Ministry of Sustainable Development and Tourism

DETAILED SPATIAL PLAN

FOR TRANSMISSION LINE CORRIDOR 400kV WITH OPTICAL CABLE FROM MONTENEGRIAN COAST TO PLJEVLJA AND SUBMARINE CABLE 500kV WITH OPTICAL CABLE ITALY-MONTENEGRO

rzup IGH Dalekovod Projekt

INVESTITOR:

The Government of Montenegro
Ministry of Sustainable Development and Tourism

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FOR TRANSMISSION LINE CORRIDOR 400kV WITH OPTICAL CABLE FROM MONTENEGRIAN COAST TO PLJEVLJA AND SUBMARINE CABLE 500kV WITH OPTICAL CABLE ITALY-MONTENEGRO

Contractor:
Consortium

rzup IGH DALEKOVOD PROJEKT

Executive Director
Igor Djuranovic, civil engineer

Podgorica, july 2011.

LEGAL BASIS

On the basis of article 20 and article 31, paragraph 1 of the Law on planning and spatial development (Official Gazette of the Republic of Montenegro, number 51/08), at the session held on April 15, 2010, Government of Montenegro made a Decision number 03-3785 on making the Detailed spatial plan for the transmission line 40kv corridor with optical cable from montenegrin seaside to Pljevlja and the undersea cable 50 kv with optical cable Italy-Montenegro with the Strategic estimation of environmental influence.

PLANNING BASIS - STARTING COMMITMENTS Planning basis for the work out of DPP for the corridor of a transmission line from montenegrin seaside to Pljevlja and the undersea cable with optical cable Italy-Montenegro, is the Spatial plan of Montenegro by 2020 which was adopted in March 2008 and the Strategy of energy of Montenegro which was adopted in 2008.

- According to the Spatial plan of Montenegro, within the Spatial concept of energy infrastructure development (chapter 2.6.2, item 23) it has been predicted to plan the electric energy facility of 400kv in the region of montenegrin seaside which would be connected by the transmission line of 400kv to the transformer station of 400/110 kV Podgorica 2 and to create conditions to realize the project of connecting the transmission systems of Montenegro and Italy by the undersea cable.

  According to the Spatial plan of Montenegro, it has been predicted corridors and locations for lines of transmission and distribution to be protected against other demands and usages.
- According to the Strategy of energy development in Montenegro by 2025 and the Action plan 2008-2012, it has been predicted to develop the transmission network by 2015 and enable exchange of electricity with the nearby systems and improve supply of certain areas and bigger towns of Montenegro providing connection of new sources of electricity and decreasing of losses. Montenegro is located at strategically significant directions of electricity corridors construction towards Serbia, Croatia, Bosnia and Hercegovina, Italy and Albania.
- Special attention, as regards development of the transmission system and regional interconnection should be paid to the possiblity of construction of the undersea transmission system which would connect Montenegro and Italy. It is neccesary to determine in details the requirement, that is, feasibility of construction of 500kV undersea cable for the purposes of interconnection between Italy and Montenegro and relevant infrastructure of Transmission for its connection with the exisiting 400kV network.
- In the future, Montenegro shall become a part of strategic network of transeuropean energy networks as defined by the Decision of the European

Commission 1254/96/EC. Transeuropean energy networks are used to increase the energy exchange between the EU member states. At the area of the electricity supply, the cross border network as regards the possiblity of trading is approximately 7% of production capacities of certain state. The aim of EU community is the member states to establish, as soon as possible, the interconnection capacities at the average of min. 10%.

AIM OF WORK OUT OF DPP as regards the transmission line 400kv corridor with the optical cable from montenegrin seaside to Pljevlja and the undersea cable 500 kv with the optical cable Italy –Montenegro with the SPU to the environment is creation of conditions to define corridors and construction of a transmission line 400 kv with the optical cable from montenegrin seaside to Pljevlja, and the undersea connection of that transmission line with the optical cable from Montenegro to Italy, in order to recognize and analyze all elements of the purpose, organization and spatial usage.

On the basis of the analysis of current spatial planning documents and on the basis of made analyses and variant solutions, an optimal model of usage space protection has been enclosed.

The Plan contains the detailed work out of the location in the zone of future converter station and TS providing the pre conditions to realize the investment project and development of space at locations which do not require permanent changes of space.

CORRIDOR (General aims of the electric energy system development) The electric energy system of Montenegro has initially been developed as an integral part of EES of SFRJ, and, as such, it has been designed to be linked with other electric energy systems. On one side, it provides simplier fitting into valid recommendations of EU member states, and, on the other side, it makes it dependable on the current situation and development plans of nearby states.

The best example is the fact that montengrin EES transmission line has eight interconnection transmission lines towards neighbours at 220kV and 400kV voltage level and only five such internal tranmssion lines. Montenegrin electric energy system is one of rare systems at the continental Europe not having closed 400kV ring, which is one of main reasons of occasional interruptions of consumers' supply at the wider area of Montenegro.

Energy potential of Montenegro The transmission line, as per definition, may not be the „bottle neck" of consumption development or exploitation of natural energy potentials. In countries with high level of usage of hydro energy

potential, the total lenght of a transmission network exceeds the values from similar states using the non renewable energy sources (thermal, nuclear...). That is why, within systems similar to montenegrin one, it should pay attention to **planning of the transmission network development which must be ready to take over the complete technically usable potential of hydro energy, wind energy or sun.**

East part of Montenegro is well covered by the existing transmission line. Connection of hydro power plants on the river Morača has been predicted by connecting to the exisitng 220kV Podgorica-Pljevlja or 400 kV Podgorica-Ribarevina.

West part of Montenegro is, due to low population and consumption requirements, underdeveloped although it has significant energy potentials. Considering it refers to renewable sources of energy, their connection to transmission network is **inevitable in the future (HE Komarnica, complex of wind power plants on Krnovo and** group of mHE in the municipality of Šavnik).

Importance of the northwest seaside supply (TS Lastva, Čevo)

Zone of west and northwest part of the seaside is the area of special tourist importance which implies its adequate infrastructural furnishing. Reliable and quality supply of electricity in that part of Montenegro is one of priorities of the Strategy of development and of daily EES exploitation.

The existing transmission line in Budva, Kotor, Tivat, Herceg Novi zones, although developed, **does not provide the required level of reliability of supply** especially during the period of summer tourist season when it is of utmost importance. **Because of that, according to all transmission network development plans, it has been predicted improvement of this part of the system.** One of the problem resolving phases is construction of new TS in Grbaljsko Polje which has been initially designed as the TS 220/110 kV, with connections to Dubrovnik and Hydro power plant Perućica.

Connection with the nearby infrastructure: Necessity of adequate **integration of montenegrin EES into the electric energy system of the south east Europe** implies the requirement of strenghtening the connections towards two most developed systems in the vicinity. The electric energy system of Bosnia and Hercegovina is, at the moment, the only system of the region having significant export potential, while the EES of Serbia, according to its structure, is extremely compatible with the montenegrin one. Unlike well developed interconnections towards Albania (the existing 220 kV transmission line towards Koplik and newly constructed 400 kV towards Tirana) and towards Kosovo (400 kV towards peci) and connection towards Serbia, it is reduced to old transmision lines 220 kV towards Bajina Bašta and Požega. There are three interconnections towards Bosnia and Hercegovina at 220 kV and 400 kV voltage level, but, considering the high concentration of production capacities along the border with Montenegro, **there is a need of further extension of the cross border**

capacities aimed to complete usage of advantages resulting from the free market of electric energy.

Justification of construction of the transmission line of 400kV corridor with optical cable from montenegrin seaside to Pljevlja and the undersea cableof 500 kV with optical cable Italy – Montenegro

Importance of this electric energy structure may be viewed in relation to the following aspects:

- direct connection of Montenegro with the electric enegry market in EU realizing additional positive effects such as acquiring profit from the energy transmission, access to european development funds and encouragement for investors into the electric energy sector;
- better transmission network, on which occasion it is formed the 400 kV ring, but connection of towns in the north of Montenegro at 110 kV voltage level to increase the supply reliability;
- increase of supply safety with the electric energy of bigger tourist centers of montenegrin seaside such as Herceg Novi, Tivat, Kotor and Budva, which will support the successful development of tourist and other facilities;
- creation of pre conditions to connect planned new sources of electric energy: hydro power plants on the river Morača, hydro power plant Komarnica, thermal power plant Berane, small hydro power plants and wind power plants;
- Montenegro is positioned as an important energy node of the region increasing the value of other inter state transmission lines through increasing of incomes of their exploitation for the purposes of the electric energy transit;

UNDERSEA CABLE AND TRANSMISSION LINE CORRIDOR SELECTION

Aiming to realize the initiative of the italian transmission network operator, according to the montenegrin electric energy system development directions determined by the Strategy of energy development by 2025, CGES has initiated first analyses by using the assumption that converter station at the montenegrin seaside may be located on two positions- **in Grbaljsko polje or in the municipality of Bar.**

Analyses performed when making the strategy of energy development show that Grbalj location is optimal from the aspect of resolving the issue of stabile supply of montenegrin seaside with the electricity. That is why, from the beginning of making the study of connection of Montenegro and Italy by the undersea cable, construction of TS 400/110kV Tivat 2 has been considered the basic variant.

The alternative solution considered has been the possibility of connecting two systems through the new transformer station of 400/110kv Bar 2. Analyses of power flows and reliability of consumer's supply in Montenegro, and analyses of

possible routes of the undersea cable placing, made by the Feasibility study of proposed connecting of Italy and Montenegro by new endersea HVDC cable, made by the Electric energy coordination center, imply the numerous advantages of this option.

From the aspect of requirements of montenegrin electric enegry system, advantages of the first variant reflect in the fact that the **new transformer station** (which would preliminary be „Tivat 2“) **would be directly connected to most centers of electricity supply at the montenegrin seaside- existing TS 110/35kV Budva, Tivat and Kotor (**currently under construction**), and in second level, with TS Bar and Herceg Novi, unlike „Bar variant“, which would directly supprot reliability of Bar municipality supply, but with no reliability of supply within the west part of montenegrin seaside, for which there are objective demands.**

Preliminary spatial analyses **implied the disadvantage in the form of larger lenght of the transmission line in relation to the existing 400kV network to new transformer station in Bar, the issue of passing the national park Skadarsko lake and existing archeological deposits in the vicinity of Bar,** which could be endangered by possible placement of the undersea cable towards Italy**.**

Analyses of the existing development and spatial-planning documents have implied the clear attitude that **the basic interest of montenegrin electric energy system is strenghtening of the transmission network of the seaside region by bringing the high voltage (220kV ili 400kV) to, during work out of the Strategy of energy development, carefully selected location of Grbalj.**

Apart from that, limitations which have determined the corridor of future transmission lines not to use planned infrstaructural corridors of the motorways Bar-Boljare or the main road Risan-Žabljak are as follows:

- Highway Bar-Boljare passes through the NP Skadarsko lake, stretching through settlements of Podgorica, Kolašin, Andrijevica, Berane and Bijelo Polje. Determination for position of the converter station location, Čevo node and the need to improve supply with electricity of seaside municipalities and Žabljak have conditioned the incapability of placing the transmission line along the highway corridor.
- Main road Risan-Žabljak stretches from Lipci which is located in the Risan bay. The most favorable location for the converter station is recommended to be in Lastva Grbaljska. Distribution of 400 kV may not follow the route of a main road becuse it has been conditioned by the converter station location and aimed point of **Čevo which has been defined by the Programming task and requirements of the transmission line (necessity of connecting the cable to current 400 kV Podgorica 2-Trebinje).** Transmission line cuts the main road nearby Trubjelo in the municipality of Nikšić and, further, it is not possible to lead the route by the main road corridor passing through Nikšić, Šavnik and settled places to Žabljak. Besides that, it is necessary the transmission line to pass **nearby Brezna settlement** where it is planned a

new transformer station due to future planned energy sources (hydro power plant Komarnica, wind power plants...). Within the NP Durmitor, the route of a transmission line follows the route of **existing transmission line passing through less populated areas which cause inability to route the transmission line along the main road Risan-Žabljak corridor.**

- If it had been possible to use the main road Risan-Žabljak, the converter station location would have been searched in the Boka kotorska bay. Having in mind the fact that the zone is under the UNESCO protection and that there is no area big enough to settle all facilties, there are additional arguments limiting the possible selection of location within the Boka Kotorska bay. It refers to plan defined tourist zones and vicinity of the airport, in relation to Tivat area. The option of placing the transmission line from Lastva Grbaljska to the zone of Boka Kotorska bay and further along the Kotor sides, through Lovćen, has limitations:
- transmission line would pass through settled places, it would not be able to fit it from the environmental aspect of view, it would be visible in the zone of Kotor sides and, it would be hardly feasible and difficult in relation to the process of exploitation. Additional limitation is that it would, in that case, pass through the II zone of the NP Lovćen and the zone of Njeguši which deserves, in the future, tourist development along with complementary development of agircultural production and may be an additional tourist attraction in future plans of the NP Lovćen and SUP of Cetinje.
- During preliminary analyses of interconnection relation, it has been considered several potential locations as regards the converter station and transformer station among which the location in the vicinity of Bar. However, detailed analysis of certain locations **is the major reason to give the location in the vicinity of Bar up, as well as possible other locations as regards construction of the converter station and a transformer station**.
- By the Strategy of energy development, it is predicted to perform connection of planned hydro power plants on the river Morača to the exisiting 110 kV transmission network by the introduction of existing transmission lines into the future plants, that is, by additional construciton of several new 110 kV transmission lines.
- At the central part of Montenegro, the transmission network is relatively well developed, while at the seaside, it is weaker, especially in the sense of connection of the north and south. It is necessary to realize the subject energy relation which will provide closing of 400 kV ring at the area of Montenegro realizing safer and more reliable transmission line together with creation of pre conditions for additional development of 110 kV netwrok at the seaside area.

DPP area- The area DPP has been worked out for comprises the corridor of approximately 1 km width at the area from territorial waters of Montenegro to

montenegrin seaside, through Lastva Grbaljska to Čevo and, further to Pljevlja. The corridor passes through eight municipalities of Montenegro: Kotor, Budva, Cetinje, Nikšić, Plužine, Šavnik, Žabljak and Pljevlja. The area, according to cartographic measurement, is cca 15 181 ha.

During the work out of DPP, variants have been analysed and an optimal variant has been proposed whose corridor is of 1 km width, which, on one side, is determined by strategic determinations and, on the other side, by technical requirements and terrain configuration of that part of Montenegro, which has the least negative effects to the subject area.

Corridor of 1 km width, is defined aiming to determine the narrower route of the transmission line route and of protection zones, after the adoption of the Plan, through the work out of project documents.
Position of the transmission line and converter station corridor and the place of transmission line connection to the undersea cable and the appropriate undersea cable corridor are mutually conditioned. Location of the converter station and transformer station have an important role as regards mutual conditioning.

DESCRIPTION OF THE ZONE AND POSITION

Corridor of the transmission line 400kV with optical cable and the undersea cable of 500kV with optical cable Italy-Montenegro comprises part of the sea within the territorial waters of Montenegro and the land part from the landing place to Pljevlja.

The border of DPP zone in the width of 1 km passes from territorial wtares of the Adriatic sea to proposed location of landing place on the Jaz cape stretching further along the edge of Mrčevo field to Lastva Grbaljska, going northeast above Budva nearby Donji Pobori, passing by Bjeloši exiting the NP nearby Dubovik, stretching further by the settlement of Resna to Čevo, by Ubli and Bijele Poljane, stretching west from Kupac and Slano lakes after which it stretches east to the canyon of Komarcnica, then passes east by the settlement of Duži, through Komarnica entering the NP Durmitor, going west from Njegovudje through Tara and,further, west from Kosanica to the vicinity of Pljevlja settlement. The border of DPP zone passes through eight municipalities of Montenegro.

The corridor lenght is cca 194 km. The area of zone is cca 15 181 ha.

CURRENT PURPOSE OF AREA AND REGIME OF USAGE By analysing purposes of areas which have been provided by valid SUP or PPO and by analysis of planning documents which have been under construction, it may be concluded that zone from the seaside to Pljevlja is mostly characterized by unconstructed areas, agricultural lands, forest lands (economic forests), lakes, recognized smaller settlements, bare lands and rocky terrain.

CONDITIONS TO DEFINE THE CORRIDOR -.In order to realize the connection from the seaside to Pljevlja, it is inevitable future corridor to pass through the area of National parks of Lovćen and Durmitor. (In case the corridor having the starting point in Bar fitted, it would have to pass through two national parks-Skadarsko lake and Durmitor).

When defining the future corridor, the underground cable and transmission line, the existing and planned purpose of space have been analyzed through current planning documents and documents under construction as regards all municipalities areas within the DPP zone. On that occasion, current structure area purpose has been respected as well as the planning concept for future development at areas of stated municipalities. The aim, in relation to defining the future corridor, is to preserve, as much as possible, areas of importance and to find the compromise between the necessary infrastructural furnishing and all aspects of purpose and protection of space. Special attention has been paid to recognizing possibity of passing the corridor through the area of National parks, respecting, by the Spatial plans of special purpose, previously defines zone of protection.

To define the future infrastructural corridor, **it is necessary to respect numerous technical conditions, on one side, and limitations, in relation to protection, on the other side. Conditions and limitations which should be respected when defining the 400 kV corridor of the transmission line are:**

- Exclusion of route from the area of World natural and cultural heritage of Kotor and Boka Kotorska bay,
- Avoidance of first and second zone of protection at the area of the NP Lovćen and Durmitor,
- Carefully placement of the route through the third zone of protection,
- Minimizing the visual influence to natural and created values of protected areas,
- Minimal and careful crossing of the transmission line route and ropeways towards Lovćen from directions of Kotor and Budva,
- Safe distance from the landing-take off paths of Tivat airport,
- Distance form the existing settlements and planned tourist facilities.

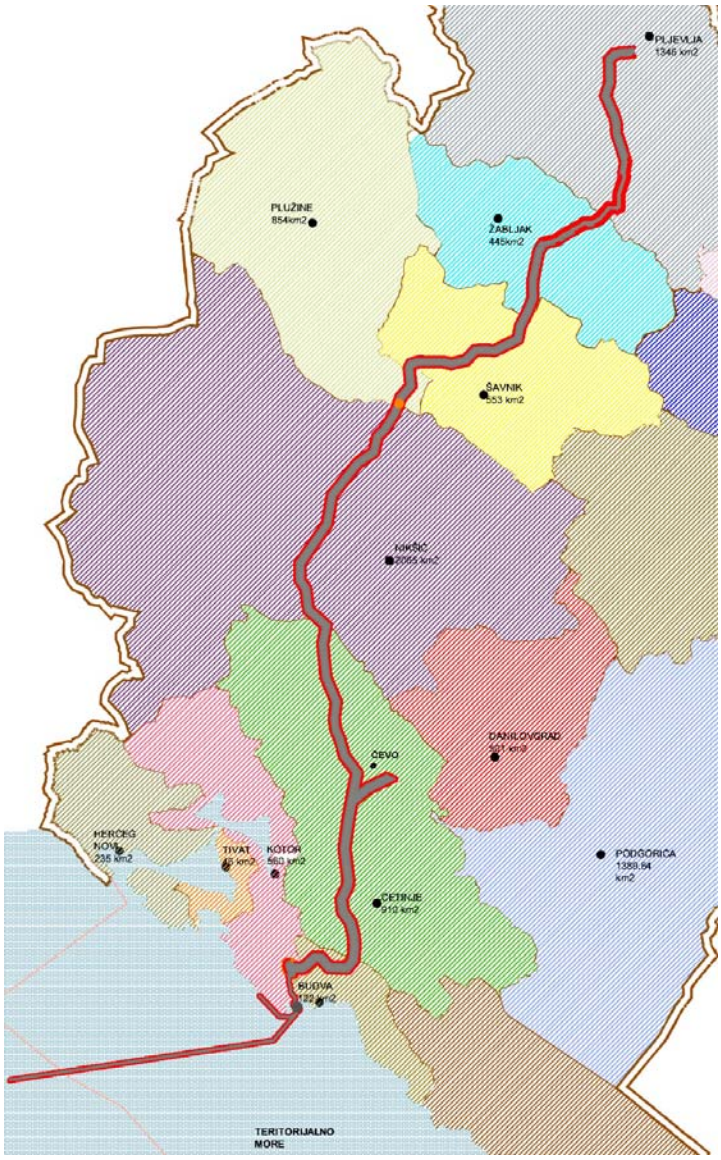
Conditions and limitations which should be respected when defining the undersea 500 kV cable corridor

- Protected zone of undersea activities from Sveti Djordje cape to Platamuni cape,
- The trawling zone from Bigove to Platamuni,
- Natural developed beaches from Bigove to Jaz,
- Preservation of the image of rocky coast and mediterranean vegetation,
- Distance from the existing settlements and tourist facilities,
- Vicinity of adequate road to place the cable to transformer station,
- Large area of converter station location and of TS with adequate protection.

PLAN

POSITION OF CORRIDOR TOWARDS THE SURROUNDING AREA

Corridor of cable and transmission line with optical cable passes through territories of eight municipalities: Budva, Kotor, Cetinje, Nikšić, Plužine, Šavnik, Žabljak and Pljevlja



Picture.12. area of DPP

Within the process of defining the infrastructural corridor for the undersea cable and transmission line, there has been made a detailed analysis of planned areas purposes within the spatial planning documents. All conception commitments at municipalities territories of DPP zone area have been taken into consideration. The corridor has been defined to avoid, as much as possible, change of areas purpose. Goals as regards corridor selection were the following:

- Avoid protected areas in the sea,
- Respecting development priorities, first of all tourism at the coastal zone, and zones defined by certain regime of protection,
- Respecting of environmental values,
- Max avoidance of the I zone of protection of the National park Lovćen area,
- Min visual effect to surrounding, especially regarding parts of infrastructural corridor requiring larger space (KP and TS),
- Avoidance of sacred objects and monuments of nature,
- Avoidance of settlements,
- Fitting into the existing transmission lines corridors,
- Favourable configuration of terrain for the purposes of feasibility and route cost-effectiveness.

Planning parameters:

Area ..... 15. 181 ha
Corridor lenght (undersea, underground and overhead part).....194,9 km
Undersea corridor part 38,9km
Underground corridor part 5,6km
Overhead corridor part (transmission line 150,4km

Transmission line through municipalities:

Kotor.....1,4km
Budva.....7,7km
Cetinje 44,2km
Nikšić.....31,5km
Plužine 5,3km
Šavnik.....17,7km
Žabljak.....17,8km
Pljevlja.....24,4km

Area required for converter station.....171.551m^2 ...(17,15ha)
Area required for transformer station 250x450 m .....112.500 m^2 ...(11.25ha)
Total area for KP and TS.....284.000 m^2 ...(28.4ha)
Width of corridor 1km

TECHNICAL CHARACTERISTICS OF INFRASTRUCTURAL CORRIDOR

- Narrow corridor of a transmission line is min. 60 m to max 100m for one transmission line, total width of corridor for two transmission lines is 120 – 200 m.
- From TS Lastva to the existing transmission line location of 400 kV (Podgorica 2–Trebinje) there are two transmission lines (two rows of towers) at the distance of approximately 60 –100 m.
- From Čevo to Pljevlja, there is only one transmission line.
- The span between towers depends on the terrain configuration, crossing with the infrastrucutral object, and is 300 – 500 m.
- Tower footprint is $25m^2$-$100m^2$, with protective layer, it is $50m^2$-$200m^2$.
- Within the corridor of 60 m of total width (approximately 30 m from the transmission line axis), it is not allowed to construct residential and other objects. Possibility of construction outside the protection zone should be adjusted to valid regulations.

PREVIOUS ANALYSES:

- **Undersea cable with optical cable routes,**
- **Landing places,**
- **Locations of converter station and TS and**
- **Corridor of transmission line with optical cable.**

According to the Programming task, based on the analysis of planning document within the DPP work out process, there have been analysed variants of corridor on the basis of which it shall be determined norrow corridor of a transmission line and protection zones as well as the boundary of the plan area.

As per the selected variant of the transmission line and transformer station corridor, it is defined the position of connection to the undersea cable and appropriate undersea cable corridor. Programming task recommends locations (Jaz cape along the east edge of the Jaz beach using entering of current stream into the sea and Platamuni cape west of Ploče beach).

Optical cable is intended to transmit light signals and in intensively used for telecommunication connection because it has large advantages over existing copper cables due to extremely high speed and low losses transmission capacity.

Besides the telecommunication infrastructure, optical cables (known as OPGW= optical ground wire) are used in electric energy sector when constructing transmission and distributional lines. Such a cable at the same time protects the electric energy line and communications, that is, signal transmission. **The optical cable may be placed not only overhead at the top of the electric energy lines tower but underground as well,** for example, along the electric energy cable to mutual cable trench.

OPGW which is placed overhead to transmission lines contains thin pipes with one or more optic fibres within surrounded by the aluminium and steel wires layer. Visible part of a cable serves for protection against direct lighting strike while optical fibres inside the cable serve for fast data transfer, personal protection transmision lines and stations management requirements, personal sound communications and other data transfer between stations of the system, or may be given on lease or sold to third party to serve as a communication connection.

On the basis of previously stated, optical cable installed on a transmission line, as a rule, instead of classic protective ropes, is part of a transmission line and does not require additional interventions within space. **In that sense, optical cable in DPP has been predicted within the same corridor and on the same towers when it refers to the transmission line and overhead part of the**

route, that is mutual cable trench of underground and undersea energy cable.

CONCEPT AND FEATURES OF INFRASTRUCTURAL CORRIDOR SEGMENTS

Planning concept defines segments of infrastructural corridor starting from the underground cable to the place entering the montenegrin territorial sea to the place of cable existing the sea, underground cable to future converter station and TS and overhead transmission line to Pljevlja. That is why it may be observed through several units which are functionally connected representing the unique object to realize the interconnection of electric energy systems of Montenegro and Italy.

- **One way undersea cable from montenegrin coast to Italy,**
- **One way undergorund cable from converter station and seacoast;**
- **Converter station and transformer station;**
- **Overhead 400 kV line between Pljevlja and future transformer station;**
- **Overhead 400 kV line between the existing 400 kV transmission line Podgorica- Trebinje and future transformer station;**

From the aspect of interconnection, out of previously stated units, it should emphasise the one way undersea/underground cable representing the techno-economic optimum to realize such undersea electric energy connections between two systems, but, at the same time, requires additional specific objects-converter stations which are necessary to convert alternate current into direct current and vice versa.

From the aspect of stated towns safety supply increase, it is necessary to construct the transformer station to realize transformation 400/110 kV voltage level, which will, along with increase of current, that is, construction of new capacities of transmission network to 110 kV voltage level, provide quality supply of electric energy consumers and encourage development of this part of Montenegro.

UNDERSEA CABLE ROUTE CHARACTERISTICS

Condition and limits to be respected when selecting the undersea cable corridor:

- Trawling zone from Bigovo to Platamuni,
- Protected zone of undersea activities from Sveti Djordje cape to Platamuni cape;
- Natural and developed beaches from Bigovo to Jaz,

- Taking care of water ways,

Evaluation of undersea cable preliminary route

Evaluation of undersea cable route has been made by Terna. It has been considered morphology of the Adriatic sea, available information in relation to relevant area and technical characteristics of HVDC cables.

Preliminary evaluation and optimizaiton of route has been made having in mind the bathymetric profile of sea and technical conditions of cable stability. The route should preferably be orthogonal in relation to isobaths and to avoid, if available, areas of large longitudinal and transversal fall.

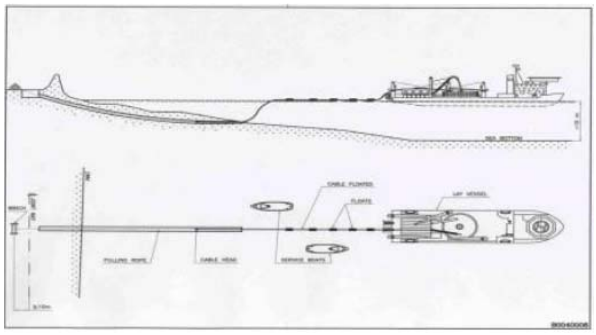
To define the route, it is important to avoid, as much as possible, port areas and is necesary to provide adequate cable protection within fishing areas. The undersea cable shall be protected to reduce risks in relation to human activities to lowest possible extent (fishing, anchorage, sailing..).

Cables will be embedded by using techniques such as „jetting“ and /or placing to trenches of 400m or more meters of depth, taking into consideration the existing risks within the area with typical depth of placing of approximately 1,5m correlated with the soil type.

In case of eneven and rocky seabed, chances for cable embedding are smaller. If it is considered necessary and feasible, according to the seabed characteristics, cable may be protected by concrete linings or „breakstone foundations“.

Terna performs analyses for corridors (1m of width) for energy cables, electrodes and electrode cables. Selection of electrode and cables location connected in territorial sea of Montenegro is basically relied on operational needs for which **electrodes should be placed at max depth of 30-35 m.** This is a complex condition having in mind the nature of the seabed bathy-morphology nearby the coast of Montenegro. On the basis of detailed preliminary research of seabed (on coast and in sea), Terna shall identify detailed bathymetry of area stated which shall be used when projecting and executing.

Nearby area defined as the landing place, cables may be protected by pipes to be placed in advance by using the HDD technique (horizontal directional drilling). This technique provides min influence of the cable exiting place to environment and does not limit tourist activity (picture 13).



Picture.13. passing of undersea/undergorund cable by HDD technique

Undersea cables protection techniques

"Jetting"

Protection of cables in the presence of seabed made by the unconnected or weakly connected sediments is usualy performed at 10 m depth (usual limit of rail part influenced by operations of divers nearby the cable existing sea place) to the depth of approximately 400 m and more in case of intensice human activities using „jetting**"** technique **which implies cable embedding to min 1,5 m of depth.**

J*etting* device is the remotely operated undersea vehicle (ROV) which can move on rails or be suspended in water by propelers. This machine ejects jets of water under pressure making the trench along the cables route. Cable, by its weight, enters the trench made. Shortly after cable was embedded, liquid material falls over the same cable covering it.

