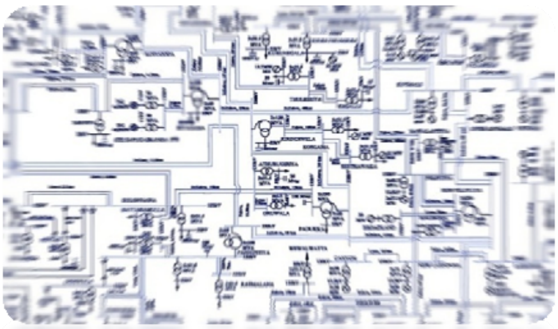
CEYLON ELECTRICITY BOARD

LONG TERM TRANSMISSION DEVELOPMENT PLAN

2013 - 2022

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P.O. Box 540
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November 2013

Long Term Transmission Development Plan 2013-2022

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Abbreviations

CATB	Cabinet Appointed Tender Board
CEB	Ceylon Electricity Board
DER	Department of External Resources
DB	Double Bus Bar
GIS	Gas Insulated Switchgear
GSS	Grid Sub Station
HMDP	Hydro Maximum Generation Day Peak Load Profile
HMNP	Hydro Maximum Generation Night Peak Load Profile
EIA	Environmental Impact Assessment
JICA	Japan International Cooperation Agency
LKR	Sri Lankan Rupees
LTGEP	Long Term Generation Expansion Plan
MLKR	Million Sri Lankan Rupees
NPEDF	National Power and Energy Demand Forecast
PIP	Public Investment Program
PS	Power Station
PSS/E	Power System Simulator for Engineering
TEC	Technical Evaluation Committee
TF	Transformer
TL	Transmission Line
TMDP	Thermal Maximum Generation Day Peak Load Profile
TMNP	Thermal Maximum Generation Night Peak Load Profile
SR	Successful Reclosing
SS	System Stable
SSLS	System Stable with Load Shedding
SB	Single Bus Bar
USR	Unsuccessful Reclosing

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Executive Summary

The “Long Term Transmission Development Plan 2013-2022” outlines the transmission development studies carried out by the Transmission Planning Branch of the Ceylon Electricity Board (CEB) for the period 2013-2022. The present status of the transmission network, transmission planning methodology and the transmission development proposal for the ten- year period from year 2013-2022 are also discussed in the plan. The investment plan and the timing to ensure an adequate capacity and reliable transmission network to cope with the load growth and future generation additions are incorporated into the plan.

The CEB transmission system comprises of 220 kV and 132 kV transmission network interconnected to grid substations and power stations. Development and strengthening of the transmission and associated grid substation facilities are of paramount importance to meet the growing electricity demand of the country. It is the function of the transmission system to transmit the electricity in bulk generated at power stations to grid substations to meet the demand of customers. The necessary transmission system reinforcements to maintain a satisfactory power system performance are identified by detailed power system analysis carried out during the long term transmission development planning process.

A Master Plan Study for the development of the transmission system from year 2006-2023 in Sri Lanka was completed by CEB with technical assistance from Japan International Co-operation Agency (JICA) in January 2006. Long term transmission development studies are carried out as a 10 year rolling plan in order to accommodate the new requirements and demand in the transmission system.

This report was prepared by reviewing the results of the previous long term transmission development plans and the 2006 Master Plan Study for the CEB Transmission System. Further, transmission network for year 2032 was formulated considering the Long Term Generation Expansion Plan 2013-2032, since the earlier master plan study was considered only up to year 2025. The map of Sri Lanka Transmission System in year 2032 is shown in the annex A-6. The long term transmission development studies were carried out based on the latest available National Power and Energy Demand Forecast, Long Term Generation Expansion Plan 2013-2032 and Regional Medium Voltage Distribution Plans.

The main objectives of the planning process are formulation of the set of transmission developments required to ensure a reliable and stable power system for the planning period of interest and the estimation of investment cost required to implement these transmission developments. During this process, the variations in project implementations, changes in generation and loading patterns are taken into account while considering financial and time limitations.

During the first stage of this planning process, the Grid Substation Peak Demand Forecast and the Grid Substation Demand Forecast at System peak for the period 2013-2022 were prepared based on the National Power and Energy Demand Forecast 2013-2037 (Table E.1). The results of the grid substation peak demand forecast were used to identify the basic grid substation capacity enhancement requirements. Proposals for grid substation development were finalized after consultation with the Distribution Regions. The details of this exercise are given in Chapter 3.

Table E. 1: National Power and Energy Demand Forecast 2013-2037

Year	Demand Energy (GWh)	Losses ( )	Net Generation Energy (GWh)	Load Factor ( )	Peak (MW)
2013	11104	11.63%	12566	57.3%	**2504
2014	12072	10.59%	13502	57.3%	2692
2015	12834	11.54%	14509	57.2%	2894
2016	13618	11.50%	15388	58.2%	3017
2017	14420	11.37%	16270	58.2%	3193
2018	15240	11.25%	17171	57.9%	3383
2019	16075	11.12%	18087	58.1%	3556
2020	16937	11.00%	19030	58.2%	3731
2021	17830	10.90%	20010	58.3%	3920
2022	18754	10.79%	21023	58.2%	4125
2023	19713	10.69%	22072	58.8%	4287
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2032	30258	9.83%	33555	59.3%	6461
2033	31670	9.74%	35087	60.0%	6671
2034	33131	9.65%	36672	60.0%	6978
2035	34652	9.57%	38320	60.0%	7294
2036	36230	9.49%	40027	60.0%	7621
2037	37873	9.40%	41804	59.9%	7962

Source: National Power and Energy Forecast for 2013-2037 prepared by CEB

- Losses* includes Transmission and Distribution losses as a percentage of Net Generation
- **Peak includes contribution from NCRE and excludes 2013 Northern Peak

Power plant additions considered were in accordance with the Long Term Generation Expansion Plan 2013 – 2032 (Table E.2). The results of the Grid Substation Demand Forecast at System Peak and the Long-Term Generation Expansion Plan were then used for the planning of the future transmission network. The methodology and the procedure adopted for transmission planning process are explained in Chapter 2.

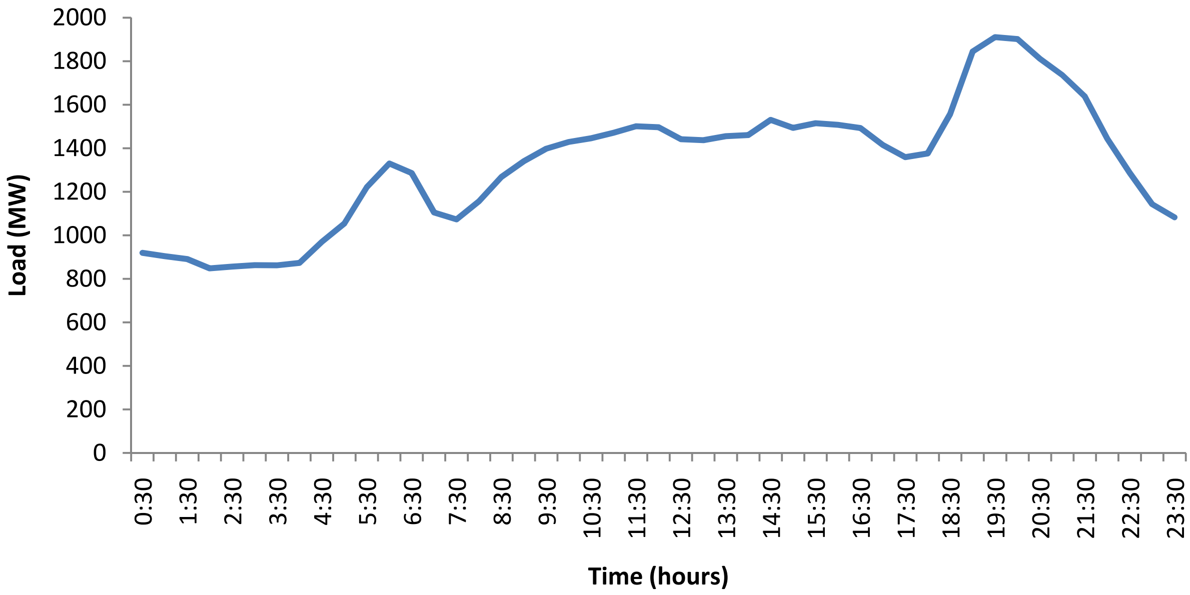
Table E. 2 : Long Term Generation Expansion Plan 2013-2032

YEAR	RENEWABLE ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS	LOLP
2013	-	-	4x5 MW ACE Power Matara 4x5 MW ACE Power Horana 4x5.63 MW Lakdanavi	1.821
2014	-	*4x5 MW Northern Power*** *3x8 MW Chunnakum Extension*** *1x300 MW Puttalam Coal (Stage II)*	-	1.357
2015	**-**	*1x300 MW Puttalam Coal (StageIII)* **3x75 MW Gas Turbine**	6x16.6 MW HeladanaviPuttalam 14x7.11 MW ACE Power Embilipitiya 4x15 MW Colombo Power	1.228
2016	*35 MW Broadlands* *120 MW Uma Oya*	-	-	1.017
2017	-	**1x105 MW Gas Turbine**	-	1.483
2018	**27 MW Moragolla Plant**	**2x250 MW Trincomalee Coal Power plant**	4x5 MW Northern Power 8x6.13 MW Asia Power	0.399
2019	-	**2x300 MW Coal Power plant**	5x17 MW Kelanitissa Gas Turbines 4x18 MW Sapugaskanda diesel	0.080
2020	**-**	**-**	-	0.247
2021	-	**1x300 MW Coal plant**	-	0.162
2022	**49 MW Gin Ganga**	**1x300 MW Coal plant**	-	0.085
2023	-	**2x300 MW Coal plant**	163 MW AES Kelanitissa Combined Cycle Plant 115 MW Gas Turbine 4x9 MW Sapugaskanda Diesel Ext.	0.045
2024	-	**-**	-	0.169
2025	**-**	**1x300 MW Coal plant**	4x9 MW Sapugaskanda Diesel Ext.	0.162
2026	-	**-**	-	0.518
2027	**-**	**1x300 MW Coal plant**	-	0.466
2028	**-**	**1x300 MW Coal plant**	-	0.370
2029	**-**	**-**	-	1.078
2030	**-**	**1x300 MW Coal plant**	-	1.094
2031	**-**	**1x300 MW Coal plant**	-	1.140
2032	**-**	**1x300 MW Coal plant**	-	1.233
Total Present Value (PV) Cost up to year 2032, **US 14,049.05 million** [LKR 1,600,181.18 million]				

Notes: Discount rate 10%, Exchange Rate as an average of January 2012 (US$ 1 = LKR. 113.9)
All additions/retirements are carried out at the beginning of each year
Committed plants are shown in Italics. All plant capacities are given in gross values.
Above PV cost includes the cost of Projected Committed NCRE, US$ 689.98 million
** Year of connection to national grid based on the estimated time schedule of Kilinochchi – Chunnakkam Tx line.

Figure E.1 shows the daily load curve of the country. The load curve is characterised by three loading conditions, i.e. night peak loading around 1930 hours, day peak loading around 1100 hours and lightly loaded condition (off peak loading) around 0300 hours.

Figure E. 1 Daily load curve



Detailed power system analysis was carried out under night peak, day peak and off peak loading conditions. Proposals were identified to improve the performance of the existing power system as well as to enhance the transmission network capabilities. The PSS/E software package was used as the planning tool for this purpose. The detailed information of the power system analysis is described in Chapter 4.

The transmission development proposals, power plant connection proposals and other development proposals are given in Chapter 5. The cost estimates are also given in Chapter 5. The investment costs are evaluated assuming 2012 constant prices of 1US$ = 129.59 LKR.

Feasibility studies including site selection, transmission line preliminary survey, environment impact assessment, land acquisition, single line diagrams, layout drawings, estimates and preliminary design work are in progress for developments up to year 2012. Feasibility studies should be carried out for the remaining proposals which are within the ten year planning period from year 2013 to 2022. The total investment cost for the transmission expansion proposals identified from system analysis planned from year 2013-2022, which are not financially committed is 80 billion LKR

Apart from the above mentioned transmission development proposals, the Chapter 5 outlines the power plant connection proposals and other developments required to enhance the reliability of the existing transmission system respectively. The total investment cost for power plant connection proposals planned from year 2013 to year 2022, which are not financially committed is 37 billion LKR.

The average incremental cost approach was used to evaluate the transmission capacity cost. The transmission capacity cost is estimated to be 11,592 LKR/kW/year when only the investments of transmission development proposals are considered. The same is estimated to be 14,351 LKR/kW/year when both investment of the transmission development proposals and the power plant connection proposals are considered. A summary of the transmission network development from year 2013 to year 2022 is shown in Table E.3.

Table E. 3: Summary of the transmission network developments 2013-2022

Description	Year 2013	Year 2022
Grid Substations		
132/33 kV (No./ Capacity [MVA])	49/3461.5	71/5344
220/132/33 kV (No./Capacity [MVA])	5/2100/500	5/2100/500
220/33 kV (No./ Capacity [MVA])	1/70	6/520
132/11 kV (No. / Capacity [MVA])	5/369	13/1125
220/132kV (No./Capacity [MVA])	2/405	11/4310
400/220kV (No./Capacity [MVA])	-	4/5300
Transmission Lines (Route length)		
220 kV, 2 cct. / (km)	319	997
220 kV, 1 cct. / (km)	183	36
220 kV UG Cable/(km)	-	24
132 kV, 4 cct. / (km)	4	7
132 kV, 2 cct. / (km)	1565	2256
132 kV, 1 cct. / (km)	315	215
132 kV UG cable / (km)	50	85
400kV/(km)	-	170
Reactive Power Sources		
Capacitors / (MVAr)	240	845

Description	Year 2013	Year 2022
Investment (Billion LKR)		
Committed Investment (Billion LKR)		
Transmission Expansions :		
Power Plant Connections		84
Funds Required (Billion LKR)		9
Transmission Expansions		
Power Plant Connections		80
		37
Total Investment (Billion LKR)		**210**

Chapter 1
Introduction

Ceylon Electricity Board (CEB) established by an act of parliament in 1969, is responsible for Generation, Transmission and Distribution of the major part of electricity in Sri Lanka. Presently, CEB has hydro, thermal and wind power stations connected to the transmission system, which operates at 220 kV and 132 kV. The total installed capacity of all hydro power stations owned and operated by CEB in year 2013 was 1355MW. The total installed capacity of all thermal power plants owned by CEB is 863 MW. In addition, 820MW of private thermal power plants are connected to the system. As at 31st December 2012, approximately 314 MW of embedded NCRE plants are connected to the national grid. Out of this, 227 MW of mini hydro plants, 74 MW of wind power plants,11.5MW of Wood fuel/Dendro power plants and 1.4 MW solar power plants are presently connected to the system..At the end of 2012, total installed capacity of the system is 3312MW. The demand for electricity has been increasing at a rate of 6-8% per annum for the last 20 years as shown in Fig. 1.1.

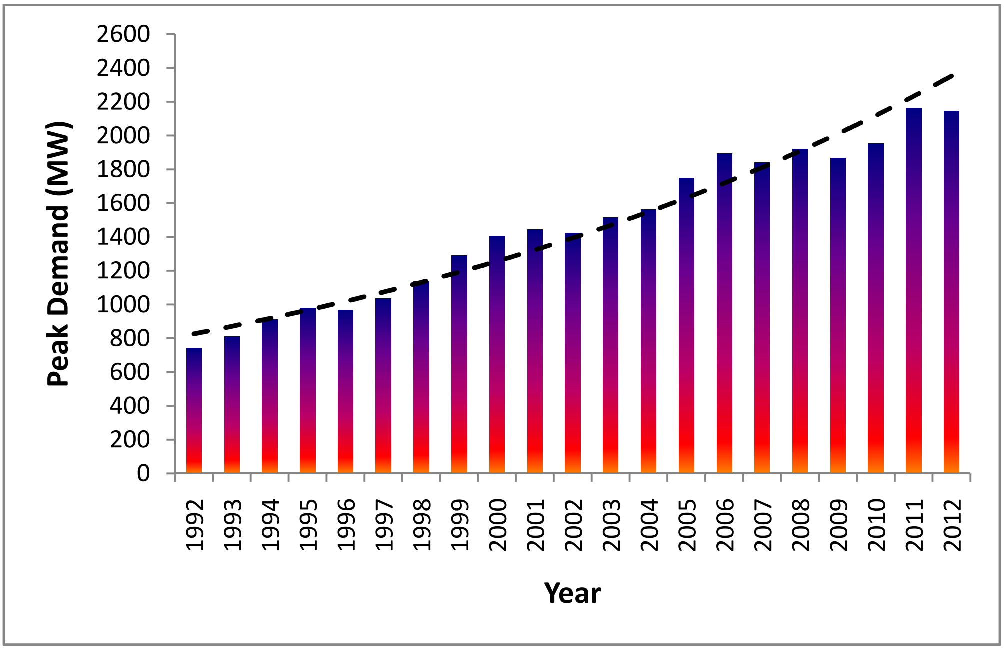


Fig 1.1: System Peak Demand over Past 20 Years

1.1. The present transmission system facilities

The map of the present transmission system and the schematic diagram are given in Figure 1.2 and Annex A-1 respectively. The 220 kV and 132 kV voltage levels are used as the transmission voltages of the system. The System Control Centre located at Dematagoda manages the operation and control of the Sri Lanka's power system.

At present, the 220 kV transmission system is mainly used to transmit power from Mahaweli hydro power generating stations, Coal power station at Puttalam and Combined cycle power plant at Kerawalapitiya to main load centres through Biyagama, Pannipitiya, Veyangoda and Kotugoda grid substations. Further, the 220 kV transmission line from Kotmale power station to New Anuradhapura grid substation is used to facilitate power transfer to Northern and Eastern provinces.

The 132kV transmission network is used to interconnect most of the grid substations and to transfer power from other power stations. 220/132kV inter-bus transformers are installed in the network to transfer power between the two voltage levels. The present transmission system has 220/132/33 kV grid substations located at Biyagama, Kotugoda, New Anuradhapura, Pannipitiya, and Kelanitissa. In addition, the system consists of forty-nine 132/33 kV grid substations, and five 132/11 kV indoor, Gas Insulated Switchgear (GIS) type substations at Fort, Kollupitiya, Maradana, Havelock Town and Kotahena. Three 132 kV underground cable sections connecting Kelanitissa, Fort, Kollupitiya, Kolonnawa grid substations; Kolonnawa, Maradana, Havelock Town, Dehiwala, Pannipitiya grid substations and Kelanitissa, Kotahena , Kolonnawa are used to feed the Colombo load.

The calculated peak power loss in the transmission network is approximately 3% of the total power generation. A typical layout of a 132/33 kV grid substation consists of single bus bar arrangement with 2x31.5 MVA transformers and eight 33 kV distribution feeders. However, the double bus bar arrangement is used for grid substations, which handle large amount of power. The total number of existing grid substations and the total length of transmission lines for each voltage in the present transmission network are given in Table 1.1 and 1.2

Table 1.1: No. of Grid Substations in present transmission network

Description	Number of GSS	Total Capacity (MVA)
Grid Substations		
132/33 kV (No./ Capacity [MVA])	49	3461.5
220/132/33 kV (No./Capacity [MVA])	5	2100/500
220/33 kV (No./ Capacity [MVA])	1	70
132/11 kV (No. / Capacity [MVA])	5	369
220/132kV (No./Capacity [MVA])	2	405

Table 1.2: Transmission network line length in present transmission network

Transmission Lines (Route length)	Length(km
220 kV, Double circuit	319
220 kV, Single Circuit	183
132 kV, 4 Circuit	4
132 kV, Double Circuit	1565
132 kV, Single Circuit	315
132 kV UG cable	50
Reactive Power Sources	
Capacitors / (MVar)	240

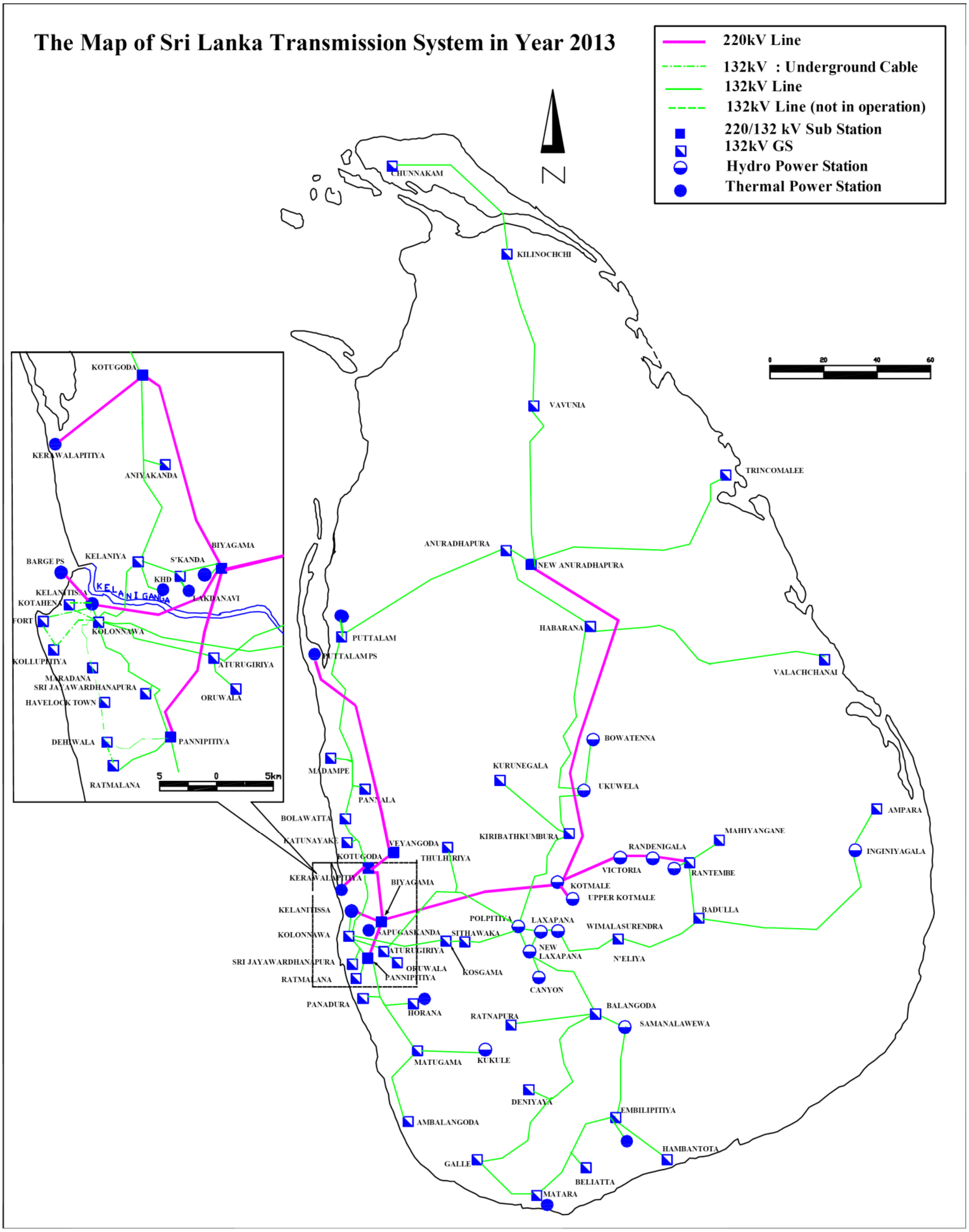
1.2. Main Ob ectives

The main objectives of the Long Term Transmission Development Studies are:

(1) To find out the transmission developments required to ensure reliable and stable power system for the period 2013 – 2022.

(2) To determine the investment cost of the transmission developments within the planning horizon, 2013 to 2022.

Figure 1.2: The Map of present transmission network system



Chapter 2
Methodology

The Generation Planning Branch of Ceylon Electricity Board (CEB) prepares National Power and Energy Demand Forecast (NPEDF) annually in the initial stage of the planning procedure. The Long Term Generation Expansion Plan is prepared based on the NPEDF. The NPEDF and the Long Term Generation Expansion Plan (LTGEP) are the key inputs considered in the transmission expansion planning. The extracts of NPEDF and LTGEP for year 2013 – 2037 are given in table 2.1and table 2.2 respectively.

Table 2.1: National Power and Energy Demand Forecast 2013-2037

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Table 2.2: Long Term Generation Expansion Plan 2013-2032

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Total Present Value (PV) Cost up to year 2032, **US 14,049.05 million** [LKR 1,600,181.18 million]				

2.1. Transmission planning procedure

The transmission planning procedure in simple terms can be described in two stages. The schematic representation of the transmission planning process is shown in Figure 2.1.

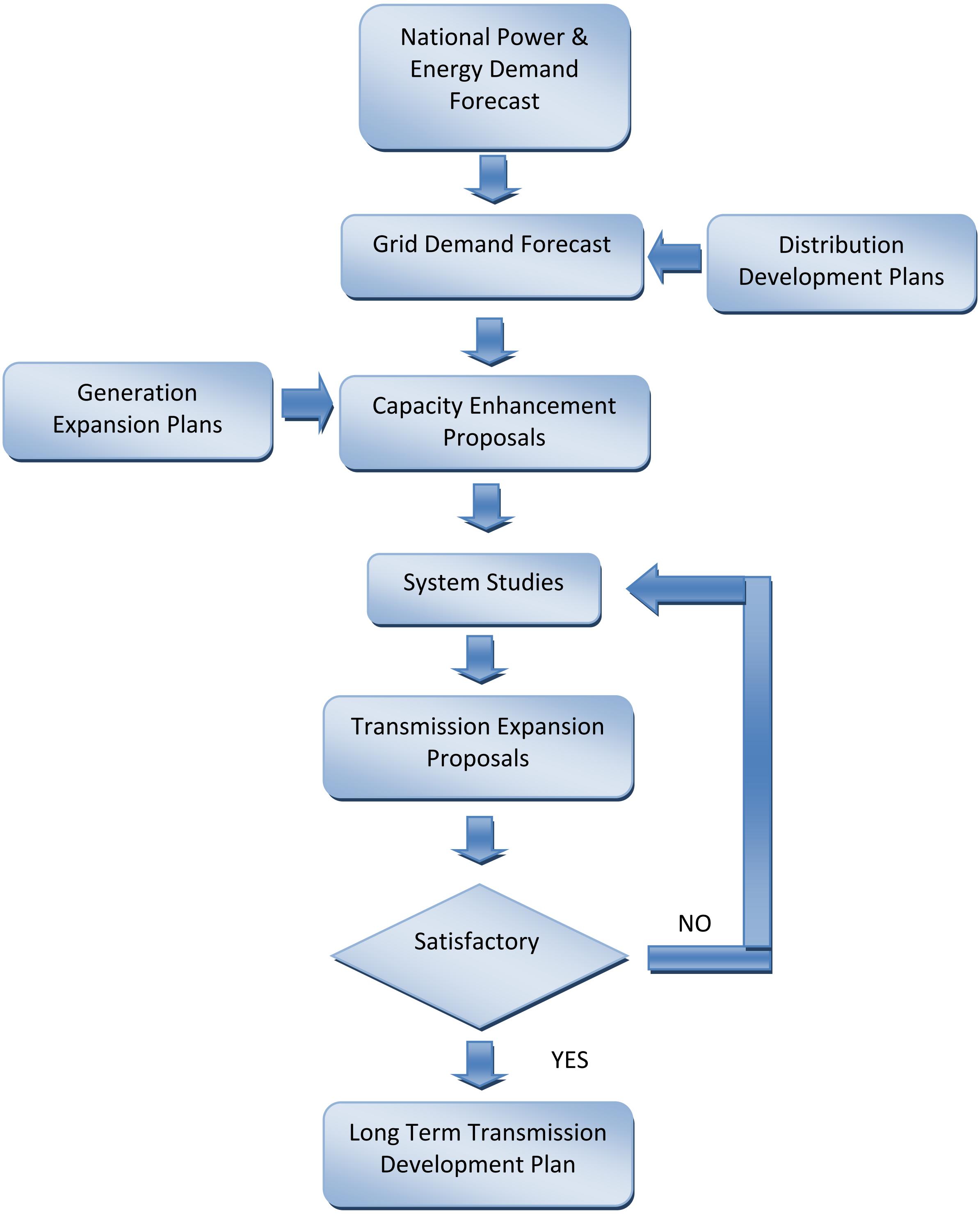

Figure 2: 1 Schematic representation of the transmission planning process

Stage 1 – Preparation of grid demand forecast and capacity improvement proposals

Preparation of the grid demand forecast and capacity improvement proposals are determined based on the NPEDF and the geographical distribution of loads. Comments and suggestions of the Distribution Division are taken into due consideration in the process of preparing the grid-wise load demand forecast. The proposals for capacity enhancement at existing grid substations and construction of new grid substations to meet the demand forecast are important outcomes of this exercise. Details of the preparation of grid demand forecast are discussed in Chapter 3.

Stage 2 – System studies and transmission connections proposals

Once the grid demand forecast is finalized, an appropriate set of network improvements needed for the entire period of planning to connect the proposed power plants and to cater for the demand in the transmission network are determined initially. A detailed power system analysis consisting of load flow, reliability, short circuit and stability studies are conducted to identify areas where planning criteria are violated. Several alternative network improvement proposals are taken into consideration and the most feasible transmission network development plan is selected among several candidate network options. This is an iterative procedure, which requires several trials before reaching the final transmission network development plan for the entire period of planning. In the course of selecting the most suitable transmission network development plan, technical as well as economic aspects are also taken into consideration.

The main objective of the load-flow study is to determine the steady state performance of the power system. The potential problems such as unacceptable voltage conditions and overloading of transmission network elements are identified from load-flow studies. Alternate proposals are devised from the results of the load–flow analysis in order to rectify foreseeable problems.

Capability of the transmission network to deliver power from generating stations to load centres within the operating limits of equipment, and without loss of continuity of supply or widespread failure is evaluated through reliability studies. These studies are performed subsequent to load flow studies. Then the stability studies are performed in order to make sure that the system will remain stable following a severe disturbance. Here, transient behaviour of the system is observed.

Finally the short circuit studies are done to calculate fault currents at each grid substation of the transmission system. The circuit breaker capacities are then checked against the calculated maximum fault current in order to identify necessary replacements or operational restrictions to meet existing switchgear capacities.

System configuration identified by the load flow studies is thus subjected to modifications according to the results of the other studies.

Based on this technical analysis, the set of transmission network developments necessary to maintain a satisfactory system performance defined by the following transmission planning criteria are identified. However, the final Long Term Transmission Development Plan is formulated considering the financial and time limitations.

2.2. Planning criteria

During the synthesis of transmission development plan, it is targeted to meet planning criteria to ensure quality and reliable supply under normal operating conditions as well as under contingencies.

2.2.1. Voltage criteria

The voltage criteria defines the allowable voltage deviation at any live bus bar of the network under normal operating conditions as given in table 2.3.

Table 2.3: Allowable voltage variations

Bus bar voltage	Allowable voltage variation ( )	
	Normal operating condition	Single contingency condition
220 kV	±10%	±10%
132kV	±10%	±10%

2.2.2. Thermal criteria

The design thermal criterion limits the loading of any transmission network element, in order to avoid overheating due to overload. The loading of elements should not exceed their rated thermal loading values for steady state conditions.

2.2.3. Security criteria

The performance of the transmission system under contingency situation is taken into consideration in the security criteria. The adopted contingency level for the planning purposes is N-1, i.e. outage of any one element of the transmission system at a time.

After outage of any one element (i.e. any one circuit of a transmission line or a transformer and without any adjustment or corrective measure), the system should be able to meet the distribution demand while maintaining the bus bar voltage levels as given in Table 2.3 and loading of all the remaining elements should not exceed their emergency ratings specified.

After system readjustment following a disturbance described above, the voltage and loading of elements should return to their corresponding normal limits.

2.2.4. Stability criteria

Stability criteria should ensure the system stability during and after a system disturbance.

For all pertaining equipment in service, the system should remain stable in case of:

- ✓ Three-phase fault at any one overhead line terminal, cleared by the primary protection with successful and unsuccessful auto re-closing
- ✓ Loss of any one generation unit
- ✓ Load rejection by loss of any transformer.

2.2.5. Short circuit criteria

The short circuit criteria limits the maximum three phase circuit currents at the 132kV, 33kV and 11kV bus bars of any grid substation (see Table 2.4), in order to protect the transmission and distribution network elements downstream.

Table 2.4: Allowable maximum 3 phase short circuit levels

Bus bar voltage	System	Maximum 3 Phase fault level (kA)
132kV and above	Over head	40.0
	UG cable	40.0
33kV	Over head	25.0
	UG cable	25.0
11kV	UG cable	25.0

2.2.6 Generator dispatching

The transmission network should allow generating scheduling in merit order and should not require regular operation of out-of-merit generation to prevent an unacceptable voltage profile or loading condition in the event of an outage of any transmission circuit.

Chapter 3
Grid Substation Peak Demand Forecast

Understanding the trends of load variation of each grid substation and the electricity generation expansion sequence are essential to work out a development plan of the transmission system. The grid substation peak demand forecast given in Tables 3.1 and 3.2 were prepared based on the National Power and Energy Demand Forecast 2013 – 2037, Long Term Generation Expansion Plan 2013 – 2037 prepared by the Generation Planning Section and the Medium Voltage Distribution Development Plans prepared by the Regional Distribution Divisions of CEB. The forecast national energy is allocated among the existing grid substations considering the trends of load variation, spot loads and the distribution network arrangements. The overloaded grid substations are identified after considering possible load transfers to adjacent grid substations. The proposals for augmentation of existing grid substations and construction of new grid substations are then established. The process is repeated until the grid substation demand forecast meets the planning criteria. The grid substation demand forecasting is a process comprising of a variety of different disciplines. The procedure can be best illustrated by a schematic diagram and it is shown in Figure 3.2.

3.1. Preparation of the initial forecast

The National Power and Energy Demand Forecast is used to determine the electricity demand at the grid substation level, considering all the accompanying losses including auxiliary supply losses, transmission line losses and transformer losses up to the medium voltage buses at the grid substations. The calculated national system peak demand variation at the medium voltage buses of the grid substations is graphically illustrated in Figure 3.1.

The initial grid substation peak demand forecast for the period 2013 – 2022 is established by allocating the above system energy at grid substation level considering past and future trends of the demand growths, and present and future distribution network requirements. Once the initial forecast is finalized, the forecast loads are compared with the available capacity of each grid substation and the overloaded grid substations are identified. As indicated in Figure 3.2, the following measures are taken to overcome the overloading problem.

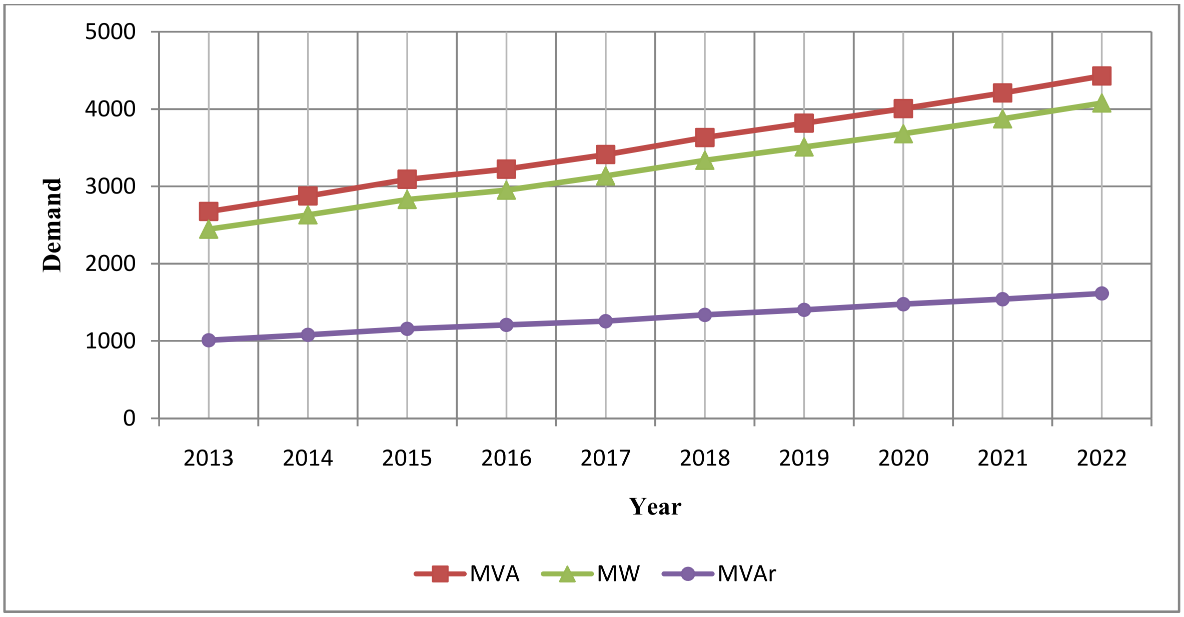

Figure 3.1: Grid substation demand variation at system peak

I. Excess loads are transferred to adjacent grid substations if the following conditions are satisfied.

- ✓ The adjacent grid substations have excess capacity.
- ✓ The required changes of the distribution network are possible.
- ✓ Voltage regulation of the adjacent grid substations can be maintained with the adjusted load distribution.

II. Enhancement of grid substation capacities is made according to the following criteria.

- ✓ Existing transformers of smaller capacities (for e.g. 10 MVA and 16 MVA) are replaced with standard normal capacity units (31.5 MVA, 45 MVA, 60MVA) if the load growth is moderate and high.
- ✓ One additional transformer of standard capacity is installed according to the availability of space as well as the overloading factor and the expected load growth.

Again the enhancement of grid substation capacities by adding more transformers can be used only if the distribution network changes required for meeting the growing demand are possible, as indicated in Figure 3.2.

III. Construction of new grid substations is proposed in the following situations.

- ✓ When load transferring and capacity enhancements of existing grid substations are infeasible.

Following factors are also taken into account before concluding to propose a new grid substation.

- ✓ Possibility of making changes in the distribution network.
- ✓ Practical difficulties arising out of site location, the design of the existing substations and other related issues such as environment and public responses.
- ✓ Facilities to acquire incoming and outgoing transmission line connections required for capacity enhancement.
- ✓ Limitations imposed on voltage regulation and the system performance due to changes in the load distribution.

3.2. Preparation of the final load forecast

In each year of the planning period, the above issues concerning the required grid substation developments are identified and the forecast is reviewed in order to formulate the final load forecast as well as the grid substation development proposals.

In this stage, the planning engineers in the Distribution Regions are consulted to identify and rectify the relevant issues such as future augmentation and development proposals of the existing distribution network, site selections, preliminary designs etc.

The final load forecast, include the grid substation loads (at 33 kV and 11 kV bus bars) at night peak and day peak is formulated as a result of the above procedures and it is presented in Tables 3.1 & 3.2 respectively. Tables 3.1 & 3.2 are used as major inputs for detailed power system analysis providing the initial condition of the transmission network.

Figure 3. 2 : Procedure for grid substation peak demand forecast

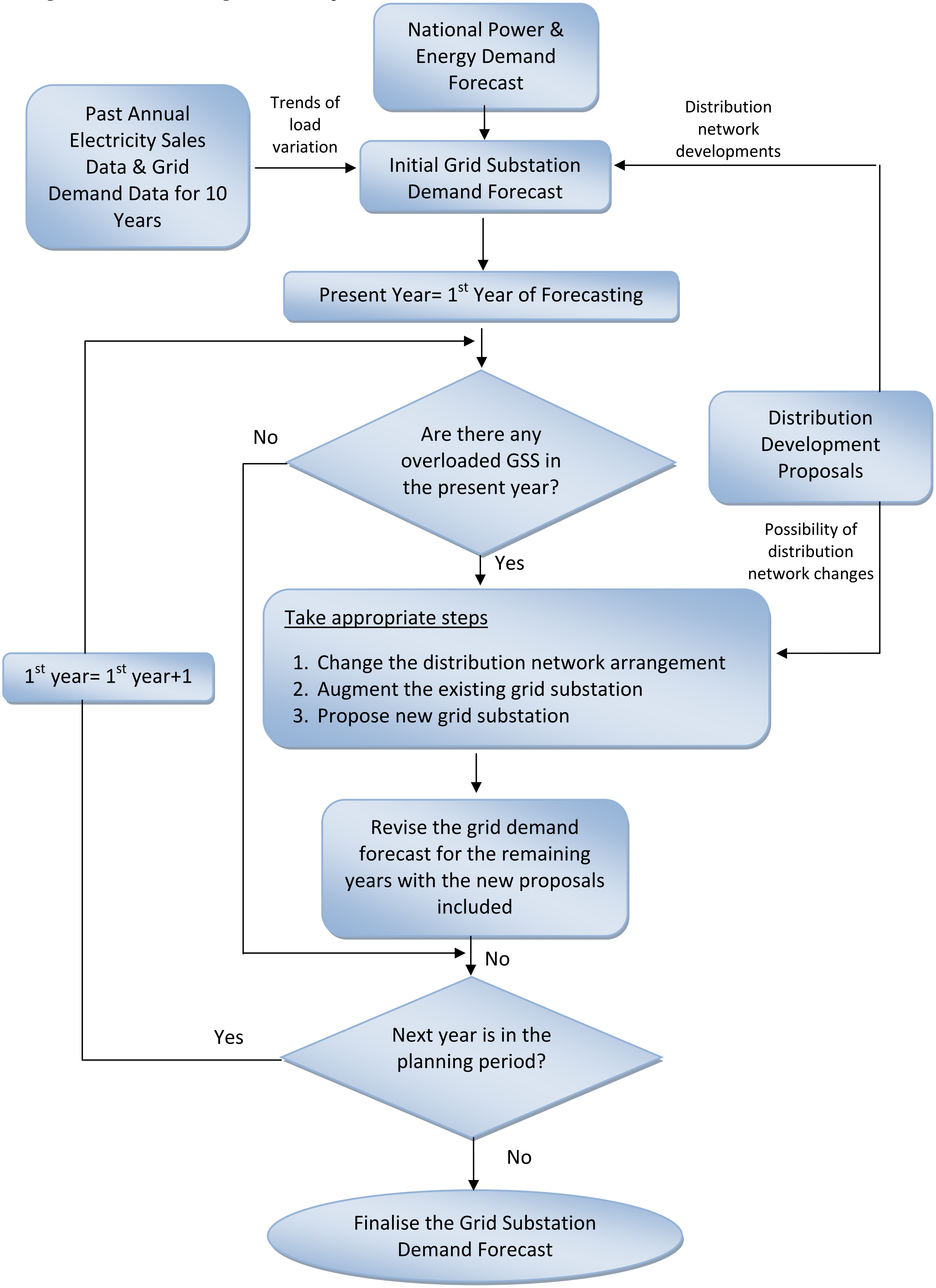

Table 3.1: Grid Substation Demand Forecast 2013-2025- Night Peak

Region	Prov.	Grid Substation	Existing Capacity	Expansion Capacity	Expansion Year	2012 Actual		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023		2024		2025	
						MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr
		Kelanitissa	120			17.8	10.4	22.1	13.7	23.6	14.6	48.9	30.3	69.5	43.1	27.2	16.9	28.6	17.7	29.6	18.4	46.1	28.6	46.8	29.0	47.5	29.5	49.2	30.6	51.6	32.0	54.0	33.5
		Kolonnawa (Indoor)	94.5			40.8	25.3	45.7	28.3	46.7	29.0	38.6	23.9	38.5	23.8	37.0	22.9	38.5	23.9	39.1	24.2	38.0	23.6	38.2	23.7	38.5	23.8	39.7	24.6	41.4	25.7	43.2	26.8
		Port City 1		90	2017											25.0	8.2	25.0	8.2	37.5	12.3	50.0	16.4	62.5	20.5	75.0	24.7	75.0	24.7	75.0	24.7	75.0	24.7
		Port City 2		90	2017											25.0	8.2	25.0	8.2	37.5	12.3	50.0	16.4	62.5	20.5	75.0	24.7	75.0	24.7	75.0	24.7	75.0	24.7
		Sub A (Havelock Town)	63	94.5	2015	30.8	12.5	33.5	13.4	34.6	13.8	35.7	14.3	39.4	15.8	33.5	13.4	34.5	13.8	34.9	14.0	34.0	13.6	34.2	13.7	34.4	13.8	35.8	14.3	37.5	15.0	39.4	15.7
		Sub B (Pettah)		63/94.5	2017/2020											21.0	13.1	24.0	15.0	25.4	15.9	41.2	25.8	42.6	26.6	45.4	28.4	49.3	30.8	54.0	33.7	58.4	36.5
		Sub C (Kotahena)	63			22.0	13.6	17.4	10.7	18.1	11.2	21.3	13.2	21.5	13.3	20.8	12.9	21.9	13.5	22.7	14.1	22.7	14.0	23.3	14.4	23.9	14.8	25.0	15.4	26.3	16.3	27.7	17.1
	CC	Sub E (Kollupitiya)	90			30.0	14.4	31.9	15.9	34.5	17.2	61.5	30.5	60.1	29.8	36.1	17.9	37.4	18.6	38.4	19.1	37.9	18.8	38.5	19.1	39.2	19.5	40.6	20.2	42.7	21.2	44.7	22.2
		Sub F (Fort)	90			25.5	15.6	40.1	24.9	42.6	26.5	56.1	34.9	66.0	41.0	34.0	21.2	37.8	23.5	39.7	24.6	46.1	28.6	47.5	29.5	50.5	31.4	54.1	33.6	58.6	36.4	63.3	39.3
		Sub I (Maradana)	63	94.5	2017	22.0	10.1	19.3	8.5	19.8	8.7	31.4	13.8	49.7	21.9	21.3	9.4	22.0	9.7	22.3	9.8	21.8	9.6	21.9	9.6	22.1	9.7	22.9	10.1	24.0	10.6	25.1	11.1
		Sub K (Wellawatta)		45	2017											4.1	1.6	4.4	1.8	5.4	2.2	6.1	2.4	6.9	2.8	7.7	3.1	8.4	3.4	9.2	3.7	9.9	4.0
		Sub L (Port)		180	2017											51.0	31.6	68.0	42.1	68.0	42.1	85.0	52.7	85.0	52.7	85.0	52.7	85.0	52.7	85.0	52.7	85.0	52.7
		Sub M (Slave Island)		90	2017											37.1	16.3	39.5	17.4	39.8	17.5	39.8	17.5	39.8	17.5	39.8	17.5	39.8	17.5	39.8	17.5	39.8	17.5
		Sub N (Hunupitiya)		90	2017											24.8	10.6	26.5	11.3	26.7	11.4	26.7	11.4	26.7	11.4	26.7	11.4	26.7	11.4	26.7	11.4	26.7	11.4
		Sub P (Town Hall)		90	2020																	27.6	12.2	27.5	12.1	27.4	12.1	28.1	12.4	29.2	12.8	30.2	13.3
1		Anuradhapura	51.5	94.5	2017	33.9	6.7	47.7	9.7	41.4	8.4	43.4	8.8	44.8	9.1	44.5	9.0	47.8	9.7	50.6	10.3	51.4	10.4	53.6	10.9	56.0	11.4	58.8	11.9	62.4	12.7	66.1	13.4
	NCP	Habarana	63	94.5	2014	62.0	19.0	54.9	14.2	58.1	15.0	34.4	8.9	33.7	8.7	29.9	7.7	32.1	8.3	33.4	8.6	31.0	8.0	31.3	8.1	31.8	8.2	34.8	9.0	39.3	10.2	43.8	11.3
		New Anuradhapura	60			28.0	4.0	35.2	7.2	29.2	5.9	30.5	6.2	30.9	6.3	30.6	6.2	32.9	6.7	34.8	7.1	35.2	7.2	36.8	7.5	38.4	7.8	40.3	8.2	42.8	8.7	45.3	9.2
		Polonnaruwa		31.5/63	2015/2017							25.7	6.6	27.2	7.0	28.8	7.4	30.6	7.9	32.4	8.4	34.2	8.8	36.0	9.3	37.9	9.8	38.8	10.0	39.7	10.3	40.6	10.5
		Chemmany		63/94.5	2017/2025											31.0	6.3	34.6	7.0	38.5	7.8	42.4	8.6	46.4	9.4	50.3	10.2	54.2	11.0	53.3	10.8	60.1	12.2
		Chunnakam	63	94.5	2022	*41.7	*8.5	51.7	10.5	64.3	13.1	72.7	14.8	79.5	16.1	49.6	10.1	53.6	10.9	56.3	11.4	55.1	11.2	56.7	11.5	58.6	11.9	60.6	12.3	69.3	14.1	70.3	14.3
	NP	Killinochchi	63			10.1	0.9	12.0	1.6	14.7	2.0	15.8	2.1	17.6	2.4	18.1	2.4	19.0	2.5	19.9	2.7	21.0	2.8	22.2	3.0	23.4	3.1	24.8	3.3	26.4	3.5	28.1	3.8
		Mannar		31.5	2017											7.1	0.8	7.8	0.9	8.6	0.9	9.3	1.0	10.1	1.1	10.8	1.2	11.6	1.3	12.3	1.4	13.1	1.4
		Vavuniyawa	63			23.2	4.2	27.6	3.7	30.7	4.1	33.6	4.5	35.6	4.8	29.0	3.9	31.8	4.3	34.3	4.6	34.4	4.6	35.9	4.8	37.4	5.0	39.2	5.2	41.7	5.6	44.3	5.9
		Bolawatta	94.5			61.5	33.2	68.4	37.8	70.2	38.8	71.0	39.2	70.8	39.1	63.9	35.3	66.5	36.8	68.5	37.9	67.8	37.4	69.1	38.2	70.6	39.0	73.4	40.5	51.2	28.3	54.1	29.9
		Eluwankulama		31.5	2016									16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8
		Kurunegala	63	94.5	2015	58.0	14.0	54.4	10.5	56.1	10.8	72.0	13.9	73.7	14.2	71.7	13.8	61.3	11.8	65.0	12.5	65.4	12.6	68.0	13.1	70.8	13.6	74.6	14.4	79.7	15.3	84.8	16.3
	NWP	Madampe	63	94.5	2016	40.6	20.0	42.8	21.7	43.5	22.0	43.5	22.0	42.9	21.7	40.8	20.6	42.0	21.3	42.8	21.7	42.0	21.2	42.4	21.4	42.9	21.7	44.4	22.5	46.4	23.5	48.5	24.5
		Maho		31.5/63	2014/2016					11.0	4.1	11.6	4.3	12.2	4.5	12.8	4.8	27.6	10.2	28.3	10.5	29.0	10.8	29.7	11.0	30.4	11.3	30.8	11.4	31.2	11.6	31.5	11.7
		Pannala	63	94.5	2020	36.6	13.0	44.8	22.7	49.0	24.9	40.4	20.5	41.9	21.3	41.8	21.2	45.1	22.9	47.9	24.3	48.8	24.7	51.1	25.9	53.5	27.1	56.2	28.5	59.8	30.3	63.4	32.2
		Puttalama	63	94.5	2024	39.0	12.0	46.7	16.8	40.8	14.7	42.6	15.3	43.4	15.6	41.8	15.0	44.5	16.0	46.6	16.8	46.3	16.7	47.9	17.2	49.4	17.8	52.5	18.9	56.0	20.2	59.6	21.5
		Wariyapola		63	2024																									27.9	9.9	28.9	10.2
		Kegalle		63	2017											21.0	10.0	21.9	10.4	22.8	10.9	23.8	11.3	24.7	11.8	25.7	12.2	26.2	12.4	26.6	12.7	27.1	12.9
		Kiribath Kumbura	94.5	126	2016	88.2	35.0	81.1	22.5	59.2	16.5	60.9	16.9	60.8	16.9	44.5	12.4	47.9	13.3	50.1	13.9	47.5	13.2	48.5	13.5	49.6	13.8	70.5	19.6	77.0	21.4	83.7	23.2
		Naula		31.5/63	2014/2016					21.1	5.5	22.7	5.9	23.7	6.1	24.6	6.4	25.9	6.7	27.1	7.0	28.2	7.3	29.4	7.6	30.6	7.9	31.3	8.1	32.1	8.3	32.9	8.5
		Nawalapitiya		63	2017											12.5	2.5	13.2	2.7	13.9	2.8	14.8	3.0	15.6	3.2	16.5	3.4	17.5	3.6	18.6	3.8	19.7	4.0
	CP	Nuwara Eliya	94.5			40.0	10.0	43.7	10.9	48.6	12.1	52.1	13.0	54.7	13.7	45.1	11.3	47.2	11.8	48.6	12.2	47.6	11.9	48.5	12.1	49.4	12.4	34.1	8.5	35.9	9.0	37.7	9.4
		Pallekele		63/94.5	2014/2021					40.7	11.2	43.6	12.0	46.1	12.7	48.6	13.4	51.5	14.1	54.3	14.9	57.0	15.7	59.8	16.4	62.6	17.2	64.0	17.6	65.5	18.0	66.9	18.4
		Ragala		63	2017											9.9	2.5	10.3	2.6	10.7	2.7	11.2	2.8	11.7	2.9	12.1	3.0	12.6	3.1	13.0	3.3	13.5	3.4
		Thulhiriya	94.5			57.0	30.8	66.6	31.7	71.0	33.8	74.1	35.3	74.9	35.6	51.9	24.7	55.0	26.2	57.4	27.3	56.2	26.8	57.5	27.4	59.0	28.1	62.2	29.6	66.7	31.8	71.3	33.9
2		Ukuwela	94.5			54.0	14.7	66.6	20.9	56.7	17.8	57.4	18.1	57.3	18.0	55.1	17.3	57.5	18.1	59.2	18.6	58.6	18.4	59.8	18.8	61.1	19.2	63.5	20.0	66.7	21.0	70.0	22.0
		Wimalasurendra	94.5			22.0	4.0	27.9	5.3	31.8	6.1	35.3	6.7	34.9	6.7	33.4	6.4	34.6	6.6	35.5	6.8	34.9	6.7	35.4	6.8	36.0	6.9	37.4	7.1	39.2	7.5	41.0	7.8
		Akkaraipattu		31.5	2019															7.5	1.2	7.8	1.2	8.1	1.3	8.5	1.3	8.8	1.4	9.2	1.4	9.5	1.5
		Ampara	94.5			60.0	10.0	65.0	10.2	67.7	10.7	46.2	7.3	45.9	7.2	43.1	6.8	45.9	7.2	40.4	6.4	39.2	6.2	40.2	6.3	41.2	6.5	43.8	6.9	47.6	7.5	51.4	8.1
		Kappalthurei		120	2017											80.3	27.3	82.9	28.2	85.2	29.0	85.4	29.1	87.3	29.7	89.2	30.3	91.5	31.1	94.5	32.2	97.5	33.2
	EP	Sampoor			2017											133.0	44.9	149.6	50.5	166.2	56.1	199.5	67.4	265.9	89.8	332.4	112.3	332.4	112.3	332.4	112.3	332.4	112.3
		Trincomalee	63			30.0	14.6	56.2	19.0	57.7	19.5	60.0	20.3	61.5	20.8	22.8	7.7	25.1	8.5	26.7	9.0	25.8	8.7	27.0	9.1	28.5	9.6	32.3	10.9	37.5	12.7	43.1	14.6
		Valachchenai	51.5	63	2017	23.1	6.0	24.6	12.4	25.5	12.9	26.1	13.2	26.3	13.3	25.6	12.9	26.9	13.6	28.0	14.2	27.9	14.1	28.8	14.6	29.7	15.0	31.2	15.8	33.1	16.8	35.1	17.8
		Vavunathivu		63	2015							23.2	3.7	24.2	3.8	25.2	4.0	26.1	4.1	27.1	4.3	28.0	4.4	29.0	4.6	30.0	4.7	30.5	4.8	30.9	4.9	31.4	4.9

