ŠOŠTANJ THERMAL POWER PLANT

Due Diligence Services

Investment of New Lignite-fired 600 MW Power Generation Unit

European Bank for Reconstruction and Development (EBRD)
Contact

Hardturmstrasse 161, P.O. Box
CH-8037 Zurich/Switzerland
Tel. +41 44 355 5554
Fax +41 44 355 5556
Jorg.lammers@poyry.com
www.poyry.com

Pöyry Energy Ltd.

Dr. Jörg Lammers
Project Manager
Power & Heat

Hans-Ulrich Bosshard
Project Manager
Power & Heat

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1 INTRODUCTION

The European Bank for Reconstruction and Development (EBRD or Bank) is considering to provide financing to the Termoelektrarna Šoštanj (TEŠ). The financing will be for the construction of a 600 MW coal fired power generation unit on the site of the existing power plant in Šoštanj, Slovenia. The new Unit 6 with all necessary auxiliaries and connections is expected to be commissioned by the end of 2014. Pöyry Energy Ltd (PE or Consultant) has been assigned by EBRD as Lender’s Engineer or Technical Advisor (TA) (with the Consultancy Contract number C18964 of 6th July 2009) to conduct a Technical Due Diligence in order to support EBRD and other Lenders to the Project (together “the Lenders”) in this process.

The plant is located about 55 km north-east of Ljubljana, in a region with extensive coal reserves, nearby to the Premogovnik Velenje (PV), the Velenje Coal Mine that produces coal to meet exclusively the power plant’s present and future needs. Both the TEŠ and PV the coal mine belong to the Slovenian power utility, Holding Slovenske Elektrarne (HSE), as two separate subsidiaries and between them there is a long term coal supply contract.

The location of the power generation facility is crucial as TEŠ’s role is to ensure that the voltage level is maintained in order to enable effective power transmission over longer distances. The service life of four power generation units with the total rated power of 410 MW will come to an end by 2016. Those units need to be replaced.

1.1 Objectives

The Consultant’s understanding of the objectives is to perform the necessary technical due diligence services on behalf of EBRD and other Lenders for the Project of the new lignite fired 600 MW Unit 6, in order to enable the Bank to assess and evaluate the technical and economical risks of the Project.

An early site visit was requested by EBRD and it was carried out end of July 2009. The objectives of the site visit was to get a personal impression of

- the Šoštanj Thermal Power Plant,
- the Velenje Coal Mine and
- the new Project Unit 6.

Further objectives are, to collect the necessary documents and information as well as to discuss and clarify with various responsible people of the Owner directly the open questions for an efficient and fast assessment for the due diligence of the new Project.

The EPC contract for the Power Island was signed with Alstom in June 2008, after a reservation agreement including payment of a 25 million € fee had been concluded between TEŠ and Alstom in September 2007. The costs have increased by more than 30% within one year and a decision to proceed with the Project has to be taken by end of this year. As negotiations in connection with additional financing were scheduled with Alstom for end of August 2009, it was urgent and of utmost importance for EBRD to get an independent opinion on the current cost situation of the Project.

This was the main objective of the TA during the site visit mission and the reason for conducting the site visit on fast track at this date. A report on the status of the Project and the cost increase issue of the EPC Contract had to be submitted urgently to EBRD.
For the actual Investment Project of Unit 6, which requires a huge amount of money and due to the cost increase additional financing, the Lenders need to be comfortable with the assumed construction budget, with the time schedule for implementation and with the design and operating characteristics of the new unit. The TA will address in the Technical Due Diligence Report these issues, in order to give the necessary input to the Lenders for their risk assessment of financing the Project.

1.2 Task and Approach

The Consultant will conduct the tasks of the Technical Due Diligence as outlined in the Terms of Reference (TOR) of the Consultancy Contract as Technical Advisor (TA) for a new coal fired 600 MW Unit at the Šoštanj TPP, Slovenia. Refer to the TOR included in Annex 1.

A technical analysis of the environment and infrastructure, where the new Unit 6 will be installed needs to be performed. This refers, in particular, to the specific situation on site, the coal supply, the ash disposal, the water supply, the existing power units with their interconnections, the grid connection and the transmission system, as well as regulatory and environmental requirements.

A review and assessment of the plant concept, general arrangement, the basic design, the performance targets and the operational features of the new Unit 6 will be carried out. Furthermore, the compliance with technical, environmental, operational standards and requirements will be checked as well as economic aspects considered. The signed EPC Contract and other supply contracts will be reviewed and the cost structure, the time schedule and the technical specification analysed.

A site visit with a team of experts to Šoštanj TPP as required by the TOR has been conducted from 27th to 30th July 2009. A Kick-off Meeting was held at the Šoštanj TPP on 28th July 2009. The coal mining experts of VEMC reviewed and assessed the mining aspects in parallel separately and followed their own program at the Velenje Coal Mine. They started already on 27th July 2009 in the morning at went home one day earlier. A visit of the underground coal mine itself was not possible due to the annual shutdown of operations. For details of the Site Visit and the Kick-off Meeting refer to Annex 2.

The team members that participated in the site visit are listed in the table below.

<table>
<thead>
<tr>
<th>Name of Expert</th>
<th>Job Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pöyry Energy Ltd. (PE)</td>
<td></td>
</tr>
<tr>
<td>Dr. Jörg Lammers</td>
<td>Team Leader</td>
</tr>
<tr>
<td>Mr. Hans-Ulrich Bosshard</td>
<td>Power Plant Expert</td>
</tr>
<tr>
<td>Mr. Alan Edwards</td>
<td>Electrical HV Expert</td>
</tr>
<tr>
<td>Mrs. Britta Lammers</td>
<td>Environmental Expert</td>
</tr>
<tr>
<td>Vattenfall Europe Mining Ag – Mining Consulting (VEMC)</td>
<td></td>
</tr>
<tr>
<td>Mr. Ullrich Höhna</td>
<td>Coal Mining Expert</td>
</tr>
<tr>
<td>Mr. Ronny Czubka</td>
<td>Geology Expert</td>
</tr>
</tbody>
</table>

Table 1.1: Consultant’s Team for the Site Visit
Due to the special objective of this Site Visit the Consultant concentrated on document review, in particular, on documents of the Power Island of the new Unit 6, like the EPC Contract with Alstom, the Tender Documents and the Alstom Reservation Agreement. However, the availability of lignite reserves for the new Project, the interconnection of the new Unit 6 into electrical grid system and environmental aspects have been assessed.

The programs of the Site Visit for both teams (PE and VEMC) and the documents that could be made available for review to them are included in Annex 2. Pictures take during the Site Visit are included in Annex 3. The visit of the mine itself and the main underground production facilities was performed separately on 26th August 2009 by a second mission of Mr. Hoehna to Velenje, when the mine was in regular operation.

A Site Visit Report was prepared and issued on 17th August 2009 to EBRD. The report does not only describe the observations of the Consultant’s team, which were made during the visit, but covered already certain evaluations for the due diligence of the new Project Unit 6. This refers especially to the costs and the time for implementation of the Project. This report is, therefore, to be considered more like an Interim Report and major parts are incorporated in this Technical Due Diligence Report.

The TA was asked by to join them in a meeting with Alstom, which was held on 20th August 2009 in Baden, CH. The purpose of the meeting was to clarify with Alstom certain issues of the EPC Contract, in particular, with regard to reasons for the long implementation period, the steep cost increase and some testing conditions for take-over of the Power Island. Dr. Jörg Lammers and Mr. Ulrich Bosshard attended from the Consultant’s side the meeting, which was very fruitful in preparation for the upcoming negotiations.

These negotiations between TEŠ and Alstom consolidating the EPC Contract took place from 7th to 14th September 2009 in Velenje and in Baden, CH. The Bank and the TA were immediately informed about the outcome and the results, which will be considered in this report (refer to Section 7).

The existing power generating plant is described and analysed in Section 2, while the new Unit 6 is dealt with, from the technical point of view, in Section 3. In Section 4 plant operation is addressed and Section 5 reports on coal mining and fuel supply also considering the new Unit 6. Section 6 is dealing with the environmental aspects of the Project taking into account the present situation on site and the current status of the permitting process. Section 7 summarises the review of the EPC contract and comments on it. Section 8 addresses the other contracts of the Project as far as they were available and the total cost estimates of the Project are discussed. In Section 9 the conclusions are drawn, the results are summarised and some recommendations are given.

Furthermore, the technical assumptions of TEŠ’ Financial Model have been reviewed, as far as the available documentation allowed. The comments are included in Annex 5. A brief overview on the regulatory features for plant construction in Slovenia and a table showing the current status of the permitting process of the Project is included in Annex 7. An overview on the technical and financial capabilities of the main contractors is given in Annex 8.
2 EXISTING POWER PLANT

Šoštanj Thermal Power Plant (Šoštanj TPP) is very important for the Slovenian energy sector and its output accounts for about one third of the total electricity generated in the country. It is the largest power production facility among the companies of the HSE Group. For Slovenia the Šoštanj TPP with a capacity of 809 MW is a vital and indispensable source of electricity. In addition, it also produces thermal energy for industrial use and district heating supplying a large part of the Saleška Valley. The fuel used for power generation at the plant is lignite, which comes from the Velenje underground coal mine located in close vicinity.

The power generation structures of the Šoštanj TPP are old and rapidly approaching the end of their respective design lives. Therefore, in order to preserve the main key characteristics of the electricity system in Slovenia a new, modern power generating unit has to be installed that would replace the present units and meet all environmental and other requirements as imposed by the applicable EU legislation.

In 2015 new EU regulations will enter into force in relation to the emission standards applicable to hazardous air pollutants. Such emissions cannot be offset by purchasing emission certificates. As the older units do not meet the pending legislation, this means that they will have to be taken out of operation in 2015. Alternatively, significant investments into the old power generating units will be required to ensure their compliance with the applicable regulations, which is economically not viable.

The TEŠ facilities are well maintained and can hold any comparison to similar thermal power plants in Europe. According to production results and operational ability of its generating units the Šoštanj TPP has an excellent record.

2.1 Power Generating Units

The Šoštanj TPP comprises five units, where Unit 4 and Unit 5 have been upgraded with adding a gas turbine set (GT) supplied by Siemens to each unit. Unit 2 has been decommissioned in 2008 and is kept in cold reserve. In the table below some technical data of the existing power generation plant are shown.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4 + GT</th>
<th>Unit 5 + GT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Capacity (MWe)</td>
<td>27</td>
<td>27</td>
<td>68</td>
<td>252 + 42</td>
<td>309 + 42</td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td>24</td>
<td>24</td>
<td>26</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>Generator Rating (MVA)</td>
<td>30</td>
<td>30</td>
<td>75</td>
<td>275 + 48</td>
<td>345 + 48</td>
</tr>
<tr>
<td>Rated Steam Capacity (t/h)</td>
<td>125</td>
<td>125</td>
<td>280</td>
<td>860</td>
<td>1050</td>
</tr>
<tr>
<td>Boiler Manufacturer</td>
<td>Sulzer</td>
<td>Sulzer</td>
<td>Sulzer</td>
<td>Babcock</td>
<td>Sulzer</td>
</tr>
<tr>
<td>Turbine Manufacturer</td>
<td>EW*</td>
<td>EW*</td>
<td>EW*</td>
<td>Siemens</td>
<td>Siemens</td>
</tr>
<tr>
<td>Generator Manufacturer</td>
<td>BBC</td>
<td>BBC</td>
<td>BBC</td>
<td>Siemens</td>
<td>Siemens</td>
</tr>
</tbody>
</table>

Table 2.1: Main Power Plant Data  *Escher Wyss
The 2 new gas turbines are operating together with the units 4 and 5. They are equipped with heat recovery steam generators and the exhaust heat is utilized to heat up the feed water of the respective boilers of unit 4 and 5. This increases the overall unit efficiency.

Within the framework of above mentioned units two heating stations are included, which provide for district heating of the towns Velenje and Šoštanj. Process hot-water is supplied to all factories in Šaleška dolina valley.

The power output of the heating station 1 (TP1), which is the older one, is 90 MW. For the generation of heat energy it requires live steam supplied directly from Units 1 to 4. The more sophisticated version of heating station 2 (TP2) has 110 MW of installed capacity in heat exchangers. It is supplied with the steam form Unit 5, running from high pressure turbine back to superheating stage. There exists also an option of steam supply from Unit 4.

2.1.1 Units 1, 2 and 3

The oldest power generating units – Units 1, 2 and 3 - have been commissioned in the years 1956 to 1960 and they are at the end of their life time. Unit 1 will be taken out of operation in 2010, Unit 2 was shut down already in 2008 and Unit 3 is planned to be decommissioned in 2014. The units look well maintained, but their efficiency is too low. They have been or will have been in service for more than 50 years before shut down, and it becomes quite difficult to comply with environmental and economic requirements.

Unit 1 and Unit 2 are both of conventional design with an identical impulse, axial, multiple-stage condensing steam turbine of Escher Wyss and a Sulzer mono-tube forced flow boiler. Each of them is capable of producing 125 tonnes of fresh steam per hour, at a pressure of 100 bar and a temperature of 515 °C. Refer to the figure below.

![Figure 2.1: Schematic Flow Diagram of Units 1 and 2](image)
The steam turbine of generating Unit 3 is of similar design, but with a higher capacity of 75 MW and fed by two Sulzer mono-tube forced flow boilers. The boilers appear identical to the ones of Units 1 and 2, but they have larger internal heating surfaces. Unit 3 can also operate with only one boiler operating in part load. Each of the boilers can produce 140 t/h of steam, at 100 bars and 530 °C.

2.1.2 Unit 4

Unit 4 is in service for 36 years and will be decommissioned in 2016. It has a Benson type boiler generating supercritical steam at a pressure of 225.6 bars and a temperature of 374.2 °C with reheating and has a capacity of 860 t/h. The power generation set of Unit 4 has a Siemens multistage, axial, extraction condensing reactive steam turbine with reheating. It comprises a high, an intermediate and a low pressure part and a system of auxiliary devices. The water steam circuit is shown in the figure below.

![Figure 2.2: Schematic Flow Diagram of Unit 4](image)

2.1.3 Unit 5

Unit 5 is the youngest power generating unit, but it is already over 30 years in service. It is planned to keep it in service until 2028. The unit is well maintained and the TA has the impression that it can be operated for a longer period under the same operating and maintenance (O&M) conditions. The process diagram of the water steam cycle is similar to the one of Unit 4 shown above, but the capacity is higher and the main components are different. The more detailed schematic flow diagram of Unit 5 is included in Annex 4.

The boiler is a Sulzer mono-pipe vertical rig with additional circulation in the evaporator and the once-through reheating. It is 96 m high and the active part of the boiler is shaped...
like a prism that narrows into a cone at the bottom. A membrane of gas-tight welded pipes of the evaporator constitutes the walls of the furnace. The furnace chamber reaches up to the height of 49 m, above which the convective part of the boiler is located. The water-walls of the furnace chamber constitute the evaporator, above which the superheater; the final superheater, the secondary reheater, the primary reheater and the economizer are located. The boiler generates 1'050 t/h of overheated steam, at 184.4 bars and 540 °C. The setup of the boiler is shown in the figure below.

![Figure 2.3: Boiler of Unit 5](image)

In 1999 a heat recovery device was installed, in order to lower the temperature of the flue gases and utilising the excess heat. This heat is extracted and used for district heating.

The steam turbine of Unit 5 has an output of 345 MW and was also manufactured by Siemens as the turbine of Unit 4 and they have a similar structure. In particular, the turbine of Unit 5 has the following design features:

- The internal high-pressure part has 13 sets of guide vane blades and the high-pressure rotor has 13 reaction blade stages,
- The internal medium-pressure part has 32 symmetrically attached guide vane sets and the medium-pressure rotor has 23 reaction blade stages,
- The medium-pressure turbine has four emergency shutdown valves and four regulating valves,
- The rotor of the low-pressure part is a twin rotor with two sets of 8 stages of reaction blades fitted on the shaft,
- The particle filters are in the pipes before the turbine,

There are only two emergency shutdown and regulating valves installed for the excess steam conduit. All the other control, monitoring and safety devices are identical and so are the primary safeties of the turbine. The setup of the steam turbine is shown in the figure below.

![Steam Turbine of Unit 5](image)

**Figure 2.4: Steam Turbine of Unit 5**

### 2.1.4 Gas Turbine Plant

In 2004, Šoštanj TPP signed a contract for the supply of 2 Siemens (SGT-800) gas turbine (GT) power generating units with a capacity of 42 MW each. In 2008 they were commissioned and are in service since. Both GT units are equipped with a heat exchanger recovering the heat of the exhaust gases. This thermal energy is utilised for preheating the feed water of Unit 4 and Unit 5 before entering the respective boilers.

This measure improves the efficiency of Unit 4 and Unit 5 requiring less coal and thus reducing CO$_2$ emissions. Unit 4 and Unit 5 have each one GT unit allocated its boiler for feed water preheating. It is referred to the flow diagram of Unit 5 in Annex 4, where the integration of the GT unit into the water steam cycle is shown.

When Unit 4 is taken out of service in 2016 both GT units will be allocated to the boiler of Unit 5 for feed water preheating. This will then further increase the Unit 5 efficiency to 37.6%. The purpose of installing these GT units for TEŠ was mainly to:

- increase the power generation capacity of the plant,
- improve the efficiency of the plant and reduce coal consumption,
- decrease CO$_2$ emissions and meet obligations from Kyoto Protocol,
- decrease the costs of power generation and improve economic performance.
The GT plant is shown on the picture below taken during the site visit of the TA. It is a view from the top of the boiler of Unit 5 down to the GT plant.

![Gas Turbine Plants](image)

**Figure 2.5: Gas Turbine Plants**

A further advantage of the GT plants is that they add to capability of the Šoštanj TPP to react quickly to changing demands and thus increase its operating flexibility. They are operating satisfactorily since about one year, as we were informed by TEŠ, and serve the purpose intended.

### 2.2 Auxiliary Systems

In the following the major auxiliary systems will be briefly described. This refers to flue gas cleaning, to cooling water, to fuel supply and ash disposal as well as to the electrical and control systems of the Šoštanj TPP.

#### 2.2.1 Flue Gas Cleaning

Due to great emissions of SO$_2$, causing visible damages to forest and other vegetation, an environmental recovery plan was adopted in 1987. Thereafter ecologic recovery of TEŠ commenced, encompassing most of the ecological problems.

All units are equipped with electrostatic precipitators (ESPs) to comply with the limit for dust emissions (50 mg/Nm$^3$). Primary measures for reduction of NO$_x$ were carried out for Unit 4 in 1991 to reduce the NO$_x$ emissions below 650 mg/Nm$^3$ and for Unit 5 in 2007 below 500 mg/Nm$^3$, which are the permitted values.

For Unit 4 a flue gas desulphurisation (FGD) plant was installed in 1995, which reduces the SO$_2$ emissions by 95%. For Unit 5 a FGD plant was installed in 2000, which also
eliminates 95% of SO$_2$. The SO$_2$ contend in the flue gas is below 400 mg/Nm$^3$, which corresponds to the allowed limit. The process diagrams of both FGD plants are shown in the figures below.

![Figure 2.3: Schematic Flow Diagram of FGD Plant of Unit 4](image)

![Figure 2.4: Schematic Flow Diagram of FGD Plant of Unit 5](image)
The technology adopted for the FGD plants is based on the wet limestone process, where the flue gases are stripped in an absorber by limestone (CaCO$\textsubscript{3}$) slurry, which is distributed by several sprinkler levels and is falling in counter-flow to the flue gas. The sulphur dioxide (SO$_2$) is reacting with the calcium, oxygen and water to produce finally gypsum. Gypsum is dewatered and used partly to be sold to the construction industry or as partly mixed with ash and used as “stabiliser” in the recovery of the mining area.

2.2.2 Fuel Supply and Ash Disposal

The Šoštanj TPP is mainly a lignite fired power plant and the lignite comes from the nearby Velenje coal mine. The responsibility of the mine for transport and storage of coal ends at the transfer point located in the area of the stockpile (see figure below), which is about 2 km away from the power plant. From this point transfer of the coal is carried out by belt conveyors to the power plant and to the individual coal bunkers at the boilers of each unit. For more details on coal supply it is referred to Section 5.

The coal is transported to the boiler storage bunkers on conveyor belts from the coal storage area. Coal is loaded and unloaded by 3 loading machines, which have different functions; partial loading, full loading, or unloading of coal. There are, in addition, intermediate coalbunkers on the way to the plant for the individual generating units.

Because of the long distance of transport routes and the winding direction, the transport is divided into several sequential conveyor belts. At the ends of individual belts, there are transfer stations. The entire coal transport system is designed to have a 100% reserve, which means that there are two parallel runs of equivalent belts. The electric power supply of the installations is also doubled, which can be controlled in three ways, for greater reliability.

![Figure 2.5: Coal Transfer Point and Stockpile (Power Plant)](image-url)
For the two gas turbine plants a natural gas station is at the power plant site. Fuel for start-up of the lignite fired boilers and for supporting fire is light fuel oil (LFO).

Ash, gypsum and sludge are processed into inorganic materials (so called stabilizer) in accordance with the Decree on Waste Management (Official Gazette of RS, no.34/08). Ash from the ESPs of Units 1, 2, 3 and 4 is pneumatically transported to a 2’000 m³ silo, which is installed above a mixer plant. The system is built according to best available technology (BAT) standards. The agitators are used to mix ash and gypsum suspension in the mixing plant in an adequate rate. From the agitator the ash-gypsum mixture is dropped to a belt conveyor.

At an interim feeding station the sludge of Unit 4, which is transported on a tube conveyor is added to the stabilising material. From there it is transported with a rubber belt conveyor to the interim storage, from where it is loaded on trucks and transported to the settlement ponds, which are located between Šoštanj Lake and Velenje Lake. After the material settled and dried it is used as filling material for the mine subsidence area. The identical process and transport procedure, but as separate system, is used for the preparation and transport of stabilizer material from Unit 5.

The sludge and ash from all power generation units and waste water from the water treatment plant, which is mixed together, can alternatively be transported with special hydraulic pumps through pipelines to the impervious settlement ponds. The water from the settlement ponds, after settlement of the solid material, is returned to the power plant for reuse. The yearly quantities of produce of the furnaces and desulphurisation that we use to remedy mining related landscape deformation are the following:

- Ash: 680’000 tonnes
- Slag: 60’000 tonnes
- Gypsum suspension: 350’000 tonnes

### 2.2.3 Cooling Systems

The cooling system of each power generating unit comprises:

- The natural draft cooling tower,
- The main cooling system of the unit including the condenser,
- The auxiliary cooling system

Besides the heat of condensation from the condenser, which is by far the major heat load to be discharged by the cooling tower, hot water from the heat exchangers of the plant auxiliary cooling system has to be cooled down. Heated water of the main cooling system is cooled down in the conventional natural draft cooling tower with single-type splash unit and containment basin.

