Modernization of the Ufa City Distribution Network: Siemens PTI Delivers Smart Grid Master Plan

Dr. Holger Mueller
Head of Steady State System Studies
hmmueller@siemens.com

One-and-a-half years ago, the privately owned Joint Stock Company Bashkirian Power Grid Company (JSC BESK), Bashkirenergo, commissioned Siemens PTI with the development of a modernization plan for the electrical network of the city of Ufa, capital of the Bashkortosan Republic in Russia. In July, 2014 the master plan was delivered to Bashkirenergo, who has now extended its cooperation with Siemens with an order for medium-voltage equipment.

Bashkirenergo has placed a first order for new substations and intelligent automation equipment to realize a Smart Grid in a pilot area. This is the first step in the implementation of the development plan delivered to the Russian utility by the Siemens PTI Steady-state System Studies department last summer.

The contract for the technical-economical feasibility study had been signed in September, 2013. The purpose was the definition of suitable modernization measures to be implemented by 2020 for the Ufa city electricity network, which comprises the voltage levels 110 kV, 35 kV, 10 kV, 6 kV and 0.4 kV. The main challenges of the existing network are a rather complex and historically grown network structure with partly inefficient supply paths, several long feeders and redundancies as well as aging equipment, which will cause major investments in new network equipment in the near future. The overall network performance is sufficient, although reliability cannot meet European standard and shall be improved. The current level of automation is very low and locally restricted with very limited communication infrastructure in the MV network. Functionality and potential of the SCADA system is limited due to improper field equipment. A high diversity of protection devices, which are partly very old, is planned to be updated and integrated into a new automation system.

Against this background the targets of the study were to define suitable measures to increase security and quality of power supply, to ensure the economic efficiency of new Smart Grid technologies integrated into the network as well as to decrease the high technical and non-technical power losses in the power system.

In the course of the master plan development, the following questions were raised and investigated:

- What is the situation of the network infrastructure today?
- What are the critical issues that have to be solved?
- Which technical solutions can be implemented to solve existing and future problems?
- Which of these measures are also economically feasible?
- How does the roadmap for implementation of the solutions until 2020 look like?

The project team defined and analyzed four possible scenarios for improvement based on the weak point analysis and future load increase of about 30% until the year 2020. Two of these scenarios used the present topology but different measures for automation, monitoring and metering. The other two scenarios additionally considered an optimization of the network structure with different level of automation and Smart Grid technologies. For each technology a technical-economical evaluation was performed, including the assessment of capital and operational expenditures, technical and commercial losses, as well as the calculation of net present value and return of investment.
All scenarios were compared with regard to the technical and economical efficiency of the application of the different standard and innovative solutions in the Ufa distribution network. Based on the results, the team derived the optimum measures for the 2020 network development: The investigations showed that optimization of network structure using existing 6 kV and 10 kV equipment and GIS technology as well as network automation using feeder condition monitoring, digital power meters and partially remote-control of transformer stations lead to a positive return of investment after 10 years.

Bashkirenergo highly appreciated the close cooperation between the company’s and Siemens PTI’s project teams in Moscow and Erlangen and the excellent quality of the results of this comprehensive study. At the same time the follow-up contract issued to EM MS expresses Bashkirenergo’s confidence in Siemens’ high quality solutions. Siemens is expecting to expand this customer relationship in further projects, even beyond the implementation of the Ufa power system modernization roadmap.