

4. OPERATING ASSETS

4.1 Wholly-owned Hydropower Plants

As of 30 September 2018, The Company has 10 wholly-owned hydropower plants with an aggregate installed capacity is 619 MW. A summary of the 10 wholly-owned hydropower plants is set out in the table below, followed by detailed description of each asset.

Assets Transferred to the Company (Wholly-Owned)

Power Plant	Location	Installed Capacity (MW)	COD
North			
Nam Khan 2	Luang Prabang	130	2015
Central			
Nam Ngum 1	Vientiane	155	1971
Nam Leuk	Vientiane	60	2000
Nam Mang 3	Vientiane	40	2005
Nam Song	Vientiane	6	2012
Nam Sana	Vientiane	14	2014
South			
Xeset 1	Saravanh	45	1991
Xeset 2	Saravanh	76	2009
Selabam	Champasak	5	1969
Houay Lamphanh Gnai	Xekong	88	2015
Total		619	

Data as of 30 September 2018

1) Nam Ngum 1 Hydro Power Plant (NNG1 HPP)

The Nam Ngum River is one of the major rivers in Lao PDR. It offers a hydropower potential up to 1,600 MW from various possible sites. NNG1 HPP commenced its COD since 1971 with an installed capacity of 150 MW. In 2003-2004, a rehabilitation project was implemented on machine units No. 1 and 2 to increase the installed capacity of each unit by 25 MW. At present, the NNG1 HPP has an installed capacity of 155 MW. The NNG1 HPP is located about 90 km north of Vientiane Capital City. The project was developed in three phases as follow:

Phase I

Phase I of NNG1 HPP commenced in 1968 and was commissioned in 1971 at the cost of USD 28 million. The facilities in this phase include a gravity concrete dam, a power plant at the base of the dam with two 15 MW generating units and provisions for three additional units. The generation units supplies electricity to EDL's single circuit high voltage transmission line, with a transmission capacity of 115 kV, from Nam Ngum site through Vientiane Capital City at Phonetong Substation to the Electricity Generating Authority of Thailand's (EGAT) grid at Nongkhai (Thailand) Substation.

Phase II

Phase II of NNG1 HPP began its activities in 1976 and was successfully commissioned in 1978 at the cost of USD 49 million. The facilities in this phase includes the installation of spillway gates, new penstocks and intake gates, an extension of the powerhouse to accommodate three new generating units of 40 MW each, connecting to EDL's double circuit high voltage transmission lines, with transmission capacity of 115 kV, from NNG1 HPP site through Vientiane Capital City at Phonetong Substation to EGAT's grid at Udone 1 and 2 (Thailand) Substations.

Phase III

Phase III of NNG1 HPP began its activities in 1983 and was successfully commissioned in 1984 at the cost of USD 20 million. The 40 MW generating unit was installed in order to fully utilize the hydro potential and the facilities previously installed. After the completion of this phase, the average annual energy production is 865 GWh.

Nam Song Diversion and Nam Leuk Hydropower Plant

The addition of Nam Song Diversion Project to NNG1 HPP reservoir in 1996 increased the average annual energy production to 995 GWh. Moreover, the completion of Nam Leuk Hydropower Plant increased the average annual energy production of NNG1 HPP to 1,025 GWh.

Summary of Principal Technical Data of NNG1 HPP

- 1. Capacity**

Total installed capacity	:	155 MW
Number of Units	:	5 units; 2 units x 17.5 MW 3 units x 40 MW
Average energy production	:	1,025 GWh/year

- 2. Storage**

Catchment area	:	8,460 km ²
Full water level	:	212.30 masl
Low water level	:	196.0 masl
Normal maximum water level	:	213.0 masl
Reservoir surface (at El. 212.00)	:	370 km ²
Storage capacity	:	7,030 x 10 ⁶ m ³
Active storage	:	4,700 x 10 ⁶ m ³

- 3. Tailrace**

Minimum tail water level (Q=0)	:	164.0 masl
--------------------------------	---	------------

- 4. Dam**

Type	:	concrete gravity
Length	:	468 m
Height	:	70 m
Width	:	6 m

5. Spillway		
Type of gate	:	Radial
Number	:	4
Width x Height	:	12.5 m x 10.0 m

2) Nam Song Hydropower Plant

The Nam Song Diversion was completed in 1996 to divert water from Nam Song River to NNG1 HPP reservoir and to help increase energy production. The hydropower equipment was installed in the diversion canal in order to develop Nam Song Diversion into a hydropower plant. The project costed approximately USD 13 million. The project has an installed capacity of 6 MW and generated 13.2 GWh of electricity in 2013. The energy generated from Nam Song Hydropower Plant is sent to the 22 kV EDL system. The project was fully completed in 2012.