Trench embedding

Waters which are partly hard of highly cohesive (but without the stone material), technique which is usually used provides embedding by the appropriate operational device with a disc (the embedding machine) in order cable to be placed at 50 m depth at least.

This machine, which is used for the technique of „embedding“ is also a remotely operated undersea vehicle which may be used at depth of 100 m providing making of a trench at 05-1 m depth under the seabed, of 20-30 cm width.

Shallow sea embedding

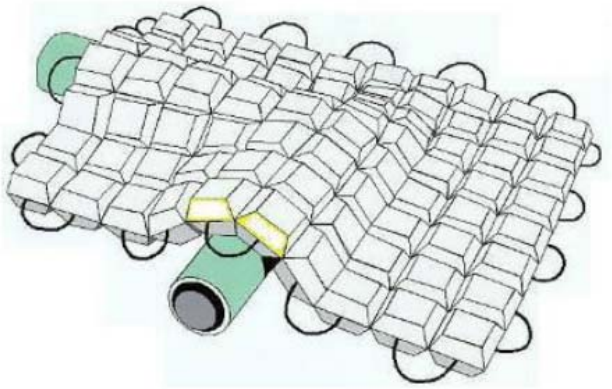
Whithin the nearby coast zone in which it is not allowed to use ROV vehicles and boats due to limited sea depth, cable embedding in sand (or sediment) is usually performed by portable machines or directly by divers: small nozzles or sprinklers under pressure.

Those "jetting" machines are conceptually similar to machines which are used in sea and do not require presence of divers, but in this case operations are controlled by divers.

Bases

Bases are made of concrete blocks connected by spikes (Picture 14) wich are placed in the same blocks of total dimensions 5 m x 2.5 m. This unique design provides flexibility and, accordingly, possibility of adjustment to discontinuities comprised area (bottom and cable).

This type of protection is applied in case of limited lenght (rarely more than 100 meters) and in case of transfer of rocks sections.



Pic.14. example of base protected cable

Stone placing

This protection technique is rarely applied. It is made of cable covered by stones of pre determined size. Specialized boats are to be used for this type of protection.

Electrodes

Electrodes are usual components of HVDC operation which are present in more than twenty HVDC operations in the world. The are monopolary or bipolary arranged. According to available documents and presentation of Terna representatives, energy connection between Italy and Montenegro may be realized by the undersea cable at 500 kV voltage level. Considering it refers to bipolar composition based on placing the cable of positive and negative polarity during normal functioning of which cable, the electrode is not in function, that is, not part of equipment participating in energy transmission. **The major function of electrode is,** to take over electricity transmission, in case of malfunction of one of cables placed after performed protection and disconnection of malfunctioned cable. **The electrode is a metal construction place in sea at the depth of approximately 30-35 m, of 600×30m dimensions. The electrode is dimensioned so that, in this case, power intensity to be under the level which may adversely affect human beings in its vicinity which is achieved**

by the appropriate creation and dimensions of electrode. This should be defined by project documents meeting safety and technical requirements.

At monopolar arrangement, circuit may be closed via electrodes. At bipoplar arrangement, electrodes are not connected to nominal current and the system is able, under extraordinary situations or during maintenance, to switch to monopolar arrangement if electrodes are present.

At HVDC connection, the eletrodes types are as follows:

- *Grounding electrode:* they are adopted in case converter station passes far from sea and their nominal connection with HVDC connection is completely realized through land.
- *Undersea electrode:* (electrodes in sea – distance more than 100 m from coast): as regards grounding electrode, it is of smaller total dimensions.

There are two basic categories of electrodes on coast: electrode which is placed on the coast and is at the coast line, active part is in contact with the land surface or in its depth, and is located in water; electrode in water on which occassion electrodes are in direct contact with sea water at the waves protected area (basin)- examples of application are Italy and Greece and sardinian electrode.

Evaluation of preliminary type and electrode location

Morphology of the coast along which the electrode is to be placed is the major inititator of electrode type characteristics selection. Selection between electrodes on coast or electrodes in sea depends on the area characteristics (that is, electrodes on coast may be used on the abandoned beach with sufficiently low ground resistance, while selection of sea electrodes is required in case of rocky coast).

Analysis od montenegrin coast has shown there are no beaches which may be used to place electrodes and, due to stated reasons, it has been made an analysis of sea electrode usage.[1]

The most significant elements to be taken into consideration at selection and projection are:

- element of localization: sub stations, place of cable exiting the sea, electric conditions (max resistivity, seismic stability, possibility of measurement during work);
- data on metal objects at the area of 3km from the electrode itself;
- area of localization: sea salinity (annual values), temperature (annual values), geological structure of the seabed surface, distance of electric substation, coast distance, currents and their direction, bathymetric profile.

[1] Pond electrodes have not been considered because they require adequate area to be reached by land and must be separated. It seems terrain morphology not to be adequate. .

Having in mind the stated criteria, area which has preliminary been estimated adequate is presented by picture 15. It is in the north of Platamuni cape but passing by the protected undersea localities and Emerald zone on Platamuni.

Pic.15. researched area of electrode

Designer shall evaluate number of electrodes to satisfy technical conditions of project.

LANDING PLACE

Conditions and limit to be respected at selection of the landing place:

- Distance from public beaches and protected nutural resources and zones,
- Decrease conflict with future spatial usage in wider environment,
- As gentle as possible seabed slope,
- Avoidance of coasts subject to erosion,
- Avoidance of strong sea currents zones,
- Minimizing negative effects to flora, fauna and hydro geologically risky areas,
- As short as possible distance from future converter station and TS
- Preservation of natural image of rocky coast and mediterranean vegetation,
- Possibility of connection to less exposed place to construct a tunnel,
- Distance from current settlements and planned tourist facilities,
- Vicinity of adequate road to place the cable to TS,

Special attention has been paid to analysis of possible landing points. When selecting the landing point, there are criteria to be met:

- Location should be within the zone of weak maritime transport so that risks of cable damages due to anchorage of huge and tourist ships, yachts and boats to be min. Locations in which fishing nets may damage the cable are also not recommended.
- When selecting the location, it should try to put it in the zone of gentle seabed slope. Seabed should preferably be sandy or muddy to decrease risks of cable's damaging at it embedding.
- Landing point should not be along coasts subjet to erosion, because coastal erosion migh damage the cable.

- Location should be easily accessible and suitable for heavy machinery transportation for the purposes of cable placing. The area should be of 50x50 m dimensions which shall be used as the working plateau to drill and places cable pipes and construction of chamber for cable connector.
- Within the undersea cable location, sea currents should not be strong because they could open the undersea cable embedded base.
- **Landing point location should be far from public beaches in order to eliminate visual environmental pollution and completely exclude possibility of any nuisances of beaches users during construction or sanation at cable exploitation and avoid future limiting of spatial purpose. Cable placing is necessary to be limited to off season period to eliminate possible negative visual effect.** Within the natural beaches zone, it is performed an intensive transportation of sediments under the influence sea waves and current influence. Extremely high waves influence results in drastic changes at the seabed caused by intensive transversal or longitudinal sediment transportation at the beach. Under certain unfavourable conditions, it would result in complete opening of deposit layer beyond the protection pipe and cable damage.
- Also, there is a danger, due to construction of cable, erosion process at the beach to be intensified, due to natural balance deterioration.
- When planning the landing point, it should pay attention to negative flora, fauna and hydro geologically risky areas effects to be minimized.
- It is especially important to minimize effect of landing point and overhead cable route to current and future usage of territory in wider cable's environment.

Analyses of previous undersea cables damages throught the world imply that damages are caused by human and natural factors.

- Human factors refer to damages caused by anchoring of various types of boats or resulting fro fishing nets taking out.
- Natural factors refer to movements of sea deposit influenced by waves and sea currents or due to landslide of deposits.

Undersea cables damages result in loss of incomes and repair expenses. **Best way to protect the undersea cable is it to be embedded into the seabed**. The deeper the cable is ebedded the protection is better.

However, increasing depth of cable embedding causes higher prices of operations and extension of works perfomance. Lately, for most constructes undersea cables, embedding depth was between 1,0 i 1,5 m. However, there are exceptions requiring higher level of security. For undersea cable in Singapore and Hong Kong, it has been required to be embedded into seabed at 5m depth. At places where this could not have been made, protection layer is of 5 m width and achieved by covering the seabed by breakstone foundation. Increasing of

cable embedding depth results in higher price of operations and extention of terms of works execution.

Depth of cable embedding is directly connected to risk and characteristics of the seabed. According to practice within the Adriatic, it has been shown that 1,5m is sufficient depth of embedding.

REVIEW OF PROPOSED LANDING POINTS AT MONTENEGRIN COAST

Feasibility study of undersea transmission line between Italy and Montenegro has been made TERNA and CGES companies. After analysing possible locations as well location of converter station, it has been concluded possible landing places could be at the area of Platamuni peninsula or within Trsteno and Jaz bays. Picture 16 shows satellite survey of that area.

Pic.16. satellite survey of considered locations of landind places

On the basis of preliminary evaluations of TERNA and visits of the subject area in January 2011 with representatives of the Ministry of tourism and sustainable development, CGES and Procesor, analysis of 5 possible locations of landing place has been made:

- **Bay Nerin –has been evaluated as unaccpetable due to technical limitations in the beach hinterland zone,**
- **Peninsula of Platamuni – has been evaluated as unacceptable due to technical limitations, rocky coast and Emerald zone,**
- **Bay Trsteno and bay Jaz – have been evaluated as unacceptable because beaches are natural heritage of tourist purpose primarily,**
- **Jaz cape- planned as landing place.**

During the terriain visit, it has been concluded that Platamuni peninsula and Nerin bay are not feasible due to technical lacks while preliminary results imply

that Jaz beach and Trsteno and Jaz capes are acceptable from the technical aspect.
Considering it is not allowed to plan the landing place at Jaz and Trsteno beaches and having in mind limitations of Nerin and Platamuni locations, only location at Jaz cape may be acceptable under the condition of careful locating and respecting environmental conditions.
After completion of researches performed by commission of representatives of Montenegrin Ministry of economy, Ministry of spatial development and environmental protection, CGES, local authorities of municipalities of Tivat and Kotor and other relevant governmental bodies, it has been proposed location of converter station in Montenegro conditioning the landing place.

Location at Platamuni peninsula has been evaluated from technical aspect as demanding one due to extremely steep and inaccessible rocks and the fact that cable embedding into the rocky bottom would be difficult to perform and economically less favourable, while, from the aspect of protection and spatial purpose, that location would be favourable. This location is characterized by the lack of roads, inaccessability of coastal area and rocky steep cliffs making construction of appropriate infrastructure difficult such as roads and working plateaus required for further construction and cable maintenance

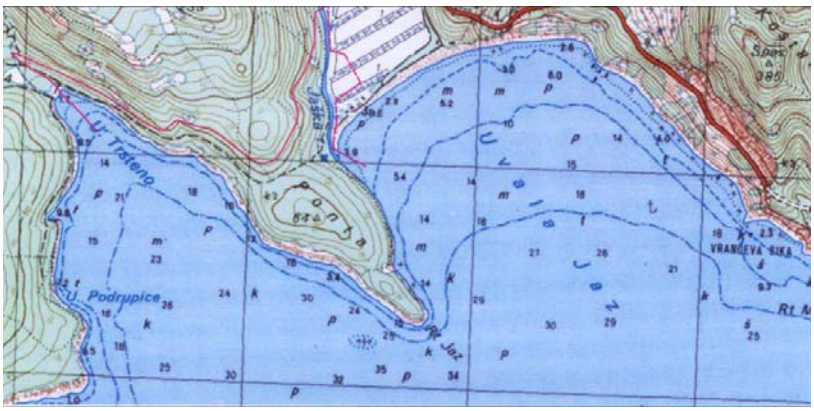
Pic.17. Platamuni location

Nerin location has been evaluated from technical aspect as unfavorable due to difficult access, steep and narrow road stretching steeply towards the Nerin bay. Limitation is also large distance of location and future converter station and TS which could be reached passing numerous settlements surrounded by numerous sacred objects. Environment would be deteriorated and adequate solution would not be profitable from economic aspect.

Pic.18. Nerin location

Trsteno location-from technical aspect are favourable bays, that is, beaches easily accessible having appropriate flat area to be used as a working plateau, in relation to steep and inaccessible terrains. However, they are very limited from the aspect of planned future purpose and envrionemntal protection. This location is accessible from transportation aspect and has the area which could be used during execution as a working area. It is extremely favourable as regards application of HDD technique and chamber position for cable connectors. Regardless all stated favorables , the location is not acceptable considering that its only purpose is tourist one.

pic.19. Trsteno location



pic.*20. sit. plan of Jaz and Trsteno bays*

Pic .20 shows the situation plan of Jaz, Trsteno bays and Jaz cape with marked isobaths position. It is evidenced that the seabed slope at the coastal area to the isobath of 10 m is gentle, cca 1:25 and from technical aspect, it is favourable to place the undersea cable, considering that HDD technique shall be used (Horizontal Directional Drilling).

Location nearby the Jaz beach- Jaz beach is one of important tourist destinations of montenegrin seaside. It is necessary to emphasise that landing place at Jaz beach would have serious lacks from professional aspect as well. result of certain beaches monitoring in Montengro imply that due to intensive erosion of beaches deposits at sea depths greater than 5 m of small widths. To apply the HDD technique, there is a question if the undersea cable would be endangered in case there is a tendency of beach erosion.

In case of small deposits widths above the transmission line layer, there is a danger the cable's protection pipe to be completely recovered due to influence of waves and sea currents which could result in its damaging. Along with basic limitation and exclusively tourist purpose, those additional limitations have excluded possibility of landing place to be at those two beaches.

Sl.21. view to Jaz

Location of Jaz cape- has been proposed at the east side of Jaz cape as a compromise between the optimal location selection from the aspect of technical suitability and protection of beaches and other protected areas at the seaside. Purpose of area as per the PPPN Morsko Dobro is bushes, shrubs and garrigue. For this location, it is necessary to make preliminary works in the sense of adequate transportation access and adequate flat working area necessary to construct cable as well as additional reseach works (geo technical researches, relief survey..) in the phase of projecting. **The goal is the loanding place to be as far as possible from public beaches, tourism zone and other protected areas at the coast.**

Working area shall be located in the central part in a way providing the least possible deterioration of environment. After the execution of works, it shall be performed development of terrain in order to bring back the original image of area as much as possible.

Pic.22. Image of Jaz cape after construction

HDD technique of cable placing implies placing of protected pipes by driling through deposits at the seabed. In that case, there is no classic trench digging. After placing, that is drilling of horizontal pipeline, a cable will be put through. Scheme review of undersea cable placing by HDD technique has been shown at the picture.

After landing, the undersea cable should, by the embedded connector to connect to inland cables. A connector requires the area of 50x50m. Inland cables shall be embedded in trenches at 1,5m depth. It is emphasised that from the couplings two paralel underground cables placed in two trenches shall be stretching. Distance between trenches is cca 3 m. **This data is especially important from the aspect of inland cable influence to possibility of future tourist centers complexes construction planning. The goal is to provide potential development of area with no special restrictions in the zone of immediate cable passing**.

Of all proposed landing locations, the only one to be proposed as landing location is the one on the east side of rocky Jaz cape coast along with respecting findings of characteristics of seabed and recommendations of a study on protection of maritime biodiversity protection which is an integral part of the Strategic evaluation of environmental influence.

Geomechanical characteristics of land for possible landing locations

Geological structure of terrain in the zone nearby stated locations is similar as regards lythofacial composition, texture characteristics and physical-mechanical features of rocks.

Jaz location- Location of Jaz predicted as landing plce is mostly made of dolomites and dolomite limestones of upper cretaceuos period falling norteast at the angle of 30^0. At the coastal zone of Jaz beach, carbonate deposits are covered by marine gravely sandy sediments and limestone blocks. At the southwest part of Jaz bay, dolomites, dolomite limestones and limestones are in layers.

Layers are of 50cm width. They are crossed with cracks and fissures of various orientation and faults of northeast-southwest direction. They are of good physical-mechanical characteristics, stabile:

bulk density $\gamma = 26$ kN/m^3

cohesion $c = 200 – 300$ kN/m^2

angle of internal friction $\varphi = 30 – 40^0$

Marine gravel and sand of Jaz beach and blocks of rocks along steep parts of

coast may be classified as incoherent, non compact, water permeable and running due to sea influence. Marine sediments of changeable width are present at coastal area which is under the sea. Those marine sediments moving under sea influence cover the base of terrain made of carbonate rocks.
Evaluated values of paramters of physical-mechanical characteristics for marine gravel and sand are:

bulk density γ = 19 - 21 kN/m^3
kohesion c = 0,0 kN/m^2
internal friction angle φ = 25 - 30^0

Trsteno location- Wider area of Trsteno location is made of carbonate rocky mass presented by limestones, dolomite limestones and dolomites of middle cretaceous period and marine sediments. General direction of layer - banked dolomites is northwest-southeast falling northeast under the angle of 15 – 20^0.

Estimated values of parameters of physical-mechanical characteristics for limestones which have cracked at the surface area:

bulk density γ= 25 - 26kN/m^3
cohesion c= 100 – 300 kN/m^2
internal friction angle φ= 30 - 40 °

Marine sediments of sandy composition have been separated at Trsteno bay I and in coastal layer under sea. Those sediments width is 2-5 m. Evaluated values of parameters of physical-mechanical characteristics for limestones cracked at the surface are:

bulk density γ= 18 - 20kN/m^3
cohesion c= 3 - 5 kN/m^2
internal friction angle φ= 18 - 25 °

Platamuni and Nerin location-Wider zone of Platamuni and Nerin location is made of layer and banked limestones of upper cretaceous period falling northeast at the angle of 20-25°.

Values of parameters of physical-mechanical characteristics, for limestones of this location there are gravely sandy sediments and limestone blocks of 2-4 m of evaluated width.

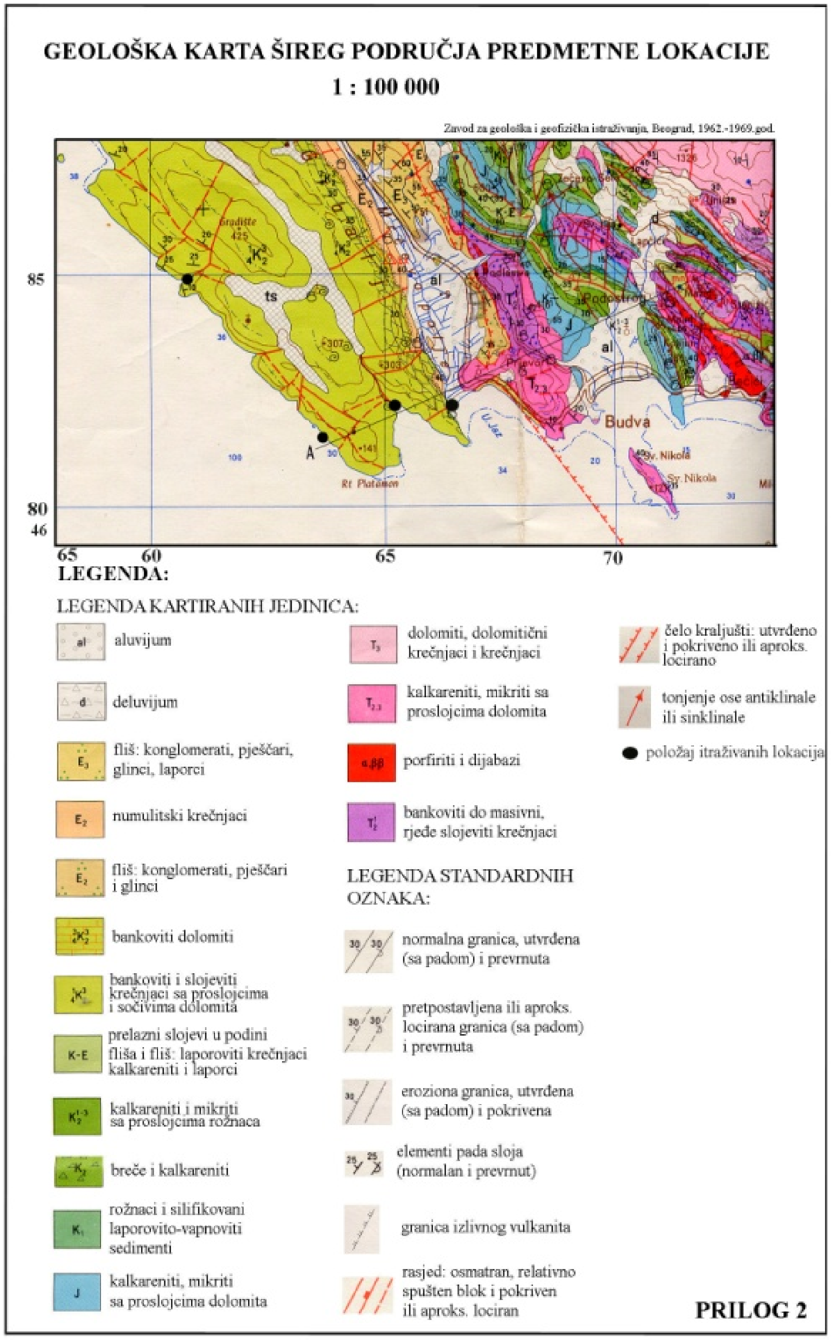
Conclusion of analysis of geological structure of possible landing places and converter station and TS location: At all locations (Jaz, Trsteno, Platamuni, Nerin) the terrain is made of:

- carbonate rocks (limestones, dolomite limestones and dolomites) of favourable physical mechanical characteristics;
    - marine sediments represented by sandy- gravely sediments of

estimated value of 2-5 m.

Considering that technology of cable to be embedded at 1,0-1,5m has been predicted, it should expect same line rocks to be present at all locations in relation to lythological composition and physical-mechanical characteristics. Namely, base of terrain is made of well carrying limestones covered by marine sediments of 2-5 m width.

To get complete data on geotechnical characteristics of subject locations, it is necessary to perfom further geotechnical reseaches according to the Law on geological researches as per previously made Project.

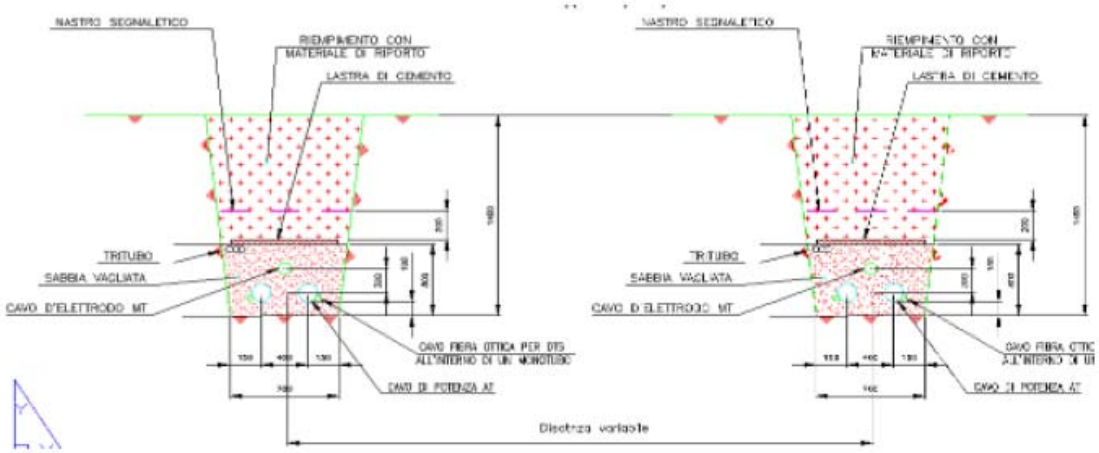

GEOLOŠKA KARTA ŠIREG PODRUČJA PREDMETNE LOKACIJE
1 : 100 000
Zavod za geološka i geofizička istraživanja, Beograd, 1962.-1969.god.
Budva
Sv. Nikola
Rt Platamon
LEGENDA:
LEGENDA KARTIRANIH JEDINICA:
aluvijum
deluvijum
fliš: konglomerati, pješčari, glinci, laporci
numulitski krečnjaci
fliš: konglomerati, pješčari i glinci
bankoviti dolomiti
bankoviti i slojeviti krečnjaci sa proslojcima i sočivima dolomita
prelazni slojevi u podini fliša i fliš: laporoviti krečnjaci kalkareniti i laporci
kalkareniti i mikriti sa proslojcima rožnaca
breče i kalkareniti
rožnaci i silifikovani laporovito-vapnoviti sedimenti
kalkareniti, mikriti sa proslojcima dolomita
dolomiti, dolomitični krečnjaci i krečnjaci
kalkareniti, mikriti sa proslojcima dolomita
porfiriti i dijabazi
bankoviti do masivni, rjeđe slojeviti krečnjaci
LEGENDA STANDARDNIH OZNAKA:
normalna granica, utvrđena (sa padom) i prevrnuta
pretpostavljena ili aproks. locirana granica (sa padom) i prevrnuta
eroziona granica, utvrđena (sa padom) i pokrivena
elementi pada sloja (normalan i prevrnut)
granica izlivnog vulkanita
rasjed: osmatran, relativno spušten blok i pokriven ili aproks. lociran
čelo kraljušti: utvrđeno i pokriveno ili aproks. locirano
tonjenje ose antiklinale ili sinklinale
položaj itraživanih lokacija
PRILOG 2

UNDERGROUND CABLES ROUTE CHARACTERISTICS

Typical cross section and standard distances

For each energy cable, it is necessary to have the trench of 0.7-1 m width. Optimal depth of placing is 1.5m. Distance between two trenches is estimated in order to optimize conditions of work and maintenance. Having in mind this aspect, distance between trenches is usually 3m. It means min road width required for operation and maintenance of installation is 5-6 m.

Graph on picture 24 shows typical cross section to place underground cables and picture 25 shows an example of application in trenches with coils usually used to transport and place underground cables (max lenght of cables is 500-600 m).



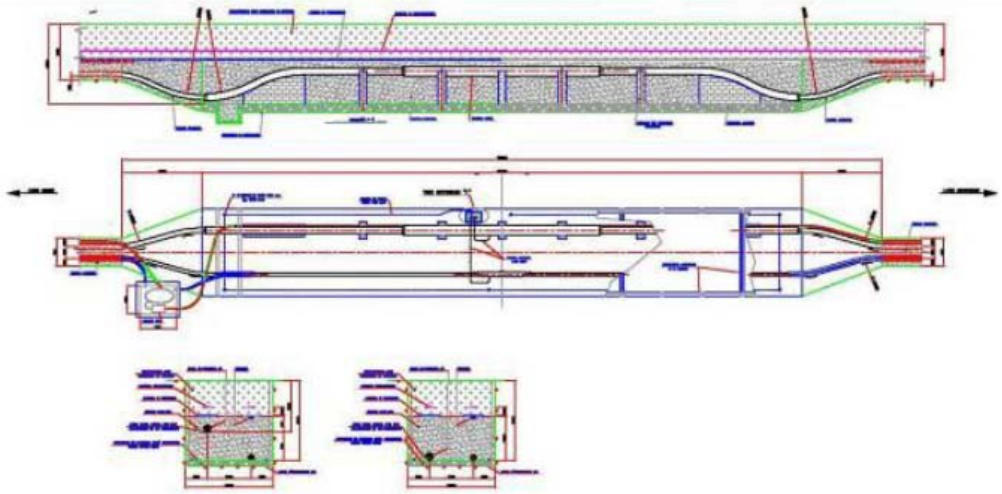
pic.24. typical cross section of cables placed in trenches

pic.25. trench example and typical coil for underground cable

Land chamber for connections

Limitations relating to weight and transportation of coils define that max lenght of each cable section should be 500-600 m. It is necessary to place connections

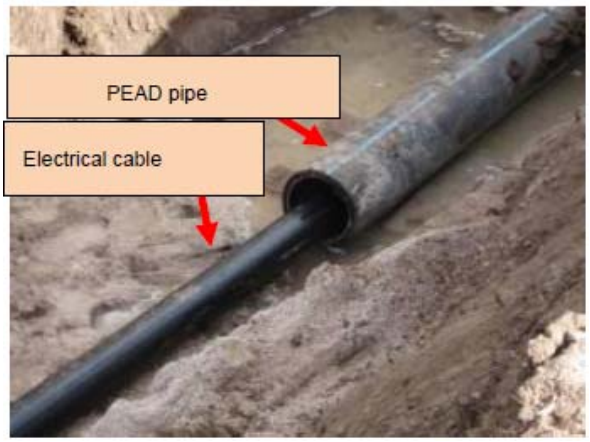
between sections. Chambers for connections for each tower for cable are usually **20 meters long, 2 meters deep and 2.2 meters wide.** Typical example of chamber for underground cables connector is shown on picture 26.



pic.26. typical diametaer of chamber for underground cable connectors

Techniques of transmission sea-land (*HDD – horizontally directed drilling)*

HDD is a method of installing by using pipes at relatively hollow areas, with no need of opening trenches and against min influence to surrounding areas.



pic.27. pipes containing electrical cable within

This is not an invasive method and has no great influence to zone areas. This technique is used to bypass obstacles such as communication routes, river, transportation channel, railways... **As regards swimmers safety and areas surrounding landing place, this technique provides placing of cable into the PVC pipe at adequate depth to insure complete safety**.