Region	Prov.	Grid Substation	Existing Capacity	Expansion Capacity	Expansion Year	2012 Actual		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023		2024		2025	
						MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr
	WPN	Aniyakanda	63	94.5	2018	42.0	21.2	45.7	21.6	48.7	23.0	43.2	20.4	44.6	21.0	44.3	20.9	57.0	26.9	60.3	28.4	60.9	28.7	63.5	30.0	66.1	31.2	69.6	32.8	74.3	35.0	78.9	37.2
		Biyagama	120			84.0	46.4	91.7	45.7	96.2	48.0	96.7	48.2	98.0	48.9	61.0	30.4	65.2	32.5	68.0	33.9	66.5	33.2	68.3	34.1	65.9	32.9	69.8	34.8	75.6	37.7	81.2	40.5
		Kadawatha		63	2025																											26.3	17.2
		Katunayaka	63	94.5	2017	34.0	17.9	43.4	13.1	48.3	14.6	51.5	15.6	53.6	16.2	60.2	18.2	64.4	19.5	68.1	20.6	69.3	21.0	71.9	21.8	74.7	22.6	78.6	23.8	83.5	25.3	55.8	16.9
		Kelaniya	31.5	63/94.5	2015/2023	26.1	13.9	25.1	12.1	24.6	11.9	39.5	19.1	40.4	19.5	39.8	19.2	42.4	20.4	44.6	21.5	44.8	21.6	46.3	22.3	48.3	23.3	51.4	24.8	55.3	26.7	59.4	28.7
		Kerawalapitiya		70	2017											10.7	5.1	11.4	5.4	11.6	5.5	11.4	5.4	29.6	14.0	29.8	14.1	30.3	14.3	31.1	14.7	31.8	15.0
		Kirindiwela		90	2017											34.7	17.3	36.2	18.1	37.8	18.8	39.4	19.6	41.0	20.4	47.0	23.4	48.6	24.2	50.2	25.0	51.8	25.8
		Kotugoda	183			62.0	34.8	64.4	54.0	78.1	65.5	81.4	68.2	85.8	71.9	76.1	63.8	84.4	70.7	91.0	76.3	94.1	78.8	84.6	70.9	90.4	75.8	96.6	80.9	104.4	87.5	112.5	94.3
		Negombo		63	2025																											34.2	9.7
		Sapugaskanda	121.5			72.5	45.0	73.0	45.8	82.2	51.7	85.4	53.6	85.6	53.8	83.0	52.2	78.1	49.1	80.9	50.8	80.4	50.5	82.4	51.8	84.5	53.1	88.2	55.4	93.0	58.4	71.3	44.8
		Veyangoda	63	94.5	2015	49.2	30.1	44.9	32.5	45.7	33.1	49.7	36.0	49.6	35.9	47.7	34.6	49.7	36.0	51.2	37.0	50.5	36.6	51.5	37.3	52.5	38.0	55.1	39.9	58.4	42.3	61.9	44.8
3	SBP	Balangoda	94.5			29.0	5.6	29.0	5.9	29.6	6.0	29.8	6.1	29.5	6.0	24.0	4.9	25.0	5.1	25.6	5.2	25.0	5.1	25.3	5.1	25.7	5.2	26.7	5.4	28.1	5.7	29.5	6.0
		Embilipitiya	63	94.5	2025	22.7	9.4	47.0	9.3	60.2	11.9	59.2	11.7	60.2	11.9	45.3	9.0	47.1	9.3	48.3	9.6	47.6	9.4	48.5	9.6	49.4	9.8	51.2	10.2	53.8	10.7	56.4	11.2
		Kukule		41.5	2017											7.1	2.4	7.3	2.4	7.5	2.5	7.7	2.5	7.8	2.6	8.0	2.7	8.2	2.7	8.4	2.8	8.7	2.9
		Maliboda		31.5	2017											4.3	1.5	4.8	1.7	5.3	1.8	5.8	2.0	6.4	2.2	7.0	2.4	7.6	2.6	8.1	2.8	8.7	3.0
		Rathnapura	94.5			22.4	8.0	25.9	11.2	28.0	12.1	32.8	14.2	33.8	14.6	29.6	12.8	31.9	13.8	33.8	14.7	34.2	14.8	35.8	15.5	37.4	16.2	40.1	17.4	43.5	18.9	47.1	20.4
		Wewalwatta		63	2017											8.2	1.7	8.4	1.7	8.6	1.8	8.8	1.8	9.0	1.9	9.2	1.9	9.4	2.0	9.6	2.0	9.8	2.0
	UP	Badulla	94.5			52.0	8.0	53.4	8.3	59.7	9.2	45.3	7.0	46.3	7.2	44.4	6.9	33.6	5.2	34.3	5.3	31.4	4.9	31.0	4.8	30.8	4.8	32.4	5.0	35.3	5.5	38.3	5.9
		Mahiyanganaya	63			*6.5	*2.8	15.8	6.8	16.8	7.3	17.3	7.5	17.6	7.6	17.5	7.6	6.7	2.9	6.9	3.0	6.8	3.0	6.9	3.0	7.0	3.1	7.3	3.2	7.7	3.3	8.0	3.5
		Monaragala		31.5/63	2015/2022							19.5	3.0	21.3	3.2	23.0	3.5	24.4	3.7	25.8	3.9	27.1	4.1	28.5	4.3	29.9	4.5	30.7	4.7	31.4	4.8	32.2	4.9
		Wellawaya		63	2018													25.8	3.8	27.4	4.0	29.2	4.3	31.0	4.6	32.8	4.8	34.6	5.1	36.4	5.4	38.2	5.6
	WPS II	Athurugiriya	63	94.5	2022	30.0	16.2	32.7	12.6	35.1	13.6	37.2	14.4	38.7	14.9	38.6	14.9	41.6	16.0	44.2	17.0	44.9	17.3	47.0	18.1	49.2	19.0	53.0	20.4	57.5	22.2	57.6	22.2
		Battaramulla		63	2017											12.6	5.5	13.1	5.7	13.7	6.0	14.2	6.2	14.8	6.5	15.4	6.8	16.1	7.0	16.8	7.3	17.5	7.6
		Horana	63	94.5	2015	43.4	23.4	44.2	35.2	44.9	35.8	45.5	36.2	45.4	36.2	43.7	34.8	45.5	36.2	46.8	37.2	46.2	36.7	47.0	37.4	47.9	38.1	49.9	39.7	52.5	41.8	55.2	43.9
		Kesbewa		63	2018													19.9	9.4	20.8	9.8	21.8	10.3	23.1	10.9	24.5	11.5	25.9	12.2	27.4	12.9	29.0	13.7
		Kollonnawa (Outdoor)	63			20.0	12.4	42.0	26.0	43.4	26.9	28.3	17.5	28.0	17.4	26.8	16.6	27.7	17.2	28.4	17.6	27.9	17.3	28.4	17.6	28.8	17.9	29.9	18.5	31.3	19.4	37.0	23.0
		Kosgama	63			50.0	20.0	50.2	22.8	50.5	22.9	51.6	23.4	51.8	23.5	37.6	17.1	39.8	18.0	41.5	18.8	40.6	18.4	41.6	18.9	42.6	19.3	44.9	20.4	48.1	21.8	51.3	23.3
		Oruwala	6.3			3.0	0.6	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4	2.0	0.4
		Padukka		90	2017											21.4	9.3	22.1	9.6	22.6	9.8	23.2	10.1	23.7	10.3	24.3	10.5	27.6	12.0	32.7	14.2	39.7	17.2
		Pannipitiya	90			50.0	32.0	43.0	20.3	45.4	21.4	47.1	22.2	48.2	22.7	47.4	22.4	50.5	23.8	53.1	25.1	53.5	25.2	55.5	26.2	57.6	27.2	60.3	28.5	63.9	30.2	67.5	31.9
		Seethawaka	94.5			32.0	8.0	40.4	14.1	45.5	15.9	48.5	16.9	51.1	17.8	38.2	13.3	42.0	14.6	45.3	15.8	46.4	16.2	49.0	17.1	51.7	18.0	51.7	18.0	50.6	17.6	47.7	16.6
		Sri Jayawardanapura	63	94.5	2015	33.1	17.0	49.1	22.3	50.1	22.8	67.4	30.6	67.3	30.6	52.4	23.8	54.7	24.9	56.3	25.6	55.1	25.0	56.0	25.5	57.0	25.9	59.3	26.9	62.5	28.4	65.7	29.9
4	SP	Ambalangoda	63			38.2	11.2	32.3	8.4	35.6	9.2	37.8	9.8	38.8	10.1	38.1	9.9	40.2	10.4	41.8	10.8	41.5	10.8	42.5	11.0	43.3	11.3	45.5	11.8	48.2	12.5	50.9	13.2
		Beliatta	63			17.0	8.2	43.5	11.2	59.4	15.3	45.5	11.7	47.4	12.2	34.9	9.0	36.8	9.5	38.8	10.0	40.8	10.5	42.8	11.0	44.7	11.5	45.7	11.7	46.7	12.0	47.7	12.3
		Deniyaya	94.5			27.0	5.4	32.4	8.6	33.7	8.9	34.4	9.1	34.6	9.2	33.6	8.9	35.3	9.4	36.6	9.7	36.5	9.7	37.5	9.9	38.5	10.2	40.2	10.7	42.3	11.2	44.5	11.8
		Galle	91.5	94.5	2015	57.4	31.5	64.0	35.5	65.6	36.4	66.2	36.7	65.7	36.5	62.9	34.9	65.3	36.3	67.0	37.2	65.9	36.6	67.0	37.2	68.1	37.8	70.7	39.3	74.3	41.3	49.7	27.6
		Hambantota	47.5	94.5	2015	21.0	7.0	44.5	12.6	46.6	13.2	84.8	24.0	89.6	25.3	53.2	15.1	43.2	12.2	45.1	12.8	61.6	17.4	61.7	17.5	69.5	19.7	72.9	20.6	78.0	22.1	83.2	23.5
		Hambantota Port		63	2017											38.5	10.9	38.5	10.9	38.5	10.9	41.7	11.8	41.7	11.8	41.7	11.8	41.7	11.8	41.7	11.8	43.6	12.3
		Matara	63	94.5	2014	60.0	20.1	42.0	10.8	44.5	11.4	46.0	11.8	46.4	11.9	43.7	11.2	47.3	12.2	50.1	12.9	49.2	12.6	51.1	13.1	53.1	13.6	56.9	14.6	62.2	16.0	67.6	17.4
		Suriyawewa		63	2017											26.1	7.4	28.4	8.0	30.8	8.7	36.4	10.3	38.8	11.0	41.2	11.7	41.7	11.8	42.2	11.9	42.7	12.1
		Tissamaharama		63	2018													12.8	3.6	13.5	3.8	14.2	4.0	14.9	4.2	15.6	4.4	16.3	4.6	17.1	4.8	17.8	5.0
		Weligama		63	2025																											28.2	15.7
	WPS I	Dehiwala	63	94.5	2022	34.0	17.8	36.4	19.5	37.1	19.9	37.2	20.0	36.8	19.8	35.1	18.9	36.3	19.5	37.1	19.9	36.4	19.6	36.9	19.8	37.4	20.1	38.8	20.8	40.6	21.8	42.5	22.8
		Kaluthara		63	2016									11.2	4.9	11.5	5.0	11.8	5.1	12.1	5.2	12.4	5.4	12.6	5.5	12.9	5.6	13.2	5.7	13.5	5.9	13.8	6.0
		Mathugama	94.5			48.3	18.9	51.5	30.4	53.1	31.4	54.0	31.9	54.1	32.0	45.8	27.1	48.2	28.5	50.0	29.6	49.5	29.3	50.8	30.1	52.3	30.9	54.6	32.3	57.7	34.1	61.0	36.0
		Panadura	63	94.5	2014	40.0	19.0	52.8	23.0	54.1	23.5	54.8	23.8	43.1	18.8	40.8	17.7	42.7	18.6	43.8	19.1	42.7	18.6	43.2	18.8	43.9	19.1	45.7	19.9	48.3	21.0	51.0	22.2
		Ratmalana	94.5			57.6	27.0	55.7	25.4	57.6	26.2	58.6	26.7	58.7	26.7	56.7	25.8	39.4	17.9	40.4	18.4	39.0	17.8	39.2	17.8	39.4	17.9	40.6	18.5	42.6	19.4	44.5	20.3
Total Demand - Night Peak						**2162.2**	**901.5**	**2445.8**	**1010.3**	**2631.3**	**1080.1**	**2830.2**	**1158.2**	**2950.2**	**1208.7**	**3134.5**	**1256.6**	**3336.6**	**1338.5**	**3508.8**	**1403.2**	**3680.2**	**1476.6**	**3872.4**	**1541.0**	**4077.7**	**1615.8**	**4236.9**	**1680.9**	**4447.4**	**1761.3**	**4661.3**	**1848.8**

*Note: In 2012 actual demand, Rantambe load is indicated in Mahiyangana GS, Chunnakam grid demand is indicated (not connected to national grid)

Table 3.2: Grid Substation Demand Forecast 2013-2025- Day Peak

Region	Province	Grid Substation	Existing Capacity	Expansion Capacity	Expansion Year	2012 Actual		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023		2024		2025	
						MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr
1	CC	Kelanitissa	120			17.0	10.5	21.5	13.3	22.5	14.0	56.6	35.1	78.5	48.6	24.6	15.3	25.5	15.8	26.0	16.1	41.7	25.8	41.9	25.9	42.1	26.1	43.4	26.9	45.3	28.1	47.2	29.3
		Kolonnawa (Indoor)	94.5			52.4	32.5	59.5	37.0	60.3	37.5	45.3	28.2	52.7	32.8	42.7	26.6	44.4	27.6	44.8	27.8	43.4	27.0	43.5	27.0	43.6	27.1	44.9	27.9	46.8	29.1	48.8	30.3
		Port City 1		90	2017											25.0	8.2	25.0	8.2	37.5	12.3	50.0	16.4	62.5	20.5	75.0	24.7	75.0	24.7	75.0	24.7	75.0	24.7
		Port City 2		90	2017											25.0	8.2	25.0	8.2	37.5	12.3	50.0	16.4	62.5	20.5	75.0	24.7	75.0	24.7	75.0	24.7	75.0	24.7
		Sub A (Havelock Town)	63	94.5	2015	50.2	19.9	52.7	21.1	53.9	21.6	54.5	21.9	57.7	23.1	48.0	19.2	49.1	19.7	55.5	22.3	47.3	19.0	47.3	19.0	47.4	19.0	49.2	19.7	51.5	20.7	53.9	21.6
		Sub B (Pettah)		63/94.5	2017/2020											27.6	17.2	30.2	18.8	30.9	19.3	46.4	28.9	46.9	29.2	48.9	30.4	52.3	32.6	56.5	35.2	60.5	37.7
		Sub C (Kotahena)	63			24.0	14.9	20.2	12.6	20.6	12.8	23.5	14.6	23.2	14.4	22.0	13.7	22.8	14.2	23.3	14.5	22.9	14.3	23.3	14.5	23.6	14.7	24.5	15.3	25.7	16.0	26.9	16.8
		Sub E (Kollupitiya)	90			50.6	34.4	51.7	30.8	53.1	31.7	73.5	43.8	74.7	44.5	49.4	29.4	50.1	29.9	50.2	29.9	48.4	28.8	48.2	28.7	48.1	28.7	49.4	29.5	51.4	30.6	53.4	31.8
		Sub F (Fort)	90			41.0	23.9	57.0	32.4	58.1	33.0	71.3	40.5	74.0	42.1	40.5	23.0	43.6	24.7	44.5	25.3	49.9	28.4	50.5	28.7	52.5	29.8	55.8	31.7	59.9	34.0	64.1	36.4
		Sub I (Maradana)	63	94.5	2017	37.7	16.4	35.4	14.9	36.3	15.3	48.0	20.2	57.1	24.0	36.4	15.3	37.5	15.8	38.0	16.0	37.0	15.6	37.1	15.6	37.3	15.7	38.7	16.3	40.6	17.1	42.5	17.9
		Sub K (Wellawatta)		45	2017											6.3	2.5	6.8	2.7	8.5	3.4	9.3	3.7	10.3	4.1	11.2	4.5	12.1	4.9	13.1	5.3	14.1	5.7
		Sub L (Port)		180	2017											51.0	31.6	68.0	42.1	68.0	42.1	85.0	52.7	85.0	52.7	85.0	52.7	85.0	52.7	85.0	52.7	85.0	52.7
		Sub M (Slave Island)		90	2017											38.4	16.2	40.8	17.2	40.9	17.2	40.1	16.9	40.1	16.9	40.1	16.9	40.1	16.9	40.1	16.9	40.1	16.9
		Sub N (Hunupitiya)		90	2017											25.5	10.9	27.1	11.6	27.2	11.6	26.7	11.4	26.7	11.4	26.7	11.4	26.7	11.4	26.7	11.4	26.7	11.4
		Sub P (Town Hall)		90	2020																	27.0	11.4	26.7	11.2	26.5	11.1	27.1	11.4	28.1	11.8	29.1	12.2
	NCP	Anuradhapura	51.5	94.5	2017	19.9	4.8	21.7	4.6	23.2	4.9	24.4	5.1	25.4	5.3	25.2	5.3	27.2	5.7	28.9	6.1	29.4	6.2	30.7	6.5	32.1	6.7	33.8	7.1	35.9	7.5	38.1	8.0
		Habarana	63	94.5	2014	40.6	20.0	51.5	22.6	42.5	18.6	26.2	11.5	25.6	11.2	22.2	9.7	23.7	10.4	24.1	10.6	21.9	9.6	21.7	9.5	21.6	9.4	23.7	10.4	26.9	11.8	30.2	13.2
		New Anuradhapura	60			20.0	4.2	20.4	3.9	21.7	4.2	22.8	4.4	23.0	4.4	22.7	4.3	24.5	4.7	26.0	5.0	26.4	5.0	27.6	5.3	28.8	5.5	30.3	5.8	32.2	6.2	34.1	6.5
		Polonnaruwa		31.5/63	2015/2017							17.8	7.8	19.2	8.4	20.7	9.1	22.3	9.8	24.0	10.5	25.8	11.3	27.5	12.1	29.3	12.8	30.2	13.3	31.2	13.7	32.2	14.1
	NP	Chemmany		63/94.5	2017/2025											24.8	5.0	27.7	5.6	30.8	6.3	34.0	6.9	37.2	7.5	40.3	8.2	43.5	8.8	43.7	8.9	44.3	9.0
		Chunnakam	63	94.5	2022	*22.8	*4.6	28.5	5.8	38.3	7.8	43.7	8.9	47.9	9.7	22.5	4.6	23.3	4.7	23.1	4.7	20.7	4.2	20.0	4.1	19.3	3.9	19.1	3.9	22.8	4.6	26.2	5.3
		Killinochchi	63			7.5	1.2	8.6	2.8	10.9	3.6	11.8	3.8	13.3	4.3	13.6	4.4	14.0	4.6	14.5	4.7	15.1	4.9	15.7	5.1	16.4	5.3	17.1	5.6	18.0	5.8	18.9	6.1
		Mannar		31.5	2017											4.4	1.5	4.9	1.6	5.4	1.8	6.0	2.0	6.5	2.2	7.0	2.3	7.5	2.5	8.0	2.7	8.5	2.8
		Vavuniyawa	63			15.1	4.2	17.8	5.8	19.9	6.5	21.9	7.1	23.1	7.5	18.6	6.1	20.4	6.6	21.9	7.1	21.7	7.1	22.4	7.3	23.1	7.5	24.1	7.8	25.5	8.3	27.0	8.8
	NWP	Bolawatta	94.5			49.5	26.7	65.4	35.5	67.3	36.6	68.2	37.1	68.3	37.1	58.8	32.0	61.8	33.6	63.9	34.7	63.5	34.5	65.0	35.4	66.7	36.3	69.5	37.8	49.2	26.7	51.8	28.2
		Eluwankulama		31.5	2016									16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8	16.1	5.8
		Kurunegala	63	94.5	2015	40.0	22.0	48.0	15.5	50.9	16.4	54.4	17.5	55.9	18.0	53.9	17.3	47.2	15.2	50.0	16.1	50.4	16.2	52.3	16.9	54.4	17.5	57.3	18.5	61.1	19.7	65.1	21.0
		Madampe	63	94.5	2016	40.0	20.0	39.8	23.1	41.5	24.1	42.6	24.7	43.1	25.0	41.8	24.3	44.2	25.7	46.1	26.8	46.1	26.8	47.6	27.6	49.1	28.5	51.3	29.8	54.2	31.5	57.2	33.2
		Maho		31.5/63	2014/2016					7.5	4.2	8.0	4.5	8.5	4.8	9.1	5.1	19.0	10.7	19.6	11.1	20.3	11.4	20.9	11.8	21.5	12.2	21.9	12.3	22.2	12.5	22.5	12.7
		Pannala	63	94.5	2020	30.2	16.8	32.2	20.6	35.5	22.7	38.3	24.5	40.5	25.9	40.8	26.1	44.6	28.5	47.9	30.6	49.2	31.4	51.9	33.2	54.7	35.0	58.8	37.6	63.7	40.8	68.9	44.1
		Puttalama	63	94.5	2024	24.0	10.5	34.0	18.5	30.7	16.7	32.0	17.4	32.7	17.8	31.1	16.9	33.0	18.0	34.5	18.8	34.1	18.6	35.2	19.2	36.2	19.7	38.5	21.0	41.1	22.4	43.6	23.8
		Wariyapola		63	2024																									25.3	10.5	26.5	11.0
2	CP	Kegalle		63	2017											12.7	6.2	13.2	6.4	13.8	6.7	14.4	7.0	15.0	7.3	15.6	7.6	15.9	7.8	16.2	7.9	16.5	8.0
		Kiribath Kumbura	94.5	126	2016	60.0	32.0	49.4	34.4	39.1	27.2	39.8	27.7	39.7	27.6	29.7	20.7	31.8	22.1	33.0	22.9	31.0	21.6	31.4	21.9	31.8	22.2	43.4	30.2	47.5	33.1	51.7	36.0
		Naula		31.5/63	2014/2016					16.1	5.2	17.4	5.6	18.2	5.9	18.9	6.1	20.0	6.5	21.1	6.8	22.0	7.1	23.1	7.5	24.2	7.8	24.8	8.0	25.5	8.2	26.2	8.5
		Nawalapitiya		63	2017											7.7	2.6	8.1	2.8	8.5	2.9	9.0	3.1	9.5	3.2	10.1	3.4	10.7	3.6	11.3	3.8	12.0	4.1
		Nuwara Eliya	94.5			20.0	10.0	22.6	12.7	25.9	14.6	28.1	15.8	29.8	16.8	26.5	14.9	27.2	15.3	27.6	15.5	26.7	15.0	26.8	15.1	26.9	15.2	18.0	10.2	18.8	10.6	19.5	11.0
		Pallekele		63/94.5	2014/2021					25.1	17.8	27.4	19.4	29.2	20.7	31.1	22.1	33.3	23.7	35.5	25.2	37.7	26.7	39.8	28.3	42.0	29.8	43.1	30.6	44.3	31.4	45.4	32.2
		Ragala		63	2017											3.6	1.8	3.7	1.9	3.8	1.9	3.9	2.0	4.0	2.0	4.1	2.1	4.3	2.1	4.4	2.2	4.5	2.2
		Thulhiriya	94.5			34.6	18.6	43.0	20.9	46.1	22.4	48.0	23.3	48.1	23.4	33.5	16.3	35.3	17.1	36.5	17.7	35.4	17.2	35.9	17.4	36.6	17.8	38.4	18.7	41.1	20.0	43.8	21.3
		Ukuwela	94.5			24.8	11.4	42.6	17.4	32.7	13.3	33.4	13.6	33.7	13.7	32.6	13.3	34.4	14.0	35.7	14.6	35.7	14.5	36.7	15.0	37.8	15.4	39.5	16.1	41.7	17.0	43.9	17.9
		Wimalasurendra	94.5			11.0	4.0	17.3	5.5	20.8	6.6	23.9	7.6	23.4	7.4	22.1	7.0	22.7	7.2	23.1	7.3	22.6	7.2	22.8	7.2	23.0	7.3	23.8	7.6	24.9	7.9	26.1	8.3
	EP	Akkaraipattu		31.5	2019															7.4	2.0	7.9	2.1	8.4	2.3	9.0	2.4	9.6	2.6	10.2	2.8	10.8	2.9
		Ampara	94.5			40.0	16.0	45.6	12.3	48.1	13.0	33.7	9.1	33.8	9.1	31.7	8.5	34.1	9.2	28.4	7.6	27.3	7.4	28.0	7.5	28.5	7.7	30.3	8.2	33.1	8.9	35.8	9.6
		Kappalthurei		120	2017											70.6	38.1	73.5	39.7	76.2	41.1	77.1	41.6	79.4	42.9	81.9	44.2	84.4	45.6	87.4	47.2	90.5	48.9
		Sampoor			2017											124.5	64.9	140.0	73.0	155.6	81.1	186.7	97.3	248.9	129.7	311.2	162.1	311.2	162.1	311.2	162.1	311.2	162.1
		Trincomalee	63			23.4	9.6	47.6	24.8	48.9	25.5	51.1	26.6	52.9	27.5	20.5	10.7	22.1	11.5	22.8	11.9	21.3	11.1	21.7	11.3	22.2	11.6	25.3	13.2	29.5	15.4	34.2	17.8
		Valachchenai	51.5	63	2017	19.5	8.3	20.8	6.5	21.9	6.8	22.6	7.0	23.0	7.1	22.4	7.0	23.8	7.4	25.0	7.7	25.1	7.8	26.0	8.1	27.0	8.4	29.0	9.0	31.4	9.7	33.9	10.5
		Vavunathivu		63	2015							16.3	4.4	17.4	4.7	18.5	5.0	19.6	5.3	20.7	5.6	21.8	5.9	22.9	6.2	24.0	6.5	24.6	6.6	25.1	6.8	25.7	6.9
	WPN	Aniyakanda	63	94.5	2018	36.0	20.0	39.5	16.6	46.8	19.7	45.2	19.0	37.2	15.7	36.7	15.4	49.2	20.7	52.0	21.9	52.5	22.1	54.8	23.1	57.0	24.0	60.1	25.3	64.3	27.0	68.3	28.7

Region	Province	Grid Substation	Existing Capacity	Expansion Capacity	Expansion Year	2012 Actual		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023		2024		2025	
						MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr	MW	MVAr
		Biyagama	120			80.0	40.0	88.2	44.2	91.1	45.7	88.9	44.5	88.8	44.5	53.8	27.0	56.8	28.5	58.3	29.2	56.3	28.2	57.0	28.6	53.6	26.9	56.7	28.4	61.4	30.8	65.9	33.0
		Kadawatha		63	2025																											23.0	11.0
		Katunayaka	63	94.5	2017	46.0	26.0	47.4	20.8	50.1	22.0	51.9	22.8	52.5	23.0	61.5	27.0	64.6	28.3	66.9	29.4	67.0	29.4	68.4	30.0	70.0	30.7	73.2	32.1	77.3	33.9	49.2	21.6
		Kelaniya	31.5	63/94.5	2015/2023	30.8	16.6	23.7	12.5	24.0	12.6	44.3	23.3	45.0	23.7	44.0	23.1	46.8	24.6	49.1	25.9	49.2	25.9	50.8	26.7	52.8	27.8	56.3	29.6	60.7	32.0	65.3	34.4
		Kerawalapitiya		70	2017											10.5	5.3	11.1	5.6	11.3	5.7	11.0	5.5	28.9	14.6	28.9	14.6	29.4	14.8	30.1	15.2	30.8	15.5
		Kirindiwela		90	2017											31.3	15.4	32.5	16.0	33.7	16.6	34.9	17.2	36.1	17.8	41.8	20.6	43.0	21.2	44.3	21.8	45.5	22.4
		Kotugoda	183			64.4	34.8	67.4	59.2	81.4	71.5	87.6	76.9	91.8	80.7	79.8	70.1	88.1	77.4	94.4	82.9	96.9	85.1	87.3	76.7	92.7	81.4	98.7	86.7	106.4	93.5	114.3	100.4
		Negombo		63	2025																											33.6	14.3
		Sapugaskanda	121.5			66.5	33.6	75.0	36.6	78.2	38.1	71.1	34.7	79.4	38.7	75.8	37.0	69.3	33.8	71.0	34.6	69.8	34.1	70.9	34.6	72.1	35.2	74.9	36.6	78.8	38.4	59.8	29.2
		Veyangoda	63	94.5	2015	40.6	21.9	47.3	15.4	49.8	16.1	51.4	16.7	52.3	17.0	50.8	16.5	54.0	17.5	56.4	18.3	56.6	18.4	58.5	19.0	60.6	19.6	64.6	21.0	69.7	22.6	74.9	24.3
		Balangoda	94.5			14.2	7.8	11.9	6.4	11.9	6.4	11.7	6.3	11.3	6.1	6.5	3.5	6.6	3.6	6.6	3.6	6.2	3.4	6.2	3.3	6.1	3.3	6.4	3.5	6.8	3.7	7.2	3.9
		Embilipitiya	63	94.5	2025	14.3	8.0	22.6	8.4	26.4	9.8	44.1	16.3	45.1	16.7	26.7	9.9	27.7	10.3	28.4	10.5	28.0	10.4	28.5	10.5	29.0	10.7	30.1	11.1	31.6	11.7	33.1	12.3
	SBP	Kukule		41.5	2017											4.7	2.0	4.9	2.1	5.0	2.2	5.2	2.3	5.4	2.4	5.6	2.5	5.8	2.6	6.1	2.6	6.3	2.7
		Maliboda		31.5	2017											4.5	1.9	4.8	2.1	5.3	2.3	5.7	2.5	6.2	2.7	6.7	2.9	7.1	3.1	7.6	3.3	8.1	3.5
		Rathnapura	94.5			12.0	8.0	13.2	9.0	13.7	9.3	16.9	11.5	16.8	11.4	12.2	8.3	12.9	8.7	13.3	9.0	13.0	8.9	13.3	9.0	13.6	9.3	14.5	9.9	15.7	10.7	16.9	11.5
		Wewalwatta		63	2017											8.1	4.3	8.2	4.4	8.3	4.4	8.4	4.5	8.5	4.5	8.6	4.6	8.6	4.6	8.7	4.7	8.8	4.7
		Badulla	94.5			30.0	10.0	34.5	7.9	39.8	9.1	32.0	7.3	32.3	7.4	30.2	6.9	25.5	5.8	25.5	5.8	23.1	5.3	22.4	5.1	21.8	5.0	22.6	5.2	24.2	5.5	25.9	5.9
	UP	Mahiyanganaya	63			*4.0	*1.7	11.5	4.6	12.1	4.8	12.5	5.0	12.9	5.2	13.1	5.2	4.9	2.0	5.1	2.0	5.0	2.0	5.0	2.0	5.1	2.0	5.3	2.1	5.5	2.2	5.8	2.3
		Monaragala		31.5/63	2015/2022							11.6	2.6	12.9	2.9	14.2	3.2	15.1	3.4	16.0	3.6	16.9	3.8	17.8	4.0	18.7	4.2	19.2	4.3	19.7	4.4	20.2	4.5
		Wellawaya		63	2018													15.2	3.3	16.2	3.5	17.4	3.8	18.6	4.1	19.8	4.3	21.0	4.6	22.2	4.8	23.5	5.1
3		Athurugiriya	63	94.5	2022	25.0	13.5	33.7	18.4	36.8	20.0	39.2	21.3	40.9	22.3	40.7	22.2	44.1	24.0	46.9	25.5	47.8	26.0	50.1	27.3	52.5	28.6	54.1	29.4	52.1	28.4	49.5	26.9
		Battaramulla		63	2017											16.2	8.6	17.4	9.2	18.7	9.9	20.1	10.6	21.6	11.4	23.1	12.2	24.6	13.0	26.1	13.8	27.6	14.6
		Horana	63	94.5	2015	38.6	20.8	50.3	24.5	52.9	25.8	54.6	26.7	55.4	27.1	53.9	26.3	57.1	27.9	59.7	29.1	59.8	29.2	61.8	30.2	63.9	31.2	68.1	33.2	73.4	35.8	78.8	38.5
		Kesbewa		63	2018													20.6	14.0	21.5	14.6	22.5	15.3	23.4	15.9	24.7	16.8	26.0	17.7	27.4	18.6	28.8	19.6
		Kollonnawa (Outdoor)	63			20.0	12.4	34.7	21.2	36.0	22.0	36.9	22.5	36.7	22.4	18.7	11.4	19.4	11.9	19.9	12.2	19.6	12.0	19.9	12.2	41.6	25.4	42.4	25.9	41.7	25.5	40.2	24.6
	WPS II	Kosgama	63			43.0	24.0	49.2	26.6	51.3	27.8	52.4	28.4	52.9	28.7	30.6	16.6	32.5	17.6	33.5	18.2	32.4	17.5	32.8	17.8	33.3	18.0	34.8	18.9	37.2	20.1	39.6	21.4
		Oruwala	6.3			4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8	4.0	0.8
		Padukka		90	2017											20.4	11.1	21.5	11.7	22.7	12.4	23.8	13.0	25.0	13.6	26.1	14.3	29.9	16.3	38.1	20.8	47.2	25.7
		Pannipitiya	90			56.0	30.0	59.3	39.2	61.1	40.4	62.2	41.1	62.6	41.4	50.8	33.5	53.6	35.4	55.7	36.8	55.5	36.7	57.1	37.7	58.8	38.8	61.4	40.5	64.8	42.8	68.2	45.1
		Seethawaka	94.5			28.0	12.0	28.9	12.9	30.9	13.8	32.5	14.5	33.8	15.1	29.1	13.0	31.4	14.0	33.3	14.8	33.5	14.9	34.9	15.5	36.3	16.2	38.0	16.9	40.4	18.0	42.8	19.1
		Sri Jayawardanapura	63	94.5	2015	26.0	14.0	46.7	25.6	49.0	26.9	50.3	27.6	51.5	28.2	61.3	33.6	64.8	35.5	67.3	36.9	66.1	36.2	67.5	37.0	47.2	25.9	49.9	27.3	55.7	30.5	62.5	34.2
		Ambalangoda	63			23.6	14.0	17.4	9.8	19.0	10.8	20.0	11.3	20.3	11.5	19.7	11.1	20.7	11.7	21.3	12.0	21.0	11.9	21.4	12.1	21.7	12.3	22.7	12.9	24.1	13.6	25.4	14.3
		Beliatta	63			8.8	4.0	30.0	19.3	48.3	31.0	31.3	20.1	32.4	20.8	16.6	10.6	17.6	11.3	18.7	12.0	19.7	12.6	20.7	13.3	21.8	14.0	22.3	14.3	22.9	14.7	23.4	15.0
		Deniyaya	94.5			16.0	6.8	16.5	5.4	17.0	5.6	17.3	5.6	17.4	5.7	16.7	5.4	17.5	5.7	18.1	5.9	18.0	5.9	18.5	6.0	19.0	6.2	19.8	6.5	20.9	6.8	22.0	7.2
		Galle	91.5	94.5	2015	42.7	28.5	53.3	28.7	54.9	29.6	55.6	30.0	55.6	30.0	53.2	28.7	55.7	30.1	57.4	31.0	56.9	30.7	58.2	31.4	59.5	32.1	62.0	33.5	65.3	35.3	35.3	19.1
	SP	Hambantota	47.5	94.5	2015	11.2	4.9	36.8	19.7	40.6	21.8	61.6	33.0	65.2	35.0	43.2	23.2	38.8	20.8	40.2	21.5	54.8	29.4	54.8	29.4	61.4	32.9	64.2	34.4	68.4	36.7	72.6	39.0
		Hambantota Port		63	2017											35.3	18.9	35.3	18.9	35.3	18.9	38.2	20.5	38.2	20.5	38.2	20.5	38.2	20.5	38.2	20.5	40.0	21.4
		Matara	63	94.5	2014	43.0	19.0	31.3	20.1	33.0	21.2	33.8	21.7	33.7	21.6	31.5	20.2	33.5	21.5	35.0	22.4	34.2	21.9	35.1	22.5	36.1	23.2	39.6	25.4	44.0	28.2	48.5	31.1
4		Suriyawewa		63	2017											20.6	11.1	22.5	12.1	24.4	13.1	29.2	15.7	31.1	16.7	33.0	17.7	33.2	17.8	33.3	17.9	33.5	17.9
		Tissamaharama		63	2018													6.3	3.4	6.4	3.5	6.6	3.6	6.8	3.7	7.0	3.8	7.2	3.9	7.4	4.0	7.7	4.1
		Weligama		63	2025																											33.4	18.0
		Dehiwala	63	94.5	2022	42.8	26.0	40.8	21.8	42.5	22.7	43.6	23.3	44.2	23.6	42.9	22.9	45.4	24.2	47.4	25.3	47.4	25.3	49.0	26.1	50.6	27.0	52.8	28.2	55.9	29.8	58.9	31.4
		Kaluthara		63	2016									17.3	12.1	18.4	12.9	19.7	13.8	21.0	14.7	22.3	15.6	23.6	16.6	25.0	17.5	26.3	18.4	27.6	19.3	29.0	20.3
	WPS I	Mathugama	94.5			32.4	18.3	50.5	39.0	51.8	40.1	39.2	30.3	39.5	30.5	34.1	26.3	36.1	27.9	37.5	29.0	37.3	28.8	38.4	29.6	39.5	30.5	41.3	31.9	43.7	33.8	46.1	35.6
		Panadura	63	94.5	2014	53.0	30.0	43.3	30.1	46.3	32.3	62.7	43.7	46.9	32.7	44.5	31.0	47.8	33.3	49.8	34.7	49.0	34.1	50.3	35.0	51.7	36.0	54.0	37.6	57.5	40.0	61.0	42.5
		Ratmalana	94.5			60.0	36.0	63.0	35.7	64.5	36.5	64.9	36.8	64.5	36.6	61.5	34.9	42.4	24.1	43.2	24.5	41.4	23.5	41.6	23.6	41.7	23.6	42.9	24.3	45.1	25.5	47.1	26.7
Total Demand - Day Peak						**1828.7**	**941.0**	**2126.7**	**1095.5**	**2284.8**	**1178.4**	**2457.8**	**1264.4**	**2562.5**	**1317.5**	**2723.0**	**1376.2**	**2896.3**	**1469.4**	**3046.1**	**1540.6**	**3195.8**	**1617.5**	**3361.8**	**1692.8**	**3538.0**	**1780.6**	**3675.7**	**1852.4**	**3857.9**	**1942.6**	**4044.4**	**2037.2**

*Note: In 2012 actual demand, Rantambe load is indicated in Mahiyangana GS, Chunnakam grid demand is indicated (not connected to national grid)

Chapter 4

Transmission System Analysis

4.1. Background

The transmission system analysis encompasses load flow, reliability, short-circuit and stability studies. These studies are carried out to identify the areas where planning criteria are violated. The load forecast is first prepared taking input from Long Term Generation Expansion Plan, Regional Distribution Development Plans and Grid Substation loadings. The forecast is prepared up to the year 2032. Next the 2032 transmission network was developed to handle forecasted demand by transmitting bulk power from existing and identified generating stations in the Long Term Generation Expansion Plan. Year wise planning studies are carried out starting from present network in the year 2013 for entire planning horizon which is from 2013 to 2022. Reinforcement and Expansion proposals identified in the year wise analysis are matched with the 2032 transmission network developed at the first stage. Proposed transmission network in the year 2032 is shown Annex A-6.

Power plant additions and retirements are considered according to the Long Term Generation Expansion Plan and locations of power plants are considered as per Annex D.

The load flow studies are performed under normal operating conditions and N-1 contingency conditions to identify system weakness for present demand and future growing demand. Several alternative network improvements are proposed to rectify each problem in the network and techno-economic analysis is carried out to select the most feasible and economical set of proposals for the planning horizon. The network performance with the selected set of proposals is re-examined against the planning criteria and necessary adjustments are made. The above process is conducted iteratively until a satisfactory network performance is ensured for the entire planning horizon.

The planning horizon considered for the present study is ten years, from year 2013 to year 2022. The detailed system studies were performed under two generation scenarios: hydro maximum and thermal maximum and three loading conditions; day peak (11.00 hours), night peak (19.30 hours) and off peak (3.00 hours) in 2013, 2014, 2015, 2017, 2019 and 2022. Table 4.1 shows all the scenarios studied for a particular year.

The system studies were carried out using Power System Simulator for Engineering (PSS/E) simulations. The load flow study results for the years 2013, 2014, 2015, 2017 and 2022 are given in the Annex C. Even though the load flow studies reveal certain planning criteria violations in the network, all of them are sometimes not resolved in the same year due to financial and project implementation time limitations.

Planning criteria violations listed under base case are not repeated under single contingency planning criteria violations throughout the report. Further, dynamic stability studies were performed for the years 2013, 2017 and 2022 to check the transient stability of the proposed transmission systems against critical system faults and failures of major generators. However, it is difficult to run stability simulations for the years 2014 and 2015 because the year-2014 and 2015 system are facing many line overload problems under normal (N-0) conditions and many severe steady state violations under single contingency (N-1) conditions. Moreover, maximum three phase short circuits levels were calculated at 220kV, 132kV, 33kV and 11kV busbars of the system.

Table 4.1: Generation and Loading Scenarios considered for the studies

Scenario	Load	Generation
TMNP	Night Peak	Thermal Max Wind 0% Mini-hydro 33% Dendro 100% Hydro Balance
TMDP	Day Peak	Thermal Max Wind 0% Mini-hydro 33% Dendro 100% Hydro Balance
HMNP	Night Peak	Wind 100% Mini-hydro 100% Dendro 0% Hydro Max Thermal Balance
HMDP	Day Peak	Wind 100% Mini-hydro 100% Dendro 0% Hydro Max Thermal Balance
OP	Off Peak	Wind 100% Mini-hydro 100% Dendro 0% Hydro Partial Thermal Partial

4.2. Steady State System Analysis - Year 2013

In the Long Term Transmission Development Plan 2013-2022, 2013 is the base year and the system studies have been carried out for two generation scenarios and three loading scenarios as given in table 4.1. Further, the over current relay settings given by Transmission O&M branch were used as the current rating of exiting transmission lines while the design ratings were used as the current rating for proposed transmission line. It is assumed that the generation of Ukuwela and Bowatanne Power Plants will be affected due to the irrigation restriction and the thermal plants were dispatched according to the merit order.

The demand for night peak; 2446MW & 1010MVar, day peak; 2127MW & 1095MVar and base load; 978MW & 404MVar for year 2013 were used according to the Load Forecast 2013-2025.
20MW of Northern Power and 24MW of Chunnakam Power plants were considered in operation and following committed projects have been taken into the analysis of system in the year 2013 for three loading scenarios and two generation scenarios.

Table 4.2 Transmission Expansion Proposals Considered for 2013 System Studies

Description	Status	Year
Grid Augmentations		
Ampara (2x31.5 MVA → 3x31.5 MVA)	Committed	2013
Valachchenai (2x10 MVA → 2x10+31.5MVA)	-do-	2013
Badulla (2x31.5 MVA → 3x31.5 MVA)	-do-	2013
Ukuwela (2x31.5 MVA → 3x31.5 MVA)	-do-	2013
Wimalasurendra (16+31.5MVA→ 3x31.5 MVA)	-do-	2013
Transmission Lines and Underground Cables		
Habarana - Valachchenai 132kV TL (1st cct.)	-do-	2013
System reactive power compensation		
Ampara (30 MVar)	Committed	2013

4.2.1 Normal Operating Condition

System studies have been carried out to identify voltage criteria violation, transformer overloading and transmission line overloading under normal operating condition.

a. Voltage Profile

In order to maintain 220kV voltage at Kelanitissa, Biyagama, Pannipitiya and Kerawalapitiya 220kV busbars under hydro maximum day peak loading scenario, Kelanitissa and Kerawalapitiya combined cycle power plants have to be operated. The voltage of above busbars could be improved by commissioning of proposed 100 MVar Breaker Switch Capacitor at Pannipiya GSS. Thus priority should be given to complete above project as early as possible to avoid usage of oil driven thermal plants during day time of hydro maximum condition.

