Hongsa Mine Mouth Power Project - Construction in Progress

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B. Project Layout
C. Project Master Schedule
D. Power Plant & Transmission Line
E. Coal Mine
F. Infrastructures; Road and Dam
G. Environment
H. Resettlement and Community
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Hongsa Mine Mouth Power Project is located in **Hongsa and Muang Nguen Districts**, Xayaboury Province, Lao PDR.

- The project comprises a lignite-fired Power Plant, a Lignite Mine, a Limestone Mine, and supporting infrastructures.
General Information

- Concession Area: 76.4 km²
- Concession Period: 25 years
- Power Plant Output: 1,878 MW
- Lignite Consumption: 14.3 Million ton/year
- Customers: EGAT 1,473 MW, EDL 100 MW
- Schedule
  - COD#1: 2 June 2015
  - COD#2: 2 November 2015
  - COD#3: 2 March 2016
Hongsa Project Activities

- Transmission Line
  To Thai Border: 67 Km (500KV)
  To EDL: 115 Km (115KV)

- Substation: 3 x 626 MW

- Lignite Mine: 1,650 MW
  - 14 MT/Y
  - 0.50 MT/Y

- Lime Stone Quarry

- Water Reservoir: Nam Ken & Nam Louk
  - 40-45 MCM/Y
Hongsa Power Company Limited (“HPC”) shall be the recipient of the Power Plant Concession and Phu Fai Mining Company Limited (“PFMC”) shall receive the Lignite Mining Concession. Lao Holding State Enterprise (“LHSE”) will hold 20% in HPC and 25% in PFMC. The remaining stakes shall be divided equally between the other Shareholders.
Total finance package worth US$ 3,710 million in capital commitments to HPC was proportionately contributed by 9 Thai commercial banks, namely, Bangkok Bank, Siam Commercial Bank, Krungthai Bank, Government Savings Bank, Kasikorn Bank, Export-Import Bank of Thailand, Bank of Ayudhya, Thanachart Bank, and TMB Bank, for long term senior debts under the typical limited-recourse project financing scheme.

Total loan facilities for this Project is US$ 2,783 million which is the largest amount the banks in Thailand have ever provided.
Benefit of the Project

When Power Plant construction completed in 2016, the Hongsa Mine Mouth Power Project will make Laos become widely renowned as the “Battery of ASEAN” with its capacity to produce 1,473 megawatts of electricity to be sold to EGAT and 100 megawatts to the Electricité du Lao (EDL), for 25 years.

- The project will provide base load of electricity supply to both Lao PDR and Thailand.
- Suitable model of achieving sustainable social and economic development.
- Improved standard of living from steady Project revenues.
- Employment opportunities and training for local communities.
- Development of infrastructure for local communities including new villages, housing, permanent roads, and improved education and health facilities.
- Relatively stable power tariff not subject to world oil & gas price unlike market coal.
- High reliable power from mine mouth power plant due to no fuel shortage risk.
- Promote bilateral economic relationship between Thailand and Lao or fulfill the bilateral power purchase with Laos.
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Hongsa Project Layout

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<tbody>
<tr>
<td>Power Plant Construction</td>
<td>2 Mar 16</td>
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<td>115KV T/L &amp; HS Sub. Construction</td>
<td>31 Jan 14</td>
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<td>500KV T/L construction</td>
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<td>Mining Fixed Equip.</td>
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<tr>
<td>Main Road construction</td>
<td>Pavement: Completed Others: 31 July 12</td>
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<td>Nam Louk Dam construction</td>
<td>30 Apr 13</td>
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<td>Nam Ken Dam construction</td>
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<td>Resettlement Activities</td>
<td>30 June 12</td>
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FGD: Fuel Gas Desulfurization is designed to have efficiency up to 92% in removing sulfur dioxide from fuel gas.

ESP: Electrostatic Precipitator is designed to have efficiency up to 99.86% in removing particular from fuel gas.

