TRANSMISSION DEVELOPMENT PLAN

2018-2027

November 2017

CONTENTS

Abbreviations

ENTSO/E – (European Network of Transmission System Operators for Electricity)

KOSTT – System, transmission and market operator JSC

KEK – Kosovo Energy Corporation J. S. C.

KEDS – Kosovo Electricity Distribution and Supply Company J.S.C.

DSO – Distribution System Operator

MED – Ministry of Economic Development

OPGW – Optical Ground Wire

TSO – Transmission System Operator

PSS/E- Power System Simulator/Engineering

TDP – Transmission Development Plan

EES –Power system

SCADA/EMS – Supervisory Control and Data Acquisition/Energy Management System

SECI – South East Cooperative Initiative (Regional transmission planning project)

EMS – Environment management system

CBA – Cost Benefit Analyses

IT – Information Technology

ERO – Energy Regulatory Office

KfW - "Kreditanstalt für Wiederaufbau"

EBRD- "European Bank for Reconstruction and Development"

1. INTRODUCTION

The Transmission Development Plan (TDP) 2018-2027 represents Kosovo's network development plan for the next 10 years. This 10 year plan introduces projects that are needed to ensure a reliable and secure operation of the transmission system, in order to achieve security of supply, support the energy market and competition, support the integration of renewable and complementary thermal sources.

Electricity sector as one of the most important industrial sectors in the economy of Kosovo should be developed and planned appropriately and in time. Transmission network, which is operated by **KOSTT**, plays an important role in the energy and electricity system enabling the transmission of power from local generators and from imports, to large customers and distribution nodes.

The development of the society and the growing dependence on electricity requires a secure, reliable and efficient transmission network. The growing dependence on electricity means that tolerance to the power outage should be minimal, and the over-extended outages are unacceptable. In future, this will inevitably require high standards of supply from the transmission network.

Since the establishment of KOSTT until now in 2017, capital investments amounting to about €200M have been made in the transmission network, mainly in the development and reinforcement of the transmission network capacities, revitalization and advancement of support systems. Based on all measurable performance indicators recorded in the last decade, ongoing investments in the new infrastructure of the transmission network; modernization of transmission system support systems; revitalization of substations and lines have contributed to an ongoing increase of security, reliability and performance of the transmission system operation. All this has helped stabilize the electricity sector in the Republic of Kosova.

The requirements for increasing the security of supply and development of transmission capacities in order to support the increasing load, integration of generation from both conventional and renewable sources represents the main factor for KOSTT to continue with investments in the network for the years to come.

Achievement of adequate security of electricity supply, further market integration and development, integration of new generating capacities, are related to proper transmission system planning. Since the demand for energy and generation varies; or since the regional transmission network becomes even more interconnected; or new loads or generation are connected to the network, the power flows in the transmission network will vary.

To accommodate these changes in power flows, it is necessary to reinforce the transmission network, so as to maintain the level of security, performance and efficiency of the transmission system.

1.1 Legal Requirements:

Related to the aforementioned responsibilities on the development of the transmission system and legal obligations, **KOSTT** has drafted the Transmission Development Plan **(TDP)**, which represents one of the main grounds for **KOSTT's** development planning. The importance of drafting and applying this document is linked to the legislative requirements relating to the drafting and addressing of this document and as such it belongs to the primary and secondary level legislation. The following are the legal requirements for drafting this document.

1.1.1 Law on Energy:

- Each year the Electricity Transmission System Operator, Electricity Distribution System Operator, Thermal Energy Distribution System Operator, and Natural Gas Transmission System Operator shall submit to the Regulator the ten (10) year network development plan, based on the current and estimated demand and supply, after consultation with all relevant stakeholders. The network development plan contains efficient measures, in order to guarantee system adequacy and security of supply.

1.1.2 Law on Electricity:

- TSO shall be responsible for preparation of ten (10) year plans in compliance with the Law on Energy and fulfilment of obligations related to such plans.

1.1.3 Law on Energy Regulator:

- The Regulator shall examine whether the ten (10) year system development plan submitted by the Transmission System Operator covers all investment needs identified during the consultation process, and may require the Transmission System Operator to amend its ten (10) year system development plan.
- The Regulator shall monitor and evaluate the implementation of the ten (10) year system development plan.

1.1.4 Licenses for the Transmission System Operator:

- In accordance with Article 10 of the Law on Energy and article 16 of the Law on Electricity, and Article 15 of the Law on the Energy Regulator, the Licensee shall develop and publish a medium (5 years) investment development plan that shall derive from long-term transmission system development plan (10 years). Such a development plan shall be made in conformity with the applicable legislation by consulting current and potential system users. Before its, publication, the plan shall be submitted to ERO for approval. The Regulator shall monitor and evaluate the implementation of the ten (10) year system development plan.

1.1.5 Grid Code – Planning Code:

- Each year **TSO** will prepare and issue a detailed plan Transmission Development Plan (**TDP**) for the next 10 years.

1.1.6 Rule on licensing energy activities in Kosovo:

- Transmission System Operator license applicant, in addition to the requirements of Article 9 and 10 of this rule, shall submit to ERO the system development plan, as defined in Article 16, paragraph 1 (1.12 and 1.13) of the Law on Electricity, and Article 10 of the Law on Energy, including the system development's impact in the tariffs approved by ERO.

1.1.7 ENTSO-E Requirements:

According to the article of the (EC) Regulation No. 714/2009 of the 3-rd package that defines the coordination of the operation and development of the transmission system "an extensive network plan for the community-wide should include modeling of integrated network, scenario development, an adequacy concept generation and an assessment of the resilience of the system". Furthermore, **TDP** (Transmission Development Plan) should "build on national investment plans and, if appropriate under the guidelines for network development". ENTSO-E publishes the 10-year Transmission Development Plan every two years, which contains the outlined and agreed national plans of all countries of Continental Europe operating in the synchronous area.

Pursuant on the above mentioned legal obligations, **KOSTT** is obliged to draft and after approval from **Energy Regulatory Office**, to publish and implement such document, which is drafted in full compliance with Energy Strategy of Kosovo.

1.2 Actual Kosovo`s transmission network

Kosovo's transmission network has been developed over the last 60 years in several stages of construction, expansion, reinforcement and consolidation. The current transmission network consists of 1353.4 km of lines, including:

- 279.7 km at the voltage level of 400 kV,
- 231.8 km at the voltage level of 220 kV and
- 841.8 km at the voltage level of 110 kV.

Transformation capacity installed in the transmission network is:

- 1200 MVA auto-transformer at voltage levels of 400/220 kV (3 ATR)
- 1200 MVA auto-transformer at voltage levels of 400/110 kV (4 ATR)
- 1350 MVA auto-transformer at voltage levels of 220/110 kV (9 ATRs)

- 80 MVA transformer at voltage levels of 220/35/10 kV and 220/10 kV s (2 TR)
- 300.5 MVA three-pole transformer 110/35/10 kV (9 TR-3psh)
- 578 MVA transformer at voltage levels of 110/35 kV (31 TR)
- 1050 MVA transformer at voltage levels of 110/10 kV (39 TR)

Kosovo Transmission Network operates with 34 substations of different voltage levels, namely:

- 1 substation 400/220 kV,
- 2 substations 400/110 kV
- 3 substations 220/110 kV
- 1 substation 220/35/10 kV
- 8 substations 110/35/10 kV
- 6 substations 110/35 kV and
- 13 substations 110/10 (20) kV

Three industry managed substations such as Feronikel, Trepça and Shar-Cem are connected to the transmission network.

- Ferronikel is supplied through two 220 kV lines, and transformation substation 2x160MVA, 220/35 kV.
- Consumption by the metallurgical complex Trepça is supplied through the 110 kV network through the 110/35/6 kV Trepça substation, with 2x63MVA + 2x31.5 MVA capacity.
- Consumption of the Sharr-Cem cement factory is also supplied by the 110 kV network, through the 110 / 6.3 kV Sharri substation, with 2x20 MVA capacities.

Regarding the interconnection capacity of the Kosovo transmission network, it is considered to be a fairly well connected network to the regional network through four 400 kV lines and two 220 kV lines in the regional network. There are also two 110 kV cross-border lines that have small transmission capacities and mainly operate in radial (island) mode.

The technical boundary between KOSTT and parties connected in the Transmission Network is shown in Figure 1-1. Figure 1-2 shows the geographical coverage of the transmission network according to the current situation (Q4-2017).

Transmission system is characterized by strong 400 kV and 220 kV interconnection network, interconnected in the regional network through three 400 kV and two 220 kV lines.

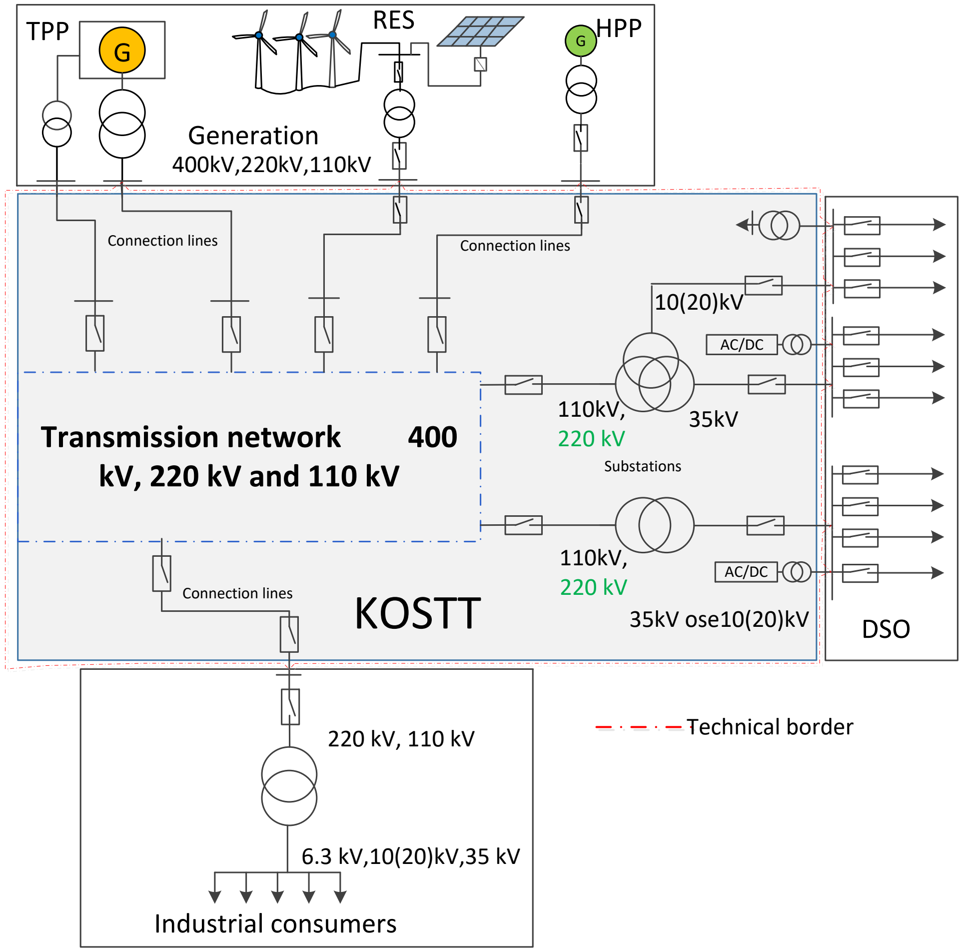

Figure 1-1. Technical boundary between KOSTT and parties connected to the transmission grid

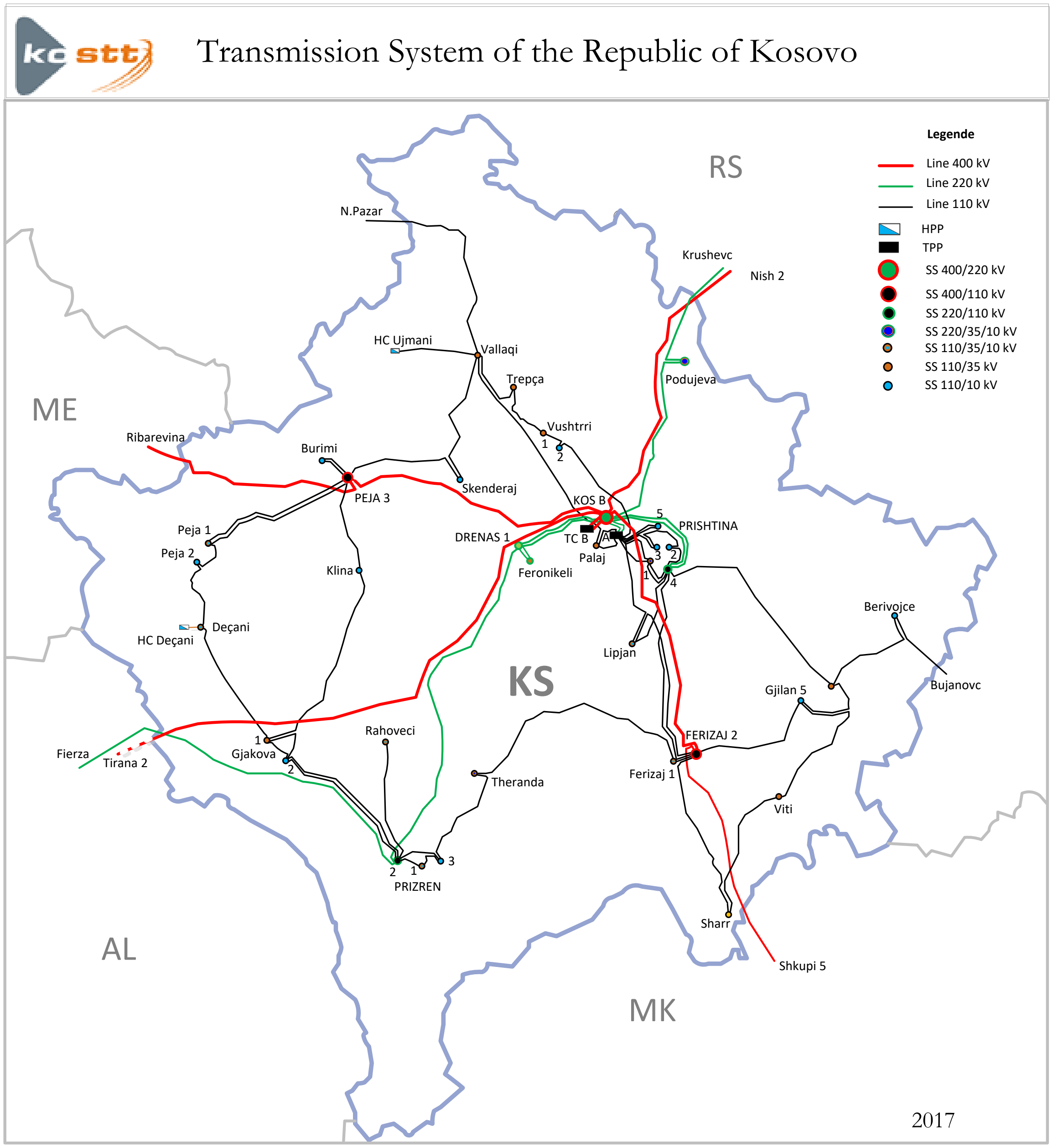

Figure 1-2. Geographical scope of the transmission network under the current situation (2017)

1.3 Long-term planning objectives of the transmission system

The planning and development of the transmission network is a dynamic and complex process. Transmission system planning is a process aimed at making decisions for the development of new or reinforcement of existing transmission system elements, to ensure long-term energy forecasts and supply. Planning as a process involves a number of activities, such as network development in relation to forecast of electricity demand, forecast to generation, enabling the identification of necessary reinforcements and extensions required to achieve a reliable and environmentally sound network operation. Although **TDP** uses as a reference the prediction for a defined period provided in the Long-Term Energy Balance, the plan must also follow the strategic developments of the transmission system in the long term period.

The planning process has evolved over the time as a result of the restructuring process of the energy market and differs from the earlier concept of centralized planning applied for vertically integrated companies.

The main reasons for the difference are:

- Uncertainties coming from the market environment and input data.
- Different objectives of various network users (generators, traders, suppliers, customers and network operators)
- Incompatibility - disproportion between technical, economic, environmental and social requirements, and
- Uncertainties coming from the integration of energy from renewable sources, especially those connected to the distribution network
- Delays in the expropriation of properties associated with the expansion of the transmission infrastructure

Also the need for regional market integration requires enhancement and strengthening of interconnection capacities, which affects the planning process at national level. Network development options are based on Planning Code and general planning rules recommended by the **ENTSO-E**. The defining methodology, which relies on the N-1 security criteria, is the basic methodology applied in this plan, with the aim of identifying and defining the list of projects required for the development of the transmission network. Zonal forecasting of the load and generation is fundamental in determining the required transmission infrastructure in the long-term

This plan includes information on the development and reinforcements expected to occur in the Kosovo transmission network for the next 10 years, in the following areas:

- Construction of new transmission and transformation capacities,
- Reinforcement of existing transmission and transformation capacities,
- Construction of interconnection lines with neighboring countries,
- Revitalization of existing high voltage facilities (lines and substations)
- Development of transmission system support systems.

The plan also contains information on the possibilities to connect new generating units and new loads in the transmission system.

The main objective of ten-year plan is to identify projects which will increase capacity, reliability and efficiency of the transmission network operation with direct support for the security of electricity supply to customers.

This plan will inform customers, energy market participants, energy producers, prospective investors on the transmission development plan for the next ten years.

This document presents development plan drafted in **KOSTT**, covering a period of ten years, from 2018 until 2027, in line with the **ENTSO-E** requirements, where the 2017 year represents the reference year, or the so-called year zero.

The document is a continuation of previous plans and includes the necessary changes identified during the previous and current year. All information in the development plan, including project details, expected date of project commissioning applications for connection to the transmission network submitted in 2016, and those until end 2017, are taken into consideration in the drafting of this document.

For the drafting of this development plan relevant calculations were carried out with the use of **PSS/E** software, simulating power flows, shorts circuits and dynamic processes in computer models in the system, based on data provided by **KOSTT** and network users, as well as based on demand forecasts for the next 10 years.

Load and generation forecast for the next 10 years. Forecasting of the load and generation for the next 10 years is based on the data from the Long-term Energy Balance (2017 – 2026). Data on interconnections expected to be developed in the region, are provided by studies made under the Planning Group for Regional Transmission Network- **SECI**, with the contribution of **KOSTT** through its representatives, as well as the 10 year Transmission Development Plan of published every two years by **ENTSO-E**.

For each planning year, relevant power flow studies have been carried out for the, also following the increased peak demand and that for two critical regimes: winter and summer. Calculations of breakdowns in different time periods have also been carried out. Based on calculations results, it is possible to provide estimates of how the network will operate for the estimated next years. Bottlenecks/overloads in the network were identified and possible solutions have been presented, including analysis of their impact to improve the transmission network operational performance. The transmission system is also analyzed in terms of minimal load operating conditions, with the aim of identifying possible problems of the network with over-voltages that can occur in summer minimal load regimes.

1.4 Content of the Plan

TDP is structured in 8 chapters including the Introduction:

Chapter 1– Introduction

Chapter 2 - Technical requirements of the Grid Code - presents the process of data collection, planning and standards criteria, and configuration of substations by voltage level 400 kV, 220 kV and 110 kV.

Chapter 3 - Presents the electricity demand forecast, broken down in the consumption of the past three years and forecasted consumption for the next 10 years.
Chapter 4 - List of existing generators and planned ones. It is also presented the renewables generation and **KOSTT** policies in support of this technology.
Chapter 5 - Describes the **KOSTT** network transmission, and interconnection with its neighbors. A part of this chapter describes in details the future developments of the network.
Chapter 6 - Includes access of environmental planning in relation to the **Transmission Development Plan**.
Chapter 7 - It contains summarized results expected from implementation of the **Transmission Development Plan.**
Chapter 8 - Contains a list of references.

2. PLANNING PROCESS OF TRANSMISSION NETWORK

2.1. Introduction

One of the main **KOSTT** objectives is development of the transmission system with the purpose of safe, efficient and reliable operation in order to enable electricity transmission, fulfilling the demand in compliance with the legal requirements. **Transmission System Operator** has planned developments of the network based on long-term electricity needs. A requirement for electricity transmission depends on many factors: increased consumption, installation of new generating units, new cross-border lines and regional, transit of electricity, development of heavy industry, development of energy market, etc.
The need for reinforcements in the transmission network is determined based on the study of network performance against the planned technical standards outlined in the Grid Code respectively Planning Code.
The Grid Code covers the operational procedures and provisions governing the interaction between **KOSTT** and users of the Transmission System in Kosovo. This code also includes the processes of planning, connection, operation and balances system in normal and emergency situations. Processes include different periods based on the situations in the past, current situation and long-term domain.
The Planning Code specifies technical criteria and procedures to be applied by **KOSTT** in planning and development of the Transmission System of Kosovo. Even users of the Transmission System during the planning and development of their systems should consider the Planning Code. This code also sets requirements for the collection of reliable information from users, so that **KOSTT** can make planning and development of transmission system in Kosovo.
Based on Article 15 of the 'License of the Transmission System Operator' **Transmission System Operator** also has developed the basic planning criteria which are detailed in the

document approved by the **ERO**, "Transmission System Security and Planning Standards". This document defines a range of criteria and methodologies that **KOSTT** should adopt (enforce) in the planning process of developing the transmission network in Kosovo.

Kosovo's transmission system in the 400 kV and 220 kV level has technical and economic characteristics which differ from the 110 kV system. Investment costs and dimensioning criteria are much higher than those of the 110 kV. The transmission system is interconnected with regional transmission systems through a 400 kV and 220 kV network, thus the impact of network investments in the 400 kV and 220 kV voltage is not isolated, but rather has a regional character.

KOSTT has developed the transmission development strategy, focused in strengthening/ development of the 400 kV and 110 kV network, while the 220 kV network will not be further developed, except for specific cases where no other solutions can be found.

Transmission network planning is made according to the criteria defined in the Grid Code, considering the fulfillment of N-1 criteria, meaning that the system must be capable of normal operation in case of occurrence of the fault in the network (in Kosovo or in other systems) and the loss of one of any network element as well:

- airline or cable lines
- transformer,
- compensator,
- generator
- one busbar from double busbars system

In case of loss of one of any network element as a result of failures, transmission system must fulfill the following operation conditions:

- transmission lines should not be loaded above their thermal limits,
- reduction of the supply capacity is not allowed
- level of voltage tension and speed change cannot exceed allowed limits,
- transient and dynamic stability of the Power System should not be endangered, and
- power transformers should not be over-loaded.

The 110 kV network, which development is done in accordance with the Transmission Connection Charging Methodology of **KOSTT**, includes all equipment, voltage 110 kV (lines and facilities) transformers 110/10 (20) kV and 110/35 kV and 220/35/10(20) kV transformer including respective fields.

In normal operating conditions the performance of the transmission system should be in accordance with operating criteria outlined in the Grid Code.

2.2. Transmission System Planning Methodology

The approach of the transmission network planning methodology consists of the following steps:

- Collection of input data (creation of data base for computer modeling of the network).
- Definition of different scenarios taking into account factors strengthening the development of generation, load, applications for connection, balance of power system, exchanges etc.
- The creation of computer models of the network transmission format to **PSS/E**.
- Identification of network constraints (N-1 analysis)
- Definition of the possibilities of strengthening the network on the basis of N-1 tests.
- Analysis of the voltage profiles and losses in the system.
- Cost benefit analysis for each scenario according to the ENTSO-E methodology
- The final definition of the reinforcement plan and plan for revitalizing transmission network

Figure 2-1 shows the planning methodology algorithm for the capacity strengthening and operational performance of the transmission system.

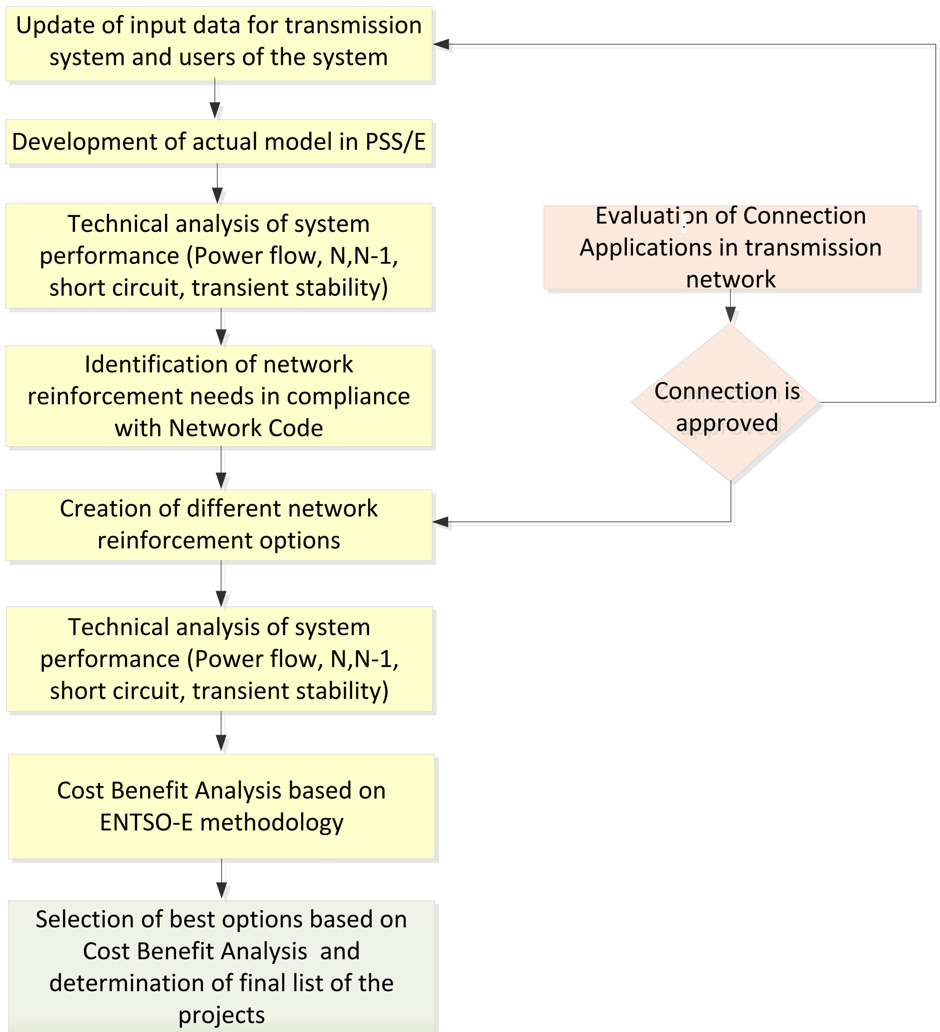

Figure 2-1 The planning process of Transmission network development

2.3. Planning process for the revitalization of the existing network

2.3.1 Introduction

The transmission system consists of a number of elements, such as lines, cables, transformers, circuit breakers, separator and much more. Each EES component has an inherent risk of failure. Many external factors affect the potential failure of components, damages by third parties (human/animal), and trees. Atmospheric conditions such as temperature, humidity, pollution, wind, rain, snow, ice, lightning and solar effects can have a crucial role in the failure of components. It is frequently assumed that the life cycle of installed electrical equipment/ components is about 35-40 years. However, to estimate the lifetime period of various components, it is necessary to consider multiple factors, such as the range of extreme operating conditions and environment, as well as the changing level of previous maintenance. Most transmission companies use components beyond 40 years, if they are not faced with extreme occurrences, such as atmospheric discharges. Power transformers are the highest cost components in substations. The highest probability of breakdowns in the transformer lies with the voltage regulator. High voltage terminals/bushings constitute the largest number of serious breakdowns in high voltage substations. The mechanism of faults/breakdowns tends to be developed in a critical level by the middle of the facilities' life cycle and such a mechanism generally results in sudden and catastrophic breakdown with an explosion, and with an enormous influence in limiting the lifetime of high voltage facilities. The transformer's negative effect mainly arises from over-heating caused by overload. The transformer consists of a magnetic iron core, enveloped with a copper winding insulation. The core is positioned inside the container filled with insulating oil, the conductor are extended through the bushings (ancillary insulators) extending outside the transformer container, and many other components are installed in the structure of the transformer. Overheating from overload causes degradation of the paper insulation surrounding conductors, which leads to internal failure of windings.

Overloads also generates a harmonic reaction, resulting in a cyclic heat and mechanical vibrations of the transformer, causing physical damage. The same negative processes may also appear in metering measuring and voltage transformers. Any short circuit in and near the substation causes large power flows currents over the equipments, and the more frequent they are, the more likely it becomes that the equipments will suffer a breakdown. Substations near generation are at the highest risk from this occurrence, where the short circuit currents are larger.

The statistical rate of failures increases over the years based on the bathtub curve as presented in Figure 2-2. The bathtub curve consists of three periods: (1) The period of failures in the beginning of the commissioning of the equipment with a high rate of continued failure (2) second period "optimal life cycle" with the lowest and most consistent rate of failure. The third period (3) "end of the life cycle" is the critical period of the component with a high degree of failure.

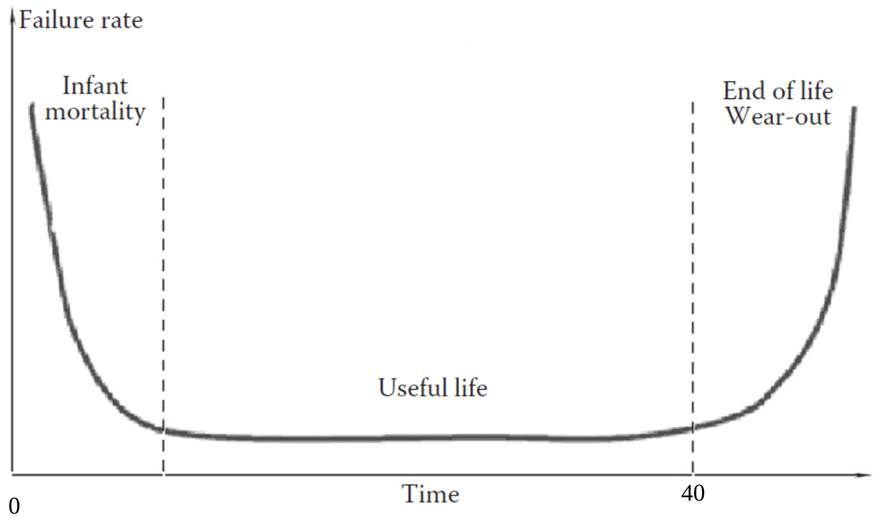

Figure 2-2 The bath tub curve: hypothetical failure rate versus time

2.3.2 Planning methodology for the network's revitalization

The revitalization plan of the transmission system facilities such as overhead lines, transformers, cables and substations, generally depends on the technical condition, their age and intensity of use of such facilities in retrospective. The revitalization plan of transmission network facilities is developed as follows:

- **Overhead lines**: Their revitalization depends on two factors: their age and level of losses incurred in the long-term. For phase and protective conductors, insulators, bridges, exceeding 50 years represents a condition for inclusion in the revitalization list. The frequency of failures in line is an additional indicator for the selection of the line in the revitalization list.

In terms of losses, the revitalization list includes cross lines of 150 mm^2, which are also connected with the first factor, as in the initial transmission network development phase (1950-1970) 110 kV lines are built with cross section conductors of 150 mm^2. The concept of developing new capacities in transmission network lines focus on 400 kV and 110 kV lines, with no intended further development for the 220 kV lines. This development concept is being applied in almost all transmission systems of **ENTSO-E**. 220 kV lines are considered as older lines (> 50-60 years) as their construction was mainly conducted in the 60s and 70s. The concept of European countries is that 220 kV lines will be gradually upgraded in 400 kV lines, mainly using only their route. Problems with expropriation of private property for purposes of building new lines are significant in all European countries.

- **Power transformers:** The plan to replace power transformers of the transmission network is based on their expected lifetime, estimated at 40 years. Another important factor that influenced the inclusion of transformers in the list of replacements is their real situation, monitored by maintenance teams through periodic testing. Historical statistical data on events on particular transformers (level of load, number and frequency of transformer protections, gas analysis, etc.) are important factors in the selection of transformers which should be replaced with new transformers. In specific cases where the transformer's soundness is considered to be good, it may continue to operate even over the age of 40 years. Figure 2-3 shows the age of 59 power transformers installed in the substations at the border with the distribution operator. From the figure it can be seen that 8 transformers have passed the projected lifespan, five others will reach the critical age value within the next three years and another 16 transformers, after 10 years in operation, will reach the age of 40.

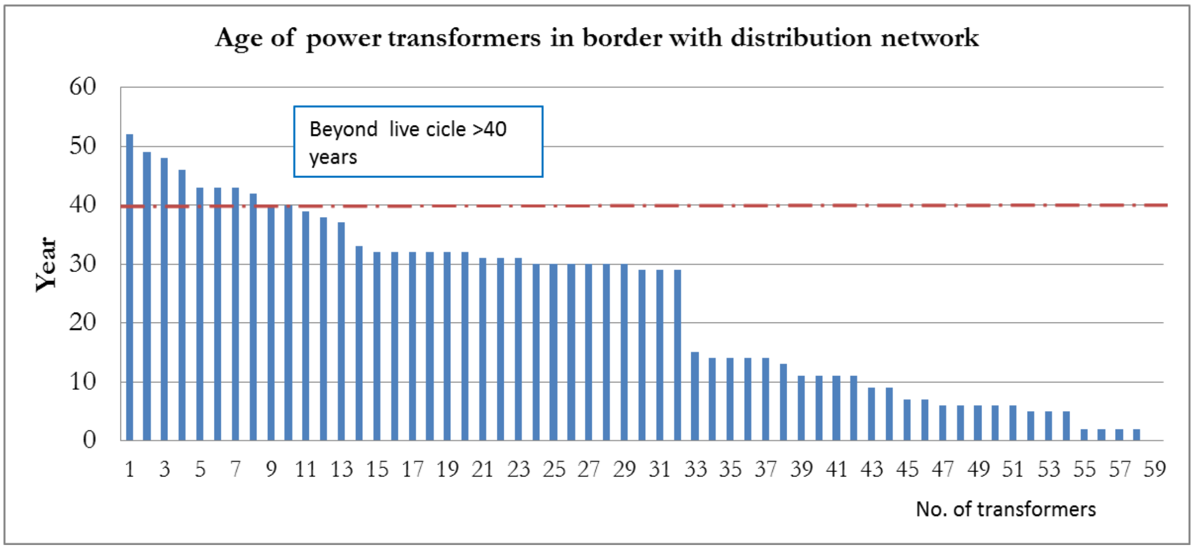

Figure 2-3. Current transformers age in operation in the power transmission network

- Substations (lines and transformers): Revitalization plan for substations fields, which are included in the defined transmission network boundaries, is also based on the age of the facilities and their factual situation. Priority in revitalization lies with substations with a high impact on the transmission system, but also all substations the life cycle of which has passed 40 years. Systematic replacement of oil-based circuit breakers with SF6 gas is a **KOSTT** objective as per the development and investment plan. In addition, the replacement includes all elements of relevant fields (transformer, lines) installing a motorized separator commanded through the **SCADA/EMS** system. The double busbar system with a connecting field is preferred for substations which have sufficient space.