Voltage criteria violations were observed under normal operating condition at New Anuradhapura 220kV bus during night peak loading condition and this will be solved with the stringing of 2nd circuit of Kotmale- New Anuradhapura 220kV transmission line being stringing at present.

b. Transmission Lines Overloading

Under normal operating condition 132kV transmission lines of Biyagama – Sapugaskanda and Sapugaskanda – Kelaniya get overloaded during both day and night peak loading conditions and hydro and thermal maximum scenarios. Construction of New Polpitiya-Padukka-Pannipitiya 220kV lines and Padukka-Athurugiriya-Kolonnawa 132kV lines will solve this problem in future. Until above line is commissioned, the Kelanitissa power plant (GTs connected to 132kV bus) has to operate to its maximum capacity to feed 132 kV lines.

During night peak loading condition 132kV transmission line of Polpitiya – Kiribathkumbura get overloaded. To overcome this, reconstruction of Polpitiya - Kiribathkumbura 132kV transmission line with zebra conductor should be done as early as possible.

Randenigala – Rantambe 220kV transmission line get overloaded during night peak loading with hydro maximum scenario. Construction of New Polpitiya-Padukka-Pannipitiya 220kV lines and Padukka-Athurugiriya-Kolonnawa 132kV lines will solve this problem in future.

c. Transformer Overloading

Rantambe 220/132kV inter bus transformer gets overloaded during thermal maximum night peak scenario. This will mitigate with the installation of 2nd , 220/132kV transformer at Rantambe.

4.2.2 Single Contingency Operating Condition

a. Voltage Profile

Table 4.3: Voltage Criteria Violations under Single Contingency Conditions 2013

Scenario	Contingency	Voltage violation	Solution
Hydro Maximum Day Peak	Inter-bus transformer outage at Pannipitiya GSS	Low voltages at Kukule, Horana, Pannipitiya, Ratmalana, Matugama, Panadura, Ambalangoda, Dehiwala GSS 132kV buses	Installation of 100MVar BSC at Pannipitiya GS.
	Panadura, Horana, Pannipitiya 132kV TL Single circuit outage	Low voltage at Horana GS 132kV bus	
	New Anuradhapura - Trincomalee 132kV TL Single circuit outage	Low voltage at Trincomalee GS 132kV bus	Stringing of 2nd circuit of Kotmale-New Anuradhapura 220kV transmission line
Thermal Maximum Day Peak	Inter-bus transformer outage at Pannipitiya GS	Low voltages at Kukule, Horana, Pannipitiya, Ratmalana, Matugama, Panadura, Ambalangoda, Dehiwala GSS 132kV buses	Installation of 100MVar BSC at Pannipitiya GS.
	Panadura, Horana, Pannipitiya 132kV TL Single circuit outage	Low voltages at Horana, Matugama, Ambalangoda GSS 132kV buses	
Hydro Maximum Night Peak	Inter-bus transformer outage at New Anuradhapura GS	Low voltages at Kukule, Horana, Pannipitiya, Ratmalana, Matugama, Panadura, Ambalangoda, Dehiwala GSS 132kV buses	Installation of 100MVar BSC at Pannipitiya GS.
	Inter-bus Transformer outage at New Anuradhapura GS	Low voltages at Trincomalee, Valachchenai GSS 132kV buses	Stringing of 2nd circuit of Kotmale-New Anuradhapura

Scenario	Contingency	Voltage violation	Solution
	Polpitiya – Kiribathkumbura 132kV TL Single circuit outage	Low voltages at Ukuwela, Bowatenna, Kurunegala, Trincomalee, Valachchenai GSS 132kV buses	220kV transmission line
	Outage of Habarana – Valachchenai 132kV transmission line	Low voltages Valachchenai GS 132kV bus	
	New Anuradhapura - Trincomalee 132kV TL Single circuit outage	Low voltage at Trincomalee GS 132kV bus	
Thermal Maximum Night Peak	Inter-bus transformer outage at Pannipitiya GS	Low voltages at Ukuwela, Bowatenna, Kurunegala, Habarana, Trincomalee, Valachchenai GSS 132kV buses	Stringing of 2nd circuit of Kotmale-New Anuradhapura 220kV transmission line
	Polpitiya – Kiribathkumbura 132kV TL Single circuit outage	Low voltages at Ukuwela, Bowatenna, Kurunegala, Habarana, Trincomalee, Kiribathkumbura,Valachchenai GSS 132kV buses	
	One circuit outage of Habarana –Valachchenai 132kV transmission line	Low voltages Valachchenai GS 132kV bus	
	New Anuradhapura - Trincomalee 132kV TL Single circuit outage	Low voltage at Trincomalee GS 132kV bus	
	Inter-bus transformer outage at Pannipitiya GS	Low voltages at Kukule, Horana, Pannipitiya, Ratmalana, Matugama, Panadura, Ambalangoda, Dehiwala GSS 132kV buses	Installation of 100MVar BSC at Pannipitiya GS.
	Panadura, Horana, Pannipitiya 132kV TL Single	Low voltages at Horana, Matugama, Ambalangoda GSS	

Scenario	Contingency	Voltage violation	Solution
	circuit outage	132kV buses	
	Outage of Embilipitiya-Beliatta 132kV transmission interconnection	Low voltages at Beliatta, Galle, Matara GSS 132kV buses	Construction of Ambalangoda – Galle 132kV transmission line
	Balangoda-Deniyaya 132kV transmission line outage	Low voltages at Deniyaya, Galle, Matara GSS 132kV buses	
	Balangoda-Galle 132kV transmission line outage	Low voltages at Galle, Matara GSS 132kV buses	

Critical voltage criteria violations were observed at New Anuradhapura 220kV bus bar and Trincomalee and Valachchenai 132kV bus bars in the event of outage of Kotmale - New Anuradhapura 220kV transmission line under all four scenarios leading system voltage collapse. This situation will solve with the stringing of 2nd circuit of Kotmale - New Anuradhapura 220kV transmission line and construction of Puttalam PS – New Anuradhapura 220 kV transmission line.
Outage of Randenigala - Rantambe 220kV transmission line will cause voltage collapse during thermal maximum night peak scenario. In order to maintain critical voltage drop in the system during the above contingency condition, Laxapana complex should be operated to its maximum generation level. However, the above problem will be solved with the implementation of Mahiyanganaya-Ampara 132kV transmission line and 2nd circuit of Kotmale - New Anuradhapura 220kV transmission line.

b. Transmission Lines Overloading

Table 4.4: Transmission line over loadings recorded under single contingency condition-2013

Scenario	Contingency	Overload		Solution
Hydro Maximum Day Peak	Polpitiya – Kiribathkumbura 132kV TL Single circuit outage	The other circuit	139.5%	Reconstruction with a higher capacity conductor
	Embilipitiya – Hambantota 132kV TL Single circuit outage	The other circuit	130.1%	Increase the present relay settings

Scenario	Contingency	Overload		Solution
Thermal Maximum Day Peak	Biyagama –Pannipitiya 220kV TL Single circuit outage	The other circuit	116.2%	Construction of 220kV line from New Polpitiya to Pannipitiya via Padukka
	Polpitiya – Kiribathkumbura 132kV TL Single circuit outage	The other circuit	137.1%	Reconstruction with a higher capacity conductor
	Katunayaka –Kotugoda 132kV TL Single circuit outage	The other circuit	116.3%	Arrange separate feeding
	Kelaniya –Kolonnawa 132kV TL Single circuit outage	The other circuit	140.3%	Open the other line and Load curtailment
	Kelaniya –Sapugaskanda 132kV TL Single circuit outage	The other circuit	140.4%	Open the Kelaniya – Kolonnawa 132kV transmission line and Load curtail to avoid Kelanitissa Inter-bus transformer overload
Hydro Maximum Night Peak	Biyagama –Pannipitiya 220kV TL Single circuit outage	The other circuit	110.0%	Construction of 220kV line from New polpitiya to Pannipitiya via Padukka
	Embilipitiya – Hambantota 132kV TL Single circuit outage	The other circuit	143.9%	Increase the present relay settings
	Katunayaka –Kotugoda 132kV TL Single circuit outage	The other circuit	134.8%	Load Curtailment/ Separate feeding to Pannala and Madampe. Problem will be solved with New Chilaw SS
	Kelaniya –Kolonnawa 132kV TL Single circuit outage	The other circuit	145.7%	Open the other line and Load curtailment
Thermal Maximum Night Peak	Biyagama –Pannipitiya 220kV TL Single circuit outage	The other circuit	126.3%	Construction of 220kV line from New Polpitiya to Pannipitiya via Padukka

Scenario	Contingency	Overload		Solution
	Rantembe –Badulla 132kV TL Single circuit outage	The other circuit	111.8%	Load Curtailment, Line upgrade to Zebra or construction of Mahiyanganaya – Ampara 132kV transmission line.
	Embilipitiya – Hambantota 132kV TL Single circuit outage	The other circuit	110.2%	Increase the present relay settings
	Katunayaka –Kotugoda 132kV TL Single circuit outage	The other circuit	153.0%	Feed Madampe from Puttalam and Pannala from Kotugoda side. Open the other line and Load curtailment. Problem will be solved with New Chilaw SS
	Kolonnawa –Athurugiriya 132kV TL Single circuit outage	The other circuit	138.5%	Open Athurugiriya-Polpitiya line and Load curtailment. Reconstruction of Kolonnawa-Athurugiriya 132kV TL with 2*Zebra conductor
	Kelaniya –Kolonnawa 132kV TL Single circuit outage	The other circuit	137.8%	Open the other line and Load curtailment

Under outage of one circuit of Katunayake- Kotugoda, Kelaniya - Kolonnawa 132kV transmission lines, the remaining circuits get overloaded during both hydro and thermal maximum generation scenarios and day and night peak loading conditions. This will be solved in the future with the implementation of 220kV transmission lines from New Polpitiya to Pannipitiya through Padukka, 132kV transmission lines from Padukka to Kolonnawa through Athurugiriya and New Chilaw 220/132kV switching station. But for immediate operation, feeding arrangements for Madampe and

Pannala can be arranged from Puttalam and Kotugoda respectively in case of Katunayake- Kotugoda 132kV transmission line. In the case of Kelaniya - Kolonnawa 132kV transmission line, the other line also can be discontinued and to avoid Kelanitissa interbus transformer overloading, load curtailment has to be carried out.

During all the scenarios, outage of one circuit of Embilipitiya – Hambantota 132kV transmission line the other circuit get overloaded. It should increase the over current relay settings of the line immediately to solve this problem. Under outage of one circuit of Polpitiya - Kiribathkumbura 132kV transmission line, the remaining circuit gets overloaded during day peak loading condition. To overcome this reconstruction of Polpitiya - Kiribathkumbura 132kV transmission line with a higher capacity conductor should be done immediately.

c. Transformer Overloading

Outage of Biyagama 220/132kV inter-bus transformer will overload the other inter-bus transformer during all loading scenario. Load curtailment and Load transfer has to be carried out in order to solve this problem.

Table 4.5: Transformer over loadings recorded under single contingency condition-2013

Scenario	Contingency	Overload		Solution
Hydro Maximum Day Peak	One Inter-bus transformer outage at Biyagama GS	Other Transformer	220/132 - 152.6%	Load Transfer
			132/33 – 147%	
Thermal Maximum Day Peak	One Inter-bus transformer outage at Biyagama GS	Other Transformer	220/132 - 144.7%	Load Transfer
			132/33 – 147%	
	One Inter-bus transformer outage at Pannipitiya GS	Other Transformer	220/132 - 139.0%	Open Pannipitiya – Kolonnawa and Installation of 100MVar BSC at Pannipitiya GS
			132/132 – 127.5%	
Hydro Maximum Night Peak	One Inter-bus transformer outage at Biyagama GS	Other Transformer	220/132 - 148.2%	Load Transfer
			132/33 – 152.8%	

Scenario	Contingency	Overload		Solution
	One Inter-bus transformer outage at Pannipitiya GS	Other Transformer	220/132 - 127.4%	Open Pannipitiya – Kolonnawa and Installation of 100MVar BSC at Pannipitiya GS
Thermal Maximum Night Peak	One Inter-bus transformer outage at Biyagama GS	Other Transformer	220/132 - 159.9%	Load Transfer
			132/33 – 152.8%	
	One Inter-bus transformer outage at Pannipitiya GS	Other Transformer	220/132 - 149.9%	Open Pannipitiya – Kolonnawa and Installation of 100MVar BSC at Pannipitiya GS
			132/132 – 138.3%	

4.2.3 Transmission Proposals for Immediate Implementation

a. Increase overcurrent relay settings of;
   - Embilipitiya – Hambantota 132kV transmission line
   - Randenigala – Rantembe 220kV transmission line

b. Re-construction of Polpitiya – Kiribathkumbura 132kV transmission line with zebra conductor as early as possible.

c. Installation of 100MVar BSC at Pannipitiya GSS

4.3. Steady State System Analysis - Year 2014

2014 transmission system was analyzed for three loading scenarios; Night peak, Day peak and Base load and two generation scenarios; Hydro Maximum and Thermal Maximum.

The forecasted load demands in the year 2014 for night peak, day peak and base load are 2631MW & 1080MVAr, 2285MW & 1178MVAr and 1053MW & 432MVAr respectively.

In this analysis, for transmission line loadings the over current relay settings given by Transmission O&M branch were used for existing lines and planning ratings were used for new lines.

The generation limitation of Ukuwela and Bowatenna power plants due to irrigation requirement is taken into consideration. The thermal plants were dispatched according to the merit order. Further following committed transmission network developments were taken for the analysis of 2014 transmission network.

Table 4.6 Transmission expansion proposals considered for 2014 system studies

Description	Status	Year
New grid substations		
Maho GS (1x31.5 MVA)	Committed	2014
Naula GS (1x31.5 MVA)	-do-	2014
Pallekele GS (2x31.5MVA)	-do-	2014
New Chilaw SS (2x250MVA)	-do-	2014
Grid augmentations		
Habarana GS (2x31.5 MVA → 3x31.5 MVA)	Committed	2014
Matara GS (2x31.5 MVA→3x31.5 MVA)	-do-	2014
Panadura GS (2x31.5 MVA →3x31.5 MVA)	-do-	2014
Kiribathkumbura GS (3x31.5 MVA →4x31.5 MVA)		2016
Transmission lines and underground cables		
Galle – Matara 132kV TL	Committed	2014
Ukuwela – Pallekele 132kV TL	-do-	2014
Puttalam – Maho 132kV TL	-do-	2014
Ambalangoda - Galle 132kV TL	-do-	2014
System reactive power compensation		
Pallekele (20 MVar)	Committed	2014
Ampara (30 MVar)	-do-	2014

4.3.1. Normal Operating Condition

System studies have been carried out under normal operating condition to check for planning criteria violation like voltage profile, Transformer and line over loadings.

- **Voltage profile**

Voltage criteria violations were observed under normal operating condition at New Anuradhapura 220kV bus during night loading condition. It will be solved with the stringing of 2nd circuit of Kotmale- New Anuradhapura 220kV transmission line project which is being implemented.

Furthermore voltage violations in Ukuwela, Pallekele, Kiribathkumbura, Naula, Kurunegala and Habarana 132kV buses in thermal maximum night peak scenario, will be solved with 2nd circuit stringing of Kotmale- New Anuradhapura 220kV transmission line.

- **Transmission Lines Overloading**

Under normal operating condition 132kV transmission lines of Biyagama – Sapugaskanda and Sapugaskanda – Kelaniya get overloaded during both day and night peak loading conditions and hydro and thermal maximum scenarios. This overloading is severe in hydro maximum scenario. Construction of New Polpitiya-Padukka-Pannipitiya 220kV transmission line and Padukka-Athurugiriya-Kolonnawa 132kV transmission line will solve this problem in the future.

Furthermore Kelaniya-Kolonnawa 132kV transmission line is severely overloaded in hydro maximum night peak and day peak scenario. Therefore it is required to upgrade this transmission line. For immediate operation, it is advisable to keep this line open in those scenarios or else it is necessary to reschedule generation deviating from hydro maximum condition.

Anuradhapura – Puttalam 132kV transmission line is severely overloaded in the thermal maximum night peak scenario under normal operating conditions. Furthermore New Chilaw – Puttalam 132kV transmission line is also severely overloaded in that scenario. In order to solve those two problems, Puttalam - New Anuradhapura 220kV transmission line should be implemented as early as possible.

During night peak loading condition 132kV transmission line of Polpitiya – Kiribathkumbura get overloaded. In order to overcome this problem, reconstruction of Polpitiya - Kiribathkumbura 132kV transmission line with Zebra conductor is proposed. New Chilaw-Bolawatta 132kV transmission line is heavily overloaded in all scenarios, therefore upgrade of this line is immediately required. Kosgama-Kolonnawa, Seethawaka-Kolonnawa, Kolonnawa- Athurugiriya 132kV transmission lines get overloaded during thermal maximum night peak loading condition. Construction of New Polpitiya-Padukka-Pannipitiya 220kV transmission line and Padukka-Athurugiriya-Kolonnawa 132kV transmission lines will solve this problem in the future.

c. Transformer Overloading

Rantambe 105MVA 220/132kV inter bus transformer gets overloaded during thermal maximum night peak and hydro maximum night peak scenarios. This will mitigate with the installation of 2nd 220/132kV interbus transformer at Rantambe.

The Biyagama GS tertiary is overloaded slightly in hydro maximum day peak scenario and load transfer is proposed. In Hambanthota GS, transformer is slightly overloaded and Hambanthota GS augmentation will solve the problem.

4.3.2. Single Contingency Operating Condition

The transmission network in the year 2014 is analyzed for single contingency condition in order to check the violation of set planning criteria.

a. Voltage Profile

Table 4.7: Voltage Criteria Violations under Single Contingency Conditions -2014

Scenario	***Contingency***	***Voltage violation***	***Solution***
Hydro Maximum Day Peak	Beliatta – Emibilipitiya 132kV transmission line outage	Low voltages at Galle, Matara, Beliatta GSS 132kV buses	Construction of Ambalangoda – Galle 132kV transmission line
	Panadura, Horana, Pannipitiya 132kV transmission line interconnection outage	Low voltages at Horana, Matugama GSS 132kV buses	Installation of 100Mvar BSC at Pannipitiya GS.
	New Anuradhapura – Trincomalee 132kV TL Single circuit outage	Low voltages at Trincomalee GS 132kV bus	2nd circuit stringing of Kotmale-New Anuradhapura 220kV transmission line
Thermal Maximum Day Peak	Beliatta – Emibilipitiya 132kV transmission line outage	Low voltages at Beliatta GS 132kV bus	Construction of Ambalangoda – Galle 132kV transmission line
Hydro Maximum Night Peak	Panadura, Horana, Pannipitiya 132kV transmission line interconnection outage	Low voltages at Horana GS 132kV bus	Installation of 100MVar BSC at Pannipitiya GS.
	Ukuwela – Naula 132kV transmission line outage	Low voltages at Habarana, Naula GSS 132kV buses	2nd circuit stringing of Kotmale-New Anuradhapura 220kV transmission line
	Balangoda – Deniyaya 132kV transmission line outage	Low voltages at Deniyaya, Galle, Matara GSS 132kV buses	Construction of Ambalangoda – Galle 132kV transmission line
	Anuradhapura – Habarana 132kV TL Single circuit outage	Low voltages at Naula, Habarana GSS 132kV buses	2nd circuit stringing of Kotmale-New Anuradhapura 220kV transmission line
Thermal Maximum	Inter-bus transformer outage at New Anuradhapura GS	Low voltages at Vavuniya, Anuradhapura, New Anuradhapura, Kilinochchi, Chunnakam GSS 132kV buses	Stringing of 2nd circuit of Kotmale-New Anuradhapura 220kV transmission line

Scenario	*Contingency*	*Voltage violation*	*Solution*
Night Peak	Beliatta – Emibilipitiya 132kV transmission line outage	Low voltages at Beliatta, Deniyaya, Matara GSS 132kV buses	Construction of Ambalangoda – Galle 132kV transmission line and Installation of 100Mvar BSC at Pannipitiya GS.
	Panadura, Horana, Pannipitiya 132kV transmission line interconnection outage	Low voltages at Horana GS 132kV bus	Installation of 100Mvar BSC at Pannipitiya GS.
	Samanalawewa – Embilipitiya 132kV TL Single circuit outage	Low voltages at Hambanthota, Matara, Beliatta GSS 132kV buses	Construction of Ambalangoda – Galle 132kV transmission line
	Balangoda – Deniyaya 132kV transmission Line outage	Low voltages at Deniyaya, Embilipitiya, Hambanthota, Matara, Beliatta GSS 132kV buses	
	Balangoda – Galle 132kV transmission Line outage	Low voltages at Deniyaya, Matara, Beliatta GSS 132kV buses	
	Galle – Deniyaya 132kV transmission Line outage	Low voltages at Matara, Beliatta GSS 132kV buses	
	Embilipitiya – Matara 132kV TL Single circuit outage	Low voltages at Matara GS 132kV bus	
	New Anuradhapura - Puttalam 132kV TL Single circuit outage	Low voltages at Anuradhapura, New Anuradhapura, Kilinochchi, Chunnakam GSS 132kV buses	2nd circuit stringing of Kotmale-New Anuradhapura 220kV transmission line and Construction of New Anuradhapura – Puttalam PS 220kV transmission line

b. Transmission Lines Overloading

Table 4.8: Transmission line overloading recorded under single contingency condition-2014

Scenario	*Contingency*	*Overload*	*%*	*Solution*
Hydro Maximum Day Peak	Polpitiya – Kiribathkumbura 132kV TL Single circuit outage	The other circuit	121.5%	Reconstruction with Zebra conductor
	Pannipitiya – Ratmalana 132kV TL Single circuit outage	The other circuit	102.8%	Reconstruction with Zebra conductor
	Anuradhapura – Puttalam 132kV TL Single circuit outage	The other circuit	104.6%	Construction of New Anuradhapura – Puttalam PS 220kV transmission
	Sub A – Sub I 132 kV cable outage	Kolonnawa – J'pura 132 kV lines	112.2%	Installation of 100MVar BSC at Pannipitiya GS.
	Kolonnawa – Sub I 132 kV cable outage	Kolonnawa – Sri J'pura 132 kV lines	131.0%	Open Pannipitiya - Sri J'pura 132kV lines and Installation of 100MVar BSC at Pannipitiya GS.
	One circuit outage of Sri J'pura 132kV connection lines	Kolonnawa – Sri J'pura T	102.4%	Installation of 100Mvar BSC at Pannipitiya GS.
Thermal Maximum Day Peak	Polpitiya – Kiribathkumbura 132kV TL Single circuit outage	The other circuit	129.2%	Reconstruction with Zebra conductor
	Sub A – Sub I 132 kV cable outage	Kolonnawa – J'pura 132 kV lines	125.3%	Installation of 100MVar BSC at Pannipitiya GS.
	Kolonnawa – Sub I 132 kV cable outage	Kolonnawa – Sri J'pura 132 kV lines	142.8%	Open Pannipitiya - Sri J'pura 132kV lines and Installation of 100MVar BSC at Pannipitiya GS.
		Pannipitiya – Sri J'pura 132 kV lines	111.6%	
	One circuit outage of Sri J'pura 132kV connection lines	Kolonnawa – Sri J'pura T	114.3%	Installation of 100MVar BSC at Pannipitiya GS.
	Anuradhapura – Puttalam 132kV TL Single circuit outage	The other circuit	103.9%	Construction of New Anuradhapura – Puttalam PS 220kV transmission line

Scenario	*Contingency*	*Overload*	*%*	*Solution*
Hydro Maximum Night Peak	Biyagama –Kotugoda 220kV TL Single circuit outage	The other circuit	102%	Load curtailment in Biyagama GS
	Ukuwela – Kiribathkumbura 132kV TL Single circuit outage	The other circuit	105.3%	2nd circuit stringing of Kotmale-New Anuradhapura 220kV transmission line via New Habarana
	Rantembe – Badulla 132kV TL Single circuit outage	The other circuit	110.8%/ 113.7%	Construction of Mahiyanganaya – Ampara 132kV transmission line
	Kolonnawa – Sub I 132 kV cable outage	Kolonnawa – Sri J'pura 132 kV lines	103.1%	Installation of 100MVVar BSC at Pannipitiya GS.
Thermal Maximum Night Peak	Rantembe – Badulla 132kV TL Single circuit outage	The other circuit	127.0%/ 123.9%	Construction of Mahiyanganaya – Ampara 132kV transmission line
	Ukuwela – Kiribathkumbura 132kV TL Single circuit outage	The other circuit	112.2%	2nd circuit stringing of Kotmale-New Anuradhapura 220kV transmission line via New Habarana
	New Laxapana – Balangoda 132kV TL Single circuit outage	The other circuit	105.9%	Reconstruction with Zebra conductor
	Kolonnawa – Sub I 132 kV cable outage	Kolonnawa – Sri J'pura 132 kV lines	105.1%	Installation of 100MVar BSC at Pannipitiya GS.
	Anuradhapura – Habarana 132kV TL Single circuit outage	The other circuit	111.5%	Operation of Ukuwela or Bowatenna power plants for immediate solution. With New Habarana-Veyangoda 220kV transmission project it will be solved

Scenario	Contingency	Overload	%	Solution
	Deniyaya-Balangoda 132kV TL outage	Embilipitiya-Beliatta 132kV TL	104.7%	Construction of Ambalangoda – Galle 132kV transmission line and Installation of 100Mvar BSC at Pannipitiya GS.
	Embilipitiya-Matara 132kV TL Single circuit outage	Embilipitiya-Beliatta 132kV line section	109.1%	
	Outage of Thulhiriya 132kV interconnection lines between Athurugiriya and Polpitiya	Athurugiriya – Thulhiriya T1 132kV line section	108.2%	Construction of New Polpitiya-Padukka-Pannipitiya 220kV and Padukka-Athurugiriya-Kolonnawa 132kV line

c. Transformer Overloading

In case of outage in one interbus transformer at Biyagama will overload the other interbus transformer. To solve this problem loads in the tertiary winding has to be curtailed.

Table 4.9: Transformer over loadings recorded under single contingency condition-2014

Scenario	Contingency	Overload	%	Solution
Hydro Maximum Day Peak	One Inter-bus transformer outage at Biyagama GS	Other Transformer	220/132 -172.4% 132/33 – 266.6%	Load Transfer
Thermal Maximum Day Peak	One Inter-bus transformer outage at Biyagama GS	Other Transformer	220/132 -158.7% 132/33 – 249.1%	Load Transfer
Hydro Maximum Night Peak	One Inter-bus transformer outage at Biyagama GS	Other Transformer	220/132 -198.8%	Load Transfer
Thermal Maximum Night Peak	One Inter-bus transformer outage at Biyagama GS	Other Transformer	220/132 -185.2%	Load Transfer

Critical voltage criteria violations were observed at New Anuradhapura GS 220kV bus bar and Trincomalee GS 132kV bus bars in the event of outage of Kotmale - New Anuradhapura 220kV transmission line under all four scenarios leading system voltage collapse. This situation will solve with the stringing of 2nd circuit of Kotmale - New Anuradhapura 220kV transmission line and construction of Puttalam PS – New Anuradhapura 220 kV transmission line.

Outage of Randenigala - Rantambe 220kV transmission line will cause voltage collapse during thermal maximum night peak scenario. In order to maintain voltage in the system during the above contingency condition, Laxapana complex should be operated to its maximum generation level. However, the above problem will be solved with the implementation of Mahiyanganaya-Ampara-Vavunativu 132kV development and 2nd circuit of Kotmale - New Anuradhapura 220kV transmission line.

Outage of Anuradhapura - Trincomalee 132kV transmission line will cause voltage collapse during hydro maximum night peak scenario. In order to maintain voltage in the system during the above contingency condition, 2nd circuit of Kotmale - New Anuradhapura 220kV transmission line is necessary. However, in order to avoid other line being overloaded, load curtailment has to be carried out. In future with the implementation of Kappalthurai Grid substation and Trincomalee coal development, this problem will be solved.

Outage of Anuradhapura - Puttalam 132kV transmission line will show critical voltage violations during hydro maximum night peak scenario. In order to maintain voltage in the system during the above contingency condition, 2nd circuit of Kotmale - New Anuradhapura 220kV transmission line is necessary. However, with the construction of Puttalam PS – New Anuradhapura 220 kV transmission line, Anuradhapura - Puttalam 132kV transmission line can be kept open and will be utilized in under contingency condition.

Outage of one circuit of Polpitiya - Kiribathkumbura 132kV transmission line will also initiate a voltage collapse. To overcome this reconstruction of Polpitiya - Kiribathkumbura 132kV transmission line with a higher capacity conductor should be done as early as possible. Under outage of Bolawatta-Kayunayaka-New Chilaw 132kV interconnection transmission lines, system experience critical voltage violations in hydro maximum night peak condition and to resolve that problem installation of 100MVar BSC at Pannipitiya is a necessity.

Under outage of one circuit of Katunayake- Kotugoda, Kelaniya - Kolonnawa 132kV transmission lines, the remaining circuits get overloaded during both hydro and thermal maximum generation scenarios and day and night peak loading conditions. This will be solved in the future with the implementation of 220kV transmission lines from New Polpitiya to Pannipitiya through Padukka, 132kV transmission lines from Padukka to Kolonnawa through Athurugiriya and New Chilaw 220/132kV switching station. During all the scenarios outage of one circuit of Embilipitiya – Hambantota 132kV transmission line the other circuit get overloaded. It should increase the over current relay settings of the transmission line immediately to solve this problem.

4.3.3. Transmission expansion proposals identified from year 2014 load flow studies

a. Re-construction of Polpitiya – Kiribathkumbura 132kV transmission line with zebra conductor as early as possible.
b. Upgrade of New Chilaw - Bolawatta 132kV transmission line to Zebra

4.4. Steady State System Analysis - Year 2015

According to the load forecast for the period 2013-2025, the system night peak, day peak and based load demands in the year 2015 are 2830MW & 1158MVAr, 2458MW & 1264MVAr and 1132MW & 463MVAr respectively.

Considering committed project proposals given below, the transmission system study has been carried out for three loading scenarios; Night peak, Day peak and Base load and two generation scenarios; Hydro Maximum and Thermal Maximum. Further, the over current relay settings given by Transmission O&M branch were used as the current rating of exiting transmission lines while the design ratings were used as the current rating for proposed transmission line. It is assumed that the thermal plants were dispatched according to the merit order.

4.4.1. Transmission expansion proposals considered for 2015 system studies

Table 4.10: Transmission expansion proposals considered for 2015 system studies

Description	Status	Year
<u>New Grid Substations</u>		
Polonnaruwa GS(31.5MVA)	Committed	2015
Vavunativu GS(2x31.5 MVA)	-do-	2015
Monaragala GS(31.5MVA)	-do-	2015
<u>Grid Augmentations</u>		
Kurunegala GS (2x31.5 MVA →3x31.5 MVA)	Committed	2015
Kelaniya GS (1x31.5 MVA →2x31.5MVA)	-do-	2015
Veyangoda GS (2x31.5 MVA→ 3x31.5 MVA)	-do-	2015
Horana GS (2x31.5 MVA→3x31.5 MVA)	-do-	2015
Sri Jayawardenapura GS (2x31.5 MVA →3x31.5 MVA)	-do-	2015
New Galle GS (2x30+1x31.5 MVA →3x31.5 MVA)	-do-	2015
Hambanthota GS (1x16+1x31.5 MVA →3x31.5 MVA)	-do-	2015
Rantembe GS (1x105MVA →2x105MVA inter bus TF)	-do-	2015
<u>Transmission Lines and Underground Cables</u>		
Puttalam PS - New Anuradhapura 220kV TL	Committed	2015
2nd circuit of Kotmale - New Anuradhapura 220kV TL	-do-	2015
Mahiyangana- Vavunativu via Ampara132kV TL	-do-	2015
Singe In & Out connection to proposed Monaragala GS from Badulla –Ampara 132kV TL	-do-	2015
<u>System reactive power compensation</u>		
Vavunativu GS (20 MVar)	Committed	2015
Kelaniya GS(20 MVar)	-do-	2015
<u>System voltage controlling</u>		
Pannipitiya GS (100 MVar BSC)	Committed	2015

4.4.2. Normal Operating Condition

In the normal operating condition, the analysis revealed that the 100 MVar BSC at Pannipitiya GSS should be commissioned in 2015 to avoid critical low voltage problem in and around Colombo city and Sothern Province. Furthermore following operation strategies and network developments have to be implemented in order to avoid critical voltage violations in southern region in night peak loading scenarios.

- ❖ Generation necessary at Samanalawewa or Embilipitiya Grid Substations
- ❖ Operate both Ukuwela and Bowatenna machines (Limitation in thermal maximum scenario)
- ❖ Existence of following two transmission network development projects,
    - ✓ Greater Colombo Transmission and Distribution Loss Reduction Project
    - ✓ Clean Energy and Network Efficiency Improvement Project

a. Voltage Profile

During night peak and day peak loading conditions with different generation scenarios, following low voltages in Southern Province were observed.

Table 4.11: Voltage Criteria Violations under normal operating Conditions -2015

<table>
<tr><th>Loading Scenario</th><th>Generation Scenario</th><th>Grid Substation</th><th>Bus Voltage (kV)</th><th>Proposed Mitigation Measure</th><th>Proposed Year</th></tr>
<tr><td rowspan="2">Night Peak</td><td rowspan="2">Thermal Maximum</td><td>Beliatta</td><td>118.53</td><td rowspan="8">20MVar Capacitor Banks at Hambanthota GS</td><td rowspan="2">2017</td></tr>
<tr><td>Hambanthota</td><td>117.57</td></tr>
<tr><td rowspan="5">Day Peak</td><td rowspan="4">Hydro Maximum</td><td>Beliatta</td><td>116.73</td><td rowspan="5">2017</td></tr>
<tr><td>Hambanthota</td><td>116.35</td></tr>
<tr><td>Matara</td><td>118.59</td></tr>
<tr><td>Embilipitiya</td><td>118.74</td></tr>
<tr><td>Thermal Maximum</td><td>Beliatta</td><td>118.62</td></tr>
</table>

b. Transmission Line Overloading

Following lines were overloaded under different loading and generation scenarios.

Table 4.12: Transmission line over loadings recorded under normal operating condition-2015

<table>
<tr><th>Loading Scenario</th><th>Generation Scenario</th><th>Overloaded Transmission Line</th><th>Loading</th><th>Proposed Mitigation Measure</th><th>Proposed Year</th></tr>
<tr><td rowspan="2">Night Peak</td><td rowspan="2">Thermal Maximum</td><td>Polpitiya – Kiribathkumbura 132kV line</td><td>120.7</td><td>Re-construction of Polpitiya – Kiribathkumbura 132kV transmission line with zebra conductor</td><td></td></tr>
<tr><td>Pannipitiya – Panadura T 132kV line</td><td>102.1 &113.7</td><td>New Polpitiya- Padukka- Pannipitiya 220kV development Project</td><td>2017</td></tr>
</table>

Loading Scenario	Generation Scenario	Overloaded Transmission Line	Loading	Proposed Mitigation Measure	Proposed Year
		Mathugama-Panadura T 132kV line	102.3	New Polpitiya- Padukka-Pannipitiya 220kV development Project and open Kolonnawa-Sri J'pura 132kV lines and Kollonnawa-Sub E 132kV cable	2017
		Kelaniya – Kolonnawa 132kV line	*149.8 (119.5)	**	-
		Biyagama – Sapugaskanda 132kV line	*142.5 (114.2)		
		Sapugaskanda – Kelaniya 132kV line	117.6		
	Hydro Maximum	Polpitiya – Kiribathkumbura 132kV line	116.2	Re-construction of Polpitiya – Kiribathkumbura 132kV transmission line with zebra conductor	
		Samanalawewa – Embilipitiya 132kV line	118.1	Upgrade the transmission line to Zebra	2017
		Kelaniya – Kolonnawa 132kV line	*167.5 (133.6)	**	-
		Biyagama – Sapugaskanda 132kV line	*146.7 (117.6)		
		Sapugaskanda – Kelaniya 132kV line	122.4		
Day Peak	Thermal Maximum	Kelaniya – Kolonnawa 132kV line	*138.3 (110.3)	**	-

Loading Scenario	Generation Scenario	Overloaded Transmission Line	Loading	Proposed Mitigation Measure	Proposed Year
	Thermal Maximum	Biyagama – Sapugaskanda 132kV line	*138.1 (110.7)	**	
		Sapugaskanda – Kelaniya 132kV line	118.9		
	Hydro Maximum	Kelaniya – Kolonnawa 132kV line	117.7	**	-
		Biyagama – Sapugaskanda 132kV line	*125.8 (100.8)		
		Sapugaskanda – Kelaniya 132kV line	106.7		

Note:

**Theses lines will trip under normal conditions due to overloading*

***For all generation and four loading scenarios, critical overloading (line tripping) is observed for following two lines,*

- Kelaniya – Kolonnawa 132 kV transmission line
- Biyagama – Sapugaskanda 132 kV transmission line

This overloading will be solved with the implementation of committed and on-going projects together with the opening of Kelaniya- Kolonnawa 132kV transmission line. Further, following operational strategies has to be implemented as early as possible.

For night peak thermal maximum and day peak hydro maximum scenarios, following operational strategies has to be followed,

- Kelaniya double busbar has to be separately operated as single bus bars, transferring Sapugaskanda – Kelaniya and Kelaniya – Kolonnawa transmission lines to one bus bar and all the other transmission lines to the other bus bar (radial feeding arrangement).
- Kolonnawa – Sri J'pura 132kV line also has to be opened.

For night peak hydro maximum and day peak thermal maximum scenarios, following operational strategies has to be followed,

- In addition to above mentioned radial feeding arrangement, Kolonnawa double bus bar also has to be separately operated (radial feeding arrangement) as single bus bars transferring corresponding transmission lines as to avoid the overload.

c. Transformer Overloading

Table 4.13: Transformer over loadings recorded under normal operating condition-2015

Loading Scenario	Generation Scenario	Overloaded Transformer	Loading	Proposed Mitigation Measure	Proposed Year
Night Peak	Thermal Maximum	New Anuradhapura Inter-bus Transformer	102.9	New Polpitiya-Padukka-Pannipitiya 220kV development Project / New Habarana – Veyangoda 220kV Project	2017
	Hydro Maximum	Trincomalee	104.1	Installation of 3rd transformer	
Day Peak	Thermal Maximum	Sub A (Havelock Town)	105.2	Greater Colombo Transmission and Distribution Loss reduction project	2017
		Sub E (Kollupitiya)	113.3		
		Sub F (Fort)	106.5		
	Hydro Maximum	Sub A (Havelock Town)	105.6		
		Sub E (Kollupitiya)	114.1		
		Sub F (Fort)	107.2		

4.4.3.Single Contingency Condition

The system cannot meet specified planning criteria under single contingency operation in the absence of aforementioned ongoing two transmission line development projects and construction of New Polpitiya – Embilipitiya 220kV Transmission Line. The only way to solve this problem as a short term measure till the said projects are implemented is to reschedule generation mix deviating from hydro maximum or thermal maximum scenarios.

4.4.4. Transmission Proposals

1. Construction of 220kV transmission line from New Polpitiya to Hambatota via Embilipitiya.
2. Installation of 20Mvar Capacitor Bank at Hambanthota GSS
3. Upgrade Samanalawewa – Embilipitiya 132 kV transmission line to Zebra

4.5. Steady State System Analysis - Year 2017

The system night peak, day peak and based load demands in the year 2017 are 3134 MW & 1257MVar, 2723 MW & 1376 MVar and 1254 MW & 503 Mvar respectively. The system analysis under normal operation and under contingency condition are carried out with the above loads and following identified transmission development proposals with their expected year of completion up to the year 2017.

Table 4.14 - Network Developments Considered for year 2017

Description	Status	Year
New grid substations		
Sub L-1(2x45MVA)	Committed	2017
Sub L-2(2x45MVA)	-do-	2017
Sub M (2x45MVA)	-do-	2017
Sub N (2x45MVA)	-do-	2017
Sub B (Pettah) (2x31.5MVA)	-do-	2017
Port 220/132kV GS (2x250MVA)	-do-	2017
New Habarana 220/132/33kV GS (2x250MVA)	-do-	2017
Mannar (1x31.5MVA)	-do-	2017
Kegalle (2x31.5MVA)	-do-	2017
Suriyawewa (2x31.5MVA)	-do-	2017
New Polpitiya 220/132kV (2x250MVA)	-do-	2017
Padukka 220/132kV (2x250MVA)	-do-	2017
Eluwankulama (31.5MVA)	Not Committed	2017
Kaluthara (2x31.5 MVA)	-do-	2017
Sub K (Wellawatta) (1x45MVA)	-do-	2017
Nawalapitiya (2x31.5MVA)	-do-	2017
Ragala (2x31.5MVA)	-do-	2017
Maliboda (1x31.5MVA)	-do-	2017
Wewalwatta (2x31.5MVA)	-do-	2017

Description	Status	Year
Battaramulla (2x31.5 MVA)	-do-	2017
Port City-1 (2x45MVA)	-do-	2017
Port City-2 (2x45MVA)	-do-	2017
Chemmany (2x45MVA)	-do-	2017
Kappalthurei (2x60 MVA)	-do-	2017
Kerawalapitiya (2x45MVA)	-do-	2017
Kirindiwela (2x150MVA)	-do-	2017
Kirindiwela (2x45MVA)	-do-	2017
Padukka (2x45MVA)	-do-	2017
Hambantota Port (2x45MVA)	-do-	2017
Grid augmentations		
Sub A (2x31.5MVA→3x31.5 MVA)	Committed	2017
Sub I (2x31.5MVA→3x31.5 MVA)	-do-	2017
Valachchenai(1x20+1x31.5→2x31.5MVA)	-do-	2017
Monaragala (1x31.5MVA →2x31.5 MVA)	-do-	2017
Polonnaruwa(1x31.5MVA →2x31.5 MVA)	-do-	2017
Madampe (2x31.5MVA→3x31.5 MVA)	Not Committed	2016
Anuradhapura (31.5 + 2x10MVA→3x31.5 MVA)	-do-	2017
Kukule (1x10→1x10+31.5MVA)	-do-	2017
Katunayaka (2x31.5MVA→3x31.5 MVA)	-do-	2017
Transmission Lines and Underground Cables		
New Habarana – Veyangoda 220kV TL	Committed	2017
Shifting of Habarana- Ukuwela and Habarana-Valachchenai 132kV TL to New Habarana GS	Committed	2017
Kelenitissa and Port GSS 220kV cable	-do-	2017
Kerawalapitiya and Port GSS 220kV cable	-do-	2017
Port and Colombo F GSS 132kV cable	-do-	2017
Colombo F and Colombo N GSS 132kV cable	-do-	2017
Colombo N and Kolonnawa GSS 132kV cable	-do-	2017
Colombo L and Colombo M GSS 132kV cable	-do-	2017
Colombo M and Colombo E GSS 132kV cable	-do-	2017

Description	Status	Year
New Anuradhapura-Vavuniya double circuit, 2*Zebra, 132kV transmission line (220kV construction & 132kV operation)	-do-	2017
Vavuniya- Mannar 132kV TL (220kV construction & 132kV operation)	-do-	2017
Thulhiriya-Kegalle 132kV TL	-do-	2017
Polpitiya-to-New Polpitiya 132kV TL	-do-	2017
Athurugiriya-Padukka 132kV TL	-do-	2017
Athurugiriya-Kolonnawa 132kV TL	-do-	2017
New Polpitiya- Padukka –Pannipitiya 220kV TL	-do-	2017
Single In & Out connection from Embilipitiya-Hambantota 132kV TL to connect Sooriyawewa GS	-do-	2017
Re-construction of Polpitiya-Kiribathkumbura 132kV transmission line with Zebra conductor	Not Committed	2016
Re-construction of the Samanalawewa-Embilipitiya 132kV TL with Zebra conductor	-do-	2016
Single in & out connection from Puttalam – Anuradhapura 132kV TL to connect Eluwankulama GSS	-do-	2016
Single in & out connection from Panadura – Matugama 132kV TL to connect Kalutara GSS	-do-	2016
Colombo E and Colombo K GSS 132kV cable	-do-	2017
Colombo K and Pannipitiya GSS 132kV cable	-do-	2017
Single in & out connection from Polpitiya - Kiribathkumbura 132kV TL to connect Nawalapitiya GSS	-do-	2017
Nuwaraeliya – Ragala 132kV TL	-do-	2017
New Polpitiya - Maliboda 132kV TL	-do-	2017
Single in & out connection from Balangoda - Ratnapura 132kV TL to connect Wewalwatta GSS	-do-	2017
Single in & out connection from Kilinochchi - Chunnakam 132kV TL to connect Chemmany	-do-	2017
Hambantota GS-Hambantota Port City 132kV TL	-do-	2017
Kotmale – New Polpitiya 220kV TL	-do-	2017
Veyangoda-Thulhiriya 132kV TL	-do-	2017

Description	Status	Year
Kirindiwela – Kosgama 132kV TL	-do-	2017
Feeding rearrangement between Kosgama & Seethawaka GS	-do-	2017
System Reactive Power Compensations		
Aniyakanda(10MVAr)	Committed	2016
Katunayaka(20MVAr)	-do-	2016
Ambalangoda (10MVAr)	-do-	2016
Kegalle (15MVAr)	-do-	2017
Biyagama(30MVAr)	-do-	2017
Sapugaskanda(35MVAr)	-do-	2017
Kolonnawa New(20MVAr)	-do-	2017
Kolonnawa Old(20MVAr)	-do-	2017
Horana (15MVAr)	-do-	2017
Pannala (20MVAr)	-do-	2017
Bolawatta (20MVAr)	-do-	2017

It is considered that the transmission development proposals under the Greater Colombo Transmission & Distribution Loss Reduction Project, Clean Energy & Network Efficiency Improvement Project and New Habarana – Veyangoda Transmission Project were implemented at the end of the year 2016.

Apart from the above projects, New Polpitiya – Hambanthota (via Embilipitiya) 220kV transmission line development project is required as early as possible to solve low voltage problem in Southern Province. Therefore in order to ensure a reliable and quality power supply to Sothern region with the increase of demand, New Polpitiya- Hambanthota (via Embilipitiya) 220kV development project should be expedited. In this study, aforementioned 220 kV transmission line is included, as it is difficult to manage the system without this transmission line in year 2017. As an alternative to this line, it is necessary to reinforce Southern region with reactive power compensation or power generation or another transmission line from hydro generation station to southern region. Further, Kotmale – New Polpitiya 220kV transmission line has been considered for the year 2017 to avoid some overloading of transmission lines and voltage issues.

4.5.1.Normal operating conditions

Considering that the proposal in table 4.14 will be implemented as scheduled, System analysis has been carried out under normal operating condition for the scenarios given above to observe voltage violation, transmission line and GSS transformer overloading.

a. Voltage profile

Voltage violations were not observed under normal operating condition with the introduction of New Polpitiya – Hambanthota (via Embilipitiya) 220 kV transmission line in the study which solved the low voltage problem in southern region.

a. Transmission line /Transformer overloading

New Chilaw- Bolawatta 132kV transmission line was overloaded during normal operating conditions. Transmission line overloading observed under normal operating conditions are listed in Table 4.15.

Table 4.15: Transmission Line overloading under Normal Operating Condition-2017

Loading Condition	Generation Scenario	OverLoaded Line	Loading	Mitigation Measure	Proposed Year
Day Peak	Hydro Maximum	New Chilaw- Bolawatta 132kV TL	113	Re-construction of the New Chilaw-Bolwatta 132kV TL with Zebra conductor	2017

4.5.2.Single contingency operating conditions

The same analysis has been carried out for single contingency condition to observe any network overloading and voltage violation.

a. Voltage profile

Voltage criteria violations observed under single contingency operating conditions are listed in Table 4.16

Table 4.16: Voltage Criteria Violations under Single Contingency Conditions -2017

Loading Condition	Generation Scenario	Contingency	Bus Bar	Bus Voltage (kV)	Mitigation Measure	Proposed Year
Night Peak	Thermal Maximum	New Anuradapura 220/132/33kV TF outage	Kappalthurai 132kV BB	118.7	220/33kV conversion of Kappalthurai GS & Construction of Sampoor - Kappalthurai 2*Zebra 220kV 2cct TL (45km) with Sampoor Coal Power Plant Development	2018
			Trincomalee 132kV BB	118.5		
		New Anuradhapura-Kappalthurai 132kV TL single circuit outage	Kappalthurai 132kV BB	98.6		
			Trincomalee 132kV BB	98.4		

Loading Condition	Generation Scenario	Contingency	Bus Bar	Bus Voltage (kV)	Mitigation Measure	Proposed Year
	Hydro Maximum	New Anuradapura 220/132/33kV TF outage	Kappalthurai 132kV BB	117.3		
			Trincomalee 132kV BB	116.8		
Day Peak	Thermal Maximum	New Anuradapura 220/132/33kV TF outage	Kappalthurai 132kV BB	117.7	220/33kV conversion of Kappalthurai GS & Construction of Sampoor - Kappalthurai 2*Zebra 220kV 2cct TL (45km) with Sampoor Coal Power Plant Development	2018
			Trincomalee 132kV BB	117.5		
		New Anuradhapura-Kappalthurai 132kV TL single circuit outage	Kappalthurai 132kV BB	98.5		
			Trincomalee 132kV BB	98.2		
	Hydro Maximum	New Anuradapura 220/132/33kV TF outage	Kappalthurai 132kV BB	117.1		
			Trincomalee 132kV BB	116.6		
		New Anuradhapura-Kappalthurai 132kV TL single circuit outage	Kappalthurai 132kV BB	85.5		
			Trincomalee 132kV BB	84.8		

b. Transmission line overloading

Line over loading observed under single contingency operating condition is listed in Table 4-17.

