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Development Plan of Distribution System Operator 2019 – 2028

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Abbreviations:

AMR - Automated Meter Reading
BEE – Electricity Balance
CCP - Consumer Care Package
CRMS – Customer Requests Management System
DG – Distribution Generators
GPRS – Package based on communication WiFi
GSM - Global System for Mobile Communication
HHU - Hand Held Unit
KEDS – Kosovo Electricity Distribution Services
KEK – Kosovo Energy Corporation
KOSTT – Operator of System, Transmission and Market J.S.C
LCD - Liquid Crystal Display
LOMAG – Land of Mining and Generation
MMO - Meter Movement Outside
MED – Ministry of Economic Development
NS – Substation
DSO- Distribution System Operator
TSO- Transmission System Operator
PEE – Energy Approval
PLC – Communication through low voltage network (Power Line Communication)
PZH – Development Plan
RRTU –Low Voltage Network
SAIDI – Index of average time duration of interruption of system
SAIFI – Index of average frequency of interruption of system
SCADA – Supervisory Control and Data Acquisition/Energy Management System)
SEE – Power System
SSH - Distribution Switchgear (usually 10/10kV, or 20/20kV)
TL – High Voltage
TM – Medium Voltage
TU – Low Voltage
ZRRE – Energy Regulatory Office



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1. INTRODUCTION

The sector of electricity is a dynamic sector which must be developed continuously. Dependency of society and economic development in system of electricity requires continuous attention and proper / genuine planning. Development plan of the distribution system operator presents the plan of development of distribution network for period 2019-2028, with the purpose to enable a safe and reliable supply with electricity.

The company KEDS, which started its expansion after privatization in 2013 in the Republic of Kosovo, inherited the pros and cons of the distribution network, and has committed and taken responsibility for new investments in the medium and low voltage network, in order to improve the quality of social welfare in terms of electricity supply. The electrical network that inherited, was most deplorable because it had not been invested for many years, including ten years of pre-war as well as very small post-war investments.

During first 5 years of privatization KEDS, as a licensed operator for distribution of electricity (further DSO), has invested over 100 M€, mainly in rehabilitation and reinforcement of distribution network, revitalization of substations and lines, laying of new network and starting of modernization of support systems.

In this document is presented the 10-year Development Plan covering the 2019-2028 investment period. The main objective of this plan is to identify important investment projects that will help improve electricity quality with a particular focus on reducing technical and commercial losses, improving voltage profiles, increasing system reliability, increasing capacity, network rehabilitation and reinforcement, security issues, network expansion and meeting the N-1 criterion. These have been the main issues addressed during network planning and analysis.

Increasing electricity consumption with the addition of new commercial and residential customers, with a strong interest in the inclusion of new renewable energy sources, with high demand from institutions for infrastructure development as a post-war country and with needs implies that DSO (DSO) should also orient its objectives in the development of the electricity distribution system in accordance with the legal requirements and codes at its disposal in order to meet the interests and needs of the society.

For the preparation of the Development Plan, different problems in the network have been identified in advance, priorities have been appointed and after various analyzes and simulations the investment category has been set. Analyzes and simulations are worked on Digsilent's Power Factory software, using data from other departments as well as other software available in the company that are many.

With recent developments in sector of electricity, now possibilities are being created to design and realize strategic sustainable solution. It is worth mentioned that many projects from side of KOSTT are realized, which has influenced in resolving of many limitations in distribution network. Some of projects foreseen of KOSTT are completed in Drenas, Mitrovica and Prishtina 6. But because of non-realization of some



projects from side of KOSTT in regions like Fushë Kosova, Ferizaj, Malishevë and Dragash, some emergency projects in medium voltage network will be realized in year 2019 from DSO with purpose of decreasing the limitations in network, which had big impact to customer and DSO.

1.1 Objectives of long term planning in Distribution System Operator (DSO)

Development plan of distribution system operator is designed to provide a safe and reliable supply with electricity with a reasonable price and to ensure operation of network in transparent method in accordance with commercial principals.

Primary objectives of development plan of distribution system operator are addressed to the following issues according to priorities:

1. Providing sustainable and quality supply with electricity and support of load increase
2. Compliance with standards of operations and performance
3. Decrease of technical and commercial losses.
4. Rehabilitation and modernization of electricity measurement

To fulfill objectives as above, used general strategy, is made of:

- Identification on time of projects of KOSTT that require increase of capacities and improving of existing substations of medium voltage (increase of capacities from level 35 kV to 110 kV), adding in those existing so that KOSTT to include in development plan of transmission network.
- Possible expansion of network 35 kV, to address limitations of load flow and raising the quality of supply only for parts of network, where construction of capacities 110kV and new feeders 10(20) kV is technically and economically impossible.
- Investments in level 10kV that are about the separation of feeders, placing of distribution switchgears, improvement of existing network, etc.
- Replacement of conductors, poles and transformers 10/0,4 kV damaged or fulfilled its economic life, to be in compliance with standards and to guarantee public safety and of supply.
- Replacement of measuring equipment and management of process of reading the metering point of customers and also calculation of energy flows in system.
- Performing of studies to review the variants / options for general rehabilitation of system (by calculating life span of objects, situation of repair and drop of performance), to appoint orientation for standards in the future, increase of capacities (example change of level of voltage of network from 10 kV to 20 kV), and to decrease technical losses in system.
- Putting in use of systems SCADA, dispatch centers and operations linked and business processes for monitoring and control of distribution system.
- Analyze of modeling of network – Software Power Factory.



Development plan for distribution system from distribution system operator will take in consideration the following criteria in accordance with planning criteria in distribution code.

- Sustainable, safe operation and application of standards to offer quality services of electricity.
- Optimal economic use of capacities of distribution system.
- Distribution network loss analysis, including estimation of technical losses and unauthorized consumption of electricity
- Selecting of development alternatives to ensure maximum economic efficiency.
- Economic operation of distribution system in conditions of maximum load.
- Respecting of safety norms and legislation about protection against fire

1.2 Content of plan

Document in question, development plan 2019-2028 of distribution system operator contain in itself the description structured in few chapters, by starting with entrance which mainly is oriented in aims / targets of planning. In second chapter is described the existing situation of network, which includes data on load of lines and transformers, technical losses and other parameters, distributive generators and also information about monitoring, commanding and measurements in system. In third chapter is given description about procedures, methodologies of long term planning, setting the priorities in investments, and practices in planning and operations. The chapter four includes in itself analysis of consumption of electricity and forecast of load in next years.

In chapter five is given description of investments in next years. This planning is more detailed in first years of ten years, since energy system is dynamic system and respectively investments might change significantly to adjust new circumstances. In this chapter initially are described required investments which will be done from side of KOSTT in harmonization with requirements that come from distribution network. Afterwards the necessary investments that are needed in network 35kV, either because of rehabilitation, or fulfilling the criteria N-1. DSO has started also with investments in converting of network to level 20kV, therefore in coming years will be focused more in this direction. In level 10kV investments will be focused mainly towards decreasing the losses, support of loads and rehabilitation of network.

In chapter six is presented examples of cost benefit analysis of projects based on previous experiences, respectively benefits from planned investments in this ten years.

It must be emphasized that DSO because of decrease of commercial losses, is focused also in investments in network of low voltage of category reinforcement of network. These projects include also investments in PLC and MMO. Investments in digitalization of measurements also are in continuation, and which will end with equipping of all customers with smart meters. For more, investments in commanding and monitoring of system as are SCADA and DMS have started one year earlier and will continue their laying / expansion also in other substations.



2. EXISTING SITUATION

Kosovo covers majority part of supply with electricity from primary sources like in following:

- Two power plants (thermos centrals) with ignition of lignite “Kosova A” and “Kosova B” in region of Pristina, with installed capacity 610MW and 678MW
- Generators of renewable sources of electricity: and that mainly hydro centrals, generators with wind and solar panels the capacity of which in under increase

Imports along network of transmission 400 kV, 220 kV and 110kV through TC “Kosova B, NS Peja 3, Ferizaji 2, NS 220kV Prizreni 2, NS 220 kV Podujeva, NS 110kV Bujanovci and NS 110kV Vallaqi. To the transmission network belong also transformers with transformation 220/35/10kV and 110/35/10kV, in the secondary of which are also located DSO equipments, whereas technical border between TSO and DSO stands in transformer bays of secondary of NS above mentioned.

System 110 kV and 220kV serve as main column of supply with electricity of seven districts of Kosovo, respectively distribution network. Districts use systems 35 kV and 10 kV to distribute electricity in locations, by supplying after majority of customers through distribution transformers 10/0.4 kV.

2.1 Projects completed during last years

Taking in consideration that distribution network is privatized in year 2013 and DSO has inherited one damaged network and old because of missing of investments before the war (1999) and also neglecting of investments along the first decade of year 2000, capital investments in past years were oriented in rehabilitation and reinforcement of network in level of low voltage and medium voltage, in replacing of overloaded transformers of TM/TM and TM/TU. In year 2017 has started also pilot project of converting from level 10kV to level 20kV, in two feeders 10kV, this project which will continue also in other years.

Projects worked from contractors and/or from teams of DSO in past years were:

- Projects in network of medium voltage
- Projects in converting in voltage level 20kV
- Projects of network reinforcement in low voltage including projects MMO and project PLC
- Replacement of transformers 10/0.4kV distributive overloaded
- Reconstruction of network of medium voltage or low voltage
- Projects in digitalization of meters
- Project for monitoring and commanding SCADA, DMS etc



In below table is given the description of these projects in last years

Table 1 – Projects realized during years 2015-2018

| Number | Project | NAME / DESCRIPTION |
|--------|--|--|
| 1 | Investments in MV 10kV | Juniku, Gllobari me Shtrubullove, Klina, Klinavci, Letanci me Llaushë, Gjinovci, Orllani, Shala-Betonjerke, Lumimadh me Prugovc, Apollonia, Bablak |
| 2 | Investments in level 20kV | Breznica, Drenica and Runiku |
| 3 | Investments in level 35kV | Rehabilitation of lines: Kosova A-Drenas 2016, Magure-P.Biznesit 2016, Kosova A-F.K |
| 4 | Replacement of transformers 10/0.4kV distributive overloaded | year 2015-160 TR year-2016- 173 TR year 2017-138 TR year 2018 – 39 TR |
| 5 | Projects of network reinforcement 2015-2018 with PLC and MMO | Are installed -21,664 PLC -299 TR -167km cable/conductor MV -1102km cable/conductor LV etc. |
| 7 | TR 35/10kV | Are added new transformers or is increased capacity of those existing 39MVA, also are replaced the old with new 4MVA and 8MVA |
| 8 | Installation of distribution switchgears | Added 88 switchgears without TR and 109 switchgears with TR, |
| 9 | Installation of SCADA central and local | In year 2018 are completed SCADA in 21 SS and 362 relays will be used for monitoring and control |

It is worth mentioning that majority of projects are focused in important efforts for reinforcement and expansion of network of medium voltage and low voltage in seven districts, preparation of network for transfer from level 10kV to level of voltage 20kV, construction of new substations 10/0.4kV, installation of distribution switchgears (SSH), expansion of existing substations so that is covered the existing load and also to offloaded (discharged) load from substations 35/10kV.



2.2 Existing Assets of Distribution Network

Company for distribution of electricity possess very big electro energy network of level medium voltage and low voltage. It is planned to start Geographical Information System (GIS) for distribution network and after finalizing the project it will be possible to give accurate data for distribution lines in medium and low voltage level, current data are inherited form KEK time and we continued reporting from that numbers. So in this part of the report it is aimed to give measurable data such as number of transformers and installed power of them.

Medium and low voltage power lines are presented below:

- 513km in level of network 35kV (from them 483km air network and 30km cable network)
- 5,070km in level 10kV (from them 4,165 air network and 904km cable network)
- 1,878km in level 10kV with possibility 20kV (1463km air network and 414km cable network)
- 50km in level 6kV (42km air network and 8km cable network)
- 5km in level 3kV (4km air network and 1km cable network)
- 20,024km in low voltage network (RRTU) in level 0.4kv (from them 17,558km air network and 2,466km cable network)

Transformation capacities in network of medium voltage and low voltage are:

- 44 NS 35/10kV, which belong to KEDS, with a total of 95 transformers with an installed power of 668 MVA
- 29 NS 35/10kV, 35/6kV, 35/0.4kV, which do not belong to KEDS with a total of 42 transformers and an installed power of 122MVA
- 5,388 TS 10(20)/0.4kV, 10/0.4kV and 6/0.4kV that belong to KEDS with total 5,482 transformers with installed power 2,184MVA
- 3,256 TS 10(20)/0.4kV, 10/0.4kV and 6/0.4kV that don't belong to KEDS with total 3,272 transformers with installed power 1,550MVA

2.3 Performance of lines and distribution substations existing

Distribution System Operator is organized in seven districts. Problems in performance of distribution network (as are: overloads of lines and transformers) with which our company faced are lines and substations in each district shown in tables below that present only those with problems.

Standard type of conductor of air lines of DSO is Al/Çe, whereas standard type of conductor of cable lines is with aluminum but there are also with copper. All new cables are of type XHE or NA2XS(F)2Y.

Network of lines 35 kV in general is implemented and operated as over head lines. Main section of conductor in use at over head lines 35kV is Al/Çe with section 70mm², 95 mm², 120 mm². In network



35kV is in use also some limited length of underground cables of type IPO, XHP and XHE with section of 95 mm² and 120 mm² and 150 mm².

In tables 2 and 3 is shown performance of some of lines 35kV selected according to highest loads and the highest technical losses during year 2018.

Table 2 – Performance of overloaded lines in level 35kV taken from 2018

| No. | Lines 35kV | Capacity | Maximum power | | Voltage in the end of line |
|-----|---------------------------|----------|---------------|--------|----------------------------|
| | | MW | MW | (%) | p.u |
| 1 | Rahovec- Malishevë | 16.91 | 23.77 | 140.58 | 0.82 |
| 2 | Bibaj- Ferizaj III | 20.12 | 25.88 | 128.61 | 0.938 |
| 3 | Prizren 1- Zhur | 13.7 | 16.64 | 121.48 | 0.88 |
| 4 | Lipjan- Magure | 16.91 | 19.03 | 112.53 | 0.964 |
| 5 | Gjilan- Gjilan I | 16.91 | 18.57 | 109.83 | 0.935 |
| 6 | Rrafshinë- Kllokot | 16.91 | 18.35 | 108.51 | 0.947 |
| 7 | Prishtinë 1- Mazgit | 16.91 | 18.1 | 107.01 | 0.935 |
| 8 | TC 'A'- Mazgit | 16.91 | 17.84 | 105.49 | 0.917 |
| 9 | Prishtinë 1- Fushë Kosovë | 16.91 | 17.82 | 105.37 | 0.917 |
| 10 | Kosovë 'A'- Drenas | 20.12 | 20.68 | 102.77 | 0.884 |
| 11 | TC A- Fushë Kosovë | 16.91 | 17.34 | 102.56 | 0.871 |

During operation in winter season in these lines are achieved loads over 100%. Based on analysis of year 2018, line 35kV NS Rahovec– NS Malisheva with capacity of 16.91 MW, is most loaded line with 40% more over nominal capacity and has technical losses higher because of big length of this line. The last column shows voltage in the end of line which is 28.7 kV in SS Malisheva.

Table 3 – Performance of technical losses in selected lines 35kV during year 2018

| No. | Overhead line LP 35kV | Energy | Technical losses | |
|-----|---|---------|------------------|------|
| | | (MWh) | (MWh) | (%) |
| 1 | NS Rahovec- NS Malisheva | 96,204 | 5,283 | 5.49 |
| 2 | NS Kosova A- NS Drenas* | 92,489 | 5,261 | 5.69 |
| 3 | NS Lipjan – NS Magure | 99,437 | 3,362 | 3.38 |
| 4 | NS Vushtrri 1- NS (Skenderaj)-NS Mitrovice II * | 41,782 | 2,249 | 5.38 |
| 5 | NS Prizreni 1- NS Zhur | 48,265 | 1,896 | 3.93 |
| 6 | NS Bibaj- NS Kaqanik | 41,293 | 1,877 | 4.55 |
| 7 | NS Lipjan- NS Shtime | 59,491 | 1,307 | 2.2 |
| 8 | NS Bibaj- NS Ferizaji II | 73,512 | 1,231 | 1.67 |
| 9 | NS Bibaj- NS Ferizaji III ** | 34,448 | 1,133 | 3.29 |
| 10 | NS Trepca- NS Mitrovice II vj dhe e re * | 109,522 | 1,230 | 1.12 |

* eliminated voltage as 35kV due to the investments by KOSTT side with new substations

**is being reinforced with additional investments



In this year are eliminated lines 35kV Kosova'A'-Drenas, line Trepçe-Mitrovice II and line Trepçe-Shupkovc, and also line 35kV Vushtrri 1-Mitrovice. Must be explained that elimination does not mean disappearance of network, but elimination of level 35kV, which can be used for network of voltage 10kV or 20kV in the future. Development Plan foresees that also other lines 35kV overloaded and loaded over 100% to be eliminated with raising of voltage level from 35kV to 110kV, or by building a new 35kV lines through which project we will benefit / gain the decrease of technical losses, increase of distribution capacity and also increase of quality of electricity.

In table 4 is presented performance of substations 35kV, without including here problems about the feeders in these substations. Must be emphasized that in certain cases, these transformers, would be loaded even more, if allowed by the capacity of lines, as example transformers in Malisheva, Fushë Kosovë etc.