Access to planning methodology for transmission network revitalization consists of the following steps:

- Collection of input data, historical frequency of breakdowns in facilities, lines, cables, transformers etc., age of equipment and general evaluation of the technical state of electric equipment for the reference year (the current year).
- Analyze the performance of equipment and technology in order to identify new technologies provided by the global market that can resolve issues in the performance of the equipment.
- Identify equipment in locations, or lines/cables to be included in the process of verifying the underperformance.
- Analyze the need for improvement or advancement of equipment. If equipment are not necessary, and not worth the investment, a decision to be made to decommission them. Otherwise, the process continues with a detailed assessment of the state of problematic equipment.
- Analyze possible options of revitalization:
  - with a regular maintenance process, or
  - inclusion in revitalization projects in the Development Plan

In figure 2-4 is presented the algorithm of network refurbishment planning methodology.

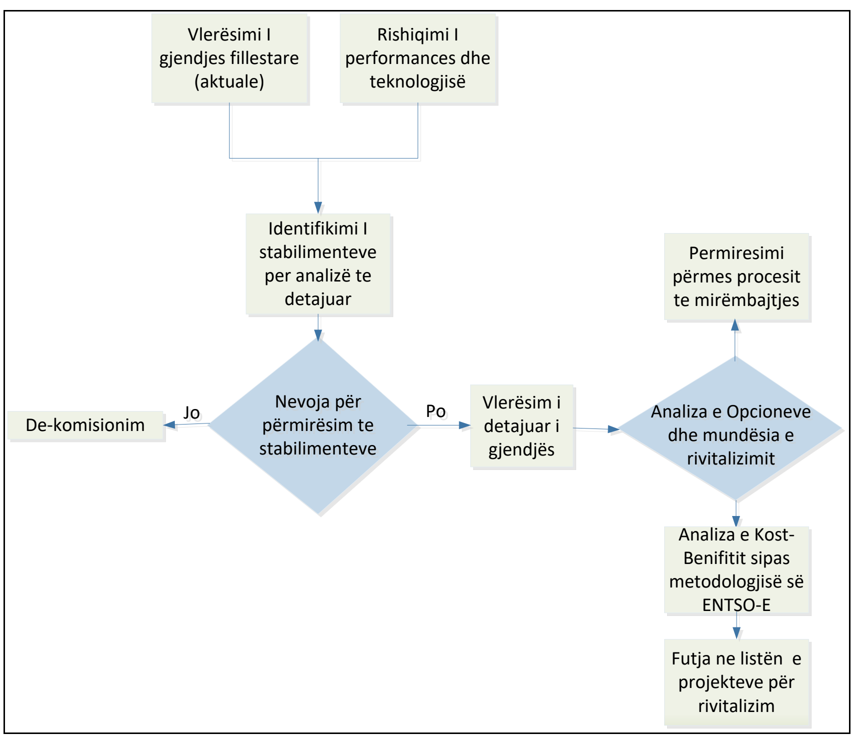

Figure 2-4 Planning process for revitalization of transmission system

2.4. Transmission projects cost-benefit estimation methodology

In accordance with the Regulation ERO / No. 13/2017 on the Assessment of Capital Projects in the Transmission and Distribution Network in the Electricity Sector, KOSTT is obliged to prepare the cost-benefit assessment of projects deriving from the 10-year Transmission Development Plan related to the 5 year time period, namely the 5 year investment and development plan of transmission.

The aim of the project's cost-benefit analysis is to determine the impact of the network infrastructure and transmission system development in the society's socio-economic welfare. The modified CBA (cost-benefit analysis) methodology published by ENTSO-E has been used by KOSTT in accordance with the ERO Regulation no. 13/2017 approved by the Energy Regulatory Office. This methodology compares the impacts of each project based on a range of indicators set by ENTSO-E. Assessment of transmission network projects is a complex task due to different categories of projects. For some projects mainly related to security of supply, efficiency, integration of renewable resources, new interconnection etc., it is easier to identify the measurement parameters of a significant number of indicators. Whereas for some projects that are mainly related to the transmission system's support processes, it is very difficult to weigh the assessment indicators as they are not directly related to any of the indicators set by ENTSO-E. For example projects related to software platforms, adaptation of IT systems according to requirements and changes occurring in ENTSO-E, defense and monitoring measurement systems, etc. do not have specifics that may relate to indicators such as security of supply, efficiency, etc. These projects are necessary for the secure and efficient operation of the transmission system, but nevertheless they cannot be weighed and cost-benefited in terms of the indicators set by the CBA methodology.

The CBA methodology is based on the following factors:

- Security of supply
- Safety of transmission system operation
- Integration of generation, RES, reduction of CO2
- Network efficiency
- Promotion of the market for socio-economic benefit of the society
- Project's Cost Calculation (Fixed and Variable)
- Environmental and social impacts

The table below describes the structure of projects for which the CBA can be applied.

Table 2-1 Categorization of projects for implementation of CBA

Projects/Network reinforcement: • New line or cable • New transmission substation • New Transformer (or Replacement) • Upgrading the existing line capacity • Network for the connection of conventional new generators and RESs • Interconnection line • Reactor or compensator • Energy accumulators for the "storage" needs)	CBA indicators can be fully implemented
Projects / Load Support: • New substation with interconnection lines	All of the CBA indicators can be fully implemented, efficiency gains are mainly transferred to the distribution network
Projects / Revitalization: • Substation as a whole • Specific line fields or transformers	The CBA indicators may be partially implemented
Projects / system support • Measuring and protection systems • IT market systems • SCADA / EMS systems • Telecommunication systems • GIS systems Software for system analysis, etc.	The CBA indicators cannot be applied. They are necessary based on the Grid Codes and the requirements of ENTSO-E

2.4.1 Benefit indicators

The assessment of transmission network projects represents a complex process which entails the linkages between all default costs needed in project development and the project's expected benefits by examining environmental and social impacts as inevitable factors for any kind of project that takes place in residential or protected areas. Figure 2-5 shows the basic structure of project evaluation.

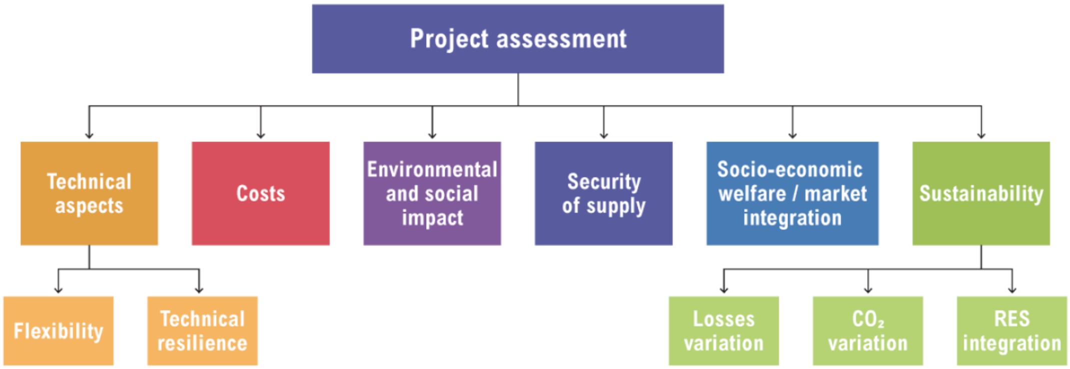

Figure 2-5 the basic structure of the project evaluation process in transmision

During the project assessment process based on the ENTSO-E adopted methodology, there are various indicators classified as:

- Benefit Indicators
- Project cost
- Environmental and social impacts
- GTC network transmission capacity

There are seven **Benefit Indicators,** which are defined as follows:

B1. Improvement of security of supply (SoS) is the ability of the power system to provide sufficient and reliable power supply under normal working conditions.

B2. Socioeconomic Wellbeing (SEW) or market integration is characterized by the ability of the power system to reduce the aberrations and thereby ensure adequate grid transfer capacity (GTC) so that electricity can be traded (generated) in the most economical way.

B3. Integration of RES, namely the support for integration of RES is defined as the ability of the power system to enable the connection of new renewable energy plants and the unblocking of "existing" and "green" generation, by reducing outages to a minimum.

B4 The change in losses of the transmission network is characterized by increased technical losses. This is an indicator of energy efficiency and is linked to the indicator of Socio-economic well-being.

B5 The change in CO2 emissions is characterized by increased CO2 emissions. This is as a result of B3 (providing the possibility of generation with low CO2 emission). Also, this indicator is linked to B4, whereby CO2 reduction is performed for the purpose of reducing losses, if that energy is produced by fossil fuels thermo-generator.

B6 The technical elasticity/system security is the ability of the power system to cope more and more with the extreme system conditions (such as exceptional occurrences - or extreme contingencies with low probability).

B7 Flexibility is the capability of proposed strengthening (investment, project) to be adequate for the various forecasted development scenarios, including trade of balancing services.

Project cost is defined as:

C1. The total project costs are based on market prices and approximate estimates in accordance with the project (ex. km of line).

Costs have their own structure as follows:

- Expected costs for materials/equipment, installation, expropriation costs, dismantling, environmental costs.
- Maintenance costs/variable costs
- Decommissioning costs

The project's impact on society is defined as:

S.1 Environmental impact represents the project impact as assessed by preliminary study, and aims to provide a project-related environmental sensitivity meter.
The environmental impact is related to the local impact of the project on nature and biodiversity, as assessed through preliminary studies. It is expressed in terms of how many kilometres of overhead or underwater/underground lines can pass through a sensitive environmental area (urban areas, protected areas, archaeological areas, national parks etc.).

S.2 Social impact represents the project's impact in the local population affected by the project as assessed through the preliminary studies, and aims to provide a measure of social sensitivity related to the project.

These two indicators refer to the remaining impacts, after possible mitigation measures when the clarity of the project becomes more accurate.

Grid Transfer Capability (GTC) is defined as:

GTC represents the network's ability to transmit electricity from an area to another. The interconnection of two areas represents a bottleneck in the energy system where the transmission capacity is insufficient to accommodate possible power flows (resulting from the scenarios). For the internal part of the network, the GTC may be affected by new lines as well as additional transformers installed in existing substations or new substations. In the new interconnection lines, GTC over 500 MW, in fact, represents a significant regional impact of the new line, as defined by ENTSO-E. Mainly 400 kV lines can affect the upgrading of the GTC to 500MW.

3. ELECTRICITY GENERATION AND LOAD FORECAST

3.1 Introduction

One of the basic data determining future transmission capacity development is to forecast electricity load or power. The load forecast represents an integral part of network planning, generation and transmission and distribution system operation. The main source of data for development of load forecast in the next 10 years is the demand forecast model developed by KOSTT, used by the document: Long-Term Energy Balance 2017 - 2026. This model represents a 10-year forecast, hour by hour, of the electricity demand. As such, this model enables the prediction of load, hour by hour, for the next 10 years, including peak loads (winter and summer).

3.2 Historical information of the load, and current situation

The historical chart of maximum load development in our country is shown in Figure 3-1. Unusual characteristics of the load curve over the years reflect the political and socio-economic conditions in which Kosovo has been through. There were two periods where consumption decreased drastically; the late 80s and the beginning of the war in Kosovo. The first was due to the discrimination of the Serbian regime, where the industrial consumption, which was the basis for the development of Kosovo, was reduced to the extent it resembled countries devastated by war or major natural disasters. After the migration of the population abroad, in the early 90s, a gradual increase of household consumption started, largely influenced by the higher number of home appliances. The second period of load reduction begins at the start of the war in Kosovo in 1997 and continues until the end of 1999. The mass destructions of entire areas, including of residential buildings, electricity grid infrastructure, etc., led to drastic load reduction. Only after the war in Kosovo did the electricity consumption, namely load, increase. This growth was very intense and challenging, both for the network as well as generating capacities, which were left in poor technical condition. By 2010, the maximum load saw an average annual increase of 6%, while after 2010, the maximum load increase was almost transformed into repletion with some variations, as a result of many factors affecting the demand, such as economic development, reduction of commercial losses in the distribution network, cogeneration in the capital, price of electricity, temperature fluctuations during winter, etc.

During 2017 ERO has changed the tariff system and this is expected to have a small impact on the increase of the load during the winter season.

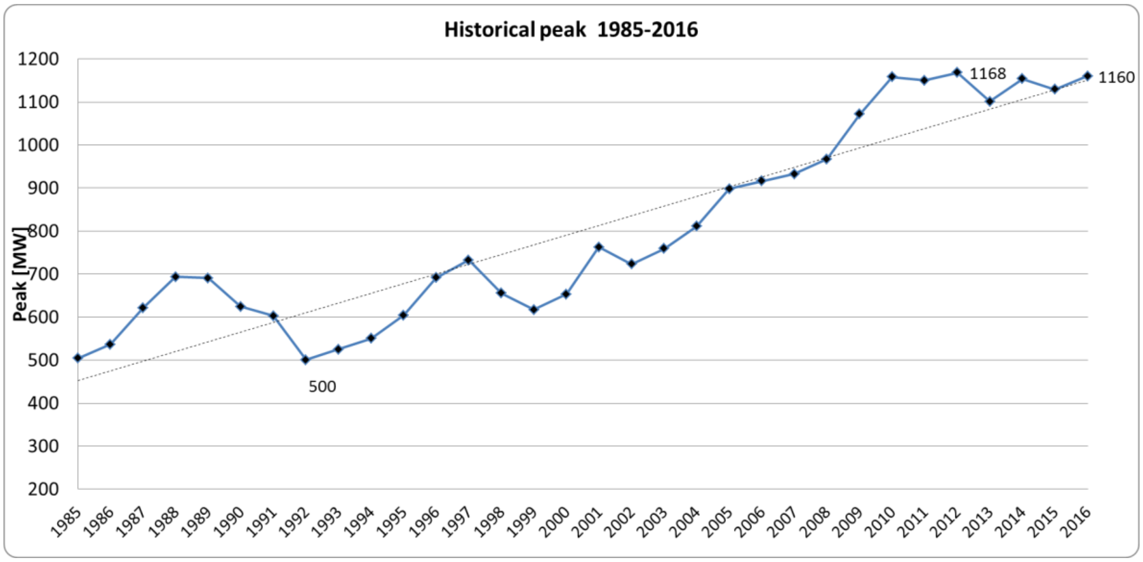

Fig. 3-1 Peak load history over years in Kosovo

The figure 3-1 shows maximum loads registered for years 2004-2016, for winter and summer seasons.

Tab. 3-1 Maximum active loads, summer and winter, for the period 2004-2016

Year		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Winter peak	MW	811	898	916	933	967	1072	1158	1150	1168	1101	1154	1129	1160
Summer peak	MW	569	617	637	690	764	795	810	798	815	799	775	774	764

3.3 Demand profile

Features of the load duration curves for Kosovo's Electricity System has went through constant changes, both in terms of proportional growth but also in terms of load factor change. Figure 3-2 shows the load duration curve for the previous year 2016, as well as basic characteristics of load. Compared with 2015, the load factor decreased as a result of increased summer consumption.

In figure 3-3 is shown the diagram of annual hour by hour load for the previous year 2016.

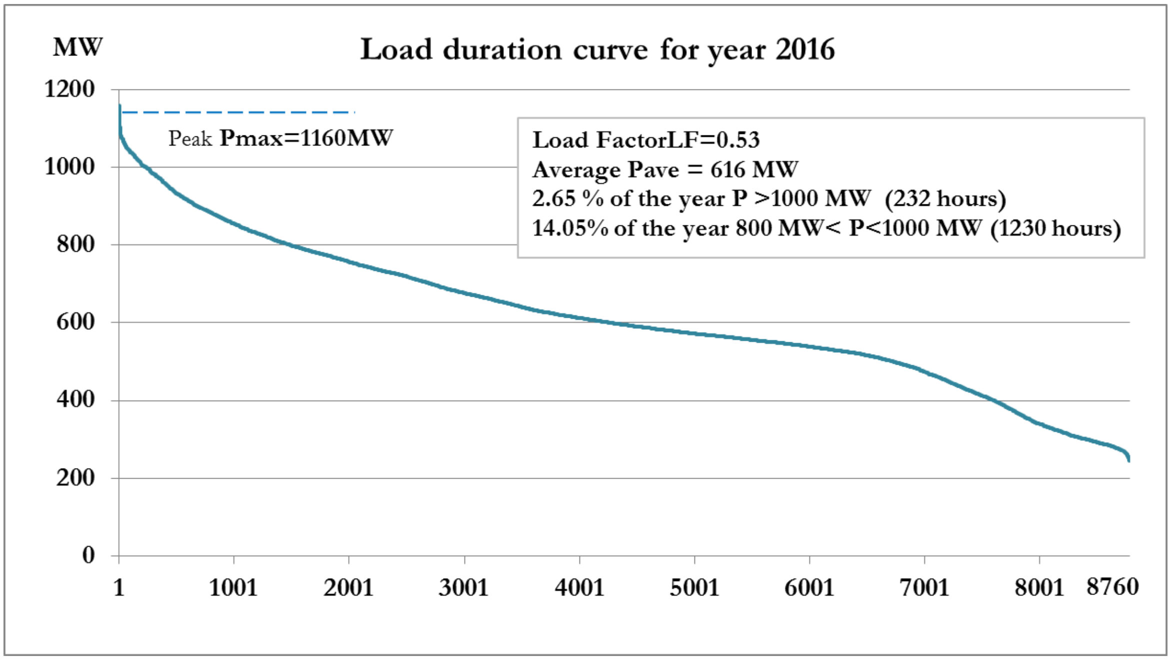

Figure 3-2 System Load duration curve for the year 2016

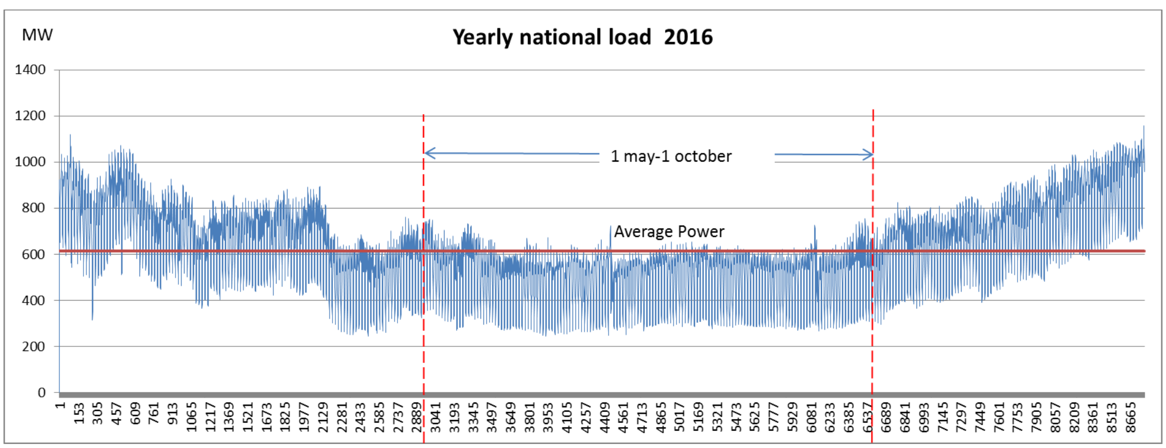

Figure 3-3 Diagram hour by hour of annual load realised during 2016

The diagram of the maximum and minimum load change for 365 days of 2016 is shown in Figure 3-4. The difference between maximal and minimal daily during the year 2016 has shifted in the range from 300 MW to 480 MW.

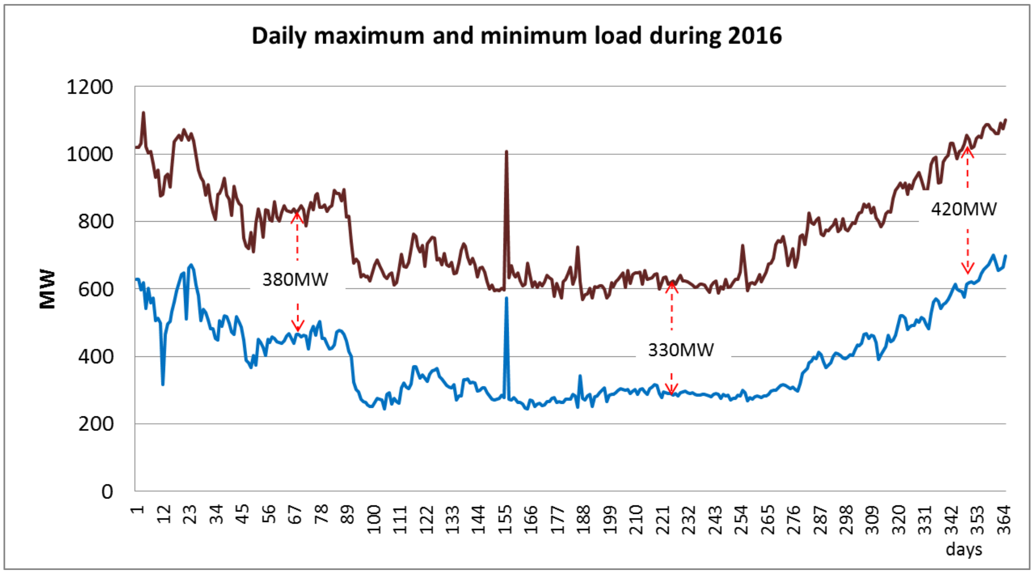

Figura 3-4 The maximum daily load diagram and a daily minimum for 2016

The weekly load diagram in the winter season, during a typical week of January and July 2017, now realized is presented in figure 3-5.

Figure 3-5 shows the daily diagram of national consumption of electricity for a typical day of January 2017 and of July 2017, which correspond to reference points according to ENTSO-E.

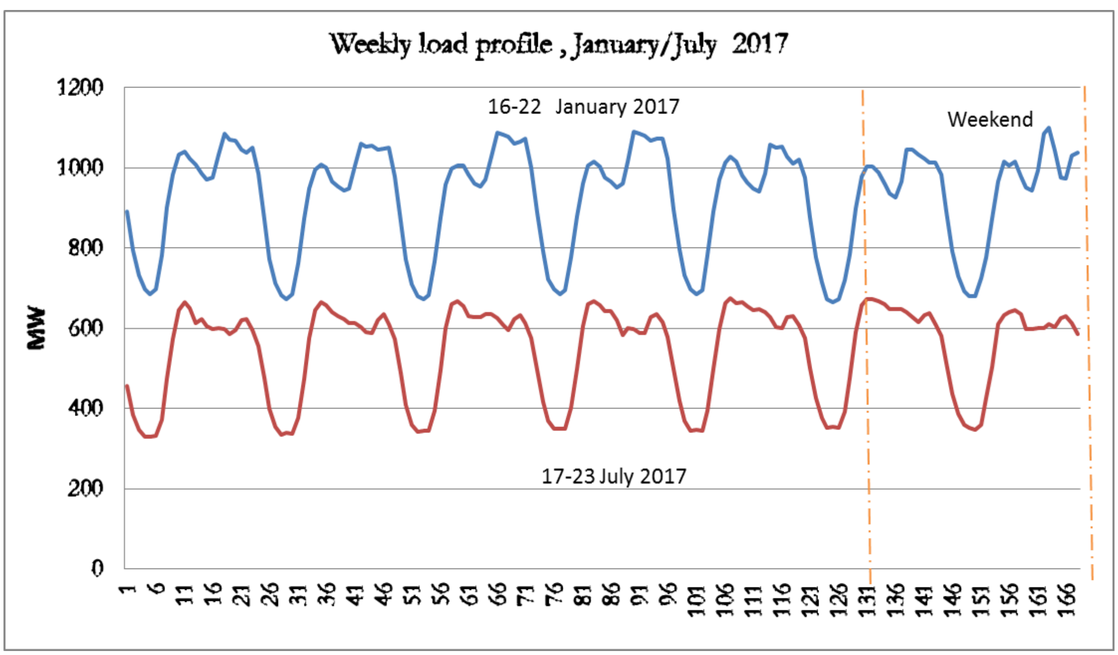

Figure 3-5 Weekly typical diagram of January and July 2017

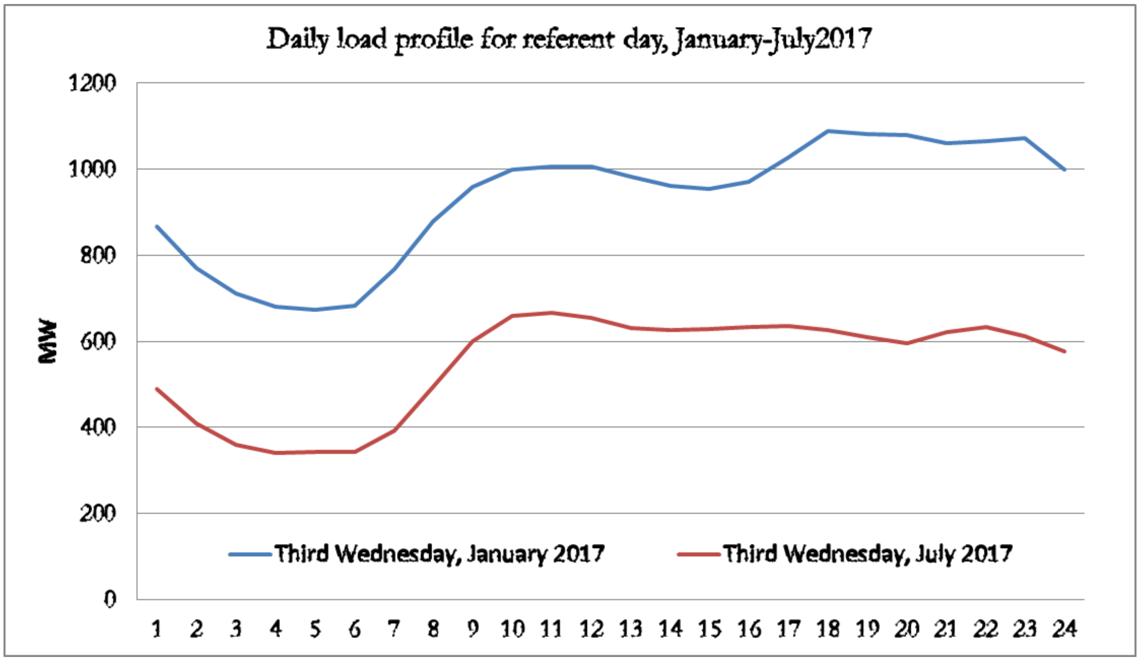

Figure 3-6 Daily load diagram for the referent point (3-rd Wednesday, January 2017 and July 2017) according to ENTSO-E

Table 3-2 shows simultaneous maximum loads in 220 kV and 110 kV consumption dividend by distribution districts, the industry connected to the transmission network and losses in transmission network. While the cumulative consumption by districts, industry and losses in the transmission network is illustrated in Figure 3-7.

Table 3-2 Loads in distribution substations forecasted for 2017

Substation loads during simultaneous peak conditions - 2017			
Regions	**Substations**	**Installed capacity [MVA]**	**Simultaneous peak P(MW)**
	Prishtina 1	126	77.0
	Prishtina 2	134.5	54.0
	Prishtina 3	71.5	45.0
	Prishtina 5	80	31.0
	Prishtina 7	80	27.0
PRISHTINA	Bardhi (Palaj)	120	26.0
	Drenasi	/	19.0
	Podujeva	80	47.0
	Kosova A+B (+C)	/	42.0
	Total Prishtina	**692**	**368.0**
	Ferizaj(Bibaj)	103	65.0
	Lipjani	63	46.0
FERIZAJ	Sharr	/	13.0
	Total Ferizaj	**166**	**124.0**
	Vallaq	94.5	44.0
	Shipkovc	/	36.0
	Vushtrri1	31.5	9.0
MITROVICA	Vushtrri 2	63	42.0
	Skenderaj	71.5	19.0
	Total Mitrovica	**260.5**	**150.0**
	Peja1	71.5	32.0
	Peja2	63	28.0
PEJA	Deçani	51.5	25.0
	Burimi (istogu)	71.5	22.0
	Klina	31.5	17.0
	Total PEJA	**289**	**124.0**
	Gjakova 1	40	25.0
	Rahoveci	63	44.0
GJAKOVA	Gjakova 2	63	25.0
	Total Gjakova	**166**	**94.0**
	Prizreni 1	103	62.0
	Prizreni3	63	37.0
PRIZRENI	Theranda	63	22.0
	Total Prizreni	**229**	**121.0**
	Gjilan 1	51.5	34.0
	Gjilani 5	31.5	16.0
	Vitia	51.5	19.0
GJILANI	Berivojca	63	14.0
	Total Gjilan	**197.5**	**83.0**
	FERONIKELI	320	51.0
	SHARR CEM	40	13.0
INDUSTRIA	TREPQA	126	9.0
	Other	/	3.0
	Total industry	**486**	**76.0**
	Losses in KOSTT		**22.0**
	Total Capacity without Ind	**2000**	
Total Peak (MW)			**1162**

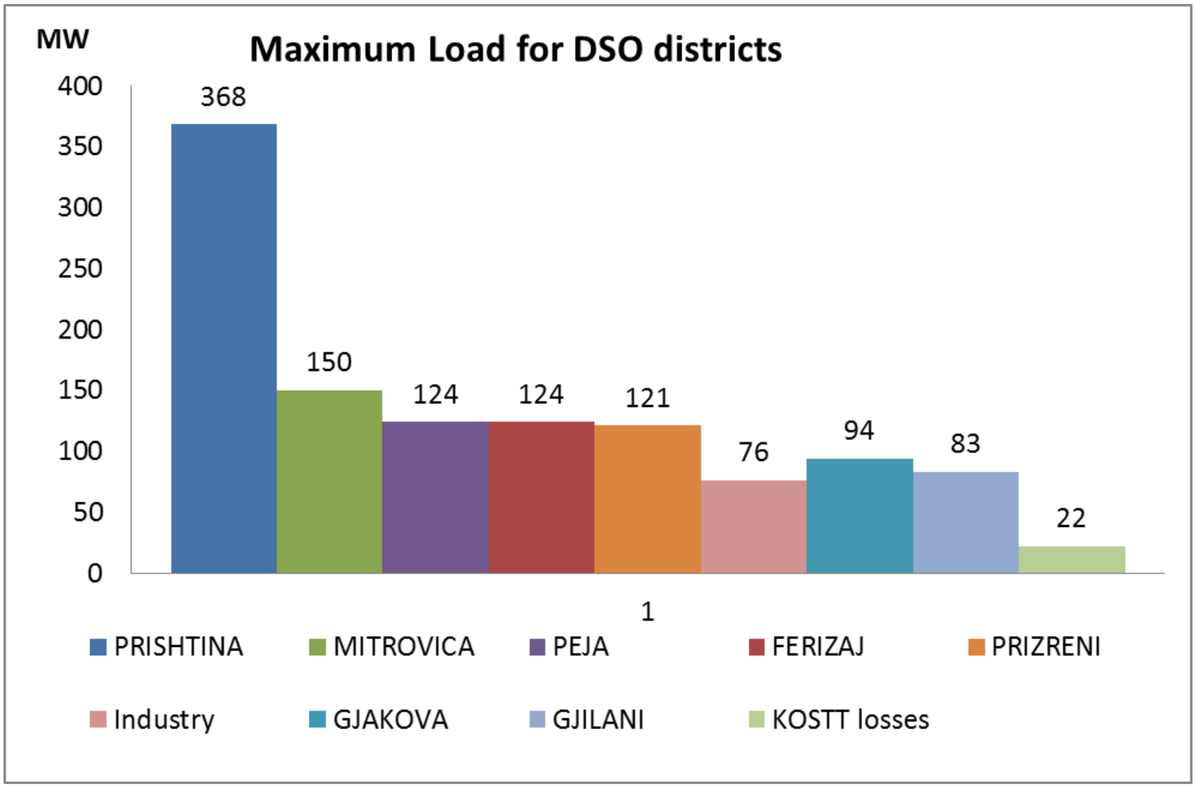

Figure 3-7 Maximum load by DSO districts, the industry involved in transmission network and losses at KOSTT

3.4 Maximum annual load forecast 2018 - 2027

Forecast of the electricity is based on the forecast described in the "Long-Term Energy Balance 2017-2026" which document is in accordance with the provisions made in the Draft Energy Strategy 2017-2026, adding the year 2027.

Forecast of the development of electricity demand for the period 2018-2027 under three different growth scenarios is shown in Figure 3-8, and numeric data are shown in Table 3-3.
The baseline scenario of load development is characterized by an annual average growth of around 1.38%. This load development scenario will be the key input in evaluating the operating performance of the transmission network.

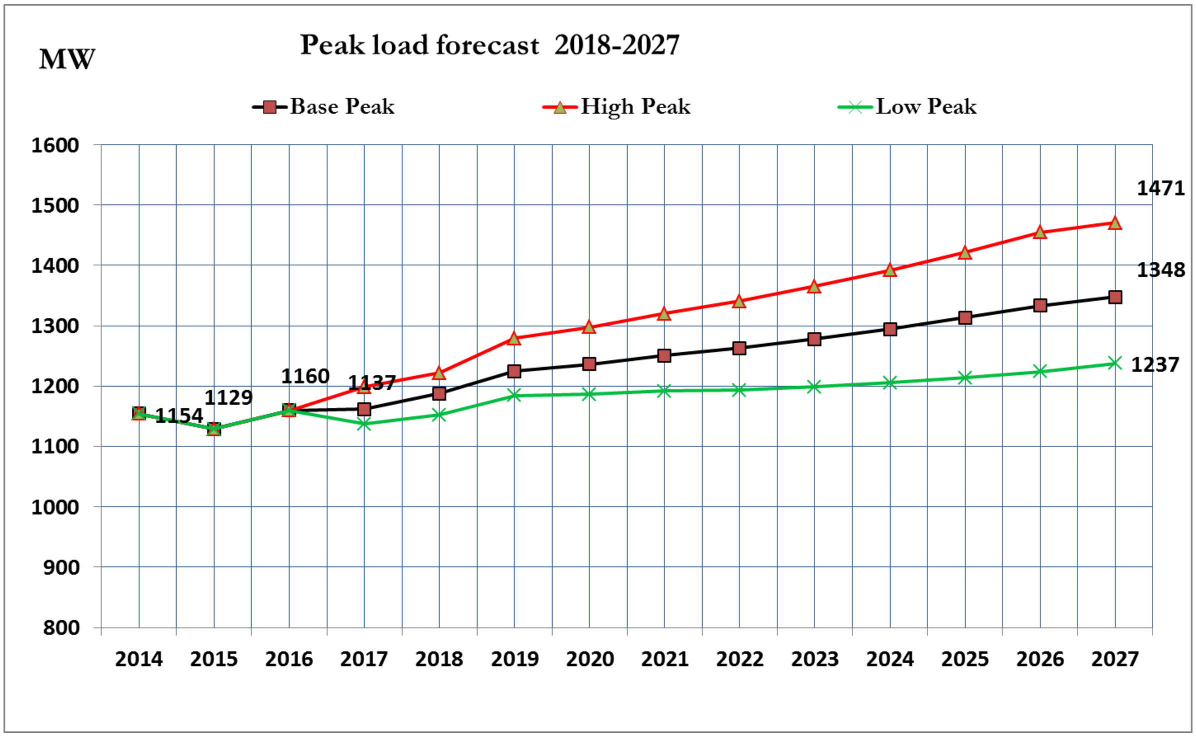

Figure. 3-8. Low, base and high growth scenarios for the peak load (maximum load)

Table. 3-3. Respective data of peak forecast, related to Figure 3-8

Peak Load	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Low Peak [MW]	1154	1129	1160	1137	1152	1184	1186	1192	1194	1199	1206	1214	1224	1237
Base Peak [MW]	1154	1129	1160	1162	1188	1225	1236	1250	1263	1278	1295	1314	1333	1348
High Peak [MW]	1154	1129	1160	1199	1222	1279	1298	1320	1341	1365	1392	1421	1455	1471

4. GENERATION CAPACITIES OF KOSOVO'S ELECTRICITY SYSTEM

4.1 Introduction

Power flows in the transmission network are affected by the distribution of system loads, generation capacity and location and the power balance linking to the interconnection network depending on the level of imports or exports. The changes to the generation capacity, along with new capacity development and decommissioning of generation have a greater impact on changing the power flows compared to the loads. The development of conventional generation capacities and those renewables, directs the development of transmission infrastructure in such way that to be capable and secure to evacuate the generated power to the point of consumption or, through interconnection lines, to export the surplus. Development of new thermal capacity in Kosovo and decommissioning of outdated capacities shall initiate the need for further development of transmission network. Construction of any type of generator requires the development of a transmission network that would allow the generator to be connected into the grid and create the path for injection of power produced in the electro-energetic system. If the power flows of the new generator do not affect the safety of the transmission network operation, such connection is considered to be a shallow connection and does not implicate additional investment in the transmission network. If the security of some parts of the network is affected as a result of the change of power flows caused by the new generation connection, in addition to the interconnection network, the transmission network should be reinforced wherever the overloads occur. This case is considered to be a profound connection and implicates additional investments to maintain the security of the transmission system.