Table 4.17: Transmission line/transformer over loadings recorded under single contingency condition -2017

Loading Condition	Generation Scenario	Contingency	Overloaded Line	loading	Mitigation Measure	Proposed Year
Night Peak	Thermal Maximum	New Anuradhapura 220/132/33 kV TF outage	Remaining TF	139	Vavunia 220kV development with 220kV operation of Vavunia-New Anuradhapura 2*Zebra TL and Construction of Sampoor - Kappalthurai 2*Zebra 220kV 2cct TL (45km) with Sampoor Coal Power Plant Development	2018
		Kolonnawa-Sri J'Pura132kV TL outage	Remaining circuit	111	Reconstruction of Pannipitiya-Kolonnawa 132kV TL with Zebra conductor	2017
		Colombo A-Colombo I 132kV cable outage	Kolonnawa-Sri J'Pura 132kV TL	107	Reconstruction of Pannipitiya-Kolonnawa 132kV TL with Zebra conductor	2017
		Kolonnawa-Colombo I 132kV cable outage	Kolonnawa-Sri J'Pura 132kV TL	113	Reconstruction of Pannipitiya-Kolonnawa 132kV TL with Zebra conductor	2017
		New Habarana-Polonnaruwa Zebra 132kV TL outage	New Habarana-Valachchena Lynx 132kV TL	132	Second circuit stringing of Habarana-Valachchenai 132kV TL with zebra conductor	2018
		New Anuradhapura-Kappalthurai 132kV single cct outage	Remaining circuit	165	220/33kV conversion of Kappalthurai GS & Construction of Sampoor - Kappalthurai 2*Zebra 220kV 2cct TL (45km) with Sampoor Coal Power Plant Development	2018
		Biyagama-Sapugaskanda 132kV TL single cct outage	Remaining circuit	123	Open both circuits of Kelaniya-Kolonnawa 132kV TL	2017

Loading Condition	Generation Scenario	Contingency	Overloaded Line	loading	Mitigation Measure	Proposed Year
		Pannipitiya-Panadura T – Horana GSS 132kV TL	Remaining Pannipitiya – Panadura T 132kV TL	118	Open both circuits of Ambalangoda – Galle 132kV TL	2017
		Pannipitiya-Panadura T – Kalutara GSS 132kV TL	Remaining Pannipitiya – Panadura T 132kV TL	108		
	Hydro Maximum	New Anuradhapura 220/132/33 kV TF outage	Remaining TF	121	Vavunia 220kV development with 220kV operation of Vavunia-New Anuradhapura 2*Zebra TL and Construction of Sampoor – Kappalthurai, 2*Zebra 220kV, 2cct TL (45km) with Sampoor Coal Power Plant Development	2018
		New Habarana-Polonnaruwa 132kV Zebra TL outage	New Habarana-Valachchena Lynx 132kV TL	130	Second circuit stringing of Habarana-Valachchenai 132kV TL with Zebra conductor	2018
		Biyagama-Sapugaskanda 132kV TL single cct outage	Remaining circuit	142	Open both circuits of Kelaniya-Kolonnawa 132kV TL	2017
		Kelaniya - Kolonnawa 132kV single cct outag	Remaining circuit	104	Open remaining circuit of Kelaniya-Kolonnawa 132kV TL	2017
Day Peak	Thermal Maximum	New Anuradhapura-Kappalthurai 132kV single cct outage	Remaining circuit	158	220/33kV conversion of Kappalthurai GS & Construction of Sampoor - Kappalthurai 2*Zebra 220kV 2cct TL (45km) with Sampoor Coal Power Plant Development	2018
		Kolonnawa- Sri J'Pura 132kV TL outage	Remaining circuit	119	Reconstruction of Pannipitiya-Kolonnawa 132kV TL with Zebra conductor	2017
		Kolonnawa-Sri J'Pura 132kV TL outage	Remaining circuit	119	Reconstruction of Pannipitiya-Kolonnawa 132kV TL with Zebra conductor	2017

Loading Condition	Generation Scenario	Contingency	Overloaded Line	loading	Mitigation Measure	Proposed Year
		Colombo L1-Colombo M 132kV cable outage	Kolonnawa-Colombo I 132kV cable	127	Open Dehiwala-Pannipitiya 132kV cable and both circuits of Pannipitiya-Sri J'Pura T 132kV TL,	2017
			Kolonnawa-Sri J'Pura T 132kV TL	110		2017
		Kolonnawa-Colombo I 132kV cable outage	Kolonnawa-Sri J'Pura T 132kV TL	127	Reconstruction of Pannipitiya-Kolonnawa 132kV TL with Zebra conductor	2017
		Colombo I – Colombo A 132kV cable outage	Kolonnawa-Sri J'Pura T 132kV TL	116	Reconstruction of Pannipitiya-Kolonnawa 132kV TL with Zebra conductor	2017
		Biyagama-Sapugaskanda 132kV TL single cct outage	Remaining circuit	119	Open both circuits of Kelaniya-Kolonnawa 132kV TL	2017
		Pannipitiya-Panadura T – Horana GSS 132kV TL interconnection	Remaining Pannipitiya – Panadura T 132kV TL	107	Ambalangoda Coal Power Plant development	2017
	Hydro Maximum	Victoria-Randenigala 220kV TL	Badulla-Laxapana 132kV TL	104	Construction of Victoria - Randenigala 220kV, 16.4km, 2*Zebra single circuit TL	2018
		Wimalasurendra-Laxapana 132kV TL single cct outage	Remaining circuit	107	Re-construction of the Wimalasurendra-Laxapana 132kV TL with Zebra conductor	2018
		New Habarana-Polonnaruwa 132kV Zebra TL outage	New Habarana-Valachchena Lynx 132kV TL	102	Second circuit stringing of Habarana-Valachchenai 132kV TL with zebra conductor	2018

4.5.3. Transmission expansion proposals identified in the year 2017 load flow studies

Following transmission developments are identified as high priority implementation proposals:

1. Construction of New Polpitiya – Hambanthota (via Embilipitiya) 2*Zebra 220kV, 150km double circuit transmission line. (As early as possible)
2. Re-construction of following 132kV transmission line with Zebra conductor
   - New Chilaw-Bolawatta
   - Wimalasurendra-Laxapana
3. Construction of the second circuit stringing of Habarana-Valachchenai, Zebra,132kV, 100km transmission line
4. Construction of Sampoor – Kappalthurai, 2*Zebra 220kV,45km double circuit transmission line
5. Vavunia substation 220kV development with 220kV operation of Vavunia - New Anuradhapura 2*Zebra transmission line
6. Construction of Victoria – Randenigala, 2*Zebra , 220kV, 16.4km, single circuit transmission line

4.6. Steady State System Analysis Year 2019

The forecasted system night peak, day peak and based load demands in the year 2019 are 3509 MW & 1403 MVar, 3046 MW & 1541MVar and 1404 MW & 561 MVar respectively. The system analysis under normal operation and under contingency condition is carried out with the above loads and following identified transmission development proposals up to the year 2019.

It is assumed that Sampoor PS and Ambalangoda PS transmission interconnection proposals were developed with 500MW and 250MW coal fired power plant developments respectively in the year 2018.

Transmission developments under Sampoor PS transmission interconnection proposal are listed below.

- Sampoor PS (220kV DB arrangement including bus coupler, 4x220kV DB TL bays, 2x220kV DB TF bays)
- Augmentation of New Habarana Switching Station (2x220kV DB TL bays)
- Construction of Sampoor PS - New Habarana Switching Station 400kV(220kV operation) , 95km, 4xZebra, double circuit transmission line
- Construction of Sampoor PS to Kappalturai grid substation 220kV, 45km, 2xZebra, double circuit transmission line
- Provision for 2x800MVA, 400/220kV inter-bus station at Sampoor PS

- Provision for 1x220kV DB TF bays at Sampoor PS

Transmission developments under Ambalangoda PS transmission interconnection proposal are listed below.

- Ambalangoda PS (400kV DB arrangement including bus coupler, 2x400kV DB TL bays, 4x400kV DB TF bays)
- Construction of Ambalangoda PS - Padukka Switching Station 400kV, 75km, 4xZebra, double circuit transmission line
- Padukka (400kV DB arrangement including bus coupler, 2x400kV DB TF bays, 2x400kV DB TL bays, 2x220kV DB TF bays)
- Provision for 2x400kV DB TF bays at Ambalangoda SS

In addition to above development proposals, following transmission line and grid substation proposals have been considered in the analysis for the year 2019.

Table 4.18: New Network developments considered for year 2019

Description	Year
New grid substations	
Wellawaya (2x31.5 MVA)	2018
Kesbewa (2x31.5 MVA)	2018
Thissamaharama (2x31.5MVA)	2018
Akkaraipattu (1x31.5MVA)	2019
Vavunia 220/132kV (2x250MVA)	2018
Grid augmentations	
Aniyakanda (2x31.5MVA →3x31.5 MVA)	2018
Naula (1x31.5MVA →2x31.5 MVA)	2018
Maho (1x31.5MVA →2x31.5 MVA)	2018
Transmission lines and underground cables	
Single In & Out connection from Pannipitiya-Panadura T TL to connect Kesbewa GS, 132kV,01km	2018
Hambantota-Tissamaharama 132kV TL	2018
Ampara-Akkaraipattu 132kV TL	2019
second circuit stringing of Habarana-Valachchenai 132kV TL	2018
220kV operation of Vavunia - New Anuradhapura 2*Zebra transmission line	2018
Victoria –Randenigala, 2*Zebra , 220kV, 16.4km, single circuit transmission line (Second Line)	2018

Description	Year
Re-Construction of 132kV Transmission Line with Zebra Conductor	
New Laxapana-Balangoda	2018
New Chilaw-Bolwatta	2018
Laxapana-New Laxapana	2018
New Habarana-Ukuwela	2018
Wimalasurendra-Laxapana	2018
System Reactive Power Compensations	
Hambantota (20MVAr)	2018

4.6.1.Normal operating conditions

Assuming that the proposals listed above will be implemented as scheduled. System analysis has been carried out under normal operating condition for the scenarios given in the table 4.1 to observe voltage violation, transmission line and GSS transformer overloading

a. Voltage profile

The analysis reveals that there is no voltage criteria violations observed under normal operating conditions in the year 2019 studies.

b. Transmission line overloading

There is no transmission line overloading observed under normal operating conditions in the year 2019 studies

4.6.2.Single contingency operating conditions

a. Voltage profile

The analysis reveals that there is no voltage criteria violations observed under single contingency operating conditions in the year 2019 studies.

b. Transmission line overloading

Transmission Line over loading observed under single contingency operating condition is listed in Table 4.19.

Table 4.19: Transmission line/transformer over loadings recorded under single contingency conditions - 2019

Loading Condition	Generation Scenario	Contingency	Overloaded Line	loading	Mitigation Measure	Proposed Year
Night Peak	Thermal Maximum	Vavunia-Kilinochchi 132kV TL single circuit outage	Remaining Circuit	105	Equipment replace of corresponding Vavunia and Kilinochchi Line Bays to operate with Zebra conductor ratings	2019
		Biyagama-Sapugaskanda 132kV TL single circuit outage	Remaining Circuit	117	Open both circuits of Kelaniya-Kolonnawa 132kV TL	2019
	Hydro Maximum	Colombo L1-Colombo M 132kV cable outage	Colombo F-Colombo N 132kV cable	101	Open Colombo N-Kolonnawa 132kV cable	2019
		Biyagama-Sapugaskanda 132kV TL single circuit outage	Remaining Circuit	134	Open both circuits of Kelaniya-Kolonnawa 132kV TL	2019
Day	Thermal Maximum	Colombo L1-Colombo M 132kV cable outage	Colombo F-Colombo N 132kV cable	103	Open Colombo N-Kolonnawa 132kV cable	2019
	Hydro Maximum	Biyagama-Sapugaskanda 132kV TL single circuit outage	Remaining Circuit	109	Open both circuits of Kelaniya-Kolonnawa 132kV TL	2019

4.6.3. Transmission expansion proposals identified from year 2019 load flow studies

In addition to the development proposals given in table 4.18 and power plant interconnection proposals, following transmission developments are identified for immediate implementation:

1. Equipment replace of corresponding Vavunia and Kilinochchi Line Bays to operate with Zebra conductor ratings
2. Open both circuits of Kelaniya-Kolonnawa 132kV TL

4.7. Steady State System Analysis - Year 2022

The forecasted system night peak, day peak and based load demands in the year 2022 are 4078 MW & 1616 MVar, 3538 MW & 1781 MVar and 1631 MW & 646 MVar respectively. The system analysis under normal operation and under contingency condition is carried out with the above loads and following identified transmission development proposals up to the year 2022.

4.7.1. Transmission expansion proposals considered for year 2022 system analysis

Table 4.20 - New Network Developments Considered for year 2022

Description	Year
New grid substations	
Sub P (Town Hall) – 2x45MVA	2020
Hambantota 220/132kV (2x250MVA)	2020
Grid augmentations	
Sub B (Pettah) – 2x31.5MVA → 3x31.5MVA	2020
Pannala – 2x31.5MVA→ 3x31.5MVA	2020
Pallekele – 2x31.5MVA →3x31.5MVA	2021
Aturugiriya – 2x31.5MVA→3x31.5MVA	2022
Chunnakam – 2x31.5MVA →3x31.5MVA	2022
Dehiwala – 2x31.5MVA →3x31.5MVA	2022
Sampoor generating station (400kV development)	2022
New Habarana switching station (400kV development)	2022
Transmission Lines	
Veyangoda-Kirindiwela 220kV TL	2020
Operate Sampoor –New Habarana 220V TL at 400kV	
System Reactive Power Compensations	
Sub B(20MVAr)	2020

According to Long Term Generation Expansion Plan 2013-2032, 3x300MW coal power development has been proposed during the year 2020 to 2022. It has been decided to install 2x300MW coal power units at Akurana/Aturuwella site in the years 2020 & 2021 (proposed total coal power development at this site up to year 2022 is 1100MW) and install 1x300MW coal power unit at Sampoor site in year 2022(proposed total coal power development at this site up to year 2022 is 800MW).

It has been decided to initiate the Colombo outer ring development and construct 220kV transmission line between Veyangoda GS and Kirindiwela SS by analyzing different loading scenarios especially in Trincomalee and Sampoor areas. Further it has been decided to operate Sampoor – New Habarana transmission line at 400kV level and upgrade the Sampoor generation switchyard and New Habarana SS to 400kV to avoid overloading under N-1 contingency of the Sampoor to New Habarana transmission line.

Further, opening of Pannipitiya-Matugama 132kV transmission line and feeding Panadura GSS from Pannipitiya end and Kaluthara GSS and Horana GSS from Matugama end were introduced to avoid overloading of Ambalangoda 400/132kV inter-bus transformer.

It has been proposed to switch off 132kV transmission connection between Kelaniya and Kolonnawa GSS to avoid overloading under N-1 contingency situations.

4.7.2. Normal operating conditions

It is assumed that the proposal in table 4.20 will be implemented as scheduled. System analysis has been carried out under normal operating condition for the scenarios given above to observe voltage violation, transmission line and GSS transformer overloading.

a. Voltage profile

No voltage violations were observed in the year 2022 transmission network under normal operating conditions.

b. Transmission line /Transformer overloading

No thermal loading violations observed in the year 2022 transmission network under normal operating conditions.

4.7.3 Single contingency operating conditions-2022

a. Voltage profile

No voltage violations observed in proposed year 2022 transmission network under single contingency conditions.

b. Transmission line/Transformer overloading

Line over loading observed under single contingency operating condition is listed in Table 4.21.

Table 4.21: Transmission line over loadings recorded under single contingency conditions in year 2022

Loading Condition	Generation Scenario	Contingency	Overloaded Line/Transformer	loading
Night Peak	Thermal Maximum	Ambalangoda 400/132kV single interbus TF outage	Remaining TF	108
		Biyagama-Sapugaskanda 132kV TL single cct outage	Remaining circuit	101

4.8. Transmission Losses

Transmission network losses have been determined during load flow analysis for peak load condition under thermal maximum and hydro maximum generation conditions. Then percentage power loss is calculated based total power generation. The peak energy loss is estimated from the loss factor method as given below.

Loss factor a (Load Factor) + b (Load Factor)^{2}

Where a =0.2 and b=0.8 for the transmission network

The transmission losses corresponding to the period from year 2013 to year 2022 are listed in Table 4.22. The losses given in Table 4.22 include the system losses from the high voltage side of the generator transformers up to the 33/11kV load buses of the network.

Table 4.22 - Transmission losses from year 2013-2022

Year	Condition	Power Generation(MW)	Power Loss ( )	Energy Loss ( )
2013	TM	2523	3.1	2.0
	HM	2515	2.7	1.8
2014	TM	2743	4.1	2.7
	HM	2726	3.5	2.3
2015	TM	2908	2.7	1.8
	HM	2908	2.7	1.8
2017	TM	3054	1.7	1.2
	HM	3055	1.8	1.2
2019	TM	3549	1.1	0.8
	HM	3546	1.0	0.7
2022	TM	4121	1.0	0.7
	HM	4128	1.2	0.8

*load factor is obtained from the table 2.1 given in Chapter 2.

4.9. Transient Stability Analysis

Any power system is operated within a technical envelope defined by a range of technical network limits. Operation within those limits allows power system security and reliability to be maintained. Some of these limits relate to the stability of the networks. The risks associated with operation outside of stability limits range from disruption of the power supply to consumers through disconnection of power stations and other plant or electrical separation of networks, to blackouts of parts of the power system and damage to plant.

The power system stability is defined as the ability of the power system to return to steady state without losing synchronism. In the transmission planning study, new generation additions and several network proposal have been introduced to provide consumers with better reliability, adequate capacity while catering for growing load demand. Thus, the stability of the network has to be studied with the proposals identified during planning study under contingency condition.

Transient system stability analysis has been carried out for present system, year 2017 and year 2022 networks under night peak and off peak loading conditions. During the study, the transmission system was subjected to specific pre-identified transient system disturbances those are expected to be critical. The studies have been carried out for two switching sequences as given below.

I.	Successful Re-closing (SR):	t=0 Fault occurs *t=120ms, fault cleared & circuit tripped t=620ms, circuit re-closed
II.	Unsuccessful Re-closing (UR):	t=0 Fault occurs t=120ms, circuit tripped t=620ms, circuit re-closed with fault t=740ms circuit tripped

*It is assumed that the maximum fault clearing time is 120 ms.

Following assumptions are made when carrying out stability studies.

- ✓ Approximately 5% spinning reserve is maintained for night peak loading conditions.
- ✓ An automatic load shedding scheme is incorporated in the study in order to sustain the stability of the system.
- ✓ Typical exciter and governor models are included for all generators.

The results of the transient stability are given in Table 4.23 and system frequency variation and rotor angle variation plots are shown in Annex E for selected fault condition. These results show that the network is stable as a whole under the simulated disturbances.

Table 4.23 - Transient stability analysis results from year 2013 to 2022 under night peak loading condition

Fault Element	Fault Type & Location	Switching Se uence	Result					
			2013		2017		2022	
			NP	OP	NP	OP	NP	OP
Kothmale-Kirndiwela/Biyagama 220kV TL, cct.1	3Φ Fault at Kothmale end	SR/USR	SS	SS	SS	SS	SS	SS
Biyagama-Pannipitiya 220kV TL, cct.1	3Φ Fault at Biyagama end	SR/USR	SS	SS	SS	SS	SS	SS
Pannipitiya-Padukka 220kV TL, cct.1	3Φ Fault at Pannipitiya end	SR/USR	-	-	SS	SS	SS	SS
Sampoor-New Habarana 220kV/400kV TL, cct.1	3Φ Fault at Sampoor end	SR/USR	-	-	-	-	SS	SS
Puttlam-New Chilaw/Veyangoda 220kV TL, cct.1	3Φ Fault at Puttlam end	SR/USR	SS	SS	SS	SS	SS	SS
Ambalangoda-Padukka, 400kV TL,cct.1	3Φ Fault at Ambalangoda end	SR/USR	-	-	-	-	SS	SS
New Polpitiya-Hambantota,220kV TL, cct.1	3Φ Fault at Ambalangoda end	SR/USR	-	-	-	-	SS	SS
Kothmale-New Polpitiya 220kV TL, cct.1	3Φ Fault at Kothmale end	SR/USR	-	-	SS	SS	SS	SS
Kerawalapitiya-Port 220kV UG Cable	3Φ Fault at Kerawalapitiya end	UG Cable fault at t=0 and cleared at t=120ms	-	-	SS	SS	SS	SS
Kelenitissa-Port 220kV UG Cable	3Φ Fault at Kelenitissa end	UG Cable fault at t=0 and cleared at t=120ms	-	-	SS	SS	SS	SS
285MW Unit at Puttlam	Machine tripping	Trip at t=0	SSLS	SSLS	SS	SSLS	SS	SS

4.9.1 Transient Stability Analysis for year 2014 & 2015

As per the section 4.3 Polpitiya-Kiribathkumbura 132kV TL, Biyagama-Sapugaskanda 132kV TL, Sapugaskanda-Kelaniya 132kV TL, Kelaniya-Kolonnawa 132kV TL, Puttalam-Anuradhapura 132kV TL, New Chilaw-Bolawatta 132kV, Kolonnawa-Kosgama 132kV TL and Kolonnawa-Athurugiriya 132kV TL loadings have exceeded their overloading trip settings under (N-0) conditions with night peak loading scenarios. Due to this reason, the steady state load flow solution is not converged. Situation has become worst under (N-1) condition. Therefore stability simulations cannot be done for the year 2014 system even with automatic load shedding scheme.

Year 2015 system is also facing severe overloading under (N-0) and (N-1) conditions according to the section 4.4. Year 2015 system steady state analysis was carried out with the proposed Pannipitiya 100MVar breaker switch capacitor banks in operation. It is difficult to run stability simulations for the year 2015 system due to cascade transmission line overloading tripping even with automatic load shedding scheme.

4.10. Short Circuit Analysis

Short circuit analysis have been carried out based on the following assumptions in order to check whether there is any breaker capacity violation in existing breakers in the system and to design breakers for grid substations and lines in future.

The calculation was based on the following assumptions.

- ✓ Uniform voltage profile of unity magnitude and zero phase angle at generator buses.
- ✓ All transformers including generator transformers are at nominal turn ratio and zero phase shift angle.
- ✓ Loads, fixed bus shunts and switched shunts are neglected in the positive sequence network.
- ✓ Line charging capacitance and line connected shunts are neglected in the positive sequence network.
- ✓ All resistive parts of impedances are neglected.
- ✓ Sub transient reactance (saturated) is used for synchronous machines. – Ref. IEC 60909 Clause 3.22
- ✓ Parallel operation of T off lines are assumed

Maximum three phase short circuit levels at each grid substation in years 2013, 2017 and 2022 are given in Table 4.24 together with the existing breaker capacities.

Table 4.24 - Maximum three-phase short circuit levels

Grid Substation/Power Station	Voltage Level (kV)	Existing Switch Gear Capacity (kA)	Maximum Three Phase Fault Level					
			2013		2017		2022	
			kA	deg.	kA	deg.	kA	deg.
Akkaraipattu	132		-	-	-	-	2.9	-78.6
	33		-	-	-	-	6.8	-83.3
Ambalangoda	400		-	-	-	-	11.7	-88.3
	132		5.2	-79.2	8.4	-76.3	16.1	-87.8
	33		7.2	-86.3	8.3	-86.6	13.2	-89.6
Ampara	132	31.5	1.4	-70.7	3.4	-78.5	3.5	-78.5
	33	25	4.4	-75.8	8.1	-83.8	8.1	-83.9
Aniyakanda	132		14.8	-83.0	15.6	-83.3	12.5	-84.3
	33		9.3	-88.9	13.1	-88.6	12.4	-88.6
Anuradhapura	132		6.4	-76.7	8.1	-83.5	7.9	-84.2
31.5MVA TF	33		4.6	-87.7	10.8	-87.8	10.8	-88.0
20MVA TF			2.9	-88.5	-	-	-	-
Asia Power	132		19.1	-83.9	26.3	-86.0	-	-
Aturugiriya	132	40	14.4	-76.4	19.4	-86.0	18.2	-87.0
	33	25	9.3	-87.8	9.7	-89.5	13.5	-89.4
Badulla	132	31.5	6.9	-76.1	10.1	-78.9	10.5	-78.6
	33	25	10.5	-85.0	12.0	-86.9	12.2	-87.0
Balangoda	132	31.5	9.3	-77.9	12.1	-81.0	11.0	-82.5
	33	25	12.1	-86.5	13.0	-87.9	12.7	-88.1
Baththaramulla	132		-	-	20.8	-86.0	18.9	-87.0
	33		-	-	9.7	-89.5	13.6	-89.5
Beliatta	132		3.5	-75.5	5.2	-74.7	5.4	-75.8
	33		6.2	-83.7	7.2	-84.7	9.4	-83.8
Biyagama	220	50	18.9	-86.8	23.7	-87.1	24.6	-86.7
	132	50	20.8	-85.7	22.4	-86.3	15.9	-87.2
	33	25	10.9	-88.7	12.2	-88.2	10.9	-88.7
Bolawatta	132	40	9.5	-81.0	10.0	-82.1	9.8	-82.5
	33	25	10.9	-87.4	11.0	-87.8	10.9	-87.9
Bowatenna PS	132	31.5	3.8	-73.8	4.0	-76.2	4.1	-76.6
Broadlands PS	132		-	-	14.1	-79.5	14.4	-79.3
Canyon PS	132	40	10.0	-75.3	10.7	-76.3	10.7	-76.2
Chemmuni	132		-	-	2.1	-82.3	2.4	-81.9
	33		-	-	5.6	-84.9	6.1	-84.9
Chunnakam	132		1.9	-78.0	2.2	-82.8	2.5	-82.3
	33		5.6	-83.3	7.2	-86.5	7.4	-85.4
Colombo A	132		14.8	-82.6	22.6	-85.5	17.7	-86.3
	11		9.9	-89.6	15.4	-89.8	15.1	-89.7
Colombo B	132		-	-	25.7	-85.9	20.6	-86.9
	11		-	-	10.6	-89.9	15.3	-89.8
Colombo C	132		21.0	-84.0	26.1	-86.1	20.9	-87.1

Grid Substation/Power Station	Voltage Level (kV)	Existing Switch Gear Capacity (kA)	Maximum Three Phase Fault Level					
			2013		2017		2022	
			kA	deg.	kA	deg.	kA	deg.
	11		10.6	-89.8	10.6	-89.9	10.6	-89.9
Colombo E	132	25	19.5	-80.9	21.6	-86.0	19.1	-86.9
	11	25	15.1	-89.4	15.3	-89.8	15.2	-89.8
Colombo F	132	25	19.2	-81.4	24.1	-86.6	20.9	-87.5
	11	25	15.1	-89.4	15.3	-89.8	15.2	-89.9
Colombo I	132		18.6	-83.5	24.8	-86.4	19.8	-87.2
	11		11.2	-89.7	15.4	-89.8	15.2	-89.8
Colombo K	132		-	-	20.4	-85.4	18.0	-86.5
	11		-	-	10.5	-89.8	5.4	-89.9
Colombo Port	220		-	-	21.8	-87.3	21.2	-86.8
	132		-	-	24.1	-86.7	21.0	-87.6
Colombo L1	11		-	-	14.9	-89.8	15.3	-89.9
Colombo L2	11		-	-	14.9	-89.8	15.3	-89.9
Colombo M	132		-	-	22.3	-86.2	19.6	-87.2
	11		-	-	14.9	-89.8	15.2	-89.8
Colombo N	132		-	-	24.7	-86.5	20.9	-87.4
	11		-	-	15.0	-89.8	10.6	-89.9
Colombo P	132		-	-	-	-	21.4	-87.5
	11		-	-	-	-	14.8	-89.9
Dehiwala	132		8.6	-86.5	22.6	-85.5	17.7	-86.3
	33		8.5	-89.1	14.0	-89.3	13.4	-89.3
Deniyaya	132	31.5	3.1	-65.8	5.3	-70.8	4.4	-68.6
	33	25	7.2	-76.8	7.5	-83.5	7.1	-81.9
Eluwankulama	132		-	-	3.8	-70.8	3.9	-73.1
	33		-	-	4.1	-84.9	6.5	-83.0
Embilipitiya	132	31.5	6.1	-79.4	9.2	-78.9	9.8	-81.4
	33		7.5	-86.8	8.5	-87.4	11.7	-87.5
Galle	132	31.5	2.4	-64.0	8.1	-75.3	8.5	-81.2
	33		5.0	-76.6	11.0	-85.1	11.2	-87.1
Habarana	132	31.5	5.2	-72.5	9.9	-83.9	11.1	-85.4
	33	25	7.0	-84.1	11.4	-88.2	11.8	-88.8
Hambantota	132	25	4.0	-79.3	8.7	-82.5	9.3	-83.3
31.5MVA TF	33	25	4.1	-87.3	11.0	-87.6	12.2	-88.0
16MVA TF	33		2.2	-88.5	-	-	-	-
Hambantota-Port	132		-	-	7.1	-81.8	7.5	-82.4
	33		-	-	10.1	-87.1	10.7	-87.3
Horana	132	40	5.2	-83.0	7.4	-79.7	4.5	-77.6
	33	25	8.1	-87.8	11.7	-86.5	8.7	-84.1
Inginiyagala	132	12.5	1.8	-71.3	3.0	-75.3	3.1	-75.2
	33		3.7	-82.7	4.4	-86.0	4.4	-86.1
Kelaniya	132	40	22.9	-84.8	26.3	-86.0	14.9	-85.8

Grid Substation/Power Station	Voltage Level (kV)	Existing Switch Gear Capacity (kA)	Maximum Three Phase Fault Level					
			2013		2017		2022	
			kA	deg.	kA	deg.	kA	deg.
	33	31.5	5.2	-89.7	10.0	-89.6	12.9	-89.1
Kalutara	132		-	-	8.1	-78.7	6.4	-77.6
	33		-	-	8.2	-87.1	7.7	-86.3
Kappalturai	132/220		-	-	2.8	-72.7	7.5	-86.4
	33		-	-	7.4	-78.7	19.3	-88.6
Katunayake	132		14.3	-83.3	16.5	-84.2	15.0	-85.1
	33		9.3	-88.9	13.2	-88.8	13.0	-89.0
Kegalle	132		-	-	4.4	-85.2	4.8	-86.7
	33		-	-	6.8	-88.2	8.9	-88.5
Kelenitissa PS	220	40	17.1	-86.5	22.6	-87.3	22.1	-86.7
	132	25	22.0	-84.4	27.5	-86.5	21.8	-87.4
Tertiary wdg.	33	25	7.0	-89.5	7.1	-89.7	7.0	-89.8
Kelenitissa-3A	33		8.4	-89.7	7.4	-89.8	6.5	-89.8
Kelenitissa-3B	33		8.4	-89.7	7.2	-89.8	6.5	-89.8
Kerawalapitiya	220		14.6	-86.3	22.1	-87.4	21.4	-86.9
	33		-	-	12.8	-89.8	23.4	-89.5
Kesbewa	132		-	-	-	-	14.2	-84.6
	33		-	-	-	-	9.2	-89.1
Kilinochchi	132		2.4	-76.1	2.9	-82.2	3.8	-82.5
	33		5.1	-82.5	5.7	-86.3	7.9	-86.1
Kiribathkumbura	132	25	8.2	-73.3	8.1	-81.1	8.4	-81.8
	33	25	11.5	-85.5	13.4	-86.4	13.8	-86.8
Kirindiwela	220		-	-	18.4	-86.2	23.0	-86.5
	132		-	-	7.3	-89.1	7.7	-89.3
Load Bus	33		-	-	14.0	-89.6	14.5	-89.7
Kolonnawa	132	40	22.7	-84.2	29.3	-86.9	22.8	-87.8
Kolonnawa	33		10.0	-89.4	10.3	-89.7	10.0	-89.8
Kolonnawa-Colombo	33	25	14.2	-89.1	14.8	-89.6	14.2	-89.7
Kosgama	132	25	7.8	-71.2	6.2	-87.6	6.5	-87.7
	33	25	8.3	-85.1	7.7	-89.3	10.0	-89.1
Kothmale PS	220	40	14.5	-86.8	21.4	-86.9	24.2	-86.8
Kotugoda	220	40	17.1	-86.2	22.0	-86.7	22.6	-86.4
	132	31.5	17.9	-85.0	20.1	-85.7	17.4	-86.7
Tertiary wdg.	33	13.1	10.3	-88.5	11.6	-88.1	11.2	-88.5
Kotugoda-New	33		9.6	-89.3	9.7	-89.5	9.5	-89.6
Kukule PS	132		4.3	-81.5	5.3	-74.7	7.6	-74.2
	33		1.7	-89.3	4.9	-86.6	5.3	-87.4
Kurunegala	132	25	4.6	-70.0	4.5	-74.4	4.6	-74.7
	33	25	6.9	-82.6	8.6	-82.7	8.7	-82.9
Laxapana PS	132	31.5	18.6	-80.6	21.9	-85.1	21.9	-85.2
Madampe	132	31.5	4.9	-72.9	11.9	-80.9	12.2	-81.3

Grid Substation/Power Station	Voltage Level (kV)	Existing Switch Gear Capacity (kA)	Maximum Three Phase Fault Level					
			2013		2017		2022	
			kA	deg.	kA	deg.	kA	deg.
	33	25	7.1	-83.9	12.1	-87.7	12.2	-87.9
Mahiyanganaya	132		5.5	-81.1	7.6	-82.2	8.3	-82.7
	33		7.4	-87.0	8.5	-88.0	9.2	-88.3
Maho	132		-	-	3.8	-75.6	3.9	-79.2
	33		-	-	6.4	-83.9	8.0	-84.4
Maliboda	132		-	-	17.2	-85.0	17.6	-85.1
	33		-	-	5.1	-89.6	5.2	-89.7
Mannar	132		-	-	2.8	-82.3	3.8	-83.2
	33		-	-	3.7	-87.4	4.1	-88.2
Matara	132	31.5	3.2	-74.6	6.9	-76.3	7.2	-78.6
	33	25	7.0	-83.1	11.6	-85.0	10.7	-85.7
Matugama	132	40	5.3	-83.2	8.4	-78.0	15.2	-77.7
	33	25	9.3	-87.0	11.3	-86.1	13.2	-87.4
Monaragala	132		-	-	3.5	-71.9	3.5	-71.7
	33		-	-	4.0	-84.9	6.3	-82.0
Moragolla PS	132		-	-	-	-	9.7	-81.8
New Chilaw	220		-	-	14.7	-85.4	16.0	-85.5
	132		-	-	15.4	-85.3	15.8	-85.9
Naula	132		-	-	5.2	-73.7	8.1	-82.9
	33		-	-	7.3	-84.4	8.2	-88.2
Nawalapitiya	132		-	-	9.5	-81.6	9.6	-81.7
	33		-	-	8.2	-88.2	8.3	-88.2
New Anuradhapura	132	40	6.4	-76.8	8.4	-84.1	8.1	-84.9
	220	25	3.4	-79.6	10.5	-83.1	12.2	-83.5
	33		3.4	-88.1	4.5	-88.7	4.5	-88.9
New Habarana	400		-	-	-	-	7.5	-86.0
New Polpitiya	220		-	-	19.4	-86.5	22.1	-86.5
	132		-	-	22.0	-86.8	22.8	-86.9
New Habarana	132		-	-	10.4	-84.9	11.8	-86.7
	220		-	-	11.7	-82.6	15.8	-84.5
	33		-	-	11.7	-88.5	12.1	-89.1
New Laxapana	132	31.5	18.6	-80.7	22.0	-85.2	22.0	-85.2
Nuwala Eliya	132	31.5	8.4	-73.9	10.0	-74.7	10.3	-74.5
	33	25	11.3	-84.9	12.1	-85.8	12.3	-85.8
Oruwala	132		12.7	-75.1	16.5	-82.9	15.6	-83.9
	33		1.1	-89.7	1.1	-89.9	1.1	-89.9
Padukka	132		-	-	17.7	-86.7	17.7	-87.6
	220		-	-	18.3	-86.1	23.8	-87.0
Tertiary wdg.	33		-	-	10.7	-88.5	11.1	-88.8
Load Bus	33		-	-	13.9	-89.6	15.0	-89.7
Pallekele	132		-	-	5.8	-80.6	5.9	-81.6

Grid Substation/Power Station	Voltage Level (kV)	Existing Switch Gear Capacity (kA)	Maximum Three Phase Fault Level					
			2013		2017		2022	
			kA	deg.	kA	deg.	kA	deg.
	33		-	-	7.5	-87.0	9.7	-86.5
Panadura	132	25	7.5	-83.6	13.0	-79.0	10.9	-80.8
	33	25	8.1	-88.3	12.3	-87.4	11.8	-87.5
Pannipitiya	220	50	13.4	-84.5	20.2	-86.1	22.7	-86.4
	132	31.5	10.2	-87.5	25.2	-85.4	21.1	-87.4
Load Bus	33	25	10.9	-89.3	13.6	-89.4	13.3	-89.6
Pannala	132		5.1	-76.4	7.5	-81.4	7.5	-81.8
	33		7.2	-85.3	8.1	-87.7	10.7	-87.1
Polonnaruwa	132		-	-	3.6	-79.8	3.9	-81.5
	33		-	-	6.3	-85.6	6.6	-86.5
Polpitiya PS	132	40	18.7	-80.0	22.5	-85.8	22.8	-85.8
Port City	220		-	-	21.1	-87.0	20.6	-86.5
Port City 1	11		-	-	5.1	-89.9	5.2	-89.9
Port City 2	11		-	-	5.1	-89.9	5.2	-89.9
Puttlam GS	132	25	6.1	-77.2	6.4	-73.4	6.7	-79.4
Load Bus	33		7.8	-86.1	8.0	-85.1	10.4	-86.0
Narakkalliya	33		4.9	-87.8	4.9	-87.2	5.0	-88.3
Puttlam PS	220		7.8	-86.7	16.9	-87.5	17.7	-87.4
Puttlam PS -Wind Collecting bus	33		9.8	-89.5	10.5	-89.8	10.6	-89.8
Ragala	132		-	-	7.7	-75.7	7.8	-75.6
	33		-	-	8.2	-86.2	8.2	-86.3
Randenigala PS	220	31.5	9.4	-85.8	11.3	-85.3	13.6	-85.5
Rantambe PS	220	31.5	8.9	-85.6	10.6	-85.1	12.6	-85.3
	132	20	7.0	-81.7	10.2	-83.3	11.2	-83.9
Tertiary wdg.	33	20	9.2	-88.5	10.5	-89.1	10.5	-89.2
Generator-1	12.5		21.6	-89.1	22.1	-89.4	23.1	-89.6
Generator-2	12.5		21.6	-89.1	23.0	-89.5	23.1	-89.6
Rathmalana	132	25	8.6	-83.9	17.0	-79.0	15.4	-85.1
	33	25	11.0	-88.1	13.1	-87.9	12.8	-89.0
Rathnapura	132	40	4.9	-78.8	5.3	-80.2	5.1	-80.9
	33	25	9.6	-85.1	9.9	-85.9	9.9	-86.1
Samanalawewa PS	132	31.5	8.7	-80.9	11.0	-81.6	10.8	-83.0
Sampoor	400		-	-	-	-	6.6	-87.0
	220		-	-	-	-	12.6	-88.8
Sapugaskanda GS	132	40	21.4	-85.1	23.5	-85.8	15.2	-86.4
	33		14.7	-89.3	17.9	-89.3	15.1	-89.1
Sapugaskanda PS	132	31.5	19.1	-85.3	20.3	-85.7	14.7	-86.6
Sithawake	132	25	8.2	-71.7	5.5	-85.2	5.7	-85.2
	33	25	11.4	-84.2	9.8	-88.0	10.0	-88.1
Sri J'Pura	132		8.6	-83.9	23.7	-82.6	20.1	-86.7

Grid Substation/Power Station	Voltage Level (kV)	Existing Switch Gear Capacity (kA)	Maximum Three Phase Fault Level					
			2013		2017		2022	
			kA	deg.	kA	deg.	kA	deg.
	33		8.3	-88.5	14.1	-88.9	13.7	-89.4
Suriyawewa	132		-	-	6.3	-79.9	6.3	-75.9
	33		-	-	7.7	-86.9	7.7	-85.7
Thulhiriya	132	40	6.4	-70.3	4.8	-85.7	5.2	-87.3
	33	25	10.3	-82.4	8.8	-88.0	11.2	-88.6
Tissamaharama	132		-	-	-	-	6.1	-81.7
	33		-	-	-	-	9.9	-86.7
Trincomalee	132	31.5	2.3	-71.1	2.5	-72.2	2.5	-72.6
	33	25	5.6	-80.1	5.7	-81.2	7.4	-77.9
Ukuwela PS	132	31.5	7.0	-74.4	7.9	-81.2	8.1	-82.6
	33	25	10.5	-84.4	10.9	-87.1	11.2	-87.6
Umaoya PS	132		-	-	7.7	-81.3	7.9	-81.2
	33		-	-	-	-	8.2	-87.7
Upper Kothmale PS	220		11.0	-85.2	14.2	-84.5	15.3	-84.2
Valachchenai	132		2.1	-72.7	2.7	-76.0	2.9	-80.9
	33		2.5	-85.0	5.5	-82.9	5.7	-85.6
Vaunativ	132		-	-	2.9	-79.6	3.2	-80.2
	33		-	-	5.8	-85.2	6.8	-85.9
Vauniya	220	40	-	-	-	-	7.1	-83.6
	132	25	3.4	-72.9	4.6	-82.7	8.4	-85.8
	33		5.5	-83.2	6.9	-87.3	11.3	-88.6
Veyangoda	220		13.7	-85.7	18.4	-85.8	22.7	-86.4
	132	25	10.3	-88.1	7.2	-89.0	7.5	-89.3
	33	25	8.6	-89.6	10.3	-89.7	10.5	-89.8
Victoriya PS	220	40	12.0	-86.5	15.2	-86.1	16.3	-86.0
Wewelwaththa	132		-	-	5.9	-80.1	5.7	-80.9
	33		-	-	4.5	-88.1	4.5	-88.2
Wimalasurendra	132	31.5	15.1	-78.2	17.5	-84.0	17.5	-84.0
	33	25	13.7	-87.6	14.0	-88.9	14.0	-88.9

Chapter 5
Transmission Expansion Proposals

The transmission system expansion and reinforcement proposals for the period from year 2013 to 2022 were formulated based on the power system analysis carried out for the network as described in Chapter 4.

5.1. Transmission Expansion Proposals Identified by System Analysis

The transmission network expansion proposals, which have been proposed by the Transmission Planning Branch based on transmission system analysis and which are already financially committed and being implemented at present, are listed in Table 5.1. The transmission network expansion proposals, which have been proposed by the Transmission Planning Brach for the period 2013-2022 based on transmission system analysis and which require funds are listed in Table 5.2.

5.2. Power Plant Connection Proposals

The power plant connection proposals are listed in Table 5.3.

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Table 5.1: Financially Committed Transmission Pro ects

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
1	**Clean Energy & Access Improvement Pro ect**	**Loan No** : 2518-SRI **Investment/ Donor**: ADB **Loan closing date:** 30.11.2015		
1.1	**Part 1-System Control Moderni ation-New System Control Center at Sri J Pura** **Package A** : **Lot 1**:Construction of National System Control Center at Sri J'Pura and installation of SCADA system	**Loan amount:** 11.6 US$ Million **Estimated Cost:** 12 US $ Million **Contractor:** Not Awarded	Second stage bidding is in progress.	2015
	Lot 2:Installation of OPGW based communication network on transmission network for SCADA and communication	**Estimated Cost:** 4.2 US $ Million **Contractor:** Not Awarded		
	Package B Replacement of earth wire with Optical Ground Wire	**Estimated Cost:** 9.07 US $ Million **Contractor:** Viscas Corporation Japan **Contract Period:** 2 year (01.01.2012-31.12.2013)	Physical progress- 20%	2014
1.2	***Part 2*** **Lot A-Transmission System Strengthening Grid Substations**	**Loan No** : 2518-SRI		
1.2.1	***Lot A1***			
	Augmentation of Kurunegala GSS (2x31.5MVA→3x31.5MVA,1x132kV SB TFbay,1x132kVBusbar Extension, 3x33kV SB TF bays, 12x33kV SB feeder bays, 2x33kV SB bus section bays , 2x5MVar BSC bays and equipment replacement of existing 132kV switchgear)	**Loan amount:** 5.41 US $ Million **Contractor:** Seimens India Ltd **Contract Period:** 1 ½ year **Date of award:** 19.04.2013	Contract agreement to be signed.	2015

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
1.2.2	***Lot A2***		Overall Physical Progress 71%. Financial progress – 50%	
1.2.2.1	Construction of Pallekele 132/33kVGSS(2x31.5MVA, 2x132kV SB TF bays, 2x132kV SB TL bays, 1x 132kV SB bus section bay inclu. SB arrangement, 2x33kV TF bays, 11x 33kV feeder bays and 1x 33kV bus section bay inclu. 33kV SB arrangement)	**Loan amount:** 24.99 US $ Million **Contractor:** Seimens India Ltd **Date of award :** 25.11.2010 **Contract Period:** 2 Years (07.06.2011-06.07.2013)		December 2013
1.2.2.2	Installation of 20 MVAr (4x5MVAr) capacitor banks inclu. 33kV BSC bays			
1.2.2.3	Augmentation of Panadura 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV SB TF bays, 1x33kV TF bay, 4x 33kV feeder bays and 1x 33kV bus section bay)			
1.2.2.4	Augmentation of Matara 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV SB TF bays, 2x132kV SB TL bays, 1x33kV TF bay ,4x 33kV feeder bays and 1x 33kV bus section bay)			
1.2.2.5	Construction of Maho 132/33kVGSS (1x31.5MVA, 1x132kV SB TF bays, 1x132kV SB TL bays, 132kV SB arrangement, 1x33kV TF bay , 4x 33kV feeder bays and 33kV SB arrangement)			
1.2.2.6	Augmentation of Puttlam 132/33kVGSS(1x132kV SB TL bays)			
1.2.2.7	Construction of Naula 132/33kVGSS (1x31.5MVA, 1x132kV SB TF bays, 2x132kV SB TL bays, 132kV SB arrangement, 1x33kV TF bay, 4x 33kV feeder bays and 33kV SB arrangement)			

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
1.2.2.8	Augmentation of Habarana 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV SB TF bays, 3x132kV SB TL bays,, 1x33kV TF bay, 4x 33kV feeder bays and 1x 33kV bus section bay)			
1.2.2.9	Augmentation of Naula 132/33 kV Grid Substation(1x 31.5 MVA to 2x31.5 MVA TF, one 132kV single busbar transformer bay, one 33kV transformer bay, one 33kV section bay, four 33kV feeder bays)	Loan Savings of 2518-SRI	ADB concurrence for additional scope is awaited.	
1.2.2.10	Augmentation of Maho GSS (1x 31.5 MVA to 2x31.5 MVA TF, 1x132kV SB TF bay, 1x132kV SB TL bay , 1x132kV Bus Section bay, 1x 33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)			
1.2.3	***Lot A3***			
1.2.3.1	Augmentation of Horana GSS (2x31.5MVA→3x 31.5MVA, 1x132kV SB TF bay, 1x33kV SB TF bays, 4x33kV SB feeder bays and 1x33kV SB bus section bay)	**Loan amount:** 2.46 US $ Million **Contractor:** LTL Projects (Pvt) Ltd **Date of award :** 29.05.2013 **Contract Period:** 2 Years	Physical Progress-Nil Contract agreement signed.	2015
1.2.3.2	Augmentation of Veyangoda GSS (2x31.5MVA→3x 31.5MVA, 1x132kV DB TF bay and 1x33kV SB TF bays, 4x33kV SB feeder bays and 1x33kV SB bus section bay)	**Loan amount:** 2.07 US $ Million **Contract Period:** 2 Years	Physical Progress-Nil Contract agreement signed in May 2013.	2015

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commiss ioning Year
1.2.4	***Lot B - Transmission System Strengthening Transmission Lines***		Overall physical progress-97%. Financial progress – 82%	
1.2.4.1 **1.2.4.2** **1.2.4.3** **1.2.4.4**	Construction of Galle – Matara, 132kV, 35km, Zebra, 2 cct. Transmission line Construction of Ukuwela-Pallekele, 132kV, 17km, Zebra, 2 cct. Transmission line Construction of Puttlam - Maho, 132kV, 42km, Zebra, 1 cct. Transmission line Single in and out connection from Ukuwela – Habarana132kV line to connect NaulaGSS (Zebra, 2 cct., 0.5 km)	**Loan amount:** 20.4 US $ Million **Contractor:** Consortium of LTL Projects (Pvt) Ltd and LTB Leitungsbau GmbH **Date of award :** 10.08.2010 **Contract Period:** 2 years (extended up to December 2013)	98% of tower erection works of Ukuwela-Pallekele transmission line has been completed. Construction of Puttlam - Maho transmission line is 100% completed.	2013
1.2.2.5	2nd circuit stringing of Puttalam – Maho 42km, Zebra, double circuit, 132kV transmission line	Loan Savings of 2518-SRI	ADB concurrence for additional scope is awaited.	
1.3	**Part 6-** **Augmentation of GSS for Absorption of Renewable Energy-GOSL**	**Investment/ Donor:** GOSL		
	Phase I-Lot A		Construction progress - 87%. Financial progress- 64%.	
1.3.1	Augmentation of Wimalasurendra 132/33kVGSS (2x31.5MVA to 3x31.5 MVA, 1x132kV SB TF bay, 3x 33kV TF bay,8x33kV feeder bays , 2x33kV bus section bays and 132kV and 33kV protection and control panels for existing TFs and feeders)	**Contractor:** LTL Projects (Pvt) Ltd **Date of award :** 30.09.2010 **Contract Period:** 2 years from 15.11.2010	02 nos. of generators bays to be installed at WPS and will be completed by December 2013.	2013

