Study for Decommissioning of Kosovo–A Power Plant

Request No. 2009/216283 – Version 1
under FWC EUROPEAID/119860/C/SV/MULTI, Lot 4

Final Report

Report submitted on 15th March 2010
Executive Summary

The main objective of this study is to advise the EC Liaison Office (ECLO) and to assist the Ministry of Energy and Mining (MEM) and the key stakeholders to prepare a decommissioning plan for the overaged, environmentally polluting and inefficient Thermal Power Plant Kosovo-A (TPP Kosovo-A) in terms of activities, time and cost.

The Consultant made three site visits during this assignment, carried out visual inspections, assessed technical and operational status and interviewed key stakeholders.

Review of the existing situation

TPP Kosovo-A has five generating units constructed during the 1960s and the 1970s. During the Consultant’s site visits in 2009 only units A3 and A5 were in operation. Unit A4 had been out of operation since April 2009 due to transformer problems and units A1 and A2 have not been in operation for several years and will continue to be non-operational. Considering the techno–economical status of the units and the related repairs that have recently been performed, units A3, A4 and A5 could continue to operate for a very limited period but at a high maintenance cost.

Availability of units A3, A4 and A5 is rather low and lies between 60 – 70 % for the best performing unit.

Today units A3, A4 and A5 operate down-rated from the 200/210 MW design capacity to 100 – 140 MW and with efficiencies far below design values. The full load efficiency of these units is very poor and estimated to be about 30 – 32 %. The overaged equipment allows only part load operation\(^1\), so that the efficiency is even lower and probably about 25 – 28 %. This compares to 41 – 43 % efficiency for modern, state-of-the-art lignite–fired units.

The TPP Kosovo-A units burn lignite with a lower calorific value and a higher content of non–combustible matters than what they were originally designed for. Under these conditions stable operation is difficult and large amounts of fuel oil are required for start-up and even during operation. All together, this results in a large, inefficient consumption of scarce natural resources with a bad environmental performance. TPP Kosovo-A is the largest polluter in Kosovo and emits sulphur, nitrogen, carbon oxides and large amounts of fly ash.

Generally speaking, all stack emissions and especially dust from TPP Kosovo-A are several times above the European Large Combustion Plant Directive. Some settlements close to the ash disposal site suffer from wind borne ash dust if the ashes are not sprinkled with water during dry weather. The content of particles in the air is far above internationally accepted limits and certainly gives rise to a proven increase of infections and illnesses in the settlements. The ashes contain salts and trace metals, which are released if water infiltrates the disposal site.

The Consultant noted that coal supply will become a bottleneck in the next few years. Due to better efficiency, reliability and availability, the TPP Kosovo–B will be supplied with coal on a priority basis leaving what ever amount of coal remains for TPP Kosovo–A. This will affect TPP Kosovo–A’s production.

\(^1\) Part load operation at reduced steam pressure has been introduced as a safety measure after the emergency repairs in 2001 – 2003 in order not to overload the steam pressure system. Efficiency is reduced during part load operation subject to the specific design features.
The TPP Kosovo–A units have essentially exceeded their lifetime and large investments would be needed for rehabilitation to bring them close to the required environmental standards. Given the limited operation time still available, this is simply not economically feasible.

While the management and staff of TPP Kosovo–A are doing an outstanding job in keeping the plant in operation, it must be noted that working at TPP Kosovo–A is actually quite dangerous. There are high health and safety risks for the operators and for the maintenance workers due to breakdown of plant systems and structures, neglected maintenance and poor housekeeping.

The generation capacity of the new TPP Kosovo–C is planned to substitute for the lost output from TPP Kosovo–A from 2015 and also satisfy the growing future electricity demand.

Today the TPP Kosovo–A units feed about 1,450 – 1,600 GWh into the Kosovo transmission grid. This still covers about 25 % of the country’s total electricity demand. The TPP Kosovo–A units consume around 2.5 million tonnes of lignite annually when running according to its normal generation scheme. The rest of the power required for the country comes from TPP Kosovo–B, the Ujman/Gazivode hydro plant and growing imports from the regional SEE market.

TPP Kosovo–A has a valid operation licence until 2011 and it is necessary to apply for an extension of its license in 2010 if the TPP Kosovo–A units are to continue operating until 2015.

Decommissioning strategy

The closure of TPP Kosovo–A is required to satisfy the Energy Community Treaty. By participating in the Energy Community of SEE, Kosovo has to implement Acquis on Environment as defined in the Treaty. This includes implementation of the IPPC and LCP Directives which currently are being reformulated in a Directive on Industrial Emissions.

In 2009 the Prime Minister declared the Kosovo Government’s decision to close TPP Kosovo–A by 2014/15. This political decision is reflected in MEM’s Energy Strategy.

Based on stakeholders’ communication, the Consultant suggests the following dates for unit shut-down:

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2 Private development of the new Kosovo C power plant envisages a first 500 MW unit to be operational by 2015, but the schedule is not confirmed. Currently, investor selection is expected by the end of 2010. Only by then reliable data on the schedule will be available.

3 Energy Community Treaty was signed in October 2005 and ratified in July 2006.


6 http://ec.europa.eu/environment/air/pollutants/stationary/ippc/proposal.htm


8 Minutes of Meeting dated 30.10.2009 between ECLO and Consultant of 13.10.2009
Table 1-1 – Shutting-down of TPP Kosovo-A units

<table>
<thead>
<tr>
<th>TPP Kosovo-A, unit</th>
<th>Shutting-down at the latest</th>
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<tbody>
<tr>
<td>A-1</td>
<td>Before end of 2012</td>
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<tr>
<td>A-2</td>
<td>Before end of 2012</td>
</tr>
<tr>
<td>A-3</td>
<td>During year 2013</td>
</tr>
<tr>
<td>A-4</td>
<td>Before end of 2014</td>
</tr>
<tr>
<td>A-5</td>
<td>Before end of 2015</td>
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</tbody>
</table>

Closure of TPP Kosovo-A would have considerable overall benefits. The negative impact on the workforce and on the external service providers would also be substantial and needs to be managed as suggested below.

From a pure technical point of view, the least cost solution would be to wait with the decommissioning and dismantling work until the last unit at TPP Kosovo-A has been shut-down. However, the Consultant suggests a different decommissioning strategy in order to alleviate social impacts. This strategy is based on making use of parts of the TPP Kosovo-A workforce to be involved in the unit-by-unit planning and implementation of the decommissioning and dismantling.

These activities need to be started in 2010 in order to achieve a cleared site by 2020.

Figure 1-1 – Time line of major decommissioning activities

For further details see the Strategic Time Schedule in Annex 2.

The closure process itself consists of different political and engineering phases. The first phase will comprise a strategic preparation phase, followed by a political decision and an engineering planning phase defining steps of decommissioning and demolition work by an agreed time schedule. The planning would take into account the remaining share of generation capacity at TPP Kosovo-A to ensure a continuous safe and balanced power supply for the country.

The Ministry of Environment and Spatial Planning (MESP) is responsible for providing a license for decommissioning to the TPP Kosovo-A operator KEK.
The demolition process itself will start with a detailed planning to obtain the necessary permissions from the state regulator ERO and the identification and approval of the necessary budget. The decommissioning shall be done by KEK with support from external consultants.

It has to be clarified between the stakeholders how the financing, planning, tendering and contract award procedures for the demolition services are to be carried out in the most efficient way and how alternatives for a balanced country-wide power supply can be established in advance.

Preparatory measures like cleaning up the entire power plant site (clearing the scrap yards, the waste heap, and ash and coal stockpiles) ought to begin as early as by mid 2010. At the same time, technical safety measures can be planned and carried out on Units A1 and A2 (early 2011). This work mainly comprises the removal of hazardous materials from facilities already shut down and guarding these facilities from unauthorised access.

**Environmental clean-up plan and implementation plan**

The Consultant identified several areas at the TPP Kosovo–A site which are the most likely to contain asbestos, mineral fibres and mineral oil hydrocarbons and which require special attention during dismantling and special treatment and disposal.

The decommissioning and dismantling plan is divided into the following phases:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
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<tbody>
<tr>
<td>Phase 1</td>
<td>Preparatory measures</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Engineering of the decommissioning and disaggregation of units and Balance of Plant(^9)</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Preliminary and in–depth exploration of the power plant site</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Development of the mass balance(^10) and disposal concept(s)</td>
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<td>Phase 5</td>
<td>Development of a decommissioning safeguard design</td>
</tr>
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<td>Phase 6</td>
<td>Compilation of licensing and tender documents for dismantling</td>
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<td>Phase 7</td>
<td>Cost and time schedule planning</td>
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<tr>
<td>Phase 8</td>
<td>Contract award planning</td>
</tr>
<tr>
<td>Phase 9</td>
<td>Safeguarding measures</td>
</tr>
<tr>
<td>Phase 10</td>
<td>Implementation of dismantling, disposal, recycling and disposal works</td>
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</tbody>
</table>

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\(^9\) Balance of Plant means auxiliary and ancillary plants which are common for the power station and not dedicated to single units, i.e. coal handling plants.

\(^10\) Mass balance means here the quantities of materials to be dismantled.
The Consultant has prepared a list of facilities and assigned various lots of dismantling using an internal selection system by time and activity.

**Time Schedule**

A total period of about 10 years starting from mid 2010 is estimated to be needed for all the technical measures for decommissioning and dismantling of TPP Kosovo–A, subdivided as follows:

**Table 1–2– Time requirements of activities for decommissioning and dismantling**

<table>
<thead>
<tr>
<th>Activities (partly overlapping)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site clearance and demolition of abandoned facilities</td>
<td>approx. 1.5 years</td>
</tr>
<tr>
<td>Implementation of safety measures</td>
<td>approx. 1.5 years</td>
</tr>
<tr>
<td>Engineering planning, regularly updated</td>
<td>approx. 5.0 years</td>
</tr>
<tr>
<td>Implementation of demolition measures</td>
<td>approx. 7.0 years</td>
</tr>
</tbody>
</table>

**Cost estimate of decommissioning and dismantling of TPP Kosovo–A**

The total cost of decommissioning and dismantling for TPP Kosovo–A in order to reach a brown-field level of decontamination has been estimated at roughly €28,400,000.

The costs of dismantling and demolition work at the sites, the preparation of the demolished materials, their transportation and disposal are included in the above total cost.

Safeguarding and revitalisation costs of contaminated soil and taxes are not considered.

**Cost estimate to minimise negative socio–economic impacts from closure of TPP Kosovo–A**

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Executive Summary – Final Decommissioning Report TPP KOSOVO–A
The related study\(^{11}\) on socio-economic impacts could not correctly establish costs, but made different assumptions and developed four cases for possible management measures to minimise socio-economic impacts. The estimated costs range from €1.6 million to €4.65 million mainly consisting of severance payments, outplacement cost and early retirement compensation. These costs are preliminary, rough estimates. They can be significantly higher but are small compared to the overall costs of decommissioning and electricity imports.

### Cost estimate of dismantling of Coal-drying, Chemical Separation and Gasification Plant

Redundant infrastructure includes not only TPP Kosovo-A but also the 12 ha site of the Coal Drying and Industrial Combined Heat and Power (CHP) plant as well as the 50 ha site of the Chemical Separation and Gasification Plant owned by KEK.

These sites have not been included in the Consultant’s assignment. However, an IDA funded study\(^{12}\) has investigated the gasification site and estimated the total costs (excluding taxes) for the disposal of the wastes from the gasification plant at €3.18 million.

This cost is only related to the disposal of chemical substances contained in tanks, containers and piping systems. The dismantling of the gasification plant, site clearance and environmental clean up as well as the closure of coal drying and industrial CHP require further investigation to arrive at more realistic cost estimates.

### Social Impacts

The Eptisa study\(^{13}\) initially envisaged that over 700 KEK employees would be affected by the closure of TPP Kosovo–A. Recent work has shown that the TPP Kosovo–A workforce cannot easily be disaggregated from that of TPP Kosovo–B and that to be effective any proposal to mitigate socio-economic impact should deal with the labour force at both sites. Discussions with KEK management have indicated that the existing workforce has many of the skills needed to undertake much of the decommissioning and dismantling works.

The Consultant identified employment opportunities during the staged decommissioning and dismantling of TPP Kosovo–A as follows:

- **Decommissioning engineering:** 30 engineers for 3.5 years;
- **Preparatory & cleaning works:** 100 unskilled workers for 1.5 years;
- **Safety measures:** 25 maintenance workers + 50 unskilled workers for 1.5 years;

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\(^{11}\) Kosovo–A Power Plant Decommissioning Study – Workforce Redevelopment to Minimise Negative Socio–Economic Impact, Eptisa & Corporate Solutions, January 2010

\(^{12}\) Clean Up of a Gasification Plant Site, Final Report, Chiresa AG and Dr. Heinrich Jäckli AG, August 2009

\(^{13}\) Workforce Redevelopment to Minimise Negative Socio–Economic Impact by M/s Eptisa & Corporate Solutions, Final Report as of 29.01.2010
Separation works: 50 skilled workers + 50 unskilled workers for 2.5 years;

Demolition works: 50 skilled workers + 50 unskilled workers for 7 years.

The above numbers do not take account of potential work associated with the decommissioning and rehabilitation of the Coal Drying and the Gasification Plant sites or jobs which might be created by bringing the entire site back into productive use through a regeneration process.

Electricity import costs under different supply scenarios

The supply scenarios which have been developed are based on providing a balanced power system operation\(^\text{14}\). These scenarios have taken into account compensating expected shortfalls caused by the closure of TPP Kosovo-A and the delayed commissioning of the planned new TPP Kosovo-C by corresponding imports from the Balkan region.

The analysis of the Kosovo system shows a growing supply/demand gap until 2015 which will be compensated for by imported power.

The biggest remaining risk for the safe, cost-efficient operation of the Kosovo power system during the decommissioning of TPP Kosovo-A is the unclear timing for the planning and construction of the new TPP Kosovo-C. It is expected to be completed by 2015 but realistically it is unlikely to be finished before the end of 2016.

Three scenarios with the start of operation of TPP Kosovo-C in 2015, 2016 and 2017 have been considered. These scenarios have taken into account the staged closure of TPP Kosovo-A and an annual demand growth at rates between 2.5% and 4.5%. All three scenarios rest on the assumption that units A4 and A5 at TPP Kosovo-A can operate until 2014/15.

Assuming that TPP Kosovo-C will start generation as planned in 2015 (Scenario A), the decommissioning of Units A4 and A5 (in 2014/15) will have no implications on the overall power balance, i.e. no electricity imports will be required in 2015 and beyond.

The annual costs of Scenario A are shown in Table 1–3 below. These costs include the main operating costs of TPP Kosovo-A until shut down, the cost of TPP Kosovo-A decommissioning/dismantling as well as related staff costs. The costs of electricity imports at a rate of 75 €/MWh to make up for the missing generation from TPP Kosovo-A in the country’s power balance are also included.

<table>
<thead>
<tr>
<th>Table 1–3 – Annual Cost breakdown of Scenario A in million €</th>
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</thead>
<tbody>
<tr>
<td>Personnel</td>
</tr>
<tr>
<td>Fuel</td>
</tr>
<tr>
<td>Maintenance</td>
</tr>
<tr>
<td>Staff Training</td>
</tr>
<tr>
<td>Staff Management Measures</td>
</tr>
<tr>
<td>Dismantling/decontaminat.</td>
</tr>
<tr>
<td>Power Imports at 75 €/MWh</td>
</tr>
<tr>
<td>Subtotal cost</td>
</tr>
</tbody>
</table>

\(^\text{14}\) Note: At this point there is no need to introduce different demand growths.
Assuming that the start of generation of TPP Kosovo–C will be in 2016 (Scenario B), the decommissioning of Units A4 and A5 will have implications on the overall power balance.

The missing production from the decommissioned unit A3 of TPP Kosovo–A in the year 2014 of 500 GWh (priced at €37.5 million) has to be compensated for by power imports. This is the same as the Scenario A case.

Under Scenario B 950 GWh need to be imported in year 2015 because of the closure of units A3 and A4 at TPP Kosovo–A and the reduced generation of TPP Kosovo–B. TPP Kosovo–B is considered with 800 GWh less in the years 2016 and 2017 due to rehabilitation of both units. In 2016 TPP Kosovo–C starts operation with 1,750 GWh which is more than the whole production of the closed TPP Kosovo–A (1,450 GWh). The resulting power deficit in 2016 of 984 GWh has been fully allocated to make up for missing output from TPP Kosovo–A. That is why power imports valued at €71.3 million (950 GWh) in 2015 and €73.8 million (984 GWh) in 2016 are required as shown in Table 1–4 below.