The connection of new generators into the transmission network, particularly large-capacity generators, results with increased level of short circuits powers in parts of the grid close to the generation and may implicate additional investment in equipment for limiting power failures or changing disconnection facilities at risk. Accurate calculation of power failure is necessary to assess the impact of new generation onto existing facilities.

The impact on future transmission network development will most certainly be attributed to the development of renewable sources. It would be more economical to connect RES with relatively low capacity (<10 MW) into the distribution network, if the network provides generation security and power evacuation. On the other hand, higher-capacity RES mostly apply for connection to 110 kV network.

In this case a 110 kV network should be developed which enables the RES connection to the transmission network. RES connected to the distribution network directly affects the reduction of power flows in the transmission network as well as the reduction of network losses. This necessarily provides a better forecast of the RES capacity development and their geographic distribution so as to avoid unnecessary investments in the transmission network determined by the initial network operation conditions.

4.2 Current generation capacities in Kosovo

The electricity produced in Kosovo is dominated by two relatively large power plants: TPP Kosovo A and TPP Kosovo B which participate with 95% in total electricity production in Kosovo. Table 4-1 shows the latest relevant information to the units of the Kosovo A and B.

Table 4-1. Main features of TPP Kosovo A and Kosovo B generation units

Termopowerplant	Units Capacity [MW]			In Operation	Decommissioning
	Installed	Net	Actual Net min/max		
TPP KOSOVA A					
A1	65	0	0	1962	Out of function
A2	125	0	0	1964	Out of function
A3	200	176	120-130	1970	Q4 2023**
A4	200	176	120-130	1971	Q4 2023
A5	210	185	120-135	1975	Q4 2023
TPP KOSOVA B					
B1	339	305	200-260	1983	>2030
B2	339	305	200-260	1984	>2030

Small hydropower plants, built in different time periods, mainly carry the remaining part of about 5% of electricity production in the country. Currently, two such hydro-power plants connected to the 110 kV transmission network, namely HPP Ujmani and HPP Kelkos, produce around 2.7% of the total domestic production, whereas a large number of small hydro-power plants with capacity ranging from 1-5 MW produce about 2.3% of the total domestic production under normal hydrological conditions. Tables 4-2 shows the current capacity of hydropower plants in Kosovo connected to the transmission network, while in table 4-3 is presented the total capacity by type of generation connected to the distribution network.

Table 4-2. Main features of existing hydro-power plants of Kosovo connected to the 110 kV Transmission System

Hidro power plants	Generator	Start of operation	Apparent power (MVA)	Installed Power (MW)	Net (MW)
HPP Ujmani	G1	1981	19.5	17.5	16
	G2	1981	19.5	17.5	16
Total Ujmani			**39**	**35**	**32**
Lumbardhi 1	G1	1957/2005	5.05	4.04	4.00
	G2	1957/2005	5.05	4.04	4.00
Belaja	G1	2015	5.88	5.29	5.00
	G2	2015	3.11	2.79	2.50
Decani	G1	2015	7.4	6.66	6.50
	G2	2015	3.5	3.15	3.00
HPP-Lumbardhi Cascade			**29.99**	**25.97**	**25.00**
Total in transmission			**68.99**	**60.97**	**57.00**

Table 4-3. The existing Kosovo RES capacities connected to the distribution network according to the situation 2017

Generation type	Installed capacity [MW]
HPP	16.71
Wind	1.35
Solar	0.602

4.3 Forecast of development of generating capacities 2018 - 2027

For purposes of electricity generation forecast, KOSTT has used data recently presented in the Long Term Energy Balance 2017-2026 aligned with the Strategy on Energy 2017-2026. Forecasts for electricity generation from domestic resources are done for three scenarios whereas the scenario selected as basic scenario is as follows:

- Construction of Thermal Power Plant Kosova e Re with a capacity of 450 MW and operationalization by 2023
- Closure of TPP Kosova A, after the TPP Kosova e Re becomes operational

- Building a flexible HPP (accumulative or reversible) with a capacity of ≥ 200 MW and operationalization by 2023
- Full revitalization of TPP Kosova B in two years 2023 and 2024
- RES: 150 MW from wind, 205 MW small HPP, 30 MW solar and 14 MW from biomass (according to feed-in tariffs support scheme)

The basic generation scenario presented in the Energy Strategy 2017-2026 foresees the introduction of 450 MW of TPP Kosova e Re in the beginning of 2023, and the closure of TPP Kosova A after the new unit becomes operational. The new power plant will be constructed in accordance with all environmental criteria as defined in D 2010/75/EC. The rehabilitation of TPP Kosova B is foreseen to be completed in years 2023 and 2024.

The system will need the development of a **flexible** unit with a capacity of ≥ 200 MW, intended as a hydro unit that can be either accumulative or reversible. This unit shall, in addition to providing additional regulatory power, support the integration of RES into the power system, and its operation will contribute to the increase of needs for regulatory power as a result of variable nature of power generation from RES.

4.3.1 Developments in renewable sources

Renewable Energy Sources (RES) represent an important source of energy available to Kosovo, with a still untapped potential. The use of such sources for energy production represents a long-term objective of achieving the country's energy policy objectives such as: supporting overall economic development; increasing security of energy supply, and environmental protection. For the purpose of encouraging the use of renewable energy sources, a feed-in tariff scheme for water, wind, and photovoltaic and biomass energy is in place in Kosovo. The goal of such a measure that encourages the use of RES is to meet the targets for RES 2020 as required by Directive 2009/28/EC, whose transposition and implementation is done under monitoring by the Energy Community Secretariat.

The Transmission and Distribution System Operator play an important role on the promotion of Renewable Energy Sources. These two Operators are obliged by law to prioritize energy produced from renewable energy sources, according to standards specified in the Grid Cod.

Investments made in the transmission infrastructure during the last decade have resulted with an efficient, reliable and significantly secure transmission grid. Such development has created favourable conditions for supporting integration of renewable sources into the transmission grid Taking into consideration Kosovo's capacities for renewable sources, the connection of such generators is expected to occur mainly in the 110 kV grids, which are well developed and distributed throughout the territory of the Republic of Kosovo.

KOSTT has developed a highly efficient procedure for reviewing Applications for Connection to the Transmission **Network**, thereby avoiding procedural delays affecting the timing of project implementation. So far, despite the fact that RES are supported with attractive **feed-in** tariffs, only one Hydropower Plant with a capacity of 35 MW (HC Kelkos) is connected to the Transmission Network in the 110 kV **network**. Additionally, the wind park "Kitka" with an installed capacity of 34.5 MW, which will connect to SS Berivojce through a 110 kV line in a length of 16 km, is under construction. This Wind Energy Park will be operational in 2018.

Three wind projects and one HC are in the process of signing the connection agreements:

- Wind power plant "Selaci 1, 2 and 3" with installed capacity 105 MW
- Wind energy park "Koznica" with installed capacity 34.5 MW
- Wind energy park "Budakova" with installed capacity 46 MW
- HC Lepenci with capacity 9.92 MW

Also, in the recent years is noted a significant interest for solar sources (photovoltaic) by investors who are interested to develop projects of large capacities that will be connected in the transmission network. To that end, KOSTT has prepared the Code for Solar Powered Generating Stations, which determines technical criteria that must be fulfilled by applicants for this type of RES. However, the projects expected to be developed during the upcoming year will be mainly connected to moderate voltage grid, such as the "Birra Peja" solar project with a capacity of 6 W, expected to be operational by 2018.

The transmission network has sufficient capacities to integrate renewable sources of all kinds; however the only problem for the System Operator remains the increase of systems regulatory reserve requirements, with particular emphasis on secondary and tertiary control reserves, due to the variable and highly unpredictable wind and solar sources. This problem will be avoided by integrating small markets into an integrated regional market where access to ancillary services will be easier, and the level of regulatory reserves required will also be reduced. The first step will be to create a common market between Kosovo and Albania, while the second step will be integration into the regional market.

5. KOSOVO's TRANSMISSION NETWORK DEVELOPMENT PROJECTS (2018-2027)

5.1 The incentive factors of the development plan

Kosovo's electrical industry and its development are based on the objectives of the National Energy Strategy, as well as essential or strategic objectives of the European Union. This focus sets out the context of capital investment carried out in Kosovo's transmission system and can be summarized as follows:

- Security of supply
- Ensuring competitiveness and development of the national economy
- Ensure the long-term sustainability terms of national electricity supply.

To achieve these strategic objectives, it is necessary to ensure continued investments in the development and maintenance of the transmission system. Specific factors conducive to investment in the transmission network infrastructure have been identified and can be described as follows:

- Ensure adequate supply of the transmission network
- Promotion of market integration and transparency
- Promotion of renewable resources and complementary thermal coal resources.

To achieve adequate electricity supply security; integration and further development of the market, integration of new generation capacities, it is necessary to ensure a long-term plan for continuous and timely reinforcement of the transmission system in Kosovo. As the demand for energy and the generation changes, namely since the regional transmission network becomes even more interconnected, or as new generation connects to the network, electric power flows on the transmission network also change. To accommodate these changes in the power flows it is often necessary to strengthen the transmission network, to maintain the level of safety, performance and efficiency of the transmission system.

5.2 Implemented projects 2007-2017

Based on the incentive factors discussed above, since the establishment of KOSTT until now, capital investments have been made in the transmission network with a value of 236 M€, mainly in developing and strengthening the transmission infrastructure as well as on the modernization of substations and supporting systems. Based on all measurable performance indicators recorded in the last decade, continued investments in transmission system infrastructure; modernization of support systems; human resource development, have resulted in a higher continuous and uninterrupted security and performance of the transmission system operation. A list of projects from 2007 to this day, implemented by KOSTT, is shown in Table 5-1. The process from planning to implementation is followed by high development/implementation dynamics and it was quite challenging for KOSTT staff to handle the interferences with the distribution system, industry and generators. Implementation of projects with an impact in supply in a simultaneous manner, and their management was rather complex, aimed at minimizing undelivered energy as a result to cuts due to works performed.

Table 5-1. List of realized projects in KOSTT from 2007 until Q4 2017.

No	LIST OF IMPLEMENTED PROJECTS 2007-2017 Project title	Year of commissionning
1	Conductor replacement in the 110 kV line No. 125, SS Kosovo A - SS Vushtrri 1&2	2007
2	Conductor replacement in the 110 kV line No. 164/3, SS Prizreni 1 - SS Prizreni 2	2007
3	Replacement of 110 kV power switches in SS Prishtina 1 and SS Prishtina 2	2008
4	New 110 kV line - SS Prizren 2 - SS Rahoveci and SS Rahoveci	2008
5	Conductor replacement in the 110 kV line No. L126/1, SS Deçan - SS Gjakova 1	2009
6	AT1 in SS Kosova A, 220/110 kV	2009
7	Revitalization of SS Kosovo A	2009
8	Revitalization of SS Prishtina 1	2009
9	Package project PEJA 3	2009
10	Replacement of relay protection facilities in SS Kosova B and SS Prishtina 4	2009
11	ITSMO meters (in borders)	2010
12	Adaptation of the L212 line as a 110 kV line SS Kosovo A - SS Ferizaj 1	2010
13	New 110 kV line SS Peja 3 - SS Klina, under the Peja 3 package project	2010
14	Connection of SS Skenderaj, with a dual 110 kV line, to the Vallaq - Peja 3 line	2010
15	AT3 in SS Prishtina 4, 220/110 kV	2010
16	Replacement of the conductor in the 110 kV line, L 126/5, SS Peja 1 - SS Peja 2	2010
17	Revitalization of SS Kosovo B	2011
18	Package Project FERIZAJ 2	2011
19	SCADA/EMS	2011
20	Package project SS Palaj with 110 kV lines	2011
21	Revitalization of SS Prizreni 2, 220/110 kV & AT3=150MVA	2012
22	Package project SS Gjilani 5 with transmission lines	2012
23	IT system supporting market operation	2012
24	Replacement of relay protection facilities in SS Prishtina 2 and SS Prishtina 3	2012
25	400 kV switches for generation fields in SS Kosova B	2012
26	Division of bus bars in two sections in SS Gjilani 1 and SS Theranda	2012
27	Rehabilitation of equipment for own-use in SS Kosova B	2012
28	General overhaul of 110 kV equipment in SS Prishtina 3 (GIS system)	2012
29	Rehabilitation of HV facilities in SS Ferizaj 1 and Gjilani 1	2013
30	Interconnection of SS Lipjan in the 110 kV L112 line	2013

31	Installation of two fields for 110 kV lines in SS Prizreni 2	2013
32	Replacement of conductors and izololatorëve. at 110 kV lines L125 / 2 and 125/3	2013
33	OPGW in 400 kV lines, SS Peja 3- SS Ribarevina, SS Ferizaj 2- SS Shkupi 5	2014
34	OPGW in 220 kV lines, SS Podujeva- SS Krushevci,	2014
35	Line allocation L1806 from SS Gjakova 2 to SS Gjakova 1 and ri-vitalization of SS Gjakova 2	2015
36	Transformer installation 40 MVA, 110/10(20) kV in Skenderaj and Burimi	2016
37	Re-vitalization of HV equipments in SS Prizreni 3	2016
38	Re-vitalization of HV equipments in SS Gjakova 2	2016
39	LFC – Secondary Regulation	2016
40	Installation of 31.5 MVA transformers, in Berivojce and Viti	2016
41	Interconnection lines 400 kV SS Kosova B – SS Tirana 2 (242 km)	2016
42	Re-vitalization of MV (35kV) in SS gjakova 1	2016
43	Installation of third transformer 40 MVA, 110/10(20) kV in SS Prishtina 2	2016
44	Second transformer 300 MVA in SS Ferizaj 2 and Peja 3	2016
45	New 110 kV line SS Peja 3 - SS Peja 1 and revitalization of SS Peja 1	2016
46	Re-vitalization of SS Peja 1 (New GIS System)	2016
47	Revitalization of the 110 kV line: L126 / 2 SS Peja 2- SS Deçan	2017
48	Re-vitalization of TM (35 kV) equipment in NS SS Gjilani 1 and SS Ferizaj 1	2017
49	Revitalization of line fields and transf. 110 kV in: SS Lipjan and NS Viti	2017
50	INTER-OST Meters - Installation of metering points in cross-border lines	2017
51	Replacement of circuit breakers and separators in SS Prishtina 4	2017
52	Third transformer 40 MVA in SS Lipjan	2017
53	New Independent and Self Redundant AC/DC Supply System of SS / HV	2017
54	Re-vitalization of SCMS / SCADA in SS Kosovo B, SS Podujeva, SS Prishtina 5	2017
55	Implementation of changes in SCADA / EMS (Observation Area)	2017

5.3 Transmission network infrastructure development 2018-2027

5.3.1 Introduction

This chapter presents and examines transmission network development projects in the period 2018-2027. These projects were also presented in the previous 2016-2025 plan, with the inclusion of changes that belong mainly in implementation times, but also change in design and priority. Considering that the planning process of the transmission network is an extremely complex process, greatly dependent on many factors, the ten-year period that defines this document is divided into two periods:

- **The first period of five years 2018-2022**, which is considered relevant and influential in the long term development of the network and with high probability of implementation. Projects included in this period of time are analyzed in detail. This timeline of the plan is linked to the 5 year investment plan and is determinant in determining the 5-year tariffs for KOSTT by the ERO.

The second period, 2023-2027, includes optional (indicative) projects in a comprehensive manner that have internal or regional character for which **KOSTT** considers their importance and their contribution in achieving the technical standards for operation of the transmission system in order to support the electricity market. This category of projects may be subject to change depending on processes that take place in the energy sector in Kosovo and the region. Generally, this relates to the development of generation and load as well as power flows expected to occur in the next decade in the regional network.

Transmission network development projects are divided into five categories:

- **Transmission network reinforcements**
- **Load support/New 110/10(20) kV nodes**
- **Rehabilitation of the transmission network**
- **Supporting projects of the transmission system (management, monitoring, measurement and control), and**
- **Generation support**

Because of considerable complex dependence on the various factors for the implementation of the projects, the time and manner of such implementation can be considered as subject to possible changes and as such the next document will revise the data and update them.
Tables contain the project identification codes (ID), a general description of the project, the expected completion time and reasons and effects of project implementation.

5.3.2 Development projects under implementation and under development

Table 5-2 presents projects which are being implemented during the current year 2017, or which are in the tender process. A large number of projects that were supposed to have been completed in 2016, are expected to be completed by the end of 2017 due to delays in the procurement process.
In the group of on-going projects, there are projects financed as loans and grants from KFW and EBRD, and a part with KOSTT's own-funding. EBRD-funded projects are mainly focused on load support projects (SS 110/X kV), while KFW projects are combined projects and are mainly focused on reinforcing the transmission network and revitalizing the equipment.
The group of projects in process includes projects financed through loans by KfW and (BERZH) EBRD and KOSTT's own funding. Projects financed by BERZH (EBRD) mainly focus on load support (SS 110/X kV), while KfW projects are combined projects primarily focused on transmission network improvement and equipment revitalization.
The following tables 5-2, 5-3 and 5-4 show projects under implementation, grouped by category.

Tab. 5-2 Projects in implementation, and projects in the tendering process (Category: network reinforcement)

		Projects under implementation and in the development process **Project category -network enhancement**			**Operation**
No.	**ID**	**Project title**	**Technical description**	**Reason for implementation**	**Year**
1	006	**New line 110 kV SS Rahoveci - SS Theranda**	- 16 km, Al. Çe 240 mm^2, - Field line 110 kV in SS Theranda, - The project is linked to the re-vitalization project of HV equipment in SS Theranda	Security of supply, N-1 criteria in 110 kV network, operational flexibility and stability, support of RES, capacity increase of 110 kV lines	Q4: 2019

Table. 5-3 Projects in implementation, and projects in tendering process (category: Load Support).

		Projects in progress and development process **(Load Support)**			**Operation**
Nr	**ID**	**Project name**	**Technical description**		**Year**
1	001	**SS 110/10(20) kV Dardania** (Prishtina 6) **with a dual underground 110 kV line**	- GIS type substation, 110/10(20) kV, 2x40 MVA - Two cable fields 110 kV - Two 110 kV lines/cables, 1000mm^2, 3.8 km in length - Two 110 kV and 10(20) kV transformation fields, one 110 kV connection field. - Command centre with ancillary equipment	Increased security of supply in the capital, reduction of losses in the distribution network, optimum distribution of power flows in the 110 kV lines and transformers.	Q4-2019

2	002	**SS 110/10(20) kV Ilirida** (SS Mitrovica 2) **with 110 kV transmission lines**	- Double 1.5 km lines, 110 kV connections to the Vallaq-Bardhi line. - SS Ilirida , 110/10(20)kV, 2x40 MVA, GIS type - Two transformation fields at 110 kV and 10(20) kV, two line fields at 110 kV and connection fields 110 kV. - Command centre with ancillary equipment	Security of supply, loss reduction in distribution network, optimum distribution of power flows in 110 kV lines, unloading of industrial transformers of Trepça	Q4-2019
3	003	**SS Drenasi 220/10(20) kV with transmision lines 220kV**	- Connection with a dual 220 kV line, 3 km in existing 220 kV line SG Drenasi –SS Prizreni 2 - GIS substation 220/10(20)kV 2x40 MVA with two 220 kV transformation fields, two 10(20)kV transformation fields, with two 220 kV line fields, and one 220 kV connection field - Command centre with ancillary equipment	Increased security of supply, reduction of losses in the distribution network, optimum distribution of power flows in the 110 kV lines and release of Ferronikel industrial transformers.	Q4-2018
3	004	**SS Fushë Kosova**	- Connection with dual 110 kV line, 1.5 km in length, in the 110 kV Kosova A- Lipjan line - GIS substation 110/10(20)kV 2x40 MVA with two transformation fields at 110 kV and 10(20) kV, with two 110 kV field lines, with one 110 kV connection line - Command centre with ancillary equipment	Increased security of supply, reduction of losses in the distribution network, optimum distribution of power flows in the 110 kV lines and transformers.	Q4-2021

Tab. 5-4 Projects in implementation and in process (category: revitalization of substations.)

		Projects under implementation and in the development process Project Category – revitalization of substations			Operation
No	**ID**	**Project Title**	**Technical description**	**Reason for implementation**	**Year**
1	005	**Revitalization of HV equipment in SS Theranda**	- Replacement of two line fields 110kV, replacement of two transformation fields 110 kV and one connection field 110 kV. Move to dual bus bar system. - Replacement of two transformation fields 10 kV and one 35 kV. - The project should be coordinated - with the design of the new line: Rahovec-Therandë	Increase security and reliability of the operation of substation and lines connected to the SS. Exceeding the lifespan of equipment and modernizing with modern equipment.	Q4-2018

Tab. 5-5 Projects in implementation and in process (category: system operation support).

		Projects under implementation and development process Project category - supporting the transmission system operation			Operation
No.	**ID**	**Project Title**	**Technical description**	**Reason for implementation**	**Year**
1	021	**Installation of metering groups at the new border between KOSTT and KEDS/DSO**	- - Electric and voltage meters transformer at 35 kV and 10 (20) kV levels conforming to the metering code, as well as following work.	Fulfilment of technical criteria from the Metering Code. Increase security and measurement system. Support for the Market Operator	Q4: 2018

5.3.3 List of new development projects planned for the period 2018 -2027

Below is a list of planned projects by categories, which are the result of optimal selection of different network reinforcement scenarios during the planning process. These projects include the period 2018-2022. The lists of projects are presented in tables categorized based on relevant specifications. Factors being considered influential in re-designing of some of the previously planned projects, changing their implementation time and selecting some new projects, are processes which do not depend from **KOSTT**:

- Application for new load or generation connections

- Ensuring financing
- Problems with expropriation of properties, substations and lines etc.
- Unplanned problems during the procurement process

Because of the aforementioned reasons, the planning process and the selected projects have been adapted to the changes that occurred overtime. Also, the movement of the technical border from the 110kV level to moderate voltage level also had a relevant influence in reviewing priorities regarding investment planned.

5.3.3.1 The list of new projects in the category of transmission network reinforcement

The table 5-6 provides a list of projects planned for the next 10 years, which are considered to be influential in establishing network capacities, pursuant to technical requirements that are obliged from the Grid Code. Projects are ranked according to their planned implementation period. The vast majority of investments in five next years will be made by **KOSTT** with soft loans offered by the German Bank for Reconstruction (KfW) and soft loans provided by the European Bank for Reconstruction and Development (BERZH) while the remaining part shall be covered by KOSTT.

Table 5-6 List of projects planned for the reinforcement of transmission network 2018-2027

PROJECT CATEGORY: TRANSMISSION NETWORK REINFORCEMENT - (2018-2027)					
Nr	**ID**	**Project title**	**Technical description**	**Reason for implementation**	**Year**
1	010	**Second 40 MVA transformer in SS Klina**	- TR2 Transformer 110/10(20) kV, 40 MVA - 1 transformation field 110 kV and 10(20) kV completed	Security of supply consumption of Klina, maintenance and optimization of SS. Increase of transformation capacities.	Q2-2020
2	012	**Revitalization of 110 kV line: SS Prizren 1 - SS Prizren 3**	- Replacement of the conductor from 150/25mm² to HW 170 mm², 4.69 km in length from SS Prizren 1 to SS Prizren 3. The conductor is taken from the Prizren 1-Prizren 2 line, which will be demolished and turned into double	Increased transmission capacities of the line from 83 MVA to 114 MVA, with the aim of reducing power losses, N-1 criterion.	Q2-2021

3	013	**New 110 kV line SS Prizren 1- SS Prizren 2**	- 4.81km, Al/St 240 mm², dismantling the existing and using the tracks. In addition, the current HW 170 mm² conductor is used for strengthening the Prizren1-Prizren 3 capacity line. - Field of the 110 kV line in SS Prizren 2, - Field of the 110 kV line in SS Prizren 1	The construction of new transmission line that enables the fulfilment of N-1 criterion..	Q2-2021
4	014	**Second 40 MVA transformer in SS Gjilan 5**	- TR2 Transformer 110/10(20) kV, 40 MVA - 1 transformation field 110 kV and 10(20) kV completed	Security of supply consumption of Gjilan, maintenance and optimization of SS. Increase of transformation capacities	Q4-2020
5	015	**Replacement of the transformer in SS Deçani**	TR2 Transformer 110/10(20) kV, 40 MVA in SS Decan	Security of supply consumption of Deqan; Reducing power loses in distribution.	Q2-2020
6	016	**Replacement of the transformer in SS 110/10 kV Gjakova 1 (40MVA)**	- TR2 110/35/10(20) kV in SS Gjakova 1(in coordination with KEDS)	Security of supply consumption Gjakova; Reducing power loses in distribution.	Q2-2020
7	023	**Replacement of the transformer in SS Theranda, (40MVA)**	- TR2 Transformer 110/10(20) kV, 40 MVA	Security of supply consumption of Theranda; Fulfilment of N-1 transformation criteria. Reducing power loses in distribution.	Q2-2023
8	050	**Replacement of the transformer in SS Ferizaj 1, (40MVA)**	- Replacement of TR2 31.5MVA (viti 1969), 110/35kV me transformatorin e ri tre-pshtjellor 40/40/40MVA, 110/35/10(20)kV -	The project avoids potential high-probability breakdown of the old transformer and enables the fulfillment of the N-1 transformation criteria even at the 10 kV level	Q2-2023
9	051	**Re-building of 110 kV line: SS Kosova A-SS Vallaq**	- Demolition of existing line 38.5 km from SS Kosova A to Vallaq; - Construction of new line 32 km ALCu, 32 km, 240 mm²	Inreased transmision capacities of linë from 83 MVA to 114 MVA, with the aim of reducing power losës, improving the N-1 security criteria for the transmision network. The technical condition of the linë built in 1958 is not good.	Q4- 2024

10	053	**Replacement of transformer in SS Prizreni 1 and SS Peja 1 (40MVA)**	- In Prizreni 1, TR1 31.5MVA(y1975),110/35kV will be replaced with 40/40/40MVA, 110/35/10(20)kV - In SS Peja 1, TR1 31.5MVA(y1985),110/35kV will be replaced with 40/40/40MVA, 110/35/10(20)kV	The project avoids potential high-probability breakdown of the old transformer and enables the fulfillment of the N-1 transformation criteria even at the 10 kV level	2025
11	052	**Revitalization of 110 kV line: L116** (L155/2) **Vallaq-border**	- Replacement of phase conductors and protection one to the border (18.78 km in lenght). - Enforcement of pillars and replacement of isolators.	Enforcement of transmission capacities and support to load management for the northern part of Kosovo.	Q4-2025
12	054	**SS PRIZREN 4-400/220/110 kV with 400 kV interconnected line**	- Construction of SS Prizreni 4, 400/110 kV, 1x300MVA, as a continuation of SS Prizreni 2, which comprises two 400 kV line fields and one 400 kV connection field, one 400 kV TR field and one 110 kV TR field. - Expansion of the 110 kV busbar system Construction of the 400 kV double line, 26 km in length from the connection point of existing line Kosova B – Tirana 2. -	Configuration of the 400 kV and 110 kV gridand optimize of active and reactive power flows, reduction of losës, and support of new generation and load. Creating conditions for the second 400 kV interconnection with Albania	Q4-2027

Remarks: Projects with red ID represent projects beyond the 5-year Investment Plan 2018-2022

5.3.3.2 List of new projects in the category: Load support

Adding the construction of new substations 110/TM to the investment plan will be confirmed when KOSTT and KEDS harmonize their respective development plans. The main signals for initiating the construction of a 110/TM substation should come from KEDS, and are based on development data of the request in the long-term domain. Also, another signal may be the level of transformers loads in the existing substations managed by KOSTT. Wherever the security of supply is compromised, and where no additional transformer can be placed due to the lack of space, in agreement with KEDS, shall commence the construction of a new substation in that area. On this occasion, after the harmonization of the project, KEDS commits to investment in the 35 kV, 10 (20) kV distribution network infrastructure installed in the 110/TM substation.
Table 5-7 shows load support projects (new substations) envisaged for the forthcoming ten years.

Table 5-7 List of projects planned for load support 2018-2027

PROJECT CATEGORY: LOAD SUPPORT - (2018-2027)					
Nr	ID	Project title	Technical description	Reason for implementation	Year
1	009	**SS Dragash and 110 kV line SS Kukes – SS Dragash - SS Prizren 2**	- SS Dragash, 2 110 kV transformation fields and one 35 kV, two field lines and one connection field of 110 kV. - Single line, 8 km in length, Al/St 240 mm2 from SS Prizren 2 to Zhur (dual pillars). - Dual line, 13 km in length, Al/St 2x240 mm2 from Zhur to SS Dragash - Single line, 26 km in length, Al/St 240 mm2 from Zhur to Kukës (from Zhur to the border, 9 km)	Qualitative and reliable supply of Dragash region. Reduction of power flows in SS Prizreni 1. Optimization of operation of systems of Kosovo and Albania.	Q4-2021
2	011	**Package project SS Malisheva with 220 kV transmission lines**	- 1 km 220 kV dual line, Al/St 490 mm² from SS Malisheva to the planned connection point in 220 kV linë SSH Drenas – SS Prizreni 2Transformer 2x40 MVA, 220/10(20) kV. - Two 220 kV and 10 (20) kV transformation fields, two line fields and one 220 kV, 1 bay field of 220 kV. - Command facility with ancillary equipment.	Increasment of security and quality of consumer supply to the Malisheva region . Reducing of power flows in SS Rahovec	Q4-2021

5.3.3.3 Projects planned for the category: Re-vitalization of KOSTT substations

The following table contains a list of projects related to the process of revitalization of substations managed by **KOSTT**.

Tab. 5-8. List of projects of the category of re-vitalization of substations 2018 – 2027

PROJECT CATEGORY: RIVITALIZATION OF SS (KOSTT) - (2018-2027)					
No	ID	Project Title	Technical description	Reason for implementation	Year
1	017	**Revitalization of 110 kV line and transformer fields in: SS Klina, SS Burimi**	- Replacement of 3 line fields 110 kV - Replacement of 2 transformation fields 110 kV (In SS Klina, initially must be installed the second transformer, and then change the fields)	Increased safety and reliability of the operation of the Substations	Q4-2021
2	022	**Revitalization of HV equipment in SS Vallaqi**	- Replacement of five field lines 110 kV, replacement of two transformer fields 110 kV. - Replacement of busbar systems 110 kV and portals and construction of a new connection field 110 kV.	Safety and reliability of supply, expiry of equipment lifespan, increasing the work safety of HC Ujmani	Q4-2024

5.3.3.4 Projects planned in the category: Supporting transmission system operation

The following table provides the projects planned in the category of supporting transmission system operation. This list was selected through an identification of transmission system in complying to technical requirements as per Grid Code and those recommended by **ENTSO-E**.

Tab. 5-9. List of projects in the category of support to system operation 2018 – 2027

PROJECT CATEGORY: Support the Transmission System (2018-2027)					
N	**ID**	**Project Title**	**Technical description**	**Reason for implementation**	**Year**
1	025	**Update of the Energy Management System (Market IT)**	Cross-Border inter-TSO Balancing Module - Electronic procurement of transmission losses and other auxiliary services.	- The project enables adequate energy management in compliance with European electricity management systems, which is related to information technology during the energy market processes in Kosovo.	Q4-2022
2	029	**Upgrade of SCADA/EMS**	Dissemination of SCADA/EMS in the National Dispatch Centre and Emergency Dispatch Centre	- Fulfilment of new ENTSO-E criteria. Increase the performance of the transmission system command and control centre	Q4-2024
2	034	**Development of telecommunication network transmission capacities**	- Capacity increase of Bandwidth: - Network segmentation, for various services and applications -Application quality, -Redundancy and network protection - Loss limitations, delays for critical time applications.	- Bandwidth: fulfil requirements for broadband, namely increased communication speed for applying video surveillance etc. - Network segmentation, for various services and applications - Quality of application, namely setting the appropriate priority and network performance for individual applications - Redundancy and network protection for most necessary and required applications. For most applications, outages for activating the spare route should not last more than 50ms, as is the case with SCADA. - Limitation of loss, delays for time critical applications. In some cases delays should be non-existent, such as applications that still use inherited PDH interfaces such as remote protection.	Q4-2024

4	055	**GIS System for supporting the Transmission System**	- Complete sets of remotely controlled devices such as: laser locator, thermo camera, digital area, photo camera equipped with GPS and internal navigation system - Relevant software for integration and processing of data from devices and presentation of data in CAD and GIS format	Increase the maintenance level of lines and substations. Processing data on pillars, lines, identifying properties where lines pass etc.	Q2-2025

5.3.3.5 Project categories: support of generation

Over the past two years, KOSTT has received applications for connection from renewable sources mainly from wind and hydro power plants.
In the following 5-10 table are presented the projects that are being implemented and those for which the connection agreement on the transmission network has been signed. It does not mean that projects that already have a connection agreement that will be implemented based on previous experiences.