The main cooling system is designed as closed circuit with conditioned decarbonised water as cooling medium. It consists of the cooling tower, of pipelines with valves, heat exchangers, control system, and the cooling water pump station.

The auxiliary cooling system is also designed as a closed circuit system. It consists of the auxiliary cooling heat exchangers, the piping system with valves and control system and the auxiliary cooling pumps. The auxiliary coolers are cooled down with water from main cooling system.
The cooling towers of Unit 1, Unit 3 and Unit 4 are shown in the picture below. The cooling towers in front of Unit 1 and Unit 3 will be demolished to provide space for the new Unit 6. The cooling tower of Unit 4 in the back will be kept at least until 2016, according to the present planning of TEŠ.

![Cooling Towers of Unit 1, Unit 3 and Unit 4](image)

**Figure 2.6: Cooling Towers of Unit 1, Unit 3 and Unit 4**

### 2.2.4 Fresh Water, Water Treatment and Waste Water Treatment

The Šoštanj TPP uses the water from Paka River and the subsidence lakes Šoštanj and Velenje as cooling water. The main water sources are the Paka River and Šoštanj Lake, while Velenje Lake serves as reserve. The Water is pumped from the Lakes Šoštanj into a sedimentation pond and from there to cooling towers and other consumers.

#### Water Treatment

Operation of the power plant requires the following waters:

- Demineralised water for the water steam cycles of the units, the plant cooling water system and the heat station;
- Make-up water (decarbonised) for the cooling towers and the main cooling system and partially for the FGD plant;
- Mechanically purified water for slag removal unit and other auxiliary systems;
- Raw water, quality of potable water for auxiliary systems, requiring better quality of water.

The existing treatment plants for demineralised water were recently upgraded and have enough spare capacity for the new Unit 6. The existing system for collection, rough and fine mechanical purification of water will be enlarged for the requirements of the new Unit 6. Mechanically purified water will be directly pumped to consumers.
The existing make-up water treatment plant has some reserves in the decarbonisation units, but for secure supply of the new Unit 6 additional capacity will have to be added. Decarbonised water is collected in the basin of decarbonised water for further use in the cooling towers and other consumers.

**Waste Water Treatment**

Waste waters from the decarbonisation process is collected in the basin of sludge water and pumped into the system for sludge elimination. The sludge from boilers and the FGD plants is dewatered in the vacuum filter press and transported to the depot. The water from this process is returned to the water treatment plants. Such process is proposed for cleaning the waste waters of:

- Water from rinsing process of rotation sieves in pumping station;
- Sludge water from reactor of Unit 6,
- Sludge water from reactors of Units 4 and 5,
- Water from rinsing process of sand filters in cooling water purifying process,
- Waste waters from slag removal unit.

The waste water treatment plant eliminates all suspended particles from the waste water in settling basins and returns purified water into the water cycle. The blow down water of the cooling towers with parts of the rainwater is discharged at three outlets into the Paka River. Part of the blow down water will be filtered in sand filters and returned into cooling system. Waste water from sand filter rinsing will be transferred to sedimentation tank (refer to figure below) of waste water treatment process.

![Sedimentation Pond](image-url)

*Figure: 2.27: Sedimentation Pond*
2.2.5 Heat Supply Plant

There are two district heating stations at the plant providing thermal energy to the towns of Velenje and Šoštanj for heating and warm water. Further it supplies process hot water to all the factories in the Šaleška valley. The only distributor of thermal energy provided by the Šoštanj TPP is Komunalno podjetje Velenje (Public Utility Company Velenje).

This company, which has a capacity line of 265 MW\textsubscript{th} thermal energy, operates on four different pressure and temperature regimes. With a distribution network of 141.5 km, it supplies 90% of the population of the Šaleška valley, including remote settlements. The principal network that extends east and west of the Šoštanj TPP has a maximum flow of 2'115 m\textsuperscript{3}/h of water with a temperature of 140 °C and 80 °C on the return line.

The district heating stations can produce parallel output into the principal line, which is necessary in the winter. One of them can be shut down in summer. The stations produce heat according to the parameters set by the distributor. The maximum possible capacity of heat produced is 500 MW\textsubscript{th}. On average, from 360 to 400 million kWh are produced. The power plant’s capability of cogeneration adds to the profitability of TEŠ and the energy utilisation of the coal is increased.

District Heating Station 1 (HS1), which is the older one, has a capacity of 90 MW\textsubscript{th}. For heat production it needs fresh steam directly from boilers 1-4. This steam must be reduced in pressure and cooled to a suitable temperature, to be used in the heat exchangers. This is not very efficient in utilising the energy. District Heating Station 2 (HS2) was built more recently and is more efficient; therefore, this heating station is mainly operated. It has heat exchangers installed with a capacity of 110 MW\textsubscript{th}. It is fed with extraction steam from the turbines of Unit 4 and/or of Unit 5, which is much more efficient. In the figure below the process flow diagram of HS2 is shown.

![Figure 2.8: Schematic Flow Diagram of Heating Station 2](image_url)

For the needs of district heating of Šaleška dolina valley it is planned within the Project of the new Unit 6 to construct a heat station (HS3), replacing HS1, which will stop operation with the shut down of Unit 4. The nominal heat output of HS3 is planned to be 120 MW\textsubscript{th}. 

Y:\1025\9A000193.01 Sonstanj TPP - Due Diligence\600_Reports\Final Due Diligence Report\Sostanj Due Diligence Report 080410_Rev2.doc
2.3 Electrical Installations and Control Systems
All major electrical equipments are in good order. Their present day conditions are confirmed as such, for example in the case of the power transformers with yearly independent tests that are undertaken by the Electrical Institute of Ljubljana (EIMV) and are endorsed as such in the concluding remarks. Note: EIMV has formal accreditation for the analysis of electrical equipments under Rva Certificate L339.

2.3.1 Generators, Motors and Protection System
The electrical equipments were observed to be in good serviceable condition which was further supported by analysis and measurement reports that were independently undertaken and evaluated by the EIMV. The generators and motors are tested during periods of planned maintenance or revision schedules (every 3-4 years) when the units are shut down and at standstill. Their serviceability is supported by written reports of tests that have been undertaken and evaluated independently by EIMV.

In additional to the tests here after mentioned, infrared thermographic surveys are also undertaken on all electrical equipment by an independent surveyor under the direct responsibility of TEŠ (LV through to HV) the tests are supported with documentary evidences and any identified hotspots are remedied immediately following discovery.

Test reports for the year 2008 were reviewed during the mission and were seen to be meticulously detailed and concise and were undertaken without exception. Their conclusions gave no cause for concern over short term life expectancy, indeed the reports reflect the care and attention to detail that one would expect of a major power producer whom has respected equipment operational parameters over the many years of production. There is every indication to suggest that the major electrical equipments have a life expectancy that will extend well beyond the scheduled decommissioning schedule.

2.3.2 Transformers
Generator step-up transformers (GSUT’s) and unit auxiliary transformers (UAT’s) are tested yearly without exception. Their serviceability is supported by written reports of the tests that have been undertaken and evaluated independently by EIMV.

Physically, the visual conditions are good with no indications of oil leaks

2.3.3 Emergency Power Supply
In the event of a total power grid system failure (Nationwide blackout), emergency power is provided to unit specific essential services. For example: Unit 4 – Motor generator sets (1 duty and 1 standby) are powered from the station 220 VDC (station battery system) whose AC feeders are connected to the 0.4kV essential services switchboard. In other words the emergency power supply systems are adequately provided for within TEŠ.

Furthermore, the station has a good order of auxiliary power redundancy, which is power grid system derived as here after explained: Station auxiliaries are for the more part provided for at 10.5 kV with multiple redundant feeders fed from the 110 kV (TEŠ) GIS connected “Station Auxiliary Transformers”, Unit Auxiliary Transformers
(Unit 4&5 UAT’s) & Unit 3 UAT interconnecting with Unit 1 UAT at 10.5/6.3 kV and where additional redundancy is provided for Units 1&3 by an 110 kV/10.5/6.3 kV auxiliary transformer which is fed from the 110 kV (TEŠ) GIS. In other words, the unit auxiliaries can be interconnected in any number of combinations which results in a more secure system.

2.3.4 Control and Instrumentation

The control systems were observed to have been sufficient and efficient and in a good state of repair. In recent years TEŠ have identified the necessity to be progressive in a competitive power market and have systematically incorporated, upgraded and retrofitted state of the art control and monitoring systems into the existing infrastructure.

Most notably is the very recent revision on Unit 5, which in essence means that no additional futuristic control system investments will be required. The control systems are adequately supported with sufficient instrumentation for the efficient operation of the power plant.

2.3.5 Switchgears

The existing switch gears at the various voltages levels are extremely well maintained, which is further supported by yearly infrared thermographic surveys that are undertaken by an independent surveyor under the direct responsibility of TEŠ (LV through to HV) the tests are supported with documentary evidences and any identified hotspots are remedied immediately following discovery.

2.3.6 Connection to the National Grid

The existing units are connected thus:

Unit 1 – is directly connected to the 110 kV system in the PODLOG substation through a GIS substation at TEŠ. The GIS substation also distributes to substations at VELENJE and MOZIRJE through two lines of double and triple circuit configuration and of which also forms a ring bus configuration that is interconnect with the PODLOG substation. At the PODLOG substation, higher order interconnectivity is afforded to the 220 kV and 400 kV East / West (backbone) systems through 2x150 MVA and 400 MVA transformers respectively.

Unit 2 – was shut down in 2008.

Unit 3 – is directly connected to the 110 kV system in the PODLOG substation through a GIS substation at TEŠ. The GIS substation also distributes to substations at VELENJE and MOZIRJE through two lines of double and triple circuit configuration and of which also forms a ring bus configuration that is interconnect with the PODLOG substation. At the PODLOG substation, higher order interconnectivity is afforded to the 220 kV and 400 kV East / West (backbone) systems through 2x150 MVA and 400 MVA transformers respectively.

Unit 4 – is connected directly to the PODLOG substation over a single circuit 220 kV line of some 12 km in length where it terminates upon the 220 kV system. At PODLOG substation, additional interconnectivity is afforded between the 400 kV (backbone) and 110 kV system through 400 MVA and 2x150 MVA transformers respectively.
Unit 4 (gas) – is directly connected to the 110 kV system in the PODLOG substation through a GIS substation at TEŠ. The GIS substation also distributes to substations at VELENJE and MOZIRJE through two lines of double and triple circuit configuration and of which also forms a ring bus configuration that is interconnect with the PODLOG substation. At the PODLOG substation, higher order interconnectivity is afforded to the 220 kV and 400 kV East / West (backbone) systems through 2x150 MVA and 400 MVA transformers respectively.

Unit 5 – is connected directly to the PODLOG substation over a single circuit 400 kV line of some 12 km in length where it terminates upon the 400 kV East / West backbone. At PODLOG substation, additional interconnectivity is afforded between the 400 kV system that of the 220 kV and 110 kV systems through 400 MVA and 300 MVA transformers respectively, additional sub-interconnectivity exists also between 220 kV / 110 kV systems through 2x150 MVA transformers.

Unit 5 (gas) – is directly connected to the 110 kV system in the PODLOG substation through a GIS substation at TEŠ. The GIS substation also distributes to substations at VELENJE and MOZIRJE through two lines of double and triple circuit configuration and of which also forms a ring bus configuration that is interconnect with the PODLOG substation. At the PODLOG substation, higher order interconnectivity is afforded to the 220 kV and 400 kV East / West (backbone) systems through 2x150 MVA and 400 MVA transformers respectively.

The TES and PODLOG substation interconnectivity is shown as snapshot in Annex 4.
NEW POWER GENERATING UNIT 6

The management of TEŠ took the decision to invest in the construction of a new modern and highly efficient lignite fired power generating unit of 600 MW capacity - Unit 6, which will replace the old units 1, 2, 3 and 4 and which complies with the fundamental development policy of the company. Taking into account the demand for increased production of electric energy, which is a consequence of increased consumption of electric energy by end users, the Šoštanj TPP will keep its essential position in the energy sector of Slovenia and will be able to comply with upcoming more stringent environmental standards.

3.1 Overview of the Project

The status of the Project is quite advanced and is more or less in the procurement phase. The supply of equipment and the provision of services required for the completion of the power generation unit have been divided into several packages, as follows:

<table>
<thead>
<tr>
<th>Package</th>
<th>Description</th>
<th>Current Contract Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package 1</td>
<td>Power Island</td>
<td>Signed</td>
</tr>
<tr>
<td>Package 2</td>
<td>Flue Gas Desulphurisation Plant</td>
<td>Signed</td>
</tr>
<tr>
<td>Package 3</td>
<td>Coal Transport</td>
<td>-</td>
</tr>
<tr>
<td>Package 4</td>
<td>Preparation and Transport of Products</td>
<td>-</td>
</tr>
<tr>
<td>Package 5</td>
<td>Preparation of Cooling Water</td>
<td>-</td>
</tr>
<tr>
<td>Package 6</td>
<td>400 kV GIS</td>
<td>Cancelled</td>
</tr>
<tr>
<td>Package 7</td>
<td>Civil Works</td>
<td>-</td>
</tr>
<tr>
<td>Package 8</td>
<td>Cooling Tower and Cooling System</td>
<td>Tender Preparation</td>
</tr>
<tr>
<td>Package 9</td>
<td>Civil Installations (Buildings)</td>
<td>-</td>
</tr>
<tr>
<td>Package 10</td>
<td>Contracting Entity services</td>
<td>Ongoing</td>
</tr>
</tbody>
</table>

Table 3.1: Project Division in Packages and Current Status

The major package is the Power Island, for which the EPC Contract has already been awarded to Alstom. Based on the signed contract, the Consultant was of the opinion, that the price for this contract is very high and much linked to escalation formulas and is, therefore, at present not fix and rather budgetary. The Consultant was informed that before end of August 2009 negotiations were planned on this matter. Therefore, the first report (Site Visit) concentrated on the Power Island and the EPC Contract with Alstom in order to give a feedback to the Client and to EBRD prior to these negotiations.

As discussed in Section 7 of this report, the main issues have been discussed with Alstom on 20th August 2009 in Baden with the Client (and unofficial Consultant participation). The report includes an update in certain sections with the results of these discussions, after receipt of the revised Bid (with updated prices and conditions) and the subsequent negotiations of the Client with Alstom.

The layout of the plant is tight and requires a good planning during the erection phase, as there is not much room for pre assembly in the vicinity of the new Unit 6. However the arrangement fits well into the existing plant.
3.2 Technical Description of Unit 6

The new planned Unit 6 is a 600 MW coal fired power plant and comprises:

− one once-through type boiler,
− one four-module type single reheat steam turbine,
− the feed heating plant,
− the cooling system with natural draft cooling tower,
− the flue gas cleaning plants with release of flue gases into the cooling tower,
− the facilities for coal supply and for disposal of ash, slag and gypsum,
− the generator power transmission system,
− the electrical distribution,
− the fully integrated digital control and supervisory system,
− building steel structures.

The design is a proven technology with supercritical steam conditions. The selected size of 600 MW has been subject of various studies by TES prior to the bidding process and has been selected as the most appropriate size considering the current unit sizes, their age and proposed decommissioning dates as well as the space requirements.

3.2.1 Power Island

The Unit 6 has been designed with the following main parameters:

<table>
<thead>
<tr>
<th>Main Data of Unit 6</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Capacity</td>
<td>MW</td>
<td>600</td>
</tr>
<tr>
<td>Own Consumption</td>
<td>MW</td>
<td>54.5</td>
</tr>
<tr>
<td>Net Output</td>
<td>MW</td>
<td>545.5</td>
</tr>
<tr>
<td>Heat Rate</td>
<td>kJ/kWh</td>
<td>8,451</td>
</tr>
<tr>
<td>Steam Flow</td>
<td>kg/s</td>
<td>420.7</td>
</tr>
<tr>
<td>Live Steam Temperature</td>
<td>°C/Bar</td>
<td>600/275</td>
</tr>
<tr>
<td>Pressure</td>
<td>°C</td>
<td>610</td>
</tr>
<tr>
<td>Reheat Steam Temperature</td>
<td>°C/Bar</td>
<td>610/56</td>
</tr>
<tr>
<td>Pressure</td>
<td>°C</td>
<td>290</td>
</tr>
<tr>
<td>Feed Water Temperature</td>
<td>°C</td>
<td>290</td>
</tr>
<tr>
<td>Condensate Pressure</td>
<td>mbar</td>
<td>42</td>
</tr>
<tr>
<td>Flue Gas Temperature at Boiler Outlet</td>
<td>°C</td>
<td>145</td>
</tr>
<tr>
<td>Operating Power Range</td>
<td>%</td>
<td>42 -100</td>
</tr>
<tr>
<td>Load Change</td>
<td>MW/min</td>
<td>12</td>
</tr>
<tr>
<td>Lignite Net Calorific Value</td>
<td>kJ/kg</td>
<td>10,300</td>
</tr>
<tr>
<td>Lignite Consumption</td>
<td>t/h</td>
<td>447.6</td>
</tr>
<tr>
<td>Ash Production</td>
<td>t/h</td>
<td>74.8</td>
</tr>
<tr>
<td>CO₂ Production</td>
<td>t/h</td>
<td>481.4</td>
</tr>
</tbody>
</table>

Table 3.2: Main Design Data of Unit 6
**Boiler Plant**

The boiler is a Benson boiler (single forced flow) generating steam with supercritical parameters and it reheat the steam with a single reheat. It is of similar design, as several units manufactured by Alstom Power Boilers. The boiler is a tower type boiler.

Within the coal range selected, complying with the lignite of the Velenje Coalmine, a direct firing system with 8 vertical, blower type mills has been foreseen (one in reserve). The pulvérised coal is fed at two levels into the combustion zone. The boiler is also provided with low NO\textsubscript{x} combustion system achieved with tangential firing, over firing air and low NO\textsubscript{x} burners. For start-up fuel light fuel oil is planned, utilising the existing facilities for storage and supply.

The combustion air will be provided by two axial fan blowers. Their supply capacity can be adjusted by changing the angle of the rotor blades. The combustion air will be preheated by two regenerative air heaters with the hot flue gases. A steam air heater will be installed in each of the two air ducts in front of the regenerative air heaters, to protect them from corrosion by too cold flue gases.

**Turbine Generator Set**

The steam turbine is designed for supercritical steam and consists of four cylinders:

- one single flow high pressure (HP) module,
- one double flow intermediate pressure (IP) module,
- two double flow low pressure (LP) modules.

The turbine is of the condensing type with steam extraction from the LP modules for district heating (up to 120 MW\textsubscript{th}). Steam at the outlet of the HP modules at a pressure of 56 bar is returned to the boiler for reheating and enters the IP module after reheating with a temperature of 610°C. The turbine-generator set will be provided with all necessary protection systems to ensure a safe and trouble-free operation.

The double vacuum condenser plant will consist of two condensers, which each are composed of:

- one steam turbine exhaust neck with expansion bellows,
- one shell including hotwell with drainage connection,
- two straight tube bundles with support plates and tube sheets,
- four water boxes coated with epoxy,
- various nozzles, interconnecting piping, etc.

The vacuum in the condensers will be maintained eliminating the inert gases by two water ring type vacuum pumps. The condenser plant is equipped with a continuous mechanical cleaning system against fouling.

The condensate will be pumped from the hot wells into the feed heating train. There will be two condensate pumps (2x100%) installed. Further, a condensate polishing plant is foreseen (3x50%), which will consist of 3 identical lines with cation and mixed filters.

The generator is a two-pole three-phase synchronous turbo-generator with hydrogen gas cooling of all internal components, except the stator winding and its connections which are cooled by water.
**Water-Steam Cycle**

The turbine-generator set is arranged in a longitudinal continuous concrete turbine hall. The location of power block components has been selected with a view to minimising costs during installation and servicing:

- The feed heating plant with the exception of the HP heaters module is located outside the turbine hall. It comprises 4 HP heaters, 5 LP heaters and 1 degasifier. The erection of the LP feed heaters and the large amount of associated steelwork, pipe-work and valves can be easily undertaken with a mobile crane in parallel with erection of the turbine generator and the contents of the turbine hall with its dedicated permanent crane. Possible project specific changes to the feed heating plant would not impact on the standard layout of the turbine hall.

- The feed pumps (3 x 50%, electrical motor driven) are provided with a dedicated permanent handling system for maintenance.

- A sufficient large area in the turbine hall allows the lay down of all turbine components during overhauls.

- The main cables routing within the power block is carried out through buried galleries, which enables to keep the electrical erection separate from the mechanical as much as possible.

- A generator-circuit breaker is inserted in the generator to main transformer isolated phase busbar for synchronising or disconnecting the turbine generator from the grid.

The digital control of the plant is performed by the control system using microprocessor based distributed control and monitoring equipment and including hardware redundancies to ensure a high level of safety and availability.

For more information it is referred to the layout drawings and heat balance sheets of Unit 6 included in Annex 4.

### 3.2.2 Electrostatic Precipitator

The particle emissions from the new Unit 6 will remain below 30 mg/Nm$^3$ at the back of the ESP. The design provides slide bearings located on the support structure to allow thermal expansions of the precipitator casing. The filter casing of all welded construction consisting of prefabricated wall and roof panels, plate thickness 5 mm. The bottom of pyramid type is consisting of prefabricated 5 mm plate panels. Each hopper is provided with a flange for vented air from ash handling system and hopper heating is provided.

Insulators are provided consisting of supporting insulators for the discharge system, insulating shafts for the discharge rapping mechanism and bushing insulators for direct connection to transformer/rectifier.

The gas screening in the hoppers and along casing walls are constructed of mild steel plate. The discharge electrodes of spiral type, made of stainless steel EN 10088, 1.4436, diameter 2.7 mm. A rapping mechanism for the discharge system is provided consisting of shaft with angularity displaced drop hammers and drive arrangement with gear motor. The inlet and outlet funnels are of welded construction (plate thickness 5 mm) consisting of prefabricated panels.
3.2.3 Selective Catalytic Reduction (SCR) of NO

Nitrogen oxides (NO\textsubscript{x}) are reduced through using up-to-date burners with graduated supply of air and tangential combustion at low concentration of O\textsubscript{2}, which assures low content of NO\textsubscript{x} at boiler outlet (below 400 mg/Nm\textsuperscript{3}, in dry flue gases at 6%O\textsubscript{2}).