Summary of important technical information of Nam Ngum 1 Hydropower Plant

1.	Capacity	
Total installed capacity	:	6 MW
Number of Units	:	3 units; 2 units x 2 MW
Average energy production	:	13.51 GWh/year
2.	Storage	
Catchment area	:	1.330 km ²
Full water level	:	219.70 masl
Normal maximum water level	:	214.50 masl
Reservoir surface (at El. 214.00)	:	1,030 km ²
Storage capacity	:	14,400 x 10 ⁶ m ³
Active storage	:	12,600 x 10 ⁶ m ³
3.	Tailrace	
Minimum tail water level (Q=0)	:	209 masl
4.	Dam	
Type	:	concrete spillway & earth fill embankment
Length	:	75 m
Height	:	21 m
Width	:	209 m

3) Nam Leuk Hydro Power Plant

Nam Leuk Hydropower Plant was completed in 2000 with a total capacity of 60 MW from two generator units of 30 MW each. The project is located approximately 10 km upstream of the dam; it has a 2,830 m long pressured tunnel, a surge tank and a 458 m long open-air penstock from the tunnel outlet to power house. The open-air penstock has a diameter of 3.40 m. From the Nam Poun diversion weir, water is transferred to the reservoir through a 2,600 m long and 3.30 m wide tunnel.

The spillway

The main spillway of the free overspill type is located on the left bank of the dam. It is 60 m wide and able to accommodate 2,100 m³/s of water. The secondary spillway, located on the nearest saddle on the left bank, is designed to supplement the main spillway for floods, with a peak discharge higher than 1,500 m³/s.

The transmission line

From the switchyard located next to the power house, electricity is conveyed by three single circuit 115 kV transmission lines, all owned and operated by EDL. The first line, 85 km long, joins Nam Leuk to Pakxan, where a 115 kV substation is located. The second 115 kV line, 55 km long follows the Nam Ngum lake shore, linking Nam Leuk to Nam Ngum power house. The third 115kV line, 187 km long, travels from Nam Leuk to Phonsavanh substation in Xiengkhuang province.

Summary of important technical information of Nam Leuk Hydropower Plant

The dam is of the rock fill type with an earth fill core. It rises to a total height of 45.5 m above the riverbed, with a crest length of 800 m and a fill volume of about 1.2 mm³.

1.	Storage		
	Full supply level	:	405 m
	Minimum operating level	:	388 m
	Reservoir area (full supply level)	:	12.8 km ²
	Reservoir active storage	:	154 x 10 ⁶ mm ³
	Reservoir dead storage	:	31 x 10 ⁶ mm ³
	Annual runoff	:	517 x 10 ⁶ mm ³
	Net head	:	182.9 m
2.	Dam		
	Height	:	45.5 m
3.	Operation Discharge System		
	Headrace tunnel length	:	2,830 m
	Headrace tunnel diameter	:	4.90 m
	Steel lining	:	305 m
	Penstock (open air)	:	458 m
	Power station rated output	:	60 MW
	Maximum operation discharge	:	39 m ³ /s

4) Nam Mang 3 Hydro Power Plant

Nam Mang 3 Hydropower Plant is a multi-purpose project. In addition to generating electricity, it serves as a water irrigation system. Nam Mang 3 Hydropower Plant is located at Phou Khao Khouay Mountain, 60 km north of Vientiane Capital City, 15 km south west of Nam Leuk Hydropower Plant. Nam Mang 3 Hydropower Plant is a run-of-river scheme. The water from Nam Yong River (750 masl), which is one of the Nam Mang River's tributaries that comes from a point substantially higher than the reservoir (200 masl). This 550m height difference is able to provide a hydropower potential up to 40 MW, with an average energy production of 138-140 GWh/year.

The preliminary feasibility study conducted in 1992 proposed the inclusion of a reservoir from another dam with an installed capacity of 35 MW. In 1994, another feasibility study, which had more information regarding the geographic of the Lao PDR, proposed various options. However, the conclusion from the feasibility study in 2001, which considered more thoroughly environmental impacts, proposed for a smaller reservoir and only one dam with a height of 28 m, located near the confluence of the Nam Yong River with the Nam Mang River. The proposed dam has a catchment area of 68 km² and water is diverted from Huay Kwang, which is a branch of Nam Yong River, through a water intake, tunnel and penstock, to Nam Mang 3 reservoir, which has a catchment area of 14 km², reservoir area (full supply level) of 10.2 km², average discharge of 4.19 m³/s and total discharge of 132 km³/year.

Nam Mang 3 Hydropower Plant construction is divided into two phases. The total construction cost of the first phase is USD 63 million and the second phase is USD 27 million. In both phases, 80 percent of the fund came from a loan from the Export-Import Bank of China and the other 20 percent came from EDL.

