



THE 220/110/35/20(10) kV

SUBSTATION

PLAT

2014

POSITION



The 220/110/35/20(10) kV substation (SS) Plat is situated at the southern access to the town of Dubrovnik, above the Adriatic main road, near the village of Plat, approximately 800 m north of the present 220 and 110 kV switchyard of the Dubrovnik hydro power plant.

The substation is located on the outer plateau, approximately 115 × 95 m wide, containing 220 and 110 kV connection towers, power transformers, roads, walls, perimeter fence and other facilities, as well as three buildings holding switchgear and systems – high voltage switchgear, medium voltage switchgear, and management and control facility.

The 220 kV switchgear (SG) in SS Plat consists of double sectioned busbars comprising nine bays: five feeder bays (CL Dubrovnik 1, TL Trebinje 1, TL Trebinje 2 and two backup bays), two transformer bays

(AT1 and AT2), a coupler bay, and a sectionizing-metering bay.

The 110 kV switchgear consists of double sectioned busbars comprising eleven bays: five feeder bays (CL Dubrovnik, TL Komolac 1, TL Komolac 2 and two backup bays), four transformer bays (AT1, AT2, TR1 and TR2), a coupler bay, and a sectionizing-metering bay.

The 220 and 110 kV are SF6 gas insulated metal-encapsulated switchgears for indoor installation situated on the ground floor of the high voltage switchgear building. Cable connections leading through the basement of the building connect the 220 and 110 kV gas insulated switchgear to power transformers and connection towers for overhead transmission lines.

To the north-east, on the open space behind the high voltage switchgear building,



the 220/110/35/20(10) kV switchgear is situated, comprising two 220/110 kV autotransformers, 150 MVA (AT1 and AT2), a 110/35 kV, 20 MVA (TR1) and a 110/20 kV, 20 MVA (TR2) transformer, and an 35/20(10) kV, 16 MVA interconnecting transformer. Unit auxiliary transformers 35/0.4 kV, 630 kVA and 20(10)/0.4 kV, 630 kVA are situated on the ground floor of the management and control facility.

The 35 kV switchgear consists of single busbars comprising eight bays – three feeder bays (SS Cavtat, SS Pločice, SS Mlini), two transformer bays, a unit auxiliary transformer bay, a ripple control bay and a metering bay.

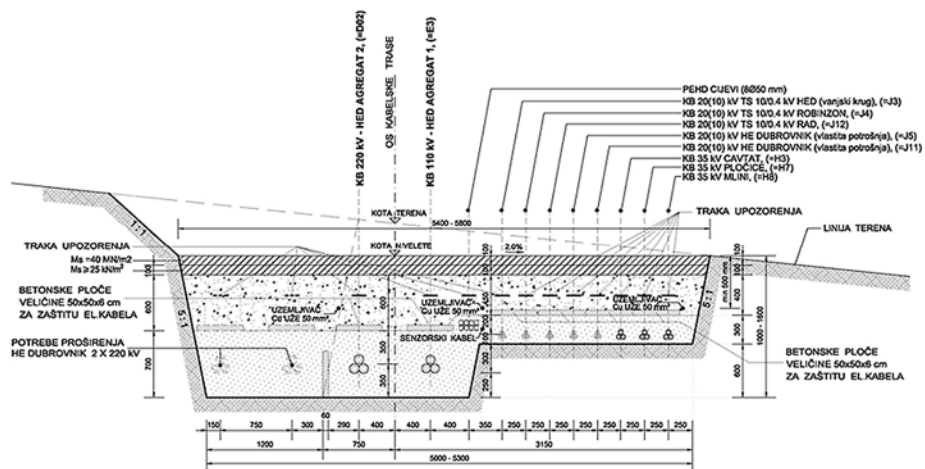
The 20(10) kV switchgear consists of single sectioned busbars comprising fourteen bays: seven feeder bays (HPP Dubrovnik engine room 1, HPP Dubrovnik engine room 2,

HPP Dubrovnik outer perimeter, SS Rad, SS Robinzon and two backup bays), two transformer bays, a unit auxiliary transformer bay, a ripple control bay, a sectionizing bay and two metering bays.

The 35 and 20(10) kV switchgear consist of standard metal enclosed air insulated switch bays situated on the ground floor of the medium voltage switchgear facility. Cable connections to medium voltage switchgear lead through the basement of the building.

SS Plat comprises auxiliary facilities for distribution and transformation of 0.4 kV, 50 Hz voltage with diesel electric power generator as backup power assistance in instances of alternating voltage supply failure, facilities for generation and distribution of auxiliary direct voltage ± 220 and -48 V, as well as other facilities for management, control and protection equipment.

