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REGIONAL STRATEGY FOR SUSTAINABLE HYDROPOWER IN THE WESTERN BALKANS

Background Report No. 6

Grid connection considerations

Final Draft 2

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Contents

List of abbreviations and symbols

Abbr. & Symbols	Description / Meaning
AERS	Energy Regulatory Agency (Serbia)
AGC	Automatic Generation Control
AKBN	National Agency of Natural Resources (Albania)
ALB	Acronym used for Albania
ASAP	As soon as possible
BiH	Acronym used for Bosnia and Herzegovina
BR	Background report
CGES	Crnogorski Elektroprenosni Sistem (Montenegrin TSO)
CP	Contracting Party
DERK	State Electricity Regulatory Authority (BiH)
DG NEAR	Directorate-General for Neighbourhood and Enlargement Negotiations
DSO / DNO	Distribution System Operator / Distribution Network Operator
EC	European Commission
ECS	Energy Community Secretariat
ECT	Energy Community Treaty
EIA	Environmental Impact Assessment
ELEM	Elektrani na Makedonija (power utility of the former Yugoslav Republic of Macedonia)
EMS	Elektromreža Srbije (Serbian TSO)
EMS	Energy Management System
EnC	Energy Community
ENTSO-E	European Network of Transmission System Operators for Electricity
EP BiH	Elektroprivreda Bosne i Hercegovine (power utility of (Federation of) BiH)
EPCG	Elektroprivreda Crne Gore (power utility of Montenegro)
EP HZHB	Elektroprivreda Hrvatske Zajednice Herceg Bosne (power utility of Croatian Community of Herceg Bosna)
EPS	Elektroprivreda Srbije (power utility of Republic of Serbia)
ERC	Energy Regulatory Commission (the former Yugoslav Republic of Macedonia)
ERE	Energy Regulatory Authority (Albania)
ERO	Energy Regulatory Office (Kosovo)
ERS	Elektroprivreda Republike Srpske (power utility of Republika Srpska)
EU	European Union
EVN	Distribution System Operator (the former Yugoslav Republic of Macedonia)
FBiH	Federation of Bosnia and Herzegovina, entity of Bosnia and Herzegovina
FERK	Federation BiH Energy Regulatory Commission
GIS	Geographic Information System
HPP	Hydro power plant
HV	High Voltage
IFI	International Financing Institution
I.O.L.R.	Institutional-Organisational-Legal-Regulatory (framework)
IPF	Infrastructure Project Facility
IPF3	Infrastructure Project Facility -Technical Assistance Window, 3rd (present) contract

Abbr. & Symbols	Description / Meaning
KEDS	DSO of Kosovo
KESH	Korporata Elektroenergjitike Shqiptare (power utility of Albania)
KOS	Acronym used for Kosovo
KOSTT	TSO of Kosovo
LV	Low Voltage
MCA	Multi Criteria Assessment
MEI	Ministry of Energy and Industry (Albania)
MEPSO	TSO of the former Yugoslav Republic of Macedonia
MH ERS	Mixed Holding of ERS (Republika Srpska, BiH)
MKD	Acronym used for the former Yugoslav Republic of Macedonia
MME	Ministry of Mining and Energy (Serbia)
MNE	Acronym used for Montenegro
Mott MacDonald-IPF Consortium	The Consortium carrying out the present project under WBIF-IPF3
MV	Medium Voltage
NOS BiH	Independent System Operator for BiH
NTC	Net Transfer Capacity
OHL	Overhead line
OSHEE	Distribution System Operator (Albania)
OST	Transmission System Operator (Albania)
REGAGEN	Energy Regulatory Agency (Montenegro)
RERS	Republika Srpska Energy Regulatory Commission
RES	Renewable energy source
RES-E	Electricity generated from RES
RHPP	Reversible Hydro Power Plant
RS	Republika Srpska, Entity of Bosnia and Herzegovina
SAA	Stabilisation and Association Agreement
SAP	Stabilisation and Association Process
SCADA	Supervisory Control And Data Acquisition
SEA	Strategic Environmental Assessment
SFRJ	Socialist Federal Republic of Yugoslavia
SER	Acronym used for Serbia
TA	Technical Assistance
ToR	Terms of Reference
TSO	Transmission System Operator
TYNDP	10-Year Network Development Plan
WB(g)	World Bank (Group)
UCTE	Union for the Coordination of the Transmission of Electricity (predecessor of ENTSO-E)
UN	United Nations
WBEC-REG-ENE-01	Designation of the subject Project
WBIF	Western Balkans Investment Framework
WB6	Western Balkans consisting of 6 countries: Albania, Bosnia and Herzegovina, Kosovo, the former Yugoslav Republic of Macedonia, Montenegro and Serbia
WFD	Water Framework Directive

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0 Preamble

The REGIONAL STRATEGY FOR SUSTAINABLE HYDROPOWER IN THE WESTERN BALKANS[1] — referred to as “the Study” — is a sub-project under the WBIF-IPF3 contract of the IPF Consortium led by Mott MacDonald, with European Commission, DG NEAR D.5, being the Contracting Authority for the WBIF-IPF3 contract.

The six Western Balkans beneficiary countries comprise Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Kosovo*, Montenegro and Serbia - the WB6 region.

The work programme of the Study includes 13 Tasks as stipulated in the Terms of reference (ToR):

- Task 1: Hydropower role (past and future) in the regional and national context;
- Task 2: Assessment of the current situation in the institutional-organisational framework relevant for hydropower development;
- Task 3: Assessment of the current situation in the legal-regulatory framework relevant for hydropower development;
- Task 4: Assessment of hydrology baseline, water-management by country and by river basin with transboundary issues;
- **Task 5: Grid connection issues in network development context;**
- Task 6: Identification of HPP projects and acquiring relevant information for the HPP inventory and investment planning;
- Task 7: Environmental, Biodiversity and Climate Change Analysis on (i) river basin level and (ii) country-level of identified hydropower schemes;
- Task 8: Establishment of the central GIS database;
- Task 9: Development of a web-based GIS application;
- Task 10: Multi-Criteria Assessment (MCA) of prospective hydropower projects;
- Task 11: Drafting of Regional Action Plan on Hydropower Development and compilation of Final report on the Study;
- Task 12: Establishment of IT-supported Information and Document Management System (IDMS);
- Task 13: Training and dissemination of Study results.

The Study deliverables encompass separate Background reports (BR) that focus on specific technical issues in professional areas related with hydropower sector development, e.g.:

- Background report n° 1 (BR-1) – Past, present and future role of hydropower
- Background report n° 2 (BR-2) – Hydrology, integrated water resources management and climate change considerations
- Background report n° 3 (BR-3) – Environment considerations
- Background report n° 4 (BR-4) – Regulatory and institutional guidebook for hydropower development
- Background report n° 5 (BR-5) – Transboundary considerations
- **Background report n° 6 (BR-6) – Grid connection considerations**
- Background report n° 7 (BR-7) – Inventory of planned hydropower plant projects
- Background report n° 8 (BR-8) – Identification of potential sustainable hydropower projects

This Background report no. 6 (BR-6) in the following is the output and deliverable of Task 5.

Enlargement process

* This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

[1] The designated WBIF code of this sub-project is WBEC-REG-EN-01.

The EU Enlargement process is the accession of new countries to the European Union (EU). It proved to be one of the most successful tools in promoting political, economic and societal reforms, and in consolidating peace, stability and democracy. The EU operates comprehensive approval procedures that ensure new countries will be able to play their part fully as members by complying with all the EU's standards and rules (**the *"EU acquis"***). The conditions of memberships are covered by the Treaty on European Union.

Each country moves **step by step** towards EU **membership as it fulfils its commitment**s to transpose, implement and enforce the Acquis.

The EU relations with the Western Balkans countries take place within a special framework known as the **Stabilisation and Association Process (SAP)** in view of stabilising the region and establishing free-trade agreements. To this end, all WB6 countries have signed contractual relationships (bilateral **Stabilisation and Association Agreements, or SAAs**) which entered into force, depending on the country, between 2004-2016.

The **accession negotiations** are another step in the accession process where the Commission monitors the candidate's progress in meeting its commitments on 35 different policy fields (chapters), such as transport, energy, environment and climate action, etc., each of which is negotiated separately.

At the time of writing (November 2017), there are four WB6 countries that have been granted **Candidate Country** status: the former Yugoslav Republic of Macedonia, Montenegro, Serbia and Albania, while Bosnia and Herzegovina and Kosovo have the status of **Potential Candidate** countries at this date. With two countries, Montenegro and Serbia, the **accession negotiations** have already started and several of the chapters of the EU *acquis* have been opened.

To benefit from EU financing for projects, each country **should respect the EU legislation relevant to that project,** even if the national legislation has not been yet fully harmonised with the EU acquis.

The "Regional Strategy for Sustainable Hydropower in the Western Balkans" aims to set guidelines for a sustainable development of hydropower in the Western Balkans.

EU Acquis relevant to the Study

In the context of this Study, **the most relevant thematic areas are spread mainly over two Acquis Chapters** (15 on Energy and 27 on Environment) relating to water resources, energy, hydropower development and environmental aspects including climate change.

- Chapter 15 Energy Acquis consists of rules and policies, notably regarding competition and state aid (including in the coal sector), the internal energy market (opening up of the electricity and gas markets, promotion of renewable energy sources), energy efficiency, nuclear energy and nuclear safety and radiation protection.
- Chapter 27 relates to 10 sectors / areas: 1 - Horizontal Sector, 2 - Air Quality Sector, 3 - Waste Management Sector, 4 - Water Quality Sector, 5 - Nature Protection Sector, 6 - Industrial Pollution Sector, 7 - Chemicals Sector, 8 - Noise Sector, 9 - Civil Protection Sector, and 10 - Climate Change Sector.

Commission President Juncker said in September 2017 in his State of the Union address that: *"If we want more stability in our neighbourhood, then we must also maintain a credible enlargement perspective for the Western Balkans".* To Serbia and Montenegro, as frontrunner candidates, the perspective was offered that they could be ready to join the EU by 2025. This perspective also applies to all the countries within the region. This timeline also corresponds to the period for preparing such major infrastructures and their lifetime. Consequently, WB6 countries have to demonstrate now that they are and will develop sustainable hydropower according to EU rules.

Relevant pieces of EU legislation and international agreements

Hydropower development should be done while respecting relevant EU legislation and international agreements to which the WB countries are Parties. This includes:

- Renewable Energy (Renewable Energy Directive 2009/28/EC)
- Energy Efficiency Directives (2012/27/EU; 2010/30/EU; 2010/31/EU)
- Environmental Impact Assessment Directive (Directive 2011/92/EU as amended by Directive 2014/52/EU) and Strategic Environmental Assessment Directive (Directive 2001/42/EC)
- Water Framework Directive (Directive 2000/60/EC)

- Habitats Directive (Directive 92/43/EEC) & Birds Directive (Directive 2009/147/EC)
- Floods Directive (Directive 2007/60/EC)
- Paris Agreement on climate change
- Aarhus Convention (the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters)
- Espoo Convention (the UNECE Convention on Environmental Impact Assessment in a Transboundary Context)
- Berne Convention (the Berne Convention on the Conservation of European Wildlife and Natural Habitats)

The framework conditions and legal obligations for hydropower development stem from the EU acquis and international obligations, the implementation of which should be supported through the Energy Community Treaty (to which all of the WB6 countries are signatories) as well as International River Basin Organisations.

As **Contracting Parties (CPs) to the Energy Community Treaty (ECT),** the WB6 countries have obligations and deadlines to adopt and implement acquis closely related to the energy sector / market development and environment such as:

Relevant to the Study are selected elements of EU energy *acquis* as transposed in the Energy Community:

- Electricity (Directive concerning common rules for the internal market in electricity (Directive 2009/72/EC); Regulation on conditions for access to the network for cross-border exchanges in electricity (Regulation (EC) 714/2009); Regulation on submission and publication of data in electricity markets (Regulation (EU) 543/2013))
- Security of supply (Directive concerning measures to safeguard security of electricity supply and infrastructure investment (Directive 2005/89/EC)
- Infrastructure (Regulation on guidelines for trans-European energy infrastructure (Regulation (EU) 347/2013)
- Energy Efficiency Directives (2012/27/EU; 2010/30/EU; 2010/31/EU)
- Renewable Energy (Renewable Energy Directive 2009/28/EC)
- EIA Directive (Directive 2001/92/EU);
- SEA Directive (Directive 2001/42/EC);
- Birds Directive (Directive 79/409/EEC);
- Directive on environmental liability with regard to the prevention and remedying of environmental damage (Directive 2004/35/EC as amended by Directive 2006/21/EC, Directive 2009/31/EC)

Note: We recognise that close coordination between the energy, environment and climate change legislation and policies is necessary in the context of sustainable hydropower development.

However, to avoid duplications in the BRs, issues related to the WFD and Floods Directives are addressed in more detail in BR-2 (Hydrology, integrated water resources management and climate change considerations) and BR-5 (Transboundary considerations), respectively while all other Directives (in addition to the WFD and Floods Directives) comprising the EU environmental legislative package (Habitats, Birds and SEA/EIA) are addressed in more detail in BR-3 (Environment considerations).

Small Hydropower Plants in the Regional Strategy for Sustainable Hydropower in the Western Balkans

While the 390 small hydropower plants in the Western Balkans 6 region represent almost 90% of all hydropower plants, they only produce 3-5% of the total hydropower generation and constitute 7% of the total hydropower capacity, most of hydropower energy and capacity in the region being delivered by the large hydropower plants.

This raises the question of the role of small hydro power plants and the pertinence of further developing such infrastructures. Their contribution to the global energy production and security of supply, or to the renewable energy sources targets, is extremely limited. In parallel, their impacts on the environment are severe, as they create multiple interruptions in water flows and fish passages, increase habitat deterioration and require individual road access and grid connections. Furthermore, while most of these small hydropower plants were commissioned after 2005, when the state-support schemes – mainly feed-in tariffs – which will be phased out after 2020 and hence it is expected that the private sector interest in developing small hydropower plants will diminish significantly.

Due to the large number of small hydropower existing plants and projects, and due to the questions on their role and pertinence, the Regional Strategy for Sustainable Hydropower in the Western Balkans focused on major hydropower contributors to the power system, that is to say large hydropower plants of a capacity above 10 MW. Nevertheless, wherever possible, small hydropower plants have also been addressed in the study.

1 Introduction

1.1 Objectives

The objective of this background report is to investigate in detail the framework for grid access and grid connection of prospective hydro power plants (HPPs), in each of the WB6 countries. For the purposes of this report, grid connection issues have been thoroughly investigated from the technical, legal, institutional, organisational, regulatory, and financial points of view. The idea behind this approach was to establish an indicator to allow a comparison to be made between WB6 countries and best common European practice. An important aspect examined in this task was an analysis of the transparency of the process through which HPP projects become connected to the grid, focusing on the accessibility of the relevant legislation in the public domain to HPP developers, especially concerning up-front information about prospective connection costs.

In parallel, the Consultant's task was to investigate the capacity of the existing electricity networks (both transmission and distribution) to accept the connection of the identified and planned HPPs in the WB6 region. Part of this task has been to determine if the capacity of the existing electrical networks is sufficient to facilitate all planned HPP connections (including the rehabilitation/repowering plans of existing HPP operators), or whether major investments are needed in strengthening the electricity networks to facilitate hydro generation development.

Last, but not least, an important task objective was to assess the impact of new hydropower generation in the generation mix and on the balancing capability of individual power systems, as well as its impact on an assortment of ancillary services required for power system control.

1.2 Activities

Work on this project task and consequently the structure of this Background report has been based on the following main activities, undertaken for each of the WB6 countries:

1) Analysis of the Grid Access and Grid Connection regulations and practices;
2) Review of the existing electrical networks' capacity to accommodate the connection of prospective and planned HPP developments; and
3) Proposals for improvements of the HPP connection facilitation framework in the WB6 region and development of proposed follow-up actions.

1.3 Links with other Background Reports of the Study

This background report is closely connected with the following other background reports that have been developed under the Hydropower Development Study:

- Task 2: "Assessment of the current situation in the institutional-organizational (I&O) framework relevant for hydropower development" and Task 3: "Assessment of the current situation in the legal-regulatory (L&R) framework relevant for hydropower development", summarised in the common Background Report No. 2 – "On Gap Analysis of the Legal-Regulatory and Institutional-Organisation Framework Relevant for Hydropower Development", and
- Task 6: "Identification of HPP projects and acquiring relevant information for the HPP inventory and investment planning", presented in Background Report No. 6 "On Inventory of Prospective HPP Projects, GIS Application and the Remaining Hydro-Potential in the WB6 Region".

The Institutional-Organisational-Legal-Regulatory (I.O.L.R.) framework for HPP development is described in detail in BR-4, elaborating on Tasks 2&3, and contains elements related to grid connections. This Background Report, No. 6, however, explains further the details and the impact of the current governing frameworks in the WB6 countries relating specifically to grid connections and HPP operations. BR-7, the inventory of prospective

HPP projects, identifies the planned hydropower development projects in the WB6 region and is used as the basis for the assessment of the network capability contained in this background report.

2 Methodology

2.1 Analysis of the Grid Access and Grid Connection regulations and practices

The Consultant undertook a detailed assessment and analysis of the existing national rules and practices governing grid access and grid connection of new hydro power plants in the WB6 countries. To that purpose, the Consultant included in its investigation all stakeholders identified in the Scoping Phase of the project, starting with line Ministries, Regulators and Network Operators and ending with private investors and project developers. A result of this activity is an in-depth analysis of legislation vs. practice in grid access and grid connections for HPPs throughout the WB6 countries, which is presented in this report separately for transmission and distribution networks. Malpractices, gaps in legislation and inconsistencies have been identified, discussed, recorded and analysed, resulting in the development of proposals for improvement. Assessment in this task has been done separately for the transmission and for the distribution networks, because of the differences in the applicable legislative framework and technical requirements for connection and operation. The Consultant met all the main institutions responsible for policy-making and implementation of grid access and grid connections, discussed and assessed the status of regulations and their implementation. The thorough analysis of the connection requirements included all relevant regulations extending from the Energy/Electricity Laws, relevant secondary legislation (Network Codes), through to internal acts of the Network Operators such as Rulebooks and Guidelines for grid connection, methodologies for determination of the network connection costs, template connection applications, template connection contracts, etc.

Using these findings as a basis, together with other findings from meetings with stakeholders and investors organised to collect further information on the actual implementation of the existing network connection rules, the Consultant developed the analysis of the rules and prevailing practices for grid access and grid connection of HPPs that is presented in this report. An additional part of this assessment was the analysis of the operational requirements for the hydro power plants, i.e. the technical requirements that hydropower generation units must comply with during their operational phase (once they are constructed, connected to the grid and operational). Analysis of the operational requirements is very important for the investors in hydropower generation projects because these requirements may impact the selection of the main and auxiliary equipment of the plant, and consequently impact the overall project costs.

In this report, quite often different legislative and regulatory documents are described that establish a certain order of procedures in the electricity sector. In this particular case, these relate to the subject of transmission and distribution grid connections and HPP operations. For the sake of consistency, these documents have been structured in the following way:

- **Primary Legislation** – Laws and Government Decrees;
- **Secondary Legislation** – Regulator's Acts/Decisions, Network Codes, Market Rules and other governing documents that have been developed, based on the requirements of the primary legislation;
- **Tertiary Legislation** – Methodologies, Rulebooks, Instructions and other documents developed based on the requirements of the secondary legislation.

2.2 Review of the existing electrical networks capability to accommodate connection of planned HPP developments

This activity was undertaken in close cooperation with the relevant network operator in each WB6 country. Counterparts for this activity were the planning and operational departments of Transmission System Operators (TSOs), i.e. those teams of TSO experts producing long-term development plans for the transmission network[2]

[2] In ENTSO-E, the standard is the development of the 10-Year Transmission Network Development Plan (TYNDP) which is updated every year or every 2 years.

and those responsible for power system control and operations (dispatch centres). Connection points of HPPs to electrical networks have been identified for each individual HPP project that has been recognised as a prospective candidate project in Task 6. In addition to the identification of the electricity network connection points for prospective HPP development projects, the Consultant and network operators' experts explored the total effect of these connections in aggregate on the power system, assuming that all selected HPP projects become connected in a foreseeable future. For rehabilitation / reconstruction projects of existing HPPs that are likely to use the existing connection points which will require upgrade / modification, such cases have also been included in this activity. Considering small HPPs, which are in most WB6 countries defined as below 10 MW of installed capacity, and are usually connected to the distribution network, a similar exercise was conducted with the relevant Distribution System Operators (DSOs). Unlike the assessment for the transmission network (usually only one TSO by the country), in the distribution network in some countries there were more operators and the analysis was completed by examining the cumulative effect of these small HPP projects on the network operated by the individual DSO. Network connection and operation issues in the distribution network are, in general, much more complex - due to the distribution systems comprising of mainly radial networks and numerous potential interactions of HPPs with other network users. In general, the assessments of an electricity network's capability to connect planned HPPs have been made from several perspectives:

- Capacity of the planned connection points and network in the vicinity of the connection point;
- Overall electricity-transfer capacity of the entire national electricity transmission network including interconnections;
- Local/areal capability of the transmission network to facilitate planned projects and the need for new investments in upgrading and rehabilitation;
- Capacity of the distribution networks to facilitate connection and integration of hydropower plants; and
- Impact of the planned and foreseeable hydropower generation development projects on the overall capability of the national (and regional) electrical networks to provide sufficient ancillary services and overall power system balancing capability.