Summary of important technical information of Nam Mang 3 Hydropower Plant

1. Storage:

Catchment area	:	68 km ²
Full water level	:	750 masl
Low water level	:	742 masl
Storage capacity	:	59 x 106 m ³
Active storage	:	44.5 x 106 m ³
Reservoir area (full supply level)	:	10.20 km ²

2. Dam:

Type	:	reinforced cement concrete
Height	:	28 m
Length	:	150.93 m
Reservoir level	:	754 masl
Over spillway	:	1,030 m ³ /s

3. Saddle Dam:

Height	:	19.9 m
Reservoir level	:	755 masl
Length	:	435.8 m

4. Operation Discharge System

Tunnel:

Size : 1.8 x 2.2 m

Length : 512 m

Penstock:

Headrace tunnel diameter : 0.95 – 1.8 m

Headrace tunnel length : 3,152 m

Maximum operation discharge : 9.14 m³/s

Power station rated output : 40 MW

5) Xeset 1 Hydro Power Plant

The Xeset 1 Hydropower Plant is a run-of-river scheme utilizing about 1.5 km of the river with a drop of 157 m. As this type of scheme has limited storage capacity, the energy production can vary with the river discharge from day to day. The intake pond is created by a 10m high gravity dam. From the intake pond to the power house, the water is conveyed through underground tunnels, which are partly steel lined to withstand the high water pressure. The power house is built in the open air with five generating units, three with 13 MW capacity each, and two units with three MW capacity each. All works were carried out in one stage and completed in 1991 after two and a half years of construction.

Lao PDR received a loan from the Asian Development Bank (ADB), grants from the United Nations Development Programme (UNDP), and support from the Swedish and Norwegian Government to finance the project. The Xeset 1 Hydropower Plant supplies electricity to the provinces of Saravan and Champasak, with surplus exported to Thailand.

Summary of important technical information of Xeset 1 Hydropower Plant

1. Storage:

Catchment area : 325 km²

Reservoir dead storage : 0.3 x 106 m³

Full water level : 482 masl

Low water level : 478 masl

2. Dam

Height : 10 m

Length : 91 m

3. Operation Discharge System

Headrace tunnel length : 436 m

Headrace tunnel diameter : 3.2 m

Maximum operation discharge No. 1 or 2 : 2.25 m³/s

Maximum operation discharge No. 3, 4 or 5 : 9.5 m³/s

6) Xeset 2 Hydro Power Plant

Xeset 2 Hydropower Plant is located in the province of Saravan and Champasak in southern Lao PDR, approximately 35 km from Saravan city and five km from Xeset 1 Hydropower Plant.

A memorandum of understanding (MOU) on the development of Xeset 2 Hydropower Plant was signed in August 2001 between EDL and Norinco Company Limited (China). In October 2003, the basic design report was submitted to EDL and in January 2004, EDL invited consultants from Norway to review the basic design report. The final design report was accomplished in September 2005. Construction began in 2005 and was completed in 2009.

The Xeset 2 Hydropower Plant has two generating units with an installed capacity of 38 MW each, and an average production of approximately 309 GWh. In addition, the Xeset 2 Hydropower Plant is a run-of-river scheme, diverting water from Houay Tapoung to Xeset reservoir.

The project total cost was approximately USD 135.5 million; 80 percent or approximately USD 108 million came from a seller credit from the Export-Import Bank of China and the other 20 percent or approximately USD 27 million came from EDL local component.

Summary of important technical information of Xeset 2 Hydropower Plant

1. Xeset 2 Dam Area

Catchments area	:	392 km ²
Mean annual precipitation	:	2066 mm
Mean annual evaporation	:	1188 mm
Normal storage level of the reservoir	:	813 masl
Design flood level of the reservoir	:	816 masl
Total storage capacity	:	800,000 m ³
Installed capacity	:	2 x 38 MW

2. Houay Tapoung Dam Area

Normal storage level of the reservoir	:	824 masl
Design flood level of the reservoir	:	826 masl

7) Xelabam Hydro Power Plant

Xelabam Hydropower Plant is located in Champasak province, 35 km north of Pakse City. The Xelabam Hydropower Plant, which is the first hydropower plant in Lao PDR, is a small hydropower plant with an installed capacity of 5.04 MW and average energy capacity of 25 GWh per annum. Xelabam Hydropower Plant has played a significant role in producing and supplying electricity for socioeconomic development, in accordance with the GOL's policy.

The construction can be divided into two phases as follows:

Phase I:

Construction started in 1966 and was completed in 1970 with three units and an installed capacity of 850 KVA per unit.

Phase II:

Construction started in 1990 and completed in 1994 with one unit and an installed capacity of 3,530 KVA per unit.