CEM: Continuous emissions monitoring system is installed at stack end to measure NOx, SOx, TSP, O2, temp. and etc. data will be real-time monitored at control room.
Power Plant

- STH#1 Structure Erection
- Inclined column of Cooling Tower#1
- Inclined column of Cooling Tower#2
- ESP#1,2,3 Foundation Excavation
- Boiler#1 Structure Erection
Transmission Line and Sub-Station

- **500kV T/L** from the power plant to Thai-Lao Border
- **115kV T/L** from Power Plant to Luang Prabang
Transmission Line

115 kV TL Foundation Work (Section from Hongsa Sub.-LPB 3 Sub)

500 kV TL Foundation Work (Section Power Plant-Thai Border)
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Coal Mine

Hongsa Lignite Mine is situated in the Hongsa Basin, Mining area is adjacent to the Power Plant to the northeast.

Extensive studies were done by RWE:
- Low sulphur and moderate ash content qualities, suitable for power generation.
- Favorable stripping ratio\(^{(1)}\) of 3.4:1 \(\text{bm}^3/\text{tonnes}\).

Lignite Resources: 577.4 Mil Ton
Lignite Required: 370.8 Mil Ton
Lignite for Power Plant: 14.3 Mil Ton/Year

Key Mine Facts

- Mining area
- Waste dumping areas (East dump & west dump)

Lignite specifications (a.r. basis):
- Gross calorific value: 2,491 kcal/kg
- Total moisture: 33.96%
- Ash content: 26.25%
- Sulphur content: 0.70%

Note: (1) Ratio determines the overburden; higher ratio implies higher mining cost.
Geological Map of Hongsa Basin
Geological Cross Section and Long Section
Stratigraphy of Hongsa Coal Deposit

**Quaternary Deposit**
- Comprising of semi-consolidated and unconsolidated grey to light brown clay, silty clay dominated sediments and intercalated with hard band of light brown dolomitic fine-grained sandstone. This formation contains fine-line coal of different thickness in several levels. Overburden thickness is up to 175 meters thick in the central part of the main basin.

**Overburden**
- The upper lignite zone is compact locally in the central part of the main basin. Lignite seam is characterized by light brown, high ash content, absence of leaf-bearing layers. There are numerous layers of light brown dolomitic fine-grained sandstone hard bands alternating throughout the zone. Upper lignite zone is divided into three seams, which separated by clayey sediments, i.e., G, H and J seams.
  - I seam: thickness is varying from 3 to 7 m.
  - J seam: thickness is varying from 6 to 10 m.
  - H seam: thickness is varying from 2 to 11 m.
  - E3 seam: thickness is varying from 2 to 8 m.
  - E2 seam: thickness is varying from 3 to 13 m.
  - E1 seam: thickness is varying from 2 to 11 m.
  - G3 seam: thickness is varying from 2 to 13 m.
  - G2 seam: thickness is varying from 2 to 15 m.
  - G1 seam: thickness is varying from 1 to 16 m.

**Upper Lignite Zone Formation**
- Comprising semi-consolidated and unconsolidated silty clay, sandy clay and clay with locally interbedded of sandstone and siltstone hard hand lens in the middle portion. There is also a less of 2 meters thick calcareous sandstone hard band in the central part of the main basin. This calcareous sandstone is fine to medium grained Greywackes. Interburden Formation 1 is varying from less than 1 meter up to 60 meters.

**Interburden Formation 1 (EB1)**
- The middle lignite zone in the basin is divided into three parts according to their qualities, and lithotypes.
  - E is characterized by a dominating combination of dark brown textural wood fragment and leaf fragment, thick massive, high ash.
  - F2 seam: thickness is varying from less than 1 m. up to 11 m.
  - F1 seam: thickness is varying from less than 1 m. up to 13 m.
  - E is characterized by high shares of dense lignite and bark including lithotypes. Lignite is brown to dark brown, thick massive, low ash content.
  - E2 seam: thickness is varying from less than 1 m. up to 20 m.
  - E3 seam: thickness is varying from less than 1 m. up to 30 m.
  - D is comprised of light brown lithotypes with abundant textural wood fragment and bark fragment, thick massive, high ash.
  - B2 seam: thickness is varying from less than 1 m. up to 26 m.
  - B1 seam: thickness is varying from less than 1 m. up to 15 m.