Table. 5-10. List of projects in the category of generation support; 2018-2027

CATEGORY PROJECTS: GENERATION / RES - **(2018-2027)**					
Nr	**ID**	**Project title**	**Technical description of equipments for connection to the transmission network**	**Reason for Support and Statute**	**Year**
1	**BRE_ERA_KITKA**	**PEE "KITKA" 34.5 MW, 10 turbine x3.45MW:**	- Line 110 kV, 240 mm2, 16 km, AlSt SS Berivojce – PEE "Kitka" - 2 110 kV lines field	Supporting the integration of RES into the Power System. The project is in the implementation phase	Q4-2018
2	**BRE_ERA_SELACI**	**PEE "SELACI 1,2 dhe 3 " 105 MW, 30 turbine x3.45MW:**	- Line 110 kV, 240 mm2, 19.35 km, AlSt SS Vushtrria 1 – PEE "Selaci 1,2 & 3" - 2 110 kV lines field	Supporting the integration of RES into the Power System. A connection agreement has been signed.	Q4-2019

3	BRE_HC_LEPENCI	**HC "LEPENCI"** **9.92 MW**	- Double line 110 kV, 240 mm2, 1.2 km, AlSt HPP "Lepenci"- Cutting point in 110 kV line SS Ferizaj 2-SS Sharr - 2 110 kV lines field	Supporting the integration of RES into the Power System. A connection agreement has been signed	Q4-2019
4	BRE_ERA_KOZNICA	**PEE "KOZNICA"** **34.5 MW** **10 turbine x3.45 MW**	- Linja e dyfisht 110 kV, 240 mm2, 1.4 km, AlÇe PEE "Koznica"-Pika e prerjes në linjën 110 kV Prishtina 4 – Gjilani 1 - 2 110 kV lines field	Supporting the integration of RES into the Power System. A connection agreement has been signed	Q4-2019
5	SOLAR_KOSTT	Supply and Installation of Solar Panels and Power Efficiency at KOSTT Substations	- Installation of solar panels in the roofs of SS facilities (total 1000 kW) and electrical systems for connection to 0.4 kV substations - Increasing the efficiency of KOSTT's facilities	Efficiency and reduction of the costs of using electricity in substations.	Q2-2024

5.4 Technical description of planned projects 2018-2027 in transmission

5.4.1 Introduction

The process of enhancing the transmission system since the establishment of **KOSTT** to this date can be divided into two important developmental phases:

- **The first phase** of the consolidation of the transmission network from a rather unsatisfactory to a stable condition, which can be considered to have been completed in 2010 after the completion of projects: SS Peja 3, line SS Kosova A – SS Ferizaj 1, 150 MVA-Auto-Transformer in SS Kosovo A. A significant positive effect on performance and reduction of losses can be observed in this phase, as the former condition was critical.
- **The second phase** of development of the transmission system was aimed at advancing safety of operation, the N-1 security criterion of the network, reduction of losses, increased quality of supply, modernization of infrastructure of support systems of the operating system, and improvement of safety in the main substations through the revitalization of high voltage facilities. This phase was completed in 2015 after the completion of major projects such as SS Ferizaj 2, additional 150 MVA Auto-transformers in SS Prishtina 4 and SS Prizren 2, connection of SS Lipjani 110 kV line L112, SCADA/EMS, modernization of protectors, revitalization of SS Prizren 2, SS Kosovo B, etc.

- **Third phase** of development which aims to achieve technical standards conforming to the Grid Code requirements and standards of ENTSO-E This phase can considered to have commenced in 2016 by implementing 11 projects in 2016 and 8 projects in 2017. The main significant project is that of the 400 kV interconnection line SS Kosova B-SS Tirana 2, LFC project, and observation areas in SCADA/EMS system, which is mainly related to the strengthening of the Kosovo transmission network within the regional network, as well as the creation of preconditions for KOSTT's membership in ENTSO-E. By the end of 2018, the transmission network will fulfil the N-1 criterion in all its elements including the 400 kV, 220 kV and 110 kV network. The third development phase that already started includes the already completed major projects such as: two 300MVA transformers in SS Peja 3 and SS Ferizaj 2, dual line 110kV Peja1-Peja 3, reinforcement of line SS Deçan-SS Peja 2 and many other new system supporting projects. These projects advance the N-1 criterion to a large part of the transmission network, by creating sufficient transmission capacities that may face different planned or unplanned network configurations. This stage of development also includes the DSO's requirements for load support, which determine the creation of conditions for construction and supply of substations 110/10 (20) kV. New substations to some extent facilitate the power flows in the existing substations as a result of shifting the load to the new supply point, but on the other hand the addition of new transformers increases the network losses. Main benefits from the construction of new supply substations are obtained from the distribution network by avoiding losses in the 35 kV and 10 kV networks, which reflect on the qualitative supply for the clients connected in the distribution network.

  Also, the third development phase shall create conditions for connection of new generation: Kosova e Re Power Plant, or RESs. In the coming year are expected various applications for connection of new generation in the transmission network. To achieve these goals, it is necessary to develop the new projects included in the plan, such as: restructuring of the 400 kV and 110 kV network configuration, in order for the transmission system to be able to accommodate the energy flows exchanges in the region, as well as exports from the planned future generation. The third phase of the transmission network development, including all other projects that are related to the operation of the transmission system, will enable the development of the electricity market, operating under the Grid Code (ENTSO-E) at the European level, support for the construction of new generating capacities, etc. The analyses carried out at the regional level on the impact of connection of the Italian system with South-East countries through underwater cables (AC-DC-AC) show an increase in the transit in the horizontal transmission network of Kosovo; therefore, with the completion of three cables 3x1000 MW, the network 400 of Kosovo should be re-configured so as to be able to handle increased power flows conform to technical criteria recommended by ENTSO-E.

The following is a description of development projects from the list of projects planned for the period 2018-2027. This projection of the transmission network development creates the conditions for the development of new conventional and renewable generation capacities in the next 10 years. This time period includes projects which directly contribute to the strengthening of the transmission network, projects to revitalize substations, load support projects and Transmission System support projects.

5.4.2 Projects of category: Transmission grid strengthening

The following are detailed descriptions of planned projects pertaining the category of strengthening or capacity increase of transmission network, for the planning period 2018-2027.

- **Projects (ID/011 and 014): Additional transformers in SS Klina and SS Gjilani 5**

Substations SS Klina and SS Gjilani 5 currently operate with only one transformer. Operation with only one transformer is a major problem in case of an unplanned outage. On the other hand there is no backup supply in such areas (ring network and the secondary voltage) which for such cases for a short time would transfer the supply to the medium voltage network. On the other hand substations operating with only one transformer, hinder the important process of periodic maintenance of the transformer and its field (110 kV, 35 kV or 10 kV). The probability of faults in the transformer and its fields is also impacted by age, power flows, and short circuits in the system, and previous level of maintenance. Many facilities or system components, including transformers and switchgear in 110/35 kV substations and 110/10 kV, are faced with severe constraints caused by breakdowns/shorts circuits in the 110 kV network, frequent in the period 1990-2006 when the network had insufficient transmission and transformation capacity. Breakdowns in transformers such as the winding, or voltage regulator are problematic, and their repair requires time and is sometimes not financially viable. The time from the moment of the breakdown occurs to its elimination, or replacement of transformer can take days, thus the damage causes to customers will be greater in the absence of a second transformer, or a reserve capacity to supply from the medium voltage network. The amount of undelivered energy will be very significant, with negative socio-economic effects for consumers.

To avoid the risk of not supplying the consumer as a result of losses/disconnection of the transformer it is necessary to install the second transformer in the substations above.

Another project: Third 40 MVA transformer in SS Lipjan was selected in the list of projects because high load of two existing transformers in the substation.

- In **SS Klina** in **2020** is planned the installation of a second transformer 40 MVA, 110/10 (20) kV in addition to the existing transformer 31.5 MVA, 110/10 kV. Also will be installed respective 110 kV and 10 (20) kV transformer fields. This project will create conditions for the fulfillment of N-1 transformation. This project should be synchronized with the revitalization project of 2 existing 110 kV areas, in order to minimize undelivered energy to consumers during the project implementation process.

- In **SS Gjilan 5** in **2020** it is planned to install a new transformer 40 MVA, 110/10 (20) kV, in addition to the existing 31.5 MVA, 110/10 (20) kV, and two respective fields 110 kV and 10 (20) kV. This project will create conditions for the fulfillment of N-1 transformation.

Expected benefits from three these projects are:

- Reduction of undelivered power to consumers,
- Increased safety and reliability of load supply
- Support for further development of the distribution network 10 (20) kV
- Increased of 110/MV kV transformation capacities and fulfillment of the N-1 in transformation
- Optimization of maintenance processes.
- Support to the development of the economic sector/industrial load

- **Project (ID/015 and 016): Replacement of transformers at SS Decani, NS Gjakova 1**

Second existing transformer in Deçan 31.5 MVA has been constructed in 1977, which implies current age of 39 years. Maximum lifespan for transformers which on average are loaded above 60% value is considered to be 40 years. This life cycle may be shorter, depending on the number of overloads in transformer and faults in network. The chemical and electrical parameters analysis carried out by maintenance teams show that the transformer has an inadequate state and therefore was considered that this transformer for the next two years must operate under significant supervision To avoid the problem of dangerous damages that may appear, it is necessary to replace this transformer with a new transformer with higher capacity of 40 MVA, 110/10(20) kV. The project increases the security of supply, substation and staff operating the transformer. The implementation of the project is expected to begin in **2020.**

The first existing transformer in Gjakova 1, with a power of 20 MVA, 110/35 kV was built in 1965, and is currently 52 years old. In principle, its normal life span has been exceeded, and based on the maintenance teams assessment this transformer can operate for another two years, and in **2020** has to be replaced with a new 110/35/10 three-pole transformer (20) kV with 40/40/40 MVA power for all three poles so that a part of the 35 kV network in the distribution network in Gjakova can be eliminated in order to reduce the losses and improve the quality of supply. N-1 criterion at 10 kV level can be realized from interconnection lines and cables between SS Gjakova 1 and SS Gjakova 2. Figure 5-1 shows a one-pole scheme that summarizes two substations: Deçan and Gjakova 1.

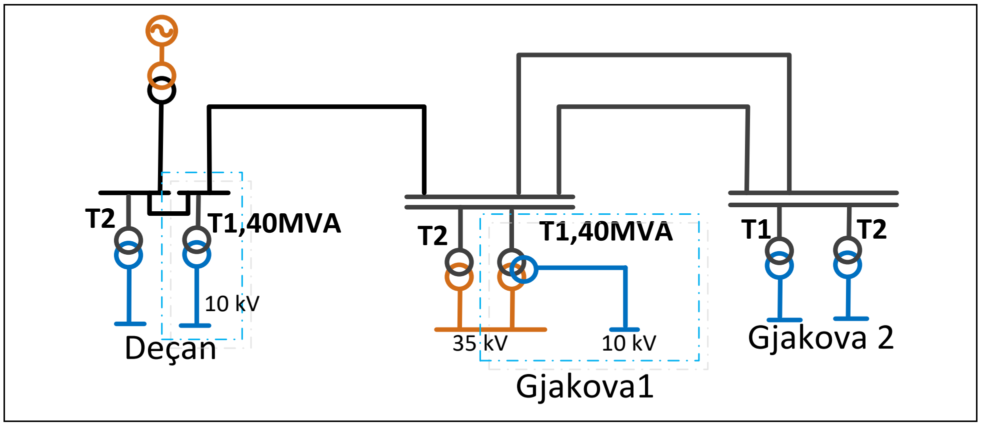

Figura 5-1. Skema një polare e projektit për zëvendësimin e transformatorit ne NS Gjakova 1 dhe në NS Deçani

Also, the first existing transformer in SS Theranda with a 31.5 MVA capacity, due to operations in conditions constrained from overloads or frequent short circuits in that area, has accelerated aging of the transformer. This transformer has been functionalized in 1985 and is still functional. The transformer will continue operation until expiration of the time period of 40 years, and the state of the transformer will be carefully supervised by operators and maintenance team. This transformer should be replaced with a new two-pole transformer 110/10 (20) kV with 40 MVA power as shown in Figure 5-2. The N-1 criterion at 10 kV level is supplemented by transformer capacities at the substation, while at 35 kV level, this criterion is supplemented by the interconnection of SS Theranda with SS Prizreni 1 with a 35 kV line, which can be used as reserve supply in case the three-layer transformer in SS Theranda fails.

The implementation of project is expected to begin in **2021.**

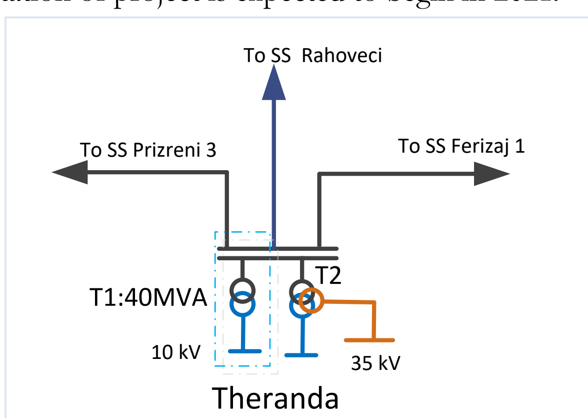

Figure 5-2. NS Theranda 110/35/10(20) kV, 71.5MVA

-

- **Project: (ID/006): New Line 110 kV SS Rahovec - SS Theranda**

Supply of the load in a radial (island) form, which is the form used for the supply of SS Rahoveci currently, is not preferred, as it does not fulfill the N-1 security criterion, while the maintenance process in a sole line causes interrupted supply throughout the performance of maintenance works in both the line and equipment on both sides. The project becomes even more important taking into consideration the planned connection in SS Rahoveci of the Wind-Powered Generation Facility 'Zatriqi' with installed capacities of 45MW. Computer simulation performed for a number of connection options in SS Rahoveci, and the comparison of results according to two basic planning criteria (economic and technical), show that the new 110 kV line from SS Rahoveci needs to be connected to SS Theranda. The 110 kV line (240 mm^2) will be approximately 16 km long. The project will also be synchronized with the revitalization equipments in SS Theranda, in which project is foreseen the replacement of 110 kV voltage equipment and passingin double bus bar system. In SS Rahovec previously installed 110 kV line fields, while in SS Theranda hasto be built a new line field.

Figure 5-3 shows the geographical extent of the new line, while Figure 5-4 shows a single pole diagram showing the line interconnection with substations 110/TM kV. The project is planned to be finalized by the second quarter of 2019.

Figure 5-3. The geographical distribution of the 110 kV line SS Rahovec - SS Theranda

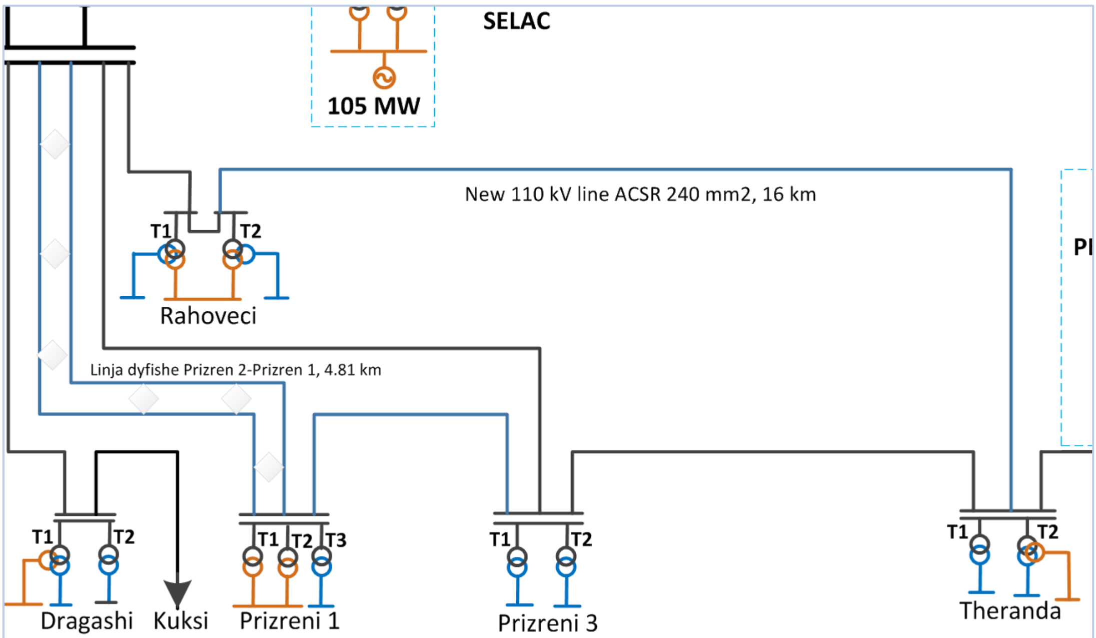

Figure 5-4. 110 kV line SS Rahovec - SS Theranda and connection to the surrounding substations

Expected benefits of the project are:
- Increase the capacity of the transmission network and completion of the N-1, respectively, eliminating the radial supply of SS Rahoveci
- Reduction of losses of active and reactive power in the transmission network.
- Reducing undelivered energy to consumers
- The creation of technical conditions for the connection of renewable energy sources in 110 kV transmission network
- Creating conditions for the grouping of 110 / MV for suppling in optimal way and with high security of supply from 400/110 kV and 220/110 kV nodes.

- **Project (ID/013): New line 110 kV SS Prizren 1- SS Prizren 2**

The consistent growth of load in the Prizren region shall put at risk the fulfillment of N-1 criteria for that area of the transmission network. The second 110 kV line from SS Prizren 1 to SS Prizren 2 is necessary since according to the current network configuration, an outage of the line SS Prizren 2- SS Prizren 3 would cause an overload on the Line SS Prizren 2 – SS Prizren 1. The project envisaged:

- Transformation of the existing SS Prizren 2 – SS Prizren 1 (HW 173mm^2) line to a double line with conductor 240mm^2 AlSt, using the existing track.

- The HW 173mm^2 conductor will be used for the revitalization project of the Prizren 1-Prizren 3 line, where the 150 mm^2 conductor with a capacity of 83 MVA will be replaced with HW 173mm^2 with a capacity of 114 MVA.

The geographic scope of the double line SS Prizren 2- SS Prizren 1 is shown in Figure 5-5, while the single line diagram is shown in Figure 5-6
The project is due to be completed by **2020**. This project is important for the realization of 110 kV consumption grouping concept as per main substations.

Expected benefits from the project are:

- Increase of 110 kV transmission network capacities
- Fulfillment of the N-1 security criterion in the long term
- Reduction of undelivered energy to consumers
- Optimization of power flows and enabling the grouping of 110 kV loads according to independent supply from main transmission system nodes (in this case from SS Prizren 2).

Figura 5-5 . Projekti linja dyfishe 110 kV NS Prizren 1- NS Prizren 2

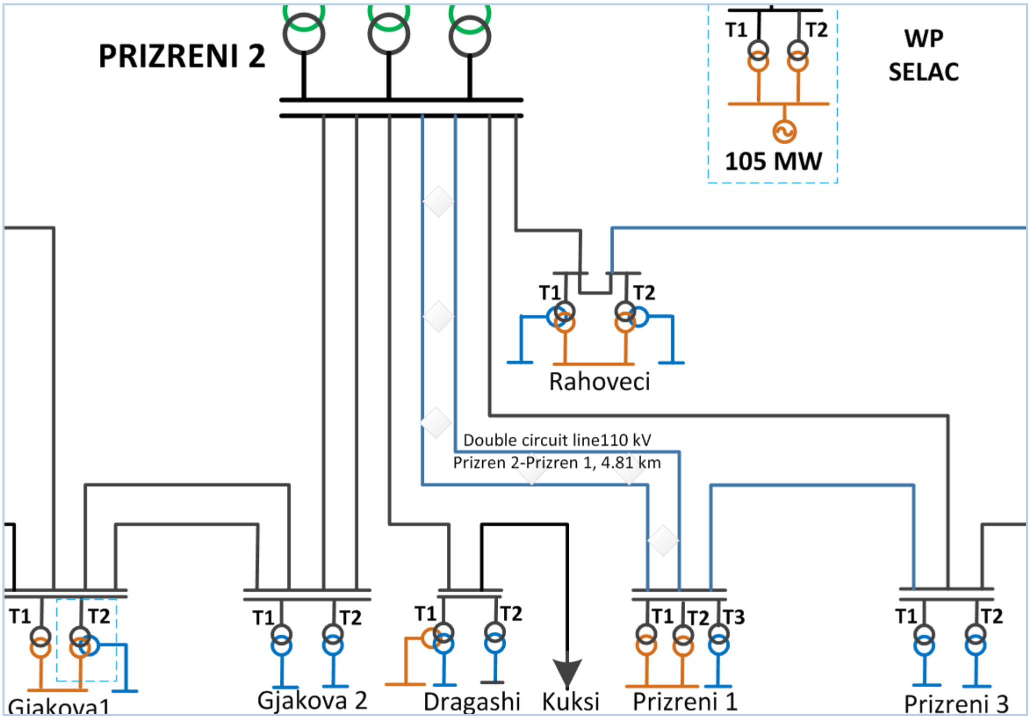

Figura 5-6. Linja dyfishe 110 kV NS Prizren 2- NS Prizren 1 dhe ndërlidhja me nënstacionet përreth.

- **Project package SS NASHECI** (Prizren 4)**, 400/220/110 kV with interconnection line 400 kV**

The development of the 400 kV network was realized in two phases: the first phase was realized in the 1980s and is related to the construction of TPP Kosova B which presented the need for construction of the first substation 400/220 kV and three 400 kV lines. This configuration remained unmodified until 2009 when the second phase of development of the network 400 kV commenced with the construction of the second substation 400 kV SS Peja 3, which had a 400/110 kV transformer. During 2011, was built the third substation SS 400/110 kV Ferizaj 2. Furthermore, in 2016, after 36 years, was built the new interconnection line 400 kV SS Kosova B-SS Tirana 2.

If we are to consider the geographical distribution of the system's load, the three areas: Prishtina with the surrounding areas, Dukagjini and South-East Kosovo are now supplied by the 400 kV network. Such configuration has avoided losses caused by transformations 400/220 kV and 220/110 kV, as well as from power transmission in 220 kV lines to distribution substations. Currently only the area of Prizren and its surroundings, including Rahovec, Gjakova and partly Theranda are supplied by the 220 kV network and the supply source is SS Kosova B and the interconnection line SS Prizren 2- SS Fierza.

Computer simulations in complex system models performed by KOSTT indicate that part of the network in Prizren region will not be able to fulfil the N-1 criterion after 2026 due to the high impedance of two 220 kV supply lines of SS Prizren 2. The biggest problem will be caused if the 220 kV Fierzë-Prizren 2 interconnection lines fail. In this case there may be a voltage collapse and disconnection of load of SS Prizreni 2.

Kosovo-Albania market integration, development of APEX stock exchange implies intense exchange of power between the two countries in different seasonal regimes. Mainly, Albania will use the interconnection network during the summer season for imports from Kosovo TPPs when hydrologic conditions do not guarantee production by HPP, while Kosovo will provide regulatory reserves throughout the year from Albania's system, including imports to Kosovo power when Albania's system has surplus. The joint market will impose a change in the maintenance schedule of Kosovo TPPs and will require sufficient interconnection capacities that will be free to exchange regulatory power between the two systems for the needs of the System Operators. Adding the developments in the new generating capacities in Albania such as HPP Skavica and TPP Kosova e Re in Kosovo, the conversion of SS Prizreni 2 to substation SS 400/220/110 kV Nashec as well as the subsequent construction of the second interconnection line 400 kV HPP Skavica - SS Nashec beyond the planning period is seen as a real option which would help both countries as well as the regional network in the successful integration of small markets in the region of South-Eastern Europe. The project is optional and will largely depend on developments in the Energy sector in both countries and the region in the next 5 years.

The concept of re-establishing SS Prizren 2 in SS Nasheci with 400/220/110 kV transformation will entail the following benefits:

- Support new generating capacities.
- Increase the reliability and security of the 400 kV network
- Increases the power exchange security between Kosovo and Albania and the countries of the region, or transit of the power through the horizontal network.
- Enables the re-configuration of the 110 kV network in order to optimize the power flows as well as optimize the operating conditions of the transmission system.
- Increase the quality of supply for consumption from the region of PrizrenNgritë kualitetin e furnizimit të konsumit të rajonit të Prizrenit.
- Helps the maintenance process of 400 kV lines.
- Creates conditions for construction of the second 400 kV line from HPP Skavica (Albania) to SS Nashec (Prizreni 4)

Detajet teknike të projektit janë si në vijim:

- Upgrading the SS 220/110 kV Prizreni 2 into a three-level substation with 400/220/110 kV, which will be called SS Nasheci based on its existing location. The substation will initially have an auto-transformer of 300 MVA installed. The substation will be located in the open areas at the SS Prizren 2, wherein the 400 kV busbar system will be constructed,

which will initially contain two line fields, a connecting field and a transformer field, along with the space for a line field and a 400 kV transformer field for future long-term developments. Figure 5-8 shows the configuration of SS Nasheci. The two substations will work in parallel on the 110 kV side, which means the use of existing 3x150 MVA auto-transformers of SS Prizreni 2, by always optimizing their work depending on the demand of the network 110 kV accessed in SS Nashec. Existing 220/110 kV auto-transformers will be utilized until the end of their lifespan, whereby two of them can be decommissioned in 2030, and the third transformer in 2050. They will be replaced by the installation of second auto-transformer 400/110 kV after 2030.
Sistemi ekzistues i zbarrave 110 kV duhet të seksionalizohet në mënyrë që të bëhet shpërndarja optimale e fushave të linjave dhe transformatorëve dhe që të arrihet selektivitet në mbrojtjen e zbarrave.

- The supply line of SS Nasheci shall be the **Dual line 400 kV** with a length of approximately 26 km, ASCR 2, 490 mm2 with a capacity of 1330 MVA will be connected at the crossing point of the existing line SS Kosova B-SS Tirana 2 approximately in the 55^{th} kilometre of the line from SS Kosova B. On this occasion, the existing line will establish the lines SS Kosovo B - SS Nashec with length of 81 km and SS Nashec - SS Komani with length of 56 km. TSO Albania plans to construct SS Komani 400/220 kV and DS Lezha 400 kV where the existing line Kosova B-Tirana 2 will be reconfigured as shown in Figure 5-7 which represents a part of the regional network. The solid lines in purple represent the lines that are expected to be operational in the next 5 years, while dash-lines belong to the long-term period. Looking at the 400 kV network surrounding Kosovo, can be noted four 400 kV rings surrounding Kosovo, namely the ring covering the territories Kosovo-Montenegro-Albania, the ring covering Kosovo-Macedonia-Albania, the ring covering Kosovo-Macedonia-Serbia and the ring covering Kosovo-Montenegro-Serbia. This configuration provides Kosovo's transmission with network stability and sustainability in operation, due to a high flexibility of shifting power flows in the event of opening one of the four abovementioned rings.

If the line SS-Nashec - SS Skavica will be built, then the fifth ring interconnecting Kosovo with Albania will be created

Figura 5-7 Shtrirja gjeografike e projektit NS Nasheci në rrjetin regjional e cila ndërlidhë rrjetin transmetues të Kosovës me katër unaza 400 kV (rrathët e kuq me vija të ndërprera)

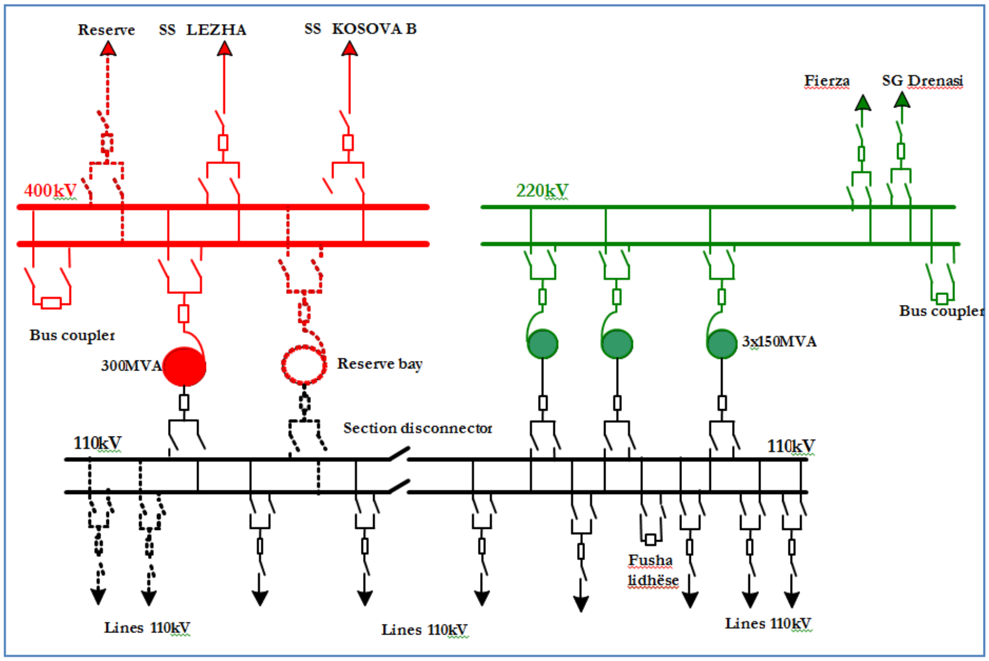

Figura 5-8. Single pole diagram of modified substation SS Prizren 2, 220/110 kV to SS Prizreni 4, 400/220/110 kV

5.4.2.1 Projects: Revitalization of 110 kV lines

The important factors that are taken into account for determining the list of lines which will have the conductors replaced with larger transmission capacity are:

- The age of the lines,
- Line overload frequency (N-1), and
- The level of power losses in the line

The first factor is clearly defined; while the second and third factors are identified by computer analysis, thereby simulating load flows for different transmission system operation conditions, in due consideration of perspective development of projects, which would considerably impact the change of load flows in the transmission network. All 110 kV lines with 150 mm² section, in the transmission network, have been analyzed in terms of load losses, thereby pursuing reinforcement at the long term.

Lines that are 40 years old and lines with larger overload frequency and, understandably, higher losses, are listed in the first place.

The main objective of this category of projects is to increase the capacity of 110 kV lines with section conductors of 150 mm^2 (83 MVA), in conductor 240 mm^2 (114 MVA). Some very old lines mainly have concrete towers and replacement of the existing conductors with conductor on greater weight in mechanical and statically terms require reinforcement of towers, with special emphasis on angular towers. In review is considered new technologies ACCC conductors (conductor aluminum, composite core) who have the same weight as 150 mm^2 conductors but the resistance and their carrying capacity is equivalent to 240 mm^2 conductor ASCR. Although the cost of ACCC conductors is two times higher than the equivalent conventional in lines where considered good technical condition of the columns, it is reasonable economically installing them. The following 110 kV lines are selected for reinforcement for period 2018-2027 as in following:

- **Project (T-RIV/L118/3): Revitalization of line 110 kV, SS Prizreni 1 – SS Prizreni 3**

The project in question relates to the project of the dual line 110 kV SS Prizreni 2 - SS Prizreni 1. The conductor, which is currently located on the line SS Prizren 2- SS Prizren 1, is of type HW 173 mm2 with a capacity of 114 MVA, during the implementation of the project will be dismantled and the same will be used to replace the 150 mm2 conductor of the line SS Prizren 1 - SS Prizren 3. This will allow for cost optimization and build the desirable capacity of the lines.

The line represents the interconnection segment for the supply of SS Prizreni 3, as shown in Figure 5-9. The re-vitalization of this line will significantly affect the enhancement of security and operational reliability of that part of the 110 kV network.

Expected benefits from the project are:

- Fulfilment of the N-1 criteria for the part of the network 110 kV that connects substations 110 kV in the region of Prizren
- Increasing transmission capacity of the line from 83 MVA to 151 MVA
- Reduction of lnotsupplied electricity

Project is planned to be completed in the third quarter of **2020.**

Figure 5-9 Line 110 kV SS Prizren 1 – SS Prizren 3 with length 4.69 km

- **Project (T-RIV/L163/1): Revitalization of the 110 kV line SS Kosova A- SS Bardhi – SS Vallaqi**

From all results obtained from computer simulations, the current L163/1 line from Kosovo A to SS Vallaq with a capacity of 83 MVA (150 mm^2) seems to be more problematic in comparison to other lines (150 mm^2) which are in the list for replacing conductors. This line was developed in 1958 (59 years) and has portal metallic towers. After the completion of the project of reinforcement of SS Bardh supply, whereby connection of SS Kosovo A – SS Vallaq was completed, a part of the line remained with the section 150 mm^2, therefore the project as a whole includes the revitalization of this section. Improvement of capacity of this line should relief its overload, in the case of disconnection of supply line SS Kosova A – SS Vushtrri 2. The same line with connect SS Mitrovica 2 as well, allowing for an improvement of security and reliability of supply for the load in the Mitrovica region. Figure 5-10 shows the section of the line planned for revitalization. After a detailed review of the line's technical condition, it was concluded that the technical condition of the pillars is not good. In a large number of pillars, it is required a continuous interference due to the static problems of the pillar's basament. This line is considered among the first lines in the Kosovo transmission network, so its partial rehabilitation does not create long-term security in using this line. The line as such at 38.5 km (where the conductor is 150mm^2) should be completely dismantled and the new AlSt line with 240 mm^2 section will be built utilizing the existing line track. At the same line will be connected the new substation SS 110/10 (20) kV Ilirida (Mitrovica 2).

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Expected benefits from the project are:

- Enhancement of line transmission capacity from 83 MVA to 114 MVA
- Reduction of active and reactive power losses
- Fulfillment of the N-1 criterion for the section of the network connecting the ring: Kosova A-Bardhi-Vushtrria 1&2-Trepça-Ilirida-Vallaq

The project is planned to complete by the fourth quarter of **2024.**

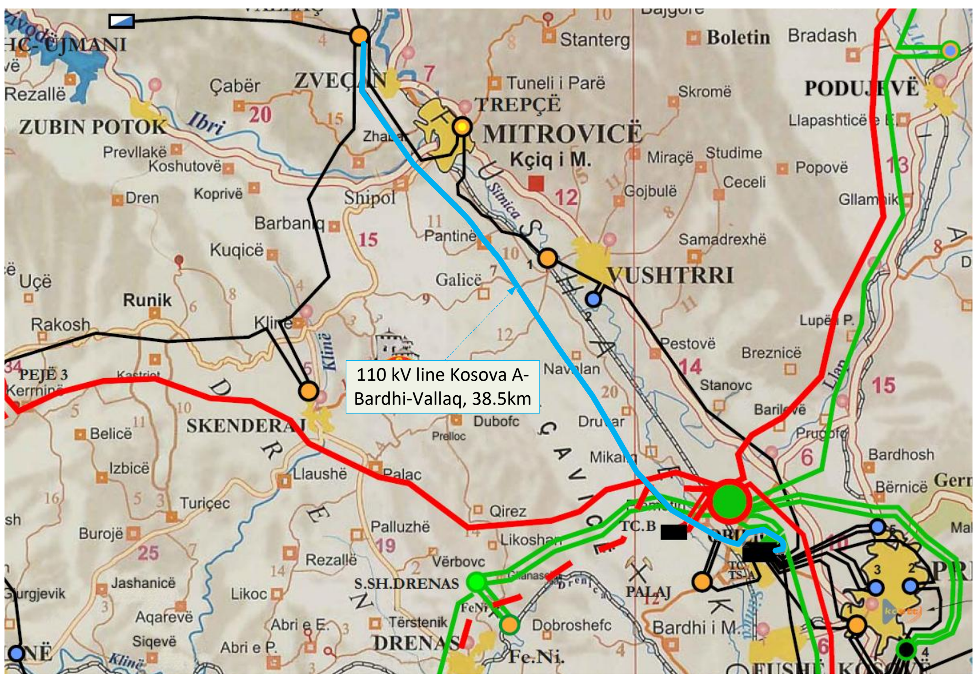


Fig. 5-10 Line 110 kV SS Kosova A – SS Bardhi – SS Vallaq with a length of 38.5 km

In figure 5-11 is presented a single line scheme of project with associated substations.