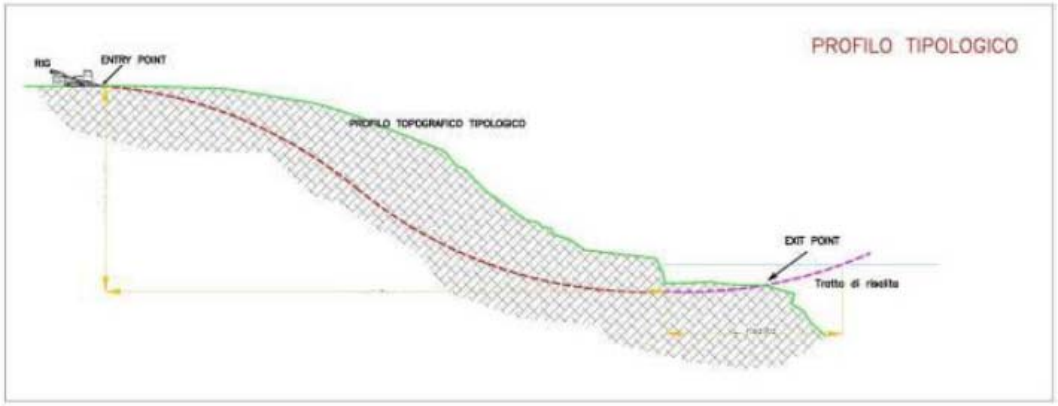
After works, infrastructure shall not deteriorate the usual activity of area. This technique has been designed to bypass areas of value, roads, rivers... **it**

requires temporary work site nearby entrance to opening the pead pipe shall be placed into. To place protection pipe the first small tunnel is to be made.

Surface electronic devices control pipe direction and provide drilling directioning.

For the purposes of this technique feasibility evaluation, first fundamental activity to be taken is geotechnical analysis of area. If the substarum is characterized by gravel or stone which is not homogeneous or characterized by holes, it is impossible to control drilling. Otherwise, substratum characterized by homogeneous stone or sediment material such as sand or clay is best for this technique application.

However, HDD has other technical limitations apart form the limitations stated, which refer to drilling profile. This limitation exists due to max slope of machine which is allowed at the entrance, the slope of which may not be higher than 20% (approximately 14^0). This is an obstacle in the sense of max difference in height and steepness of profile, both land and marine ones. Typical profile of drilling by HDD technique is shown on picture 28.



pic.28. typical drilling profile

Apart from stated limitation, attention should be paid to works to be performed such as putting cable into pipe providing adequate safety during the phase of works on sea. Entrance opening shall not be deeper than 10-15 cm.

Drilling pipe is usually not shorter than 11 m and wider than 2.5 m and requires adequate flat surface at the entry point to provide its stabile positioning. As regards construction, dimensions of temporary work site shall be approx. **30 m x 30 m**. To apply this technique, apart from drilling pipes, other machines, such as machine to take and transport material is required (pipes, drilling heads..). To execute HDD, it is necessary ti find appropriate area nearby the landing place as well as adequate roads to transport machines.

Other techniques – As an alternative to drilling, open trenches at surface may be formed as the landing place. Trenches start from connectors chamber going up to 2 m of isobaths to the sea after which embedding activities shall be

continued by using special equipment for placing at the seabed. An example of embedding at landing place is shown on picture 29.

pic.29. trench example

Width of each trench, assuming the depth of 1m, depends on terrain consistency. At the worst case, when the base width is 80 cm, the area is of 5m width.

CONNECTION OF CHAMBER FOR TRANSFER

Connector chamber for tranfer between the undersea and underground cable is necessary for each pair of electrodes/cable to be realized. Dimensions of those works are: 20 m x 2.2 m x 2 m . Forming of at least one chamber for each cable and area necessary for works on cable placing and land embedding requires work site of smaller dimensions of approximately 50m x 50m.

After the implementation, chamber shall be filled up and the ares shall be given the quo ante status.

WORKS SITE FOR TRANSSITION ROUTE

For the purposes of works execution, there shall be organized special areas during the phase of implementation. As regards transition works, assuming those two operations are performed at various times, it is necessary to have work site of min dimensions of **50m x 50m**. Those surfaces **should be flat and easily accessible** to roads which are suitable for:

- movement of heavy vehicles;
- movement of trucks for cable transportation;
- movement of technical machines to execute all construction works related to those operations;
- cable placing.
  Placing of cable shall be performed with the least possible local traffic deterioration. Cables shall be placed in phases so that at least half the road to be free for passing. Apart from stated area, it shall be determined area for the purposes of logistics during the construction phase.

CONVERTER STATION LOCATION

Conditions and limitations to be respected when selecting the converter station location:

- Sufficient area for converter station and TS. According to Programming task it is cca 16 ha, and as per the technological-technical requirements 17.15 ha KP and 11.25ha for TS.
- Suitability from the aspect of interconnection connection.
- Visual shelterness and environmental values preservation.
- Sufficient distance from settlements.
- Respecting of future areas purpose defined by plans.
- As short as possible distance from the landing place.
- Have in mind position of consumption centers (Herceg Novi, Tivat, Kotor and Budva) in central part of montenegrin seaside, as well as existing transmission line 400 kV Podgorica – Trebinje route position.
- It has been performed the analysis of several potential locations which would fulfill criteria required.

According to the Programming task, the location of Blato in Lastva Grbaljska has been proposed as converter station location as a result of common Feasibility study as regards the project of undersea energy interconnection between Italy and Montenegro made by Terna and CGES. On the basis of stated study, there have been made necessary interventions in relation to transmission network development in Montenegro, especially at the seaside, which, apart form max usage of interconnection, comprise the aspect of **safety supply of consumers, respecting dimensions subject station,** potential locations for cable entering sea and other relevant parameters.

From the aspect of interconnection, out of previously stated, it should emphasise the **one way undersea/underground cable** representing the techno-technological optimum to realize such undersea electric energy connection between two systems, but requires additional specific objects- **converter stations** which are necessary to convert alternate current into direct one and vice versa.

From the aspect of stated towns supply increase, it is necessary to **construct transformer stations to realize transformation 400/110** voltage level which will, along with increase of existing ones, that is, construction of new capacities of transmission network to 110kV voltage level, **provide quality supply of consumers with electric energy and encourage development of this part of Montenegro**.

According to CGES demands, area required for the convereter station is cca 17.15 ha and additional cca 11.25 ha for TS.

Considering the position of consumer centers (Herceg Novi, Tivat, Kotor and Budva) in central part of montenegrin seaside causing overloading of transmission network during summer and position of the existing transmission line route of 400kV Podgorica-Trebinje which is in accordance with the concept of electric energy infrastructure

development, it has been predicted to „introduce" the future transformer station, **„plain" between Tivat and Budva as an optimal solution as regards selection of converter station and transformer station location**.

In that sense, respecting the terrain character of the whole montenegrin seaside complicating finding of adequate, relatively flat terrain of stated dimensions, on the basis of available documents of Terna and CGES, it has been performed analysis of several potential locations to be suitable as regards requires criteria.

After numerous terrain visits, following potential locations have been designated:

1. Area on the right side of the main road from Tivat to Budva

2. Area nearby Lovanja deposit

3/4- Plateaus nearby Mirac location and Nalježići

5. Blato location

1. Area on the right side of the main road from Tivat toward Budva, after completion of take off path of Tivat airport.

This location imposes the route of 400kV transmission line above Kotor and through Njeguši to Ćevo the lacks of which has been emphasised within the variant solution of transmission line description. Additional collision is the necessity of crossing the 400 kV transmision line route and take off path, which has been regulated by valid regulations. It also defines min distance of route and height of object which are obstacles for planes. It may be emphasised negative visual effect of this location due to its exposure along the trank road.

pic.30. location nearby airport

2. **Area nearby Lovanja deposit , on the left side if the main road from Tivat to Budva.** This location also imposes route of 40kV transmission line beyond Kotor and through Njeguši to Čevo, the lacks of which have been emphasised at the transmission line variant solution description. It also may be emphasised negative visiual effect of this

location due to the main road vicinity, but settlements as well, especially for its potential extension.

pic.31. location nearby deposit of Lovanja

3/4- Plateaus nearby location of Mirac and Nalježići, on the left side of the main road from tivat towards Budva. This location also imposes the route of 400 kV transmission line beyond Kotor and through Njeguši to Čevo, the lacks of which have been emphasised within the transmission line variant solution description. It also may be emphasised negative visual effect of this location due to their exposure, but also a significant difference between certain elevations within the area predicted of cca 400 m × 400 m for converter station and additional 200x350m for TS, unsuitable for subject station representing negative technical aspect for its realization.

pic.32. locations Mirac and Nalježići

Considering the tendency the route of cable to be between the convereter station and a place of cable entering sea **to be as short as possible**, along with usual placing of it into the existing road infrastructure, **all three stated location suggest the wider area of Trašte bay, that is, of Oblatna bay**, as a preliminary point of cable sea entering. However, due to planning of tourism and complementary activities in that zone which are planned to be realized at the location stated, it has been given up from further considering the Oblatno bay.

According to available reports, after receiving of representatives of competetive ministries, CGES, local authorities of municipalities of Tivat and Kotor, and other relevant bodies, it has been given up from previous locations of converter station and **location of Blato in Lastva grbaljska has been selected as optimal one**.

5.Location of Blato – This location is on the left side of the main road from Tivat to Budva. It is well sheltered from almost all main road and predicts the route of 40 kV transmission line by the east variant beyond Budva.

pic .33. location of Blato

Main characteristics of those routes have been described in a chapter „Variant solutions of transmission lines routes".

Apart from positive visual effect, it should also be emphasised distance from the existing bigger settlements, vicinity of existing roads and shortest possible distance from coast as well as increased distance of location from the airport of Tivat.

Selection of required dimensions area is extremely complex task, and has been resulted in previously stated locations out of which location of Blato in Lastva Grbaljska has been emphasisied as an optimal choice as regards the converter station and transformer station location but for future transmission line route toward Čevo, that is Pljevalja, and future cable route and location for cable entering sea.

pic.34. Blato location

Goelogical structure of Blato location

Blato location, predicted for construction of a converter station and transformer station is made of: sediment of flysh at the terrain base: quarternary sediments (alluvial, deluvial and deluvial- eluvial) which are present at the surface if terrain.

Estimated values of parameters of physical-mechanical characteristics for flysch sediments are: bulk density γ=23-24 kN/m^3 ; internal friction angle φ=28-30°; cohesion c=60-100 kN/m^2 .

Estimated values of physical-mechanical charcteristics of quarternary sediments (complex of semi cohesive and non cohesive rocks) are: bulk density γ=18-20 kN/m^3 internal friction angle φ=20-32°; cohesion c=10-20 kN/m^2 .

Morphologically, terrain of Blato location is flat with levels of 12-14 m.n.m. Terrain is suitable for projected objects construction, foundation engineering is to be performed at the flysch bedrock or quarternary sediments along with previous sediments with prior drainage of terrain and regulation of temporary surface flows.

ANALYSIS OF TRANSMISSION LINE ROUTE WITH SUB VARIANT SOLUTIONS

Conditions and limitations to be respected at defining the 400 kV transmission line corridor:

- Exclusion of route from the area of Worlds natural and cultural heritage for Kotor and Kotor bay,
- Within the area of NP Lovćen and Durmitor, according to programming task, zones of I and II level of protection are excluded from the transmission line routing. Work out of PP Lovćen and Durmitor is under course and protection zones shall be reviewed during work, according to strategic commitments and real condition of protection at the area of national parks.
- Min passing of route through the III zone of protection,
- Minimizing of visual influence on natural and created values of protected areas,
- Min and careful crossing of transmission line route and ropeways towards Lovćen, from Kotor and Budva directions,
- Safe distance from take off –landing corridors of Tivat airport,
- Distance from existing settlements and planned tourist facilities,
- Possibility of corridor usage along the road Risan-Žabljak.

By a detailed analysis of geographic bases and other rlevant documents, having in mind current condition and position of existing objects within the electric energy system, and planned production and transmission objects of EEs, configuration of terrain, position of settlements, natural and cultural values and other characteristic facilities of area comrpised by this plan, it has been selected a variant of subject electric energy object, on which occassion numerous sub- variant solutions have been considered at certain areas.

Considering significant distance between the starting and final point (route lenght is cca 150 km), and the fact that **mutual corridor has been considered, within certain part, for two physically separated transmission lines, the route has been divided in three major parts**:

- **Lastva – Čevo,**
- **Čevo – Šavnik and**
- **Šavnik – Pljevlja.**

D.1. Part: Lastva Grbaljska – Čevo

At the area of the NP Lovćen three route variants have been considered, of which two have been proposed by the Programming task (**east variant through the NP Lovćen and west beyond Kotor**), **and third has additionally considered possibility of passing the NP Lovćen from east side beyond Budva.** After having insight into situation, taking into consideration the terrain character, natural and cultural heritage,

potential tourist importance of certain locations, visual effect of route, viewpoints, possibility of solving the property relations during the phase of objects constructions, passing through settlements, that is, satisfactory distance form residential objects, **it has been proposed the zero route** of the transmission line at the subject first part from Lastva to Čevo.

It follows considerations in relation to all three condsidered route variants with advantges and lacks.

D.1.a) West sub-variant through Kotor

From proposed location of converter station/transformer station at Lastva Grbaljska location, route is directed nortwest through the area covered by forest under Kaludjerovići and Gorovići settlements following planned corridor of fast roads Tivat-Budva at a distance of approx. 200-400. Nearby Bratešići settlement the route breaks directing towards north to the bottom of Branjevina hill on the east side of Mirac settlement crossing the road Lastva-Sutvara-Kotor and is placed east of Šišići and Nalježići settlements. On that part the route enters the protection zone of NP Lovćen. Further, it goes norteast by extremely steep and inaccessible terrain to location nearby Krstac-Ivanova Korita road **located in the II zone of the NP Lovcen**. In that part the route is placed paralel to stated road at distance of cca 50-110 m. Due to extremenly **unfavourable terrain configuration,** avoidance of Žanjev Do, Krstac, Vratnica, Njeguši settlements, selected route is the only possible choice to realize the subject structure on which occassion it is not possible to avoid passing through the II zone of the NP Lovćen. North of Njeguši, at the distance of 100m from the nearest objects, route goes towards Vučji do settlement crossing the road čekanje-Resna. In that part the route passes the rocky areas with no overgrowth and objects. Further, is is placed paralel to the road at a distance of 50-200 m and after approx. 1,6 km it breaks northeast to the new breaking point located nearby Resna settlement on its southeast side. From stated breaking point, routes separate – one goes towards the existing DV 40 kV Podgorica 2-Trebinje at the location southeast of Čevo settlement while another one goes further north to stated 400 kV transmission line at the location west of Čevo. On those locations it has been planned the connection of new transmission lines to the existing one and only one single transmission line goes towards Pljevlja. This route **lenght is appr. 30 km** and is longer for appr 1,5 km from D.1. variant passing through Lovćen.

Main characteristic of this route is the **negative visual effect** from Šišići settlement to Njeguši, from numerous **viewpoints** on **Lovćen** and from from Tivat to Lastva, Kotor and other locations in this part of the seaside. Due to unfavourable terrain in the area beyond Kotor. Considering the inaccessible terrain, it would be necessary to have an extremely demanding access road along the slope of Banjevina hill, from bottom to top, which would additionally deteriorate the natural environment. Also, **inability to visit the II zone of the NP Lovćen, passsing nearby Njeguši settlement and vicinity of numerous settlements** in the area of Lastva to Njeguši is an additional negative aspect of this route. It also should be mentioned that selection of this corridor for construction of 400kV would complicate and **disable placing of corridor for new 110kV transmission lines of new TS Lastva towards Tivat and Kotor, especially if it is**

taken into consideration planned road from Budva to Tivat passing nearby the selected transmission line corridor.

D.1.b) East variant beyond Budva – part of proposed variant

From the location of converter station/transformer station the route is directed east by slopes of Trebaljevica hill, in the lenght of app 1,5 km. This part of route is visible laterally from the seaside and main road Tivat-Budva, in the west.From Zečevo village and Pobora, the route breaks northeast avoiding passing through potential tourist area, with good route sheltering. At the bottom of Okovica/Murakovac hills, the route breaks towards east in the lenght of 800 m, and than towards southeast passing through the bottom of Raskavica hill up above Lapčići settlement. It is further placed at extremely inaccessible slopes of Široka strana hill, above Budva-Cetinje road, to the bottom of Kuliješ hill crossing with DV 110 kV Cetinje –Budva route. Due to inaccessible terrain in this part, it is necessary to consider, when constructing objects, technical solutions avoiding deterioration of natural environment by making the access roads along the slope of Široka strana hill. Further, it breaks towards north entering the II **zone of NP Lovćen,** partly following corridor of the existing DV 110 kV Budva –Cetinje to location south of Dubovik settlement, passing through the uninhabited area covered with forest and low vegetation. Further, the route goes towards Dubovik settlement passing its northeast side towards nort to Resna settlement through uninhabited terrains partly covered by forests. Within this area, there are many access roads and the need for their construction shall be minimized. As in D.1.a, on this location, routes separate and direct towards the existing 400kV transmission line. In this part, the route passes through the Ii zone of NP Lovćen becuase it is not possible to bypass this zone due to extremely inaccessible terrain which is not suitable to realize the route fro technical aspect, especially because, in this part, corridor consists of two paralel transmission lines. Lenght of this route is cca 34,5 m.

Major characteristic of this route is passing through the II zone of NP, in the lenght of 9 km, but in relation to D.1.c route, it passes through less attractive part of the II zone and **is far from the central part of national park** (Ivanova korita, Majstori), preventing the effect of the national park separation in two parts. Increased lenght and vicinity of planned tourist zones in the area os Lapčići and Pobori, to be analysed in details when projecting, may cause potential problems when resolving the property relations. Vicinity of Budva-cetinje road, that is, negative visual effect in the sense of exposure of parts of route to certain viewpoints on Lovćen and possibility of being noticed from Budva and other locations is also a negative aspect of this route which should be taken into consideration through project solutions. As in variant D.1.a, at the area of Lapčići, beyond Budva and beyond Budva-Cetinje road, it is expressed the influence of unfavourable relief as regards the route selection which, along with technical limitations in relation to tower footprints realization and necessity to extend corridor, disables relocation of route to less attractive area, that is, to III zone of the NP Lovcen.

This route absolutely excludes passing through the area of World natural and cultural heritage of Kotor and Kotor bay. Selected route passes through the national park Lovćen but avoids and moves away from part of the Park marked as special protection zones and forbidden zones and, in that sense, is favourable solution in relation to route described under D.1.c.). Since future transmission lines of 110 kV which shall have to

be constructed due to proper valorization of investment, be directed to seaside settlements (Kotor, Tivat, Herceg Novi, Budva,) their corridors shall not cross with corridors of planned route of 400 kV transmission line, while selection of variant under D.1.a) would cause problems regarding projecting and performance of such crossings. Similar problems regarding crossing refer to planned ropeway Cetinje-Kotor because west variant is to be crossed at very demanding part which is not the case with selected final route.

D.1.c) East sub variant through the NP Lovćen

From proposed location of converter station/transformer station at the location of Lastva Grbaljska, the route is directed east along the Trebaljevica hill slopes, in the lenght of 1,5 km. This part of route is visible from the seaside and the main road Tivat – Budva, after which the route goes northeast, west of Zečevo selo and Pobori settlements, avoiding passing through a potential tourist attractive area and shelters the route by stated hill from numerous positions.

Further, the route goes north along the steep inaccessible terrain with no vegetation nearby **the settlement of Majstori in the II. zone of NP Lovćen**. Further, the route passes southeast from the settlement of Majstori, at a distance of cca 500 m by a rocky terrain with rare vegetation not deteriorating valuable natural, cultural and hystorical values, bypassing the zone of potential tourist development in the vicinity of Ivanova korita. In this area, there are many access roads and the need for their construction would be minimized to protect the natural environment.

The route further directs north crossing the route of planned ropeway Cetinje-Lovćen nearby Cetinje – Bjeloši – Ivanova Korita road. It further goes towards Dubovik settlement, than goes north to the settlement of Resna through uninhabited terrains partly covered by forests. As described in D.1.a, in this location, routes divide and direct to the exising 400 kV transmission line.

This route lenght is approximately 28,5 km and is the shortest route from Lastva to Čevo.

Major characteristics of this route are: well sheltered from most positions at the seaside and viewpoints on Lovćen, large distance from most settlements, passing through the unattractive terrain. Lenght if route in the II zone of NP is 6,7 km. This route includes passing through the area of World natural and cultural heritage of Kotor and Kotor bay, has no influence on beautiful and unique visual experiences of view from Lovćen to Kotor and bay.

This sub-variant has, regardless the technical advantages, been estimated as unacceptable because passing through the central part of the national park Lovćen which would have negative effect on biodiversity and protection of nature.

D.2. Part: Čevo – Šavnik

After connection with the existing DV 400 kV Podgorica 2 – Trebinje, two variants of route to the location above Šavnik have been considered:

- east variant passing nearby the HE Perućica and

- west variant passing nearby planned HE Komarnica.

D.2.a) East sub- variant

From the existing transmission line at the location of Čevo, the route is directed northeast through rarely settled areas partly covered by forest, to the settlements of Škuletići and Bogetići, nearby the main road Podgorica – Nikšić.

After that, there is a crossing of several transmission lines on which occassion the route passes north from HE Perućica at a distance of approximately 2 km.

Further, the route directs north and is placed on slopes of hills passing from the east side of Kunak and Ozrinići settlement and west from settlement of Prijevori, Laz and Briški do. After passing the river Gračanica, the route is placed in the valley to the bottom of Vardar and Gradina hills where the route breaks northeast in a direction east of Bukovik settlement at the bottom of Djurkovo hill. At wider area of previously stated settlement, numerous small objects of residential and possible tourist purpose have been noticed.

Further, the route is placed at a plateau with low vegetation, in the lenght of 6 km on which occassion it passes west of Gvozd settlement to Gradačka Poljana settlement from where it is directed towards Šavnik passing the rocky terrain partly covered by forest, with rare residential objects in the settlement of Miloševići.

After passing the Bijela river, the route changes the terrain level, in order to cross the Bukovica river canyon at the area southeast of Šavnik.

Further, the route passes the settlement of Dobra Sela in the south and is directed north by the uninhabited rocky terrain with forest, west of Donja Bukovica settlement to the point in which it connects with the west variant (B.2.b)- nearby Gusarevci settlement on its west side.

Lenght of this route is approximately **59,5 km** which is its major advantage in relation to the west variant.

Major charateristics of this route are: vicinity of local roads, least possible distance between Čevo and Šavnik, on which occassion the route passes nearby settlements , that is, residential objects, at several areas (especially at the area nearby Bršno, Laz, Bukovik, Gvozd, Miloševići and Dobra Sela settlements). **Negative visual effect** is reached in the part around Bukovik settlement, that is, under Djurkovića hill, and at the location of passing the canyon of the Bukovica river. Namely, in this part of route, there is an influence of extremely unfavourable relief which, along with technical limitations of tower footprints realization and mechanical characteristics of conductors and equipment conditions the route selection. **Also, this route does not provide valorization of planned electric energy objects at the area of Brezna, Komarnica and Krnovo.**

D.2.b) West variant – part of proposed variant

From existing transmission line at the location of Čevo, the route directs northwest through rarely settled area partly covered with forest in the corridor of the existing 400 kV transmission line of 400 kV in the lenght of 2 km.

After that the route goes north along the rocky terrain partly covered in forest bypassing rare small settlements and individual residential objects, following the road Čevo – Nikšič, to location 2 km far from the settlement of Bijelo Polje.

Further, the route goes northwest by mostly uninhabited terrain covered in forest, bypassing settlement of Bročanac Nikšički and Slansko lake in the west side, crossing the existing 220 kV Peručica – Trebinje transmission line and the main road Nikšić – Trebinje.

Further, the route goes north along the uninhabited rocky area, in the lenght of 12 km, bypassing Slansko and Krupačko lake from their west side.

After the breaking point nearby Sjenokosi settlement, the route gently breaks continuing towards norteast nearby individual objects and small settlements such as Jasikovac, Bukovi Doli, and around 3 km west of one of possible locations for future TS 400/110 kV nearby Šipačno settlement.

Further, the route reaches the area of Brezna settlement, in the vicinity of which it has been considered the location for TS 400/110 kV, due to vicinity of planned HE Komarnica in the canyon of the same named river. passing through the Komarnica river canyon has been predicted at the optimal place from the aspect of span size over the canyon, as well as distance **from residential objects on both sides of the canyon.**

As per the Strategy of energy development, Book D: Plan of Montenegrin electric energy system development (Master plan), it has been predicted to connect locations of Brezna, Šavnik and Žabljak at 110 kV voltage level by construction of appropriate transmission lines. To save space taken by corridors of a transmission line, the subject 400 kV transmission line and 110 kV transmission line from Brezna to Šavnik, and, further, to Žabljak, it is predicted to place in common corridor with additional evaluation of common towers.

From breaking point in the north part of canyon, the common route of 400 + 110 kV is directed east along the gently waved terrain with low vegetation bypassing rare residental objects above Duži settlement. After one more passing over the river Komarnica at the location avoiding visual influence to waterfall Skakavica and camping zone, the route bypasses Godijelji settlement, north of Šavnik reaching the point nearby Gusarevci settlement.

Lenght of this route is approximately **71,5 km and is longer by 12 km** from east variant which is its major lack.

Major characteristic of this route is unfavourable economic aspect due to increased lenght in relation to previously described route (2.a) while it could be considered positive vicinity of local roads, **max avoidance of settlement vicinity**, that is residential objects, and of special importance is **favourable position towards planned objects of transmission network, which relates to HE Komarnica and planned wind powers at the location of Krnovo, west of Nikšić.** From the aspect of position of route in space, that is, **visual effect**, it may be concluded that it is **well sheltered** from most of main roads and significant settlements,except nearby the canyon of Komarnica river. Also, placing of route of planned 110 kV transmission line and subject 400 kV transmission line by mutual corridor is an important saving of space and positive

economic effect. Influence of relief to route selection is expressed when selecting location to pass the canyon of Komarnica river due to technical limitations of towers, conductors and equipment when passing great distances and significant terrain levels.

Respecting previously stated, this route is considered the **optimal one for considered part between Čevo and Šavnik.**

D.3. Part: Šavnik – Pljevlja- part of proposed variant (passing through Đurđevića Tara)

From previously stated final point of second part located nearby Gusarevci settlement, the route crosses the road Šavnik-Gornja Bukovica bypassing wider area of Gornja Bukovica in the southeast side to avoid planned ski terrains in that area. Further, the route is placed mostly at rocky terrain. Further, the route is placed mostly at rocky terrain, north, at a distance of 2 km east of Vražje and Riblje lake, and 3 km from the location of Žablljak airport, bypassing rivers, irregulary located, individual houses and several small settlements.

The following breaking point is located at the area of Suvodo settlement nearby Njegovudja settlement crossing the existing 110 kV transmission line Pljevlja-Žabljak. Namely, at the area between Njegovudja and Kosanica, located at the other side of the Tara canyon, and, especially, through the Tara canyon, there have been considered numerous variants of new 400 kV transmission line corridor with all advantages and disadvantages.

having in mind the Assembly declaration on the Tara river protection (Official Gazette of Montenegro No. 78/4 dated December 22.2004) forbiding construction interventions at the area of the Tara canyon, respecting criteria of placing new transmission lines in the corridor with the existing transmission lines, as the final option of new 400 kV transmission line in this area, it has been selected placing in corridor with **existing 110 kV transmission line Žabljak-Pljevlja**, and mostly, along with necessary positioning of it due to removal from residential objects. It relates to the area around settlements of Aluga, Rasova, Đurđevića Tara and Kosanica-Ornice, where the route is partly removed from the existing transmission line by 600 m. During the project documents work out, in that area, it may be expected the need for additional allocation of route on the occassion of microlocation of breaking points, within the corridor defined by this plan to select optimal relation of route and tower footprints according to current residential, sacred and other objects, and configuration of terrain, infrastructure and elimination of possible negative visual effect along with max fitting of transmission lines into the natural environment.

As stated, form Suvodo settlement, the route has been placed in paralel to the existing 110 kV transmission line at a distance of 50-60 m, depending on technical parameters to be determined by project documents to the breaking point nearby the road Žabljak – Đurđevića Tara in the settlement of Aluga where it is necessary to be removed from residential buildings. Further, the route is directed towards the Tara canyon following the exising 110 kV transmission line, at a distance of cca 50.-300m. Passing through the Tara canyon is realized by the span of cca 500-600 m of lenght, in paralel to 110 kV transmission line, at a distance of cca 150 m, which is conditioned by residential objects on both sides of a canyon and technical parameters.

Before the rise to the area of Kosanica and Bitinsko field, the route passes between the existing residential objects and, during projecting, it is necessary to perform detailed microlocating of breaking points, according to terrain situation.

In case it is considered the option which would apply technical solutions for usage of common towers for 400 kV and 110 kV voltage level at Žabljak-Pljevlja part, and, possibly Šavnik-Žabljak part, it could be realized from the location of Suvodo to the location nearby Kosanica settlement, on which occassion the existing 110 kV transmission line on that part would be completely disassembled and went along mutual route. **In that case, it would be necessary to make a new transmission line from this location at the route of the existing 110 kV transmission line to planned TS 110/35 kV Žabljak, while in Pljevlja direction, 400 + 110 kV transmission lines would be made at the route of existing 110 kV transmission line at mutual towers.**

Passing nearby the road Žabljak – Đurđevića Tara provides approach to construction and maintenance of future transmission line as well as accomodation of it in the area having the energy corridor in order not to occupy additional area within the protected area of the NP Durmitor.

Further, the route is placed along Bitinsko field and in the corridor of the existing 110 kV transmission line to the bottom of V. Kovčica hill where it is necessary to separate routes of 400 kV and 110 kV at a distance of 200 – 300 m, in the lenght of 2 km, to avoid several residential objects. After that, from previously mentioned breaking point south of Krijesterevina to the breaking point nearby Zbljevo settlement, the route of subject transmission line is mostly **placed in the same corridor with the existing 110 kV transmission line,** in paralel, at a distance of 50 – 200 m, on which occassion it passes nearby several smaller settlements by rocky terrain coverd by forest.

Further, the route directs to TS 400/220 kV Pljevlja passing among residential objects in the vicinity of TS Pljevlja. As a consequence of numerous smaller settlements nearby TS Pljevlja, and numerous transmission lines connected to stated transformer station, and position of station, the selected route is **the only solution of transmisssion line introduction into TS Pljevlja**.

