CHAPTER 3

Network System in North and Central 1 of EDL

3.1 Network System in North and Central-1 of EDL

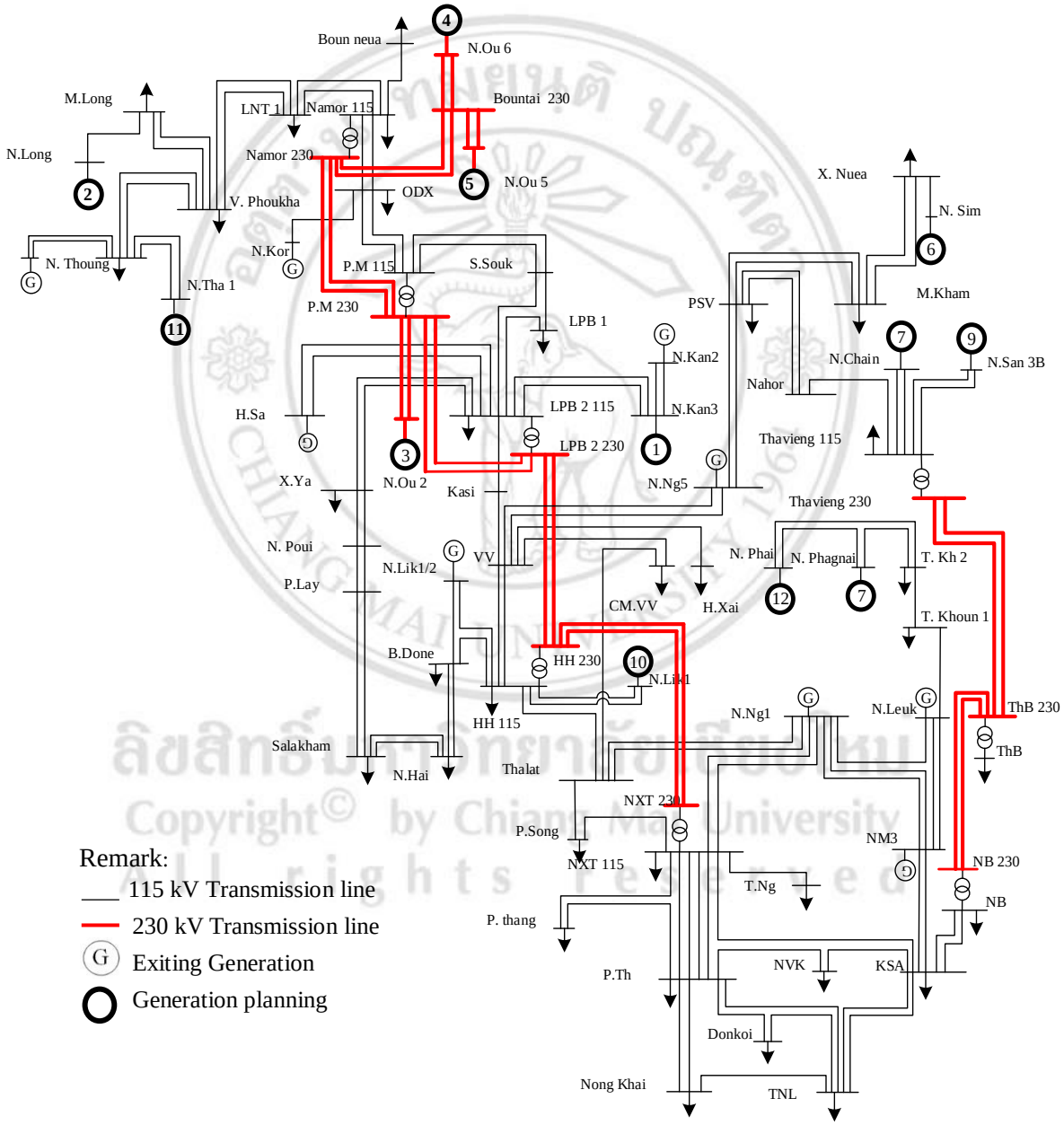

Figure 3. 1 The network system in north and central 1 of EDL.