Summary of important technical information of Selabam Hydropower Plant

1. Storage

Catchment area	:	6,360 km ²	:
Full water level	:	120.70 masl	
Low water level	:	118.80 masl	

2. Dam

Height	:	23 m
Length	:	435 m

3. Operation Discharge System

Headrace tunnel diameter (No. 1, 2 and 3)	:	2 m
Headrace tunnel diameter (No. 4)	:	3.2 m
Maximum operation discharge (No. 1, 2, 3)	:	15 m ³ /s
Maximum operation discharge (No. 4)	:	25 m ³ /s

8) Nam Sana Hydropower Plant

Nam Sana Hydropower Plant is located in Kasi district, Vientiane province, 7.5 km from Rd. 13 north. The Nam Sana Hydropower Plant is a run of river plant and three units with an installed capacity of 14 MW and average capacity of 4.69 MW per unit.

Summary of important technical information of Nam Sana Hydropower Plant

1. Storage

Catchment area	:	96 km ²
Mean Operating water Level	:	642 masl
Minimum Operation Level	:	640 masl

2. Main Dam and Embankment

Type	:	Concrete Weir
Height	:	7 m
Length	:	30 m

3. Powerhouse

Type	:	Surface
Dimension of Substructure	:	48.9 m x 16.75 m

4. Generating Equipment

4.1 Turbines

Number and Type of hydraulic Turbine	:	3/Horizontal Francis
Rated Output	:	14 MW
Rated Speed	:	750 rpm
Rated Head	:	145.77 m
Rated Discharge	:	4.07 m ³ /s per unit

4.2 Main Generators

Rated generator output when operating	:	4690 kW
at the rated net head of 145.77 m and discharge of 3.69 m ³		
Maximum generator output when operating:	:	5159 kW
at the rated net head of 145.77 m and discharge of 4.07 m ³		
Rate Power Factor	:	0.85 lagging
Rate Frequency	:	50 Hz
Rate Voltage	:	6.6 kV
Rate Speed	:	750 rpm

4.3 Main Transformers

Number and Type of transformers	:	3/3-phase, 2 windings. Oil
Rated Capacity	:	6.5 KV
Vector Group	:	Ynd1
Rated No-Load Voltage Ratio	:	6.6 kV / 22kV
Short Circuit Impedance	:	7.63%

5. Double circuit 22 kV Nam Sana switchyard to Kasi Substation.

9) Houay Lamphan Gnai Hydropower Plant

Houay Lamphan Gnai hydropower Plant is located in Kafe Village Thataeng district, Sekong province, 10 km from the power house site and the dam is located in Thongvide Village Thataeng district, Sekong province, 18 km from the dam site. The Houay Lamphan Gnai Hydropower Plant is a reservoir plant consisting of two units of with an installed capacity of 88 MW.

Summary of important technical information of Nam Sana Hydropower Plant

1. Reservoir

Catchment area	:	237 km ²
Est. long term mean flow	:	11.4 m ³ /s
Total reservoir storage	:	141 x 10 ⁶ m ³
Reservoir storage below the normal level	:	122 x 10 ⁶ m ³
Regulation reservoir capacity	:	19 x 10 ⁶ m ³
Normal storage water level	:	820 m
Dead water level	:	795 m
Reservoir areas at the normal water level	:	6.8 km ²

2. Main Dam

Type	:	Clay core rock – fill dam
Max. height	:	75.6 m
Crest length	:	557.3 m
Crest elevation	:	195 m
Crest width	:	8 m

3. Saddle Dam

Type	:	Homogenous earth dam
Max. height	:	75.6 m
Crest length	:	557.3 m

4. Spillway Tunnel

No. of gate	:	2
Type	:	WES curved weir
Opening diameter	:	7.5 m (W) x m (H)
Design Flood Discharge	:	718 m ³ /s

5. Flood Discharge Tunnel

Opening diameter	:	Radium 10m (pressurized/unpressurized)
Design Flood Discharge	:	718 m ³ /s
Check Flood Discharge	:	618 m ³ /s

6. Headrace Tunnel

No. of Tunnel	:	1
Length	:	2,598 m
Diameter	:	2.4 m
Lining	:	Reinforced concrete lining

7. Penstock

Length	:	2,134.2 m
Inner Diameter	:	2 m/m-trunk/branch
Max. Static Head	:	614

8. Powerhouse

Powerhouse structure	
Type	: Reinforced concrete
Dimension of Main Hall	: 44.7 m(L) x 31 m(W) x 31 m(H)
Dimension of secondary Hall	: 46 m(L) x 40.7 m(W)

9. Generating Equipment

No and Type of turbines	: 2 units / Vertical Shaft (Pelton type)
Rated Head	: 529 m
Rated Rotation d	: 428 r/min
Rate Discharge	: 9.69 m ³ /s (per Unit)
Total Installed Capacity	: 88 MW
Energy Output	: 480 GWh per year
Type of Generator	: 3 phase AC synchronous
Rated capacity	: 44 MW
Rated Voltage	: 11 kV

10. Interconnection with the EDL's Grid System

Transmission Line Voltage	: 115 kV
Conductors Size	: 300 mm ³
No of circuits	: 2
Length of Transmission Line	: 9 km
Transmission Destination	: Nongbonk Substation (Sekong Province)

10) Nam Khan 2

Nam Khan 2 is located in Nongdy Village, Xiengngern district, Luangpranang province, 34 km from Xiengngern. The Nam Khan 2 Hydropower Plant is a reservoir plant consisting of two units with an installed capacity of 130 MW and average capacity of 65 MW per unit.