Table 4 - Performance of substations 35/10kV in January 2018

| No. | District | Substation | Voltage level | Transformation capacity (MVA) | Max load (MVA) | NOC Max load (%) |
|-----|----------|--------------|---------------|-------------------------------|----------------|------------------|
| 1 | DPR | Prishtina II | 35/10kV | 8 | 8.13 | 101.63 |
| 2 | DPZ | Zhuri | 35/10kV | 8 | 7.82 | 97.80 |
| 3 | DGL | Gjilani II | 35/10kV | 8 | 7.66 | 95.76 |
| 4 | DMI | Shupkovc | 35/10kV | 16 | 15.07 | 94.21 |
| 5 | DPR | Mazgiti | 35/10kV | 16 | 15.03 | 93.97 |
| 6 | DGJ | Malisheva | 35/10kV | 24 | 22.50 | 93.74 |
| 7 | DGJ | Gjakova I | 35/10kV | 24 | 21.74 | 90.60 |
| 8 | DFE | Ferizaji I | 35/10kV | 16 | 14.15 | 88.44 |
| 9 | DGJ | Gjakova III | 35/10kV | 8 | 7.04 | 87.98 |
| 10 | DFE | Shtime | 35/10kV | 16 | 13.89 | 86.82 |

Network of lines 10kV in city and other urban parts is of type ring, whereas in rural parts is of type radial. For air lines 10kV used conductor of type Al/Çe 3x35mm² in wooden poles and Al/Çe 3x50 mm² or Al/Çe 3x70 mm² in concrete poles. For underground lines 10kV used type of cable XHP 1x150 mm². In old lines 10kV there is no possibility to pass to the level 20kV of voltage, whereas all new lines 10kV are designed for operation in 20kV in the moment when there will be increase of capacities in network 10kV.

In table 5 was given performance of 10kV problematic feeders and their classification based on technical losses. It is seen that these feeders have also big load of lines and also big drops of voltage. Each of them has also a big number of customers.



In feeder Drenica, NS Magure and feeder Breznica from NS Mazgiti is being invested in converting from level 10kV to 20kV and energizing of feeder expected to be completed in year 2019.

In lines 10kV Juniku, Drenica, Klinavci, Shala, Letanci, Hogosht and Kastrati the investments have started in year 2017 and in year 2018 projects are completed. Impact of investments of these lines will be seen in reports of year 2019. In the feeder Runiku, 20 kV conversion project is started and line will be energized and will be started to be operated as 20 kV in 2019.

Table 5 Performance of lines 10kV according to highest technical losses in year 2018

| No. | District | Feeder 10 kV | Energy | Technical losses in 10 kV | | Pmax | Voltage | Customers |
|-----|-----------|-------------------|--------|---------------------------|-------|------|---------|-----------|
| | | | MWh | MWh | % | MW | [p.u] | Number |
| 1 | Ferizaj | Drenica* | 19,887 | 4,776 | 24.02 | 4.36 | 0.6 | 2,552 |
| 2 | Pejë | Juniku* | 21,415 | 3,584 | 16.73 | 5.32 | 0.8 | 2,754 |
| 3 | Prizren | Zhupa*** | 20,040 | 2,780 | 13.87 | 4.54 | 0.78 | 3,879 |
| 4 | Prishtinë | Gllobari* | 21,175 | 2,731 | 12.9 | 5.27 | 0.86 | 1,991 |
| 5 | Gjakovë | Kijeva | 14,885 | 2,515 | 16.9 | 3.17 | 0.65 | 1,860 |
| 6 | Gjakovë | Mirusha | 16,588 | 2,365 | 14.26 | 3.92 | 0.76 | 1,961 |
| 7 | Gjakovë | Denji | 14,581 | 2,361 | 16.19 | 3.63 | 0.83 | 1,528 |
| 8 | Pejë | Onix | 13,912 | 2,299 | 16.53 | 3.31 | 0.74 | 1,885 |
| 9 | Prizren | Mushtishti | 23,578 | 2,080 | 8.82 | 7.26 | 0.86 | 3,090 |
| 10 | Ferizaj | Kosovapetroli** | 17,280 | 1,987 | 11.5 | 4.47 | 0.63 | 1,377 |
| 11 | Ferizaj | Sllovia | 15,502 | 1,953 | 12.6 | 4.09 | 0.77 | 2,314 |
| 12 | Prishtinë | Shtrubullova* | 14,560 | 1,693 | 11.63 | 3.07 | 0.8 | 1,436 |
| 13 | Pejë | Barani(Prapaqani) | 18,962 | 1,886 | 9.95 | 4.84 | 0.72 | 2,233 |
| 14 | Ferizaj | Gadime | 13,827 | 1,853 | 13.4 | 3.02 | 0.88 | 1,897 |
| 15 | Mitrovicë | Shipoli | 19,112 | 1,844 | 9.65 | 4.55 | 0.77 | 2,021 |
| 16 | Gjakovë | Bellanica | 12,029 | 1,831 | 15.22 | 3.06 | 0.83 | 1,863 |
| 17 | Prizren | Kamenica | 24,346 | 1,818 | 7.47 | 6.13 | 0.92 | 1,470 |
| 18 | Prishtinë | Fshatrat 2 | 18,524 | 1,798 | 9.71 | 4.26 | 0.74 | 1,648 |
| 19 | Ferizaj | Bablaku* | 12,860 | 1,731 | 13.46 | 3.25 | 0.8 | 1,445 |
| 20 | Mitrovicë | Maxhunaj | 16,017 | 1,627 | 10.16 | 3.85 | 0.91 | 1,947 |

*in these feeders has been invested in previous years and in some of them investment is completed in 2019

**will be invested in year 2019

*** has been invested earlier, but investment had the purpose to rehabilitate of one branching of feeder 10kV, therefore this feeder still appears as problematic feeder and needs to be converted in 20kV

By placing distribution switchgears in branching's of radial lines where number of interruptions and their time duration is higher, these switchgears have helped better management concerning the interruptions and finding faster of location where it happens. These switchgears are placed from teams of operations and from side of investments during implementation of projects in medium voltage.



Below table shows Saidi and Saifi calculated for each feeder in year 2018. Last column shows number of customers affected from these interruptions. There is given index of average time duration of interruption of system SAIDI and index of average frequency of interruption of system SAIFI.

Table 6 – Performance of lines 10kV selected according to SAIDI higher in 2018

| No. | District | Feeder 10kV | SAIDI average | SAIFI average | TR 10/04 kV No. | Customer No. |
|-----|-----------|-------------|----------------------|------------------------------|--------------------|-----------------|
| | | | hour/cust./ month | Interruption /cust./month | | |
| 1 | Peja | Juniku* | 1.94 | 0.84 | 56 | 2740 |
| 2 | Ferizaji | Drenica* | 1.82 | 0.9 | 51 | 2544 |
| 3 | Gjakova | Cermjani | 1.08 | 0.74 | 41 | 1684 |
| 4 | Peja | Klinavci* | 1.06 | 0.37 | 20 | 621 |
| 5 | Mitrovica | Shala* | 0.99 | 0.71 | 58 | 1716 |
| 6 | Mitrovica | Runiku** | 0.98 | 0.7 | 47 | 1774 |
| 7 | Prizreni | Restelica | 0.97 | 0.27 | 20 | 3268 |
| 8 | Peja | Radavci | 0.94 | 0.59 | 48 | 2270 |
| 9 | Ferizaji | Sllovia | 0.92 | 0.61 | 38 | 2311 |
| 10 | Peja | Dubrava | 0.9 | 0.37 | 54 | 1857 |
| 11 | Peja | Baran | 0.89 | 0.46 | 56 | 2225 |
| 12 | Prishtina | Letanci* | 0.81 | 0.4 | 46 | 1944 |
| 13 | Mitrovica | Likovci | 0.8 | 0.63 | 49 | 1921 |
| 14 | Mitrovica | Novolani | 0.8 | 0.5 | 39 | 1639 |
| 15 | Mitrovica | Turiqevci | 0.79 | 0.6 | 52 | 1917 |
| 16 | Ferizaji | Caraleva | 0.78 | 0.61 | 42 | 1535 |
| 17 | Prishtina | Llapushnik | 0.74 | 0.39 | 43 | 1642 |
| 18 | Gjilani | Hogoshti** | 0.73 | 0.52 | 42 | 1457 |
| 19 | Prizreni | Mushtishti | 0.73 | 0.4 | 54 | 3075 |
| 20 | Peja | Kastrati*** | 0.7 | 0.43 | 49 | 1404 |

*Investments completed in year 2019

**Investments in continuation

***Feeder that has been indirectly implicated in investment

Parameters in low voltage network are based mainly in BEE in substation regions, which compares value measured of electricity in entrance of NS 10/0.4kV with billing of customers. This comparing for Tr 10/0.4kV is taken according to day of reading of customers.

In below table are shown total losses (technical and commercial) in medium voltage network for year 2019, the data are based on sub districts and according to higher percentage of losses. From table is seen that precedes the municipality of Podujeva, Drenasit, Mitrovicës, Obiliqit and Deçani have highest losses. This shows in which direction should be focused investments in low and medium voltage network for improving the technical losses and stopping of commercial losses.



Table 7 Performance in network of low voltage, based on BEE (January – December) 2018

| No. | District | Subdistrict | Input Energy MWh | Billing MWh | Total Losses MWh | Total losses (%) |
|-----|-----------|---------------|------------------|-------------|------------------|------------------|
| 1 | Prishtinë | Podujeva | 204,253.10 | 115,948.80 | 88,304.31 | 43.23 |
| 2 | Prishtinë | Drenasi | 110,815.53 | 64,780.00 | 46,035.53 | 41.54 |
| 3 | Mitrovicë | Mitrovicë | 199,119.84 | 130,523.83 | 68,596.01 | 34.45 |
| 4 | Mitrovicë | Skenderaj | 84,897.74 | 56,788.82 | 28,108.92 | 33.11 |
| 5 | Mitrovicë | Vushtrria | 156,609.57 | 106,643.65 | 49,965.93 | 31.9 |
| 6 | Prishtinë | Kastrioti | 109,305.28 | 74,475.86 | 34,829.42 | 31.86 |
| 7 | Pejë | Deçan | 90,163.33 | 62,116.11 | 28,047.22 | 31.11 |
| 8 | Gjakovë | Malisheva | 83,145.33 | 62,127.51 | 21,017.82 | 25.28 |
| 9 | Pejë | Istog | 83,021.89 | 62,330.80 | 20,691.08 | 24.92 |
| 10 | Prishtinë | Prishtina III | 286,328.11 | 216,197.91 | 70,130.20 | 24.49 |

2.4 Generations connected in network of distribution system

Distributed units of generation are sources of de-centralized of low generating capacities which can connect in levels of medium voltage or low voltage in distribution network. Use of distributive generators in network offers gains / benefits for customers, suppliers and society. However, exist technical issues for connections of distributive generators that are related to reliability, quality of supply, protection, deviations of voltage and levels of short circuit.

Generations connected in distribution system are one important source that help in operation of distribution system, it decreases imports, technical losses, voltage drops and in certain cases offers advantage about the issues of environment.

Regulation of voltage, shaking / vibration of voltage, harmonics and injection of DG are main qualities of supply. Issues of protection are with high importance for equipment DG and also for equipment of network. Issues of protection from DG depend from type of generator, characteristics of network, from type and location of installation of DG etc. All these are described in network code.

Actual risks (dangers) of distribution system from parallel operation of small generators, that represent only one small part of capacity of local network of distribution, usually are manageable. But cumulative effects of many generators would be one other issue that company should take in consideration.

In last years the requests for installation of distributive generators (water, solar or wind) are in ongoing increase. All these requests are evaluated from company and energy approvals for connection in distribution network are given in accordance with legislation in force and technical conditions of



network. In below table is given number of requests and installed power of generators, as indication that shows big interest of investors in this field.

Table 8 Distributive generators in last years (implemented and in process)

| Hidro | No. | Installed power (kVA) |
|--------------------|-----|-----------------------|
| Biomass | No | Installed power(kVA) |
| Request | 1 | 1,200 |
| Energy permission | 1 | 1,200 |
| Hydro | No | Installed power(kVA) |
| Request | 42 | 238,289 |
| Energy permission | 17 | 73,320 |
| Not subject to DSO | 8 | 55,760 |
| Operation | 11 | 97,485 |
| Pending | 6 | 11,724 |
| Prosumers | No | Installed power(kVA) |
| Request | 61 | 2,841 |
| Energy permission | 50 | 2,046 |
| Operation | 5 | 33 |
| Pending | 6 | 762 |
| Solar | No | Installed power(kVA) |
| Request | 27 | 98,570 |
| Energy permission | 7 | 18,400 |
| Not subject to DSO | 11 | 64,030 |
| Operation | 7 | 10,140 |
| Pending | 2 | 6,000 |
| Wind | No | Installed power(kVA) |
| Request | 2 | 36,350 |
| Not subject to DSO | 1 | 35,000 |
| Operation | 1 | 1,350 |
| Grand Total | No | Installed power(kVA) |
| Request | 133 | 377,250 |
| Energy permission | 75 | 94,966 |
| Not subject to DSO | 20 | 154,790 |
| Operation | 24 | 109,008 |
| Pending | 14 | 18,486 |

In below figures are given production capacities of generators of category hydro in total for year 2018. Monthly energy and capacities available depend so much from water available and hydrology of one appointed / certain year. Values for one average hydrology year are shown in table 8 and in the following figures =.



It must be emphasized that by having in consideration nature of these hydro – objects and monthly flows of water available, the higher available capacity and production of energy of these centrals appears during spring season and does not coincide with annual request during peak of system.

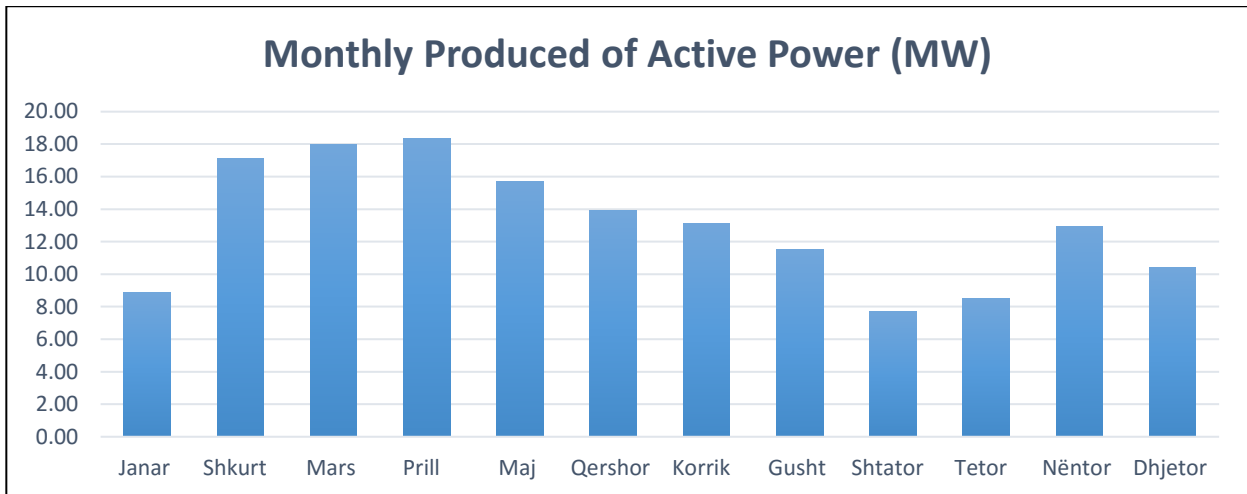


Figure 1 – Small existing HPP – total monthly available capacity

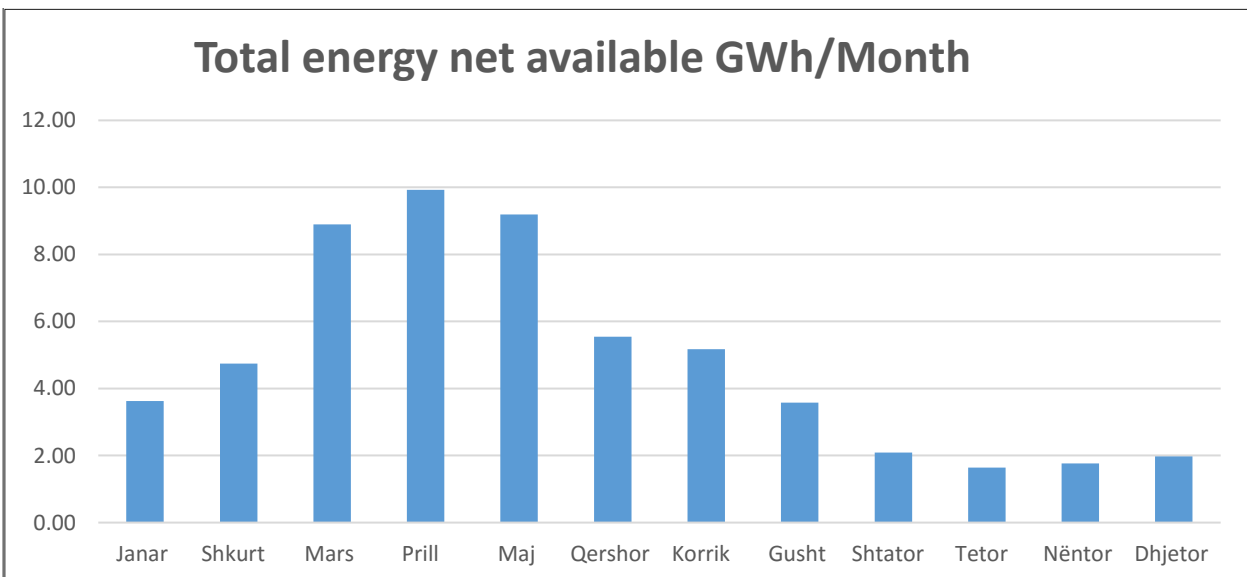


Figure 2 – HC small existing – total monthly energy available



2.5 Measurements, monitoring and commanding of distribution system

2.5.1 Measurements

Main challenges which have faced the distribution system operator in fields of measurement of electricity consumed from customers and calculation of energy are classified below.

