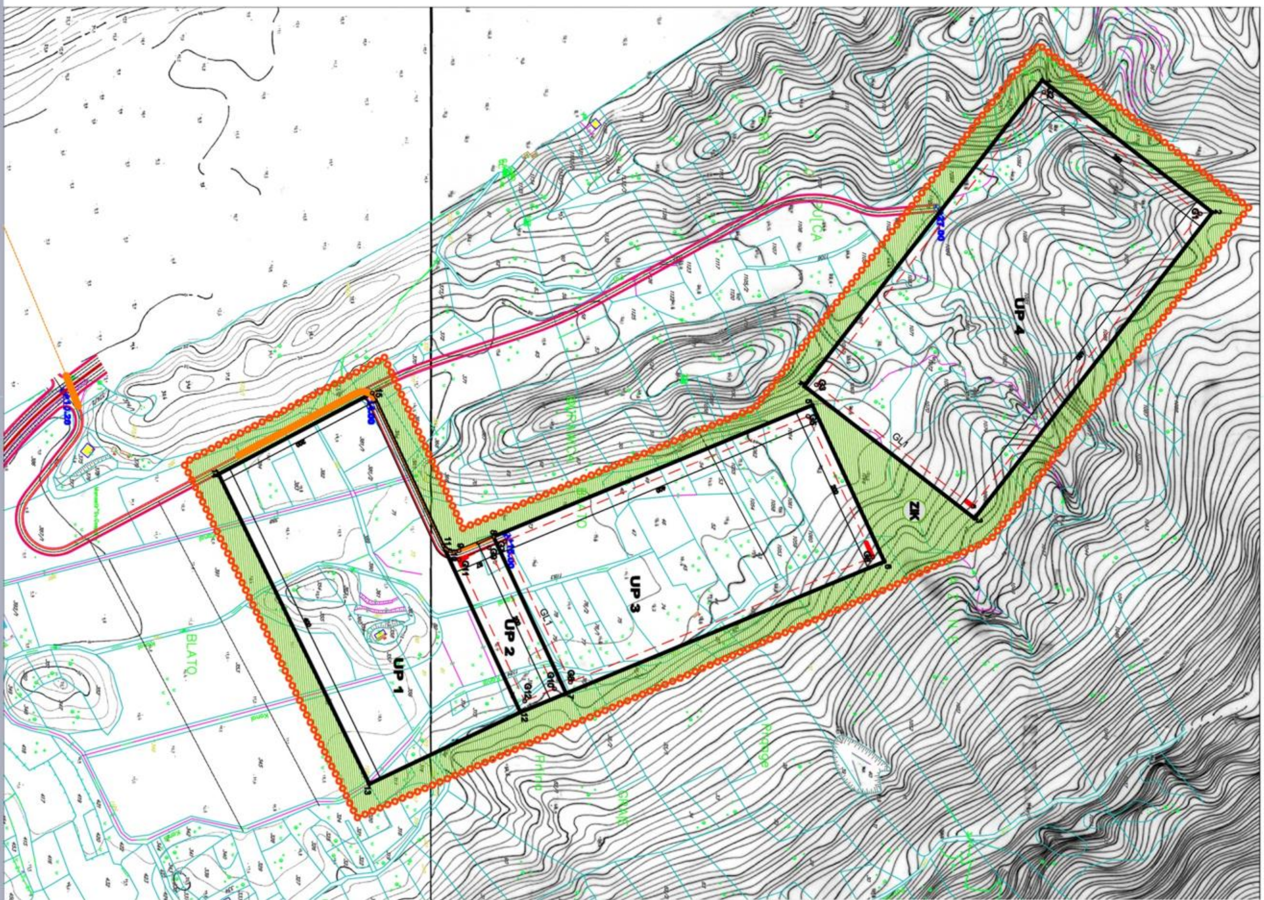
Ministry of Sustainable Development and Tourism

DETAILED ELABORATION

OF LOCATION FOR TRANSFORMER SUBSTATION AND CONVERTER SUBSTATION - BLATO IN LASTVA GRBALJSKA-



INVESTITOR:

The Government of Montenegro
Ministry of Sustainable Development and Tourism

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Contractor:
Consortium

Executive Director
Igor Djuranovic, civil engineer

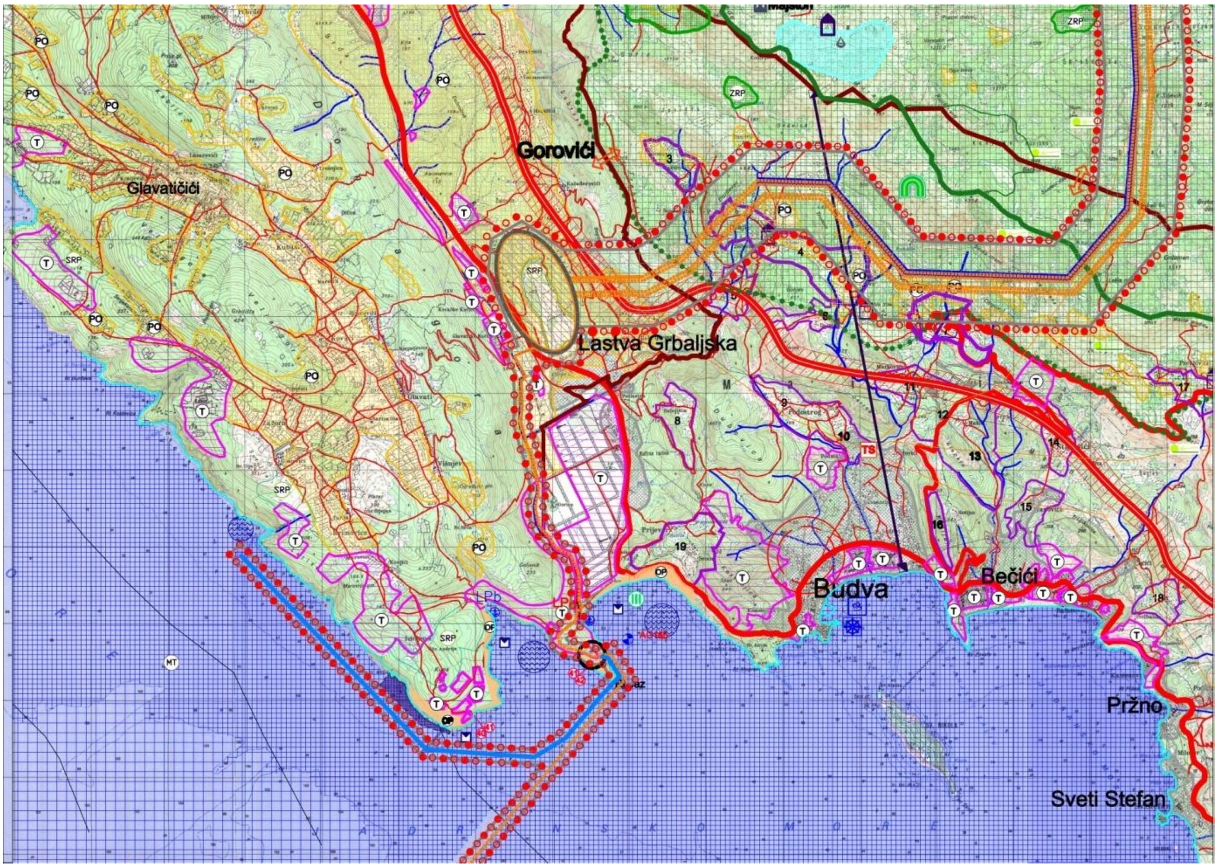
Podgorica, july 2011.