In the flue gas channel, between boiler and air heater, the unit for selective catalytic reduction (SCR) of NO\textsubscript{x} is installed. Through dosing of water solution of ammonia (NH\textsubscript{4}OH), decomposition of NO\textsubscript{x} in N\textsubscript{2} and H\textsubscript{2}O is performed in catalytic converters. Emission of NO\textsubscript{x} will be less than 200 mg/Nm\textsuperscript{3} (shown as NO\textsubscript{2} in dry gases at 6% O\textsubscript{2}), and ammonia concentration under 3 ppm.

3.2.4 Flue Gas Desulphurisation (FGD) Plant

The technological process described in the Tender Documents consists of the following main processes:

- Flue gas flow,
- Elimination of sulphur oxides and other acid foreign matters from flue gases,
- Preparation of limestone suspension,
- Gypsum dewatering,
- Process water supply,
- Plant discharging,
- Closed cooling system.

The flue gas desulphurisation plant is constructed at the back of the ESP. It is designed for the flow rate of flue gases 2’100’000 Nm\textsuperscript{3}/h, corresponding the conditions of poor quality of coal from Premogovnik Velenje, and content of SO\textsubscript{2} in front the plant up to 8’200 mg/Nm\textsuperscript{3} (dry flue gases at 6% O\textsubscript{2}).

The technology of wet washing of flue gases on the basis of limestone (CaCO\textsubscript{3}) and gypsum as by-product is selected as the most appropriate. Purified flue gases are not additionally heated and released through a stack. They are led and released through the cooling tower, thus eliminating the stack.

The plant operates without disposing waste waters. The required outflow of liquid needed for maintaining permissible concentration of chlorides and fluorides is achieved with the gypsum suspension, being mixed with ash into stabilised material.

The vacuum belt filter (2x 50%) will be installed directly above the gypsum silo. A part of gypsum will be put into further treatment to customers, and a part will be processed together with ash and slag into stabilizing material according to the Slovenian technical approval (STS) and used for recovery of coal mine subsidence area.

Active part of the scrubber will be constructed with a lining made of stainless steel, while reservoir for suspension is rubberised. For noise protection and low temperature protection the entire equipment of the plant is in closed building.

**Absorber**

Central part of the process, i.e. elimination of sulphur oxides shall be performed within the tower-type absorber. The lower part of the absorber is a stainless steel vessel, protected against corrosion with rubber lining.
The top part of the absorber, above suspension level, shall be equipped with 5 spray nozzle levels. Each spraying level shall have one circulation pump designed for suspension feeding from the absorber vessel. A reserve space shall be foreseen for later installation of additional spraying level of spray nozzles and circulation pump.

Sprayed suspension droplets present in purified flue gases shall be eliminated by a mist eliminator, installed in top part of the absorber. The mist eliminator shall be periodically washed with process water in order to eliminate deposits generated during the process.

Oxidation air shall be fed by the two blowers (third one stand-by), installed in a separate room in order to decrease the noise level.

The Consultant deems the basic concept of the absorber as appropriate and in line with state of the art technology. In particular, the consideration of space reserve for an additional spraying level is deemed as good practise and will ensure the plant owner with an absorber design, which can remain competitive over time.

Other Equipment

The rest of the FGD Plant equipment:

- Preparation of limestone suspension
- Gypsum thickening and dewatering
- Process water supply
- Closed cooling system
- Plant discharging
- Electric power distribution
- Distributed control system

The concept described, also represents the state of the art of current FGD technology.

The Consultant has the following remarks on specific FGD sub-systems:

- Limestone system: it is understood that the limestone is supplied to the Plant already pulverised and ready to form the slurry for the desulphurisation process. Such concept allows to avoid additional equipment for crushing and milling the limestone and consequently the associated risks of rotating components failure.

- The gypsum dewatering is not fully clearly described. The Consultant understands that the gypsum is partially thickened to a maximum moisture content of 50% prior to being either mixed with the fly ash or to be sent to further dewatering for re-commercialisation purposes. However, it appears that the gypsum dewatering plant for commercial gypsum is not included in the scope of supply of the FGD plant, while the requirement to deliver gypsum of saleable quality is indicated in the Tender Documents. This point should be clarified with the Contractor during the

FGD Technical Requirements

The Sulphur content in the guarantee coal is specified at 1.36% (resulting in a SO$_2$ concentration of 6'400 mg/Nm$^3$ in the untreated flue gas). The FGD shall be designed on the basis of a maximum sulphur content of 1.64% (resulting in a SO$_2$ concentration of 8'200 mg/Nm$^3$ in the untreated flue gas).
For what concerns the other pollutants the following concentrations for dry untreated flue gas are given at the entry of the absorber:

- $\text{SO}_3: 30 \text{ mg/Nm}^3$ (at 6\% $\text{O}_2$)
  
  (80 mg/Nm$^3$ at 6\% $\text{O}_2$ for the worst type or design coal)

- $\text{HCl} < 210 \text{ mg/Nm}^3$ (at 6\% $\text{O}_2$)

- $\text{HF} < 15 \text{ mg/Nm}^3$ (at 6\% $\text{O}_2$)

- Solid particle $< 30 \text{ mg/Nm}^3$ (at 6\% $\text{O}_2$)

The following emission limits are specified for dry flue gas at the exit of the absorber tower in mg/Nm$^3$, dry at 6\% $\text{O}_2$:

- $\text{SO}_2 < 200 \text{ mg/Nm}^3$

- $\text{HCl} < 100 \text{ mg/Nm}^3$

- $\text{HF} < 15 \text{ mg/Nm}^3$

- Solid particles $< 20 \text{ mg/Nm}^3$

The required emission abatement efficiencies comply with the European standards for flue gas quality emitted by large stationary sources. The desulphurization efficiency of 97.5\% appears high, but achievable with state of the art technology.

Remark: these emissions value are not in line with what describe din the Construction of 600 MW Unit 6 at TES – Investment Plan, section 5.7, where $\text{HCl} < 30 \text{ mg/Nm}^3$ and $\text{HF} < 5 \text{ mg/Nm}^3$. The Consultant suggests bringing consistency between the two documents. The values specified in the Tender Documents are deemed as appropriate.

In terms of operation, the following is required in the Tender Documents:

- Operation of FGD Plant without flue gas by-pass, with direct flow from draft fan through absorber to smoke stack or cooling tower.

- The option of installation of additional plane of spray nozzles as well as room for circulation pump with pertaining pipeline shall be foreseen.

- Operation shall be performed without waste waters. Water shall be discharged from the system with gypsum suspension, which is added directly into the agitator for preparation of ash and gypsum mixture, so called stabilizer. Approximately 50\% of thick gypsum suspension shall be used for preparation of stabilizer.

- Flue gases shall not be re-heated. They shall be conducted from absorber to smoke stack or cooling tower.

- Desulphurization product/residue collected as thick gypsum suspension in product/residue vessel shall contain at least 55\% of solid matters.

- Gypsum quality shall be acceptable for construction purposes.

- The plant shall be able to receive flue gases with the temperature up to 180 $^\circ\text{C}$ without limitations and special measures for flue gas cooling.

- The operation shall be performed primarily with waste waters of Unit 6, cooling system bilge or neutralised water from condensate polishing, exceptionally with decarbonised water and only for special purposes drinking water.
The above listed requirements appear appropriate to the Consultant with the exception of the requirement of the gypsum quality. It is understood that the gypsum dewatering plant is not part of the scope of supply of the FGD plant; as such the requirement for gypsum quality cannot be placed within the scope of the FGD plant.

3.2.5 Carbon Capture and Storage (CCS)

With regard to CO₂ emission from flue gases, the plant is prepared for the installation of a later CO₂ abatement, should the future legislation require. Next to the plant there is extra space for construction of a facility for extraction of CO₂ from the flue gases at the location of the existing cooling tower of Unit 4, which will be obsolete after shutting down the unit in 2016. All solutions related to cleaning of flue gases (dust, SO₂, NOₓ) are designed in such a manner, which will allow upgrading of this unit at any time.

In the documents reviewed, there are no more references made to the provisions for later CO₂ abatement systems. The key issue will be to divert the flue gases to a future CO₂ abatement system prior to entering the cooling tower and to have sufficient space for such an installation. The plant plot for the new unit is not provided with a lot of spare space. Therefore this potential future project will have to be investigated in more detail.

3.2.6 Cooling Tower and Cooling Water System

Cooling Tower

The cooling system comprises a new natural draft cooling tower to be constructed at the south side of the new Unit 6 along the hillside. After the decision to release the cleaned flue gases after the FGD plant into the cooling tower, it had to be enlarged in size. Because of the aggressive flue gases containing up to 200 mg/Nm³ SO₂ and SO₃ the interior of the tower shell and the concrete parts of the steel structure of the flue gases channel and spraying unit will need to be protected with acid resistant coating. The flue gases channel requires additional support structure and the opening for the duct through the tower shell. Since the flue gases are directed into the cooling tower, there is no need for the stack.

The cooling tower is of natural draft type of concrete design with a single-type splash unit and containment basin. In order to ensure sufficient free air flow to the cooling tower, a partial excavation of the hillside will be carried out. The technical main data of the tower are:

- diameter of foundation 103.00 m
- diameter at the narrowest part of jacket 56.00 m
- jacket height 145.00 m
- height of air inflow and outflow opening 9.00 m

The main characteristics of cooling system are:

- cooling water flow rate 60,850 m³/s
- water differential temperature 8.7°C
- design temperature of cooled water 26.8°C
  (at ambient conditions of 9.8°C / 75% RH)
Main Cooling Water System

Two circulating water pumps take the cooling water from the tower basis of the cooling tower and ensure in closed loop the cooling of the condenser, the closed cooling water system, the vacuum pumps and the submerged scraper conveyor. Each pump discharges to each half condenser via individual pipe. A debris filter is installed prior to the condenser in each of the 2 supply lines. The cooling water is returned to the cooling tower.

One of two dedicated pumps mainly supplies cooling water to the generator transformer by means of two booster pumps and also a debris filter. The second pump is on standby.

Closed Cooling Water System

On normal operation, the cooling is ensured through two raw water/demineralised water exchangers (one on standby). The closed cooling water system provides cooling with demineralised water to the new Unit 6 consumers. The expansion head tank secures the cooling of the essential coolers.

On normal operation, cooling is ensured by one of two NORIA raw water/demineralised water exchangers, while the other one is on standby. One expansion head tank secures the cooling of the essential coolers.

3.2.7 Electrical Systems

In the following the various electrical systems of Unit 6 are described.

Generator

The Proposed Generator will be a three phase, two pole, turbo type with cylindrical rotor. Stator and rotor winding insulation will be class F; however, the temperature at full capacity will not exceed class B.

The generator rotor will be placed on radial bearings, continuously fed with lubricating and hydraulic oil for bearings. Generator cooling will be combined, for example the rotor will be cooled with hydrogen and the stator with water. The generator's cos φ will meet reactive power requirements for in 400 kV network.

Basic Data:

- nominal power: 727 MVA
- nominal operating power: 618 MW
- frequency: 50 Hz
- nominal cos (φ): 0.85
- nominal voltage: 21 kV
- nominal revolutions: 3000 rpm.

(Static) Excitation System

The excitation system of the generator will enable quick responses to disturbances in power supply system in order to ensure stable operation and provide for the needed reactive power in the power supply system.

The power supply for the excitation system is taken from generator terminals or IPB (Isolated phase busbar) through an (excitation) transformer of appropriate design. The
Excitation system will be equipped with a two-channel redundant type voltage regulator, and will comprise of the following functions:

- adjustable compensation for voltage drops due to reactive and operating power
- voltage limiting
- excitation current limiting
- stator current limiting
- voltage, i.e. cos φ adjustment
- stabilisation of system oscillations

**Electrical Protection System**

The protection of the unit (Generator and Step-Transformer) will be a modular numeric microprocessor version of the redundant type.

During activation of the protection system, the generator will be disconnected from the network by means of the GCB (Generator Circuit breaker). This will occur during abnormal operating condition or upon the detection of electrical failures in the generator for example earth faults.

**Generator Step up Transformer (GSUT)**

**Basic Data**

- nominal power: 710 MVA
- off-load tap changer: 21/410 kV ± 8 x 1.25%
- cooling: OFWF
- vector group: YN,d5

The transformer will have adjustable transformation ratios which is provided for by an integral (inside the transformer tank) off-load tap changer located on the HV (400 kV) primary winding side of the transformer. The Secondary side (21 kV) of the transformer is connected to the generator through Isolated Phase Busbar. The Transformer primary will be connected to a short (unit related) 400 kV substation that will be constructed in close proximity to the GSUT.

**400 kV Open Air Type Switchgear**

The Primary (400 kV) output of the GSUT will be connected to a short (unit related) 400kV Open Air Type substation comprising of VT’s (Voltage Transformers) & CT’s (Current Transformers) an off-load disconnector with earthing blade and Circuit breaker, in a similar arrangement to that of the existing Unit-5 since the conceptual 400 kV GIS / 400 kV Line arrangements cannot be realised in due time.

The substation will provide for the portal that will connect the National grid over a 400 kV line that will terminate at the PODLOG substation which is some 12 km distance.

**Unit Auxiliary Transformer UAT**

The UAT will supply power to unit related ancillary equipments and will comprise of a single, three winding transformer whose primary winding will be connected to the generator Isolated Phase Busbar with the following specifications:

- nominal power: 70/40/45 MVA
- off-load tap changer: 21/10.5 kV ± 8 x 1.25%
Station Auxiliary Transformer (SAT)

The SAT will supply power to non-unit related ancillary equipments (general supplies) whose primary winding will be connected to the existing 110 kV GIS and will comprise of a single two winding transformer with the following specifications:

- nominal power: 40 MVA
- off-load change: 115/10.5 kV ±8 x 1.25%

Power Distribution - General

The concept considers the need for suitable operating availability of the new Unit and the voltage levels used are hereafter described:

- high voltage 400 kV for the evacuation of power
- high voltage 110 kV for Unit start-up and supply of general consumers
- medium voltage 24 kV generator bus-bars (Isolated phase busbar)
- medium voltage 10.5 kV for motors, transformers 10.5/0.72 kV
- low voltage 0.69 kV and 0.4 kV for connection of minor consumers

Uninterrupted power supply system with voltages 220 VDC, 220 VAC and 24 VDC, designed for all technological consumers which require and uninterrupted energy source and shall also be used for the supply of measuring regulation equipment.

Power Distribution – MV (Medium Voltage)

The medium voltage level is distributed at 10.5 kV and comprises for:

- own (Unit) consumption
- own general consumption.

The unit’s own consumption is used for the supply of larger consumers required for normal operation of it and is supplied from the UAT. The supply is thereafter divided into two sections (Switchboards). The arrangement of consumers on both sections ensures that during failure or breakdown of one section the unit still operates, but at a reduced capacity.

General (own) consumption is used for unit start-up and for the supply of other larger consumers, which must continue to operate during failure or, when it is at standstill. General consumption is supplied from the SAT and is divided into two sections in the same manner as for the UAT. In case of a failure of the UAT; the operation of the unit is still assured because it will then be supplied from the SAT; the selection of the appropriate feeder is achieved automatically by High Speed Switching equipment in the 10 kV switchboards.

Power Distribution LV (Low Voltage)

Low voltage will be supplied at 0.69 kV and 0.4 kV. Its distribution shall be divided into sub-distribution sections appropriate to the needs of the station, for example lighting, power outlets for office equipment and workshop tools.

The supply to the various sections will be made through DST’s (Distribution Service Transformers) supplied from various sources, for example; from the UAT & SAT MV switchboards, meaning that the Low Voltage levels will have a high degree of security.

In case of a failure of one of 10.5/0.72kV/0.4kV, DST’s additional assurance in security is afforded by interconnectivity between the sub-distribution switchboards.
Emergency Power Supply & Distribution

Unit 6 will have its own diesel generating set and will start-up automatically according to a predetermined time delay, if voltage failure occurs on the main 0.69 kV distribution switchboard or a failed automatic switch over occurs. The main low voltage distribution will be automatically switched to take care of Unit related essential supplies and auxiliary distributions in ancillary buildings.

Black-out Power Supply & Distribution

In case of complete failure of the 0.69 kV or 0.4 kV sources, important technological equipments and important consumers will be connected to a special section of the 0.69 kV or 0.4 kV switchboards that are fed from respective UAT & SAT supplies. In case of supply voltage failure, the diesel generating set will automatically start-up.

Uninterrupted Power Supply (UPS) & Distribution

The UPS supplies the most important systems which must operate during a complete main source power supply failure and includes all technological control and monitoring equipment; for example the DCS and DC (Direct Current) consumers and is provided by batteries until the diesel generator set starts-up, which then takes over the load of all consumers that are supplied from the black-out essential services supply.

3.2.8 Unit Control System

Control and Monitoring of Unit 6 will be through a Distributed Control System (DCS), it will assure safe operation, adequate availability and economic operation. The unit control and monitoring comprises of the “complete facility”, including ancillary buildings and will form technologic integrity with the main facility.

The main tasks of the control system are:

- automatic start-up and stopping of the Unit
- automatic operation
- automatic change of power
- transfer of power (decrease) and power limiting during generator failure
- automatic switching of redundant units
- participation in secondary frequency/power regulation
- maintaining of voltage conditions with voltage regulation.

The control system engineering will be based on sound engineering practice for thermal power plants of which complies with international and (Verband der Großkessel- Besitzer e.V., abbreviated VGB) standards. “Fail Safe” control according to international standards will be used for burners, boiler and turbine protection.

Control system of the “main facility” consists of the following main components:

- system automation,
- supervision and monitoring of systems,
- electrical systems,
- engineering system
- archiving system.

Redundant features of the control system means increased availability of the facility.
Plant data will be transmitted via the intranet and the TES process network and it will be possible to access archived data of the central control system. Separate local control units of the ancillary units will be linked through the peripheral data bus together with Unit control system (data transmission of local controls into the main control system). Supervision and monitoring of the entire facility will be performed through monitors in the Unit control room. Local monitoring for boiler, turbine and Unit control are proposed.

The following equipments (but limited to) will be monitored from control room:

- boiler,
- generator and switchgear,
- flue gases and desulphurisation plant
- emergency power system and generating set
- ancillary units for ash, slag removal, coal transport, water preparation, and heat station

### 3.3 Integration into the Existing Plant and Infrastructure

The integration of the new Unit 6 is shown on the plot plan included in Annex 4. The space is very limited. Unit 6 will be constructed mainly on the area, where Units 1 to 3 with their cooling towers are located. The existing systems and infrastructure will remain and will be used as far as possible and economical reasonable.

#### 3.3.1 Fuel Supply

Fuel for operation of the new Unit 6 is local coal from Premogovnik Velenje Coalmine. Unit 6 will be supplied by the existing conveyor system of Units 1 - 4, which will be rearranged and increased in its capacity to 800 t/h. Additional conveyors will be needed. The coal depot, the coal loading and the transport to the intermediate bunkers remain the same, with the exception of one transfer station, which needs to be modified. It will get two new conveyor line for the supply of Unit 6 with capacity of 2x800 t/h (2x100%). The transport direction is changed and continues with two conveyors of the same capacity, up to the two reversible conveyors above the bunkers, where coal will be distributed to the 8 bunkers. All conveyors will be trough-type and covered to prevent dust emission.

Fuel for start-up and for supporting fire will be light fuel oil (LFO) as for the existing units. The existing supply and storage facilities of LFO are sufficient in capacity and can be used for the new unit. It should be investigated to switch to gas as fuel for this purpose, considering technical, operational and economic aspect.

#### 3.3.2 Ash and Gypsum Disposal

Treatment of solid products of the coal combustion process and desulphurisation of flue gases are processed into inorganic material (stabilizer), which is used as filling material for the mine subsidence area. Slag from the bottom of the boiler, rough ashes from in front of the air heater and fly ash from the ESP of the new Unit 6 as well as gypsum from the FGD process will treated as described in Chapter 2.2.2. Some upgrading and modifications to the existing transport, storage and processing facilities are necessary.
For slag and rough ash of Unit 6 a silo with volume of 1'000 m$^3$ will be constructed. From the silo the bottom ash is transferred with a chain feeder unit (2x100%) to the belt conveyor and to the stabilizer mixing plant. Fly ash from the ESP is transferred pneumatically into the silo with volume 3'000 m$^3$. It will be used for reinforcing the walls and filling gaps in the Velenje Coal Mine and in the construction industry. The remaining part will be mixed with gypsum suspension into stabilizer material and transferred by belt conveyors to the existing intermediate depot and from there it will be transported to the coal mine subsidence area.

Gypsum, dewatered on vacuum belt filters will be stored in the existing gypsum storage. Gypsum is sold on the market to be used in the construction industry. The remaining part will be added to the stabilizer material.

### 3.3.3 Water Supply and Waste Water Disposal

Operation of the new Unit 6 requires the same waters qualities as already described in Chapter 2.2.4. For raw water supply, the water intake building on the Paka River will be enlarged. The existing water treatment trains for demineralised water were recently upgraded and have enough spare capacity for the new Unit 6, requiring up to 40 m$^3$/h of demineralised water.

The existing system for collection, rough and fine mechanical purification of water will be enlarged for the requirements of the new Unit 6. Mechanically purified water will be directly pumped to consumers of Unit 6, which need together about 50 m$^3$/h.

For make-up water a new train with a capacity of 1’200 m$^3$/h will be constructed for the decarbonisation process. Make-up water will be collected in the basin of decarbonised water for further use. In the same building will be the units for storing and preparation of required chemicals for decarbonisation.

Waste waters from decarbonisation process will be collected in the basin of sludge water and pumped into the system for sludge elimination. The sludge will be eliminated in vacuum compacting unit (vacuum filter press) and transported to the depot. The extracted water from the sludge will be returned into the process.

Maximum make-up water consumption (at ambient temperature 20°C) is estimated to:

- 745 m$^3$/h for covering the losses of evaporation in cooling tower,
- 330 m$^3$/h for blow down of main cooling system,
- 135 m$^3$/h for flue gas desulphurisation plant,
- 15 m$^3$/h for sand filter rinsing.

Consumption of industrial water from Paka River or from Družmirsko Lake will be about 1’300 m$^3$/h as an average, considering minimum reserve quantities. Raw water of potable water quality will come from the existing system. Expected consumption will be up to 20 m$^3$/h.