Figure 3.1 as shown the network system of EDL was already linked between north and central 1 region. The northern region has six generations with 241 MW of installed capacity. The central 1 region has seven generations, which have 503 MW of installed capacity. The transmission line is operated in the voltage range of 115 kV to 230 kV with the total length is 6,198 km [1], [2].

Presently, the network system of EDL is divided into 4 part such as: Northern, Central 1, Central and southern region, which are detailed below.

- Northern region consists 6 Provinces such as Phongsaly Province, LangNamtha Province, Oudomxai Province, Bokeo Province, LangPrabang Province and Xayabury Province.
- Central 1 region consists 4 Provinces such as Vientiane Capital, Huaphanh Province, Xiengkhuang Province and Vientiane Province.
- Central 2 region consists 3 Provinces such as Borikhamxay Province, Khammuane Province and Savannakhet Province.
- South region consists 4 Provinces such as Saravane Province, Sekong Province, Champasack Province and Attapeu Province.

3.2 Existing Generation in North and Central-1 Region

3.2.1 Northern

The existing generation in the north region has Nam Dong, Nam Kor, Nam Nhon, Nam Tha 3, Nam Long, Nam Khan 2 and Hongsa lignite. The total installs capacity has 241 MW. The detail are shown in Table 3.1 and Figure 3.2.

Table 3. 1 Existing Generation in the north region.

No.	Name of Project	Location	Installed Capacity (MW)	COD	Owner-ships
	North				
1	Nam Dong	Luangprabang	1	1970	EDL
2	Nam Nhon	Borkeo	3	2011	IPP.D
3	Nam Tha 3	Luangnamtha	1.25	2011	IPP.D
4	Nam Long 1	Luangnamtha	5.5	2014	IPP.D
5	Hongsa Lignite	Xayaboury	100	2015	IPP.E
6	Nam Khan 2	Luangprabang	130	2015	EDL
	Total		241		

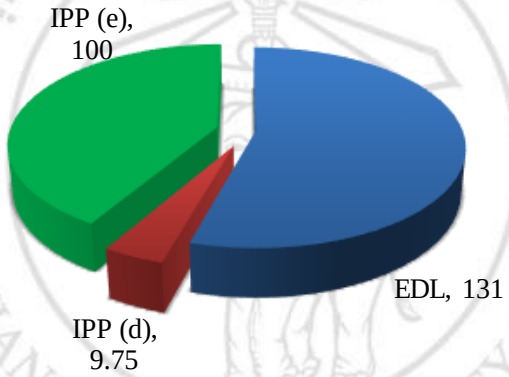

Figure 3. 2 The install capacity of existing generation in north region.

3.2.2 Central 1

Existing Generation Facilities in central 1 has NamNgaum1, Nam Leuk, Nam Mang 3, Nam Lik 1/2, Nam Song, Nam Ngum 5, and Nam Sana hydropower plant. The total install capacity has 355MW. As detailed in Table 3.2 and Figure 3.3.

Table 3. 2 Existing Generation in the north region.

No.	Name of Project	Location	Installed Capacity (MW)	COD	Owner-ships
	Central 1				
7	Nam Ngum 1 (H)	Vientiane	155	1971	EDL
8	Nam Mang3 (H)	Vientiane	40	2004	EDL
9	Nam Leuk (H)	Vientiane	60	2000	EDL
10	Nam Lik 1/2	Vientiane	100	2010	IPP.D
11	Nam song (Ex)	Vientiane	13.5	2011	EDL
12	Nam Ngum 5	Xieng Khuang	120	2012	IPP.D
13	Nam Sana	Vientiane	14	2014	EDL
	Total		503		

Figure 3. 3 The install capacity of existing generation in central 1 region.

3.3 Existing Transmission Line

The existing transmission line of EDL was already linked between northern and central 1 which connected height voltage (115 and 230 kV). The system in EDL was also interconnected with neighboring countries for the purpose of exchange power (Import/Export) each other. The lengths of transmission line is total 1,905.7 km, 2556.9 cct-km [1], [2].