Converter and transformation stations site Blato in Lastva Grbaljska

Site description and current conditions

Converter and transformation stations site is located in Lastva Grbaljska, municipality of Kotor.

The site is located on the left side of highway that leads from Tivat to Budva. Being well sheltered from the highway, this site is partly spread over flat area called Blato, and partly extending over raised area on its northwestern part.



picture 1- Site Blato's position and its wider angle of view

An object expected to be demolished is situated on the mentioned site.

Project boundary

Project boundary is determined by coordinates of breakpoints and provided in graphical display ''Topographic-cadastral map with project boundary''. It covers an area of 39,66 ha.

picture 2 - Blato Site

Natural features – Geological composition of the site Blato

The site Blato, envisaged for construction of converter and transformation stations is made of:

-flysch sediments of Upper Eocene age that are deposited in the base of the terrain;
-quarternary sediments (alluvial, diluvial and diluvial-eluvial) that are deposited in the surface area of the terrain.

Estimated values of parametres on physical-mechanical properties of 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 properties of quarternary sediments (complex of moderately jointed and unjointed rock masses) are: bulk density γ=18-20 kN/m^3, internal friction angle φ=20-32°, cohesion c=10-20 kN/m^2 .

In morphological sense, terrain of the site Blato is flat area and at its points stands 12-14 metres above the sea level. Terrain is suitable for construction of projected objects, provided that basic flysch rock mass or quarternary sediments are to be used for foundation, with the previous terrain drainage and regulation of occasional surface flows.

Principles of spatial organization

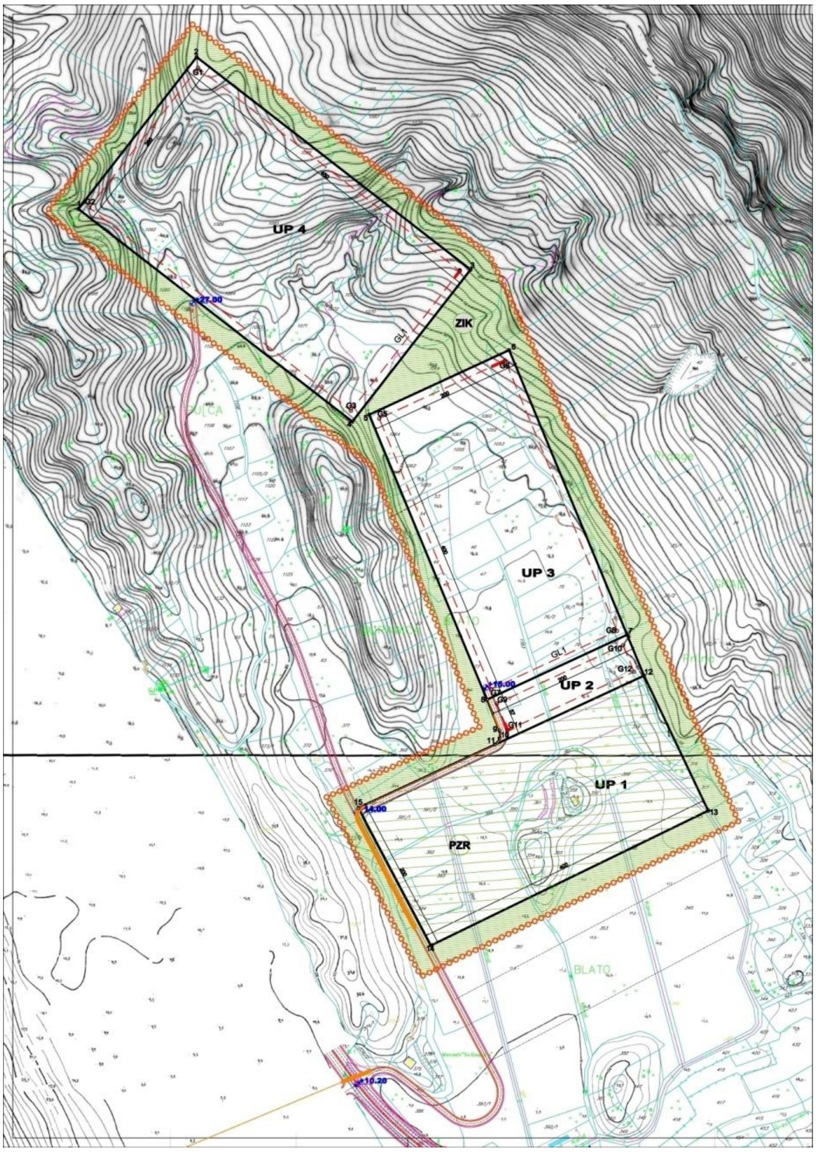
Location entrance is made from existing reconstructed road leading to the main road M2 (Adriatic highway). Internal roads network will be provided within urban parcels depending on adopted technological solution and equipment needed for the Main project of transformation and converter stations construction.

Land uses

According to land uses site area is divided into:

- Technical infrastructure areas (transformation and converter stations);
- Infrastructure greenery,
- Green areas for recultivation.

Zone is divided into four urban parcels, at an altitude of 10 up to 60 metres above the sea level.



picture 3 - Parcellation

The zone is divided into locations – urban parcels

Urban parcel 1, envisaged for temporary working area and essential for construction preparations, will be necessarily recultivated upon finishing works. No construction works or installation of electrical devices are allowed at this parcel.
At one part of urban parcel 2, a warehouse building is envisaged with Gross Construction Area (GCA) of 2541m^2 maximum. The rest of the parcel is planned to be green area.
Urban parcel 3, envisaged for construction of converter station and within its boundaries alternative plan for an administrative building is possible. Gross Construction Area (GCA) is 4000 m^2maximum. Capacity and floor plan of intended building is P maximum. Taking into consideration that this is a distinctive object its maximum height is 24m.
Urban parcel 4, enisaged for tranformation station and within its boundaries alternative plan for an administrative building is possible. Gross Construction Area (GCA) of 5626 m^2maximum. Capacity and floor plan of intended building is P maximum.
In accordance with requests of space holders it is possible to enlarge UP1, UP2, UP3 parcels where a station would be provided agreeably to accepted technical solution of selected equipment supplier, and following construction lines. Simultaneously, the following condition should be complied – converter station at 400m distance from the first buildings.

Current and planned area capacities

<u>Current condition</u>

- Area coverage……..39,66ha
- Total ground plan area……...90 m²
- Total gross construction area ……….............................90 m²

<u>Planned condition</u>

- Land area coverage...39,66ha
- Total area of urban parcels………..............................284000 m² (28,4 ha)
- Total ground plan area..12166 m²
- Total gross construction area.......................................12166 m²

Floor space index of UP2 parcel..0.22
Construction index of UP2 parcel...0.22
Floor space index of UP3 and UP4 parcels.................................0.05
Construction index of UP3 and UP4 parcels................................0.05
Floor space index of land area coverage....................................0.03
Construction index of land area coverage...................................0.03

Parcels areas

UP 1 parcel = 80000m2- Working area planned to be recultivated upon finishing.
UP 2 parcel = 11551m2- (2541m2 maximum for the warehouse area),spare area to be used for the greenery.

UP 3 parcel= 80000m2-(4000 maximum for the area of Terna administrative building), spare area to be used for converter station.
UP 4 parcel= 112500m2-(5626 maximum for the area of Prenos administrative building) spare area to be used for transformation station.

Buildings planned for UP2,UP3 i UP4 parcels.

Areas purpose:

Infrastructure greenery 11.22ha
Technical infrastructure area...........................20.44ha
Recultivation areas...8.0ha

Climate features and sea distance should be considered regarding buildings projection. A ground operational command building and relay houses should be obtained within the station for the purpose of equipment placement such as: control, measurement, protection and signalization equipment, auxiliary power composition, remote control and telecommunication etc.