**Interburden Formation 2 (EB2)**
- Comprising of argillaceous rocks, e.g. clayey, silty and carbonaceous clay. It also contain high ash coal and numerous hard bands in the central of the basin. Interburden Formation 2 thickness is varying from less than 1 meter up to 60 meters.

**Lower Lignite Zone Formation**
- The lower lignite zone is complex and splited, and divided into three seams, i.e., A, B, and C seam.
  - C contains dark to brown lignite, which is characterized by high xylite or huminite/linite proportions.
  - C3 seam: thickness is varying from less than 1 m. up to 16 m.
  - C4 seam: thickness is varying from less than 1 m. up to 13 m.
  - C2 seam: thickness is varying from less than 1 m. up to 30 m.
  - C1 seam: thickness is varying from less than 1 m. up to 15 m.
  - B contains dark to brown lignite, which is characterized by high xylite or huminite/linite proportions, intercalated by dark dull seams.
  - B2 seam: thickness is varying from less than 1 m. up to 15 m.
  - A is the lowest seam, and consisting of black dull tissue bearing lignite, which is sapropelite lignite.
  - A seam: thickness is usually 1 meter or less.

**Underburden Formation**
- Underburden Formation is divided into two units:
  - UB1: over- A seam, and is characterized by intercalation of yellowish brown clay, silty sandy clay, commonly occur brownish red spotted, with a few lignitic clay layers.
  - UB2: characterized by intercalation of silty to sandy clay, light brown with red brown flamed increasing to lower part of the unit. There is no lignite inclusion in UB2.

**Basement**
- Comprising of limestone, quartzitic sandstone, and phyllitic shale, reddish brown to purple red, calcareous of Jurassic Age.
Coal Quality

Inherent moisture | % | 15.43
Total moisture | % | 33.98
Ash content | % | 26.25
Volatile matter | % | 25.86
Fixed carbon | % | 13.87
Total sulphur | % | 0.70
Combustible sulphur | % | 0.57
Gross calorific value | kcal/kg | 2,491
Relative density, in-situ | t/m³ | 1.43
Relative density, air-dried | t/m³ | 1.61
Hardgrove Grindability Index | | 61.40
Coal Resources

<table>
<thead>
<tr>
<th>JORC Code Categories</th>
<th>Measured Resource (0-125 m.)</th>
<th>Indicated Resource (125-250 m.)</th>
<th>Inferred Resource (250-500 m.)</th>
</tr>
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<tr>
<td>JORC Code (JRC)</td>
<td>I</td>
<td>H</td>
<td>G</td>
</tr>
<tr>
<td>1 (0-250m.) Measured (kt)</td>
<td>1,780</td>
<td>7,352</td>
<td>70,849</td>
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<tr>
<td>2 (250-500m.) Indicated (kt)</td>
<td>-</td>
<td>1,102</td>
<td>9,402</td>
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<tr>
<td>3 (500-1000m.) Inferred (kt)</td>
<td>-</td>
<td>-</td>
<td>2,022</td>
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<tr>
<td><strong>Total (kt)</strong></td>
<td><strong>1,780</strong></td>
<td><strong>7,454</strong></td>
<td><strong>80,343</strong></td>
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</table>