Lenght of this route is cca **46 km**, which is an advantage in relation to west subvariant of a route. Additionally, it should be emphasised that, by analysis of proposed corridor of 400 kV transmission line delivered by the processor of **Spatial plan of NP Durmitor,** it has been determined that selected route mostly matches proposed route, especially regarding part refering to passing the canyon of Tara river and, further, towards Pljevlja. In the part from Tara canyon towards Šavnik, the route partly deviates from proposed route, in order to **avoid individual objects and passing through the area of settlement of Njegovudja,** Novakovići and Gornja Bukovica, and **selection of most favourable terrain configuration** to realize the subject object.

Major characteristics of this route is max usage of common corridor with the existing transmission line 110 kV Pljevlja - Žabljak, avoidance of settlements and individual residential objects and natural and cultural values, most planned tourist ares (ski-paths

and ropeways in the area of settlements of Donja i Gornja Bukovica), airport and numerous local roads necessary to perform works and maintain objects.

It is necessary to emphasise that selected route and proposed technical solutions are optimal solutions even as regards route passing through the area of NP Lovćen and Durmitor. **Possible placing of underground cables is neither justified from technical aspect nor acceptable**, at this voltage level, because of:

- need to construct **additional facilities at places of turning from the overhead line to underground cable,** which will take additional space (construction of busbars, lightning arrestors, cable heads, facility fence),
- longer **duration of malfunction repair at the underground cable** in relation to overhead line and interconnection, which, at this voltage level, may affect the **system stability,** and significant **negative economic effects due tu undelivered electric energy**,
- demanding **configurations and terrain characteristics** in relation to excavation and placing of cables,
- higher **prices** of underground cable

D.3.a) West sub-variant of Durmitor bypassing (through Bosnia and Hercegovina)

From previously stated final point of second part located in the vicinity of Gusarevci settlement, the route crosses the road Šavnik-Gornja Bukovica bypassing wider area of Gornja Bukovica in the southeast to avoid planned ski terrains at that area. Further, the route is placed mostly north along the rocky terrain at a distance of 2 km east from Vražje and Riblje lakes, bypassing rivers, irregulary allocated, individual houses and several smaller settlements.

Additional variant which has been considered as regards realization of interconnection between the converter station and TS Pljevlja, is the update of West variant from the location in the vicinity of the existing 110 kV i 35 kV, approx 4 km west of Šipačno settlement, to Pljevlja, bypassing the NP Durmitor on west and north sides, on which occassion, from the location in the vicinity of the Tara river canyon, with inevitable deviations, it follows the corridor of existing 220 kV transmission lines Pljevlja – HE Piva.

By analysing bases of planning documents in digital form containing routes of existing 220 kV transmission lines, as well as realistic condition visible on the bases of terrain survey, it has been determined that routes of existing transmission lines have not been correctly drawn into digital bases, that is, there is a deviation of 800 m from their real position. At the part of considered additional variant of subject 400 kV transmission line where it has been provided it to be placed in parallel to the existing 220 kV transmission lines, it is evident a collision with residential objects at several locations along the route and that, at that part, the route moves off from the corridor of existing transmission lines to bypass settled areas.

Looking from Pljevlja direction to the west, those are following settlements: Zbljevo, Podrogatec, Mala, Jovići, Moraice, Jelov panj, Slatina, Vukovići, and, at the area of Bosnia and Hercegovina: Topalovići, Meštrovac and Orešje.

Looking the route of mentioned location west of Šipačino settlement, it partly folllows corridor of the existing transmission lines to Brezna settlement in which vicinity the location for TS 400/110 kV has been considered. Avoiding certain objects, the route goes further north passing west of planned HE Komarnica at a distance of 1,5 – 2 km.

After passing the river Komarnica canyon, the route passes through Pivska mountain bypassing rare settlements and individual residential objects, following local roads which, during winter, due to climatic conditions, may be impassable for longer period of time. Also, rare vegetation at most of Pivska moutain implies unfavourable climatic conditions. At the location 2 km away from south of the river Tara, the route reaches the existing 220 kV transmission lines, continues in parallel to them, at a distance of 50 – 100 m, in the north. After passing the river Tara, the route enters the territory of Bosnia and Hercegovina.

Further, the route continues in the corridor with the existing transmission lines, partly by steep slopes of the Tara canyon bypassing several residential objects in the lenght of 4 km to plateaus several smaller settlements are located at. After bypassing the stated settlements, the route continues along terrain which is partly covered with forest to the state border and reenters the territory of Montenegro, in the lenght of approximately 5,5 km. Total lenght of the subject transmission line is at the territory of Bosnia and Hercegovina 9,5 km. Further, the route follows the existing 220 kV transmission lines along the rocky terrain partly covered with forest on which occassion it max bypasses settled areas and certain objects to the location of existing transformer station Pljevlja located at the southwest approach to a town.

Lenght of this route to location west of Šipačno settlement where it separates from the West variant is approximately **94.4 km and is by 18.6 km longer** than „West variant“ whic is **one of major disadvantages**.

Major characteristic of this route is the **unfavourable economic aspect due to increased lenght** in relation to the „West variant“, **and passing of the route through the territory of nearby state in the lenght of approximately 9.5 km which is the biggest limitation**, and passing through forest area in **the Tara river canyon in the lenght of 5 km** in the corridorr with the existing transmission lines, but passing through planned new **extended protected area of the NP Durmitor/Tara/Piva**, and **bad traffic connection** which, having in mind **difficult climatic conditions** during winter may be a serious problem as regards maintenance and possible repair of transmission lines. Advantage of this route is almost complete **avoidance of this route and almost complete avoidance of the area of NP Durmitor** and bigger settlements, that is, residential objects, and it is of special importance a favourable position towards planned **transmission network opbjects**.From the aspect of route position in the space, that is, **visual effect, it** may be concluded that it is mostly placed along with local, that is, roads of less importance, a rare small settlements, except in the vicinity of the Komarnca river. Namely, relief influence to the route selection is expressed when selecting location to pass the Komarnica river canyon and necessity of usage of the existing 220 kV lines usage at the passing of the Tara river canyon, due to technical limitations of towers, conductors and eqipments when conquering large spans and important terrain levels.

D.3.b) Subvariant over the Lever Tare

Within te phase of the plan draft work out, the route passing the Lever Tare used to be the selected variant. It was rejected during the public hearing due to the reason of respecting the Assembly declaration on the river Tara protection, („Official Gazette of Montenegro“, No. 78/04 dated 22.12.2004.).

This route is to the point at the area of Suvodo settlement identical to previously stated route. Limitation is passing over Tara at the forest part of Lever Tare and, as the optimal route, it was selected the route of passing on Đurđevića Tara with max usage of the existing transmission line.

D.3.c) Subvariant of Durmitor bypassing (through Montenegro)

While trying to avoid passing through the territory of nearby state, various possibilities of possible passing through the Tara canyon, at the part from Nikovici, through the area called old Crna Gora have been analysed, however, many disadvantages and obstacles have been observed at the area:

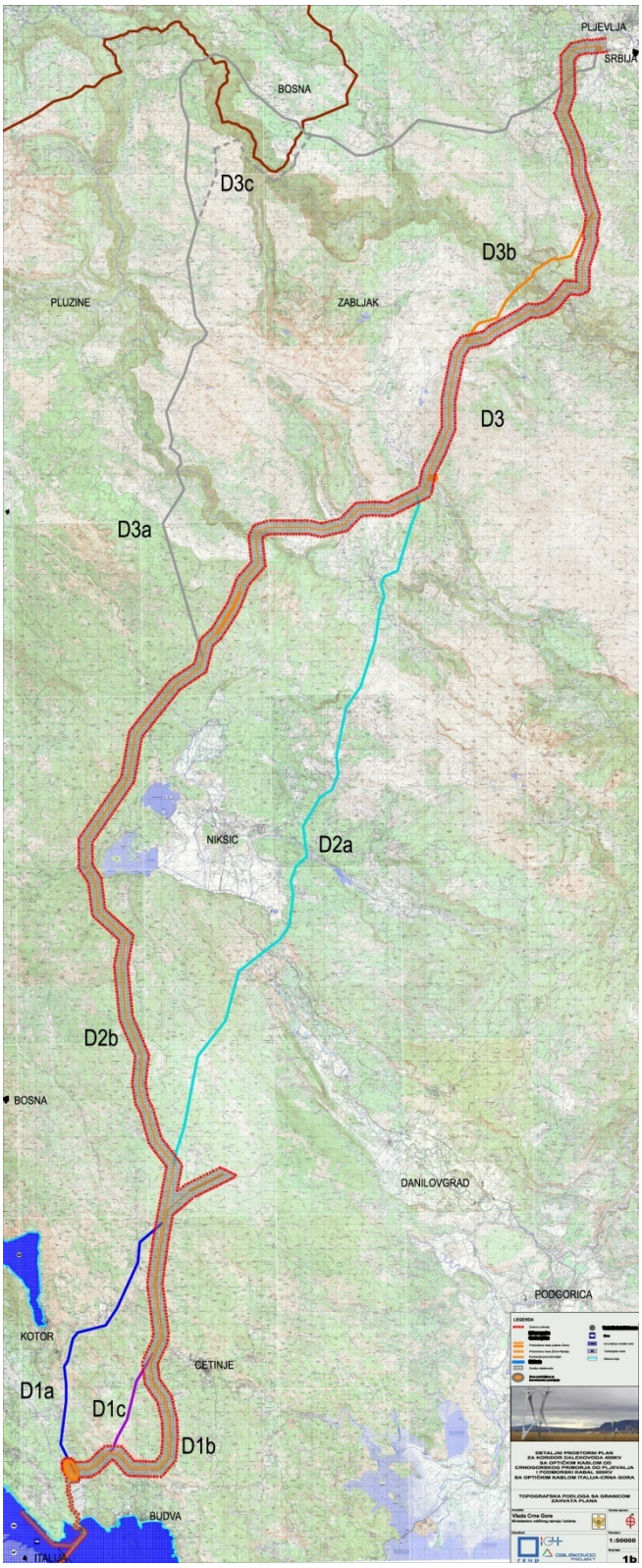
- three canyons passing – Sušica, Tara and Draga
- extremely inaccessible terrain with no access roads, which construction would be demanding and deteriorate the natural environment,
- necessary application Of specific technical solutions and complexity of performance
- difficult and demanding approach to maintain and possible repair of malfunctions during several months of the year due to difficult climatic conditions
- partial passing through the edge area of the NP Durmitor.

If the route would be placed at this terrain of extremely unfavourable configuration with large height differences with no access roads, to avoid the passing through the territory of nearby state, it would be necessary to place route alongside the canyon in the lenght of 3 km with crosing the canyons of Sušica, Tara and Draga.

Considering that only one route has been considered to the settlement of Nikovici, from Brezana, as regards mentioned subvariant all negativties refered to in previous part of the text as well as for Pvska subvariant.

It should also take into consideration the purpose of objects and possible consequences of undelivered electric energy, due to increased critical points on the route and possible negative effect to stability of electric energy system. Respecting all stated disadvantages and limitations, this area is not acceptable to route the transmission line.

ADVANTAGES AND LIMITATIONS OF ROUTE AND SUB VARIANT SOLUTIONS



LANDING PLACE	
1 NERIN BAY	
ADVANTAGES	LIMITATIONS
• Favourable from the aspect sa aspekta zaštiof protection and distance from protected area	• Low accessability • Economically demanding. • Distant from converter stat. and TS • Deterioration of environment. • passage through settlements • Unsufficiently explored zone.
2 PLATAMUNI CAPE	
ADVANTAGES	LIMITATIONS
• Fulfilled aspects of purpose and protection.	• Lack of roads. • Economically unfavourable and technically unachievable.
3 TRSTENO LOCATION	
ADVANTAGES	LIMITATIONS
• Accessability of terrain and technically suitable.	• Beash is protected as natural heritage. • Tourist purpose.
4 LOCATION NEARBY JAZ BEACH	
ADVANTAGES	LIMITATIONS
• Accessability of terrain and technically feasible.	• Beach is protected natural heritage. • Tourist purpose.
5 JAZ CAPE	
ADVANTAGES	LIMITATIONS
• Fulfilled compromise of purpose and protection of space. • Technically adjustable. • Distant from public beaches. • Possibility of traffic approach resolution.	

LOCATION FOR CONVERETER STATION AND TS	
1 AREA ON THE RIGHT SIDE OF THE MAIN ROAD FROM TIVAT TO BUDVA SA	
ADVANTAGES	LIMITATIONS
	• Negative visual effect of this location due to its exposure along the main road. • Collision is necessity of crossing the route of 400kV transmission line axis and take off path which is regulated by valid regulations, and it is defined by min distance of route and height of object which is the obstacle for airplanes.
2 AREA NEARBY LOVANJA DEPOSIT ON THE LEFT SIDE OF MAIN ROAD FROM TIVAT TO BUDVA	
ADVANTAGES	LIMITATIONS
	• Negative visual effect of location due to vicinity of main road and settlements. • Vicinity of take off path.
3,4 PLATEAUS NEARBY LOCATION OF MIRAČ AND NALJEŽIĆI,ON THE LEFT SIDE OF MAIN ROAD FROM TIVAT TOWARDS BUDVA	
ADVANTAGES	LIMITATIONS
	• Vicinity of quarries. • Significant height difference between certain levels of terrain. • Negative technical aspect on its realization. • Impose the route over Kotor.
5 **BLATO IN LASTVI GRBALJSKOJ**	
ADVANTAGES	LIMITATIONS
• Well sheltered from the main road. • Vicinity of current roads and shortest possible distance to the coast, increased distance of it from Tivat airport Tivat. • Technically feasible. • 400m distant from the nearest objects. • In the northwest part sheltered by a natural barrier.	• Imposes passing through the NP Lovćen II zone of protection (east variant beyond Budve). • Visually visible from the upper part of Lastva Grbaljska.

ANALYSIS OF PROPOSED ROUTE WITH SUB VARIANT SOLUTIONS

D1a WEST VARIANT THROUGH KOTOR , LASTVA-ČEVO

ADVANTAGES	LIMITATIONS
• **1** Avoidance of settlements of Žanjev Do,Krstač,Vratnica and Vučiji Do. • **2** Avoidance of majority of II protection zone of NP Lovćen	• Passes through Njeguši. • Inability to bypass the II zone of the National park. • Infavourable terrain configuration. • Construction of new roads for construction and maintenance of a transmission line. • **A** West of Bratešići settlement it crosses the existing transmission line 110-35kV Budva – Kotor. • Crosses planned ropeway Kotor-Cetinje. • **B** From Žanjeva dola to Njeguša enters II zone of NP Lovćen. • Longer by 1.6 km of D1b • **C** Negative visual effect from Šišića to Njeguša,from the viewpoint on Lovćen, and from the area of Tivat to Lastva, Kotor and other locations at the seaside. • Vicinity of numerous settlements from Šišići to Njeguši. • The whole Bokokotorski bay belongs to the world cultural heritage. • Selection of this corridor to construct 400kV would complicated or disable placement of a corridor for new 110kV transmission lines from new TS Lastva towards Tivat and Kotor.

D1b EAST SUB VARIANT ABOVE BUDVA LASTVA-ČEVO-**part of proposed one**

ADVANTAGES	LIMITATIONS
• Well sheltered from most positions at the seaside and viewpoints on Lovćen. • Large distance from most settlements, passing through inattractive terrain • Passes through II zone of NP from the zero route. • Avoidance of passing through the central part of the NP Lovćen.	• Crossing with the existing transmission line 110 kV Budva-Cetinje. • **A** partly enters the II zone of protection of the NP Lovćen (from Kulješa to Gole strane). • Longer by 6.5 km from variant D1c. • less favourable economic aspect. • Crosses planned ropeway Kotor-Cetinje

D1c EAST SUB VARIANT THROUGH THE NP LOVĆEN LASTVA-ČEVO	
ADVANTAGES	LIMITATIONS
• Well sheltered from most positions at the seaside and viewpoints on Lovćen. • Large distance from most settlements. • Excludes passsing through the area of world natural and cultural heritage of Kotor. • Numerous accessible roads • Future transmission line 110 kV would not cross with planned transmission line 400 kV.	• **A** Passes through the II zone of NP Lovćen. • Passes through the central part of the park and negatively influences biodiversity and protection of environment. • Insufficient distance from Majstori and Konjsko.
D2a EAST SUB VARIANT ČEVO - ŠAVNIK	
ADVANTAGES	LIMITATIONS
• Vicinity of local roads. • **A** the least distance between Čevo and Šavnik.	• Does not provide valorization of planned electric energy objects at the area of Brezne, Komarnice and Krnova. • Passes nearby settlements and residential structures. • Negative visual effects at the part of route nearby Bukovik.
D2b ČEVO ŠAVNIK (WEST)-part of proposed	
ADVANTAGES	LIMITATIONS
• Vicinity of local roads. • Max avoidance of settlements vicinity. • Favourable position to planned objects of a transmission network. • Well sheltered from most of roads except in the vicinity of Komarnica river canyon. • placement of te route of planned 110 kV transmission line and subject 400kV transmission line along the mutual corridor is a significant saving of space. • **1** Favourable position towards planned transmission network objects (HE Komarnica and wind power plants on Krnovo).	• Infavourable economic aspect because of increase of lenght in relation to east variant D2a.

D3 ŠAVNIK-PLJEVLJA part of proposed route (over Đurđevića Tare)

ADVANTAGES	LIMITATIONS
• Avoidance of passing through settled area of Đurđevića Tare,distance from the monastery of St. Archangel Mihaila,and distance from the zone of potential tourist development at the area of Kosanica,favourable configuration of terrain from the aspect of construction and maintenance. • Mostly matches with proposed route, from wider area of Krieštorevine to Pljevlja. • Usage of mutual corridor with current DV 110 kV Pljevlja-Žabljak partly on mutual towers. • Max avoidance of settlements and most of planned tourist area and facilities (ski-paths and ropeways),airports and local roads necesssary to construct and maintain objects. . • Possibility of optimal solving of electricity supply of Žabljak by using mixed towers of 400 +100kV with optimal usage of space. • Favourable micro climatic conditions.	Possible placing of underground cables is not technically justified and acceptable at this voltage level because of the following: • the need to work out additional facilities at places of overhead line turning into the underground one which would take additional space. • multiple longer duration of repair of malfunction at the underground cable in relation to the overhead one which may affect tthe stability of system and significant negative economic effects due to undelivered electricity.

D3a WEST SUB VARIANT OF BYPASSING THE NP DURMITOR ŠAVNIK-PLJEVLJA (through BiH)

ADVANTAGES	LIMITATIONS
• **1** Avoidance of area of the NP Durmitor. • Favourable position towards planned objects of a transmission network. • Advanatages from the aspect of settled structures.	• Assembly declaration on the Tara river protection. • Infavourable economic aspect because of prolonged lenght. • Passes through the territory of BIH. • **A** Passes through the regional park Ljubišnja. • **B** Vicinity of Pljevlja airport. • Windy area which make maintainance more difficult during winter. • High altitudes, beyond 1500mnm.

D3b ŠAVNIK-PLJEVLJA sub variant over Lever Tare

ADVANTAGES	LIMITATIONS
• Aspire to move away from the bridge of Đurđevića Tari • Possibility of optimal solving of electricity supply of Žabljak by using mixed towers 400 +100kV with optimal space usage.	• Assembly declaration on the Tara river protection. • Passing through the forest area. • Wide span to cross the Tara river.

D3c ŠAVNIK-PLJEVLJA sub variant of bypassing of Durmitor (through Montenegro)

ADVANTAGES	LIMITATIONS
• Bypassing of the NP Durmitor.	• Assembly declaration on the Tara river protection. • Passes three canyons - Draga, Sušica and Tara. • Emerald zone. • Windy area making repair more difficult during winter. • High altitudes, beyond 1500mnm. • Passes through the Regional park Ljubišnja.

ZONES OF CORRIDOR SEGMENTS VISIBILITY

LANDING PLACE AND CABLE ROUTE
Cable and related equipment is placed undergorund and has no visual influence to the surrounding during exploitation, except in the part where it is planned to change the existing terrain permanently for the purposes of construction of the access road for cable route and working plateau to place machinery at when executing works, and placement of cable couplings.

CONVERTER STATION LOCATION	
1 ARE ON THE RIGHT FROM THE MAIN ROAD TIVAT- BUDVA	
LOCATION	VISIBILITY
1. Main road from Tivat to Budva, airport Tivat, and nearby settlements.	• Completely visually exposed from all stated locations due to vicinity of the main road and settlements.
2 ARE IN THE VICINITY OF LOVANJA DEPOSIT ON THE LEFT FROM THE MAIN ROAD FROM TIVAT TO BUDVA	
LOCATION	VISIBILITY
2. Main road from Tivat to Budva, airport Tivat, and nearby settlements.	• Completely visually exposed from all stated locations due to vicinity of the main road and settlements.
3,4 PLATEAUS IN THE VICINITY OF LOCATIONS MIRAC AND NALJEŽIĆI,ON THE LEFT SIDE OF THE MAIN ROAD FROM TIVAT TO BUDVA	
LOCATION	VISIBILITY
1. Main road from Tivat to Budva, airport Tivat, 2. nearby settlements.	• Well sheltered from stated locations due to distance from the main road and increased terrain level. • Visually exposed towards settlements Mirac, Nalježići, Šišići.
5 **BLATO IN LASTVA GRBALJSKA**	
LOCATION	VISIBILITY
1. Main road in Lastva Grbaljska 2. Nearby settlements	• Completely sheltered from the main road and part of settlements located on the southwest side of the main road. • Visually exposed to residential objects in the north-east part of nearby settlement of Lastva Grbaljska.

PROPOSED ROUTE WITH SUB VARIANT SOLUTIONS	
D1a WEST SUBVARIANT OVER KOTOR **,** LASTVA-ČEVO	
LOCATION	VISIBILITY
1. Main road from Tivat to Radanovići, 2. Kotor, serpentines, road Njeguši - Ivanova Korita 3. Lovćen, Njegošev mausoleum, 4. Njeguši, Žanjev Do, 5. Road Čekanje - Resna-Čevo,	• Exposure of the route part placed above settlements of Šišići over Nalježića, to location in the vicinity of Žanjev Do setttlement in the lenght of approximately 7,5 km, • Due to towers height, the route is partially visible from Kotor, and due to vicinity to the road i Njeguši – Ivanova Korita, which is rich in viewpoints, it would be located in the foreground with extremely negative visual effect, • Partially visible from the viewpoints on Štirovik, while, in relation to the mausoleum, it is well sheltered, • Completely visually exposed to residential structures in stated settlements, • Because of the endeavor the route to follow the mentioned road at the most part, for the purposes of accessability during construction and exploitation, it is mostly visibly from this road and nearby settlements

D1b EAST VARIANT ABOVE BUDVA LASTVA-ČEVO-part of proposed one	
LOCATION	VISIBILITY
1. Main road from Budva to Cetinje, Budva, 2. Lovćen, viewpoints, Njegoš maousoleum, 3. Road Cetinje – Ivanova Korita, 4. Road Cetinje - Čekanje – Resna – Čevo, 5. Settlements Dubovik, Resna	• Exposure of the part of a route placed above the road and in the vicinity of lapčići settlement, in the lenght of approximately 3 km, and visibilityfrom most of locations in Budva and settlements in the vicinity of said road, • Mostly well sheltered from most viewpoints on Lovćen and due to distance bigger than 3 km it is partially poorly visible from tha laocation nearby the mousoleum, • Partially visible from this road and settlements along it, • The route approaches or crosses the said road, for the purposes of accessability during construction and exploitation, but it is mostly well sheltered, • The route passes in the vicinity of those settlements and is partially visible

D1c EAST SUBVARIANT THROUGH NP LOVĆEN, LASTVA-ČEVO	
LOCATION	VISIBILITY
1. Main road from Tivat to Lastva Grbaljska 2. Pobori 3. Majstori 4. Ivanova Korita 5. Lovćen, Njegošev mousoleum 6. Road Čekanje - Resna-Čevo 7. Settlements Dubovik, Resna	• Route is well sheltered except that it is partially visible at the part from the transformer station to Majstori location, it is partially visible from the position in Lastva Grbaljska, in the lenght of approximately 1 - 1,5 km, • Mostly well sheltered from most locations of the seaside apart from this settlement area, • Route is max moved away from Majstori, and during projection of breaking points and tower footprints location, it should carefully select places, • Beceuse it is surrounded by mountains, the route is not visible from this area, • Due to distance bigger than 2 km and because it is partially sheletered by mountains, the route is poorly visible from Lovćen and around the mousoleum, while, in relation to viewpoints marked at the tourist mao of this area, it is max removed, • The route approaches or crosses the said road, for the purposes of accessability during construction and exploitation, but it is mostly well sheltered, • Route passes in the vicinity of those settlements adn is partially visible.
D2a EAST SUBVARIANT ČEVO - ŠAVNIK	
LOCATION	VISIBILITY
1. Main road Podgorica – Nikšić, Ozrinići 2. Bukovik, Šavnik 3. Settlements	• The route mostly bypasses the attractive tourist settlements and is well visible from the main road at the area of settlements of Bogetići and Ozrinići, • Negative visual effect at the area of Bukovika, potential tourist area, that is, Đurkovog hill, and when passing the canyon of the river of Bukovice nearby Šavnik, • Negative visual effects due to numerous settlements in the vicinity of the route.
D2b ČEVO ŠAVNIK (WEST)-part of proposed route	
LOCATION	VISIBILITY

1. Roads, tourist areas, viewpoints 2. Komarnica	• Route is well sheltered because it bypasses attractive tourist areas an major main roads, • Visibility of route at the passing over the Komarnica river canyon

D3a WEST SUB VARIANT OF PASSING THE NP DURMITOR ,ŠAVNIK-PLJEVLJA

LOCATION	VISIBILITY
1.Roads, tourist areas, viewpoints 2.Tara	• Route is well sheltered because it bypasses attractive tourist areas an major main roads, • Visibility of route at the passing over the Tara river canyon

D3 ŠAVNIK-PLJEVLJA part of proposed route

LOCATION	VISIBILITY
1. Road Šavnik – Žabljak – Pljevlja 2. lake 3. Njegovuđa 4. Canyon of Tara, Kosanica	• Route is well sheletered because it bypasses major main roads, • Route is located at a distance bigger than 1.5 km and has no negative influence on the said objects, • Route uses the current corridor of a transmission line and has no significant visual effect as regards the existing corridor.

Possible placement of underground casbles is not justified or acceptable technically, at this voltage level because of the following:

- Need to construct additional facilities at places of overhead line truning into the underground one which would require additional space for their construction.
- Longer lasting of repair at underground cable in elation to the overhead one which may result in instability of the system and have negative economic effects due to undelivered electricity.
- Higher price of underground line equipment in relation to the overhead line.

CREATED CONDITIONS – INFLUENCE OF INFRUSTRUCTURAL CORRIDOR

POPULATION

All considered routes of a transmission line were favourable from demographic aspect because of their passing in the vicinity of settlements of low population with old population.

On all routes, it is mainly about settlement of scattered type with rare housing objects, except for the route Nikšić-Čevo in the east subvariant of this route passing through Ozrinići (settlement in Nikšićko field which, in 2003 had 2 057 citizens) due to which it is proposed west variant of this part of the route, which is the most optimal solution, from demographic aspect of view.

Considering that settlement are on the route of scattered type with significant distance between houses, it is easy to avoid the harmful effect of radiation on population.

AGRICULTURE

Primary agricultural production, generally speaking, is based on usage of land areas, as basic resource,on a long term sustainable manner. Land area used for various types of agricultural production may be categorized as agricultural lands with several subcategories (pastures, meadows, orchards and vineyards, ponds) and forest lands (shrubs of spring and high forests) and wastelands.

An important aspect of recognizing and work out of detailed spatial plan for corridor of 400 kV transmision line from montenegrin coast to Pljevlja is the influence of this energy infrastructural object on usage of small agricultural areas on its route. It is especially important aspect of recognizing of possible unfavorable influences of this object to agricultural production in the area and its vicinity.

Generally, according to practice, placing of route of a transmission line requires certain continual ususrpation and change of purpose of the agricultural land for the purposes of placing converter stations, transformer stations and tower footprints. Agricultural areas under the transmission line route may be used through certain types of agricultural production like hay production, mechanized land processing and not for making orchards or temporary or permanent infrastructural objects in agriculture.

First part of the route (so called east variant of Lastva-Čevo route) in the lenght of 37 km goes from Lastva Grbaljska entering the zone of the National park Lovćen, goes east through the territory of municipality of Budva towards the existing main road, that is, by the south edge of the NP lovćen bypassing Mastori stretching east from Ivanova korita (through the II zone of the national park Lovćen) and further through Resan to Čevo.

Main converter station in Lastva Grbaljska is planned to be located in the part behind the industrial zone, location Blato. Those are, mildly broken agricultural areas of low fertility dominated by ponds. In order those lands to be used according to their purposes, it would be necessary to perform numerous complex agrotechnical measures, it is not predicted by current spatial plans. Thus, although it is about a large area, from the aspect of quality and previous volume and manner of usage of those

areas, it is a good solution because it does not deteriorate current agricultural areas which are used for that purpose or may be used according to their purpose.

The transmission line route from converter station along Lovćen sides and further through the zone of national park Lovćen to Čevo, stretches mainly through the area of stone, low vegetation and low to high forests while flat agricultural areas are mainly present in the form of smaller of bigger plateaus which are suitable for intensive processing although most of them is not accessible for machinery and, thus, not available for processing. Such a structure of agricultural and other lands and a possibility of their usage is not a limitation factor as regards future transimission line route stretching (not only housing objects but other infrastructural objects on the route or in the vicinity of transmission line passing along with technically prescribed security from possible harmful influence to people, animals). When projecting, it shall be defined the transmission line route and optical cable route.

Second part of the route of a transmission line (Čevo– Šavnik) goes from Čevo through Bijele fields, on the west side it bypasses settlements of Gornje Polje, Miločani, further through Jasenovo polje and Donje Brezane, passing the canyon of Komarnica and enters Šavnik municipality. This route is of 72 km lenght.