The system for waste water treatment has also already been addressed in Chapter 2.2.4. It is expected that the existing waste water treatment plants are sufficient in capacity to serve the additional requirements caused by Unit 6. The goal of TEŠ is to achieve zero discharge of waste water. That will be achieved by the re-circulation, treatment and recycling of industrial water. The only waste water discharged into the Paka River will be the cooling tower blow down.
3.4 Switch Gear and Connection to Grid

Under the present concept there is intention to connect the Unit-6 station auxiliary supply transformer (SAT) to the existing 110 kV GIS. This arrangement provides for an alternate means of supply in any event that the 400 kV side of Unit-6 is disconnected and provides redundancy in terms of supply safety. Otherwise, no other integration into the existing systems is foreseen, unless at some point in the futures TEŠ reverts to install the 400 kV GIS system, which was conceptually intended to be located inside Unit 5’s open air switch yard (at the 400 kV level) and would have served as a dual transmission portal with the potential of combining both outputs of Unit 5 and Unit-6.

3.4.1 Proposed Power Grid Connection

The proposed power grid connection for Unit 6 is to be made at the Podlog substation, which is located some 12 km distant from TEŠ.

In order to satisfy grid code compliance, EIMV was commissioned to undertake a grid impact assessment and performed multiple load flow and transient stability cases and concludes that the 400 kV link of Unit-6 (between TEŠ and PODLOG) shall be done in such a manner as to be connected with two (2) overhead power lines.

They conclude that this arrangement assures that Unit 6 will remain connected to the power grid system, if one of the lines is affected by a powerful transient. Conversely however, they conclude that a single line arrangement will mean that the unit will disconnect from the power grid system and, if this event occurs at the same time as other events within the Slovenia grid, then it will result in a weak grid and, if it occurs at the same time as errors and defects caused by others in adjoining countries near to the Slovenian grid, then it will result in an unstable condition of the electricity supply.

Presently it is understood that TEŠ have reverted to what they call plan “B” for the transmission of Unit 6 energy because their conceptual arrangement cannot be put into place until circa 2013 and have subsequently removed the 400 kV GIS from the cost estimate (Package 6) and advise that they now intend to follow the “Plan - B” strategy by connecting Unit 6 to a single 400 kV line to the PODLOG substation, which contravenes the EIMV study in terms of N-1 criterion (redundant line - power evacuation capability) that could lead to weak grid and grid instability if the line is affected by a strong transient that results in the disconnection of Unit 6 from the power grid system.

Whilst we agree with the EIMV findings we would not necessarily dismiss a single line arrangement for Unit-6, since statistically speaking the 400 kV line between Unit-5 and PODLOG substation has only been interrupted for 12 minutes in 30 years of operation and then only for reasons of adverse atmospheric conditions.

3.4.2 Integration into the Power Grid

The electrical characteristic of the unit was taken into consideration during a detailed dynamic theoretical study that was undertaken and performed by EIMV, where multiple load flow and transient stability cases were satisfactorily modelled, which also took into consideration the existing units, existing and future power grid system configurations.

We would agree with the concluding remark where the EIMV report states that Unit-6 will integrate smoothly into the existing power grid system.
3.5 Project Implementation

The project implementation chart was not available at the time of project review. However the topic was discussed with TES during the review.

Due to the size, complexity and risk involved in this new Project of constructing Unit 6, it is recommended to establish a separate project organisation with no other duties in the organisation. A number of staff can have dual functions in the project as well as in the plant, i.e. operation staff, legal and procurement staff or specialists from key equipment. A supervisory board of key members of the TES organisation and preferably of the Owners of TES (HES) should be installed in order to allow the management to stay fully advised on project matters and to be able to make the necessary decisions and support the project team.

The dedicated project team not only has to handle the EPC contract of the new unit 6, but also the individual package contracts, the civil works contracts etc. This will require a considerable project team. It is also expected that the EPC contractor will be strong in claim management and it is therefore advisable to install some counter organisation on the Owners side. The key of the Owner’s organisation is to form a strong counterpart to the Contractor’s organisation and to ensure professional and timely responses to all Project issues, whether they are technical or commercial in order not to jeopardize the Project goals.

It was emphasized, that the project organisation can be made up of own staff and outside parties, who can contribute with knowledge not available in-house, i.e. the function of an Owner’s Engineer. TES informed that they have internal staff and that they intend to use their own sources as far as possible and practical. TES wants to complement and reinforce their project organisation with outside resources consisting of national and international firms or individuals required.

The following organisation chart is very general and serves only as a guideline in order to see what general functions need to be carried out:

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![Diagram](image.png)

Figure 3.1: Project Implementation Organisation
TES was advised to set up the project organisation in general to be a counterpart to Alstom. However, there are various other key issues to be considered, such as:

- Overall scheduling of the Project (integration and continuous tracking of all sub-projects into the overall schedule)

- Coordination between the main EPC contractors (who supply the civil loads and outline drawings, the civil detail designer (who generates the civil detail drawings) and the civil contractor (who constructs the civil works according to the detail drawings) as well as the erection contractor (who implements the detail drawings). This function is important in particular the management of changes and additions which are unavoidable.

- Overall interface engineering and interface management

- Variation orders and claim management

- Checking and approving contractors’ invoices to be in line with progress or with defined milestones in accordance with the payment schedule

- Overall cost control and updating of the applicable indices for the EPC contract of Alstom

- Document management of all drawings to ensure that on the erection contractors and the civil contractors are working with the latest drawings to avoid later claims.

Of course, there are many other tasks to be considered, like reporting and progress monitoring, safety aspects on site, permits and licences, environmental issues, etc. These tasks have to be defined and clearly assigned to competent members of the Project Team, which take full responsibility.
4 POWER PLANT OPERATION

For the Slovenian energy sector the Šoštanj TPP is one of the three pillars of power supply and it provides about one third of the total electricity generated in the country. It is very flexible operating as load following plant. The location of the power generation facility is crucial as TEŠ’s role in the national grid is to ensure that the voltage level is maintained in order to enable effective power transmission over longer distances.

An important addition will be the construction of the generation Unit 6, an energy unit with 600 MW capacity. This is a project of national importance, which was included into the Resolution on National and Construction Projects for the Period 2007 – 2023. With its construction they will be able to produce 4’700 GWh of electricity in TEŠ from four million tons of coal that they use in a year, instead of 3’600 GWh annually as they do at present with less impact on the environment.

4.1 Operational Aspects

The new Unit 6 will have a large impact to the future operation of the remaining units. The schedule of the shutdowns of the existing units has been set, obviously based on the current time schedule for the new Unit 6. Any delay in the Project of the new Unit 6 will have a detrimental effect of the remaining units.

An overview, as communicated by TES, regarding the operation status of the existing units is shown below:

<table>
<thead>
<tr>
<th></th>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
<th>Unit 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (MW)</td>
<td>30</td>
<td>30</td>
<td>75</td>
<td>275</td>
<td>345</td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td>24</td>
<td>24</td>
<td>26</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>Operating Time (h)</td>
<td>310’000</td>
<td>317’000</td>
<td>314’000</td>
<td>236’000</td>
<td>216’000</td>
</tr>
<tr>
<td>Condition of Unit</td>
<td>old, good</td>
<td>shut down</td>
<td>old, good</td>
<td>good</td>
<td>Good</td>
</tr>
<tr>
<td>Planned Operation End</td>
<td>2010</td>
<td>2008</td>
<td>2014</td>
<td>2014*</td>
<td>2027</td>
</tr>
</tbody>
</table>

*stays in cold reserve until end of 2016

Table 4.1: Operation Data of the Existing Units

The existing power generating units of the Šoštanj TPP are built with components, equipment and systems produced by well known manufacturers from Germany and Switzerland. It is because of this that the operation of the Šoštanj TPP is comparable to similar European plants in terms of production results, and it even surpass them in terms of operational responsiveness. The results are a result of very good maintenance and management of the production facilities. Today Šoštanj TPP is the largest fossil fuel power plant in Slovenia contributing 33% of the country’s electrical energy production.

Slovenia is a net importer of electric energy; it is therefore reasonable for to search for optimum technical and economical solutions for the replacement of the old units by the new Unit 6. The goal in electric energy production for TEŠ is to utilise the primary energy sources lignite with the highest possible efficiency, thus reducing the specific consumption of coal per MWh generated electricity and greenhouse gas missions into environment.
4.1.1 Plant Output

The electricity production output of the Šoštanj TPP in 2008 was 3'850 GWh, which represents 33.86% of Slovenia’s power generation. At the beginning of 2008, Unit 2 was shut down, but the two GT plants were put into service at the end of 2008.

In the table below the gross and net power production figures of the Šoštanj TPP for the years 2003 until 2008 are given. For comparison the national production figures are also shown, in which the power production of the Nuclear Power Plant Krško is only half considered, as the other half is belonging to Croatia.

<table>
<thead>
<tr>
<th>Year</th>
<th>Production TEŠ (GWh)</th>
<th>National Production (GWh)</th>
<th>% TEŠ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At Generator</td>
<td>Net Production</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>3,961.6</td>
<td>3,464.4</td>
<td>9,713.5</td>
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<tr>
<td>2004</td>
<td>4,044.1</td>
<td>3,549.7</td>
<td>10,786.5</td>
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<td>2005</td>
<td>4,138.7</td>
<td>3,640.7</td>
<td>10,482.5</td>
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<td>2006</td>
<td>4,268.9</td>
<td>3,748.7</td>
<td>10,535.5</td>
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<td>2007</td>
<td>4,268.3</td>
<td>3,756.3</td>
<td>10,421.5</td>
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<tr>
<td>2008</td>
<td>4,358.6</td>
<td>3,850.0</td>
<td>11,329.6</td>
</tr>
</tbody>
</table>

Table 4.2: Production of Electric Energy in TEŠ and its Share in the National Production

4.1.2 Coal Consumption and CO₂ Emissions

The Šoštanj TPP utilizes the lignite from Velenje Coalmine as primary energy source for production of electric energy. Average annual consumption of coal for the period 2003-2008 amounts to 4 million tons, and thus burdening with 4.6 million tons of CO₂ the environment. TES is facing increased pressure to reduce coal consumption in the electric energy production, because of environmental concerns and mainly due to the commitments Slovenia has made pursuant to the Kyoto Protocol. Reliable national power supply thus confronts with the limits of environmental concerns.

The table below shows the annual net production of electric energy, coal consumption, emission of CO₂, specific emission of CO₂ (emission factor) in Šoštanj TPP.

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Production (GWh)</th>
<th>Coal Consumption (t/a)</th>
<th>Emission of CO₂ (t/a)</th>
<th>Emission Factor (t CO₂/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>3,464.4</td>
<td>4,078.3</td>
<td>4,366.6</td>
<td>1.26</td>
</tr>
<tr>
<td>2004</td>
<td>3,549.7</td>
<td>4,174.2</td>
<td>4,536.8</td>
<td>1.27</td>
</tr>
<tr>
<td>2005</td>
<td>3,640.7</td>
<td>4,014.2</td>
<td>4,623.0</td>
<td>1.27</td>
</tr>
<tr>
<td>2006</td>
<td>3,748.7</td>
<td>3,991.9</td>
<td>4,662.4</td>
<td>1.24</td>
</tr>
<tr>
<td>2007</td>
<td>3,756.3</td>
<td>4,072.6</td>
<td>4,908.8</td>
<td>1.30</td>
</tr>
<tr>
<td>2008</td>
<td>3,850.0</td>
<td>4,037.7</td>
<td>4,798.2</td>
<td>1.21</td>
</tr>
</tbody>
</table>

Table 4.3: Net Production of Electric Energy in TEŠ, Coal Consumption and Emission of CO₂

The data for coal consumption and emission of CO₂ take the production of electric and heat energy into account.
TEŠ is entitled to free emission coupons pursuant to the Ordinance on the National Plan for the Allocation of Emission Coupons for the Period 2008-2012, as part of which the Government of Slovenia adopted a national emission coupon allocation plan. In October 2007, TEŠ received from the Environmental Agency of the Ministry of the Environment and Spatial Planning, the allocation of 21’504’120 CO₂ coupons for the period from 2008 to 2012 or to 4’300’824 coupons per year.

In 2008 TEŠ released 4’798’171 tons of CO₂ through the production of electricity. In accordance with the Environment Protection Act, the company was thus obliged to pay the environment pollution tax (1 coupon per ton of CO₂) for the exceeding amount of CO₂ emission. The difference of 497’347 coupons will be compensated with a purchase of emission coupons from HSE.

By constructing the new Unit 6 TEŠ will achieve the following goals:

− enhance power generation while retaining the planned consumption of coal;
− reduce emission factor (tCO₂ / MWh);
− reduce electric power generation costs, and thereby, securing the future economic viability for power sector in the Šaleška valley;
− compliance with the Kyoto protocol commitments.

4.1.3 Operation Mode

The current operating mode of the power plant follows the grid requirements and is varying considerably between day and night. A typical load pattern is shown below:

Figure 4.1: Typical Load Pattern of Šoštanj TPP

The typical diagram shows peak loads during the day and a lower load of less than 50% during the night. The Sostanj TPP needs to be very flexible as load following plant.
TEŠ also provides a number of essential ancillary services to Slovenia’s power generation sector. Generating Units 4 and 5 are equipped with a power controller, which facilitates regulation according to a daily consumption schedule, while the output of Units 1, 2 and 3 varies on the basis of daily operational plans.

These grid support services for stabilising the grid, which TEŠ provides are at present not separately sold to and paid by the off-taker HSE, except for reserve capacity. But it is under discussion to value the grid support services separately from the normal power sales. The new Unit 6, with an advance and modern control system will be well prepared for this purpose.

4.2 Operation within the National Grid

As already mentioned in Chapter 3.2.4, EIMV has undertaken and performed a detailed dynamic theoretical study, where the electrical characteristic of the new Unit 6 was taken into consideration and where multiple load flow and transient stability cases were satisfactorily modelled. Some operational aspects regarding the national grid and Unit 6 integration are addressed in the following.

Power Grid Stability

In terms of grid stability, the EIMV study has highlighted the importance of completing the 2 x 400 kV (Krško-Beričev) lines that are presently under construction and near completion. The report goes on to conclude that Unit 6 will integrate smoothly into the grid once this link has been established.

In elaboration therefore; the introduction of the new 2 x 400 kV lines will serve to accommodate the huge load swings that Slovenia have experienced in the past years, where for example the well documented event that occurred on the 28 September 2003 with the blackout of Italy, that caused a huge power swing to occur (through the Slovenian power grid) between the Eastern Countries and Italy. The severity of the power swing was such that it caused significant instability within the Slovenian power grid and to TEŠ since it is directly connected to this East - West load flow corridor at Podlog substation. In our case however, when the new 2 x 400 kV (Krško-Beričev) lines are put into service, future power swings will effectively bypass the present load flow corridor (whose route passes through the Podlog substation whereupon TEŠ is connected), thus effectively leaving TEŠ and the Slovenian power grid undisturbed and largely unaffected by these huge power swings.

And as an additional measure of assurance towards stability, the Slovenian power grid has planned to install phase shifting transformers in the distribution transformer substation Divača (boarder distribution substation with Italy) which will serve to throttle the amount of power that can pass the Slovenian boarder, effectively protecting the Slovenian power grid system from the huge power swings experienced in the past years.

Voltage Level

We would agree with the findings of the EIMV report that takes into consideration the starting, stopping, on and off line status of Unit 6 where they conclude that with respect to the completion status of the national transmission grid that the voltage situation is good, and that there will be no problems related to controlling of the voltage level.
UCTE

We would agree with the findings of the EIMV report and in its statement that the increased power provided by Unit 6 within the Slovenian power grid shall have a positive impact to the global dynamic stability of the UCTE (stability according to the I Lyapun theorem).

Power Grid Instability

The EIMV report however also identifies an adverse reaction to the increased power production due to initial increased angular displacement of the existing operating power units and consequential decreased transient stability (stability according to the I. Lyapun theorem). It then goes on to conclude with a solution that all 3 phase short circuits in the 400 kV power transmission lines within the Slovenian power grid must be eliminated in the stage I of the distance and differential protection in order to resolve the issue.

In summary though; the adverse reaction is in no way detrimental to the project concept, because the EES (Slovenian power grid) will accordingly adjust the protection relays to suit the integration of the unit.

4.3 Organisation and Staffing

From the initial Project information the organisation of the power plant is as follows:

![Organisation Chart](image)

**Figure 4.2: TES Organisation Chart**

The above organisation represents the overall organisation of TEŠ, with management, administration and operating and maintenance (O&M) personnel. The Šoštanj TPP has a very experienced O&M staff, which is well trained and has a good record of power plant performance.

It is the intention to execute the new Project – Unit 6 - within the existing organisation. TEŠ indicated that outside local consultants will be engaged to assist them in this task.
4.3.1 Present Operation and Maintenance Staff

TEŠ employs at present (as per 31.12.2008) 490 full-time workers. The number of employees and their professional qualifications per sectors is shown in the table below:

<table>
<thead>
<tr>
<th>Sector / Qualification</th>
<th>I-III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering and Maintenance</td>
<td>18</td>
<td>76</td>
<td>70</td>
<td>19</td>
<td>15</td>
<td>198</td>
</tr>
<tr>
<td>Operation</td>
<td>43</td>
<td>57</td>
<td>78</td>
<td>14</td>
<td>3</td>
<td>195</td>
</tr>
<tr>
<td>Economics</td>
<td>1</td>
<td>9</td>
<td>14</td>
<td>3</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>Human resources</td>
<td>5</td>
<td>14</td>
<td>8</td>
<td>4</td>
<td>7</td>
<td>38</td>
</tr>
<tr>
<td>Management</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>15</td>
<td>23</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67</strong></td>
<td><strong>157</strong></td>
<td><strong>173</strong></td>
<td><strong>44</strong></td>
<td><strong>49</strong></td>
<td><strong>490</strong></td>
</tr>
</tbody>
</table>

Table 4.4: Operation and Maintenance Personnel

For operation and maintenance (O&M) the staff number is in total 393. The number of employees continued to decline in 2008 and 2009 in line with Šoštanj TPP’s long-term employment policy. The down sizing of personnel will increase with the closing down of the Units 1 to 4. The new Unit 6 will require less operating staff, due to its modern control system and its high degree of automation.

4.3.2 Operation and Maintenance Staff for Unit 6

Operation personnel of Unit 6 are required, according to TEŠ, as follows for:

- Power Island
  - In the control room: Unit manager, operator of boiler section and desulphurisation plant, operator of turbine section,
  - Outside control room: duty mechanic, duty electrician, operator of boiler auxiliaries operator of turbine auxiliaries, operator of desulphurization plant, ash transport and purifying plant product/residue;
- Water Treatment Plants;
- Coal Transport Systems.

Operation of Unit 6 is carried out in 5 shifts, which means, that (according to the organization structure of the TEŠ), some 70 employees will be required, including Unit Managers, Head of Water Treatment Plants and head of Coal Transport Systems. In addition, about 10 employees of technical staff, not connected with shift operation, are required for smooth running of Unit 6. For administration and for maintenance some 120 people are foreseen. For operation of the new Unit 6 altogether 200 employees are planned, which is within current staffing limits of coal fired conventional power plants.

4.4 Power Production Costs

The current power production costs of TEŠ are mainly governed by the costs for lignite. The operation of the Šoštanj TPP is based on a “Long-term Agreement for the Purchase of Coal, Capacity and Power” concluded between the Holding Slovenske elektrarne (HSE), Velenje Coalmine and Šoštanj Power Plant (TEŠ), signed in September 2004.
The agreement determines the mutual relationships between the parties and stays in force until 2015. The agreement defines the fixed and additional volumes of coal (in GJ) to be supplied by the Velenje Coalmine to TEŠ, and at the same time, it stipulates that all the power generated by Šoštanj TPP is to be purchased by HSE at the prices agreed in annual contracts. Velenje Coalmine provides Šoštanj TPP with the coal required for the generation of power and heat. The price of coal is also agreed with annual contracts.

Following the upgrading and of Units 4 and 5 with gas turbines, in 2008 alternative sources of energy were used to generate electricity at the Šoštanj TPP. These alternative fuels are mainly gas and, to a lesser degree, biomass. As set forth by the Long-term Agreement, all the power generated was sold to HSE.

4.4.1 Variable Costs

The variable costs are mainly those depending on the volume of power generation, as the costs for raw materials. They were in 2008 as follows:

- Lignite at 2.25 EUR/GJ or 23.18 EUR/t
- Light fuel oil at 450 EUR/t
- Limestone at 25.50 EUR/t
- Ammonia at 155.00 EUR/t
- Make-up Water at 0.10 EUR/m\(^3\)
- Demineralised Water at 1.40 EUR/m\(^3\)
- Other variable costs, as ash and gypsum disposal, chemicals, ware parts, etc.

For raw materials were in 2008 spent by TES 153'737’000 EUR and 3’850 GWh power were generated (heat generation was 408.8 GWh). Considering only power generation, as heat generation is small the specific costs of raw materials is 39.93 EUR/MWh.

The major cost item in the variable costs is the lignite cost. The Sostanj TPP is burdened presently by its low efficiency and as consequence high specific consumption of lignite.

4.4.2 Fixed Costs

The fixed costs are mainly costs for personnel and for maintenance. In the documents of TES reviewed these costs are called as follows:

- Costs of services 17'031’000 EUR
- Costs of work 17’397’000 EUR
- Other business expenses 17’540’000 EUR

These fixed costs sum up to 51’968’000 EUR spent by TES in 2008. The specific costs with the power generation as mentioned above are 13.50 EUR/MWh.

Other cost items independent from generation, like depreciation, financing costs, etc. are not addressed. They are better analysed by the Bank.

4.5 Off-taker and Sales (PPA)

Slovenia is currently a net importer of electricity and TEŠ informed that about 20% has to come from outside. The power market is described in some more detail in Annex 6.
4.5.1 **Electricity Sales**

There is only one off-taker for the generated power of the Šoštanj TPP, which is HSE. The power sales are divided in a capacity and in an energy part. Grid support services are provided to HSE, but only paid for reserve capacity.

4.5.2 **Heat Sales**

The only distributor of thermal energy provided by the Šoštanj TPP is Komunalno podjetje Velenje (Public Utility Company Velenje).

4.6 **Policy of Quality Control**

Šoštanj TPP (TEŠ) involves the integrated control system that is composed of: the quality management system following the requirements of SIST ISO 9001:2000, environment treatment system following the requirements of SIST EN ISO 14001:1997 and occupational safety and health managements system following the requirements of OHSAS 18001:1999.