- Interventions in meter
- Old age of meters
- Customers without meters and difficulty to access locations of customer
- Non closure of equipment where are installed meters
- New connections
- Accuracy, maintenance and calibration of meter, etc.

Mechanical meters in Kosovo are very old meters (produced before year 2000) and as such is very costly and difficult their maintenance, especially because some from parts that must be replaced are missing in market, since those are not produced anymore as such.

Electronic meters are those that display energy consumed in LCD. Except measurement of energy consumed, these meters can register also other parameters of load and supply, such as momentary values of energy and maximum power P_{max} , profile of load, voltages, currents, etc. They also enable registrations for billing, by registering amount of energy consumed according to daily and seasonal tariffs.

Smart meters also display energy of customer in LCD, but they also can transmit readings in distance and also possibility of connection – disconnection from distance. Except measurement of energy consumed, these meters can register also other parameters of load and supply, as are momentary values of energy and maximum power P_{max} , profile of load, voltages, currents, power factor, reactive energy, etc. Further they make possible registration of billing by registering quantity of energy consumed according to daily and seasonal tariffs. Smart meters enable communication in both sides method between meter and central system in different methods of communication.

During year 2018 was invested in meters like in following:

- 5,363 meters with direct measurement with communication GSM GPRS;
- 17,727 meters with direct measurement with PLC;
- 614 meters with semi indirect measurement and indirect measurement, from which 160 are new meters and 454 replaced meters;
- 13,899 mechanical meters that are replaced to digital; and
- 25,734 meters dedicated for new connections;



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These meters are installed from different departments, not only from department of new connections, but also from department of losses, measurements and department of operations.

Table 9 shows information about the old age of meters installed in locations of customers. This information in these tables was used for development of one strategy for measurement which will help in focusing of investment in one effective approach and oriented in results to decrease commercial losses, improve balance of electricity and to assist in regulation of reading of customers.

Until now in July of year 2019 are found / located 587,609 meters in total. Here are included all active customers, residential consumers, commercial, etc.



Table 9 – Presentation of meters according to old age in districts

| District | Total | < 10 years | | 10 - 20 years | | 20 - 30 years | | 30 - 40 years | | > 40 years | | No production year | |
|------------------|----------------|----------------|--------------|----------------|--------------|---------------|-------------|---------------|-------------|---------------|-------------|--------------------|-------------|
| | | Number | % | Number | % | Number | % | Number | % | Number | % | Number | % |
| Prishtina | 174,216 | 143,305 | 82.3 | 17,225 | 9.9 | 2,892 | 1.7 | 2,784 | 1.6 | 2,295 | 1.3 | 5,715 | 3.3 |
| Prizreni | 84,123 | 65,234 | 77.5 | 5,683 | 6.8 | 3,918 | 4.7 | 4,171 | 5 | 3,824 | 4.5 | 1,293 | 1.5 |
| Ferizaji | 82,666 | 67,096 | 81.2 | 6,850 | 8.3 | 2,973 | 3.6 | 2,137 | 2.6 | 1,617 | 2 | 1,993 | 2.4 |
| Peja | 68,721 | 55,556 | 80.8 | 7,524 | 10.9 | 2,697 | 3.9 | 788 | 1.1 | 785 | 1.1 | 1,371 | 2 |
| Gjilani | 65,313 | 48,566 | 74.4 | 8,689 | 13.3 | 2,655 | 4.1 | 2,783 | 4.3 | 1,337 | 2 | 1,283 | 2 |
| Mitrovica | 56,647 | 49,062 | 86.6 | 4,194 | 7.4 | 1,268 | 2.2 | 606 | 1.1 | 768 | 1.4 | 749 | 1.3 |
| Gjakova | 55,923 | 43,920 | 78.5 | 4,546 | 8.1 | 2,842 | 5.1 | 2,373 | 4.2 | 1,755 | 3.1 | 487 | 0.9 |
| Year 2019 | 587,609 | 472,739 | 80.5 | 54,711 | 9.3 | 19,245 | 3.3 | 15,642 | 2.7 | 12,381 | 2.1 | 12,891 | 2.2 |
| Year 2014 | 494,538 | 226,662 | 45.83 | 104,407 | 21.11 | 42,219 | 8.54 | 48,020 | 9.71 | 32,942 | 6.66 | 40,288 | 8.15 |

In table 9, is seen that by comparing year 2019 with year 2014 is seen one big improvement about the situation of old meters and their replacement with electronic meters or smart meters. In year 2014 there were 54.17% of meters without production year and older than 10 years. Number of meters that were younger than 10 years was 45.83%. After almost five years, in year 2019, this number of meters older than 10 years has decreased to 19.6% and has increased to 80.5% of meters that are younger than 10 years.



2.5.2 Communication through PLC

PLC projects (communication of line of energy – communication through conductors) include mounting /installation of meters PLC on side of network 0.4 kV of transformer 10/0.4kV, where also reading of meters is done through concentrator (equipment that collects data of meters PLC) through lines of network.

Registers from measurements (data) are collected / gathered from concentrator on regular daily bases by including reading of all their data, which after are transferred in database. These data are used for billing of customers and for different analyzes according to specific requests. Concentrator usually is placed in object of substation TS 10/04 close to control meter (also with reading from distance). This way, we have data for energy registered from substation TS 10/04 and energy that customers consume through meters PLC. In this way we have under control balance of energy of substations TS 10 / 0.4.

Concentrator can collect the data for over 1000 meters PLC. Communication PLC which is done through lines of network 0.4 kV which means no need making additional investments in communication equipment has resulted as one very successful communication. In figure is shown communication PLC of one concentrator which collects the data. By analyzing all meters with communication PLC on daily bases, there is communication with over 98% with all meters.

Until the year 2018 has been invested in 250 projects PLC laid in whole territory of Kosovo and where have benefited 21 800 customers. These projects are mainly linked with projects MMO of investments.

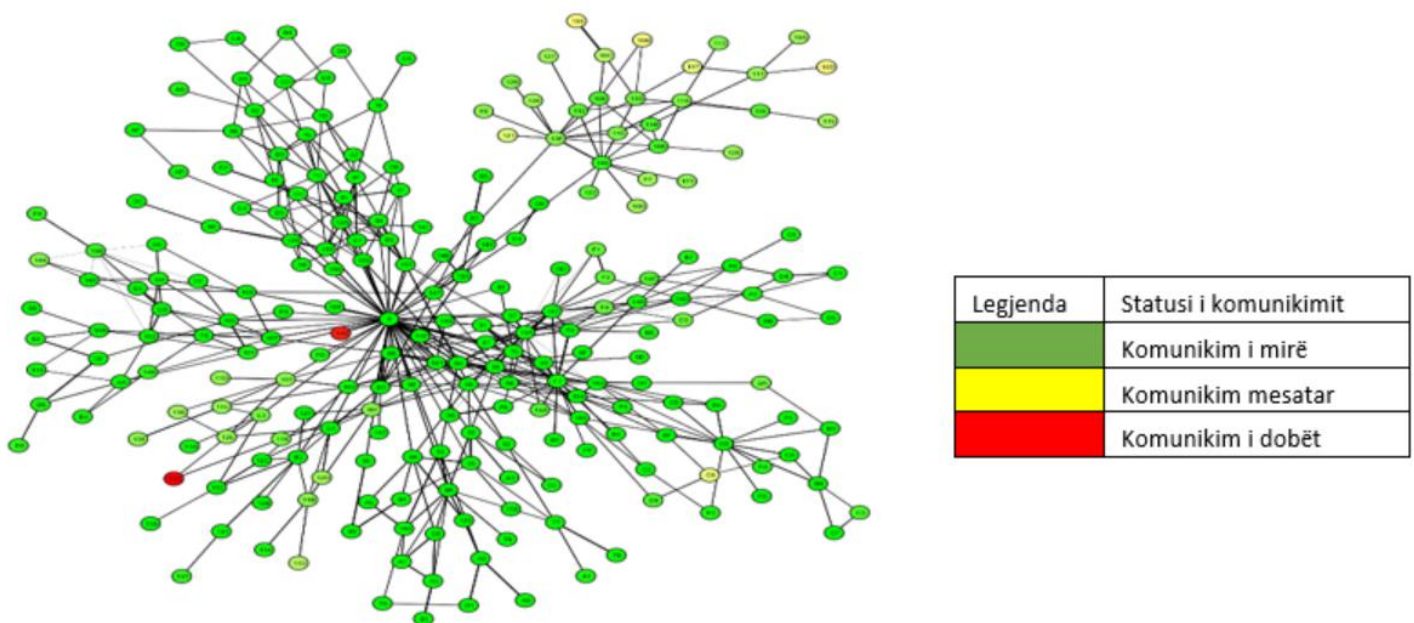


Figure 4 communication through PLC



2.5.3 Monitoring and commanding of distribution system

SCADA- 'supervisory control and receiving of data' allows installations in wide scale to be monitored and commanded from one single center of monitoring.

Today systems SCADA, in answer of change of requirements of business, have added new functions and are help for strategic advancements towards smart networks. One modern system SCADA is also one strategic investment which is necessary for distribution companies that face the challenges of competitive market and levels in increase of data exchange in real time.

SCADA system planned and implemented good not only helps customers to offer reliable and secure energy, but also helps in decrease of costs and in fulfilling of requirements of customers. First phase of system SCADA has been completed in November of year 2018 and was installed in 21 substations.

Table 10. First phase of project SCADA

| No. | District | Substation | No. of relays KEDS | No. of relays KOSTT | No. of customers | [%] of customers |
|-----|----------|-----------------------------|--------------------|---------------------|------------------|------------------|
| 1 | DPR | Podujeva 220/35/10 [kV] | 23 | 3 | 22,842 | 3.85% |
| 2 | DPR | Prishtina 2 110/10 [kV] | 23 | 3 | 29,994 | 5.05% |
| 3 | DPR | Prishtina 5 110/10 [kV] | 20 | 2 | 13,793 | 2.32% |
| 4 | DPR | Parku i Biznesit 35/10 [kV] | 15 | 0 | 3,715 | 0.63% |
| 5 | DMI | Skenderaj 110/10 [kV] | 16 | 2 | 13,372 | 2.25% |
| 6 | DMI | Vushtrria 2 110/10 [kV] | 16 | 2 | 18,929 | 3.19% |
| 7 | DMI | Mitrovica 110/10 [kV] | 24 | 2 | 24,987 | 4.21% |
| 8 | DPE | Peja 2 110/10 [kV] | 19 | 2 | 15,736 | 2.65% |
| 9 | DPE | Deçani 110/10 [kV] | 12 | 2 | 11,526 | 1.94% |
| 10 | DPE | Istogu 110/10 [kV] | 12 | 2 | 9,881 | 1.66% |
| 11 | DPZ | Prizreni 1 110/35/10 [kV] | 22 | 3 | 36,319 | 6.11% |
| 12 | DPZ | Prizreni 3 110/10 [kV] | 17 | 2 | 22,129 | 3.73% |
| 13 | DPZ | Prizreni IV 35/10 [kV] | 17 | 0 | 8,602 | 1.45% |
| 14 | DFE | Ferizaj 1 110/35/10 [kV] | 23 | 1 | 41,881 | 7.05% |
| 15 | DFE | Kaçanik 35/10 [kV] | 14 | 0 | 8,226 | 1.38% |
| 16 | DGL | Vitia 110/35/10 [kV] | 12 | 2 | 18,259 | 3.07% |
| 17 | DGL | Kamenica 110/10 [kV] | 13 | 2 | 12,262 | 2.06% |
| 18 | DGL | Gjilani 5 110/10 [kV] | 15 | 2 | 11,767 | 1.98% |



| | | | | | | |
|----|-----|-----------------------|----|---|--------|-------|
| 19 | DGJ | Gjakova 2 110/10 [kV] | 11 | 2 | 15,258 | 2.57% |
| 20 | DGJ | Gjakova I 35/10 [kV] | 22 | 0 | 10,576 | 1.78% |
| 21 | DGJ | Malisheva 35/10 [kV] | 16 | 0 | 12,131 | 2.04% |

From first phase of implementation of SCADA, can be monitored and controlled 362 relays.

2.6 Technical and commercial losses in distributive network

Network of electricity distribution has technical losses in all levels of voltage. These losses can be with load and without load. Except technical losses, operator of distribution system is facing also the commercial losses mainly because of unauthorized use of electricity.

DSO knows and calculated all losses: according to voltage level, with load or without load, technical or commercial, according to feeders 10kV, according to substation region in network 04kV, according to district or subdistrict or substation, etc.

Exist different methods for calculation of them, where one among them is explained in methodology given in development plan of years 2014-2023. With development of technology and new investments is increased also accuracy of evaluation of losses through measurements. Kosovo is one of rare countries in region or wider that calculates technical or commercial losses on monthly bases as regular reports. In below table are given technical losses according to level of voltages and commercial losses in low voltage network

Table 11 – Technical and commercial losses according to level of voltages in network 2018

| Months | Energy at the entrance of the distribution | Total losses | |
|-----------|--|--------------|--------|
| | MWh | MWh | % |
| January | 557,073 | 161,430 | 28.98% |
| February | 499,690 | 144,331 | 28.88% |
| March | 512,637 | 136,406 | 26.61% |
| Aprill | 372,910 | 68,065 | 18.25% |
| May | 345,531 | 63,947 | 18.51% |
| June | 327,782 | 51,254 | 15.64% |
| July | 350,318 | 55,050 | 15.71% |
| August | 361,285 | 51,111 | 14.15% |
| September | 332,878 | 57,622 | 17.31% |
| October | 392,051 | 80,428 | 20.51% |



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| | | | |
|-----------------------------|------------------|------------------|---------------|
| November | 455,971 | 116,123 | 25.47% |
| December | 611,949 | 171,362 | 28.00% |
| Totally accomplished | 5,120,076 | 1,157,129 | 22.60% |

Remark: In losses presented are not included northern part of Mitrovica and consumption- in Lomag.



3. PROCESS OF PLANNING

3.1 Law obligations

The drafting of long term plans that cover periods from at least 10 years, for development of distribution system it is one law obligation determined in law for electricity, conditions of license of DSO (DSO) and in rule for general conditions for supply with electricity. Drafting and implementation of this document is linked with legislator requirements and various rules in force.

3.2 Practices in planning and operation of distribution network

DSO (DSO) does the planning and is responsible for development of distribution system in accordance with requests of customers, urban plans, in accordance with rules for planning and construction and normal operation of SSH.

Dynamic change of consume, caused as result of connection of new customers and increase of power of existing customers, requires continuous planning and review of plans approved of development of distribution system. Planning is done based on analyses of existing situation of network and forecasts of needs for power and energy in time of maximum loads (peak).

During drafting of development plan are respected these general principles:

- Quality of electricity
- Safety of supply and
- Economic aspect (economy/cost)

Quality of electricity is determined by analyzing functioning of transmission network from which is supplied distribution network, condition / situation of distribution network and deviation from allowed values of voltage drops and frequency in place of connection.

Security / safety of supply is based in reliability analyze of system, which includes type of defects, damages caused for energy that was not delivered to customers, time duration of interruptions and criteria “n-1”. To offer safe supply is planned optimal number of reserve elements of network and making automatic the work process to one part of elements of network.

Economy (cost) is provided by selecting suitable planning and respective elements of distribution network based on procedures and policies / politics of company.

During preparation of development plan of 10 years was selected most optimal variant of development of SSH for period 10 years and is included:



- Description of existing situation;
- Forecast of maximum power and expenditure (consume) of electricity;
- Inspection of support equipment of system, like commanding from distance, management of consumption, information for equipment, telecommunication, etc;
- Analysis of construction or reconstruction of electro energy objects of transmission system operator;
- Harmonization of development plan 10 years with the one of transmission system operator;
- Harmonization of plans of DSO (DSO) with municipalities and other institutions

During drafting of development plan (PZH) these data are taken in consideration:

- Data for consumption of electricity.
- Data for electric energy received (maximum power active and reactive, energy in entrance of objects where measurement, technical losses, loads, voltage drops, etc.)
- Data for generating units connected in distribution network.
- Data for measuring of currents for each feeder and transformer field, voltages in bus bars of SS 110/x/xkV and 35/x kV and also voltages and currents in all SS 10(20)/0.4kV in time of maximum loads;
- Data for network. Are used the data updated of SS and lines of voltage levels 35kV, 20kV and 10kV presented in Google Earth, k-kat of lines and SS, single line diagrams of SS and lines, time duration of use of network elements (age), value of investments for period of planning, value of technical losses and non-technical losses in SSH, etc.
- Data for new customers
- Urban and demographic data, etc.

During planning, also are taken in consideration various criteria based on code of network and standards in force.