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
1.3.2 1.3.3	Augmentation of Ratnapura 132/33kVGSS (2x31.5MVA to 3x31.5 MVA, 1x132kV DB TF bay , 1x 33kV TF bay , 1x33kV bus section bay and 2x33kV feeder bays) Augmentation of Rantambe 132/33kV PS (2x 132kV DB line bays, 132kV BB protection panel and 2 nos .of 132kV TL protection & control panels)		Construction completed. Scope of the Rantambe GS was changed.	
	Phase I-Lot B			
1.3.4	Construction of Rantambe – Mahiyangana, Zebra, 132kV, 21km, double cit. line	**Contractor:** CEB-Transmission Projects **Contract Period:** 2 years from 05.01.2011	Commissioned.	2013
	Augmentation of GSS for Absorption of Renewable Energy-ADB	**Loan No** : 2518-SRI **Investment/ Donor:** ADB **Loan amount:** USD 21.615 Million **Loan closing date:** 30.11.2015		
	Phase II			
1.3.5 1.3.6 1.3.7	Augmentation of Balangoda 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV DB TF bay and 1x 33kV TF bay, 2x33kV feeder bays) Augmentation of Seethawake 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV SB TF bay and 1x33kV TF bay) Augmentation of N'Eliya 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 132kV SB bus section bay, 1x 33kV TF bay and 2x33kV feeder bays)	**Contractor:** Consortium of LTL Projects (Pvt) Ltd and LTB Leitungsbau GmbH **Date of award :** 26.07.2010 **Contract Period:** 2 years from 24.11.2010	Construction completed Construction completed Construction completed	2013 2013 2013

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
1.3.8	Augmentation of Ukuwela 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV DB TF bay, 1x 33kV TF bay,7x33kV feeder bays , 2x33kV bus section bays and 132kV and 33kV protection and control panels for existing TFs and feeders)		Construction will be completed by Oct. 2013	2013
1.3.9	Augmentation of Badulla 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 132kV SB bus section bay, 1x 33kV TF bay,8x33kV feeder bays , 2x33kV bus section bays and 132kV and 33kV protection and control panels for existing TFs and feeders)		Construction works 98% completed. Construction will be completed by Feb. 2014	2014
1.3.10	Construction of Mahiyanganaya 132/33kVGSS(2x31.5MVA, 2x132kV SB TF bays, 2x132kV SB TL bays, 1x 132kV SB bus section bay inclu. SB arrangement, 2x33kV SB TF bays, 8x 33kV feeder bays and 1x 33kV bus section bay inclu. 33kV SB arrangement)		Construction completed	2013
1.4	***Part 7*** ***Transmission System Strengthening in the Eastern Province***	**Loan No** : 2519-SRI **Investment/ Donor:** ADB **Loan amount:** USD 26.5 Million **Loan closing date:** 30.09.2015		
	Lot A		Physical progress- 96%. Financial progress -79%.	
1.4.1	Augmentation of Ampara 132/33kVGSS(2x31.5MVA to 3x31.5 MVA, 1x132kV SB TF bays, 1x33kV TF bay, 4x 33kV feeder bays and 1x 33kV bus section bay)	**Contractor:** ABB Limited **Date of award :** 04.03.2011 **Contract Period:** 2 Years (Additional time Extension given - 3 months)	Ampara GSS-Transformers and feeder bays energized on 16.03.2013.	2013

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
1.4.2 **1.4.3**	Installation of 30 MVar (6x5MVar) capacitor banks inclu. 33kV BSC bays Augmentation of Valachchenai 132/33kVGSS(3x10MVA to 2x10+31.5 MVA, 1x132kV SB TF bay, 1x132kV SB TL bay,1x33kV TF bay, 4x 33kV feeder bays and 1x 33kV bus section bay)		Equipment erecting of BSC bank and 132kV bus section are in progress.	
1.4.4 **1.4.5**	220V DC battery charger at Ampara Grid Substation Augmentation of Valachchenai GS (2x10+1x31.5MVA to 2x31.5 MVA transformer, one132kV single busbar transformer bay, one 132kV single busbar transmission line bay,132kV single busbar including bus section bay, one 33kV transformer bay, one 33kV bus section bay, four 33 kV feeder bays)	Loan Savings of 2519-SRI	ADB concurrence for additional scope is awaited.	
	Lot B			
1.4.6	Construction of Habarana-Valachchelai, Zebra, 132kV, 100km, 2 cct. line (single cct. stringing)	**Contractor:** Consortium of LTL Projects (Pvt) Ltd and LTB Leitungsbau GmbH **Date of award :** 08.11.2010 **Contract Period:** 2 Years Additional time Extension given -4 months	Physical progress-100%. Final inspection proceeding by O&M branch before taking over.	2013

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commiss ioning Year
2	**Kilinochchi- Chunnakam Transmission Pro ect**	**Loan No** : 2626-SRI **Investment/ Donor:** ADB **Loan amount:** 14 US $ Million **Loan closing date:** 30.11.2015	Commissioned	2013
	<u>Lot A</u>			
2.1	Construction of Chunnakam 132/33kVGSS(2x31.5MVA, 2x132kV SB TF bays, 2x132kV SB TL bays, 1x 132kV SB bus section bay inclu. SB arrangement, 2x33kV SB TF bays, 8x 33kV feeder bays and 1x 33kV bus section bay inclu. 33kV SB arrangement)	**Contractor:** Siemens Ltd-India **Date of award :** 07.03.2011 **Contract Period:** 2 Years	Construction Completed and energized in September 2013.	2013
	<u>Lot B</u>			
2.2	Construction of Kilinochchi – Chunnakam , Zebra, 132kV, 67.2km, double cct. line	**Contractor:** KEC International Ltd-India **Date of award :** 12.04.2011 **Contract Period:** 2 Years	Construction Completed and line energized in September 2013.	2013
3	**Sustainable Power Sector Support II Pro ect**			END 2014
3.1	**Part I - New Galle Power Transmission Development Pro ect**	**Loan No** : 2733-SRI**Investment/ Donor:** ADB **Loan amount:** 23.3 US $ Million **Loan closing date:** 30.10.2014		
	Lot A			
3.1.1	Construction of New Galle 132/33kV GSS(3x31.5MVA, 3x132kV DB TF bays, 6x132kV DB TL bays, 1x 132kV bus coupler bay inclu. DB arrangement, 1x132kV SVC bay, 3x33kV TF bays, 12x 33kV feeder bays and 1x 33kV bus section bay inclu. 33kV BB, 30 MVar (6x5MVar) capacitor banks inclu. 33kV BSC bays)	**Contractor:** ABB Limited-India **Date of award :** 24.08.2012 **Contract Period:** 2 years	Physical Progress -13 %. Financial progress – 11%. Civil works is in progress.	Nov 2014

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
3.1.2 **3.1.3**	Augmentation of Galle 132/33kV GSS(2x132kV DB TL bays) **System Reactive Power Compensation** ✓ Installation of 20 MVar at Katunayake GSS (4x5MVar) capacitor banks inclu. 33kV BSC bays ✓ Installation of 10 MVar at Aniyakanda GSS (2x5MVar) capacitor banks inclu. 33kV BSC bays ✓ Installation of 10 MVar at Ambalangoda GSS (2x5MVar) capacitor banks inclu. 33kV BSC bays		Construction will be done by CEB. Material will be procured from ADB funds. Awaiting ADB concurrence for the arrangement.	2016
	Lot B			
3.1.4	Construction of Ambalangoda- Galle, Zebra, 132kV, 40km, double cct. Line	**Contractor:** KEC International Ltd-India **Date of award :** 24.08.2012 **Contract Period:** 22 months	Physical Progress -25% Financial progress-11%	Sep. 2014
3.2	**Part II- North East Power Transmission Development Pro ect**	**Loan No** : 2733-SRI **Investment/ Donor:** ADB **Loan amount:** 55.2 US $ Million **Loan closing date:** 30.10.2014		
3.2.1	**Lot A**		Physical Progress -17% Financial progress – 10%	Dec. 2014
3.2.1.1	Construction of Vaunativ 132/33kVGSS(2x31.5MVA, 2x132kV SB TF bays, 2x132kV SB TL bays, 1x 132kV SB bus section bay inclu. SB arrangement, 2x33kV SB TF bays, 8x 33kV feeder bays, and 1x 33kV bus section bay inclu. 33kV SB arrangement)	**Contractor:** Consortium of LTL Projects (Pvt) Ltd and Mitsubishi Corporation **Date of award :** 17.07.2012 **Contract Period:** 2 years		

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
3.2.1.2	Installation of 20 MVAr (4x5MVAr) capacitor banks inclu. 33kV BSC bays			
3.2.1.3	Construction of Polonnaruwa 132/33kVGSS(1x31.5MVA, 1x132kV SB TF bays, 2x132kV SB TL bays, 1x 132kV SB bus section bay inclu. SB arrangement, 1x33kV SB TF bays, 4x 33kV feeder bays and 33kV SB arrangement)			
3.2.1.4	Construction of Monaragala 132/33kVGSS(1x31.5MVA, 1x132kV SB TF bays, 2x132kV SB TL bays, 1x 132kV SB bus section bay inclu. SB arrangement, 1x33kV SB TF bays, 4x 33kV feeder bays and 33kV SB arrangement)			
3.2.1.5	Augmentation of Monaragala 132/33kV Grid Substation (1x31.5MVA to 2x31.5 MVA transformer, one 132kV single busbar transformer bay, one 33kV transformer bay, one 33kV section bay, four 33kV feeder bays)	Loan Savings of 2519-SRI	ADB concurrence received for additional scope of Monaragala and Polonnaruwa GSS.	
3.2.1.6	Augmentation of Polonnaruwa 132/33 kV Grid Substation (1x31.5 MVA to 2x31.5 MVA 132/33 kV transformers, one 132 kV S/B transformer bay, one 33 kV transformer bay, one 33 kV bus section bay including bus bar, 4x33 kV feeder bays) Installation of 20 Mvar Breaker Switched Capacitors at Polonnaruwa 33 kV BB			
3.2.1.7	Augmentation of Kiribathkumbura 132/33 kV grid substation(3x31.5MVA to 4x31.5MVA transformers (adding new 2x31.5 MVA transformer), 3x 132kV S/B transformer bays, 4x132kV S/B transmission line bays, 1x 132kV bus section bay, 2x132kV Protection		Tender Documents prepared.	

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commiss ioning Year
	&Control panels for line bays, 1x 132kV Protection and Control panels for transformer bays, 4x 33kV indoor transformer bays, 12 x 33 kV indoor line feeder bays, 2x 33kV indoor capacitor bank bays and 1x33kV indoor bus coupler bay and busbar arrangement			
3.2.2	**Lot B**		Physical Progress -45% Financial progress – 25%	Aug.2014
3.2.2.1 **3.2.2.2**	Construction of Mahiyangana-Vaunativ(via Ampara), Zebra, 132kV, 129km line Construction of Medagama-Monaragala16km132kV line and PolonnaruwaGSS In & out 0.5kmline	**Contractor:** Kalpataru Power Transmission Ltd. **Date of award :** 03.04.2012 **Contract Period:** 2 years		
3.2.3	**Lot C**		Physical Progress -61% Financial progress – 25%	May 2014
3.2.3.1	Construction of the second cct. Of Kotmale- New Anuradhapura, Zebra, 220kV, 163km line.	**Contractor:** China Gezhouba Group Company Ltd **Date of award :** 27.01.2012 **Contract Period:** 2 years		
4	Construction of Colombo B 132/11kV GS (2x31.5MVA, 2x132kV SB GIS TF bays, 2x132kV SB GIS cable bays, 1x 132kV SB GIS bus section bay inclu. SB arrangement, 2x11kV GIS TF bays, 12x 11kV feeder bays and 1x 11kV bus section bay inclu. 11kV SB arrangement) ✓ Single in & out connection from Colombo C - Kolonnawa 132 UG cable	**Investment/ Donor:** CEB **Loan amount:** MLKR 1234.8	Construction will be done by Transmission Construction Branch. Procurement is in progress.	2016

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
5	Augmentation of Hambantota GS (16+31.5 MVA to 3x31.5 MVA, one 132kV S/B transformer bay, 1x132kV bus section bay, one 33kV transformer bay, 4x33 kV feeder bays and 1x33kV bus section bay)	**Investment/ Donor:** GOSL/CEB **Loan amount:** MLKR 535	Construction is done by Transmission Construction Branch. Procurement and civil works are in progress.	2015
6	Augmentation of Sri J'Pura GS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 33kV TF bay, 4x33kV and 1x33kV bus section bay)	**Investment/ Donor:** GOSL/CEB **Loan amount:** MLKR 354	Construction is done by Transmission Construction Branch. Procurement is in progress.	2015
7	Installation of 100MVAr BSC at 132kV BB of Pannipitiya Grid Substation to control Pannipitiya 220 kV BB voltage	**Investment/ Donor:** GOSL/CEB **Loan amount:** MLKR 271	Construction is done by Transmission Construction Branch.	2015
8	Installation of 2nd 220/132kV, 105 MVA inter-bus TF at Rantambe PS (1x220kV SB TF bay, 1x132kV DB TF bay)	**Investment/ Donor:** GOSL/CEB **Loan amount:** GOSL-MLKR 678 CEB- MLKR 12	Construction is done by Transmission Construction Branch. Line shifting civil works and procurement of equipment are in progress	2015
9	Construction of Suriyawewa 132/33kVGS(2x31.5MVA, 2x132kV SB TF bays, 2x132kV SB TL bays, 1x 132kV SB bus section bay inclu. SB arrangement, 2x33kV TF bays, 8x 33kV feeder bays and 1x 33kV bus section bay inclu. 33kV SB arrangement) ✓ Single in & out connection from Embilipitiya-Hambantota, Zebra, 132kV, 9km, double cct. TL.	**Investment/ Donor:** GOSL/CEB **Loan amount:** GOSL-MLKR 1236.6 CEB- 37.9	Construction is done by Transmission Construction Branch. Design and Procurement is in progress.	2016

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commiss ioning Year
10	**Habarana-Veyangoda220kV Transmission Pro ect**	**Loan No** : SLP-106 **Investment/ Donor:** JICA **Loan amount:** JPY 9573 M **Loan closing date:** 28.03.2019	JICA approvals received for tender documents of Lot B and lot A have been announced.	2016
10.1	**Lot A**			
10.1.1	Construction of New Habarana SS (2x250MVA, 220/132/33kV TF, 2x220kV DB TF bays, 8x220kV DB TL bays, 220kV DB arrangement inclu. bus coupler, 132kV DB arrangement inclu. bus coupler, 2x132kV DB TF bays and 6x132kV DB TL bays)			
10.1.2	Augmentation of Veyangoda Switching Station (2x220kV double busbar transmission line bay)			
10.2	**Lot B**			
10.2.1	Construction of New Habarana SS - Veyangoda GS, 2xLow Loss TACSR550, 220kV, 148km double cct. TL			
10.2.2	Double in & out connection from Kotmale- New Anuradhapura ,Zebra,220kV 1km TL			
10.2.3	Construction of Zebra,132kV,3km Quadruple tower line to shift 132kV Habarana-Ukuwela, Habarana-Valachchenai transmission line to New Habarana Terminating Habarana-Anuradhapura 132kV line at New Habarana SS by Zebra, 132kV, 2km double cct. transmission line			

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
11	**Greater Colombo Transmission and Distribution Loss Reduction Pro ect**			
11.1	Construction of Port 220/132kV GS (2x250MVA, 220/132kV transformer, 2x220kV indoor double busbar transformer bay,2x220kV indoor double busbar cable bay,1x220kVindoor double busbar bus coupler bay 2x132kV indoor double busbar cable bay, 2x132kV double busbar transformer bay,1x132kV bus coupler bay.) **11.2** Construction of Colombo L1 GS 132/11kV GS(2x45MVA, 132/11kV indoor transformers,2x132kV indoor double busbar transformer bays, 2x11kV indoor single busbar transformer bays, 12x 11kV indoor cable bays , 2*X11kV indoor bus section bays with single busbar arrangement) *It is recommended to open proposed 11kV bus section bay between L1 and L2 GSS to limit 11kV fault level. **11.3** Construction of Colombo L2 GS 132/11kV GS(2x45MVA, 132/11kV indoor transformers,2x132kV indoor double busbar transformer bays, 2x11kV indoor single busbar transformer bays, 12x 11kV indoor cable bays , 1X11kV indoor bus section bays with single busbar arrangement) **11.4** Construction of Colombo M GS 132/11kV GS(2x45MVA, 132/11kV indoor transformers,2x132kV indoor single busbar transformer bays, 2x11kV indoor single busbar transformer bays, 18x 11kV indoor cable bays ,2x132kV single busbar indoor cable bays,1x 132kV indoor bus section bay with single busbar arrangement and 1X11kV indoor bus section bays with single busbar arrangement)	**Loan No** : SL-P107 **Investment/ Donor:** JICA **Loan amount:** JICA- JPY 15,941 M CEB- MLKR 4,896 Million	RFP has been called and opened on 02.09.2013	December 2016

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
11.5	Construction of Colombo N GS 132/11kV GS(2x45MVA, 132/11kV indoor transformers,2x132kV indoor single busbar transformer bays, 2x11kV indoor single busbar transformer bays, 12x 11kV indoor cable bays ,2x132kVsingle busbar indoor cable bays,1x 132kV indoor bus section bay with single busbar arrangement and 1X11kV indoor bus section bays with single busbar arrangement)			
11.6	Augmentation of Colombo A GS (1x31.5 MVA, 132/11kV indoor transformer, 1x132kV indoor single busbar transformer bay, 1x11kV indoor single busbar transformer bay, 6x 11kV indoor cable bays and 1X11kV indoor bus section bays with single busbar arrangement)			
11.7	Augmentation of Colombo I GS (1x31.5 MVA, 132/11kV indoor transformer, 1x132kV indoor single busbar transformer bay, 1x11kV indoor single busbar transformer bay, 6x 11kV indoor cable bays and 1X11kV indoor bus section bays with single busbar arrangement)			
11.8	Augmentation of KerawalapitiyaGS (1x220kV double busbar cable bay)			
11.9	Augmentation of KelenitissaGS (1x220kV double busbar cable bay)			
11.10	Augmentation of KolonnawaGS (1x132kV double busbar cable bay)			
11.11	Construct 220kV, Cu (XLPE) 1600mm2, 7.2km cable between Kelenitissa and Port GSS.			
11.12	Construct 220kV, Cu (XLPE) 1600mm2, 14.9km cable between Kerawalapitiya and Port GSS.			

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
11.13 **11.14** **11.15** **11.16** **11.17** **11.18** **11.19**	Construct 132kV, Cu (XLPE) 1200mm2, 1.2km cable between Port and Colombo F GSS. Construct 132kV, Cu (XLPE) 800mm2, 2.4km cable between Colombo F and Colombo N GSS. Construct 132kV, Cu (XLPE) 1200mm2, 6.1km cable between Colombo N and KolonnawaGSS. Construct 132kV, Cu (XLPE) 1200mm2, 3.2km cable between Colombo L and Colombo M GSS. Construct 132kV, Cu (XLPE) 800mm2, 1.5km cable between Colombo M and Colombo E GSS. Installation of 18 nos. of 33kV GIS panels at Kelanitissa Switching Station. Construction of 11kV 92km cables in the Colombo city from new grid substation.			
12	**Clean Energy & Network Efficiency Improvement Pro ect**			2016
12.1	**Package 1- Mannar Transmission Infrastructure**			
	Lot A			
12.1.1 **12.1.2**	Augmentation of Vavuniya grid substation with 2x132kV double busbar transmission line bays Construction of Mannar grid substation with 1x31.5 MVA, 132/33 kV transformers, 132kV single busbar arrangement including bus section, 33kV single busbar arrangement including bus section, 4x132 kV single busbar transmission line bays, 1x132kV single busbar transformer bays, 4x33 kV feeder bays, 1x33kV transformer bays	**Loan No** : 2892-SRI/ 2893-SRI **Investment/ Donor:** ADB **Loan amount:** 6.47 US $ Million **Loan closing date:** 30.06.2017 **Contract Period:** 2 years	Concurrence of ADB and SCAPC for the bidding document is pending.	June 2016

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
	Lot B			
12.1.3 **12.1.4**	Construction of 55km, double circuit, 2*Zebra, 132kV transmission line from New Anuradhapura to Vavuniya Construction of 70km, double circuit, Zebra, 132kV transmission line from Vavuniya to Mannar	**Loan No** : 2892-SRI/ 2893-SRI **Investment/ Donor:** ADB & CEB **Loan amount:** 34.52 US $ Million **Loan closing date:** 30.06.2017 **Contract Period:** 2 years	Concurrence of ADB and SCAPC for the bidding document is pending.	May 2016
12.2	**Package 2-Construction of 132kV Transmission Infrastructure**	**Loan No** : 2892-SRI **Investment/ Donor:** ADB & CEB **Loan amount:** 28.85 US$ Million		
	Lot A			
12.2.1. **12.2.2.** **12.2.3.**	Construction of Kegalle grid substation with 2x31.5 MVA, 132/33 kV transformers, 132kV single busbar arrangement including bus section, 33kV single busbar arrangement including bus section, 2x132 kV single busbar transmission line bays, 2x132kV single busbar transformer bays, 8x33 kV feeder bays, 2x33kV transformer bays Installation of 15 MVAr (3x5MVAr) capacitor banks including 33kV BSC bays at Kegalle33kV Bus Bar to control load PF Augmentation of Thulhiriya grid substation with 2x132 kV single busbar transmission line bays		SCAPC approval for draft bidding documents is to be received.	2016

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commissioning Year
	Lot B			
12.2.4. **12.2.5.** **12.2.6.** **12.2.7.** **12.2.8.** **12.2.9.** **12.2.10.**	30MVAr at Biyagama 33kVbusbar (7x5MVArinclu. BSC bays) 35MVAr at Sapugaskanda33kVbusbar (10x5MVArinclu. BSC bays) 20 MVAr at Kolonnawa-new 33kVbusbar (6x5MVArinclu. BSC bays) 20 MVar at Kolonawa-old 33kVbusbar (6x5MVArinclu. BSC bays) 15 MVar at Horana 33kV busbar (3x5MVArinclu. BSC bays) 20 MVar at Pannala 33kV busbar (4x5MVArinclu. BSC bays) 20 MVar at Bolawatta 33kV busbar (4x5MVArinclu. BSC bays)		CAPC approval for draft bidding documents is to be received. ADB concurrence is awaited for revised schedule of BSCs.	2016
	Lot C			
12.2.11. **12.2.12.** **12.2.13.** **12.2.14.**	Construction of 22.5 km, double circuit, Zebra, 132kV transmission line from Thulhiriya to Kegalle Construction of 10km, double circuit, 2xZebra, 132kV transmission line from Polpitiya to New Polpitiya, Construction of 10 km, double circuit, 2xZebra, 132kV transmission line from Athurugiriya to Padukka Construction of 15 km, double circuit, 2xZebra, 132kV transmission line from Athurugiriya to Kolonnawa		Draft bidding documents sent for ADB concurrence.	2016

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commiss ioning Year
12.3	**Package 3- Construction of 220kV transmission infrastructure**	**Loan No** : 2892-SRI **Investment/ Donor:** ADB **Loan amount:** 53.48 US $ million **Loan closing date:** 30.06.2017		December 2016
	LOT A			
12.3.1.	Construction of New Polpitiya grid substation with 2x250MVA 220/132kV transformers, 220kV double busbar arrangement including bus coupler, 132kV single busbar arrangement including bus section, 2x220kV double busbar transformer bays, 4x220kV double busbar transmission line bays, 2x132kV double busbar transformer bays and 2x132kV double busbar transmission line bays, Provision for 2x220kV double busbar transmission line bays to connect New-Polpitiya-Hambantota(via Embilipitiya) 220kV transmission line		SCAPC approval and ADB concurrence received for the bidding document	
12.3.2.	Construction of Padukka Grid Substation with 2x250 MVA,220/132/33 kV transformers, 220kV double busbar including bus coupler, 132kV double busbar including bus coupler, 33kV single busbar arrangement, with 4x220kVdouble busbar transmission line bays, 2x220kV double busbar transformer bays, 2x132kV double busbar transformer bays ,2x132kV double busbar transmission line bays, [Provision for 2x220kV double busbar transmission line bays to connect Kirindiwela-Padukka 220kV transmission line, 100MVar capacitor banks at 132kVbusbar and 2x45MVA, 132/33 kV transformers, 33kV single busbar arrangement including bus section, 2x132kV double busbar transformer bays, 12x33 kV feeder bays, 2x33kV transformer bays]		.	

	Pro ect Description	Loan and Contract Details	Progress (As at August 2013)	Commiss ioning Year
12.3.3.	Augmentation of Pannipitiya grid substation with 2x220kV double busbar transmission line bays			
	LOT B			
12.3.4.	Construction of New Polpitiya - Pannipitiya, 2xZebra, 220kV, 58.5km, double circuit transmission line through Padukka		CAPC approval received for bidding documents and sent for ADB concurrence	
13	**Kelaniya-Vavuniya Augmentation Pro ect**			
13.1	**Part 1: Vavuniya Grid Substation Augmentation Pro ect** Augmentation of Vavuniya Grid Substation Automation system and Procurement of Essential spares for Northern Transmission system	**Loan No** : SL-P83 SL-P102 **Investment/ Donor:** JICA **Loan amount:** 1278 MJPY 1422 MJPY LKR 536M will be utilized out of these two loans as savings	ERD & JICA concurrence is received for the proposed work at Vavuniya Grid Substation	
13.2	**Part 2: Kelaniya Grid Substation Augmentation Pro ect**			
	Augmentation of Kelaniya GS (1x31.5MVA to 2x31.5 MVA, 1x132kV double bus bar transformer bay, 1x33kV transformer bay, 4x33kV feeder bays and 1x33kV bus section bay including all control & protection schemes) Installation of 20MVAr Capacitor bank at 33kV bus bar (including 4x5MVAr BSC bays) to control load power factor	**Loan No** : 2518/2519 (SF) - SRI **Investment/ Donor:** ADB **Loan amount:** LKR 365.9M	Preparation of Bidding documents for Kelaniya Augmentation works is in progress	

Table 5.2: Uncommitted Transmission Development Pro ects

	Description	Commiss. Year	Base Cost (ML K R)	
			F.C.	L.C.
1	Construction of Kerawalapitiya 220/33kV GSS(2x45MVA 220/33kV TF, 2x33kV GIS TF bay, 12x33kV GIS feeder bays and 33kV GIS SB arrangement including bus section) *Existing 220kV bays at Kerawalapitiya PS used to connect transformers	2017	908	159
2	Construction of Kappalturai 220(132)/33kV GSS(2x60MVA, 2x132kV SB TF bays, 4x132kV SB TL bays, 1x132kV bus section bay including SB arrangement, 2x33kV TF bays, 16x33kV feeder bays and 1x33kV bus section bay including 33kV SB arrangement) a) Construction of double in and out connection from New Anuradhapura-Trincomalee 132kV TL to connect Kappalthurai GS, Zebra, double circuit ,1km * Transfomers are initially operated at 132/33kV and later upgrate to 220/33kV operation.	2017	1,389	228
3	Augmentation of Trincomalee 132/33 kV grid substation a) Replace of 132kV switchgear protection, control & auxiliary equipment, 132kV transmission line bay and 132kV bus with a bus section for parallel operation of Anuradhapura – Trincomalee transmission line	2017	120	14
4	Augmentation of Old Anuradhapura 132/33kV GSS(3x31.5MVA 132/33kV TF, 3x132kV SB TF bays, 2x132kV SB TL bays , 132kV SB arrangement including bus section, 3x33kV TF bays, 12x33kV feeder bays, 33kV SB arrangement including 2x33kV bus sections) a) Construction of 2x132kV SB TL bay at New Anuradhapura GS (To connect Puttalam-New Anuradhapura 132kV 2cct TL) b) Construction of 132kV, Zebra, 2km , double circuit transmission line to connect Puttalam-New Anuradhapura 132kV transmission line	2017	1,142	199
5	Mannar - Nadukuda Transmission Development a) Construction of Nadukuda 220(132)/33kV GSS(4x60MVA, 4x132kV isolators, 12x132kV CTs, 4x33kV TF bays, 12x33kV Generator bays and 2x33kV bus section bay including 33kV SB arrangement) * Transfomers are initially operated at 132/33kV and later upgrade to 220/33kV operation. *Provision for two transformers and four 33kV feederbays and 220kV GIS b) Mannar - Nadukuda 220kV (132kV operation), 30km AAAC (equivalent to Zebra) double circuit transmission line	2017	2,717	665

	Description	Commiss. Year	Base Cost (ML K R)	
			F.C.	L.C.
6	Augmentation of grid substations - (Kotugoda, Biyagama, Kolonnawa) a) Augmentation of Kotugoda SS Replace of 132kV circuit breakers,132kV isolaters, 132kV protection & control panels, Battery system, AVRs and extend of SAS with IEDs b) Augmentation of Biyagama GSS Construction of Biyagama 33kV GIS system (2x33kV TF bays, 8x33kV feeder bays ,1x33kV Bus section bays including Bus bar) and Construction of new control building c) Augmentation of Kolonnawa Stanly GSS Construction of Kolonnawa -Old 33kV GIS system (2x33kV TF bays, 8x33kV feeder bays ,1x33kV Bus section bays including Bus bar) and Construction of new control building	2017	963	133
7	Construction of New Polpitiya-Hambantota(Via Embilipitiya) Transmission line with Hambantota GSS 220kV development a) New Polpitiya - Hambantota(Via Embilipitiya) 2*Zebara, 220kV, 150km double cct. TL b) Upgrade Hambantota GSS (2x250MVA, 220/132kV TF, 220kV DB arrangement including bus coupler, 2x220kV DB TF bays, 2x220kV DB TL bays and 2x132kV DB TF bays) c) New Polpitiya GSS (2x220kV DB TL bays)	2017	7,362	2,614
8	Construction of Chemmany 132/33kV GSS(2x31.5MVA 132/33kV TF, 2x132kV SB TF bays, 2x132kV SB TL bays, 132kV SB arrangement including bus section , 2x 33kV TF bays, 12x33 kV feeder bays, 1x33kV SB arrangement including bus section) Provision for 3rd Transformer a) Single in & out connection from Kilinochchi - Chunnakam 132kV TL, Zebra, double circuit , 10km b) *Provision for 31.5 MVA transformer	2017	1,070	254
9	Re-construction of Polpitiya – New Habarana 132kV , Zebra, 164 km, double circuit transmission line *- Existing TL bays use with equipment replacement	2017	3,225	1,724
10	Construction of Kotmale – New Polpitiya, 2Zebara, 220kV, 23km double cct. TL a) Kotmale PS (2x220kV , one-and-half breaker line bays)	2017	1,042	372
11	Construction of Kirindiwela GSS (2x150MVA 220/132kV Inter bus TF, 220kV DB arrangement including bus coupler, 132kV DB arrangement including bus coupler, 2x220kV DB TF bays, 8x220kV DB TL bays, 2x132kV DB TF bays,2x132kV DB TL bays) a) Construction of Kirindiwela 220/33kV GSS(2x45MVA 220/33kV TF, 2x220kV DB TF bays, 2x33kV TF bays, 12x33kV feeder bays, 1x33kV SB arrangement including bus section)	2017	3,311	588

	Description	Commiss. Year	Base Cost (ML K R)	
			F.C.	L.C.
	b) Double in & out connection from Biyagama- Kotmale 220kV TL to connect Kirindiwela GS & Modification of existing 220kV protection and control facilities at Biyagama and Kotmale GSS. c) Kirindiwela – Kosgama, Zebra, 132kV, 10km, double cct. TL d) Construction of 2x132kV SB TL bay,132kV bus section bay and rehabilitation work at Kosgama GS & Construction of 132kV bus section bay at Seethawaka GS * -Existing Lynx, 132kV double cct. line between Kosgama GS and Seethawake GS use to feed Seethawaka GS from Kosgama GS *-Provision for 2x220 DB TL bays at Kirindiwela GSS			
12	Construction of Veyangoda- Kirindiwela-Padukka 2Zebra, 220kV ,38km double circuit TL a) Veyangoda GSS (2x220kV DB TL bays) b) Padukka GSS (2x220kV DB TL bays)	2017	1,723	608
13	Construction of Veyangoda -Thulhiriya -, 2* Zebra, 132kV, 28km, double cct. TL a) *-Veyangoda existing 2x132kV DB TL bays used (former Kotugoda-Veyangoda 132kV line) *- Thulhiriya existing 2x132kV Lynx SB TL bays used with equipment replacement	2017	726	352
14	Construction of Battaramulla 132/33kV GSS (2x31.5 MVA, 132/33kV TF, 2x132kV SB TF bays, 4x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bays, 8x33kV feeder bays and 1x33kV SB arrangement including bus section) a) Double in & out connection from Kolonnawa-Athurugiriya 132kV TL, 2xZebra,1km	2017	1,195	168
	b) Modification to existing 132kV protection and control facilities at Kolonnawa and Athurugiriya GSS			
15	Reconstruction of Pannipitiya- Kolonnawa ,13km,132kV Zebra, double circuit transmission line	2017	256	137
16	Construction of Nawalapitiya 132/33kV GSS(2x31.5MVA 132/33kV TF, 2x132kV SB TF bays, 2x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bays, 8x33kV feeder bays and 1x33kV SB arrangement including bus section) a) Single in & out connection from Polpitiya -Kiribathkumbura 132kV TL, Zebra,7km	2017	946	223
17	Construction of Ragala 132/33kV GSS (2x31.5 MVA 132/33kV TF, 2x132kV SB TF bays, 2x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bays, 8x33kV feeder bays and 1x33kV SB arrangement including bus section)	2017	1,239	354

	Description	Commiss. Year	Base Cost (ML K R)	
			F.C.	L.C.
	a) Construction of Nuwaraeliya – Ragala 132kV Zebra, 2cct, 19km TL b) Construction of 2x132kV SB TL bay at Nuwaraeliya GS			
18	Construction of Maliboda 132/33kV GSS (1x31.5 MVA TF, 1x132kV SB TF bay, 2x132kV SB TL bays, 132kV SB arrangement including bus section, 1x33kV TF bay and 4x33kV feeder bays) a) Construction of New Polpitiya - Maliboda 132kV Zebra, 2cct, 12km TL b) Construction of 2x132kV DB TL bay at New Polpitiya GS	2017	893	268
19	Construction of Wewalwatta 132/33kV GSS (2x31.5 MVA TF, 2x132kV SB TF bay, 2x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bay and 8x33kV feeder bays and 1x33kV SB arrangement including bus section) a) Single in & out connection from Balangoda - Ratnapura 132kV TL, Zebra, 2cct,0.5km	2017	818	157
20	Construction of Padukka 220/33kV GSS(2x45MVA 220/33kV TF, 2x220kV DB TF bays, 2x33kV TF bays, 12x33kV feeder bays, 1x33kV SB arrangement including bus section) *-It is assumed that the Padukka 220/33kV SS located at the same premises of Padukka 220/132kV GSS.	2017	1,016	169
21	Augmentation of Katunayaka GSS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2017	289	38
22	Construction of Kalutara 132/33kV GSS(2x31.5MVA 132/33kV TF, 2x132kV SB TF bays, 2x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bays, 8x33kV feeder bays and 1x33kV SB arrangement including bus section) a) Single in & out connection from Panadura – Matugama 132kV TL, Zebra,2cct,6km	2017	926	213
23	Augmentation of Madampe Grid Substation (2x31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2017	286	38
24	Construction of Port City-1 220/33kV GSS (2x45MVA, 220/33kV indoor TF, 2x220kV indoor DB TF bays, 2x220kV DB indoor cable bays, 1x220kV indoor bus coupler bay with DB arrangement, 2x33kV indoor SB TF bays, 8x33kV indoor cable bays and 1X33kV indoor bus section bays with SB arrangement) a) Augmentation of Port 220/132kV GS (2x220kV DB indoor cable bay) b) Construct 220kV, Cu (XLPE) 500mm2, 1km double cable between Port 220/132kV GSS and Port City-1 220/33kV	2017	1,868	218

	Description	Commiss. Year	Base Cost (ML K R)	
			F.C.	L.C.
25	Construction of Port City-2 220/33kV GSS (2x45MVA, 220/33kV indoor TF, 2x220kV indoor DB TF bays, 2x33kV indoor SB TF bays, 8x33kV indoor cable bays and 1X33kV indoor bus section bays with SB arrangement) *- Connected to Ocean City-1 220kV Bus bar	2017	1,404	181
26	Capacity enhancement of Samanalawewa – Embilipitiya, Lynx 132kV, 38 km, double circuit transmission line to Zebra a) Samanalawewa – Embilipitiya, Zebra, 132kV, 38 km, double circuit transmission line *Existing TL bays use with equipment replacement b) Construction of Embilipitiya 33kV GIS system (2x33kV TF bays, 8x33kV feeder bays ,1x33kV Bus section bays including Bus bar)	2017	954	404
27	Construction of Eluwankulama 132/33kV GSS (1x31.5MVA 132/33kV TF, 2x132kV SB TL bays, 1x132kV SB TF bay, 132kV SB arrangement including bus section ,1x33kV TF bay and 2x33kV feeder bays) a) Single in-and-out connection from Puttalam – Anuradhapura 132kV TL ,Zebra, 2cct, 26km	2017	1,050	389
28	Augmentation of Kukule GS (10 MVA to 31.5 MVA, 1x132kV TF bay, 1x33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2017	286	38
29	Construction of Colombo K 132/11kV GS (2x45MVA 132/11kV indoor TF,2x132kV indoor SB TF bays, 2x11kV indoor SB TF bays, 18x 11kV indoor cable bays ,2x 132kV SB indoor cable bays, 1x132kV indoor bus section bay with SB arrangement and 1X11kV indoor bus section bays with SB arrangement) a) Augmentation of Pannipitiya GS (1x132kV DB line bay) b) Construct 132kV, Cu (XLPE) 800mm2, 6.5km cable between Colombo E and Colombo K GSS. c) Construct 132kV, Cu (XLPE) 1200mm2, 14.1km cable between Colombo K and Pannipitiya GSS * Existing cable bay at Colombo E (Connected to Kolonnawa) used for Colombo K connection.	2017	3,346	292
30	Construction of Hambantota Port 132/33kV GSS(2x31.5MVA, 132/33kV TF, 2x132kV indoor SB TF bays, 2x132kV SB indoor line bays, 1x132kV indoor bus section including SB arrangement, 2x33kV indoor SB TF bays, 12x33kV indoor cable bays and 1X33kV indoor bus section bays with SB arrangement) Provision for 3rd Transformer a) Construction of Hambantota- Hambantota Port 132kV Zebra, 2cct, 10km TL b) Construction of 2x132kV DB TL bay at Hambantota GS	2017	1,327	266

	Description	Commiss. Year	Base Cost (ML K R)	
			F.C.	L.C.
31	Installation of 20MVAr capacitor bank in Hambanthota GS at 33kV Bus Bar including 33kV BSC bays to control voltage at 132kV level	2017	29	2
32	Construction of Kesbewa 132/33kV GSS (2x31.5 MVA 132/33kV TF, 2x132kV SB TF bays, 2x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bays, 8x33kV feeder bays and 1x33kV SB arrangement including bus section) a) Single in-and-out connection from Pannipitiya -Matugama 132kV TL b) Reconstruction of Pannipitiya-Panadura T 12.3km 132kV Zebra TL	2018	1,070	292
33	Construction of Wellawaya 132/33kV GSS (2x31.5 MVA 132/33kV TF, 2x132kV SB TF bays,2x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bays, 8x33kV feeder bays and 1x33kV SB arrangement including bus section) a) Construction of 2x132kV DB TL bay at Uma Oya GS b) Construction of Uma Oya-Wellawaya 132kV Zebra, double circuit, 1km TL	2018	887	174
34	Vavunia GS 220kV Development (220/132kV 2x250MVA TF, 220kV DB arrangement including bus coupler, 2x220kV DB TF bays, 2x220kV DB TL bays and 2x132kV DB TF bays) a) Construction of 2x220kV DB TL bays at New Anuradhapura GSS b) 220kV operation of Vavunia - New Anuradhapura 2*Zebra transmission line	2018	1,497	256
35	Construction of Victoria –Randenigala, 2*Zebra , 16.4km ,220kV single circuit transmission line a) Construction of Victoria –Randenigala, 2*Zebra , 16.4km ,220kV single circuit transmission line b) Construction of 1x220kV one-and-half breaker TL bays at Victoria GSS c) Construction of 1x220kV SB TL bay including bus section at Randenigala GSS	2018	650	195
36	Capacity enhancement of Pannipitiya-Rathmalana 132kV, Lynx 7km, double circuit transmission line to Zebra a) Pannipitiya-Rathmalana 7km Zebra TL b) Augmentation of Ratmalana SS Replace 132kV circuit breakers, 132kV isolaters, 132kV protection & control panels, 33kV isolaters and SAS c) Augmentation of Pannipitiya SS Replace 132kV circuit breakers, 132kV protection & control panels, 132kV CVTs	2018	652	125

	Description	Commiss. Year	Base Cost (ML K R)	
			F.C.	L.C.
37	Capacity enhancement of 132kV Lynx transmission lines to Zebra - Package I a) New Laxapana-Balangoda 44km Lynx TL b) New Laxapana-Polpitiya 8.3km Lynx TL c) Laxapana-Polpitiya 8.3km Lynx TL d) Laxapana- New Laxapana 0.6km Lynx TL e) Wimalasurendra-Laxapana 5.1km Lynx TL	2018	1,311	701
38	Capacity enhancement of 132kV, Lynx transmission lines to Zebra - Package II a) Puttlam-New Chilaw 61km Lynx TL b) New Chilaw - Bolawatta 23km Lynx TL c) Rehabilitatin of Puttalam GSS Expansion of control building d) Rehabilitatin of Bolawatta GSS Replace 132/33kV 31.5MVA transformer, 132kV transformer bays and 33kV transformer bays	2018	1,846	926
39	Second circuit stringing of Habarana-Valachchenai, Zebra, 100km 132kV transmission line	2018	356	13
40	Construction of Tissamaharama 132/33kV GSS (2x31.5 MVA 132/33kV TF, 2x132kV SB TF bays, 2x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bays, 8x33kV feeder bays and 1x33kV SB arrangement including bus section) a) Construction of Hambantota-Tissamaharama 132kV Zebra, 2cct, 22km TL b) Construction of 2x132kV DB TL bay at Hambantota 132/33kV GS	2018	1,300	385
41	Augmentation of Aniyakanda GSS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2018	289	38
42	Construction of Akkaraipattu 132/33kV GSS (2x31.5 MVA 132/33kV TF, 2x132kV SB TF bays, 2x132kV SB TL bays, 132kV SB arrangement including bus section, 2x33kV TF bays, 8x33kV feeder bays and 1x33kV SB arrangement) a) Construction of Ampara-Akkaraipattu 132kV Zebra, 2cct, 25km TL b) Construction of 2x132kV SB TL bay at Ampara 132/33kV GS	2020	1,357	414
43	Construction of Colombo P GSS (2x 45 MVA, 2x132kV SB GIS TF bay, 1x132kV GIS bus section bay,3x 33kV GIS TF bay, 8x11kV GIS feeder bays and 1x33kV GIS bus section bay)	2020	938	141
44	Augmentation of Pannala GSS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2020	289	38

	Description	Commiss. Year	Base Cost (ML K R)	
			F.C.	L.C.
45	Kappalturei 220kV Development a) Kappalturai 220/33 GS(2x220kV DB TF bays, 2x220kV DB TL bays, 220kV DB arrangement inclu. bus coupler) b) Construction of Sampoor SS to Kappalturai GS 45km, 2*Zebra, 220kV double circuit transmission line	2020	2,356	848
46	Augmentation of Colombo B GSS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB GIS TF bay, 1x 11kV GIS TF bay, 4x11kV GIS feeder bays and 1x11kV GIS bus section bay) a) Install 20Mvar capacitor banks at 33kV BB (4x5MVar)	2021	422	59
47	Augmentation of Pallekele GSS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2021	286	38
48	Capacity enhancement of Badulla-Inginiyagala-Ampara Qriole, 132kV ,105 km single circuit TL to Zebra	2022	1,632	839
49	Augmentation of Chunnakam GSS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2022	286	38
50	Augmentation of Dehiwala GSS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2022	340	46
51	Augmentation of Athurugiriya GSS (2x 31.5 MVA to 3x31.5 MVA, 1x132kV SB TF bay, 1x 33kV TF bay, 4x33kV feeder bays and 1x33kV bus section bay)	2022	286	38
52	Capacity enhancement of New Anuradhapura-Anuradhapura Lynx , 132kV ,1.5 km double circuit TL to Zebra	2022	29	16
53	Capacity enhancement of Balangoda-Deniyaya Tiger,132kV ,44 km double circuit TL to Zebra	2022	865	463
TOTAL			**62,770**	**17,546**

Table 5.3 Power Plant Connection Proposals

	Description	Commiss. Year	Base Cost (MLKR)	
			F.C.	L.C.
	Committed Pro ects			
1	**Power transmission facilities related to Puttlam Coal Power Power plant phase II** a) Puttlam PS (2x220kV GIS DB TL bays) b) New Chilaw SS (2x250MVA 220/132kVTF,220kV DB arrangement inclu. bus coupler, 132kV DB arrangement inclu. bus coupler, 2x220kV DB TF bays,4x220kV DB TL bays,2x132kV DB TF bays and 6x132kV DB TL bays) c) New Anuradhapura GSS (2x220kV DB TL bays) d) Construction of Puttlam PS – New Anuradhapura GSS, AAAC-400, 220kV, 100km doubles cct. TL	**2014**	**5,315**	**2,745**
2	**Power transmission facilities related to Broadlands 35MW hydro PS** a) Broadlands PS (132kV SB arrangement, 1x132kV SB TL bay) b) New Polpitiya SS (1x132kV SB TL bay) c) Construction of Broadland PS – New Polpitiya SS, Lynx, 132kV, 5km single cct. TL	**2015**	**215**	**62**
3	**Power transmission facilities related to Umaoya120MW hydro PS** a) Umaoya PS (132kV DB arrangement, 2x132kV SB TL bay) b) Badulla GSS (2x132kV DB TL bay) c) Construction of Umaoya PS – Badulla GSS, Zebra, 132kV, 5km double cct. TL	**2015**	**536**	**231**
	TOTAL		**6,066**	**3,038**
	Uncommitted Pro ects			
1	**Power transmission facilities related to Kelanitissa75MW GT** a) Kelanitissa PS (132kV DB U connection TF bay and 132kV BB extension)	**2015**	**140**	**3**
2	**Power transmission facilities related to Kerawalapitiya105MW GT** a) KerawalaitiyaGS (220kV DB GIS TF bay and 220kV BB extension)	**2015**	**196**	**9**
3	**Power transmission facilities related to Kerawalapitiya105MW GT** a) KerawalaitiyaGS (220kV DB GIS TF bay and 220kV BB extension)	**2017**	**196**	**9**
4	**Power transmission facilities related to Moragolla27MW Hydro PS** a) Moragolla PS (132kV SB arrangement, 2x132kV SB TL bays) b) Single in and out connection Polpitiya- Kiribathkumbura132kV TL	**2018**	**179**	**34**

5	**Power transmission facilities related to Trincomalee 2x250+300MW coal PS** **Phase I - (for 2x250MW generating units)** a) Sampoor PS (220kV 1 1/2 bus arrangement inclu. bus coupler, 6x220kV 1 1/2 bus TL bays) b) Construction of Sampoor PS to New Habarana SS 95km, 4*Zebra, 400kV double circuit transmission lines (220kV operation) c) Construction of Sampoor PS to Sampoor GS 1km, 2*Zebra, 220kV double circuit transmission line	**2018**	**11,292**	**2,468**
	Phase II - (for 1x300MW generating unit) a) Augmentation of New Habarana SS (2x800MVA, 400/220kV TF 400kV DB arrangement inclu. bus coupler, 2x400kV DB TF bays, 2x400kV DB TL bays,2x220kV DB TF bays) Provision for another 800MVA inter-bus to accommodate DC LINK) b) Sampoor SS (2x300MVA, 400/220kV TF 400kV 1 1/2 bus arrangement inclu. bus coupler, 3x400kV 1 1/2 bus TF bays,2x220kV 1 1/2 bus TF bays, 2x400kV 1 1/2 bus TL bays) Provision for another 300MVA inter-bus transformer with the load growth of 220kV side Provision for 2x400kV 1 1/2 bus TF bays with the2x300MW generator units	**2022**	**6,040**	**1,222**
6	**Power transmission facilities related to Akurana/Aturuwella 3x300MW coal PS** a) Ambalangoda PS (2x250MVA,400/132kV TF, 400kV DB arrangement including bus coupler, 2x400kV DB TL bays, 5x400kV DB TF bays,2x132kV TF bay,) b) Construction of Ambalangoda-Padukka, 75km, 4*Zebra, 400kV double circuit transmission line. c) Padukka (2x800MVA,400/220kV TF,400kV DB arrangement including bus coupler, 2x400kV DB TF bays, 2x400kV DB TL bays, 2x220kV DB TF bays)	**2018**	**12,797**	**2,853**
	TOTAL		**30,839**	**6,598**

Chapter 6
Investment Plan

This chapter focuses on investment requirement for the transmission network development for the period 2013-2022. The cost estimations for the identified projects are based on the cost database maintained by the Transmission Planning Branch of CEB and the year 2012 is taken as the base year for the prices /costs. Normal project completion period is taken as three years and the proportion of disbursement of project costs are assumed as 20%, 70% and 10% for the first, second and third years respectively. The conversion rate of 1US$ is taken as 129.59LKR.

6.1. Investment Plan for all Transmission Expansion Proposals

Table 6.1 shows the total investment requirement for all the transmission expansion proposals including power plant connection proposals and other transmission expansion proposals. Figure 6.1 illustrates the variation of total investment (including funds required and funds available) and funds required for the transmission expansion proposals from year 2013 to 2022.