By the end of 2005 TEŠ started the activities, leading to the transfer on a new version of standard SIST EN ISO 14001:2005. The transfer was finished with the certification in 2006. For this reason TEŠ performed the education about environment legislation and standard SIST EN ISO 14001:2005 for all owners of the processes and internal auditors.

**ISO 9001**

The advanced judgement ISO 9001:94 was performed during 22-23 November 1999, the certification judgement during 15-17 December 1999 and the certificate ISO 9001 was obtained on 5 April 2000. In 2002 we performed within the framework of the control judgement the extended judgement of ISO 9001:2000.

**ISO 14001**

The advanced judgement 14001:1996 was performed during 21-22 November 2002, the certification judgement during 17-20 December 2002 and the certificate ISO 14001 was obtained on 25 February 2003.

The first combined external judgement of ISO 9001 and ISO 14001 was performed during 21-22 April 2004.

**OHSAS 18001**

The advanced judgement OHSAS 18001:1999 was performed on 13 April 2004, the certification judgement during 4-5 May 2005. In May 2005 we obtained the certificate of occupational safety and health management system OHSAS 18001:1999. Thus we became the first plant in the world that has ever obtained the certificate OHSAS 18001 by the certificate organ, company TÜV Management Service GmbH.

The survey of the efficiency of the established system is performed by the integrated internal judgements and external judgements of the certificate organ.
5 LIGNITE MINE

The Mining Expert Mr Ullrich Höhna and the Geologist Mr Ronny Czubka from Vattenfall Europe Mining Consulting (VEMC) visited from 26th to 29th July 2009 the site. A visit of the underground Velenje Coal Mine itself, the underground production facilities and infrastructure, main mine equipment, lignite faces, repair workshops etc. was not possible due to shutdown of operations during the last week of July and the first week of August. It was agreed to undertake the visit of the underground mine itself separately later. The provisional date for the visit of the production sites and facilities are the 24th or 31st August 2009. However, responsible staff members of the technical, geological and financial departments were available and enabled VECM to look through the required documents.

The visit of the mine itself and main underground production facilities was performed separately on 26th August 2009 by a second mission of Mr. Hoehna to Velenje, when the mine was in regular operation. In addition to reviewing of the required documents, discussions were held with the available representatives. The site visit program and the list documents made available to look at are included in Annex 2.

The Velenje Mine Management was cooperative in providing the requested data and they were responsive in answering questions of the Consultants. The Consultants have recognized the high professional competence of the involved counterparts from the Velenje Mine.

Due to safety reason, it was not permitted to make photos underground during the mine visit. All photos of this report have been provided by the Velenje mine to the Consultant. The Consultant confirms that the real situation in the mine corresponds to the photos shown in this report.

5.1 Velenje Lignite Deposit, Reserves and Quality

The Velenje coal deposit is unique in terms of geological conditions and relatively young having its origin in the late Tertiary and early Pliocene period approximately 2.5 million years ago. The deposit during its genesis formed one of the thickest lignite seams in the world – up to 170 m. It has been formed within a tectonic depression that had been sinking in the Salek Valley. Simultaneous accretion of sediments locked the lignite formations and contributed to a fast conversion of wood into lignite.

Figure 5.1: Schematic Cross Section of the Velenje Lignite Deposit

The 2.5 million years old Pliocene coal seam is of special economic interest. It runs via a length of approximately 8.5 km in East-Western direction and in North-Southern direction it has a length of 1.5 to 2.5 km. The top of the seam was localized at depths
between 250 m (= + 100 mMSL) and 350 m (= 0 mMSL), the bottom lies in between 300 (= + 50 mMSL) and 450 m (= - 100 mMSL). The average thickness of the seam is 60 m with maximal values reaching up to 170 m. The northern area of the coal seam dips at angles between 10° to 15°.

The lignite deposit stretches 8.5 km long and 2.5 km wide as set out in the figure below.

![Figure 5.12: Lignite Boundary of the Velenje Deposit](image)

The deposit is characterised by several groundwater aquifers in the sediment layers above the top of the lignite seam and requires as well dewatering of Triassic rocks below the bottom of lignite seam. The groundwater is of good quality and is partially used for drinking water production. Mine water is used for industrial purpose. The total amount of water pumped from the mine is around 8,000 m³ per day what corresponds to 0.7 m³ water per each t of coal produced.

The long term underground mining of the Velenje lignite deposit is closely connected with long term investigation and modelling of geo-mechanical behaviour of overlaying rock material. 130 years of mining of the thick seam without refilling the backspace caused significant vertical (up to 70 m and more) and horizontal movement of overlaying material. The three lakes in Figure 5.12: Lignite Boundary of the Velenje Deposit are artificial and have been emerged as consequence of process soil subsidence after the underground lignite mining in the Salek Valley.

The continuation of underground lignite mining under the lakes is possible because of the properties of the insulating clay layer over the top of coal seam. Velenje mine is operating sophisticated models for predicting the consequences of mining process and is using these models for the dimensioning of the safety pillars, the prevention of sudden
coal and gas outbursts and in order to ensure the required stability and geotechnical safety of the underground facilities and roof support systems. The forecasted movements are monitored by geotechnical measurements.

5.1.1 Exploration Status

During a period of 130 years of mining activities totally 2’600 drillings were made in the Velenje deposit. The number of drillings made from the surface is 620. The total length of these drillings is approximately 210’000 m displaying both the basin sedimentation and the base rock sediments. More than 2’000 drillings were made from the shafts of the underground mine.

At present, about 100 operational exploration drillings are made per calendar year (predominantly underground). Geophysical exploration is carried out in addition to the drilling explorations. Seam structure and base rock for example were explored by means of seismic measurements. The data base consisting of exploration drillings and other information covers a large number of samples for analysing coal qualities and geomechanical properties of the formations.

Therefore, it can be concluded that the Velenje lignite deposit is detailed explored and well studied, investigated and known. Mining methods used have been adopted in a permanent process and proven as sustainable for many decades. However the future mining of remaining smaller and deeper areas will require increasing efforts in this direction. The Velenje mine seems to be well prepared to resolve these issues in the future.

5.1.2 Coal Reserves

The Velenje mining operations has already extracted over 215 million t of lignite from the deposit from the very beginning of industrial mining till now as can be seen in Figure 5.1: Schematic Cross Section of the Velenje Lignite Deposit.

At present the geological reserves determined by PREMOGOVNIK VELENJE as of 31.12.2008 are under review by the State Register of Mineral Resources (Ministrstvo ZA Gospodarske Dejavnosti, Ljubljana) and to be proven.

The official geological reserves within the mining concession area of the Velenje Coal Mine confirmed by the State Balance (Status as of 31st December 2008) are consisting of 204 million t or 163 million t when considering safety pillars as set out in the table below.

<table>
<thead>
<tr>
<th>Velenje mine reserves within concession area</th>
<th>Geological Reserves (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total RESERVES (over 8.4 MJ/kg)</td>
<td>232’000’000</td>
</tr>
<tr>
<td>BALANCE SHEET RESERVES</td>
<td>204’000’000</td>
</tr>
<tr>
<td>BALANCE SHEET RESERVES (considering write-off due to safety pillars)</td>
<td>163’000’000</td>
</tr>
</tbody>
</table>

Table 5.1: Remaining geological reserves according to State Balance

Considering the assessable geological balance reserves of 163 million tons the Velenje mining experts assessed the remaining mineable reserves with 124.4 million tons as
from the end of 2008 considering the mining losses, due to technology and geotechnical conditions. A breakdown by Velenje mine area and assessment method is set out in the table below.

<table>
<thead>
<tr>
<th>Velenje Coal Mining by Area</th>
<th>Remaining Mineable Reserves (t)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine Area North</td>
<td>9’065’088</td>
<td>Detailed Mine planning</td>
</tr>
<tr>
<td>Mine Area South</td>
<td>4’446’362</td>
<td>Detailed Mine planning</td>
</tr>
<tr>
<td>Mine Area CD</td>
<td>13’808’321</td>
<td>Detailed Mine planning</td>
</tr>
<tr>
<td>Mine Area Pesje</td>
<td>48’037’315</td>
<td>Detailed Mine planning</td>
</tr>
<tr>
<td><em>(Bound resources)</em></td>
<td><em>(NOP pillar, L panels, northern part of G panels, floor rock segments of the layer)</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>49’000’000</td>
<td>Professional Judgement</td>
</tr>
<tr>
<td>TOTAL</td>
<td>124’357’086</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.12: Remaining Mineable Reserves According to Velenje Mine Assessment

Velenje mine has assessed the remaining mineable reserves by undertaking substantiated detailed mine planning of the underground lignite extraction process of remaining reserves from the Velenje mine areas North, South, CD and Pesje in accordance with approved mining assuming the application of the existing mining method, using the professional experience and current knowledge of the geotechnical situation. The parameters of each mining block have been determined. As a result of this work 75 million t of lignite were justified in detail as mineable reserves from the four areas of the mine.

The remaining “Bound resources” of totally 49 million t have been estimated by Velenje mining experts based on their professional judgement and experience. Bound resources are remaining reserves at different locations of the Velenje mine: NOP pillar, L panels, northern part of G panels, floor rock segments of the layer, which are partly not accessible today, since they are used as safety pillar or due to other reasons. No mining studies were available to substantiate this reserve estimate. In practice the mining of these reserves requires a de-concentration of mine production to different sites what is not problematic due to decreasing lignite demand of the TPP to 2 million t per annum but may have impact on future mining cost.

### 5.1.3 Lignite Quality

Analyses of coal qualities of the Velenje deposit were already carried out during all exploration phases. The coal analysed from this deposit can be classified as lignite with a density value of 1.28 t/m³.

The following average calorific value for the seam was determined:

\[
\text{Lower Calorific Value } Q = 10,470 \text{ MJ/kg}
\]
In terms of calorific value there is a slight decrease in quality from the top of the coal seam to the bottom. This is no factor to be considered, if the whole seam is mined and the coal blended on the stockyard.

The average content of ash amounts to 15.87% for the entire reserves of the deposit. An average sulphur content of 1.39 % has been determined, while a moisture content of 35.23 % was calculated for the deposit. The international investigation standards used with regard to the coal qualities are mentioned in the following Table.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>International Standard (Analyses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Calorific Value</td>
<td>10'470 MJ/kg</td>
<td>DIN 51900 del 1 (2004)</td>
</tr>
<tr>
<td>Moisture</td>
<td>35.23 %</td>
<td>DIN 51718</td>
</tr>
<tr>
<td>Ash content</td>
<td>15.87 %</td>
<td>DIN 51719 (1997)</td>
</tr>
<tr>
<td>Sulphur content</td>
<td>1.39 %</td>
<td>ASTM D 4239 (1997)</td>
</tr>
</tbody>
</table>

Table 5.13: Coal Quality Data Regarding the Total Reserves

Coal demand is an important factor for the fuel supply to the power plant. The planned design of the new Unit 6 with an installed capacity of 600 MW is used for determining the needed coal quantity for the lifetime of the power plant. The study “Construction of 600 MW Unit 6 at the Termoelektrarna Sostanj; tes Termoelektrarna Sostanj, hse Moc energije (2009)” contains the coal consumption parameters for the Units 1 to 6, which were taken as basis for the calculation. Assuming a lifetime for Unit 6 until 2054 and considering the planned dates for Units 1 to 5 to be taken out of operation an accumulated coal demand of 134 Mt can be calculated.

The comparison with the indicated Reserves shows a trouble-free supply of the power plant until 2028. After that year the accumulated coal consumption will amount to approximately 76 Mt, which is the exact figure for the Proved Reserves of the Velenje Coal Mine with available detailed mine planning. At that time, a detailed study for the mining of the Measured Reserves to the amount of 49 MT should be available to cover the coal demand with this quantity until 2048. Up until the year 2054 there will be a deficit of about 10 Mt. This deficit could be covered by mining of the resources in the Sostanj field. Another alternative would be blending of lignite from the Velenje Coal Mine with imported hard coal.

5.1.4 Lignite Demand versus Remaining Mineable Reserves

Coal demand is an important factor for the fuel supply to the power plant. The planned design of the new Unit 6 with an installed capacity of 600 MW is used for determining the needed coal quantity for the lifetime of the power plant. The study “Construction of 600 MW Unit 6 at the Termoelektrarna Sostanj; tes Termoelektrarna Sostanj, hse Moc energije (2009)” contains the coal consumption parameters for the Units 1 to 6, which were taken as basis for the calculation. Assuming a lifetime for Unit 6 until 2054 and considering the planned dates for Units 1 to 5 to be taken out of operation an accumulated coal demand of 134 Mt can be calculated.
The comparison with the indicated Reserves shows a trouble-free supply of the power plant until 2028. After that year the accumulated coal consumption will amount to approximately 76 Mt, which is the exact figure for the Proved Reserves of the Velenje Coal Mine with available detailed mine planning. At that time, a detailed study for the mining of the “Bound Resources” to the amount of 49 MT should be available. This will allow covering the coal demand of the TPP until the year 2048.

Up to the assumed end of operation of the TPP Unit 6 in year 2054 a deficit of coal of round 10 million t may occur due to depletion of reserves in the Velenje lignite field before the year 2054. There is a chance that no deficit will occur. Such situation might happen, if the Velenje mine is able to involve additional geological reserves from the concession area, which are out of balance today or can reduce mining losses.

However if in a later phase of mine operation it becomes clear that a deficit of reserves from the Velenje lignite field will occur, then such deficit of reserves could be covered by partial expansion of the mining concession area towards the Sostanj field. The Sostanj lignite field contains 59 million t of measured resources and has been separated from the mining concession of the Velenje mine in year 2003.

Another alternative would be the blending of lignite from the Velenje Coal Mine with imported hard coal. Since hard coal has significant higher heating value a deficit of 10 million tons lignite over the lifetime could be replaced by approx. 4 million tons of hard coal with heating value of 24’000 kJ/kg. (Such hard coal could be transported by rail directly to the lignite stockyard along which a rail for loading/unloading of coal is already existing and workable.)
5.2 Setup and Structure of the Mine

The Velenje lignite deposit of Slovenia is situated about 55 kilometres northeast of the capital of Slovenia and about 2 km north of the city of Velenje. The Velenje Coal Mine covers an area of 1’104 hectares. Above the underground mine on the surface there is a recreation centre, sports grounds, infrastructural facilities and some buildings. The mine employees 1’365 people, which produce annually lignite with an energy content of 43.947 TJ.

The Velenje deposit and the Velenje underground mine have direct access to the public road and railway network. The highway no. 4 goes from highway no. 1 (E 57) into northern direction to the city of Velenje. Coming from Velenje, highway no. 425 crosses Sostanj into north-western direction. In addition to the road connection there is also a railway line. It also runs from the south across Velenje, directly passing mine and Sostanje power plant into north-western direction.

5.2.1 Coal Production

Underground lignite mining in Velenje has a rich history and tradition. Industrial lignite mining from the Velenje deposit takes place since 130 years and is ongoing at the level of around 4 million t per annum. Since the very beginning approximately 200 million t of lignite have already being mined until now. The Velenje lignite deposit is unique in Europe regarding its geological conditions. Special mining methods are being used and large practical experience gathered in the underground lignite mining of Velenje lignite deposit.

The installed mine production capacity is 4 million t based on 230 working days per annum, what is sufficient to cover the TPP coal demand. In case of need the Velenje mine could increase the mine capacity by increasing the number of working days.

![Figure 5.24: Actual Location of Long-Wall Operation Blocks at Velenje Mine](image-url)
supply and transport of equipment and coal. The main mine shaft is used as entrance for workers. The further transport to the long-wall faces and the advancing gateways is organized with hanging rail transport and chair lifts.

Currently, the Velenje Coal Mine is operating two high production long-wall faces located in Jama and Pesje pits as shown in Figure 5.4. The average daily production from the long-wall faces is around 18’000 tones per day with average calorific value of 10–12 MJ/kg (lignite). Production from one long-wall face can be maximum 16’800 t/day. The current situation also faces the company’s general policy which defines the operation of long-wall faces at the same time.

5.2.2 Mining Technology

The Velenje Mine is using advanced main mine equipment from leading suppliers- so DBT roof supports, Eickhoff combines and Joy conveyors. It has already undertaken significant restructuring, rationalisation and modernisation of its operations and became a state of the art operation as can be seen in the pictures shown on the following pages. The mine has increased labour productivity more than three times compared to the year 1990. Refer to figures 5.4 to 5.8.

Figure 5.5: Mine long-wall face with Shearer Loader and Hydraulic Roof Supports

The Velenje Mine has installed a comprehensive safety and technology information system and is permanently improving it. The system allows monitoring online all relevant safety parameters, content of dangerous gases in the mine atmosphere, fire control and control machine operation, ventilation, drainage, power supply, compressed air, water, number and names of workers being currently underground. It bases on fibre optic information transmission technology. Recently, this system was complemented by a video monitoring system based on 116 cameras.
Preparation workings, which are held to provide a sufficient length of new-built gateways for new long-wall faces, are advancing in all three parts of the exploitable area. For each long-wall face preparation there is a pair of two gateways needed. Average daily advance of the new-built gateway is dependent on several parameters and ranges from 5 to 6 m/day. All gateways cumulative daily production is 350–800 tons.
For the achieved production of the existing long-wall faces a sophisticated network of transportation was developed over the years. On one hand material for new works has to be transported into the mine, on the other hand, coal has to be transported to the surface. The range of high capacity conveyor belts provides capacities up to 25’000 tons per day; therefore, coal production can be transported from all mining areas to surface.

Figure 5.28: Mine Rail Transport

Material, needed for continuous mining, is transported to the mine through main shaft. Mine transport is organized with classic mine rail transport and with hanging rail transport (monorail) to distant and non-horizontal parts of the mine.

Figure 5.29: Chair-Lifts Transport
Miners are entering the mine through the main shaft. Further transport is organized with chair-lifts to all main workings (long-wall faces, advancing gateways) and with hanging rail transport.

Figure 5.210: Hanging Rail Transport (monorail)

The performance of the labour force and the productivity of the Velenje Mine has increased considerably of the last 8 years. This is shown in the figure below.

Figure 5.2.11: Labour Productivity Development since 1990

Other important issues, apart from mining operations, transport of miners, material and coal, are ventilation (27'000 m³/min) and water drainage (0.7 m³/ton of produced coal).
5.3 Mine Operations

The Velenje Coal Mine is currently changing from operating with three active long-wall face complexes to two systems increasing the concentration of production. The active long-wall faces are located in two separated parts of the mining area: Jama Pesje and Jama Preloge. The excavation scheme by applying the Velenje mining method in Jama Pesje is shown in the figure below.

![Excavation Scheme for the Velenje Coal Seam in Jama Pesje](image)

**Figure 5.312: Excavation Scheme for the Velenje Coal Seam in Jama Pesje**

5.3.1 Velenje Method

The Pesje long-wall face is operating by the so called Velenje Method - separated into upper and lower excavation sections. The upper excavation section (maximum 12 m high) breaks the upper section of the coal seam. Thereafter the coal only needs to be placed on the conveyors. This method can be applied because of thick insulating clay layer above the coal seam in Pesje. In Preloge the long-wall is operated in the conventional method due to geotechnical conditions.

A hydraulic prop system supports the lower excavation section up to a height of 4 m. This allows cutting the coal seam with a shearer and removing via chain conveyors. The preparation workings are advancing in all parts of the exploitable area. They are held to provide a sufficient length of new-built gateways for new long-wall faces.

For the new-constructed gateway the daily advance ranges between 5 to 6 meters per day. The cumulative daily production of all gateways reaches 350 to 800 tons.

One of the important facts beside the mining operation and the transport of material and coal are ventilation and water drainage. Continuously 450 m³/s of air have to be provided and 0.6 m³/ton of produced coal have to be pumped.

In future, one long-wall face can be relocated and prepared for operation whereas the other two remaining long-wall faces will mine the coal. This secures continuous coal extraction.

In addition to the extension of the supply shafts, a new vertical main haulage shaft with new skip elevator shall be erected between surface and mine from 2010 onward. This shaft aims at shortening the coal transportation way which was realised by means of conveyor belts so far. The produced coal is planned to be transported via this shaft on a short but discontinuous way to the surface.
5.3.2 Quality and Safety Standards

The standards of operation are high. The Velenje Coal Mine operates in compliance with the following quality standards:

- ISO 9001 (since year 2000 for the coal mining processes)
- ISO 14001 (since year 2004 for the environmental management system)
- OHSAS 18001 (since 1999 for the occupational health and safety system)
- USP S10 (since 2005 for the learning organization)

No major mine damages are known except for the predicted surface subsidence above the active coal mining areas. The Velenje Coal Mine is undertaking high quality reclamation works on the areas of surface subsidence and created three lakes together with a nice recreation area.

The 2009 production programme foresees the following key business factors/results:

- Revenue: 129’776,490 €
- Net profit: 22’861 €
- Production (Sales): 43’947 TJ
- Calorific value: 10.5 MJ/kg
- 39-hour working week
- 235 / 303 working days
- Investment value: 17’034’585 €
- Number of employees (31st Dec 2009): 1’365 (without subsidiaries)

5.4 Mine Development Plans

The Velenje Coal Mine has a DEVELOPMENT PLAN 2009-2018. The necessary number of employees will be reducing further resulting in the reduction of labour costs as set out in the figure below.

![Diagram showing trends of external realisation and number of employees 2007-2012](image)

Figure 5.413: Development Plans for Group Revenues and Total Manpower 2007 – 2012
The cost price of coal is planned to be reduced and the business result shall improve annually. In 2008 the Velenje mine was making first small profit whereas in the years before losses were made at the end of the years.

The coal production plan for the period till 2018 is 41,700 TJ for electricity generation and 1,300 TJ of thermal energy production.

5.4.1 Selling Price of Lignite

The selling price of coal for electricity production ranges from 2.80 to 2.51 €/GJ. From 2009-2012 the price shall increase to approx. 2.74 €/GJ and then gradual decrease until the year 2015 to approx. 2.50 €/GJ.

The selling price of coal production for heating amounts to 2.44 €/GJ in 2009, followed by the planned increase of 1.5% every year.

The remaining realisation is planned within the range from 6 to 11 million €. It is foreseen to provide services to third companies, earn revenues from rents, sales of material, make financial and other revenues.

In the period 2015-2018, the Velenje Coal Mine plans to sell the land plots released due to the investment in the NOP II shaft, in the amount of 8.3 million €.

Mine investments for regular replacement of the main and auxiliary mine equipment is planned between 16 and 18 million EUR per annum and corresponds to the practical experience from the years before.