The necessity of two additional years of power imports caused by only a one year delay in the start of operation of TPP Kosovo–C is mainly based on

(i) the reduced production of TPP Kosovo–B in 2016 and 2017, and

(ii) the methodology to assume the same TPP Kosovo–C production run–up as for Scenario A. According to the MEM Energy Strategy paper, the new TPP Kosovo–C is planned with

- 1,750 GWh in the first year of operation (equivalent to one 500 MW unit operating for about 5 months at full load),
- 5,500 GWh (equivalent to two 500 MW units operating for about 7 months at full load), in the second year of operation and
- the full 7,500 GWh (equivalent to two 500 MW units operating for about 11 months at full load) in the third year of operation.

Annual cost for Scenario B is shown in Table 1–4.

| Table 1–4 – Annual Cost breakdown of Scenario B in million € |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Personnel       | 5.6     | 5.6     | 5.6     | 5.6     | 5.3     | 5.0     | 38.3    |         |         |         |         |
| Fuel            | 21.0    | 21.0    | 23.4    | 23.4    | 15.3    | 8.1     | 133.3   |         |         |         |         |
| Maintenance     | 36.7    | 37.8    | 38.9    | 40.1    | 27.0    | 14.7    | 230.7   |         |         |         |         |
| Staff Training  | 1.0     | 1.0     |         |         |         |         |         |         |         |         |         |
| Staff Management Measures | 0.4 | 1.0 | 1.0 | 1.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 | 28.4 |
| Dismantling/decontaminat. | 0.4 | 1.0 | 1.0 | 2.0 | 3.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 | 28.4 |
| Subtotal cost   | 63.7    | 66.4    | 69.9    | 72.1    | 50.7    | 34.7    | 40.4    | 4.0    | 4.0    | 3.0    | 3.0    |
| Power Imports at 75 €/MWh | 37.5 | 71.3 | 73.8 | 0.0 | 0.0 | 0.0 | 0.0 | 182.6 |         |         |         |
| Total cost      | 63.7    | 66.4    | 69.9    | 72.1    | 88.2    | 106.0   | 77.8    | 4.0    | 4.0    | 3.0    | 3.0    |

Assuming the start of generation of TPP Kosovo–C in 2017 (Scenario C), the total imports in 2016 are projected to amount to 2,734 GWh of which 1,450 GWh are caused by the decommissioning of Units A3, A4 and A5 at TPP Kosovo–A. Slightly less imports will also be necessary in 2017.
Power imports under Scenario C in 2016 are inevitable, since TPP Kosovo–A is closed, TPP Kosovo–B is planned with reduced power generation and TPP Kosovo–C is not yet operational.

Annual cost for Scenario C is shown in Table 1–5.

<table>
<thead>
<tr>
<th>Year</th>
<th>Personnel</th>
<th>Fuel</th>
<th>Maintenance</th>
<th>Staff Training</th>
<th>Staff Management Measures</th>
<th>Dismantling/decontaminat.</th>
<th>Subtotal Cost</th>
<th>Power Imports at 75 €/MWh</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>5.6</td>
<td>21.0</td>
<td>36.7</td>
<td>3.0</td>
<td>4.0</td>
<td>0.4</td>
<td>63.7</td>
<td>37.5</td>
<td>63.7</td>
</tr>
<tr>
<td>2011</td>
<td>5.6</td>
<td>21.0</td>
<td>37.8</td>
<td>4.0</td>
<td>4.0</td>
<td>1.0</td>
<td>66.4</td>
<td>71.3</td>
<td>66.4</td>
</tr>
<tr>
<td>2012</td>
<td>5.6</td>
<td>23.4</td>
<td>23.4</td>
<td>4.0</td>
<td>4.0</td>
<td>1.0</td>
<td>69.9</td>
<td>108.8</td>
<td>69.9</td>
</tr>
<tr>
<td>2013</td>
<td>5.5</td>
<td>23.4</td>
<td>23.4</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
<td>72.1</td>
<td>83.8</td>
<td>72.1</td>
</tr>
<tr>
<td>2014</td>
<td>5.3</td>
<td>15.3</td>
<td>40.1</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
<td>88.2</td>
<td>0.0</td>
<td>88.2</td>
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<tr>
<td>2015</td>
<td>5.0</td>
<td>8.1</td>
<td>14.7</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>106.0</td>
<td>0.0</td>
<td>106.0</td>
</tr>
<tr>
<td>2016</td>
<td>3.8</td>
<td>8.1</td>
<td>14.7</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>112.8</td>
<td>0.0</td>
<td>112.8</td>
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<td>2017</td>
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<td>4.0</td>
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<td>2018</td>
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<td>4.0</td>
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<td>2019</td>
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<td>3.0</td>
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<td>2020</td>
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<td>738.9</td>
</tr>
</tbody>
</table>

The costs presented above do not consider the financial implications of a severe accident or a major failure affecting key equipment of TPP Kosovo–A during its remaining operation period. Such a collapse can cause single units or even the complete TPP Kosovo–A to be out of operation for a rather long time, perhaps even requiring a year for repair. Necessary emergency power imports at a high price of around 120 €/MWh could cost up to €174 million for 1,450 GWh corresponding to the market situation.

The diagram below shows the total cost distribution of each scenario over time.
The cost in the years 2010 – 2014 are the same for all scenarios. However, a delayed commissioning of TPP Kosovo-C will increase the total cost because of necessary imports to make up for the missing generation from both TPP Kosovo-C and TPP Kosovo-A.

Development of Kosovo’s Power Imports considering Scenarios A – C and different Demand Growths

The Consultant has estimated the development of the total power imports regardless of if they are caused by TPP Kosovo–A closure or not.

The diagram in Figure 1–4 shows the development of the country’s power imports under consideration of different demand growth rates of 2.5 % (low), 3.8 % (medium) and 4.5 % (high) and under consideration of delayed commissioning of TPP Kosovo–C as per Scenarios A – C.

The calculated power imports are priced with a mean unit price of 75 €/MWh for scheduled imports as reported by KOSTT for the recent past.

The largest power imports will be required in years 2015 – 2017.

It becomes obvious that it is not the closure of TPP Kosovo–A, but the earliest possible operation of the new TPP Kosovo–C that is the main challenge in terms of power supply security for Kosovo and the stakeholders.

![Figure 1–4 Cost of Power Imports as per Scenarios A – C and growth rates of 2.5 %, 3.8 % and 4.5 %](image)

Benefits and economic justification of shutting down and dismantling TPP Kosovo–A

Settlements in the vicinity of TPP Kosovo–A, including the capital Pristina, would benefit substantially from the closure of TPP Kosovo–A by significantly improved air quality and
reduced emissions in water bodies and soil. The Consultant has estimated the cost\(^{15}\) of environmentally induced health impacts at about €65 – 70 million annually\(^{16}\).

Dismantling and site clearance of TPP Kosovo–A is the pre-condition to enable further business activities and industrial land use at the site.

Closure and safeguarding of TPP Kosovo–A will also eliminate the risk of injury and fatal accidents to the power station staff during operation.

Decommissioning of TPP Kosovo–A will ease the fuel supply situation so that the available coal can be fully used in the more efficient TPP Kosovo–B. TPP Kosovo–A is using relatively large amounts of diesel oil of which imports can be stopped upon shut–down of the plant.

Until shutdown, TPP Kosovo–A remains a heavy polluter of air, water and soil. Therefore, it is fair to factor environmentally induced damage costs on health and economy into the operation of TPP Kosovo–A using World Bank / OECD methodology.

The Consultant compared the costs of the Status Quo (continued operation of TPP Kosovo–A at maximum generation) and scenarios A, B and C.

**It becomes apparent that even if TPP Kosovo–A would operate until 2017 under the Status Quo to avoid / reduce power imports, the total costs of the Status Quo scenario are 9 % higher than the costs for a scheduled shut down of TPP Kosovo–A including the cost of power Imports (Case C). This clearly justifies the scheduled closure of TPP Kosovo–A by 2015. The sum of annual costs between the years 2010 – 2017 has been considered in the following chart.**

![Graph](image)

**Figure 1–5 Cost of continued operation of TPP Kosovo–A vs. its closure in 2015**

\(^{15}\) Based on Environmental Impact Assessment of Kosovo power plants by M/s. Carl Bro in 2003.

\(^{16}\) See Section 9.2 for explanation
Conclusions and Recommendations

The units of Kosovo-A power plant have exceeded their lifetime and large investments would be needed to bring them close to the required environmental standards. This is economically simply not feasible.

The most favourable economical solution is an orderly decommissioning of TPP Kosovo-A unit by unit with reduced generation until 2015 and the earliest operation of the new TPP Kosovo-C.

Since a reliable date for commercial operation of TPP Kosovo-C will only be available after selection of the Independent Power Producer (currently envisaged by end of 2010), it is recommended to adapt the rehabilitation of TPP Kosovo-B (which is planned between 2016 – 2017) suitably.

It is recommended to draft an energy action plan to identify and implement all possible energy saving measures, especially at public, residential and industrial customers in order to limit the energy demand.

The planning process for decommissioning and dismantling of TPP Kosovo-A shall start by mid-2010 at the latest to support an well-ordered decommissioning without endangering those units which are to be operated for a limited period till 2015.

Further studies of the gasification site are recommended to arrive at more realistic cost estimates for environmental clean-up, dismantling of equipment and site clearance.

Because of the technical connections between the coal drying plant, the industrial CHP plant, the gasification plant and TPP Kosovo-A, it is necessary to consider the decommissioning of all these plants together. The overall dismantling planning of all these sites will certainly provide cost benefits compared to a sitewise dismantling process. In addition, if the whole TPP Kosovo-A and the gasification area is cleared and cleaned-up, this will make it more attractive for new industries and traders to settle there.
### CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Contractual background</td>
<td>20</td>
</tr>
<tr>
<td>2 Introduction</td>
<td>22</td>
</tr>
<tr>
<td>2.1 Brief characterisation of Kosovo–A TPP</td>
<td>22</td>
</tr>
<tr>
<td>3 Overview of the existing situation</td>
<td>25</td>
</tr>
<tr>
<td>3.1 General description of the buildings</td>
<td>25</td>
</tr>
<tr>
<td>3.2 Air quality and solid residues</td>
<td>31</td>
</tr>
<tr>
<td>3.3 Treatment and discharge of technological wastewater</td>
<td>33</td>
</tr>
<tr>
<td>3.4 Treatment of wastewater from cleaning processes and leaks in the power plant</td>
<td>33</td>
</tr>
<tr>
<td>3.5 Rainwater treatment</td>
<td>33</td>
</tr>
<tr>
<td>3.6 Substances harmful to water</td>
<td>34</td>
</tr>
<tr>
<td>3.7 Fuel oil/diesel storage and transport</td>
<td>34</td>
</tr>
<tr>
<td>3.8 Oil–filled electrical and hydraulic equipment</td>
<td>35</td>
</tr>
<tr>
<td>3.9 Waste management</td>
<td>36</td>
</tr>
<tr>
<td>3.10 Asbestos</td>
<td>38</td>
</tr>
<tr>
<td>3.11 Mineral fibres</td>
<td>40</td>
</tr>
<tr>
<td>3.12 Areas and materials contaminated by mineral oil hydrocarbons</td>
<td>40</td>
</tr>
<tr>
<td>3.13 Safety</td>
<td>41</td>
</tr>
<tr>
<td>4 Decommissioning strategy</td>
<td>45</td>
</tr>
<tr>
<td>4.1 Decommissioning/dismantling permit procedure</td>
<td>46</td>
</tr>
<tr>
<td>4.2 Description of the planning steps</td>
<td>48</td>
</tr>
<tr>
<td>4.3 Safety measures</td>
<td>50</td>
</tr>
<tr>
<td>4.4 Requirements for decommissioning/dismantling</td>
<td>50</td>
</tr>
<tr>
<td>4.5 Dismantling process</td>
<td>51</td>
</tr>
<tr>
<td>5 Assignment of individual facilities to dismantling lots</td>
<td>54</td>
</tr>
<tr>
<td>6 Approximate time schedule for the decommissioning process</td>
<td>55</td>
</tr>
<tr>
<td>7 Rough cost estimation for the dismantling works</td>
<td>56</td>
</tr>
<tr>
<td>8 Coal–drying structures including the industrial power plant and gasification plant</td>
<td>58</td>
</tr>
</tbody>
</table>
8.1 Coal–drying structures including the industrial power plant 58
8.2 Coal gasification plant 58
8.3 Recommendation 59
9 Environmental and health impacts 60
9.1 Environmental standards 60
9.2 Environmental health impact from emissions and economic losses 60
10 Social impacts 62
10.1 Current position 62
10.2 Workforce age profile 62
10.3 Work Force Development Plan 62
10.4 Financial Implications of Redundancy and Early Retirement Programmes 63
10.5 The Potential to create new employment opportunities 63
10.6 Conclusion and next steps 64
11 Supply scenarios considered 65
11.1 Country framework 65
11.2 Background 66
11.3 Demand and supply forecast 68
11.4 Supply Scenarios Considering 2.5 % up to 4.5 % Demand Growth 70
11.5 Development of Power Imports considering Scenarios A – C and different Demand Growths 73
12 Comparative cost analysis for operational alternatives 77
12.1 Cost input data 77
12.2 Annual Cost breakdown of Scenarios A – C 78
12.3 Cost for Operation of TPP Kosovo–A till shut–down and of related imports 79
12.4 Economical Justification for closure of TPP Kosovo–A 80
13 Conclusion and recommendation 84
Annexes to this report 12
## Annexes to this report

<table>
<thead>
<tr>
<th>Annex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Topographic map of the surroundings of Prishtina</td>
</tr>
<tr>
<td>2</td>
<td>Decommissioning and dismantling strategy for TPP Kosovo–A</td>
</tr>
<tr>
<td>3</td>
<td>List of buildings and objects</td>
</tr>
<tr>
<td>4</td>
<td>Assignment of dismantling lots</td>
</tr>
<tr>
<td>5</td>
<td>Data sheets of all buildings at the power plant</td>
</tr>
<tr>
<td>6</td>
<td>Site map showing the dismantling lots</td>
</tr>
<tr>
<td>7</td>
<td>Site map of expected hazardous decontamination area – asbestos and mineral fibres</td>
</tr>
<tr>
<td>8</td>
<td>Site map of expected hazardous area of decontamination – mineral oil hydrocarbons</td>
</tr>
<tr>
<td>9</td>
<td>Study on social impacts by M/s Eptisa</td>
</tr>
<tr>
<td>10</td>
<td>Site map showing borders of TPP Kosovo–A</td>
</tr>
</tbody>
</table>
FIGURES AND TABLES USED IN THE REPORT

Table 1-1 – Shutting-down of TPP Kosovo-A units .................................................................4
Table 1-2- Time requirements of activities for decommissioning and dismantling ........6
Table 1-3 – Annual Cost breakdown of Scenario A in million € ........................................8
Table 1-4 – Annual Cost breakdown of Scenario B in million € ........................................9
Table 1-5 – Annual Cost breakdown of Scenario C in million € .........................................10
Table 2-1 – Emission limit values according to LCPD compared to current emission ...32
Table 3-1 – Overview of the existing operational status of the 5 units at TPP Kosovo-A ...23
Table 3-2 – Decommissioning dates of TPP Kosovo-A .......................................................45
Table 4-2 – Licensing status according to ERO .................................................................47
Table 6-1 – Time required for activities .............................................................................55
Table 7-1 – Cost estimates of dismantling .....................................................................56
Table 7-2 – Specific cost benchmarks used in the study report .....................................57
Table 10-1 – Current over-manning estimates .................................................................62
Table 10-2 – Financial Implications of Redundancy and Early Retirement ..............63
Table 11-1 – KEK electricity generation/demand forecast [GWh] based on existing profile 69
Table 11-2 – Total Cost of Power Imports in million € for three demand growth rates under Scenarios A – C .................................................................76
Table 12-1 – Input Cost breakdown per annum ...............................................................77
Table 12-2 – Annual Cost breakdown of Scenarios A in million € ................................78
Table 12-3 – Annual Cost breakdown of Scenarios B in million € ................................78
Table 12-4 – Annual Cost breakdown of Scenarios C in million € ................................78
Table 12-5 – Comparison of annual total cost of Scenarios A – C in million € .........79