Whole area of transformer station should be protected with fence in order to stop trespassing.

Access to the main highway along with internal transport, emergency and evacuation roads at the transformation station plateau should follow widths and radii in terms of transportation and equipment installation, especially transformer station and subsequent maintenance as well.
Transformation station plateau should be designed in a way that storm and wastewater are efficiently drained, therefore ensure its adequate care. Supply and drainage of sanitary water should be provided for transformer station. Lightning protection system should be designed with the help of ropes, spikes and grabs of a specific height in order to protect the station as well as people from atmospheric discharge.

The outdoor lighting should be installed by using pole lights, and if necessary, by facade lights on the building.
To provide protection in case of fire, active and passive safety measures should be taken. Passive measures are applied in terms of appropriate choice of equipment, material, fire protection sectors, allowed and permitted objects distance etc.
Active measures are measures such as hydrant network, fire alarm system, fire extinguishers etc.
In that sense, fire safety requirements on roads should be applied as well.
In the case of noise which is primarily produced in the transformer, certain measures should be applied so the noise level is permitted.
Oil and stormwater tank is to be bellow energy transformers, stored on a concrete foundation, and have it placed in oil pyth of the same capacity as the largest transformer. Protection of groundwater to be applied.
The transformer station should be designed in a way that all working and environmental protcetion rules are taken into account. Power section should be designed to protect against high voltages and electrical hazards. Protection against direct and indirect interactions should be perforemd according to professional rules and legislation. All electrical equipment should be connected to the ground system to limit the growth potential during short circuit.

Beside adequate roads, closer surrounding space should be arranged in terms of external decoration. Size and basic shape of buildings, stations and roads are subjected to needs, size and disposition of equipment storage space, ie. Sectors of the station and their technical,technological and functional connections.

picture 4 – Example of a converter station

Transformer Station TS 400/110/35 kV (kilovolts) at Lastva Grbaljska site

Based on the Spatial Plan of Montenegro by the year 2025 and Action Plan 2008-2012 it is enisaged to connect electric power systems of Montenegro and Italy, with the help of underwater high voltage direct current cable. Moreover, it is necessary to build a transformer station at Lastva Grbaljska site and converter station for the purpose of direct current into alternating current voltage conversion.

Area of 17.15 ha is envisaged at aimed location for a converter station and area of 11.25 ha for a transformer station, with the total amount of 28.4 ha.

Future transformer station Lastva Grbaljska includes 400/110 kV transformation, 400 kV outside station, 110 kV outside station, self-supply power stations and integrated protection and control systems. Two 3 phase oil auto transformers, range 300/300/100 MVA (million volt amperers) are necessary for a 400/110 kV transformation, with the gear ratio 400±8x1,25%115,5/10,5 kV triangular compensating winding as well as voltage regulation under the load. 110/35 kV transformation wil be the issue of future discussions with EPCG (Electric Power Industry of Montenegro) considering the importance of its implementation for the quality improvement of consumers power supply in this part of the distribution network.

400 kV station:

- Building specification: oudoor, air insulated,
- Envisage thirteen 400 kV fields,
- Carriers of high voltage appararatus, measuring transformers, lightning arresters, busbars etc. are made of steel previously corrosion proofed in an adequate manner.
- Carriers height and spacing should be reached in order to maintain a safety distance and heights needed for the station of 400 kV rated voltage,
- Station grounding: directly grounded in the 400 kV network,
- Basbars shape will be of a tubular type, whose intersection is in accordance with anticipated power flows. Double 400 kV busbar systems will be provided.
- ACSR (aluminum conductor steel reinforced) cable and rods are to be used for circuits connections,
- Transformer fields to be in 300 MVA range each, and junction box and power line fields in 1356 MVA.

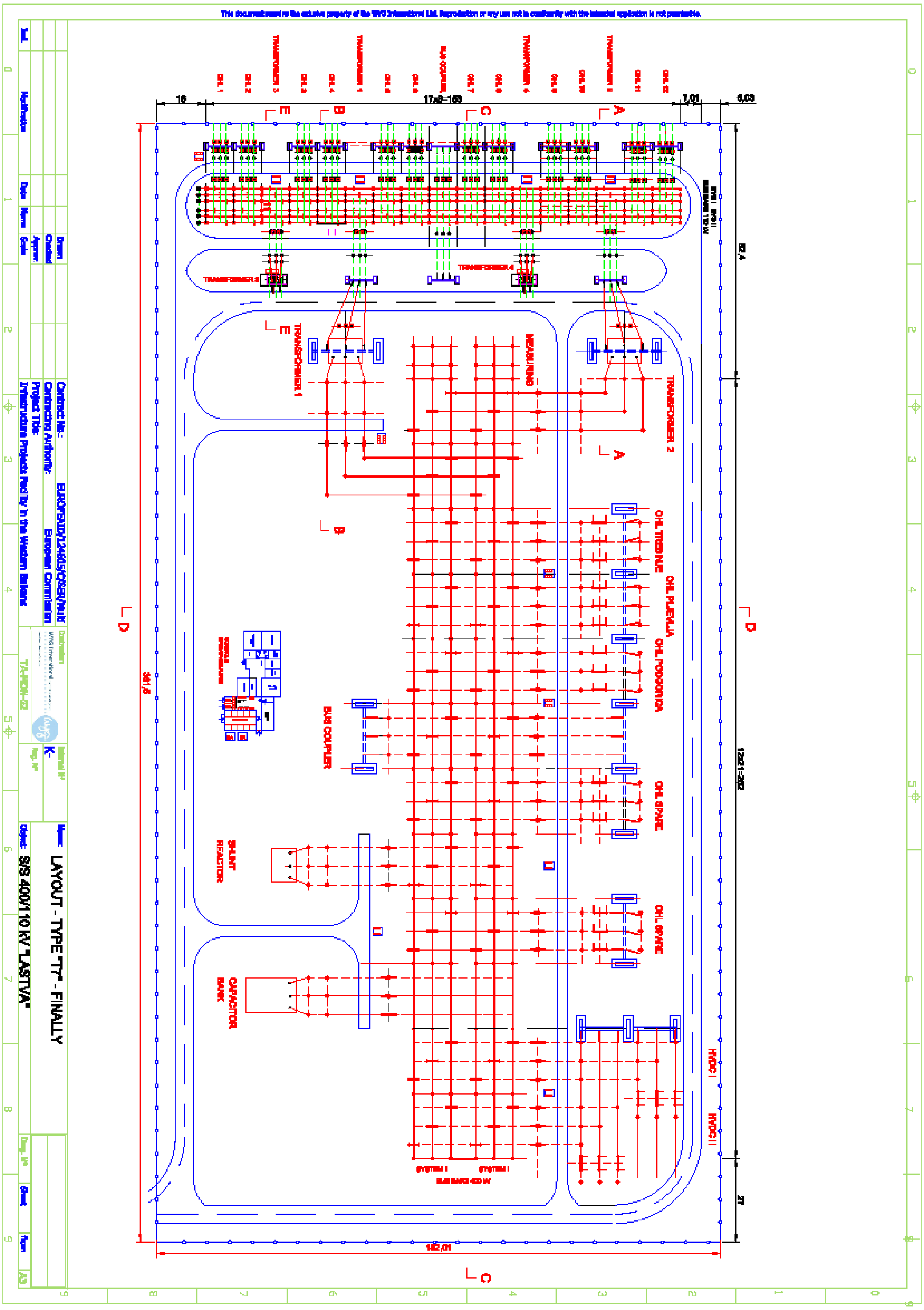
Transformation station of 110 kV:

- Building specification: oudoor, air insulated,
- Its design will be to the extent necessary for final transformer station construction,
- Carriers of high voltage appararatus, measuring transformers, lightning arresters, busbars etc. are made of steel previously corrosion proofed in an adequate manner.
- Carriers height and spacing should be reached in order to maintain a safety distance and heights needed for the station of 110 kV rated voltage,
- Station grounding: directly grounded in the 110 kV network,
- Basbars shape will be of a tubular type, whose intersection is in accordance with anticipated power flows. Double 110 kV busbar systems will be provided.
- ACSR (aluminum conductor steel reinforced) cable and rods are to be used for circuits connections,
- Transformer fields to be in accordance with 300 MVA transformer power, junction box in accordance with 2x300MVA, and power line fields along with transformer fields in 110/35 kV range for 240/40 mm^2 intersection.