5.4.2 Development Strategies by Individual Segments

Major future mine investment project is the construction of shaft with skip facility, new main connections for coal transportation and for the needs of ventilation in the mine until the year 2011. It is planned to close certain existing main connections in the Preloge mine, to construct new connections for the needs of transportation, delivery and ventilation at the level of the future floor k.-140 in the southern section of the Preloge mine. The total investment needs for this complex new shaft project is according to the current estimates of the Velenje coal mine around 30 million EUR and shall be financed by revenues from sales of land and commercial credits. It is planned to repay the commercial credits until 2018.

The coal production process shall be improved further in order to increase productivity, mechanization, appropriately constructed roadways, safety and health at work, cooperation with external institutions, detailed research of geo-mechanical properties of the lignite layer, project management, etc.

A «Clean Coal Technologies» project shall be implemented in order to develop the best existing technologies, reduce the specific greenhouse gas emissions in electricity production, introduce CCS and develop innovative methods for gas drainage in mining of thick lignite layers.

Environmental management measures are planned for rational use of water, heat energy and electricity, environmentally sound wastewater, emissions under MPC, hazardous substance management to reduce the amount of degraded surfaces and to provide quality final rehabilitation, education of the employees etc.
In the fields of IT and IS the following measures are planned: document system ODOS, system for business reporting to the management staff – MIK, the device maintenance system – MAXIMO, information protection pursuant to the ISO 27001 standard, introduction of the business information system Pantheon in the associated companies, integration of the system Špica for recording of presence and calculation of salaries.

In the fields of safety and health at work the following is planned: target education and information of the employees, direct control at working sites and assessment of knowledge at workplaces, searching for new solutions for increased safety, execution of new requirements of the legislation/standards, execution of preventive fire protection measures.

A Group's education centre is planned, scholarships, stimulation of off-the-job study, education of key personnel, education and training for the production process, transfer of knowledge and good practice among co-workers and marketing of knowledge.

5.5 Lignite Transport and Supply Chain

The coal is transported from the mine to the power plant by means of belt conveyors. The belt conveyors transport the material with an average inclination of 14° via a distance of approximately 6 km to the surface. From there, other conveyors take over transport to a transfer point which is located as agreed between the Sostanj TPP and Premogovnik Velenje. This transfer point is about 2 km away from the power plant and located in the area of the stockpile. The responsibility of the mine for the transport and storage of the coal ends at this point with the transfer of the coal.

The existing lignite stockyard of the Šoštanj TPP has a maximum storage capacity of 1.0 million tons of lignite. Practically power plant and mine try to arrange fuel supply in a way that the active storage capacity is not exceeding 350'000 to 400'000 t in order to avoid lignite degradation by rainfall and oxidation process leading to higher moisture and subsequently lower energy content of the fuel. The capacity of lignite supply facilities at the power plant stockyard shall be sufficient for the supply of the new Unit 6 since older units will be decommissioned and the total amount of fuel per day to be supplied will not change significantly.

Both companies’ power plant and mine are working closely together under the same owner. The mine representatives did not report about any claims or problems in lignite supply of the plant so far.

5.6 Lignite Supply Agreement

The lignite supply from the mine to the power plant is based on a long term fuel supply agreement. This agreement came into force on 1st January 2005 and has been concluded for 10 years between the mine, the power plant and the holding company. It agrees the supply in terms of base quantities (38'500'000 GJ) average CV of lignite (9'800 kJ/kg) the maximum price cap of 2.80 EUR/GJ. It includes further an obligation to reduce lignite mining cost by 15%, the range of possible changes, the electricity supply to the mine, etc.

The contracting parties agreed that the prices of basic and optional quantities of lignite for an individual calendar year shall be determined based on the prices of the coal for
the year in question and the price of power generation from lignite. They agreed to conclude a tripartite agreement before the beginning of each new calendar year fixing the annual dynamics of the supply of coal and electric energy, price, the manner of invoicing, payment terms and other provisions.

The figure below shows the surrounding of the Velenje Coalmine, the access by road and rail and the distance to the Sostanj TPP.

![Figure 5.614: Overview Map Infrastructure of the Velenje Coal Mine](image)
ENVIRONMENTAL ASPECTS

The first Unit of Šoštanj Thermal Power Plant was commissioned in 1956 and Unit 5 in 1978. At that time it was legally not required to carry out an environmental impact assessment. The first regulations in Slovenia concerning EIAs and SEAs have been issued in 1993 and have been amended to be in compliance with the EU regulations in 2004. To be in compliance with the emission reductions required, Šoštanj Thermal Power Plant has implemented several mitigation measures during the last years. For the planned Unit 6 of Šoštanj TPP an environmental impact assessment was carried out.

6.1 Environmental Permitting Requirements and EIA Procedures

The environmental Protection Act of the Republic of Slovenia was issued in June 1993. It provides a framework for both Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) in Slovenia (Official Gazette of the Republic of Slovenia, Nos. 32/93 and 1/96). EIA was introduced by ZVO (Zakon o varstvu okolja) as a procedure in which it must be determined whether the planned activity in the environment presents a potential risk to the environment and can cause environmental damage or degradation, or whether such an activity is actually possible in terms of consequences for the environment. More specific requirements regarding cases when an environmental impact assessment needs to be carried out are specified in the Decree on categories of activities for which an environmental impact assessment is mandatory (Official Gazette of the Republic of Slovenia, Nos. 66/96, 12/00, 83/02).

The environmental impact assessment is based on the environmental impact report, which must be drawn up in accordance with the Instruction on the methodology of preparing reports on environmental impact (Official Gazette of the Republic of Slovenia, No. 70/96). Under ZVO, the environmental impact assessment was carried out by the issue of the environmental protection consent, which was issued by the Environmental Agency of the Republic of Slovenia (ARSO) as a body within the Ministry of the Environment and Spatial Planning, and was considered a supplementary act to a permit for an intervention in the environment.

In the year 2004 the Environmental impact assessment (EIA) and environmental protection consent under the Environmental Protection Act (ZVO-1) (Official Gazette of the Republic of Slovenia, No. 41/04) was adopted. The most important change is the change saying that the environmental impact assessment should in its entirety fall within the competence of the ARSO, which is also competent for issuing the environmental protection consent, now as an independent decision and not a supplementary decision.

6.1.1 Compliance with EU Regulations

of the activity for which the environmental impact assessment is to be carried out may obtain preliminary information on the scope and content of the environmental impact report. The investor must provide, for the purposes of environmental impact assessment, a project for the planned activity, a report on environmental impacts of the project implementation, and revision of the report. The revision can only be performed by a person who has been appointed by the minister of the environment and spatial planning as an environmental expert, and has been entered into the registry of environmental experts.

6.1.2 Local Legal Requirements for Spatial Plans

For the Šoštanj TPP Unit 6 there have been elaborated a spatial (zoning) plan to meet the requirements of the local community, which have been adopted in two municipal ordinances:

- Municipal ordinance on detailed spatial plan for spatial arrangement of common concern for Unit 6 TEŠ with ancillary buildings (Official Gazette of the Republic of Slovenia, No. 88/2007), and
- Ordinance on municipal detailed spatial plan for arrangement of common concern for cooling tower and chimney of Unit 6 TEŠ (Official Gazette of the Republic of Slovenia, No. 64/2008).

During the process of adopting the spatial plan an EIA report has been carried out. The EIA has been presented to public during the process of presentation of the draft spatial plan in the period from 25th May to 25th June 2007 at the Šoštanj municipality head office.

In compliance with the regulations, public reading of the draft spatial plan and of the EIA report has been carried out. Because of the complex process of adopting the spatial plan by the Šoštanj Municipality, the Ministry of Environment and Spatial Planning supported the process. The Ministry has issued a decree on eligibility of the elaborated documents and their opinion on admissibility of the impacts of the adopted local plan to the environment.

6.1.3 Project Permitting Status

TEŠ has filed the application for issuing the environmental protection consent, for the »thermal energy unit, called Unit 6« on 19th October 2007 at the Ministry of the Environment and Spatial Planning, Environmental Agency of the Republic of Slovenia. The application included the EIA Report »Report on Environmental Impact – Construction of Unit 6 at TEŠ«. A Public Participation Process was carried out during the period of the impact assessment and the complete project documents were available to the public on the internet. Furthermore, all related documents have been made available to the relevant ministries and organizations. All required amendments have been made by TEŠ, so it is expected that the Ministry will issue the consent.

The review of the EIA focuses on the environmental impacts, if all important impacts are addressed and if adequate mitigation measures are recommended.
6.2 Project Site and Present Situation

The EIA was made for the future Unit 6 of Šoštanj TPP, which is located in the northern part of Slovenia in the village Šoštanj. The Šoštanj TPP consists at the moment of five Units and two gas- turbine plants (See table below) the main fuel is the lignite from the Coalmine in Velenje. Unit 6 shall be constructed until 2014; it is planned that the new unit will replace step by step the old Units.

<table>
<thead>
<tr>
<th>Year of Commissioning</th>
<th>Unit</th>
<th>Installed capacity</th>
<th>Efficiency</th>
<th>Year of shut down</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>1</td>
<td>30</td>
<td>26.6</td>
<td>2014</td>
</tr>
<tr>
<td>1956</td>
<td>2</td>
<td>27.3</td>
<td>2008</td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>3</td>
<td>75</td>
<td>39.9</td>
<td>2014</td>
</tr>
<tr>
<td>1972</td>
<td>4</td>
<td>275</td>
<td>34.3</td>
<td>2016</td>
</tr>
<tr>
<td>1978</td>
<td>5</td>
<td>345</td>
<td>2028</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>FGD 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>FGD 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>2 GT units</td>
<td>84</td>
<td></td>
<td>2028</td>
</tr>
<tr>
<td>2014</td>
<td>Unit 6 / FGD</td>
<td>600</td>
<td></td>
<td>2056</td>
</tr>
</tbody>
</table>

Table 6.1: Development of Šoštanj TPP

Figure 6.1: Layout of the Šoštanj TPP.

The main new parts of Unit 6 are integrated in a schematic form into the layout plan.
Unit 6 of Šoštanj is a planned unit on the existing area of the Power plant. Two of the cooling towers (cooling tower for Unit 1 and 3) will be demolished and the place will be used for unit 6 including the new cooling tower. (See Figure:6.2)

![Figure 6.2: Overview of the Existing TPP (5 Units) and the Future TPP including Unit 6](image)

Source: Powerpoint presentation of TES

### 6.3 Observations during the Site Visit

During the field missions discussions were held with Mr. Branko Debeljak Manager - Plant Operation Section (Responsible for the EIA) and Mr. Egon Jurač the Responsible Environmental Manager. A site visit of all major plant areas, like boilers, turbine halls of Unit 1, 2, 3, 4 and 5, as well as the two FGD plants and the auxiliaries systems was carried out. For a good overview of the TPP and its surrounding a visit on top of the Unit 5 boiler, 65 m above the ground, was included. The future construction site of Unit 6 has been seen including the area for the new cooling tower.

The coal storage, the storage areas for ash, gypsum and stabiliser and the deposit area of the stabiliser, have been visited as well as the water supply system and the sedimentation ponds for the waste water. The finished product called ”stabiliser” is a mixture of sludge, ash and gypsum, which is used to build a dam between the two lakes Velenje Lake and Šoštanj (Družmirje) Lake.

In general it should be mentioned that the power plant and the surrounding of the mine seems to be very well maintained, no waste is laying around, the wastes seems to be collected separately, no spillage of oil or any other liquids could be seen. Even near the coal storage and the “stabiliser” storage were no dust on the leaves of the trees. Additional, sprinkling systems are used to reduce the dust formation on the stabiliser deposit.

### 6.4 Existing Environmental Impact Assessment Report

The main environmental document was the Report on Environmental Impact (EIA) - Construction of the Unit 6 Šoštanj TPP of September 2008 (Report No.: 1866/2), which was produced in Slovenian language was handed over to the Consultant. Parts of the EIA like, the table of contend and the relevant chapters have been translated into English. Additional documents received were:
− the water balance,
− data on water quality in the surrounding of the power plant,
− heavy metal contend and radioactivity of carbon, gypsum, ash and stabiliser and
− a list of the used chemicals at the TPP.

Furthermore, a map indicating the monitoring measurement points for imissions and water quality was received.

A preliminary screening and review of the EIA Report leads to the conclusion, that it covers all necessary environmental aspects. Therefore, only the important environmental issues, like air pollution, water consumption and waste disposal, will be addressed in the following.

### 6.4.1 Air Pollution and other Emissions

In 1987 a recovery plan has been adopted for the existing units to reduce the high emissions. The Situation concerning air pollution in the ambient air has improved significant in the last 8 years, several steps like the installation of EPS and FGDs have lead to a strong reduction of SO$_2$, NO$_x$ and particulate matter (PM10) emissions. Noise absorbers have been Installed to all exhausts between 1981 and 1994. The following Table gives an overview on the actions taken and on the achieved goals in the last 30 years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>ESP replacement Unit 1 – 3</td>
<td>The emission of particulate matters will be under 50 mg/m$^3$.</td>
</tr>
<tr>
<td>1990</td>
<td>Ecological information System</td>
<td>Emission control, changes can be recognised early and actions can be taken.</td>
</tr>
<tr>
<td>1990</td>
<td>Additive desulphurisation of flue gases</td>
<td>Adding calcium carbonate leads to a desulphurisation of the flue gases of about 40% to 50%.</td>
</tr>
<tr>
<td>1990</td>
<td>Silos for calcium carbonate</td>
<td>Reduction of dust emission</td>
</tr>
<tr>
<td>1991</td>
<td>Primary measures for reduction of NOx Unit 4</td>
<td>The reconstruction of the whole fuelling system, decreased the nitric oxides beneath the permitted value of 650 mg/m$^3$</td>
</tr>
<tr>
<td>1994</td>
<td>Gypsum and stabiliser depot</td>
<td>Reduction of dust emission</td>
</tr>
<tr>
<td>1994</td>
<td>ESP replacement Unit 4</td>
<td>The emission of particulate matters will be under 50 mg/m$^3$.</td>
</tr>
<tr>
<td>1995</td>
<td>FGD for Unit 4</td>
<td>95 % of the SO$_2$ in the flue gases is eliminated due to the FGD. The SO$_2$ contend in the flue gas is below 400 mg/m$^3$. Yearly SO$_2$ reduction: 30.000 - 35.000 t</td>
</tr>
<tr>
<td>1997</td>
<td>Construction of emission measurement stations on all Units</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>Central Unit for ecological information system</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>ESP replacement Unit 5</td>
<td>The emission of particulate matters will be under 50 mg/m$^3$.</td>
</tr>
<tr>
<td>2000</td>
<td>FGD Unit 5</td>
<td>95 % of the SO$_2$ in the flue gas is eliminated due to the FGD. The SO$_2$ contend in the flue gas is below 400 mg/m$^3$.</td>
</tr>
<tr>
<td>2003</td>
<td>Flue gas channels from Unit 1, 3 to FGD of Unit 4</td>
<td>Decrease of SO$_2$ emissions from in Unit 1-3 by passing them through the FGD of Unit 4.</td>
</tr>
<tr>
<td>2007</td>
<td>Primary measures for reduction of NOx for Unit 5</td>
<td>Emissive values of NOx fall under 500 mg/m$^3$</td>
</tr>
</tbody>
</table>

**Table 6.2: Environmental measures taken in the last 30ty years**
An ecological information system had been installed and started operation in 1991. The online monitoring system for emissions and imissions covers temperature and SO$_2$ concentration of the ambient air at 10 measurement stations in the surrounding of the Šoštanj TPP and pH, temperature, turbidity and water level in the Paka River. The emissions are measured at the stack and the imissions at the 10 locations around the TPP shown in the map of Figure 6.3.

![Figure 6.3: Measuring Points of the Monitoring System](image)

Since Unit 2 has been shut down in 2008 all operating units are passing through a FGD, the sulphur content of the flue gas of all units is at the moment below 400 mg/Nm$^3$ and can be reduced to 200 mg/Nm$^3$ as mentioned by the Responsible Environmental Manager.

Unit 3 is just at a concentration of 500 mg/Nm$^3$ of NO$_x$, and Unit 4 and 5 are below the emission limit of 500 mg/Nm$^3$. Unit 1-4 will be shut down until 2016 and just Unit 5 and Unit 6 will be in operation, when the new concentration limits for NOx (200 mg/Nm$^3$) come in force.

The emission limit for PM10 of 50 mg/Nm$^3$ is kept by all units.
With the construction of Unit 6, which will be built in the best available technology and the shut down of Unit 1-4 an additional reduction of emissions will be achieved. Unit 5 will operate until 2028 simultaneously. Until 2020 the lignite consumption will be at the same level and after 2020 it will decrease and therefore the CO$_2$ emission will decrease. The efficiency of the planned Unit 6 is approx. 43%, which means a reduction in carbon dioxide emission per unit of energy produced. Unit 6 will be equipped with ESPs, FGD and low NO$_x$ burner, all limits will be kept by the new Unit.

The streets around the coal deposit and between the stabiliser interim deposit and the final deposit are cleaned every day, trucks which are transporting the stabiliser to the deposit drive through a sprinkling station. A sprinkling system is installed at the final deposit for the stabiliser which is functioning as construction material for the dam between Šoštanj Lake and Velenje Lake, after completion of a part of the dam the area is covered with soil and recultivated.

### 6.4.2 Water Consumption

The water consumption of Šoštanj TPP in the year 2008 was 12'520'013 m$^3$; the process water is taken from the Topoliščica catchment and cooling and transport waters are taken from Paka River and Lake Šoštanj, while Lake Velenje serves as reserve.

Lake Šoštanj had in 1999 a volume of 14 million m$^3$ in 2007 16.9 million m$^3$ and it will continue to increase due to extraction of coal from mine. In line with the needs of the Šoštanj TPP the water sources are used in following order.

- Lake Šoštanj until a water level of 359.9 m asl.
- Lake Šoštanj and River Paka, if the Water level of Lake Šoštanj is between 359.9 and 359.2 m asl.
- River Paka, if the Water Level of Lake Šoštanj is below 359.2 m asl,
- Lake Velenje, if the flow rate in River Paka is too small to ensure the ecological acceptable flow rate

The following waste waters arise from the Šoštanj TPP:

- Industrial waste waters (from decarbonisation and demineralisation),
- process water from the desulphurisation plants,
- blow down water from cooling towers,
- transport water and
- sanitary wastewater.

The most important achievement concerning water consumption was the closed water circuit which was implemented in 1994. The process water from the desulphurisation is used as transport water for ash, gypsum and stabiliser. This water and the drainage water from the coal storage and other areas are led in a closed circuit. The water is led from the TPP to the new impermeable stabiliser settlement basins. After settling of the stabiliser, it is pumped back to the TPP.

The bilge water from the cooling water and parts of the rainwater’s are led through three outlets into the Paka River. Operational monitoring is carried out at all 3 outlets. The samples are taken 12 times per year. The important parameters (temperature, biological & chemical oxygen demand, heavy metals and many others) are covered. Furthermore, it was learned that TES has an Emergency Preparedness Plan for the Paka River.
Since Unit 6 is a replacement for Unit 1-3 and Unit 4 will be closed down two years after commissioning of Unit 6. Unit 5 is closed down in the year 2028 it would be an advantage if a table would be in the EIA report showing the water consumption of the Power Plant over the years, how it would change with the commissioning of the new Unit and the shut down of the old Units. To get a better view over the total water balance of the plant over the years and to see how much the total water consumption will increase or will be reduced.

In general it can be mentioned that the minimum flow in the Paka river should not be below 400 l/s, the maximum available water for the power plant per day should not exceed 67'200m³ taken from Paka river, lake Šoštanj and lake Velenje. Due to the higher energy efficiency of Unit 6 the consumption of water per unit of produced power will be reduced. The total water consumption will be higher than now and simultaneously operation of individual Units (4, 5 and 6) must be adapted to this quantity.

The impacts which can occur during construction phase and operation phase are mentioned and mitigation measures are identified.

6.4.3 Waste Disposal

The quantity of the main waste materials (ash, gypsum, stabiliser, etc.), which are produced during operation of the TPP with the new Unit 6, will be about of the same amount as before, since Unit 6 replaces Unit 1-4 and the coal consumption will be the same as before. This waste materials are processed using the R5 procedure into inorganic material (so called stabilizer) in accordance with the Decree on waste management (Official Gazette of RS, no.34/08) and is used for the reconstruction of the subsidence areas of the Velenje Coal Mine as construction material.

Construction and demolition waste covers a wide range of materials. Some of the produced waste requires special attention and handling as the waste is of hazardous or potentially hazardous character. This includes solvent based concrete additives, damp roofing emulsions, asbestos based materials, etc., which have to be disposed in special deposits.

All proposed mitigation measures for the handling of construction and demolition waste can be summed up in the usually used hierarchy on waste management.

- Prevention or reduction
- Re-use
- Recycling for material recovery
- Disposal in a safe manner

The Waste water is used in a closed circuit, only the blow down water of the cooling towers with parts of the rain water are lead into the Paka River.

6.4.4 Problem Areas

It has been mentioned during the site visit, that until now, the EIA for the new 12 km long transmission line from the Šoštanj TPP to the PODLOG substation was not yet carried out. The EIA is in the responsibility of the Transmission Company.
7 EPC CONTRACT FOR POWER ISLAND OF NEW UNIT 6

The main focus of the Consultant’s review has been on the new Unit 6, as this unit will be the major power producer once it is installed and commissioned. The investment costs and operating costs of this unit also have the highest impact to the financial results of the company for the future. It is a huge commitment and has therefore been reviewed together with the related packages.

7.1 Bidding Procedure and History

7.1.1 Tendering

The initial steps to award the EPC Contract to Alstom were as follows:

- A periodic indicative notice calling for expressions of interest from interested parties for the supply of Power Island for the 600 MW Unit 6 was published in the Official Journal of the European Communities No. 2006/S 192-204488 on 07 October 2006.
- Applications were submitted by two Bidders (Alstom and Siemens); in the decision adopted on 08 December 2006 both were awarded qualified supplier status for the purpose of supplying Power Island for TEŠ Unit 6.
- A tender document for the supply and installation of Power Island was drafted and sent to both bidders on 12 April 2007.

7.1.2 Selection of Preferred Bidder

An evaluation of the initial offers submitted by Siemens and Alstom with "Target Prices" was carried out by TES, which resulted in the following summary:

- Alstom with 654 million EUR
- Siemens with 711 to 786 million EUR

The evaluation of the “Initial Bids with the Target Prices” was carried out based on pre determined procedure. Based on the brief review the procedure was carried out in accordance with the procedures defined. There is a detailed evaluation report available with a separate protocol in Slovenian language only. The protocol was handed out to the Consultant and contains the key issues. It is signed on 16th July 2007 and contains 16 pages with key information about the Bids from Siemens and Alstom on the Technical and Commercial Part.