Figure 1-1 – Time line of major decommissioning activities ............................................4
Figure 1-2– Time sequence of the planning phases .......................................................6
Figure 1-3 – Cost distribution over time of Scenario A – C costs ................................10
Figure 1-4 Cost of Power Imports as per Scenarios A – C and growth rates of 2.5 %, 3.8 % and 4.5 % .................................................................11
Figure 1-5 Cost of continued operation of TPP Kosovo-A vs. its closure in 2015 .......12
Figure 3-1 – Turbine house for the units A1 to 5 ............................................................25
Figure 3-2 – Stacks of units 1 to 5 ...............................................................................26
Figure 3-3 – Ventilator cooling tower for unit 2 .............................................................26
Figure 3-4 – Coal conveyor bridge with transfer station .............................................27
Figure 3-5 – Water conditioning building ....................................................................28
Figure 3-6 – Ash pipeline bridge leading to the ash disposal .....................................28
Figure 3-7 – Coal supply substation ............................................................................29
Figure 3-8 – Concrete corrosion at the cooling tower stairs ....................................30
Figure 3-9 – Pipeline support at the cooling water pipeline .......................................30
Figure 3-10 – Roof at the entrance to the office and workshop building ..................31
Figure 3-11 – Air emission – stacks 3 to 5, situation in Nov. 2009 .........................33
Figure 3-12 – Diesel tanks .......................................................................................35
Figure 3-13 – Transformer – out of function ...............................................................36
Figure 3-14 – Waste congregation ............................................................................37
Figure 3-15 – Waste at the scrap-yard ....................................................................37
Figure 3-16 – Asbestos cement cladding on the coal conveyor bridges ..................39
Figure 3-17 – Asbestos cardboard ..........................................................................39
Figure 3-18 – Mineral wool on the flue gas ducts ......................................................40
Figure 3-19 – Filling station for the oil pumping house ..............................................41
Figure 3-20 – Missing banister in the cooling water pumping house ......................42
Figure 3-21 – Missing egg grates in the oil pumping house ......................................42

Figure 3-16- Asbestos cement cladding on the coal conveyor bridges.................................39
Figure 3-17– Asbestos cardboard .............................................................................39
Figure 3-18– Mineral wool on the flue gas ducts..........................................................40
Figure 3-19 – Filling station for the oil pumping house ..............................................41
Figure 3-20– Missing banister in the cooling water pumping house .......................42
Figure 3-21 – Missing egg grates in the oil pumping house ......................................42
Figure 3–22– Unsatisfactory dangerous electrical installation in the coal supply substation .............................................................................................................................. 43
Figure 3–23 – Sub-standard electric lighting installation in the workshop building ........................................ 44
Figure 4–1 – Time line of major decommissioning activities ............................................................................ 46
Figure 4–2 – Timely sequence of the planning phases ....................................................................................... 48
Figure 6–1 – Decommissioning Schedule ......................................................................................................... 55
Figure 9–1 – Air emission standards of Germany, the World Bank and Kosovo in 2007 .................................. 60
Figure 11–1– KEK generation and supply chart with partners and customers ..................................................... 65
Figure 11–2– Annual load duration curve for Kosovo, 2008 ........................................................................... 66
Figure 11–3– Monthly power system load distribution for Kosovo, 2008 ......................................................... 67
Figure 11–4– Kosovo power system balance 2007–2015 .................................................................................. 70
Figure 11–5– Generation Forecast Scenario A using different demand growth rates ........................................ 71
Figure 11–6 – Generation Forecast Scenario B using different demand growth rates ..................................... 72
Figure 11–7 – Generation Forecast Scenario C using different demand growth rates ..................................... 73
Figure 11–8 – Power Imports and Exports at Scenario A ................................................................................. 74
Figure 11–9 – Power Imports and Exports at Scenario B .................................................................................. 74
Figure 11–10 – Power Imports and Exports at Scenario C .............................................................................. 75
Figure 11–11 – Total Cost of Power Imports for three demand growth rates under Scenarios A – C ................................................................. 76
Figure 12–1 – Annual Total Cost in m € for Scenarios A – C at 2.5 % demand growth ........................................ 79
Figure 12–2 – Cost Comparison between Status Quo and Case A for the period 2010 – 201581
Figure 12–3 – Cost Comparison between Status Quo and Case B for the period 2010 – 201682
Figure 12–4 – Cost Comparison between Status Quo and Case C for the period 2010 – 201782
ABBREVIATIONS USED

CHP  Combined heat and power plant generation (here: coal–based)
CLRP  World Bank project on cleaning of equipment and land reclamation of former coal gasification site near TPP Kosovo–A location (Aug 2009)
DH  District heating
ECLO  EC Liaison Office, Prishtina, Kosovo
EHI  Environmental health impact; economic effect of TPP air emission affects
EnCT  EC Energy Charter Treaty for SEE Balkan region
ERO  Energy regulation operator for Kosovo
HPP  Hydro Power Plant
HV  High voltage power system in Kosovo, managed by KOSTT
IPPC  Integrated Pollution Prevention and Control
KEK  Kosovo Energy Corporation (coal mine operation, power generation, energy supply, distribution) – key beneficiary, project stakeholder
Kosovo–A  Thermal power station Kosovo A with a total nominal installed capacity of 800 MW
Kosovo–B  Thermal power station Kosovo B with a total nominal installed capacity of 678 MW
Kosovo–C  New power station Kosovo C with a planned nominal capacity of 2000 MW by 500 MW units
KOSTT  Independent transmission system and market operator of Kosovo
LCPD  European Large Combustion Plant Directive
LPTAP  Lignite–based Power Technical Assistance Project for Kosovo (World Bank–financed programme)
MEM  Ministry of Energy and Mining, Prishtina
MEF  Ministry of Economy and Finance, Prishtina (privatisation issues)
MESP  Ministry of Environment and Spatial Planning, Prishtina
MLSW  Ministry of Labour and Social Welfare, Prishtina
MKW  Mineral construction wool (heat insulation material)
OPEX  Operational Expenditure comprising mainly of fuel cost, staffing cost and maintenance cost
RLEAK  ERO Regulation of Legal Energy Activities in Kosovo – Licensing (from 2005)
TPP  Thermal power plant station
1 Contractual background

This study has been prepared by Vattenfall Europe PowerConsult GmbH, Vetschau and processed on the basis of a framework contract between EVONIK Energy Services GmbH and the European Commission Liaison Office in Kosovo No. IPA/2009/216283/1 of 08.09.2009.

The Terms of Reference comprised the following main tasks:

- Review of the existing situation of Kosovo–A power station
- Decommissioning strategy including environmental clean-up and implementation plan
- Supply scenarios of the energy supply to 2017 and cost estimates.

The purpose of this study is to support energy sector development in Kosovo in compliance with the Energy Community Treaty and related environmental standards.

The ten-year energy strategy for Kosovo envisages the development of a new lignite–fired generation capacity: Kosovo–C. Currently, the Ministry of Energy and Mining is preparing the development of a new 500 MW capacity during a first phase, with the possibility of developing another 500 MW capacity at a later stage. According to the ToR, the first unit of the new power plant is expected to be in operation by around 2015.

In order to ensure a reliable power supply until the new power plant is built and put into operation, the units of Kosovo–A power plant play an important role in KEK’s mid-term power generation plan.

The planned decommissioning of all five units of Kosovo–A power plant within the next five years follows the Kosovo Prime Minister’s presentation in August 2009 and is intended to create the environmental and commercial basis for a more efficient power generation throughout the country.

This Study Report was prepared from October 2009 until February 2010. The Consultant started work on 13.10.2009, performed three site visits to Pristina and the thermal power plant (TPP) site, collected necessary documents and data, and processed the information received. Each mission and site visit included a reporting round-table meeting and presentation of the results to all the stakeholders of the decommissioning procedure in Kosovo.

The Consultant would like to draw attention to the different understanding of some technical terms:

The term “decommissioning”\(^\text{17}\) refers in this paper to the process of a well-coordinated shutdown of plant systems at the end of its economic life taking into account environmental and safety requirements.

“Dismantling” in this paper means the well-coordinated demolition and recycling of decommissioned plants, related buildings and installations for site clearance and

\(^{17}\) The Consultant noted that many of the stakeholders in Kosovo refer to “decommissioning” in the sense of closure, preliminary decontamination, dismantling, recycling and environmental clean-up in order to make the site available for further commercial usage.
environmental clean-up in order to achieve brown-field\textsuperscript{18} level enabling the rather flexible further commercial use of the TPP site.

\textsuperscript{18} Clean-up for brown-field level was requested by stakeholders in the kick-off meeting with the Consultant.
2 Introduction

This study, according to the related ToR, comprises a review of the current situation at TPP Kosovo–A on the basis of several site visits and processing local data and information obtained from analytical site assessment and from the partners and stakeholders contacted. It provides a very detailed analysis of the overall shutdown and demolition of Kosovo–A power plant with the following activities: scheduling, cost estimate and the impact on the electricity supply in Kosovo.

The legal and institutional basis of this study is the Law on Energy from 2003 and the Law on Electricity No. 2004/10 in Kosovo, the power-related regulations brought into force by ERO (mainly RLEAK), and other legal framework regulations for the construction and supervision of key strategic works at TPPs in Kosovo.

Work took place on the site of TPP Kosovo–A within its boundaries as shown on the ground plan, Annex 10.

Drawing up the timetable for the shutdown and demolition of TPP Kosovo–A and estimating the resulting costs of decontamination and demolition was based on intensive surveys of individual buildings and facilities (see breakdown in Annex 4). This included surveying contaminated areas, the measurement of facilities, assessing the structural condition, and recording characteristics of design, construction and the equipment installed. The subsequent steps were:

- Evaluating the data recorded
- Calculating the area and volume of each building
- Allocating demolition unit costs (based on experience) to the individual buildings taking into account design, the extent of equipment and demolition technology envisaged
- Quantifying contamination with asbestos, mineral wool, oil, grease and fuel (diesel and fuel oil)
- Calculating the costs of decontamination with the clean-up goal of industrial reuse, demolition and disposal
- Dividing the individual buildings into demolition lots taking into account the shutdown strategy and operating connections between individual facilities
- A description of the required processing and planning stages until the completion of all demolition work
- Drawing up a timetable for shutdown, decontamination and demolition.

2.1 Brief characterisation of Kosovo–A TPP

TPP Kosovo–A is located about 5 km northwest of Prishtina, the largest city in Kosovo, in the region of the village of Obilic and completely belongs to KEK, a state-owned, vertically organised multi-utility for coal production, power generation and supply.

The mean altitude of the site is 540 m above sea level. The entire power station plant has an area of approx. 0.49 km².

The power plant owns a railway and a local road link (partly in bad condition).
The lignite-based thermal power plant was constructed over 1962–1975 and includes in total five units of very different origin.

The power plants Kosovo–A and B were erected on one of the largest lignite reserves in Europe with good-quality lignite and favourable mining conditions (overburden/coal ratio: 1:1). The site is contaminated by not only by current business activities but also a gasification plant which was decommissioned about 15 years ago with most of the (internally and externally contaminated) installations is still remaining.

Two rivers passing the TPP site are the main recipient of liquid waste products and drain water from the site.

Lignite is mined from two almost empty mines, which is one of the reasons for the low quality of the lignite currently extracted. Opening a third mine (Sibovic) during the next few years remains an urgent option already planned. The mining process also faces problems with the self-ignition of lignite and land sliding.

Lignite is transported in open belt conveyor systems to the coal yards at the power plant for temporary storage, separation, crushing and mixing. Due to the underbalanced mining capacity, there are difficulties in meeting the requested consumption and the lignite is received at the power plant with a large variation in heating value and content of non-combustible materials, which makes efficient combustion difficult.

The environmental impact of the TPP activities in Kosovo is related as elsewhere to the quantities of natural resources (coal, ground, water, air emissions and ash) consumed through an efficient management of all the TPP processes. Air pollution and the contamination of rivers, lakes and ground water are the main concerns as residuals from the combustion process are still heavily distributed in the surrounding air and water.

Details of today’s operational efficiency are to be seen from Table 2–1 below:

**Table 2–1: Overview of the existing operational status of the 5 units at TPP Kosovo–A**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Installed capacity in MW</th>
<th>Capacity in MW net available</th>
<th>Status</th>
<th>Estimated residual lifetime (FS –2005(^{19}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>65</td>
<td>Not in operation</td>
<td>Not in operation</td>
<td>About 1–2 years</td>
</tr>
<tr>
<td>A-2</td>
<td>125</td>
<td>Not in operation</td>
<td>Not in operation</td>
<td>Not evaluated</td>
</tr>
<tr>
<td>A-3</td>
<td>200</td>
<td>Max. 135</td>
<td>Partial operation</td>
<td>About 3–4 years</td>
</tr>
<tr>
<td>A-4</td>
<td>200</td>
<td>Max. 135</td>
<td>Not in operation</td>
<td>About 5–7 years</td>
</tr>
<tr>
<td>A-5</td>
<td>210</td>
<td>Max. 135</td>
<td>Partial operation. One flue–gas duct (out of three) still under repair.</td>
<td>About 5–7 years</td>
</tr>
</tbody>
</table>

\(^{19}\) Economic and technical feasibility of the rehabilitation of units of Kosovo–A power plant, A\(^{3}\)i Consortium, September 2005
Considering the results of the 2005 Feasibility Study for the residual lifetime of the units, the further operation of the units beyond these dates (i.e. 2010 – 2012) will increase the risk of unplanned breakdown.

This study describes all the main buildings, facilities and installations identified within the power station area. The related legal borders are generally presented in the site map (see Annex 10).

The dismantling of the facilities and building structures is carried out down to bottom edge of the foundations. Furthermore, land sealing (streets, squares, etc), track plants and the complete underground supply and disposal networks have to be considered.

The study was prepared with the following main working steps:

- Review and assessment of available stock and project documents of the power station (archive work)
- Site visits (42nd, 47th and 52nd calendar weeks of 2009)
- Preparation of building lists with construction data
- Sampling of construction groups (common construction type, similar usage)
- Consultations with power station staff
- Evaluation of places suspected of asbestos contamination
- Preparation of the rough time schedule/dismantling plan
- Calculation of a rough cost estimate

A rough time schedule was drawn up in close cooperation with Kosovo–A management staff under which all 5 power units are intended to be decommissioned by 2015, the completion target for all main dismantling works being 2020.

According to the conceptual formulation, an analysis of all existing facilities at the site had been carried out (inspections, findings, and archive work).

The size and complexity of the power station location requires a detailed planning of all decommissioning measures as well as the measures for the well-regulated dismantling of the selected plants.

Detailed planning of the disintegration and dismantling works need to start immediately in order to achieve final decommissioning of most of the power station components in 2014/2015. This planning process includes:

- Object assessment
- Description of the dismantling measures
- Compilation of a rough time schedule of dismantling works
- Cost estimate
- Concluding the measures required

The rough cost estimates drawn up in this study were based on experience from several dismantling measures of power stations in Germany, the cubic content of buildings and the size of the areas built on or sealed.
3 Overview of the existing situation

3.1 General description of the buildings

The main structures of the power plant are the boiler and turbine buildings, smokestacks, cooling towers, electrostatic precipitators, supply and disposal facilities, water conditioning lines, workshops, storage buildings, as well as offices and social facilities. All facilities of the power plant are listed in Annex 5.

The 65 MW, 125 MW and three 200 MW units are part of the main plant structures and include relevant technical equipment such as turbine-generator sets, boilers, vessels, pumps, pipes, etc.

The main structures were predominantly built from reinforced concrete or structural steel with masonry and Durisol slabs (concrete slabs) as well as glass facades.

![Turbine house for the units A1 to 5](image)

**Figure 3–1** – Turbine house for the units A1 to 5

The boiler stacks each consist of a reinforced concrete shaft with internal masonry lining. Stacks 1 to 4 are 100 m tall while stack 5 is approx. 120 m high.
Cooling towers 1 to 5 are reinforced concrete structures with a ventilator cooling system. The fill packings in the cooling tower of unit 1 consist of asbestos, while those of the cooling towers of units 2 to 5 are made of high-pressure impregnated wood.
The coal and ash conveyor bridges were built from structural steel with asbestos cement plate cladding and glass facades while the transfer stations and coal crusher building were built out of reinforced concrete.