Summary of important technical information of Nam Sana Hydropower Plant

1. Reservoir

Catchment area	: 5167 km ²
Est. long term mean flow	: 67 m ³ /s
Total reservoir storage	: 686.2 10 ⁹ m ³
Reservoir storage below the normal level	: 10 ⁹ m ³
Regulation reservoir capacity	: 10 ⁹ m ³
Normal storage water level	: 470 m
Dead water level	: 465 m
Reservoir areas at the normal water level	: 30 km ²

2. Main Dam

Type	: CFRD
Max. height	: 136 m
Crest length	: 10 m

Crest elevation	:	481 m
Crest width	:	371.75 m
3. Spillway Tunnel		
No. of gate	:	4
Type	:	Open type
Opening diameter	:	13.5 m(W) x 20(H)
Design Flood Discharge	:	9,974 m ³ /s
4. Flood Discharge Tunnel		
Opening diameter	:	Unpressurized
Design Flood Discharge	:	m ³ /s
Check Flood Discharge	:	m ³ /s
5. Headrace Tunnel		
No. of Tunnel	:	1
Length	:	173.3 m
Diameter	:	7 m
Lining	:	Reinforced concrete lining
6. Penstock		
Length	:	147.7 m
Inner Diameter	:	5.4, 3.7
Max. Static Head	:	m
7. Powerhouse		
Powerhouse structure		
Type	:	Hall
Dimension of Main Hall	:	56 m(L) x 18.5 m(W) x 60.5 m(H)
8. Generating Equipment		
No and Type of turbines	:	2 units / Vertical Shaft (Francis type)
Rated Head	:	111 m
Rated Rotation d	:	272.7 r/min
Rate Discharge	:	67 m ³ /s
Total Installed Capacity	:	130 MW
Energy Output	:	558 GWh per year
Type of Generator	:	3 phase AC synchronous
Rated capacity	:	66 MW
Rated Voltage	:	11 kV
9. Interconnection with the EDL's Grid System		
Transmission Line Voltage	:	115 kV
Conductors Size	:	240 mm ³
No of circuits	:	2
Length of Transmission Line	:	23.792 km
Transmission Destination	:	Luangprabang2 Substation

A single line diagram is to be attached indicating the following:

- Delivery Point : Switchyard of Project Power Station
- Metering Point – in – duty and back-up meters: Switchyard of Project Power Station.

4.2 Project Investments in IPPs

As of 30 September 2018, the Company has invested in 13 IPPs and one solar power project in order to improve the Company's capacity to respond the increase in demand for power. These IPPs and the solar power project gives the Company's a total equity attributed capacity of 853.2 MW. A summary of the IPPs is set out in table below, followed by detailed description of IPPs that are currently operational.

EDL-Gen's IPPs

Power Plant	Location	%	Equity attributable Capacity (MW)	COD	Transfer Year
Nam Ngum 2	Vientiane	25	154	2011	2012
Nam Lik 1-2	Vientiane	10	10	2010	2012
Theun-Hinboun	Bolikhamxai	60	300	1998,2013	2012
Houay Ho	Champasak	20	30	1998	2012
Nam Ngum 5	Vientiane	15	18	2012	2015
EDL Solar power	Vientiane	60	19.2	2017; 2018	2017; 2018
Nam Long	Luangnamtha	20	1	2013	2018
Nam Beng	Oudomxay	10	3.4	2016	2018
Don Sahong	Champasak	20	52	2019	2019
Lower HLP	Sekong	60	9	2020	2021
Nam Dik 1	Huaphan	70	8.4	2021	2021
Nam Phoun	Xayaboury	50	23	2021	2021
Nam Bi 1-2-3	Xekong	80	108	2023	2022
Nam Theun 1	Borikhamxay	15	97.5	2022	2022
Total IPP Capacity (MW)			853.2		

1) Theun Hinboun Hydropower Project

The Theun Hinboun Hydropower Project (excluding the expansion project and Nam Gnuang) achieved its commercial operations in 1998. Currently, the Company holds 60 percent of the total share capital, while GMS Lao Company Limited and Statkraft SF (Norway) each hold 20 percent of the total share capital. In order to increase the generating capacity of the project, the expansion project consisting of Theun Hinboun Expansion (220 MW) and Nam Gnuang (60 MW) was initiated and later completed in 2012. Currently, the total combined installed capacity of Theun Hinboun Hydropower Project stands at 500 MW, of which 440 MW of electricity is exported Thailand and 60 MW is supplied to EDL.