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<thead>
<tr>
<th>JORC Code (JRC)</th>
<th>INSITU ORE (KBCMS)</th>
<th>INSITU ORE (KTONNES)</th>
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<tr>
<td>Measured</td>
<td>347,702</td>
<td>493,189</td>
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<tr>
<td>Indicated</td>
<td>55,804</td>
<td>79,790</td>
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<tr>
<td>Inferred</td>
<td>2,839</td>
<td>4,429</td>
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<tr>
<td><strong>SUMMARY</strong></td>
<td><strong>406,134</strong></td>
<td><strong>577,409</strong></td>
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Remark: Quality Average calculate from data of geological model 2008 that term of coal type is lignite, clayey lignite and lignitic clay. Fixed Carbon (Quality of Proximate Analysis) calculated from formula (FC=100-TM-Ash-Volatile) Assumption drill hole used in seam by seam composite and boundary is model boundary JORC Code defined by search distance radius of data (125m, 250m, 500m)
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Dam

- Nam Ken
- Power Plant
- Pipeline
- Nam Louk
Nam Ken Dam

U/S and D/S Cofferdam

Slope Protection at Spillway

Grouting work at Main Dam (Riverbed)
Retention Level + 632.0 M (MSL)
Capacity 16.7 MCM
Nam Louk Dam

U/S Cofferdam and Main Dam

Grouting work at Main Dam

Lean Concrete work at Spillway
Approximate 32 km of roadways (solid red lines) constructed and upgraded to the Thai Highway Standard and the American Association of State Highway and Transportation Office.
Main Road

Before Construction

After Construction
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# Water Quality Monitoring

## Surface Water

1. Bore depth  
2. Temperature  
3. pH  
4. Turbidity  
5. Conductivity  
6. Total Suspended Solids (TSS)  
7. Total Dissolved Solids (TDS)  
8. Sodium  
9. Hardness  
10. Calcium  
11. Magnesium  
12. Iron  
13. Manganese  
14. Nitrogen/Nitrate  
15. Phosphate  
16. Cadmium  
17. Chromium  
18. Arsenic  
19. Lead  
20. Zinc  
21. Mercury  
22. Nickel  
23. Copper  
24. Oil & Grease  
25. Sulfate  
26. Coliform Bacteria  
27. Fecal Coliform Bacteria  
28. Alkalinity  
29. Potassium

## Ground Water

1. Bore depth  
2. Temperature  
3. pH  
4. Turbidity  
5. Conductivity  
6. Total Suspended Solids (TSS)  
7. Total Dissolved Solids (TDS)  
8. Sodium  
9. Hardness  
10. Calcium  
11. Magnesium  
12. Iron  
13. Manganese  
14. Nitrogen/Nitrate  
15. Phosphate  
16. Cadmium  
17. Chromium  
18. Arsenic  
19. Lead  
20. Zinc  
21. Mercury  
22. Nickel  
23. Copper  
24. Oil & Grease  
25. Sulfate  
26. Coliform Bacteria  
27. Fecal Coliform Bacteria  
28. Alkalinity  
29. Potassium
Ambient Air and Noise Monitoring

**Ambient Air**
1. Total Suspended Particulates (TSP)
2. Particulate Matters less than 10 um (PM10)
3. Wind Speed and Direction
4. Nitrogen Dioxide (NO2)
5. Sulphur Dioxide (SO2)
6. Ozone (O3)

**Noise**
1. Leq 8 hour
2. Leq 24 hour
3. L max
4. Ldn
5. L90

**Location**
1. Nan Province, Thailand (3 Stations)
2. Ngern District, Lao PDR (3 Stations)
3. Hongsa District, Lao PDR (3 Stations)

**Frequency**
- Quarterly
Weather Stations

Phu Fai Station

Ban Champa Station

- Wind Speed
- Wind Direction
- Temperature
- Relative Humidity
- Evaporation
- Pressure
- Precipitation
**Locations**

1. Napung village = 5.5 ha.
2. Kiew Ngew village = 49.5 ha.

Re-Forestation

Erosion Control
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Resettlement Village
(Total about 450 households)
Type of Resettlement Houses
Community Development
Career Development Program

Motorcycle Repair Shop

Non-chemical vegetable demonstration plots

Pavement Block

Lighting Balloon
Learning Center
 agréable