Part of this route to Duga and Jasenovno polje in Nikšić is similar, as regards configuration and structure and manner of usage, to first part of the route Čevo, resulting in the same recommendations. Part from Jasenovo polje through Brezna is dominated by pastures, meadows and forests,that is, areas accessible and efficient for agricultural production althhough relatively rarely settled. This area should be carefully approached referring to placing of the transmission line route, especially through Donja Brezna, not only in relation to settlements and arable agricultural lands but in relation to current and potentially planned eco tourist settlements.

Third part of the route (Šavnik – Žabljak – Pljevlja) bypasses Šavnik in the north west side, through Mljetička and Gornja Bukovica and further through Jezerska plateau bypassing the settlement Njegovudje entering the canyon of Tara following the existing road infrastructure, passing over Tara downstream from the bridge on Djurdjevića Tara and in the vicinity of current transmission line from where it goes up along the canyon and exists in the east part of Kosanica, further through Bitinsko polje and Kruševo to the final transformer station in the vicinity of thermal power plant. This route is of 45 km lenght.

It shoud be emphasised that this part of a transmission line route passes throguh the national park Durmitor by its largest part. Besides that, this part of the route mostly passes through relatively quality agricultural areas or forest areas of high forests. From the aspect of agricultural areas, it is expressed in the part of Gornja Bukovica and Jezerska plateau which are used for the purposes of a traditional cattle production and lately, for commercial production of potato and crops. When placing the transmission line route, it should pay attention to preserve the environment of the National park and agricultural areas.

Carefully selected and placed routes in this part are necessary from the aspect of settlements, current and potential economic objects, especially as regards potential tourist objects and capacities for usage and exploitation of sources.

Part of the transmission line route at the territory of the municipality of Pljevlja, apart from certain forest areas, is made of quality agricultural areas used for production of crops, potato and other vegetables, and for cattle feeding as well. In the river Tara canyon and part of settlement close to Pljevlja (Kruševo, Rabitlje), apart from agricultural areas for processing, route passing shall demand permanent elimination of most of orchards to be on the way of the transmission line route.

Considering that transmission line through this ares is inevitable, and usage of agricultural land shall, for the purposes of farming and crop production, be continued with intensive usage of various machines and equipment, it is necessary to pay attention to safety (safety heights, protection layer around tower fooprints..) according to technical regulations for this area.

For all tower footprints to be located at agricultural ares which have been intensively used or shall be used with agricultural machines of larger dimensions (trailers with connections, harvester), the protective layer shall be predicted for security reasons.

Possible deterioration of agricultural area and of total environment does not relate only to placement of tower footprints and transmission routes but to breaking of access roads and consrtuction of necessary transofrmer stations or other infrastructural objects.

During construction of the transmission line route, the contractor and, later, user of this infrastructural object, must provide to population located at the transmission line routing, basic information regarding potential dangers and risks, measures of precaution to be complied with.

FORESTRY

Influence of infrastructural corridor to environment and measures of protecton

Condition of biodiversity at the area of transmission line route is stabile because the route shall proportionally influence vicinity of its narrower corridor. Possible conflicts, such as passing through protected area, passing through the national parks, interventions of trees cutting and influence to ornithofauna shall be additionally resolved.

Transmission line route at the subject corridor shall have negative influence on:

- faunu and flora at the area of the zone – changes on land, decrease of vegetation, obstacles for animals movement;
- pollution of land at the transmission line route due to cargo, oil and derivatives spillage, and throwing out the trash;
- influence of electro magnetic radiation of transmission line to wildlife.

As regards protection of forest ecosystems, special attention should be paid to protection of forests and other vegetables from fire. Namely, fires at the whole adriatic layer are big problem because occurring during dry periods during the year.

Evergreen vegetation and its degradation forms, conifers, are very sensitive to fires, whether undergorund ones of ground ones which are fastly spread at the lightest wind and not easy to control. This problem is even bigger if having in mind that fires may drastically devastate the vegetation cover and pedologic layer which is difficult to recover, usually to the grass form or low bushes.

Repair of fire exposed areas is an expensive and long term process requiring seemingly simple activities of afforestation, insemination... However, due to burnt and degraded humus layer in the pedological profile changing its structure and texture in that case, yield of planted seedlings is often low making faster renewal of grass formations only, but, during the dry period, just formed grass layer is very sensitive to the new fire in which case the humus layer is permanently destroyed encouriging sudden development of pluvial and aeolian erosion.

Measure to protect and upgrade the environment should be realized through:

- Application of technical measures to remove or decrease to acceptable level of unfavourable influences,
- Application of protective measures agains: fire, electro magnetic radiation, flora and fauna, negative influences, aesthetic development of the route corridor area... .
- Measure to upgrade the existing vegatation condition – *afforestation on forest lands* (allocation of planting at allowed transmission line edge to a distance allowing growth of forest trees);
- The investor is obliged to provide the following: reconstruction and landscape development of a complex and preservation of current high vegetation.

Measures to realize planting of forest vegetation with protective function:

New seedling should be directed to creation of new habitats on forest lands and bare lands at safe distance from the transmission line on which occasion the investor must oblige to offer such solutions as regards aesthetics and visualisation providing not only functionality but positive aesthetic charazeristic to the transmission line. Planting of trees and bushes using material of max 2,5 m height with evergreen species of dense crown to provide dense of plants and protect the area but support aesthetic development of the transmission line rooute. Measures of animal protection shall be provided whenever possible by creation of favourable habitual conditions for wild fauna.

As regards the location of main transmision line station, at the landing place on Jaz cape, the terrain is characterized by expressed karst phenomena with bushy vegetation. From the aspect of accessability, it is possible to make excavations in them and locate transmission towers with no special limitation. Still, due to numerous specifities of this space, it should pay attention to plants and animals and of their protection measures.

In this contex, especially at the starting station of a transmission line, it should pay attention to the following circumstances:

1. part of the location comprises the Morsko dobro zone which may have an adverse effect to the landscape and affects tourism development and activities relying on it in this area;
2. the fact that Montenegro is a signatory of a Convention for the protection of the Marine environment and the coastal region of the Mediterranean (Official Gazette of Montenegro No. 64/07) that is, Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources obliges the state to follow obligations resulting form this document.

Vaiety of geological base, area, climate and land and the position of Montenegro at the Balkan peninsula and Mediterranean have created conditions for creation of biological diversity of high values which classifies Montenegro in biological „hot spots" of european and world biodiversity. Namely, if compared to other european countries, montenegrin biodiversity has very high values (as per the index size S/A= 0.837 which is the ratio of vascular flora species and the size of state territory, Montenegro is considered one of the most significant centers of biodiversities in Europe). At the proposed route location, various elements of flora and fauna are present, from mediterranean, sub mediterranean thermophilic vegetation, through mesophilic, xerophilic or frigoriphilic deciduous forests to conifer forests of euro-north-american region with various bilogical species which are to be protected as much as possible during construction of infrastructural objects.

Biogeographic position of Montenegro has determined presence of numerous migratory bird species whose main direction of migration are from continental Europe towards Mediterranean and, further, to Africa, that is, Asia. Many species of international importance are among them. Previous should have in mind because such infrastructural objects, like transmission lines, may negatively affect the migratory paths and security of ornitofauna at the aea it is located at.

Sl.35. – forest landscape in the vicinity of Njegovuđe

TRAFFIC INFRASTRUCTURE

Considering the size of area the subject transmission line spread at, there is no doubt there will be conflict with numerous existing traffic coridors of Montenegro. When creating project documents, it is necessary to respect all conditions and legal regulation defining the manner of transfer and conditions of 40kV transmission line spreading through and along the traffic corridors.

Road transportation

Highway – Corridor of 400kV transmission lines crosses planned Adriatic- ionian motorway (border with Bosnia and Hercegovina (in the region of Nudola) – Grahovo – Čevo –Podgorica – tunnel through Dečić (border with Albania) in the visinity of Čevo. Graphic enclose shows the route with protective layer taken from the General project (part Nudo-Zelenika).

Main roads for fast motor traffic crossed by the 400kV transmission line route and whose routes and protective layer have been taken from PP of Monteengro are:

- **Adriatic motorway for fast motor traffic**: Debeli brijeg (border towards Croatia) – Herceg Novi – crossing through Bokokotorski bay-Tivat - Budva – Bar – Ulcinj – region of Fraskanjela (border towards Albania).
- **Šćepan polje (border towards Bosnia and Hercegovina) Plužine– Nikšić – Podgorica.**

Major condition to be taken into consideration when projecting the transmission line route in relation to planned motoray and main road for fast traffic is not to deteriorate the area reserved for construction of planned roads. Also, it should pay attention to provide safety height beyond the highway of 7m. Distance from any part of tower to the edge of motorway is 40 m. Isolation must be mechanically and electrically enforced. The angle of crossing must not be lower than 30^0.

Planned and current main roads crossed by the corridor of the transmission line or located in its vicinity are:

M – 2 Transmission line crosses the main road at Radanovići2- Budva (entrance). This main road shall be reconstructed into the raod of boulevard type in the forthcoming planning period which should be taken into consideration when creating project documents of the transmission line. Planned profile wiidth is 2x (2x3.5m) with an area between of 2 m width and both sided sidewalk of 2.0m width. Profile of a road may vary up to 31m depending on number of access paths.

New main road Cetinje – Nikšić which will use parts of current regional roads.

M – 6 Transmission line crosses the subject road at the part of new main road Risan – Žabljak. The road retains its current route.

M – 18 (Šćepan polje (border with B and H)– Nikšić - Podgorica - Božaj (border with Albania)). Transmission line crosses the subject road at i Vilusi –Riđani aprt.Part of the road from Šćepan polje to Podgorica has been acquiring the rank of a main road for fast motor taffic.

New main road Prijepolje (border with Serbia)-Pljevlja-Žabljak-Nikšić-Boka Kotorska has been using parts of current roads: Regional road R-4 part Pljevlja – Đurđevića Tara, regional road R-5 part Đurđrvića Tara – Žabljak, the newly constructed road Šavnik –Žabljak and planned road Brezna- Prošćenje.

Main conditions of crosing and maintaining the transmission line in relation to main roads are:

- safety height of 7m
- distance from any part of the road edge must not be smaller than 20m.
- isolation must be mechanically and electrically enforced ;
- angle of water and regional road crossing is at least 30^0

Planned regional roads crossed by the corridor of a transmission line or which are located in its vicinity are:

R – 13 Corridor of a transmission line crosses the subject road along the development zone of Ivanova Korita.

R – 15 On parts of part Čekanje – Resna, the transmission line spreads in paralel to the road crossing a part Resna –Čevo. It is predicted to reconstrruct the road, while certain parts shall be parts of the new main road Cetinje – Nikšić.

R – 6 Vir - Krstac (border with BiH); Corridor of a transmission line srosses the subject road nearby Duga. Reconstruction of road is predicted.

New regional road Kosanica-Gibći-Meštrevac (border with BiH), corridor is defined by the spatial plan of Montenegro and route shall be determined during the projecting phase.

Considerinf that the transmission line corridor passes through 8 municipalities, it is inevitable that it will cross numerous local roads.

DPP provides undergorund placement of cable of 500Kv in basis of a road from the landing place, along the edge of Mrčevo field, to Blato location. The road route separates from the existing local road nearby the mouth of Jaška river, follows the riverbed, crosses Mrčevo field to Adriatic motorway. At that place the cable crosses the motorway following the route of current unpaved one to Blato location. When crossing cable with the Adriatic motorway, it should pay attention to installations placed within the road and protective layer (regional water supply, optical cable and other local lines).

Main geometric parameters for projecting and reconstruction of local road from the landing place to Blato location in whose basis 400 kV cable shall be constructed are:

- Velocity Vr = 30 km/h;
- Min diameter of horizontal curve min R=40m;
- Max longitudinal slope 7%;
- Width of a road 3.0m;
- Width of a sidewalk 1.5m;
- Road construction flexible with asphalt surface.

Planned road at the edge of Mrčevo polje stretches between development zones in the function of tourism and shall be used as a backbone of total planned road infrastructure in the function of purposes taken over from PPO Budva and Kotor.

Main conditions of crossing and placement of a transmission line in relation to regional and local roads are: :

- safety height of 7m
- distance from any part of the road outer edge must not be smaller than 10m.
- isolation must be electrically enforced;
- angle of crossing of line and regional road is at least 30^0 , while for local roads and for industrial objects the angle of crossing is not limited.

Railway traffic
The transmission line crosses planned rail of secondary network Nikšić – Bileća which would provide connection to Corridor V.
Main conditions of crossing and placement of the transmission line in relation to railway are:

- Angle of srossing must not be smaller than 45^0;
- Safety height of the line from the upper edge of rail must be 12m, considering that all rails in planning period shall be electrified;
- If lines are placed above the station terminals, discharging ramp and areas, safety height of line from the upper rail edge must not be lower than 15 m, considering that all rails in the planning period shall be electrified;
- When crossing or approaching of water and railway, the least horizontal distance of tower from the nearest rail is 10m.

Air traffic- Current and planned airports in the vicinity of a transmission line corridor and which must be taken into account when projecting and placement of it:

- **Airport Tivat** which if primary importance importance for Monteengro and as such shall be developed into 4D category.
- **Secondary airports:**
  Airport Nikšić (Kapino polje),
  Airport Žabljak
  Airport Pljevlja

These airports shall be developed into category 3C at least. They will be used as special purposes airports: recreational flying and (seasonal) regional traffic and for smaller business planes.

Transmision lines must not go over the airport. Distance of the line from the take off-landing path must not be smaller than 1000m, the direction of the path must not be crossed at a distance smaller than 3000m. Lines must not go over the helioport or to get closer to the basic basic directions of taking off and landing at a distance smaller than 1000m.

Water traffic – landing place and its placement to a converter station is not at sufficient spatial distance from the port and marine in Budva, and shall not have influence to their functioning.

In the planning period, it is predicted to construct a pier in the bays of Trsteno and Jaz, which must be taken into consideration when projecting and placement of undersea cable to provide safe and secure marine traffic.

When projecting and placement of cable, it is necessary to take all precautions to eliminate conflict of cable and waterways. Namely, there is no doubt the planned undersea cable crosses the waterway. To eliminate possible risks, cable shall be placed in the vicinity of of coast by HDD (horizontal directional drilling) technique. That technique implies placement of protective pipes by drilling thrugh layers at the sea bed. After placement, that is, drilling of horizontal pipelines, the cable shall be placed.

In the vicinity of planned corridor of a transmission line, there is a light “Platamuni” serving to provide waterways at position 42 16.046; 18 46.737. (the list of lights of montengrin coast of Adriatic sea and Skadar lake- table of lights from 2010, number of light 778, international number E3685). Considering that subject light is of importance for safety and security of sailing and its undisturbed operation must be enabled when projecting and performing works.

After completion of works at the sea bed it is necessary to be enterd into nautical cards and publications.

ELECTRIC ENERGY INFRASTRUCTURE

The following graphics show development phases until 2016. and 2020. which are excerpts from development plans of EPCG.

Pic 36. Developemnt phase until 2016.

Pic 37. Development phase until 2020.

ELECTRIC ENERGY INFRASTRUCTURE AND CONNECTION OF INFRASTRUCTURAL CORRIDOR WITH INFRASTRUCTURAL SYSTEM IN THE SURROUNDING

Construction of TS 400/110 Lastva Grbaljska , connection with DV 400 kV Podgorica 2- Trebinje at principle „entrance-exit and construction of DV 400 kV Lastva Grbaljska – Pljevlja 2

Current transmission network of CGES was made as an integral part of a big system of ex Yugoslavia. having in mind that in the last thirty years no major investments into the transmission network were made with the exception of several projects that have been under realization for the last few years, and having in mind that main pre condition of transmission network development planning is to provide reliable, safe and stabile operation of complete energy system, future development of a transmission system should be adjusted with development of production capacitities, distribution system and requirements of consumers directly connected to transmission system.

Infavourable characteristics of transmission network of Montenegro are paralel 400 kV and 220 kV connections (400 kV Pljevlja 2 – Ribarevine – Podgorica 2 – Trebinje and 220 kV HE Piva – Pljevlja 2 – Podgorica 1 – HE Perućica – Trebinje) of uneven transmission powers (1330 MVA per line in 400 kV network opposite to 301 MVA per line in 220 kV network) and malfunctioning of certain parts of 400 kV network in certain conditions some parts of 220kV network are overloaded 220 kV which may cause the system breakdown.

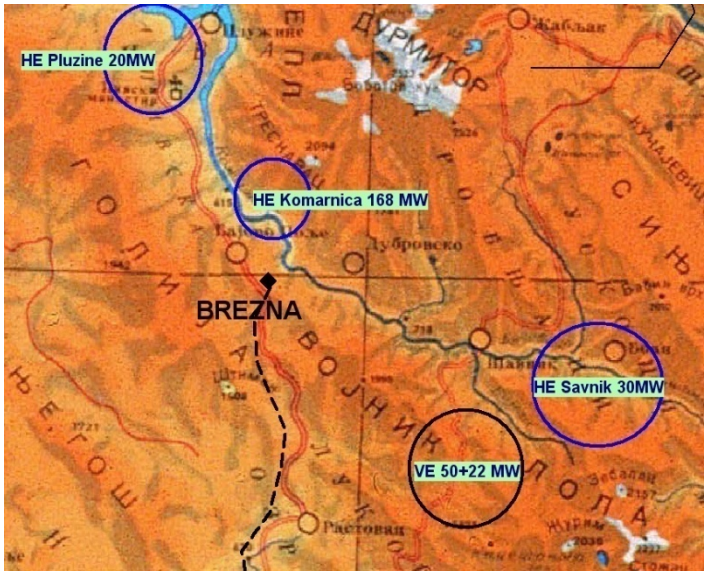
At the same time, with the above stated problem, there is a question of max usage of DC cable bewteen Montenegro and Italy of 1000MW, which has been planned by the Study of construction. If the full capacity of cable is to be used, one of main pre conditions is construction of one more connection from TS Lastva Grbaljska, where it has been predicted to construct the new TS 400/110 kV, the subject DC line should be introduced to. As a result of numerous analyses, it has been proposed construction of 400 kV DV Lastva Grbaljska – TS Pljevlja 2.
According to analyses, construction of new transformer station 400/110 kV Lastva Grbaljska, its connection to transmision network and 400 kV transmission line Lastva - Pljevlja 2 is provided by :

- Creation of necessary infrastructure for development of northern part of montenegrin seaside through strong supply point Lastva Grbaljska for the purposes of reliable supply of current consumers, creation of possibility to connect new supplier, having in mind requirements of potential investors of tourist objects in this part of montenegrin seaside.
  Regardless the construction of undersea cable, pursuant to the Strategy of energy development, it has been determined bringing of high voltage to Grbalj, and, according to the Spatial plan, it has been planned 400kV facilitiy in montenegrin seaside which would be connected to the transmission network appropriately;
- Losses of active power in transmision network, observed together with the construction of new 400/110 kV TS Lastva and its connection at the principle of entrance/exit to 400kV transmission line Podgorica 2 Trebinje, are reduced, at the annual level by 26252 MWh. Within the distribution network, losses decrease is 3037 MWh/god;
- Upgrading of voltage situation in coastal transformer stations Herceg Novi, Kotor, Tivat and Budva which are under nominal values within the analized regimes of winter and summer max. Future transformer station TS 400/110 kV Lastva Grbaljskara is unburdening the highly burdened 110 kV transmission lines Podgorica 2 - Budva and Podgorica 2-Virpazar-Bar. Observed critical conditions in regimes without the subject transformer station, difficult

voltage conditions in the region of Bar and Ulcinj, in case of malfunction of a transmission line 110 kV Podgorica 2-Virpazar with overburdening of a transmission line 110 kV Podgorica 2- Budva and critical condition due to failure of 110 kV DV Podgorica2-Budva, shall be resolved by putting the TS Lastva in operation.

- Decrease of undelivered electricity as a consequence of increased reliabiilty of the system operation
- Construction of 400 kV DV Lastva-Pljevlja 2 closes 400 kV ring within the transmission line of Montenegro (Lastva-Pljevlja-Ribarevine-Podgorica) making it safer and more reliable and decreasing the influence of nearby systems in cases of huge system disturbance;
- Construction of DV 400 kV Lastva-Pljevlja shall provide connection of new production units north from Nikšić (HE Komarnica, power plant in the surrounding of Šavnik and Plužine, VE in the area of Krnovo ..);
- For the purposes of double supply of TS Žabljak and occupying as less as possible part of the national park Durmitor, it is proposed part of the route of 400 kV transmission line Lastva - Pljevlja 2 from Brezane to Pljevlja to be realized by the double system towers of various voltage level 400 and 110 kV which would provide connection between TS 110/35 kV Brezna and TS 110/35 kV Žabljak and replace current conduct rope Al steel 150/25 mm^2 from TS Žabljak to TS Pljevlja with a section of 240/40 mm^2.
- Spatial plan and Strategy of development of energy of Montenegro provide construction of
- DV 110 kV Brezna – Žabljak and connection of HE Komarnica to 110 kV Durmitor ring. Construction of DV 400 kV Lastva Grbaljska – Pljevlja 2 and mixed towers of 400kV/110kV through the national park Durmitor it would save space and achie better solution of cinnection of HE Komarnica to transmission line which would determine the Study of connection once technical conditions are achieved;
- 400 kV DV Lastva Grbaljska – Pljevlja 2 resolves problems with congestions at the border Montenegro-Bosnia and Hercegovina observed on the occasion of transfer of 1000 MW through DC cable to Italy and is a pre condition for complete usage of capacity of 1000 MW of undersea cable between Monteengro and Italy. In this way, Montenegro shall be positioned as an important electricity-energy node within the region.

Seleciton of future 400 kV DV Lastva-Pljevlja 2 shall, apart from the aspect of environmental protection and demographic aspect, shall be defined by technical (fulfilment of ssafety criterion of transmission system according to temporarry codex of montenegro) and economic aspect (evaluation of the lowest investments into the transmission metwork in order to connect the analized objects). This project has been analized through the ten year plan of transmission network development taking into consideration all available data on new production objects.Projects predicted on the basis of requirements for conncetion of objects have been shown on the picture:



Slika 38. - Priključenje proizvodnih objekata na prenosnu mrežu Crne Gore

Construction of TS Brezna (I phase – transformation of 110/35 phase – transformation 400/110 kV)

Having in mind that, according to delivered plan of the competetive ministry, it is expected putting into function in 2014 of VE Krnovo (certain project) and, after that, mHE Šavnik and mHE Plužine and HE Komarnica, it is necessary to provide the optimal manner of their connection to the transmission network. Installed capacities (and planned extension) of production objects which, according to plan delivered by the competetive ministry, would be connected to a transmission network in the region, north of Nikšić, are as follows:

- HE Komarnica – **168 MW** (2018) dividing position for HE Komarnica is predicted in the profile Lonci, 45 km upstream from the current dam Mratinje (HE Piva) on the river Piva.
- VE Krnovo – phase I **50 MW** (2014-2018), phase II **72 MW** (2018-2020),phase III **144 MW** (2021-)

Wind power plant Krnovo is located north from Nikšić. During the first phase of construction, it is predicted to install 72 MW (50MW in 2014. and additional 22 MW in 2018.) at the location of i Krnovo 1, while, during the second phase, it is predicted to construct the remaining 67.2 MW at the location Krnovo 2 and 3.

- HE Plužine – **21 MW** (2014) – installed power includes mHE Stabna - 7.4 MW, mHE Jasen - 10 MW, mHE Vrbnica - 3.5 MW
- HE Šavnik – **30 MW** (2014) - installed power includes HE Šavnik -15.8 MW, mHE Podmalinsko - 5.7 MW, mHE Boan - 6.7 MW, mHE Sirovac - 1.7 MW

Watercourse on which the subject power plants shall be constructed are divided on two main groups: area of Plužine i Šavnik, in the north part of Montenegro. The first group of HE shall be realized at the territory of Plužine on the river Vrbnica, while other group shall be realized at the territory of Šavnik on rivers Bukovica, Bijela and Tušinja. Government of Montenegro has agreed with the realization of project through private investments.

On the basis of those data on installed power of production objects which shall be realized and plans of their capacities extension, it is necessary to systematically resolve the manner of their connection to prevent congestion on 110 kV directed to HE Perućica – TS Podgorica 1 which is important for stability and safety of complete EES of Montenegro operation. The above stated 110kV direction is highly burdened in winter regimes when max engagement of HE Perućica. Upon entering into operation G8 into HE Perućica (58.5 MW, according to 2012 plan) and increasing of its installed capacity to approximately 350 MW, this 110kV direction is congested because the safety criterion N-1 is not complied with. Further, after connection of stated production objects (VE Krnovo, HE Šavnik, HE Plužine) to 110 kV network in the region of Nikšić, the complete power from those sources would be placed through directions of HE Perućica-TS Podgorica 1 which would burden it additionally deteriorating the N-1 criterion of safety, that is, it would cause loadings in case of failure of one of transmission lines in that direction.

Problem would be solved by construction of TS 400/110/35 kV Brezna, on which occasion complete produced energy would be expelled through transformers to TS Brezna to 400 kV voltage level. On the other side, by increasing the transformer station Kličevo-Brezna (AlFe 240/40 mm^2) which has been pre dimensioned for 110 kV voltage level. Construction of TS 110/10 kV Nikšić 2 (Kličevo) shall, on the long term basis, will resolve the problem of lack of capacity as regards transformation in Nikšić. Also, transformation of 110kV/35 in Brezna is necessary to supply, through 35kV voltage level, the settlements of Brezna, Plužine, Unač, Mratinje and Crkvičko Polje.
On the basis of above stated, as guuidelines of future development of transmission network, it is necessary to provide the following:

1. Connection of mHE Šavnik and Plužine (total power 50MW), on which occasion, as optimal and technically feasible, variants of connection to new TS 110/35 kV Brezna are imposed.
2. Connection of VE Krnovo (power 50+22MW), with the most favourable variant of connection to future TS 110/35 kV Brezna , that is, if it is requested 140MW, connection to future TS 400/110/35 kV Brezna
3. Connection of HE Komarnica to TS 400/110 kV Brezna

It is recommended the future DV 400 kV Lastva Grbaljska-Pljevlja 2 route to be made in order to provide connection of all previously stated production objects. It is considered that location of new TS 110/35 kV Brezna, that is in future phase TS 400/110/35 kV Brezna, would ba strong encouragement to potential investors to plan construction of new production objects in the vicinity of such an object providing disposal of power to DC cable and the rest of part of EES of Montenegro through 400 kV network decreasing losses in the transmission network (in relation to losses which might occur if the subject power plants are connected to 110 kV network).

At the same time, construction of new TS 400/110/35 kV in Brezna would enable connection of EES Monteengro with nearby EES of Bosnia and Hercegovina from direction of TS Gacko, or HE Buk Bijela if Bosnia and Hercegovina decides to construct it. It is important if taking into consideration the fact that current TS 400/110 kV Pljevlja 2 has no possibility to extend for more than two transmission line fields (reserved for transmission line from direction of B.Basta (RS) or TS Višegrad (BA)).

Resolution of 110 kV line in Lastva Grbaljska

It is expected new transformer station TS 400/110 Lastva Grbaljska to resolve problems of supply in the coastal part of EES Montenegro with the major idea to unburden 110 kV network supplying the seaside from the east (TS Podgorica 2). Having in mind that 400 kV transmission network of Montenegro is relatively lightly loaded and that power is mostly

transfered through 110 kv network, construction of said transformer station helps better usage of and reducing of lossses in 400 kV network. As previously stated, putting into operation of new transformer station TS 400/110 kV Lastva Grbaljska shall upgrade voltage situation in transfromer stations Herceg Novi, Kotor, Tivat and Budva which are under nominal values within regimes of stated transformer station.The subject transformer station shall unburden the highly burdened 110 kV transformer lines Podgorica 2 – Budva and Podgorica 2 – Virpazar-Bar.

Due to stated reasons, it is necessary the following:

- The existing transmission line 110 kV Budva – Tivat to be cut in the zone beyond Lastva Grbaljska, in Gorovici settlement and make entrance-exit towards transformer station
- TS 400/110 Lastva Grbaljska, to get two transmission lines 110 kV Lastva Grbaljska – Budva and Lastva Grbaljska – Tivat.
- To plan the transmission line 110 kV Lastva Grbaljska – Kotor, whose route would be paralel, to the great extent, to the existing transmission line Budva –Tivat route, while, in the vicinity of monastery Sv. Trojica the route would be common, on the same towers, with the planned transmission line 110 kV Tivat – Kotor. In this manner, it would be upgraded supply of Kotor, which, within current system, is the point of low reliability of supply with electricity.
- It is necessary to supply, by expressed power and energy of future consumers and large investors, TS 110/35 kV Tivat by one more transmission line of 110 kV, which would start from the newly planned TS Lastva Grbaljska. In order to provide the corridor for this this line, and save the space, it should plan construction of double line 110 kV Lastva –Kotor and 110 kV Lastva- Tivat, to the location nearby monastery Sv. Trojice.

TELECOMMUNICATION INFRASTRUCTURE

The plarfom to construct planning solutions in the area of telecommunication infrastructure is made of elements of programming task and program indicators. Out of programming tasks for this area, it is important to emphasise aims relating to connection the subject area with centers of immediate and wider surrounding.

Programming indicators define the concept of spatial purpose and infrastructural furnishing according to current regulations and standards. If geography of area is taken into consideration, it is imposed the concept of planning solution of telecommunication infrastructure strategy. The basis is construction of telecommunication optical main road going along the planned transmission line route. Distribution of optical main road is possible to be made at any place necessary. Optical cables are to be placed at cable tk canalization of min capacity 4PVC Ø110mm. It should provide cables to be placed through flexible and, than, through, PE pipes. In this way one more cable optic main road shall be created as well as possibility for alternative and new connection of telecommunication resources of all areas comprised. Positioning of subject areas in relation to planned and current optical cable main roads provides almost indefinite possiblities for development of telecommunication infrastructure and resources for a long period of time.