The hydropower project of the Theun Hinboun Power Company (THPC) (excluding the expansion and Nam Gnuang Projects) is a run-of-river dam which diverts approximately

110 m³/s of water from the Nam Theun through a tunnel into the power plant located at the valley 240 meters below the dam level. The water flows into the spillway and the reservoir before being released into the Hai River, which is a part of Hinboun River. This hydropower project uses modern equipment produced by various international companies, including ABB Generator (Sweden) and Kvaener Energy (Norway). In addition, the power plant was designed and constructed by an international engineering company.

The primary purchaser of THPC (excluding the Expansion and Nam Gnouang Projects) is EGAT. Under the 27 years power purchase agreement (PPA), EGAT will be supplied at least 95 percent of all the power generated. In addition, THPC is supplying the power generated to EDL in response to the electricity demand in the local area of Bolikhamxai and Khammouan provinces.

The main capital contributor in this IPP projects the collaboration between the USD loan facilities provided by various international financial institutions for the amount of USD 84 million and THB loan facilities provided by a group of Thai commercial banks for the amount of THB 2.8 billion.

In April 2002, THPC completed its restructuring to repay its debt in the amount of USD 152 million.

With the consultation of the GOL and project-affected persons, THPC has already paid the compensation in the amount of more than USD 2.5 million to compensate and mitigate all the environmental and social effects caused by the Project. In addition to the proper performance of its obligations as agreed by the GOL, THPC also contributes its funding to provide financial assistance to other projects arranged by the provincial or district authorities such as the construction of schools, bridges and the ferry connecting to Route Number One at Bolikhamxai province.

In the years after it commenced operations, THPC found additional effects caused by the Project which have been left unsolved. At the end of 1999, THPC proposed to the ADB to send a committee to study and monitor measures that have been implemented at the site and to conduct further research for other recommended solutions. Thereafter, at the beginning of 2000, THPC engaged an experienced consultant to seek and prepare the mitigation measures with diligence in order to further its measures to mitigate the effects from the Project. At the end of 2000, the ten-year Mitigation and Compensation Measure (MCM) was established and subsequently at the beginning of 2001, THPC established its internal Environment Management Unit (EMU) to implement the MCM. The initial implementation plan of the MCM is to designate the scope of work and the budget plan.

The summary of the important technical information of the Theun Hinboun Hydropower Project (excluding the Expansion and Nam Gnouang Projects) is as follows:

1. Reservoir

Catchment area	:	8,937 km ²
Yearly averaged discharge capacity	:	460 m ³ /s

2. Dam

Type	:	Concrete gravity
Crest elevation	:	400 masl
Height	:	25 m
Width	:	268 m

3. Headrace Tunnel

Type	:	Concrete-lined
Width	:	5,540 m
Cross section	:	48.5 m
Height (above the penstock)	:	390.7 m
Discharge capacity as designed	:	110 m ³ /s

4. Tailrace Canal

Diameter	:	5.2 m
Length	:	900 m

5. Powerhouse

Type and number of units	:	2 units of aboveground powerhouse
Turbine type	:	Vertical Francis
Water supply for the generation (through turbine)	:	2 x 55 m ³ /s
Gross head	:	230 m
Installed capacity	:	2 x 105 MW
Yearly averaged power generated	:	1,561 GWh

6. Downstream Channel

Length	:	3,500 m
Width	:	12 m
Depth at the maximum discharge	:	4 m
Storage volume	:	540,000 m ³

7. Transmission Line

Type	:	Double circuit (Alternating Current)
Voltage	:	230 kV
Distance from the powerhouse to Thakek switchyard	:	86 km
Distance from Thakek switchyard to Sakonnakhon substation	:	74 km

2) Houay Ho Hydropower Project

Houay Ho Hydropower Project (152 MW) began commercial operation in 1999. The project's existing shareholders are Glow Company Limited, Hoyay Ho Thai Co., Ltd and EDL, holding 55 percent, 20 percent and 20 percent of the total share capital respectively. In addition to the equity contribution, this Project received loans from many international private banks.

Of the electricity generated, 98 percent is supplied to EGAT in accordance with the Take-or-Pay commitment clause of the PPA for the period of 30 years and the remaining power energy is supplied to EDL's grid for distribution to the adjacent areas.

This Project was developed in 1993 by Daewoo Engineering and Construction (Korea), who was also the equity contribution to the Project as a construction contractor. Daewoo Corporation entered into a confidentiality agreement (CA) with the GOL on 23 September 1993 for the concession period of 30 years, 1999 to 2029.