3.3.1 Northern

The transmission line system in the north region with connected to china power system by a single circuit of 115 kV transmission line from Namo substation, Oudomxay province (Lao PDR) – Meung La substation (China), which this point EDL has 60 MW energy imports. And the connected with Provincial Electricity Authority of

Thailand (PEA) via the 22kV distribution line. The lengths of the transmission line are total 497.2 km, 676.7 cct-km. As shown in Table 3.3 below.

Table 3. 3 Existing transmission line in the north region.

No	Project		Length		No. cct	Voltage	Conductor	
	Form	To	(Km)	(cct-km)		(kV)	Type	(Sq.mm)
	North							
1	Luang Prabang 1	Xieng Ngeun	15	15	1	115	ACSR	(1x117)
2	Xieng Ngeun	Xayaboury	74.6	75	1	115	ACSR	(1x240)
3	M. La	Na Mo	34.4	34.4	1	115	ACSR	(1x185)
4	Na Mo	Luangnamta	42.7	42.7	1	115	ACSR	(1x240)
5	Pakmong	Sensouk	86.9	173.8	2	115	ACSR	(1x240)
6	Sensouk	Luangprabang 1	16	16	1	115	ACSR	(1x240)
7	Na Mo	Oudomxai	40.86	81.72	2	115	ACSR	(1x240)
8	Oudomxai	Pakmong	51.71	103.4	2	115	ACSR	(1x240)
9	Xieng Ngeun	kasi	75	75	1	115	ACSR	(1x117)
10	kasi	Vang Vieng	60	60	1	115	ACSR	(1x117)
Total North			497.2	676.7	13			

3.3.2 Central 1

The high voltage transmission systems in Central 1 is connected to three major hydropower plant such as Nam Ngum 1, Nam Mang 3 and Nam Leuk. The central 1 has imported energy from three major to response energy for the Vientiane Capital. And the 115 kV transmission system is also interconnected to EGAT's system for the purposes of exchange power each other (import/export). The lengths of the transmission line are total 1408.5 km, 1880.2 cct-km. The detail is shown in Table 3.4.

Table 3. 4 Existing transmission line in the central 1 region.

No.	Project		Length		No. cct	Voltage	Conductor	
	Form	To	(Km)	(cct-km)		(kV)	Type	(Sq.mm)
1	Nam Ngum 1	Thalat	4.8	9.6	2	115	ACSR	(1x240)
2	Phontong	Nong Khai	25.7	51.4	2	115	ACSR	(1x240)
3	Thalat	Phonsoung	16.5	16.5	1	115	ACSR	(1x240)
4	Thanaleng	Nong Khai	9.2	9.2	1	115	ACSR	(1x240)
5	Naxaithong	Tha Ngon	12	12	1	115	ACSR	(1x185)
6	Thalat	Vang Vieng	63.5	63.5	1	115	ACSR	(1x117)
7	Nam Ngum 1	Naxaithong	61	122	2	115	ACSR	(1x240)
8	Nam Ngum 1	Nam Leuk	55.2	55.2	1	115	ACSR	(1x240)
9	Ban Don	NonHai	54	54	1	115	ACSR	(1x240)
10	Nam Mang 3	Khoksa-at	34.5	34.5	1	115	ACSR	(1x240)
11	Koksa-at	Thanaleng	18.5	18.5	1	115	ACSR	(1x240)
12	Naxaithong	Phontong	12.8	38.4	3	115	ACSR	(1x240)

Table 3.4 (Continued)