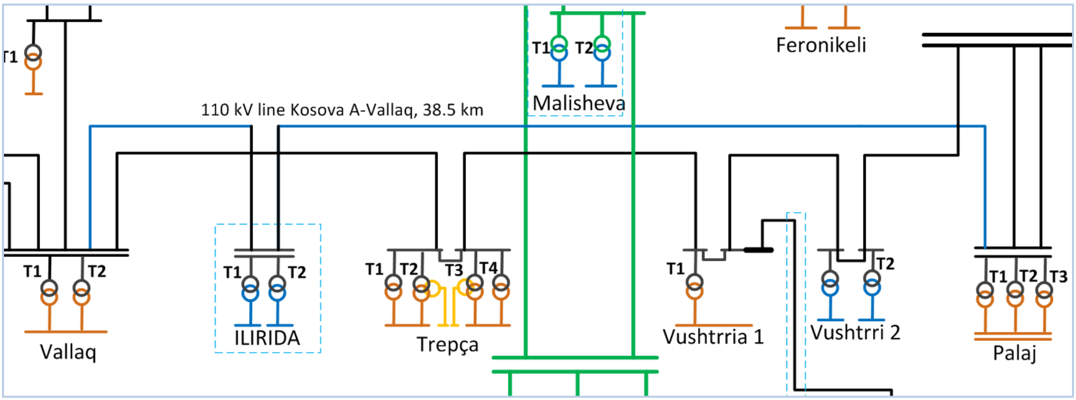


Figure 5-11 Single line scheme of interconnection 110 kV line SS Kosova A – SS Bardhi – SS Vallaq with 38.5 km length

- **Project** (TRIV/L155/2)**: Revitalization of the line SS Vallaq – border (N. Pazar)**

The line currently does not have sufficient capacity due to its sectional width (150 mm^2). On the other hand, this line is one of the oldest lines of the transmission system of Kosovo, therefore its reinforcement is necessary. Replacement of the conductor is planned for 18.4 km of the line, starting from SS Vallaqi to the border with Serbia. The project should be previously coordinated with Inter-TSO agreement with neighbour system. The construction of the SS Leposaviqi 110/35/10 kV, which will be connected in the section in the cross-border line SS Vallaq-SS N.Pazar, remains optional.The figure 5-12 shows the geographical position of the project.

Expected benefits from the project are:

- Enhancement of the line transmission capacity from 83 MVA to 114 MVA
- Reduction of active and reactive power losses
- Enabling the realization of SS Leposaviq 110/10(20) kV

The project is due to complete by the fourth quarter of **2025**

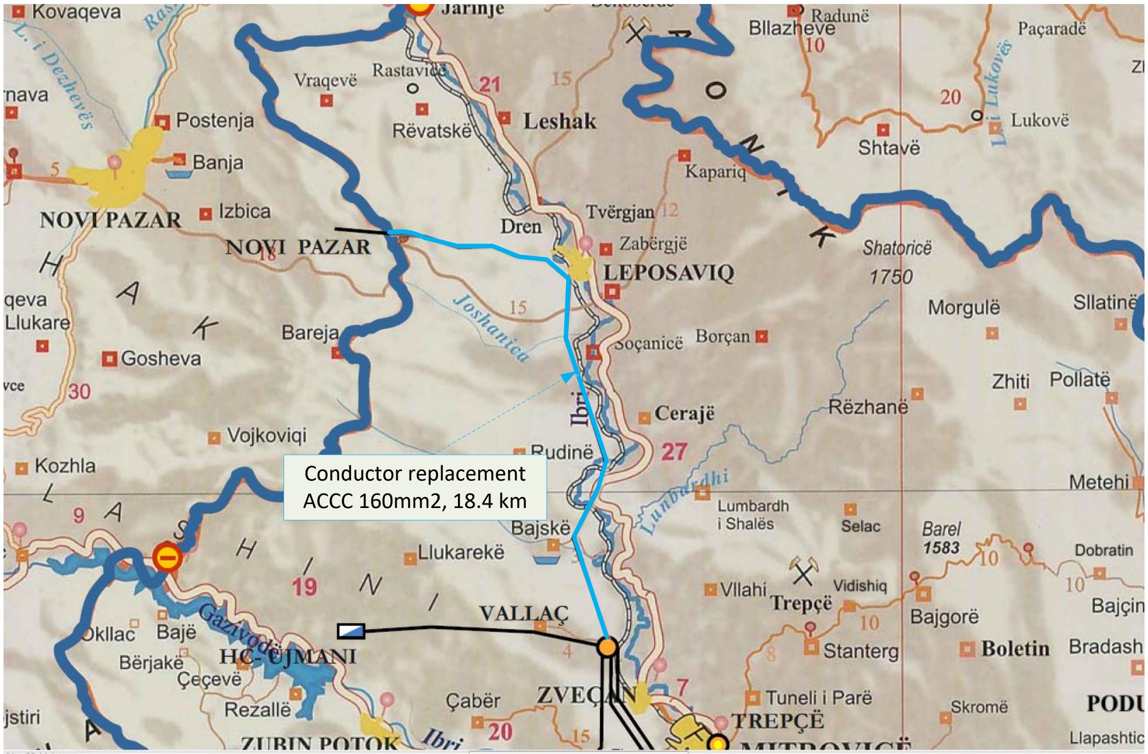


Fig. 5-12 Revitalization project for the interconnection line L155/2

5.4.3 Load support projects

The following are technical descriptions of projects supporting the load and expected benefits from them.

- **Project (ID/002): SS Ilirida, 110/10(20) kV**

The continuous increase in electricity demand in the area of Mitrovica raise the need for creating a new distribution facility in the area. The southern part of Mitrovica is currently being supplied by the substation in the Industrial Complex of Trepça. The current capacities of the distribution grid are limited, and during peak loads, 35 and 10 kV lines and cables are overloaded. On the other hand, the mining and metallurgic industrial development requires special, safe and independent supply. These are the factors necessitating the construction of an SS Ilirida, 110/10(20) kV, transforming capacity 2x40MVA.

The line in SS Bardh – SS Vallaq, approximately 9.1 km from SS Vallaqi, will be cut and a dual 110 kV cable line will be constructed, XLPE Al 1000 mm^2 with an estimated length of around 1.5 km.

Due to limited space, substation Ilirida 110/10(20) kV will be developed in line with compact GIS technology. The secondary side of the two transformers will be connected into the existing SS Mitrovica II, 35/10 kV, eliminating voltage of 35 kV. Existing MV equipment of KEDS must meet the technical safety criteria, adjusted to nominal parameters and established fault currents as a result of the installation of two 40 MVA transformers, 110/10 (20) kV in the new substation.

In terms of power flows and security criteria, this option enables the fulfillment of criteria of the Grid Code.

The previous Figure 5-11 shows the connection to the transmission network substation, while the Figure 5-13 shows the satellite view of the location of SS Ilirida and the supply cable. With this topology that enables substation high security in terms of the N-1 criteria, and as such, it will be an important 110 kV node for the energy system of Kosovo.
The project is currently in the pre-implementation phase, where the cable track is in the final stage of the expropriation process.

The expected benefits of the project are:

- Long – term and reliable and secure supply of consumption in south part of Mitrovica
- Reduction of large amounts of undelivered power, as a result of elimination of bottlenecks in the distribution grid 35 kV.
- Increasing security of supply of complex Trepca and Metallurgical Mining due to re-location of supply from SS Trepca in SS Ilirida.
- Reduction of technical losses in the distribution network and creating conditions in rebuilding the network from 10 kV to 20 kV level.
- Provision of economic development of Mitrovica, in terms of supply reliable and quality electricity.

The project is planned for completion in the fourth quarter of **2018**.

Figure 5-13 Satellite view of the location of SS Mitrovica 2 and dual cable path to the point of connection

- **Project (T&D/Dardania): SS Dardania (Prishtina 6), 110/10(20) kV**

From the perspective of security of supply of distribution network consumers, construction of a new 110 kV substation, SS Dardania, in the city center, is more than necessary in the medium term due to bottlenecks time in the medium voltage network and the inability for additional supply from other substations in the capital.

Consumption in the capital and its suburbs represents almost a quarter of the overall consumption of Kosovo. Currently, the center of Prishtina is supplied by the 35/10 kV substation Prishtina III, which has an installed capacity of 4x8 MVA transformers. Maximum load during January 2013 reached the critical value 106% of available capacity. To avoid the operation of relay protections, distribution operators are forced to reduce load resulting in significant amounts of undelivered energy. Customers tend to offset such outages with diesel generators which cause noise and pollution in the center of the Capital. The current capacity is insufficient and cannot follow the continued growth of consumption. In the years to follow the security of supply in the center of Prishtina will worsen, and businesses will not be able to carry out their activities in normal conditions during the high peak season in the system.

The reasons above are the main factors that determine the need for the construction of a new substation Dardania, 110/10(20) kV, 2x40 MVA, near the center of the load, namely the location of the existing 35/10 kV substation. This project is aligned with KEDS which will be obliged to invest in medium voltage equipment and cable exists 10 (20) kV. The geographical location of the proposed SS Dardania site is characterized as highly urbanized area and the implementation of the project will be complex, in particular in the management of mandatory power cuts. Due to the limited area, GIS technology will be implemented in the construction of the substation. The substation will be supplied by SS Prishtina 4, 220/110 kV through a double line 1000 mm^2 XLPE Al cable in a distance of around 3.87km, as shown in Figures 5-13 and 5-14.

Secondary side of the two transformers will be linked into the existing SS Prishtina III, 35/10 kV, eliminating voltage 35 kV. Existing devices KEDS TM must meet technical safety criteria which would suit the nominal parameters and fault currents arising as a result of the installation of two transformers 40 MVA, 110/10 (20) kV substation new.

The route of the cable line will mainly use sidewalks and unused spaces in order to avoid obstacles for commercial and residential facilities.

Figure 5-14. Geographical position of two SS Prishtina 4 and Dardania and the proposed route of the 110 kV double cable line

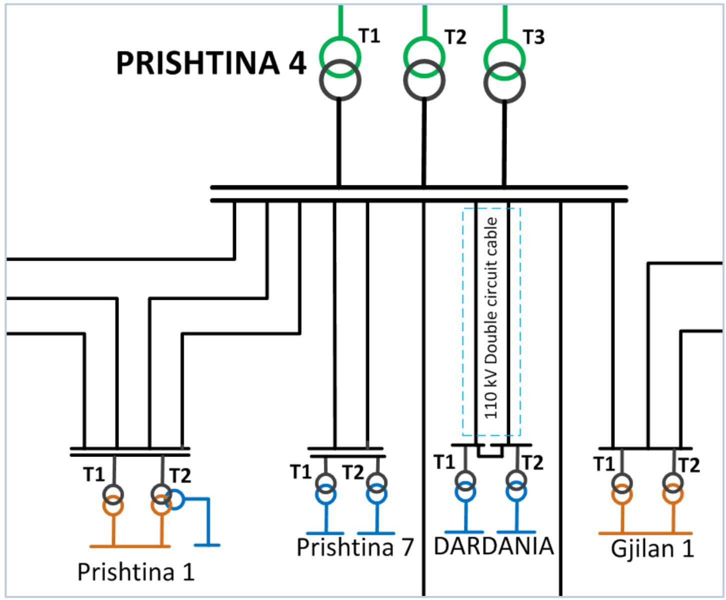


Fig. 5-15 Connection configuration of SS Dardania, 2x40 MVA, 110/10(20) kV in transmission network

Expected benefits of the project include:

- Secure and reliable long-term supply for the center of Prishtina
- Reduction of substantial amounts of undelivered energy as a result of the elimination of bottlenecks in the 35 kV distribution network.
- Discharge of power flows in transformers SS Prishtina 1, 2 and 3 and 110 kV lines that connect these substations.
- Reduction of technical losses in the distribution network and conditions to enhance the 10 kV to 20 kV network.

The project is planned to be completed by the fourth quarter of **2018.**

- **Project (ID/009): SS Dragash and 110 kV line SS Kukës - SS Dragash - SS Prizren 2**

Consumption of electricity in the region of Dragash and Zhur is realized through the distribution network 35 kV and 10 kV, extending in the southern part of the territory of Kosovo. The main supply line is 35 kV line connected to SS Prizren 1, 110/35/10 kV which supplies, in a serial connection, Zhuri and Dragash consumption. 35/10 kV substation is operating in Dragash, with two transformers of a total capacity of 8 + 4 = 12 MVA. Security of power supply for the areas in question is not satisfactory. The main reasons are listed as follows:

a) Consumption of Dragash and Zhur is supplied through a single 35 kV line, of the indirect section ASCR 95mm^2 in a distance of 11 km to Zhur and an additional 11 km through a Cu 35mm^2 conductor to Dragash, as shown in Figure 5-18. The narrow section and significant distance cause huge losses of active/reactive power, with a negative reflection on the quality of supply.

b) The voltage level of 35 kV, 10 kV and 0.4 kV of the distribution network in the region of Dragash in high peak season is below allowed values provided in the Distribution Code.

c) Existing transformers 35/10 kV in the substation during winter consumption re over-charged in values which require load shedding to avoid total collapse of transformers. The same problem appears in the supply line of 35 kV with frequent overload operations which often result in overload protection (disconnection of lines) and total supply cuts.

d) Disconnection of the single 35 kV line and planned load shedding to avoid total supply failure, causing large amounts of undelivered electricity. Non-delivery of electricity harms the overall development of economic activities and lives of the people in the municipality.

e) The small HPP Dikance is connected to Dragashi SS 35/10 kV through the 35 kV line, Cu 35mm^2 in a distance of 5 km. Any problem in the network in the substation adversely affects the safety and reliability of operation of this hydropower plant. The significant difference of voltage levels creates problems in the synchronization of HPP Dikance with the 35 kV network.

f) High tourism potentials and possibility to develop light industry in the region of Dragash are negatively influenced as a result of the unreliable supply and the poor quality of supply.

Elimination of the aforementioned problems in the long-term is achieved after the construction of a new substation 110/35/10 (20) kV, with a capacity of 2x40 MVA in Dragash and 110 kV lines as shown in Figure 5-16.

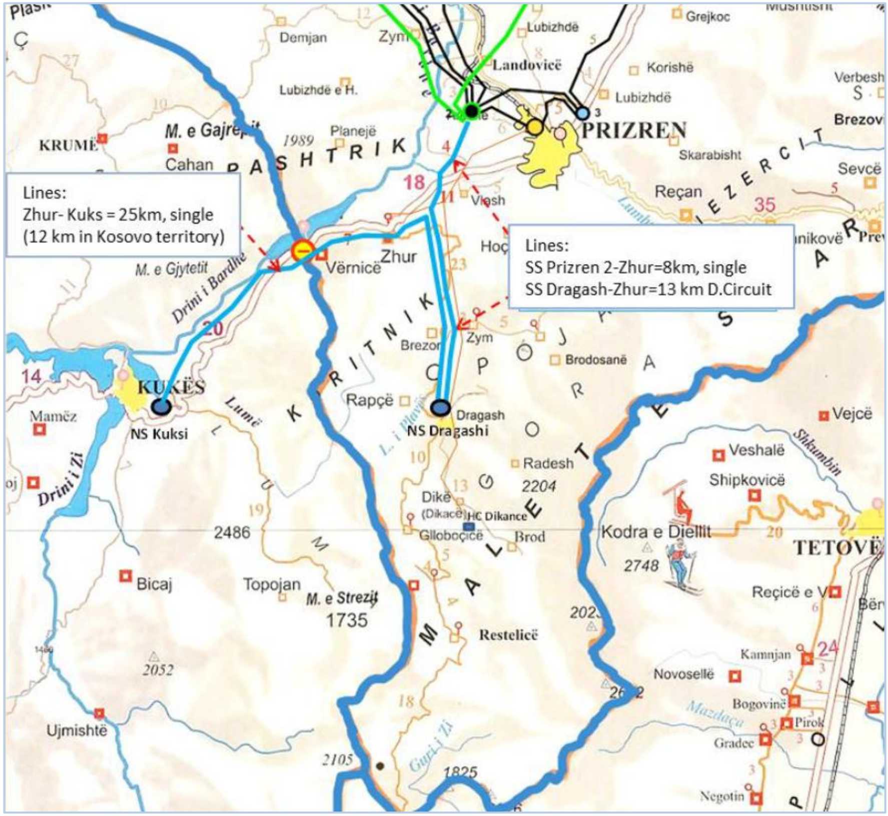


Figure 5-16. SS Dragash and 110 kV line project with SS Kukës.

Expected benefits from the project:

Considering the Dragash region as an area with a high potential for the development of mountain tourism and light industry, the construction of the new 110 kV substation will create optimal conditions to achieve security of energy supply.

The network configuration surrounding SS Dragash project and the connection with the current distribution network is shown in Figure 5-17.

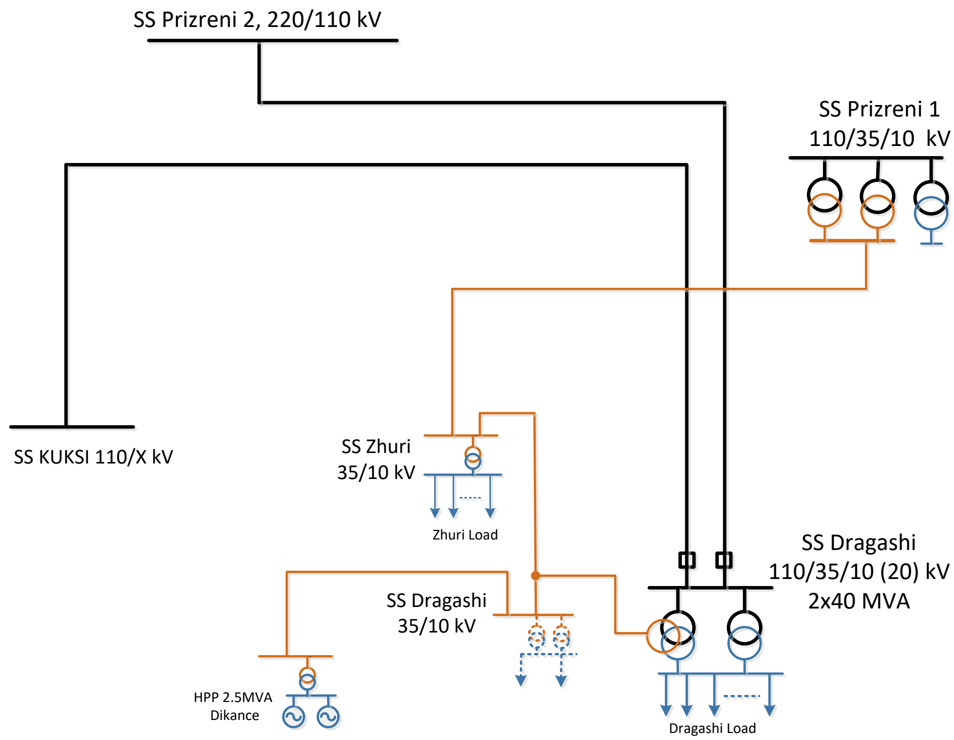


Figure 5-17 Configuration of network project: SS Dragash and 110 kV interconnection line with SS Kukës.

Benefits that Dragash customers would have are presented as follows:

- Increased security of electricity supply through two 110 kV lines
- Quality and reliable supply
- Efficient supply reducing technical losses in the distribution network
- Relief of power transformers in SS Prizren 1 to a load equivalent to the consumption in the region of Dragash

The project also includes the construction of the 110kV interconnection line, which will connect, for the first time, the 110 kV transmission networks of Kosovo and Albania. Thus, in addition to the importance of the project to support the load of Dragash, this is considered a mutually beneficial project for Kosovo and Albania.

Expected benefits for both countries are listed as follows:

- Optimization of power flow between the two systems Kosovo/Albania
- Mutual exchange of electricity surpluses through radial operation of the connection line.
- Increased security and reliability of supply for Kukes and its surroundings, as per the N-1 criterion, through reciprocal supply
- Increased quality and efficiency of supply of Kukes
- Increased security of supply for the consumption of the Kalimashi tunnel

- Optimal conditions for maintenance of the 110 kV network for both systems KOSTT/OST

The project is planned to be completed by the fourth quarter of **2018.**

- **Project (ID/004): SS Fushë Kosova 110/10(20) kV**

The list of priority projects from the perspective of KEDS includes the construction of the substation Fushë Kosova 110/10(20) kV, close to the existing substation 35/10 kV. The rapid development in the municipality of Fushë Kosova, in terms of high constructions after the war, which is also ongoing, has resulted with a continuous increase of electricity consumption. This substation is currently supplied by two 35 kV lines, 95 mm^2 from SS Kosova A and SS Prishtina 1. Based on the information from KEDS, 35/10 kV transformer capacities are close to their critical limit, while on the other hand, the load in the region of Fushe-Kosova shows an increasing trend. For this reason, there is a need to create a new 110/10(20) kV node in Fushë Kosova, which should have sufficient long-term transforming capacities in 2x40 MVA, which would be able to respond to the continuous load growth, in accordance with technical criteria of transformation reserve. The construction of the substation should allow for the relief of transformers at SS Prishtina 1 and SS Kosova A, and reduction of load flows in supply lines of the SS Prishtina 1. In the technical aspect of connection, based on the geographical position of the substation, the optimal position of connection with the transmission grid would be the 110 kV L112 line SS Kosova A- SS Lipjan, which passes close to the position proposed. The geographical position of the connection of SS Fushë Kosova is presented in the figure 5-18, while the connection of SS Fushe Kosova with the transmission network is shown in Figure 5-18.

The connection network of the new 110 kV substation in Fushë Kosova will be a combined, air/underground cable line. The connection point will be realized in a non-urban area, to continue with a dual overhead line of a distance of 1.4 km. The line with adjust to the dimensions of conductors of the line, with a section of 360 mm^2.

The overhead line will be extended until the beginning of the urbanized area. Almost half of the route needed to connect the substation is situated in a highly urbanized area. For this reason, the continuation of the 1.35 km line from the overhead line to the substation will be though a double underground XLPE Al, 1000 mm^2 cable. Due to limited space, GIS technology will be implemented in the construction of the substation.

Secondary side of the two transformers will be linked into the existing SS Fushë Kosova, 35/10 kV, eliminating voltage 35 kV. Existing devices MV of KEDS must meet technical safety criteria which would suit the nominal parameters and fault currents arising as a result of the installation of two 40 MVA transformers, 110/10 (20) kV in new substation.

The dual connection of the substation enables the fulfilment of N-1 security criterion, allowing for sufficient secure supply of Fushë Kosova consumption.

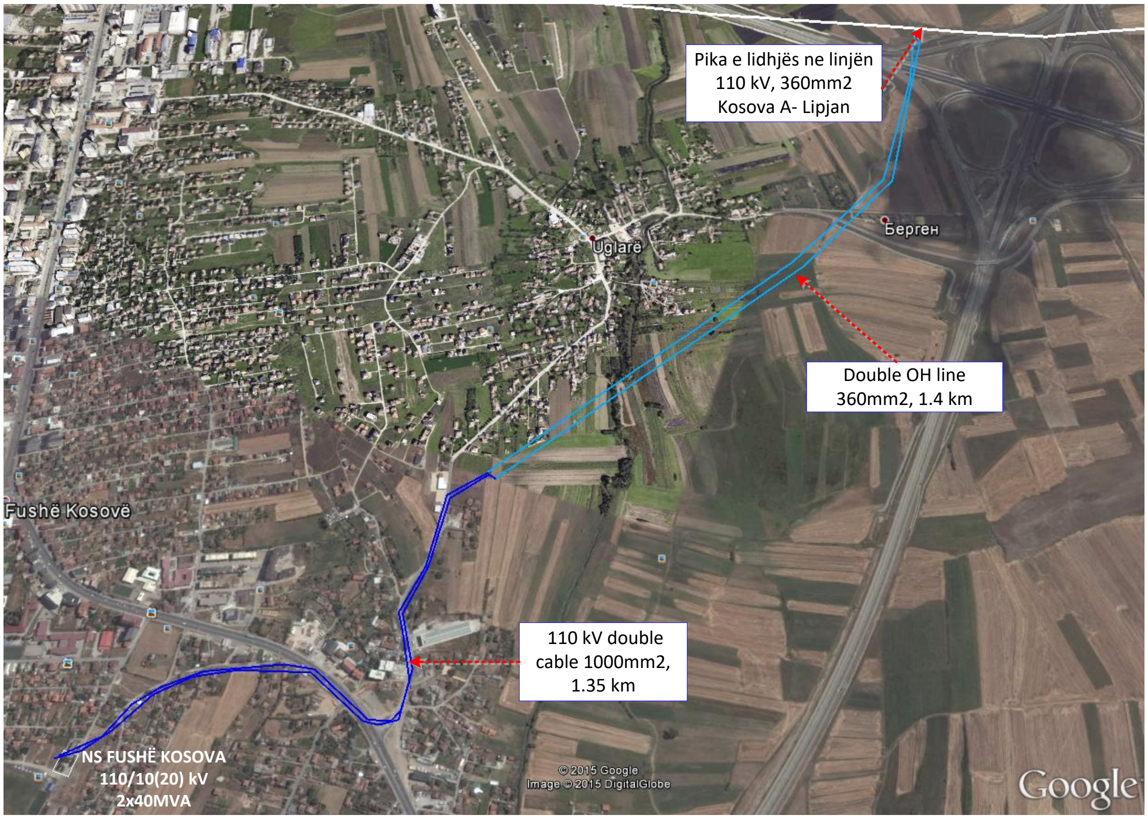


Figure 5-18. Connection configuration of SS Fushë Kosova in transmision network

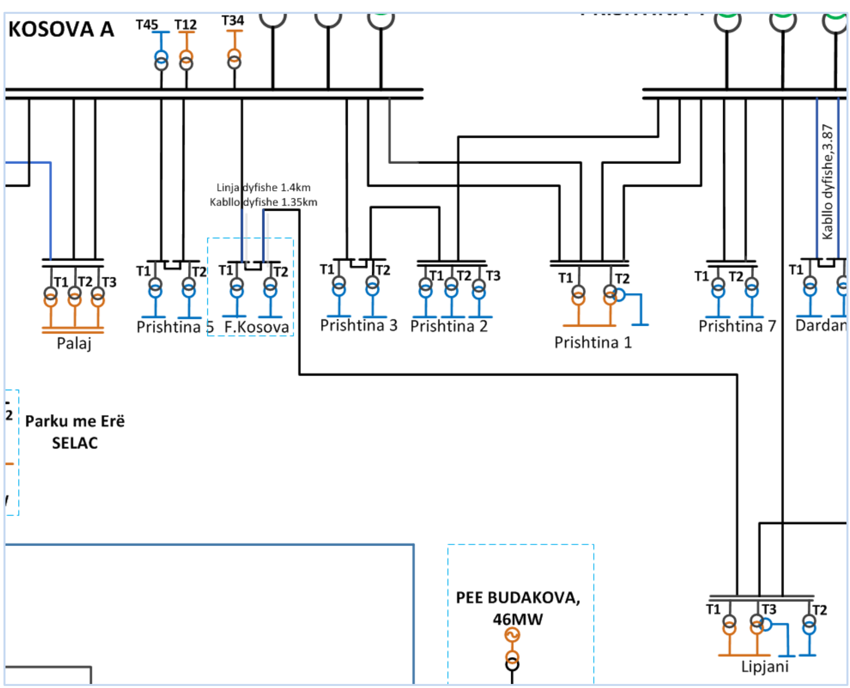


Figure 5-19 . Connection configuration of SS Fushë Kosova in transmision network

Expected benefits of the project include:

- Reliable and quality supply of Fushë Kosova consumption
- Relief of transformers in SS Prishtina 1 and SS Kosovo A
- Reduction of technical losses in the distribution network
- Optimal use of the converted line (SS Kosovo A - SS Lipjan - SS Ferizaj 2)
- Optimization of power flows in 110 kV lines supplying substations of Pristina as a result of the offloading of transformers in SS Prishtina 1 and SS Kosovo A
- Reduction of significant amounts of undelivered energy to consumers as a result of eliminating bottlenecks in the network of distribution

The project is scheduled to conclude in the fourth quarter of **2018**.

- **Project (ID/003): SS Drenasi 2, 220/35/10(20) kV**

Drenas and its suburbs are currently supplied by the very weak 35 kV network after termination of supply from the industrial substation SS Feronikeli, 220/35 kV since 2016. Supply is made through the 35 kV line from SS Palaj and SS Lipjani, which supplies the substation 3x8 MVA, 35/10 kV. The quality and safety of supply in Drenas and the industrial zone in Komoran is not satisfactory. The construction of SS Drenasi 2, 220/10 (20) kV, with a capacity of 2x40 MVA is of high priority in achieving the supply security of Drenas and industrial zone, which is expected to have even greater development in the upcoming years.

The substation will be constructed near the load center, namely near the existing substation 35/10 kV. According to computer analysis and technical-economic criteria, the optimal configuration of supply to SS Drenas 2, is to provide the substation with a dual 220 kV line, with a length of 3 km, which will have a solid connection in the end of existing lines 220 kV 490 mm^2 SS Prizren 2 -SG Drenasi 1. The Substation will be designed as the level voltage substation 220/10(20) kV with two 40 MVA tranformers, which in the medium voltage side will not be working in parallel because of the large fault currents as shown in Figure 5-20. Satellite imagery is shown in Figure 5-21.

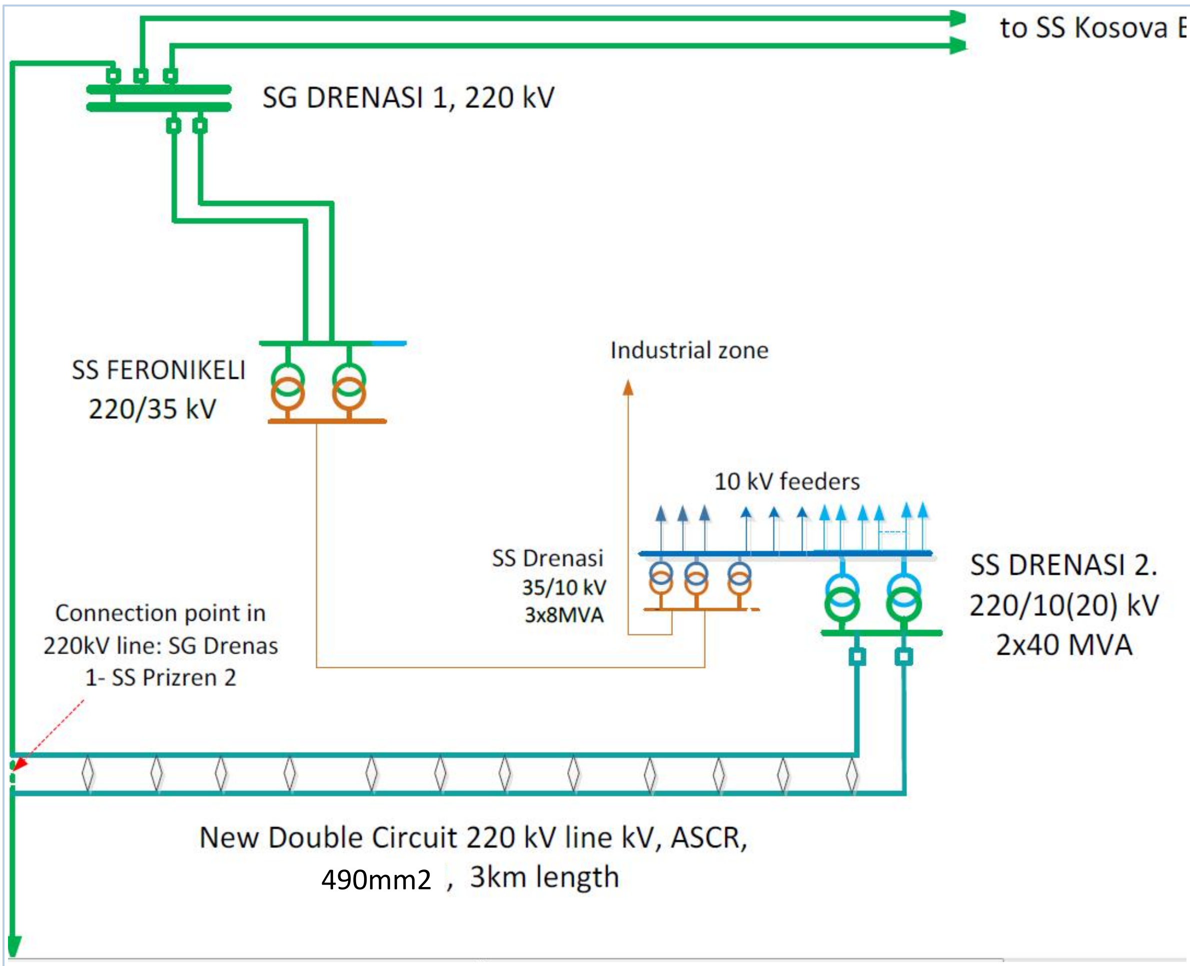


Figure 5-20. Connection configuration of SS Drenasi 2 in transmission network

Due to limited space, GIS technology will be implemented in the construction of the substation.

Secondary side of the two transformers will be linked into the existing 35/10 kV SS Drenasi, eliminating voltage 35 kV. Existing devices MV KEDS must meet technical safety criteria which would suit the nominal parameters and fault currents arising as a result of the installation of two transformers 40 MVA, 220/10 (20) kV in new substation.

Figure 5-21. Satellite imagery of SS Drenas 2 and the layout of the dual 220kV

Expected benefits from the projects are:

- Reliable and efficient supply of consumption for Drenas and its suburbs
- Reduction of significant amounts of undelivered energy to the consumer as a result of eliminating the bottlenecks in the network of distribution
- Reduction of technical losses in the distribution network
- Support to economic development in the region of Drenas
- Quality supply for the industrial area in Komoran

The project is planned to be completed in the fourth quarter in **2019**

- **Project: (TD/MALISHEVA): Project Malisheva 110/10(20) kV**

The Malisheva Project was included in the list of capital projects for load support and strengthening transmission capacities of the network for the following reasons:

a) The situation of supply for the Malisheva region is unsatisfactory, as this region is currently supplied by a 35 kV line from SS Rahovec. The great distance of this line causes significant losses of active and reactive power, thereby adversely influencing the quality of electricity delivered to consumers. The 35 kV voltage level and other distribution levels during the winter load are below minimum allowed values provided in the distribution code. To achieve a sustainable and long-term electricity supply for the Malisheva region, it is necessary to develop a 110/10(20) kV substation, with transformation capacities of 2x40 MVA.

b) SS Malisheva will be connected in line 220 kV SS Drenasi - SS Prizren 2, through the dual line ASCR 490 mm^2 as shown in figure 5-21.