Table 6.1 Total investment re uirement from year 2013 to 2022

Year	Foreign Cost		Local Cost		Total	
	Committed	Not committed	Committed	Not committed	Committed	Not committed
2013	18,084	67	4,777	2	22,860	70
2014	14,503	235	4,470	8	18,973	244
2015	19,544	8,832	5,340	2,296	24,884	11,128
2016	17,280	35,008	6,053	9,145	23,333	44,153
2017	2,183	19,205	797	5,055	2,980	24,260
2018	-	5,856	-	1,442	-	7,299
2019	-	12,586	-	3,029	-	15,615
2020	-	4,165	-	1,029	-	5,194
2021	-	6,706	-	1,872	-	8,578
2022	-	948	-	266	-	1,214
Grand Total	**71,594**	**93,610**	**21,436**	**24,144**	**93,030**	**117,754**

Note - All Costs are in MLKR

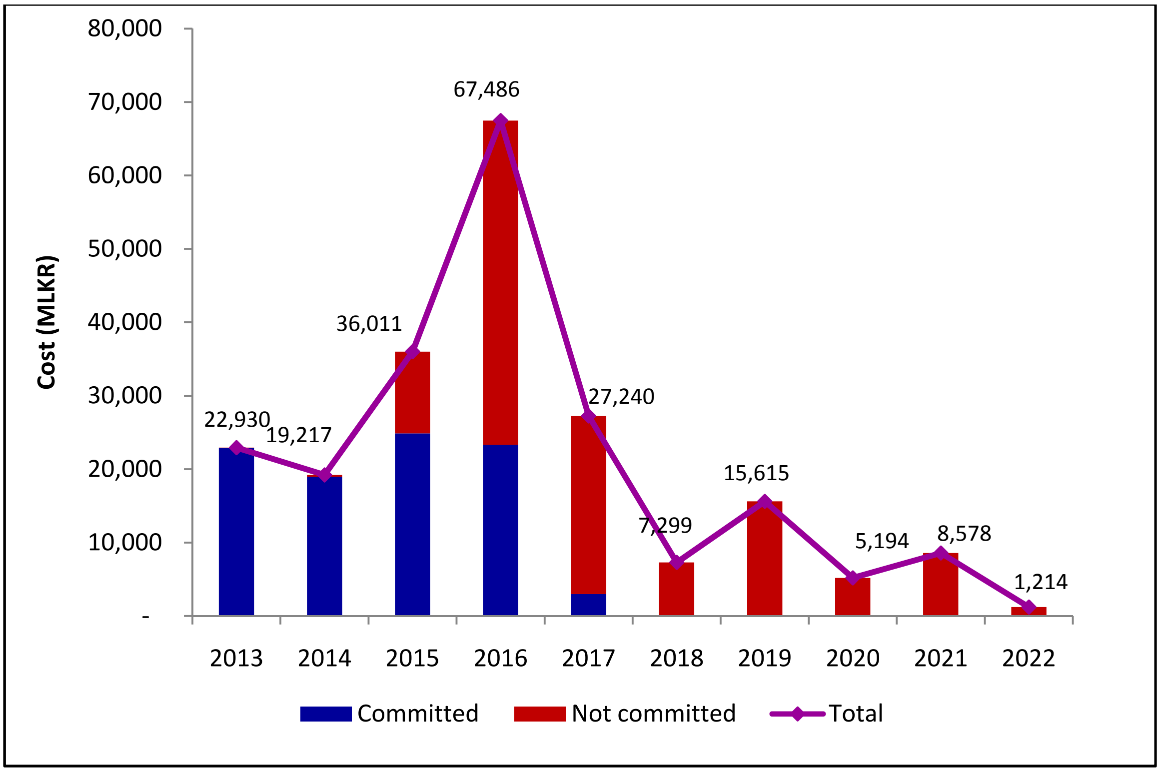


Figure 6.1 Disbursement of total transmission investment up to year 2022

6.2. Investment plan for transmission expansion proposals identified from system analysis

Table 6.2 shows the expected investment plan for the transmission development proposals identified from system analysis for the period from year 2013 to 2022 and which are uncommitted.

Table 6.2 Funds re uired for uncommitted transmission proposals identified from system analysis

Year	Foreign Cost	Local Cost	Total
2013	-	-	-
2014	-	-	-
2015	8,759	2,293	11,052
2016	32,577	8,638	41,215
2017	11,156	3,302	14,458
2018	2,150	622	2,772
2019	3,628	1,032	4,660
2020	1,677	499	2,177
2021	2,478	1,017	3,495
2022	344	144	488
Grand Total	**62,770**	**17,546**	**80,316**

Note - All Costs are in MLKR, No Escalation Costs are added

Figure 6.2 illustrates the investment requirement for the period from year 2013 to year 2022 for the implementation of these uncommitted transmission proposals. Table 6.3 shows the expected investment plan for the committed transmission development projects, which were identified from system analysis. Table 6.4 lists the total investment required for the transmission expansion proposals identified from system analysis.

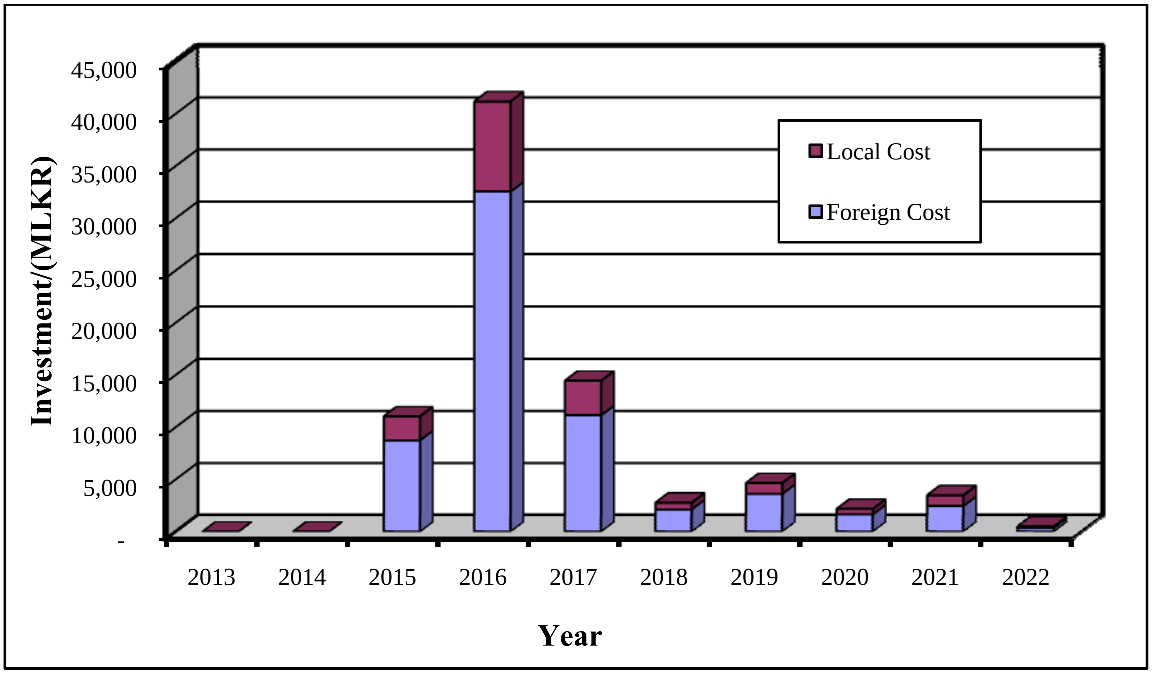


Figure 6.2 Estimated investments for financially uncommitted transmission development proposals identified from system analysis

Table 6.3 Investments for committed transmission pro ects identified from system analysis

Year	Foreign Cost	Local Cost	Total
2013	17,021	4,228	21,248
2014	10,632	2,490	13,122
2015	18,486	4,860	23,347
2016	17,205	6,023	23,229
2017	2,183	797	2,980
Grand Total	**65,528**	**18,398**	**83,926**

Note - All Costs are in MLKR, No Escalation Costs are added

Table 6.4 Total investment for transmission development proposals identified from system analysis

Year	Foreign Cost	Local Cost	Total
2013	17,021	4,228	21,248
2014	10,632	2,490	13,122
2015	27,246	7,153	34,399
2016	49,783	14,661	64,444
2017	13,339	4,099	17,438
2018	2,150	622	2,772
2019	3,628	1,032	4,660
2020	1,677	499	2,177
2021	2,478	1,017	3,495
2022	344	144	488
Grand Total	**128,299**	**35,944**	**164,243**

Note - All Costs are in MLKR, No Escalation Costs are added

6.3. Investment plan 2013 2022 for power plant connection proposals

Table 6.5 shows the expected investment plan for the uncommitted power plant connection proposals. Figure 6.3 illustrates the investment requirement for the period of year 2013 – 2022 for the implementation of these power plant connection proposals. Table 6.6 shows the expected investment plan for the committed power plant connection proposals. Table 6.7 gives the total investment for the power plant connection proposals.

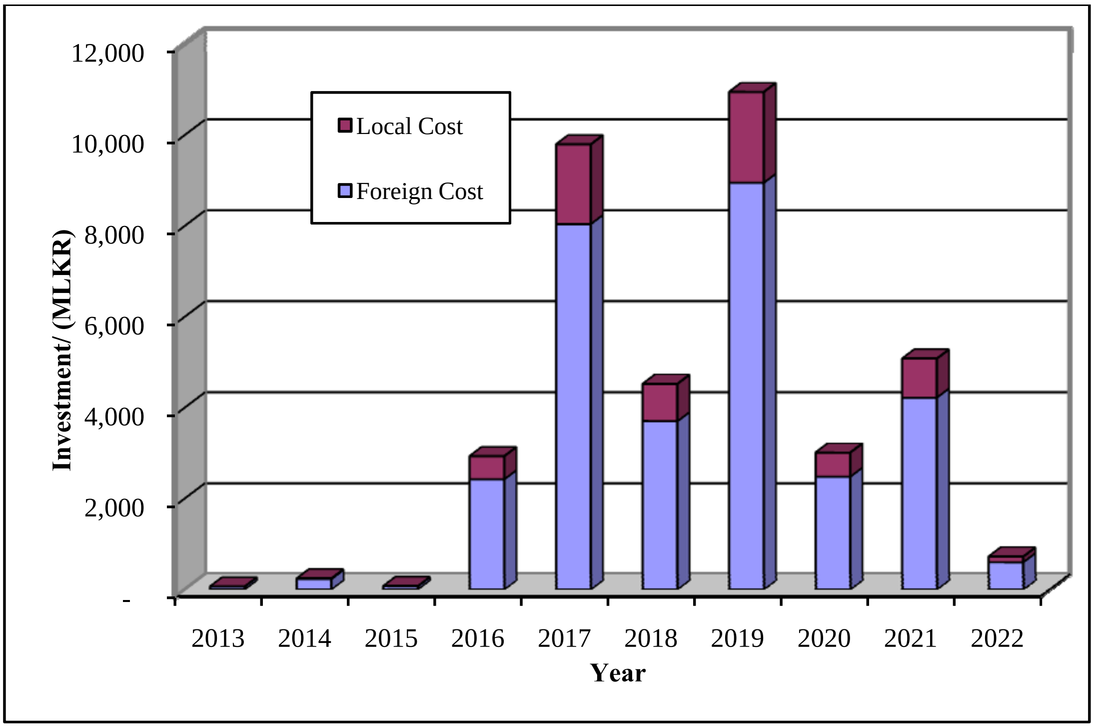


Figure 6.3 Estimated investment for financially uncomitted power plant connection proposals from year 2013 to 2022

Table 6.5 Funds re uired for uncommitted power plant connection from year 2013 to 2022

Year	Foreign Cost	Local Cost	Total
2013	67	2	70
2014	235	8	244
2015	73	3	76
2016	2,431	507	2,938
2017	8,049	1,752	9,802
2018	3,706	821	4,527
2019	8,958	1,997	10,955
2020	2,488	530	3,017
2021	4,228	855	5,083
2022	604	122	726
Grand Total	**30,839**	**6,598**	**37,437**

Note - All Costs are in MLKR, No Escalation Costs are added

Table 6.6 Investment for committed power plant connection pro ects

Year	Foreign Cost	Local Cost	Total
2013	1,063	549	1,612
2014	3,871	1,980	5,851
2015	1,057	480	1,537
2016	75	29	104
Grand Total	**6,066**	**3,038**	**9,104**

Note - All Costs are in MLKR, No Escalation Costs are added

Table 6.7 Total Investment for power plant connection proposals from year 2013 to 2022

Year	Foreign Cost	Local Cost	Total
2013	1,130	551	1,682
2014	4,106	1,989	6,094
2015	1,130	483	1,613
2016	2,506	536	3,042
2017	8,049	1,752	9,802
2018	3,706	821	4,527
2019	8,958	1,997	10,955
2020	2,488	530	3,017
2021	4,228	855	5,083
2022	604	122	726
Grand Total	**36,905**	**9,636**	**46,541**

Note - All Costs are in MLKR, No Escalation Costs are added

Chapter 7
Economic Evaluation

The implementation of transmission network proposals improves reliability, operational efficiency and increases the network capacity to cater for the anticipated growing load demand. Thus it is imperative to get every effort to implement the identified transmission proposals at the specified time. The delay in implementation of said proposals may lead to deteriorate the system reliability, high system losses and in adequate network capacity to cater for growing demand.

In this chapter it focuses on economic analysis of identified network proposal. Here, an incremental costing approach is used. The incremental costing approach deals with the incremental costs to meet the additional power and energy demand.

Table7.1 Evaluation of average incremental cost

Year	Demand MW 33/11kV	Incremental demand from prev. year (MW)	Discounted inc. demand	Investment cost MLKR			
				Transmission Developments (MLKR)	Power Plant Connections (MLKR)	Discounted Transmission Developments (MLKR)	Discounted Power Plant Connections (MLKR)
2012	2146						
2013	2445.8	300	300	21,248	1,682	21,248	1,682
2014	2631.3	186	169	13,122	6,094	11,929	5,540
2015	2830.2	199	164	34,399	1,613	28,429	1,333
2016	2950.2	120	90	64,444	3,042	48,418	2,286
2017	3134.5	184	126	17,438	9,802	11,911	6,695
2018	3336.6	202	125	2,772	4,527	1,721	2,811
2019	3508.8	172	97	4,660	10,955	2,631	6,184
2020	3680.2	171	88	2,177	3,017	1,117	1,548
2021	3872.4	192	90	3,495	5,083	1,630	2,371
2022	4077.7	205	87	488	726	207	308
Discounted Inv. Cost 2013-2022						***129,240***	***30,758***
Discounted Inv. Demand 2014-2022			1036				
Average Incremental Cost		Rs/kW				***124,698***	***29,677***
		Rs/kW/Year				***11,592***	***2,759***

*Investment cost does not include taxes and duties

A time slice of transmission expansion program for the period 2013 – 2022 has been analyzed to determine the average incremental capacity cost due to the transmission development proposals. The lifetime of transmission developments are assumed to be around 40 years.

The incremental investment should not include the replacement costs, for example, in the case of reconstruction of economic life time exceeded lines, only the investment attributed to capacity expansion were considered.

Discount rates of 10% were used for the analysis and the average incremental cost of capacity was shown in LKR/kW of incremental demand/year.

As shown in Table 7.1, the transmission capacity cost is estimated to be **11,592 LKR/kW/year** when only the investment of transmission development proposals is considered. The same is estimated to be **14,351 LKR/kW/year** when both investment of transmission development proposals and power plant connection proposals are considered.

Chapter 8
Implementation of Transmission Plan

Transmission Division of the Ceylon Electricity Board is responsible for the implementation of transmission development proposals.

The total estimated investment required to complete all the financially uncommitted projects included in the Long Term Transmission Development Plan 2013-2022 is shown in Fig. 8.1.

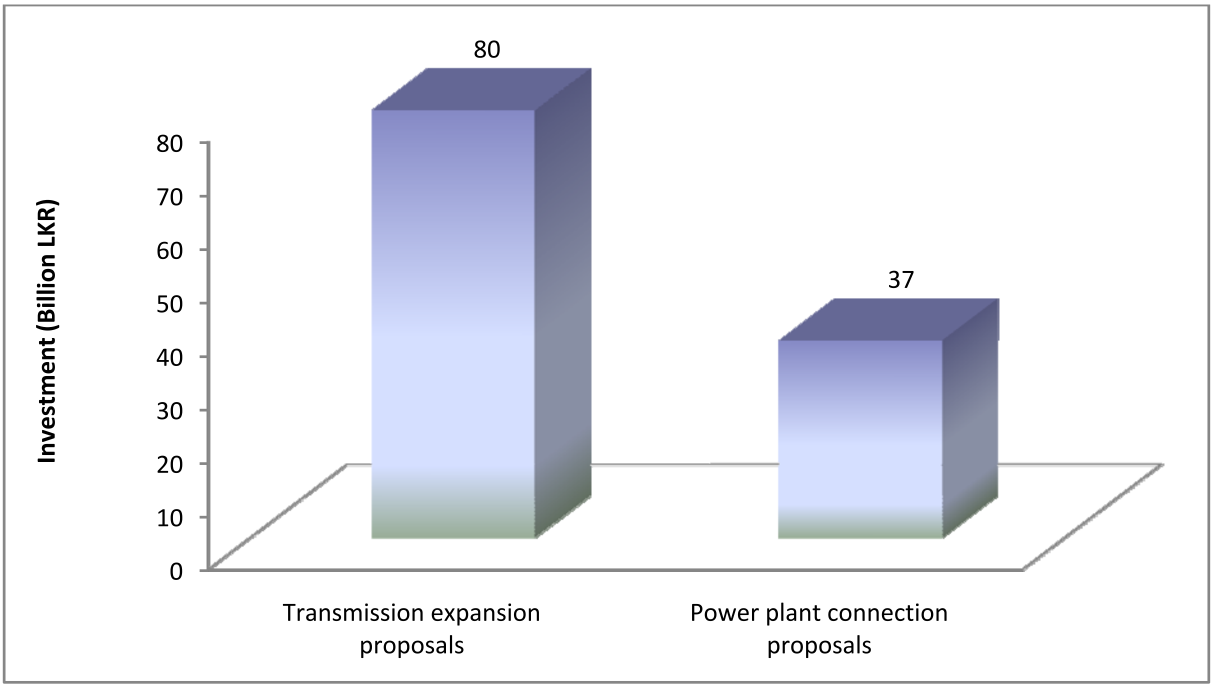


Figure 8.1 Total estimated investment re uired to complete all the financially uncommitted pro ects

8.1.Implementation of a transmission pro ect

Figure 8.1 illustrates the steps involved in the implementation of a transmission project. Normal procedure in the implementation of a transmission project is further elaborated as follows.

Step 01 Preparation of Transmission Plan for 10 years by reviewing the Transmission Master Plan which was prepared for 20 years and by developing the transmission network for 2032. Then the board approval is taken for the plan.

Step 02 Prioritizing the projects for next six years for Public Investment Program (PIP) from Transmission Plan and forwarding to Department of National Planning through the Ministry of Power and Energy.

Step 03 Carrying out conceptual design and technical justification of the projects, and land acquisition, preliminary survey, EIA clearance, etc, if feasible.

Step 04 Arranging Board funds for implementation of projects which are urgent, but difficult to find funding agencies.

Step 05 Formulation of projects for different funding agencies depending on the priority and maturity of the project as well as the fund allocation, loan conditions of the funding agencies and request of Department of External Resources (DER).

Step 06 Preparation of feasibility study reports and project proposals and submitting to Ministry of Power and Energy for National Planning approval. After National Planning approval, DER forwards them to different funding agencies through foreign embassies.

Step 07 Collection of data related to the forwarded projects by fact finding missions of funding agencies.

Step 08 Appraisal of the projects by the corresponding funding agencies and signing of minutes of discussion held among Chairman CEB, General Manager CEB, Secretary to Ministry of power and energy, Secretary to Ministry of finance and funding agency.

Step 09 Obtaining approval of relevant funding agencies and the Government of funding agencies for financial assistance, and receiving the message of intimation through DER.

Step 10 Obtaining the approval of the Board of Directors of CEB and the Cabinet for the implementation of the project.

Step 11 Appointing a project manager, Technical Evaluation Committee (TEC) and Cabinet Appointed Tender Board (CATB).

Step 12 Conducting financial negotiations between funding agencies and the Government of Sri Lanka by DER.

Step 13 Signing of loan agreement and subsidiary loan agreement between Government of Sri Lanka and CEB.

Step 14 Selection of consultants.

Step 15 Preparation of draft tender documents by CEB.

Step 16 Reviewing and finalizing the tender document by consultants.

Step 17 Obtaining approval of funding agency and the CATB for the tender document.

Step 18 Invitation of bids for the implementation of the project.

Step 19 Evaluation of bids and selection of a contractor.

Step 20 Obtaining approval of funding agency, the CATB and the Cabinet for award of the contract.

Step 21 Bid negotiation and award.

Step 22 Implementation of the project. This step includes design checking, manufacturing of equipment, delivery, civil works, erection, commissioning and takeover of the project.

8.2. Environmental considerations

In terms of National Environmental Act No. 47 of 1980 amended by the Act No. 56 of 1988, Ceylon Electricity Board should obtain approval from project approving agency for the construction of transmission lines with length over 10 km and voltage above 50 kV and for those located in environmentally sensitive areas.

The Transmission Division of Ceylon Electricity Board is responsible for carrying out Initial Environmental Impact Examination (IEE) for transmission projects. This process involves identification of environmental impacts of different alternative routes, evaluation of environmental impacts identified, proposing counter measures for significant environmental impacts, consultation of relevant agencies and produce reports on IEE.

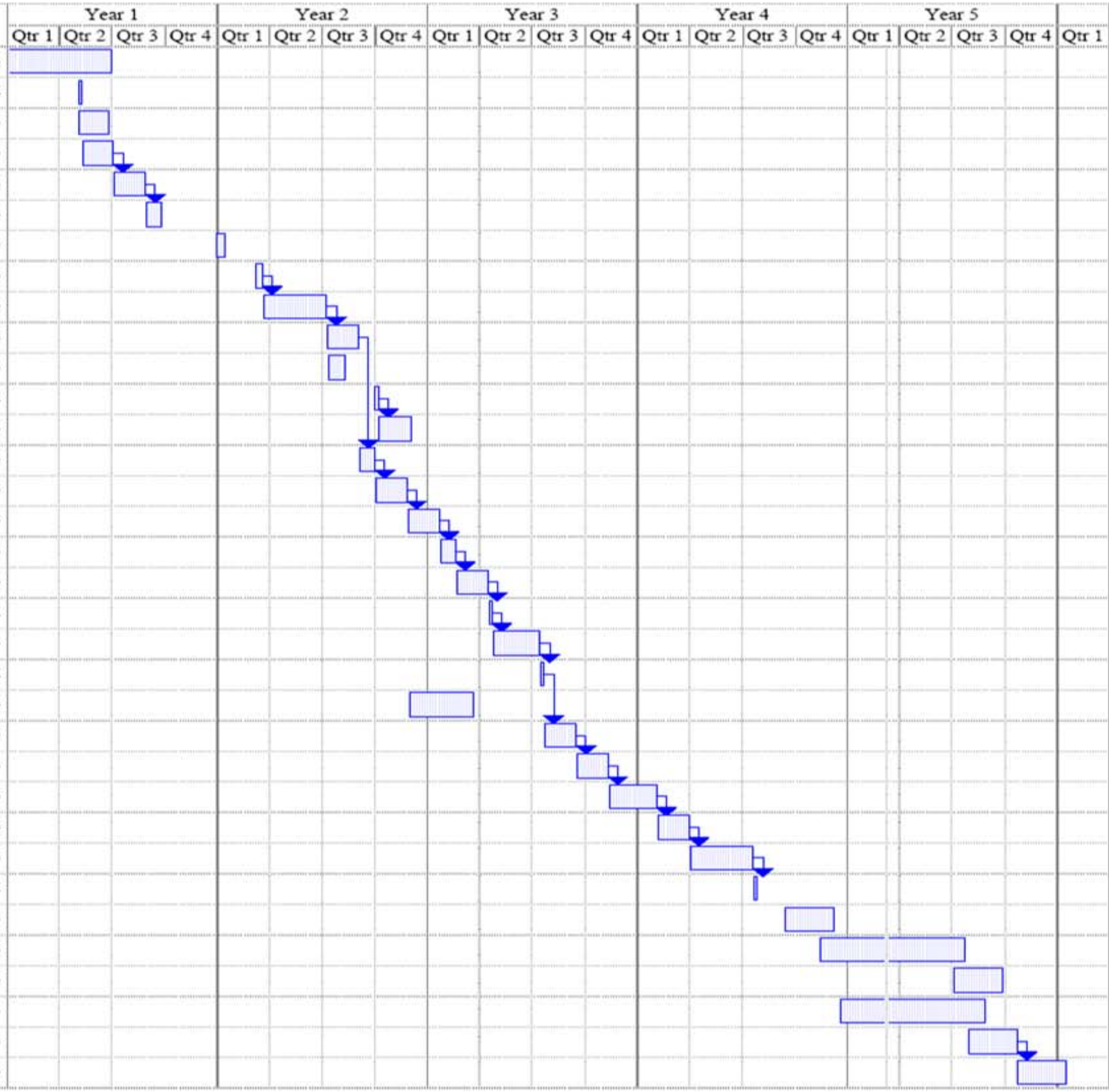
The reports on IEE are submitted to the project approving agency for approval. The decision for approval is to follow the Environmental Impact Assessment procedure and it takes at least two months including 30 working days for public comments. In addition, CEB has to meet requirements of funding agencies as well. Further transmission lines and substation projects are implemented in accordance with the Electricity Act.

8.3. Resettlement policy

While implementing the projects comes under the Long Term Transmission Development Plans, acquisition of land and resettlement of affected people takes place. To avoid or minimize the impacts on people, always alternative project proposals are considered. Where involuntary resettlement is unavoidable, affected people are treated conforming to the Sri Lanka National Involuntary Resettlement Policy established by Ministry of Environmental and National Resources, Ministry of Lands and Central Environmental Authority.

Figure 8.2: Implementation of a transmission pro ect

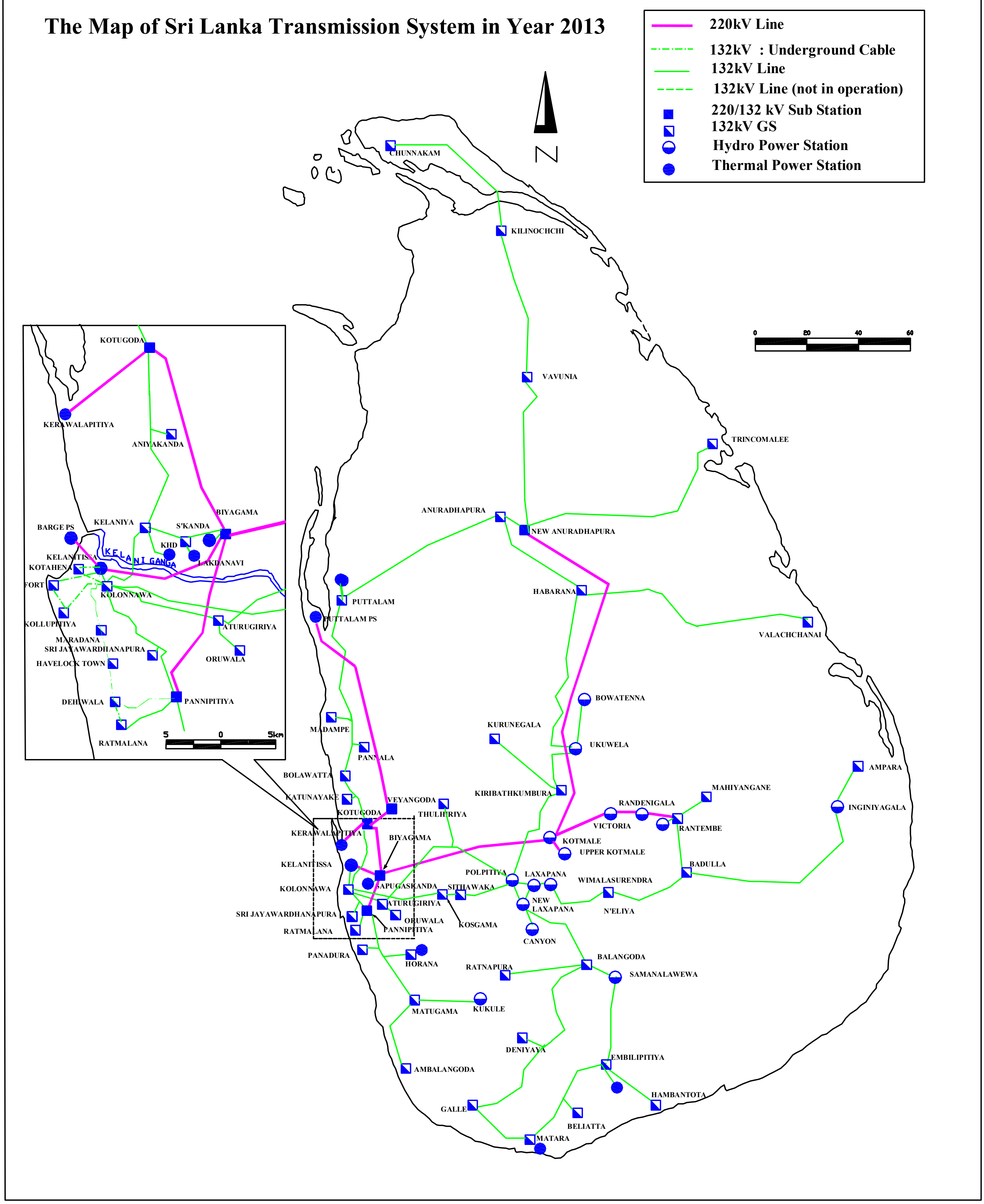
ID	Task Name	Duration
1	Identification of projects and feasibility study	26 wks
2	Formulation of projects for funding	1 wk
3	Arrangememnt Board funds if necessary	8 wks
4	Preparation of feasibility study reports	8 wks
5	Obtaining National Planning approval	8 wks
6	Submission of proposals for funding agencies	4 wks
7	Collection of data by fact finding missions	2 wks
8	Appraisal of project by funding agencies	2 wks
9	Obtaining approval of funding agencies and governments	16 wks
10	Appointing PM, TEC and CATB	8 wks
11	Conducting financial negotiations	4 wks
12	Signing of loan agreement	1 wk
13	Obtaing approval of the Board and the Cabinet	8 wks
14	Short list of consultants	4 wks
15	CATB and funding agency approval	8 wks
16	Call for proposals	8 wks
17	Evaluation of proposals	4 wks
18	CATB and funding agency approval	8 wks
19	Open financial proposals and negotiations	1 wk
20	Cabinet, CATB and funding agency approval	12 wks
21	Award of contract and contract signing	1 wk
22	Preparation of draft tender document	16 wks
23	Review of tender documents by consultants	8 wks
24	Approval of funding agency and CATB for tender documents	8 wks
25	Invitation of bids	12 wks
26	Evaluation of bids	8 wks
27	Approval of funding agency , CATB and Cabinet	16 wks
28	Bid negotiations and award	1 wk
29	Design checking	12 wks
30	Manufacturing of equipment	36 wks
31	Delivery	12 wks
32	Civil works	36 wks
33	Erection	12 wks
34	Commissioning and takeover	12 wks



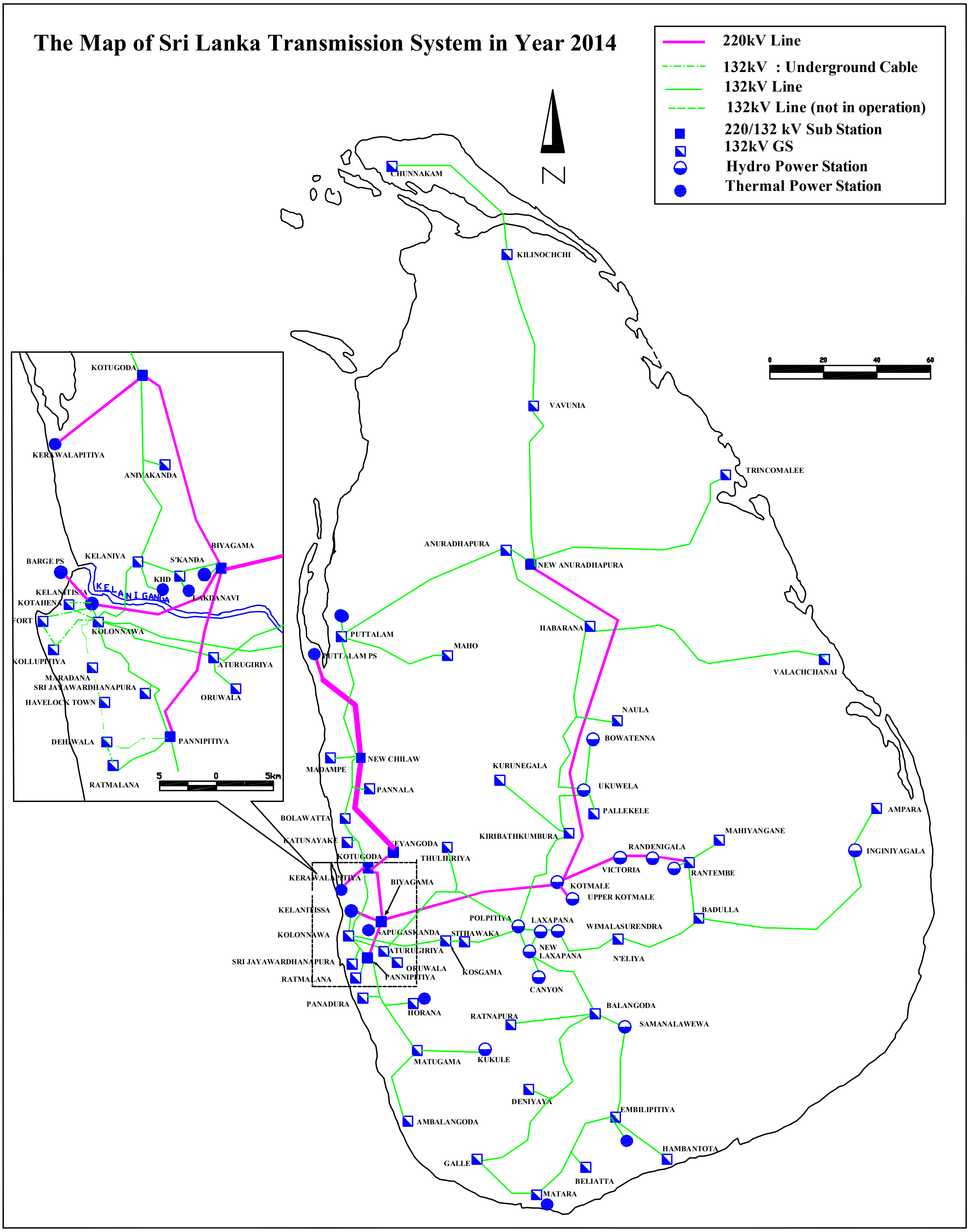
ANNEX A

Annex A-1

The Map of Sri Lanka Transmission System in Year 2013

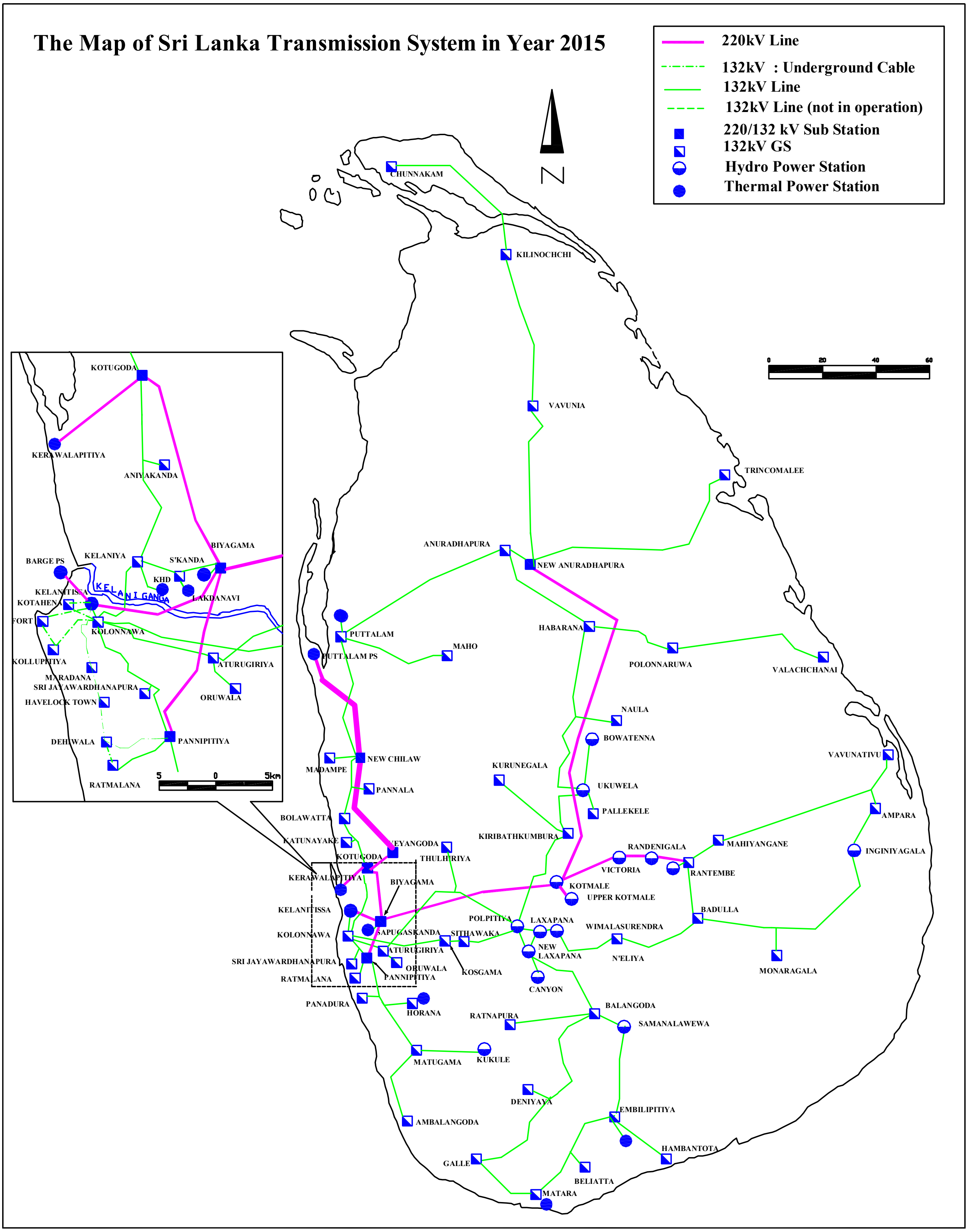


Annex A-2



The Map of Sri Lanka Transmission System in Year 2014
220kV Line
132kV : Underground Cable
132kV Line
132kV Line (not in operation)
220/132 kV Sub Station
132kV GS
Hydro Power Station
Thermal Power Station
N
0
20
40
60
CHUNNAKAM
KILINOCHCHI
VAVUNIA
TRINCOMALEE
ANURADHAPURA
NEW ANURADHAPURA
PUTTALAM
MAHO
PUTTALAM PS
HABARANA
VALACHCHANAI
NAULA
BOWATENNA
NEW CHILAW
MADAMPE
KURUNEGALA
PANNALA
UKUWELA
PALLEKELE
AMPARA
BOLAWATTA
KIRIBATHKUMBURA
MAHIYANGANE
KATUNAYAKE
VEYANGODA
THULHIRIYA
RANDENIGALA
INGINIYAGALA
KOTUGODA
VICTORIA
RANTEMBE
KERAWALAPITIYA
BIYAGAMA
KOTMALE
UPPER KOTMALE
KELANITISSA
BADULLA
POLPITIYA
LAXAPANA
WIMALASURENDRA
KOLONNAWA
SAPUGASKANDA
SITHAWAKA
NEW LAXAPANA
N'ELIYA
SRI JAYAWARDHANAPURA
ATURUGIRIYA
ORUWALA
KOSGAMA
RATMALANA
PANNIPITIYA
CANYON
PANADURA
HORANA
BALANGODA
RATNAPURA
SAMANALAWEWA
MATUGAMA
KUKULE
DENIYAYA
EMBILIPITIYA
AMBALANGODA
HAMBANTOTA
GALLE
BELIATTA
MATARA
ANIYAKANDA
BARGE PS
KELANIYA
S'KANDA
KHD
LAKDANAVI
KOTAHENA
FORT
KELANI GANGA
KOLLUPITIYA
MARADANA
HAVELOCK TOWN
DEHIWALA
5
0
5km

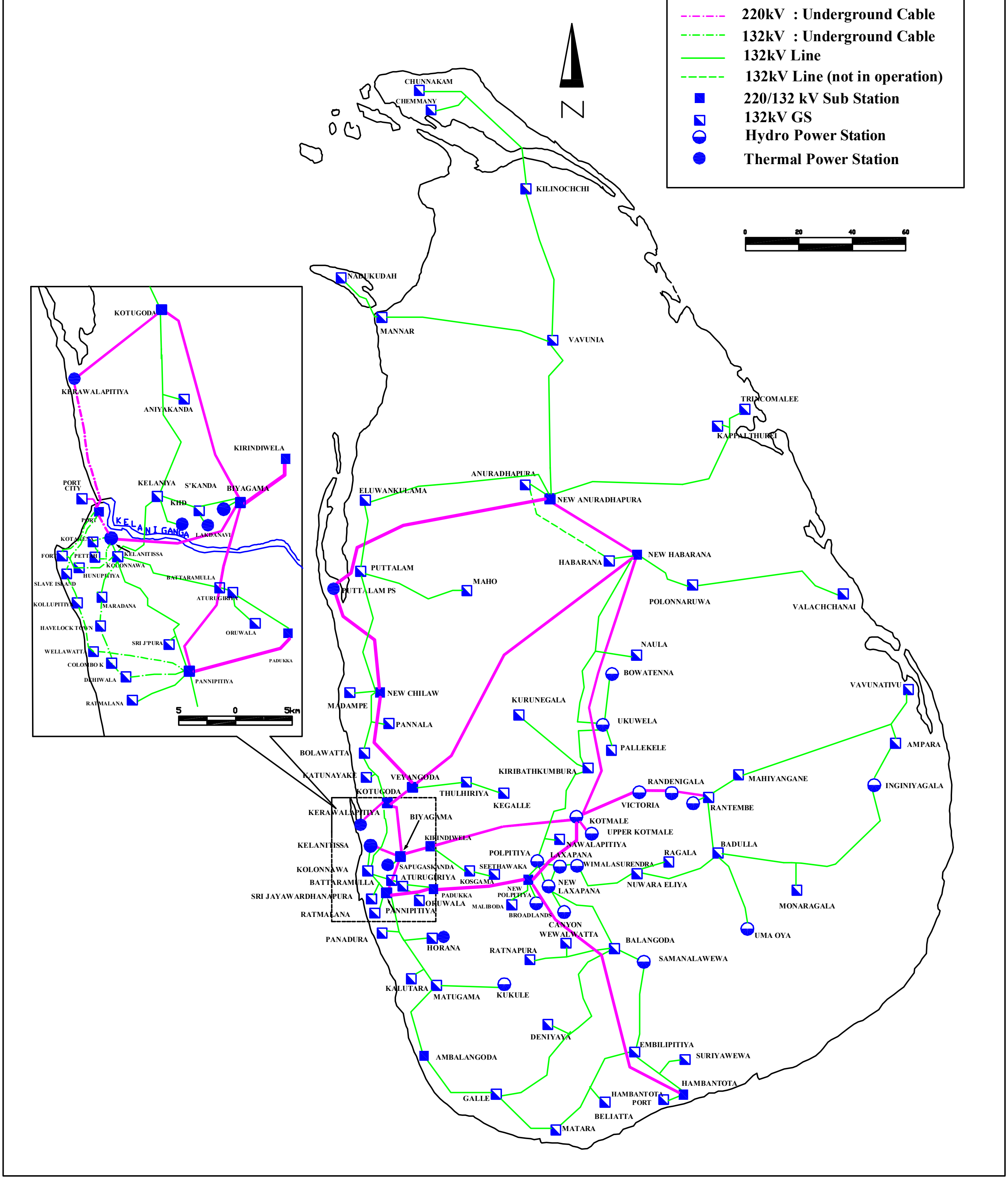
Annex A-3



The Map of Sri Lanka Transmission System in Year 2015
220kV Line
132kV : Underground Cable
132kV Line
132kV Line (not in operation)
220/132 kV Sub Station
132kV GS
Hydro Power Station
Thermal Power Station
N
0
20
40
60
CHUNNAKAM
KILINOCHCHI
VAVUNIA
TRINCOMALEE
ANURADHAPURA
NEW ANURADHAPURA
PUTTALAM
PUTTALAM PS
MAHO
HABARANA
POLONNARUWA
VALACHCHANAI
NAULA
BOWATENNA
VAVUNATIVU
NEW CHILAW
MADAMPE
KURUNEGALA
PANNALA
UKUWELA
PALLEKELE
AMPARA
BOLAWATTA
KATUNAYAKE
VEYANGODA
KIRIBATHKUMBURA
RANDENIGALA
MAHIYANGANE
INGINIYAGALA
KOTUGODA
THULHIRIYA
VICTORIA
RANTEMBE
KERAWALAPITIYA
KOTMALE
BIYAGAMA
UPPER KOTMALE
KELANITISSA
BADULLA
POLPITIYA
LAXAPANA
KOLONNAWA
SAPUGASKANDA
SITHAWAKA
WIMALASURENDRA
ATURUGIRIYA
NEW LAXAPANA
N'ELIYA
SRI JAYAWARDHANAPURA
ORUWALA
KOSGAMA
RATMALANA
PANNIPITIYA
MONARAGALA
CANYON
PANADURA
HORANA
BALANGODA
RATNAPURA
SAMANALAWEWA
MATUGAMA
KUKULE
DENIYAYA
EMBILIPITIYA
AMBALANGODA
HAMBANTOTA
GALLE
BELIATTA
MATARA
KOTUGODA
KERAWALAPITIYA
ANIYAKANDA
BIYAGAMA
BARGE PS
KELANIYA
S'KANDA
KHD
KELANI GANGA
LAKDANAVI
KELANITISSA
KOTAHENA
FORT
KOLONNAWA
KOLLUPITIYA
ATURUGIRIYA
MARADANA
SRI JAYAWARDHANAPURA
ORUWALA
HAVELOCK TOWN
DEHIWALA
PANNIPITIYA
RATMALANA
5
0
5km