3.3 Methodology implemented in planning

Planning is focused everywhere in medium voltage and low voltage level where customers need safe and reliable supply. Basic criteria was resolving of limitation of capacities in parts of overloaded system in levels of high voltages and creation of conditions for development of system in network of low voltage. This criteria in reality fulfills also the all requests technical – economic of planning of distribution system, because makes possible quality and safe supply with electricity of majority part of customers.

Realization of criteria N-1 is focused only in levels of high and medium voltages. Now this condition mainly developed for voltage level 35 kV in transformation 35/10 kV and lines 10(20)



kV of urbanized localities, mainly big cities. Planning is focused from level of high and medium voltages since with these objects are attacked bigger number of customers and effect of increase of safety of supply is higher. During planning has been taken as base also including as much bigger number of customers in selected projects and resolving of bottlenecks in system. Methodology mainly is based in energy analyzes of distribution system from voltage drops, loads of parts of system in lines and transformers of medium voltage, technical losses that consequently are presented also in this document according to plan of respective projects and riskiness of electrical objects.

Report for criteria of planning of network of KEDS was reference for all proposals for investment. Comprehensive studies are undertaken to draft that report, which ensures achieving of targets of KEDS, and also following of world trends, taking in consideration situation and local circumstances and those specific for region.

Existing distribution electrical network in medium voltage of DSO is modelled in programs of modeling and simulation Power Factory DigSilent from team of DSO. After this, models are controlled and reviewed based on one pole schemes of substations of KOSTT TL/TM/TM and of DSO TM/TM, together with geographical presentation (in Google Earth) of all network. Except these, continuous investments projects are collected and modelled, by arriving to last schematic model for network of medium voltage of DSO.

Model DigSilent Power Factory covers all distribution network of medium voltage from substations of KOSTT TL/TM/TM up to loads in secondary of distribution transformers MV/LV. In this model, are done analyzes “flow of load”, “short circuits”, “contingency N-1 also for study is modelled also network of low voltage of few substations with all other follow up elements and after are used for comparing for losses or for investments.

Operating normal loads of transformers of KOSTT are analyzed and situations contingency N-1 of each transformer of KOSTT is checked during investment planification. Analyze of contingency includes loads of transformers in case that some transformer TL/TM comes out of function in case of some interruption.

In content of analyze, transformers overloaded (over 70%) in normal operation and also over 100% are determined in contingency cases, whereas optimal solutions are drafted taking in consideration regional specific conditions. As result of this study, and also taking in consideration the investments in KOSTT, the necessary investments (increase of capacities of existing transformers, new transformers, and also new installations of KOSTT) are proposed to overcome problems of overload and continuation of supply. Are evaluated and discussed with representatives of KOSTT the needed requests of distribution. In rare cases, except development plan of KOSTT, are proposed investments in new substations TL/TM.



During analysis of network, municipalities were visited, there were frequent meetings, are taken information for big investments and new urbanistic plans for expansion of network, etc, and these data are synchronized with our data and are taken in consideration in short term and long term plans.

Furthermore, the system of central heating in Pristina has been studied and through Termokos (responsible company for heating in region of Pristina) are collected the respective data of system. During planning are taken in consideration plans of development of this system, actual capacity and regions supplied from him. In respective fields is reflected influence of investments for services of heating in decrease of request of electrical network, influence which consist in fact that request DTR, are not increased as happens usually in other zones.

During planning is considered also including of as much high number of customers in selected projects and resolving of bottle necks in system.

Methodology mainly is based in energy analyzes of distribution system from voltage drops, loads of parts of system in lines and transformers of medium voltage, technical losses that consequently are presented also in this document according to plan of respective projects and danger of electrical objects.

3.4 Applications used during planning

For preparation of development plan of 10 years, respectively for various analyzes, DSO uses many applications where among others are:

Application “Power Factory”

Calculations for various analyzes of network are realized through use of software “DIgSILENT PowerFactory”.

Except calculation of technical losses of power, software package “DIgSILENT PowerFactory” enables also analyzes like in following: analyze of flow of load and calculation of losses, analyze of short circuits, analyze of voltage stability, analyze of air and cable lines and distribution network, functions of protection, analyze of sustainability, etc.

Application Advance and BEE: let say all TS MV / LV in DSO (DSO) have installed system of measurement with reading from far distance. After DSO has improved software for automatic reading and managing of data of meters that can be integrated in effective method with meters with reading from distance / far away and which offer reports to help operations on regular bases. Functions of actual software are: time synchronization of meter with server AMR, control of meter connection by reading momentary values of currents, voltages and angles between them,



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integration in database for billing, characteristics of narrowing of meters, profile of load every 15 minutes.

Google Earth: for better modeling by using coordinates GPS and visualization of objects (lines or substations), lines and transformers are drawn in Google Earth

CCP-CRMS: also are other application in DSO which is required to take different data like: billing, number of customers, etc.

AMRmod: is one web application which serves for placing the data of active and passive meters with reading in distance. The data which are placed in AMR_MOD for meters are: code of TS, code of feeder, name of TS, name of feeder, tariff group, constant of meter, installed power of TS, etc., data which reflect information of metering point. Data for customers are synchronized in regular schedules from CCP. Data e AMR-MOD are reflected in software Advance.

KosovaNetMap: is one other application in further development which makes possible that visually to see customers where they are located, this based on maps connected with 'satellite map'. Through this program there is possibility that accurately to know the location of calls of customer. Many data / info are provided from use of HHU, apparatus which is used by workers in terrain with which is evidenced accurately coordinates of customers, SS, elements of network (lines, poles, line separators, etc). By linking with these data KOSOVANET will evidence: Location of SS 10(20)/0.4kV and calls in map, registration of failures / defects and manual disconnections of feeders 10kV, history of defects. Mirror / reflection of interruption in real time for Kosovo, localization of customers and also their basic data. The data which will be used from various departments for accurate reporting's in network.



4. ANALYZE OF CONSUME OF ELECTRICITY AND FORECAST OF DEMAND

Request / demands for electricity in the future, by forecasting value and his form inside horizon of planning and also by following history of loads are essential for development of distribution system operator. Forecast of load present integral part of planning of network, generation and operation of distribution system. DSO (DSO) regularly reviews and develops forecast and maximum load “peak” and also request for electricity short term and long term by using various techniques and mathematic modeling’s.

4.1 History of load and actual situation

Concerning the consume of before the war, information are missing or are half info and as such we cannot take them for base, but data after the war show continuous increase of number of customers in Republic of Kosova. In year 2002, number of customers was 305,489 and in end of year 2018 this number exceeds 580 thousand customers active registered which shows one increase of around 50% for last 17 years. This increase was visibly / significantly higher in district of Pristina compared with other districts.

Increase of number of customers is associated also with increase of consume concerning the active power, with one increase around 35%. Majority part of users of electricity are household customers, with around 64.89% towards total consume in level of distribution in the end of year 2018.

Increase through years of number of customers and load is shown in below graph.

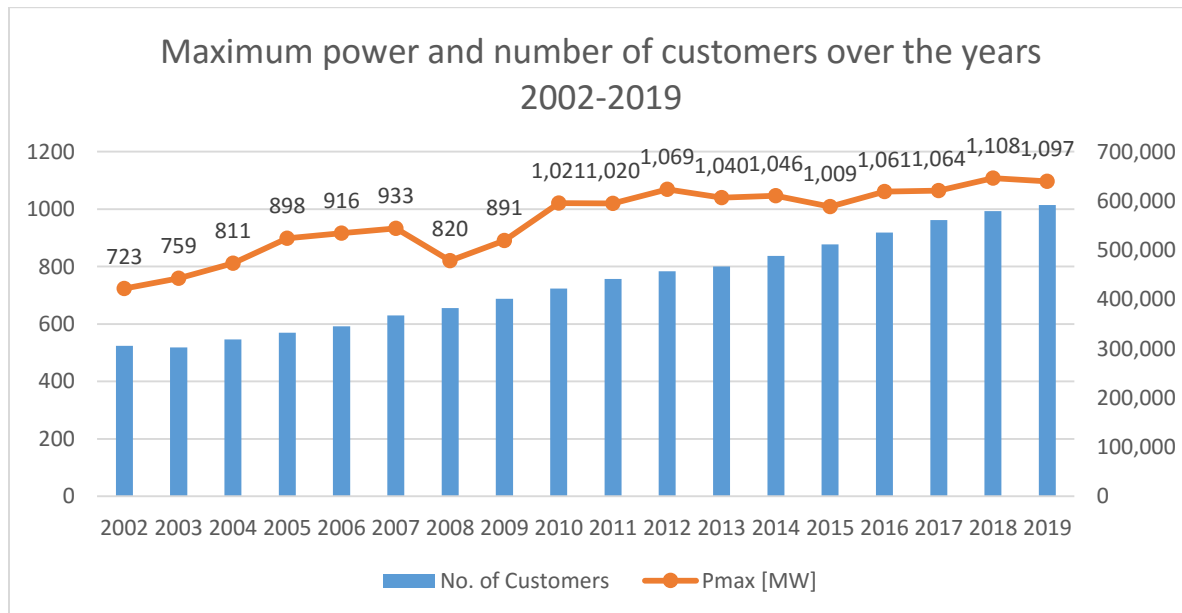


Figure 5 – Increase of number of customers and peak power 2002-2019



The data of year 2019 are not final, for sure this number of customers will be increased until the end of year. In figure 6 below is shown increase of gross consumption of electricity and maximum load (peak) from year 2009 until 2018.

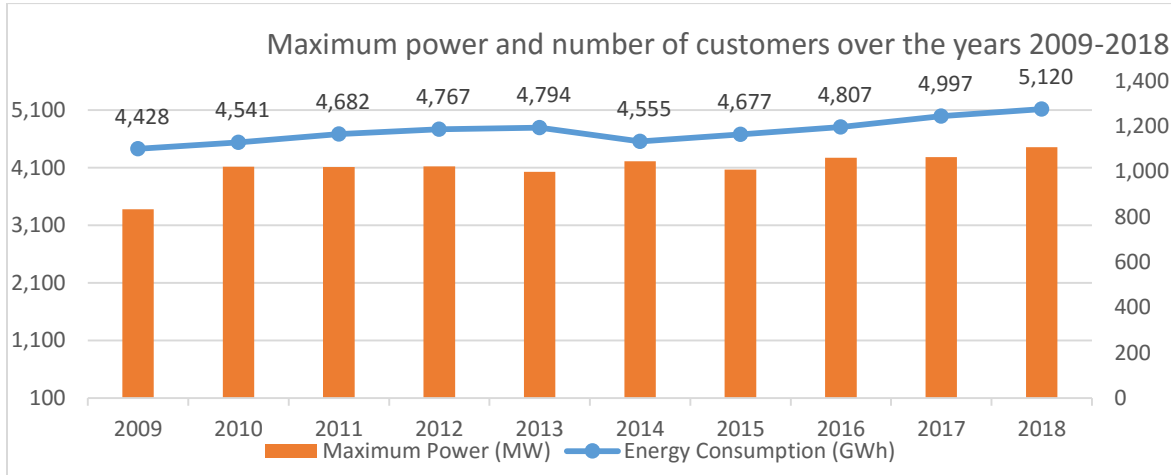


Figure 6 – Monthly consumption of electricity and maximum load of DSO (DSO) for year 2018

4.2 Seasonality and other variations of demand

Other important parameters, in operative planning of system are seasonal variations, weekly and daily of load. These parameters have main importance in accurate planning of system and providing the sufficiency of system during certain monthly and daily periods.

Figure 7 present monthly consumption of electricity and maximum load during year 2018. From the graph we understand changeability in use of energy between summer and winter season which result because of the use of electricity for heating which has influence in winter period and which must be taken in consideration during all forecasts and planning's.

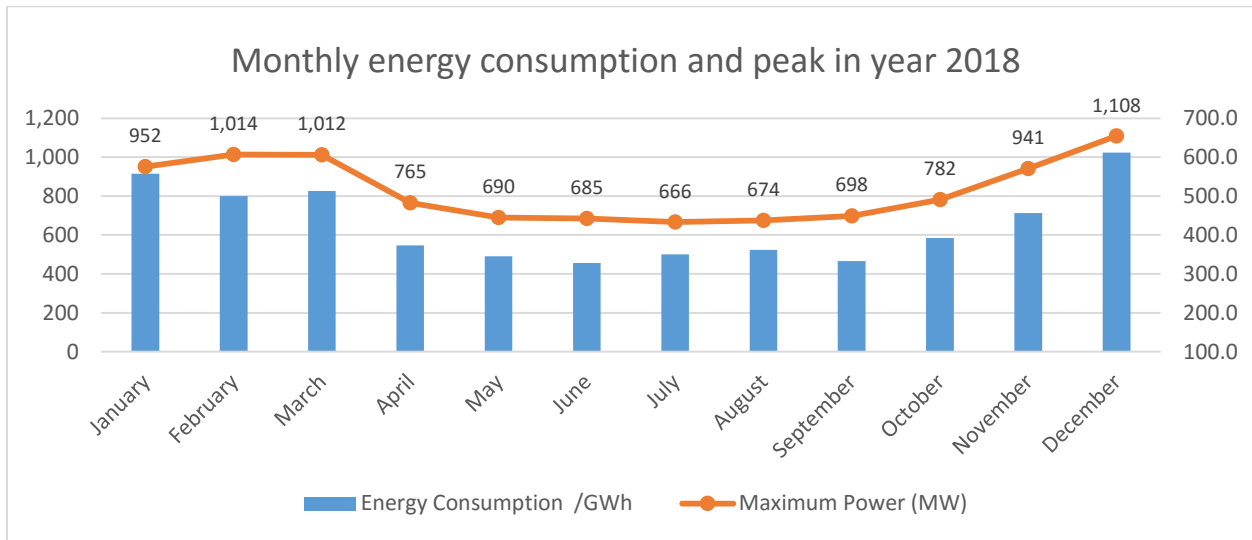


Figure 7 monthly consumption and peak in year 2018

In figure 8 is shown curve of daily consumption for maximum of load which is achieved on 31 December 2018 and curve of daily consumption for minimum load achieved on date 27 May 2018. In both cases is seen that form of load is the same along day respectively minimum values are written during morning hours whereas maximum value achieved in evening. The only difference stands in hours where during winter the maximum values are written earlier (around hour 18) whereas in summer little later (around hour 20).

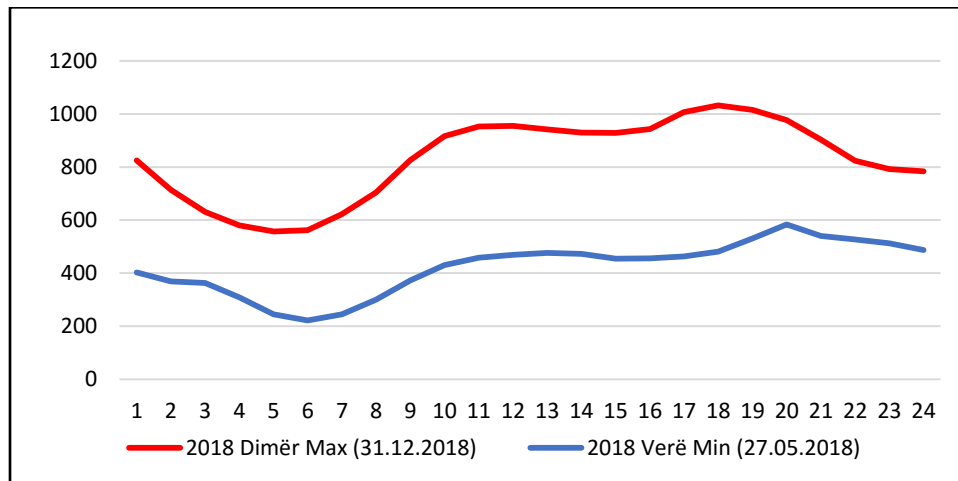


Figure 8 – curves of load for maximum days of winter and those minimum of summer in year 2018 in MW



According to figure 8, is seen that maximum in year 2018 was achieved in last day of month December 2018, and which we believe was influenced also by other factors like festivity / holiday of New Year, whereas months January and February had similar load. However is important to emphasize that minimum of load of month January is equal with maximum of load of month June, for the fact that Kosovo is dominated with household customers which use electricity for heating.

One new phenomena observed from analyzes shows that with change of tariff structure during year 2017, respectively with elimination of seasonal tariffs and blocks, is increased significantly the use of electricity, by surpassing every possible forecast. Annual increase of load in two last years is surpassing values from 5% without any emphasized economic development. This simultaneously is creating concern in overloaded distribution system by changing the orientation of development projects towards adjustment of new requests of energy market. Model of increase of load and capacities.

Projecting of criteria for new generating capacities based on total annual demand for electricity, annual peak and factor of annual load of system, does not guarantee always that generation / production will be sufficient (which means available when is required). The actual data about foreseen requirements for capacity of distribution in substations or lines that supply customers and increase of number of customers per district are shown in Table 12. With actual load (use) of distribution capacities (recommended load is around 80 %). Even there are many loads and limiting capacities in network if reviewed as elements one by one separately, as entirety in district, the last investments have softened so much the situation in supply primary points and this trend is foreseen to be kept also in following / coming years. Below table present quotient of actual maximum load (or forecasted) with follow up installed capacity.

Based on investments that will happen in following years in network from side of DSO (5.2) or KOSTT (5.1), they will influence that limiting capacities concerning the district to be reduced.