The outcome of this analysis is presented in the following sections of this background report.

2.3 Proposals for improvement of the HPP facilitation framework in the region and follow-up actions

Summarising the previous activities and associated investigations, proposals for improvements of the existing rules and practice concerning access to and connection to the electrical grids, have been developed through the activities described above and are presented in the later stages of this report. These proposals were developed at the country level, recognising the measures that should be applied by individual stakeholders and at different institutional levels while taking into consideration the interactions between them. These proposals for improvement of the existing rules and practice concerning access and connection to the electrical grids are not only part of this background report, but also an element of the regional Action Plan (presented in Annex 1 of the Final report on the Study).

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3 Grid Access and Grid Connection regulations and practices

3.1 Regional level

All WB6 countries committed to fully transpose and implement the EU legislation through the European integration progress and to joining the EU. They are signatories of the Energy Community Treaty which is supporting the implementation of the EU legislative framework applicable to the energy sector, based on decisions made by the Ministerial Council of Energy Community (MC-EnC). This applies also to the ownership, organisation and operations of the electrical transmission and distribution networks in the WB6 countries, in accordance with the EU 3rd Energy Legislative Package, which is mandatory for all Contracting Parties (CPs) to the Energy Community Treaty (ECT). Consequently, all transmission and distribution network operations are subject to a very similar set of rules, with the prospect to completely unify them under the ENTSO-E Network Codes umbrella. Unlike the case of water management, where coordination at the regional level and on the river basin level practically does not exist in the WB6 region, in the sector of electricity this coordination and cooperation is at a very high level. This is partly due to the fact that generation, transfer and consumption of electricity are real-time activities associated with high level of risks, and partly due to the fact that this region was operating isolated from the main European grid from 1992 till 2004, in a small and vulnerable regional interconnection (which was also known as the Second UCTE Synchronous Zone), where close cooperation and mutual assistance was a must.

Electricity grids in WB6 countries have been significantly improved during the last 20 years. This applies mainly to the transmission networks, including cross-border transmission interconnection lines. The HV electrical grid in the WB6 region today has much higher power Net Transfer Capacity (NTC) than in the 1990s. On the other hand, the development of major hydro power plants and their integration into existing electrical grids practically ended in the early 1990s.In all WB6 countries, the transmission network includes facilities operating at voltage levels of 110 kV, 220 kV and 400 kV. Nowadays, the trend in transmission networks is to limit the network facilities to only two voltage levels, 400 kV and 110 kV, the 220 kV voltage is being phased out and is not developed any more. Accordingly, all refurbishment works of existing 220kV facilities are planned as upgrades to 400kV. The main reason for this is the optimisation of development and maintenance costs. On the other hand, most of the major HPPs in the region are still connected to the 220kV network, because at the time of their commissioning it was the highest voltage level in their respective networks. Later, these 220kV lines have been connected to the nearest 400kV substations, but majority of HPPs in the region are still heavily dependent on their original 220kV connections: Drinsko-Limske HPPs in Serbia, HPP Piva and HPP Peručica in Montenegro, all HPPs in the Neretva river basin in BiH, and all major HPPs on Drini river in Albania.

A limited number of HPPs were connected to the distribution network under the control of the vertically integrated power utility, which was at the same time owner and operator of the distribution network, and the only supplier of electricity to consumers. Nowadays, RES-E power generation plants are also almost by default connected to the distribution network, but the role of the networks and their future are completely different. In some WB6 countries (BiH, the former Yugoslav Republic of Macedonia), the development of small HPP during this decade was significant. Liberalisation and strong incentives for RES development resulted in many new small HPPs, wind and solar power generation projects, causing entirely different power flow patterns in some parts of the distribution networks. Distribution networks are becoming more and more active, with permanently growing power generation and the pressing need for ancillary services and balancing services. These issues, together with the distribution network's capacity to facilitate connection of RES-E power generation facilities, will be among the major challenges for distribution system operators in the future. The assessment of the distribution network's ability to facilitate growing demands for connection from HPPs (taking into consideration the impact of other RES-e power generation facilities) considers the overall capacity in the network, the capacity of specific areas/zones in the network, and local capacity at the desired connection points.

In recent years, as a consequence of electricity sector unbundling and a high increase in the demand for connection of RES power generation units to electrical grids, rules for access and connection to the network have become an important component of each hydropower development project, equally important from the technical and from the financial side. **The regulatory framework in most of the WB6 countries states that, for the connection of RES-E power generation to electrical grids, the investor in RES-E facility should bear the connection costs up to the nearest (or the most convenient, optimal) connection point in the electrical network. Works at the connection point and the consequent network extensions and reinforcements necessary to enable the connection should be made on the account of the network operator and subsequently recovered through tariff.** This is one of the critical points which significantly delays a number of RES-E power generation projects - simply because network operators, due to the relatively low prices of electricity for final consumers in their countries, have no capacity to finance all these works, while at the same time maintaining and operating the rest of their network to the desired quality.

Concerning grid access and grid connection regulations and practices in the WB6 region, the situation is quite uniform, due to the fact that all WB6 countries committed to transpose and implement the EU Acquis through the European integration progress and to joining the EU. They are also CPs to the ECT and are accordingly obliged to ensure full compliance with all EU legislation. Moreover, the Energy Community Secretariat (ECS) is authorised to initiate sanctions against ECT Parties that do not strictly comply with the effective legislation. As a result, all regional countries achieved significant progress in unbundling of their electricity industries, harmonisation of their legislation with EU 3rd Energy Package, and transparency in their operations. Access to the electrical networks is fully granted in a non-transparent manner to all potential network users. Grid connection procedures are defined in the relevant legislation at the country level –through Electricity/Energy Laws, Transmission or Distribution Codes, as well as various Methodologies, Procedures and Rules defined by the network codes). A summary of the transmission network connection regulations and practices in individual WB6 countries is presented hereafter in Table 3.1, while a summary of the distribution network connection regulations and practices in individual WB6 countries is presented in Table 3.2.

Table 3.1: Transmission grid connection regulations and practices in individual countries

	ALB	BiH	MKD	MNE	KOS	SER
Electricity/Energy Law articles on DSO	2015, harmonised with 3rd Energy Package	2004, NOT in line with 3rd EU Energy Package, new draft ready	2011, amended and harmonised with 3rd EU Energy Package	End 2015, fully harmonised with 3rd EU Energy Package	Mid 2015, harmonised with 3rd EU Energy Package	End 2014, harmonised with 3rd EU Energy Package
Transmission Code (TC)	2008, needs update	End 2016	End 2015, very comprehensive	2011, needs update	February 2015	October 2015
Connection Rules	From the Code	From 2008, new draft in the procedure	In the Transmission Code	Partly in Law, partly in TC	2015, Connection Code (KOSTT)	2015, Connection Procedure (EMS)
TSO's right to refuse connection	NO	YES	YES, with justification	NO	NO	NO
Connection costs methodology	Guidelines by OST from 2010	Transmission Company Rulebook approved by DERK	Annex 7 of the TC	CGES 2016, in the approval procedure	Connection charging Methodology, KOSTT October 2013	AERS (Regulator) December 2015
Connection payment principle	Shallow connection costs[3] in legislation, Deep Connection costs[4] in reality	Shallow connection costs	Realistic connection costs	If investor constructs and transfers connection assets to TSO, connection costs are Shallow. If not, are Deep.	Realistic connection costs	Realistic connection costs
Ownership transfer	Voluntary, with compensation	Mandatory	Mandatory		Mandatory	Mandatory
Use-Of-System	Consumers	Consumers	Consumers	Consumers	Consumers	Consumers

[3]Shallow connection costs are only costs of the connection infrastructure on its side of the connection point.

[4]Deep connection costs are all costs of the connection infrastructure, including costs of the necessary network reinforcements.

charges	only	only	only	only	and Generators	only

Table 3.2: Distribution grid connection regulations and practices in individual countries

	ALB	BiH	MKD	MNE	KOS	SER
Electricity/Energy Law articles on DSO	2015, harmonised with 3rd EU Energy Package	2015, harmonised with 3rd EU Energy Package	2015, harmonised with 3rd EU Energy Package	End 2015, fully harmonised with 3rd EU Energy Package	2015, harmonised with 3rd EU Energy Package	End 2014, harmonised with 3rd EU Energy Package
Distribution Code (DC)	2003, needs update	2008/2009, new version in procedure	2012/2014 very comprehensive	2012, EPCG, needs update	2014, KEDS	July 20th, 2017
Connection Rules	Partly available in the DC	2008 (FBiH in DC) 2014 (RS, separate from DC)	Part of the DC	2012, EPCG	Inside the DC	Amendments to the Distribution Code from 2014
DSO's right to refuse connection	NO	YES	YES, with justification	NO	NO	NO
Connection costs methodology	None	Methodology by entity Regulators	Annex 1 of the DC	Not available	2005, KEK	AERS (Regulator) December 2015
Connection payment principle	Shallow connection costs in legislation, deep in reality	Between[5] Shallow and Deep connection costs	Between Shallow and Deep connection costs	Not available	Realistic connection costs	Deep connection costs
Ownership transfer	Voluntary, with compensation	Voluntary[6]	Voluntary[7]	Not available	Mandatory	Mandatory

3.2 Country level

3.2.1 Albania

3.2.1.1 Introduction

Albania is a country which is one of the focus areas in this hydropower development study, due to its high hydropower potential and very high number of already-issued concessions for development of hydropower generation facilities. On the other hand, electricity networks in Albania are significantly less developed than other countries in the region. For these reasons, the assessment of potential grid connections and the integration to the grid of future hydropower plants in Albania is a rather demanding and challenging exercise.

[5]Investor participates partly in the costs of the distribution network reinforcement for facilitation of the requested connection. Share is defined on a case-by-case basis at early stage of the project development.

[6]Investors which do not transfer ownership of the connection infrastructure to the DSO are obliged to maintain it.

[7]Same as above.

3.2.1.2 Detailed description of the grid access and grid connection regulations and practices

3.2.1.2.1 Responsible institutions and effective regulations

As described in BR-4, the institutional framework for electricity sector in Albania is reasonably well developed. There are, however, gaps in this structure, but main components are in place and operational. Institutions in Albania responsible for, and involved in, the process of access and connection of hydropower plants to the electrical grids are:

- Ministry of Energy and Industry (MEI)
- Energy Regulatory Authority (ERE)
- Transmission System Operator (OST)
- Distribution System Operator (OSHEE)

In addition to the institutions, another important component of the grid connection framework is having effective legislation in place. In the case of the Albanian electricity sector, the legislative framework exists but it is still incomplete and is, to a certain extent, inconsistent. The Law on Energy Sector from 2015 transposed the requirements of the EU 3rd Energy Legislative Package into local legislation, but the consequently required update of the secondary legislation is lagging – a revised Transmission Grid Code is under development and a similar revision needs to be made to the Distribution Grid Code and the Metering Code. Tertiary legislation is very much missing, with the requirements needing to be made more explicit. The currently valid documents that regulate transmission and distribution network access and connections are the following:

- Law on Energy Sector (approved on April 30th, 2015)
- Transmission Grid Code[8] (from October 24th, 2008)
- Distribution Grid Code (from May 22nd, 2003)
- Metering Code (from August 26th, 2008)
- Guideline on application and tariffs for new connection, or modification of existing connection in the electric grid of TSO (OST document from December 2010),
- Transmission Service Agreement (template) approved by the ERE Decision no.60 of 03.06.2013,
- Regulation on the procedures of asset transfer from licensees (ERE).

Regarding HPPs to be connected to the distribution system, OSHEE is using both different instruction documents and ad-hoc arrangements for connection purposes to by-pass the lack of updates in the Distribution Grid Code. These documents have been developed on a case-by-case basis to facilitate individual connections. Since the distribution business has become state-owned again, OSHEE has devoted huge efforts to restructure and regulate distribution sector, but major challenges still remain relating to both operational aspects and network losses.

3.2.1.2.2 Implementation of the grid connection

Connection Procedure

The Law on Energy Sector, in its Article 63, paragraph 3, bullets b, c and d, specifies that the transmission Grid Code should determine all aspects of the grid connection and operation of the new hydropower generation facilities. Details of the procedure for connection are listed in Section V (Connection Code) of the "Transmission Grid Code", complemented with the explanations in the "Guideline on application and tariffs for new connection, or modification of existing connection in the electric grid of TSO".

At the start of the process, potential transmission network Users (i.e. HPP investors) are invited to have preliminary discussions with OST on possible connections, where OST may offer a preliminary solution for the connection. These preliminary discussions are informal, and not to be considered as an Application for

[8]New version of the Transmission Grid Code, in accordance with the new Law on Energy sector and compliant with the EU 3rd Energy Package is under preparation and due for adoption in 2017.

Connection. In the context of these discussions, OST may propose the optimal point of connection for Users to connect to the transmission network. For the preparation of its application, a User may require additional information from OST, which shall be provided unless they are confidential. The network connection process formally starts with the submission of the Application for Connection to the TSO together with payment of the application tariff which is published by OST and is therefore known in advance. The Application for Connection should appoint the Party Responsible for Connection, which is the person responsible for the design, tendering, construction, testing and commissioning process. The Application for Connection submitted by the User should follow the format prepared by OST, and should be complemented with the following documents (for HPPs, the required planning data are set out in the Code):

- Details of requested generation units' connection,
- Details of generation equipment,
- Project implementation plan (designing, implementation, testing and commissioning).

Upon receipt of the Application for Connection, OST undertakes the necessary calculations/studies for the selected connection point. OST is obliged to respond to the HPP Developer with either the Connection Offer or with its refusal within:

- 60 days when study of the connection point is completed and the solution for connection is acceptable, and
- 90 days when there is no appropriate solution in the study of the connection point and additional data are required from the User.

In case of refusal, OST shall communicate the reasons of refusal. If the Application for Connection is accepted, OST will issue a Connection Offer. In this Connection Offer, OST will specify all technical and other requirements that User must comply with in order to proceed with the network connection process. If this Connection Offer is accepted by the User, the parties will start the procedure for concluding a Connection Agreement. The Connection Agreement specifies general conditions of the connection process, as well as detailed technical and financial conditions for connection. This information is used by the HPP Developer to develop the design of the connection point. With the design completed, HPP Developer applies for Connection Approval. OST checks the design and, if the design is compliant with the Connection Agreement, Grid Code and ENTSO-E Network Codes, approves the design. With this approval, the HPP Developer may start construction of the connection to the transmission network.

OST will monitor and actively participate in the entire process of construction of the connection point. Once construction is completed, OST will participate in testing and commissioning, and if all requirements are successfully met, OST will issue clearance/approval for connection point works and will proceed to energising. Upon successful energising, OST and the HPP Developer will conclude an Operational Agreement.

In Albania, **use-of-system charges** are paid only by the consumers.

The connection procedure for HPP developers to connect to the distribution network is similar, but the actual implementation is much more complex. The Law on Energy Sector stipulates in its Article 69 that all HPP Developers have to be connected in a transparent and non-discriminatory manner under the transparent conditions. This is where a major difference compared with connections to the transmission network exists. Specifically, the outdated Distribution Grid Code[9] and lack of effective tertiary legislation regarding connections, creates a connection process for the distribution network that is quite unclear and difficult to plan, both from the DSO side and from the investor's side. This is partly due to the complexity of the network and outdated facilities, but also partly due to the lack of clear and detailed regulations in this area.

The electricity distribution network in Albania is definitely in a condition where new connections are huge challenges (sometimes practically impossible) in number of cases, if the technical requirements are to be strictly followed. OSHEE is trying its best to meet applications of potential Users, but without the major refurbishment of the network, the majority of applications will not be completed as planned. Prospective connections are not a matter of costs and who pays them, because it is not only the connection point capacity which is an issue. In the

[9]Article 73 of the Law on Energy Sector foresees in paragraph 1 that detailed rules for access and connection to the distribution network should be defined in the Distribution Grid Code prepared by the DSO (OSHEE) and approved by ERE.

distribution network, the main problem is the low capacity or unreliable network between the planned connection point and main substation, whether it is HV substation of OST or MV substation of OSHEE.

Technical requirements for connection

Technical requirements for a connection to the transmission grid are specified in Section V of the Transmission Grid Code. The basic principles used in this code for specifying technical requirements for a connection (which are the same in both the Transmission and in Distribution Grid Codes) are that:

- All existing or prospective Users should be treated equally,
- New Connections should not cause a negative effect on the existing Users, or a New Connection should not be influenced by negative effects of existing Users, and
- Users are obliged by their Licenses to provide high quality operation and maintenance of their assets; therefore, technical requirements for connection to the network and operation must be clearly established and adhered to.

Subsection V.7.9 of the Transmission Grid Code contains technical requirements for the connection of new hydropower facilities. These requirements also apply to the rehabilitation of existing HPPs. The requirements in the Grid Code are incomplete and are in some cases unclear, which may create problems for the HPP Developers. For example, requirements concerning voltage and frequency withstand limits, as well as operations under conditions of voltage and frequency deviations are quite clear, while the requirements for HPPs operation in the context of load-frequency control are unclear. Also, there are some basic mistakes in operational requirements in Section IV, relate to definitions of primary and secondary control. This Grid Code is currently under revision and it is expected that it will be significantly improved.

The boundary between transmission and distribution networks in Albania is defined by the Article 54, paragraph 2 of the Law on Energy Sector as" *the point of measurement of power on the 110kV side of the 110/MV transformers, including switching equipment of 110kV lines*".

As indicated earlier, the technical requirements for connection to the distribution network are listed in the Distribution Grid Code from 2003. This document needs to be significantly improved in the process of harmonisation with the new Law on Energy Sector, and accordingly complemented with all necessary additional documents, procedures and instructions, etc.

3.2.1.2.3 Connection Costs and Use-of-System charges

In Albania, costs for connection to the grid are defined by the Law on Energy Sector (Article 28). Paragraph 1 of that article clearly defines that: *"Full costs for connection to the existing grid shall be borne by the party requesting the connection".* Costs of connection to the transmission network in Albania can be split into the costs of the preparations for a connection (design, approvals and permits) and the costs of connection point infrastructure construction and energising. Costs of preparations for connection in Albania are fully transparent and consist of two components:

- **Application Tariff,** which covers costs for the preparation of the preliminary study of the project, administration costs and preparation of the Connection Agreement. This tariff is fixed to the amount of 300,000[10]Leke (equivalent of 2,200 EUR), and
- **Supervisory Tariff**, which covers costs of the OST staff undertaking the review of the connection design, supervision of the construction, and participation in testing and commissioning of the connection. This tariff is variable and depends on the installed power of the generation unit declared by the HPP Developer. It amounts to 50 Leke/kVA, but not higher than the cap value of 2,500,000 Leke (equivalent of 18,300 EUR). This tariff is paid at the time of signing of the Connection Agreement.

Transmission network connection point construction costs, which include the costs of grid connection assets and works associated with the construction of the connection point, are covered by the connection HPP Developer (future network user). The Law on Energy Sector, Article 28, also provides a solution for connection of new generation units where the ownership of assets for the grid connection remains with the investor until full depreciation of the connection assets, at which time ownership is transferred to the network operator. However,

[10]Proposal for the new Grid Code, due in 2017, is to raise this tariff to 500,000 Leke.

according to the Law "*The Transmission System Operator or Distribution System Operator has the right to take over a part or the whole ownership of the constructed asset from the user, against a compensation of the full costs calculated in accordance with this law and new connection rules, in accordance with Civil Code, if such assets are important to the transmission system development or distribution or if such assets could serve more than one client*"**.** In any case, the network operator is responsible for maintenance of the connection point assets, but the maintenance costs will be paid by the investor/user while the assets remain his property.

The costs of the transmission grid strengthening necessary to facilitate the connection, as well as the operation and maintenance (O&M) costs when assets become property of the network operator, are to be borne by the TSO (OST), compensated by the transmission tariff in compliance with the transmission tariff methodology, approved by the ERE. The TSO has right to approve the connection of the new user to a connection point that was constructed by an already-connected previous user, and in such cases, needs to provide fair compensation from the new user to the previous user which paid for construction of the connection points. This is in theory, a requirement/stipulation from the Law – that "shallow connection costs" shall be applied. In practice, both OST and OSHEE, mainly due to their lack of network investments, apply "deep connection costs" - where investors pay not only for the connection point but also for the network reinforcements necessary to facilitate their connection (and in reality, rarely get monetary compensation from charges for the consequent connections, if any).

3.2.2 Bosnia and Herzegovina

3.2.2.1 Introduction

Bosnia and Herzegovina (BiH) is a state consisting of two administrative divisions (entities), Federation of Bosnia and Herzegovina (FBiH) and Republika Srpska (RS), plus one internationally supervised district around city of Brčko in the north of the country, the Brčko District. Administrative and legal power at the state level is rather weak and limited to few areas, while most of the legal jurisdiction is at the entity level. Entities have their own parliaments, governments, ministries and regulatory authorities. Electricity transmission is an activity unified for the whole country, while generation and distribution of electricity are organised and administered at entity levels. Bosnia and Herzegovina (BiH) is ranked the second country in the region by identified hydropower generation potential and recognised hydropower development projects. The electricity transmission network in BiH has been recently refurbished and it is in relatively good condition, while the distribution network has undergone major improvements during the previous decade and is set to continue. A specific feature of BiH electricity legislation relates to the two entities, FBiH and RS: The electricity network legislation is common for the transmission network, while for the distribution networks, it is separate for each entity and for each DSO in the country.