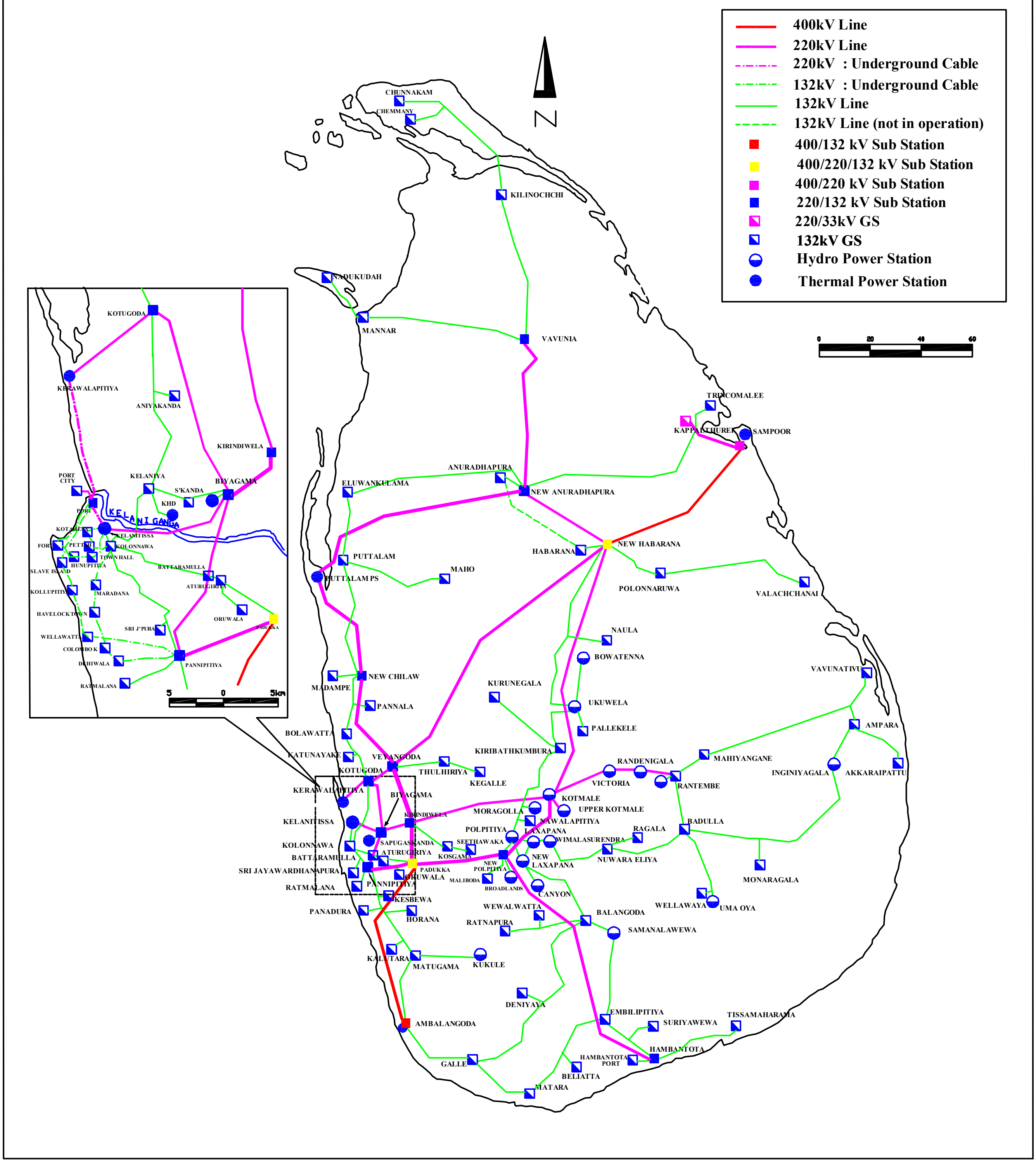
Annex A-4

The Map of Sri Lanka Transmission System in Year 2017

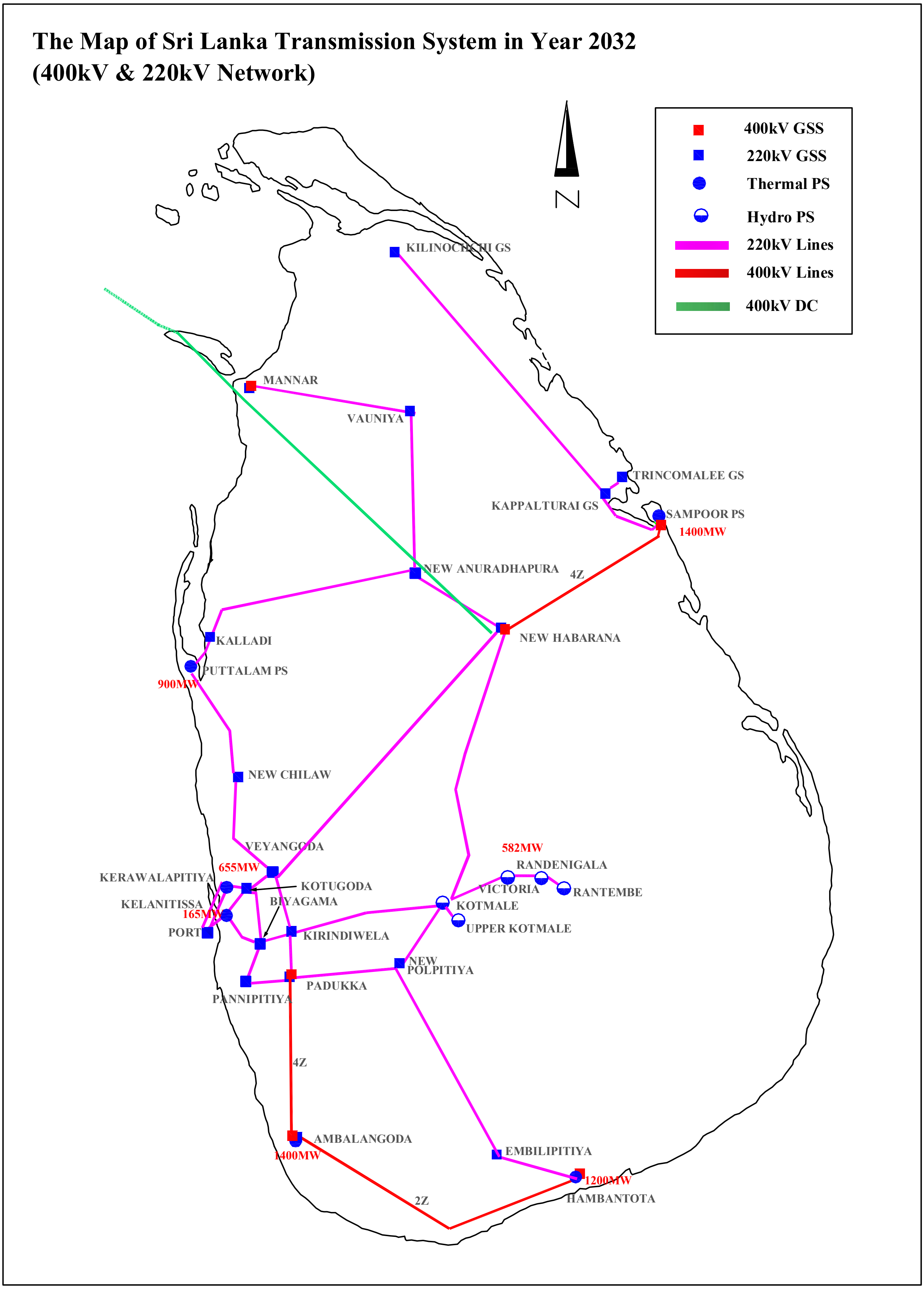


Annex A-5

The Map of Sri Lanka Transmission System in Year 2022



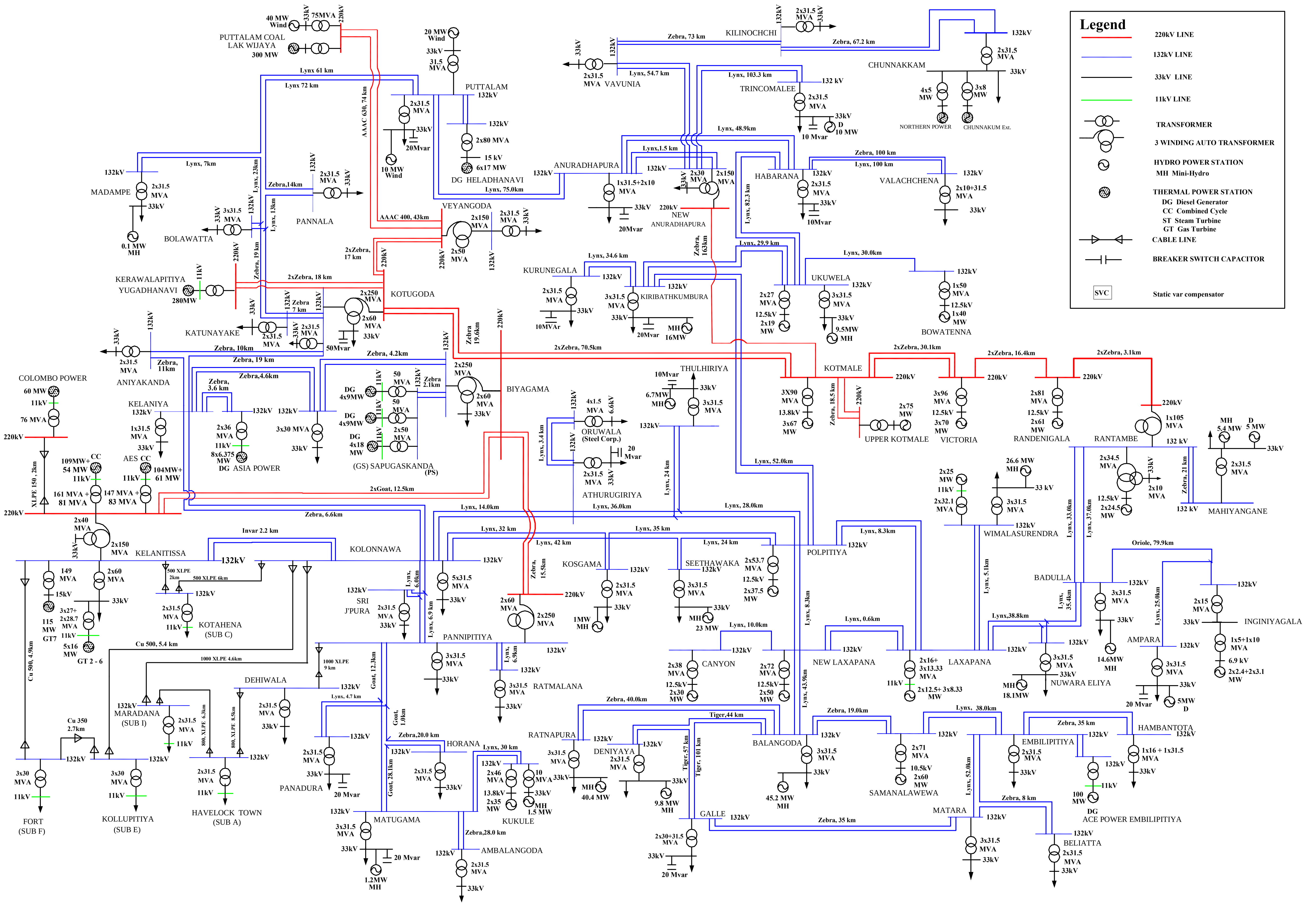
Annex A-6


The Map of Sri Lanka Transmission System in Year 2032
(400kV & 220kV Network)
N
400kV GSS
220kV GSS
Thermal PS
Hydro PS
220kV Lines
400kV Lines
400kV DC
KILINOCHCHI GS
MANNAR
VAUNIYA
TRINCOMALEE GS
KAPPALTURAI GS
SAMPOOR PS
1400MW
NEW ANURADHAPURA
4Z
NEW HABARANA
KALLADI
PUTTALAM PS
900MW
NEW CHILAW
VEYANGODA
655MW
KERAWALAPITIYA
KOTUGODA
BIYAGAMA
KELANITISSA
165MW
PORT
KIRINDIWELA
582MW
RANDENIGALA
VICTORIA
RANTEMBE
KOTMALE
UPPER KOTMALE
NEW POLPITIYA
PADUKKA
PANNIPITIYA
4Z
AMBALANGODA
1400MW
EMBILIPITIYA
1200MW
HAMBANTOTA
2Z

ANNEX B

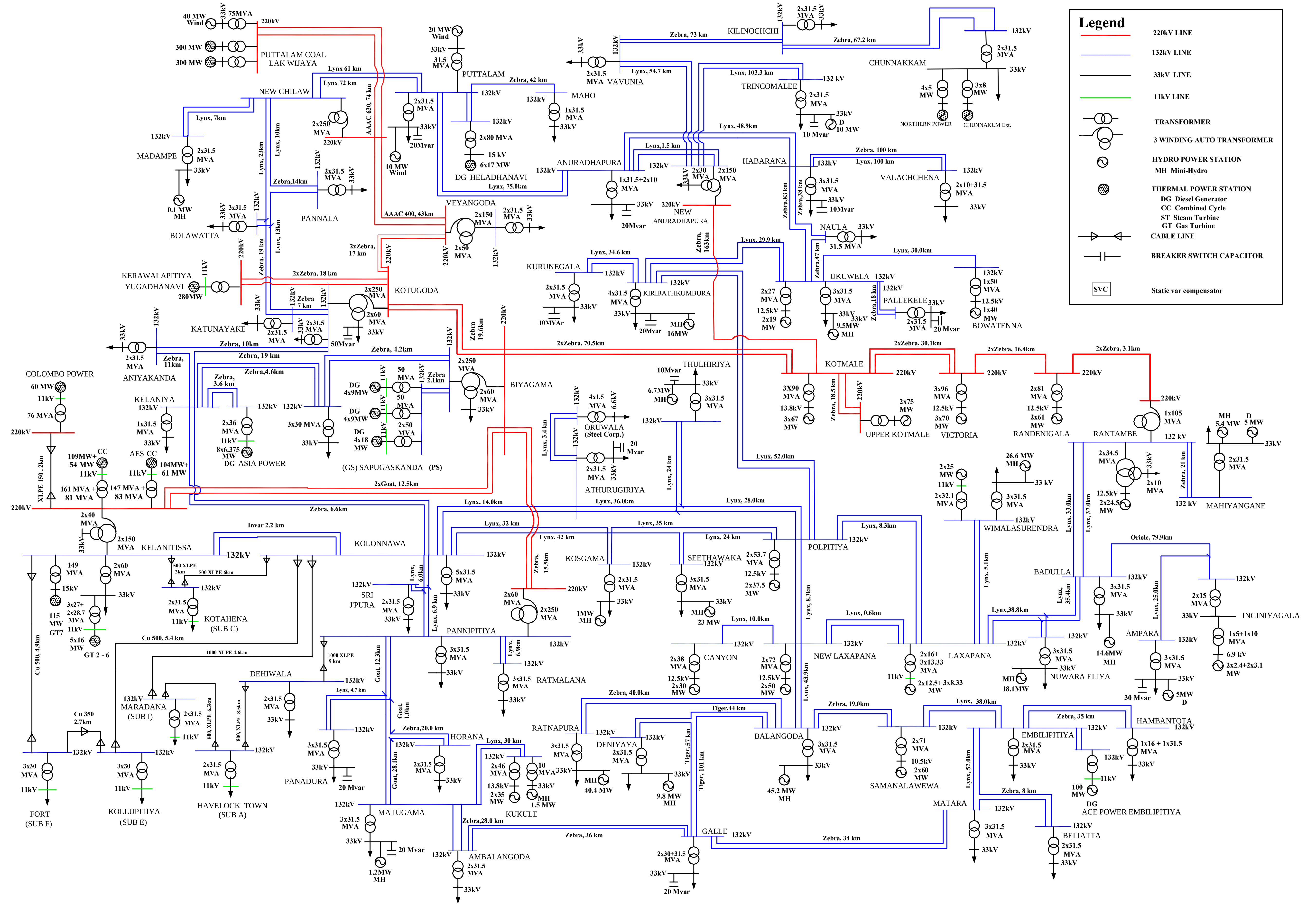
Annex B-1

Schematic Diagram of the 2013 Transmission System



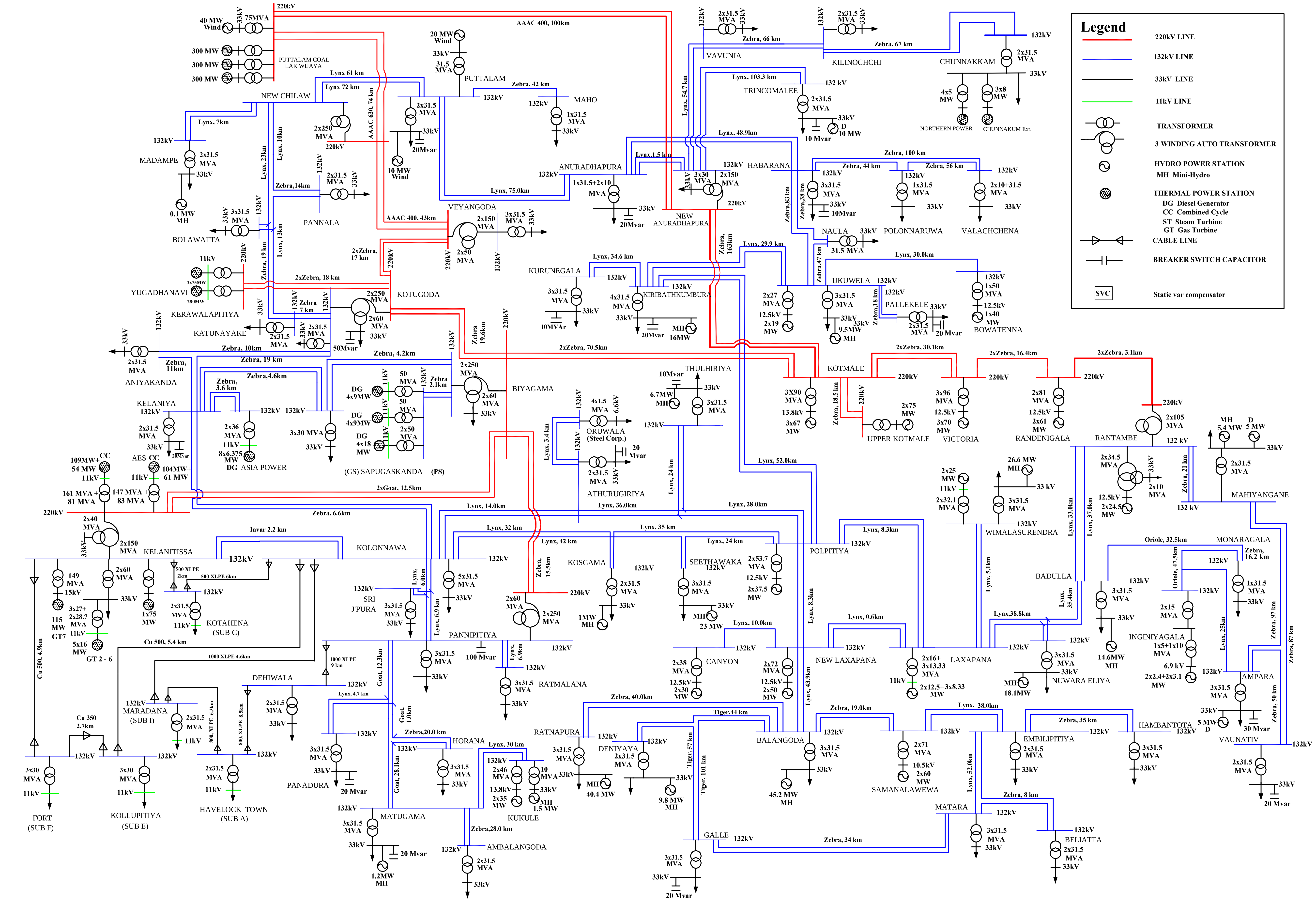
Annex B-2

Schematic Diagram of the 2014 Transmission System



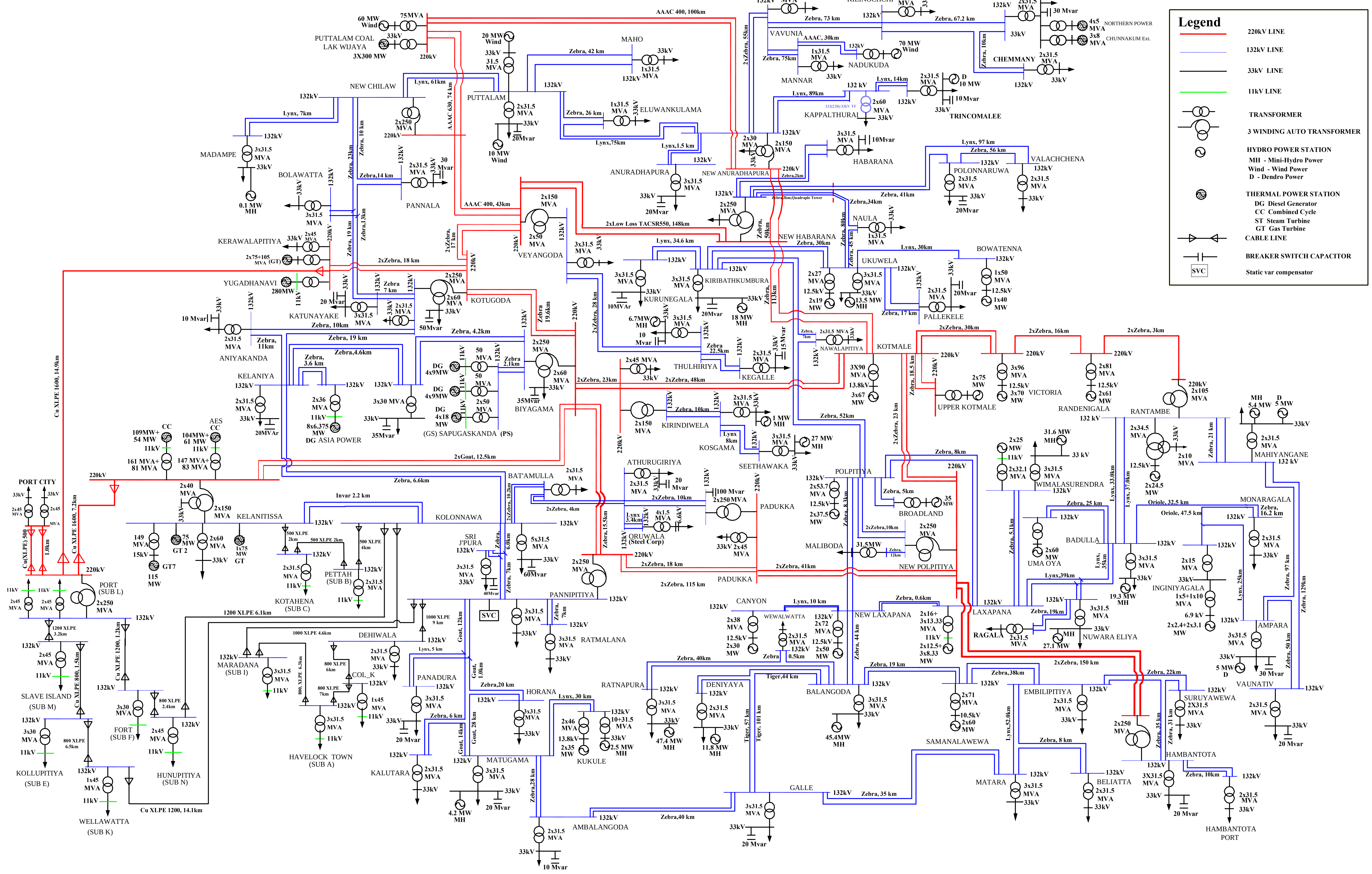
Annex B-3

Schematic Diagram of the 2015 Transmission System



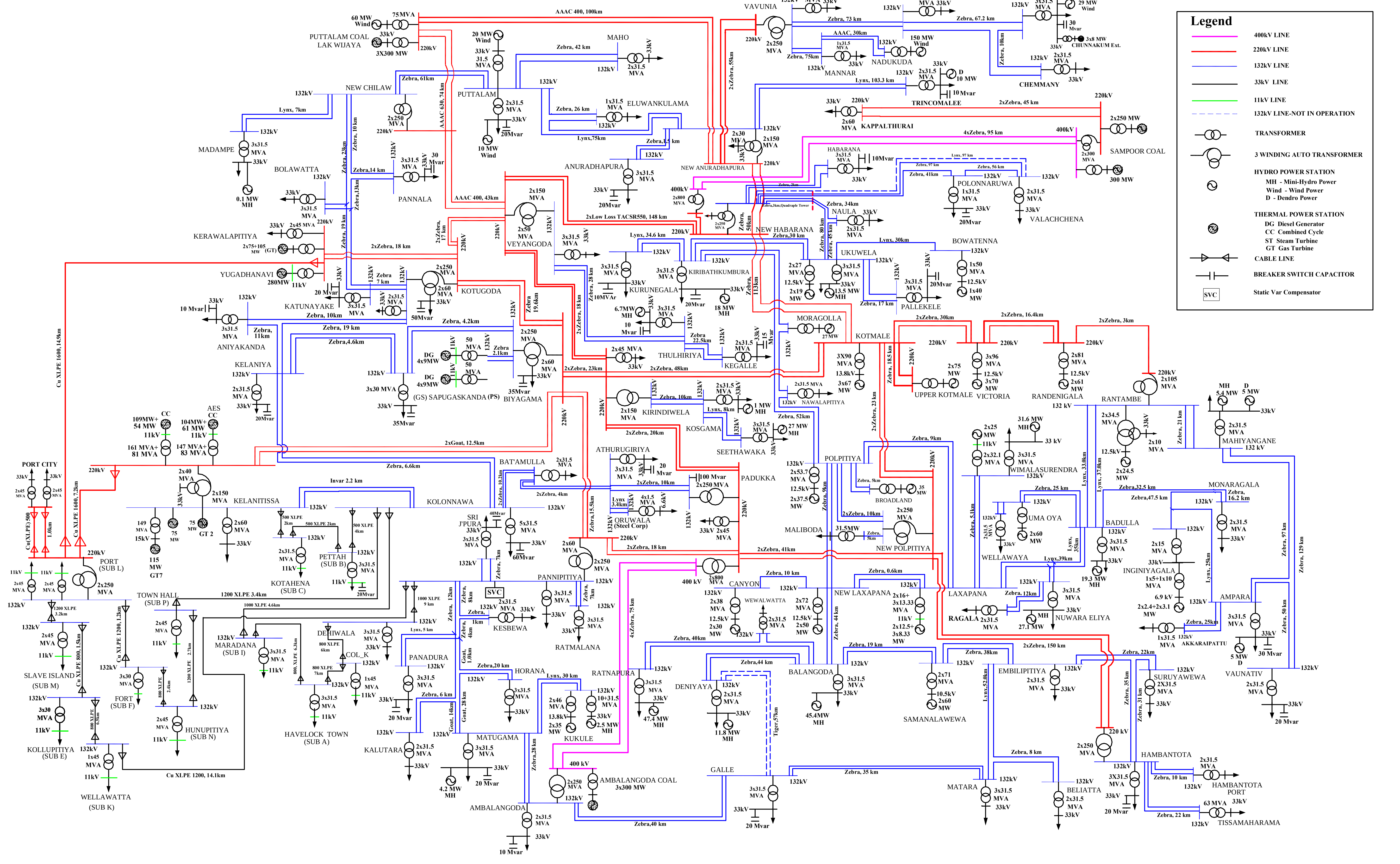
Annex B-4

Schematic Diagram of the 2017 Transmission System

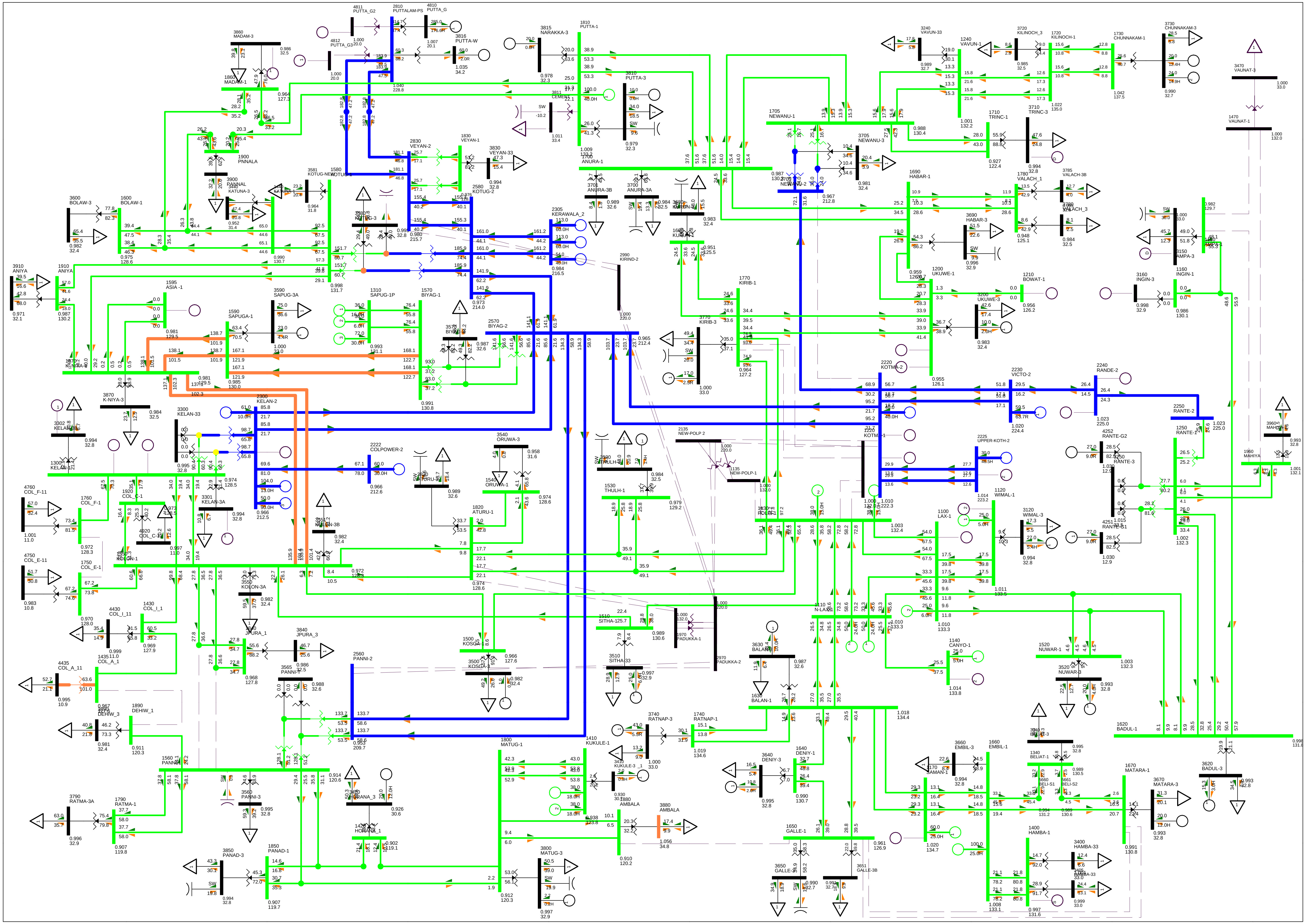


Annex B-5

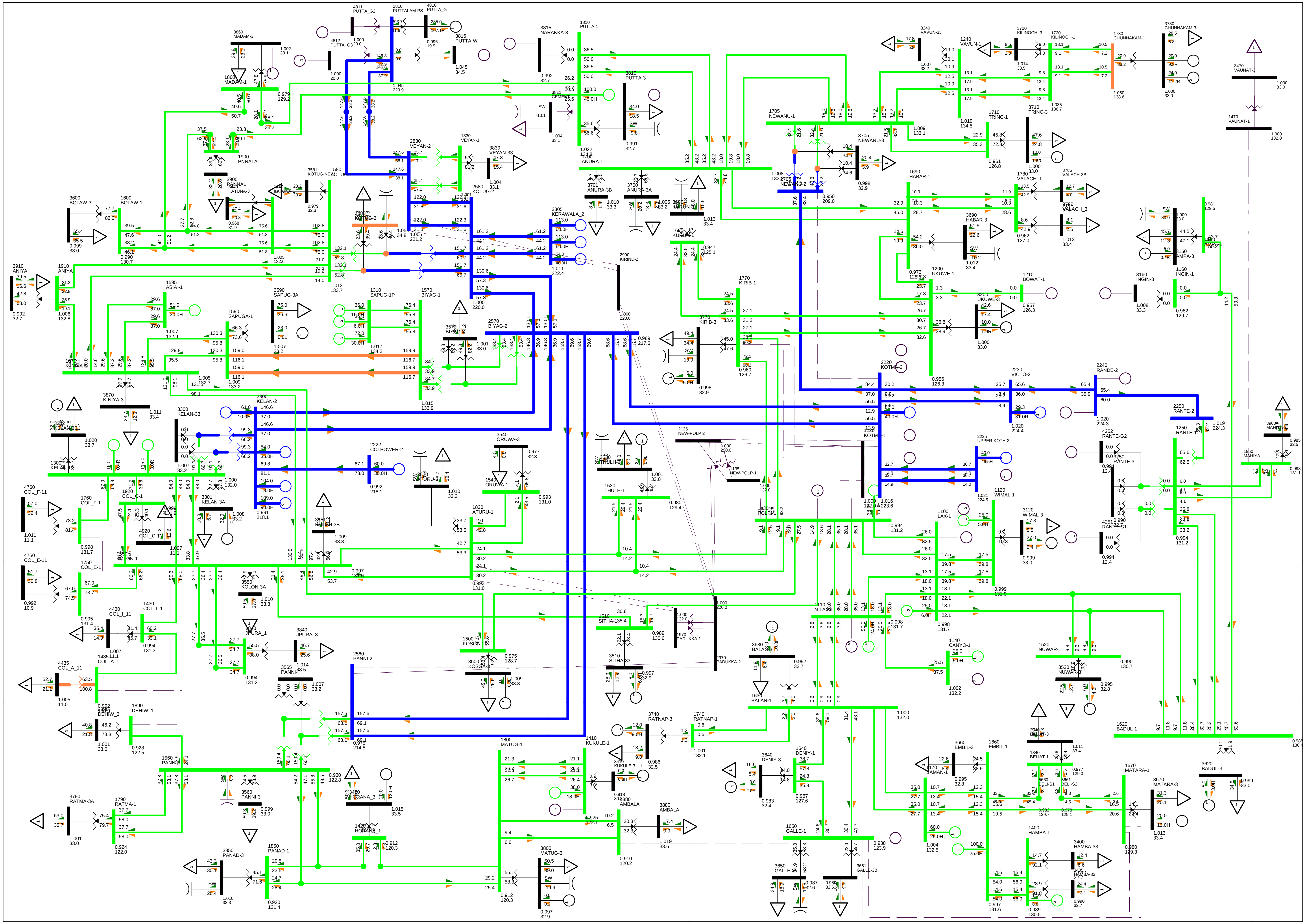
Schematic Diagram of the 2022 Transmission System



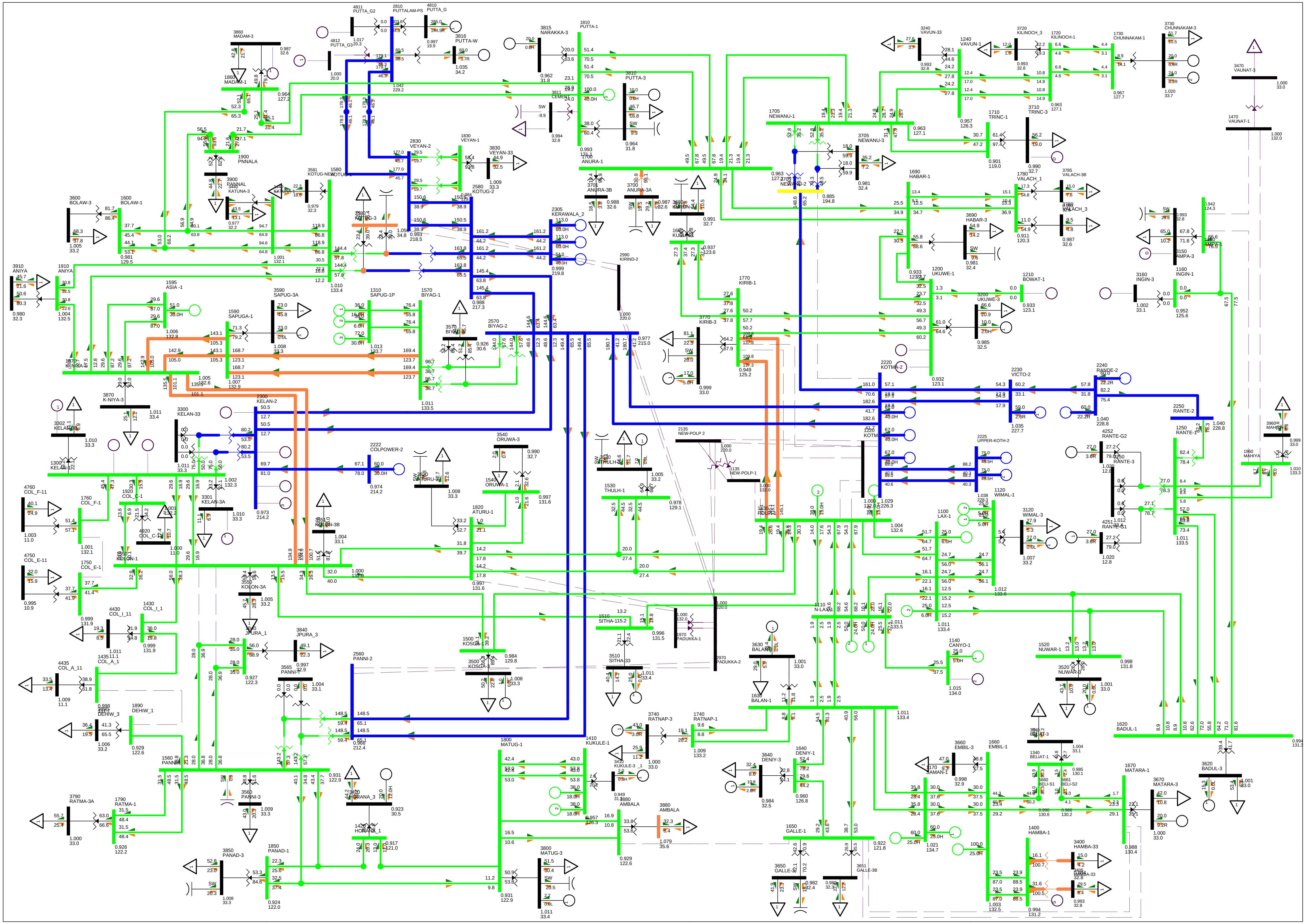
ANNEX C



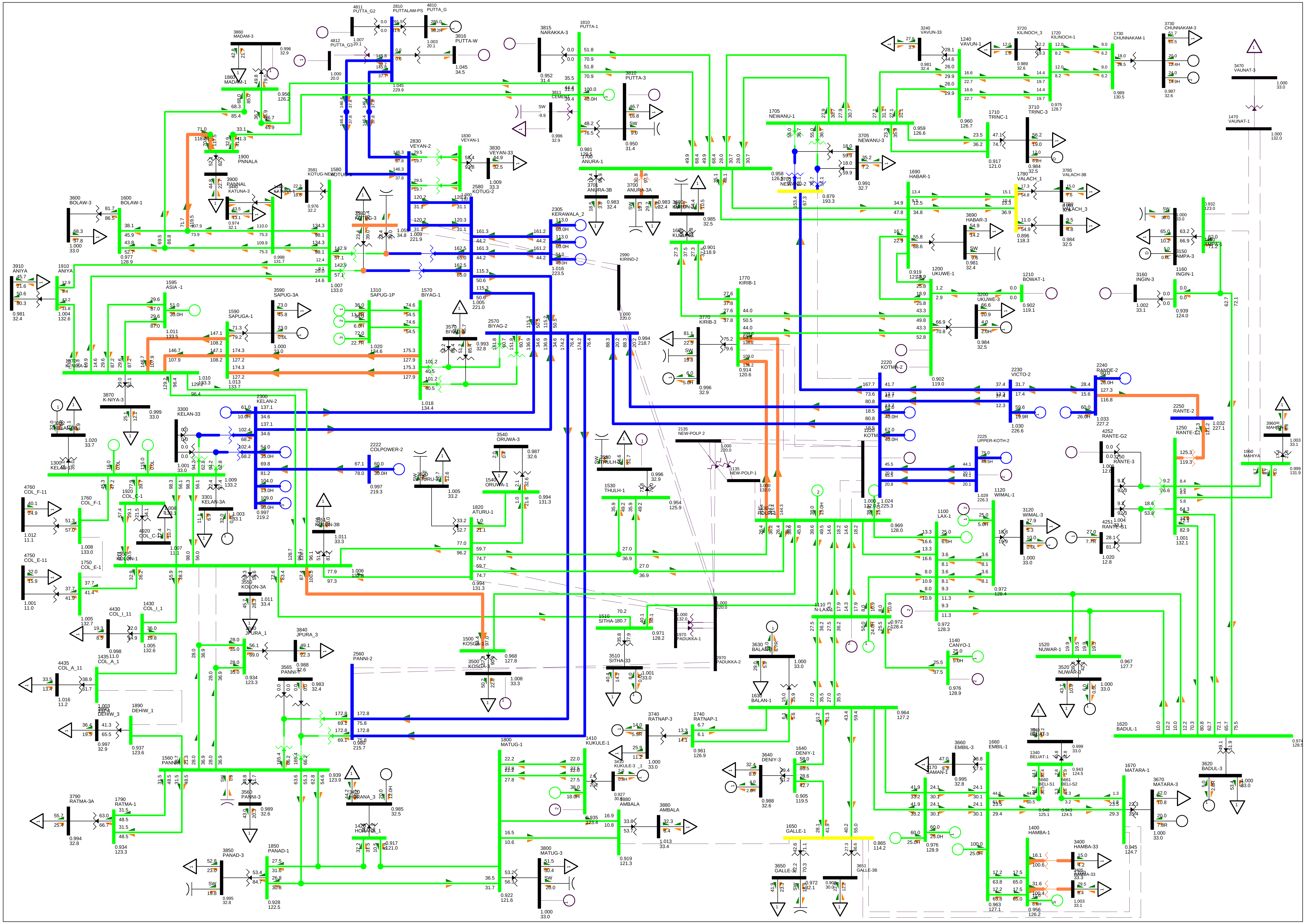
Annex C-1: Year 2013 Sri Lanka Transmission Network - Hydro Maximum Day Peak



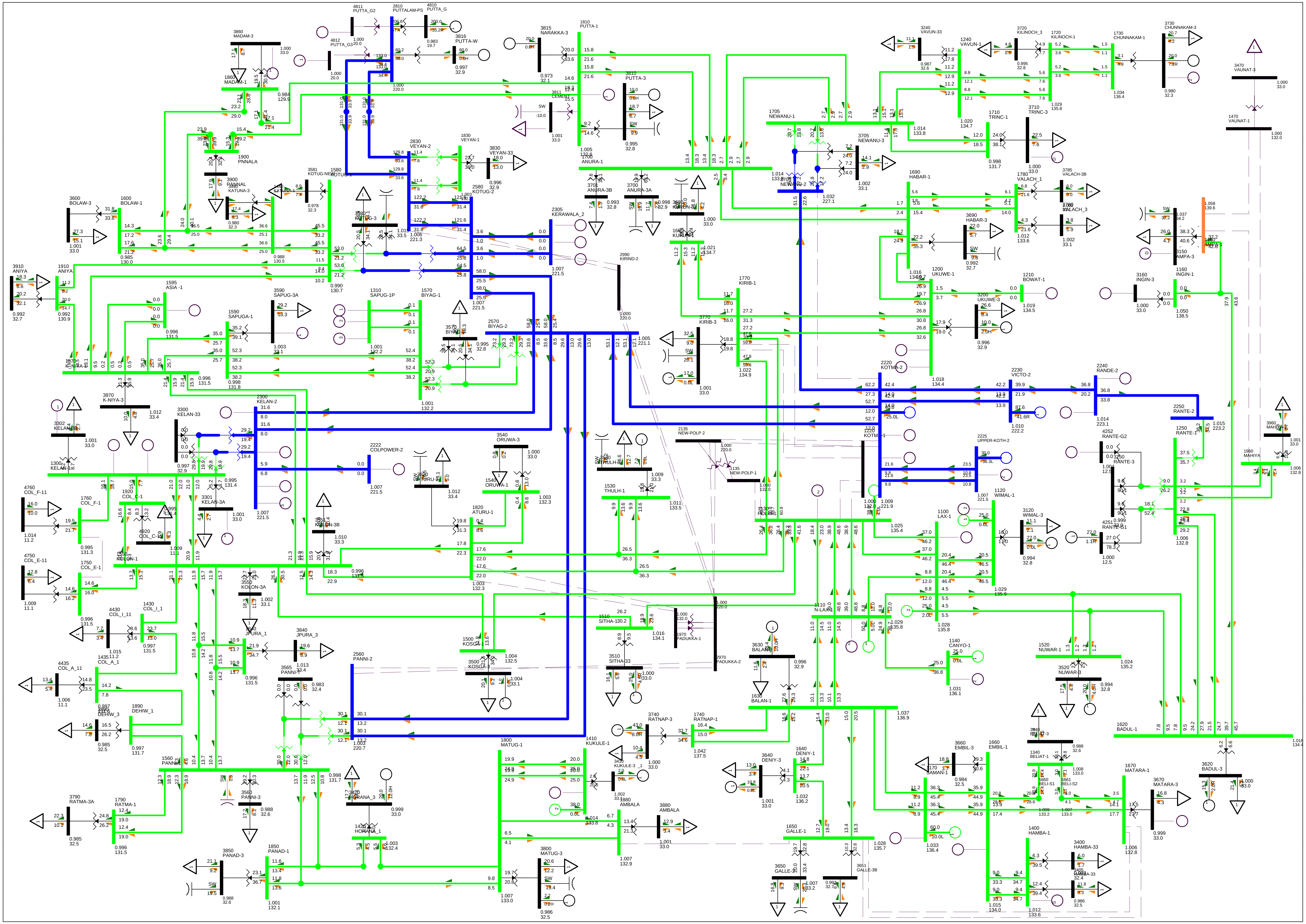
Annex C-2: Year 2013 Sri Lanka Transmission Network - Thermal Maximum Day Peak



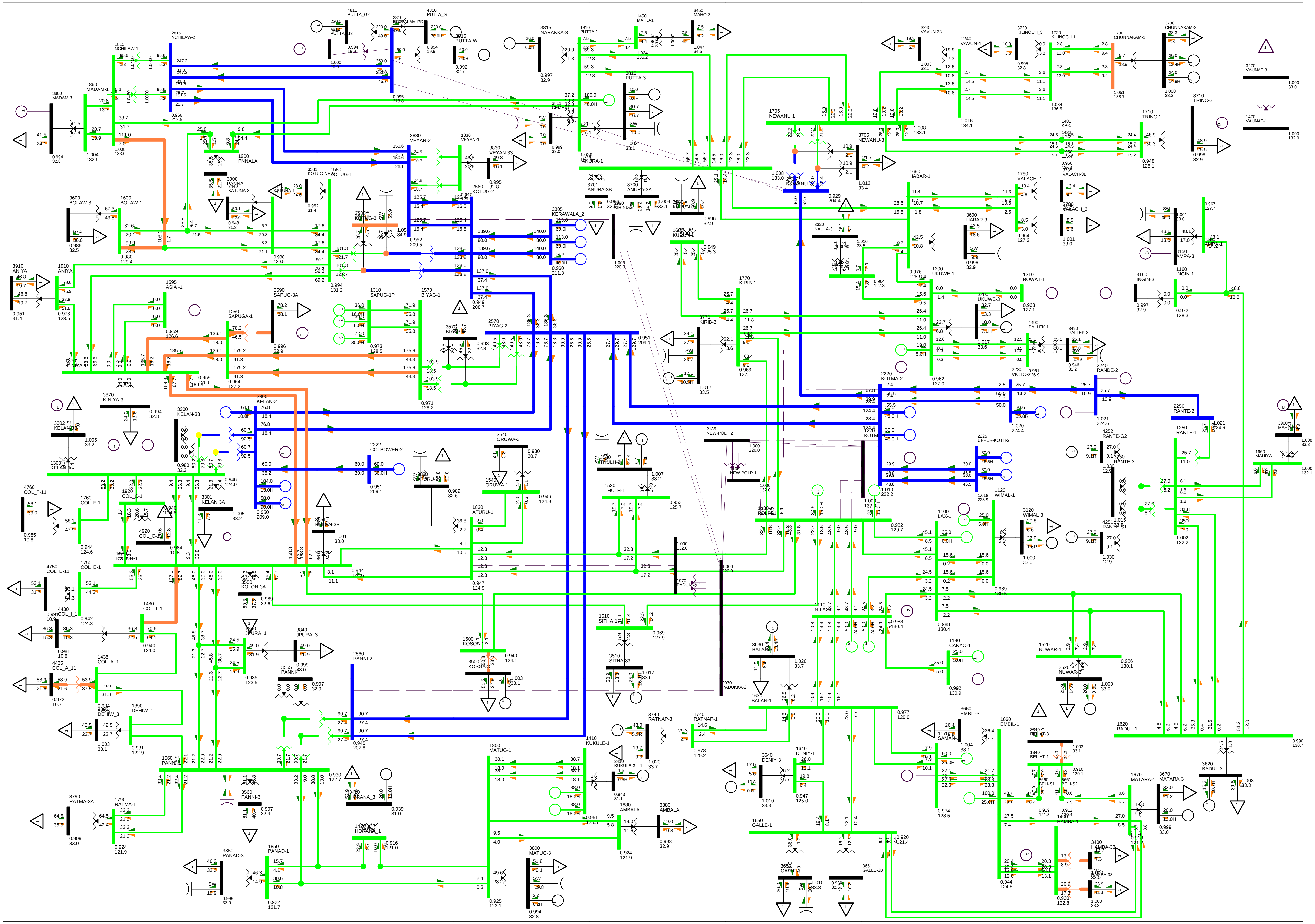
Annex C-3: Year 2013 Sri Lanka Transmission Network - Hydro Maximum Night Peak



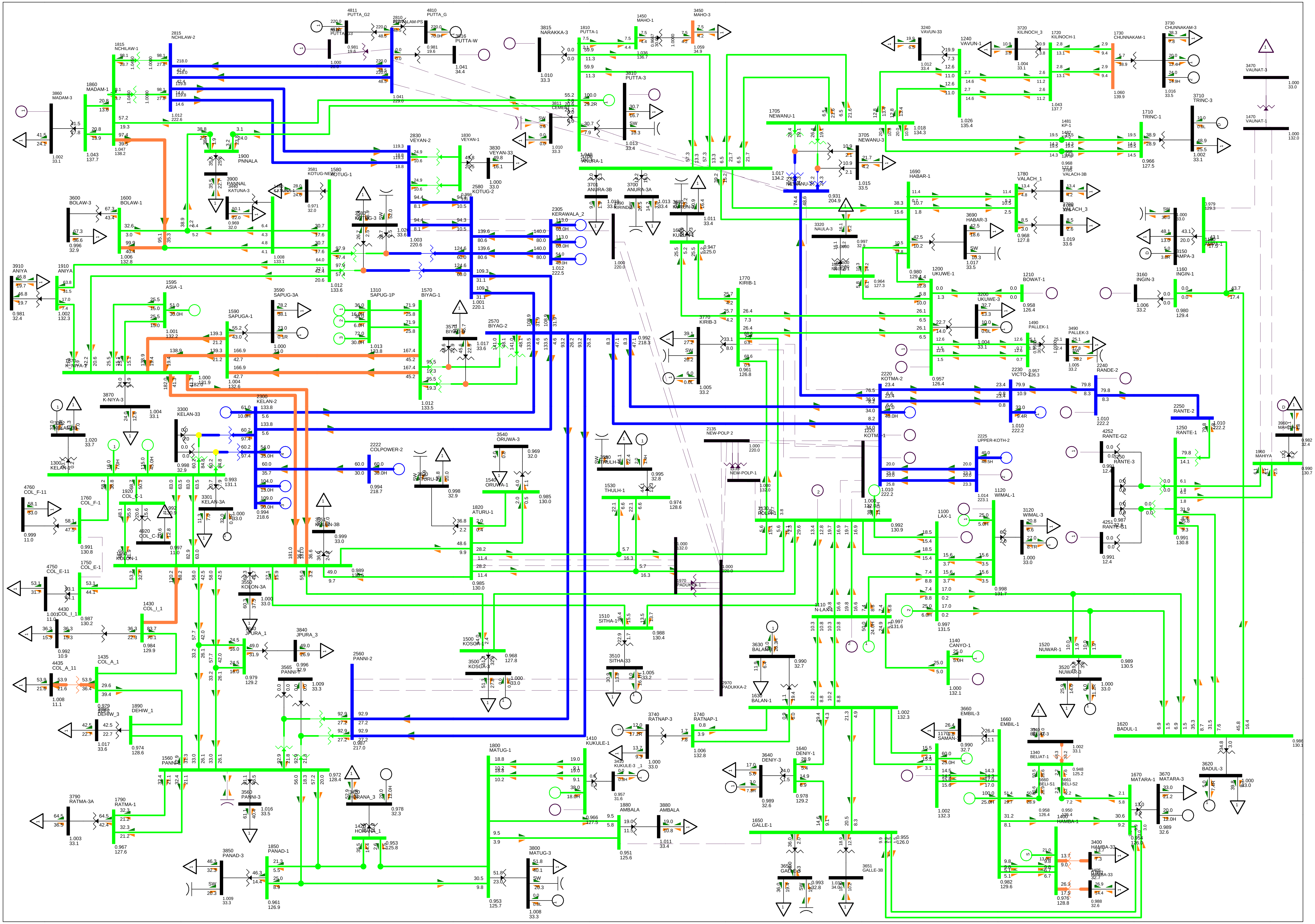
Annex C-4: Year 2013 Sri Lanka Transmission Network - Thermal Maximum Night Peak