![Coal conveyor bridge with transfer station](image)

**Figure 3–4– Coal conveyor bridge with transfer station**

The chemical water conditioning facilities are housed in reinforced concrete buildings with partial masonry web bracings. The vessels and water basins used are made of steel or reinforced concrete. Various chemicals (acid, lyes, salts) are to be found here.
Figure 3–5 – Water conditioning building

The existing pipe bridges are made from steel frames with reinforced concrete foundations.

Figure 3–6– Ash pipeline bridge leading to the ash disposal
Most of the other buildings (cooling water pump houses, storage and workshop buildings, and office buildings) are made of reinforced concrete with masonry web bracings or Durisol plate facades.

When the power plant was built, a significant part of the structural facilities was fitted with asbestos-containing materials (e.g. wall claddings, fireproof bulkheads, seals). Throughout the usage period, structural alteration has taken place in connection with maintenance along with the replacement of equipment and insulation. In many cases, asbestos-containing materials were replaced by asbestos-free alternatives.

All structural facilities are in a very bad condition. Façades are ramshackle, windows broken, doors unusable. As a result, indoor conditions may be freezing in winter, considerably limiting the availability of buildings.

---

**Figure 3-7**– Coal supply substation
Concrete corrosion and exposed reinforcement are at severe risk of structural collapse.

Figure 3–8 – Concrete corrosion at the cooling tower stairs

Foundations cannot take the technological loads any more.

Figure 3–9 – Pipeline support at the cooling water pipeline
The permissible loads on the building roofs have been exceeded several times over by additional loads of ash, coal sediment and various contaminants.

The status of these buildings and structures is so poor that it poses extreme risks for the health and safety of operating and maintenance personnel and for operation during the envisaged operating time until closure of the plant.

3.2 Air quality and solid residues

The Kosovo TPP plants produce about 1 million t of ash per year, of which about 700,000 t is collected while about 300,000 t is released into the air. The result is specific dust emission with levels between 900 and 9,000 mg/Nm$^3$ from Kosovo-A units, totalling an air emission volume of about 100,000 tons a year.

The European Large Combustion Plant Directive 2001/80/EC (LCPD) specifies an emission limit of 30/50 mg/Nm$^3$ subject to the thermal capacity of the units (100 mg/Nm$^3$ for old plants with limited operation until 2015). 20

While modern emission control technology achieve values down to 30 mg/Nm$^3$ there is no technical possiblility to reduce the pollution from Kosovo-A units in order to meet the threshold of EC directive on pollution from old power plants due to the limited space for the ESP and the technical condition of the boiler.

---

20 It should be noted that the LCPD and different other EC Directives incl. IPCC are currently to be integrated in a Directive on Industrial Emissions specifying lower emission limit values than the LCPD.
The sulphur content in the lignite has been quoted at 0.7 -1.0 % but the lignite contains calcium which traps some sulphur oxides. The SO$_2$ emissions from TPP Kosovo–A measured in the 1990s were indicated to be about 500–700 mg/Nm$^3$ while the EC emission limit is 200 mg/Nm$^3$. Modern desulphurisation technology could achieve this emission limit value, but requires major investment.

NOx concentrations in the flue gas are mainly related to the specific coal quality and the temperature of the combustion process. The emission values were indicated between 500 and 900 mg/Nm$^3$. While sound NOx control technologies are available, they would also require substantial investment.

The result of these air emissions is the very bad (and still deteriorating) air quality in the Kosovo valley where TPP stations Kosovo–A and B are located close to the city of Prishtina.

Large quantities of particle dust, SO$_2$ and NOx and probably also other particles and gases accompany the CO$_2$ emissions coming from TPPs Kosovo–A and B.

The largest quantity of solid waste from TPP Kosovo–A remains from the ash volume delivered from the TPP combustion process as a liquid ash/water mix, disposed of without major environmental concern at an open disposal area.

Some neighbouring housing developments close to the ash disposal additionally suffer from ash dust winds if the ash is not sprinkled in dry periods. The content of particulate in the air is measured between 80 and 400 mg/Nm$^3$ at different locations – far exceeding internationally accepted limits and certainly supporting the increase in local infection and illness observed.

Ash contains salts and trace metals, which are released if water infiltrates disposal (salts almost immediately and trace metals over one to hundreds of years). Also, local problems with dust wind occur.

Generally speaking, all emissions are far above the European Large Combustion Plant Directive, which specifies the following values relevant for the Kosovo–A units:

**Table 3-1 – Emission limit values according to LCPD compared to current emission**

<table>
<thead>
<tr>
<th></th>
<th>Dust</th>
<th>SO$_2$</th>
<th>NOx</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPD Limit</td>
<td>100 mg/Nm$^3$</td>
<td>2,000 mg/Nm$^3$ (for units A–1 and A2)</td>
<td>200 mg/Nm$^3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>400 mg/Nm$^3$ (for units A–3, A–4 and A–5)</td>
<td></td>
</tr>
<tr>
<td>approx. Kosovo–A stack emission</td>
<td>1,000 mg/Nm$^3$</td>
<td>1,500 mg/Nm$^3$</td>
<td>400 mg/Nm$^3$</td>
</tr>
</tbody>
</table>

No systematic monitoring programmes have been set up by the authority or the power plant.

The few individual measurements applied today using obsolete methodology were not suitable for assessing the air quality situation in the Kosovo–A area. Moreover, no measures were in place at TPP Kosovo–A to limit emissions or to control ambient air pollution.
3.3 Treatment and discharge of technological wastewater

The technological wastewater comes from cleaning processes, raw water treatment for boiler feed water and rainwater collection. There are different types of warmed-up waters from cooling processes in the ancillary equipment. These cooling waters are discharged untreated into the sewer for the warmed-up cooling water downstream of the condensers. There is no equipment to retain oil for all cooling water.

Experience of power plant operation indicates the need for such equipment even at facilities with high safety standards.

Because of the enormous flow of cooling water, oil can only be trapped on the surface of the water. As the equipment for trapping oil is only needed in the event of a malfunction in the facilities, an oil barrier will be sufficient. It should be installed in the warmed-up water sewer.

3.4 Treatment of wastewater from cleaning processes and leaks in the power plant

There are no coalescence precipitators to trap the suspended oil and satisfy the norms of European Community (5 mg/l) at the designed mass flow of 100 m³/h.

3.5 Rainwater treatment

The rainwater collection system in the power plant appears not to be working because the ducts, street inlets and pipes are clogged with sand, sludge and other solid waste.

Accelerated cleaning should take place during the preparation phase as part of the decommissioning process.
3.6 Substances harmful to water

The old storage for chemicals used in water treatment does not meet the requirements for the successful protection of the soil, groundwater and atmosphere.

The following chemicals are used in the power plant:

- Liquids: HCl, H₂SO₄, NaOH, Fe₂(SO₄)₃, NH₄OH
- Solids: NaCl, MgO, CaO

The acids and the lyes must be stored in tanks sited in separate depots. Each depot needs its own catchment basin for leakages and rainwater. Separate catchment basins are also necessary for the storage of HCl and H₂SO₄. Having just one common catchment basin could result in undesirable reactions between the individual leaks with a harmful impact for the operating staff and the environment.

Sulphuric acid is to be used as pickling liquid. However, because it is a water–toxic substance, it must be kept in the storage for chemicals in the feed water treatment facility.

Chemicals needed for wastewater treatment are only flocculation ancillary substances like Fe₂(SO₄)₃. This liquid is also harmful to water and must therefore be stored like acids or lyes with a separate catchment basin. Leaks and rainwater will flow to the neutralisation basin.

The laboratory chemicals are currently stored in a separate storage area in the laboratory building with a catchment basin. This storage area meets the safety requirements.

At the Kosovo–A power plant, the equipment using chemicals is not concentrated at one site. Accordingly, there are long pipes for transporting chemicals, making monitoring complicated. Furthermore, the installation of double–walled pipes is very expensive because of the long distances. Double–walled pipes cost nearly 2½ times as much as normal pipes.

Regardless of which system is chosen, in the event of a pressure drop the feeding pump must be shut down. The pumps are able to be switched on only after leaks have been eliminated. This system is not proposed for the pipes transporting chemicals at the Kosovo–A power plant at all and therefore the work regime is dangerous.

3.7 Fuel oil/diesel storage and transport

The old facilities for unloading, storing and supplying fuel oil are in a bad condition and do not meet the requirements for protecting the soil and groundwater.

Double–walled pipes for the transport of fuel oil from the storage tanks to the boilers are state of the art but were not usual at the time of construction. The pipe system is mostly designed as an underground system. This is not acceptable in terms of environmental protection because leaks will only be detected very late (if at all).

The basin in which the fuel tank is placed above the base plate has two openings. This will drain oil with the rain water running into the surroundings and contaminate the soil round about. This system is not safe if an accident occurs, as can be seen from the following photograph.
3.8 Oil-filled electrical and hydraulic equipment

The main oil-filled electrical equipment is the transformers.

We have not received any reliable information that the HV insulation oil used is free of PCB.

In the event of a fire on a transformer, this could have a major negative impact on the atmosphere, the soil, ground and surface water. The most dangerous consequences could be the formation of dioxins and furans from the PCB inside the transformer insulation oil.

Even the combustion of PCB-free oil and other materials from the transformer could result in a large number of dangerous substances. There is no sprinkler system which can be started by an operator without delay in case of a fire.

There is no fire protection wall between the transformers. Such a wall would prevent the fire from crossing from one transformer to the next.

There must be a collecting basin for the fire-fighting water because it contains water-harmful substances from combustion.

The transformers and the surrounding area are significantly contaminated with mineral oil.
3.9 Waste management

Typical waste from coal-fired power generation includes ash as well as waste from water and wastewater treatment. Other types of waste are caused by the many different substances used. Although waste management legislation exists in Kosovo,21 improved operating conditions are not apparent. Indeed, there are numerous illegal waste dumps in the operating area.

Substances found in the accumulation of material include wood, steel parts, plastic materials, and even hazardous waste such as oil drums (partly filled and leaking) and sealants with suspected asbestos. The situation is eminently displayed in the following photographs.

21 ADMINISTRATIVE INSTRUCTION No.03/07–MMPH, January 2006, FOR ADMINISTRATION OF WASTE AND OILS THAT ARE USED
Figure 3-14 – Waste congregation

Figure 3-15 – Waste at the scrap-yard
3.10 Asbestos

Weakly bound asbestos products were found at several places in the boiler house (thermal insulation at boilers), in the turbine building (thermal insulation of piping and turbines), at precipitators, cyclones and pipes etc.

In the years since the power plant was built, asbestos products have been used for a wide variety of technical issues. Some of them have been exposed to direct mechanical or thermal effects.

The main purpose of weakly bound asbestos materials (cardboard asbestos, asbestos tightening and wraps, spray asbestos) was for insulation (boiler insulation, steam piping insulation, mechanical insulation) and cable openings.

Large sections of the high-temperature areas of the main buildings turbine and boiler house (pipelines and vessels) and the electrostatic precipitator including the flue gas ducts are fitted with sheet metal and insulation (mineral fibre). This equipment could only be subjected to visual inspection, supported by looking through the existing design documents and interviews of plant operators.

The technical requirements contained in Technical Rule 519 and technical rules of Directive 2003/18/EC of 27 March 2003 amending Council Directive 83/477/EEC about the protection of employees against asbestos in the workplace are to be strictly observed for the demolition of weakly bound asbestos products which are hazardous to health. The works must be carried out exclusively by a licensed company.

Asbestos cement products

Asbestos cement products have primarily been used for the walls and roofs of individual buildings and installations (as weather protection, partition walls, as fixtures in the cooling towers, and as an underlay on cable trays.

Different sheeted asbestos cement products have been used in the plant area.

The decommissioning of the roof and wall areas using asbestos cement sheets must be carried out by experts. After being tied together, the plates must be packed in a hermetically sealed receptacle and undergo special disposal.

Asbestos is classified as a carcinogenic hazard group 1 risk owing to specific claims regarding health and safety at work.

Only coated asbestos cement products may be wrapped and transported in a dry state.

Uncoated asbestos cement products:

- must be kept moist during the dismantling, or sprayed with a dust-binding agent
- are to be kept moist in their shipping container (not required if a dust-binding agent has been used)
- must not be allowed to break or pulled over the edges

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22 German TRGS – Technical Rules for Hazardous Substances
After the dismantling of asbestos cement products, the former installation is to be thoroughly cleaned (vacuum cleaning) followed by wet cleaning.

**Figure 3–16– Asbestos cement cladding on the coal conveyor bridges**

**Figure 3–17 – Asbestos cardboard**

Due to the high hazard of asbestos, prior to demolition comprehensive inventories of asbestos are to be drawn up. After all, one of the first steps of dismantling is the decontamination of buildings and equipment of asbestos. Since this involves handling a hazardous substance, this process is very time-consuming and expensive.
Judging by the initial inspections, a high amount of cement asbestos and asbestos in weakly bound form is to be expected.

Asbestos occurrences are shown in Annex 7.

### 3.11 Mineral fibres

According to numerous medical studies, mineral fibres from older production have the same status as asbestos products and can cause cancer. For this reason, specific health and safety requirements apply to the handling and use of mineral fibres. Mineral fibres also constitute hazardous waste subject to special monitoring requirements.

Judging by the initial assessment, Kosovo–A power plant contains mineral wool products with at least hazard class 2, possibly even class 1 according to the German Ordinance on Hazardous Substances. That means they are suspicious or known to be carcinogenic. Separate demolition and separate handling will be required.

Mineral fibres occurrences are shown in Annex 7.

![Figure 3-18: Mineral wool on the flue gas ducts](image)

### 3.12 Areas and materials contaminated by mineral oil hydrocarbons

Some parts of the ground and the buildings at the Kosovo–A site show clearly visible signs of contamination owing to the extensive use of oils and fats. Judged by our inspections made, the critical sites initially suspected were as follows:

- Waste storage area
- Transformers
- Underground oil pipes
- Oil storage
• Oil-conducting channels
• Turbine house basement area and 0.00 m level
• Boiler house – area of the mills
• Induced draught fans

As part of the decommissioning / dismantling plan, the extent of contamination is to be determined from thorough in-depth investigations especially for the above-mentioned areas. Subsequently, more precise estimates of the cost of decontamination can only be made after such an investigation. Contaminated areas are displayed in Annex 8.

Figure 3–19 – Filling station for the oil pumping house

3.13 Safety

The safety condition of all the facilities and roads at the power plant is poor. Many of the buildings do not have lockable doors and many windows are broken, making it impossible to prevent unauthorised access.

There is mainly a lack of handrails on stairs and landings. The outdoor steps are in poor structural condition. Pits and channels are in many cases not covered up. As can be seen from the following photographs, all these aspects result in the danger of falling and severe injury.
Figure 3–20 – Missing banister in the cooling water pumping house

Figure 3–21 – Missing egg grates in the oil pumping house
The electro-technical facilities in various buildings were found to be badly neglected. The electrical distribution systems were unlocked but still in operation. Cables were laid in disorganised aisles. Risky connections had been made in areas with difficult climatic conditions (such as in shower rooms). These are all major hazards for employees. It is vital that changes be made here soon regardless of when demolition begins.

Figure 3-22– Unsatisfactory dangerous electrical installation in the coal supply
Figure 3–23 – Sub-standard electric lighting installation in the workshop building
4 Decommissioning strategy

The closure of Kosovo-A Thermal Power Station is required in line with the Energy Community Treaty\(^23\) (The Treaty). By participating in the Energy Community of SEE, Kosovo has to implement Acquis on Environment as defined in the Treaty. This includes implementation of the IPCC\(^24\) and LCP\(^25\) Directives which are currently to be recast in a Directive on Industrial Emissions.\(^26\)

The Prime Minister declared in 2009 the Government of Kosovo decision to close TPP Kosovo-A by 2015. This political decision is reflected in the Energy Strategy\(^27\) of the MEM.

Based on stakeholder communication\(^28\) the Consultant suggests the following dates for unit shutdown as shown in Table 4-1.