CONNECTING LINES



THE 220/110/35/20(10) kV PLAT SUBSTATION AND 220, 110, 35 AND 20(10) CONNECTING LINES

The 220/110/35/20(10) kV Plat substation (SS) and the 220, 110, 35 and 20(10) kV connecting lines represent a complex energy facility for transformation of electricity on different voltage levels with connections to the electric power system at 220, 110, 35 and 20(10) kV.

220 AND 110 kV CONNECTING OVERHEAD LINES

Of the two 220 kV transmission lines previously connecting the switchgear (SG), the hydro power plant (HPP) Dubrovnik and SS Trebinje – the 220 kV line connecting HPP Dubrovnik and Trebinje (first line – western), and the 220 kV line connecting HPP Dubrovnik and Trebinje (second line – eastern) – the first line leads now into the SS Plat, while the second keeps connecting HPP Dubrovnik and SS Trebinje.

For its introduction a double 220 kV transmission line was

constructed, approximately 1300 m long, between the corresponding connection towers in SS Plat and the new towers on the routes of the two above mentioned transmission lines, along the border with Bosnia and Herzegovina enabling the connection of the new double 220 kV line onto two existing 220 kV lines leading towards SS Trebinje.

For the introduction of the existing double 110 kV transmission line Plat – Komolac into SS Plat a double 110 kV transmission line was constructed, approximately 550 m long, between the corresponding connection towers of SS Plat and the existing tower on the 2×110 kV transmission line route between Plat and Komolac.

220, 110, 35 AND 20(10) kV CONNECTING CABLE LINES

Connecting cable lines are situated in the route running between SS Plat, the existing switchyard of the HPP Dubrovnik, and its external perimeter. The route is approximately 1200 m long, containing 220 and 110 kV cables for HPP Dubrovnik, 35 kV



distribution cables leading towards SS Cavtat, SS Pločice and SS Mlini, 20(10) kV cables running toward SS Rad and SS Robinzon, as well as 20(10) kV cables for the supply of the HPP Dubrovnik (HPP Dubrovnik engine room 1, HPP Dubrovnik engine room 2, HPP Dubrovnik outer perimeter).

The 220 and 110 kV cable lines connect SS Plat and HPP Dubrovnik being connected on one side to the 220 and 110 kV gas insulated switchgear in the high voltage facility in SS Plat, and on the other, to the switchyard of the HPP Dubrovnik wherefrom cable connection leads towards the power plant generators. As opposed to the 110 kV cable line, the 220 kV cable line in the HPP Dubrovnik's switchyard has not been connected to the corresponding generator since the 220 kV connection between HPP Dubrovnik and SS Trebinje remains via the existing, eastern, 220 kV transmission line Dubrovnik – Trebinje (second line).

The starting point of 35 and 20(10) kV connecting cable lines is the

switchgear in the medium voltage facility of SS Plat. The 35 kV lines run from the SS Plat in a joint route, eventually branching into the first separate route for SS Cavtat and SS Pločice, and then the other for SS Mlini, to ultimately reach the final point on the towers where there is a transition from cables to overhead lines leading on toward SS Cavtat, SS Pločice and SS Mlini.

The 20(10) kV cable lines from SS Plat to the HPP Dubrovnik's engine room 1 and 2 run down the joint route from the starting point in SS Plat to the switchyard of the HPP Dubrovnik where they connect with the existing 20(10) kV lines leading to the power plant's engine room to meet the needs of auxiliary consumption. Other 20(10) kV cable lines for SS Rad, SS Robinzon and HPP Dubrovnik outer perimeter, have the same starting point in SS Plat running down the joint route through the switchyard of the HPP Dubrovnik, and on below the Adriatic road, to the connecting point in HPP Dubrovnik wherefrom they lead on towards the above mentioned substations.

6.

CONSTRUCTION





The construction of the 220/110/35/20(10) kV Plat substation and the connecting lines began on 22 October 2010. The construction was characterised by demanding field work in the area potentially prone to landslides. The first concrete was placed in the substation on 14 January 2011. The total of 57.000 m³ was excavated for foundations, and the total of 6.839 m³ of concrete was used.



8.



The erection of electric power facilities in SS Plat began on 15 February 2011 when the grounding grid was installed during construction works. The work on electrical installations and lighting began on 10 January 2012 in the room wherein the gas insulated switchgear was to be placed in the 220 and 110 kV facility. An overhead travelling crane with load capacity of 5t was installed in the room.



The first shipment of the gas insulated switchgear for the 220 kV facility arrived on 6 March 2012. The installation works and testing on-site lasted until 30 August 2012. The gas insulated switchgear in SS Plat is the first of a kind in the Republic of Croatia.



The delivery of the gas insulated switchgear for the 110 kV facility began on 2 April 2012, and continued in batches following each state of completion. The installation works and testing on-site was completed on 24 May 2013. The total of 36.932 m of feeding cables, and signal and control cables was laid, as well as 1.146 m of cable splices and routes.