The figure 5-22 shows the geographical extend of the project. Figure 5-23 shows the single pole configuration of the connection of SS Malisheva to the network 220 kV.

Figure 5-22 Geographical position of SS Malisheva project

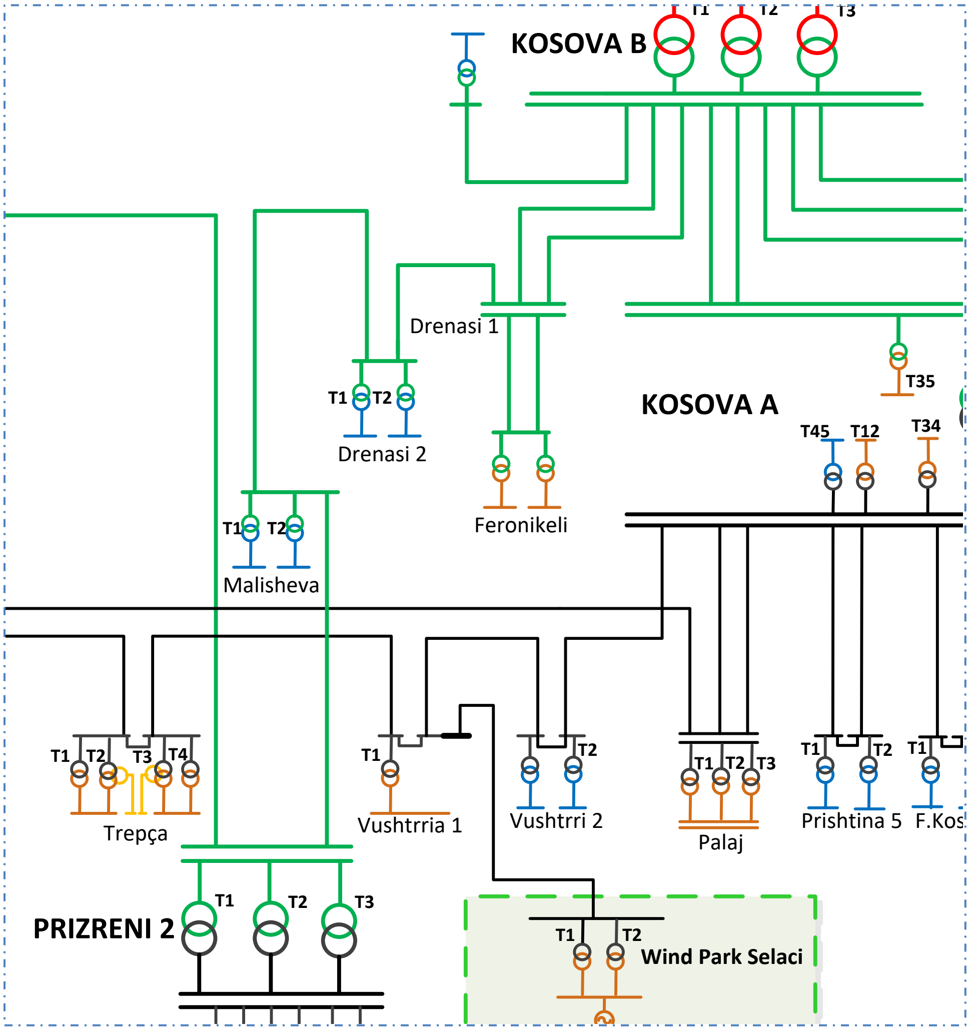


Figure 5-23 Connection unipolar configuration of SS Malisheva 220 kV network

Expected benefits from this project are:

- Reliable and quality supply of consumption in Malisheva
- Optimization of load flows and discharge of transformers at SS Rahovec
- Reduction of large amounts of undelivered power to consumers, as a result of elimination of bottlenecks in the distribution network
- Reduction of technical losses in the distribution grid
- Support to economic development of Malisheva

The project is planned for completion by the fourth quarter of **2020**.

5.4.4 Projects: Substations Revitalization

In determining the list of substations that required revitalization the following factors were taken into consideration:

- Impact of the failure of the substations in the transmission system
- The age of the substation
- Frequency of the failures and damages in the equipments of the high voltage
- The level of the fault currents in the substations

Probability of failures in high voltage equipment begins to rise with age of equipment, especially equipments that are greatly used. Also the substations which are characterized by large currents failures considerably influenced in the accelerating the loss of their credibility. Based on data archived in **KOSTT** related to the above mentioned factors a list was drafted of substations requiring revitalization in the first five years of the development plan.

- **Project (ID/005): Revitalization of SS Theranda**

This project is of particular importance, as it is related to the construction project of SS Malisheva where the new 110 kV lines; SS Rahovec – SS Theranda which will be connected in this substation.

The current bus bar (H system) configuration of the SS Theranda does not allow for an optimization of system operation, while representing a difficulty in the process of maintenance. Based on planning standards, substations that have three or more lines must be configured in double bus bar systems and connection fields. This project envisages the replacement of existing 110 kV high voltage equipment, HIS system with double busbar system, with installation of a 110 kV connection field, and the replacement of medium voltage transformer fields. The existing relay protection system in line fields is planned to be replaced with modern numeric relays.

Expected benefits from the projects are:

- Enhancement of the security and reliability of the operation of substation
- Optimization of operation of the substation after the shift to dual busbar system
- Reduction of undelivered energy to the customers
- Reduction of maintenance costs
- Higher safety conditions for the staff working in substation and maintenance staff

The duration of the project is expected to be coordinated with the new project of 110 kV line Rahovec - Theranda, namely in the fourth quarter of **2018.**

- **Project (ID/017): Revitalization of 110 kV line and transformer fields in: SS Klina, SS Burimi**

The project for re-vitalizing the 110 kV equipment in the abovementioned substations is in progress and its completion is expected by the fourth quarter of **2020**.

Replacement with modern equipment is important for the safe operation of the transmission system. The investment reduces the maintenance costs, and increases the operational reliability and security of the respective substations. The second transformer should initially be installed in SS Klina in order to enable the installation of the transformer field, without interruption of supply for Klina

The project includes:

- Replacement of third line fields - 110 kV, two in Burim and one in Klina
- Replacement of second transformer fields - 110 kV, one in Burim and one in Klina

The expected benefits are provided as follows:

- Increase the security and reliability of operation of the respective substations
- Reduction of unsupplied energy to the customer
- Increase the security of staff working in substation and the maintenance staff
- Reduction of maintenance costs

- **Project: (ID/022): Revitalization of the substation SS Vallaq**

SS Vallaqi is one of the first substations built in Kosovo. Revitalization of this substation is necessary because of the fact that its 110 kV busbars are connected with five 110kV lines, one of which transmits electricity generated by HPP Ujmani. The technical condition of the substation is not satisfactory and it threatens the safety and reliability of supply to consumers. Revitalization of the substation envisages the replacement of high voltage 110 kV equipment, replacement of the busbar system and its portals with the development of a double busbar system but with connection field. The project is scheduled to be completed in the fourth quarter of **2023**.

Expected benefits from the projects are:

- Enhancement of the security and reliability of the substation operation
- Optimization of the operation of the substation after crossing the double busbar system
- Reduction of undelivered energy to customers
- Enhancement of security of staff working on the substation and maintenance staff

5.4.5 Projects: Enhancement of the monitoring, control and metering system of the Transmission System

The following are TDP projects considered necessary to fulfill the requirements of the Grid Code and **ENTSO-E** Operation Handbook.

- **Project 025/ Update of the Energy Management System (Market IT)**

The update of energy management systems is done periodically in line with developments in the European market and in compliance with changes and establishment of regional markets.
Within this line is planned to include the replacement of obsolete hardware as well as improvements to the existing system. Also, it is foreseen security by replacing the existing firewalls with more advanced ones and related software.
The new modules to be installed include:
1. Cross-Border inter-TSO Balancing Module
2. Electronic procurement of transmission losses and of other auxiliary services.
3. Other modules that can be added, due to increased dynamics of ENTSO-E and the implementation of the KOSTT-ENTSO-E Agreement.

The project enables adequate management which is in compliance with European energy management systems, related to information technology during the energy market processes in Kosovo. The project is expected to be operational in the fourth quarter of **2022.**

- **Project (ID/029): Upgrade of SCADA/EMS**

Considering that the existing SCADA/EMS system was designed based on the information technology, normative codes, and standards that have been used during 2008-2009 and based on recent technological developments and advancements in SCADA/EMS systems, which are integrated into the ENTSO-E TSO, our system can operate until 2021 under existing condition, and after that will have to be rebuilt based on the ever-evolving technological developments and requirements stipulated by ENTSO-E.
Below have been provided the facts showing the reason that the existing system should be rebuilt during 2021-2022:

- The existing server hardware platform is 32 bits - now only 64 bit servers can be found on the market, which prevents the maintenance of existing servers;
- HDDs are SATA technology with capacities up to 32GB - now the market is dominated by ISCI and SAS technologies with capacities over 100GB and upon the damage of HDD the existing servers will be out of use;

- The operating system installed on the servers is MS Windows Server 2003 R2 for which the Microsoft operating system has stopped the support in July 2015, so it is impossible for these servers to be protected from viruses, damage, and to place any new hardware into them (HDD, LAN cards, VGA cards, RAM, etc.) due to the lack of software ("drivers") to be installed on MS Windows Server 2003 R2.
- On existing servers is installed MS SQL Server 2005 (Support expired in April 2016), MS Visual Studio 2005, MS Office 2003, and other software (Java, ORACLE,...) for which support from manufacturers has also expired. Based on these facts, no expansion or adaptation to new 64-bit software platforms is possible, so the complete maintenance of the existing system cannot be ensured.
- Communication between RTUs and the SCADA/EMS system is being conducted through IEC60870-5-104, and based on the publications in ENTSO-E, especially the platform named CGME, from 2018 will be implemented the IEC61970 standard or known in public as the CIM mandatory standard for application in EMS (see annexes of this reasoning). Based on such developments and audits that will be conducted to KOSTT for the membership in ENTSO-E, KOSTT with the existing SCADA/EMS platform will not be compatible with ENTSO-E requirements and will not obtain the member status of this organization.
- For the SCADA/EMS system, KOSTT is using the so-called "e-terra platform 2.7", and now is applied the advanced platform "e-terraplatform 3.2" that can work on 64-bit systems and which has incorporated all new requirements of ENTSO-E and EU codes. Also other SCADA/EMS manufacturers are at this level.

  Based on all the facts mentioned, and KOSTT's fundamental and essential duty of secure and reliable operation of the Kosovo Transmission System in real time, the project is necessary at the time for which it is planned.

Expected benefits from the project:

- Completion of technical requirements required by ENTSO-E in terms of SCADA/EMS systems
- Enhanced security of transmission system operation in terms of network operation in the ENTSO-E synchronous area
- Exchange of data with the Security Co-ordination Centres, which are expected to be soon developed in the region of South-eastern Europe, based on new formats and protocols for data exchange.
- Adequate protection from possible cyber-attacks that could endanger the country's security of supply

The project is planned to be operational in **Q2-2024.**

- **Project (ID/034): Development of telecommunication network transmission capacities**

Currently, KOSTT has a telecommunication network based on TDM technology that delivers various operating applications used in substations and control and centers for control and monitoring. Most applications are created and adapted to circulate through networks based on IP or Ethernet, such as SCADA, high voltage measurement, etc. Other sensitive remote protection applications still use dedicated transmission lines. However, due to the evolution of smart electrical networks, the ever-increasing need to reduce costs and increase efficiency and flexibility, require even the most critical services to connect to a telecommunications network. Moreover, there is a growing need for increased bandwidth in substations due to increased use of video surveillance and communications such as internet access or intranet across substations and main centers. KOSTT's telecommunications network architecture is currently based on three different network technologies / layers: PDH, SDH and Ethernet / IP switching, which have been designed for over 10 years. Given the timeliness and rapid development of new technologies, it is not difficult to notice that further switching of time makes the existing network system increasingly flexible, complex and more expensive to manage and maintain. The latest technologies and standards are increasingly being developed by the telecom industry to replace these three technologies / layers into a single, multiple, unified, high reliability network for all the necessary services.
SDH and PDH transport technologies are TDM format, and now all KOSTT telecommunication network services are based on Ethernet / IP. Therefore, SDH and PDH infrastructure over time can not support the flexibility required by Ethernet / IP protocols.

Expected benefits from the project are:

- Bandwidth: to meet wider bandwidth requirements, respectively communication speeds for applications such as video surveillance etc.
- Network segmentation, for various services and applications
- The quality of the application, respectively setting the appropriate priority and network performance for individual applications
- Redundancy and network protection for highly required and required applications. For most applications, outages for activating the backup path should not last more than 50ms, as is the case with SCADA.
- Loss limitation, delays for critical time applications. In some cases delays should be non-existent, such as applications that still use PDH interfaces inherited as remotely protected.

The project is expected to be operational in Q4-2024, which means that the current telecom systems will be exploited for the next 5 years.

- **Project (ID/055): Sistem GIS for Transmission System Support**

The geographic system for information processing GIS is planned to be used for the organization and processing of transmission infrastructure data extended throughout the territory of the Republic of Kosovo. The basic characteristic of the GIS system is the possibility of geographic-geographical interconnection of data, the arrangement of all technical details of the transmission assets in correlation with the environment. The GIS system enables communication with other IT systems as well.

The application of the GIS system to the Transmission System enables:

- The exact geographic position of the lines (pillars) and substations, property information in and around the position of their installation.
- Detailed technical information for each line (pillar), substation, telecommunication antenna.
- Information on the property structure and construction on planned lines for new lines.
- Remote communication with devices such as: thermovision cameras, laser beam gauge (conductors) photo cameras equipped with GPS, logistic tools of maintenance teams equipped with GPS.
- Collection and processing of data in a collection center.
- Communication with other IT systems.

Benefits from the GIS system are great both in terms of savings in the maintenance process as well as in the process of operational planning and long-term planning. This system is also expected to integrate a system for identifying the intensity and position of atmospheric discharge (lightning), which will contribute to further advancement of preventive maintenance. The project is planned to be implemented in 2025.

Expected benefits from the project are:

- Minimizing the costs of maintaining the transmission network
- Optimizing the planning and maintenance process, reducing the time of action, and
- Systematization of technical data.

5.4.6 Category Projects: Support of generation

The technical details of two generation-related projects, which weren't included in the TDP 2016-2027 because of implementation uncertainties existing at the time of preparing the document, have been provided below. Projects of such nature, mainly in this phase, are related to the integration of renewable resources in the transmission network, confirmed by investors and with approved connection agreements. During the 2016-2017, a considerable number of renewable sources generator developers have also applied for connection to the transmission network, but they could not be included in this document as there are still implementation uncertainties, mainly because of developers' problems to ensure the investments. The costs of the transmission infrastructure allowing the connection of network generators are covered by the project developer, based on the connection taxes methodology, considering the technical boundary between the TSO and the Generator. After energization, the new high voltage assets are under KOSTT management, which means maintaining them until the decommissioning of the Generating Station. The maintenance cost is covered by the developer based on the connection taxes methodology approved by ERO.

- **Project (ID/20): Supply and Installation of Solar Panels and Energy Efficiency at KOSTT Substations**

Energy efficiency and development of renewable resources represents one of the important objectives in the Energy Strategy 2017-2026. In this regard, KOSTT, in discussion with its international partners kfW, has ensured a grant covering the installation of solar (photovoltaic) panels in the roofs of KOSTT substation facilities, as well as improving the energy efficiency of facilities according to European standards.
The substations of KOSTT, while performing fundamental functions of supplying national consumption electricity, spent an amount of energy which is used for the following:

- The supply of equipment installed in the substation (relay, AC/DC systems, SCADA systems and measurements, circuit breaker, separator motors, cooling of transformers, telecommunication etc.)
- Interior and exterior lighting
- Air conditioning for equipment and commanding facility
- Environmental heating for equipment and personnel during the winter season

The electricity used for covering the aforesaid functions is realized through the self-transformation of the substation from the medium 10 kV voltage to 0.4 kV, and in certain cases from the reserve distribution line provided by the DSO.

The level of energy consumption depends mainly on the number of elements installed in the substation, the magnitude of the commanding facility and the level of energy efficiency of facilities (wall isolation, windows, roof etc).

The project is divided into two components:

- Installation of solar panels (in the roofs) and electric systems for converting and connecting to the 0.4 kV network of the substation;
- Improving energy efficiency of KOSTT's substations facilities according to European standards (isolation, lighting, efficient consuming)

The first component is related to the ERO Regulation on Micro-Generators aimed at reducing own costs but not for export or sale of electricity surpluses generated from solar panels.

The installed capacities in substations should not be dimensioned so that their generation is almost the same with the annual substation consumption, i.e. not exceed it.

Based on the state of the art technology of solar panels, the installed power of 10 kW requires 64 m^2 surface area covered in solar panels. Hence, if 250 W units, with dimensions 1mx1.6m, are to be used, around 40 such units, which can be placed in roofs, and oriented in southwest, will be needed.

Electric connection of solar panels with 0.4 kV electric network of the substation will be made through the DC/AC converter system.

Electricity consumption for own needs of several KOSTT substations has been presented in Table 5-1. Substation with larger consumption is SS Kosova B, whereas consumption for other substations ranges from 60000 kWh to 190000 kWh.

Table 5-1. Annual electricity consumption of several KOSTT substations

SUBSTATIONS	Yearly consumptio MWh
Kosova B	1,050
Lypjani	191
Prizreni 1	136
Prishtina 1	132
Ferizaji 1	121
Vushtrria 1	74
Peja 2	66
Vushtrria 2	62

Data in this table it is estimated that the substations roof surfaces may accommodate around 5576 m^2 solar panels, with a total capacity of 870 kW and estimated annual generation of around 1587 MWh.

The data indicate that none of solar panels installed in substations can cover the total annual consumption. Based on the reports for electricity consumption costs in substations, they amount to around 300,000 - 350,000 € per year.

Whereas the benefits from reduction of energy consumption covered by solar panels is around 185,000 € per year, namely around 53% of total costs.

The other remaining part will be reduced from the project second components related to the energy efficiency of substation facilities. Numerous international studies carried out for commercial buildings indicate that around 20-30% cost reduction for energy can be achieved, if energy efficiency measures are applied in buildings.

Second component will be based on European directives:

- Energy Efficiency Directive (2012/27/EU)
- Directive on Energy Performance of Buildings (2010/31/EU)
- Energy Labelling Directive
- Ecodesign Directive

This project component aims to reduce electricity consumption in substation facilities from 20% to 30% based on measures to be taken in accordance with the abovementioned Directives.

Expected benefits from the project:

- Reduction of energy consumption costs from KOSTT substations, which is returned as consumer benefit
- Reduction of CO2 emission
- Supporting the fulfilment of national targets based on the efficiency program and Energy Strategy 2017-2026.

- **Project (ID/049): Wind Park "KITKA" 34.5 MW**

  The 20/110kV substation (accumulator) of the Wind Park planned by the applicant for connection is located in the village of Poliçka, namely on the 1100m hill called Kitka. This park will have 10 wind generators installed with a maximum power of 10x3.45MW=34.5MW, which will be accumulated through underground cables at the 20/110kV substation that will be built near the generating units. According to the applicant for connection, 10 generating units of "3.45MW" General Electric with a full converter will be connected to each other in a loop connection with 20 kV underground cables and with the 20/110kV accumulative substation, whereby the connection to the SS Berivojce substation through the 14 km long 110 kV line must be made possible as shown in Figure 5-24.

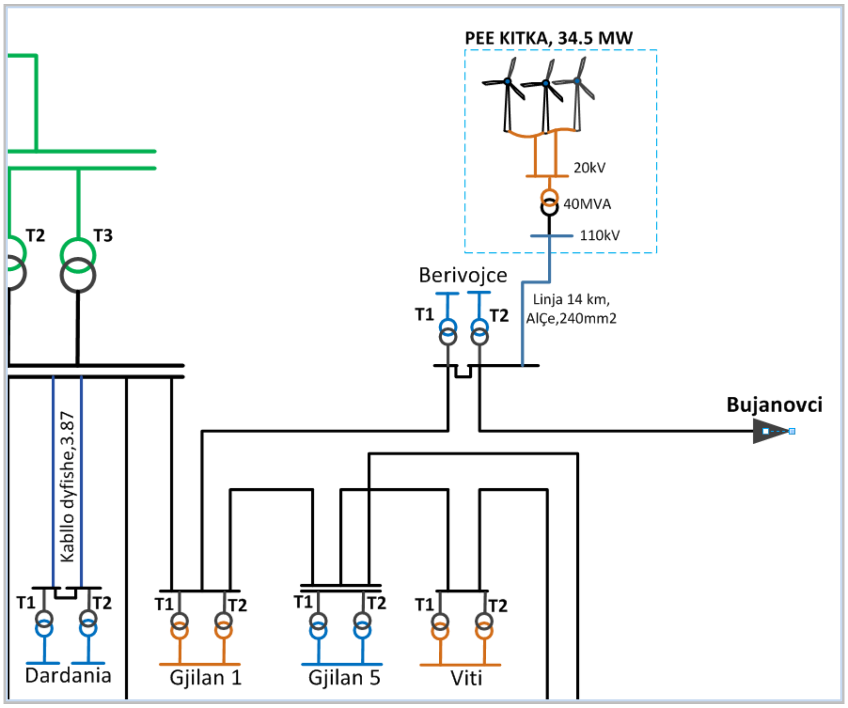


Figure 5-24 Configuration of wind park and substation SS KITKA 20/110kV

It is apparent that any electric power injection at the 110 kV level of the transmission network in terms of power flows has positive impacts. During the computer analysis of the Kosovo SEE model in which the wind park "Kitka" was modelled, the following benefits were observed:

- Injection of the 34.5 MW power at 110 kV SS Berivojce node from wind generators affects the discharge of some system elements such as autotransformers in SS Prishtina 4 as well as the 110 kV lines Prishtina 4- Gjilan, Ferizaj 2 - Gjilan, Berivojce-Gjilan
- Affects the reduction of losses
- Helps to accomplish our country's ambition to meet its obligations to the Energy Community in terms of renewable energy production

Based on this, it can be concluded that the project positively affects the developments in the energy sector and such impacts can be noticed in the transmission and distribution network.

On the other hand, the variable and hardly predictable power produced by wind parks will increase the system's needs for regulatory reserves; mainly the impact will be on the secondary reserve. This will be challenging for the system operator under the current conditions, if the wind capacities increase over the capacity supported by the feed-in tariffs of 150 MW. The geographic distribution of wind parks could reduce the variability of power produced because of the fact that wind speed is not the same in all locations.

The project is under construction and its production is expected to start in **2018.**

- **Project (ID/056): Wind Park "SELACI" 105 MW**

This WP represents one of the largest projects in the region as far as installation of wind turbines is concerned. The park consists shall be composed of three groups with separate operating licenses - Selaci 1, 2 and 3, each of which will be equipped with 10 turbines of the VESTAS V136-3.45MW type with full converters and permanent magnet generator. Individual turbines will connect to the 30/110 kV accumulative substation with 2x63 MVA transformer capacity, through underground cables of different dimensions.
The location of this wind park will be in Bajgora. Upon receipt of the application for connection, KOSTT has conducted a study on the WP Selaci connection options in the transmission network. Three different options have been analysed and the most optimal version based on the technical and economic criteria is selected.

WP Selaci with a capacity of 105 MW will be connected to 110/35 kV SS Vushtrria 1, through the 110 kV ASCR line, 240 mm^2, 114 MVA with a length of 19.35 km, as shown in Figure 5-25.

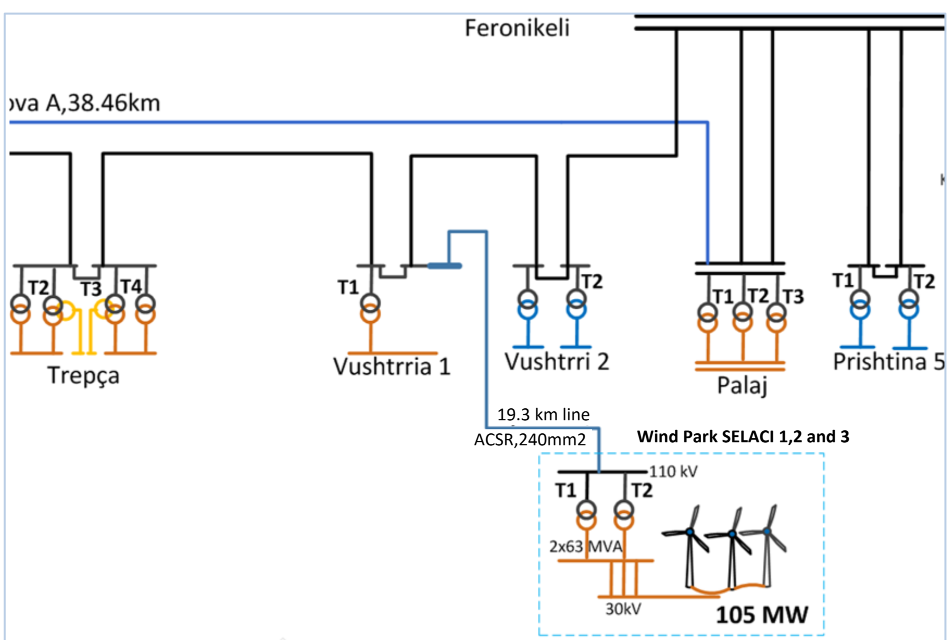


Figure 5-25 Configuration of the Selaci 1.2 & 3, 105MW Wind Park Connection to the Transmission Network

The study shows that the connection of WP Selaci with a capacity of 105 MW in the transmission network in the aspects:

- Power Flows-Criterion N-1
- Transient stability
- Short links

does not affect the safety of the transmission system operation. The only concern remains the need for regulatory power and balance of the system in real time.

The computer simulations carried out for the various production capacities of WP Selaci and for various transmission system regimes indicate that the flows in the 220/110 kV transformers in SS Kosova A will be significantly reduced, helping to reduce transformation losses. Planning of the rest of the network with intensive integration of renewable resources with variable power remains complex by the fact that a WP may not produce power even in critical system conditions, therefore, during the planning process, the full installed power of these resources is not considered, but mainly 30% to 50% is taken based on recommendations from ENTSO-E.

According to project investor predictions, WP Selaci is expected to be operational in 2019.

- **Project (ID/057): Hydropower plant "LEPENCI" 9.92 MW**

The planned hydropower plant is located near the highway M2 (Prishtina-Hani i Elezit) 2.1 km near Hani i Elezit.

The geographic position of the 35/110 kV substation location to the nearest 110 kV network of transmission network is the determining factor in finding the optimal point where the hydropower plant will be connected.
By avoiding the "T" connection, the connection of HPP Lepenci will be done through the ASCR double circuit and section line with the SS Ferizaj 2- SS Sharri line to the most optimal point, taking into consideration the minimum distance. In this case we will have two lines with other names: SS Ferizaj 2- HPP Lepenci, as well HPP Lepenci - SS Sharri.

Within the network development, KOSTT aims to reduce network losses with line capacity amplification as well as replacement of 150 mm^2 conductors with 240 mm^2 conductors, standard for 110 kV network. In some cases, KOSTT will also use high-tech conductors, but always comparing the cost/benefit of the projects. For this reason, in order to avoid creating a bottleneck in the future, the double circuit line connecting HPP Lepenci with the transmission network will be designed with 240 mm^2 standard dimensions, so that in the future, there will be no need to replace this connection line when the existing 150 mm^2 line gets replaces. The 110 kV double circuit line will be approximately 1.2 km long, while the exact length will depend on the selection of the track from the applicant.

Figure 5-26 shows the configuration of the HPP Lepenci connection, 9.92 MW in the transmission network, respectively in the existing line SS Ferizaj 2- SS Sharri. The hydropower plant consists of three generators with visible power: G1 = 5.1 MVA, G2 = 5.1 MVA and G3 = 1.6 MVA. The planned substation will contain a 12 MVA transformer, with 35/110 kV voltage.

It is apparent that any electrical power injection at the 110 kV level of the transmission network has positive impacts. During the computer analysis of the EES model of Kosovo in which HPP Lepenci was modelled, the following impacts were observed:

- An injection of 10MW in the transmission network reduces power flows in the SS Ferizaj 2- HPP Lepenci line for 10 MW
- Affects the reduction of active and reactive losses
- Helps in accomplishing our country's goals for meeting EU directives by improving the level of energy production from renewable sources

The hydropower plant will be flowing and generation will largely depend on the level of water flow in the Lepenci River, and cannot therefore be considered as a source of alternative services. Based on this, it is concluded that the project, has positive impacts on developments in the energy sector and that such impacts are also noticed in the Transmission and Distribution network.

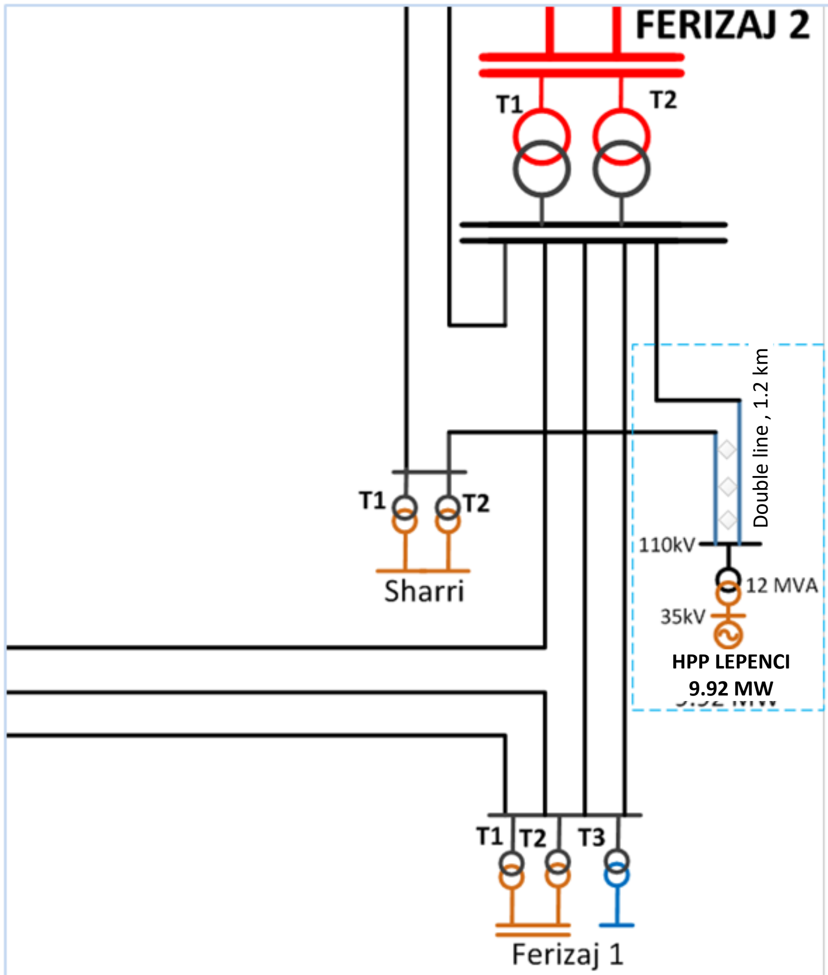


Figure 5-26 Configuration of the Lepenci HPP 9.92 MW connection in the transmission network

- **Project (ID/058): Wind Park "Koznica" 34.5 MW**

The WP "Koznica" is located in the village of Koznica, 1 km east of Prishtina-Gjilan highway. The proposed WP consists of 10 Vestas-type wind turbines V112/3.45 MW, each with a capacity of 3.45 MW, type: asynchronous generator with full converter.

The main WP substation will have a 40 MVA, 30/110 kV power transformer, which transforms the output power (or generated energy) of the WP at 110 kV voltage level, for injection into KOSTT's 110 kV network.

WP with installed capacity of 34.5 MW will be connected:

- Through the 110 kV double line, with a ASCR 240 mm^2 conductors, and 1.4 km length from the connection point in the 110 kV transmission network.

- The existing SS Prishtina 4-SS Gjilani 1 line, ASCR 240mm^2 with a length of 35.2 km, will be cut off somewhere at the middle of the line and the new 110 kV double line will be connected from WP Koznica, thus creating 110 kV lines: SS Prishtina 4-WP Koznica with a length of 18.8 km and WP Koznica- SS Gjilani 1, with a length of 19.2 km.

The configuration of the WP connection on the 110 kV transmission network is shown in Figure 5-27.

During normal operation of the power system (all elements are in operation), there is no overloaded line or transformer. The voltage profile is in accordance with the technical requirements of the Grid Code. Simulation of the N-1 criterion for the network as a whole is done with the purpose of assessing the security of the transmission system, and it results that no transmission line and transformer in the transmission network is overloaded for any unpredictable circumstance (contingencies). Also, the voltage profile in the transmission system busbars, during operation under the N-1 criterion, with regard to the WP connection, remains within the boundaries defined by the Grid Code. So, during normal operation, the WP connection (34.5 MW) to the 110 kV transmission network has no negative impact on the security and reliability of the system. The ability of proposed **Vesta** wind turbines to support the system with reactive power when required (in accordance with the Grid Code) will have an important role in ensuring safe operation of the system and the WP.