Table 4-1 – Decommissioning dates of TPP Kosovo-A \(^29\)

<table>
<thead>
<tr>
<th>TPP Kosovo-A, unit</th>
<th>Shutting down at the latest</th>
<th>Decommissioning start proposed at the latest in</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>Before end of 2012</td>
<td>Beginning of 2014</td>
</tr>
<tr>
<td>A-2</td>
<td>Before end of 2012</td>
<td>Beginning of 2014</td>
</tr>
<tr>
<td>A-3</td>
<td>During 2013</td>
<td>End of 2014</td>
</tr>
<tr>
<td>A-4</td>
<td>Before end of 2014</td>
<td>Beginning of 2015</td>
</tr>
<tr>
<td>A-5</td>
<td>Before end of 2015</td>
<td>During 2015 after stopping operation of unit A-5</td>
</tr>
</tbody>
</table>

Closure of TPP Kosovo-A would have considerable environmental benefits. The negative impact on the workforce and external service providers are considered less important if dealt with in a proper way, as explained later.

From a pure technical point of view, the least cost solution would be to wait with the decommissioning and dismantling until the last unit has been shut-down. However, the Consultant suggests a different decommissioning strategy in order to alleviate social impacts. This strategy is based on making use of parts of the Kosovo-A workforce to be involved in the unit-by-unit planning and implementation of the decommissioning and dismantling.

\(^{23}\) The Energy Community Treaty was signed in October 2005 and ratified in July 2006.


\(^{26}\) http://ec.europa.eu/environment/air/pollutants/stationary/ippc/proposal.htm


\(^{28}\) Minutes of Meeting dated 30.10.2009 between ECLO and Consultant of 13.10.2009

\(^{29}\) According to the Minutes of Meeting dated 30.10.2009 between ECLO and Consultant of 13.10.2009
The decommissioning process itself consists of various political and engineering phases, comprising a strategic preparation phase first, followed by a political decision-making and an engineering planning phase, defining steps of decommissioning and demolition work with an agreed time schedule, and coordination with the remaining share of generation capacity to enable a continued, safe, balanced national power supply.

The demolition process itself starts with in-depth planning to obtain the necessary permission from the state regulator ERO and the clarification and approval of the necessary budget to be prepared for the outrunning operation licences at TPP Kosovo–A in 2011. Decommissioning shall be performed by KEK with support by external consultants.

It has to be clarified how the planning, tendering and award procedures for the demolition services are to be carried out in a most efficient way between the operational stakeholders and how alternatives for a nearly balanced power supply could be established in advance.

Preparatory measures such as cleaning up the complete power plant site (clearing the scrap-yards, the waste heap, and ash and coal stockpiles) ought to begin as early as mid–2010. At the same time, technical safety measures can be planned and carried out on Units 1 and 2 (early 2011). This chiefly comprises work to remove hazardous materials from facilities already shut down and guarding these facilities from unauthorised access. Furthermore, unused containers and barracks can be cleared and demolished in this early phase.

### 4.1 Decommissioning/dismantling permit procedure

The preparedness of the operational body (KEK management) has been checked on the basis of the existing local legal regulation basis (RLEAK) and compared with European/German application rules to obtain a decommissioning/ deconstruction licence for TPP Kosovo–A (KEK to the MESP) in due time. A general application from KEK was reported by the MESP in November 2009 but no confirmed formal application could be shown or explained to the Consultant. The following planning items have to be considered:

- Clarification of cleaning target (green or brown field) to be agreed between the stakeholders
• Technical activities to be done for a decommissioning application by responsibility, time and action
• Checking for hazardous materials potentially existing at the site
• Environmental and social impacts before, during and after decommissioning
• Cleaning effects to be achieved corresponding to further planning and the planned future business purpose of the site

ERO and the MESP jointly with the MEM serve as dedicated state agencies controlling the country’s system balance, making comparative analysis of inter-system relations, checking the completeness of applications provided for permits, and analysing the environmental and social impacts of the decommissioning measures according to Kosovo–And regional partner legislation.

The application forms presented generally at the final stakeholder meeting on 18.12.2009 and agreed with ERO and the MESP should be structured as follows:

Table 4–2 – Licensing status according to ERO

<table>
<thead>
<tr>
<th>TPP Kosovo–A , unit</th>
<th>Capacity and maximum availability in MW</th>
<th>Licensing status</th>
</tr>
</thead>
<tbody>
<tr>
<td>A–1</td>
<td>65/0</td>
<td>No license after 2011</td>
</tr>
<tr>
<td>A–2</td>
<td>125/0</td>
<td>No license after 2011</td>
</tr>
<tr>
<td>A–3</td>
<td>200/120</td>
<td>License to be reviewed 2011</td>
</tr>
<tr>
<td>A–4</td>
<td>200/120</td>
<td>License to be reviewed 2011</td>
</tr>
<tr>
<td>A–5</td>
<td>210/130</td>
<td>License to be reviewed 2011</td>
</tr>
</tbody>
</table>

The necessary extension of TPP operation permits for units A–3 to A–5 should follow the general procedure described below:

1. Description of site and unit to be applied for
2. Management information on generation date etc.
3. Environmental and other information.

The roughly designed decommissioning procedure represents a very complex follow-up of institutional activities and practical works at the TPP site to be performed by an experienced team of KEK experts coordinating all these actions. We recommend setting up a dedicated KEK business unit as soon as possible to rationally handle disaggregation and manage the process with all economic, social and technical consequences.

30 Minutes of Meeting between ECLO, ERO and Consultant of 18.12.2009
4.2 Description of the planning steps

A detailed decommissioning plan taking into account the legal framework of Kosovo–A and respecting the client’s (KEK) supply duties is required to obtain a permit for the decommissioning and demolition of the plants and facilities and to ensure orderly and selective dismantling and demolition.

The decommissioning and dismantling plan is divided into 8 phases with the groups of works described below:

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Phase 5</th>
<th>Phase 6</th>
<th>Phase 7</th>
<th>Phase 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparatory measures</td>
<td>Detailing of the decommissioning and dismantling</td>
<td>Preliminary and in-depth exploration of the power plant site</td>
<td>Engineering of the decommissioning and disaggregation of units and balance of plants</td>
<td>Preliminary and in-depth exploration of the power plant site</td>
<td>Engineering of the decommissioning and disaggregation of units and balance of plants</td>
<td>Preliminary and in-depth exploration of the power plant site</td>
<td>Engineering of the decommissioning and disaggregation of units and balance of plants</td>
</tr>
</tbody>
</table>

Figure 4–2 – Timely sequence of the planning phases

For further details on the timely arrangement see the Strategic Time Schedule in Annex 2.

Phase 1: Preparatory measures

- Development of Terms of Reference for planning and engineering of decommissioning and dismantling
- Examination of existing documents and as–built plans
- Definition of those plant systems which are necessary for operation for specific units and definition of those plants and facilities which can be dismantled before the last unit is shut down
- Definition of the scope of performance
- Carrying out necessary coordination with the competent technical authorities, e.g. Ministry of Construction, Ministry of Environment, related authorities and neighbours concerned

Phase 2:
Engineering of the decommissioning and disaggregation of units and balance of plants

Phase 3:
Preliminary and in–depth exploration of the power plant site considering laws like Law on Environmental Protection\(^\text{31}\) and the Waste Law\(^\text{32}\)

\(^{31}\) Law on Environmental Protection (Law no. 03/L–25)
- Examination of historical development
- Sampling and analysis of the demolition materials
- Sampling and analysis of soil and groundwater if contamination is suspected
- Hazard assessment for the demolition materials
- Hazard assessment for the soil and groundwater (if necessary).

**Phase 4:**

Development of the mass balance and disposal concept(s)

- Examination of structures and buildings
- Study of existing building files, design documents, etc
- Quantity surveying
- Drawing up a secondary usage or disposal concept(s)
- Asbestos survey
- Drawing up decontamination and safety plans (abolition of soil and groundwater contamination)
- Mass balance of the demolition materials

**Phase 5:**

Development of a dismantling strategy

- Elaboration of a health and safety plan
- Presentation and description of necessary safety and protection measures
- Planning of necessary measures to guarantee ground stability of adjoining facilities
- Specification of measures to provide necessary utilities (water, energy, compressed air)

**Phase 6:**

Compilation of licensing and tender documents for dismantling considering the Law on Construction\(^{33}\)

- Presentation of the demolition project
- The development of building descriptions, including specifications and preferable dismantling technologies
- Development of scope of supplies and services

**Phase 7:**

Cost and time schedule planning

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32 The Waste Law (Law no. 02/L-30)

33 Law on Construction (Law no. 2004/15)
• Ascertainment of the dismantling and disposal costs
• Ascertainment of recoverable proceeds
• Preparation of the dismantling time schedule.

**Phase 8:**
Contract award planning

• Compilation of the criteria catalogue for bid evaluation
• Bid meetings
• Evaluation of tenders
• Award.

### 4.3 Safety measures

The safety measures include rules for safe decommissioning in compliance with health, work, environment and fire protection.

Implementation should preferably take place immediately after the shutdown of the plants.

Safety measures include the following work:

• Clearance of buildings
• Idling of electrical installations
• Utility separation (water, heating, electricity, compressed air, fuel)
• Emptying and cleaning of plant components (coal and ash handling systems, tanks, gearboxes, etc.) and disposal of the remaining consumables such as fuels, lubricants, chemicals, etc
• Implementation of measures to ensure the fire load ‘zero’ (removal of rubber conveyors, disposal of oil, greases, chemicals, etc)
• Measures to ensure the ground stability of abandoned installations and structures
• Measures to ensure facilities are locked up to prevent unauthorised access.

If possible, the above measures should be implemented by the existing power plant personnel. Conventional disposal channels in Kosovo should be used to dispose of the various waste substances.

The masses are to be determined and the appropriate disposal routes fixed in order to prepare for these measures. Where appropriate, a tender document for the disposal of residual materials must be drawn up.

### 4.4 Requirements for decommissioning/dismantling

The main requirement for the dismantling of the individual facilities of Kosovo–A power plant is the decommissioning of units, the implementation of safety measures and the receipt of the necessary permits.
A related time schedule of this shutdown per unit and functional unit has to be prepared/endorsed by the management TPP Kosovo–A, approved by KEK and confirmed by the MEM.

Preparation and cleaning works may be done before decommissioning if safety measures have been installed properly.

Necessary corporate divestment measures are also necessary to be done, e.g. disconnection of the water supply to the chemical water conditioning plant, disconnection of energy discharging to the 110 kV and 220 kV facilities, and disconnection of the ash disposal (pipeline bridge and belt system to the landfill).

### 4.5 Dismantling process

To create a rough dismantling time schedule, the decommissioning and dismantling of the power plant have been divided into separate phases and lots. Annex 2 contains the time schedule and Annex 4 contains the register of objects of each lot.

**Lot 1:**
Before the general shutdown of the power plant (1 year):

- Clearance of the complete area of rubbish and waste of any kind (bins, waste boxes, containers)
- Cleaning of (disaggregated) equipment and buildings no longer in use
- Implementation of safety measures in these systems
- Dismantling of technical equipment of disused facilities
- Partial demolition of facilities that are directly assigned to units 1 and 2.

**Lot 2:**
After the general shutdown of the power plant:

Safety measures in all power plant facilities to be carried out before dismantling of lots 4–9 with a differing duration

**Lot 3:**
Dismantling of technical equipment in all power plant facilities to be carried out before dismantling of lots 4–9 with a differing duration

**Lot 4:**
Demolition (1 year) of:

- Ancillary buildings (one- and two-storey buildings)
- Workshop buildings
- Pipe bridges, belt conveyors, coal handling and ash removal systems with low dismantling complexity

**Lot 5:**
Dismantling of all ancillary facilities down to ground surface (1 year)
• Chemical water conditioning
• Cooling towers and cooling water pump houses
• Offices, administrative and social buildings

Lot 6:
Structural facilities with high dismantling complexity requiring heavy lifting equipments (1 year)
• Coal and ash conveyor bridges
• Ash silo, crusher building, transfer buildings
• Electrostatic precipitators
• Transformers and outdoor installations

Lot 7:
Smoke stacks’ site clearance by detonation (9 months)

Lot 8:
Main buildings (turbine house, boiler house) – blasting (18 months)

Lot 9:
Dismantling of all buildings down to the lower edge of foundations (11 months)
• Buildings with basements
• Paved areas and rail tracks
• Underground pipelines, vessels, tanks, cables

Procedural organisation depends on staffing, the number of contractors and the availability of the necessary demolition equipment. Demolition is to be carried out using conventional equipment (ball and chain, breaking, cutting or with hand tools) or by explosives. Afterwards, the site clearance of the demolition areas as well as removal can be carried out for the treatment, secondary usage or disposal of the demolition masses.

Lot 9 includes the demolition of basements, foundations, cooling tower cups, underground tanks and containers. This can be followed by the backfilling of the building pits with recycled construction materials.

As far as the Consultant has been informed, no additional drainage or water management measures will be required for deep underground work.

The treatment of mineral demolition materials (concrete, masonry) should preferably take place at the site of the power plant using mobile recycling equipment, assuming that sufficiently large areas are available.

The mineral recycling material can be reused after appropriate treatment for the backfilling of the building pits. The backfilling of the recycled material has to be done layer by layer, followed by compaction. Compaction of at least 97 % is to be
ensured using the Proctor compaction test. The length of the edge of the material should not exceed 63 mm.

No detailed investigation of potentially contaminated areas and soil has been made; simply a walk-through contamination audit has been executed at places known for such a potential environmental load (turbine gears, oil storage buildings etc), resulting in an indicative resolution of such areas.

The attached cost estimate for spot contamination works needed is based on these audits and has to be accomplished by an in-depth investigation before starting decommissioning works.
5 Assignment of individual facilities to dismantling lots

The individual facilities of Kosovo-A power plant were classified according to the item numbers used in the site map of 1974. Buildings or plants not shown on the map were described by consecutive numbering on the site plan (Annex 3).

Based on this list of facilities, assignment was carried out to complete the various dismantling lots using an internal selection system by time and activity.

All lots are described in more detail in Annex 4 and shown in the site map in Annex 6.
6 Approximate time schedule for the decommissioning process

A total period of about 10 years is estimated for all the general measures for the decommissioning and dismantling process of Kosovo–A power plant in its entirety, subdivided as follows:

Table 6-1 – Time required for activities

<table>
<thead>
<tr>
<th>Activities</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site clearance and demolition of abandoned facilities</td>
<td>Approx. 1.5 years</td>
</tr>
<tr>
<td>Implementation of safety measures</td>
<td>Approx. 1.5 years</td>
</tr>
<tr>
<td>Engineering planning, regularly updated</td>
<td>Approx. 5.0 years</td>
</tr>
<tr>
<td>Implementation of demolition measures</td>
<td>Approx. 7.0 years</td>
</tr>
</tbody>
</table>

The sequence of these activities will be staggered, according to the progress achieved within the consecutive actions. Some of the activities could be done in parallel, assuming sufficient staff.

![Decommissioning Schedule](image)

Figure 6-1 – Decommissioning Schedule

For details see the strategic time schedule in Annex 2.
7 Rough cost estimation for the dismantling works

The total costs of dismantling for the TPP Kosovo–A power plant were estimated to be

approx. €28,400,000

The total expenditure is made up as follows:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning of dismantling</td>
<td>€1,400,000</td>
</tr>
<tr>
<td>Safety measures</td>
<td>€1,700,000</td>
</tr>
<tr>
<td>Dismantling works</td>
<td>€20,400,000</td>
</tr>
<tr>
<td>Supervision of complete dismantling</td>
<td>€1,000,000</td>
</tr>
<tr>
<td>Decontamination of asbestos and mineral fibres(^{34})</td>
<td>€5,000,000</td>
</tr>
<tr>
<td>Decontamination of areas with mineral oil hydrocarbons(^{35})</td>
<td>€2,500,000</td>
</tr>
<tr>
<td>Income from sale of materials(^{36})</td>
<td>- €3,600,000</td>
</tr>
</tbody>
</table>

The costs for the site facilities, dismantling and demolition work, the preparation of the demolition materials, transportation and disposal are included in the costs of deconstruction. Safeguarding and revitalisation costs for contaminated soil have not yet been included.