At the time of receipt and evaluation of the Bids, there were no details available about the pricing. TES have assumed that those target prices were fixed prices, as there was no reference to any indexation. The prices were target prices only.

The evaluation of the “Initial Bids with the Target Prices” led to the selection of Alstom as preferred Bidder based on cost, technical merits and time schedule, derived from the procedure established before the bidding process started. The procedure included all the main parameters, the costs and resulting overall costs based on clear pre agreed procedure and calculation method. The results of this selection are available and have been summarized in a Memorandum with all input and output data. Both pre qualified Bidders Siemens and Alstom would be capable in technical and commercial terms to undertake this assignment.
TES informed us that both bidders have requested exclusive reservation fee even though TES intended to proceed with both Bidders up to the conclusion of the EPC contract. The requested reservation fee is also included in the protocol. The requested fees were 25 million EUR from Alstom and 30 million EUR from Siemens.

7.1.3 Reservation Agreement and EPC Bid from Alstom
Since both bidders insisted on a reservation contract being signed, an annex to the tender document to that effect was subsequently sent to the bidders on 14th June 2007.

A reservation contract with Alstom was signed on 19th September 2007.

After selection of the preferred Bidder, the detailed proposal was carried out by Alstom with the pricing and technical and commercial details, as indicated later in the report. This was followed by numerous meetings held for the purpose of reaching agreement on and finalising relevant details pertaining to technical and commercial issues involved in the supply of Power Island. The contract was eventually signed on 27th June 2008.

7.1.4 Comments to Procurement Approach
The procurement approach as applied for the Sostanj Project has been selected by the TES on the basis of very limited competition. Finally there were only 2 competitors available with the capability and capacity to design and construct this new big power generating Unit 6, namely Siemens and Alstom.

In order to proceed with the permitting process for the Project and based on the fact that both companies were only prepared to proceed on an exclusive basis the procurement approach is understood. Obviously the preferred way would be to keep the competition in place with both companies up to award of the EPC contract. This was, however, not possible in the given situation. Furthermore, with the technology defined, the permitting work could proceed, which has a big impact to the schedule.

It was unfortunate that the power market has become so unstable in terms of pricing and delivery, just exactly during this period. This was difficult to foresee by TES. The approach as selected can be justified and was handled diligently based on the review of the available documentation.

7.2 Specific Conditions of the EPC Contract for the Power Island
The EPC Contract of Alstom was reviewed by the Consultant and some important items are summarised in the following sections.

7.2.1 Guarantees in Contract for Unit 6
The contract between TES and Alstom provides the following guarantees:

- **Completion Time**: 63 months from NTP
- **Performance:**
  - Output: 553.7 MW
  - Thermal Power: 120 MW th
  - Unit Net Heat Rate: 8289 kJ/kWh
7.2.2 Liquidated Damages in Contract for Unit 6

The contract between TES and Alstom provides the following liquidated damages for delay and performance:

- **Delay Damages**
  - 0.35% for delay in take over per completed week (0.175% of long lead items)
  - Overall cap 12%

- **Performance LD’s**
  - Output: 1% of the contract price per 1% shortfall below the guaranteed value (Net output)
  - Heat Rate: 1% of the contract price per $\frac{1}{2}$% excess of the guarantee value
  - Heat Extraction: 200’000 € for each 1% of shortfall
  - Load gradient for each MW/min: 100’000€ for each MW/min shortfall
  - Overall Cap: 10% of contract price

- **Overall Cap of LD’s**: Overall Cap of LD’s 16.5% (Performance and Delay)

The LD’s often represent the market situation. The values shown above are considered acceptable.
7.2.3 Other Key Issues in Contract for Unit 6

The contract between TES and Alstom further includes the following:

- **Trial Run**
  - Trial run in totally 3 stages:
    - 10 days periods
    - Various conditions specified (i.e. 42% - 100% load, tests not successful if material shutdowns occur, meaning more than 24 hrs!)

- **Performance Test**
  - Performance test after the trial run: Not detailed, however max. 3 attempts

- **Reliability Period**
  - 2 years after taking over, max 3 years for any part
  - Wear & tear parts definition not found

- **Final Acceptance**
  - After completion of defect liability period
  - After receipt of “as built” drawings
  - Meeting FAC conditions

- **Limitation of liability**
  - 100% of contract price
  - Loss of profit excluded
  - Max 4 years after taking over

The above conditions are generally acceptable. The trial run conditions should preferably be defined more stringent, i.e. as follows:

- Max. shutdown in stage 1 24 hrs as currently proposed
- Max. shutdown in stage 2 8 hrs (currently 24 hrs)
- Max. shutdown in stage 3 0 hrs (currently 24 hrs)

This was indicated to TES during the site visit.

The performance test will be carried out only after PAC in accordance with the sequence proposed. Alstom claims that the lignite fired boiler needs a certain operating time to receive the initial “dirtiness” of the tubes to achieve operating parameters. The disadvantage is that the ageing factor comes into play when the performance measurement is made.

7.3 EPC Contract Price of Alstom

After the selection of the preferred Bidder the detailed proposal was prepared by Alstom in the period 2007 to 2008. During this period the international market for power plant equipment was overheated and it was difficult to receive bids from subcontractors for reasonable prices. The big price increase at that time was not fully reflected in the escalation indices. It was really an extreme market situation. All major contractors and subcontractors had full workshops and order books and had no engineering capacity. It was understood that under those circumstances no responses were received from subcontractors, and if they made an offer, the prices were far higher than normal.
Updated Status 18th Sep 2009:

This very critical and crucial issue of the high price increase in less than one year has been discussed intensively with Alstom on 20th August 2009 in a meeting in Baden. TES asked the TA to participate in this meeting, which had the purpose of clarifying certain issues in preparation for the upcoming negotiations. Alstom has been made aware that the current market has changed back to more considerate terms. Alstom have indicated that, even though the indices for escalation have changed, the power market has remained stable on a high level in terms of pricing. Alstom explained that the power market has not seen any remarkable slowdown in the last 12 months, but they have promised to review carefully the situation and to involve their top management prior to submission of the adjusted Bid price. The criticality of this aspect was explained to Alstom during the meeting.

Based on the final pricing received by the Client from Alstom following the meeting, Alstom have made a big effort to reduce the costs and the latest offer and negotiated price has now been reduced by approx. 9.8%, which is a considerable reduction (approx. 78 million EUR) as explained later in detail. The pricing as finally achieved in the last meetings with Alstom are now considered acceptable considering all circumstances in this project.

7.3.1 Price Development

Alstom presented their Bid with a price of 798 million EUR (without erection) for the Power Island of the new Unit 6. TES have estimated the erection costs based on their experience and came to a total price of 878 Mio EUR, compared to the previous target price by Alstom of 654 million EUR. This represented a cost increase of over 30% in less than one year! In any case the contract has been negotiated between Alstom and TES and was finally signed in June 2008.

The contract provides for various cost positions and comprises “fixed” cost positions, subject to escalation and ”sliding” cost positions, subject to negotiation and escalation. The “fixed” cost positions are approx. 15% of the total EPC price and the majority of approx. 85% is ”sliding” as explained below.

- The “fixed” cost positions are subject to the escalation specified in the contract
- The”sliding” cost positions are adjustable at NTP-3 (Notice to Proceed minus 3 months) and are yet to be negotiated between Alstom and TES ,These prices are also subject to escalation. For these positions, Alstom by Contract has to provide “reasonable evidence” and this will occur prior to NTP.
- The escalations will be calculated on each invoice with indices specified in the contract. The number of indices will require specific dedication from TES during the implementation period. The current price in the contract is based on the indices from the time of signing the contract, i.e. June 2008. TES have made preliminary calculations and have established that the current contract price would be considerably lower. TES are estimating this “reduction” with approx. 10%.This seems high for 1 year however needs to be verified in detail.
This implies that Alstom has yet to substantiate the main portion of the price and TES is looking forward to these discussions with Alstom. It is expected that Alstom will not deviate from their prices unless forced to by TES with the ultimate threat to cancel the contract. This would of course mean that the reservation fee would be lost.

Updated Status 18th Sep 2009:

As stated above, the price issue has been discussed seriously with Alstom after the Consultant’s site visit and fact finding mission to Slovenia. The current situation after the submission of the revised contract price and the subsequent TES negotiations is as follows:

The final price has been reduced from 798.8 million EUR to 720.0 million EURO (both without erection), which represents a reduction of 78 million EURO or 9.9%.

This is a good achievement. Furthermore, the delivery portion is now firm, but still with escalation according to the agreed escalation formulas. There are no more “open book” portions in the contract. This makes the contract price more predictable. As escalation is still there, it leaves an uncertainty about the final cost. However, the current pricing structure is more predictable than before.

The financing of the escalation needs to be defined by TES, either in the loans or as part of their own costs.

7.3.2 Price Split

The so called submission of reasonable evidence is not further described and the coming negotiations between Alstom and TES will show how the Alstom interpretation of this clause.

The table below summarizes the prices split up as described above with the price in the signed contract from June 2008.

<table>
<thead>
<tr>
<th></th>
<th>Offshore Fix</th>
<th>Offshore Sliding Negotiation &amp; Escalation</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(EURO)</td>
<td>(EURO)</td>
<td>(EURO)</td>
</tr>
<tr>
<td>EP - Engineering, manufacturing, delivery, supervision of erection, commissioning and acceptance test</td>
<td></td>
<td></td>
<td>798'808'000</td>
</tr>
<tr>
<td>C - Erection, EAR and cost of cranes later (3 month prior to NTP)</td>
<td></td>
<td></td>
<td>Later</td>
</tr>
<tr>
<td>Main Equipment Offshore:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiler Offshore</td>
<td>60'739'000</td>
<td>343'292'000</td>
<td>411'216'000</td>
</tr>
<tr>
<td>Steam Turbine Off shore</td>
<td>1'605'000</td>
<td>80'765'000</td>
<td>113'282'000</td>
</tr>
<tr>
<td>ROP Off Shore</td>
<td>55'948'000</td>
<td>218'362'000</td>
<td>274'310'000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>118'292'000</td>
<td>642'419'000</td>
<td>798'808'000</td>
</tr>
<tr>
<td>Total without Erection:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate TES for Erection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Total including Erection Estimate</td>
<td></td>
<td></td>
<td>878'592'000</td>
</tr>
</tbody>
</table>

Table 6.1: EPC Contract Price Split
As the erection is not anymore included in the Alstom price, there is a clause, which allows Alstom to add 35% to the cost of the offer for a subcontractor for erection work. It is therefore of utmost importance to analyse the evidence of Alstom, which will be provided during the coming renegotiations.

**Updated Status 18th Sep 2009:**

The detailed pricing figures are not available. However, the following updated overall figures have been communicated by TES following the latest offer from Alstom and subsequent discussions:

<table>
<thead>
<tr>
<th></th>
<th>TOTAL (EURO)</th>
<th>Previously (EURO)</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Equipment Offshore:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>719’973’000</td>
<td>798’808’000</td>
<td>-9.9%</td>
</tr>
<tr>
<td><strong>Total without Erection:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate TES for Erection</td>
<td>89’000’000</td>
<td>79’784’000</td>
<td>+11.6%</td>
</tr>
<tr>
<td><strong>Overall Total including Erection Estimate</strong></td>
<td>808’973’000</td>
<td>878’592’000</td>
<td>-7.9%</td>
</tr>
</tbody>
</table>

Table 6.2: EPC Contract Price Split Update 18th Sep 2009

Based on the details above the estimate of erection has been increased by approximately **9.2 million EURO**. It is expected that this increase has been made based on the offers available.

The price adder for EPC is now reduced to the erection of the power plant and it has been reduced from **35% to 25%**, which can now be accepted as EPC management and risk fee. It is important that TES keeps a closed supervision during the negotiations of the erection contract.

### 7.4 Project Time Schedule Unit 6

The implementation schedule of the Project is governed by the EPC Contract for the Power Island with Alstom. Therefore, the following is focused on the Alstom schedule.

The time schedule as negotiated in the contract included an implementation period of 63 months from the unconditional NTP (Notice to proceed) to PAC (Provisional Acceptance). The time period has also been determined in 2008 prior to signing the contract and is obviously influenced heavily by the market conditions at that time. This phenomena has not only been experienced in coal fired power plant projects, but also in projects of combined cycle power plants worldwide and is due to the fact that subcontractors had full shops and no spare capacity.

A shortening of the overall schedule by approx. one year appeared feasible, considering that the market has considerably changed. This would produce savings in the financing cost alone of estimated 40-50 million EUR. It would also reduce Contractors cost (and Price) due to shorter project execution period and the cost of TES for the project management of the Project. This issue was discussed again in the recent meetings between Alstom and TES.
The main events were scheduled as follows:

- NTP (unconditional) 0 months
- Access to site for erection 22 months
- Utilities connected (water, waste water, elect) 23 months
- Start Boiler steelwork erection 25 months
- Start Boiler pressure parts 26 months
- Start ST installation 38 months
- Demin water for hydro test available 40 months
- HV to unit trafo 43 months
- MCW inlet / outlet available 46 months
- Fire fighting for boiler 47 months
- Compressed air 48 months
- Coal 50 months
- CCW 50 months
- First Firing 52 months
- First Coal firing 52 months
- First Steam to turbine 53 months
- First Synchronisation 54 months
- Complete load tests 57 months
- Complete optimisation 62 months
- Complete trial runs 63 months
- PAC 63 months

During the discussions with Alstom on 20th August 2009, the schedule issue has been discussed at length. Alstom explained the required 63 months mainly on the 2 reasons:

- The first 6 - 7 month period after NTP is still without full access to the site as it is dedicated to the construction permitting process and cannot be classified as execution time.
- The area of construction where the new Unit 6 will be constructed is very congested and does not leave any room for prefabrication. All items have to be supplied to site on time and prefabrication is limited to the space requirements.

These 2 aspects have obviously not been sufficiently reflected in the Consultants initial review and site visit report, where we estimated a possible reduction of 1 year compared to other projects.

However, during the meeting Alstom have promised to review this aspect again and to make an attempt to reduce the execution schedule, if at all feasible.

The results of the review of Alstom and subsequent negotiations have now led to a shortening of the schedule from originally 63 months to 60 months, which can be accepted considering the permitting period and limited access to the site during the initial period.
OTHER CONTRACTS AND ESTIMATED TOTAL PROJECT COSTS

Besides the EPC Contract for the Power Island various packages for supply and services are part of the Project. These are mainly the following packages:

- FGD Plant
- Water Preparation (extension of existing water treatment plants)
- Coal Transport (extension of existing coal supply facilities)
- Product/Residue Treatment (extension of existing waste and waste water treatment plants)
- Cooling system (new cooling tower and main & auxiliary cooling system)
- GIS 400 kV (this item has been dropped recently)

8.1 EPC Contract for FGD

The following FGD related documentation has been made available to the Consultant at the time of writing the present Due Diligence:

- FGD Bid (Slovenian language)
- FGD Contract (Slovenian language)
- FGD Tender (English language)

Because the FGD bid and contract documents are in Slovenian language, in this preliminary evaluation of the FGD Plant, only the FGD tender documentation has been reviewed.

8.1.1 Bidding Procedure

The FGD contract has been tendered and procured under a separate turnkey contract. The contract has been awarded in June 2009 to the consortium Rudis-Esotech-Engineering Dobersek GmbH. Because the Offer and the Contract are in Slovenian language it is not possible for the Consultant to fully evaluate these documents. However, as per Owner's confirmation, the Consortium's Offer is fully in compliance with the specification requirements and contains no deviations. The offered price is below the budget. The references of the Consortium and of the single companies forming the Consortium are limited for what concerns large FGD plants in international environment. The Consortium, however, counts a series of relevant local (Slovenian) references both as single entities and as Consortium. The fact that the companies forming the Consortium have already worked together to deliver the FGD systems (Sostanj TPP Unit 5 and Trbovlje TPP) contributes to minimize the risk associated with planning and execution of such a complex project. For what concerns the offered FGD technology it is recommended to clarify the ownership or license agreement set-up (refer to Annex 8 for details on this issue).

In particular this sections focuses on the Volume C and D of the Tender Documents, related to the technical part. For the Volume C, the Schedules C.10 (Technological Scheme, Plan Views and Cross Sections, Unit 6 Site Plan) are not available to the Consultant and could therefore not be reviewed. The reviewed Tender Documents otherwise appear comprehensive. The scope is clearly defined as well as the battery limits for the plant supply. The major technical performance requirements are clearly
defined. The required technology represents the state of the art of European FGD systems, based on limestone, for thermal power plants burning coal or lignite.

The redundancy requirements are not always clearly defined in the opinion of the Consultant. A review of the missing Schedules C.10 would enable the Consultant to deliver a clearer statement on the redundancy concept for the plant. The costs are shown in Section 9. It is noted that the conclusion of this contract has resulted in considerable savings compared to the original budget. This is taken into account in the summary of the overall project costs.

8.1.2 Time Schedule

The employer plans the realisation of the project within the specified crucial dates, given in months, after Pre-contract / Contract signature. The contract has been signed in July 2009:

- Pre-contract / Contract signature 0 months
- Documents for Building permit documentation of FGD 5 months
- Contract validity 11 months
- Documents for foundation design 16 months
- Documents for planning of other participants 18 months
- Commencement of assembly 30 months
- Commencement of start-up tests 45 months
- Expert technical inspection 50 months
- Commencement of trial run 59 months
- Provisional take-over 60 months

The date of trial run commencement, 1st February 2015, is harmonised with Alstom, the Supplier of the Power Island and, therefore, binding for the FGD Supplier. With the shortening of the EPC contract from 63 months to 60 months, the schedule interface should be fine tuned; however, no problems are envisaged. The time schedule for the construction, assembly and erection of the FGD plant and equipment is considered representative of a typical FGD Plant of large size.

The time schedule for the Start-up tests is deemed too long, unless this period includes commissioning activities. The 12 months between technical inspection and trial run are not understood and are also considered too long. This needs to be discussed during the project execution.

8.2 Other Contracts

As shown in the overview of the procurement packages in Section 3, the other packages have not been awarded yet apart from smaller contract required for the development of the Project. The project cost of the other contracts is shown in Chapter 8.3. Some of the other packages can only be definitely tendered and awarded after the key design information from Unit 6 – Power Island is available. Typically this includes the civil and structural design, where the basic design with the design loads and the layout are the input for the civil and structural design.
8.3 Estimated Total Project Costs

The estimated Project costs have risen considerably over the last two years and the budget that was originally foreseen for the Project had to be revised two times. A third revision is expected after the coming renegotiations with Alstom and has occurred after the Consultant’s site visit. An update has been added to this chapter reflecting the current situation.

8.3.1 Development of Cost Increase

Main reasons for elaboration of the amendments:

- Increased price of Power Island
- Rescheduled deadlines for implementation of works and completion
- Modified dimensions and heights of the constructed buildings
- Modified scope of equipment by Lots
- Changed financing terms and conditions and consequently financing costs

A breakdown of the cost variations between July 2007 and December 2008 is given in the following table:

<table>
<thead>
<tr>
<th></th>
<th>Original</th>
<th>Revision 1*</th>
<th>Revision 2**</th>
<th>Variation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Works</td>
<td>See Investment Plan</td>
<td>93'575.5</td>
<td>96'896.2</td>
<td>+3.5</td>
</tr>
<tr>
<td>- Preparatory works</td>
<td>Investment Plan</td>
<td>10'094.2</td>
<td>11'700.0</td>
<td>+15.9</td>
</tr>
<tr>
<td>- Main power facility</td>
<td>April 2006, Page 82</td>
<td>48'818.6</td>
<td>54'207.2</td>
<td>+11.0</td>
</tr>
<tr>
<td>- Cooling tower</td>
<td></td>
<td>9'900.0</td>
<td>13'194.0</td>
<td>+33.3</td>
</tr>
<tr>
<td>- Other buildings</td>
<td></td>
<td>24'762.8</td>
<td>17'795.0</td>
<td>-28.1</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td>775'800.0</td>
<td>1'010'062.3</td>
<td>+30.2</td>
</tr>
<tr>
<td>- Power Island</td>
<td></td>
<td>654'000.0</td>
<td>878'592.0</td>
<td>+34.3</td>
</tr>
<tr>
<td>- FGD</td>
<td></td>
<td>99'159.6</td>
<td>97'176.4</td>
<td>-2.0</td>
</tr>
<tr>
<td>- Water preparation</td>
<td></td>
<td>5'520.0</td>
<td>5'796.0</td>
<td>+5.0</td>
</tr>
<tr>
<td>- Coal transport</td>
<td></td>
<td>4'328.6</td>
<td>4'545.0</td>
<td>+5.0</td>
</tr>
<tr>
<td>- Product/residue treatm.</td>
<td></td>
<td>4'291.8</td>
<td>4'506.4</td>
<td>+5.0</td>
</tr>
<tr>
<td>- Cooling system</td>
<td></td>
<td>0.0</td>
<td>11'446.5</td>
<td></td>
</tr>
<tr>
<td>- GIS 400 kV</td>
<td></td>
<td>8'500.0</td>
<td>8'000.0</td>
<td>-5.9</td>
</tr>
<tr>
<td>Other Investor's costs</td>
<td></td>
<td>20'670.0</td>
<td>22'116.9</td>
<td>+7.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>890'045.5</td>
<td>1'129'075.5</td>
<td>+26.9</td>
</tr>
<tr>
<td>Financing costs</td>
<td></td>
<td>63'874.6</td>
<td>213'662.7</td>
<td>+234.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>953'920.1</td>
<td>1'342'738.2</td>
<td>+40.8</td>
</tr>
</tbody>
</table>

*Revision 1 = amended Investment Programme September 2007
**Revision 2 = amended Investment Programme March 2009

Estimated Cost (excluding financing) 1,881.80 EURO/kW
therefrom:
- Preparatory works 19.50 EURO/kW
- Equipment with installation and construction works 1,825.40 EURO/kW
- Investor's costs 36.90 EURO/kW

Table 8.1: Price Increases from Revision 1 to Revision 2
Updated Status Sep 2009:

During the negotiations with Alstom the prices were discussed in detail and with the determination to achieve substantial reductions. As indicated in Chapter 7.3, Alstom have reviewed their pricing and came up with revised prices.