No.	Project		Length		No. cct	Voltage	Conductor	
	Form	To	(Km)	(cct-km)		(kV)	Type	(Sq.mm)
13	Nam Leuk	Thongkhoun	59	59	1	115	ACSR	(1x240)
14	Thongkhoun 1	Phubai Mining	13	13	1	115	ACSR	(1x240)
15	Hinheup	Thalat	27	27	1	115	ACSR	(1x240)
16	Hinheup	Ban Don	20	20	1	115	ACSR	(1x240)
17	Vang Vieng	Hin Heup	44.6	89.3	2	115	ACSR	(1x240)
18	Vang Vieng	Nam Ngum 5	75	150	2	115	ACSR	(1x240)
19	Nam Ngum 5	Phonsavan	67	67	1	115	ACSR	(1x240)
20	Nam Lik 1/2	Hin Heup	31	31	1	115	ACSR	(1x240)
21	Nam Lik 1/2	Ban Don	16	16	1	115	ACSR	(1x240)
22	Phonsavan	Xam Neua	176	176	1	115	ACSR	(1x240)
23	Hinheup	Naxaithong	72	143	2	230	ACSR	(1x630)
26	Nam Mang 3	Kaly Protus	7	7	1	115	ACSR	(1x185)
27	Naxaithong	Pakthang	8	8	1	115	ACSR	(1x240)
28	Pakthang	Phontong	4.5	4.5	1	115	ACSR	(1x240)
29	Phontong	Don Koi	10	10	1	115	ACSR	(1x240)
30	Donkoi	Thanaleng	13	13	1	115	ACSR	(1x240)
31	Naxaithong	Nongviengkham	10	10	1	115	ACSR	(1x240)
32	Nongviengkham	Khoksa-at	11	11	1	115	ACSR	(1x240)
33	Nam Mang 3	Iron melting (Tha Ngon)	30	30	1	115	ACSR	(1x240)
34	Vang Vieng	Hoysai	38	38	1	115	ACSR	(1x240)
35	Phonsoung	Naxaithong	30	30	1	116	ACSR	(1x240)
36	Hinheup	Luangprabang 2	164	328	2	230	ACSR	(1x630)
37	Thongkhoun 2	Nahor	81.6	81.6	1	115	ACSR	(1x240)
38	Nahor	Phonsavan	33	33	1	115	ACSR	(1x240)
Total Central 1			1408.5	1880.2	46			

3.4 Load Demand Forecast

Presently, the electricity demand in Lao PDR has increased rapidly such as mining industries, manufacture, business, services and rural electrification projects of the government of Laos (GOL) to alleviate the poverty of the people in the country. The electricity demand forecast is importance for the power development, the transmission lines expansion, substations, distributions and others of EDL [2].

3.4.1 Northern

The electricity demand forecast in the northern region is divided two parts (General section and Large industry). The general section is forecasted the residential and non-residential energy consumption, which the energy consumption forecasts from the households, government office, enterprise, education - spot, entertainment, and agriculture. The large industry forecast from the energy consumption of industrial, industrial processing, special economic zone, and the high-speed train construction.

The table 3.5 shown the electricity demand forecast period 2015-2025. The energy demand of general section has increased because of the rural electrification projects. As shown in Table 3.5 and Figure 3.4.

Table 3. 5 Load demand forecast of north region.

Actual		Forecast										Unit: MW
2014		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GENERAL SECTOR	110	123	141	169	188	200	214	230	244	260	277	294
LARGE INDUSTRIES	9	9	10	15	20	42	95	113	117	137	158	183
TOTAL	**107**	**132**	**151**	**184**	**208**	**242**	**309**	**342**	**361**	**397**	**435**	**476**

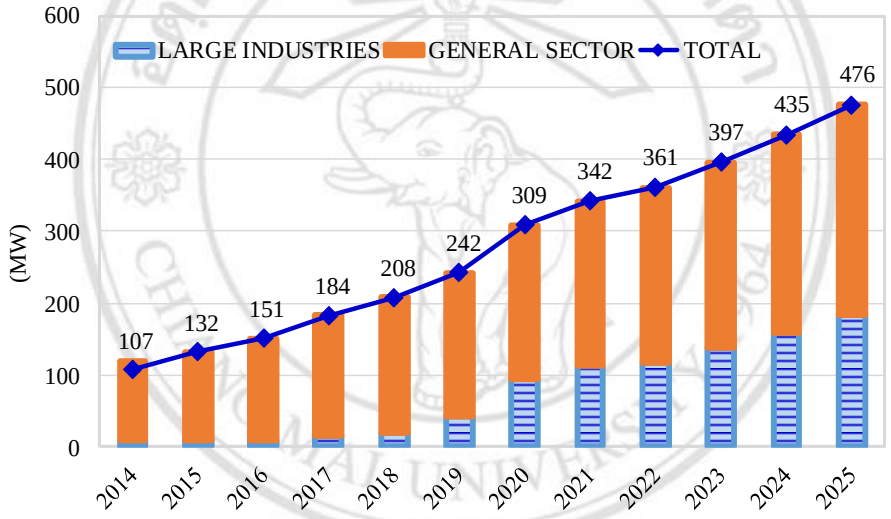

Figure 3. 4 The load demand forecast of north region.