Table 12 – Limiting capacities according to districts 2019-2028

| District | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|-----------|------|------|------|------|------|------|------|------|------|------|------|
| Prishtina | 61% | 54% | 52% | 52% | 53% | 55% | 52% | 53% | 53% | 54% | 55% |
| Ferizaji | 59% | 70% | 71% | 72% | 60% | 59% | 60% | 61% | 62% | 63% | 64% |
| Gjakova | 53% | 56% | 49% | 50% | 51% | 52% | 58% | 58% | 59% | 60% | 61% |
| Gjilani | 38% | 44% | 37% | 37% | 38% | 38% | 39% | 38% | 38% | 39% | 39% |
| Mitrovica | 56% | 57% | 58% | 58% | 54% | 55% | 55% | 56% | 57% | 58% | 59% |
| Peja | 39% | 41% | 42% | 42% | 43% | 43% | 44% | 45% | 45% | 46% | 47% |
| Prizreni | 57% | 64% | 58% | 59% | 62% | 63% | 59% | 61% | 62% | 62% | 63% |
| Kosova | 53% | 54% | 52% | 52% | 52% | 53% | 52% | 53% | 53% | 54% | 55% |



From this table we observe that based on districts there will be no limitation of loads, even these limitations might be in lower levels of 35kV, but which will be eliminated through investments which will be done from side of KOSTT also from side of KEDS will decrease.

4.3 Forecast of annual maximum load 2019-2028

Requests / demands for electricity in the future, by forecasting value and his form inside horizon of planning are essential for development of distribution system operator. DSO (DSO) regularly reviews and develops forecast of maximum load “peak” and demand for electricity short term and long term by using various technics and mathematical modelling.

Results of most recent forecasts from DSO (DSO) are given in Figure 9 and in Table 13. Scenario basic of change of load is characterized with one annual average increase around 1.43%. These data will be communicated with KOSTT as is required from regulatory framework for development of long term electro energy balance for years 2018-2028.

Eventual changes that derive /flow according to requirements of market are updated on annual basis through annual balance which is approved from energy regulatory office.

In below table we have presented values forecasted 2019-2028 reviewed for years 2019-2028

Table 13 Forecast of peak and consume 2019-2028 (Caglar, Sherife)

| Values foreseen 2019-2028 | | | | | | | | | | |
|---|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
| Forecast of peak (MW) | 1118 | 1136 | 1154 | 1172 | 1190 | 1208 | 1226 | 1244 | 1262 | 1280 |
| Forecast of consumption of energy (GWh) | 5054 | 5112 | 5170 | 5228 | 5285 | 5343 | 5401 | 5459 | 5517 | 5574 |
| Increase of peak from previous year [%] | - | 1.61% | 1.59% | 1.56% | 1.54% | 1.52% | 1.49% | 1.47% | 1.45% | 1.43% |
| Increase of energy from previous year [%] | - | 1.14% | 1.13% | 1.12% | 1.10% | 1.09% | 1.08% | 1.07% | 1.06% | 1.05% |

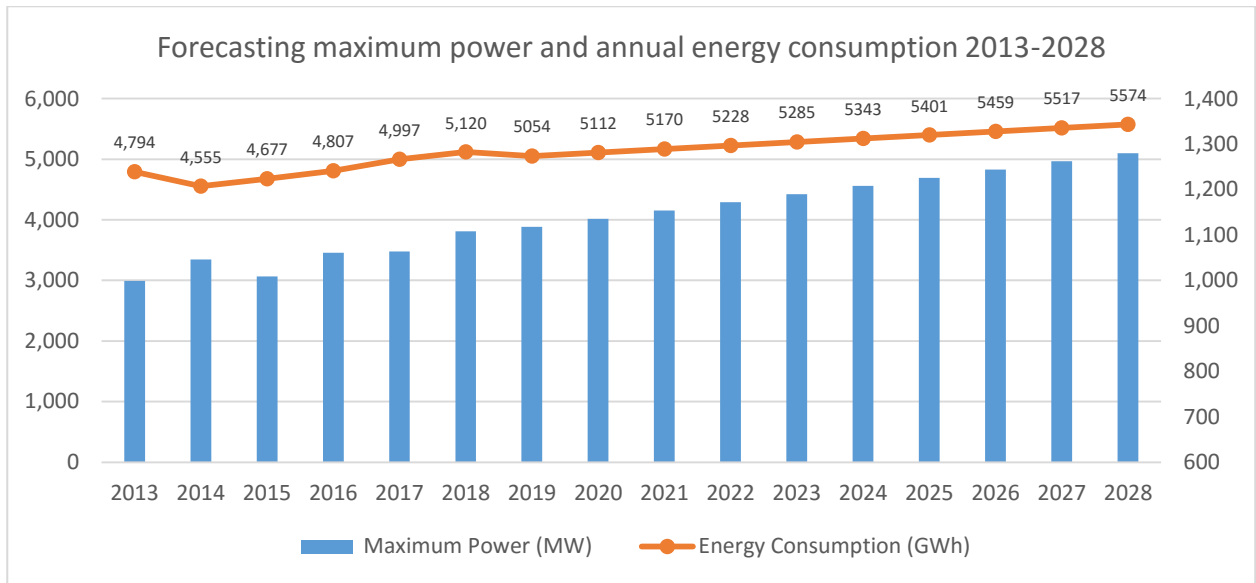


Figure 9 Forecast of load in coming years



5. PROJECTS PLANNED FOR PERIOD 2019 -2028

Based on developments of sector and actual challenges are foreseen required projects for period 2019-2028. DSO for tariff purposes has submitted to ERO investments plan of 5 years, which was approved from ERO. For year 2019, DSO in his plan has foreseen also realization of emergency projects in Ferizaj and Fushë Kosovë for softening of actual situation until are constructed new substations from KOSTT.

Plan of 10 years 2019-2028 contains projects that are expected to be realized in first years in accordance with plan of investments approved from ERO for tariff purposes and financings provided for this period, and also orientation of investments in second 5 years.

DSO initially has given priority to emergency investments and will address in particular the required steps for transfer of network 10 kV to 20 kV, development of network to be in one step with economic development, elimination of voltage level 35 kV etc. Also will present approach to rehabilitate distribution infrastructure in level 400V, since this approach will have maximum influence in decrease of commercial losses. Resulting projects will follow to be considered in next years as part of strategic general plan for development of network. Study will try to model elasticity of demand – load taking in consideration decrease of commercial losses and to ensure that plans of implementation to be taken in consideration by including also regional differences.

5.1 Major projects for substations 110 kV with KOSTT - Plans and challenges

Most important advancements like improving of technical quality and continuation of supply; decrease of technical losses in network can be achieved mainly with combination of investments of DSO in rehabilitation and also new investments of KOSTT.

Having in consideration that initiatives of distribution network for continuous supply as only will be insufficient, except formal investments plans of KOSTT, new investments are proposed for KOSTT in meaning of new capacities, increase of existing capacities, adjustment of existing capacities for 20kV etc.

In the moment when is being finalized drafting of this document in year 2019 are energized new substations of KOSTT 110/10(20)kV Ilirida in Mitrovica, 220/10(20)kV Drenasi and 110/10(20)kV Dardania in Prishtina. Urgent request of DSO is to construct new substation in Fushë Kosova, Ferizaj and in Malisheva. Until are constructed new substations from KOSTT, in Fushë Kosova and Ferizaj from side of DSO will be rehabilitated network and will be invested to overcome this emergency situation. Except these three substations, other needed requests iare new substation in Mazgit and in region which covers Kaqanik with Hani e Elezit. In principle, we have agreed with KOSTT to add these substations in the second phase, but these substations may not



be in KOSTT's plans yet because of the application procedures that need to be started with them. We will begin with the application once the Development Plan is approved by the ERO.

During own analyzes DSO has observed that in some existing substations of KOSTT during coming years there is need for increase of capacities, which are described in this document. Also because DSO has started with transfer from level 10kV to level 20kV, then KOSTT shall support DSO by placing new transformers which are missing level 20kV.

DSO has foreseen that converting's in 20kV in substations of KOSTT to happen in two phases. In first phase are selected problematic feeders in which DSO will invest for transfer to 20kV and for these feeders will be requested from KOSTT to adjust his transformers to support transfer in level 20 kV. First phase is expected to happen in first five years (2019-2023), whereas second phase, is expected to happen in second five years (2024-2028).

However during joint discussions with KOSTT for adjustment and harmonization of projects, is observed one hesitation from their side for transfer of only one transformer in level 20kV, because they will lose criteria N-1. Therefore in this meaning, KOSTT will support DSO only if:

- To transfer complete network 10kV (to finish complete construction) in level 20kV which is supplied from one substation of KOSTT and after to make connection in level 20kV; or
- To transfer one transformer of KOSTT in level 20kV without losing criteria N-1 but by placing one middle transformer to make connection again with level 10kV

Taking in consideration the above mentioned, DSO had to review once more own plans concerning the transfer of substations of KOSTT in operation of 20kV. Below we have summarized joint projects with KOSTT according to districts, whereas in table form are summarized reasons and requirements for these investments.

Prishtina

In district of Prishtina, substation which was Prishtina III 35/10kV is expected to be raised in capacities 2x40MVA with transformation 110/10(20)kV from side of KOSTT and which will be called SS Dardania. Now there are being completed works for placing of first transformer and for a short time is expected to energize this substation. This substation will have sufficient capacity also for construction of new objects many floors closely or energizing of those existing.

Region of Drenas also was region with big problems concerning the network of medium voltage. With putting in work the new substation 220/10(20)kV 2x40MVA from side of KOSTT and with elimination of level 35kV are eliminated also problems with voltage, technical losses, interruptions, etc. To avoid other emergency problems in District of Pristina in this period, are required the below investments:



- New substation of KOSTT in Fushë Kosova (2x40MVA), phase I
- Transfer of two TR 220/35/10(20)kV in Podujeva in 220/35/20kV, phase I
- Transfer of two transformers 110/10(20)kV Prishtina 7 in level 110/20kV, phase II
- New substation in Mazgit (2x40MVA) with three windings transformer 110/35/20kV and 110/10(20)kV, phase II

Prizren

District of Prizreni, with special emphasize Region of Dragash is facing with high request of connection of GJD – renewable sources. Since consume in that zone does not coincide with production request / demand and because the existing capacities in level 35kV cannot afford this transfer / carrying of electricity, momentary are foreseen few emergency plans in level 35kV for softening of situation, but which don't present long term solution, therefore new substation of KOSTT in Dragash is required.

This investment in Dragash will offload also transformers in substation in Prizreni 1 in level 35kV, therefore for this period to avoid problems in terrain is requested from KOSTT to invest like in following:

- New substation Dragash 40MVA three windings 110/35/10(20)kV with possibility of using the capacity 100% in all sides, phase I
- Prizreni 1, change of existing TR 110/35 from 31.5MVA to 40MVA with TR 110/10kV (after is constructed substation in Dragash). If substation of Dragash is not realized, then in Prizren urgently must be placed the fourth transformer three windings. These investments both options must happen in phase I
- Transfer of transformers 110/35/10(20)kV in Theranda in level 110/35/20kV, phase II

Ferizaj

District of Ferizaji has only one substation of KOSTT in city center, which highlights possible problems in conditions N-1. Therefore is proposed to construct one new substation of KOSTT close to city center, which as result of studies Master Plan (2016-2025) required to be placed nearby Ferizaj II.

Substations NS 35/10kV Ferizaj II and Ferizaj III will supplied from new substation of KOSTT and old substation in Bibaj through regular lines and /or rings 35kV which will be constructed with emergency plan in year 2019 and Ferizaj I 35/10 substation will be eliminated. In substation NS



Bibaj exist two TR 110/35kV and one transformer 110/10kV. After construction of new substation in Ferizaj-Kastrioti one from transformers 110/35kV in Bibaj must be replaced with one TR three winding 110/35/10 kV with possibility of use 100% in secondary and tertiary.

Existing substation in Lipjan has three transformers, one of them has secondary voltage 35kV, other has 10kV and third is three windings 110/35/10(20kV). In Lipjan expected to start with level 20kV, therefore there is need to change transformer 110/10kV with 110/20kV. This change can be done in accordance and in synchronization with plans of DSO so that KOSTT not to have need to buy new transformer with 10kV, but only with 20kV.

Because of big distances, region in direction of Kaçanik and Hani i Elezit are facing big problems concerning the quality supply with electricity. Must be highlighted that distributive transformers which are supplied from NS Hani i Elezit-private, have level of voltage 6/0,4kV. Taking in consideration the above mentioned the required investments from side of KOSTT are:

- New substation in Ferizaj (Kastrioti), in north part, 1x40MVA with transformation 110/35/10(20)kV, phase I
- Change of TR 110/35kV in Bibaj with one TR three windings 40MVA with transformation 110/35/10(20)kV and with possibility 100% in secondary and tertiary, phase I (after investment of SS Kastrioti)
- Passing of transformers 110/35/10kV in Lipjan in level 110/35/20kV, phase I-II
- Second transformer 40MVA in SS Ferizaji (Kastriot), with transformation 110/10(20)kV, phase II
- New substation in Kaçanik - Hani Elezit in phase II

Peja

In district of Peja, existing transformers in substation of Deçani are old and do not support the transfer in 20kV, therefore is required that initially to replace existing transformer 20MVA in Deçan with new one 110/20 kV, whereas the second can be placed in later period. Also because the loads in city of Peja are in increase, then is proposed to add one new transformer 40MVA 110/10(20)kV in NS Peja 1 which would provide N-1 also on side of level 10kV. Same time with placing of this transformer are offloaded transformers in NS Peja 2 which are in ongoing loading, and which can be done through feeders 10kV Kosovatransi, Qarshia e gjatë, Qyteti 2 etc.

Actual plans of KOSTT, foresee one new transformer in Klina, to fulfill condition N-1. However to adjust to the requirements of market from KOSTT are required also other investments like:



- Second transformer in Klina with possibility of transfer to 20kV, to fill the condition N-1, phase I
- Replacement of first TR 31.5MVA with transformation 110/35kV in Peja 1 with TR 40MVA 110/35/10kV, phase I
- Replacement of first TR 20MVA with transformation 110/10kV in Deçan with TR 40MVA and with possibility of transfer to 20kV 110/20kV and preparation of other transformer for transfer to 20kV 110/20kV, phase II

Gjilani:

As result of analysis of emergencies, is required to invest in one second transformer in NS Gjilani 5, investment which is foreseen also in plans KOSTT to cover criteria N-1. This at the same time will resolve problem also of feeders 10kV of Gjilani II, which after one time is expected to be eliminated and those feeders to be transferred with supply from Gjilani 5.

In NS Gjilani 1 where exist two transformers 31.5MVA and 20MVA, but to adjust to requirements of customers the transformer with lower power must be replaced with TR with higher capacity. In this meaning the requests of DSO for KOSTT are:

- Second transformer in SS Gjilani 5 to fill the criteria N-1 and to eliminate TR 35/10kV in Gjilani II, phase I
- To replace transformer 20MVA of Gjilani 1 110/35kV with 110/35/10(20)kV with 40MVA, phase II
- To replace transformer 20MVA of Vitia 110/35kV with 110/35/10(20)kV with 40MVA, phase II

Mitrovica

To support the transfer to 20 kV and also to decrease load of transformers installed to NS Vushtria 2, is suggested to add one new transformer 110/10(20kV) in NS Vushtria 1, which simultaneously will transfer one part of load of NS 110/10kV Vushtri 2.

In Skenderaj one of transformers has possibility of transfer to 20kV, whereas other transformer not. Then is request of KEDS also second transformer to be replaced with quotient of transformation 110/20kV. In this meaning, for elimination of problems with load, for phase I and II, from KOSTT in district of Mitrovica is expected to be invested like in following:



- To replace 31.5MVA TR 110/35kV in Vushtrri 1 with TR 40MVA with transformation 110/20kV, phase I
- Transfer of transformers 110/10(20)kV and 110/10kV in Skenderaj in voltage level 110/20kV, phase II

Gjakova

In district of Gjakova the most emergency investment will happen from KOSTT in region of Malisheva in first phase. DSO is investing in that zone with purpose that in advance to turn whole region of Malisheva in level 20kV. This simultaneously will make possible that new transformers from KOSTT to be with transformation 110/20kV. However, as result of problems with voltage and evaluation of demand of peak, is suggested that this investment to be made faster.

In NS Gjakova 1 exist two TR with power 20MVA, one of them must be replaced with transformer of three windings 110/35/10(20)kV and with capacity 40MVA.

Taking in consideration the above mentioned, is requested that in phase I and II to invest like in following:

- New substation of KOSTT in Malisheva (1x40MVA), with transformation 220/10(20)kV, phase I
- Change of TR 110/35kV 20MVA in Gjakova with TR 40MVA with transformation 110/35/10(20)kV, phase I
- After investment from side of KOSTT in Malisheva, then in Rahovec there is no need for two TR three windings. One from them can be replaced with TR with quotient of transformation 110/10(20)kV, during phase II
- Second transformer in new substation KOSTT in Malisheva (1x40MVA), with transformation 220/20kV, phase II

In below table are given justifications and requirements for new projects that are requested to be invested from KOSTT, which are necessary for DSO with purpose to adjust to the conditions of market and requests and needs of end customers.