3.2.2.2 Detailed description of the grid access and grid connection regulations and practices

3.2.2.2.1 Responsible institutions and effective regulations

The structure of the electricity sector in BiH is quite different compared to other WB6 countries. The key institutions at state level are(i) the Transmission Company, in charge of development, operation and maintenance of the transmission network, (ii) the Independent System Operator for BIH, in charge for power system operations, control and cross-border issues, and (iii) the State Energy Regulatory Authority, responsible for transmission system operation, cross-border trade and the Brčko District. Electricity production, distribution system operation and supply of electricity are governed by the legislation of the entities, FBIH and RS. Institutions in BiH responsible and involved in the process of connection of hydropower plants to the electrical grids are:

- State Electricity Regulatory Authority (DERK)
- Independent System Operator for BiH (NOS BiH)
- Transmission Company in BiH (Elektroprenos BiH)
- Republika Srpska Energy Regulatory Commission (RERS)
- Federation BiH Energy Regulatory Commission (FERK)

- Distribution System Operators[11] (JP EPBiH DSO[12], JP EP HZHB[13]DSO and MH ERS DSO[14])

At the state level, there are three main laws governing the electricity sector: the Law on Transmission, Regulator and Electricity System Operator, the Law on the Establishment of Transmission Company and the Law on the Establishment of the Independent System Operator. Transmission network connections are not part of any law at the state level. At the entity level, there are Electricity Laws, where connections to distribution networks are defined only via two very general articles. In practice, network connection issues are governed by the network codes, i.e. by the network companies and relevant regulatory authorities. Existing documents that regulate transmission and distribution network access and connections are the following:

- Transmission Grid Code (December 15th, 2016)
- Rulebook on connection to the transmission network (existing is from 2008/12/14, new version is in the adoption procedure)
- Distribution Grid Code EP BiH (2008, new draft in the procedure)
- Distribution Grid Code EP HZHB (2008, new draft in the procedure)
- Distribution Grid Code MH ERS (2009, new draft in the procedure)
- Rulebook on connection of generation units to the distribution network of ERS (RERS, 2014)
- Rulebook on connection to the distribution network of EP BiH (FERK, 2009)
- Rulebook on connection to the distribution network of EP HZHB (FERK, 2009)

Distribution Grid Codes have been drafted and submitted to the entity Regulators for approval, but in the meantime new General conditions for electricity supply have been adopted in both, establishing higher standards in the quality of electricity supply. The drafted Distribution Grid Codes have been returned to the DSOs by the Regulators to be aligned with these new standards, and for that reason they have not been updated yet.

3.2.2.2.2 Implementation of the grid connection

Connection procedure

Authority and responsibility for connections to the transmission network in BiH is, as are transmission network operations and management, split between the Transmission Company and NOS BiH. According to the Connection Code (section 5 of the Transmission Grid Code), NOS BiH must agree with the Connection Agreement concluded between the network user and the Transmission Company. The Transmission Company runs and controls the entire process of connection to the transmission network, while NOS BiH joins the process at the time of commissioning: The Transmission Company controls network assets and their performance, and NOS BiH manages operational parameters through the testing and commissioning of each generation unit (typical tests are defined in the Grid Code).

As indicated above, the transmission network connection procedure is mainly coordinated by the Transmission Company (with the participation of NOS BiH where appropriate) in accordance with the Rulebook on connections to the transmission network. This document was developed in 2008, revised in 2012 and 2014, and in late 2016 a completely new version was submitted to DERK for approval. The connection process starts with the request by the HPP developer to the Transmission Company for conditions for connection to the network. The HPP developer submits the basic data of the planned facility, such as location, installed capacity, type of the plant, average planned electricity generation, etc. together with this request. Conditions for connection to the network are issued by the Transmission Company based on a Study which can be executed either by the Transmission Company or by a third party. The deadline for issuing Conditions for the connection to the network is 90 days if Study is done by the Transmission Company or 30 days after submission of the Study if it is done by a third party. A review of the Study is also performed by NOS BiH at this time, and NOS BiH gives its consent to the proposal of the Conditions for connection to the network made by the Transmission Company. Conditions for

[11]In Bosnia and Herzegovina, DSOs have not yet been unbundled from the public enterprises that also perform electricity generation and supply role.

[12]Public Enterprise BiH Power Utility Distribution System Operator

[13]Public Enterprise Power Utility of Croatian Community Herzeg Bosnia Distribution System Operator

[14]Mixed Holding Republika Srpska Power Utility Distribution System Operator

connection to the network must contain all necessary technical details determining connection, planning, operation, control and metering requirements that have to be established at the connection point. The HPP developer for the connection should, upon receipt of the Conditions for connection to the network, send its consent to the conditions for connection to the Transmission Company within 30 days. Conditions for connection to the network are valid for one year and can be re-issued, subject to changes in the application and/or in the technical requirements.

Once Conditions for connection to the network have been established, Transmission Company and HPP Developer conclude the Connection Agreement. In the Connection Agreement are prescribed all the technical, legal and financial conditions of connection to the transmission network, all the details of construction of the connection infrastructure, ownership boundary and future ownership relations, as well as responsibilities with respect to the operation and maintenance of the constructed facilities, between the User and the Transmission Company. Based on the Connection Agreement, construction of the connection point infrastructure can be undertaken either by the Transmission Company (Elektroprenos BiH) or by the investor. In the cases when the investor executes construction of the connection point infrastructure, design documentation needs to be approved by the Elektroprenos BiH before their application for a construction permit. Upon completion of the construction works for the connection point infrastructure, the investor applies for the Connection Approval. The Transmission Company and NOS BiH jointly check (and if necessary test) the facilities of the future transmission network user and, if successful, issue the Connection Approval. Upon Connection Approval, the transmission network user (in this case the HPP developer), upon successful commissioning, signs Agreement on the use of the transmission network with the Transmission Company, and another Agreement on operations and control with NOS BiH.

In contrast, the procedure for connection of a HPP to the distribution network is simpler than a connection to the transmission network, although this does not necessarily mean that the process is more efficient. In many cases it is quite the opposite, partly because of the regulations and partly due to the complexity of the connections. DSOs are, by the Electricity Laws in both entities, allowed to reject connection to the distribution network for properly documented technical or operational reasons (RS Electricity Law Article 44 paragraph 1, and FBiH Electricity Law Article 51, paragraph 1). The Electricity Laws in both entities also stipulate that Distribution Grid Codes should define the connection process - which is currently not the case (RS Electricity Law Article 46 paragraph 2, and FBiH Electricity Law Article 53, paragraph 2), but this should be corrected as part of the above-mentioned planned revision to documentation. The Rulebook for connection of generation units to the distribution network in MH ERS contains all details of the connection process, including necessary forms and guidelines how to apply. In FBiH, applicable for EP BiH DSO and EP HZHB DSO, the rulebooks for connection to the distribution network issued by individual DSOs are out of date, not very clear and incomplete. However, the general rules on electricity use and delivery (FERK, October 24th, 2014) are very detailed, clear and consistent, so this document should be used until it is superseded by the relevant rulebooks to be issued by the DSOs.

Technical requirements for connection

Technical requirements for connection to the transmission grid are specified in the Transmission Grid Code: general requirements are in Subsection 5.7 and additional requirements for generation units are in Subsection 5.8. Specific requirements for HPPs in this Transmission Grid Code are related to:

1. their capability to withstand wide deviations of voltage and frequency in the power system,
2. to be able to deliver primary, secondary (units above 20 MW) and tertiary load-frequency control,
3. to have fault-ride-through capability in accordance with the defined parameters,
4. to maintain stable output at frequency and voltage excursions within predefined limits, and
5. to participate in the voltage and reactive power control.

An obligation for HPPs to participate in the power system restoration as black-start units is not clearly defined in the Grid Code. Other sections of the Code define details important for operation of the generation unit, including planning of outages, participation in power system defence and restoration, communication and remote-control requirements, exchange of planning and operational data, etc.

The boundary between transmission and distribution assets in BiH is not defined by legislation, but via an agreement between the Transmission Company and Distribution Companies. Generally, the ownership boundary is at the MV terminals of the incoming feeders in the HV/MV substation of the Transmission Company. In operational terms, although MV switchgear is used for the distribution of electricity, the whole HV/MV substation is owned, maintained and operated by Transmission Company staff. This means that MV switchgear requests for operation are issued by the distribution company but the actual operation is done by the Transmission Company operators.

The Rulebook for connection of generation units to the distribution network of MH ERS lists very detailed technology specific connection conditions and operational requirements for generation units. In the Grid Codes of EP BiH DSO and EP HZHB DSO (versions from 2008), technical requirements for both connection and operations of HPPs connected to the distribution network are rather general and out of date. In EP BiH, the DSO still uses the Technical Recommendation for connection of HPPs from the time of the common power utility in BiH from before the 1990s.

3.2.2.2.3 Connection Costs and Use-of-System charges

Costs of **connection to the transmission network** are determined based on Section V, Articles 19-26 of the Rulebook on connection to the transmission network, which is approved by the state Regulator (DERK). Overall costs of connection consist of the fixed and variable parts. The fixed part of the connection costs is proportional to the installed capacity of the generation plant, in accordance with the unit price (currently 30 EUR/kW regardless of voltage level where connection will be made) which is publicly available in the price list agreed between the Transmission Company and NOS BiH. Generation plants using renewable energy sources (applicable to HPPs up to 10 MW) pay only 50% of the fixed part of the connection costs. The variable part of the connection costs exists only if the connection point is constructed by the Transmission Company. It consists of the costs of the connection point construction plus all the costs of equipment and facilities at the connection point. If the connection point is constructed by the User, no payments should be made on the variable costs basis to the Transmission Company. In both cases, upon construction completion and successful commissioning, the owner of the constructed connection point assets is the Transmission Company (Rulebook on connection to the transmission network, Article 23, paragraph 2). Costs of the transmission network reinforcements, necessary to facilitate connection of the generation unit to the transmission network, are the complete responsibility of the Transmission Company, financed from the fixed part of the connection costs and from the transmission tariff. This is a truly shallow connection cost regime, both in regulation and in practise.

In BiH, **use-of-system** charges are paid only by the consumers.

Costs of connection to the distribution network are regulated at the entity level[15] (with the same costs for EP BiH and EP HZHB which operate in FBiH). Common for both entities and for all distribution companies is that investors in generation facilities connected to the distribution network pay all the costs of the infrastructure at the point of connection to the distribution network, plus part of the costs for the distribution network reinforcement necessary to facilitate the planned connection. The rest of the costs for network reinforcements are borne by the distribution company and compensated by the entity Regulator through the distribution network tariff. The proportion of the network reinforcement costs that will be paid by the investor is decided on each individual case, but the important fact is that all these costs are known at very early stage of the project development and all the data and price lists are publicly available.

3.2.3 The former Yugoslav Republic of Macedonia

3.2.3.1 Introduction

The former Yugoslav Republic of Macedonia has developed the majority of its hydropower generation potential, although there are still few major HPP development projects in the pipeline. The same applies to the potential for small HPPs, where the best locations have already been utilised - some of them constructed and operational, and others under construction and/or development. Electrical networks of the country are in very good condition and ready to provide connections for new hydropower generation projects. Both the transmission and distribution networks are well-regulated with relevant legislation, well planned and developed, and are finally well operated and maintained.

[15] MH ERS DSO operates in Republika Srpska, their work is regulated by the RERS which is Republika Srpska Energy Regulator, while JP EP BiH DSO and JP EPHZHB DSO operate in FBiH where Energy Regulatory role is performed by FERK (see Sub-section 3.2.2.2.1 above).

3.2.3.2 Detailed description of the grid access and grid connection regulations and practices

3.2.3.2.1 Responsible institutions and effective regulations

The Institutional framework in the former Yugoslav Republic of Macedonia is characterised by the very strong independent Regulator's role in the electricity sector. The Ministry of Economy (in charge for the electricity sector) deals with primary legislation and strategic determinations, while all other regulatory aspects and secondary legislation issues are fully controlled by the Regulator. MEPSO (the TSO) is the power system operator, transmission network operator, market operator and single buyer of electricity from RES-E generators. The DSO role is performed by the Austrian company EVN (local branch) which purchased the distribution business from the former vertically integrated ESM during privatisation. Institutions which are responsible and involved in the process of connection of hydropower plants to the electrical grids are:

- Ministry of Economy (Directorate for Energy)
- Energy Regulatory Commission (ERC)
- Transmission System Operator (MEPSO), and
- Distribution System Operator (EVN)

In the former Yugoslav Republic of Macedonia, the legislative framework in electricity sector is complete, all documents are up to date and consistent. The Electricity Law originates from 2011, and through series of amendments has been fully harmonised with the requirements of the EU 3rd Energy Legislative Package. Secondary legislation is very well developed, especially network codes - a very comprehensive Transmission Grid Code from 2015 and the Distribution Grid Code from 2012 was amended with very detailed rules for connection of generation units to the distribution network in 2014. The Tertiary legislation framework is also very detailed, consisting of series of methodologies and rulebooks, some of them in annexes of the network codes (adopted by network operators and approved by the Regulator). Existing documents that regulate transmission and distribution network access and connections are the following:

- Electricity Law (February 3rd, 2011, as regularly amended)
- Transmission Grid Code (November 6th, 2015)
- Template transmission network Operational Agreement
- Distribution Grid Code (2012, amended in 2014 with very detailed Rules for connection of generation units to the distribution network)
- Methodology for determination of costs for connection to the Distribution Network (Annex 1 of the Distribution Grid Code from 2012)

3.2.3.2.2 Implementation of the grid connection

Connection Procedure

Based on Article 123 of the Electricity Law, the TSO/DSO may reject an application for connection on the basis of insufficient capacity in the network, but must provide written detailed justification for such a decision. The affected HPP Developer may then file a complaint with the Regulator. Article 125 of this Law stipulates the obligation for both TSO and DSO to introduce in their network codes rules for connections to the network and the methodology for calculation of the network connection costs. Truly, MEPSO developed and adopted (and the Regulator approved) a Transmission Grid Code that complies with all requirements of the Electricity Law. The procedure for connection to the transmission network is described in Section III.3 of the Transmission Grid Code, where Article 65 stipulates that the phases of the connection are:

- submitting a request for approval of connection to the transmission network,
- preparation of a Study for connection to the transmission network,
- granting Consent for connection to the transmission network,
- signing the Connection Agreement for the connection to the transmission network (start of main design),
- approval of project documentation (start of works),

- reporting on connection construction completed, compliance and testing (trial operation, testing and verification of real and simulated dynamic response of the generator, regulator settings, protection, quality of electricity output, etc.)–i.e. energisation,
- signing a contract for Use of the transmission network- i.e. regular operation.

In order to support this process, the Transmission Grid Code further specifies precise inputs (documents necessary to be submitted) and outputs (contents of each document in the process: Consent, Agreement, Contract) at each phase of the process, as well as deadlines for completion of each phase. However, until now there have been no opportunities to observe this procedure in practice, because no HPPs have been connected to the transmission network in accordance with this procedure (So far, only one wind power plant has been subject to this process).

The procedure for connection of the generation units to the distribution network is described in the Distribution Grid Code from 2012 and Amendments to the Distribution Grid Code from 2014, as well as by the Guidelines for non-standard connection to the distribution network issued by the Regulator. Compared to other countries, and also compared to the provisions of the procedure in place before the amendments to the Distribution Grid Code from January 2014, the current procedure is significantly simplified. The procedure starts with an application for connection, submitted by HPP developer to the DSO together with some basic information about the plant that should be connected (concession agreement, registration, basic design data of the plant and generation units, location, etc.). Based on this application, the DSO then determines an optimal techno-economical solution for connection to the distribution network in the vicinity of the plant, and in this way the preferred connection point is established. The HPP developer has the ability to participate in the decision-making which identifies the optimal connection point. The DSO is obliged to decide on the prospective connection and to issue a technical solution for the connection to the distribution network within 40 days. This technical solution should be complemented with all details of calculations and assessments done during determination of the connection point, as well as calculation of the connection costs. If the proposed technical solution is acceptable for the HPP Developer, the two parties conclude a Connection Agreement.

A specific feature in the former Yugoslav Republic of Macedonia, where a connection to the distribution network is concerned is that, once the connection point has been determined and an application for connection submitted, then all documents necessary for connection will be acquired by the DSO (i.e. a kind of one-stop-shop solution) with a firm deadline of 70 days for their completion[16].An HPP developer requesting a connection is entitled to compensation in the case of a delay in providing the construction permit for connection point. Actual construction of the connection point infrastructure is done by each party (i.e. both the HPP developer and the DSO) for their respective parts of the facilities at the connection point. DSO work must be completed within 50 days under the clause on compensation in case of delays.

Technical requirements for connection

Technical requirements for connection to the transmission grid are specified in the transmission grid code, in Section III.3 “General connection conditions” and in Annex 8 “Additional connection conditions for generation units” which are technology-specific in accordance with the logic applied in ENTSO-E Network Code “Requirements for connection of generators to electrical grids”[17]. Also, Annex 10 of the Transmission Grid Code presents the contents of the compliance tests that have to be conducted as part of the commissioning procedure for generation units, prior to issuing Use Permit and signing an Operational Agreement with the TSO.

Requirements for generation units to remain connected to the power system when voltage and frequency deviate beyond standard operational limits are higher than for other power system users. On top of that, all individual hydropower generation units (i.e. at the level of the machines, not at the level of the hydropower plant) must have turbine controllers and be capable to participating in primary load frequency control, and this is precondition for connection approval. However, continuous participation in primary control is mandatory only for hydropower generation units of ≥10 MW (other HPP generation units should switch their controllers on only if requested by the TSO). Similarly, each hydropower generation unit must be capable of delivering secondary load frequency

[16]With exemption for cases when delays occur for reasons that are out of the DSOs control, such as delays in local administration.

[17]Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators.

control with the control capacity of minimum 30% of the HPP nominal output power (0.3 P_{nom}) and the capability to control output power at the rate of 1.5% of P_{nom} in 1 second. Finally, each hydropower generation unit must be capable of providing tertiary load frequency control. Hydropower generation units have to maintain voltage at the connection point within defined limits, and have to maintain stable operation at reduced active power output up to 0.2 P_{nom}. At the same time, HPPs are requested to limit the drop of their active power output to a maximum 2% of the installed capacity for a frequency drop of 1 Hz below 49.5 Hz. All HPPs have to have capability for black start and island mode operation (this requirement is not fully detailed), have to be connected to SCADA/EMS/AGC and are required to participate in power system restoration.

The Distribution Grid Code defines the technical requirements for connection and operation in the distribution network, partly in the original text from 2012 and mainly in the amendments introduced in 2014. Unlike in the transmission network where larger HPPs are typically connected and their operational impact may be at the level of overall power system and even neighbouring interconnected power systems, issues in HPP operations connected to the distribution network are mainly of a local nature. Accordingly, the main concerns specified in the technical requirements for connection are related to voltage magnitude deviations (the impact of the HPP in switching ON and OFF on other distribution network users and voltage levels in the area of the network to which the HPP is connected) and waveform quality (harmonics and flickers). Another important issue is the loading of the distribution lines with/without the HPP in operation. Due to the complexity of the distribution network and the huge number of options for connection, each with its own set of associated potential technical challenges, it is not possible to specify strict requirements for each generator. What is specified are the requirements of network operations and for each specific case of connection calculations and studies are performed to identify a solution to connect the HPP while maintaining operations at the connection point within tolerable limits. For that reason, the DSO is not determining the nearest connection point but the optimal one, which is the connection point that satisfies minimum technical requirements at reasonable costs.

3.2.3.2.3 Connection Costs and Use-of-System charges

Article 125 of Electricity Law stipulates in paragraph 2,for both TSO and DSO, that connection costs are paid by the investor and that they consist of two parts: the costs of the construction of the connection point infrastructure and the costs of the preparation of technical conditions for connection, which usually have to do with the necessary network reinforcement (substation, overhead line, circuit breaker, transformer, etc.) in the vicinity of the connection point to enable sufficient capacity for the planned new connection. In the following paragraph 3, the TSO/DSO is given an obligation to provide a detailed estimation of connection costs with an estimation of costs for issuing technical conditions for the connection to the parties that apply. The Methodology for determination of costs for connection to the Transmission Network (Annex 7 of the Transmission Grid Code from 2015) defines the structure and calculation of costs for connection to the transmission network as required by the Electricity Law.

According to the Methodology for determination of costs for connection to the Distribution Network (Annex 1 of the Distribution Grid Code), the costs of connection consist of two components: costs of issuing technical conditions for connection, and costs for construction of the connection point infrastructure (DSO part). All these costs and the methodology for their determination, unit costs of the DSO works and services, are approved by the Regulator, transparent, and available to the HPP Developer at the time of conclusion of the Connection Agreement. Costs of connection to the distribution network can be paid in three instalments:

- 25% upon conclusion of the Connection Agreement,
- 50% upon receiving Construction Permit for connection point infrastructure, and
- 25% upon receiving Use Permit for connection point infrastructure.