3.4.2 Central 1

The electricity demand forecast in the central 1 region is divided two parts (General section and Large industry). The general section is forecasted the residential and non-residential energy consumption, which the energy consumption forecasts from the households, government office, enterprise, education - spot, entertainment, and agriculture. The large industry forecast from the energy consumption of industrial, industrial processing, special economic zone, and the high-speed train construction.

The table 3.5 shown the electricity demand forecast period 2015-2025. The energy demand of large industry has increased because in the central 1 have the special

economic zone project, industrial and supermarket. As shown in Table 3.6 and Figure 3.5.

Table 3. 6 Load demand forecast of central 1 region.

Actual		Forecast										Unit: MW
2014		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GENERAL SECTOR	401	436	491	553	612	671	731	788	857	919	981	1,044
LARGE INDUSTRIES	94	103	146	220	322	423	542	659	734	806	955	1,027
TOTAL	**480**	**539**	**638**	**773**	**934**	**1,094**	**1,273**	**1,447**	**1,591**	**1,725**	**1,935**	**2,072**

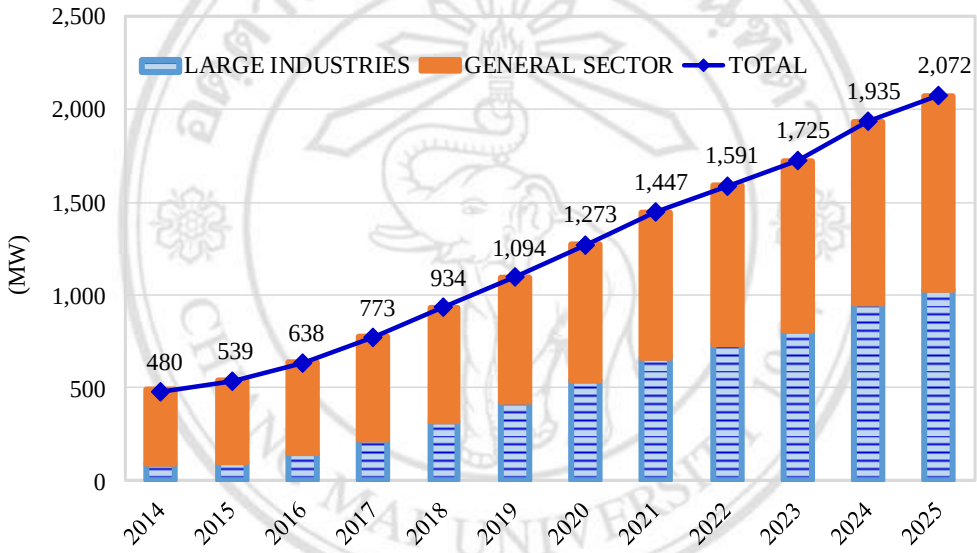

Figure 3. 5 The load demand forecast of central 1 region.

3.5 Power Development Plan of EDL in 2015-2025

Power development plan (PDP) of EDL is an important role for developing the economic-social because the electrical section is the base factor that effects to the economic growth of the nation which can the income to the country. To responding the energy demand for the domestic energy consumption and export to the neighboring country. Therefore the EDL has defined the policy for developing in the future [2].

- The EDL will be investing the new production source construction such as hydropower plant, solar cell, wind, thermal, and other.

- The EDL will be buying the total power energy produced from the SPP/IPP.D and IPP.E.

- The EDL will be imported the energy from the neighboring country by the reasonable price.