Disposition of 110 kV and 400 kV transformer stations should provide a good visibility of functional parts, simple equipment transport, easy interaction between fields and functional relations between specific fields or within the field itself.

Building specification: 35 kV station placed inside an object will be subjected to future agreement with EPCG (Electric Power Industry of Montenegro). Its design will be to the extent necessary for final transformer station construction.

Station of all 400 kV,110kV and 35 kV voltage levels and their elements (switches, disconnectors, current transformators, voltage transformators, lightning arresters, insulators and connecting material) are to be of the dimensions that are in accordance with IEC (International Electrotechnical Commission) standards and study results of the system analysis.

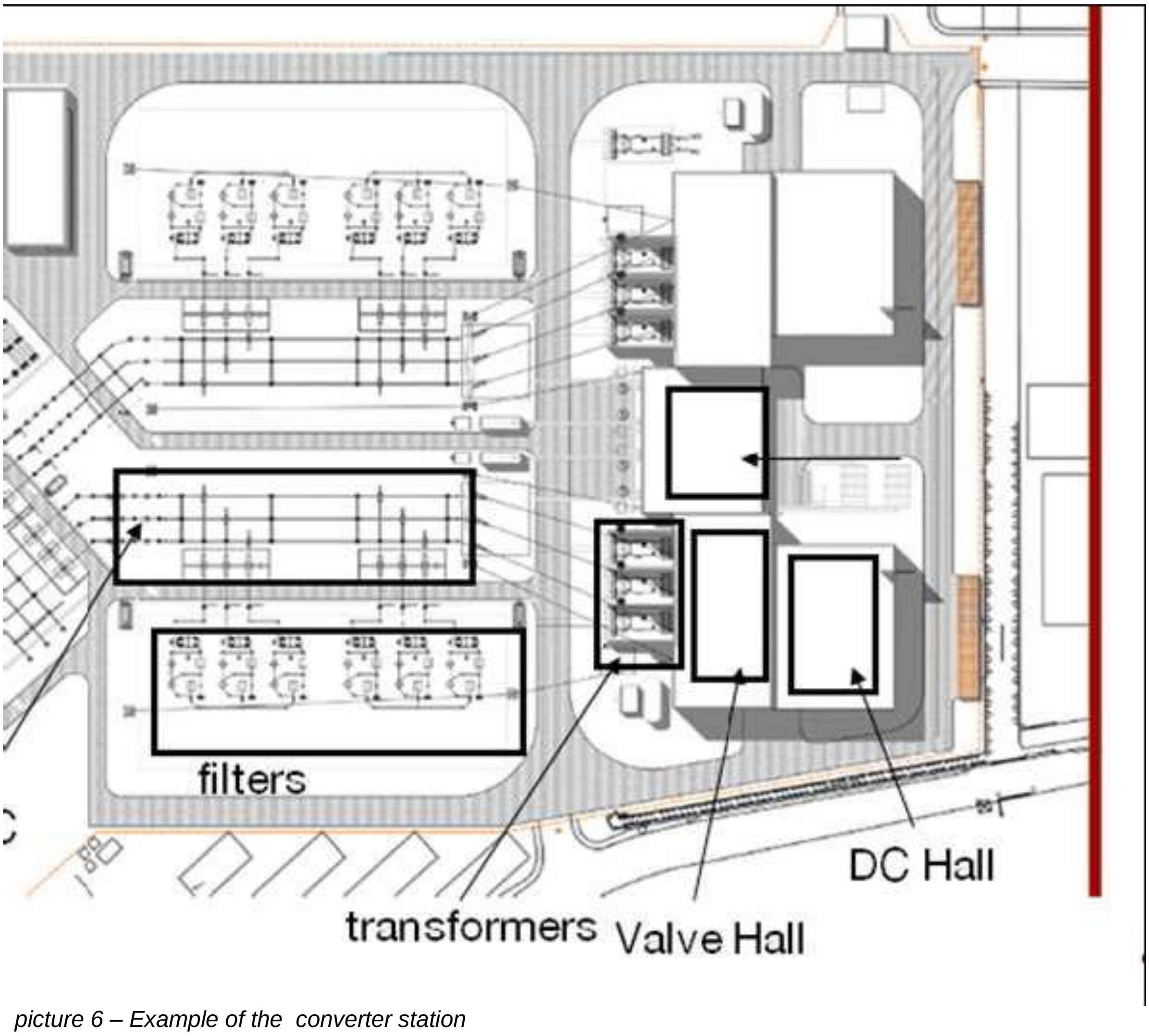


Picture 5 – Example of a transformation station's disposition

Description of the converter station in Lastva Grbaljska

Converter station contains alternating current distribution switchgear (AC part, usually normally opened) and high voltage direct current switchgear (usually enclosed HVDC part). AC part at the 400 kV voltage level provides connection to transformer station of CGES (Montenegrin Electrical Transmission System) and its basic elements are:

- 400 kV busbars with all connected AC equipment,
- Converter transformers which link AC network and bridge rectifiers. Usually there are three single phase units (for each polarity). Converter transformers are of great importance for converter station.
- Alternating current filters (AC filters) for higher harmonics removing, made in converter station or in existing AC network.
- AC filters, at nominal frequency, supply converter with an amount of reactive power that is necessary for its performance;
- High voltage equipment at 400 kV level for network connection. Essential ones are: switches, disconnectors, curent and voltage measure transformers.



picture 6 – Example of the converter station

Direct current distribution switchgear (HVDC 500 kV part) is constituted of converter bridge, made of two six phase bridge rectifier circuits (Graetz circuits).

Bridges are composed of thyristors and used for alternating current to direct current conversion and vice versa.

There are technological systems in the converter station such as:

- Control and management system(local and remote);
- System of auxiliary and general services.

A command centre building with support facilities will be part of the converter station, besides the above mentioned.
The project will include architectural lighting and building coverage. Converter station's final plan will be determined unitedly with tender winner of converter station's actualization. Maximum height of a planned building is approximately 24 m.

Converter station covers the area of 17.15 ha. It is visually hidden from the highway and, at the same time, protection zone is provided which measures 400 m distance from the first buildings.

ASPECT OF CONVERTER AND TRANSFORMER STATIONS EFFECTS ON POPULATION

Certain studies and expertises have been done, for the necessity of DPP (Detailed Spatial Plan) accomplishments such as transmission line corridor, optical cable and Detailed elaboration of Blato site, that clearly determine the infrastructural object's building influence on human health. Impact analysys have been done in relation to HVDC/AC electric field, static magnetic and alternating magnetic field, ionizing radiation and noise.

HVDC CONVERTER STATION

For the purpose of influence determination in relation to converter station's performance effects when it comes to health, certain assessments given during the characterization of EMP fields (electromagnetic fields) are used as starters, in accordance to which, within determined converter station's area, effects size of EMP fields, at various positions, exceed permitted limitations for permanent human exposure. However, areas where mentoned effects are at their highest level are narrow, right by the HVDC station's elements, usually where none of the staff is expected nevertheless.
Outside a specific converter station's parcel, there are influences of EMP fields and other mentioned converter's performance effects, primarily sounds of radio interference and acoustic noise interference, which, according to analyzed and estimated indicators, stay within prescribed limit values determined by these relevant international standards.