Considering it refers to almost new areas from the aspect of telecommunication infrastructure and resources development, the processor has no dilemma referring to selection of the type of access network in zones of settlements and content holder concentration.

Those are optical transmission access neworks. Such a solution is important when having in mind the fact regarding expected highly demanding levels of telecommunication services, planned users in the vicinity of processed area. All optical cables are to be placed through cable canalization by using PVC pipes of Ø110mm and flexible PE pipes of Ø40mm.

All internal installations in objects are to be constructed by optical and structural cables of FTP and SFTP 4x2x0.5mm, min category 6e and 7 and to be placed through installation OVC pipes of appropriate section. Optical access networks belonging to certain zones and settlements as well as internal tk installations in objects shall be the subject of plans of lower rank and special development projects.

WATER MANAGEMENT AND HYDROTECHNICAL INFRASTRUCTURE

Planned condition

As regards water management and hydrotechinical infrastructure, related to DPP of transmission line corridor, the following basic tasks have been recognized:

- to list interaction (or possible conflict) of newly planned transmission line with constructed or predicted water management objects, and search for optimal solutions as regards object position and decreasing of negative effects when making decisions
- when planning new objects following the transmission line, provide hydrotechnical infrastructure required for their functioning

Within basins of the rivers Ćehotina, Tara, Piva, Zeta, and in the vicinity of the Adriatic sea basin, it is necessary to identify contact points of a transmission line with water management objects, current or potential

- water sources (to supply population, bottling, industry supply or watering) – recognition of zones of sanitary protection of sources
- water supplies - primary water supplies routes
- accumulations (all kinds and purposes)
- fish breeding objects - ponds and zones of mariculture
- water ways

Proposed route of planned transmission line starts at the coast of the Adriatic sea by underground water towards the converter station. The underground transmission line route is of cca 5,6 km lenght, passing through the area in which spatial plans of subject municipalities did not provide significant water management objects. This solution is not in conflict with water ways and does not require disturbance of environment or functionality of beaches. South from the converter station, it is necessary to make adequate crossing of underground transmission line with primary pipeline of regional water supply for Montenegrin coast.

From converter station, the transmission line goes north as an underground line, bypassing the area of Ivanova korita in the east. It passes the karst area nearby Čevo. Further, in the east, it bypasses artifical accumulations Slansko and Krupačko lake.
Canyon of Komarnica is passed by the route at the most favourable place – considering the possible future accumulation- west of Duži.
The area of Gornja Bukovica, which is significant due to its sources is bypassed by the route in the east, like the Vražje and Riblje lakes

As passing throught the canyon of Tara, it was selected the location of Đurđevića Tara. On left and right banks, there are several sources in the vicinity of which the

transmission line would be passing. At the area until Pljevlja, tha route area refers to several sources which are numerous in the subject area.

Apart from crossing with Komarnica canyon, proposed transmission line route avoids every area recognized by the Water management basis of Montenegro as potential location for hydro accumulation (Komarnica and Bukovica in any variant solution, accumulations for the purposes of watering or water supply).
After defining the route of future transmission line, the following objects have been defined within its area:

Lake	Distance from the transmission line axis	Area	Depth	Volume	Altitude
	[m]	[m^2]	[m]	[m^3]	[mnm]
Pošćensko	1000	15 300	1,0	15 000	1495
Krupačko	1700	19 500 000	5,2	42 100 000	620
Slansko	920	21 200 000	8,9	111 000 000	621

Source	Basin	Distance from the transmission line axis	Approximate yield
		[m]	[l/s]
Dedovica	Adriatic sea	200	1,00
Karlica	Slansko lake	670	0.08
Gornja Tisa	Krupačko lake	330	0.40
Sources Gornja Bukovica	Bukovica	0	0,09
Sources Gusarevci	Bukovica	120	1,62
Sources of village Bare Žugića	Tara	630	0,40
Sources of village Rasova	Tara	200	0,15
Sources of s. Đurđevića Tara	Tara	300	0,43
Sources of village Bitine	Tara	500	0,86
Sources of Kriješterovina	Tara	340	0,52
Sources of village Javorak	Mandovačka r.	200	0,23
Sources Krivački pond	Mandovačka r.	380	1,88
Sources of village Zabrđe	Mandovačka r.	70	1,51
Lučino source	Vezišnica	350	1,00
Sources of village Vrbica	Voloder	350	0,40
Sources of village Ljuće	Vezišnica	600	7,10
Sources of Babića pond	Vezišnica	140	7,87

Water supply system structure	**Water supply**	**Distance from the transmission line axis**	**Characteristics of a structure**
		[m]	
Reservoir	RO Boka, Mrčevo field	0	65 m3
Reservoir	Godijelji	350	60 m3
Prim. pipeline	Regional water supply CP	crossing	

Around the route axis, it is predicted a corridor of total width of 1000 m within which projected transmission line shall be more precisely located on the occasion of detailed projecting. In that phase, it is necessary to identify zones of sanitary protection of sources and other water management objects and avoid their unfavourable interactions with the transmission line (according to the Regulation book on determination and maintenance of zones and layers of sources sanitary protection and limitations of those zones (Official Gazette of Montenegro No. 66/09)
As regards providing of hydro technical infrastructure for planned objects related to the transmission line, attention is to be paid to the converter station object in Lastva Grbaljska. The station shall be equipped with sanitaries because of which it should be equipped with water and waste water drainage.

Station supply with water is possible by connection to water supply system of the settlement- from Lastva water supply. Treatment of collected waste water would-until the creating the possibility to connect to the local network of foul drainage- provide a small device to purify sanitary waste water, according to appropriate norms and regulations.

CULTURAL HISTORICAL HERITAGE

Possible influence of cables and transmission lines placing to cultural heritage and possible measure for its minimizing

Construction of a transmission line with optical cable from Montenegrin seaside to Pljevlja may influence the cultural heritage located at the areas on which it is planned to construct the stated transmission line. Cultural heritage located at areas the future transmission line route is passing through has a few protected cultural resources of significant monumental qualities, while numerous are characterized by objects of constructruction heritage, mainly sacred ones. Only a few protected cultural resources and recorded objects are located within the corridor, while numerous other are outside, it may be estimated that influence of construction of a transmission line to the cultural heritage may not be worrying to the extent to imply taking of certain protection measures. Certain, strongly expressed influences may be expected at the part of cultural heritage to be comprised by the transmission line like protected cultural heritage - Djurdjevac fort and archeological locality Municipium in the village of Komine nearby Pljevlja but part of recorded cultural heritage like church objects and archeological localities. Performing of earthen works as regards placement of towers of a transmission line with possible forming of appropriate access roads migh endanger the archeological locality, that is, archeological findings at the unrevealed parts of ancient necropolis and architectonic remains of Municipium in the village of Komine nearby Pljevlja, but they are located at undersea locations nearby Jaz cape. Unlike the archeological localities, at cultural heritage belonging to the construction heritage, mainly churches, which do not posses sensitive monumental values, it may be expected changes of landscapes. It is similar as regards remnants of traditional architecture it is necessary to take care of when working out the project documents and construction of a transmission line.

Proposal of necessary measures and researches

Besides the recommendation that during works on construction of transmission line in the vicinity of protected cultural heritages or recorded objects of construction heritage certain measures of precaution are to be taken in order to prevent drastic changes of monuments vicinity, it is not necessary to take other, special measures considering that no construction heritage is significantly endangered at the moment.

Special attention is recommended when performing earthen works on parts of transmission line passing by designated archeological localities, nearby Jaz cape and in the vicinity of Ivanova korita and Municipium.

Since there are no data if there are other archeological localities within the transmission line corridor because the area considered has never been archeologically reconnaissanced, it is proposed detailed archeological reconnaissance to be made before commencement of works, as it is practice around the world.

DESCRIPTION OF CURRENT ENVIRONMENTAL CONDITION AND ITS DEVELOPMENT

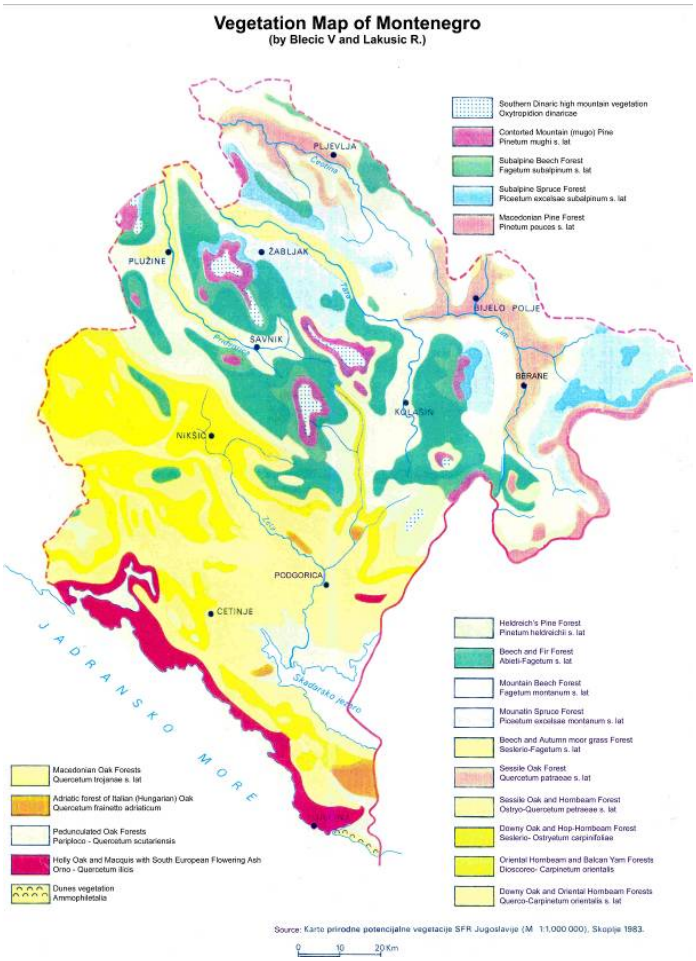
When defining corridor, it was taken into consideration biodiversity condition and natural values at considered transmission line routes. It is not possible to avoid completely negative influences to eco systems and protected areas and regions which have been proposed for protection.
Transmission line corridor is of 1 km width influencing the following zones[2].
Location of Blato in Lastva Grbaljska of new transformer station 400/110 kV Lastva. Besides the key negative effect to the part of settlement within the contact zone, this locality has been recognized as wetlands (swamp) at 12-14 m above sea level, with vegetation of natural meadows *Juncetalia maritimi*. For now, this location has not been recognized as a potential protected area, area of special importance-EMERALD area, Important bird area-IBA or Important plant area (IPA).

As regards considered variants of corridor for 400 kV transmisssion line Lastva – Pljevlja, a part Lastva – Čevo passes through rocky (limestone) area with extraordinary mountain Lovćen (Nationla park since 1952 but is also recognized as an Important plant area-IPA area and EMERALD area. In the zone of east and west variant of a corridor, there are forests which are characteristic to bio-geographic region of the mediterranean such as macchia plant (including communities of *Orno-Quercetum ilicis* and *Paliuretum adriaticum*) in the area of Grblje, various forests of beech on Lovćen (including protected beech forests on Konjsko at the area of 400 ha) and widely spread mixed forests of *Carpinus orientalis* with *Ostrya carpinifolia*, *Ruscus sp.*.... (including communities of *Rusco-Carpinetum orientalis* and *Ostryo - Carpinion orientalis).*

In the part Čevo–Šavnik, the transmission line continues through the waterless rocky area passing by the Krupac and Slano lakes (identified as IBA area) crosses the canyon of the river Komarnica (identified as the IPA area). Final part of this route part in in continental bio geographic region entering the zone nearby proposed widening of the National park Durmitor and the most attractive part of the Komarnica river canyon named Nevidio. In the vicinity of Nevidio canyon, there is a famous water fall Skakavica. Part of a corridor passes under slopes of Vojnik mountain having beech forests belonging to 9130 *Asperulo – Fagetum* beech forests stated in Appendix 1 of EU Habitat Directive 92/42 EEC.

Within the part Šavnik – Pljevlja, several variants have been considered.Considered variants cross the canyon of the Tara river reaching Pljevlja. They cross the NP Durmitor (identified as IPA, IBA and EMERALD area) which is also the UNESCO area of world heritage, part of M&B reserve of the river Tara basin.

Picture 39. – Map of vegetation of Montenegro



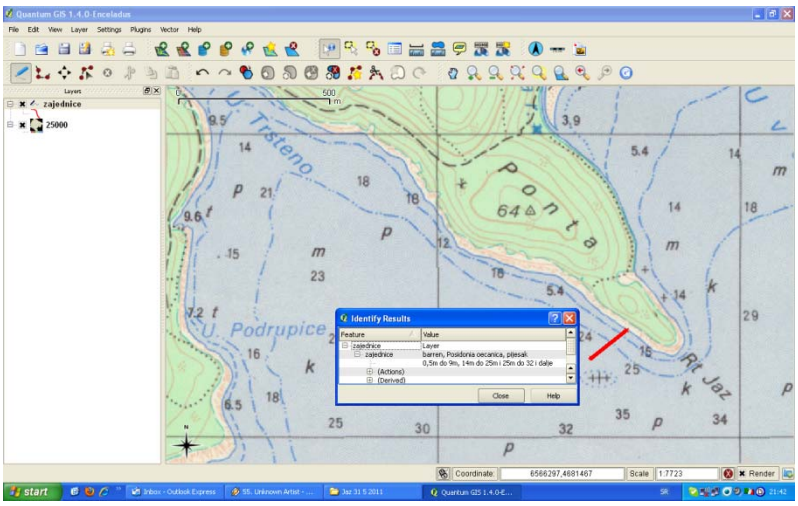
INFLUENCE OF A TRANSMISSION LINE TO ECOLOGICAL RESOURCES AND BIODIVERSITY

For the purposes of work out of DPP, studies have been made for the aspect of nature and biodiversity protection in the coastal part of the route and landing place of the cable, and for the aspect of nature and biodiversity protection in the land part of a transmission line/cable route. The study regarding the cultural heritage has also been made, influence of electro magnetic fields and analysis of HVDC connection and transmission line to people's health. They are part of the Strategic environmental influence.

Excerpt from the study for the aspect of environmental and biodiversity protection in coastal part- In the Adriatic sea and its east coast, there is a classic allocation of sediments from coast to depths. Coastal, littoral area is characterized by cliff and rocky bottom and various types of coastal, sandy- testaceous or so called dietrich bottoms. After those sediments, there is an area of coastal muddy bottoms and

sandy dietrich bottoms of open areas and muddy bottoms of open south Adriatic. (Morović, 1951, Alfirević, 1959).
Most of the wild life of the Adriatic sea belongs to littoral system and, thus, the wild life of open sea of Montenegrin coast. Those settlements, in the south Adriatic, spread to the depth of 200-250 meters.
Aphital (depth) system of deeper open south Adriatic comprise smaller part of the wild life of the south adriatic valley.
Depending on the influence prevailing, either the land and coast or open waters of south Adriatic, three biocenosis may be detected in this part of the Adriatic which are organized in a manner disabling making boundaries among them. Those are: biocenoses of terrigenous mud, biocenoses of dietrich bottoms of open seas, biocenoses of bathyal mud at depths.

Characterisitcs of biodiversity of researched area, cable routes to depth of 40 m, at the position of Jaz cape –Researches of underwater area, from the aspect of biodiversity, at the Jaz cape area, to 40 m depth, were made in June 2011.



Picture 40. Map and GIS projection of researched area of Jaz cape

Within the analysis, it was made the analysis of flora and fauna, ichthyofauna, phytobenthos and zoobenthos.
Special attention was paid to activities of fishing- trawling.

Sea fishing, in the sense of the Law on sea fishing and mariculture (Official Gazette of Montenegro No. 56/09) is management of sea living resources, collection and protection of fish and other sea organisms at principles of sustainable development, in the fishing sea of Montenegro. According to article 2 of this Law, the fishing sea of Montenegro is defined as follows: the fishing sea of Montenegro comprises the sea and undersea aea of internal sea waters, territorial sea and epicontinental area of Montenegro, defined by the law. The fishing sea comprises the sea areas of exclusive economic zone, according to this law.

Part of sea fishing which will be influenced by the activities of placing the undersea cable is the trawling fishing and some activities of coastal fishing (putting of treats). Those two kinds of fishing are extremely active in the coastal aree of open sea. According to article 25 of the law on sea fishing and mariculture „for protection of sea biodiversity in shallower zones of littoral, it is forbiden the fishing by pelagic and bottom trawls at the distance of 3 nautical miles following the coastal configuration, that is, at the depth of 50m, if the isobath of 50 m is at the distance smaller than three nautical miles".

Influence of magnetic field of undersea cable and electrode to flora and fauna

Cable – Pursuant to estimation given at special study characterizing electro megnetic fields of HVDC station, it is not expected the significantly expressed influence to flora and fauna and health and safety of humans (regardless the minor possiblity the man shall be in the vicinity of HVDC cable under sea). However, from the aspect of reducing to min possible negative effects to people's health, it is necessary to follow measures prescribed by the Satudy of influence to people's health, in the context of evaluation of influence of EMP field when placing the undersea cable.

Electrodes – By increasing the dimension of electrode in the sea, it is achieved prescribed value of electric field (field strenght is decreased) at the surface securing the safety of swimmers and divers, flora and fauna of the sea in the vicinity of electrode, even at physical contact with the construction. The lenght of construction of SAPEI cathode of HVDC connection in Italy is approximately 600m. On the basis of stated dimensions, it may be recognized the influence of construction to deterioration of natural configuration of coast. The electrode shall be anchored to the bottom and it has to be visibly marked and protected from vessels.

Excerpt from the study for the aspect of nature and biodiversity protection within the land part of the transmission line/cable route- Jaz cape is a wider location which has been recognized for landing place of 500 kV cable. Having in mind the ratio of proposed variants for passing of 500 kV cable on Jaz cape, pursuant to area and spatial position of protected Jaz area (monument of nature since 1968). That is why it is necessary, in the next phase of projecting and performance of works, to take into consideration thje environmental fitting of cable landing place to the coupling in the central part of the most protruding zone of Jaz cape. Previously stated variant for landing place of 50kV cable at the area of Platamuni is also unacceptable because it would endanger the spatial integrity of EMERALD area of Platamuni where there are certain habitats and protected species.

Location for converter station and transformer station- Blato location, which has been proposed in the DPP draft is not acceptable for vicinity of settlements, possible negative influence to environment and people's health.

At the location of Blato, it has also been registered the presence of wetland area with vegetation appropriate to habitat 1410 of Mediterranean salt meadow (Juncetalia

maritimi) of the Anex I EU Habitat Directive No. 92/43 EEC. Until now, the area has not been recognized as potentially protected one, EMERALD site, IBA are and IPA area. In the central part of Blato and along the edge of drainage channels, there is a species Juncus acutus making the community of Juncetum maritimo-acuti H-ić. Problems regarding the selection of transformer station and convereter station location within Blato shall not be resolved by allocation of location of TS and CS by a few hundred meters west because by its one part the TS and CS shall be present at previously stated type of habitat while by its other part they will require putting in the surrounding hill terrain having the macchia vegetation.

Passing through the NP Lovćen – Apart from spatial distribution of species and habitats which have been identified on the basis of Bern convention (EMERALD site Lovćen) and EU directive on habitats, it should take into consideration so called stable functional-ecological connections securing the zones among, mainly previously identified reservation/I zone of protection within this NP. At its character, those zones are not of greatest ecological importance to protect species/habitats they are located in them, but for mutual connection of other, ecologically important zones and securing of ecological integrity of the NP Lovćen.

Not neglecting other types of habitats, as regards securing of ecological integrity of NP Lovćen, it should emphasise forests, especially forest habitats which have already been identified by Bern convention (EMERALD site Lovćen) and EU directive on habitats. Having in mind the east variant of plan (DPP) for construction of double 400 kV transmission line Lastva Grbaljska –Pljevlja through the NP Lovćen it may be provided the ecological integrity for the most important forest and other habitats within the continual zone with mutual connection of previously defined of I zone of protection and reservation.

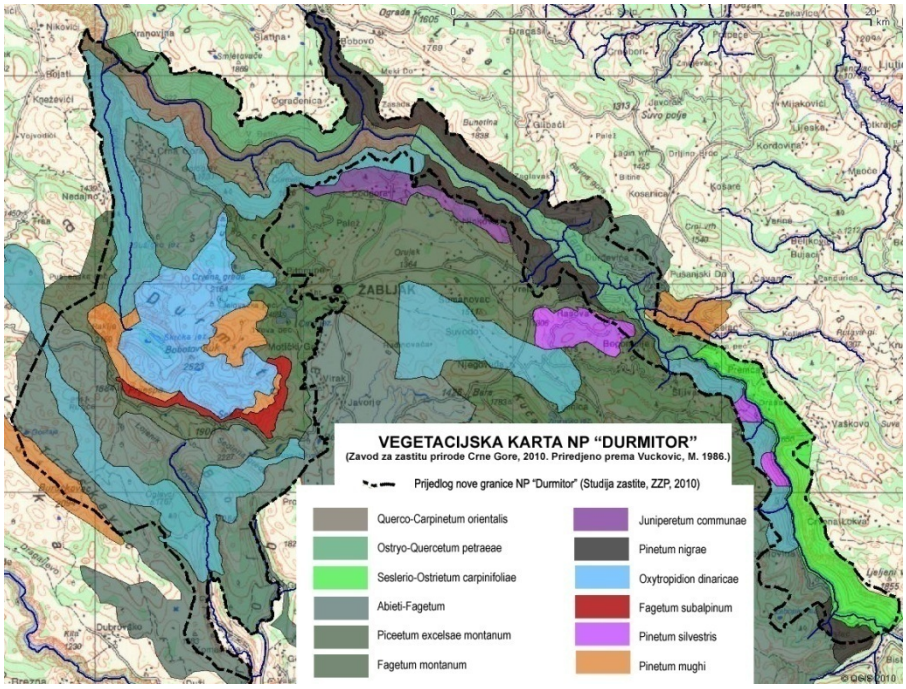
Passing through the NP Durmitor – The route of mixed transmission line 110 and 400 kV passes through the I zone of NP Durmitor protection in the zone of Đurđevića Tara. Thanks to complex physical – geographic factors on Durmitor, it has formed various vegetation layer considering that height difference from the bottom of canyon to highest mountain peaks is at 2000 m above sea level. There are approximately 1600 representatives of vascular flora and almost all fiso cenosis on the southern hemisphere. The area is rich in numerous endemic, rare, protected and otherwise useful and significant plants. There are few protected species (*Gentiana lutea*) and certain types of orchidea of *Orchis* and *Ophrys* which are due to anthoropogenic factors reduced to minimum.

Area at the bottom of Savin kuk is mostly represented by grass vegetation composed of meadows and pastures and smaller fragments of beech and mixed spruce and fir forests. No endemic and endemic-relic types of narrow distribution have been recorded.

Apart from previously treated forest vegetation, there are significant areas of grass vegetation made by pastures and meadows. All meadow associations may be pastures depending on the regime of usage and requirements of population. It is not the case

with pasture vegetation because some pastures may not become meadows under any conditions because of their flora, plant mass and habitat conditions.

It is about characteristics of certain phytocenosis in relation to some indicators such as unity of plants within the plant community.



Picture 41.Vegetation map of NP Durmitor

INFLUENCE OF TRANSMISSION LINE TO LANDSCAPE AND ENVIRONMENTAL VALUES

The greatest influence of proposed zero route with variant solutions of possible future transmission line route passing may be expected to protected areas landscape, that is, influence to natural landscape of the national park Lovćen and national park Durmitor.

Influence of planned transmission line which will deteriorated the existing balance of landscape infrastructures at wider area of the zone is reflected through inevitable changes of physical structure and visual perception of landscape as well as through possible devaluations of its ecological, economic and cultural-hystorical values. Considering it refers to the area which is, due to special landcape values, already protected, such type of intervention shall deteriorate characteristics of special natural values.

Pursuant to the Spatial plan of the national park Lovćen, natural landscape has been changed under the anthropogenic influence. With respect to geological, geomorphological and vegetation aspect, it is the basic value of the national park. Its relief has been formed by moderate process of glaciation and strong process of karstification and it is covered with vegetation.

Natural landscape is made of jagged morphological complex of mountain chain with all forms of „ angry rocks" combined with forest cover and bare areas. Karst landscape is present with all its forms. Glacial landscape is present at highest peaks of Lovćen. Flora landscape is made of forest and grass complexes. Anthoropogenic landscape is present in contact zones at karst fields of Cetinje, Njeguši, in troughs and plateaus of Bjeloši, Očinići, Uganji, Uganjska vrela, Obzovica and Brajići.

The following are environmental wholes: Ivanova korita with Small and Big Bostur, Dolovi with Lokve, Njeguši, Kuk, Majstori and Konjsko.

Pursuant to the spatial plan of the national park 'Durmitor', the area of park comprises 33 896 ha, and is one of the biggest national parks in Montenegro. The Law on national parks defines borders, park management, special protection zones and development and upgrading measures of natural resources.

Natural landscape of the national park 'Durmitor' is made of 5 basic biotopes:

Biotope of highmountain pastures and brown bullhead, biotope of rocks and cliffs, biotope of conifer forests, biotope of deciduous forests, biotope of water objects.

Based on the analysis of spatial planning documents, there were determined basic structural elements making the stated area landscape. Having in mind characteristics of the zone, it has been estimated possible influence of the subject transmission line to protected areas characteristics.

If it is not possible to avoid passing of the transmission line through protected areas, planned construction of a transmission line may pass through zones of special protection regime in which the anthopogenic influence to landscape has been allowed. Within the zones of strict protection of protected areas, it is not possible to construct the transmission line because it would affect the physical structure of landscape of the protected area: by removing the surface layer, placing the infrastructure and changing the landscape view.

During the usage of a transmission line, there will be influences to physical structure of landscape of protected area by maintaining the zone of constant clean layer, that is, by cutting down of shrubby and forest vegetation of the working layer.Removal of surface layer shall make tracks resulting in degradation of visual values of the area. Inside the subject layer activities will not be possible. Stated changes shall be obvious at high vegetation areas (forest and macchia area) as a result of forests tracks.

For the purposes of estimation of planned transmission line to the landscape and environmental values, some areas have been separated to be under legal protection (National parks) and they should be paid attention to on the occasion of final selection of a variant and during realization and usage of infrastructural object. Considering that route has been conditioned by the aspect of technical feasibility, it is not possible to

avoid the landscape and environmental values deterioration in some zones. It is proposed to work out the project of landscape development to establish the natural balance and adjusted relations with human influence.

Besides the influence of a transmission line to protected areas, it is expected the influence on the change of visual qualities and conversion of land. Such anthropogenic line element is visible in organic lines of natural landscape and is a continual degradation of visual landscape values. By passing through the forest area new tracks shall be formed creating the new forest edge resulting in defragmentation of habitat. When defining the transmission line route, it is necessary to follow the existing infrastructural elements to decrease the influence to visual and natural qualities of surrounding landscape.

GUIDELINES TO CONSTRUCT OBJECTS AND MINIMIZATION OF CONFLICTS WHEN USING THE SPACE, FROM THE ASPECT OF DEVELOPMENT OF AREA AND ENVIRONMENTAL PROTECTION

Transmission line, cable, converter station and transformer station are specific objects for whose realization is necessary to build in equipment and material which, upon completion of construction, must have the function of one techno-economic whole.

Considering the importance of object as regards safety of supply and drive and safety of people, objects and property, it is necessary to comply with all valid laws and regulations when projecting and construction.

- Special attention should be paid to crossing of the transmission line route and underground cable with the existing transmission lines, roads, railway, infrastructural objects and other significant existing and projected objects.
- Also, at the part of route passing through the national parks and sensitive areas, it should apply all known methods and procedures which shall minimize the influence of a transmission line to natural environment („fitting into the environment by using appropriate colours for towers, adequate form and height of tower, decreasing of the access roads number, putting two transmission lines on mutual towers..).
- Construction of subject structure is to be made according to final design on the basis of which the construction permission is to be issued. For the purposes of subject structure construction as well as for reconstruction of existing DV 400 kV Trebinje – Podgorica 2, it will be necessary to organize the basis- building site.

  This will be used only as the basis for delivery of tools, material, equipment, workers.. and its distribution to certain locations, that is, tower footprints, along the transmission line route. No construction interventions shall be made on such a building site in the sense of construction of a transmission line but the available terrain shall be adjusted to, with minor construction interventions and min preparations (putting of containers workers, development of terain to dispose material and tools, parking place, fence putting...) requirements of worker's staying and provide efficient construction of structure itself.

Concrete construction interventions, in the sense of excavation, concrete work, construction mounting, access roads construction are performed at a terrain which is, depending on the lenght of a transmission line and base location, at bigger or smaller distance from it. Stated works refer to locations of future tower footprints and depend on the allocation of towers which results in their performing at appropriate locations along the transmission line route. As it is evident that a transmission line is a construction to be observed as a sequence of partial segments, it is necessary to mention that each microlocation of such observed structure and zone is a specific one because of possible various terrain circumstances and technical solutions.