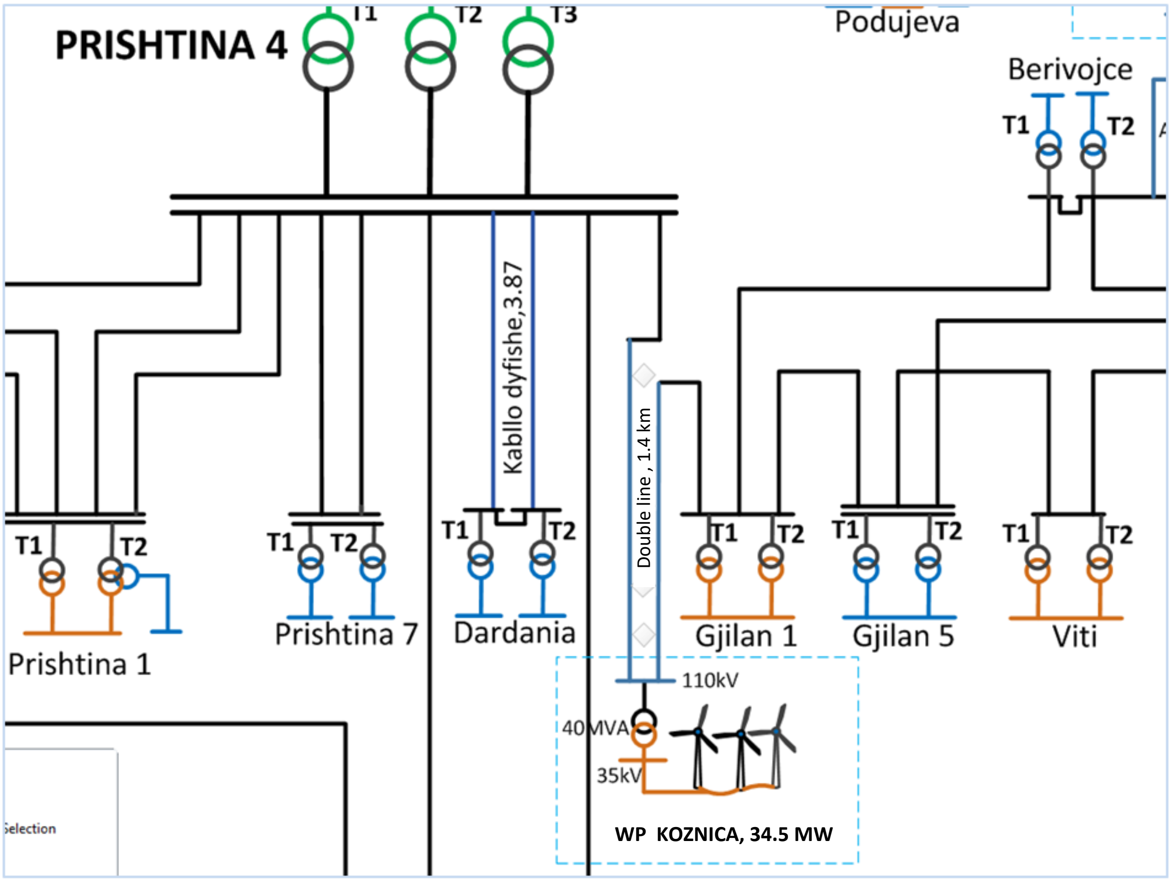


Figure 5-27 Configuration of the Koznica wind park connection, 34.5MW in the transmission network

6. ENVIRONMENTAL IMPACTS

6.1 Environmental protection

Continuous caution for environment will be part of the overall **KOSTT** Policy and engagement of this police is addressed in the certification of **KOSTT** with ISO 14001:2004 Standard. **KOSTT** Development Plan will take measures to prevent and correct any mistake that is referred to the environmental protection in accordance with the internal and external legal bases. Negative impacts mainly include terms of the impact of electromagnetic fields (EMF), noise and visual impact on the environment (more important effects).
It is a primary objective for KOSTT for the future to put particular attention to gaps, which can directly or indirectly affect the health and wellbeing of the KOSTT staff, and certainly the health and wellbeing of parties outside of KOSTT.

6.2 Environmental problems in the transmission system

One can say that the Environmental problems in the transmission system are divided into following:

- Environmental problems caused by the lines, and
- Environmental problems caused by the substations

6.2.1 Environmental problems caused by the lines

Today when needed energy necessary for the development of our country, appeared in the Development Plan, we need to adjust the priority of claims being aware of their impact on the environment. Therefore we can say that the priority is set towards a necessary development of electricity transmission of high voltage (during the above elaboration this need is reflected and justified), not to eliminate the need to minimize the possible impacts on the environment.
Most of the lines pass through the agricultural areas, while a little less of those lines that pass on the mountain ecosystems where their impact is not so expressed.
From the aspect of electromagnetic radiation, greater influence has the industrial frequency electromagnetic fields. The research of harmful effects of this type of non-ionizing radiation on man have not yet given the final answer, but it should be noted that nowadays there is a special interest for the possible effects of electromagnetic fields on electrical equipment as well as on the living creatures, especially on people. On the moment of the legal sanction of electromagnetic impact this plan will take into consideration and will be subject to **TDP**'s implementation.
Therefore KOSTT will soon have adequate recordings for most sensitive aspects of environment impact, aiming to adapt to the requirements recommended by the WHO. We also have to monitor the causes of faulty automatics actions, reduction of the signal-noise ratio in

communication and transmission equipment, and other important impacts, summarizing the necessary and required data.

6.2.2 Environmental problems caused by the substations

Besides occupying the surfaces substations carry the biggest visual changes in their surroundings, but in aesthetic terms do not affect significantly, since under the rules they should be located outside residential areas. The continuous noise caused (transformers work) or the non-continuous work (disconnection equipment/circuits), the most direct impact on the environment of substations, and due to vegetation relief is rarely transferred to the residential areas, but in the substations location is likely to have greater value than those allowed. This will be determined soon, and adequate measures are likely planned and undertaken.

In modern equipment, breakers/disconnections include inert gas, hazardous for human health of not used properly and sufficiently (timelines are specified and gas releases must be sporadically measured), but have a undesirable impact in the ozone layer and with toxic products in small concentrations, which are caused during the working process in equipment.

Having in mind that there are strict procedures in accordance with international rules, in the use and maintenance of SF_6 circuits, it is proposed that the implementation of SF_6 technology, is ensured after a period of time, when we consider the need to add gas, detectors issuing leaking warning near the switch, followed by measurements of compensated amounts, and also through adequate measurements, so that the risk index will be brought to minimum.

Large quantities of synthetic oils found in power transformers, while a little less in the high voltage equipment. Having in mind that oils possess a high potential for environmental pollution, adequate measures are taken, such as the construction of collecting pool and protection for collections of any oil leakage. These pools at the same time are a kind of prevention in cases of large failures likely to occur.

After the second half of 2012, 28 other facilities of SS 110/TM kV have been integrated in KOSTT, for which GAP-analysis – non-conformity analysis have been carried out, which should be oriented with ToR towards appropriate improvements, the same as with earlier SS of KOSTT; this is a perspective of objectives in development plans of environmental aspects in KOSTT with regards to substations

6.2.3 Caution on the other environmental impacts

At a time when the need for more and more energy is growing, the real impact on the environment and aims for qualitative protection of this segment including this **TDP** that supports the following:

- Reduction of emissions in water, air and land
- Increase of energy efficiency
- Enforcing preventive measures in order to reduce the number of accidents

- Addressing remains, particularly hazardous ones
- Possibility for recycling in many functional forms, including in indirect ways
- Development of systems for data collection and database (electronic forms)
- Reduction of parts and equipment that are outdated
- Follow-up of gaps in the Line system
- Drafting documentation for this Transmission segment
- Construction of dual lines, where there are possibilities to rationalize the use of surfaces and corridors
- In general, the improvement of corridor occupation for transmission, where possible

All these are implemented in preliminarily planned time frames, such as:

- Reducing the damage done in the past
- Reduce the impact of ongoing activity in the relevant sector, and
- Prevention of pollution from activities in the future (e. g. EIA - Environmental Impact Assessment and preventive measures in proper reduction)

6.2.4 Activities and advancements during the period

1. Compilation of numerous documents on environment and protection from corrosion.
2. One of the important KOSTT projects, which was finalized during the period, included the analyses of toxic oil matters (PCB and PCT) in power transformers. The analyses revealed good results, as no PCB or PCT traces are found in any of the transformers possessed by KOSTT. The said analyses were performed in an Italian laboratory licensed for such examinations – in this aspect, the green mark is our protective sign.
3. KOSTT started to conduct measurements of environmental impacts in its staff's healthcare. A report on such impacts, conducted through contemporary instruments, was prepared to this end. The repetition of these relevant parameters and the impact in our lines (external impact) to external parties will be performed soon.
4. Noise impact in detected and monitored locations, in direct vicinity of our staff's workplaces, was also analyzed and new protective equipment for our staff was ordered.
5. Regarding waste, we were incorporated in the Municipal Recycling Project, and have drafted the Initial Project for paper and plastic waste recycling.

6.3 Environmental plans

In favor of the implementation of the requirements for environmental protection is the well supported initiative in setting environmental policy in **KOSTT** which is under the procedure to be adopted. Clear definition of environmental issues in **KOSTT** and orientation on what will be done to control the environment, means planning. Planning is accomplished through new projects, which are followed by the Environmental Impact Assessment. The implementation is started by established the organizational structure, staff responsibilities, competencies and training. Communication practices, control of documents and procedures, operational control and emergency preparation, define the operational part of the program. These points are also included in the **EMS** Manual (Environmental Management System) which will document a program that has determined objectives and targets to be achieved. This Manual was developed and has 18 procedures included which will be complemented with the Operational part, based in practical requirements of the Transmission Operator and its operational plans. These, along with routine monitoring conducted in the period 2014 – 2023, reporting the situation recorded along with appropriate recommendations, constitute a program of controlling acts and corrective ones in **EMS**. Finally, a review of routine management activities is lowed by the highest level in **KOSTT** the aim of which is to ensure future environment protection and sustainable development.

The long term environmental planning will support the benefit and **KOSTT** development plan, by aiming:

- Proper financial management, which directs a better environmental control

Work in due prevention needs to be adjusted to legal requirements. Therefore all operational parts that have impact in environment will be included in **KOSTT,** controlling the costs and its impact in the overall budget.

In addition to this, the following elements shall be respected:

- Domestic legislation (environment, energy)
- EU Legislation (environment, energy)
- Technical codes in **KOSTT**
- International standards and norms
- Conventions signed, etc.

For all these requirements, necessary documents for work were issued.

More needs to be done to improve and update of the new technologies and in improvement of the infrastructure of the operation system (**SCADA**) and transmission system (construction of the double and triple lines. The world has advanced much in terms of environment, and we have to progress in achieving the required and targeted goals.

7. Expected Results from TDP 2018-2027 in the Transmission System Development

The Kosovo transmission system must be continuously developed in a manner of allowing for a secure, reliable and quality supply of consumption, pursuant to technical requirements of the Grid Code and the Operation Handbook of **ENTSO/E**. An adequate and sustainable transmission system development provides for favorable conditions of development of conventional and renewable generation capacities. Appropriate long-term planning for transmission system development is essential to meeting the abovementioned requirements. **The Transmission Development Plan** 2018-2027 has identified medium and long term needs for infrastructure projects, necessary for the enhancement and maintenance of the operational performance of the system, in relation to development in consumption, generation and regional energy markets.

The **TDP** 2018-2027 sets forth the development priorities broken down by categories and implementation timelines. The full implementation of transmission development plans is challenging even for most developed countries. Difficulties in accessing property, global economic crises, lack of financial resources, and social implications, are some of the factors which may slow or prevent the realization of projects which are necessary to be taken into account by planning engineers. Positive impacts of completed and ongoing projects have been analyzed in the previous development plan, while the following are general comments on new development projects presented in the **TDP** 2018-2027.

Developments in the last 5 years in the transmission system have created conditions for **KOSTT** membership to **ENTSO/E**. Regarding policies arising from **ENTSO/E** Operation Handbook related to technical requirements to be fulfilled by each TSO, with its recent investments to increase transmission capacities, raise security and reliability of the system as well as development of modern systems for measurement, monitoring and control, **KOSTT** is in the same, or possibly better position than some of the regional TSO-s which are already members of **ENTSO/E**. With development of the secondary control project which represents one of the main technical requirements for membership in the **ENTSO/E, KOSTT** will be fully ready for membership. Given the activities for the establishment of a common market with Albania and joint operation of both systems, the accession process to **ENTSO/E** shall not have any technical restriction.

7.1 Actual state of the network in 2017

The current transmission system of the Republic of Kosovo operates under optimal conditions as a result of investments made in the last decade. The number of unplanned outages of lines and transformers, the amount of energy not supplied is satisfactory reduced compared with the previous period when the transmission system was not developed in coherence with the development of the system load.

The system under normal condition (N criteria), in all modes of operation with maximum load and minimum are operating optimally. In the last three years, was noted an increase in the horizontal network voltage level; this increase is mainly noticed in 400 kV level, as presented in figure 7-1. Throughout several periods, particularly during the summer regime of system operation, the voltage level exceeds the nominal values set by the grid code, but they are still under extreme levels. This problem cannot be solved by KOSTT, as this is a regional problem resulting from the construction of numerous 400 kV lines in the region and without the compensation of reactive power. On the other hand, the load level of the horizontal network of South-East Europe Network was reduced due to the economic recession in the region. This problem a few years ago has occurred in the horizontal network of Croatia, Bosnia and Herzegovina, whereas gradually expanded in the areas close to our transmission network. Operationalization of the Nish-Vranje-Shtip line with a low load level caused the presence of surplus of reactive power capacity, thus significantly increasing the voltage level. This problem cannot be solved in an isolated manner by the individual TSOs; therefore, a regional study is being carried out currently and will define optimum points for installing inductive reactors, which would have an impact on brining the voltage level within the allowed level. Operation at high voltage is not good for the electro-energetic appliances as it causes high constraints to the isolation and increases losses in the transformers core. KOSTT, by changing the network typology and in cooperation with neighbour TSOs, has tried to manage the voltage levels so they do not exceed critical values. This is mainly achieved with the disconnection of parallel lines and lines with low level of loads, through the coordination of National Dispatch Centres, in compliance with agreements between TSOs.

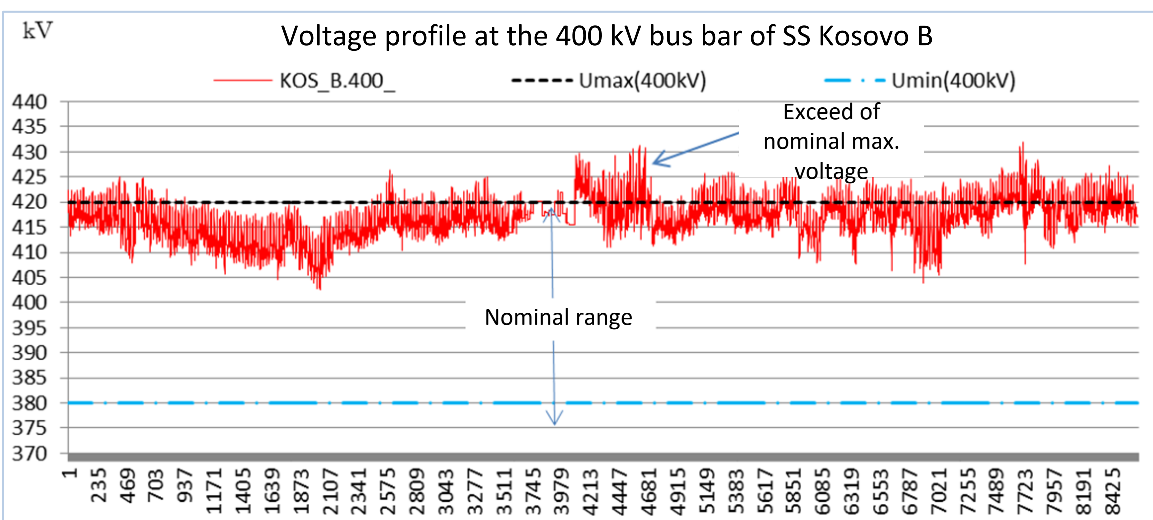


Figura 7-1. Voltage profile at the 400 kV bus bar hour per hour in SS Kosova B registered from SCADA in 2017 year

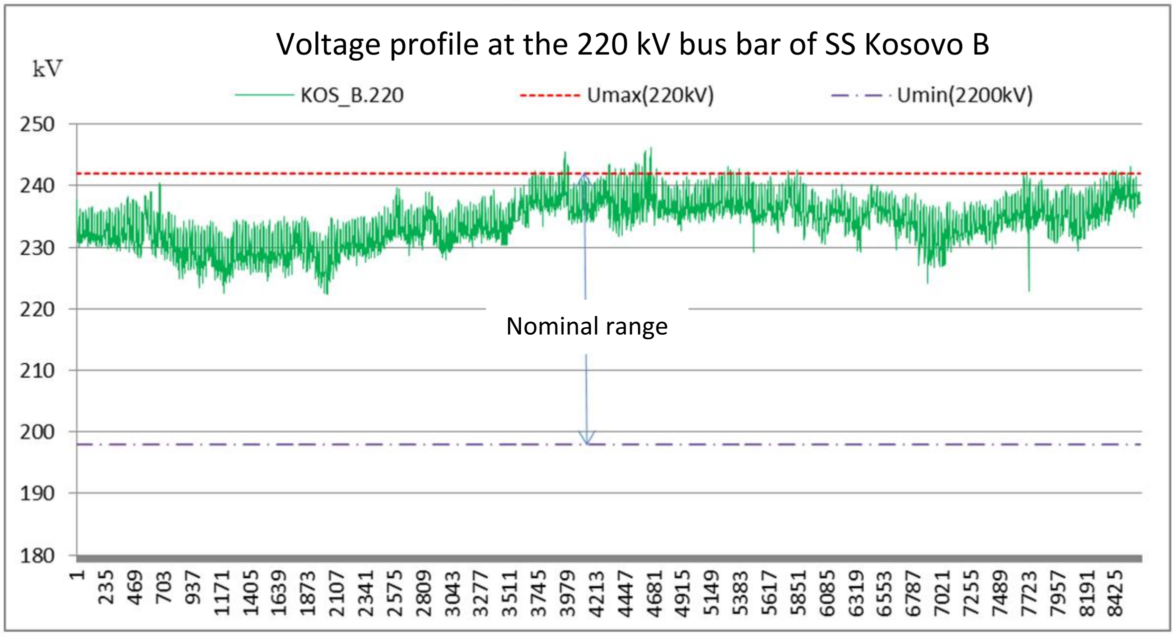


Figure 7-2. Voltage profile at 220 kV hour per hour in SS Kosova B registered from SCADA for 2017 year

The level of electricity losses has entered the saturation area and is almost the same as two previous years. The greatest losses are usually caused in 110 kV lines, while the horizontal network losses dependent on the balance of the system and the electricity transits flowing in our network. Figure 7-3 presents the table of calculated losses per system maximum load. The lines share dominated in terms of total losses in transmission network with **67.1 %**, whereas transformers with **32.9 %**. It is noted that transformers transferred from DSO to KOSTT caused about **18.9 %** of total power losses. Comparing losses to those of previous year, it is noted an increase in transformer losses caused by the increase of transformers in the last two years. A large part of losses (around 4 MW) is attributed to losses in iron. These losses depend on the voltage; therefore cause significant losses of active energy, which is around 35 GWh. In general, as far as the balancing of system reactive power is concerned, throughout most of the year the network is balanced, namely during minimum loads the system is over-compensated, while during maximum loads the system needs around 60 MVAr which are obtained from local generators and interconnection.

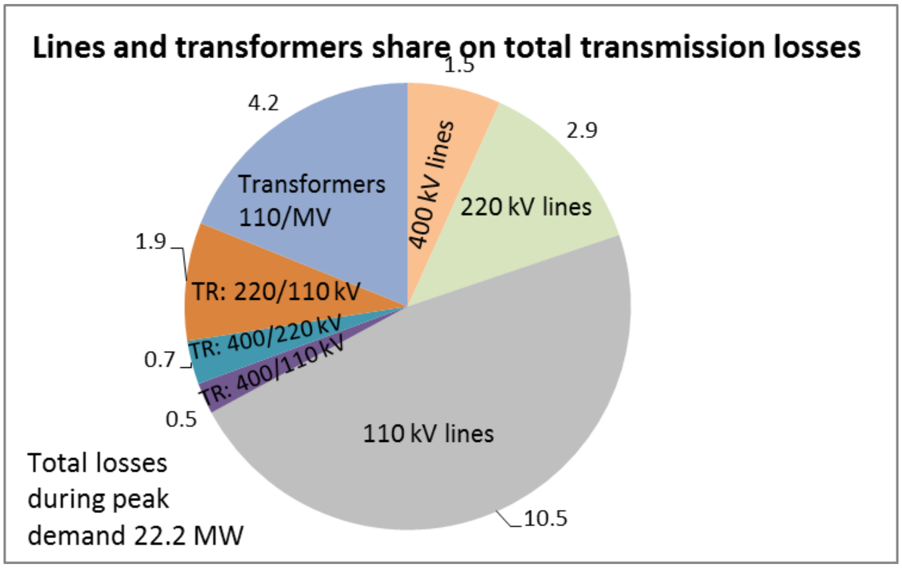


Figura 7-3. The participation of lines and transformers in the losses of the transmision network -2017 during the maximum load

In aspects of N-1 criteria, when an element falls off surprised, in transmission network are still occur constraints relatively small compared with previous years and especially if consumption is higher than 1150 MW. Following are the critical failures and critical system elements analyzed through computer simulations in PSS/E.

Tabela 7-1. List of critical outage and critical system elements -2017

N-1 Security Analysis				
Nr	**Critical outage Q4-2017**	**Overloaded element**	**It[%]**	**Bus bars with voltage drop > 10%Un**
1	L 110 kV Prizren 2-Prizren 3	L 110 kV Prizren 2-Prizren 1	105	Voltage remains in the range as per Grid Code requirements
2	L 110 kV Prizren 2-Prizren 1	L 110 kV Prizren 2-Prizren 3	103	
	Radial lines			
1	L 110 kV Rahovec -Prizren 2			

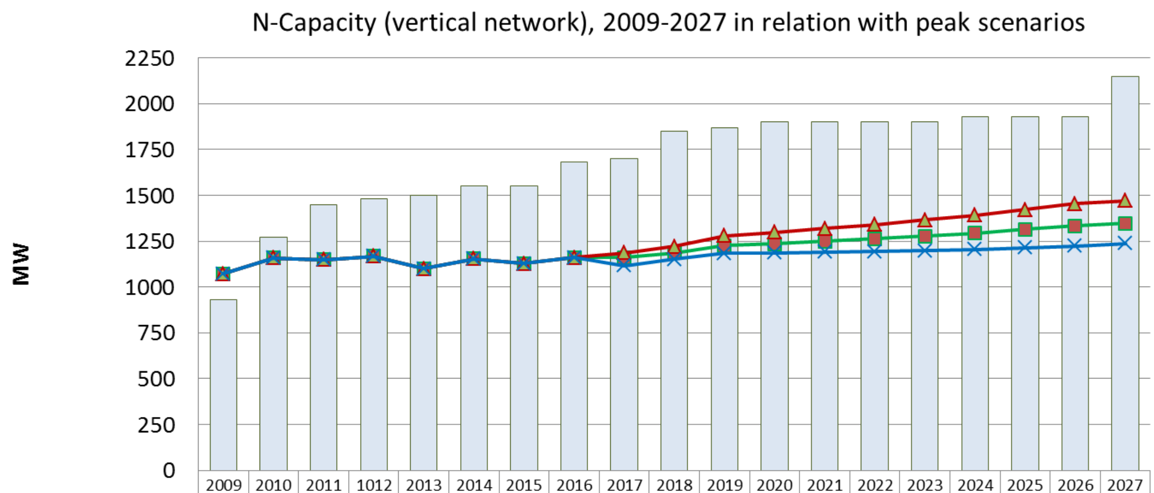
Part of the network that connect SS Prizren 2 and SS Prizren 1 and Prizren 3 will continue to remain a critical for larger loads than 1150 MW. However, this problem may be avoided with specific network configuration, namely by opening the line Prizren 3- Theranda. Loads over than 1150 MW has probability about 0.2% (18 hours per year) to happen in the next two years, so the impact on the security of the system will be relatively small. The problem in this part of the network will be solved after the commissioning of the new line 110 kV SS Rahovec-SS Theranda, and construction of the SS Dragash where its loads will be provided by SS Prizren 2, discharging the existing 110 kV lines. There is no voltage problem with regards to criterion N-1, which implies any unplanned decrease of a voltage element (line or transformer) in bus bars of transmission network, will remain within the allowed voltage range according to the Grid Code.

However, in the aspect of transformation, substations 110/35/10 kV still have nodes which do not fulfil the N-1 criterion. However, a part of the reserve supply in case of transformer outage may be realized through distribution network 35 kV and 10 kV.

From 28 substations supplying the distribution network, 20 substations fulfil the N-1 criterion in terms of transformation, 3 substations fulfil the N-1 criterion through the 35 kV ring network, and 5 substations do not fulfil the N-1 criterion. These substations have a dual voltage system, whereby the 35 kV network fulfils the N-1 criterion, whereas the 10 kV network, upon line failure or during maintenance of transformer 110/35/10 kV, cannot be supplied. Such substations are: SS Prishtina 1, SS Ferizaj 1, SS Prizreni 1 and SS Peja 1, whereas SS Klina has only one transformer 110/10 kV.

7.2 Development of the transmission network capacities in the next 10 years

Implementation of planned projects determined from planning process of CBA will enable the continuous development of internal capacity in the network which will create favorable conditions for the generation support. Constructions of new substations, 110 kV lines, and construction of SS Nasheci 400/110 kV, will be key reinforcements that will result in enhancing the capacities of the transmission network. The figure 7-4 shows the network's internal capacity building diagram in relation to the load for the next 10 years according to three scenarios of peak development. Since 2010, the transmission network has been operating with sufficient transmission reserves and with an increased trend in terms of N security criterion. This means that under the conditions of maximum load system operation, wherein all network elements are operational, no critical values of electricity and voltages are noticed in any of the lines, transformers and transmission system busbars.



	2009	2010	2011	1012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
N-1 Capacity [MW]	930	1270	1450	1480	1500	1550	1550	1680	1700	1850	1870	1900	1900	1900	1900	1930	1930	1930	2150
Base peak	1072	1158	1150	1168	1101	1154	1129	1160	1162	1188	1225	1236	1250	1263	1278	1295	1314	1333	1348
High peak	1072	1158	1150	1168	1101	1154	1129	1160	1186	1222	1279	1298	1320	1341	1365	1392	1421	1455	1471
Low peak	1072	1158	1150	1168	1101	1154	1129	1160	1116	1152	1184	1186	1192	1194	1199	1206	1214	1224	1237

Figura 7-4. Development of simultaneous interconnection capacities network in relation to generation adequacy for next ten years

The capacity of the interconnection lines of the transmission network in Kosovo will be much higher than the needs for imports, or opportunities for exports of electricity that our country will have in the next 10 years and considering the volume of significant transit flows (in our network) for the region needs. But on the other hand in the regional network may appear restrictions that are difficult to realize high volume of imports. In most cases the capacity provided by the TSO-s in the region, are significantly lower than they are in reality. Figure 7-5 shows indicative values of the simultaneous interconnection capacity (KNTI) for export and import calculated in a regional model and generation adequacy assessment for two development scenarios. Calculated capacity are taking into consideration the N-1 criteria for all horizontal network of the transmission systems in the region.

If we refer to planned generation developments in Kosovo, horizontal network will be capable of accommodating significant generation capacities in full compliance with the technical criteria required by ENTSO-E. Figures 7-7 till 7-13 shows the geographical maps and the single line diagram of the system of Kosovo for three periods: 2017, 2022 and 2027.

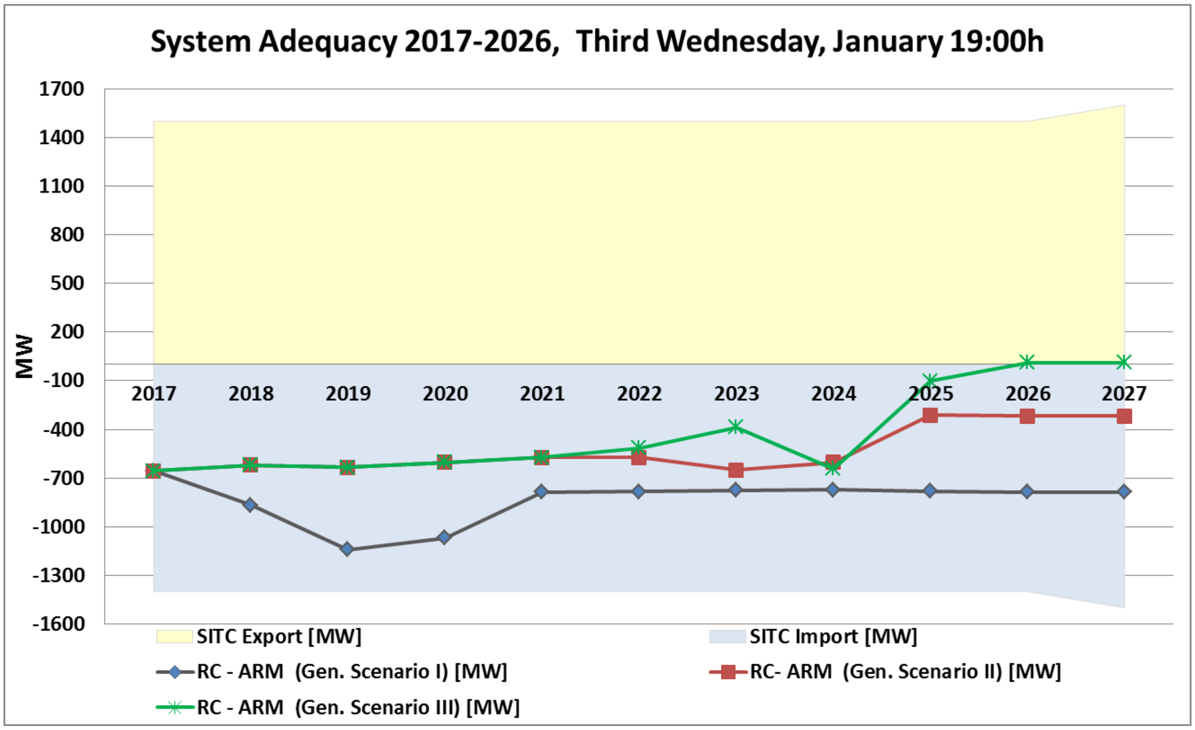
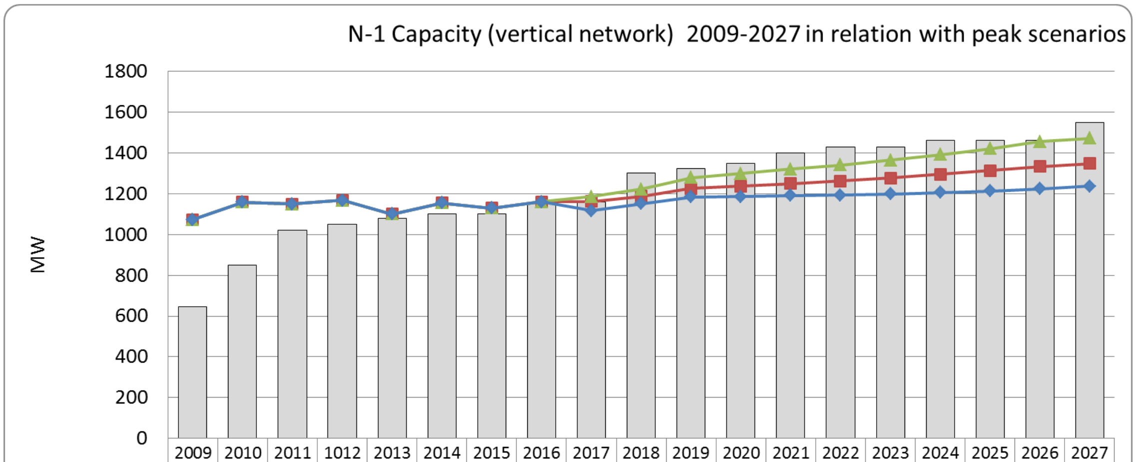


Figure 7-5 Simultaneous development of interconnection capacity in relation to the generation adequacy for the next 10 years (reference: Generation Adequacy 2018 – 2027)

7.3 N-1 security criterion

Looking at the situation in the network before 2009, the N-1 security criterion wasn't met even in summer consumption, while in normal operation conditions, the network would be subject to overloads which were managed by load shedding.

Full implementation of the N-1 security criterion requires considerable investments. Considering the development processes planned for the next 10 years, the security criterion will be fully complied only after 2018, while if not taken into account radial lines Rahovec-Theranda, the N-1 criteria almost completed since current year with some specific configurations of 110 kV grid. The N-1 criterion in 220/MV kV and 110/MV kV substations, due to the high cost and tariff implications, will not be completed entirely but, in coordination with KEDS, technical possibilities will be examined to partially complement this from reserves in the distribution network. Figure 7-6 shows the ability of the network to fulfil the N-1 security criterion, in relation with the maximum load for the next 10 years, for the three load scenarios.



	2009	2010	2011	1012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
N-1 Capacity	645	850	1020	1050	1080	1100	1100	1155	1160	1300	1325	1350	1400	1430	1430	1460	1460	1460	1550
Base peak	1072	1158	1150	1168	1101	1154	1129	1160	1162	1188	1225	1236	1250	1263	1278	1295	1314	1333	1348
High peak	1072	1158	1150	1168	1101	1154	1129	1160	1186	1222	1279	1298	1320	1341	1365	1392	1421	1455	1471
Low peak	1072	1158	1150	1168	1101	1154	1129	1160	1116	1152	1184	1186	1192	1194	1199	1206	1214	1224	1237

Figure 7-6. N-1 capacity development of vertical transmission network 2009-2027

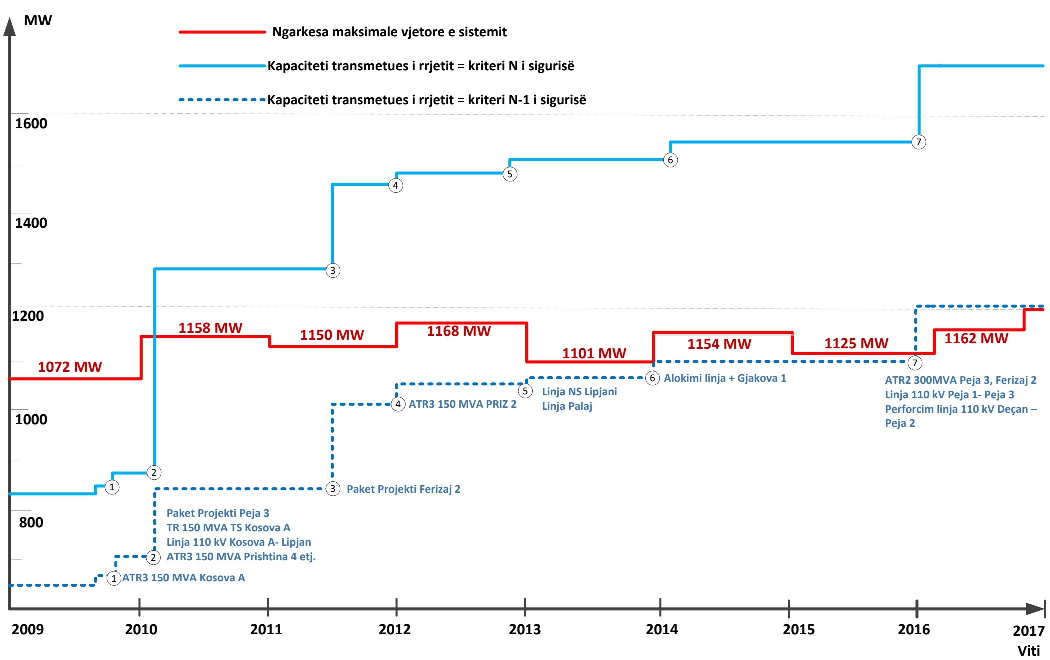


Figura 7-7. The impact of projects in the development of N, N-1 capacity of vertical transmission network in the period 2009-2017

7.4 Quality of supply and efficiency

Not long ago, a considerable part of the transmission network could not provide quality supply in winter peak due to the poor network, and large active and reactive power losses. All this resulted in rather low voltage levels at the 110 kV level, especially in areas farther from generation sources. On the other hand, the amount of undelivered energy as a result of restrictions in the transmission network was rather high. Investments made in the network, in particular after 2008, created the conditions for a quality supply of consumption and an extraordinary reduction of active and reactive power losses in the grid. The voltage level for a considerable part of the network was stabilized after the commissioning of SS Peja 3 project, whereas the construction of SS Ferizaj 2 and other developments in the southeast Kosovo brought the voltage levels to those allowed as per the technical requirements of the Grid Code. Reinforcements planned for the upcoming 10 years will enable further advancement of supply quality and efficiency and its maintenance as per the limits set forth in technical requirements described in the ENTSO/E Operational Handbook. Figure 7-8 reflects the impact of investments in the reduction of losses and indirectly confirms the improved quality of supply.