It can be evaluated that, in the context of study's recommendations, changes in CS and TS placement in relation to given Draft plan, such as 400 m distance from the first buildings, acceptable width of protective ''buffer'' zone is provided.

- Primarily if electromagnetic fileds and noise are taken into consideration, their intensities fall-off for the reason of quadratic and linear attenuation and distance increase on the other hand, therefore, every move to the north, towards mountanious hinterland slope surely contributes to reduce converter station's influence on settlement. Residential buildings on the west side by the road, are hill protected from the influence, therefore the effects are minimal. Suggested move towards the north, and the mountanious slope and making distance between the converter station and settlement leads to reducing of all negative effects.

  With the converter station's relocation to the stated site it is essential to simultaneously provide an amortization of negative visual impact on landscape features, which is particularly relevant for the local population's psichological experience of planned projects.

- Reduction of ionizing radiation exposure of a settled area is provided with the converter station's relocation to the stated site. As each non-electric facility around converter station reduces the measured amount of ionizing radiation, except for making a distance between station and settlement, it is necessary to place additional facilities around the station in order to reduce ionizing radiation, and simulatneously contribute to reduce negative visual effects on surroundings when it comes to constructing a converter station.

- It can also be concluded that additional positive effect from the aspect of health can be reached with certain station's parts disposition within fenced area in order to make it more distant from a settlement, in other words, from the nearest residential building as a reference point.

- Specific elements of a converter station (cable or DC line, higher harmonics filters or DC reactor) which cause negative effects on health from the aspect of electromagnetic field and noise influences, should be placed within the building, with an additional isolation of the building itself, in order to reduce influence of these station's elements.

- In fenced spaced and areas of the converter station, where EMP fields effects are the strongest, the staff presence should be minimized as much as possible by work pattern regulation.

- It is necessary to perform precise effects measures of EMP firlds, noise and sound after the construction, in order to determine if reached values are in accordance with legally perscribed Montenegrin standards and with relevant international standards as well, and to establish regular monitoring and make it possible to emphasize additional protection measures.

Previously given proposals are based on precautionary principles application, since suficient quantity of converter station's technical documentation, for the characterization needs of EMP fields at strategic planning level, was not available, and which need to be at the disposal for company ''Terna''.
In regard to that matter it is necessary to additionally analyse all recommendations, including those given from the aspect of health care and at the level of providing spatial-planning documentation. The additional analysis would be at the level of project implementation which leads to precise

characterization of converter station's performance effects on human health is given.

HVDC TRANSFORMER STATION

In order to determine influences of performance effects on human health, a start can be made from engineers' assessments given during EMP fields characterization and anticipated noise level (chapter ''HVDC Transformer Station), mostly based on comparative performance analysis of TS called Ernestinovo which showed compliance with planned 400/110 kV TS Lastva measured by electrical engineering experts.

Since the calculation for TS Ernestinovo might be considered as indicative for the future TS Lastva in Montenegro, it is possible to make following conclusions that are of crucial importance for envisaged 400/110 kV TS Lastva:

- According to results of EMP fields analysis it is expected that amounts of transformer station's electrical field are above prescribed amounts of 10 kV/m for the staff and 5kV/m for general population exposure, at the level between 1.5 and 2m at critical station's spots, such as bus bars and switching equipment. Those high amount levels along the station are reduced quickly with distance increase.

- At transformer station edges, on no occasion does given strength exceed 5kV/m, and they are within limits of permissible amounts. It is usually 1 to 2 kV/m at the fence of transformer station.

- If magnetic field, created in the transformer station caused by alternating current, is further from conductive elements it loses its intensity level much more faster than electric field, what is particularly important, viewed from the aspect of health effects assessment. Therefore, the strength outside transformer station are around zero, what, at the same time, reduces the risk of negative effects on human health.

- That is not the case with electric field which spreads beyond border lines of a transformer station. As stated before, it can be expected that strength of electric field is within permissible limits outside a transformer station, but the exact field strength is only determined after preparation of complete technical documentation.

- Therefore, it is necessary to take precautionary measures, if viewed from the aspect of effects on health. In that sense, creating an additional, protective ''buffer'' zone around the transformer station is suggested. Determination of protective "buffer" zone around the transformer station should be followed by ''buffer'' zone defining with regard to the converter station and considering the fact that the plateau for constructing the plant as well as the station is one entity. Namely, relocation of the converter station to a site at the northest part in comparison to DSP Draft's envisaged site, better to say, deeper as possible towards hilly slope in site's hinterland (bearing in mind all importamt elements for the decision stated in the Chapter of ''HVDC Converter Station), goes along with transformer station relocation. Layout optimization of each of the station according to the other one is possible to obtain, but in a way to reach most favorable effects on human health, in other words, to lower the the effects of human exposure to negative influences on health in a working environment.

- **Simoultaneously, as it goes for converter station, an additional positive effect from the aspect of health is to be brought to by adequate disposition of station's parts, within fenced area of transformer station in order to make them as further as possible from the settlement, that is from the nearest residential building as a reference point.**

- Staff presence should be minimized by means of work mode, in sectors within fenced area for the transformer station, where EMP fields effects are at highest level.

- Since bigger distance reduces noise level of transformer station, the same distance between transformer station and residential buildings should be included. In the sense of taking precautionary and preventive measures and from the aspect of reducing noise impact, safety ''buffer'' zone around transformer station has been suggested.

- Upon finishing, it is necessary to make accurate measurements of EMP fields and noise, in order to determine if the results are in accordance with legally perscribed standards of Montenegro as well as relevant international standards, and obtain monitoring on a regular basis which will make additional safety measures possible to define.

Previously given recommendations and conclusions, as it goes for converter stations, are based on precautionary principles and their application, considering the fact that when it comes to characterization need of EMP fields at the strategic planning level, no thorough techical documentation for transformer station is available. Therefore, all recommendations, including those given from the aspect of health, at the level of providing spatial-planning documentation, should be additionally analysed at the level of project implementation, when precise characterization of performing effects of transformation station that have influence on human health.

TRAFFIC

Current conditions

The site for a transformer and converter station is located in Lastva Grbaljska, Kotor municipality, on the left side of M2 highway in Kotor-Budva direction. On the whole area there is only one constructed ground building (individual living), which is accessed by the existing gravel road.

picture 7 – Current traffic access to the site

Planned conditions

Access to the site is provided by planned road, whose width is to be 6m and with pavement from both sides, width 1,5m. Underground 500kV cable has the same direction as this road, from the spot where it comes out from the sea, along with edge of Mrčevo field, all the way to the mentioned site. Special attention is to be paid to the spot of underground cable and M2 highway intersection. Installations set in road zone and protective zone(regional water supply, optical cable and other local supplies) are to be carefully treated during the intersecting of underground cable and Adriatic highway. Likewise, the fact that the highway in this part is being reconstructed into a road of a boulevard type should be borne in mind.

Trafic network at the site itself is organized in a way to provide access to urban parcels of converter and transformer station. Width of mentioned roads is 6.0m, to which the network of internal roads is subjected and situationally defined during the project, depending on equipment choice and disposition of the converter, that is, transformer station itself.

Car park for needs of employees will be defined within each urban parcel.

Terrain features should be considered during the leveling of all roads. Since we are dealing with relatively flat area, minimum gradients should be envisaged during the designing, in order to mantain effecient drainage. Longitudinal gradients should not be planned less than 0.3% while special attention should be paid to transversely carrying of the line direction, that is, to the length of zero gradients at turning points of the road.