- Considering the lenght of a transmission line route, it is evident the need of forming several building sites-bases at several locations along the route.
- Transport of tower construction, electro-mounting equipment, devices, tools and other material necessary is predicted to be performed by appropriate transport means to the building site- tower footprints at the transmission line route, that is, cable trenches.
- For the pruposes of transport of material to tower footprints, it is required to perform repair of existing and construction of new access roads. It should use the existing and partially abandoned acces roads and take care not to devastate the existing arable land and agricultural corps on it meaning that it should use one accesss road to serve numerous towers.
- When performing the electro mounting works(stretching of cables through the high voltage cables, telecommunication lines and important roads), it should take measures of protection to prevent damages of stated objects.
- After construction of subject transmission line, it is necessary to develop the route, remove waste material and surplus excavated material to locations predicted to deposit such a material, repair demaged roads and dismantle the construction site and develop the surrounding terrain. In other words, terrain which would be occupied during construction shoud be put in condition before construction started.
- As regards tower footprints, it is necessary to mention that terrain around the tower footprints should be put in the original condition. If the excavation was made by mining, it is necessary to stabilize bigger broken off rocks, that is, secure the deposited material from possible rockfall...
- After construction of tower footprints at arable land, it would be necessary to perform development of completely damaged part of a parcel in a manner to provide the land deposited at that location to be redeposited to terrain which has been used for tower construction.
- In that manner it would be provided the said land to be used for appropriate agricultural purposes, with the exception of a part having tower footprints. It also refers to access roads if they will not be permanently used as access roads.
- At places where the route of subject transmission line passes through the forest area, that is terrain with low vegetation, it will be necessary to construct the appropriate forest track, when constructing the subject transmission line, that is, prior to putting into operation. On that occasion it is necessary to develop the terrain

by removing logs and cut mass from the location, that is, by depositing to prevent possible fires.

- As regards the tower footprints and their specificities, that is, complete transmission line routes, it is necessary to perform all interventions previously stated in the sense of land repair on which appropriate construction interventions have been made. **The route should be analysed in details especially at sensitive areas of national parks and by selected width of corridor of 1 km, it is provided possible displacement of the route axis inside the corridor when projecting. It is recommended to respect natural characteristics of terrain and property structure of land for the purposes of easier realization of the Project.**
- When projecting and constructing the transmission line within the corridor, it should precisely determine zones of tower footprints in a manner to provide the least possible negative effect, depending on the location. It should avoid valleys which are usually used as appropriate places considering the terrain configuration and fertile area within the corridor zone, to largest possible extent avoid valleys, sinkholes in order them to be reserved for agricultural production, summer villages..
- Tower footprints and placing of transmission line through the project to adjust to be as least as possible visible from attractive view points such as Ivanova Korita, zone Majstora, zone NP Durmitor, especially the zone of Tara.
- Width of corridor of 1 km has been given in order to provide, by detailed survey and projecting, the most acceptable solution with least possible influence on the environment and its values in the zones of passing from montenegrin seaside to Pljevlja.
- Within corridor of approximately 60 m of total width (around 30 m from the transmission line axis), it is not allowed to construct the residential and other structures. Possibility of construction outside the zone of protection should be adjusted to valid regulations.
- The investor is obliged, after constrtuction of energy structure on land, to make the as built documentation and submit it to the cadastre keeping records of energy structures „cadastre of lines“ to prevent possible collisions with planned structures and activities at some area. Procedure of undersea cables survey which is delivered to competetive institutions for their implementation into the record of sea objects, respecting the water ways and zones of trawling and fishing.
- In case of any research works performance (on land or in the sea) the contractor is obliged to gain all required permissions and make a possible list of objects with their exact position (coordinates) to prevent possible damages at current objects.
- Transmission line and cable are to be projected to reduce electro magnetic influences to frames prescribed by the leguslation.
- It is necessary to provide the register of protected monuments of culture (monuments of culture of extraordinary importance, monument of culture of great importance and important monuments).

- Respect recommendations of expert team which, within the studies to be a part of SPU, has performed characterization of EMP field of HDC facility and influence of HVDC operation to health and safety of man, influence of electrode to wildlife shall be localized abd mitigated by means of protection proposed by experts in those theme reports/analyses.
- In case the location of transformer station and of converter station is in the zone of „Natural habitat“, it is necessary to make its inventorisation, which is necessary for the purposes of work out of the Study of environmental influence and issuance of ecological consent.
- For spatial locating of a transmission line route in national parks, the routes of existing high voltage electro-energy lines may be used: (a) existing 110 kV transmission line Pljevlja – Žabljak whose passing over the canyon of Tara would be optimized.
- Provide optimization of spatial locating of tower footprints at planned transmission line route in a manner to prevent cutting of forests, whether within space of the transmission line route of tower footprints itself.
- Pursuant to DPP, provide spatial locating of the access roads network which are necessary for construction and maintenace of planned transmission line(s) by using the existing roads in national parks within the zone of current **110 kV** transmission lines, with possible extensions of smaller extent to prevent cutting of forests and plowing of pastures and meadows.
- It is recommended, through Evaluation of environmental influence during the project realization, objects to store equipment and construction material for transmission line construction with optical cable, and objects to accommodate engaged workers, to be located outside the territory of national parks and other protected natural goods.
- At the location which has been treated by detailed work out on UP1 which ahs been provided as temporary operational are, it is necessary to perform recultivation and form the green area, after completion of works. It is not allowed to construct and place any electric devices on the same parcel.
- When making the project documents, it is necessary to make the Evaluation of influence to area.
- It is recommended to make the Study of cultural resources protection, in order to have a detailed review in the phase of project documents work out.
- The corridor mostly influences tourism and recreation because of negative visual influence. Agriculture and forestry and other economic branches using the land are also within the area of influence and it is necessary, when projecting, to provide performance of activities outside the protective corridor.

Within points of conflict of planned transmission line route with water management objects, the following is necessary:

- at existing (currently in use) sources, with performed consultation with competetive company, pursuant to documents on sanitary protection zones, correct the route
- at potential sources, by engaging experts for hydro geology, determine the volume and difficultness of transmission line conflict with the water supply purpose. According to received conclusions, search for optimal technical solution.
- at natural lakes or water sourses, minimize placing of transmission line in paralel to the coast, search for conditions from competent subject (competetive sector of Municipality or Water management of Montenegro)
- at the artificial accumulations, search for conditions from the subject managing them
- at water supply objects, to proceed in accordance with the Rule book on determination and maintenance of zones and layers of sanitary protection of sources and limitations within zones.
- at possible current ponds, bottling plants.. the transmission line is to be put away and consult the managing subject.

SAFETY HEIGHT AND SAFETY DISTANCE AT OVERHEAD LINES

According to the Rule book on technical norms for construction of overhead electro energy lines of rated voltage of 1 kV to 400 kV („Official gezette of SRFJ", number 65/88 and „Official Gazette of SRJ", number 18/92), safety height is the least allowed vertical distance of conductor, that is, parts under pressure, from land or other object at the temperature of 40 ^{0}C that is at t-5^{0}C with normal additional load without wind. Safety distance is the least allowed distance of conductors, that is, parts under voltage, from land or other object, in any direction at t 40^{0}C and wind load of 0 to full amount. Safety heights and distances for lines 1 – 110 kV are shown in the table. Those values are increased for lines of bigger rated voltage: by 0,75m for lines of rated voltage of 220 kV,

- **by 2 m m for lines of rated voltage of 400 kV.**

As regards some objects, additional criteria have been defined according to which it is considered the line passes over the object making the safety height or distance applicable:

Overhead line passes over the fence, green house or when the horizontal projection distance of nearest conductor in uncovered position from the object is less than 3m for objects of rated voltage of 20kV and less than 5m for lines of rated voltage bigger than 20kV.

Overhead line passes over parking places and bus stations when the distance of horizontal projection of nearest conductor in uncovered position is less than 5m.

Object	safety height	safety distance	Poj.isol.
inaccessible places	4.00	3.00	
places inaccessible to vehicles	5.00	4.00	
place accessible to vehicles	6.00	5.00	
buildings (inaccessible part: roof, chimney)	3.00	3.00	E;(M)
buildings (accessible part: terrace, construction scales.)	5.00	4.00	E;(M)
buildings of drving plants	≥3.0 with protection measures	≥3.0 with protection measures	E;(M)
buildings with flammable roof	12.0*)	5.0*)	E;M
objects with easily flammable materials sa	must not	tower height + 3.0 min. 15.0	
inhabited places	7.00		E
Sportska igrališta	must not over the shooting range places	12.00	E;M
public beaches	must not		
ski jumps	must not	8.0 from starting path 12.0 from final path	E;M
forests and trees		3.00	
regional roads, local roads and industrial objects roads	7.00	tower 10.0 (extremely: 5.0)	E
main roads	7.00	tower 10.0 (extremely: 10.0)	E;M
motor ways	7.00	tower 40.0 (extremely: 10.0)	E;M
densely populated places	7.00		E;(M)
markets and fairs		12.00	E;M
parking places and bus stations	7.00		E;M
Trams and trolleybus		3.00	E;M
raft rivers	7.00		E

navigable rivers and channels	15.00	tower 10.0 from the coast 6.0 from settlement	E;M
bridge constructions		5.0 from accessible parts 3.0 from inaccessible parts	
aerials of TV and radio receivers	2.00	5.00	E;M
aerials of transmitting and receiving stations	must not		
high voltage line	2.50	1.00	E
low voltage line	2.50	2.00	E;M
telecommunication cables		tower: 10.0 za 1÷110kV (exceptionally 1 for 1÷35kV) 15.0 for 220kV 25 za 400kV	
telecommunication overhead line	5.5 za 400kV 4.0 za 220kV 3.0 za 35÷110kV 2.5 za 1÷35kV	Prov.: 5.0 from tower TK line tower: 2.0 from prov. TK line	E;M
ropeways		5.00	E;M
metal and rope fences		3.0 tower: 0.7 Un(cm) min. 20cm	
rope grids	3.75	3.75	E
gas lines, oil pipelines, steam pipelines	8.00	8 tower: tower height +3.0m	
stacks and drying premises	12.0*)	5.0*9	
cemeteries	6.00 tower must not	5.00	E;M
object	safety height	safety distance	Poj.isol.
airports	nemjust not	1000 from take off path (exceptionally:<1000) 3000 at crossing with the path	
Heliports	must not	1000 in direction taking off/landing 200 in other directions	

anti hail stations	must not	200.00	
railways which are not predicted to be electrified	7.0 (exceptionally :6.0)	tower:10,0 from the rail (exceptionally:5,0)	M
station platforms, discharging ramps...	12.00		
electrified railways with overhead contact line	12.00	towwer:15.0 from rail	E;M
industrial tracks	7.0 with no k.line 12.0 with k.line		M E;M
green houses and conservatories	3.00	3.00	
LEGEND:	**'-regardless the voltage*		
	Un-rated cable		
	E-electrically reinforced isolation		
	M-mechanically reinforced isolation		
Note: when the lines pass over the objects, that is, at approaching the lines to the objects, safety height is equal to safety distance if a special value has not been stated for safety height.			

In further work of the processor on DPP, it will use findings of the report of Feasibility study which has been prepared by the expert group of Prenos (GAP analyses), analysing the social and environmental aspects.

According to preliminary findings, the main goal is early identification of conflicts within the environment and society because of lack of previously made studies for the pursposes of DPP.

EXCERPT FROM THE REPORT ON STRATEGIC EVALUATION OF ENVIRONMENTAL INFLUENCE

Strategic evaluation of environmental influence is an instrument describing, evaluating and estimating possible significant influences of planning solutions to environment which may be acquired by the plan implementation, in this case, the Detailed spatial plan for corridor of a transmission line 400kV with optical cable from Montenegrin seaside to Pljevlja and undersea cable of 500kV with optical cable Italy-Montenegro, and determining measures to decrease negative influences to environment and health of people. As regards modern planning of space, introduction of Reports on strategic evaluation of influence, the ecological dimension permeates the whole process of planning documents work out and is integrated into the planning solutions making the plans quality and more adjusted to the sustainable development concept.

According to the Law on strategic evaluation of influence (Official Gazette of Montenegro No. 80/05), it is defined an obligation to implement the procedure of strategic evaluation of environmental influence for plans and programs regarding the urban and spatial planning.

When working out the Report on strategic evaluation of influence, appopriate principles and environmetal concept for planning area have been defined. Major principles the strategic evaluation is based on are contained in article 3 of the Law on strategic evaluation on environmental influence are: principle of sustainable development, principle of integrity, principle of precaution, principle of hierarchy and coordination and principle of public.

During the work out if Strategic evaluation of environmental influence, the working team of processors has made the following analysis: current conditions (created and natural conditions), program commitments of users of space, current manner of space usage and influence in zones of possible conflicts and recognition of inputs from the following plans and strartegic documents: Spatial plan of the Republic of Montenegro by 2020, National strategy of sustainable development of Montenegro; Strategy of energy development of Montenegro; Strategic evaluation of environmental influence of PPCG draft, Spatial pšlan of the NP Lovćen, Spatial plan of the NP Durmitor and Spatial plan of special purpose area of Morsko dobro. Those strategic documents are the basis a Detailed spatial plan should be adjusted to.

Areas which potentially may be exposed to significant risk

Planning concept defines the segments of infrastructural corridor starting from the underground cable from montenegrin territorial waters entering to the landing place, underground cable to future converter station and TS and overhead transmission line to Pljevlja. That is why this object may be observed through several separate wholes which are mutually interconnected and are the unique object.

When defining the corridor, it is not possible to completely avoid negative influences to eco systems and protected areas which have been proposed for protection. Four potential locations may be identified which may be individually analysed within the work out of Strategic evaluation of influence (when working out the Study of influence evaluation) they have to be individually analysed.

1. Location Blato in Lastva Grbaljska for new converter station. Besides possible negative effect to part of settlements within the contact zone, this location has been recognized as a wetland (swamp) at 12-14 m above sea level, with vegetation of natural meadows *Juncetalia maritimi*. For now, this location has not been recognized as potentially protected area, area of special importance as regards protection – EMERALD are, important bird area (IBA area) or important plant area (IPA area).
2. In the part of corridor Lastva–Čevo, the transmission line passes through the rocky (limestone) area with an extraordinary mountain of Lovćen (National park). In the zone of east and west variant of corridor, there are forests which are characteristic to biogeographic region of Mediterranean such as macchia plant (including copmmunities of *Orno-Quercetum ilicis* and *Paliuretum adriaticum*) in the area of Grbalj, various beech forests on Lovćen and widespread mixed forests *Carpinus orientalis* with *Ostrya carpinifolia*, *Ruscus sp.*.
3. In the part Čevo–Šavnik, the transmission line goes further in the waterless rocky area but passes by the lakes Krupac and Slano (identified as important bird areas) crossing the canyon of Komarnica river (identified as the important plant area). When routing the corridor, it is necessary to take care on the Komarnica river canyon. Final part of this route part is in continental bio geographic region and enters the zone nearby proposed extention of the National park Durmitor and the most attractive part of the canyon of Komarnica river named Nevidio. Not far from the Nevidio canyon there is a famous water fall Skakvica. Part of a corridor passes under the slope of Vojnik mountain with beech forests belonging to 9130 *Asperulo – Fagetum* beech forests.
4. In the part Šavnik–Pljevlja, there is a sensitive area of the National park Durmitor (identified as IPA, IBA and EMERALD area), with connected canyon of the river Tara which is under the UNESCO protection as an area of world natural heritage.It is important visual influence of a transmission line to be reduced in this zone, especially when passing the river Tara. In that sense, it was proposed to introduce the existing transmission line into the same corridor.

During exploitation of a transmission line there will be the long term influence to physical structure of landscape of protected areas due to maintenance of the zone of constantly clean area, that is, by clearing of forest vegetation in the working are. Removing of surface coverage shall form the track resulting in degradation in the sense of visual value of area. Within the stated area, it will be impossible to perform other activities. Stated changes will be obvious at high vegetation areas (forests and macchia) by creation of forest tracks causing permanent landscape changes. passing through the forest area new tracks shall be opened and new forest edge causing defragmentation of a habitat. When defining the transmission line route, it is necessary to follow the existing

infrastructural elements to reduce influence on visual and natural qualities of surrounding landscape.

Natural characteristics of a transmission line corridor, created values and plans for the following planning period are the basis to estimate the ecological capacity fo space and prevent possible conflicts in space in transmission line-environment direction. Locating of objects which may be potential polluters of environment may be performed based on detailes reseaches of terrain and location conditions and its surrounding. This implies work out of the Study of evaluation of environmental influence, according to legal provisions, providing appropriate projecting of conditions of locating and construction, technological procedures and protection measures, according to ecological principles. On the basis of preliminary estimation shown at the previous table, it may be concluded that subject project may initiate the following influences: influence on characteristics of area, biodiversity influence, ornithofauna influence, noise intensity increase influence, influence on non ionizing radiation.

General and special goals, selection of indicators in SPU

General goals of strategic estimation have been defined based on the request and goals as regards environmental protection in other plans and programs, and goals of environmental protection determined at the national and international level, but, especially, in relation to characteristics of planned purposes defined within the subject plan.

Special goals of planning area environmental protection are determined based on the analysis of environmental condition and significant issues, problems, limitations and potentials of planning are, as well as priorities to resolve ecological problems, according to general goals and principles of environmental protection.

Based on defined special goals, approriate indicators have been selected which will be used to work out the strategic evaluation of environmental influence. Indicators of environmental condition are very important segments within the work out of ecological studies and planning documents. Indicators are appropriate to measure and estimate planning solutions from the aspect of possible damages of the environment and to determine which infavourable influences should be decreased or eliminated. The purpose of its usage is directing the planning solutions towards realization of goals set.

Having in mind the spatial area of the plan, planned purposes of areas, condition of environment in planning area and defined special goals of strategic evaluation of influence, it was performed a selection of indicators in relation to which there will be made an evaluation of planning solutions to environment influence. It is important to mention that indicators have been defined in the context of realization of planning not the technical and technological solutions. SPU is planning oriented and considers planning solution as the basis to relaize goals of sustainable development and protection of environment. The subject plan is accordingly based. On the other side, evaluation of influence is technically and technologically oriented aimed to define

measures of protection when working out the final designs (not plans) to reduce certain negative influences to legally defined limits.

Evaluation of possible influences of planning solutions to environment

The goal of the subject plan strategic influence evaluation work out is recognition of possible negative influences to environmental quality and provided measures for their reduction, that is reducting to acceptable limits without making conflicts in space and taking care of on the environment capacity at the area observed. When working out the Report on strategic evaluation, it is necessary to select such evaluation measures and methods of determination and evaluation of plan influence providing all significant influences of plan as regards realization of protection goals to be determined and those influences to be appropriately evaluated.

In strategic evaluation, the accent was made to the analysis of planning solutions contributing to environmental protection and increase of life quality at the area observed. In that context, the Report analysis possible influences of planned activities to the environment which shall be evaluated in relation to defined indicators.

Reviewing positive and negative effects of the Plan variants, the following may be concluded:

1. in all variants of the Plan, it is expected to have positive influences in the context of infrastructural development as a precondition for further economic and sustainable development. Sustainable development in the sense of creation of preconditions to realize the project of energy production from renewable sources, first of all, hydro power plants and wind power plants;
2. variant solutions have certain negative influence to environmental quality, but, also, have significant positive economic influence which is aslo important having in mind that strategic evaluation of influence is an instrument to realize the sustainbale development goals and that sustainable development implies not only valorization of ecological but social and econimic poentials and limitations.
3. analysing the variant solutions in the wider context, it may be concluded that certain solutions imply bigger or smaller effects to defined goals of strategic evaluation which are an inevitable price of social-economic development. Having in mind the general estimation of variant solutions in relation to elements of sustainable development, those which have been estimated as the most acceptable have been selected. In that sense the following variant solutions have been selected:

- landing place locality–west side of Jaz cape,
- location of converter station and of transformer station - Blato in Lastva Grbaljska on the left side of the road Tivat-Budva,
- corridor route: part Lastva Grbaljska - Čevo – east variant through the NP Lovćen; part: Čevo - Šavnik – west variant pssing nearby the planned HE Komarnica; part: Šavnik – Pljevlja – west variant.

Review of significant Plan influences

On the basis of evaluation made in SPU, it is concluded that implementation of plan produces numerous strategically significant positive influences, but certain number of significant negative influences at the planning area. Besides that, certain positive and negative effects of planned purposes have been identified which have been characterized as strategically significant, but it should have them in mind when defining adequate measures of protection.

Reviewing the results of multicriteria evaluation of planning solutions in relation to defining of goals and indicators of strategic influence, the following may be concluded:

- planning solutions do not directly affect the following elements defined within the strategic evaluation goals: pollution of water resources, deterioration of coastal sea quality, change of agricultural land quality, increase of exposure of population to increased level of noise, endangering of structures chategorized as immovable cultural heritage;
- in relation to change of air quality, it is possible to expect minor temporary negative effects of the plan resulting from manipulation of mechinery and works on placing the structure of planned transmission converter system (placing of cable after exiting the sea, works on construction of converter station, works on placing the transmission line towers). Those influences are not characterized as strategically significant;
- selecting of Jaz cape location for landing place, it has been acquired the compromise in the sense of biodiversity protection which is on other considered locations more significant (for example Platamuni cape – EMERALD and IPA area). On the other side, as regards passing of the transmission line route through national parks Lovćen and Durmitor, there is a certain disturbing factor implied by clearing of the transmission line route corridor;
- certain negative influences to ornithofauna are also possible because of the vicinity of the corridor route by the Slansko and Krupačko lakes. Those influences are not strategically significant and are not influences relating to increase of the electro magnetic field strenght;
- although, when defining the location of landing place, location of converter station with the transformer station and the transmission line corridor route, it would be taken care on protection of area and environmental values by placing objects to sheltered places, it is possible to expect certain negative effects on micro parts. The special problem in that sense is passing of the transmission line over the canyon of Tara river, that is of area marked as a zone of I protection regime. In that context, it is necessary to recognoze usage of the route of existing corridors in order to minimize such influences;
- by careful routing ot the transmission line it was avoided the influence of elements of a transmission system to settlements, population and health of humans, protection of immovable cultural heritage by their bypassing. Besides that, the offered solution is economically acceptable;
- realization of the project shall have strong positive influence of national importance which will create preconditions for development of various economic branches:

tourism, electric energy and usage of renewable sources of energy (hydr oenergy, wind energy)....

According to the law on strategic evaluation, strategic evaluation should comprise estimation of cumulative and synergy effects. Those effects may result from the interaction among numerous smaller influences of existing objects and activities and various planned activities in the plan area. Cumulative effects occur when individual planning solutions do not have significant influence, and several individual effects may have a significant effect. Sinergy effects occur in the interaction of individual influences producing the total effect which is bigger than the sum of individual effects.Having in mind characteristics of planned purposes, that is, the fact it refers to unique line infrastructural object, in this case it may not be talked about the interaction of various planning solutions.

Variant solutions

Numerous positive effects may be expected in the variant a Detailed spatial plan to be implemented and adopted. **First of all, Montenegro shall position itself as an important energy node of the region increasing the value of other interstate transmission lines through increasing of incomes from their exploitation for the purposes of electricity transit.** Also**,** importance of this electric energy object may be reviewed through following aspects:

- direct connection of Monteengro with the electricity market in EU realizing additional positive effects such as realization of incomes from energy transmission, access to european development funds and incentive to investors into the electric energy sector;
- increasing of stability and availability of electric energy system;
- better transmission network on which occasion the 400 kV ring is formed but connection of towns in the north of Montenegro to 110 kV voltage level to increase the supply reliability;
- increase of electricity supply safety of bigger tourist towns on montenegrin coast which will contribute to development of tourist and other facilities;

Analysing this variant solution in the wider context, it may be concluded that certain solutions imply bigger or smaller negative effects to defined strategic evaluation goals which are inevitable price of social-economic development. During the transmission line realization, there is a certain negative influence to environmental quality which shall be minimized to acceptable level by prescribed measures of protection.

In case the Detailed plan is not adopted and development is continued according to existing tendencies, it is not possible to expect the above stated benefits for development of the electric energy system..

Measures of environmental protection

Besides the evaluation of planning solution influence to the environment and recognition of possible negative influences, the aim of work out of the Report on strategic evaluation of the subject plan influence is precribing of appropriate measures for their decreasing, that is, reducing within the acceptable limits defined by the law, taking care on the environmental capacity at the area observed.

Measures of protection are aimed to reduce the environmental influences within the planning area within the acceptable limits for the purposes of preventing endangering of environment and health of people. Measure of protection provide development and prevent conflicts at the area concerned which is in the function of realization of sustainable development goals. Execution of environmental protection measures shall influence decreasing of pollution and environmental degradation risks and increasing of environmental quality which will reflect in increasing of total quality at the plan area. Measures of protection have been given in the Report on strategic evaluation of environmental influence:

1. It is necessary to work out the study- Evaluation of transmission line influence to environment at the level of the project on the basis of which the construction permission shall be issued.
2. Considering the importance of the project as regards safety of supply and protection of people and property, it is necessary to comply with all valid laws and regulations relating to the subject problem when projecting and construction.
3. Special attention should be paid to crossing of the route of a transmission line and underground cable with current transmission lines, roads, railway, infrastrucutral objects and other significant existing and projected objects.
4. At the part of the route passing through national parks and sensitive areas, it is necessary to apply all known methods which shall minimize the transmission line influence to the natural environment (fitting into the environment- by using appropriate colors for towers, by form and height of the tower, decreasing of numebr of access roads, putting of two transmisssion line on mutual towers..).
5. Agricultural area located under the transmission line route (under the transmission line conductor) may be used through certain types of agricultural production such as feeding usage, hay production, mechanized processing of land and planting of annual and perennial plants while it may not be used for orchards creating, or permanent or temporary infrastructural objects in agriculture.
6. When placing the transmission line, it should take care not to deteriorate the National park environment. Careful selection and placing of the route in this part is necessary in relation to settlements, existing and potential economic objects.
7. Measures to protect population from the long term exposure to electircal and magnetic fields must be a part of the object planning process including the appropriate positioning of a transmission line towers in relation to settled areas and creation of safety zones.

8. For all tower footprints which shall be located at the agricultural areas which are intensively used or shall be used by applying the appropriate larger machines (tractors with connections, harvesters...), it would be good to provide larger protection area.
9. Decreasing of forests and forest lands in the zone of immediate transmission line influence, it is necessary to compensate by forest-breeding works on forest lands and bare lands.
10. New planting should be directed to increasing of forest habitats on forest lands and bare lands at the safe distance from the transmission line on which occasion the investor must oblige itself to offer such solutions in biological and aesthetic-visual sense providing to the transmission line route not only the functionality but positive aesthetic characteristic.
11. Planting of trees and shrubs to be performed by selection of material which may grow up to 2.5 m, containing the evergreen types of shrubs and types of dense crown in order to provide density of plants at the old age and terrain protection, but also contribute to aesthetic development of the transmission line route corridor.
12. At places where the transmission line route passses through the forest area, that is, terrain with low vegetation and underbrushes, it will be necessary to make the appropriate forest track. It is also necessary to develop a terrain by taking off logs from the location of the route, that is, by depositing, in order to prevent possible fire.
13. Measures to upgrade the existing condition of vegetation- afferestation at forest lands shall be made by removal of plants to allowed distance from the tranmsission line edge, that is, a distance alllowing the forest trees growth.
14. It is the obligation of an investor to provide: reconstruction and landscape development and preservation of current high vegetation.
15. In the phase of a transmission line projecting, within the left corridor of 1000m, it is necessary to identify the zones of sanitary protection of sources and other water management objects. It is necessary to avoid their unfavourable interaction with the transmission line, according to the Rule book on determination and maintenance of zones and areas of sanitary protection of sources and limitations in those zones.
16. In zones of strict protection within the protected areas (NP Lovćen and Durmitor), it is not possible to construct the transmission line because it will result in direct influence to physical structure of protected areas landscape by removal of surface cover and placing of infrastructure and change of the landscape view.
17. It is proposed to work out the Project of landscape development in oder to reestablish the natural balance and adjusted relations with human influence.
18. It is necessary to organize the building site-basis for supply of tools, materials, equipment and workers and for distribution of stated to certain locations, that is, tower footprints along the transmission line route.
19. Considering the lenght of the transmission line route, it is evident the need of forming several buidling sites- basis at several locations along the route. Each micro location is specific because of possible various terrain circumstances and technical solutions.
20. Concrete construction interventions, in the sense of excavation, concrete works, construction mounting, access roads construction are performed at the terrain which is, depending on the transmission line lenght and basis location, at smaller or bigger

distance in relation to it. The above works relate to locations of future tower footprints and are performed at appropriate locations along the transmission line route.

21. Transport of tower construction, electric mounting equipment, tools and other necessary material is predicted to be performed by appropriate transportation means to the building site- tower footprints at the transmission line route, that is, cabke trenches. It should pay attention to use the existing and abondoned access roads and to minimize devastation of existing arable lands.
22. After construction of the subject transmission line, it is necessary to develop the route, remove the waste material and surplus excavation material to locations prescribed for depositing of such material, repair possible damaged roads, dismantle the building site and develope surrounding terrain. The terrain which has been occupied during construction is necessary to be taken to the conditions at which it has been before starting the construction.
23. It is necessary the terrain aroung tower footprints to bring to previous condition: if the excavation is made by mining, it is necessary to perform stabilization of bigger separated rocks, that is, provide filled material from possible escarpment and similar, tower footprints are made at the arable or fertile land. After construction of the tower footprint, it shall be necessary to develop the completely damaged part of a parcel in a manner the land deposited from that location to be refilled on part of terrain which is used for tower construction.

Monitoring of environmnetal condition

As the basis to monitor environmental influence, it is necessary, within the phase of the work out of the Study of evaluation of environmental influence, to perform the zero measurment of electric and magnetic fields at locations where it is expected bigger influence of the transmission line to environment. Based on previous, it may be concluded that the transmisssion line has no influence on the air, water and land quality, it is not necessary to monitor the quality.

Transmission line construction phase	Parameter to be monitored	Monitored place	Time of monitoring
Previous works	Electric and magnetic field	Within the transmission line corridor *	Until the beginning of construction
	Noise	At future route	Until the beginning of construction
During works	Facilities and conditions for work	Along the route **	Until the end of construction
	Equipment and tools	Along the route **	Until the end of construction
	Protected goods (natural, cultural)	Along the route **	Until the end of construction
During exploitation	Electrical and magnetic field during max currents	Within the transmission line corridor *	Periodically , once in four years
	Noise	Within the	If needed

		transmission line corridor	

* it is necessary to perform measures immediately after putting the object into operation, and, than, every four years. For measures after putting the transmission line into operation, to provide max current load to measure max values of those parameters. If measured values are under allowed limits or unchanged in the following three months, measurements shall not be necessary.
** monitor at places of current operation.