The summary of the important technical information of the Houay Ho Hydropower Project is as follows:

1. Reservoir

Reservoir area	:	37 km ²
Maximum flood level	:	883 masl
Minimum flood level	:	861 masl
Effective volume	:	527 x 106 m ³
Maximum flowing volume	:	22 m ³ /s
Yearly averaged rainfall	:	2,300 mm
Catchment area	:	192 km ²

2. Dam

Type	:	mixed concrete
Height	:	79 m
Volume	:	1.11 x 106 m ³

3. Powerhouse and Transmission Line

Installed capacity	:	150 MW (75 MW x 2) and the small turbine unit of 2.1 MW for the domestic supply
Turbine brand	:	Pelton
Gross head	:	775.5 m
Waterway	:	3,540 m (pressured underground tunnel)
Transmission line	:	230 kV x 2 (for the length of more than 161 km to the Thai-Lao border)

3) Nam Lik 1-2 Hydropower Project

Nam Lik 1-2 Hydropower Project (100 MW) was established as a joint venture between China Water & Energy, Ltd. and EDL, each holding 90 and 10 percent of the total share capital respectively. According to the PPA between EDL and the Nam Lik Power Company (NLPC) executed on 19 November 2006, all of the power generated is to be conveyed by the 115 kV transmission lines of EDL, in accordance with the Take-or-Pay Commitment for the period of 25 years for the domestic consumption. The Project began construction in 2007 and was completed in 2010; it achieved commercial operation in 29 August 2011.

The summary of the important technical information of the Nam Lik 1-2 Hydropower Project is as follows:

1. Reservoir

Catchment area	:	1,993 km ²
Estimated long term mean flow	:	883 masl
Total reservoir storage	:	84.9 m ³ /s
Reservoir storage below the normal level	:	1.33 x 10 ⁹ m ³
Regulation reservoir capacity	:	0.97 x 10 ⁹ m ³
Normal storage water level	:	305.0 m
Dead water level	:	275.0 m
Reservoir areas at the normal water level	:	46 km ²

2. Main Dam

Type	:	Concrete faced rockfill dam
Maximum height	:	103.0 m
Crest length	:	327.84 m

3. Saddle Dam

Type	:	Homogenous earth dam
Maximum height	:	5 m / 10 m / 16 m
Crest length	:	44 m / 81 m / 102.3 m

4. Spillway Tunnel

Type	:	WES curved weir / tunnel
Opening dimension	:	13 m (W) x 20 m (H)
Design flood discharge	:	2,513 m ³ /s

5. Flood Discharge Tunnel

Opening dimension (pressurized / unpressurized)	:	Radium 6 m/ 10 m x 12 m
Design flood discharge	:	1,371 m ³ /s
Check flood discharge	:	1,390 m ³ /s

6. Headrace Tunnel

Number of tunnel	:	1 unit
------------------	---	--------

Length	:	280.73m
Diameter	:	8.0 m
Lining	:	Reinforced concrete lining

7. Penstock

Length	:	128.94m
Inner diameter	:	6.4 m / 4.0 m - - trunk / branch
Maximum static head	:	85.71 m

8. Powerhouse

Type	:	Surface
Dimension of main hall	:	60 m (l) x 21.6 m (w) x 43.67 m (h)
Dimension of secondary hall	:	21.6 m (L) x 12 m (W)

9. Generating Equipment

Number and type of turbines	:	2 units / HL240-LJ-300 (Francis type)
Rated head	:	72 m
Rated rotation	:	214.3 r/min
Rated discharge	:	80.31 m ³ /s
Total installed capacity	:	2 x 50 MW
Energy output	:	435 GWh per year
Type of generator	:	SF50-28 / 6300
Rated capacity	:	50 MW
Rated voltage	:	10.5 kV

10. Interconnection with the EDL's Grid System

Transmission line voltage	:	115 kV
Conductors size	:	240 mm ²
Number of circuits	:	2
Length of transmission line	:	15 km
Transmission destination	:	Nam Lik – Ban Don

4) Nam Ngum 2 Hydropower Project

Nam Ngum 2 Hydropower Project (615 MW) achieved its initial operations on 26 March 2011.. The Project was established as a joint venture between South East Asia Energy Limited holding 75 percent of the total share capital and EDL holding 25 percent of the total share capital.

Nam Ngum 2 Hydropower Project has generating capacity of 2,310 GWh per year. All the power generated from Nam Ngum 2 Hydropower Project is distributed to Thailand via EGAT's grid, resulting in benefits for both Thailand and Lao PDR.

Nam Ngum 2 Hydropower Project commenced its initial study pursuant to the UNDP in cooperation with the International Bank for Reconstruction and Development (IBRD) in 1986 and conducted the feasibility of the Project study from 1986 to 1996. Subsequently, the Project entered into the PPA with EGAT in 2005 and entered into the CA with the GOL on 14 March 2006.