The following assumptions for cost estimation were made:

- Blasting of stacks and main buildings
- Recyclability of the mineral demolition material (concrete, masonry)
- Overfilling of mineralised material at the location
- Disposal of other demolition materials in a radius of 50 km from TPP site

The cost estimation for all the demolition and dismantling activities was carried out on the basis of collected data for gross volumes of the facilities ascertained and

\(^{34}\) See Annex 7 for site map of expected hazardous decontamination areas of asbestos and mineral fibres

\(^{35}\) See Annex 8 for site map of expected hazardous decontamination areas of mineral oil hydrocarbons

\(^{36}\) Subject to actual market prices at the time of sale
using the following specific benchmark values from experience of various dismantling projects in Germany and Europe:

**Table 7-2 - Specific cost benchmarks used in the study report**

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Description</th>
<th>Specific cost benchmarks [€/m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dismantling cost to ±0.00m for facilities in concrete or masonry with high solids fraction</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>Dismantling cost to ±0.00m for facilities in concrete or masonry with medium solids fraction</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Dismantling cost to ±0.00m for facilities in concrete or masonry with low solids fraction</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>Dismantling cost to ±0.00m for structural steel facilities with high solids fraction</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>Dismantling cost to ±0.00m for structural steel facilities with medium solids fraction</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Dismantling cost to ±0.00m for structural steel facilities with low solids fraction</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>Dismantling cost under ±0.00m for facilities with high solids fraction</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>Dismantling cost under ±0.00m for facilities with medium solids fraction</td>
<td>22</td>
</tr>
<tr>
<td>9</td>
<td>Income from sale</td>
<td>2 – 4</td>
</tr>
</tbody>
</table>

The executed model calculation values were compared with different similar values of demolition plans already carried out in Germany and adapted to the local situation.

With the market situation permanently changing, the current costs for works and services mentioned above may fluctuate by as much as 15–20 %.

The same relationship has to be considered for the market price situation of sales from steel and other valuable scrap collected during the demolition process.
8 Coal-drying structures including the industrial power plant and gasification plant

The sites of the coal-drying and industrial power plant as well as the gasification plant were not subject of the Consultant’s assignment, but are briefly covered in this report for reasons of completeness.

8.1 Coal-drying structures including the industrial power plant

The coal-drying equipment and the associated power plant (the area of the industrial power plant) are located in the immediate vicinity on the north–west perimeter of Kosovo–A power station. This territory covers an area of about 12 ha and has approximately 55 structures of various sizes.

The coal-drying towers with their coal conveyor bridges and the coal loading equipment are still in operation. These facilities are technologically connected to Kosovo–A power station.

Local inspection took place without specific structural or environmental assessment since this area did not belong to the scope of work. For this reason, no information can be provided regarding the costs of planning, demolition, disposal or decontamination. This section has no impact on energy considerations.

Before the decommissioning of the coal-drying equipment, all connections to other areas have to be clarified.

The shutdown and demolition of Kosovo–A power station considered due to the scope of this report would inevitably entail the shutdown of the coal-drying equipment since the supply of the facilities (steam, electricity, coal) would be interrupted.

8.2 Coal gasification plant

The coal gasification equipment is located further north–west. Judging by maps and satellite photographs, the size of this area is almost as big as Kosovo–A power station (approximately 50 ha).

Detailed layouts showing the precise design of the facilities were not available. It is assumed that the gasification plant is technologically connected to Kosovo–A power station by coal conveyor bridges. While the gasification plant is out of operation for many years, there is no information whether there is single equipment still in operation. Clarification has to be provided on the way the equipment is connected to Kosovo–A power station and on the ownership structure.

Local inspection was not carried out because this area did not belong to the scope of this report.

In August 2009, the government of Kosovo was furnished with a report by Chiresa AG and Jäckli Geologie AG (Switzerland) on the remediation of subareas of the gasification plant on behalf of the International Development Association and the

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government of the Netherlands. This report analyses 34 facilities (tanks, containers, barrels, basins, collecting vessels and the tar separator) of the gasification plant. These facilities were evaluated in terms of chemical waste and its quantities (page 25 of the report). The total waste amounts to 20,241 tonnes.

The decontamination costing was estimated using the quantities, classification into categories of waste, and the envisaged disposal route. The costs of decontamination in the following stages:

1. Preparation of a work area
2. Emptying containers, basins and tanks, clearing the separator
3. Cleaning the above-mentioned equipment areas
4. Loading and transporting the waste
5. Declaration of the waste
6. Permanent disposal (in Hungary, Slovakia and Germany)

were estimated at €3.161 million (page 87 of the report).

These costs do not include the cost for decommissioning the gasification plant, which are recommended to be estimated during a separate assignment.

Reasons:

1. The Chiresa/Jäckli report only indicates the decontamination costs of hazardous waste in the form of environmentally harmful liquids (in containers, tanks and basins) and tar mixtures (exposed tar deposition).
2. Contamination with asbestos, mineral wool and oil was not surveyed and therefore the clean-up costs for these types of contamination are not shown.
3. As the report does not contain any information about structural facilities (e.g. the size of buildings and equipment, etc), their demolition costs cannot be calculated.
4. The timetable shown only reflects the time required to clean up a part of the whole site. Thus, this only represents part of the decontamination work necessary. Therefore, a new timetable needs to be drawn up for the decontamination of the entire gasification plant and dismantling.

8.3 Recommendation

The Swiss study merely evaluates a small section of the gasification plant. Further extensive investigation and planning would be necessary for a complete assessment of the expenditure required for shutdown, decontamination and dismantling as well as planning the time required for the preliminary work involved.

Due to the technological connections between coal drying plant, industrial power plant, gasification plant and TPP Kosovo–A, it is necessary to consider the decommissioning for all those plants together. The overall decommissioning and dismantling planning of all those sites together will certainly provide cost benefits over an isolated dismantling process.
9 Environmental and health impacts

9.1 Environmental standards

Kosovo TPP emissions exceed the European emission standards set by the Large Combustion Plant Directive (LCPD) several times, but are considered to be roughly in line with World Bank Pollution Prevention Handbook 1998 for existing thermal power plants.

![Comparison of Emission Norm Values](image)

Figure 9-1 – Air emission standards of Germany, the World Bank and Kosovo in 2007

9.2 Environmental health impact from emissions and economic losses

The Environmental Impact Assessment\(^{38}\) executed by M/s. Carl Bro in 2003 for the Kosovo power plants applied specific values for different air emissions considering the stack height. These values are recommended by the World Bank and OECD to calculate the environmental health impact on the population.

Such damage costs need to be considered from a cost/benefit point of view in addition to the generation cost of the obsolete units at Kosovo–A TPP, which have low flue-gas stacks and thus strongly affect the neighbouring population.

In the case of stacks below 150 m in height, this applicable factor would be US$1,400 per tonne of dust emitted annually. Based on 85,117 t of dust emissions in 2007, this amounts to US$119 million annually. The annual airborne dust emission projected corresponds to a nearly 50% time availability of all blocks working at a capacity factor of about 60%. This seems rather unrealistic when considering today’s operating conditions at TPP Kosovo–A. Therefore, adapting the estimated unit operation times and available capacity accordingly, the Consultant

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estimated the environmentally induced theoretical health impact cost at about US$90–115 million for 2009 and 2010, corresponding to €65–70 million annually at current exchange rate.

These figures roughly match our own socio-economic model estimating a simple illness rate of about 20% of the population investigated due to emission–influenced infection by the mechanism described – for one month annually, using a geographical circle of about 20 km around the TPP site near the village of Obilic.
10 Social impacts

An assessment of the social impacts caused by the closure of Kosovo–A TPP is not part of this study, but under separate assignment by M/s. Eptisa and Corporate Solutions. This section includes the preliminary findings of the Eptisa study as per 20.01.2010 and of the Final Report as of 29.01.2010 which are cited below. The complete Eptisa study on social impacts is included as Annex 9.

10.1 Current position

Currently (January 2010), over 2,100 people work on the Kosovo–A and B Power Plant sites. Of these, just under 1,500 work in the KEK Generation Division: 777 on TPP Kosovo–A and 705 on TPP Kosovo B. The remaining 600 workers are employed in KEK Mining Division (159), KEK Chemical Separation (82), NJ Railways (41) and a range of private contractors carrying out transport, security, catering and coal retail functions (340).

There is general recognition in the company that it is significantly “overmanned”. Senior managers estimate that following the closure of TPP Kosovo–A, the remaining TPP Kosovo B plant could be operated by about 500 workers.

Table 10-1 – Current over-manning estimates

<table>
<thead>
<tr>
<th>Workplace</th>
<th>Current Total</th>
<th>Estimate of Numbers required</th>
<th>% over manned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kosovo–A</td>
<td>777</td>
<td>600</td>
<td>30 %</td>
</tr>
<tr>
<td>Kosovo B</td>
<td>705</td>
<td>500</td>
<td>40 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1482</strong></td>
<td><strong>1100</strong></td>
<td><strong>35 %</strong></td>
</tr>
</tbody>
</table>

With an average annual staff cost of c. €5000 per worker, this “overmanning” equates to €1.9 million, per annum.

10.2 Workforce age profile

Based on the data on the some 1,500 employees in the KEK Generation Division, the workforce is of above average age, with over 50 % aged 50 or over and fewer than 20 % under 40. At least 230 workers will have reached retirement age by 2015.

10.3 Work Force Development Plan

This plan for the development of the work force that will be displaced by the closure of TPP Kosovo–A and any rationalisation of the KEK Generation work force as a whole is based on five key elements.

Firstly that a proportion of the work force will be deployed in jobs associated with the decommissioning of TPP Kosovo–A and the Gasification Plant and the subsequent decontamination and regeneration of the site.

Secondly that a proportion of the work force will be made redundant and be supported to find alternative employment, either in other companies or through self employment or small business formation.
Thirdly that a proportion of the work force will retire and leave the labour market.

Fourthly, a proportion of the work force will continue to work in power generation, with KEK or any successor company.

Finally a proportion of the work force currently associated with external independent contractors will continue to provide services to KEK and other clients.

10.4 Financial Implications of Redundancy and Early Retirement Programmes

At this stage it is impossible to be specific of the costs of this reorganisation until a number of key decisions have been taken. However we recognise that the Government and KEK management would benefit from having an indication of the costs of a range of measures and options.

Table 10–2 – Financial Implications of Redundancy and Early Retirement

<table>
<thead>
<tr>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
<th>Example 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assumptions</strong></td>
<td><strong>Assumptions</strong></td>
<td><strong>Assumptions</strong></td>
<td><strong>Assumptions</strong></td>
</tr>
<tr>
<td>Kosovo-A continues to operate all three remaining units as it currently does and then closes in 2015</td>
<td>Kosovo-A will close on a phased basis between 2010 and 2015</td>
<td>Kosovo-A will close on a phased basis between 2010 and 2015</td>
<td>In 2010 offer early retirement to workers aged 60 and over on enhanced terms of half pay until retired. All of these workers accept this offer.</td>
</tr>
<tr>
<td>Employee numbers as calculated by KEK (732) to be made redundant in 2015</td>
<td>Stage 1: In 2010 make redundancies to reduce supernumerary staff (at Kosovo-A and B) currently estimated at c.380</td>
<td>Stage 1: In 2010 make redundancies to reduce supernumerary staff (at Kosovo-A and B) currently estimated at c.380</td>
<td>From 2010, offer early retirement to workers aged 55 and over on enhanced terms of half pay until retired. Half of these workers accept this offer.</td>
</tr>
<tr>
<td>An outplacement team with 30 members is formed and operates for two years</td>
<td>Stage 2: a further 400 KEK workers made redundant between 2010 and 2015</td>
<td>Stage 2: a further 400 KEK workers made redundant between 2010 and 2015</td>
<td>Enhanced severance pay of 12 month’s salary</td>
</tr>
<tr>
<td>Enhanced severance pay of 12 month’s salary</td>
<td>150 private contractors workers made redundant</td>
<td>Enhanced severance pay of 12 month’s salary</td>
<td>Establish Outplacement Team of 15 to provide support for five years</td>
</tr>
<tr>
<td><strong>Estimated Cost:</strong></td>
<td><strong>Estimated Cost:</strong></td>
<td><strong>Estimated Cost:</strong></td>
<td><strong>Estimated Cost:</strong></td>
</tr>
<tr>
<td>Total: €4 Million</td>
<td>Total: €4.65 Million</td>
<td>Total: €3.7 million</td>
<td>Total: €1.6 million</td>
</tr>
</tbody>
</table>

10.5 The Potential to create new employment opportunities

Discussion with KEK management indicates that the existing workforce has many of the skills needed to undertake much of the decommissioning and Vattenfall has identified employment opportunities during the staged decommissioning and dismantling of Kosovo–A as follows:

- Decommissioning engineering: 30 engineers for 3.5 years
- Preparation & cleaning works: 100 unskilled workers for 1.5 years
Safety measures: 25 maintenance workers + 50 unskilled workers for 1.5 years
Disaggregation works: 50 skilled workers + 50 unskilled workers for 2.5 years
Demolition works\(^{39}\): 50 skilled workers + 50 unskilled workers for 7 years.

The above figures do not take account of potential work associated with the decommissioning and rehabilitation of the Coal-drying and the Gasification Plant sites or jobs which might be created by bringing the entire site back into productive use through the regeneration process.

\section*{10.6 Conclusion and next steps}

In summary our main conclusions are:

\begin{itemize}
  \item The strategy to minimise the social and economic consequences of the closure should be based on a fundamental restructuring of KEK’s power generation activities over at least a five year period from 2010 combined with an early decommissioning of already closed plant to create employment opportunity.
  \item The closure programme and the regeneration of the Kosovo site needs to be led by powerful and vigorous government intervention.
  \item There is no one single measure that will form the basis of the strategy. Instead it will need a range of different measures, involving a range of public, private agencies, NGOs and partners. These measures may include:
    \begin{itemize}
      \item a) Redeployment of some of the workforce on the redevelopment of the former Kosovo–A site
      \item b) Natural turnover of staff and early retirement
      \item c) Redundancy of both KEK direct employees and those of private contractors providing services to KEK
      \item d) Training and support to redundant workers to maximise their chances in the labour market, particularly the opportunities that will arise from the regeneration of the site
    \end{itemize}
  \item To deliver the strategy will involve a complex change management programme for KEK, MEM, RDA and other partners.
  \item The closure of Kosovo–A, while in the short term presents many serious threats to the work force and the local community can also present many opportunities if managed and resourced properly.
  \item The project will also provide many opportunities for the partners to develop their expertise and capacity to manage industrial reorganisation, which can be applied across Kosovo in the future.
\end{itemize}

\(^{39}\) The number of staff from Kosovo–A to be used for dismantling works is depending on the strategy to be selected for contracting of these works.
11 Supply scenarios considered

The purpose of this section is to develop supply scenarios in the framework of the Kosovo power sector under consideration of three different demand growth rates. The resulting power imports will be calculated in terms of electrical work (GWh) and in terms of money.

This section reviews also possibilities to cover load once TPP Kosovo-A has been shut down.

11.1 Country framework

KEK, as a vertically structured corporation is the main provider of power generated in three different power stations in Kosovo, two thermal and one hydro power station. The generated power mainly originates from 2 coal-based TPPs (95 %) and has to be transferred via the transmission grid (owned by the state and operated by the transmission system and market operator KOSTT) and finally is sold to clients using the KEK distribution grid for end-consumer supply.

The chart below illustrates KEK’s central role in the energy sector in Kosovo.

![Diagram](image)

**Figure 11-1**  KEK generation and supply chart with partners and customers

ERO is the state regulation agency responsible for TPP commissioning and partly the decommissioning permits (in agreement with the MESP and the Ministry of Construction) as well as for tariff control for power generation, gas and central (district) heating. This agency has made a preliminary assessment of the existing
and expected system power balance in Kosovo, including a projected OPEX\textsuperscript{40} cost from 2005 until 2009/2010.\textsuperscript{41}

KOSTT as transmission operator is responsible for analysing executed and forecasting expected import price bands for the near future and for trading issues to contract sufficient power capacity by time and volume to run a balanced Kosovo power system.

11.2 Background

For years, the Kosovo power system situation has shown a balance deficit, indicating shortfalls in generation capacity and/or in the coal supply of existing power stations. This deficit has slightly increased during recent years.