Table 15 New substations requested to be constructed from side of KOSTT

| | | |
|----------|-----------------|---|
| 1 | Project: | Adding and raising of capacities of SS 35/10 kV Fushë -Kosova – phase I |
| | Description: | <p>Municipality of Fushë Kosova, is one of municipalities with biggest increase of objects residential and business, especially last years. Except the city of Fushë Kosova, this substation supplies also villages that belong to Fushë Kosova: Bardhi Madh, Bardhi i vogël, Grabovci i Poshtëm, Henc, Kuzmini, Lismiri, Miradi i lartë dhe i Poshtme, Nakarada, Pomozotini, Sllatina big and small.</p> <p>Existing air lines 35 kV which supply Fushë Kosova come from SS Prishtina 1 and Kosova A. Each one of them supplies by two or three transformers of SS Fushë Kosovës. Capacities of transformers 35/10 kV have surpassed their critical limit, whereas on other side, load in region of Fushë-Kosova shows one trend in increase. Fifth TR is placed in the end of last year</p> <p>Substation Fushe Kosova has 17 exit cubicles 10kV, which is typical with results that might have one substation of KOSTT. From these feeders, 6 of them supply only commercial customers.</p> <p>Installation of new substation, 2x40 MVA Fushë- Kosova would cover load of existing substation 35/10 kV and load from new customers and would provide higher sustainability of supply with electricity in this region where existing feeders are overloaded. New feeders will offload the existing feeders since load is separated between all feeders. Sustainability of supply will be improved and possibility for alternative supply will be available for airport of Pristina, transmitting station in Golesh and mines in Golesh that are close to this substation.</p> |



| | | |
|---|----------------|---|
| 2 | Project | Adding of capacities of SS 35/10 kV Ferizaji II in SS 110/10 kV – phase I |
| | Description: | <p>Municipality of Ferizaji covers one surface of 345 km², which means city and 45 villages around it. This zone has a population of 172 thousand residents. Today compared with other cities in Kosova is considered as second city most developed after Pristina and is the city of market in Kosovo. Few from factories and enterprises which before many years were base for development of economy in this municipality are still functional. Some of these factories and enterprises are: Factory of steel pipes, factory of oil, woods combinate, Factory for processing the exotic fruits, factory of bricks, etc. The energy data in level of distribution for year 2018 show that district of Ferizaji is classified second after district of Prishtina concerning the consume (energy billed).</p> <p>Actually the city of Ferizaj with surrounding is supplied from existing substations: NS 110/35/10kV Ferizaj-Bibaj 1, NS Ferizaj I (2x8 MVA), NS Ferizaj II (4x8 MVA), NS Ferizaj III (2x8 MVA). During last years these substations operate in conditions of overload, especially when criteria N-1 is not fulfilled, and also during planned maintenance taking in consideration that also in summer months their load passes 80% of installed capacity.</p> <p>With purpose to improve the sustainability in supply are under realization few emergency investments in level 35kV for overcoming of situation. With realization of this project is done one temporary improvement, but as long term solution is construction of new substation 110/35/20(10) kV near the location where actually is SS 35 kV Ferizaj II.</p> <p>With construction of new substation 110/35/10(20) kV in this region will be provided sufficient energy for unobstructed development, secure supply where reliability will be higher, drops (interruptions) will not be frequent and will be controlled time duration of these interruptions and also quality supply in values determined with technical norms.</p> <p>Also with construction of this substation would be shutdown / closed SS 35 /10 kV Ferizaji I. For more with this project will be eliminated actual limitations in lines 35 kV</p> |



| | | |
|---|-----------------|---|
| 3 | Project: | Adding of capacities of SS Malisheva 35/10 kV in SS 110/10(20) kV (2016-2018), phase I |
| | Description: | <p>SS 35/10 kV Malisheva with capacity 24 MVA (3x8MVA) is supplied from SS 110/35/10 kV Rahoveci through air line 35 kV that crosses one difficult forest terrain. This substation supplies 8 feeders 10 kV where are connected 225 transformers 10/0.4 kV with one installed capacity of 51.38 MVA. Maximum load during last years in line 35kV is more than 100% and it limits the capacities of transformer 35/10kV which can reach more than 100% if lines allows.</p> <p>Because of limitations in capacities of distribution of electricity in lines 35 kV the sustainability of supply with electricity for customers that are supplied from this substation is poor. Line 35 kV which supplies this substation and which present 'bottleneck' is long 15 km, with high technical losses, voltage drops and operates with high cost of operation and technical losses.</p> <p>Raising of level of SS Malisheva from level 35/10 kV to 2200/10(20) kV, will result in decrease of technical losses, making possible the plans in the future for transfer of operation from level of voltage 10 kV to 20 kV, will be provided sufficient energy for unobstructed development, secure supply where reliability will be higher, drops (interruptions) will not be frequent and will be controlled time duration of these interruptions and also quality supply in values determined with technical norms</p> |



| | | |
|---|-----------------|--|
| 4 | Project: | Adding of capacities of SS 35/10kV Dragash in SS 110/10(20) kV Dragash |
| | Description: | <p>SS 35/10kV Dragashi is located in south part of Kosovo and supplied from SS Prizreni 1 110/35kV through SS 35/10kV Zhuri with air conductor from 11km of type AlFe 70mm² up to Zhur, and after with air conductor from 15km of type Cu 35 from Zhur up to Dragash (now as emergency plan is being constructed also second line underground 35kV Zhur-Dragash). After from Dragash also exist air line 35kV of type Cu35 which supplies SS 35kV Dikanca. Dragashi possess two transformers with power (8+8)MVA.</p> <p>Line 35kV NS Prizren – NS Zhur present one bottleneck during all the time. This line has no sufficient capacity to supply other SS 35/10kV. Line 35kV NS Zhur – NS Dragash did not have capacity more than 10.5MVA to carry power up to transformer, whereas now this capacity is increased also for 25MW. Keds has had to urgently invest in a new line to build new capacities of 35kV line for the distribution of existing generations and new hydropower plants, until the KOSTT SS is built</p> <p>In this region there are many interest to construct and connect hydro centrals. According to requests received for issuing of energy approvals (PEE), their installed power would reach up to 50MVA.</p> <p>Because the lines mentioned don't allow sufficient capacity of carrying of energy, then also transformers there is no possibility to be loaded with full capacity. Momentary SS 35kV Dragash is loaded around 80%.</p> <p>SS 35/10kV Dragash is foreseen to increase capacities from level of operation 35kV to SS 110/35/10kV, with capacity of transformer 1x31.5MVA. With realization of this project will be offloaded line 35kV NS Prizreni 1 – NS Zhur.</p> <p>With construction of this SS will be decreased technical losses, will be improved performance of voltage and customers of this region will have better quality of electricity.</p> |



| | | |
|--|--|--|
| | | <p>KOSTT now planned in own development plans the investments in this zone, but because of postponing of project Dragash from side of KOSTT, during year 2019 DSO made emergency investments in line 35kV Zhur-Dragash, to overcome problems with GJD, but this investment offers only temporary solution.</p> |
|--|--|--|

| | | |
|---|-----------------|---|
| 5 | Project: | Adding of capacities of SS 35/10kV Kaçaniku in SS 110/10(20) kV Kaçaniku-Hani Elezit, phase II |
| | Description: | <p>Substation Kaçanik 35/10kV with location in entrance of Kaçanik has two transformers of power 2x8MVA and supplied from SS Ferizaj 110/35kV with AlFe 70mm² with length 19.5km. Kaçanik 35/10kV operates with 2x8MVA.</p> <p>In 2007 SS 35 kV Kaçanik supplied about 6200 customers and by 2018 this number has reached more than 8600 customers. At the beginning of 2019 transformers were loaded 70%, during the winter season this load is expected to increase further reaching 90%. This growth is expected to be even greater by 2026. Adding additional transformers to the existing SS is not a solution as this does not allow for 'narrow throat' in the 35kV transmission line with a large length and small conductor section having a limiting capacity of 14 MVA. This line has been loaded 85% during peak times this year.</p> <p>With construction of this SS 110/20kV will be created also conditions for operation from level of voltage 10kV to 20kV. This will create also other possibility that distribution feeders 6kV which are supplied from SS 110/6kV Sharri to be supplied from new substation 110kV Kaçaniku with transfer of network operation from level of voltage 6kV to 20kV. If added also 2,500 customers of Hanit të Elezit, then this new substation will supply more than 10,000 customers.</p> <p>With raising of capacities in SS of Kaçanik will be eliminated 'bottleneck' in line 35kV and transformation in SS 35/10kV. With elimination of them will be reduced significantly technical losses in level 35kV in Kaçanik, voltage drops in last points will be significantly corrective / improvable, will be created possibilities for transfer in higher level of voltage and also will be added possibilities for placing of new lines.</p> |



| | | |
|---|-----------------|--|
| 6 | Project: | Adding of capacities of SS 35/10kV Mazgit in SS 110/10(20) kV Mazgit, phase II |
| | Description: | <p>Substation Mazgit 35/10kV with location close to Obiliq possess three transformers of power 3x8MVA and is supplied from overhead line AlÇe 95mm² NS 110/35kV Prishtina 1 with length 7.6km and another lines ALÇe 95 mm² from NS “Kosova A” with length 4.85km . One more step-up transformer 10/20kV 2.5MVA is added this year-2019 for supplying 20kV feeder Breznica .Bus bars 35kV of this substation serve to supply further:</p> <ul style="list-style-type: none"> - Seven feeders 10kV - One feeder 20kV - One line 35kV that goes to private substations 35/10kV “Besia” and also supplies our TR (two our 10kV feeders are supplied from there) - Feeder 35kV Hamidia (Bivolaku) - LP 35kV Mazgit – Koliq (as reserve for NS Koliq) with some private substations 35/0,4kV connected <p>Serves as alternative supply for warehouse of water supply in Shkabaj which is important point for Prishtina (third TR us set for this purpose).</p> <p>Maximum power which have achieved these transformers in year 2018 was 102%. Also overhead line LP 35kV (NS Kosova A – NS Mazgit) is loaded up to 105% whereas overhead line LP 35kV (NS Prishtina 1 – NS Mazgit) up to 107%, therefore right now this line 35kV present one bottleneck.</p> <p>Except the existing lines are overloaded, in direction towards Shkabaj there is interest and expected to have expansion of network and to increase even further the load, mainly commercial customer. Also the NS 35/10 kV Koliq in the future can be supplied from Mazgiti and to be offloaded substation NS Podujeva 220/35/10 kV.</p> <p>With construction of new substation 110(220) /35/10kV will be eliminated lines 35kV from substation NS Prishtina 1 and NS Kosova A and will be eliminated transformers 35/10kV, whereas supply through lines 35kV for NS Besi, NS Koliq and</p> |



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| | | |
|--|--|---|
| | | <p>NS Hamidi will remain the same. Will be reduced technical losses in level 35kV, will be increased possibilities for supply of more feeders 10(20)kV and which results in more quality supply with electricity also of level 10kV. With construction of this new substation, there is possibility to offload also Besia or to remove complete transformer if this requested by owner of substation of Besisë.</p> |
|--|--|---|



5.2 Major projects in distribution system

5.2.1 Construction of new substations 35kV and new lines 35kV

Even the KEDS is following the European rules and standards of voltage level and is going / moving in elimination of level 35kV, then in few cases is impossible that these rules to be followed, therefore we are forced to invest even further in this level.

NS Mushtisht 35/10(20)kV – existing feeder 10kV Mushtishti is analyzed for investments in 10kV, in 20kV and in 35kV. Because the main line of this feeder possess network 35kV, then there is possibility to be used that network and to construct one TS 35/10kV, to rehabilitate network 10kV by extracting new feeders from this substation. Supply of new substation 35/10kV Mushtishti, will be done from NS 110/35/10kV Theranda through existing track of feeder 10kV “Mushtisht,” since this feeder is dimensioned and constructed to serve in level 35kV therefore we will not need to invest in level of voltage 35kV.

Construction of new lines 35kV is unavoidable in this phase. Projects in lines 35kV in which must be invested are:

- Ring 35kV in city of Ferizaj
- Line 35kV Prishtinë 1-Fushë Kosovë
- Line 35kV Zhur-Dragash, phase I
- Line 35kV Prizren 1-Zhur, phase II (if is late project 110/35/10kV Dragash)
- Line 35kV Kastriot-Shtime, phase II
- Rehabilitation of lines Gjilan-Gjilan1 and Rafshinë-Kllokot

5.2.2 Expansion of existing substations 110/35/10kV and 35/10 kV and rehabilitation of them

In substations 35kV, except the problems with overloads of transformers 35/10kV, other problem to be emphasized are also technical conditions very difficult for operation of substations. With purpose of respecting the norms of safety and improvement of technical conditions for operation, sustainability / reliability in supply, decrease or elimination of requirement for reduction, support towards increase of load and possibility of operation of voltage level 20kV in the future, are determined projects to advance and adding transformers and cubicles in below written substations

These projects improve technical conditions of operation, add transformation capacity and cubicles 10(20)kV and reconfigure feeders selected to distribute load in more effective method. Some from substations for rehabilitation in the future are:



Rehabilitation of existing substations 35/10kV and expansion of them concerning the space will be done in NS Ferizaji II, Ferizaji III, Fushe Kosova, Zhuri, Artana, Gjakova II, Badovci, Prizreni IV etc.

Must be emphasized that exist also one problem of substations between DSO and KOSTT concerning the investments in space for adding of cubicles. This way in NS Prishtina 3 110/10kV or Peja 2 110/10kV, there is no sufficient space towards side of cubicles 10kV to place new other cubicles. This issue is not determined in no agreement therefore it would be right to be reviewed in the future by both parties.

5.2.3 Adding of transformation capacity in substations 35kV

In substations 35kV listed in table 16, there are problems as consequence of overloads in transformers 35/10kV. With purpose to improve the sustainability in supply, decrease or elimination of reduction because of overload, support towards increase of load and possibility of operation in level of voltage 20kV in the future, are determined projects to advance or add transformers and cubicles in these substations. These projects add transformation capacity and cubicles 10(20) kV and reconfigure feeders selected to distribute load in more effective method. Table 16 below present one list of substations with actual data and same time are shown requirements for investment of transformers.

Table 16 – Increase of power of transformation in substations selected KEDS

| Priority | Existing substations | Actual | | | | Planned |
|----------|----------------------|---------|----------|--------------|--------|--|
| | | Voltage | Capacity | Maximum load | | Description |
| | | kV | MVA | MVA | % | MVA |
| 1 | Prishtina II | 35/10 | 8 | 8.13 | 101.63 | Replacement of TR 4 with 8MVA |
| 2 | Zhuri | 35/10 | 8 | 7.82 | 97.8 | Placing of one new TR 8MVA |
| 3 | Gjilani II | 35/10 | 8 | 7.66 | 95.76 | Replacement of one TR 4 with 8MVA |
| 4 | Shupkovic | 35/10 | 16 | 15.08 | 94.21 | Supply of SS from 10kV with 3 underground cables |
| 5 | Mazgiti | 35/10 | 16 | 15.03 | 93.97 | Activation of third TR 8MVA |
| 6 | Malisheva | 35/10 | 24 | 22.5 | 93.74 | Construction of substation of KOSTT |
| 7 | Gjakova I | 35/10 | 24 | 21.75 | 90.60 | Offloading through substation of KOSTT |
| 8 | Shtime | 35/10 | 16 | 14.33 | 89.6 | Placing of third TR in Shtime |
| 9 | Ferizaji I | 35/10 | 16 | 14.15 | 88.44 | Offloaded with emergency plan |
| 10 | Gjakova III | 35/10 | 8 | 7.04 | 87.98 | Placing of second TR 8MVA |
| 11 | Palaj | 35/10 | 8 | 6.76 | 84.54 | Placing of second TR 8MVA |



5.2.4 Elimination of network 35kV

DSO is operating actually one network 35kV as network sub – transmission to transfer energy in zones that in general are located far away from substations of KOSTT. Substations 35/10kV TM/TM transform voltage of operation and transformers of distribution are supplied in level 10kV. In one long term plan, is planned that networks 35kV and 10kV to turn / transfer to 20 kV. All new substations in KOSTT are designed as 110/10 (20) kV, in accordance with circumstances.

According to projects of Master Plan (2016-2025), in accordance with development plan of transmission operator and based on proposals of DSO for construction of new substations from KOSTT, DSO will eliminate level of network 35kV in few substations.

In year 2018 and until the end of year 2019 DSO will eliminate substations 35/10kV in Drenas, Prishtinë III, Shupkovc, Mitrovice II, Therandë and Lipjan. In later projects is foreseen also elimination of substation 35/10kV Gjilani II, feeders of which will be supplied from Gjilani 5 and same will serve as distribution switchgear for city. For more in Malisheva, Ferizaj, Fushe kosova, existing objects will be converted in distribution switchgears that will operate in 20 kV, and also will happen elimination in Vitia.

5.3 Projects for transfer in level of voltage 20kV

From all methods for decrease of technical losses, method of transfer from one level of voltage in one higher level is best method for improving the quality of voltage, respectively it decreases technical losses extraordinary so much and improves voltage until the last point of customer through feeders 20kV. To realize investments 20kV in feeders 10kV, DSO will use three supply sources:

- Will invest in feeders 10kV in transformers of KOSTT that have possibility of transfer to 20kV or requested from KOSTT to adjust TR (as described above)
- Will use own transformers 8MVA to adapt in 35/20kV and will supply feeders selected
- Will use step-up transformers 10/20kV to supply selected feeders

Transfer to 20kV is one long process costly that except DSO is seen that involves also operator of transmission KOSTT. Existing substations of KOSTT are designed partially in accordance with principle of converting to 20 kV of DSO. In transformers that are recently installed, transformers of energy provide required level of voltage that network normed



with 20 kV will be supplied from points of supply 20kV. But to achieve full operation in 20kV of substations of KOSTT, it depends also from other technical obstacles.