3.2.4 Montenegro

3.2.4.1 Introduction

Montenegro is a country whose hydropower generation potential has significant impact on other regional countries, due to its central position in the region and high average altitude[18]. For that reason, this country has a

[18]Numerous rivers in the region have their sources in Montenegro.

number of hydropower development projects with trans-boundary issues which impact their implementation. The electricity transmission network in Montenegro is reasonably well-developed, unlike the case with the distribution network where due to wide and scarcely-populated areas the distribution network is under-developed. Unfortunately, these remote sites are also where the majority of prospective HPP project sites are located.

3.2.4.2 Detailed description of the grid access and grid connection regulations and practices

3.2.4.2.1 Responsible institutions and effective regulations

The Institutional framework in Montenegro is coordinated by the Energy Department of the Ministry of Economy (in charge of electricity sector), which deals with primary legislation and strategic determinations, and the Energy Regulatory Agency which adopts or approves secondary and tertiary legislation, as well as numerous procedures, tariffs (mainly the network operators' tariffs), rulebooks, etc. The Montenegrin TSO (CGES) is the only TSO in the WB6 region which is not fully state-owned. CGES has been a joint-stock company for some time now. The majority of shares are in state ownership, but company is also partly owned by the Italian TSO (TERNA), Serbian TSO (EMS) and by other small stakeholders in Montenegro. CGES is the power system operator and transmission network operator. The DSO role is performed by the functionally unbundled part of the joint-stock company EPCG, which was the former vertically integrated power utility (currently ownership shared between the state, Italian company A2A and other small stakeholders). The Institutions responsible and involved in the process of connection of hydropower plants to the electrical grids are:

- Ministry of Economy (Directorate for Energy)
- Energy Regulatory Agency (REGAGEN)
- Transmission System Operator (CGES), and
- Distribution System Operator (EPCG DSO)

The legislative framework in the Montenegrin electricity sector is reasonably well completed, but not all documents are at the same level of development and accordingly are not fully consistent. The Electricity Law is quite new, adopted at the very end of 2015, and is fully harmonised with the requirements of the EU 3rd Energy Legislative Package. Secondary legislation is lagging with respect to the new Electricity Law and appropriate harmonisation is underway. The Tertiary legislation framework is accordingly also out of date, currently awaiting completion of the secondary legislation framework before being revised. The existing documents that regulate transmission and distribution network access and connections are the following:

- Electricity Law (December 29th, 2015)
- Transmission Grid Code (October 27th, 2011)
- Methodology for determination of costs for connection to the Transmission Network (CGES 2016, currently in public consultations, awaiting Regulator's approval)
- Distribution Grid Code (CGES, October 1st, 2012)
- Methodology for determination of prices, timelines and conditions for connection to the Distribution Network (CGES, October 1st, 2012)

3.2.4.2.2 Implementation of the grid connection

Connection Procedure

Based on Article 175 of the Electricity Law, the TSO/DSO has no right to reject a request for connection to the network on the basis of possible future limitations in the existing transmission capacity, such as for example congestion in distant parts of the transmission network, or due to the potential costs for power system reinforcements necessary to facilitate the connection. The same article stipulates that the TSO/DSO have to provide the HPP developer who makes the application for connection, all necessary information. General terms, taken into consideration when defining conditions for connection to the transmission network, are defined in the Transmission Grid Code Article 39 through the following criteria:

- Any new user connection to the transmission system may not cause negative impacts on the entire power system, or to any user of the system,
- Any new user should not be exposed to negative effects after joining the transmission system;
- All users of the transmission system are treated on an equal, non-discriminatory manner.

The procedure for a new connection to the transmission network starts with an application for an opinion on the possibilities for connection of a new facility to the transmission system, and is submitted to the Ministry of Economy relevant for issuing the decision on approval for construction of the concerned energy infrastructure, in this case a HPP.

During the application for the connection of a new HPP, CGES issues the following documents:

1) **Opinion on possibilities for connection –** issued based on the developer's request to the relevant Ministry, containing possible points of connection, feasibility of connection and overall impact of the connection on the power system**;**
2) **Consent for connection -** issued based on the Application for connection; must be issued within 15 days (for connections where only technical analysis is required, paid for by the TSO), except for connections to the networks of 110kV and above, where a detailed technical connection study is required and the deadline is 4 months (study is executed either by CGES or a third party hired by CGES, and paid by the HPP developer);
3) **Consent for project documentation –** based on the analysis or study, the HPP Developer develops the design for construction of the connection point infrastructure; this design, before application for construction permit to responsible authority, must be approved by CGES;
4) **Temporary permit for connection during the testing and trial operation –** when construction of the connection point is completed, CGES issues a temporary permit for connection to facilitate testing and commissioning of the plant;
5) **Connection Agreement[19] –** signed by the TSO and the Applicant/User upon successful testing and commissioning and, where applicable, trial operation.

According to the Government Decree from 2007, all HPPs below 10 MW installed capacity should be connected to the distribution network, except in cases when it is not technically feasible. Also, for HPPs up to 5 MW installed capacity, connection is approved only by the DSO only, while for the HPPs larger than 5 MW but smaller than 10 MW for this approval the DSO must consult with the TSO. The Distribution Grid Code, Article 57, describes the procedure for connection to the distribution network. In this process, DSO issues[20]:

1) Opinion on possibilities for connection;
2) Connection conditions;
3) Decision on Consent on Connection, and
4) Concluded Connection Agreements.

The DSO may only connect HPPs to the distribution network after the conclusion of the Agreement on supply of electricity to the HPP by the distribution network and Agreement on sale of electricity generated by the HPP, within not more than 15 days.

Technical requirements for connection

Technical requirements for connection to the transmission grid are specified in the Transmission Grid Code. Section 5 of the Transmission Grid Code defines the general technical conditions for connection to the transmission network, while Section 6 of the same document specifies additional (complementary) requirements for the connection of generation units. Requirements for staying connected to the power system when voltage and frequency deviate beyond standard operational limits are higher for generation units than for other power system users. On top of that, all hydropower generation units (individual generators) must have a turbine controller and be capable to participate in the primary load frequency control, and this is precondition for

[19] Contents of the Connection Agreement are stipulated in detail in the Electricity Law article 179.

[20] All forms used in the connection procedure are defined and provided by DSO, including publishing on DSOs website.

connection approval. However, participation in the primary control is mandatory only for hydropower generation units of an installed capacity ≥10 MW (other HPP generation units should switch their controllers ON only if requested by the TSO). Similarly, each hydropower generation unit must be capable of delivering secondary load frequency control with the control capacity of minimum 30% of their nominal output power (0.3 P_{nom}) and capability to control output power at the rate of 1.5% of P_{nom} in 1 second. Finally, each hydropower generation unit must be capable of providing tertiary load frequency control. Hydropower generation units must maintain voltage at the connection point within defined limits. Active power control of the hydropower generation units must allow change of active power output of 40% of P_{nom} per minute. All HPPs must have capability for black start and island mode operation (this requirement is not fully clear), have to be connected to SCADA/EMS/AGC and will participate in power system restoration. Technical requirements in the Montenegrin Grid Code are almost identical to those in the Transmission Grid Code in the former Yugoslav Republic of Macedonia.

The asset boundary between transmission and distribution network is, generally prescribed to be at the bushing of the MV side of the HV/MV transformers, although in some cases CGES (TSO) also owns the 35kV switchgear.

Conditions for connection to the distribution network are given in Section III of the Distribution Grid Code. These technical requirements are very detailed and very demanding (although feasible) for small HPP investors.

3.2.4.2.3 Connection Costs and Use-of-System charges

All costs of connection to either the transmission or distribution networks in Montenegro should be covered by the HPP Developer. Article 180, paragraph 3 of the Electricity Law allows the HPP Developer to independently build a connection in accordance with the Connection Approval and, instead of paying part of the fee for the creation of technical conditions for connection to the network, to transfer the ownership of the connection point infrastructure to the network operator. Details of the connection costs are defined by the Methodology for determination of costs for connection to the Transmission Network (not yet approved). The cost for connection to the transmission network consists of two parts:

1) A part for construction of transmission network connection point infrastructure - determined on the basis of the costs of construction and which must be completely covered by the HPP Developer for connection;

2) A part for creation of technical conditions for connection to the transmission network – proportionate to the installed capacity of the facility that applies for connection; equal for all connections at the same voltage level and as such will not fully correspond to the actual costs to the transmission system operator for network reinforcement.

The part of the costs for creation of technical conditions for connection to the transmission network equals

$$N_{tu}=3x\ C_{apk}xP_{inst}\ \text{[EUR]}$$

where

N_{tu} – the part of the connection costs for creation of technical conditions for connection to the transmission network.

P_{inst}–the installed capacity of the applicant's facility in kW.

C_{apk} – monthly cost of use of transmission capacity, defined by the Regulator by the decision on use of transmission system charges for the year when application for connection is submitted.

The Electricity Law, Article 180 paragraph 2, says that funds collected by the TSO/DSO for creation of technical conditions for a connection to the network may only be used for the development of the system and the creation of technical conditions for new connections, for the increase in connected power of existing users, and for the construction of interconnectors.

3.2.5 Kosovo

3.2.5.1 Introduction

Kosovo has the lowest identified hydropower generation potential and the least number of recognised hydropower development projects in the WB6 region. The electricity transmission network in Kosovo is regularly refurbished and it is in good condition, while the distribution network is not nearly as good. The distribution system was privatised a few years ago and certain improvements are on-going.

3.2.5.2 Detailed description of the grid access and grid connection regulations and practices

3.2.5.2.1 Responsible institutions and effective regulations

The institutional framework for grid connections in Kosovo is coordinated by the Energy and Mining Directorate of the Ministry of Economic Development, which oversees the electricity sector. The main roles of this Directorate are the development and implementation of primary legislation and strategic determinations. The Regulatory Commission (ERO) adopts or approves secondary and tertiary legislation, as well as numerous procedures, tariffs, rulebooks, etc. Kosovo TSO (KOSTT) is the power system operator, electricity market operator and transmission network owner/operator. The distribution business in Kosovo has been privatised, so the role of the DSO is performed by the KEDS, which is owned by the Turkish companies Çalik Holding and Limak. The Institutions responsible and involved in the process of connection of hydropower plants to the electrical grids are:

- Ministry of Economic Development (Directorate for Energy and Mining),
- Energy Regulatory Office (ERO)
- Transmission System Operator (KOSTT), and
- Distribution System Operator (KEDS)

In Kosovo, main legislative framework is quite new, with the set of main laws adopted in July 2016, all of them highly harmonised with the requirements of the EU 3rd Energy Legislative Package. The Transmission Grid Code dates from 2015 and the Distribution Grid Code from 2014. These documents will now have to be aligned with the new legal acts. In general, the electricity sector legislation is reasonably well completed. The Tertiary legislation framework is accordingly also slightly out of date, although the majority of instructions and methodologies exist. The documents that regulate transmission and distribution network access and connections are the following:

- Law on Electricity (July 21st, 2016)
- Law on Regulator (July 14th, 2016)
- Rule on General Conditions for Energy Supply (Connection Chapter –adopted by ERO)
- Transmission Grid Code (February 2015, KOSTT)
- Procedures for connection to the transmission network (KOSTT, November 2014)
- Transmission connection charging methodology (KOSTT, October 2013)
- Distribution Grid Code (KEDS, March 2014)

3.2.5.2.2 Implementation of the grid connection

Connection Procedure

According to the Electricity Law from 2016 (Article 51, paragraph 1 and 2), network operators in Kosovo have no right to reject a request for connection to the network based on possible future limitations to the existing transmission/distribution network capacity, such as for example congestion in other parts of the network, or due to the potential costs for power system reinforcements necessary to facilitate the connection. HPP Developers for connection to electrical networks may exercise this right of connection if they fulfil (in accordance with the Article 50 of the Electricity Law) all technical requirements specified in the Transmission/Distribution Grid Code, Procedures for connection and Connection Offer by the network operators.

Although the Transmission Grid Code from 2010 is slightly out of date, KOSTT updated the connection procedure by introducing very detailed supplementary procedures for connection to the transmission network in November 2014. According to this procedure, in the very beginning of the transmission network connection process, potential transmission network Users (HPP investors) are invited to have preliminary discussions with KOSTT on potential technical solutions for connections, where KOSTT also provides an initial estimation of connection costs. These preliminary discussions are not to be considered as an Application for Connection, and they are kept fully confidential. In this process, KOSTT may propose the optimal point of connection for Users to connect to the transmission network. For the preparation of its application a HPP Developer may request additional information from KOSTT, which shall be provided unless they are confidential. The network connection process formally starts with the submission of the Application for Connection to the TSO, together with payment of the publicly available application tariff. The Application for Connection submitted by the User should follow the format prepared by KOSTT, and should be complemented with the following documents (for HPPs, required planning data are set out in the Code):

- Details of the requested generation unit's connection,
- Details on the generation equipment,
- Project implementation plan (designing, implementation, testing and commissioning).

Upon receipt of the Application for Connection, KOSTT either undertakes the necessary design study for the selected connection point, or reviews the study done by the HPP Developer. KOSTT is obliged to respond to the HPP Developer with the Connection Offer or with the refusal within:

- 90 days under normal circumstances,
- 90 + 30 days in case of difficult connections when additional data are required from the User.

The Application and Offer for Connection should appoint the Party Responsible for Connection, who shall be responsible for the design, tendering, construction, testing and commissioning process. If the HPP developer is not satisfied with the terms and conditions, or results of the network study, he can do it himself, at his own cost. If the Application for Connection is accepted, KOSTT will issue a Connection Offer. In this Connection Offer KOSTT will specify all technical and other requirements that HPP developer must comply with in order to proceed with the network connection process. The Connection Offer is valid for 45 days. If this Connection Offer is accepted by the User, the parties will start the procedure for concluding a Connection Agreement. The Connection Agreement specifies, among other aspects:

- Connection Responsible Party,
- Connection Capacity,
- Connection Date,
- Connection Point and Connection assets,
- Transmission Assets to be constructed by the HPP developer,
- Transmission Assets to be constructed by KOSTT,
- Technical requirements of the Grid Code associated with the connection,
- Connection process including timetable and detailed design,
- Connection Fee and its payment,
- Operation requirements for the connection, and
- Use of system conditions.

The Connection Agreement will be attached to the Connection Offer and must be signed within 30 days of the acceptance of the Connection Offer. Based on the Connection Agreement, the party that will execute construction of the connection point infrastructure will develop design documentation. If HPP Developer chooses to execute construction, then KOSTT checks the design and, if the design is compliant with the Connection Agreement, Grid Code and ENTSO-E Network Codes, approves it. With this approval HPP Developer may start construction of the connection to the transmission network.

KOSTT will monitor and actively participate in the entire process of construction of the connection point. Once construction is completed, KOSTT will participate in testing and commissioning, and if all requirements are successfully met, KOSTT will issue clearance/approval for construction point works and proceed to energising. Upon successful energising, KOSTT and HPP Developer will conclude Operational Agreement.

Connection to the distribution network is described in the Distribution Code, developed by KEDS in March 2014.

Technical requirements for connection

Technical requirements for connection to the transmission grid are specified in the Connection Code section of the Transmission Grid Code. The minimum technical, design and operational criteria specified in the Connections Code are designed so that a new connection to the transmission system shall:

- Not deteriorate the system operating conditions beyond standard ranges and conditions defined in the Connection Code;
- Not adversely impact the quality of operations in the transmission system of any other user:

The asset technical boundary between the TSO and the generator is, in general, at the bottom of the insulator chains at the outer wall of the generator's premises or at the metallic construction (portal) where connection is coming from the generator terminals of the high voltage bushings of step-up transformers (block transformers) and auxiliary supply transformers of the plant. In special cases, this boundary is set in the Connection Agreement.

The Connection Code requires from all generation units "*to be capable to continuously supply its registered power output within the system frequency range 50 ± 0.5 Hz. Any decrease of output power occurring in the frequency range 48.5 to 51.5 Hz, should not be more than pro rata with frequency."* Also, each generating unit must, as a minimum, be capable of supplying rated active power output (MW) at any point between the power factor limits of 0.85 lagging and 0.95 leading at the generating unit terminals. The reactive power output, under steady state conditions, should be fully available within the voltage range of ± 5% at 400, 220 and ± 10% at 110 kV. The generated electricity must have balanced phase voltages with harmonic distortion of no greater than 2%. All hydro power generation units have to provide voltage control at the connection points to the transmission network, and units larger than 25 MW have to be equipped with Automatic Voltage Control (AVR) devices which enable receiving voltage set-point from the control centre.

Each hydro power generating unit with a registered capacity of 10 MW or more must be capable of:

- receiving Load Frequency Control signals from the TSO control centre,
- providing primary and secondary load frequency control, and
- having a black start capability.

3.2.5.2.3 Connection Costs and Use-of-System charges

Costs for connection to the transmission network are defined by the Transmission connection charging methodology. In Kosovo, all HPP Developers for connection of new generation facilities to the transmission network will pay a "deep connection" fee defined as follows:" *deep connection" means that the applicant will provide at his own cost or pay the direct costs of the all assets required to connect to the nearest suitable point of connection on the existing Transmission System plus any indirect costs arising from works associated with the reinforcement, extension or reconfiguration of the existing network which are caused as a direct consequence of the operation of the connection point*".

Connection charges consist of the following components:

1. **Application Fee** – covering design study, evaluation of the Initial Cost and drafting of the Connection Agreement, paid with the Connection Application;
2. **Engineering Cost** - cost that HPP Developer pays to KOSTT, in relation to the responsibilities and activities of the tender and construction process of the New Transmission Assets and depending on the responsibility as the responsible party shall be calculated as:
   - 1.5% of the New Transmission Assets when HPP Developer is Connection Responsible Party
   - 5% of the New Transmission Assets when KOSTT is Connection Responsible Party
3. **Costs of New Transmission Assets** - costs of purchasing and construction of the new transmission assets
4. **Costs of Network Infrastructure Reinforcement**
5. **Compensation and depreciation costs** - costs associated with depreciation and land access and for any eventual damage during project implementation, and

6. **Maintenance costs**- costs associated with the maintenance of the new transmission assets.

Engineering Cost and the costs of the Assets (Components 2, 3, 4 and 5) are to be paid as specified in the Connection Agreement, and are a prerequisite for the commencement of works. The HPP Developer can decide if the implementation of the Components 3, 4 and 5 shall be done by KOSTT or by the HPP Developer.

The Distribution System Operator is obliged by the Law on Electricity to establish and publish standard rules on cost coverage for network connections or network reinforcements necessary to integrate new electricity generation facilities to the distribution system. Such rules shall be based on objective, transparent and non-discriminatory principles and shall be submitted for approval to the Regulator. The DSO must provide any new electricity producer wishing to be connected to the distribution system with a comprehensive and detailed description of the costs associated with the connection, and for this service the DSO may levy a charge that reflects its reasonable costs; the DSO must establish and publish standards and rules for sharing costs of grid connections and reinforcements, between all system users benefiting from these installations. Similarly, the DSO is obliged to develop and submit to the ERO their Connection Charging Methodology by defining all parameters required for the connection, including the costs that may arise from such connection. This document is currently under development. Currently, KEDS (DSO) is still using a pricing methodology for distribution network connections developed by KEK in 2005, which defines payment of the realistic/actual costs of the distribution network connection infrastructure and only necessary reinforcements.

According to the paragraph 2 of the article 58 of the Electricity Law, "*Tariffs applied for the use of the network by producers and consumers shall take into consideration losses, network maintenance, other operation costs, and infrastructural investment".*

Use of System Charges in Kosovo are paid by the consumers and by the producers according to the following algorithm:

- Both Consumers and Producers share costs (50% each) for system operation and system losses,
- Only Consumers pay costs for the use of the transmission network.

3.2.6 Serbia

3.2.6.1 Introduction

Serbia has the biggest HPP installed capacity in the region, and in doing so, it has also utilised a significant amount of its hydropower generation potential. Because of this, the identified number of new major hydropower development projects is rather small, and additions to hydropower capacity and energy generation are mainly expected from the refurbishment/repowering of the existing large HPPs. The electricity transmission network in Serbia is regularly refurbished and currently it is undergoing major upgrading with several 400kV OHL projects. Local distribution network operators have recently been grouped into one state-owned DSO. Distribution network facilities are in relatively good condition.

3.2.6.2 Detailed description of the grid access and grid connection regulations and practices

3.2.6.2.1 Responsible institutions and effective regulations

The institutional framework is Serbia is well-developed and functional. Institutions in Serbia responsible for and involved in the process of connection of hydropower plants to the electrical networks are:

- Ministry of Mining and Energy (MME)
- Ministry of Infrastructure, Construction and Traffic (MSIG), or the relevant regional or local administration in charge for issuing construction permits for connection infrastructure
- Energy Regulatory Agency (AERS)
- Transmission System Operator (EMS)
- Distribution system operator (EPS DSO)

In the case of the Serbian electricity sector, the legislative framework is complete, up to date and quite consistent. The majority of the legislation is fully harmonised with the EU 3rd Energy Legislative Package. Secondary legislation has been revised and follows the development of the primary legislation. Most of the tertiary legislation is in place, although some documents should be made more explicit while others have to be formally approved by the Regulator (where applicable). The documents that regulate transmission and distribution network access and connections in Serbia are the following:

- Energy Law (adopted on December 29th, 2014)
- Law on Planning and Construction (adopted in2009, numerous amendments since then)
- Transmission Grid Code[21] (from October 24th, 2015)
- Distribution Grid Code (from 2009, amended in 2013, 2014 and 2015)
- General conditions of delivery and supply of electricity (MoME, 2013)
- Rulebook on Energy Permit from 2013
- Procedure for connection to the transmission network (from November 27th, 2015)
- Methodology for determination of costs for connection to the system for the transmission and distribution of electricity (AERS, December 18th, 2015)

3.2.6.2.2 Implementation of the grid connection

Connection Procedure

Connection to the transmission network is under the exclusive authority of the Serbian TSO PE Elektromreža Srbije (EMS), with respect to the provisions of the Energy Law. This Law was adopted in December 2014 and it transposes the requirements of the EU 3rd Energy Legislation package into the legislation of the Serbian energy sector. Details of the procedure for connection to the transmission network are defined by the Procedure for connection to the transmission network (an internal document of the TSO). The Transmission Grid Code adopted by the TSO and approved by the Regulator (from October 2015, harmonised with the Energy Law) deals only with the technical parameters for operation of the network users, with compliance and performance testing prior to connection to the network, and with the Operational Agreement. All these documents are available on the TSOs website. Based on the Article 117 of the Electricity Law, the TSO may not refuse to connect the facility based on possible future limitations to the existing transmission capacity, such as congestion in distant parts of the transmission network. Also, the TSO may not refuse to connect the facility based on additional costs required to increase the capacity of the transmission network elements in the close vicinity of the connection point. The TSO shall submit to the HPP Developer the necessary information on possible future restrictions in the existing transmission capacity.