3.5.1 Northern

The PDP of EDL in the north region to respond energy reasonable in future. The PDP consist of the under construction, concession agreement (CA), project development agreement (PDA), feasibility study Approval (FS), and memorandums of understanding (MOU). Detail is shown in Table 3.7.

Table 3. 7 Power development plan of north region.

No.	Power Plant	Provinces	Ins. Capacities (MW)	COD Year	Owner	Status
1	Nam Khan 3 (H)	Luangprabang	60	2016	EDL	Under Construction
2	Nam Long 2 (H)	Luangnamtha	12.5	2016	IPP.D	Under Construction
3	Nam Ou 2 (H)	Luangprabang	120	2016	IPP.D	Under Construction
4	Nam Ou 5 (H)	Phongsaly	240	2016	IPP.D	Under Construction
5	Nam Ou 6 (H)	Phongsaly	180	2016	IPP.D	Under Construction
6	Nam Seng (H)	Luangprabang	1.2	2017	EDL	FS
7	Nam Boun 2 (H)	Phongsaly	15.0	2017	IPP.D	FS
8	Nam Tha 1 (H)	Borkeo	168	2018	IPP.D	Under Construction
9	Nam Ham 2 (H)	Xayaboury	5	2018	IPP.D	FS
10	Nam Pha (H)	Luangnamtha	180	2019	IPP.D	PDA
11	Nam Phoun (H)	Xayaboury	60	2019	IPP.D	CA
12	Nam Ou 3 (H)	Luangprabang	210	2020	IPP.D	CA
13	Nam Ou 4 (H)	Phongsaly	132	2020	IPP.D	CA
14	Nam Ou 7 (H)	Phongsaly	210	2020	IPP.D	CA
15	Nam Phak 1 (H)	Oudomxay	28	2020	EDL	FS
16	Nam Phak 2 (H)	Oudomxay	28	2020	EDL	FS
17	Nam Nga (H)	Luangprabang	100	2020	IPP.D	FS
18	Nam Phak 3 (H)	Oudomxay	40	2021	EDL	FS
19	Nam Seung 1 (H)	Luangprabang	30	2021	IPP.D	MOU
20	Nam Mee (H)	Luangnamtha	15	2021	IPP.D	FS
21	Nam Bak (B. Phonesai) (H)	Luangprabang	15	2021	IPP.D	FS
22	Nam May (H)	Luangnamtha	5	2021	IPP.D	FS
23	Nam Tha 2 (B. HatGnao) (H)	Luangnamtha	25	2021	IPP.D	FS
24	Nam Houng Ton Neua (H)	Xayaboury	5	2021	IPP.D	FS
25	Nam Ngao (H)	Borkeo	20	2021	EDL	FS

Table 3.7 Power development plan of north region (Continued).

No.	Power Plant	Provinces	Ins. Capacities (MW)	COD Year	Owner	Status
26	Nam Ou 1 (H)	Luangprabang	180	2021	IPP.D	CA
27	Nam Ban (H)	Phongsaly	12	2022	IPP.D	FS
28	Nam Meuk 1 (H)	Phongsaly	10	2022	IPP.D	FS
29	Nam Seung 2 (H)	Luangprabang	108	2022	IPP.D	MOU
30	Nam Tha 2 (B. Hat Mouak) (H)	Luangnamtha	14.8	2023	IPP.D	FS
31	Nam Pheir (H)	Phongsaly	13	2023	IPP.D	FS
32	Nam Ngum-Nam Ken (H)	Xayaboury	70	2023	EDL	FS
33	Nam Poui (H)	Xayaboury	60	2023	IPP.D	FS
34	Nam Mat (H)	Luangprabang	15	2023	IPP.D	MOU
35	Nam Leng (H)	Phongsaly	60	2024	IPP.D	PDA
36	Nam Noua 1 (H)	Phongsaly	15	2024	IPP.D	MOU
37	Nam Ta Lan (H)	Luangnamtha	15	2024	IPP.D	FS
38	Nam Mouk 2 (H)	Phongsaly	44	2024	EDL	FS
39	Nam Seung 3 (H)	Luangprabang	42	2024	IPP.D	MOU
40	Nam Seung 4 (H)	Luangprabang	47.1	2024	IPP.D	MOU
41	Nam Seung 5 (H)	Luangprabang	72	2025	IPP.D	MOU
42	Nam Ou 8 (H)	Phongsaly	15	2025	IPP.D	FS
43	Nam Houn 1	Phongsaly	15	2025	IPP.D	FS
44	Nam Hoi (H)	Phongsaly	15	2025	IPP.D	FS
45	MK. PakLay (H)	Xayaboury	1320	2025	IPP.E	FS
46	MK. Pakbeng (H)	Oudomxay	912	2025	IPP.D	PDA
	EDL		**291**			
	IPP.D		**3,348**			
	IPP.E		**1,320**			
	Total		**4,960**			

