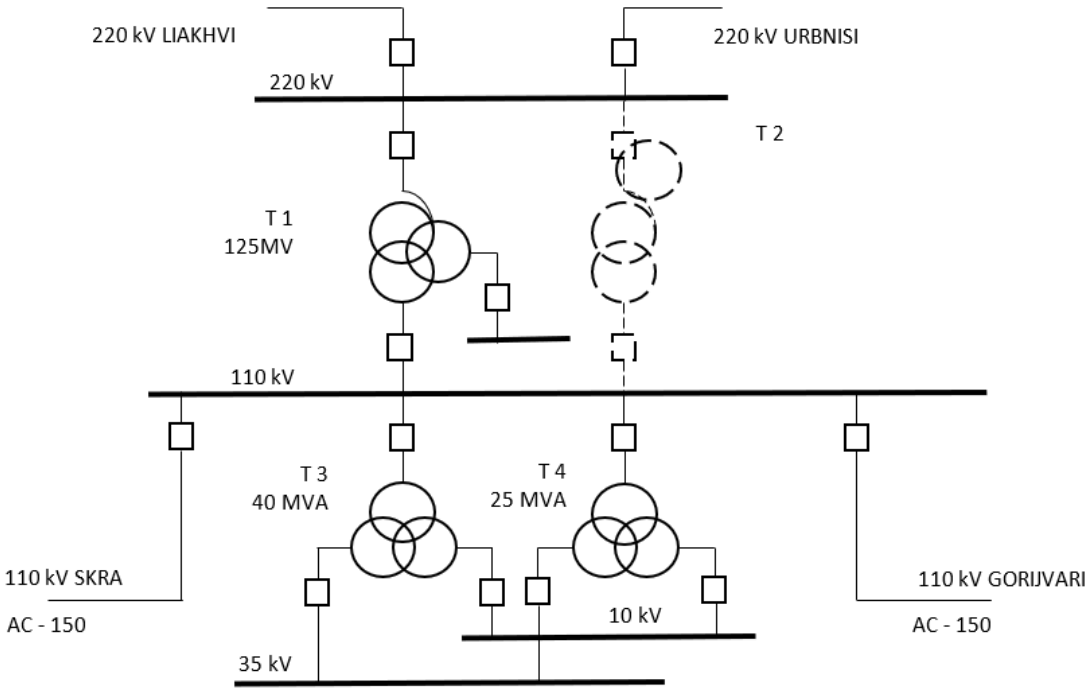


Fig 3. Map of Substation Gori

Source: Google map

Connection to the system: The substation is connected to the 220 kV system through two electricity lines: OHL 220 kV Liakhvi and OHL 220 kV Urbnisi. The Gori substation is connected to the 110 kV system through two electricity lines: OHL 110kV Skra with conductors type AC 150 and OHL 110 kV Gorijvari with conductors type AC 150.

Operational constraints: Absence of a second power transformer 220/110 kV makes the substation unstable and it is impossible to reach the reliability criteria N-1 on 110 kV switchgear. The 35 kV switchyard is completely full with apparatus and there is no free cubicles for connection of new lines.

OPTIONS FOR CONNECTION OF A NEW WIND FARM TO SUBSTATION GORI

Connection of the 50 MW wind farm to the 110 kV bay in substation Gori:

There are two empty areas within the substation for construction of 110 kV bays. One is the area in front of T4, and second is between the substation control room and the 110 kV electricity lines. Feasibility studies must be completed for the construction of a new 110 kV bay in the empty area in front of transformer No: 4. and the empty area between control center and the 110 kV electricity lines. For this option, the 10 kV switchgear would need to be relocated to another place in the substation.

Connection of the 50 MW wind farm to the 35 kV:

The new wind farm may be connected through HV cables to 35 kV network. In this variant, construction of a new 35 kV switchgear is required or expansion of the existing 35 kV switchgear.

Connection of the 50 MW wind farm to the 220 kV electricity line

This variant requires a 220 kV substation to be constructed next to the new wind farm and transmission connection made with nearest 220 kV electricity line.

CONCLUSIONS

There are several options for connection of the proposed wind farm to Gori Substation. These options need to be evaluated further.

For reaching the criteria N-1, a second 220/110 kV transformer would need to be installed.

For increasing the flexibility of the 110 kV switchgear, a section circuit breaker needs to be installed to divide the busbar system on two parts. In this case, the second set of voltage instrument transformers need to be installed for the second part of the busbar system in case of dividing the busbar system in two parts.

USAID Energy Program

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