The key steps in the transmission network connection process are the following:

- Application for connection;
- Development of the network connection study;
- Development of the planning and technical documentation and obtaining the necessary permits for the construction of the grid connection point;
- Issuing of the Connection Approval;
- Monitoring of construction of the grid connection point;
- Approval for connection of the plant (upon completion of the connection point construction);
- Checking compliance with technical conditions of the Connection Approval, agreements signed between HPP Developer and the TSO, and with the transmission grid code requirements.

The rights and obligations of the TSO and the HPP Developer, are governed by concluding following contracts during the connection process:

1. Contract on the development of a study for the connection to the transmission system;

[21]New version of the Transmission Grid Code, in accordance with the new Law on Energy sector and compliant with the EU 3rd Energy Package is under preparation and due for adoption in 2017)

2. Contract on preparation of planning and technical documentation and obtaining the necessary permits for construction of the connection point infrastructure; and
3. Contract on monitoring of construction of the connection point infrastructure.

The actual work on design, permitting process and construction of the connection point infrastructure can be done by EMS, by the HPP developer requesting a connection or by a third party hired by the HPP Developer. In latter two cases, the HPP developer is doing all the work “on behalf of EMS”, signs relevant agreement with EMS, and all the permits are titled to EMS only. Once the connection point infrastructure is constructed and all conditions from the Connection Approval are met by the HPP Developer (balancing responsibility agreed, electricity sale contracts concluded, successful testing and commissioning including, where applicable, trial operation completed, etc.), the TSO is obliged to connect the concerned generation facility to the transmission network within a maximum of 15 days. The HPP Developer may file a complaint to the Regulator (AERS) if this stipulation from Energy Law (Article 123) is not met. Once construction of the connection point is completed, all facilities automatically become part of the transmission system.

The procedure for connection to the distribution network is regulated by the Energy Law and by the General conditions of delivery and supply of electricity. The Distribution Grid Code defines only technical requirements for connection to the distribution network. Similar to the connection to the transmission network, in the case of a distribution network connection, the DSO is by default the investor in the grid connection infrastructure and builds it on its own. At the request of the HPP Developer for connection, the DSO is obliged to authorise the investor to build the grid connection at its own expense but on behalf and in the name of the DSO. The rights and obligations of the DSO and the HPP Developer for connection are regulated by the contract which, besides the elements specified by the law governing contractual relations in particular, determines: monitoring of the connection point construction, the dynamics of works, completion deadlines, supervision of works by the DSO, etc. Once construction of the connection point is completed, all facilities automatically become part of the distribution system.

Technical requirements for connection

Technical requirements for connection to the transmission network in Serbia are specified in the Transmission Grid Code (Section 4–Connection Conditions). General technical conditions applicable to all transmission network users from Sub-section 4.2 are complemented by the additional requirements for generation units in Sub-section 4.3. Requirements for staying connected to the power system when voltage and frequency deviate beyond standard operational limits are higher for generation units than for other power system users. On top of that, all hydropower generation units (i.e. not plants) with an installed capacity >50 MW are mandatorily obliged to participate in secondary load-frequency control, with a control capacity of minimum 30% of the nominal output active power (0.3 P_{nom}). Also, all hydropower generation units must be capable to synchronise within a maximum of 15 minutes (in the case of reversible power plants this is applicable to both generation and pumping regimes) and to deliver tertiary control. Hydropower generation units must maintain voltage at the connection point within defined limits, and have to maintain stable operation at reduced active power output even below 0.45 P_{nom}. All HPPs should have the capability for black start and island mode operation (this requirement is not fully clear in the Transmission Code), have to be connected to SCADA/EMS/AGC and must participate in power system restoration[22].

The boundary between transmission and distribution in Serbia is by default at the MV terminals of the transformers in the 110/MV substations. Distribution networks in big cities are exempted from this rule, since some of them have extra high voltage power cables in their city networks.

Technical requirements for connection to the distribution network in Serbia are defined by Section 3.5 of the Distribution Grid Code adopted by the EPS DSO in the end of 2009, approved by the Regulator in 2010, as well as with the Amendments to the Distribution Grid Code from March 2014. Having in mind the complexity of the connection of the HPPs to the distribution network, as well as the potential impact that these units may have to other distribution network users and the network as a whole, the technical requirements for connection are defined in a very detailed and precise way for all foreseeable cases. HPPs connected to distribution network are not requested to contribute to the required ancillary services, but they must comply with demanding requirements

[22]Power System Restoration is the process of power system recovery after partial or total blackout. The process is guided by the predefined Power system restoration plan, which is supposed to be regularly updated and checked.

concerning their performance and maintaining regular operational conditions at the point of connection to the network.

3.2.6.2.3 Connection Costs and Use-of-System charges

According to the "Methodology for determination of costs for connection to the system for the transmission and distribution of electricity" (adopted in the end of 2015, in force from 1.3.2016), producers[23] pay only costs of the preparations for the connection (application, study, design, permits, etc.) and actual costs for the construction of the connection point and associated equipment, while costs of the network reinforcement for facilitation of the connection are paid by the network operators, financed through the network tariff. Although the HPP Developer actually pays for the construction of the network connection point infrastructure, including the costs of the connection study and approval of the design and supervision of the works by EMS staff, through the effective legislation (Energy Law, Article 118) the formal investor into connection point infrastructure is always EMS (TSO).

In Serbia, **use-of-system** charges are paid only by the consumers.

All costs of works for the connection to the distribution network are publicly available, approved by the Regulator, and HPP Developer (together with the DSO) can easily make very good approximation of the actual connection costs due to be paid for connection of the HPP once connection point and been determined (this normally happens at the very early stage of the project development).

[23]Consumers pay all the costs – for connection and for network reinforcement, if necessary. There is no clear understanding how this clause applies to reversible hydro power plant for pumping regime.

4 Capability of the existing electrical networks to accommodate connection of planned HPPs

The main objective of this Study in WB6 countries is to investigate the amount of remaining sustainable hydropower potential in the region and to make proposals for sustainable HPP development. In this section of the report, an analysis is presented of the existing electrical networks, together with their likely development plans, to determine if the networks are sufficiently strong to accommodate the expected development of the hydropower generation in the WB6 region, and if not, to propose measures on how to achieve this required capacity. Sufficient hydropower generation in the electricity generation mix of individual countries, or in the region as a whole, is essential for power system control and stability.

This issue was traditionally related to the transmission network only. However, with the development of distributed generation throughout the WB6 region, the analysis of distribution networks becomes equally important with respect to their capacity to accommodate new hydropower generation projects.

4.1 Regional level

4.1.1 Summary of the assessment of the transmission network capacity to facilitate new hydropower generation developments

The existing capacity of the transmission network's 400kV and 220kV backbone, due to the numerous new 400kV lines that have been developed during the last two decades when practically no new HPPs were constructed, is sufficient to accommodate **all the existing major HPPs**. The capacity of the transmission grid, if observed from the regional level, seems to be sufficient to facilitate **all additional major planned HPP development projects**. This fact, however, does not apply equally to all countries and in general does not apply to the transmission network facilities in the specific vicinity of the planned hydro generation plants where significant improvements will, in general, be required at the time of project implementation. Also, the 110kV network may not be sufficient in some areas to meet the demands for connections to these sections of the network (either the network is lacking in needed capacity or the network may not even exist) to facilitate and integrate medium size HPP development projects, and this need differs from one WB6country to another (more details are given in the country reports below). Hydropower generation development sites are often rather far away from populated areas, where most of the existing electrical network facilities are located. Especially in the cases of HPP cascades or a series of independent projects in the same geographical area, some major reinforcement of the 110kV network may be required. This requirement differs between individual WB6 countries. It is high on the agenda in Albania, and partly applicable to Montenegro. Demand for transmission network development at 110 kV is also high in BiH, but it is carefully and properly planned to follow development of the generation project plans. In Serbia and the former Yugoslav Republic of Macedonia, the network is considerably more developed, well planned and equally spread over the territory, while in Kosovo demand for connection is significantly less compared to other WB6 countries.

To be on the safe side, each individual project needs to be assessed separately from the network connection perspective, to make sure that all power generated can be evacuated from the HPP in all operational circumstances and regimes, as well as having the security that the power plant will be supported from the transmission and distribution networks at all times. Having in mind that the development of transmission network facilities is few times faster than the development of generation projects, especially hydropower generation facilities, together with the fact that unbundled network operators are not supposed to reject applications for connection to their networks, **power network capacities and facilities should never be a major constraint for hydropower generation development projects**.

Hydropower plants connected to the transmission network, by default, are required to have a capacity / capability to deliver secondary and tertiary load-frequency control to the TSO, as well as to provide voltage support at the connection point and black start capability for support of power system restoration. Because of this, **all new hydropower generation projects connected to the transmission network:**

- **Improve the overall stability of regional power system operations,**
- **Increase power system control capacities, and**
- **Enhance conditions for integration of other generation facilities using renewable energy sources, such as wind and solar generation**.

One of the issues that need to be addressed in the future is coordinated development of the transmission networks in the region with an objective to facilitate large power generation projects (including hydropower developments). Currently, regional long-term transmission network development planning is practically the sum of individual national long-term network development plans, with minor coordination for cross-border transmission lines. Aspects such as the development of new transmission lines to facilitate development of a large hydropower (or any other technology) project in the neighbouring country are not considered in network development planning. The reason is very simple: costs of new transmission capacities are born by the consumers in the concerned country, and new hydropower generation in neighbouring country is not good justification for regulatory authorities to approve such an investment. On the other hand, during the network connection assessment for new hydropower generation projects only the impact on the local network (and possibly on cross-border connections) is taken into account. The possibility that new generation in one country may cause congestion on an internal transmission line in another country is not considered. Development of the regional electricity market and gradual integration into a pan-European single electricity market framework will most likely bridge these kinds of gaps.

The increase in transmission connectivity throughout the WB6 region has significantly improved operations of the national and regional electrical networks and has facilitated numerous new generation development projects. However, lately numerous environmental and social challenges were identified, associated with the construction of new electricity transmission lines. In the WB6 countries are there more and more protected areas (national parks, regional parks, special protected areas, etc.) as well as internationally recognised areas to be avoided, which are further growing as a consequence of: 1) growing awareness of the need for higher environmental protection standards; 2) harmonisation with EU legislation, the implementation and enforcement of environmental directives as well as applicable international conventions. This results in increased challenges for project developers to provide environmental and social acceptance of new transmission lines projects. Significant efforts have already been made and in the future the design of transmission line routes will need to be engineered to minimise social and environmental impact, using to a maximum possible extent existing corridors, scarcely-populated areas away from environmentally sensitive zones, using underground connections[24] where applicable, etc.

4.1.2 Summary of the assessment of the distribution network capacity to facilitate new hydropower generation developments

Distribution networks in all regional countries consist of facilities operating at the voltages below[25] 110 kV, i.e. medium voltage (MV) networks at 35 kV, 20 kV and 10 kV, and low voltage (LV) networks at 0.4 kV. Distribution networks have, in the past, always been designed as passive networks used only to distribute electricity to final consumers. These networks are local by their character and there either are no interconnections or they are interconnected to a very limited extent, to achieve a desired level of security of supply. The development of the distribution networks is, in general in the WB6 region, lagging behind the development of the electricity transmission facilities. Historically, the development of the distribution networks has always been demand driven, easily controlled and coordinated through centralised planning. Distribution networks in WB6 countries are predominantly radial, except in and around the big cities where distribution networks can become looped and heavily meshed. Accordingly, the relevant connection logic is entirely different from the connection to the transmission grid. In the transmission network, a connection is usually 1:1 (sometimes even 1:2, for the security reasons and to provide secure evacuation of the produced electricity), meaning one HPP is connected to one or more connection points in the transmission network, without any other network user sharing this facility. In the

[24] When technically feasible for construction, underground transmission lines (cable) are 10-15 times more expensive then overhead lines.

[25] There are however, certain facilities operating at 110 kV and even higher voltages, but still part of the distribution network assets. The reason is the fact that they are within the distribution network and they are used exclusively for that purpose.

distribution network, it is in most cases X:1, where X is number of different users connected to a single (1) connection point in the distribution network.

Development of distributed generation has changed planning and operational routines for distribution network operations dramatically. Distribution networks are becoming very active, the embedded level of generation is increasing and operational scenarios are multiplying. In some cases, due to the new generation capacities in the distribution network being closer to the load centres, energy losses in the transmission grid (lines and transformers) are reducing, as is the demand for transformer capacities. On the other hand, in several opposite cases, the existing capacity of the HV/MV network has been insufficient to facilitate the injection of power from multiple HPPs during extreme hydrological (i.e. hydropower production) periods. It is becoming critical to undertake major rehabilitation and upgrading of the distribution grid in all WB6 countries by adding new facilities and modernising existing ones.

The general perspective for the WB6 region as a whole is that, **the capacity of the distribution networks in the region is insufficient to facilitate growing demand for connection of new small HPPs and distributed generation in general**[26]. Distribution companies are lacking network assets, control facilities, communications, metering, human resources. In short there is a pressing need for a radical upgrade of the distribution networks. Looking country by country, the situation is most critical in Albania, where the gap between demand for connection and network capability is the largest. All of the other WB6 countries need reinforcement of the distribution networks particularly in the areas where new HPPs are planned (because they are by default in the remote, scarcely populated areas). However, this demand is stronger and more urgent in Montenegro, BiH and Kosovo, and less critical in Serbia and the former Yugoslav Republic of Macedonia.

Hydropower plants connected to the distribution network may contribute to the delivery of ancillary services for power system control, but in the past, this was not the case with existing HPPs. Moreover, the owners of the majority of so-called small HPPs (although some of them are not that small, since the limit is typically 10 MW) are exempted from the obligation to compensate for deviations from their planned generation schedules. These habits are rapidly changing. In some countries, small HPPs (usually units above 500 kW of installed capacity) started gradually to participate in the balancing mechanism (where they pay for their imbalances from declared schedules). The most recent Distribution Grid Codes have drastically increased the technical requirements for connection of HPPs, including their capability for voltage and frequency control. It is expected that in the future, the contribution of HPPs connected to the distribution network to provide ancillary services may be larger in total than the contribution from the large HPPs connected to the transmission network, due to the fact that they are closer to the demand and may have higher flexibility. It is only matter of the legal/regulatory mechanism and technical legislation to determine when these opportunities will start to be implemented.

4.2 Country-specific actions

4.2.1 Albania

4.2.1.1 Detailed description of the electrical grid in the country

4.2.1.1.1 Transmission Network

The transmission network in Albania is owned, maintained and operated by the Albanian TSO (OST). OST develops, and the Albanian Energy Regulatory Authority (ERE) approves the Transmission Grid Code and all other by-laws relevant for Albanian power system operations, as well as for the connection of new generation capacities and consumers to the transmission grid. The electrical power system of Albania, until recently, had serious difficulties in electricity transmission inside the country and with the interconnected neighbouring states, because the whole transmission network was constructed for, and operated at, the 220kV level. There were number of operational regimes when existing large HPPs could not operate at their full capacity (during periods of extremely high-water inflows, since all these plants are in the cascade on the same river – the Drini River) due to the transmission network constraints. Similarly, there were periods when the transmission network had to be split

[26] Although main focus of this study is connection of new HPP facilities, in case of distribution network cumulative effects are caused by multiple requests for connection coming from various distributed generation sources (especially solar and wind due to the incentives of feed-in-tariffs).

into sections in order to maintain voltage stability in the grid. Last but not least, due to the lack of the so called "n-1" network stability criterion, which is ability of the power system to maintain stable operations in case of loss of a single transmission network element[27], partial blackouts and power supply restrictions became more common.

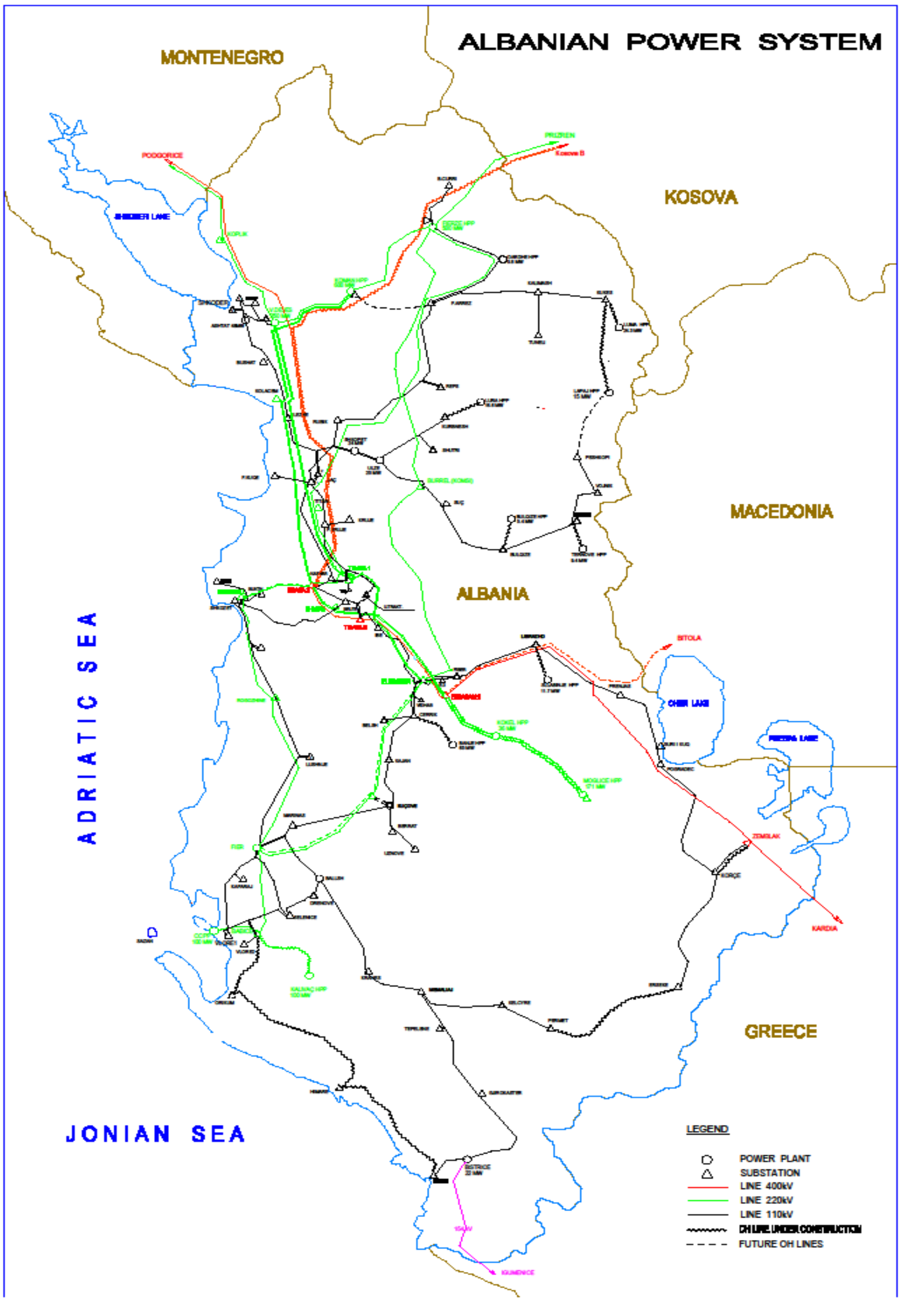

Figure 4.1: Transmission network of Albania

Upon completion of the 400kV OHL Tirana – Podgorica (MNE) in 2011, the main transmission 400kV backbone in the country was completed (the connection to Greece in the south was made several years earlier) and network operations significantly improved. In June 2016, the 400kV OHL Tirana – Prishtina (KOS) was commissioned. This line additionally improved parallel operation of the Albanian power system with the ENTSO-E interconnection by connecting Albanian power system, via a new 400kV substation in Peja (KOS), with one of the

[27] Transmission line, busbars, transformer,…

major 400kV hubs in the region - the 400kV substation Kosovo B (this substation hosts the existing 400kV links to Serbia, Montenegro and the former Yugoslav Republic of Macedonia). Finally, construction of the 400kV OHL Bitola (MKD) – Elbasan (ALB), which is currently under preparation and expected to be completed by Q2 2020, will finally strengthen the high voltage grid in Albania and will provide stability of operations in the long run. After the completion of the on-going projects, interconnections of the Albanian power system will be:

- 1x400 kV and 1x220 kV lines to Montenegro,
- 1x400kV and 1x220kV lines to Kosovo,
- 1x400kV and 1x150kV lines to Greece, and
- 1x400kV line to the former Yugoslav Republic of Macedonia.