3.5.2 Central 1

The PDP of EDL in the central 1 region to respond energy reasonable in future. The PDP consist of the under construction, concession agreement (CA), project development agreement (PDA), feasibility study Approval (FS), and memorandums of understanding (MOU). Detail is shown in Table 3.8.

Table 3. 8 Power development plan of central 1 region.

No.	Power Plant	Provinces	Ins. Capacities (MW)	COD Year	Owner	Status
1	Nam PhaGnai (H)	Saysomboun	15	2016	IPP.D	Under Construction
2	Nam Sim (H)	Houaphanh	9	2016	IPP.D	Under Construction
3	Nam San 3B (H)	Saysomboun	45	2016	IPP.D	Under Construction
4	Nam Chiene 1 (H)	Saysomboun	104	2016	EDL	Under Construction
5	Nam Lik 1 (H)	Vientiane Pro	65	2017	IPP.D	Under Construction
6	Nam Mon 1 (H)	Houaphanh	12	2017	IPP.D	FS
7	Nam Mon (H)	Vientiane Pro	6	2017	IPP.D	FS
8	Nam Phai (H)	Saysomboun	86	2018	IPP.D	Under Construction
9	Nam Phouan (H)	Saysomboun	53	2018	IPP.D	PDA
10	Nam Them (H)	Vientiane Pro	4	2018	IPP.D	FS
11	Nam The (H)	Xieng khuang	15	2018	IPP.D	FS
12	Nam Mo 2 (H)	Xieng khuang	120	2018	IPP.D	MOU
13	Nam Ken (H)	Vientiane Pro	5	2018	IPP.D	PDA
14	Nam Xam 3 (H)	Houaphanh	156	2018	IPP.D	PDA
15	Nam Bak 2 (H)	Saysomboun	40	2019	IPP.D	FS
16	Nam Et 4,5,6 (H)	Houaphanh	38	2019	EDL	FS
17	Nam Sa Nen (H)	Vientiane Pro	7	2019	IPP.D	FS
18	Nam Chee 1 (H)	Saysomboun	15	2019	IPP.D	PDA
19	Nam Chee 2 (H)	Saysomboun	7.5	2019	IPP.D	PDA
20	Nam Xam 1 (H)	Houaphanh	75	2019	IPP.D	PDA
21	Nam Ngum 3 (H)	Saysomboun	480	2020	EDL	Under Construction
22	Nam Bak 1 (H)	Saysomboun	160	2020	IPP.D	MOU
23	Nam Ngipe 2A (H)	Xieng Khuang	12.55	2020	IPP.D	SHOA
24	Nam Lik (B. Keng Luang) (H)	Vientiane Pro	15	2020	IPP.D	FS
25	Nam Sana (Up) (H)	Vientiane Pro	10	2020	IPP.D	FS
26	Nam Ngum - Nanin	Vientiane Pro	15	2020	IPP.D	FS
27	Nam Feung (B. Nongsan) (H)	Vientiane Pro	15	2020	IPP.D	FS
28	Nam Mat 1 (H)	Xieng khuang	15	2020	IPP.D	PDA
29	Nam Mat 2 (H)	Xieng khuang	15	2020	IPP.D	PDA
30	Nam Chat 2 (H)	Xieng khuang	8	2020	IPP.D	PDA
31	Nam Cha Gnai (H)	Vientiane Pro	2.5	2021	IPP.D	PDA
32	Nam Sana (Down)	Vientiane Pro	2.5	2021	IPP.D	FS
33	Nam Kay (H)	Vientiane Pro	3	2021	IPP.D	PDA
34	Nam Mat (H)	Xieng khuang	15	2021	IPP.D	PDA
35	Nam Neun 2 (H)	Xieng khuang	56	2021	IPP.D	PDA
36	Nam Dick 2 (H)	Houaphanh	15	2022	IPP.D	FS
37	Nam Ngeip (Mengmai) (H)	Saysomboun	25	2022	IPP.D	FS
38	Nam Pot (H)	Xieng Khuang	15	2022	IPP.D	PDA
39	Nam Ngum 4 (H)	Xieng Khuang	220	2022	IPP.D	FS
40	Nam Ngum (Down)	Vientiane Capital	60	2022	IPP.D	FS