Identified difficulties when working out the report on SPU

Considering the transmission line environmental influence, negative influence shall be expressed in the part of a converter station and transformer station, landing place and connection with converter station and transformer station and the zone of placing of cable and electrode in sea. When determining those zones in previous researches, it was taken into consideration on current and planned purpose of space. Negative influences in this phase of work on Detailed spatial plan have not been shown in details and it is expected delivery of data by Terna in the course of future work out of documents. Also, as per the law, the Report should contain description of the existing condition of the zone environment. At the area of the transmission line corridor and for the purposes of work out of the report on strategic evaluation of influence, no special measurements, analyses and researches of environmental factors,level of preservation or pollution were made. To evaluate condition of environment, it was performed the estimation, based on the insight on terrain of current spatial-planning documents and natural characteristics. The main disadvantage in the procedure of Strategic evaluation of influence is the existance of information basis on condition and quality of environment because of which it is missing the „zero condition“ presentation.

ECONOMIC MARKET PROJECTION (macro economic evaluation of the project)

This analysis provides enclosures for economic-financial estimation, that is, recognition of macroeconomic effects of realization of content within the detailed spatial plan for transmission line corridor of 400kV with optical cable from montnegrin seaside to Pljevlja and undersea cable of 500kV (hereinafter- project). Concrete goals of analysis are as follows:

- Describe the economic-social context for proposed planning solutions;
- Provide review of key economic benefits and influences resulting from the planning concept;
- Determine potential sensitive economic limitations and circumstances which are indicated and
- Provide the forecast of concept implication to social community.

The analysis was prepared on the basis of available information consideration, including information provided by the Ministry of sustainable development and tourism, interested stakeholders (Elekroprenosni sistem Crne Gore) and municipalities comprised by the Plan and visits to areas of the plan. The analysis was made on the basis of available information and documents for which it is assumed that have been accurate when working out the report. Basis of this analysis of the concept of spatial organization and planned contents of a transmission line corridor 400kV with optical cable from montenegrin seaside to Pljevlja and the undersea cable 500kV.

Social-economic context

At the Spatial plan of Montenegro, infrastructural systems corridors are considered public interest areas (including the transmission lines). When considering the subject plan and realization of infrastructural system of a transmission line, it is perceived purpose of the project, that is, to improve reliability of the transmission system and electricity supply. Improvement of the electricity transmission infrastructure is defined in the strategy of energy development of Montenegro by 2025 (hereinafter: SRECG), Action plan 2008-2012 for realization of SRECG (hereinafter: AP) where it has been planned the transmission network to provide the exchange of electricity with neighbouring systems and improve supply of certain area and major towns of Montenegro and to provide connection of new electricity sources and decrease of losses. An important step in realization of presented strategy is work out of the subject planning document which has to create assumptions to remove limits of the transmission system and its development.

In many countries, restructuring of electic company is followed by stronger investment activity in the electricity production sector, but not transmission. The transmission sector

misses initiatives relating to investments and effective mechanisms to cover expenses which ahs contributed problems to get accumulated and to enlarge the gap between the distribution capacities construction and electricity production capacities. It is the fact that in Montenegro distribution systems are limited from the aspect of reliability, economic efficiency, competitiveness abd environmental influence. Limitations result from obsoleteness of equipment, physical limitations, regulation…. The analysis of plans of economic development of Monteengro plans, according to regional allocation of resources and potentials shows that it is necessary to provide the safe transfer of energy and reliability of supply as a precondition of certain sectors development, first of all tourism, agriculture and industrial capacities. It is, also, the required infrastructure to construct new sources of electricity.
The subject plan comprises municipalities Budva, Kotor, Cetinje, Nikšić, Plužine, Šavnik, Žabljak and Pljevlja. Plan does not comprise towns and town settlements so there is no interesting or significant elements to analyse a demographic influence. In other words, the plan shall not directly influence the increasing or decreasing of demographic structure. However, the treatment of this infrastructural object as a public domain determines the need of the project effects recognition at the macro level. Many influences of project realization are indirect and is necessary to be qualitatively recognized. Direct influence of the project may be quantified, although only preliminary in this phase. Precise indicators may be acquired after detailed project of a transmission line and other capacities.

Priorities of the Government of Montenegro as regards energy sector development

Total final consumtion of electricity in Montengro was projected to 4.503.2 GWh in 2010 which means that electricity consumption per capita is 7.130 KWh approximately.
It is apparently high level of consumption. However, this calculation is disturbed by the need to reserve several big industrial consumers. CGES forecasts to transfer 4.086 GWh through its transmission network in 2011. The average tariff of domestic transmission is 5,75 euro per MWh, and average import price is 52,58 per MWH. If the strategy of bigger valorization of resources and potentials of Montenegro are taken into consideration, electricity consumption must increase.

According to the strategy of energy sector development, Government of Montenegro has planned to increase production of electricity through construction of new hydro power plants, mini hydro power plants, exploitation of coal reserves and promotion of electricity production by using wind from solar sources. Besides investments in the infrstructure, the Government has recognized the necessity of investing to transmission capacities as an important priority. Improvement of quality of the transmission and distribution network to provide safety of supply at domestic market and participation at the regional market is planned through the Strategy of energy sector development by 2025.

Having in mind the geographic position, Montenegro would like to take bigger role as regional hab to exchange energy on the Balkan, especially by perceiving the possibility

of connecting to Italy in the context of possible import of energy from the region, where it might be bought at lower prices.

So, streghtening of the transmission system is of high priority to the Government. As a result of such commitments, the subject spatial plan is under construction.

Objects and positioning

Optimal allocation of objects and physical structures has been determined through the plan at the area of influence of future transmission line 400 kV and the undersea cable. The plan establishes bases to develop the space the infrastructural corridor passes through, with establishment of necessary space for technological functioning in order to provide the following:

- corridor,
- defining of the usage regime and infrastructural corridor protection,
- transfer of pure energy aimed to decrease pollution of the planet and of climate changes,
- provide sufficient capacities to supply montenegrin consumers with electricity,
- increase stability and availability of electric energy system,
- provide the wide approach theough interconnection arrangements with world nodes by placing the underground optical cable,

As regards the areas of Montenegro the project shall have the greates influence at, it should mention the folllowing municipalities: Budva, Kotor, Nikšić, Šavnik, Pljevlja and Žabljak.

Budva – Budva riviera makes the central part of montenegrin coast comprising the territory of 122 km2 with approximately 15.000 citizens. The town has 11.000 citizens. it is important to emphasise that this area is one of the most important tourist destinations in Montenegro which grows during summer. The projects creates assumptions for realization of Budva development priorities, first of all, development of tourism with various offer in unconstructed zones (Jaz, Lučice and Buljarica), construction of high category objects and increasing of tourist offer quality in already constructed objects.

Kotor – Municipality of Kotor is of 355 km^2 with 23.000 citizens. The town of Kotor has 5.000 citizens and, together with nearby Dobrota, it has approximately 13.000 citizens. Like Budva, this municipality is one of the most important tourist destinations in Montenegro making the number of citizens a lot bigger during summer. The project provides support to realization of development priorities of Kotor, first of all, of new tourist capacities in complete subzone with the town of Kotor and other settlements (Perast, Risan, Prčanj ,Grbaljsko and Mrčevo hill) and coastal municipalities along the open sea with settlements of Trsteno, Žukovica and Bigovo.

Nikšić – Municipality of Nikšić comprises the area of 2.065 $km^{2,}$ which is 15% of total area of Montenegro and is the biggest municipality in Montenegro.Total population is approximately 75.000, out of which 58.000 lives in a town. Nikšić is a very important

industrial center. It contains: the Steel plant (production of steel and highly alloyed steels) Trebjesa brewery, wood processing plant, Bauxite mines, Nika dairy... In the vicinity of Nikšić, there are bauxite deposits and forest complexes. Hydro power plant Perućica is located in this municipalilty. Priorities of this municipality development are industry, especially the timber processing and mechanical engineering with taking over the role of the metal processing development in Montenegro, based on the steel, bauxite mines, intensifying of agricultural production, food industry, high rank service center functions. The lack of energy is an important threshold of development, and realization of project is the basis to eliminate that development limitation.

Šavnik - Municipality with lowest population in Montenegro (2.900), and the town of Šavnik has 570 citizens. Agriculture is the main activity of population. The municipality area is treated as one of important tourist areas of the state although it has not been used in that sense. Priorities of development are the agriculture, oriented to cattle breeding, mountain tourism, usage of hydro potentials of Piva basin and water bottling. Realization of project shall provide increasing of safety of supply with electricity and possiblity of this municipality energy potentials usage.

Pljevlja – Municipality is of 1.346 $km^{2,}$ and is the third municipality as regards the size in Montenegro. In 2003 the municipality had 35.000 citizens while the town (administrative center of municipality) had 21.000 citizens. From the aspect of electric-energy sector, through capacities of thermal power plant, it is provided 45% of electricity offer in Montenegro. Priorities of development are mining, energy and cement production, agriculture, tourism, timber processing, brick production and other processing industry oriented to higher level of finalization and employment of labor force as well as Pljevlja heating system. There is no doubt that the project provides development of electric-energy sector of Pljevlja with positive direct and indirect effects.

Žabljak – Municipality comprises the territory of 445 $km^{2.}$ It has 2.000 citizens and the town of Žabljak 2.000. Municipality is an important resource of mountain tourism. The whole area of Durmitor is protected as a national park offering great possibilities for winter and summer tourism. The project provides to realize further development of tourism with the accompanying activities through the possiblity of Žabljak supply improvement.

ECONOMIC-FINANCIAL IMPLICATIONS OF PLANNED CONTENTS REALIZATION

Projection of benefits

Determination of projects benefit of this kind has been made more difficult due to the fact that possible benefits are not easy to identify. Those benefits have been recognized, and considered qualitytively on the occasion of methodological approach during the planning process.In this analysis, it is emphasised the following:

- Electric energy system of Montenegro is relatively small and sensitive to surrounding countries influences. Considering that a lot of energy is imported, safe and reliable functioning of the system depends on the connection with surrounding systems. Planning document provides realization of project which will influence significant positive changes of the transmission system of Montenegro and its surrounding, energy flows and market possiblities and safety of supply. Planning document provides realization of project which will influence significant positive changes of the transmission system of Montenegro and its surrounding, energy flows and market possibilities, electricity price and supply safety.

- Montenegro is influenced by inadequate integration of market at the area of the southeast Europe and it is expected enormous benefit from the market integration to be achieved. Better integration- more benefits for the electricity price in Montenegro. Pursuant to that, future integrations-future infrastructural benefits for Montenegro. In other words, Montenegro shall have more benefits than other countries based on better usage of hydro power plants and easier access to export (import) of energy from/to other countries resulting from possible integration of market within the Southeast Europe and between the Southeast Europe and Italy.

- Reducing of market changeability is considered the public interest. Less changeability provides better planning and management over the surrounding for consumers and public. It protects the public from the prices schock, reduces commercial risks and provides better safety.

- Also, benefit from this infrastructural object is acquired through the possibity of new production capacities connection to the transmission network, better connection of montenegrin transmission network with transmission systems of neighbouring countries for better disposal of produced electricity, increase of stability and availability of system, improvement of safety of supply with electricity of bigger tourist centers at montenegrin seaside and further development of that part of Monteengro.

This type of project benefit participates in total benefits and has to be dynamically observed as a function of changes facilitating and development of transmission systems and usage of economic resources.

When determining benefits which may be quantitatively measured, standard economica analysis means were used, on which occasion the following benefits were identified:

- electricity transmission benefits;
- other benefits:
    - benefits based on the increase of electricity trade volume;
    - benefits based on transmission expenses decrease;
    - benefits based on technical losse descrease in the tranmssion network;
    - benefits based on renewable sources usage;
    - benefits based on congestion management;
    - increase of property tax incomes;
    - possible concession benefits.

P**rojection of quantitative benefits**

Transmission capacity increase

By realization of the project of the transmission line and undersea cable, the transmission capacity shall increase. It means that CGES may realize additional incomes on the basis of transmission through new lines.

Realization of the project shall enable increase of CGES incomes on the basis of more efficient aplication of a method of congestion management. According to preliminary analyses, it is expected CGES incomes to be increased during the first year of exploitation from 10 to 11 million. This income is used to decrease the transmission expenses paid by consumers in Monteengro.

It should emphasise that total benefits from the transmission increase depend on the transmission capacities towards Serbia and Bosnia and Hercegovina. In this moment, in the north part of Montenegro, towards the territories of Bosnia and Hercegovina and Serbia, there is no 400kV connection.Taking in consideration the ambitious plans of natural capacities development in Bosnia and hercegovina and Serbia, nort of Montenegro and the project of undersea cable construction between Montenegro and Italy, at least one 400kV interconnection towards the transmission system of Montenegro would be useful in case of export from Bosnia and Hercegovina, that is, Serbia towards Italy and would provide safe and undisturbed transit of electricity. Expected benefits of construction of at least one interconnection 400kV towards Bosnia and hercegovina and serbia would be as follows:

- increase of transmission capacities on borders with Bosnia and Hercegovina and Serbia,
- improvement of voltage-reactive conditions in 400 kV network

Other benefits

If the project is realized, the following efects may be expected:

- decrease of loss share in totally tranfered energy;
- decrease of non-delivered electricity;
- decrease of unit operational expenses;
- increase of transmission capacity.

Effects of transmission loss decreasing

Transmission losses may be calculated on the basis of average price for electricity supply to cover transmission losses in the amount of 51,06 euro per MWh. This information is taken on the basis of combinations of domestic sources price and imported electricity price (as per data of CGEP).

Preliminary data show that, after realization of the transmission line project and undersea cable, losses would be decreased by min 29 GWh per annum in 2016.In that mannner, direct financial saving as regards decrease of electricity losses may be predicted to the amount of 1.5 milion euro per annum. Variable expenses of transmission paid by the consumers in Montenegro shall be reduced by this amount.

Effects of non delivered energy decrease

Non delivered energy refers to quantity of energy which could be served by the system but it has not been made due to incapability of CGES system to deliver the required energy to consumers. The average tariff for transmission is approximately 5,78 euro per MWh and may be adjusted to calculate the effects of non delivered energy effects.

The approximate value of MWh of electricity in national GDP is 671 € (GDP value is divided by the consumption in MWh). benefits from decrease of non delivered energy may be observed as incapability to perform economica activities due to lack of electricity inputs which is directly reflected to decrease of Monteengro GDP. Calculation of non delivered electricity decrease may be performed in later phasis of the project when detailed information are provided regarding the system projection.

Strating form the stated value of MWh in GDP, it is acquired savings due to avoidance of one partial system breakage (loss of consumption power 150MW for 2 hours) in the amount of 200.000 €. taking into consideration the existing limitations of electric transmission system, it would be increased the quantity of undelivered energy.

Decrease of domestic consumers participation in operational expenses allocation

By increasing the total quantity of transmited electricity through montenegrin electric transmission system by three times, operational costs of the transmission network operation shall be allocated by decreaseing the part of domestic consumers in their coverage.
On the basis of this, it is expected increase of incomes due to change of ITC mechanism (mechanism for mutual compensation of electricity transfer expenses

between the operator of network applied at the territory of continental Europe) in the amount of 2-3 million euro for which amount fixed expenses of transmission paid by consumers in Monteengro shall be reduced.

Decrease of required reserve of the system to cover losses and operational management

It is assumed that one MW of expenses generated by the heating sources of energy are 1 milion euro. When calculating the effect of the system capacity savings, it is assumed the annual effect of 1/40 of it, with the assumption that annual depreciation of installed capacities is up to 1 MW (that is, 25.000 € per MW per annum).

In that manner, the forecast of positive effects from implementation of project as regards decrease of system capacity is around 325.000 € per annum.

Property tax income

If we analize the income data which, during 2009 and 2010, were realized by the montenegrin budget on the basis of property tax and mandatory contributions from the company crnogorski elektroprenosni sistem a.d., we may project the amount of budgetary incomes on the basis of taxes and contributions in relation to real estate of companies which would build the transmission cable. The fact is that part of those taxes and contributions through the price of electricity would be „collected“ from citizens of Montenegro (33% in proportion to participation of montenegrin partner regarding the investment at the territory of Montenegro-100 million in relation to total value of investment in Montenegro of 300 million). However, part of that property tax would be collected by italian tax payers through the electricity price(proportionally to 66,6% of participation of italian company in total investment in Montenegro). Total value of property value of Crnogorski elektroprenosni sistem a.d. is(according to financial report) 132,220.005 euro and the tax expense to this property is 490.904 euro. If the same tax participation is retained after construction of the transmission line, the state would acquire the incomes of 1,15 million euro per year on which occasion, in proportion to participation of italian partner in cable ownership, 2/3 of that amount, that is, 750 thousand euro, would be paid by italian citizens. It directly increases montenegrin GDP by that annual amount.

INVESTMENT POTENTIAL OF PLAN

Approximate proposal of investments in the period of plan realization is based on perceiving of major investments within the plan realization by Montenegro. Those are the following investment:

- investments in elements of the transmission network of EES of Montenegro,
- investments in land and
- investments in interconnection at the territory of Montenegro.

According to preliminary data, value of investment of electric energy interconnection between Montenegro and Italy, undersea cable is 758 mil. € and is the obligation of TERNA-Rete Elettrica Nazionale S.P.A. Value of investment of related infrastructure of undersea cable which shall belong to Montenegrin transmission system a.d. CGES is 100,28 mil € . Related infrastructure of undersea cable comprises TS 400/110 kV Lastva Grbaljska, turning of existing transmission line 400 kV Podgorica 2-Trebinje to transformer station Lastva Grbaljska and construction of new transmission line 400 kV Lastava Grbaljska –Pljevlja 2.

Expenses of elements of the transmission network of EES of Montenegro

Calculations of this kind of capital expenses are based on data provided by the EPCG. table 1 shows the individual expenses of components and total investment expenses. it is assumed that the transformer station conception shall be with two main and one auxiliary basbur systems. The related expenses of secondary equipment and expenses of network construction are included into total expenses.

As it may be seen in table 1, expected total expenses of a transformer station construction with connection to the existing 400 kV transmission line Podgorica 2-Trebinje are around 34.14 mil. €.

Table – Total expenses of investments in the transmission network of EPCG

	Br.	**Specific costs**	**Total costs**
Type of element	**[km] ili [MVA]**	**[M€/km-MVA]**	**[M€]**
400 kV transmission line	60	0.331	19.86
110 kV transmission line	16	0.183	2.93
TRANSFORMER STATIONS 400/110 kV [MVA]	600	0.010	6.00
TRANSMISSION LINE FIELD 400 kV	2	1.000	2.00
CONNECTION FIELD 400 kV	1	0.730	0.73
MEASUREMENT FIELD 400 kV	2	0.058	0.12

TRANSMISSION LINE FIELD 110 kV	4	0.184	0.74
CONNECTION FIELD 110 kV	1	0.157	0.16
MEASUREMENT FIELD 110 kV	3	0.030	0.09
TRAFO FIELD 400 kV	2	0.582	1.16
TRAFO FIELD 110 kV	2	0.178	0.36
TOTAL			**34.14**

Along with stated expenses, it is predicted to construct 400kV transmission line Lastva Grbaljska – Pljevlja, buying of related land, and land for the purposes of construction of TS Lastva Grbaljska.

Total investment in construction of new elements of a transmission network of Montenegrin EES within the project is estimated to 100,28 mil. €

Analysis of sosts of investment into construction of interconnection at the territory of Montenegro

At the territory of Montenegro there will be constructed the converter station with related equipment (SVC facility, underground cable, part of the undersea cable) as an integral part of an interconnector of a direct current between Montenegro and Italy.

Total costs of interconnector may be divided to the fixed part (converter stations) and variable part (the undersea cable) whose price depends on the length.

Investment costs for SVC equipment depend not only on the volume of installation but on specific requirements of installations. Examples of such requirements are: control and management system, system of protection and telecommunication (secondary equipment) and main component (primary equipment) such as reactors, condensators or transformers…

Considering the usual volume of expense of a device (around 40 - 50 €/kVAr) and values of necessary SVC devices in a converter station in Lastva Grbaljska, 350 MVAr (acquired from: Feasibility study of new undersea HVDC cable between Italy and Montenegro, Analysis of static protection, june 2008, ordering party: Terna, voltage stability I dynamic analysis, part 1 and 3 of the Project) total costs of equipment for SVC are 6 – 10,7 mil. €.

Estimation of investment value in this part of the project are approximately 200 milion €,and a precise amount depends on final route of the undersea cable in Montenegrin territorial waters and of selection of the equipment deliverer as well as of the final price of land buying, which shall be defined through the detailed project.

It is emphasized that, within the analysis, compensation costs of environmental influence could not be estimated and they shall be determined after defining details project solution because the plan enabled flexibility of determination of detailed project solution in corridor of 1 km width (transmission is of 60 m width) which is necessary because of technical solutions but leaves the space to take care of economic parameters (selection of cheap technical realization and smaller influence to the environment within the corridor).

Direct influence of the project to macro economic indicators

Investment for the transmission line 400 kV with optical cable from montenegrin seaside to Pljevlja and undersea cable 500 kV (Project) is estimated to 758 milion €. Investment at the territory of Montenegro is approximately 300 milion €, and it is planned Montenegro to invest 100, and Italy 200 milion. It is planned realization of the project and construction of undersea cable and related infrastructure and transmission line network at the territory of Montenegro to last for 5 years. This section identifies a diret influence of the Project to GDP and the state's budget- those are immediate effects of the project in the following five years of realization (long term effects have been identified and quantified in section of project's benefits).

Analysis of direct effects of the investment of 300 million €, which is the project's value, thta is, of investment at the territory of Montenegro is made on the basis of investment multiplier with the usage of structural aggregate macroeconomic model which is based on quarterly data. Multiplier measures increase of income (gross domestic product) under the influence of unit increase of investment). In such a model of investment, investments are treated as exogenous variable. It is because the investments are economic variable influenced by the state in various manners, like creation of business environment.

Having in mind that investment of project construction in montenegrin part in the amount of 300 milion € is financed from domestic and foreign sources, investment multiplier has been calculated through estimated regressive dependence between the gross domestic product and total investment (sum of value of domestic investments and foreign direct investments).

The aim is to calculate the influence of unit change of investment to change of gross domestic product. In other words, it is calculated how the foreign direct foreign investments shall influence the gross domestic product. Economic theory suggests that unit increase of investments results in above unit increase of national income and because of that the measure of relation between the change of income and change of the investment level which has brought the change of income level was called the

investment multiplier. If the gross domestic product is marked GDP and investments are marked I through the appropriate regression model, we are trying to estimate the investment multiplier presenting the measure of influence of the investment level change to the change of gross domestic product, that is, we estimate how much the gross domestic product shall be increased if investments are increased by 1 monetary unit.

On the basis of the appropriate macro economic model for Montenegro, on the basis of quarterly data on total values movement (foreign and domestic) of investments and GDP is estimated value of investment multiplier. The regression model has been formed at quarterly level for period 2000-2010 which meets all criteria of statistical significance and which provided value to invesment multiplier at the level from 1.17. In other words, increase of total (domestic and foreign) investments by 1 € increases the gross domestic product by 1.17 €.

$$\text{Investment multiplier} = \frac{\partial \text{BDP}}{\partial \text{INV}} = 1.17$$

That is:

$$\text{BDP} = 285359982.9 + 1.176855288*\text{INV}$$

It is estimated that investment of 300 milion € into the part of the project to be realized at the territory of Montenegro during the 5 year period shall increase montenegrin GDP ba approximately 351 milion. It means that, on the basis of this project realization montenegrin GDP shall, during 5 years, increase by 11% in relation to the level from 2010. In other words, during 5 years of project realization, montenegrin GDP shall increase by 70.2 miliona € per annum.

Direct increase of GDP on the basis of infrastructural investment and transmission lines at the territory of Montenegro which shall provide functioning of the undersea cable is equal to the value of approximately 300 milion €.[2] Direct effect of investment results in average annual growth of GDP of approximately 60 milion €. Besided the direct effect, analysis suggests that investment of 300 milion € , within 5 years, increase the GDP by additional 51 milion € GDP – on the basis of multiplicative effects. Multiplicative effect shall reflect in increasing of construction sector activities but through incomes to be received by owners of land to be expropriated in order the project to be realized.

All those activities are taxable and on that basis, within 5 years of project realization, there will be the budgetary incomes growth. The appropriate macro economic model for Montenegro provides quantification of those effects. Major assumption in this analysis

[2] GDP is, pursuant to expenditure method, calculated as a sum of personal expense (household expense) – C, invesment expense – I, state expense – G and balance of export and import – E-U: GDP=C+I+G+(E-U).

is that GDP is the exogenous variable. On the basis of a model, it is estimated the coefficient of budgetry incomes in relation to gross domestic product.

Table- Coefficient of budgetary incomes elasticity in relation to GDP

COEFFICIENT OF ELASTICITY	VALUE
$\varepsilon_{UKPRIM,GDP}$	0,28

Estimated equation which meets all econometric requirements means that if GDP is increased by 1% it shall increase budgetary incomes by 0.28%.

On the basis of estimated direct and multiplicative effects, realization of the part of project relating to the undersea cable construction which is realized in Montenegro shall result in total increase of GDP by 351 milion €. It shall increase GDP during years by approximately 11% in relation to 2010 level. Estimated value of budgetary expenses for 2010 is at the level of 1,138. If we assume that GDP shall grow, during the five year period, by 11% totally, it means that budgetary incomes in the same period shall grow by 35 million euro. It means that, during 5 years if this project realization, budget shall realize incomes of 7 million per year, on the basis of the project realization. Those incomes shall be generated based on taxes, contributions and customs duties paid by the companies to participate the project realization at the territory of Montenegro.

The project shall influence the increase of BDP of production, supply and elecricity sectors. Expenses of interphase consumption of production, supply and distribution of electricity make approximately 45% of total realized output ot sector's turnover resulting in participation of added value of said sector in total GDP of montenegro of 5,7%, in 2009. (4,2 % in 2007 and 2008.). Having in mind the fact that significant part of incomes of said sector relates to interphase consumption, that is, operational expenses, important effects regrading decreasing of interphase consumption and increase the gross added value of said sector, that is, total GDP of Montenegro would be realized by the project realization.

Conslusive considerations of benefits and investment potential of the project

Proposed plan shall enable realization of significant benefits for the economy of Montenegro. Long term benefits suggest the profitability of investment with significant positive effects for consumers of electricity and the state. In that context, on the basis of framework planning standards of business and parameters of incomes generation, employment and creation of newly created value, the following should be taken into consideration when estimating the economic influence of this plan:

• Montenegro is unproportionally exposed to influence of unfavourable integration of electricity market in the south eastern Europe. It pays the higher price of electricity

when importing and it is not able to evaluate adequately its own available hydro potentials. It is considers the project shall influence the stability of the south east Europe market which shall positively influence Montengro.

• project shall improve utilization of existing infrastructure in Montenegro and provide incentive for future investments;
• project shall create additional income for Montenegrin electric distribution system providing decreasing of transmission expenses for domestic consumers in Montenegro;
• project shall probably improve the level of available resource utilization foe electricity production in the south east Europe;
• at the same time, the project influence shall remove negative consequences of majority of share of hydro resources in the energy mox ad increase positive aspects of better hydro energy usage. As a consequence, the project shall improve the possibility for new investments into hydro capacities and upgrade the existing capacities;
• having in mind the unused hydro potential in Montenegro, realization of project shall probably influence the improvement of investment climate even before putting the project into operation;
• the intention to implement the project shall influence the increase of energy subjects means in Montenegro and their financial value even before the project realization. It shall be created favourable market possibilities for futher commercialization of energy subjects and increase of their credit rating;
• project may increase the market value os other means in Montenegro (real estate value, tourist possibilities, infrastructure, water supply, strengthening of economy and industry…).

Besides stated project influences (quantitatively described), benefits which may be quantified in this phase are:

- effect of technical losses decrease in the transmission network at the annual level are forecasted to 1.5 mil. €, which is a direct saving fro final consumers in Montenegro, through decrease of tariffs for the transmission network losses;
- improvement of voltage circumstances and decrease of total undelivered electricity through decrease of supply breaks number in coastal transformer stations of Herceg Novi, Kotor, Tivat i Budva; savings due to avoidance of only one partial system breakage for 2 hours is approximately 200.000 €. Also, decrease of breaks number has a direct positive effect (with no decrease of BDP) .
- it is acquired with no investments 20% of capacities and cable exploitation incomes; this shall provide decrease of incomes paid by domestic consumers for usage of transmission network during the first year of exploitation by 5-6 milion, and in the phase of full exploitation of 12 milion, through effects of a contract of ITC and congestion management.
- on the basis of the system capacity decrease, it is projected the benefit of 325.000 euro per year;

- significant future benefits of CO2 emission decrease.
- on the basis of property tax it is estimate the income of state at 1.150.000 eura.

Iindirect benefits are long term and shall contribute to GDP growth. Apart from indirect benefits, it should emphasise that realization of investment shall provide multiplicative effects such as:

- employment growth
- construction sector growth
- transport sector growth
- public incomes growth
- aggregate demand growth and
- improvement of macroeconomic and fiscal indicators

MANNER, PHASES AND DYNAMIC OF DPP REALIZATION

According to the transmission network development study, it is predicted the following realization:

- transfromer station 400/110 kV Lastva and its connection to 400 kV network
- transmission line 400 kV Lastva – Pljevlja 2 – until October 2015.

Realization of the project of connection of Montenegro and Italy by the undersea cable implies construction of TS 400/110 kV and KP at the montenegrin seaside, is planned as follows:

I phase

- construction of overhead transmission lines with optical cable from TS to existing 400 kV transmission network and transmission line 400 kV Podgorica-Trebinje.
- construction of KP-a and TS-a.

II phase

- planned construction of a transmission line with optical cable Pljevlja-Tivat.
- placement of 500 kV underground cable with optical cable along the road infrastructure to the place of entering the sea, accordingt to PPCG and SRECG.
- placement of undersea cable woth optical cable from montenegrin to italian coast, according to PPCG and SRECG.