The main facilities in the transmission network are 400kV overhead lines (320 km), 220kV overhead lines (1,128 km), 110kV overhead lines and cables (1,250 km), and HV/MV transformers with an overall capacity of 3,916 MVA.

Transmission network development planning

The TSO prepares a 10-year network development plan (TYNDP) in consultation with the stakeholders and presents it for approval to ERE, together with a 3-year financial plan for investments in the transmission network. Each year, in the tariff procedure, the TSO (OST) submits its annual investment plan (an extract from the 3-year plan) for transmission network infrastructure to ERE for approval. By the Law, the ERE should have developed and adopted the regulation on the procedures of submission and approval of the development plans, but as yet this is not effective.

The TYNDP is developed using ENTSO-E methodology, and it is updated every 2 years. This plan takes into consideration, among other factors, connections of existing (in case of rehabilitation) and planned electricity generation facilities, primarily those which are part of the Energy Strategy and National Renewable Action Plan (NREAP). According to Article 60 of the Law on the Energy Sector, in the event that ERE determines that the TSO is unable to fulfil its previously planned investments, which according to the TYNDP plan should have been carried out in three previous consecutive years, and if ERE (based on the demand forecasts and connection applications) finds that the investment is needed and can be financed without impeding the normal operation of the network, then the ERE takes at least one of the following measures:

- requests OST to execute the investments in question;
- requests OST to organise a competitive procedure open to any investors for executing the concerned investment, or
- requests OST to accept capital increase to finance the necessary investments.

In exercising its power in this regard ERE always sets relevant tariffs to cover the costs of the investments in question. Also, for similar decisions ERE is obliged by the Law to consult Minister of Energy and Industry.

4.2.1.1.2 Distribution network

The distribution network in Albania is managed by the Distribution system operator (DNO) - OSHEE sha. This network operator was privatised and became consequently owned and operated by the company CEZ from the Czech Republic since 2009. Following a dispute with the Albanian Energy Regulatory Commission and revocation of the DNO license from CEZ in 2013, the parties reached a solution for financial compensation and the distribution network in Albania returned to public ownership. It is composed of substations 110/20kV, distribution network lines and cables of 35/20/10/6 kV, and transformers 110/35/20/10/6kV. The distribution network is around 15,600 km long, is rather old and in some areas, is technologically out of date. Due to the aging infrastructure and electricity overloading regimes, OSHEE has encountered a lot of difficulties in network management, which has been reflected in the quality of electricity supply that has been provided to the customers, in the numbers of interruptions, in the duration of interruptions, and at the levels of technical and non-technical losses.

The distribution sector is facing a combination of challenges, regarding unbilled revenue, damaged or uninstalled smart meters, electricity theft in the system, as well as insufficient debt collection of invoiced energy from families and businesses. The distribution sector aims to guarantee a continuous and reliable supply nationwide, having no electricity supply interruptions, while improving electricity distribution efficiency, through losses reduction and revenue improvement. Key measures outlined by OSHEE, to reduce the level of technical and non-technical losses, will be taken through the implementation of an investment program to improve and modernise the distribution system, improve and modernise smart meter capacities, introduce a secure data collection system, implement a program to identify and disconnect illegal connections to the power system and to improve distribution network control and maintenance.

The Distribution Grid Code is now significantly out of date (2003). The same applies to the formal document describing connection procedures for new HPP capacities to the distribution network. The entire process is based on partial actions and pieces of legislation with a number of open issues being solved on the case-by-case basis. This exposes the entire process of connection of new distribution network users (including new HPPs) to a number of technical and especially financial obstacles that seriously delay or in some cases completely cancel potential HPP developments. On the other hand, the distribution system operator OSHEE is flooded with requests for connection of small HPPs as a consequence of non-selective and non-coordinated granting of an extremely high number of concessions for HPP development. Lack of funds for network rehabilitation and extensions, as well as a general lack of professional capacity within OSHEE to cope with the increasing demand for connection of RES-based power generation facilities under the incentives regime, are a major challenge for OSHEE both now and in the future.

4.2.1.2 Analysis of the existing transmission network capacity towards planned capacity of future HPPs

Recent developments of the main transmission backbone, the 400kV network, in Albania made the transmission backbone more than sufficient to facilitate operation of the existing HPPs in Albania, as well as to accommodate the new hydropower development projects planned to be connected to the transmission network. However, the existing capacity of the 110kV network is not sufficient for the connection of new HPP projects in all areas where hydropower potential exists. Subject to the specific location of the connection point, the capacity of the transmission network between the connection point and the main 400kV and 220kV transmission backbone needs to be verified.

Based on OST’s assessment, the critical zones in the 110kV network relating to network capacity and operational parameters are the following:

- North-East zone (Fierze-F.Arres– Kukes– Peshkopi– Bulqize-Burrel),which is the most critical zone of the 110kV network, and
- South-East zone (areas of Elbasan and Korca).

The main problems in these areas are related to significant voltage drops, especially during off-peak hours, high transmission losses in some branches, reduced security of operation of already-connected HPP and insufficient capacity for the connection of new HPPs to be developed in those areas. OST did the necessary analysis and planning, so there are measures that may improve current situation. However, financing of the transmission network reinforcement and upgrading is still a major challenge in Albania, due to the numerous transmission network development candidate projects.

Another important issue for operation of HPPs is power system monitoring, control and operations. OST developed a SCADA/EMS system with Automatic Generation Control (AGC), but a number of existing HPPs are not connected to that system and the load-frequency control capacity in the Albanian power system is inadequate. This is because the current Grid Code requirements were introduced after these HPPs were already operational or being designed. According to the Grid Code, the provision of Primary, Secondary and Tertiary control is mandatory for all HPPs, which is not a standard solution.[28]

4.2.1.3 Analysis of the existing distribution network capacity towards planned capacity of future HPPs

Performance of the distribution network in the areas where distributed generation is connected is getting worse as consequence of many factors, where the dominant factor is geographic position, because HPPs are usually

[28]Usually this requirement applies only to HPP above certain installed capacity.

located deeply inside the rural areas where the distribution network is weak. Key technical and operational problems associated with operations of the distribution networks are:

- Very old (sometimes thermally damaged) feeders, radial overhead lines without alternative supply routes,
- Very low demand (as a consequence of population migrations) and according lack of investment,
- Located in the mountains and exposed to harsh weather conditions causing frequent faults,
- Lack of access roads in these zones which increases time for fault detection and repairs,
- Negative effects of over voltages and in the periods of huge water inflows extreme power production causing tripping of feeders,
- Increase of the technical losses in some regions due to line overloads caused by injected power from HPPs,
- Increased voltage profiles over the maximum allowed values because of the injected reactive power from HPPs,
- Overloading of the power transformers and lines because the injected power from HPPs was above the designed capacity of the substation and lines in 35kV network,
- Lack/absence of a remote monitoring and control infrastructure,
- Lack of operating rules (procedures) for dispatching of HPPs.

OSHEE is trying very hard to fulfil its role and connect all parties that have received concessions for hydropower generation development, but it is definitely not realistic. In addition to the technical issues which are listed above, there are number of other, legal and organisational aspects that limit further progress in connecting some of the planned HPPs to the distribution network. All the above listed issues can be overcome, but they need time, action by all involved parties and significant investments.

4.2.1.4 Conclusion – Proposals for network reinforcements and/or extensions

The transmission network development projects for new 400kV OHLs Elbasan (ALB) – Bitola (MKD) and Elbasan – Fier need to be completed as planned. Also, OST needs to significantly upgrade the 110kV network, especially in the North-East and in the South-East zones. Costs associated to bringing these parts of the 110kV network into satisfactory operational condition are estimated to lie between 35 and 40 million EUR. These transmission network developments are very important for the development of recognised HPP projects in Albania.

The distribution network requires significant upgrades and OSHEE contracted a study that delivered proposals for prioritised actions and has made a preliminary financial estimation. The estimation of the investment needed to reinforce the existing distribution network is in the range of 40 to 45 million EUR. The projected time for execution of this project, including design and land acquisition is 5-10 years. Monitoring and control facilities (SCADA) were not assessed in that study because the design of the SCADA system was not available at the time the report was generated. Without the above indicated improvements and modernisation of OSHEE operations it will be difficult to facilitate the integration of many of the foreseen HPP development projects.

4.2.2 Bosnia and Herzegovina

4.2.2.1 Detailed description of the electrical grid in the country

4.2.2.1.1 Transmission Network

The electrical power system of Bosnia and Herzegovina has been connected to the UCTE (now ENTSO-E) grid since 1975, at that time as part of the common power system of former SFRJ, and it has good connections with the neighbouring countries. Despite the fact that Bosnia and Herzegovina has only three neighbouring countries (power systems), the number of interconnection lines is rather significant. These interconnections are:

- 2x400kV and 6x220kV lines to Croatia,
- 1x220kV and 1x400kV lines to Serbia,

- 1x400kV and 2x220kV lines to Montenegro (the second 220kV line is constructed as 400kV, but operating at the 220kV voltage level).

There are also 22 interconnection 110kV lines to the neighbouring power systems, where some of the lines are in parallel operation and others are used for an isolated power supply. Due to this high level of interconnectivity, the stability of the power system in Bosnia and Herzegovina has a significant impact on the operation of the neighbouring power systems and vice versa (e.g. power system of BiH is heavily influenced by the loop flows from the south to the north of Croatia), as well as on the future establishment and operation of the Regional Electricity Market.

The transmission network in BiH has been thoroughly reconstructed after serious devastation during the civil war in 1990s. Most of the high-voltage lines and relevant substations have been either reconstructed or newly-erected. Additional expansions of the transmission interconnections, as well as reinforcements of the internal transmission network, depend heavily on new generation investments, except for the planned new 400kV line between Banja Luka and Lika (Croatia) and the upgrade of the 220kV line to Serbia, which are driven by the idea of TSOs to reinforce the networks in those areas.

The transmission network is jointly operated by the Independent System Operator for BiH (NOS BiH) and BiH Transmission Company (Elektroprenos BiH). The main facilities in the transmission network are 400kV overhead lines (865 km), 220kV overhead lines (1,524km), 110kV overhead lines and cables (3,950 km), and 255 HV/MV transformers with a total capacity of 12,388 MVA. Network operations, as well as the connections to the network, are regulated by the Transmission Grid Code (developed by NOS BiH) and Transmission Network Connection Rules (developed by the BiH Transmission Company). Both documents are approved, and the entire process is monitored by the State Electricity Regulatory Authority (DERK).

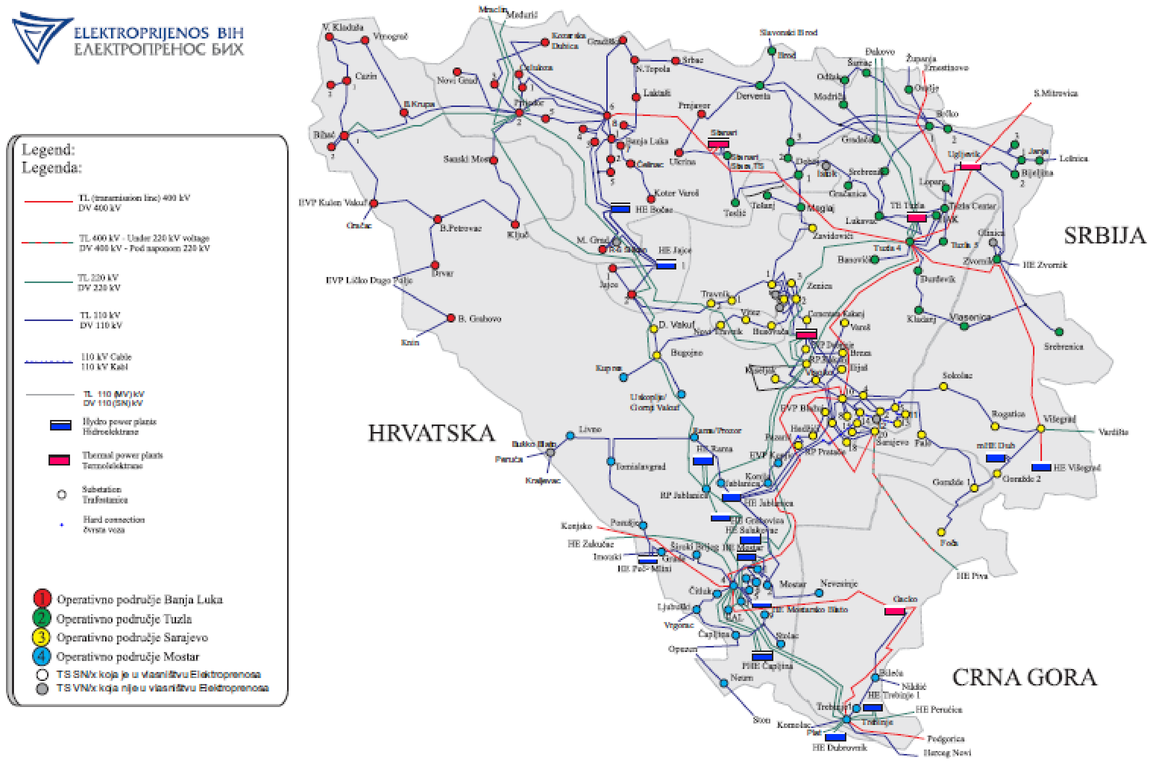

Figure 4.2: Transmission network of Bosnia and Herzegovina

4.2.2.1.2 Distribution network

The distribution network in BiH is split between three main electricity companies, each of them former vertically integrated power utilities. Two (EP BiH and EP HZHB) are in the process of establishment of the DSO that will take care of the distribution network owned by these two power utilities, while unbundling the electricity supply activities. The third electricity company, MH ERS, is a holding company with five distribution companies in its portfolio, and it is still unclear how DNO functionality will be organised. Following opening of the retail market on

January 1st, 2015, unbundling of the DNOs became major activity in the sector. The distribution network in BiH was significantly destroyed during the civil war in the 1990s, but unlike with the transmission network, it is not yet fully rehabilitated. Facilities in the distribution network have been brought to a level which enables a reasonably good and reliable supply of electricity to final consumers, as well as operations at normal quality and security standards, but there are still a lot of works to be undertaken to upgrade the distribution network to the desired level. A number of rehabilitation projects are currently on-going, including projects for smart meters and SCADA systems in all distribution companies in BiH.

Legislation in the distribution sector in BiH exists to govern activities at the level of the existing power utility companies, i.e. the future DNOs. As indicated earlier in this section there are Distribution Grid Codes (although some of them are out of date), Network Connection Rules and other by-laws, rulebooks and procedures, monitored and coordinated by the entity[29]regulatory authorities (FERK and RERS).

4.2.2.2 Analysis of the existing transmission network capacity towards planned capacity of future HPPs

The transmission network in BiH, although reasonably well developed, seems to be still insufficient to facilitate the numerous hydropower generation development projects in the pipelines of all generation companies. However, this is not due to the lack of the network facilities, but due to the delays in large HPP projects development by the project owners/developers. BiH transmission company Elektroprenos BiH, in its 10-Year Network Development Plan[30] (TYNDP), applies the clear principle that connection of all new generation plants included in the Indicative Generation Development Plan (IGDP) prepared by NOS BiH (Independent System Operator for BiH) have to be facilitated according to the dynamic of their construction foreseen in the IGDP. Since the IGDP is updated every year, timelines for construction of the transmission infrastructure for connection of new generation units change accordingly in the TYNDP which is updated every two years (while the financial 3-year transmission network investment plan is updated on annual basis). This TYNDP explains in detail the planned new connections to the transmission network for each planned power generation plant, including location details and a drawing of the connection point facilities linked to other neighbouring transmission network components (see extract from the TYNDP below for the planned HPP Dabar). Based on the above it can be concluded that transmission network in BiH is (or will be at the time when required) sufficient to facilitate connection of all hydropower generation projects which are part of the IGDP.

[29] The BiH state is composed of two entities (BiH Federation and Republic of Srpska) with very strong political powers. Accordingly, regulatory framework in electricity sector is regulated at both levels. State Regulator (DERK) is responsible for power system operations, transmission, cross-border exchanges and trade, while Entity Regulators (FERC and REERS) are responsible for electricity generation, distribution and supply).

[30] Recently, State Electricity Regulatory Commission (SERC/DERK) approved the TYNDP for the period 2017-2026.

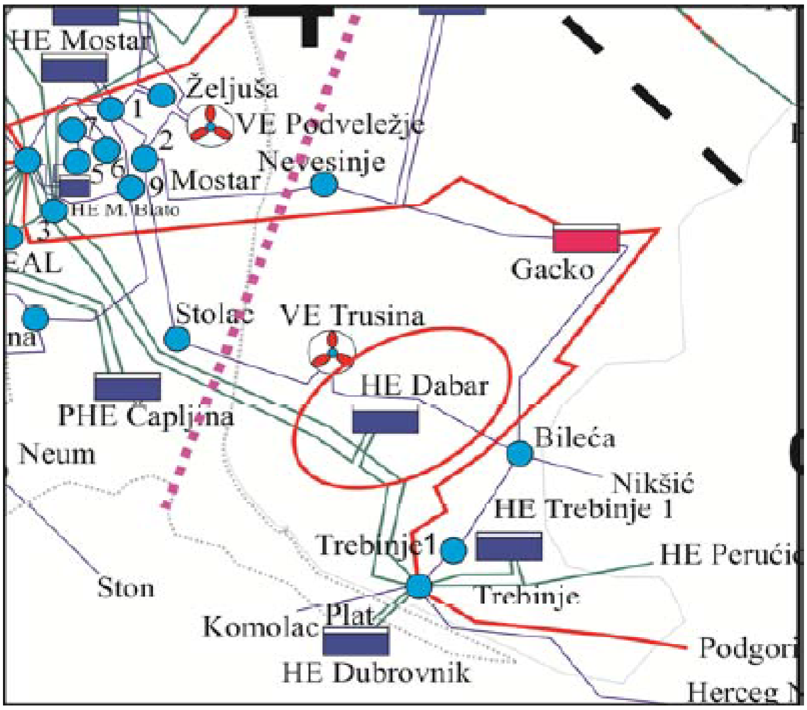

Figure 4.3: Presentation of the grid connection details in the TYNDP for BiH for period 2017-2026

However, in BiH there are number of other HPP development projects of medium size (close to or larger than 10 MW, some of them in cascades), whose connection has not been included in the IGDP of BiH ISO and the TYNDP of Elektroprenos BiH. The approach to this issue can be twofold: the first is to ignore these projects until they become part of the IGDP and accordingly the TYNDP, assuming that BiH institutions in electricity sector are prudent in their work, and the second is to try to take these projects into account by making an assumption of their potential impact in the event that they get constructed. Based on the previous experience, with long lists of potential HPP projects where none of them gets completed, ever, as well as having in mind that all these types of HPP projects will be connected to the 110kV transmission network, the first approach seems more appropriate.

4.2.2.3 Analysis of the existing distribution network capacity towards planned capacity of future HPPs

Current distribution system operators in BiH, still parts of the large holding companies, are successfully managing connections and operations of the RES-based generation facilities, where the majority of them are hydro power plants. However, each new connection so far was associated with a reinforcement of the distribution network in the close vicinity of the future power generation facility, or their connection was made to the transmission network because there was no distribution connection available near the planned HPP development site. Most of the future HPPs are planned to be located in the gorges in the hilly or mountainous areas, away from main roads and settlements, and also from the existing distribution networks. BiH has significant hydro power potential, and for that reason, the capacity of the distribution network needs to be continuously upgraded to continue to successfully facilitate hydropower generation developments. Distribution companies do not have sufficient financial resource to strengthen their networks and to enable new HPP connections, while maintaining at the same time undisturbed connections of existing network users. There are no long-term development plans for the distribution network which take into account planned HPP developments - connection requests are assessed on a case-by-case basis. Therefore, most of the network reinforcements are done by the HPP investors, assuming that these investments do not obstruct overall feasibility of the entire project.

4.2.2.4 Conclusion – Proposals for network reinforcements and/or extensions

Transmission network planning in BiH is extremely well done and coordinated with all developments of future connections. The transmission company in BiH and BiH ISO need to continue with their existing planning and development approach and so that all planned HPP connections to the transmission network will be successfully accommodated.

Distribution system operators must begin to include in their development plans solutions for connections of HPPs and other RES based generation facilities, in accordance with the maturity of data on their planned developments, as a minimum based on the latest version of NREAP.

4.2.3 The former Yugoslav Republic of Macedonia

4.2.3.1 Detailed description of the electrical grid in the country

4.2.3.1.1 Transmission Network

The transmission network in the former Yugoslav Republic of Macedonia is owned, maintained and operated by the transmission system operator (MEPSO). Main facilities in the transmission network comprise of 400kV overhead lines (602 km, with future OHL to Albania), and 110kV overhead lines and cables (1,514 km) as well as 148 HV/MV transformers with an overall capacity of 6,417 MVA. In the former Yugoslav Republic of Macedonia 220kV transmission lines (there were only 102 km of these lines) are out of operation and their corridors are preserved for future network developments.