Covering parts of roads are made of asphalt, pavements and independently provided pedestrian paths made of asphalt, stone, concrete, gravel etc. that is, of elements

created from mentioned materials. Planned car park spaces are made of raster elements concrete-grass, tiling (behaton) elements or asphalt.
Each of the mentiond road should be equipped by lighting and appropriate traffic signalisation.

Drainage system is solved by stormwater sewer system with channel runoffs hidden from the road surfaces. Shafts of all installation except for the fecal one, should be placed away from the motor traffic surfaces.

Passes for disabled persons should be envisaged at all zebra crossings where the curbs are raised, likewise each access to the building, in accordance with Yugoslav standards JUS U.A9 201-Access and passing space and 202-Pedestrian crossing zones.

Planned roads are determined by coordinates of horizontal curves and centres of crossroads and their cross section is given in graphical display enclosure. Since the geodetic base ratio is R 1:2500, which does not provide possibility of precise defining of height levels, by using this plan crossroads leveling points are orientationally defined. Height levels will be clearly defined after geodetic base has been put down for the needs of the roads' main projects developments and acquiring leveling points of converter and transformer station.

Relevant minimum right-turn radii, as well as cross sections along with the directions and specified detailes, are showed on graphical display enclosure.

Note: In the process of main projects of planned roads development, certain corrections are possible, in comparison to parameters given by the plan.

Electroenergetics

Current condition

There are no electricity network or objects at a subject area.

Planned condition

Electricity supply needs for the complex, depending on object structure and purpose, are specified by the plan.
Peak load of the complex that is included in Deatiled site elaboration of transformer station and converter station – Blato in Lastva Grbaljska consists of the following peak loads:

- bulidings or objects on urban parcels UP 2 and UP 3 (warehouse and Terna administartive building),
- bulidings or objects on urban parcels UP 4 (Prenos administrative building) and
- public lighting installation

which will be supplied from boths sides of the existing 35kV network, in accordance with conditions of relevant electric utility company.

Peak load of buildings

In order to determine necessary simultaneous load, data on needed specific load in relation to specific building type, are used such as:

Urban parcel	Building	Maximum net area m^2	Specific load W/m2
UP2	Warehouse	2.541m^2	100 W/m^2
UP3	Terna - administrative building	4.000m^2	150 W/m^2
UP4	Prenos administrative building	5.626m2	150 W/m2

Based on stated data and mathematical relationships, we came to the conclusion that the peak load caused by buildings, will be:

- for the object on the parcel UP2 (warehouse –Terna)

$$P_{p1} = 2.541 \ x \ 100$$
$$P_{p1} = 254.100 \text{ W} = 254{,}10 \text{ kW}.$$

- for the object on the parcel UP3 (Terna - administartive building)

$$P_{p2} = 4.000 \ x \ 150$$
$$P_{p2} = 600.000\text{W} = 600{,}00 \text{ kW}.$$

- for the object on the parcel UP4 (Prenos – administrative building)

$$P_{p3} = 5.626 \ x \ 150 \text{ (W)}$$
$$P_{p3} = 843.900 \text{ W} = 843{,}90 \text{ kW}$$

Total amount of the load related to both objects is:

$$P_{pl} = P_{p1} + P_{p2} + P_{p2} = 0{,}95 \ x \ (254{,}10 + 600{,}00 + 843{,}90) = 0{,}95x \ 1.698{,}00\text{kW}$$
$$P_{pl} = 1.613{,}10\text{kW}$$

Public lighting peak loads

Public lighting peak loads in total load of the complex, is varying between 2,5 up to 5% from the total peak within the whole area. In regard to our case, 5% load has been accepted. In that sense, we have:

$$P_{ppl} = 0{,}05 \ x \ P_{vo} \text{ (W)}$$

$$P_{ppl} = 0{,}05 \ x \ 1.613{,}10$$

$$P_{ppl} = 80{,}65 \text{ kW}$$

where P_{pl} stands for – total peak load initiated by buildings.

Total peak load

Estimating peak load and the reserve of 10% each, along with power factor cosφ=0,98 we reach the amount of the total peak load:

$$T_p=1,21 \text{ x } (P_{pl}+P_{ppl}) / 0,98$$
$$T_p=1, 2\text{x } (1.613,10+80,65) / 0,98$$
$$T_p=2.073,98\text{kVA}.$$

Two new TS 35/0,4kVA (transformer stations), each of the 2 x 630kVA strength, will produce this power, which are planned as a part of object for Terna administrative building, as well as of object for Prenos administrative building, what has been displayed on the plan - electroenergetics.

Load capacity of transformer station is:

$$k = 2.073,98/ 2.2520 = 0,82$$

what is immensely satisfying.

For the purpose of making a site choice for constructing new TS 35/0,4kV the following issues were taken into consideration so that:

- transformer station is close as much as possible to the center of gravity load,
- high voltage connecting cables are short as much as possible,
- low voltage cables are short as much as possible, and design simple cable lines,
- there is an easy access to the transformer stations for the purpose of construction part and its installation, power transformer station and installation of other equipment.

This transformer station contains standardized equipment, in accordance with reccommendations of Electric Power Industry of Montenegro (EPCG) and relevant regulations. It is made of 37kV stations, strength transformer and 0,4 kV station. Three-phase transformers are oil immersed, tested according to relevant Yugoslav standards JUS.N.H1.005, with or lacking a conservator, and with a possibility of thermal oil expansion, without permanent deformity of a container.

New transformer stations joining is from both of the sides by means of the existing 35 kV network, and all in compliance with relevant electric utility company.

Objects supplying on the urban parcels UP2, UP3 and UP 4 and public lighting is to be obtained by means of planned transformer stations TS 35/0,4kV, followed by relevant utility company’s conditions, and with 1kV cables of a type and cross section chosen depending on the peak power of certain objects.

Cables should be lined according to relevant technical regulations related to this type of work. Cables that go into the ground should be with the least protection of PP00. While placing cables, minimum horizontal and vertical distances from other installation should be taken into consideration. Cables should be placed in accordance with relevant technical regulations and all of them are to be put inside PVC pipes of 110mm cross section.
During the object construction, things that should be followed are regulations on minimum distance from electricity power lines / voltage cables and all voltage levels

according to relevant guidebooks on technical normatives for constructing aboveground and underground electricity power lines of 1 kV up to 400 kV voltage, which shows and represents minimal safety horizontal distance and safety height of objects from electricity power lines.

Technical conditions and measures that should be applied during the designing and construction of objects connections to the low voltage distributive network are determined by Techical recommendation TP-2 of Electric Montenegrin Industry.

All possible intersections, vicinities or parallel lining along with other underground installations when it comes to cables placement, should be treated in accordance with relevant regulations and recommendations.

• Mutual distance between power cables of low voltage should not be less than 7 cm, in parallel lining, thatis, 20 cm in mutual cables intersections.
• Distance between power cables should amount at least 20 cm if it is the case of the same or different voltage level cables and their intersection.
• Parallel lining is not allowed below or above water or sewer pipe (except in intersection) is not allowed. Horizontal space between the cable and water or sewer pipe should be at least 0,40m.
• Cables can be placed below or above water or sewer pipe during the intersection, with the distance of 0,3m.
• If stated distances cannot be made, the power cable should be placed into a protective pipe.
• In parallel lining of cables with telecommunication cable the least allowed horizontal space of 0,5m long.
• Intersection of power and telecommunication cables should be done with mutual distance of 0,50m, except that the power cable is placed below the telecommunication cable. Crossing angle should be closer to 90 °, but not less than 45 °.
• Power cables by walls and building foundations should be placed at the distance of 30cm at least. If there is a pavement by the building then that cable should be away from the pavement.