DSO will use voltage step up transformer which will be mounted temporary in gardens / yards of substations of KOSTT or DSO, which mainly will be 4 or 8MVA.

During different analyzes, DSO will invest in long feeders with many substations on it and with high losses and drops of voltage. DSO has changed possibility to start first projects of 20kV in the cities because the problems with quality of electricity are smaller compared with some radial feeders and for the reason / cause the city losses rings for one time and which are very important for distributive network. But there will be also investments as such later, to support increase of load, in certain zones.

In year 2017, DSO has started with one pilot project for converting of feeder 10kV to 20kV. The selected feeder was the feeder Drenica in district of Ferizaji. Later it has joined also one usual / normal feeder called Breznica in district of Pristina.

From system operator was requested that all substation to pass to 20kV, or at least to be used one linking substation 10/20kV 16MVA for elimination of this problem so that is not lost criteria N-1. Therefore, DSO will use TR 10/20kV which will serve as connection field until is constructed complete substation. After the same will be dislocated to other substations of KOSTT. According to plans of DSO substations which will start transfer to 20kV will be:

1. Transfer of SS Lipjani 110/35/10(20)kV to 110/35/20kV, phase I-II
2. Transfer of SS Podujeva 220/35/10(20)kV to 220/35/20kV, phase I
3. Transfer of SS Prishtina 7 110/10(20)kV to 110/20kV, phase I
4. In SS Vushtri 1 110/35kV, one TR will be replaced with 110/20kV and there will be dislocated few feeders for transfer to 20kV, phase I
5. Transfer of SS Theranda 110/35/10(20)kV to 110/35/20kV, phase II
6. Transfer of SS Skenderaj 110/10(20)kV to 110/20kV, phase II
7. Transfer of SS Deçan 110/10(20)kV to 110/20kV, phase II



5.3.1 Transfer of certain feeders 10kV to 20kV and adaptation of TR of DSO for level 20kV

Converting in 20kV in substations of DSO are foreseen:

- NSS Ferizaji III, 8MVA converted to 20kV for transfer of feeders Gaçka and Varoshi to 20kV
- SS Malishevë 2x8MVA converted to 20kV for transfer of few feeders to 20kV; (Mirusha, Kijevea, Bellanica, Caralluka and one part of feeder Llapushniku)
- SS Xërxë 8MVA converted to 20kV for transfer of few feeders to 20kV (Denji, Ratkoci)
- SS Parku Biznesit 2x 8MVA converted to 20kV for transfer of all business feeders to 20kV and stadium in the future
- SS Gurrakoc, placed transformer 8MVA with transformation 35/20kV for feeder Onixi

5.3.2 Placing of step up transformers 10/20kV

Converting to 20kV by using step up transformers:

- TR step up 8MVA 10/20kV in Drenas for Parku e Biznesit
- TR step up 4MVA, 10/20kV for feeder Preoci, in Prishtina 1 110/10kV
- TR step up 8MVA, 10/20kV for feeder Zhupa, in Prizreni 3 110/10kV
- TR step up 8MVA, 10/20kV for feeder Baran-Prapaqan, in Decani 110/10kV
- TR step up 4MVA, 10/20kV for feeder Vrella, in Istog 1 110/10kV
- TR step up 4MVA, 10/20kV for feeder Gremnik, in Klina 1 110/10kV
- TR step up 8MVA, 10/20kV for feeder KFOR, in Vushtrri 2 110/10kV

5.4 Investments in level 10kV

With these projects is foreseen decrease of technical losses and improvement of voltage drops based on solutions which are achieved with investments in level 10kV, without requiring to invest in level 20kV. These projects are foreseen for feeders:



District of Ferizaj: Rexhep Bislimi, Vellezerit Gervalla, Nikadini, Kosovapetrolli, Fshatrat-Ferizaj, Magure-villages, Carraleva-Shtime, Voskopoja dhe Kaqaniku i vjetër, Gotovusha-Shtërpçë

District of Prishtina: Mati1-2, Dalja nr.21, Lagjja e Spitalit 4/1, Çagllavica, daljet e qytetit Fushë Kosovë, Komuna e re-Prishtinë, Keqekollë, Mramor, Velania-V.JAhudive, Kodra e diellit2, Shkabaj, Vragoli, Rezervoaret, Hajvali-Graçanicë, Arbëri, Luboteni, Karadaku

District of Prizreni: Budakova-Therandë, Kamenica, Podrumi, Rahovec, Velezhë, Korishë, Hasi, Mamusha, Krusha, Restelica, Radesha, NS te ri Mushtishti, Shirokë-Therandë, B.Curri, qyteti Prizren

District of Peja: Arbreshi, Radavci, Vitimirica, Loxha, Rugova, F.Pejës, Dubrava, Istogu, Dobrusha, Klina III, Strellci, qyteti-Pejë, Ledinat, Zallqi, JAshanica-Gllareva

District of Gjilani: Bresalci, Malisheva, Kufca, Ropotova, Koretini, Gjilanit II, Binqa

District of Gjakova: Cërmjani, Skivjani, Beci, Ura Terzive, Bistazhini, Raq Moglicë, Opterusha, Shkoza, Pataqani, Dobroshi, Ponosheci, krijimi i unazës qytet 10(20)kV, Xërxa

District of Mitrovica: Shipoli, Ibër-Lepenci, Koshtova, Novolani, Stacioni Hekurudhor, Qytet e Fshatra, Qirezi, Likovci, Kqiqi,

5.4.1 Projects for reinforcement and rehabilitation of network of LV 2019-2022

Rehabilitation and general reinforcement of network is made from replacement of lines and poles 0.4kV and 10kV and transformers 10/0.4kV. Specific requirements for investments are identified from districts based on situation of assets of network and level of performance related to load and voltage (in few zones, voltage is 15-30% under wished standards).

5.4.2 Reinforcement of network – Projects MMO and PLC

Major problems of the distribution network are focused in the low voltage levels. This is one of the main remains why since privatization DSO was focused mainly towards investments in the low voltage. It should be admitted that the distribution grid is still not in the satisfactory level, and the need for network rehabilitation as well as network expansion, improvement of the reading system and decrease of losses remain still as highest priorities for the DSO.

To achieve the network objectives and improve the situation in the field, DSO has oriented its investments mainly in the low voltage projects, respectively in most problematic area which need an emergency solution. It should be emphasized that through these projects a



wider number of customers benefit, and the effect of increased security of supply is bigger. Upgrading limited capacities in the overloaded systems with high voltage and creation of condition for the development of the low voltage network is considered as basic criteria as it fulfills technical and economic conditions for the distribution network panning and ensures qualitative and safe electricity supply for the majority of customers.

Since privatization, KEDS continued the investment in the Meter-Moving Outside- MMO-project, which was a pilot project that begun before privatization. Generally, these projects aim to improve the quality of electricity supply and reduction of technical losses, and enable easier access to the metering point and reduction of commercial losses

MMO project includes in itself two sub projects: improving of existing network (new poles, new conductor, mounting of cabinets, house new connections, etc.) and dislocation of meters outside houses.

Main purposes of projects is to achieve objectives like in following:

1. Improvement of quality of supply with electricity and decrease of technical losses
2. Easy access in metering point and decrease of commercial losses

a. Improvement of existing network

During projects is aimed / targeted to replace majority of poles, since majority of them are old and for purpose to avoid their fall and in such cases a big number of customers might remain without voltage. Also inside the project is foreseen to be replaced conductor, so existing network that has no insulated conductor since is replaced with cable conductors (insulated). In majority of cases in urban zone, instead of installation of boxes in poles, boxes are installed fastened / reinforced in ground, this way the air network is replaced with underground cables. Project in itself includes or does not include placing of new transformer or new ones, depending from zones, which means also rehabilitation of existing network 10kV.

b. Dislocation of boxes – meters outside the houses

Dislocation of metering points from houses in external point in pole – makes easier access from many teams of DSO in reading and control of metering points and in this case possibility of misuse of electricity is reduced to a great deal. In this case meters are transferred outside the houses in boxes that are constructed in advance and also mounted PLC same time.



Projects of network reinforcement are mainly embedded / linked with projects MMO and PLC which before were separated. These projects of rehabilitation include few points under itself.

- Construction of distributive transformers new 10(20)/0.4kV (one or more) in one substation region or more where value of technical and commercial losses in low voltage network is very high. There is case when is no need to add any transformer
- Rehabilitation of existing network 10kV up to new transformer
- Rehabilitation of existing network or construction of new network in low voltage
- Mounting of boxes (frames) in poles if is air network and through ground frames if is underground network
- Construction of house connections from boxes through poles and up to houses
- Placing, transfer of meters from houses to be placed in frames mounted in poles
- Replacement of mechanical meters with ‘smart’ ones
- Mounting of PLC
- Mounting of concentrators

Main focus of the investments in the first phase of the development plan, given the actual circumstances will be reinforcement of the LV network, including construction of new substations in the low voltage levels, but in some cases also reinforcement of the medium voltage network.

5.5 DMS/SCADA

The first phase of project of SCADA has been completed in the end of year 2018, through which SCADA is installed in 21 substations. In this second phase is foreseen the expansion of project also in other substations like in below table. This phase is expected to be completed during year 2019, in this case will benefit 39% of overall customers in Kosovo. In following years is expected to be expanded in other substations and also in switchgears. Also will be worked in DMS-OMS, will be started with GIS and FID.

Table 18 Second phase of project SCADA

| No. | District | Substation Name | Customer Count | [%] to all customers |
|-----|----------|----------------------------|----------------|----------------------|
| 1 | DPR | Prishtina 1 110/35/10 [kV] | 14,570 | 2.45 |
| 2 | DPR | Prishtina 3 110/10 [kV] | 18,245 | 3.07 |
| 3 | DPR | Prishtina 7 110/10 [kV] | 16,357 | 2.75 |
| 4 | DPR | Prishtina 6 110/10 [kV] | 11,755 | 1.98 |



| | | | | |
|--------------|-----|--------------------------|----------------|--------------|
| 5 | DPR | Fushë Kosova 35/10 [kV] | 23,790 | 4.01 |
| 6 | DPR | Drenasi 220/10 [kV] | 8,949 | 1.51 |
| 7 | DPR | Mazgiti 35/10 [kV] | 7,008 | 1.18 |
| 8 | DPR | Palaj 110/35/10 [kV] | 5,036 | 0.85 |
| 9 | DPE | Peja 1 110/35/10 [kV] | 2,0557 | 3.46 |
| 10 | DPE | Klina 110/10 [kV] | 11,644 | 1.96 |
| 11 | DPZ | Theranda 110/35/10 [kV] | 17,762 | 2.99 |
| 12 | DFE | Lipjani 110/35/10 [kV] | 29,892 | 5.03 |
| 13 | DFE | Hani i Elezit 110/6 [kV] | 2,559 | 0.43 |
| 14 | DGL | Gjilani 1 110/35/10 [kV] | 25,021 | 4.21 |
| 15 | DGJ | Gjakova 1 110/35 [kV] | 5,313 | 0.89 |
| 16 | DGJ | Rahoveci 110/35/10 [kV] | 13,190 | 2.22 |
| Total | | | 231,647 | 39.00 |

6. EXPECTED RESULTS OF PROJECTS 2019-2028

Based on rule ZRRE/No. 13/2017 Rule for evaluation of capital projects in network of transmission and distribution in sector of electricity, approved from energy regulatory office, DSO (DSO) is obliged to evaluate projects in financial terms.

For implemented projects that are about the decrease of technical and commercial losses, improvement of voltage, decrease of number of interruptions and decrease of their time duration, etc, is easier to identify measuring parameters by having metering point in all levels of voltage.

Detailed financial analyzes of analyze cost-benefit are send to regulator through investment plan. For first regulatory period 2018-2022 DSO has submitted analyze cost -benefit detailed, part of which are also projects shown in this development plan. For purposes of development plan, during evaluation of projects are taken in consideration various indicators in which is based the evaluation of project like: value of technical losses, value of commercial losses, number of customers included in project, voltage drops, time



duration without electricity, frequently of interruptions with electricity to customers, internal level of return of means, number of means in monetary quantity that are spend for customer, price of losses and price of buying or selling of electricity, etc.

Based on these values above, are identified priorities of projects. In this meaning the highest investment of projects in network is based in investments based on voltage levels: in level 10kV, in level 20kV and in level 0.4kV that have direct impact to customers and for sure also investments in level 35kV but which are projects mainly emergency or to fill criteria N-1.

All investments have their importance and all influence in improving of life of citizen, from these investments benefit all.

With all investments that happen in network are achieved these benefits:

- Ensuring of sustainability and quality of supply with electricity
- Support of load with creation of conditions for expansion of network and new investments
- Elimination of 'bottlenecks' in feeders 10kV
- Decrease of technical losses and voltage drops
- Decrease of number of interruptions and time duration and also localizing of failures/defects
- Transfer of level 10kV and 35kV in voltage level 20kV
- Elimination of old network by creating higher security for surrounding
- Decrease of commercial losses and easier access in meter point for reading and maintenance of meter.
- Digitalization, accuracy and modernization of meter point
- Increase of quality of safety and health of worker at work
- Possible decrease of accidents at work
- Increase of quality at work by using the same work force for a shorter time
- Monitoring and control of system in real time by taking the data immediately from system and intervention more faster
- Modern equipment with applications and software that make possible the recording of data, analyzes, detection and interventions in distance, decrease of time for collecting and processing of them
- Easier access of customer to his data by using applications online
- Creating of better conditions for work ambient of worker concerning the buildings, machinery and that reduce their danger / risk, etc.



6.1 Impact of projects realized in level 10kV

Investments in network of voltage 10kV, will be implicated with more projects which means more feeders 10kV, and the number of customers affected will be much higher compared with other category of projects. Also elimination of ‘bottlenecks’ will be faster in these cases and also isolation of failures / defects.

In below table is shown one example of investment in feeder 10kV Juniku, with this investment are decreased significantly hours interrupted 84% (taken in Advance all interruptions) and also technical losses have dropped 46%.

Table 19 Impact of investments 10kV in feeder Juniku

| Project | Period | Number of customers | Interruptions (h) | MV Technical Losses (MWh)/6 months |
|---------|--------------------|---------------------|-------------------|------------------------------------|
| Juniku | February July 2017 | 2,570 | 124 | 1,596 |
| Juniku | February July 2019 | 2,787 | 20 | 855 |
| Benefit | | | 104 | 741 |

6.2 Impact of projects realized in level 20kV

If invested in network of medium voltage 20kV, then this project has big benefits concerning the quality of electricity and interruptions in medium voltage. The interruptions are decreased around 70% (taken in Advance software all interruptions) for project of feeder Drenica, also technical losses are decreased around 70% for one month (simulated and calculated). But the impact of this project will be observed best way after passing of time, especially during winter season.

Difference with investments in 10kV is that this type of investments requires higher financial means compared with investments in projects 20kV

| Project | Period | Number of customers | Interruptions (h) | MV Technical Losses (MWh)/6 months |
|--------------|------------------|---------------------|-------------------|------------------------------------|
| Drenica 10kV | July-August 2018 | 2513 | 28.75 | 256 |
| Drenica 20kV | July-August 2019 | 2572 | 9 | 73 |
| Benefit | | | 20 | 183 |



6.3 Impact of projects realized with PLC

If invested in network of low voltage and which means also installation of PLC then with these projects are decreased and stopped commercial losses, increased billing, but there is decrease of energy in entrance. In these projects the number of customers that benefit is much smaller compared with above projects but in aspect of energy not supplied benefits are high. In below table is given impact of 40 projects for 9 months

Table 21. Impact of investments in 40 projects PLC completed.

| Projects PLC | Before PLC | After PLC | Difference After-Before | After/Before |
|---------------------|------------|------------|----------------------------|--------------|
| Energy in entrance | 23,299 MWh | 17,483 MWh | -5,816 MWh | -25.96 % |
| Energy billed | 13,335 MWh | 16,255 MWh | 2,920 MWh | 21.90% |
| Energy losses | 9,964 MWh | 1,228 MWh | -8,736 MWh | -87.68% |
| Total energy losses | 42.77 % | 7.02% | -35.75% | |
| Number of consumers | 3,385 | 3,609 | | |

The advantage of these projects is decrease of energy in entrance of substations (as result of drop of illegal connections), decrease of losses (easy monitoring of energy flow), decrease of mistakes in reading (more accurate billing), elimination of eventual mistakes related to meters (decrease of complaints of clients), decrease of time for reading and billing (reading is done from distance and billing automatic in CCP, and also transfer of these data in system HHU, and in this occasion the reader only must print bill and deliver to customer), connection / disconnection from distance (decrease of cost and time of functioning for disconnection of connection), etc.

6.4 Impact of project SCADA

Although the initial costs of the SCADA project may seem high, the rate of return is 14%, ie the system itself is capable of depreciation over a short period of time, given its benefits, which are: The system can be monitored at any time, gain of time and manpower, ability to record and analyze production data, monitor and maintain energy system, obtain location information and immediate intervention, record system interference, detect areas with risk of malfunction and the system has great advantages such as immediate information about functioning / operation (breakers situation, etc.).