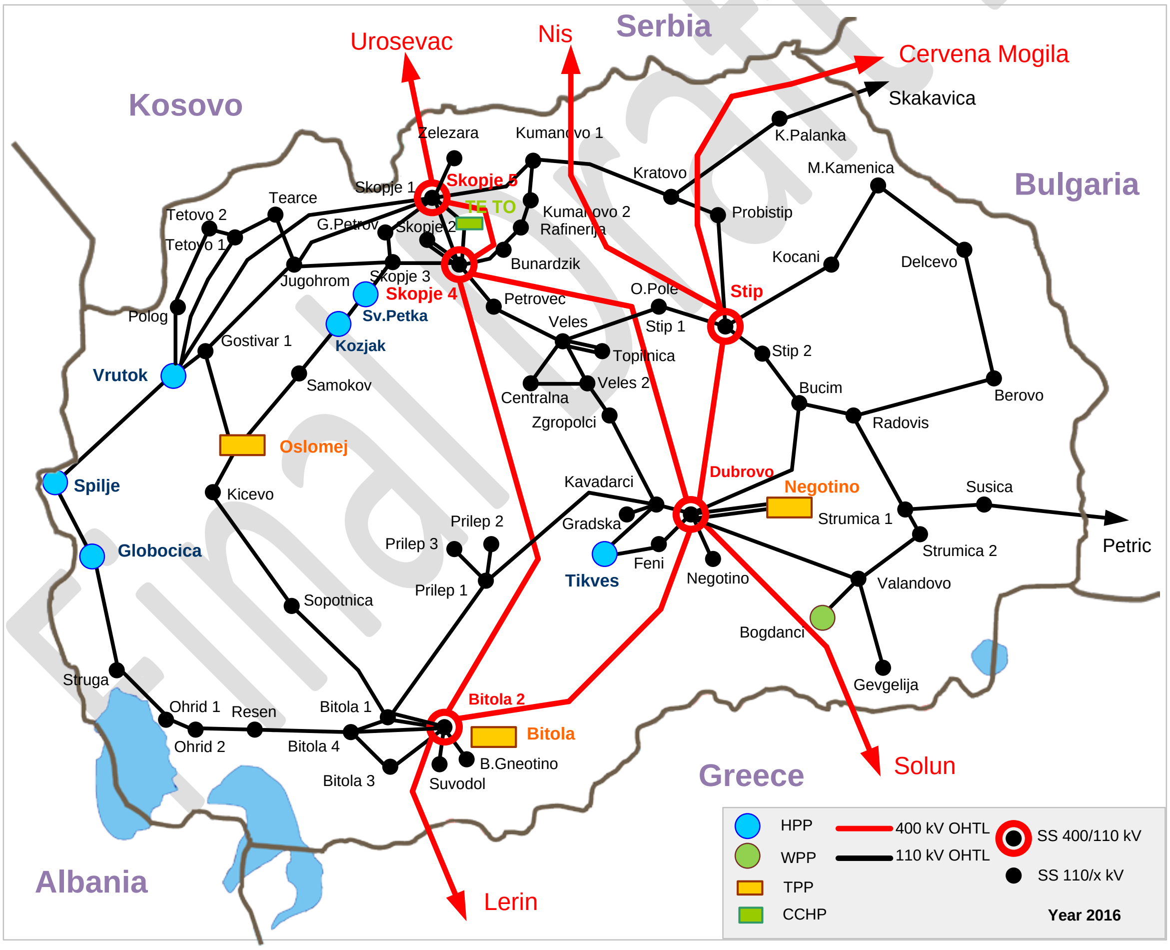

Figure 4.4: Transmission network in the former Yugoslav Republic of Macedonia

In the power system of the former Yugoslav Republic of Macedonia, most of the large hydropower plants were constructed and operational by the early 1990s. At those times, the only 400kV connection in the country was a north-south line, linking with power systems in Kosovo and Greece. Since then, only 105 MW of new hydropower generation capacities have been constructed and connected to the transmission grid, while at the same time four major 400kV interconnections were commissioned (to Greece, Serbia, Bulgaria and on-going to Albania) together with the associated internal transmission network facilities, 400kV substations Skopje 5 and Štip together with numerous new 110kV lines.

After the completion of the on-going interconnection project to Albania, 400kV OHL Bitola (MKD) – Elbasan (ALB) together with the new 400/110kV S/S Ohrid, the interconnections of the power system of the former Yugoslav Republic of Macedonia will be:

- 1x400 kV line to Serbia,
- 1x400kV line to Kosovo,
- 1x400kV and 2x110kV to Bulgaria,
- 2x400kV lines to Greece, and
- 1x400kV line to Albania (in final preparations for construction).

MEPSO has very consistent and extraordinarily good planning policies. They study, plan, design, construct and expand network facilities on time and practically do not have any serious congestion in the network.

4.2.3.1.2 Distribution network

The vertically integrated power utility ESM was unbundled in the year 2005 through the separation of the transmission system operator MEPSO into a legally independent entity, following implementation of the EU 2^{nd}energy regulatory package. A year later, in 2006, the electricity company EVN from Austria acquired the majority of shares in the distribution division and became the owner and operator of the distribution network in the country, as well as the main supplier of electricity to final consumers. Together with the distribution network assets, in the privatisation process EVN acquired 11 small HPPs previously owned and operated by ESM with a total installed capacity of 26.4 MW.

The distribution network in the former Yugoslav Republic of Macedonia has been significantly enhanced and modernised since the privatisation, in spite of relatively low prices of electricity for final consumers. Today, this network consists of 168 km of 110kV lines (this is transmission voltage level, but some lines that are exclusively used for distribution purposes remained assets of the distribution network), 841 km of 35kV lines, 10,527 km of 20/10/6kV lines, 14,599 km of 0.4kV lines and 7,891 transformer stations. The network is regularly maintained and managed following the Distribution Grid Code and its associated set of rules and procedures developed by the DNO and approved by the national Energy Regulatory Commission (ERC).

4.2.3.2 Analysis of the existing transmission network capacity towards planned capacity of future HPPs

The main transmission network backbone, the 400kV grid, is capable of accommodating all planned hydropower generation projects, as well as other electricity generation power projects foreseen to get connected to the transmission grid in the National Energy Strategy and the NREAP. Also, the transmission network in the former Yugoslav Republic of Macedonia successfully transfers all quantities of electricity that flow through the main regional north-south power transfer corridor. The existing 110kV network is also rather strong, regularly maintained, extended and upgraded. A main driver for these improvements has been the expected new network users, whether large direct consumers or planned generation facilities. Except for potential minor extensions, which may be needed on top of investments already planned in the transmission network long-term development plan, the transmission network in the former Yugoslav Republic of Macedonia is fully reliable and capable of supporting all planned hydropower generation development projects.

MEPSO has the consistent practice of developing very comprehensive and realistic 10-Year Network Development Plans (TYNDP) following, just like all other transmission network operators in the region, the common methodology prescribed by ENTSO-E. In their TYNDP, MEPSO elaborates all foreseeable new connections, consumers and power plants (including hydro power plants), recognised by the Energy Strategy, Action Plan for implementation of Energy Strategy and NREAP, to the transmission grid; the TYNDP also deals with necessary reinforcement of the transmission grid due to the cumulative effect of multiple electricity generation development projects. This planning includes also refurbishment and reconstruction of existing hydro power plants in cases where their rehabilitation leads to refurbishment requirements of the connection infrastructure. Such an approach provides certainty, due to the fact that construction of the transmission network facilities is much faster than construction of the new hydropower plant, that electricity infrastructure will not become an obstacle for development of new hydropower generation in the former Yugoslav Republic of Macedonia. The TYNDPs prepared by MEPSO are regularly accompanied by the 3-years detailed investment plan and so far, these plans have always been approved by the Regulator (ERC).

4.2.3.3 Analysis of the existing distribution network capacity towards planned capacity of future HPPs

Integration of new power generation facilities into the distribution network grew significantly over the last decade, and with the joint efforts of the investors and DNO, all of them have been successfully connected. Demand for connection of more RES-based generation facilities, mainly from HPPs, solar power plants and wind power plants is still growing, resulting in pressure on the DNO to expand the network as necessary. These requests are not always in line with the development plans of the DNO nor with the schedule for network elements upgrade, refurbishment or replacement. The overall capacity of the distribution network is sufficient to facilitate all the currently identified HPP projects, as well as most other RES-based generation projects that are in the pipeline. But the capacities or characteristics of network facilities at the specific locations of the future hydro power plants, as well as the surrounding network facilities, are usually insufficient - simply because the hydropower potential is not evenly spread over the network. The best locations for RES-based generation development are usually far away from the major electricity consumption areas where, quite the opposite, distribution network is the most powerful.

4.2.3.4 Conclusion – Proposals for network reinforcements and/or extensions

The only proposal for the former Yugoslav Republic of Macedonia is to continue to develop its transmission and distribution networks in accordance with their long-term development plans. In such a way, necessary capacity for the connection of new HPPs will always be possible.

4.2.4 Montenegro

4.2.4.1 Detailed description of the electrical grid in the country

4.2.4.1.1 Transmission Network

The transmission network in Montenegro is owned, maintained and operated by the Montenegrin TSO (CGES – Crnogorski Elektroprenosni Sistem). As aforementioned, the CGES is the only TSO in the region which is not fully state-owned. While the Montenegrin State is the majority owner of the CGES, other shareholders are also the Italian TSO (TERNA), the Serbian TSO (EMS) and some small private shareholders.

The main facilities in the transmission network comprise of 400kV overhead lines (283.3 km), 220kV overhead lines (337.4 km) and 110kV overhead lines and cables (552 km). Network operations, as well as the connections to the network, are regulated by the Transmission Grid Code and the associated set of rules for the connection to the transmission grid, developed by the CGES and approved by the State Energy Regulatory Agency (ERA).

Interconnections of the Montenegrin power system with neighbouring power systems are:

- 2x220kV and 2x110kV lines to Serbia,
- 1x400kV line to Kosovo,
- 2x400kV (one operating at 220 kV), 1x220kV and 2x110kV lines to Bosnia and Herzegovina,
- 1x400kV and 1x220kV to Albania, and
- HVDC 500kV submarine cable to Italy (under construction).

The transmission network in Montenegro is currently under major development. The new 400/110/35kV substation Lastva in the coastal region is under construction, together with the internal 400kV OHL Lastva-Pljevlja. Lastva substation is adjacent to the converter station, which is the terminal of the HVDC 500kV cable to Italy. This major reinforcement of the transmission network will significantly improve security of electricity supply in the touristic region at the sea coast which until now has been fully dependant on 110kV lines, some of them even radial. These reinforcements will also provide additional network capacity for various investments and developments, including investments in new generation facilities.

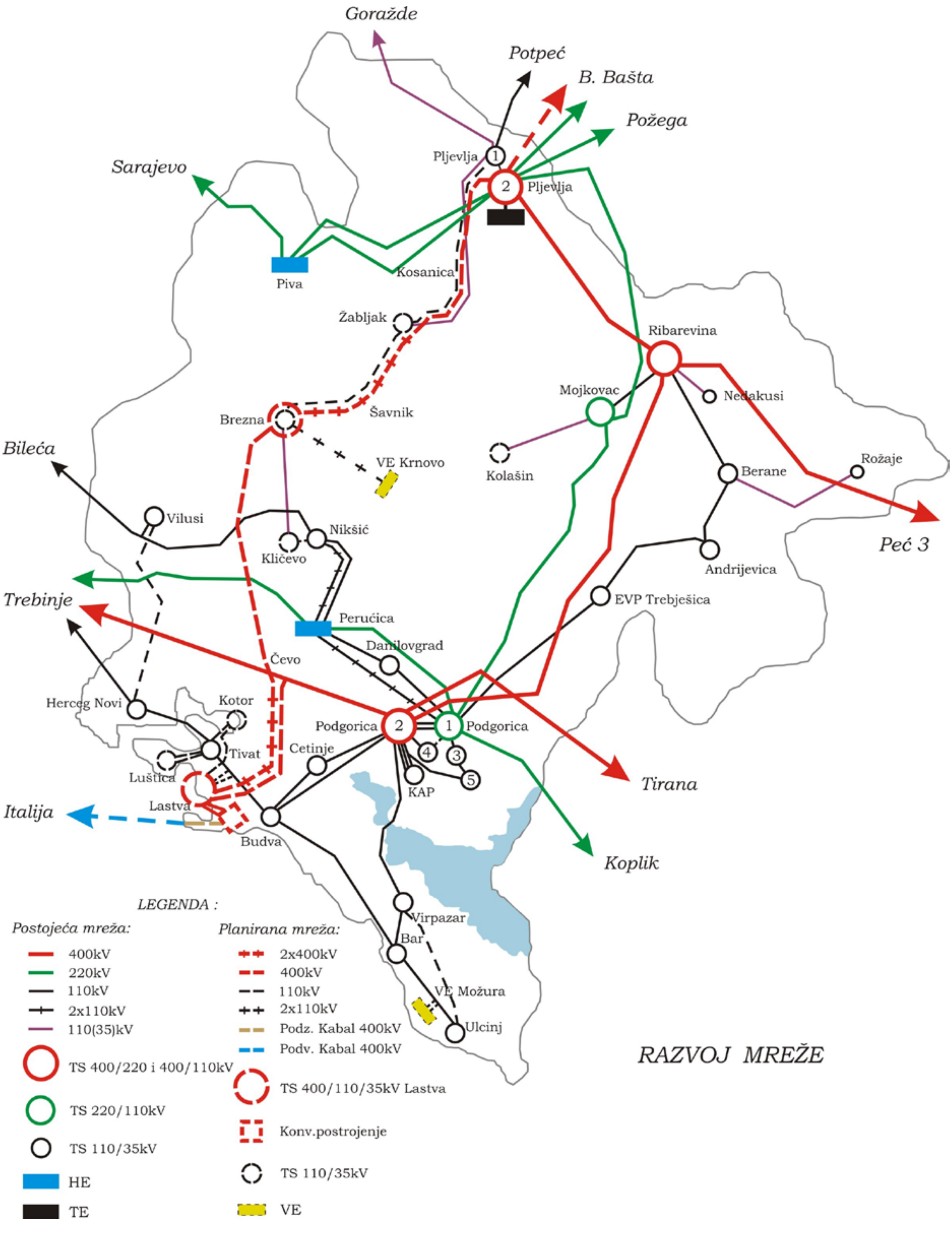

Figure 4.5: Transmission network in Montenegro

4.2.4.1.2 Distribution network

Distribution network operations and the supply of consumers in Montenegro are still part of the portfolio of EPCG (Elektroprivreda Crne Gore), which is a company majority owned by the Italian company A2A. Following the

Energy Community Treaty obligations of Montenegro, both distribution network operations and the electricity supply businesses have been functionally unbundled from EPCG by establishing FU Distribution and FU Supply. This action was satisfactory from the point of view of compliance with the EU 2nd energy regulatory package. Opening of the electricity retail markets in the region and the requirements of the EU 3rd energy regulatory package however demand full legal unbundling of distribution network operations (as a regulated activity) and electricity supply businesses (as a market activity), and in this sense, there is an on-going dispute between the State of Montenegro and Energy Community.

The distribution network's main role is providing electricity from the transmission grid or power plants connected to the distribution network, to the final customers. It consists of system of power lines and substations (4,888 in total) of the following voltage levels: 35 kV (1,118 km), 10 kV (4,831 km) and 0.4 kV (12,890 km). These facilities are maintained and operated by the functional unit FU Distribution of EPCG, which is the basis for the future DNO in Montenegro.

Montenegro is a sparsely populated country. Accordingly, the distribution network is highly radial and with numerous associated technical constraints. From the technical point of view, connection of new hydropower generation capacities to the distribution network is, in each particular case, a serious challenge that needs to be assessed on a case-by-case basis. As a general conclusion, the distribution network in Montenegro requires significant reinforcements to facilitate the planned HPP developments. On top of that, the overall framework for network access and connection of RES-based generation in Montenegro is underdeveloped, compared to most other WB6 countries.

4.2.4.2 Analysis of the existing transmission network capacity towards planned capacity of future HPPs

The capacity of the transmission network in Montenegro, in spite of all recently completed and on-going transmission system reinforcements, is not fully sufficient to facilitate the numerous planned hydropower generation development projects. Due to the size and locations of the HPP development projects which are under consideration in Montenegro, certain reinforcements of the transmission network exclusively for the purposes of facilitating new HPPs connection will be necessary in the vicinity of the HPPs being developed. The transmission network development plans of CGES are trying to foresee the actual requirements to connect new generation capacities. For example, the route of the new 400kV OHL Lastva – Pljevlja has been planned to include the new 400kV substation Brezna (phase 2 of this project), whose main purpose is to accommodate the planned HPP Komarnica and the wind power plant Krnovo in that area. Connection of other planned large HPPs to the transmission network has not been included in the TYNDP of CGES. High hydropower generation potential in Montenegro is major challenge for the transmission network operator, especially due to the extremely difficult terrain and climatic conditions in the Montenegrin relief. According to the information from the planning department of the Montenegrin TSO CGES, no other large hydropower generation development has yet reached the status when the precise connection to the transmission network should be defined (for example, in the case of the potential HPP cascade on river Morača). Most of the existing HPP development plans in Montenegro are still under discussion, with a few possible options remaining which differ in both location and size. Accordingly, CGES decided to participate in these discussions and to include the required new transmission network capacity in its TYNDP once individual HPP development plans become fixed and firm. This position of CGES is based on the expectations that the already reasonably developed 400kV network in Montenegro offers sufficient options for connection to existing transmission facilities, and in the event that the transmission assets are not sufficient, their development time is much shorter than that of the construction of large HPPs.

4.2.4.3 Analysis of the existing distribution network capacity towards planned capacity of future HPPs

As previously indicated, Montenegro is sparsely populated country, especially in the North of the country, where the majority of hydropower potential is located. The distribution network in northern areas is highly radial and with associated numerous technical constraints, hardly accessible terrain and difficulties caused by the extreme weather conditions during the winter periods (some areas are not accessible for more than 5 months in winter times). From the technical point of view, connection of new hydropower generation capacities to the distribution network is, in each particular case, a serious challenge and needs to be assessed on the case-by-case basis. As a general conclusion, the distribution network in Montenegro requires significant reinforcements in order to facilitate planned HPP developments. This applies both to the distribution network assets at the connection points and the required reinforcements in the MV network necessary to integrate the planned HPPs. On top of that, the overall framework for network access and connection of RES based generation in Montenegro is underdeveloped, compared to most of other countries in the WB6 region.

4.2.4.4 Conclusion – Proposals for network reinforcements and/or extensions

Upgrading of the transmission network is on-going process in Montenegro. CGES is following its long-term network development plans and medium/short term investment plans, and with minor delays normally finalises what has been planned. In that sense, planned works for construction of new 400kV OHL Lastva – Pljevlja should be completed soon, together with first phase of the 400/110kV S/S Brezna. Another important network extension is an 110kV OHL in the area around city of Nikšić, important for full facilitation of wind park development in the vicinity and for the future connection of the large HPP Komarnica and together with some HPPs connected to the distribution network planned in that area.

4.2.5 Kosovo

4.2.5.1 Detailed description of the electrical grid in the country

4.2.5.1.1 Transmission Network

The transmission network and power system in Kosovo are managed by the TSO of Kosovo, which is the publicly-owned company KOSTT. The main role of the KOSTT is to ensure non-discriminatory access to the transmission network, and to plan, operate, maintain and develop the transmission network comprising of 400, 220 and 110kV elements. The transmission network in Kosovo was developed at 400 kV, 220 kV and 110 kV level. Like other regional countries, the 220kV transmission grid is no longer developed – all new transmission lines are either 400kV or 110kV. The high voltage network was originally relatively simple, concentrated around two major generation nodes in TPP Kosovo A (220kV node) and TPP Kosovo B (400kV node) which were the terminations of interconnection lines to the neighbouring power systems. Interconnections of the power system of Kosovo with neighbouring power systems are:

- 1x400 kV, 1x220 and 2x110kV lines to Serbia,
- 1x400kV line to Montenegro,
- 1x400kV and 1x220kV lines to Albania,
- 1x400kV line to the former Yugoslav Republic of Macedonia.

4.2.5.1.2 Distribution network

The distribution network in Kosovo is owned, maintained and operated by KEDS, the company operational since 2013, upon its separation from the vertically integrated company KEK. KEDS has been privatised and it is owned, as has been mentioned, by the Turkish companies Çalik Holding and Limak. KEDS has duty to perform electricity distribution up to the end-customer and to manage and maintain the distribution network assets, consisting of 625 km of 35kV lines, 6,852 km of 20/20/6kV lines, 11,636 km of 0.4kV lines and around 7,512 transformers and transformer stations. In organisational terms, KEDS has seven divisions and 30 sub-districts geographically distributed over the country. Before privatisation, distribution network operations in Kosovo suffered serious problems of very high network losses (a significant share of these losses were non-metered electricity) and a very low level of collection of payments for consumed electricity. Since the unbundling and privatisation of KEK these problems have been significantly reduced, which has directly influenced much better maintenance and refurbishment of the distribution network.