The summary of the important technical information of the Nam Ngum 2 Hydropower Project is as follows:

1. Reservoir

Reservoir Area	:	5,640 km ²
Yearly averaged discharge capacity	:	6,270 MCM
Full supply level	:	378.75 masl
Maximum flood level	:	375 masl
Reservoir area (full supply level)	:	122 km ²
Storage (full supply level)	:	6,774 MCM
Minimum operating level	:	345 masl
Storage (minimum operating level)	:	3,780 MCM
Active storage	:	2,994 MCM

2. Dam

Type	:	concrete face rockfill
Crest length	:	485 m
Crest level	:	381 masl
Height from foundation	:	181 m
Width of concrete face	:	0.30 – 0.90 m

3. Headrace Tunnel

Type	:	concrete-lined divided into 2 tunnels
Diameter	:	11.7 m
Length of the first tunnel	:	1,141 m
Length of the second tunnel	:	1,263 m
Height (above the penstock)	:	209.1 masl

4. Tailrace Canal

Amount	:	3 units
Diameter	:	5.35 m
Length	:	212 m

5) Nam Ngum 5 Power Co., Ltd. Project

Nam Ngum 5 Power Co., Ltd. Project (120 MW) began its initial operations on 2 December 2012. The Project was a joint investment between Sinhydro Corporation (China) and EDL.

Nam Ngum 5 Power Co., Ltd. Project has generating capacity of 507 GWh per year. All the power generated from the Project is supplied to EDL in accordance with the Take-or-Pay Commitment for the period of 25 years.

The summary of the important technical information of the Nam Ngum 5 Power Co., Ltd. Project

1. Reservoir

Reservoir Area	:	483 km ²
Yearly averaged discharge capacity	:	314 MCM
Full supply level	:	1,100 masl
Reservoir area (full supply level)	:	15 km ²
Minimum operating level	:	1,060 masl

2. Dam

Type	:	concrete face rockfill
Crest length	:	234.83 m
Crest level	:	99 masl
Height from foundation	:	99 m

3. Headrace Tunnel

Type	:	concrete-lined
Diameter	:	4.2 m
Length	:	8,917 m

6) EDL-GEN Solar Power

Background

EDL-Gen Solar was established to secure energy supply stability and sufficiency for serving the increasing energy demand of the society. The project was established on 18 December 2015 after a thorough consideration of the Ministry of Energy and Mines (MOEM), resulting in a strong support from the MOEM, EDL and EDL-Gen and in order to gradually realize the government's policy on renewable energy development. EDL-Gen Solar Power Company Limited is a joint venture company which is 60% owned by EDL-Generation Public Company and the other 40% is owned by Patthana Energy Absolute Sole Co., LTD.

Vision: EDL-Gen Solar Power Limited has strong desire:

1. To be a number one leading company in renewable energy in Lao PDR to ensure the supply of electricity for the socio-economic development of Lao PDR, together with electricity produced by water resources (hydropower plants).
2. To be a company which strongly contributes to the realization of Lao PDR's vision of being a battery of ASEAN in order to contribute and ensure sustainable and reliable power supply to ASEAN community.

Mission

1. To be a number one leading company in electricity generating business by renewable energy to provide Lao PDR and neighboring nations, with sustainable power at reasonable prices and to become a future public company listed in Lao Securities Exchange (LSX).
2. To stand side by side closely with EDL-Generation Public Company in order to maintain sustainable power both quality and quantity in order to supply electricity for socio-economic development of Lao PDR as well as the ASEAN nations.
3. To upgrade and train its staff, so that they can actively participate in the development of the company with pride, responsibility and ownership.

Core Business

1. To generate electricity by solar, wind farms as well as by other renewable energy sources and sell this electricity to EDL.
2. To jointly invest with both local and international investors to generate electricity by various renewable energy, in particular solar farm to supply domestic energy demand as well as ASEAN neighboring countries demand.
3. To provide services in installation of solar roofing and solar street lights systems.
4. To generate renewable power to support agricultural production as well as clean water supply to communities.

Current Solar Power Project and Expansion Plan:

EDLGEN – Solar Power First Project is located at Chaengsavang village, Naxaithong district, Vientiane capital, 2017. According to the agreement between EDL and EDL-Gen Solar Power Limited, solar power electricity generation with 100 megawatts are set for 2 phases:

Phase 1 with installed capacity of 32 megawatts are planned in Vientiane capital

- The 3 and 1.8 megawatts projects is located at Chaengsavang Village, Naxaythong District, Vientiane Capital
- The 7 and 8 megawatts projects is located at Phonkham Village, Pak Ngum District, Vientiane Capital
- The 2 megawatts project is located at Nahoi Village, Sangthong District, Vientiane Capital
- The 5.2 megawatts project is located at Mai Village, Sikhodtabong District, Vientiane Capital
- The 5 megawatts project is located at Sisavath Village, Naxaythong District, Vientiane Capital

Phase 2 with installed capacity of 68 megawatts are planned to operate the construction in the potential area which the projects can linked to where the EDL's transmission lines reached.

Obligated Assets

As of 30 September 2018, the Company did not have any obliged, mortgaged, or pledged operating assets.