Moreover, modern SCADA systems are contributing and playing a key role in many enterprises towards achieving:



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- New levels in reliability of electrical network – increase of incomes
- Detection and proactive resolving of problems – higher reliability
- Fulfilling of necessary requests of energy quality – increase of satisfaction of client
- Strategic decision taking in real time – decrease of cost and increase of incomes



CONCLUSION

As it was emphasized in previous parts, it is very important to develop continuously network of distribution, especially in Kosovo, which is still not in satisfactory level. These investments are needed for DSO to provide sustainable and quality services.

However, in general, with these investments until year 2028, DSO (DSO) will have lower level of technical and commercial losses, improvement of voltage profile, alternative supply of substations and feeders so that for customer to have lower number of interruptions, respectively improvement of indexes of Saidi, Saifi and Ens, and the fulfillment of criteria N-1. Also there will be improvement of quality of services, expansion of capacities, faster reaction in every potential failure / defect, and not only.

Need for important rehabilitation, expansion, adaptation and application of standards in assets of distribution system is very clear. Because of conditions in terrain which are evident, and in order to the network objectives, the need to orient investments in the low voltage level as projects with high priority is very clear, especially in most problematic area which need an emergency solution, and which effects a wider number of customers. Upgrading limited capacities in the overloaded systems with high voltage and creation of condition for the development of the low voltage network is considered as basic criteria as it fulfills technical and economic conditions for the distribution network panning and ensures qualitative and safe electricity supply for the majority of customers, and as such these projects are included in development plan of distribution system operator 2019-2028.

Projects are focused in increase of reliability by decreasing interruptions of electricity because of load (by improving SAIDI and SAIFI) in aspect of fulfilling the criteria N-1 and by decreasing loads in overloaded feeders. Project – design will ensure that general quality of voltage to improve also. Improvements in quality of voltage and decrease of loads in overloaded feeders will result in decrease of technical losses.

Based on analyzes which DSO works them in monthly time, identifies ‘bottlenecks’ in all levels of voltage and appears needs for new investments. In level 35kV where lines have limited capacity or in substations of this level, where there is no possibility to be added same other capacities, based on forecast of trend of increase of load and adding of customers, are foreseen increases of capacities in level 110kV. Increase of capacities in level 110kV is selected in agreement with operator KOSTT taking in consideration priorities and requirements of distribution for development.

In level 35kV are followed loads of transformers and based on their request are added new capacities of transformers, which will be one temporary solution or even long-term.



Selection of investments in level of network 10kV was done based on overloads in lines, technical losses and big voltage drops, SAIDI and SAIFI high, old network or different difficulties in maintenance, overloads of lines and big expansion of network with additional capacities. Because mainly network is radial, in these lines is foreseen to increase section of conductor, separation of line, placing of distribution switchgears, placing of one part of line in one other supply or change of poles or old conductors because of different difficulties in maintenance. In case of lines in city, investments are directed in cable lines but also eventually are foreseen investments there where is need for alternative supplies.

Based on analyzes, the best investment for network 10kV is transfer from lowest level of voltage in highest level of voltage, in this case transfer from level 10kV to level 20kV of voltage. These projects of transfer from level 10kV of voltage to level 20kV of voltage are foreseen step up transformers, or SS 35/10(20)kV or substations 110/20(10)kV where transformers have possibility of operation also in level 20kV. But it cannot be eliminated one investment in one voltage level and to focus in other investment because all have their importance. Investments in 10kV in this phase are more than necessary for elimination of ‘bottlenecks’ in this phase, in combination with investments in level 20kV and of course investments PLC which greatly/large extent have eliminated commercial losses in network.

For level of low voltage network there will be investments with emphasized focus, will be rehabilitation and reconstruction of network, increase of power of transformers or new substations.

It is important to note that some of the benefits of DSO (DSO) are immeasurable, yet they affect all electricity consumers, by improving distribution services, increasing workforce efficiency and quality of supply. Moreover, as stated earlier, some of the projects forecasted are also due to legal requirements, such as meter replacements, or to new requirements arising from changes in legislation (market opening)

However, the implementation of these projects will enable the continuous development of the sector, creating favorable conditions for safe, quality and efficient consumption of electricity.



7. Annex I – Development Plan per districts

Table below presents project plan per districts and expected year of implementation for the first phase of the development plan. Nevertheless, it should be considered that these projects are subject to changes, depending on annual analysis of the distribution system operator, and investments plans forecasted and approved by the regulator during each regulatory period.



| Development plan – District of Ferizaj | | |
|---|---|-----------|
| I. | Projects of expansion of existing substations 110/35kV, 35/10kV and investments in network 35kV | |
| KOSTT | KOSTT new substation in Ferizaj, north part, 40MVA, 110/35/10kV | 2023 |
| Lines 35kV | Transfer of TR 110/35/10kV to 110/35/20kV and 110/10kV to 110/20kV in Lipjan | 2023-2025 |
| | Construction of line 35kV NS Bibaj 110/35 / 10kV -NS 35 / 10kV Ferizaji III | 2019 |
| 35kV TR | Construction of line 35kV I NS KOSTT 110/35 / 10kV - NS 35 / 10kV Ferizaj I | 2019 |
| | Construction of line 35kV Ferizaji -Kastriot 110/35/10kV with Shtime 35/10kV | 2024 |
| | Expansion of NS 35 / 10kV Ferizaj III | 2019 |
| | Transfer of TR 8MVA Ferizaji III 35 / 10kV to 35/20kV for feeders Gaçka and Varoshi | 2024 |
| | Elimination of NS 35 / 10kV Ferizaj I | 2019 |
| | Placing of TR third 35/10kV 8MVA in Shtime | 2021 |
| II. | Investments in level 10kV | |
| Feeders 10kV | Emergency investments in feeders V.Gërvalla, Rexhep Bislimi, Sillosi, Fshatrat, Kosovapetrolli, Nikadini, Ylli, qendra | 2019 |
| | Investments in feeders: Carraleva, Magure Fshatrat, Voskopoja Fshatrat dhe Kaqaniku, | 2021-2024 |
| III. | Transfer in operation of network 10kV in level 20kV | |
| Feeders 20kV | Transfer of feeders 10kV in NS 110/35/10 kV Lipjan, in operation in network with level of voltage 20kV | 2022-2023 |
| | Transfer of feeders 10kV in TR 35/20kV in Ferizaj III, in operation in network with level of voltage 20kV: Gaçka, Varoshi | 2024 |



| Development plan – District of Pristina | | |
|--|---|--|
| I. | Projects of expansion of existing substations 110/35kV, 35/10kV and investments in network 35kV | |
| KOSTT | KOSTT new substation in Fushe Kosova 2x40MVA Transfer of TR 220/35/10kV to 220/35/20kV in Podujeve | 2023 2020-2021 |
| Lines 35kV | Emergency investments in lines 35kV in subdistrict Fushe Kosova Elimination of network 35kV in Prishtina III and Drenasi | 2019 2019 |
| 35kV TR | Rehabilitation of network 35 / 10kV: Drenas, Prishtina III Change of TR 4MVA to NS 35 / 10kV Batllava with TR 8MVA Change of TR 4MVA to NS 35 / 10kV Prishtina II with TR 8MVA | 2019-2020 2020 2020 |
| II. | Investments in level 10kV | |
| Feeders 10kV | Emergency investments in lines 10kV Fushe Kosove: Pozhegu, U.Kabllovik, Shtëpia e kulturës, Ndërtesat e Bardha Investments in lines 10kV: Mati1, Mati 2, Çagllavica, feeder no. 21, j38 Lagjja e Spitalit, Komuna e re, Mramor, Velania, Vragoli, Rezervoart, Arbëria, Karadaku, V.Jahudive, Luboteni Investments 10 (20) kV in new lines Drenas-Komoran for NS 35/10 (20) kV Park Biznesi, | 2019 2021-2025 2021 |
| III. | Transfer in operation of network 10kV in level 20kV | |
| Feeders 20kV | Transfer of feeders 10kV to NS 220/35/20 kV Podujevë, in operation in network of voltage level 20kV Transfer of feeder 10kV Preoc in SS 110 / 10kV Prishtina, in operation in voltage level 20kV Prishtina 7 transfer feeders Mati1, Mati 2, Çagllavica, feeder no. 21, j38 Lagjja e Spitalit to 20kV* Transfer of feeders of Parkut të Biznisit to 20kV | 2020-2025 2023 2020-2025 2021 |



| Development plan – District of Prizreni | | |
|---|---|-----------|
| I. | Projects of expansion of existing substations 110/35kV, 35/10kV and investments in network 35kV | |
| KOSTT | KOSTT new TS in Dragash 1x40MVA with transformation 110/35/10(20)kV | 2024 |
| 35kV TR | Placing of TR 8MVA in NS 35/10 (20) kV Zhur and rehabilitation of substation | 2021 |
| | Construction of new substation 35/10kV Mushtishti with 8MVA | 2022 |
| 35kV -line | Emergency investments for construction of new line 35kV line from NS 35 / 10kV Zhuri to NS 35 / 10kV Dragash | 2019 |
| | Rehabilitation of existing line 10kV Mushtishti for level 35kV | 2022 |
| II. | Investments in level 10kV | |
| Feeders 10kV | Investments 10kV in feeders:Podrumi, Rahoveci, Velezhë, Korishë, Budakova, daljet e reja te Mushtishtit, Restelice, Hasi, Mamusha | 2022-2025 |
| III. | Transfer in operation of network 10kV in level 20kV | |
| TR step up 10/20kV | Placing of TR step up 10 / 20kV 8MVA in Prizren 3 | 2021 |
| Feeders 10kV | Transfer of feeder 10kV Zhupa in SS 110 / 10kV Prizreni 3, in operation in voltage level 20kV | 2021 |



Development plan – District of Peja

| Development plan – District of Peja | | |
|-------------------------------------|---|-----------|
| I. | Projects of expansion of existing substations 110/35kV, 35/10kV and investments in network 35kV | |
| 35kV TR | Placing of TR 8MVA with 35 / 20kV in Gurrakoc | 2022 |
| II. | Investments in level 10kV | |
| | Investments in feeders 10kV Peja: Arbreshi, Radavci, Vitimirica, Loxha, Rugova, F.Pejes, Dubrava, Istog, Dobrusha, Klina III, Jagoda, Strelci | 2021-2025 |
| III. | Transfer in operation of network 10kV in level 20kV | |
| | Placing of TR step up TR 4MVA 10 / 20kV in NS 110 / 10kV Istog | 2024 |
| | Placing of TR step up TR 8MVA 10 / 20kV in NS 110 / 10kV Decan | 2022 |
| | Transfer of feeder 10kV Prapaqan in NS 110 / 10kV Decani, in operation in voltage level 20kV | 2022 |
| | Transfer of feeder 10kV Onixi in NS 35/10 Gurrakoc, in operation in voltage level 20kV | 2022 |
| | Transfer of feeder 10kV Vrella in NS 110 / 10kV Istogu, in operation in voltage level 20kV | 2024 |



Development Plan – District of Gjilani

| Development Plan – District of Gjilani | | |
|---|--|-----------|
| I. | Projects of expansion of existing substations 110/35kV, 35/10kV and investments in network 35kV | |
| 35kV | Placing of second TR 8MVA in Gjilani II | 2022 |
| | Elimination of Gjilanit II | 2025 |
| II. | Investments in level 10kV | |
| | Investments 10kV in Gjilan: Bresalci, Malisheva, Kufca, rehabilitation of feeders of Gjilanit II, Ropotova | 2024-2025 |



| Development Plan – District of Gjakova | | |
|---|---|-----------|
| I. | Projects of expansion of existing substations 110/35kV, 35/10kV and investments in network 35kV | |
| KOSTT | New substation of KOSTT in Malisheva 220/10(20)kV 1x40MVA | 2023 |
| 35kV TR | Placing of TR second 8MVA Gjakova III | 2019 |
| | Renovation of Gjakova II | 2020 |
| | Transfer of TR 8MVA to 35 / 20kV in Xërxë | 2022 |
| | Transfer of TR 8MVA to 35 / 20kV in Malishevë | 2022-2023 |
| II. | Investments in level 10kV | |
| | Investments 10kV in feeders of Gjakova: Cërmjani, Skivjani, Beci, Ura Terzive, Bistazhin, Raq Moglice, Optrusha, Pataqani, Dobroshi, Ponosheci, Xërxa | 2021-2025 |
| III. | Transfer in operation of network 10kV in level 20kV | |
| | Transfer of feeder 10kV Denji NS 35 / 10kV Xërxa in operation in level 20kV | 2022 |
| | Transfer of feeders 10kV in Mirushë from level of operation 10kV in operation in voltage level 20kV | 2022-2023 |

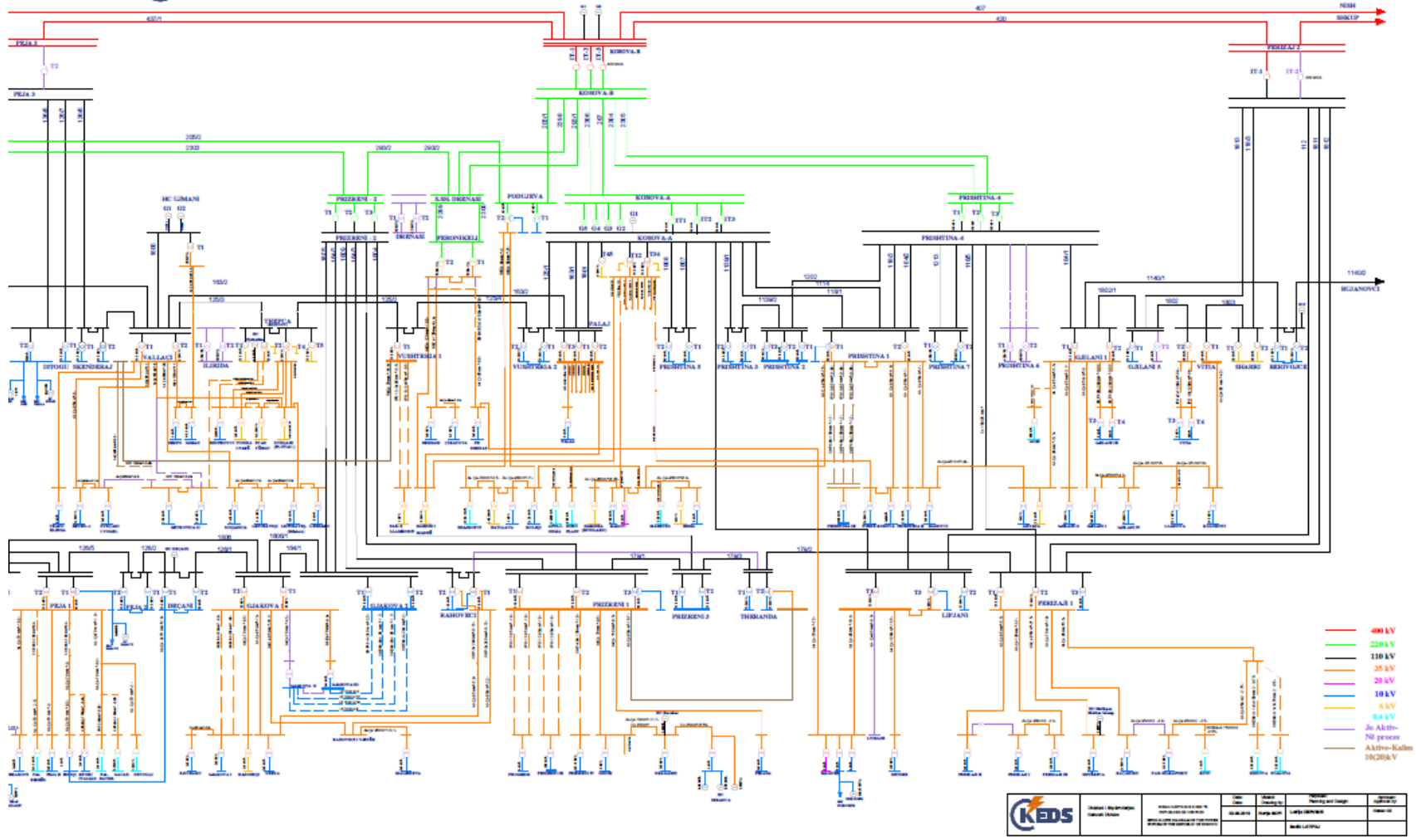


| Development plan – District of Mitrovica | | |
|--|--|-----------|
| I. | Projects of expansion of existing substations 110/35kV, 35/10kV and investments in network 35kV | |
| KOSTT | Placing of TR 110/20kV in Vushtri 1 | 2022-2025 |
| 35kV TR | Rehabilitation of NS 35 / 10kV Shupkocv* | 2019-2020 |
| II. | Investments in level 10kV | |
| | Investments in feeders 10kV Mitrovica: Shipoli, Iber Lepenci, Koshtova, Novolan, Stacioni Hekurudhor, Qytet e Fshatra, Qirezi, Likovci | 2021-2025 |
| III. | Transfer in operation of network 10kV in level 20kV | |
| TR step up 10/20 | Placing of step up TRs 10/20kV in Vushtri 2 | 2020 |
| | Transfer of feeder KFOR to 20kV | 2020 |
| | Transfer of feeders 10kV: Ekstra, Martiraj, Kabllat, Maxhunaj, to 20kV | 2022-2025 |

*We are in the planning phase and are considering the possibility of investing these outputs as 10kV or 20kV



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