The delivery of the 35 and 20(10) kV switchgear began on 1 March 2012. On-site testing was completed by April 2014. In the basement of the medium voltage facility in SS Plat there is a 35 and 20(10) kV ripple control system whose delivery and installation began on 24 July 2012. The system was ready for putting it into operation on 1 July 2013.



The 110/35 kV, 20 MVA and 110/20(10) kV, 20 MVA power transformers, as well as the 30/20(10) kV, 16MVA interconnecting transformer were delivered on 31 May 2012, and 1 June 2012, respectively. Following the installation, on-site testing was conducted on 11 October 2012.



Two 220/110 kV, 150 MVA transformers were delivered to SS Plat on 20 June 2012. Installation works and on-site testing was completed by 8 December 2012.



The installation of 220 and 110 kV cable connections in SS Plat began on 28 November 2012 when the first cables were laid. The process ended with the execution of terminators, and testing of the cable protection cover on 25 May 2013.



10.



Installation and testing of the entire secondary equipment in SS Plat lasted from 1 October 2012 until 23 December 2013.



Construction works on connecting cable lines began on 24 March 2011, while the installation works began on 31 July 2012. The total of 7.850 m of 220 and 110 kV cables, and 39.024 m of 35 and 20(10) kV cables were buried in SS Plat and the connecting cable routes.



The works on the construction of overhead connecting lines went parallel with the works on the substation. Construction works began on 24 March 2011. All works on the overhead lines were completed by 22 October 2014.



The completion of works on the facility was harmonised with the time schedule of equipment installation, with all the works being completed on 25 June 2013, when the trial run was registered. It lasted until operational license was obtained. Technical review was conducted in the period from 14 – 18 July 2014.

THE IMPORTANCE OF THE SUBSTATION

11.



Construction and putting into operation of the 220/110/35/20(10) kV SS Plat and its connecting lines is the largest investment in the Croatian transmission system of the decade. It is most important for the southernmost part of Croatia, that is the Dubrovnik – Neretva County, and especially for the Dubrovnik area. Namely, before the construction of SS Plat, the area extending from the Neretva River to Prevlaka had the most unstable electricity supply in the Croatian Electricity System, with electricity supply interruptions causing great damage to local economy, and creating a negative impact on tourism in the area, especially in Dubrovnik. The reason for it was the supply of the entire area from one nodal point in the transmission system (the 110/35 kV SS Komolac), which was not an adequate solution.

The greatest benefits of the construction of the 220/110/35/20(10) kV SS Plat and the connecting lines which shall contribute to additional economic development of the Dubrovnik area are the following:

- Enabling a high level of security and reliability of electricity supply
- Enabling the connection of new electricity customers (especially entrepreneurs)
- Enabling secure takeover of electricity produced in the existing generators of HPP Dubrovnik
- Creating preconditions for the connection of new wind farms in the Dubrovnik area
- Creating preconditions for the realisation of the second phase of construction of HPP Dubrovnik (subject to agreement between Hrvatska elektroprivreda d.d. / HEP / and its partners, the electric power companies from Bosnia and Herzegovina).

**THE 220/110/35/20(10) kV SS PLAT
AND THE 220, 110, 35 AND 20(10) kV
CONNECTING LINES**

INVESTOR

CROATIAN TRANSMISSION SYSTEM OPERATOR LTD.

CONSTRUCTION AGREEMENT: September 2008

CONSTRUCTION DEADLINE: 30 months

INVESTMENT: 350 million kunas

BEGINNING OF CONSTRUCTION: October 2010

END OF CONSTRUCTION: June 2013

220 kV TL Plat – Trebinje: December 2013

TRIAL RUN: June 2014

TECHNICAL REVIEW: July 2014

OPERATIONAL LICENCE: 31 October 2014

PROJECT DESIGN AND PLANNING

ETING SPLIT

PROJEKTNI BIRO SPLIT

DALEKOVOD PROJEKT

GEODATA

**PROJECT MANAGEMENT
AND CONSTRUCTION INSPECTION**

CROATIAN TRANSMISSION SYSTEM OPERATOR

DEVELOPMENT, INVESTMENT

AND CONSTRUCTION DEPARTMENT

CONTRACTORS

**KONČAR – POWER PLANT AND ELECTRIC
TRACTION ENGINEERING**

DALEKOVOD

EQUIPMENT DELIVERY AND SUBCONTRACTORS

KONČAR – HIGH VOLTAGE SWITHGEAR

KONČAR – DISTRIBUTION AND SPECIAL TRANSFORMERS

KONČAR – ELECTRONICS AND INFORMATICS

KONČAR – INSTRUMENT TRANSFORMERS

KONČAR – POWER TRANSFORMERS

KONČAR – ENGINEERING FOR PLANT INSTALLATION
AND COMMISSIONING

SIEMENS

ABB

ELKA

SOKOL VINKOVCI



Croatian Transmission System Operator Ltd.

KONČAR