The graph in Figure 11–2 shows a system peak load of 967 MW, which occurred in December 2008. For most parts of the year, load ranges between 200 – 800 MW which can be provided by TPP Kosovo–B (currently 515 MW net capacity) in conjunction with TPP Kosovo–A (currently 240 MW net capacity plus another 120 MW after repair of unit A4) and HPP Ujman/Gazivode\textsuperscript{42}. That means, TPP Kosovo–A has still an important function in the power system of Kosovo to supply that power which is beyond the capacity of TPP Kosovo–B and HPP Ujman/Gazivode.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{load_duration_curve_kosovo_power_system_2008.png}
\caption{Annual load duration curve for Kosovo, 2008}
\end{figure}

The total annual country load demand for 2008 has been reported to be 4944 GWh.

\textsuperscript{40} Operational Expenditure

\textsuperscript{41} www.ero–Ks.org

\textsuperscript{42} Some sources call Kosovo’s single HPP “Gazivode”, others call it “Ujman”.

Final Decommissioning Report TPP KOSOVO–A
The Kosovo monthly load curve of 2008 presented in Figure 11–3 below shows during the largest parts of the year, i.e. from March till November a monthly load between 460 – 510 MW. At first sight it seems that this demand – under a load shedding regime – can be satisfied by TPP Kosovo-B alone (up to 515 MW), provided its two units are operational. However, this impression is distorted by three facts:

- Every power plant unit needs a standstill for maintenance and cleaning usually once a year; this annual shut-down is typically done during the low-load season, i.e. in summer. That means only one unit of TPP Kosovo-B is available during this time. If this missing output cannot be balanced by TPP Kosovo-A or HPP Ujman/Gazivode, KOSTT needs arrange power imports. Due to the scheduled power purchase, import prices will be moderate.
- Short–term disruptions of the power plant process may not allow to achieve the maximum output or even cause shutdown of a unit for hours or days. In that case KOSTT needs to purchase imported power – usually at high prices.
- The monthly consumption figures are mean values, whereas the daily and hourly consumption varies substantially. While Figure 11–3 shows an average value of 370 MW for June 2008, consumption at the 03.06.2008 varied between 300 – 630 MW\(^4\). This shows again that TPP Kosovo-B is not capable to alone provide sufficient electricity even during low-load months.

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measures of heat supply. An analytical review of typical monthly load behaviour reveals the strong influence of public and residential electrical heating, especially in the winter heating period.

The need for load shedding to improve the stability of Kosovo’s power system especially during winter load is apparent.

This monthly load curve indicates the ongoing high use (20 %) of electricity for space heating, to be decreased by alternatives for heating and adapted tariff regulation.

**11.3 Demand and supply forecast**

According to the Kosovo statistical data collected for economic and population development and the related demand projections made in the MEM national energy strategy, the Kosovo population is predicted to grow by about 1.2 – 1.5 % annually. Consequently, the growth rates of GDP may be expected (MEM study) to be 2.5 – 3.5 % annually.

Both socio–economic indicators have a strong impact on the expected energy and electricity demand in the country and its future development, including a suitable power inter–system exchange for balance deficits and reserve capacity management.

The Kosovo power balance is showing a growing balance gap until year 2015. The documented MEM energy strategy paper from 2009 is considering only the existing and projected static general Kosovo system balance. It does not yet reflect all the necessary dynamic possibilities of intersystem power exchange, including UCTE regulation principles and contractual pre–arrangements for different system reserves to be delivered or received, corresponding to the applied frequency stabilisation and intersystem regulation regime in accordance with EnCT.

According to the MEM’s strategy, published in 2009, the national electricity demand is expected to rise annually between 3.8 (medium–rate) and 4.0 % (high–rate), compared with 6 % as the maximum total national energy growth rate (high) annually. Projections made by KOSTT additionally give a growth range between 2.5 % and 4.5 % annually.

In line with some recent engineering reviews of the national annual demand profile and its composition, the Consultant proposes to use a slightly decreased low–rate scenario with an annual growth–rate of only 2.5 %. This proposal is based on an estimated share of 20–30 % of the total used for direct electrical heating to be replaced soon, consequently decreasing the total national demand for electricity during the next few years. Under a planned District Heating project to supply heat from TPP Kosovo–B to Prishtina city, financed by the EC and KfW, potentially 10,000 residential customers could be transferred from electricity to central district heating, potentially reducing the increase in system demand substantially.

Using the national energy strategy developed by the MEM in 2009 based on projected Kosovo country demand, the following forecast for necessary power generation broken down into expected TPP production has been copied and analysed.

Three different scenarios for the average perspective country load development have been considered applying a low (2.5 %), medium (3.8 %) and high growth rate (4.5 %) annually as shown in Table 11–1. This basically corresponds with assumptions made by KEK, KOSTT and MEM.
They data were taken over from KOSTT study reports and adapted to equal starting demand data in year 2009 to reach comparability of results.

Only the low rate scenario has been considered as a realistic value for the national demand situation for the next years, leaving space for energy efficiency measures to be implemented especially in the public and HH heating sector.

Table 11–1 – KEK electricity generation/demand forecast [GWh] based on existing profile

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TPP Kosovo–A</td>
<td>1300</td>
<td>1300</td>
<td>1300</td>
<td>1450</td>
<td>1450</td>
<td>950</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPP Kosovo B</td>
<td>3300</td>
<td>3300</td>
<td>3300</td>
<td>3300</td>
<td>3300</td>
<td>3300</td>
<td>2500</td>
<td>2500</td>
<td>3400</td>
<td></td>
</tr>
<tr>
<td>TPP Kosovo–C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1750</td>
<td>5500</td>
<td>7500</td>
<td>7500</td>
</tr>
<tr>
<td>HPP Ujman</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>HPP Zhur</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>398</td>
<td>398</td>
<td>398</td>
<td>398</td>
</tr>
<tr>
<td>Small HPPs</td>
<td>42</td>
<td>100</td>
<td>125</td>
<td>150</td>
<td>175</td>
<td>200</td>
<td>210</td>
<td>225</td>
<td>240</td>
<td>250</td>
</tr>
<tr>
<td>Total generation</td>
<td>4721</td>
<td>4779</td>
<td>4804</td>
<td>4979</td>
<td>5004</td>
<td>4529</td>
<td>6237</td>
<td>8702</td>
<td>10717</td>
<td>11627</td>
</tr>
<tr>
<td>Demand up by 2.5 %</td>
<td>4994</td>
<td>5119</td>
<td>5247</td>
<td>5378</td>
<td>5513</td>
<td>5650</td>
<td>5792</td>
<td>5936</td>
<td>6084</td>
<td>6237</td>
</tr>
<tr>
<td>Balance–low</td>
<td>-340</td>
<td>-443</td>
<td>-399</td>
<td>-509</td>
<td>-1121</td>
<td>445</td>
<td>2766</td>
<td>4633</td>
<td>5390</td>
<td></td>
</tr>
<tr>
<td>Demand up by +3.8 %</td>
<td>4994</td>
<td>5181</td>
<td>5376</td>
<td>5577</td>
<td>5786</td>
<td>6003</td>
<td>6228</td>
<td>6462</td>
<td>6704</td>
<td>6956</td>
</tr>
<tr>
<td>Balance–medium</td>
<td>-402</td>
<td>-572</td>
<td>-598</td>
<td>-782</td>
<td>-1474</td>
<td>9</td>
<td>2240</td>
<td>4013</td>
<td>4671</td>
<td></td>
</tr>
<tr>
<td>Demand up by +4.5 %</td>
<td>4994</td>
<td>5219</td>
<td>5454</td>
<td>5699</td>
<td>5955</td>
<td>6223</td>
<td>6503</td>
<td>6796</td>
<td>7102</td>
<td>7422</td>
</tr>
<tr>
<td>Balance–high</td>
<td>-440</td>
<td>-650</td>
<td>-720</td>
<td>-951</td>
<td>-1694</td>
<td>-266</td>
<td>1906</td>
<td>3615</td>
<td>4205</td>
<td></td>
</tr>
</tbody>
</table>

The Kosovo system balance analysis shown in Table 11–1 and Figure 11–3 depicts a growing balance gap within the Kosovo system balance until 2015, to be compensated for by imported power. The growing system balance gap is apparent until the new TPP Kosovo–C becomes operational. The start of TPP Kosovo–C in 2015 (as shown in Table 11–1) is questionable from today's point of view.

This balance gap will have to be compensated for by suitable time-adapted contracts for regional imports, by the improved efficiency of electricity use in the country, and by the accelerated preparation of the construction of the new Kosovo–C TPP.
11.4 Supply Scenarios Considering 2.5 % up to 4.5 % Demand Growth

The biggest remaining risk for the balanced, cost-efficient operation of the Kosovo power system during the decommissioning of TPP Kosovo–A is the unclear timing for the planning and construction of the new TPP Kosovo–C, expected to be completed by 2015 but realistically unlikely to be finished before the end of 2016.

When considering the staged closure of TPP Kosovo–A and the resulting electricity supply on the one hand and an annual load growth rate between 2.5 % up to 4.5 % on the other hand, the following Scenarios A, B and C – reflecting different operation starts of TPP Kosovo–C – have been taken into consideration.

The same production run-up data for TPP Kosovo–C (i.e. 1750 GWh in the first year, 5500 GWh in the second and 7500 GWh in the third year as per MEM Energy Strategy) have been considered in each scenario.

11.4.1 Scenario A – TPP Kosovo–C becomes operational in 2015

Scenario A includes the staged shut-down of TPP Kosovo–A as projected within 2010–2015 with TPP Kosovo–A generation figures according to Table 11–1, electricity imports to fill the balance gap until the new TPP Kosovo–C becomes operational in 2015 as per Table 11–1.
The MEM Energy Strategy forecasts a generation of 1450 GWh for TPP Kosovo–A in the years 2012 and 2013. The shut down of Unit A 3 will reduce generation down to 950 GWh. This balance gap of 500 GWh for Unit A 3 compares to 1121 GWh of total imports in 2014 and needs to be considered as a direct implication of the TPP Kosovo–A decommissioning process.

Assuming the generation of the first block of TPP Kosovo–C as planned for 2015, the decommissioning of Units A4 and A5 will have no implications on the overall power balance, i.e. no electricity imports will be required in 2015 and beyond.

11.4.2 Scenario B – TPP Kosovo–C becomes operational in 2016

Scenario B includes the staged shut-down of TPP Kosovo–A as projected within 2010–2015 with TPP Kosovo–A generation figures according to Table 11–1, electricity imports to fill the power balance gap until the new TPP Kosovo–C becomes operational with a one year delay in 2016.
Study for Decommissioning of Kosovo–A Power Plant

EU-funded project managed by the European Commission Liaison Office to Kosovo

Figure 11–6 – Generation Forecast Scenario B using different demand growth rates

The MEM Energy Strategy forecasts a generation of 950 GWh for TPP Kosovo–A in the year 2014.

The shut down of Unit A 4 in 2014 will reduce generation down to 500 GWh. This balance of 950 GWh for Units A 3 and A 4 compares to 1305 GWh of total imports in 2015 and needs to be considered as a direct implication of the TPP Kosovo–A decommissioning.

Assuming the generation start of new TPP Kosovo–C in 2016, the decommissioning of Units A4 and A5 will have implications on the overall power balance, i.e. electricity imports of 950 GWh in 2015 (due to missing Units A 3 and A4) and 984 GWh (due to complete shut down of TPP Kosovo–A to make up for the projected demand) attributable to the missing TPP Kosovo–A generation will be required. Scenario B will also have implications on 2016 imports of which 984 GWh are attributable to the missing TPP Kosovo–A generation.

11.4.3 Scenario C – TPP Kosovo–C becomes operational in 2017

Scenario C includes the staged shut-down of TPP Kosovo–A as projected within 2010–2015 with TPP Kosovo–A generation figures according to Table 11–1, electricity imports to fill the power balance gap until the new TPP Kosovo–C becomes operational with a two years delay in 2017.
Figure 11–7 is showing the implications of the missing generation volume of TPP Kosovo–C on the total power imports during years 2016–2017:

- in 2015 the total imports are projected with 1305 GWh of which 950 GWh would be attributable to decommissioned Units A1 – A4,
- in 2016 the total imports are projected with 2734 GWh of which 1450 GWh would be attributable to decommissioned Units A1 – A5,
- in 2017 the total imports are projected with 1117 GWh of which 1117 GWh would be attributable to decommissioned Units A1 – A5.

11.5 Development of Power Imports considering Scenarios A – C and different Demand Growths

In accordance with the Terms of Reference, the Consultant has prepared three demand scenarios (low, medium and high growth), supply scenarios and estimated costs of necessary power imports.

11.5.1 Imports in GWh considering Scenarios A – C and different Demand Growths

The following figures 11–8, 11–9 and 11–10 show the development of Kosovo’s power balance in GWh per year under consideration of different demand growth rates of 2.5 % (low), 3.8 % (medium) and 4.5 % (high).

Negative figures in the diagrams indicate power imports and positive figures exports.
If TPP Kosovo–C commences operation in 2015 as assumed under Scenario A, power imports will become unnecessary at low and medium load growth. Only the high load growth of 4.5% requires imports – subject to the exact start and generation data of this new power station.

A one year delay in commissioning of TPP Kosovo–C by 2016 will induce especially high imports in the years 2015 and 2016. The difference between the low and the high demand growth is considerable (in 2016: 87% difference).
Figure 11–10 shows the implications of the worst case Scenario C: Assuming the same production run-up data in the first two years of TPP Kosovo–C operation (i.e. in 2017 and 2018), it will be necessary to import power till the year 2017, regardless of the load growth. The largest imports will be required in the year 2016.

However, all regulation and control measures should be taken to stabilise the growth rate of the country’s electricity demand down at an internationally (and economically) suitable level during system reconstruction. Otherwise the resulting higher imports will drastically diminish the economical Kosovo state budget balance through necessary compensation payments, as done before.

Even if the demand growth can be managed at a low rate, the biggest influence on the required power imports will be induced by the time for development of TPP Kosovo–C.
11.5.2 Price of Power Imports considering Scenarios A – C and different Demand Growths

The calculated power imports are priced in Table 11–2 with a mean unit price of 75 €/MWh for scheduled imports as reported by KOSTT for the near past.

**Table 11–2 – Total Cost of Power Imports in million € for three demand growth rates under Scenarios A – C**

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<thead>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Scenario A - Imports at 2.5%</td>
<td>26</td>
<td>33</td>
<td>30</td>
<td>38</td>
<td>84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario A - Imports at +3.8%</td>
<td>30</td>
<td>43</td>
<td>45</td>
<td>59</td>
<td>111</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario A - Imports at 4.8%</td>
<td>33</td>
<td>49</td>
<td>54</td>
<td>71</td>
<td>127</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario B - Imports at 2.5%</td>
<td>26</td>
<td>33</td>
<td>30</td>
<td>38</td>
<td>84</td>
<td>98</td>
<td>74</td>
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</tr>
<tr>
<td>Scenario B - Imports at +3.8%</td>
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<td>43</td>
<td>45</td>
<td>59</td>
<td>111</td>
<td>131</td>
<td>113</td>
<td></td>
</tr>
<tr>
<td>Scenario B - Imports at 4.8%</td>
<td>33</td>
<td>49</td>
<td>54</td>
<td>71</td>
<td>127</td>
<td>151</td>
<td>138</td>
<td></td>
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<tr>
<td>Scenario C - Imports at 2.5%</td>
<td>26</td>
<td>33</td>
<td>30</td>
<td>38</td>
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</tr>
<tr>
<td>Scenario C - Imports at +3.8%</td>
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<td>43</td>
<td>45</td>
<td>59</td>
<td>111</td>
<td>131</td>
<td>245</td>
<td>130</td>
</tr>
<tr>
<td>Scenario C - Imports at 4.8%</td>
<td>33</td>
<td>49</td>
<td>54</td>
<td>71</td>
<td>127</td>
<td>151</td>
<td>270</td>
<td>160</td>
</tr>
</tbody>
</table>

The costs of power imports from Table 11–2 are graphically represented in Figure 11-11.

The highest import costs are shown in the years 2015 – 2017. It becomes obvious that it is not the closure of TPP Kosovo-A, but the earliest possible operation of the new TPP Kosovo-C that is the main challenge in terms of power supply security for Kosovo and the stakeholders.

![Total Cost of Power Imports](image-url)
12 Comparative cost analysis for operational alternatives

Whereas Section 11 reviewed demand and supply scenarios for the whole Kosovo power sector, this Section 12 focuses on TPP Kosovo–A related costs.