Distribution network operations and connections to the distribution grid are guided and regulated by the Distribution Grid Code and Network Connection Rules adopted by KEDS, as well as by the General terms of electricity supply and the Rules on connection and disconnection of customers in Energy Sector in Kosovo, adopted by the Energy Regulatory Office (ERO).

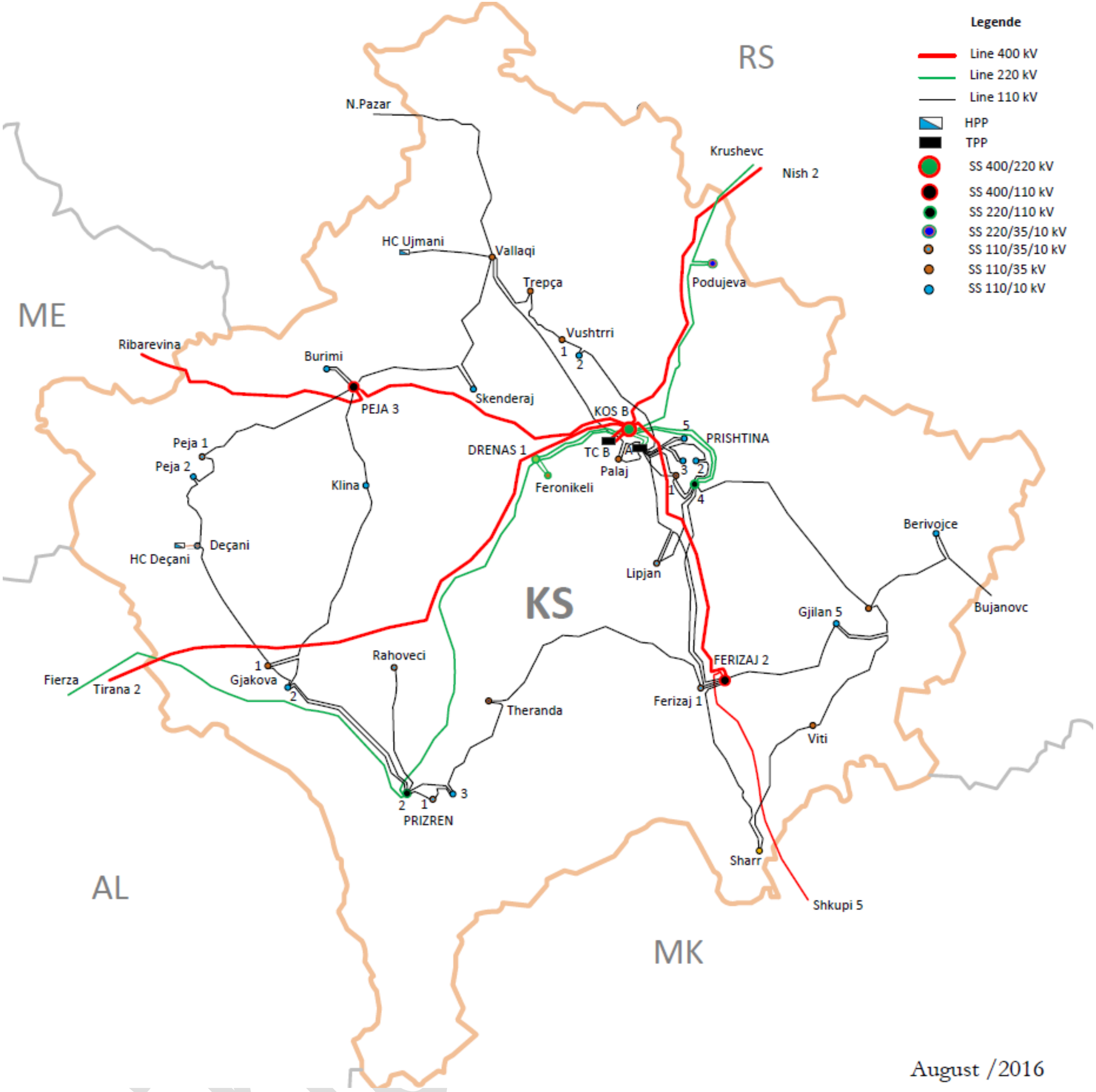

Figure 4.6: Transmission network in Kosovo

During the last 15 years, the focus of KOSTT was to strengthen internal high voltage grid, and to that purpose, new 400kV substations have been built and number of other transmission network facilities refurbished and upgraded. In June 2016, a new interconnection 400kV line from Prishtina to Tirana was commissioned. The electrical power system of Kosovo is seriously lacking hydropower generation facilities, required for power system balancing purposes. The only HPP in Kosovo is 35 MW HPP Ujmani, operated by the public water enterprise Ibar-Lepenac.

4.2.5.2 Analysis of the existing transmission network capacity towards planned capacity of future HPPs

The TYNDP framework in Kosovo is functional – the most recent adopted and approved TYNDP was for the period 2016-2025. The existing transmission network in Kosovo, because it has been gradually increased and regularly maintained in the previous periods, is capable of accommodating the planned hydropower generation development projects which are, unfortunately, very few and with limited potential capacity.

4.2.5.3 Analysis of the existing distribution network capacity towards planned capacity of future HPPs

Unlike the transmission network which is still publicly/state-owned, the distribution network has been privatised and it is doubtful if it is capable of connecting the registered HPP development projects in Kosovo. Like most of the distribution networks in the region, the distribution network in Kosovo requires further significant upgrading. To a great extent, this is a consequence of extensive and uncontrolled construction of buildings after the conflict, which could not be followed by proper power distribution network planning. Many distribution lines and already fully loaded transformers became even more overloaded, which caused numerous faults. In addition, the distribution system in Kosovo is extremely radial. Therefore, further integration of decentralised power generation sources is, in most cases, very limited. In general, a separate assessment should be made in the area where connection is requested and at the specific connection point. From a high-level assessment, it seems that, in addition to the new infrastructure at the connection point, MV distribution network upgrading will be necessary in the majority of cases.

4.2.5.4 Conclusion – Proposals for network reinforcements and/or extensions

There are no explicit proposals for network reinforcements in Kosovo, mainly due to the relatively small number of potential projects for new HPPs.

4.2.6 Serbia

4.2.6.1 Detailed description of the electrical grid in the country

4.2.6.1.1 Transmission Network

The transmission network in Serbia is owned, maintained and operated by the Serbian TSO (EMS – Elektromreža Srbije). EMS is a 100% state-owned company, established upon separation of the transmission and system operation activities from the former vertically integrated power utility EPS (Elektroprivreda Srbije) in 2006. It holds licenses for transmission network operations, for power system operations, and for the electricity market operations[31] in Serbia.

The Serbian power system is strongly interconnected with eight neighbouring power systems at various voltage levels. The interconnections of the Serbian power system with neighbouring power systems are:

- 2x220kVand 2x110kV lines to Montenegro,
- 1x400kV, 1x220kV and 2x110kV lines to Kosovo,
- 1x400kV, 1x220kV and 2x110kV lines to Bosnia and Herzegovina,
- 1x400kV line to Hungary,
- 1x400kV and 2x110kV lines to Croatia,
- 1x400kV and 2x110kV lines to Romania (another 400kV line is currently under construction),
- 1x400kV and 1x110kV lines to Bulgaria, and
- 1x400kV line to the former Yugoslav Republic of Macedonia.

The main facilities in the Serbian transmission network are 400kV overhead lines (1,614 km), 220kV overhead lines (1,795 km), 110kV overhead lines and cables (5,562 km), and 186 HV/MV transformers with an overall installed capacity of 18,487 MVA.

In the previous decades, a high demand for interconnectivity with other systems could have been a reason for lack of investments in the internal transmission network in Serbia. For that reason, transmission capacity bottlenecks in Serbia are not at the interconnections with other power systems, but in the internal transmission lines. There are two reasons for this: heavy transits of electricity over the Serbian transmission network due to its geographical position on one side, and the limited capacity of the internal transmission network on the other side.

[31] EMS operates Serbian Power Exchange (SerPEx).

It is a paradox that besides the powerful interconnections presented above, the major generation nodes inside the country, Obrenovac and Bajina Bašta, with a total generation capacity exceeding 3,500 MW, are still connected via multiple 220kV overhead transmission lines. Therefore, the latest development plans of the Serbian TSO (EMS), in addition to the major regional project, the Transbalkan transmission corridor (Serbia – Montenegro – BiH), with peripheral connections to Romania/Hungary and Italy, are focusing on strengthening of internal HV grid, in particular, in closing the internal 400kV ring in the country. TYNDPs are developed by EMS on a regular basis and submitted to the Regulator, but currently their approval from AERS is pending because these necessary investments in the transmission network may have a significant impact on tariffs and final electricity prices.

4.2.6.1.2 Distribution network

The Distribution network in Serbia is managed by the Serbian DNO, the company ODS EPS Distribucija, which was legally unbundled from EPS in 2015, although remains 100% owned by EPS. This company was created by the merger of the existing 5 distribution companies from EPS portfolio into a single company. In a similar way, in 2013 the company for the supply of electricity EPS Snabdevanje (Supply) was created, by separating all electricity supply parts of the existing 5 distribution companies, all of them parts of EPS. The company ODS EPS Distribucija is the largest DSO in the region, managing 6,823 km of 35kV lines, 9,388 km of 20kV lines, 32,701 km of 10kV lines, 110,919 km of 0.4kV lines and 38,729 transformer units with an installed capacity of 31,852 MVA.

The distribution network in Serbia is mixed, partly heavily meshed and partly radial. The network is relatively old, but due to the regular maintenance it remains in relatively good operational condition. Currently, there are 70 HPPs connected to the distribution network with a total installed capacity of 71.3 MW and an annual production of 200 GWh already connected to the distribution network, although some of them are not operational due to their age (mainly these HPPs are owned by EPS and they have been planned for major reconstruction). In 1986, in Serbia developed a cadastre of potential locations for small HPP development which contained 856 locations. This fact shows that a large potential for small HPP development in Serbia exists, on one side, and how low the actual development of the natural potential has been on the other, since less than 60 locations from the cadastre have actually been developed. The reasons for this low level of HPP development are various. The small HPP cadastre is definitely out of date and requires general revision (which is currently on-going), but low utilisation of the available hydropower potential has more to do with the inertia of administration and with difficulties in obtaining network connections.

4.2.6.2 Analysis of the existing transmission network capacity towards planned capacity of future HPPs

Major developments of new large HPPs in Serbia are planned in the western part of the country, where the transmission network is 220 kV, and that network is already heavily loaded with the generation facilities along rivers Drina and Lim (more than 1,000 MW) and power exchanges with Montenegro. It is obvious that the capacity of the transmission network in Serbia is hardly sufficient to accommodate new hydropower generation facilities in conjunction with existing thermal and hydro power generation and heavy electricity transits from other power systems. Due to the size and locations of the HPP development projects which are under consideration in Serbia, certain reinforcements of the transmission network are necessary, exclusively for the purposes of facilitating new HPPs connections. Without major reinforcements (which have been planned by EMS but remain undeveloped due to the lack of investment funds), the transmission network in Serbia does not have sufficient capacity to accommodate planned hydropower generation development projects in the future. These development plans must solve existing congestions which fortunately coincide geographically with the pattern of planned large HPPs. Transmission network development will, strategically, consist of the construction of new 400kV OHL, upgrading of existing 220kV overhead lines to 400kV, and construction of new 110kV lines where necessary to facilitate HPP connections.

4.2.6.3 Analysis of the existing distribution network capacity towards planned capacity of future HPPs

The overall capacity of the distribution network in Serbia, as clearly shown in the paragraphs above, seem to be strong enough to support connection of a much higher HPP capacity than is currently connected. However, all existing HPPs connected to the distribution network are connected in two (out of five) distribution network zones. Therefore, more detailed assessment on a zonal basis needs to be undertaken to check actual capacity for connection of HPPs to the distribution network in the areas where potential for their development is highest. From the high-level analysis undertaken for this report, the highest potential for HPP (and general RES) development is far away from the consumption areas and consequently in the areas with a weak radial distribution network.

4.2.6.4 Conclusion – Proposals for network reinforcements and/or extensions

The main precondition for facilitation of the large HPP development plans is upgrading of the transmission network in Western Serbia from 220 kV to 400 kV, i.e. completion of the development projects for upgrading of existing 220kV OHL Bajina Bašta – Kraljevo, Kraljevo – Kragujevac and Kraljevo – Kruševac, as well as construction of the Transbalkan corridor, primarily upgrading of existing OHL Obrenovac–Bajina Bašta from 220 kV to 400 kV and construction of new 400kV OHL Bajina Bašta (SER) – Višegrad (BiH) – Pljevlja (MNE). In addition, the local 110kV network in the vicinity of individual power plants will need to be upgraded and/or constructed (where it does not currently exist) for connection to the nearest 400kV substation. All these transmission network development projects are already included in EMS's 10-Year Network Development Plan.

Concerning distribution network development plans related to the connection of HPPs, they do not exist. In other words, EPS DSO is assessing this issue on a case-by-case basis. From the assessment presented above, once the small HPP cadastre is updated, the distribution system operator should undertake a study to investigate necessary investments in MV network in the distribution areas of Western Serbia (former distribution company Elektro Srbija – Kraljevo) and in the South of the country (former distribution company Elektrojug – Niš).

5 Proposals for action

5.1 Regional level

Table 5.1: Proposed actions at the regional WB6 level

SN	Brief description of proposed Action	Assumed implementing agent	Anticipated timeframe
1	Regular (timely) revision of the Energy Strategy, Action Plans for implementation of Energy Strategy and NREAPs using realistic approach vs. project overall feasibility and expected time of commissioning and entry into operation	Line Ministries	Regular planning cycle
2	Develop pending or update existing secondary legislation (Network Codes) and associated connection procedures and charging methodologies.	TSOs DSOs	ASAP
3	Further improvement in transparency of the conditions and charges for connection to the transmission and distribution networks. Perform regional study/benchmarking on connection costs and tariffs, assessing legislation vs. practice in WB6 with respect to the best international experience.	TSOs DSOs	Regular activity
4	Application of realistic apportionment of costs for connection to the transmission and/or distribution network. This includes using a fair solution on all aspects of financing network reinforcement for facilitation of the requested connection and future ownership of those assets	Line Ministries, TSOs, DSOs, Regulators	1 year
5	The DSOs responsible for distribution system planning and implementation shall conduct regular 10-years distribution network development planning studies (DNDP) with yearly updates to provide for regular network development which can facilitate growing demand for connection of new generation facilities, and submit them to national Regulators for approval	DSOs, Regulators	Every year
6	The TSOs which do not have fully functional cycle of 10-years transmission network development planning studies (TYNDP) with yearly updates and approvals by the national Regulators should improve their practice	TSOs, Regulators	Every year
7	Invest in development of new and refurbishment of existing distribution network facilities – action item is applicable to all WB6 parties only the level of necessary investment differs	DSOs, Regulators, IFIs	ASAP
8	Improve distribution network monitoring and control facilities	DSOs	ASAP
9	Provide technical assistance to regional countries where the process to undertake preliminary assessment of the grid connection options, before concessions are given does not exist yet. The main objective is to improve efficiency of the project execution which is beneficial for the investor, for the network operator and for the state/society	EU, ECS	ASAP

5.2 Country level

Table 5.2: Proposed actions at the country level

SN	Brief description of proposed Action	Assumed implementing agent	Anticipated timeframe
	(1) **Albania**		
1.1	Harmonise and complete exiting framework for HPP development: Law – Network Codes – Connection Procedures – Methodology for connection charges – Connection Agreement	MEI, ERE, OST	ASAP
1.2	Develop, adopt and approve the revised version of the Transmission Grid Code, reflecting definitions from new Electricity Law	OST, ERE	2017

SN	Brief description of proposed Action	Assumed implementing agent	Anticipated timeframe
1.3	Develop TYNDP framework and provide for regular planning, adoption, approval, implementation and yearly updating of the TYNDP	OST, ERE	End 2017
1.4	Execute planned transmission network developments, in particular new 400kV OHLs Elbasan – Bitola and Elbasan – Fier, as well as numerous developments of the 110kV network components, OHLs and substations	OST, IFIs	As planned
1.5	Develop, adopt and approve revised version of the Distribution Grid Code, reflecting definitions from new Electricity Law	OSHEE, ERE	2017
	(2) **Bosnia and Herzegovina**		
2.1	Adopt new Law on Electricity transposing EU 3rd Energy Package	Council of Ministers	ASAP
2.2	Finalise, adopt and approve new Distribution Grid Codes for all DSOs, as well as associated follow-up procedures and methodologies	DSOs, FERC, RERS	ASAP
	(3) **The former Yugoslav Republic of Macedonia**		
3.1	No country specific proposals for action.	N/A	
	(4) **Montenegro**		
4.1	Develop, adopt and approve a revised version of the Transmission Grid Code, reflecting definitions from new Electricity Law	CGES, REGAGEN	2017
4.2	Approve TYNDP by the Regulator (REGAGEN) and maintain regular update of planning framework	REGAGEN	ASAP
4.3	Finalise on-going and planned reinforcement of the transmission network, such as section of the 400kV Transbalkan corridor in Montenegro and extension of existing 110kV network in the country	CGES, REGAGEN, IFIs	As planned
4.4	Develop, adopt and approve revised version of the Distribution Grid Code, reflecting definitions from new Electricity Law	EPCG DSO, REGAGEN	2017
	(5) **Kosovo**		
5.1	No country specific proposals for action.	N/A	
	(6) **Serbia**		
6.1	Completion of the development projects for upgrading of existing 220kV OHL Bajina Bašta – Kraljevo, Kraljevo – Kragujevac and Kraljevo – Kruševac to 400kV, as well as construction of the Transbalkan corridor, primarily upgrading of existing OHL Obrenovac – Bajina Bašta from 220 kV to 400 kV and construction of new 400kV OHL Bajina Bašta (SER) – Višegrad (BiH) – Pljevlja (MNE).	EMS	As planned
6.2	Approve TYNDP by the Regulator (AERS) and maintain regular update of planning framework	AERS, EMS	ASAP

Annex 1: List of used literature sources

1. "Guideline on application and tariffs for new connection, or modification of existing connection in the electric grid of TSO" – OST, December 2010
2. "Law on energy Sector no 43/2015" – Albanian Parliament, April 30th, 2015
3. "Transmission Service Agreement" – OST, approved by ERE decision on June 3rd, 2013
4. "Transmission Grid Code" – OST, approved by ERE, 2008
5. "Distribution Grid Code" – OSHEE, approved by ERE, 2003
6. "Transmission Grid Code" – BiH ISO, approved by SERC, December 15th, 2016
7. "Rulebook on connection to the transmission network" – draft, Elektroprenos BiH, April 4th, 2016
8. "Distribution Grid Code" – EP BiH, 2008
9. "Distribution Grid Code" – EP HZHB, 2008
10. "Distribution Grid Code" – ERS, 2009
11. "Indicative generation development plan 2017-2026" – BiH ISO, June 2016
12. "10-years Transmission Network Development Plan 2017-2026" – Elektroprenos BiH, November 2016
13. "Law on Energy" – Parliament of former Yugoslav Republic of Macedonia, Official Gazette no 16 from February 10th, 2011 (numerous changes and additions from 2011 till 2016)
14. "Law on construction" - Parliament of former Yugoslav Republic of Macedonia, Official Gazette no 70 from May 16th, 2013
15. "Tariff system for transmission of electricity and electricity market operation" – Energy Regulatory Commission (ERC) decision from February 28th, 2014
16. "Transmission Grid Code" – MEPSO, approved by ERC, January 30th, 2015
17. "Distribution Grid Code" – EVN, approved by ERC, Official Gazette no. 87 from July 10th, 2012 (annexes in 2014 and 2015)
18. Transmission network development study 2010 – 2020" – MEPSO, July 2011
19. "Transmission network adequacy study" – EIHP for MEPSO, December 2016
20. "Law on Energy" – Parliament of Montenegro, December 29th, 2015)
21. Law on Spatial Development and Construction - Parliament of Montenegro, Official Gazette no 51 from 2008
22. "Transmission Grid Code" – CGES, approved by REGAGEN, October 17th, 2011
23. "Distribution Grid Code" – EPCG, approved by REGAGEN,,Official Gazette no. 50 from October 1st, 2012
24. "Methodology for determination of costs for connection to the distribution network" – EPCG, approved by REGAGEN, Official Gazette no. 50 from October 1st, 2012

25. “10-years Transmission Network Development Plan 2017-2026”, CGES 2016
26. “Electricity Law” – Parliament of Kosovo June 16th, 2016
27. “Transmission Grid Code” – KOSTT, approved by ERE, February 2015
28. “Distribution Grid Code” – KEDS, approved by ERE, March 2014
29. “Transmission network connections charging methodology” – KOSTT, October 2013
30. “Procedure for connection to the transmission network” – KOSTT, November 2014
31. “10-years Transmission Network Development Plan 2016-2025” – KOSTT, December 2015
32. “Energy Law” – Parliament of Serbia, Official Gazette no. 145 from December 29th, 2014
33. “Transmission Grid Code” – EMS, approved by AERS, Official Gazette no 91/2015
34. “Distribution Grid Code” – EPS Distribucija, approved by AERS, July 20th, 2017
35. “Procedure for connection to the transmission network” – EMS, approved by AERS, November 27th, 2015
36. “10-years Transmission Network Development Plan 2017-2026” – EMS, November 2016
37. “Methodology for determination of costs for connection to the distribution network” – EPS Distribucija, approved by AERS, June 2016