Table 3.8 Power development plan of central 1 region (Continued).

No.	Power Plant	Provinces	Ins. Capacities (MW)	COD Year	Owner	Status
41	Nam Xam 4 (H)	Houaphanh	150	2023	IPP.D	FS
42	Nam Khao (H)	Xieng khuang	12	2023	IPP.D	FS
43	Nam Vang (H)	Xieng khuang	12	2023	IPP.D	FS
44	Nam Khien (H)	Xieng khuang	9	2023	IPP.D	FS
45	Nam Neun 1 (H)	Xieng khuang	124	2023	IPP.D	PDA
46	Nam Dick 1 (H)	Houaphanh	15	2024	IPP.D	FS
47	Nam Ma 1A (H)	Houaphanh	39	2024	IPP.D	FS
48	Nam Kan (B. Kon Ngoua) (H)	Houaphanh	15	2024	IPP.D	FS
49	Nam Houay (H)	Xieng khuang	7	2024	IPP.D	PDA
50	Nam Ma 2A (H)	Houaphanh	18	2024	IPP.D	FS
51	Nam Dick 3 (H)	Houaphanh	10	2025	IPP.D	FS
52	Nam Ma 2 (H)	Houaphanh	30	2025	IPP.D	FS
53	Nam Ma 3 (H)	Houaphanh	18	2025	IPP.D	FS
54	MK Sanakham (H)	Vientiane Pro	660	2025	IPP.D	PDA
55	Houa Muang (Lignite)	Houaphanh	400	2025	IPP.D	FS
56	Xam Tai (Lignite) (T)	Houaphanh	413	2025	IPP.D	FS
57	Nam Neun 3 (H)	Houaphanh	80	2025	IPP.D	FS
58	Nam Et 3 (H)	Houaphanh	107	2025	IPP.E	FS
	EDL		**622**			
	IPP.D		**3,427**			
	IPP.E		**107**			
	Total		**4,156**			

This research will be considered the 12 hydropower plan projects to construction. The total installed capacity is 1,095 MW. As shown Table 3.9.

Table 3. 9 12 hydropower plan projects construction.

Projects No.	Name of project	Location	Installed Capacity (MW)	Owner-ships
1	Nam Khan3 (N.Kan3)	Luangprabang	60	EDL
2	Nam Long 2 (N.Long2	Luangnamtha	13	IPP.D
3	Nam Ou 2 (N.Ou2)	Luangprabang	120	IPP.D
4	Nam Ou 6 (N.Ou2)	Phongsaly	180	IPP.D
5	Nam Ou 5 (N.Ou2)	Phongsaly	240	IPP.D
6	Nam Sim (N.Sim)	Houaphanh	9	IPP.D
7	Nam Phagnai (N.Phagnai)	Saysomboun	15	IPP.D
8	Nam Chien (N.Chien)	Saysomboun	104	EDL
9	Nam San 3A (N.San 3A	Saysomboun	23	IPP.D
10	Nam Lik 1 (N.Lik1)	Vientiane Pro	64	IPP.D
11	Nam Tha 1 (N.Tha1)	Borkeo	168	IPP.D
12	Nam Pai (N.Phai)	Saysomboun	88	IPP.D
	Total		1,095	