Outdoor lighting construction

With the construction of new public lighting in outdoor areas, and roads around the complex, photometric parameters given by international recommendations (recommendations of CIE - Commision Internationale d'Eclairage, that is, International Commission on Illumination).
2 segments and 3 segments poles are to be used as lamp carriers, envisaged for the installation on prepared concrete foundations, so that they, depending on the needs, can be taken down, and electricity supply of public lighting will be implemented by cables (underground), where standard cable types will be used (PP 00 4x25mm2; 0,6/1 kV for street lighting and PP 00 3(4)x16mm2; 0,6/1 kV for lighting as a part of landscape design). In lighting installation projecting as a part of the terrain desing around planned objects special attention to be paid to aesthetic look of lighting installation.
Lighting system should be designed to operate whole night. When choosing lamps, attention to be paid to standardization for the purpose of simple exposure lights.

Maximum allowed voltage drop in the lighting installation, during the work mode, can be 5%. In the case of wiring installation, safety measures against electric shock (protection against direct and indirect voltage) should be completely applied. To this end, placing a common grounding conductor of all lighting installation poles should be obtained, by means of Fe-Zn (Iron-Zinc) 25x4mm layer and its link to poles and grounding of feeder transformer stations. Selective protection of the complete feeder and specific lamps to be provided.
Measurement of the consumed electricity to be provided. Management of public lighting turning off and turning on to be provided with the help of an integrating meter or a photocell.
The same conditions, as before mentioned lining of low voltage power cables, go for placing feeder power cables.

Energy efficiency measures

Enhancement of energy efficiency is especially related to positioning or implementation of low energy buildings, enhancement of air-conditioning device and preparation of warm water, lighting enhancement, concept of intelligent building (managing energy consuming of major consumers from one central place). All named possibilities should be used, o a certain extent, in object construction on the area of site study.

TELECOMMUNICATION INFRASTRUCTURE

Current conditions

At the Blato site, which is the subject matter of this documentation's elaboration, the prevailing operater of fixed telephony in Montenegro, called Crnogorski Telekom, did not have developed telecommunication infrastructure, for there was non need for it.

On the very edge of observed zone there is constructed telecommunication canalisation along with the traffic direction Budva-LKotor. Telecommuniaction canalisation has been done by using 110mm PVC pipes and telecommunication panels with light tf covers.

Telecommuniaction canalisation is set beside and following the left side of mentioned road.

There is one optical cable in telcommunication canalisation, owned by Montenegrin Crnogorski Telekom. Site Blato itself is covered by the signal of mobile telephony due to mobile operaters of M-Tel, T-Mobile and Telenor.

Hence, there is no good telecommunication infrastructures - available telecommunication networks and canalisations, in the zone of Blato site, excluding telecommunication canalisation at the edge.

Planned conditions

In the description of current condition it has been already emphasized that observed Blato site is not provided with constructed telecommunication infrastructure at the moment.

Telecommunication canalisation of Montenegrin Crnogorski Telekom, in the direction of Kotor-Budva, gives technical assumptions that this area might be well connected to fixed telephony network, that is, future users at this zone can count on all services offered by modern fixed telephony.

Connection of this area with the existing optical direction has been planned by projected solution.
If Crnogorski Telekom should opt for another approach in solving users requests for telecommunication jacks, it does not change suggested solution in the sense of telecommunication canalisation construction.

Therefore, if any solution is adopted (optical approach or some other), any kind of additional supply of telecommunication jacks in the covered zone is impossible, without constructing a new telecommunication infrastructure – telecommunication canalisation and available telecommunication network. In determining a number of PVC 110 mm pipes of the new telecommunication canalisation, data on planned construction areas and object purposes (within area) are taken into consideration.
Current trends regarding cable television issues and solutions should be taken into consideration, so that one PVC pipe is planned exclusively for the needs of KDS operater (cable television provider).

In compliance with stated facts, along with data on existing telecommunication infrastructure at this and surrounding terrain, provided by Crnogorski Telekom, upon the request of problem solving, that is, for the assignment of telecommunication jacks at the Blato site, construction of new telecommunication canalisation away from highway with three PVC pipes of 110mm cross section.

Total length of planned telecommunication canalisation in that manner, with 3 110mm PVC pipes amounts approximately around 1800 meters, and the construction of new 13 tk panels with light tf cover is planned. Planned solutions regarding the construcion of new telecommunication canalisation, will be, without any doubt, linked to existing telecommunication canalisation by the Kotor-Budva traffic direction.

Route of planned telecommunication canalisation is necessary to, wherever possible, fit into routes of pavements or green areas, for the reason of following condition: if telecommunication panels are provided in road or car park route, heavy framed lids would be placed and in accordance with the situation, enhancment of panels would be necessary, which is not economical.

Telecommunication canalisation planned within the zone, as well as telecommunication panels, should be done in all aspects following the relevant law regulations in Montenegro, higher degree plans and recommendations of ZJ PTT in relation to this area.

The plan and the conecction way of each object will be in accordance with planned contents within the area, including telecommunication panels, projects for specific objects in the covering zone. Telecommunication canalisation in the matter of specific projects should be envisaged all the way to the object themselves.

Home telecommunication installation in objects, should be carried out in standard tf cabinets, located on the entrance to the objects at a prescribed height or in technical sectors of the objects.
Cabinets for concentrated installation should be carried out in the same way, for the purpose of TV signal's cable distributing. For home telecommunication installation in all sectors/halls UTP (unshielded twisted pair), IySty or other cables of similar features should be used, and put through PVC pipes, with the appropriate number of junction boxes integration, bearing in mind that minimum 4 telecommunication installations should be envisaged in each of the business sectors.

In case route of telecommunication canalisation matches with route of water works canalisation or power installation, prescribed distance should be followed, and the pace of construction to be time synchronized. Designer obtained estimated bill of quantities of telecommunication canalisation materials and construction works, which is given as the elaboration part of adopted technical solution.

Bill of quantities and estimated bill of quantities for materials and works used for telecommunication canalisation construction

A / MATERIAL

1. Delivery of 110 mm / 6 m PVC pipes pcs 900x 12,00=10800,00 €
2. Delivery of light tf covers with frame pcs 13x 120,00= 1560,00 €

T O T A L A : 12360,00 €

B / CONSTRUCTION AND ASSEMBLY WORKS

1. Arrangement of tc canalisation with 3 PVC pipes m 1800x14,00=25200,00 €
   (trench digging dim. 0,40x0,80 u the ground of
   IV category, complete work and material)
2. Arrangement of tc panels un.dim. 1,80x1,50x1,90m PCS 13x 700,00= 9100,00 €
   With the light framed cover
   (hole digging dim. 2,20x1,90x2,30 in the ground of
   III/IV category, complete work and material)

T O T A L B : 34300,00 €

OVERALL A+B : 46660,00 €

HYDRO-TECHNICAL INFRASTRUCTURE

Current condition of hydro-technical infrastructure

Existing water supply

There is no registered water supply of the objects at the location itself.

There is a small diameter local water supply network near the site – southeastern contact zone. Mentioned local water supply is made for the local community Lstva Grbaljska. The urban plan of this settlement envisages further development of hydro-technical infrastructure in this zone (complement and enhancement of water supply network).

Existing fecal canalisation

There is no provided fecal canalization at the site.

Urban plan of Lastva Grbaljska settlement near the site – southeastern contact zone envisages construction of arranged fecal canalization network.

Existing stormwater piping

Geological ground structure at the subject site has flysch character. Stormwater drainage at the location, and in wider zone as well, has been solved by using surface water runoffs directed to the south towards Grbaljsko polje (Grbaljsko field).