This section analyses the cost of operating TPP Kosovo–A till its closure in 2015, the cost for its decommissioning and dismantling in addition those power import costs which are directly attributable to TPP Kosovo–A closure.

12.1 Cost Input data

Generally speaking, all the generation and consumption data used herein were taken from Table 11–1 in this study report and agreed with the key stakeholders.

Due to bad plant status and operating conditions as well as the strongly decreased availability of TPP Kosovo–A, the following cost data have been applied for cost calculations in subsection 12.2:

Table 12–1 – Input Cost breakdown per annum

<table>
<thead>
<tr>
<th>Year</th>
<th>Maintenance [€m]</th>
<th>Fuel [€/MWh]</th>
<th>Personnel [€m]</th>
<th>Staff training [€m]</th>
<th>Staff management [€m]</th>
<th>Dismantling/Decontamination [€m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>35.6</td>
<td>16.15</td>
<td>5.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2010–2015</td>
<td>35.6 + 3 % p.a.</td>
<td>16.15</td>
<td>5.6 with reductions in 2014 – 2015</td>
<td>1.0 in 2011 – 2013</td>
<td>4.0 in 2015 only</td>
<td>varying</td>
</tr>
</tbody>
</table>

Maintenance costs have been reported to be about €15–20 million annually by EC studies and KEK/ERO reports, but ought to be about €35 million annually when corresponding to an annual average of 5 % from total investment for equipment short before closure, judging by the Consultant’s experience. Some over-aged East-German TPPs based on lignite after some 40 years of operational life time realistically did have a 6–7 % annual maintenance cost compared to total equipment investment.

The fuel cost has been calculated at €21 million annually while direct annual staff costs have been calculated to be €5.6 million (data from KEK’s 2009 business report and from interviews of KEK management). No escalation has been applied.

Power imports were calculated on base of a mean unit price of 75 €/MWh as reported by KOSTT for the near past.

Personnel cost has been considered with €5.6 million annually with reductions down to €5.3 million in 2014 and €5.0 million in 2015.

Staff training costs of €1 million annually in the years 2011 – 2012 plus €4.0 million staff management cost for about 600 employees were used according to Table 10–2 – Financial Implications of Redundancy and Early Retirement, Example 1 (taken from Eptisa report).
Dismantling/decontamination costs of €28.4 million for a ten-year time schedule (according to Section 7 of this Study) were broken down to the related annual figures.

12.2 Annual Cost breakdown of Scenarios A – C

The following tables show the breakdown and timely dispersion of the cost related to TPP Kosovo–A operation, decommissioning, dismantling, staff training and management as well as power imports which are attributable to the closure of TPP Kosovo–A for the period 2010 – 2020.

Table 12–2 – Annual Cost breakdown of Scenarios A in million €

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</thead>
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<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
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<td>21.0</td>
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<tr>
<td>Maintenance</td>
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<td>37.8</td>
<td>38.9</td>
<td>40.1</td>
<td>27.0</td>
<td>14.7</td>
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<td></td>
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</tr>
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<td></td>
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<td>28.4</td>
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<td>Dismantling/decontaminat.</td>
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<td></td>
<td></td>
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<tr>
<td>Subtotal cost</td>
<td>63.7</td>
<td>66.4</td>
<td>69.9</td>
<td>72.1</td>
<td>50.7</td>
<td>34.7</td>
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<tr>
<td>Power Imports at 75 €/MWh</td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Total cost</td>
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<td>66.4</td>
<td>69.9</td>
<td>72.1</td>
<td>88.2</td>
<td>34.7</td>
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<td>4.0</td>
<td>4.0</td>
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Table 12–3 – Annual Cost breakdown of Scenarios B in million €

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<td>21.0</td>
<td>23.4</td>
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<tr>
<td>Staff Training</td>
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<tr>
<td>Power Imports at 75 €/MWh</td>
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<td>72.1</td>
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Table 12–4 – Annual Cost breakdown of Scenarios C in million €

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<td>Dismantling/decontaminat.</td>
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<td>3.0</td>
<td>3.0</td>
<td>437.7</td>
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<td>Power Imports at 75 €/MWh</td>
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<td>3.0</td>
<td>738.9</td>
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12.3 Cost for Operation of TPP Kosovo–A till shut-down and of related imports

The below cost overview has been compiled for better comparison among the three scenarios. It includes the major operation cost data for TPP Kosovo–A, the cost for decommissioning and dismantling and the cost for electricity imports at a rate of 75 €/MWh to make up for the missing TPP Kosovo–A generation in the country’s power balance.

The difference in the total cost between the scenarios is only caused by late operation start of TPP Kosovo–C.

Table 12–5 – Comparison of annual total cost of Scenarios A – C in million €

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario A</th>
<th></th>
<th>Scenario B</th>
<th></th>
<th>Scenario C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
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<td>69.9</td>
<td>69.9</td>
<td>72.1</td>
</tr>
<tr>
<td>2011</td>
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<td>69.9</td>
<td>72.1</td>
<td>88.2</td>
<td>106.0</td>
</tr>
<tr>
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<td>69.9</td>
<td>72.1</td>
<td>88.2</td>
<td>106.0</td>
<td>112.8</td>
</tr>
<tr>
<td>2013</td>
<td>72.1</td>
<td>88.2</td>
<td>106.0</td>
<td>112.8</td>
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</tr>
<tr>
<td>2014</td>
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<tr>
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<td>221.0</td>
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</tr>
<tr>
<td>2019</td>
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<td>221.0</td>
<td>251.0</td>
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<td>321.0</td>
</tr>
<tr>
<td>Sum</td>
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<td>770.8</td>
<td>878.0</td>
<td>1020.2</td>
<td>1240.0</td>
</tr>
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</table>

The costs in the years 2010 – 2014 do not differ between the scenarios. However, a delayed commissioning of TPP Kosovo–C will drive the total cost due to necessary imports to make up for the missing generation of both TPP Kosovo–C and Kosovo–A.

Figure 12–1 – Annual Total Cost in m € for Scenarios A – C at 2.5 % demand growth

The costs presented in tables 12–2 till 12–5 do not consider financial implications of a severe accident or major failure affecting key equipment (e.g. coal supply) of TPP Kosovo–A. Such collapse can cause the power station to be out of operation for a rather long time, perhaps even requiring nearly a year for necessary repair. This would result in a lack of generation capacity. Necessary emergency power imports at a high price of around 120 €/MWh could cost up to €174 million corresponding to the market situation.
The best economical solution is the well-ordered decommissioning with the down-sized continuation of power generation at TPP Kosovo–A until 2015 and earliest commencement of TPP Kosovo–C operation.

12.4 Economical Justification for closure of TPP Kosovo–A

In this subsection, the Consultant estimates the economic implications of TPP Kosovo–A shut-down compared to a continued operation of TPP Kosovo–A.

There might be arguments to continue operation of TPP Kosovo–A in order to reduce power imports if the new TPP Kosovo–C will be delayed. In fact, the MEM Energy Strategy envisages as one of the measures to meet the demand: “…In line with the European Directive for Large Combustion Plants, the units of TPP Kosova A could be operated until end of 2017.”

The Consultant’s methodology for estimating the economic impacts considers those direct and indirect costs which are attributable to TPP Kosovo–A and which were available to the Consultant.

Until shutdown, TPP Kosovo–A remains a heavy polluter of the air, water and soil. Therefore, it is fair to factor environmentally induced damage cost on health and economy into the operation of TPP Kosovo–A.

Using the World Bank / OECD methodology and related cost as cited in subsection 9.2 "Environmental health impact from emissions and economic losses", cost of €65 million related to 1300 GWh production have been considered for the operational life of TPP Kosovo–A.

It could be argued that the environmental health impact will not immediately stop with the shut-down of TPP Kosovo–A since there are certainly medium–term implications and the related health impact costs need to be considered to a lesser degree also after the decommissioning of TPP Kosovo–A. However, the stoppage of air emissions by TPP Kosovo–A – and it should be remembered that only such air–related impact cost are considered here – will have an immediate effect on air quality. Insofar this methodology seems to be appropriate.

The Consultant considered the Status Quo and three cases:

- **Status Quo**, i.e. assumed continued operation of TPP Kosovo–A with the maximum generation of 1300 GWh for the years 2010 – 2011 and 1450 GWh as per MEM Energy Strategy for the years 2012 – 2013. It is assumed that this electrical work of 1450 GWh will be generated also in the following years.

- **Case A**, i.e. scheduled shut–down of TPP Kosovo–A as per MEM Energy Strategy till end of 2015. Analogue to Scenario A (i.e. TPP Kosovo–C becomes operational as planned in 2015), those power imports which are induced by TPP Kosovo–A are considered.

- **Case B**, i.e. scheduled shut–down of TPP Kosovo–A as per MEM Energy Strategy till end of 2015. Analogue to Scenario B (i.e. TPP Kosovo–C becomes operational as planned in 2015), those power imports which are induced by TPP Kosovo–A are considered.

operational with one year delay in 2016), those power imports which are induced by TPP Kosovo–A are considered.

- Case C, i.e. scheduled shut–down of TPP Kosovo–A as per MEM Energy Strategy till end of 2015. Analogue to Scenario C (i.e. TPP Kosovo–C becomes operational with two years delay in 2017), those power imports which are induced by TPP Kosovo–A are considered.

In order to determine the economical benefits, the total cost for the respective production periods i.e. 2010 – 2015 (Case A), 2010 – 2016 (Case B) and 2010 – 2017 (Case C) were calculated and are presented below. The differing time horizon in the below diagrams results in differing total cost, but this is not relevant for determination of the economic benefit.

![Cost Comparison between Status Quo and Case A for the period 2010 – 2015](image)

**Figure 12–2 – Cost Comparison between Status Quo and Case A for the period 2010 – 2015**
The comparison of Figures 12–2 to 12–4 reveals that – although power imports are increasing from Case A to Case C – there is always a cost benefit of 8 – 10 % compared to the continued operation of TPP Kosovo–A in terms of total cost.

This clearly justifies the scheduled shut down of TPP Kosovo–A by 2015.
In conclusion of the analysed scenarios it is obvious that – regardless of the selected scenario – it is always cheaper to decommission and dismantle the old and poorly maintained TPP Kosovo–A than operating it beyond 2015.
13 Conclusion and recommendation

Existing situation

Kosovo–A power plant has 5 units which were constructed during the 1960s and the 1970s. Currently only units A3 and A5 are in operation, whereas unit A4 has been out of operation since April 2009 due to transformer problems and units A1 and A2 have not been used for several years.

Kosovo–A power plant today in average provides about 1,450 GWh net power annually into the Kosovo HV transmission grid, still accounting for about 25 % of the country’s total power demand. The remaining power comes from Kosovo–B power plant and HPP Ujman/Gazivode besides a growing import balance share of about 10 % of total national demand imported from the regional SEE market.

Since many years, Kosovo–A power plant operates poorly with efficiencies far below design. The overall efficiency of the remaining units at TPP Kosovo–A is very bad and is said to be about 25 %. Since the obsolete equipment only allows part load operation, efficiency is probably even lower. This compares to 41–43 % net efficiency for state-of-the-art lignite–fired units.

Considering the technical and economic status of the units and the related repairs that have been performed recently, units A3, A4 and A5 could operate for a very limited period requiring rather high maintenance costs.

The Kosovo–A units are currently burning lignite with a lower calorific value and a higher content of non–combustible substances than they were designed for. Under these conditions, stable operation is difficult and large amounts of fuel oil are required for start–up and re–start. Altogether, this results in the excessive, inefficient consumption of natural resources and the TPP’s bad environmental performance. Kosovo–A is the largest polluter in Kosovo and emits sulphur, nitrogen, carbon oxides and high amounts of fly ash. TPP Kosovo–A today is consuming around 2.5 million tonnes of local lignite annually when running a normal generation scheme.

The units at Kosovo–A power plant have (mainly) exceeded their lifetime and large investment/rehabilitation would be needed to bring them close to the required environmental standards. Given their limited operating time, this is economically simply no longer a feasible option. New generation capacities of Kosovo–C are planned to substitute the Kosovo–A output and satisfy the growing electricity demand in future.

When carrying out a specific efficiency analysis, it should be borne in mind that the energy intensity of Kosovo industry is still three times higher than the EC average at 3.5 kWh/€ GDP and that the implementation of energy efficiency technologies on the demand side and energy management on the control side of the system electricity supply process need to be encouraged.

Planned Decommissioning

The planned decommissioning of all five units at Kosovo–A power plant within the next five years following a statement by the Kosovo Prime Minister should create the environmental framework and the commercial basis for more efficient power generation throughout the country and at same time enable KEK to develop an alternative operational business strategy with the more efficient use of local coal.
The decommissioning of units A1 and A2 is envisaged in year 2012, of A3 in 2013, of A4 in 2014 and of A5 in 2015.

The total costs for the technical decommissioning, dismantling and decontamination of the whole of the Kosovo–A TPP site were estimated at €28.4 million.

The cost/benefit analysis to either maintain the status quo, i.e. the continued operation of TPP Kosovo–A with today’s OPEX and environmental (health) conditions, or decommission TPP Kosovo–A step by step and achieve the balancing of the power demand by imports – supports the closure of Kosovo–A.

In technical terms, the decommissioning process of all five units of TPP Kosovo–A will be quite a complex procedure regarding activity coordination and timing, and therefore may require up to 10 years depending on its further commercial use. It is recommended that the initial works for the planning and preparation of a decommissioning permit application to be commenced no later than mid–2010 in order to have a well–coordinated decommissioning process after the shutdown of the first units A–1 and 2 and to achieve final site clearance by 2020 at the latest.

777 people are currently working at Kosovo–A as direct employees, making it a significant employer in the country. However, the station is considered heavily overstaffed. The proposed gradual closure of TPP Kosovo–A by 2015 will have a significant impact on the workforce and the local community. While some of the staff (about 20 %) will reach retirement age between now and decommissioning, the 7 years of dismantling works offer various work opportunities for a few hundred employees (total estimate: 400). Additional job opportunities for about 100 employees are thought to be available in the new Kosovo–C plant. All ways of offering alternatives for employment inside and outside KEK should be considered and supported by the state administration.

The planned decommissioning process has to be coordinated in good time with the stakeholders responsible for the national electricity balance (MEM, ERO and KOSTT) and also within KEK. The still existing (temporary) limitations in local coal supply and consequently the underbalanced generation profile of thermal power plants in Kosovo require an intelligent investment policy to ensure an efficient regional coal supply and a sufficient supply to the remaining and planned TPP units on the one hand and the optimisation of power imports and the provision of ancillary system services on the other hand to achieve a stable and reliable supply of electricity.

All possible legal and organisational steps for upgrading the contractual trading security for Kosovo’s substantial necessary power imports should be taken intelligently to achieve suitable medium to long–term contract conditions for power imports.

**Comments on potential future outlook**

The units of Kosovo–A power plant have exceeded their lifetime and cannot be economically brought into compliance with environmental standards.

The best economical solution is the well–ordered decommissioning unit by unit with the down–sized power generation at TPP Kosovo–A until 2015. The missing generation of TPP Kosovo–A shall be compensated for by the new TPP Kosovo–C and power imports.

It is of utmost importance to accelerate the development of the first unit of the new TPP Kosovo–C in order to have as early as possible available.
Since a reliable date for commercial operation of TPP Kosovo–C will only be available after selection of the Independent Power Producer envisaged by end of 2010, it is recommended to adapt the rehabilitation of TPP Kosovo–B (which is currently planned between 2016 – 2017) suitably.

It is recommended to draft an energy action plan to identify and implement all possible energy saving measures, especially at public, residential and commercial customers in order to limit the energy demand.

The planning process for decommissioning and dismantling of TPP Kosovo–A shall start by mid–2010 at the latest to support a well–ordered decommissioning without endangering those units to be operated for a limited period till 2015.

Further studies of the gasification site are recommended to arrive at more realistic cost estimates for environmental clean–up, dismantling of equipment and site clearance.

Due to the technological connections between coal drying plant, industrial power plant, gasification plant and TPP Kosovo–A, it is necessary to consider the decommissioning for all those plants together. The overall dismantling planning of all those sites will certainly provide cost benefits over an isolated dismantling process. In addition, if the whole TPP and gasification area is cleared and cleaned–up, this will be more attractive for new industries and trades to settle down.

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