TES have subsequently reviewed these price figures and developed a new overall cost schedule, which is reflected below:

<table>
<thead>
<tr>
<th>Revision 2**</th>
<th>Revision 3***</th>
<th>Variation %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>**</td>
<td>Fixed Prices in 1000 EUR</td>
<td>Fixed Prices in 1000 EUR</td>
<td>**</td>
</tr>
<tr>
<td>Construction Works</td>
<td>96'896.2</td>
<td>78'857.2</td>
<td>-18.6</td>
</tr>
<tr>
<td>- Preparatory works</td>
<td>11'700.0</td>
<td>6'852.0</td>
<td>-41.4</td>
</tr>
<tr>
<td>- Main power facility</td>
<td>54'207.2</td>
<td>48'137.2</td>
<td>-11.2</td>
</tr>
<tr>
<td>- Cooling tower</td>
<td>13'194.0</td>
<td>11'304.0</td>
<td>-14.3</td>
</tr>
<tr>
<td>- Other buildings</td>
<td>17'795.0</td>
<td>12'564.0</td>
<td>-29.4</td>
</tr>
<tr>
<td>Equipment</td>
<td>1'010'062.3</td>
<td>908'240.9</td>
<td>-10.1</td>
</tr>
<tr>
<td>- Power Island</td>
<td>878'592.0</td>
<td>694'973.0</td>
<td>-28.7</td>
</tr>
<tr>
<td>- Power Island erection</td>
<td>97'176.4</td>
<td>75'970.0</td>
<td>-21.8</td>
</tr>
<tr>
<td>- Previous work*</td>
<td>above included</td>
<td>89'000.0</td>
<td>25'000.0</td>
</tr>
<tr>
<td>- FGD</td>
<td>5'796.0</td>
<td>4'832.0</td>
<td>-16.6</td>
</tr>
<tr>
<td>- Water preparation</td>
<td>4'545.0</td>
<td>3'483.0</td>
<td>-23.4</td>
</tr>
<tr>
<td>- Coal transport</td>
<td>4'506.4</td>
<td>3'536.4</td>
<td>-23.4</td>
</tr>
<tr>
<td>- Product/residue treatm.</td>
<td>11'446.5</td>
<td>11'446.5</td>
<td>0.0</td>
</tr>
<tr>
<td>- Cooling system</td>
<td>8'000.0</td>
<td>0.0</td>
<td>-100.0</td>
</tr>
<tr>
<td>- GIS 400 kV</td>
<td>0.0</td>
<td>0.0</td>
<td>-100.0</td>
</tr>
<tr>
<td>Other</td>
<td>22'116.9</td>
<td>10'116.9</td>
<td>-54.3</td>
</tr>
<tr>
<td>Total</td>
<td>1'129'075.5</td>
<td>997'215.0</td>
<td>-11.7</td>
</tr>
<tr>
<td>Financing costs</td>
<td>213'662.7</td>
<td>124'185.7</td>
<td>-41.9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1'342'738.2</td>
<td>1'121'400.7</td>
<td>-16.5</td>
</tr>
</tbody>
</table>

* Reservation Fee
** Revision 2 = amended Investment Programme March 2009
*** Revision 3 = Investment Program September 2009 (based on Alstom’s new Offer and final negotiations)

Table 8.2: Price Decreases from Revision 2 to Revision 3

<table>
<thead>
<tr>
<th>Estimated Cost (excluding financing)</th>
<th>Revision 3</th>
<th>Variation (to Rev 2) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>therefrom:</td>
<td>1’662.0</td>
<td>-11.7</td>
</tr>
<tr>
<td>Preparatory works</td>
<td>11.40</td>
<td>-41.4</td>
</tr>
<tr>
<td>Equipment with installation and construction works</td>
<td>1’633.70</td>
<td>-10.5</td>
</tr>
<tr>
<td>Investor's costs</td>
<td>16.90</td>
<td>-54.3</td>
</tr>
</tbody>
</table>

Y:\1025\9A000193.01 Sonstanj TPP - Due Diligence\500_Reports\Final Due Diligence Report\Sonstanj Due Diligence Report 080410_Rev2.doc
8.3.2 Main Cost Increase Items in Revision 2

The cost increases in Table 6.2 had been discussed in some details with TES. Four items had been identified, which have considerable impact on the cost increase. These are as follows:

- Power Island
- Cooling tower
- Cooling system
- Financing costs

The cost increase of the EPC Contract of Alstom for the Power Island has been assessed and commented in the previous chapter. However, it is worthwhile to mention that during the discussions with TES it was mentioned that a recalculation of the total EPC price, with the contractual escalation formulas and with the current indices, would give about a 10% lower price.

The cooling tower had to be modified and has now a larger diameter as the flue gases are released into the cooling tower, thus making the stack superficial. This should in total result in a saving. This needed further clarification.

The cooling system seems to have been included before in the EPC Contract scope. If this item is taken out of the scope of Alstom, their price increase is even more by this amount. This also needed to be clarified.

The second biggest cost increase item is the financing cost item. One major cost driving factor is that the financing over the extended construction period had to be increased. The implementation time for the Power Island is long and a reduction would reduce these costs significantly.

8.3.3 Main Cost Reduction Items in Revision 3

After the negotiations between TES and Alstom, the new prices were submitted by TES to the Consultant and the revised table has been presented above. The EPC contract with Alstom for the Power Island was reduced by 69.62 million EUR. The other changes, like the Construction Works, which have been reduced in total by 18.04 million EUR, the further Equipment Costs and the other Investors Costs, are discussed briefly in the following paragraphs.

Costs of Preparation Works and other Buildings

The site preparation works have been reduced by 4.85 million EUR, mainly be taking out the demolishing works from the Project. Further, impact had lower unit prices this year in the civil works sector. The same applies to the costs for other buildings and, in addition, the new Administration Building was taken out saving 5.23 million EUR.

Main Power Facility Costs

The civil works of the new Unit 6 have been recalculated and the current price levels were applied. Some changes in the conceptual design have also been considered. The cost reduction achieved so far is 6.07 million EUR. However, there seems to be still some potential for more savings, in particular, with regard to the turbine building, which will be briefly addressed in the next chapter.
Cooling Tower Costs
The modifications required for the cooling tower, in order to receive the flue gases from the FGD plant have been calculated new and the elimination of the stack has been taken into account. The reduction in the cost estimate amounts to 1.89 million EUR.

FGD Cost
The amount for the FGD plant has been reduced from 97 to 76 million EUR. In the meantime the bidding process for the FGD plant has been carried out and a contract was signed for the indicated amount.

Other Investor’s Costs
These costs comprise the project management, the engineering services and other costs TES has to bear (Package 10). They included also the 12.0 million EUR insurance fee of the Project, which is now included in the Power Island erection.

Financing Costs
The amount for the financing costs had been decreased from 214 million EUR to now 124 million EUR. The original loan distribution and timing of the loans was reviewed and confirmed during the Site Visit as follows:

<table>
<thead>
<tr>
<th></th>
<th>Paid</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Own</td>
<td>30'390.2</td>
<td>18'185.0</td>
<td>54'189.7</td>
<td>60'547.8</td>
<td>91'212.2</td>
<td>34'933.6</td>
<td>70'616.2</td>
<td>40'243.9</td>
<td>400'318.6</td>
<td>29.5%</td>
</tr>
<tr>
<td>2. EIB</td>
<td>84'452.4</td>
<td>56'936.2</td>
<td>187'702.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>329'090.8</td>
<td>24.0%</td>
</tr>
<tr>
<td>3. Bank</td>
<td></td>
<td></td>
<td>298'893.7</td>
<td>221'966.2</td>
<td>87'251.6</td>
<td>25'743.2</td>
<td></td>
<td></td>
<td>633'854.7</td>
<td>46.5%</td>
</tr>
<tr>
<td>Total</td>
<td>30'390.2</td>
<td>102'637.4</td>
<td>111'125.9</td>
<td>248'250.0</td>
<td>390'105.9</td>
<td>256'899.9</td>
<td>157'867.7</td>
<td>65'987.1</td>
<td>1'363'264.1</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 8.3: Financing Sources and Investment Schedule March 2009

The revised financing arrangement was established by TES following the receipt of the revised offer from Alstom and the subsequent negotiation with them, which resulted also in 3 months less implementation time. It was submitted to us as follows:

<table>
<thead>
<tr>
<th></th>
<th>Paid</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Own</td>
<td>31'768.9</td>
<td>85,458.8</td>
<td>10,132.3</td>
<td>13,718.8</td>
<td>25'848.7</td>
<td>104'685.9</td>
<td>122'076.7</td>
<td>19'002.9</td>
<td>412'693.0</td>
<td>36.8%</td>
</tr>
<tr>
<td>2. EIB</td>
<td>84'349.1</td>
<td>170'230.6</td>
<td>268'934.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>523'514.1</td>
<td>46.7%</td>
</tr>
<tr>
<td>3. EBRD &amp; Banks</td>
<td>67'059.4</td>
<td>118'134.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>185'193.6</td>
<td>16.5%</td>
</tr>
<tr>
<td>Total</td>
<td>31'768.9</td>
<td>85,458.8</td>
<td>94'481.4</td>
<td>183'949.4</td>
<td>361'842.6</td>
<td>222'820.0</td>
<td>122'076.7</td>
<td>19'002.9</td>
<td>1'121'400.6</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 8.4: Financing Sources and Investment Schedule September 2009

The EBRD Loan includes now also the Commercial Bank Loans. Saving in financing cost is a considerable portion of the total savings. As can be seen in the comparative tables above, the reason for this saving is based on:

- Increase of own financing from 29.5% to 36.8%
- Increase of EIB Financing from 24.0% to 46.7%
- Decrease of EBRD & Bank Loan from 46.5% to 16.5%

Due to the initial few months period dedicated mainly to engineering and permitting, the financing could be shifted by a few months. This also is reflected in the financing costs. Also the reduction of the implementation time from 63 months to 60 months has been taken into consideration.
8.4 Potential Cost Reduction Findings in Civil Works and in the Electrical System

Civil Works

The turbine hall dimensions have been increased resulting in about 50% larger volume, if compared to the original planning and the costs have increased accordingly. This was caused by the design of Alstom, as we were informed, and creates difficulties to place the new Unit 6 into the available space. This seems unbelievable and should be checked again. Maybe, Alstom took a standard design not specifically suitable for this 600 MW turbine generator set or the original basic design was wrong.

Electrical System

The Alstom project concept SLD (Single Line Diagram) F5498 dated 19/11/07 was reviewed and a possible cost reduction was identified. In essence the conceptual GCB (generator circuit breaker) could be eliminated in favour of synchronising the unit through the proposed 400 kV GIS circuit breaker. Initial arguments for and against the conceptual arrangement were:

1. That it promoted ease of commissioning, true, however it is also common to disconnect the links between the GSUT and Generator to facilitate commissioning and then reinstate the links when it is time to synchronise.

2. That the protection is tighter, debateable, and subject to a deeper analysis in reaction and time current coordination.

FWP feeder N-1 criterion: The arrangement of the boiler feed water pumps (FWP) MV feeder also raised a question concerning their connection to the 21 kV (IPB bus). The initial argument was that it was arranged in such a manner, so as to avoid excessive voltage drop during starting of the motors. This may well be the case, but would ordinarily be subject to the outcome of a dynamic motor starting analysis.

The real question is a question of redundant supply, that is to say, the present conceptual arrangement does not provide for an alternative means of supply as it is connected (through UAT-2) to the 21 kV IPB and in it present conceptual arrangement fails to satisfy the N-1 criterion, since the loss of UAT-2 equates to the shut down of Unit -6, which is not the case in the loss of UAT-1 since the MV switchboard (833-06BBA/B) has an inter-connector or bus-tie linking the unit auxiliary switchboard to the Station auxiliary switchboard (833-06BBA/B – 830-06BBE/F).

The recommendation is to revise the conceptual arrangement and to provide an alternative supply, so satisfying the N-1 criterion or (depending on the outcome of the motor start transient analysis) to supply the FWPs from the main MV switchboards (833-06BBA/B).

Power system model: Whilst on site, a basic power system model was constructed for comparative analysis and discussion purposes.
CONCLUSION

The Šoštanj TPP is an important pillar for the energy sector of Slovenia and its output accounts for about one third of the country’s total electricity generation. The power generation structures of the Šoštanj TPP are old and are rapidly approaching the end of their operating live cycles. In order to keep the essential power generating position in Slovenia and to preserve the main key characteristics of the electricity system, a new, modern power generating unit has to be installed that would replace the present units and meet all environmental and other requirements as imposed by the applicable EU legislation.

The Consultant confirms this situation and supports the decision of investing in the construction of a new modern and highly efficient lignite fired power generating unit of 600 MW capacity - Unit 6, which will replace the old units 1, 2, 3 and 4. TES concluded with Alstom an EPC Contract for the Power Island on 27th June 2009. However, the total investment costs according to Revision 2 of December 2008 were considered high and seemed to endanger the economic viability of the Project.

At the time of Revision 2 of the pricing during 2008 the international market for power plant equipment was overheated and it was difficult to receive bids from subcontractors for reasonable prices. The big price increase at that time (between target price and calculated price) was not fully reflected in the escalation indices. It was really an extreme market situation. All major contractors and subcontractors had full workshops and order books and had no engineering capacity. It was understood that under those circumstances no responses were received from subcontractors, and if they made an offer, the prices were far higher than normal.

After the meeting with Alstom on 20th August 2009 and their subsequent submission of new prices to TES, followed by negotiations of TES and Alstom, the situation has improved considerably to an overall project cost reduction of 221.3 million EUR, which reflects the current contractual pricing and, which is acceptable and reflects the present market situation.

 Summary

As part of the Consultant’s technical due diligence services for the Project the Site Visit was performed. A Kick-off Meeting with TES took place. A longer plant visit and several short visits to specific locations of the Šoštanj TPP was carried out. The Velenje Coal Mine could not be visited at that time, as the mine operation was closed down for the annual vacation and the scheduled repairs.

However, the Mine was inspected during a consecutive visit of the Mining Consultant and extensive discussions were held with the responsible Mine Management staff. The visit and discussions gave a good impression of the underground mining activities and the special Velenje technology.

The major part of the time during the mission was taken by document review as well as by meetings and discussions with the management of TES, in particular, with the Project Manager of the new Unit 6. In the following the results and/or comments are summarised.
9.1.1 Present Condition of the Existing Power Plant

The Šoštanj TPP with its four power generating units in operation, is old, except for Unit 5, and operates with rather low efficiencies. The old units are soon at the end of their life cycle and need to be closed down and replaced by 2014. However, the power plant is very well maintained and seems to be a reliable source of electricity production for the country.

9.1.2 Technical Evaluation of the New Unit 6

The design of the Power Island of Unit 6 is based on proven advanced technology with supercritical steam conditions. The selected size of 600 MW has been subject of various studies by TES, prior to the bidding process, and it has been selected as the most appropriate capacity considering the current existing unit sizes, their age and proposed decommissioning dates as well as the space requirements. The layout of the plant is tight and requires a good planning during the erection phase, as there is not much room for pre assembly in the vicinity of the new Unit 6. However, the arrangement fits well into the existing plant.

9.1.3 Comments to Plant Operation

The Consultant got the impression that the operation and maintenance (O&M) staff seems to be well trained and reliable. The power plant looks clean and well organised. The electricity production output of the Šoštanj TPP in 2008 was 3’850 GWh, which represents one third of Slovenia’s power generation. The power plant is an intermediate load plant (load following plant), which has to follow the fluctuating demand and, which requires high flexibility. This requirement has added some costs to Alstom’s EPC price of the Power Island of Unit 6.

Due to the rather low efficiency of the existing plant, TEŠ is burdened with high lignite consumption figures and consequently with high specific costs on power generation. This unfavourable condition will change with the new Unit 6.

9.1.4 Lignite Reserves in Coal Mine

The lignite reserves are sufficient for a trouble-free supply of the power plant until 2028. With the quantity of Measured Reserves available it should be possible to cover the coal demand until 2048. Up until the year 2054, (40 years life time of Unit 6) there may be a shortage of about 10 million tons. This could be covered by mining of the resources in the Sostanj field, which might be more difficult to exploit, or by blending of lignite from the Velenje Coal Mine with imported hard coal, which is foreseen anyhow.

9.1.5 Environmental Aspects Related to Unit 6

A comprehensive EIA study for the Unit 6 Project has been prepared and was submitted in September 2008 and the environmental permitting process is being carried out. It seems to be on track and quite advanced. However, it could not be verified, in the short time available for this task, whether all environmental requirements of the European Union and of the EBRD will be met. This refers specifically to the long term disposal of ash and gypsum, as well as to the discharge of the cooling tower blow down water.
9.2 Analysis of EPC Contract of the Power Island for Unit 6

In the following some findings of the analysis of the EPC Contract with Alstom are summarised and some conclusions of the Consultant are given. They are based on the situation found end of July 2009 during the site visit. During the negotiations between TES and Alstom in September 2009 some of the Consultant’s initial recommendations were discussed, negotiated and improvements achieved.

9.2.1 Price of Power Island

As stated previously in the report, the contractor was selected based on a public tendering procedure and submission of an “target price” based on a basic scope of work. Following this “target price” submission, the selected contractor carried out the basic engineering and submitted a price in 2008 based on project requirements and the final scope of work, which was discussed and agreed with TES in a series of meetings. The overall costs of this submitted price in 2008 of the new Unit 6 were initially considered high in particular, the price increase between the “target Price” communicated by Alstom in 2007 and the finally established price in 2008 as included in the Contract was difficult to understand. Specifically, this applies to the increase from 654 million EUR in 2007 (including erection) to 878 million EUR in 2008 (with estimated erection by TES). There are reasons explained in the report, such as:

− Price determination established in 2008, in a period of extremely overheated power market, where offers from suppliers and contractors were extremely hard to obtain.
− Alstom was selected at the time, when only Indicative Bids or “Target Price Bids” were available. Once selected as preferred Bidder, it was difficult to negotiate.

The Consultant proposed to discuss with Alstom a number of items from his preliminary recommendations including the pricing based on the facts that the overheated market situation no longer existed to the extent at that time and based on the market recession. The concerns of the Consultant and TES were communicated to Alstom an a meeting on 20th August 2009.

After the meeting and subsequent submission of new prices, followed by negotiations of TES and Alstom the situation has been improved as indicated in the cost section in more detail. The price of the Power Island, including the estimated erection price was reduced by 70 million EUR to 808 million EUR. If we take into account that the insurance fee of 12 million EUR is included in the erection costs, the price reduction for this main item is 82 million EUR. The overall price reduction was possible as stated above due to the insistence of TES and the Consultant and based on the change of market conditions.

The price is now considered reasonable within the current market conditions.

9.2.2 Contractual Conditions:

It is obvious that TES was not in a position to force the various contractual issues through, once they had selected Alstom as the preferred Bidder. With the indexing of all costs according to the escalation clauses (for each invoice), the risks have been shifted from Alstom to TES. However, this was common practice in the power plant industry, because of the extremely volatile market situation in 2008, which is still ongoing. This leaves an uncertainty about the final prices of the contract. It is recommended, that TES
review the estimated final cost of the Project periodically based on the forecasted indices in order to avoid the risk that the Project might run into a funding shortfall.

After the meeting with Alstom on 20th August 2009, the Escalation Clause could not be removed. Alstom had explained that, if required this could be done, but the estimated escalation would have to be factored into the price. As this would contain an EPC risk margin, this is not desirable.

The 35% adder to the erection contract price and other items of the Power Island to be purchased by TES could be reduced to 25%, which can be accepted. This was achieved during the negotiations of TES with Alstom.

9.2.3 Time Schedule

The original time schedule of the new Unit 6 of 63 months from NTP to PAC was considered too long. It came from a period, when the supply market was overheated as stated above.

The Consultant had proposed to reduce the implementation time of the Project, mainly to save interest costs during construction. In the negotiations between TES and Alstom, the time schedule was reduced from 63 to finally 60 months. Alstom explained that the execution period include initial 6 – 7 months for permitting (Construction permit). In this time they have not full access to the site.

9.3 Risk Assessment and Mitigation

A project of such magnitude - implementing the new Unit 6 at the Šoštanj TPP - has, of course, certain risks, which need to be taken into consideration. These risks are common for these kinds of large investment projects and are to be assessed and mitigated. They can be of technical, environmental, economical, legal or political nature and they will be less, if the Project has been well developed and prepared before the actual realisation starts. This seems to be the case for this Project.

The technical risk, with regard to conceptual design, to the main plant components and systems as well as to its operational functions, is considered low. Unit 6 is of advanced technology, but of proven design. The main suppliers have a good reference record and should be capable to provide high quality equipment and services.

For the environmental, economical and legal risks we refer to the specific Chapters and Annexes were some information for risk assessment is given. However, we consider these risks bearable, without analysing them further. For the political risk there are more competent experts at the Bank to give an opinion.

9.3.1 Delays and Cost Overruns

There is in every such huge project, like Unit 6 implementation, the risk that delays and cost overruns occur. We consider the risk of delay rather low, as the time schedule still gives 60 months until completion, which is a quite comfortable time period and should be sufficient for the construction of Unit 6. Political risks may delay the Project and TES should convince the political authorities to avoid this as every delay will add to the costs and endanger the economic success of the Project.
The risk of cost overruns is considered higher, as the EPC Contract with Alstom leaves some uncertainties. Many of the prices are indexed, but the main effect of the indexation occurs in the first 18 months after NTP. Several packages, such as erection, civil works, etc. are not yet procured and their costs are only estimated at present. However, with a strict cost control and claim management this risk should be kept under control. It is vital that the Project is run by a dedicated project organisation with a balanced power and responsibility distribution.

9.3.2 Project Team for Implementation

TES was advised to set up a strong project organisation in general to be a counterpart to Alstom. There are various key issues to be considered, such as:

- Overall scheduling of the Project (integration and continuous tracking of all sub-projects into the overall schedule)
- Coordination between the main EPC contractors and the civil contractor as well as the erection contractor
- Overall interface engineering and interface management
- Variation orders and claim management
- Checking and approving contractors’ invoices to be in line with progress or with defined milestones in accordance with the payment schedule
- Overall cost control and updating of applicable indices for the Alstom EPC contract
- Document management of all drawings to ensure that on the erection contractors and the civil contractors are working with the latest drawings to avoid later claims.

Of course, there are many other tasks to be considered, like reporting and progress monitoring, safety aspects on site, permits and licences, environmental issues, etc. These tasks have to be defined and clearly assigned to competent members of the Project Team, which take full responsibility.

The qualification of the Project Team has great influence on a good and trouble free implementation of the Project. Professional competence, experience, motivation and sufficient resources are important requirements for the success of the Project. A good Project Team is the best mitigation measure against many problems and risks that may happen.
Annexes