Planned condition of hydro-technical infrastructure

Planned water supply

Administrative buildings are envisaged at urban parcels UP2, UP3 and UP4 (total gross construction area amounts 12166 m^2). Sanitary blocks and their watter supply might be needed in mentioned areas.

Water requirements:

Consumption norms:

- Maximum daily need of water for operations in several shifts – 60 litres per employee

Assumed losses: 20%.

Purpose	Consumers	Consumption norms	Consumption [m^3/day]
Operating	16 [employees]	60 [l/employee/day]	0,96
Total including 20% losses			**1,15**

Thus:

- average daily consumption

Q av = 1.15 / 86.4 = 0.013 l/s

- maximum daily consumption

Q maxd = Q sr * 1,3 = 0.013 * 1,5 = 0.017 l/s

- maximum consumption per hour

Q maxh = Q maxd * 1.5 = 0.017 * 1.5 = 0.026 l/s

Way of supplying:

Necessary water quantities can be provided by connection to the local community's water network. (Water supply network – pipeline Ø110 is planned at the crossroads, circa 300m away, from where the access road is included for the covering zone).
If there is no possibility of getting water from the local community water network, finding an appropriate water for technical water is suggested. (Water requirements are minimum, therefore it would not be profitable of drinking water is provided).

Necessary water supplying will be arranged byusing one branch shared for all objects on urban parcels UP2, UP3 and UP4.
High density polyethylene (HDPE) pipes are suggested – material used PE100, maximum preassure 10 bars. Minimum supply dimensions that goes from the local water network is Ø63.

Planned fecal canalisation

Wastewater collection from all objects is envisaged for the covering zone.

Drainage collecters DN200 will be gravitationally directed towards south.

A small wastewater purification plant will be built close to the road, on the south border line of UP2. This object needs to be provided with 10 ES capacity. Dismissal of purified water can be directed towards nearby surface channel or an absorbing trench.

A solution of this kind provides also, in due course of time, possible connection to the local community's fecal canalisation. (DN collector is envisaged by urban planning as of the crossroads where the access road is included. From the considered coverred part, drainage system would be put preassure upon with additional 0.8 x 0.013 x 2.5 = 0.026 l/s of wastewater.) However, envisaged plant represents permanent solution which can operate precisely and independently of surrounding infrastructure constructing pace.

Planned stormwater drainage

Keeping the basic concept is envisaged for stormwater drainage, which is characterized by using surface channels at the location.
Depending on the organization plan of objects, movement of existing channels can be considered to a certain extent, without reducing their passability. Channels should be regularly kept in good condition and passable.

Water that comes out of the gutters and larger concrete or asphalt areas needs to be directed as well towards existing surface channels. Objects which lead to these channels, should preferably have the possibility of their own ground infiltration (perforated pipes, shafts with an absorbing base etc.). Ability to absorb water in communal conditions is not ideal and technical solution has to be chosen according to the analysis of the precise geological base of a specific spot.

Estimated amount of the stormwater in a drainage management system at the site and that is recommended is 250 l/s per ha of rain intensity.
In case if precise disposition provides efficient stormwater collecting from the roofs, plateaus and other surfaces impervious to water, getting a small collection tank for the technical water would be favorable. It would be used for yards washing and green areas watering.

LANDSCAPE ARCHITECTURE

Concept of landscape designing

Landscape interventions are envisaged primarily in order to reduce the visual effects of the converter station and transformer station that they create when the landscape is considered. This approach on the one hand implies the affirmation of spatial landscape values, with maximum appreciation and preservation of its dominant structural elements and existing landscape form, and on the other hand tends to shelter the converter station from the highway's view.

Green areas chategorization is managed according to their purpose. Following types of green area are planned:

- greenery for ecosystem preservation
- greenery for recultivation

General guidelines of landscape designing:

- Maximum sheltering of built structures by means of higher vegetation
- Preservation of natural spatial values (terrain configuration, hydrological processes, wetlands)
- Harmonization of compositional solution of greenery with landscape features and area purposes
- Maximum preservation of existing vital and functional trees, whether they grow as a group or individually and their fitting into the new urban solution

For the purpose of maximum preservation of existing trees and their fitting into new landscape and urban solutions, inventarisation should be taken during the project documentation development along with taxation assessments and existing greenery valorisation (condition and decorative characteristics).

Landscape designing guidelines for the site
Greenery for recultivation PGR

Conditions subjected to existing site and requirements of visually shelterness towards the upper part of Lastva Grbaljska settlement should be borne in mind at the process of recultivation after the work constructions.

Designing guidelines:

- Green areas linked in the unique system of dense and high greenery
- Maximum preservation of existing trees
- Preserve natural terrain congiguration

Greenery for the purpose of ecosystem preservation – G2

Landscape designing should be in accordance with site's ecological features.
With the landscape designing nature and built structures interaction should be provided.

Designing guidelines:

- Preserve natural terrain configuration
- Usage of primarily autochthonous plant species, especially autochthonous grass species (Juncetalia maritimi).

Green areas balance sheet

- Greenery for recultivation.. 8 ha
- Greenery in order to preserve ecosystem................11.22ha

Total: 19.22ha

General proposal of planting material:

When choosing planting material, the following conditions have to be adopted:

- Species that are resistant to environmental conditions and in accordance with compositional and functional requests to be used,
- Bedding plants have to be healthy, treated in a proper way, with standard dimensions, and turfs.

Species that should be useful to complement biological basis, and enhance the effect of vegetation potential are:

- ***Coniferous trees:*** *Cupressus sempervirens* var*. pyramidalis, Cupressocyparis leylandii, Juniperus phoenicea, Pinus halepensis, Pinus pinea, Pinus maritima.*
- ***Deciduous trees:*** *Quercus pubescens, Celtis australis, Ziziphus jujuba, Acacia sp., Albizzia julibrissin, Melia azedarach, Lagerstroemia indica.*
- ***Evergreen trees***: *Quercus ilex, Olea europaea, Ceratonia siliqua, Citrus aurantium, Eriobotrya japonica, Ligustrum japonicum, Magnolia grandiflora.*
- ***Bushy species:*** *Agave americana, Arbutus unedo, Callistemon citrinus, Erica mediteranea, Feijoa sellowiana, Laurus nobilis, Myrtus communis, Nerium*

oleander, Pittosporum tobira, Poinciana gilliesii, Cotoneaster sp., Pyracantha coccinea, Tamarix sp., Viburnum tinus, Yucca sp.

- ***Palm trees:*** *Chamaerops humilis, Chamaerops excelsa, Cycas revoluta, Phoenix canariensis, Washingtonia filifera.*
- ***Perennial plants:*** *Canna indica, Cineraria maritima**,** Hydrangea hortensis**,** Lavandula spicata, Rosmarinus officinalis, Santolina viridis, Santolina chamaecyparissus.*

Preservation measures end effects elements on the environment, designing guidelines and spatial shape

Protection conditions
This location provides and has conditions for well fitting of converter and transformer station into the landscape.

Protection from the highway viewpoint
By planting dense bulk of greenery on the south part of parcel, it is possible to shelter the converter and transformer station from the highway viewpoint. Natural terrain configuration hides the coverter and transformer station from the other viewpoints.

Ecosystem protection
Since this area is registered as the one with presence of wetland areas and the vegetation that is suitable to Mediterranean salt meadow habitat (Juncetalia maritimi), quality of the surrounding habitat has to be provided on green areas.

Fire protection and fire fight

Protection against unanticipated consequences implies providing of transformer station and converter station accesses, which is suceeded by providing vehicular access to the site and blank area zone right next to the station.