The figure shows that the level of losses has entered the saturation area, with a trend of slight increases in absolute values, but in relative terms, they will almost remain at the current level. In 2016 was noticed a significant increase of losses for 10 GWh caused by a long-term operation with open rings of the 110 kV network due to implementation of projects such as: lines 110 kV Peja 1- Peja 3 and Deqan-Peja 2. The no load operation of line 400 kV Kosova B-Tirana2 had significantly increased the losses of active power during 2016 and 2017. Reactive power injected in busbars of SS Kosova B reached to 156 MVAr and this power reflected in capacitive electricity creates continuous losses in conductors.

A part of additional electricity losses is attributed to losses greater than the nominal value in the transformer core due to operation of the transmission system with increased voltage levels.

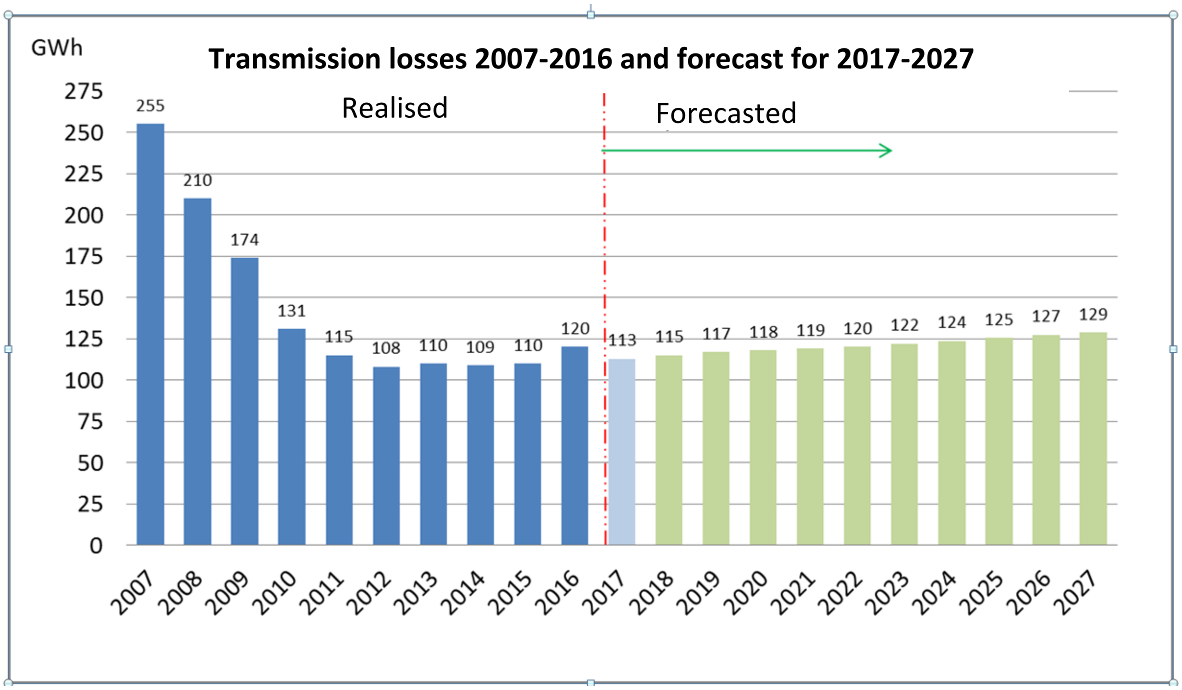


Figure 7-8. Power active losses in transmission network 2007-2016 and forecast 2017 - 2027

7.5 Reasons for changes in TDP projects 2018-2027 compared to TDP 2017-2026

Since the approval of TDP 2017-2026 to the preparation of TDP 2018-2027, KOSTT has received relevant information which has been determinative for changing or expanding the list of projects and changes to the new tariff periods. Find below additional projects that are related to three out of 5 categories elaborated earlier in document:

The list of projects contains and the period of implementation is different compared to TDP 2017-2026. The main reasons for these changes are projects:

- Replacement of transformer at SS Gjakova 1 (40MVA)
- Wind power Park "KITKA" 34.5 MW and new RES projects in the phase for signing the connection agreements.
- Supply and installation of solar panels and energy efficiency in KOSTT substations
- Upgrading of SCADA/EMS
- Enhancing the telecommunication network's transmission capacities
- SS Nasheci 400/220/110 kV

a) The re-launching of the project for changing the transformer TR2 20 MVA, 110/35 kV, which has already exceeded its lifespan (1965), is a result of its state and limited capacity of 20 MVA. This project is also related to KEDS's Master Plan, where it is aimed the elimination of a part of 35 kV network in the region of Gjakova. Therefore, this will be a three-pole transformer, whereas the second transformer 20MVA (1974), 110/35 kV will be replaced after the tariff period with a two-pole transformer 110/10(20) kV, with a capacity of 40 MVA. Due to the technical inability to fully eliminate the 35 kV network, the 35 kV pole of the transformer TR2 will be used for supplying the consumption of Xerxa according to the criterion N-1, as shown in figure 7-9

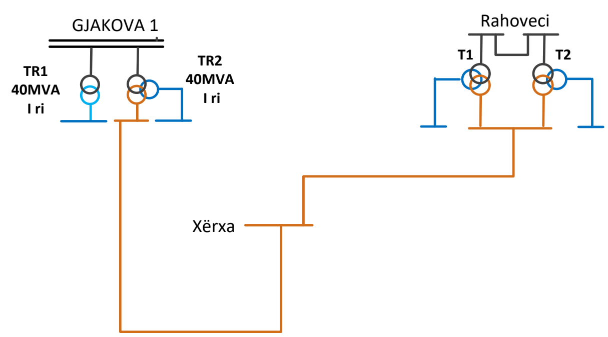


Figure 7-9. Long-term vision of SS Gjakova 1 and interconnection to 35 kV network

b) During the one-year period following the approval of the development plan, the project for Wind Park “KITKA” 34.5 MW has been initiated, and has been confirmed to be at the construction phase. The deep connection methodology is applied to generators, thereby obliging project developer to cover the costs for new transmission infrastructure, which is necessary for connection to the transmission network. The cost of this infrastructure is included in the feed-in tariff for wind centrals set by ERO. However, its impact on the transmission network is evident in two aspects: impact on power flows, losses and voltages, and in increased needs of System Operator for regulatory reserves based on the operating nature of these generators. This Development Plan showcases the new RES projects, which are at the phase of being designed; signing connection agreements and some of them are almost implemented. It is worth mentioning the projects: EEP “Selac 1 2 and 3” 105 MW, EEP “Koznica” 34.5 MW, HPP Lepenci 9.92 MW, EEP Budakova 46 MW. This does not mean that all these projects will be implemented, because based on the experience so far, the implementation of such projects almost completely depends on applicants access to finances.

c) The project “Supply and installation of Solar Panels and Energy Efficiency in KOSTT Substations” has been initiated following KOSTT’s discussions with the German Development and Construction Bank KFW under phase VI and VII of the financial support, where this project will be 100% grant from the state of Germany. The project is highly important because consumers directly benefit for the savings generated by the project.

d) Project "Upgrading the SCADA/EMS" has been initiated due to the assessments by the SCADA/EMS systems experts in terms of current system compatibility to rapid developments of SCADA/EMS modern systems being applied in ENTSO-E. Also, the changes in communication formats and protocols between SCADA/EMS of different member states of ENSTO-E oblige KOSTT to upgrade the current system so that ENTSO-E audits expected during the process of KOSTT joining ENTSO-E will be positive in terms of such systems which are considered very important by ENTSO-E.

e) The project "Development of the transmission capacities of telecommunication network", similar to the SCADA/EMS project, is linked to rapid developments in telecommunication technology and rapid obsolesce of current systems, excluding physical network capacities (OPGW) which are adequate for a long period of time.

f) The previous conceptual project "400 kV Ring" has been revised and reduced in NS Nasheci 400/220/110 kV project. This change has been influenced by several factors related to generation developments in Kosovo and the region, developments in neighboring systems in the 400 kV network, and the trend of generation development in the distribution network. After long-term computerized computer analysis, the importance of the 400 kV ring within Kosovo territory does not justify the investment cost, considering the projections for the aforementioned factors. The NS Nasheci project (Prizren 4) presents the project of reinforcing the transmission network in the Prizren region, creating the four main consumer groups, powerful 400 kV nodes. This project compared to the 400 kV ring project has a much lower cost as it eliminates the 400 kV line Prizren-Ferizaj 2 as well as the 400 kV Distribution Station Gjakova 3.

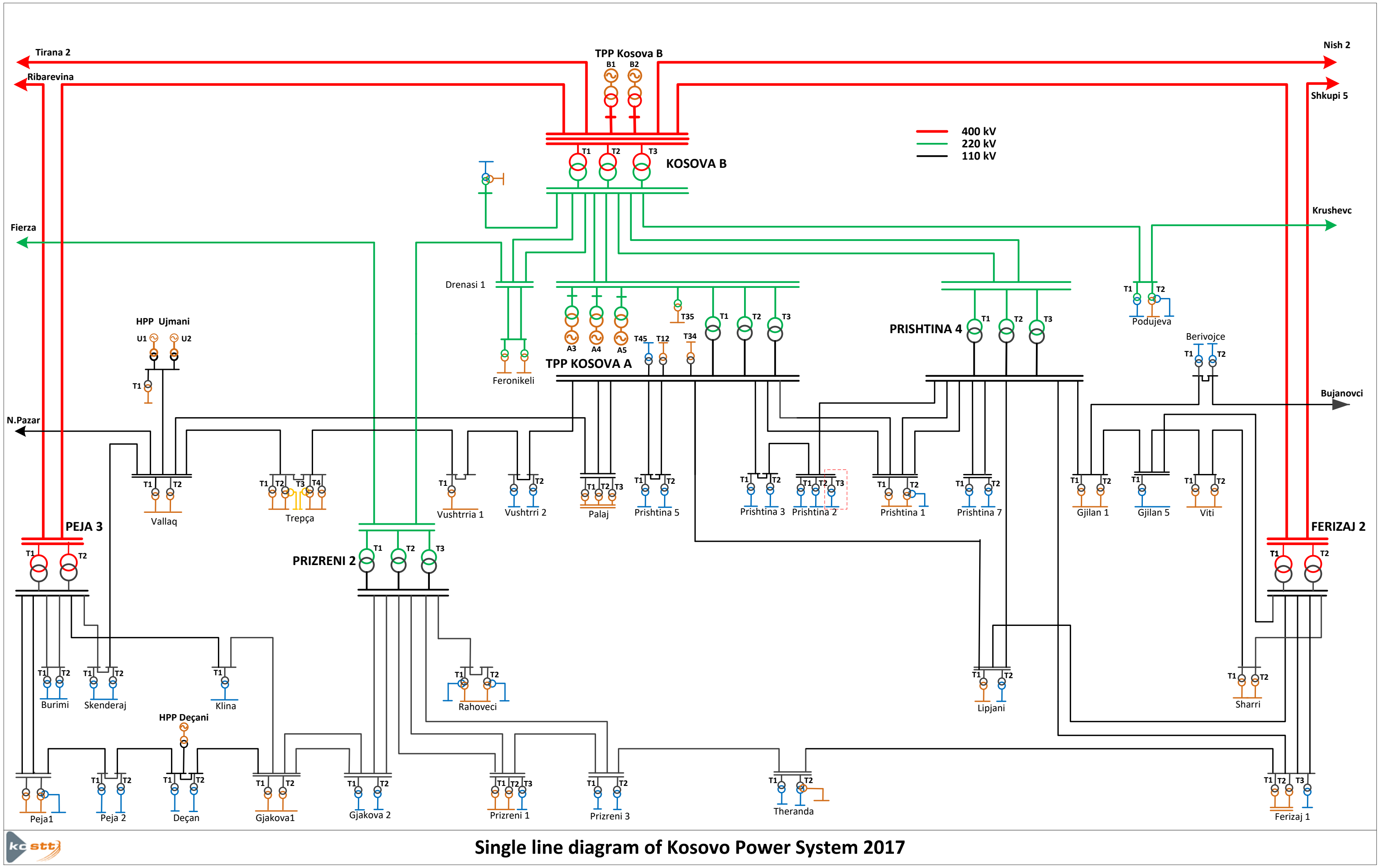


Figure 7-10 Single line diagram of Kosovo Power System 2017

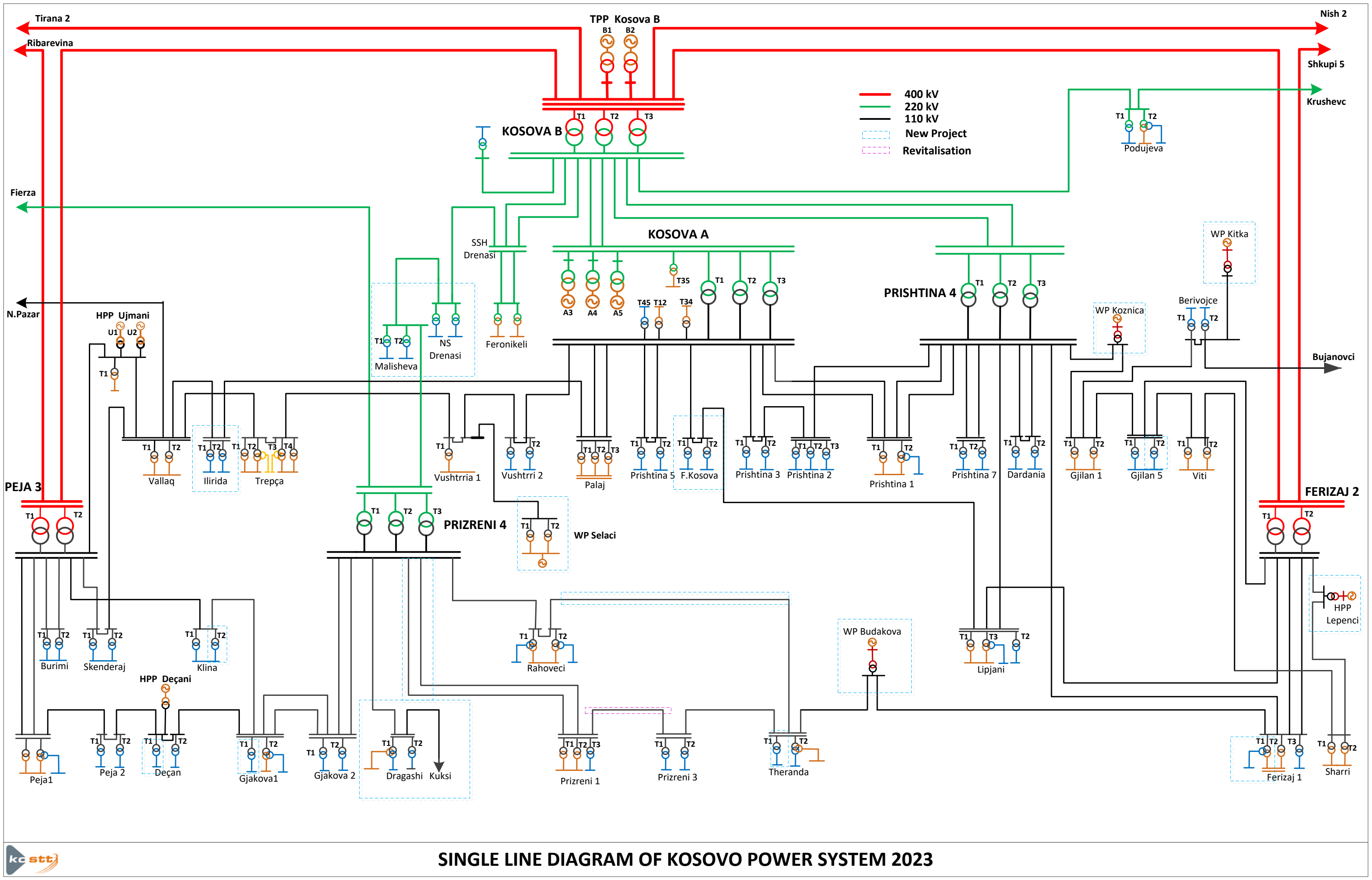


Figure 7-11 Single line diagram of Kosovo EES according to 2023 network topology

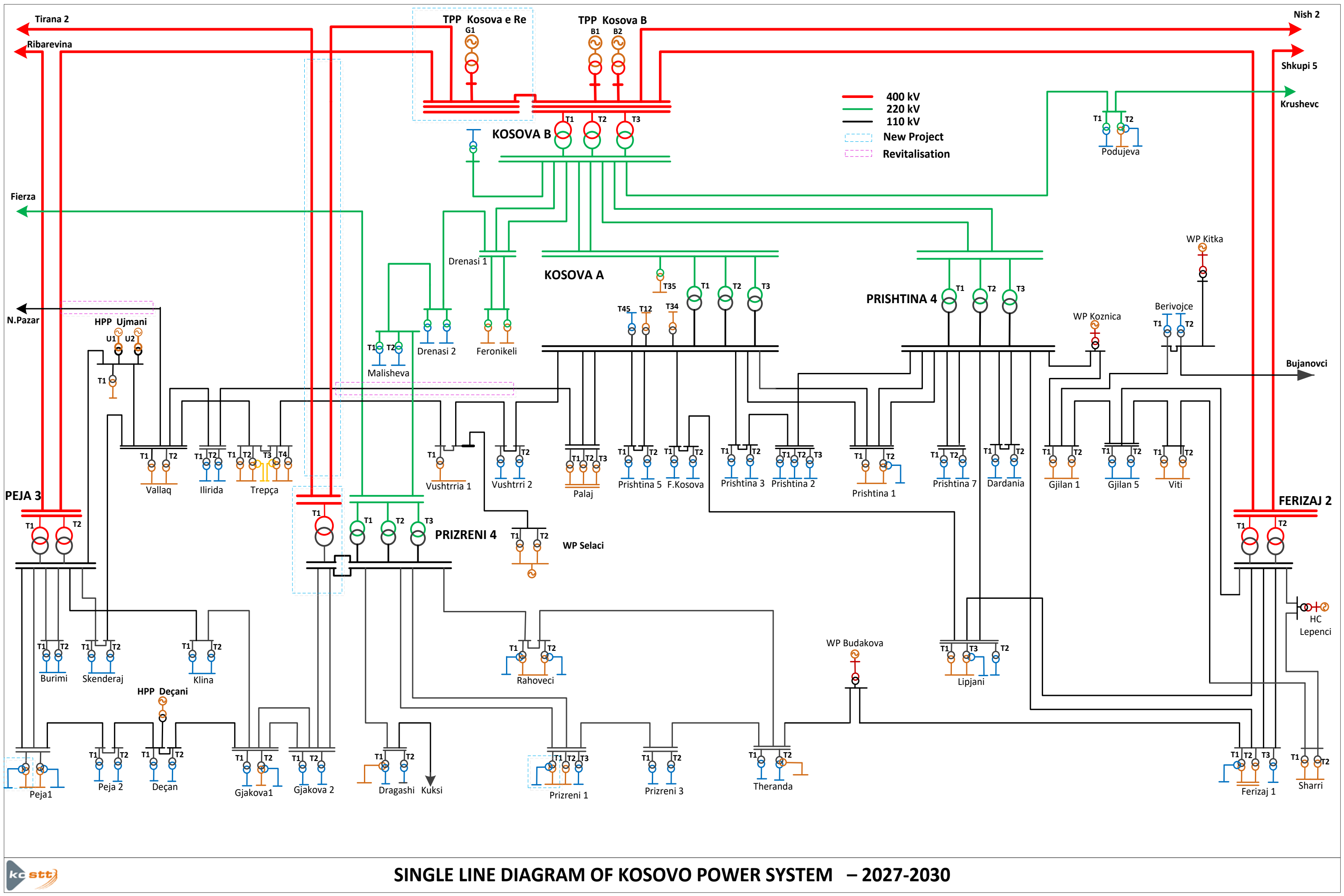


Figura 7-12 Single line diagram of Kosovo EES according to 2027-2030 network topology

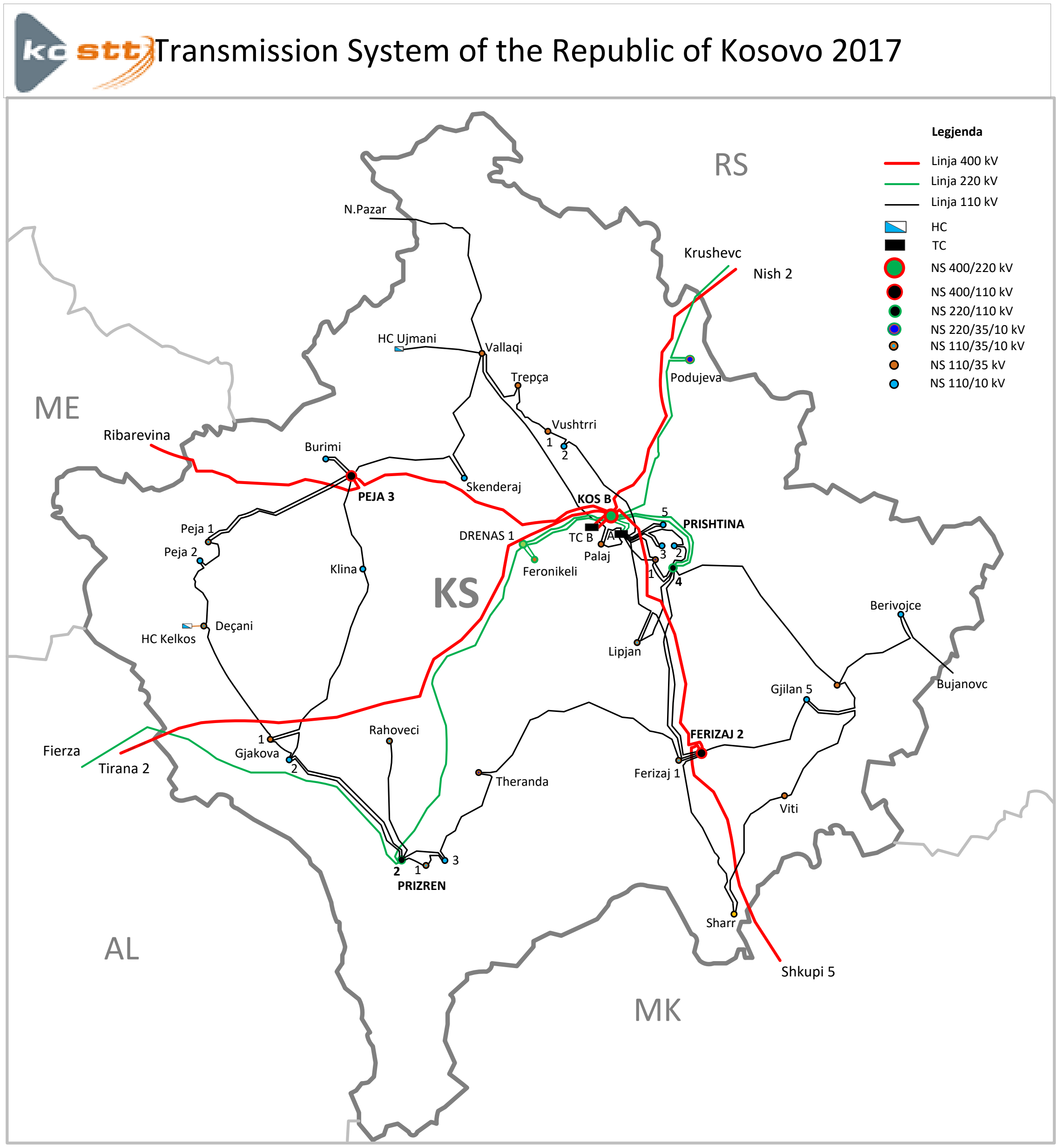


Figure 7-13 Kosovo Power System according to December 2017 network topology

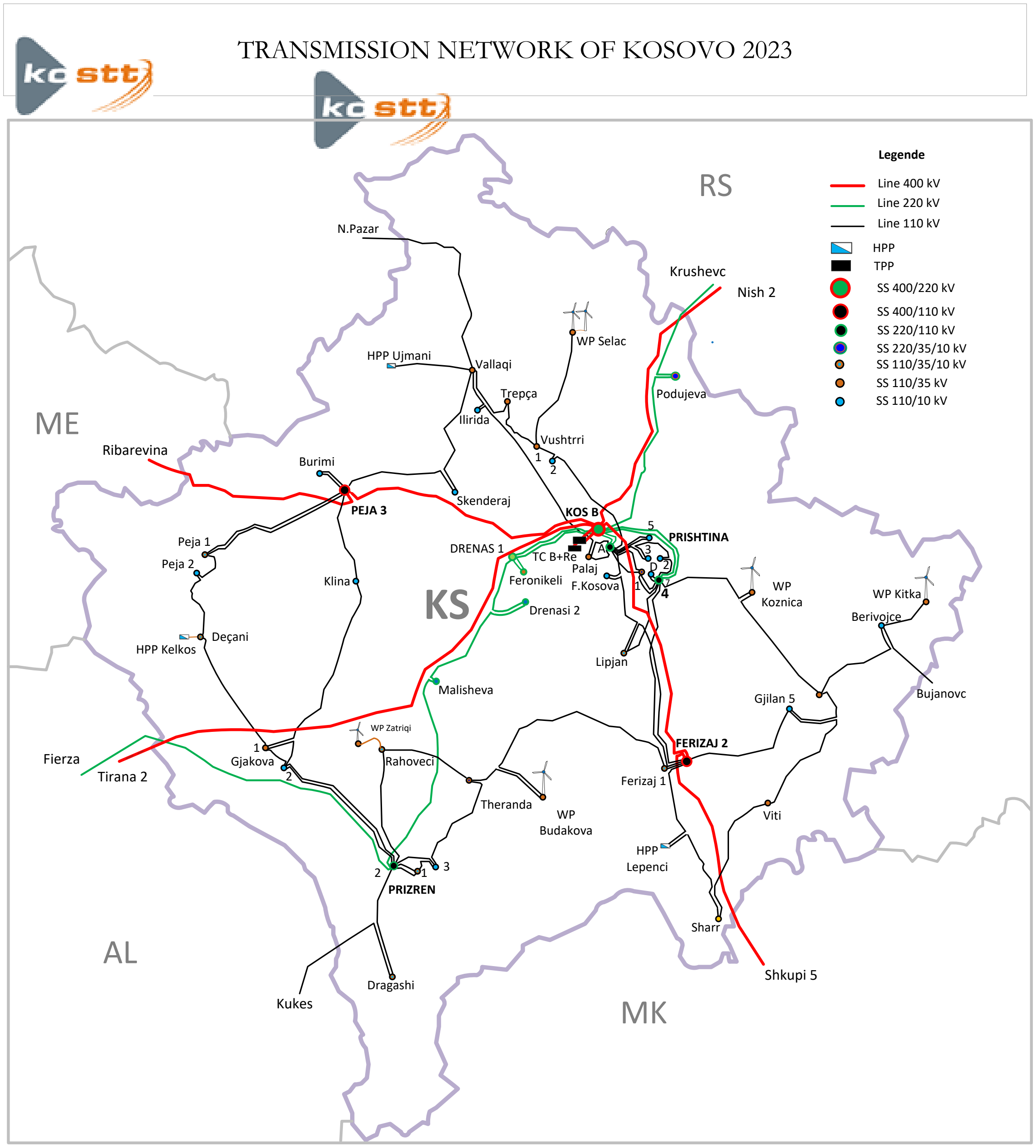


Figure.7-14. Kosovo power network topology 2023

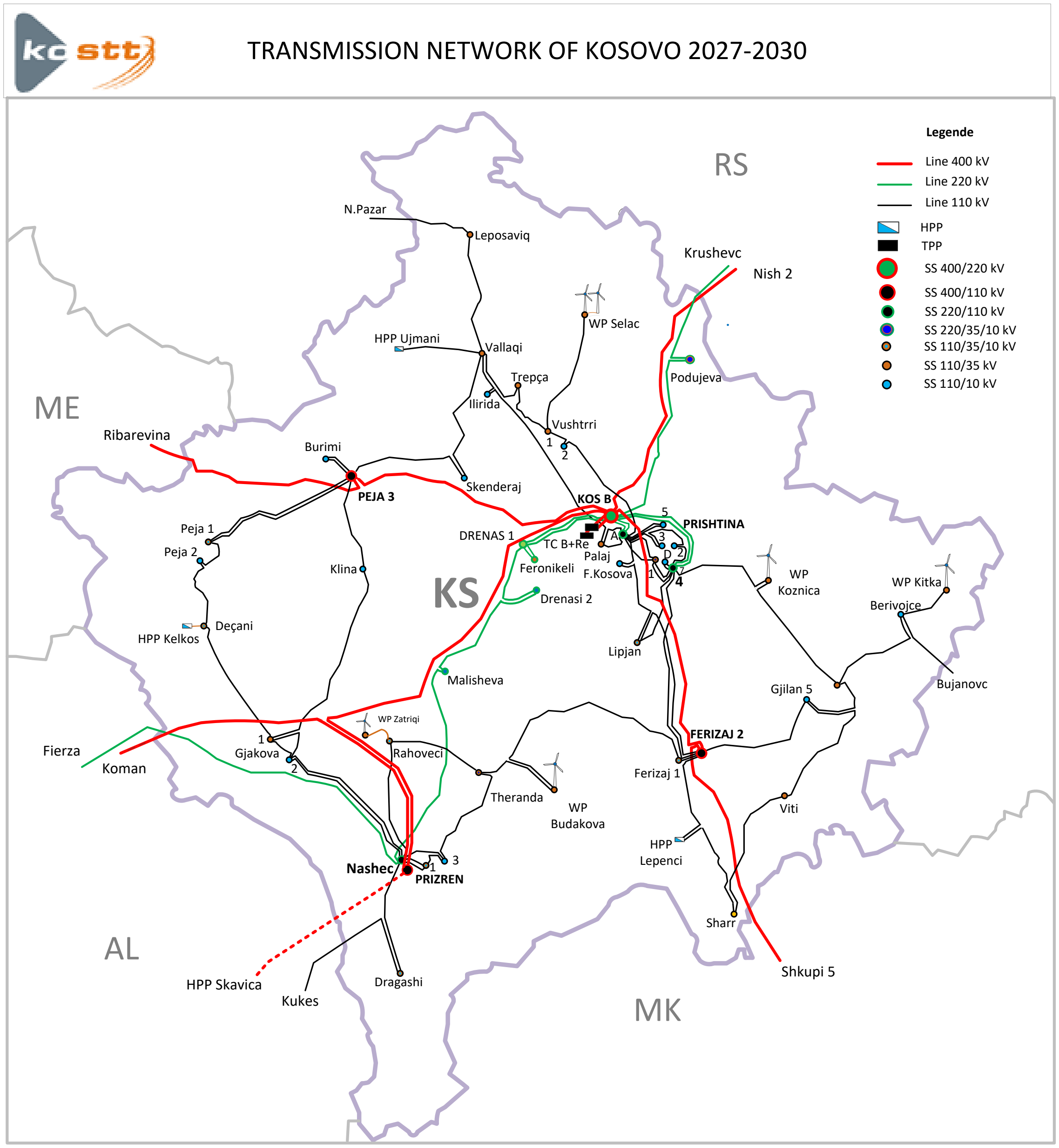


Figure 7-15. Kosovo power network topology 2027-2030

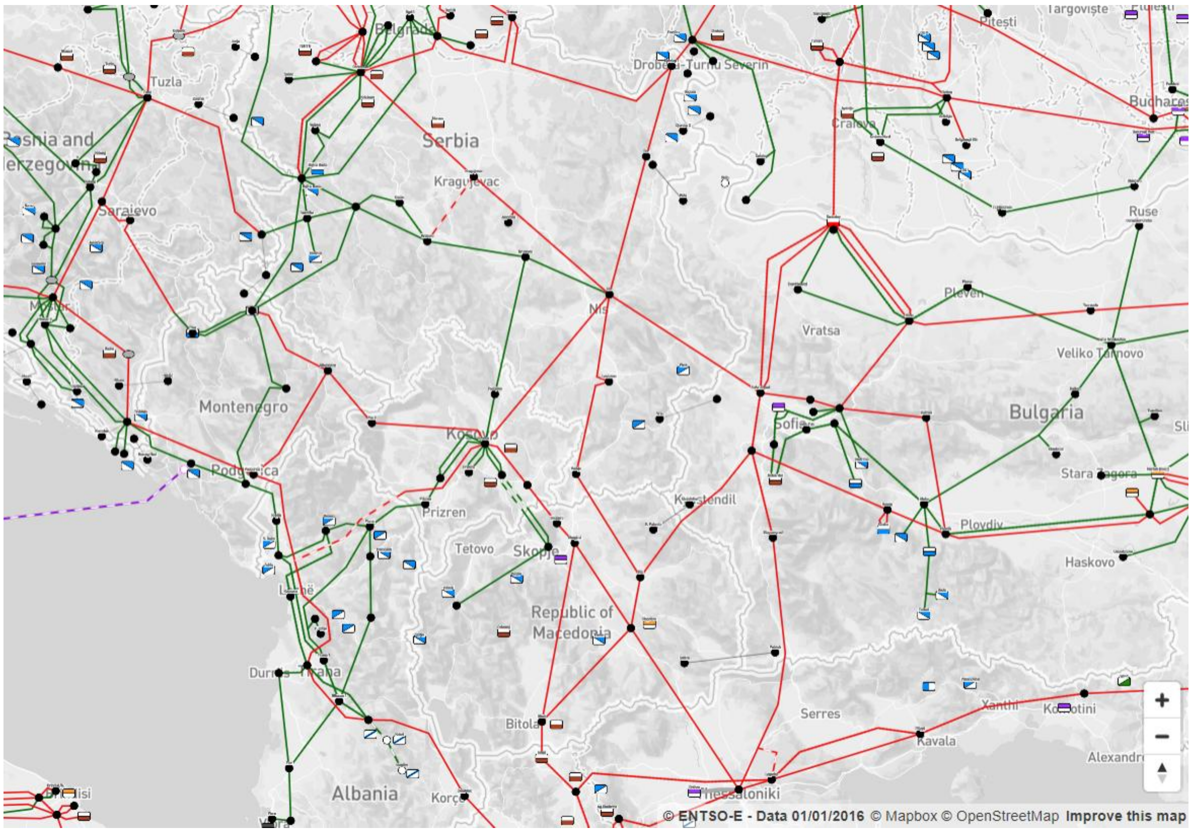


Figure 7-16. Kosovo Power System interconnected to the regional network (ENTSO-E)

8. REFERENCES

The following are references made on published studies and reports:

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(End of the document)