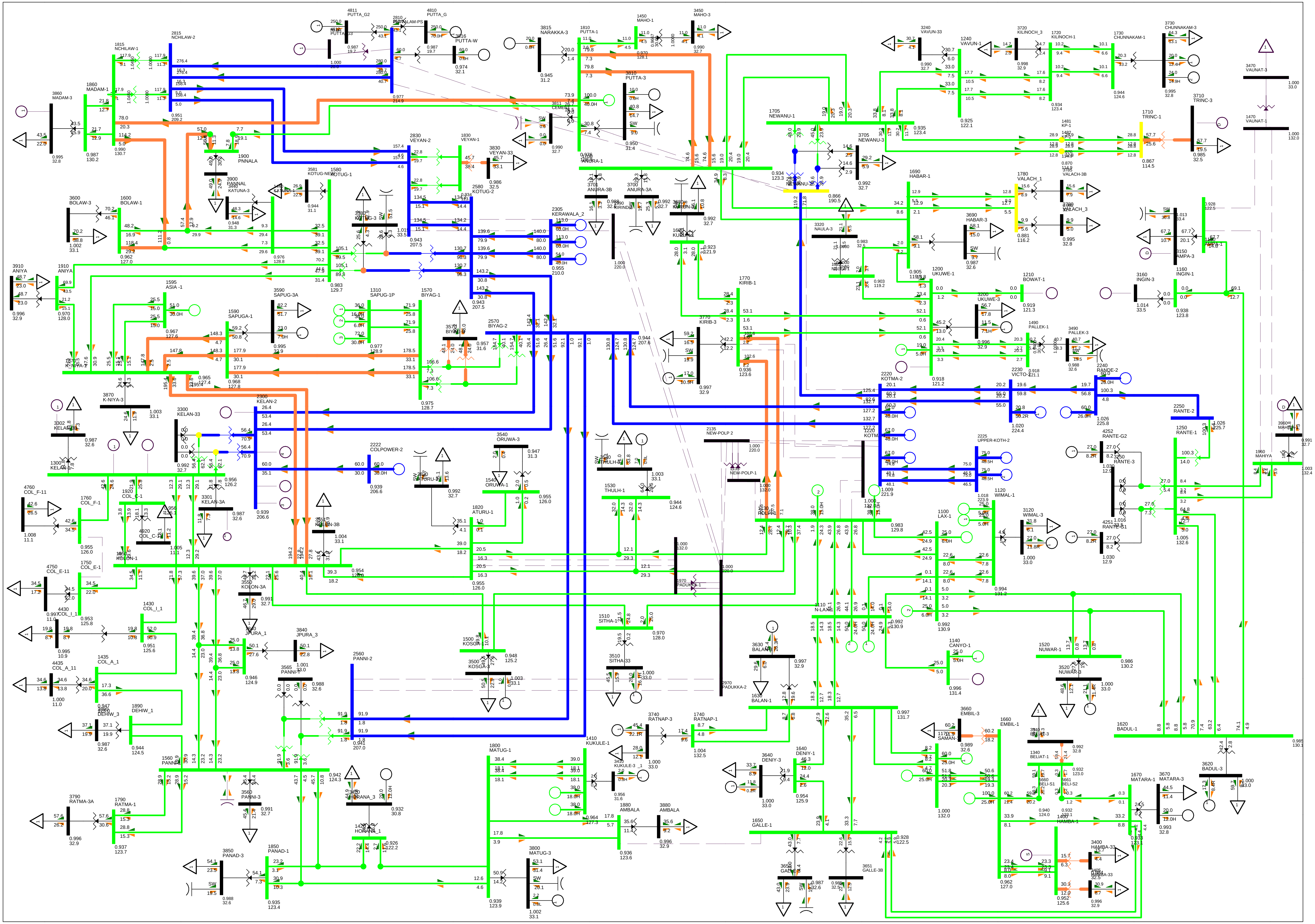
Annex C-5: Year 2013 Sri Lanka Transmission Network - Off Peak



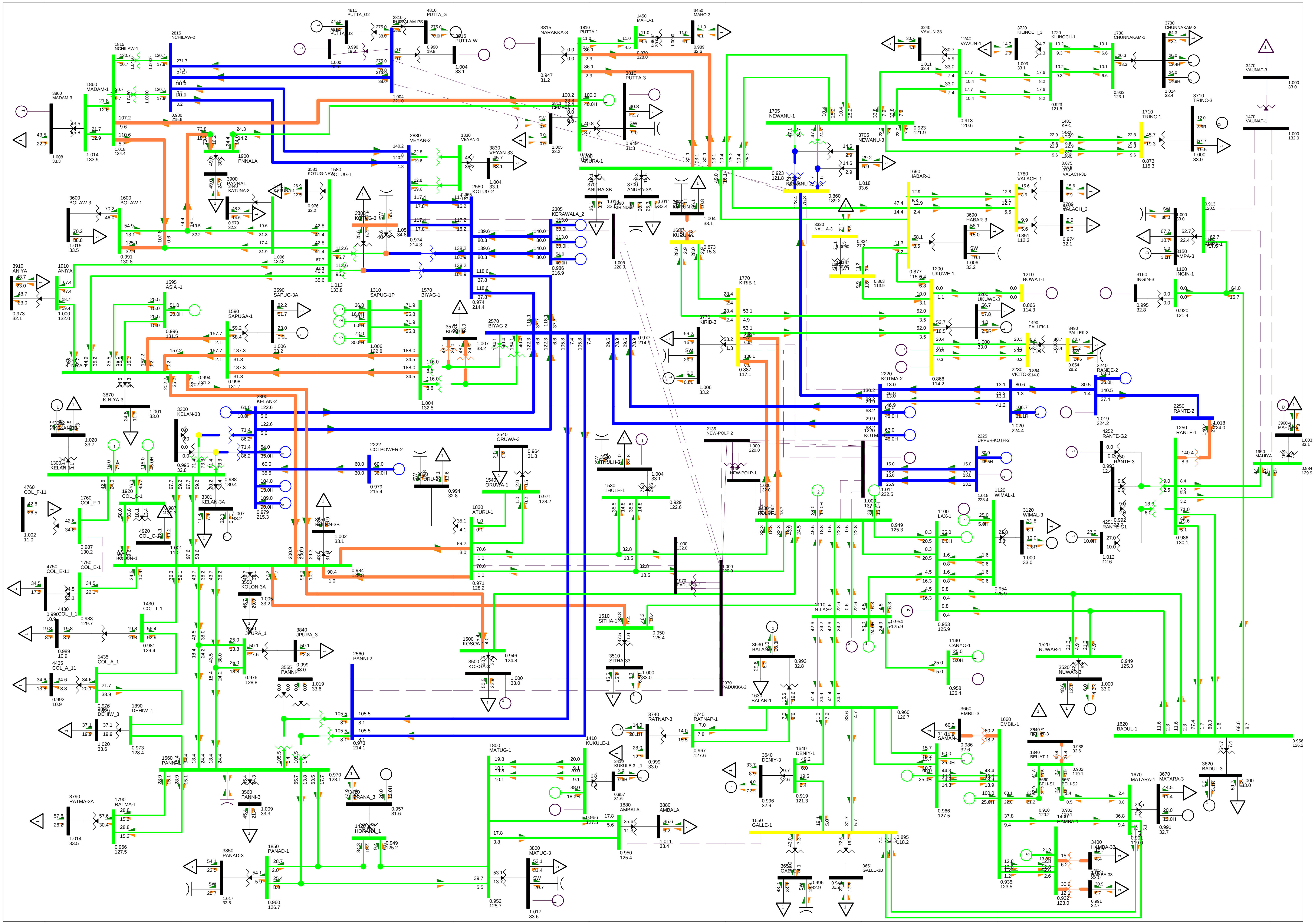
Annex C-6: Year 2014 Sri Lanka Transmission Network -Day Peak Hydro Maximum



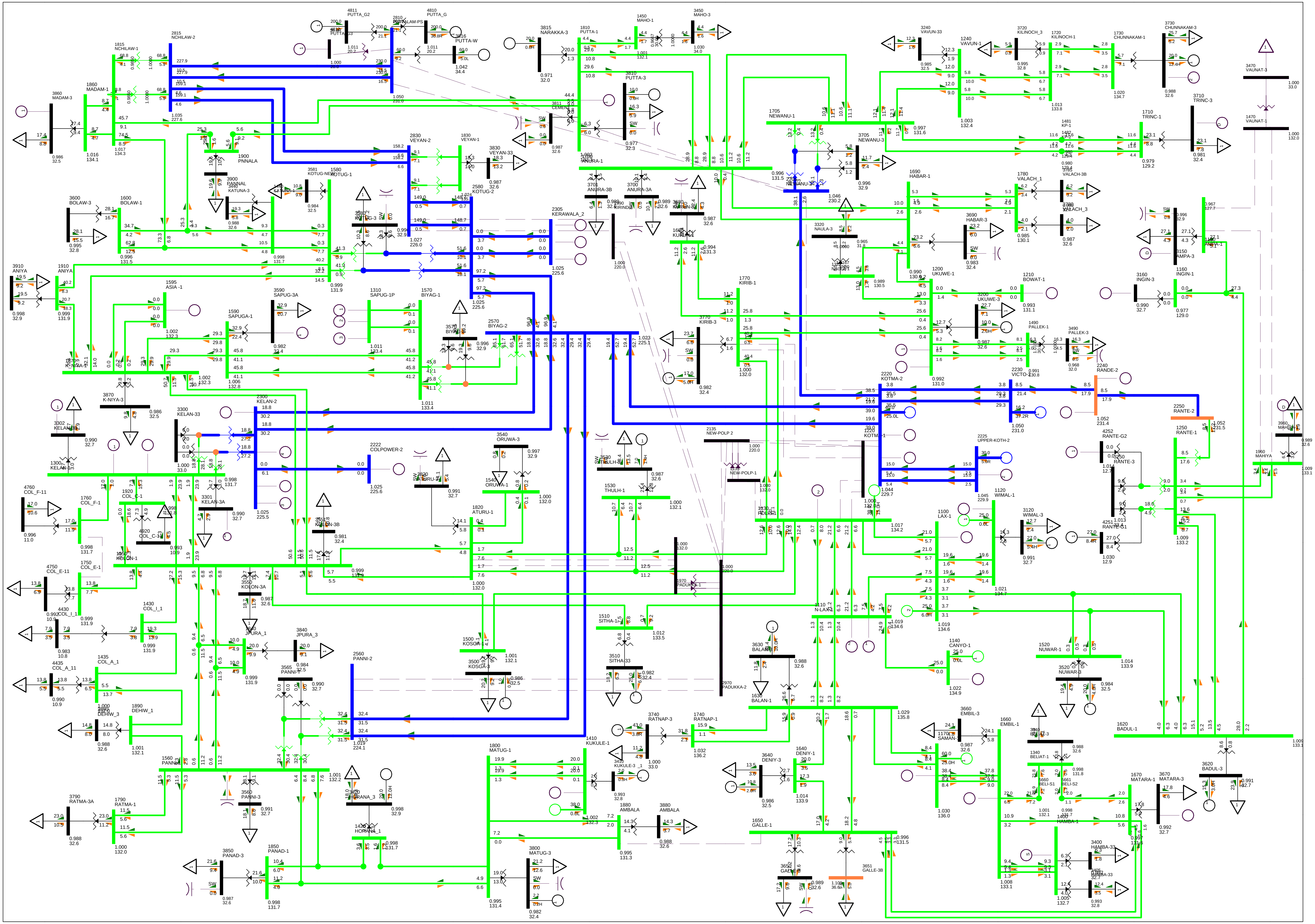
Annex C-7: Year 2014 Sri Lanka Transmission Network -Day Peak Thermal Maximum



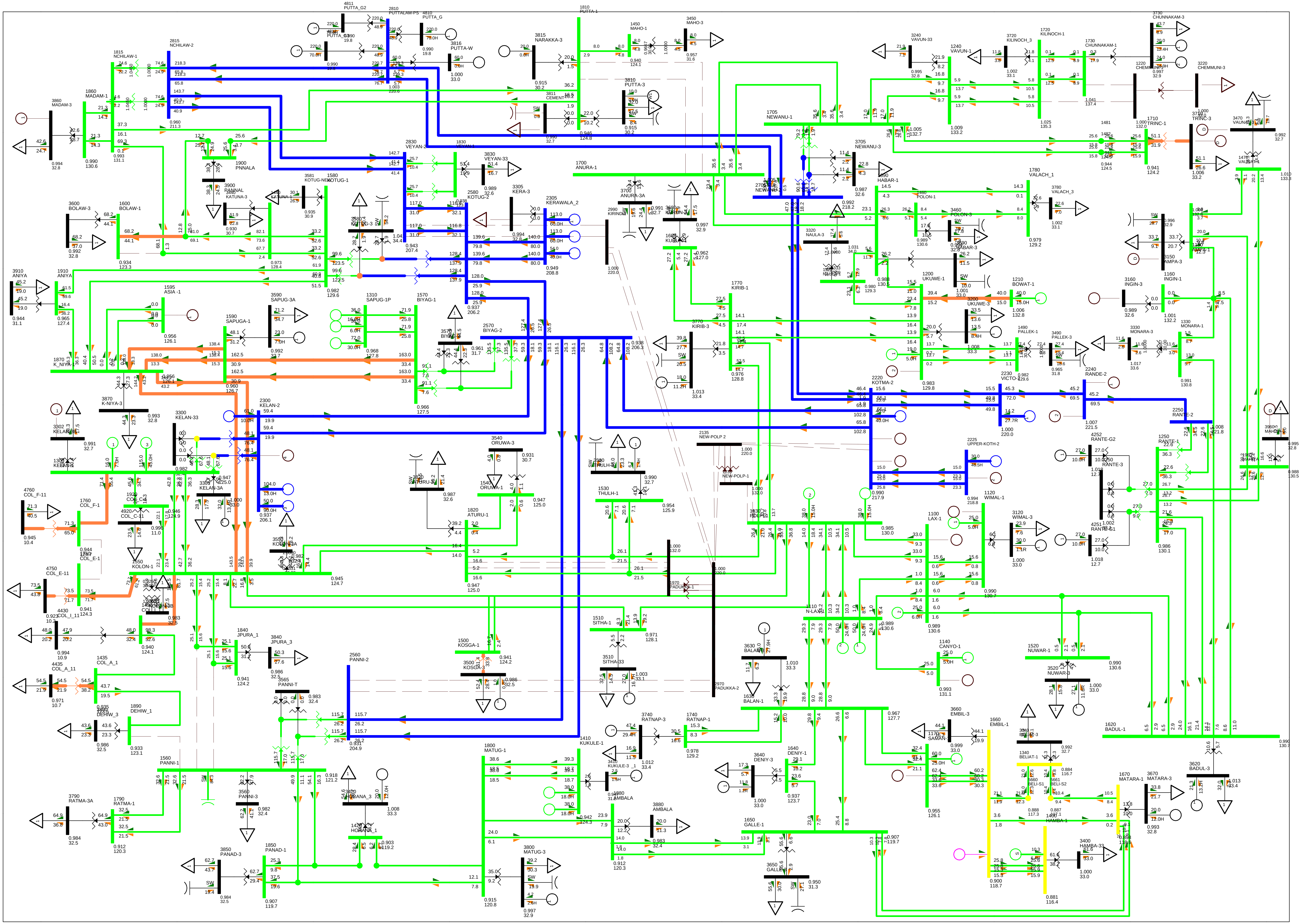
Annex C-8: Year 2014 Sri Lanka Transmission Network -Night Peak Hydro Maximum



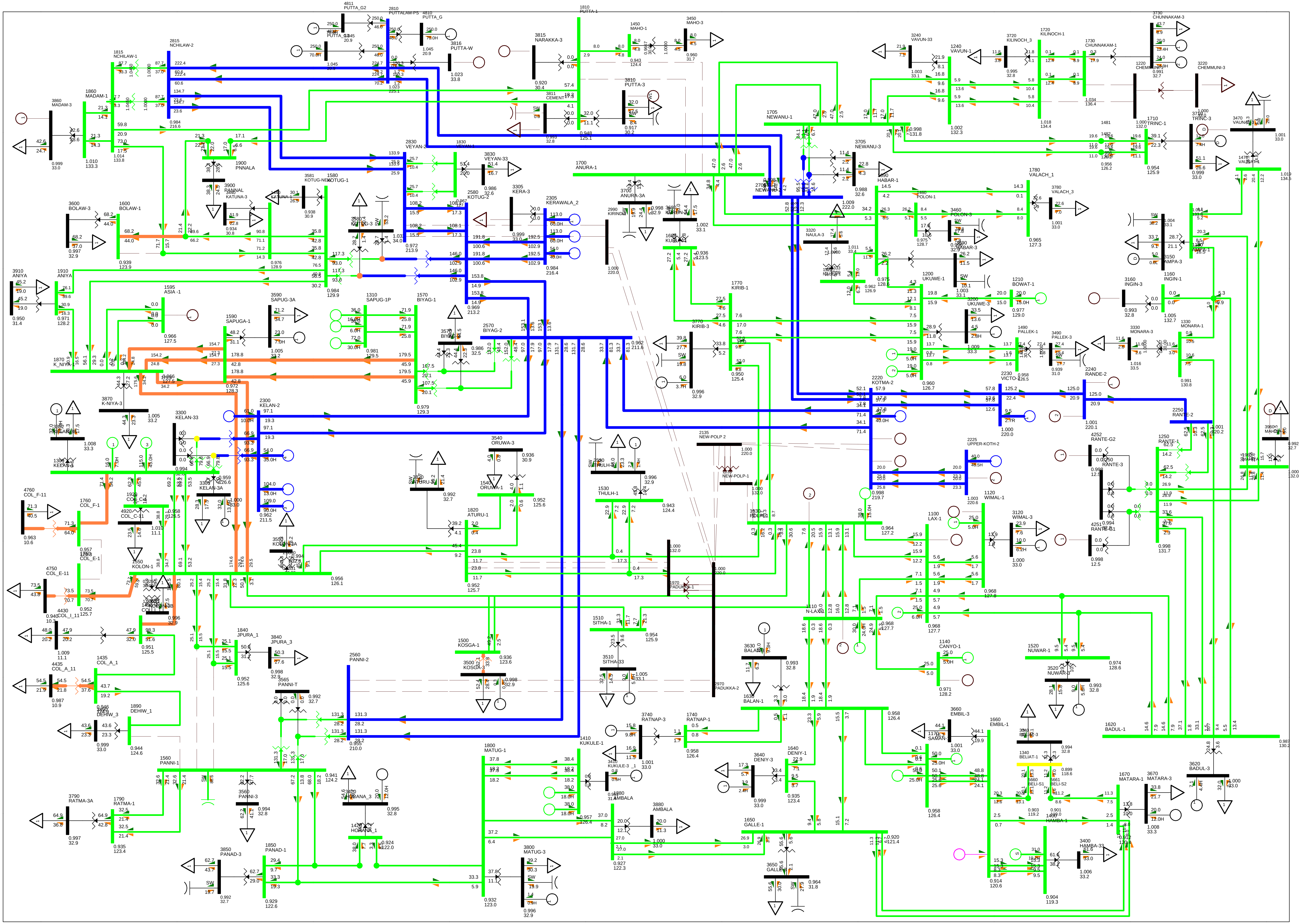
Annex C-9: Year 2014 Sri Lanka Transmission Network -Night Peak Thermal Maximum



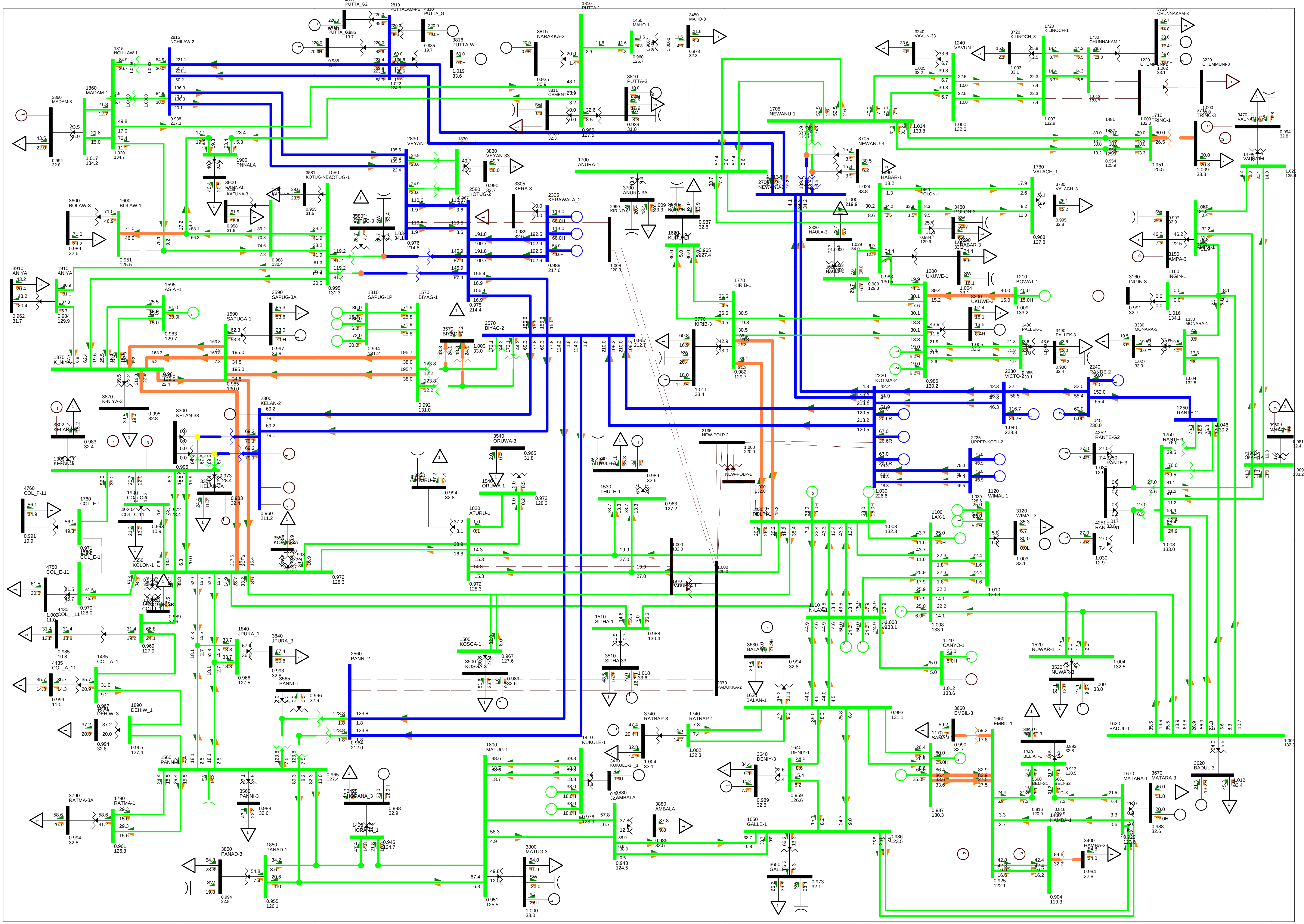
Annex C-10: Year 2014 Sri Lanka Transmission Network -Off Peak



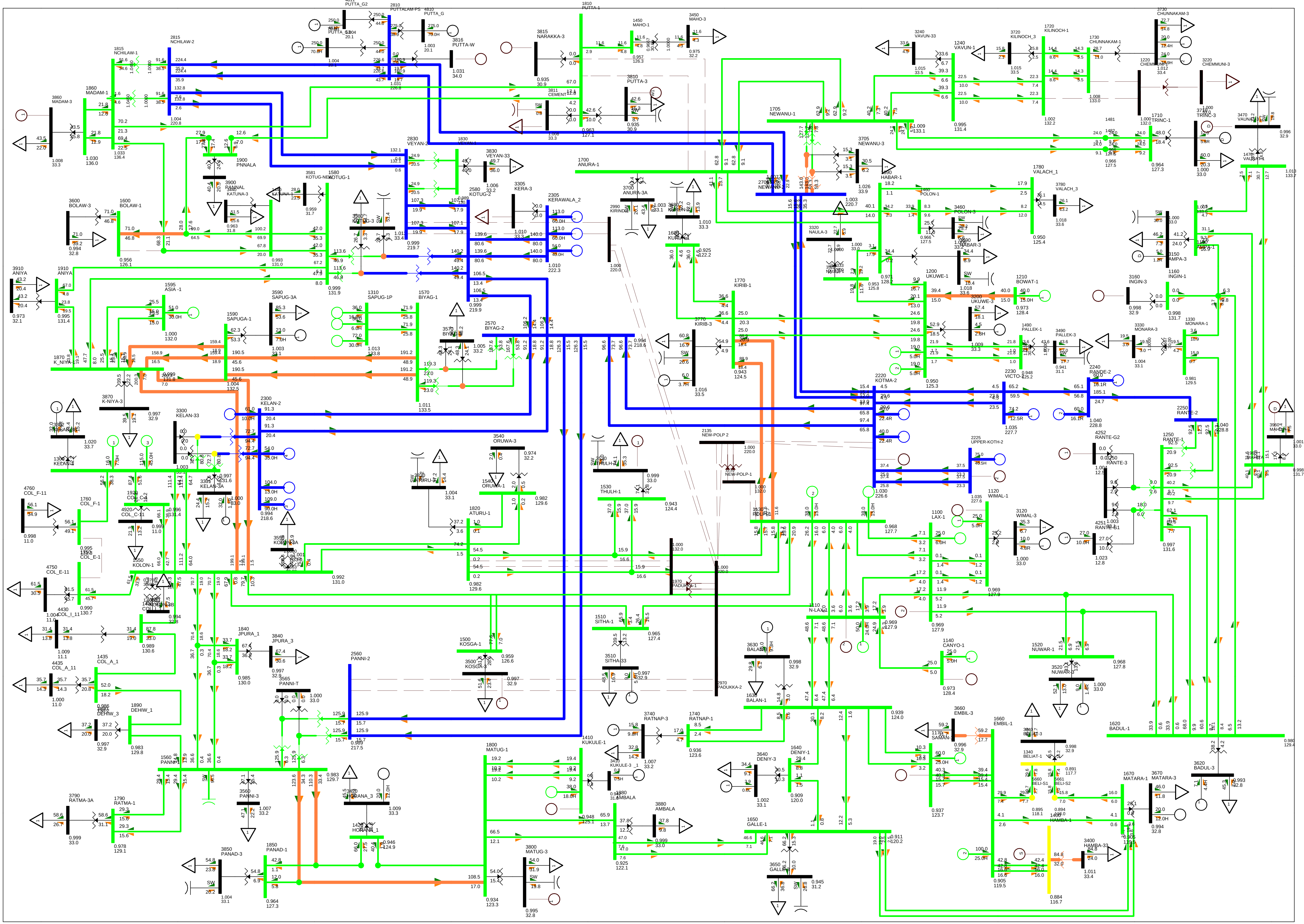
Annex C-11: Year 2015 Sri Lanka Transmission Network -Day Peak Hydro Maximum



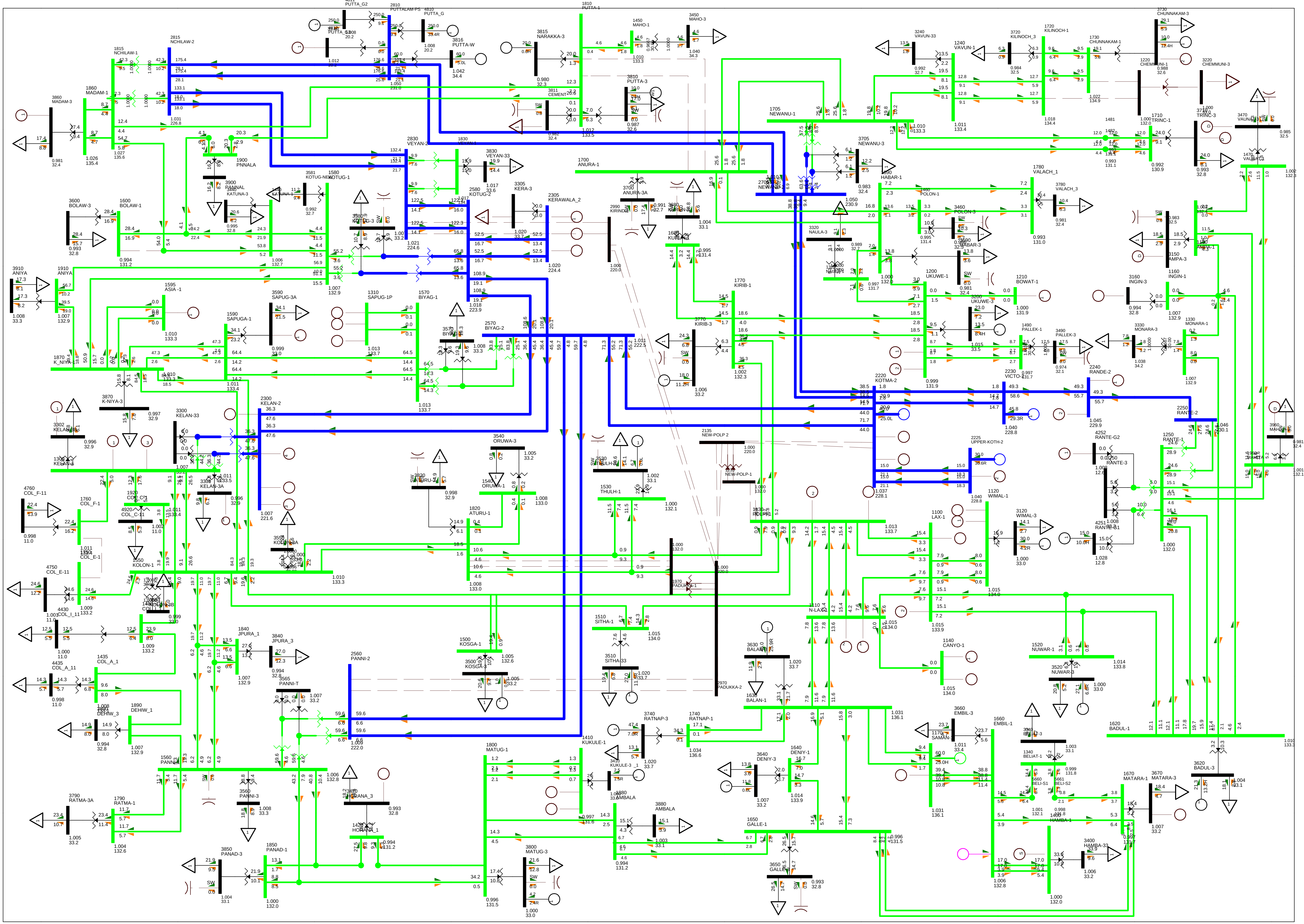
Annex C-12: Year 2015 Sri Lanka Transmission Network -Day Peak Thermal Maximum



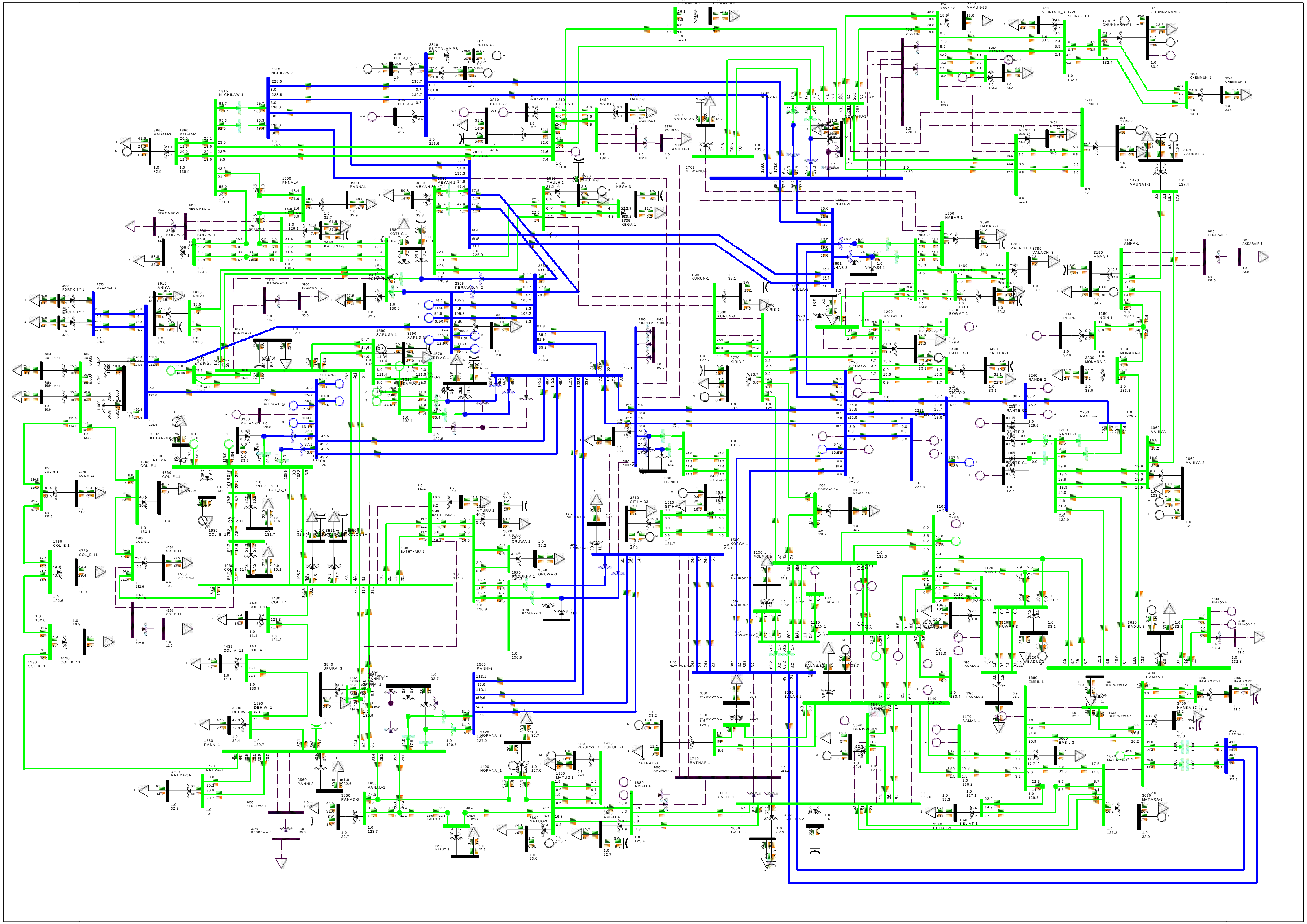
Annex C-13: Year 2015 Sri Lanka Transmission Network -Night Peak Hydro Maximum



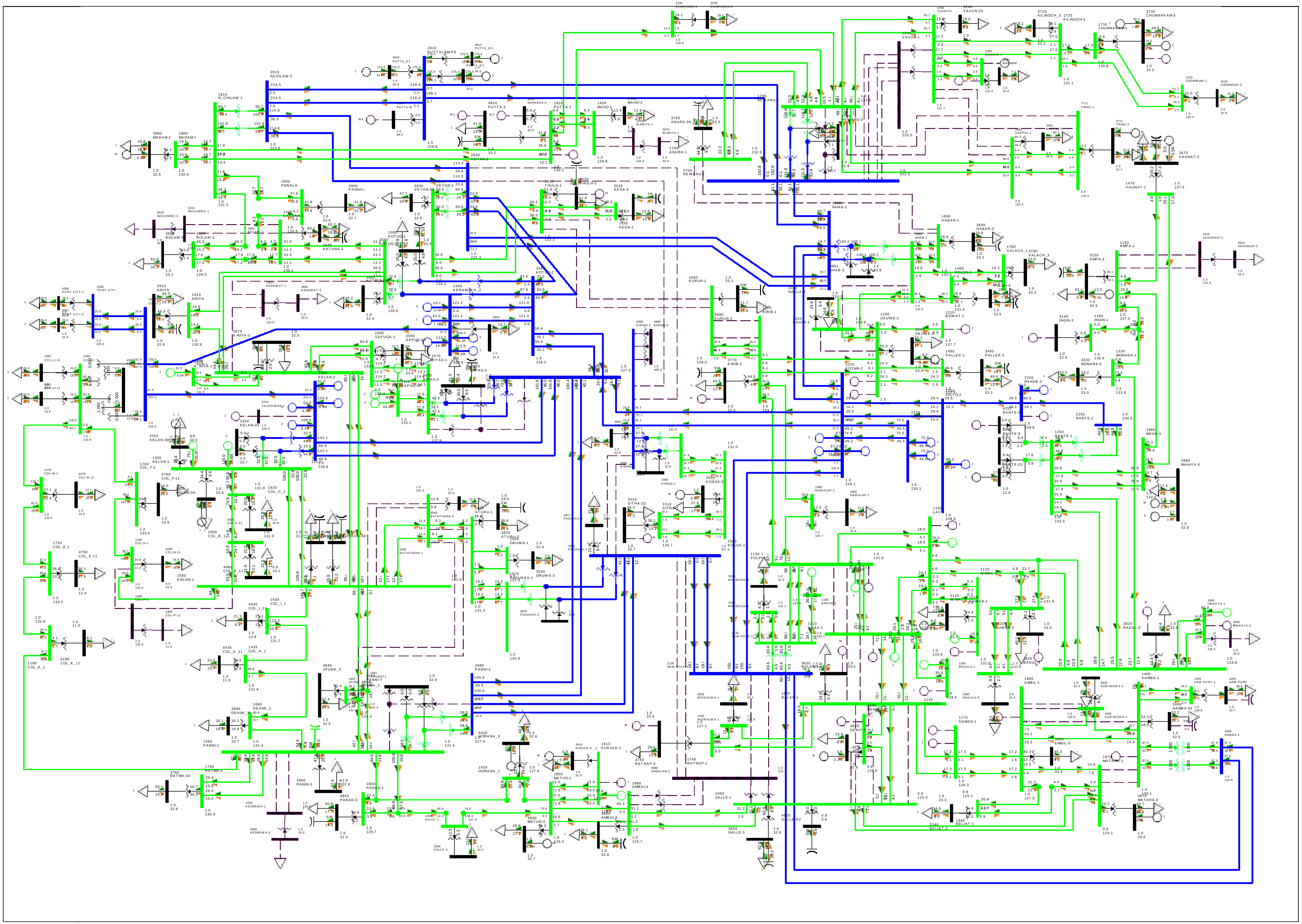
Annex C-14: Year 2015 Sri Lanka Transmission Network -Night Peak Thermal Maximum



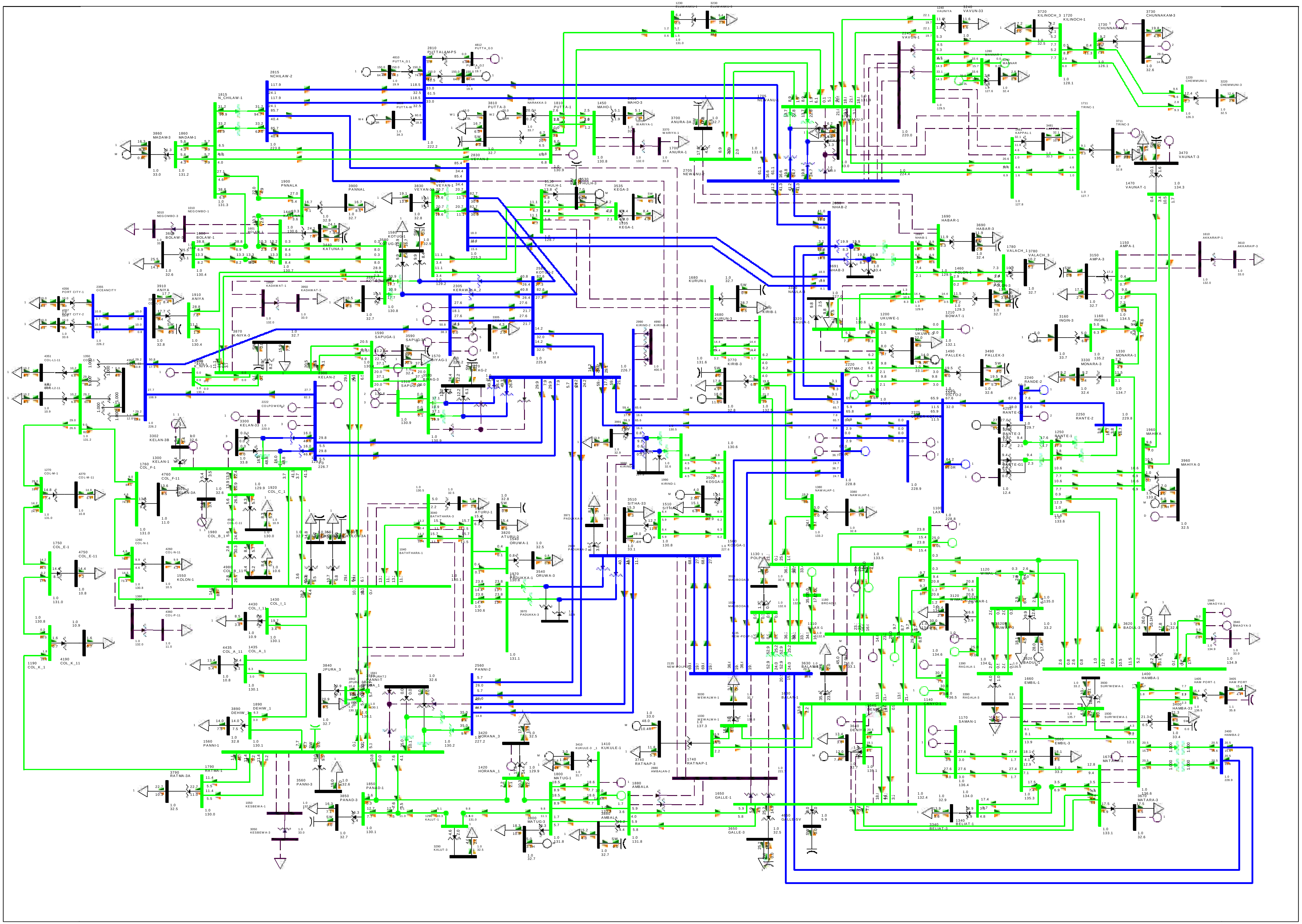
Annex C-15: Year 2015 Sri Lanka Transmission Network -Off Peak



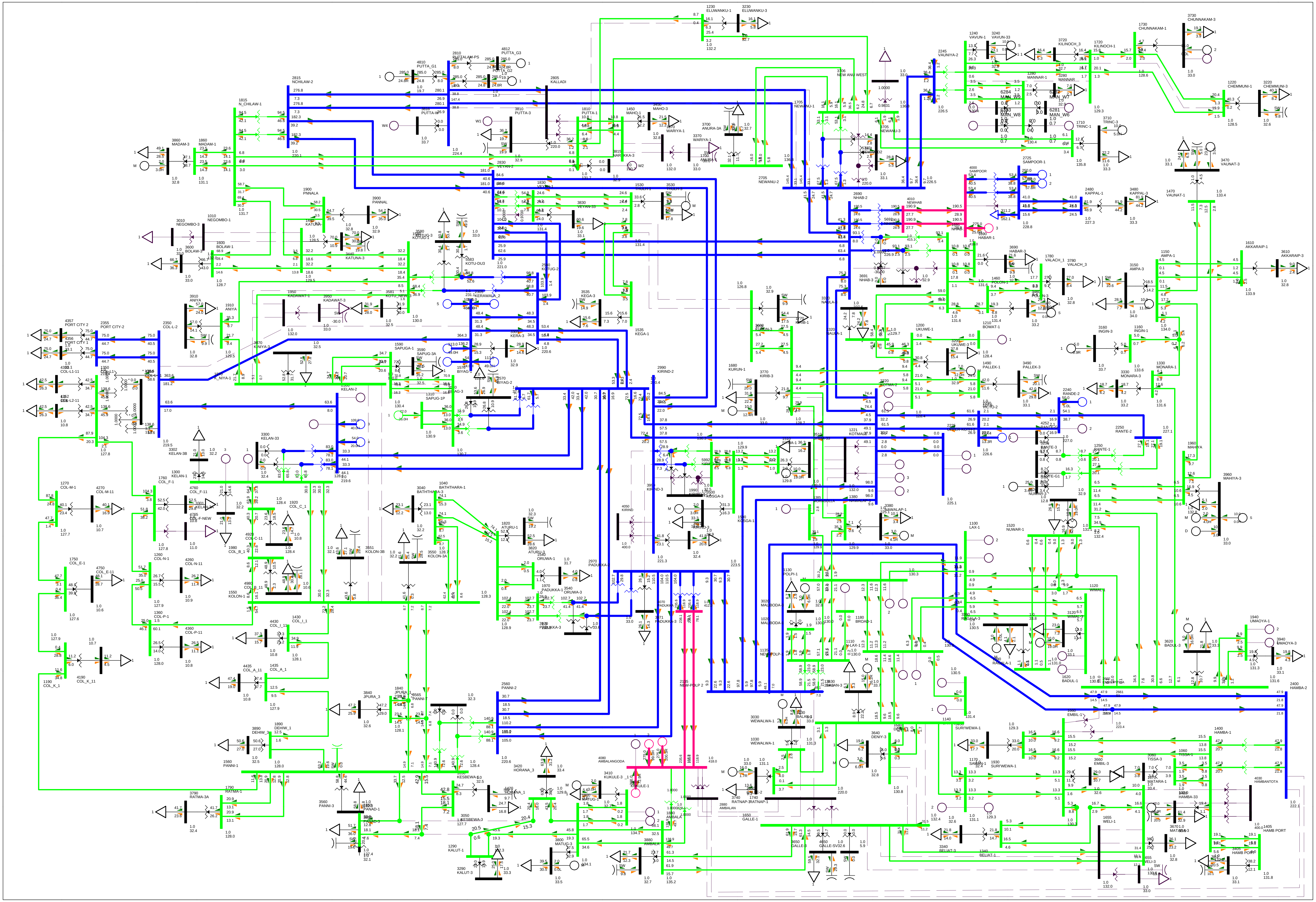
Annex C-16: Year 2017 Sri Lanka Transmission Network- Thermal Maximum Day Peak

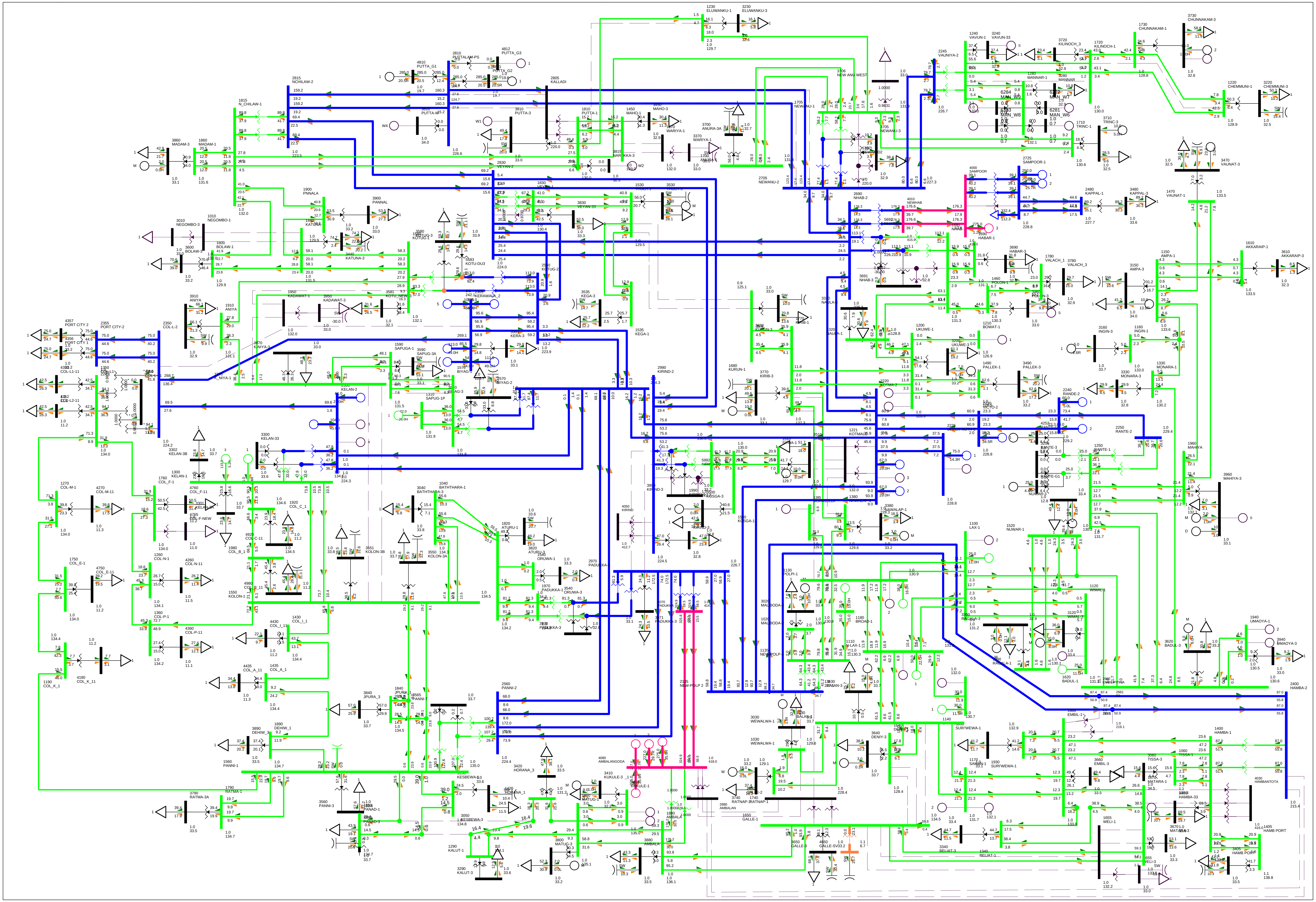


Annex C-17: Year 2017 Sri Lanka Transmission Network- Thermal Maximum Night Peak

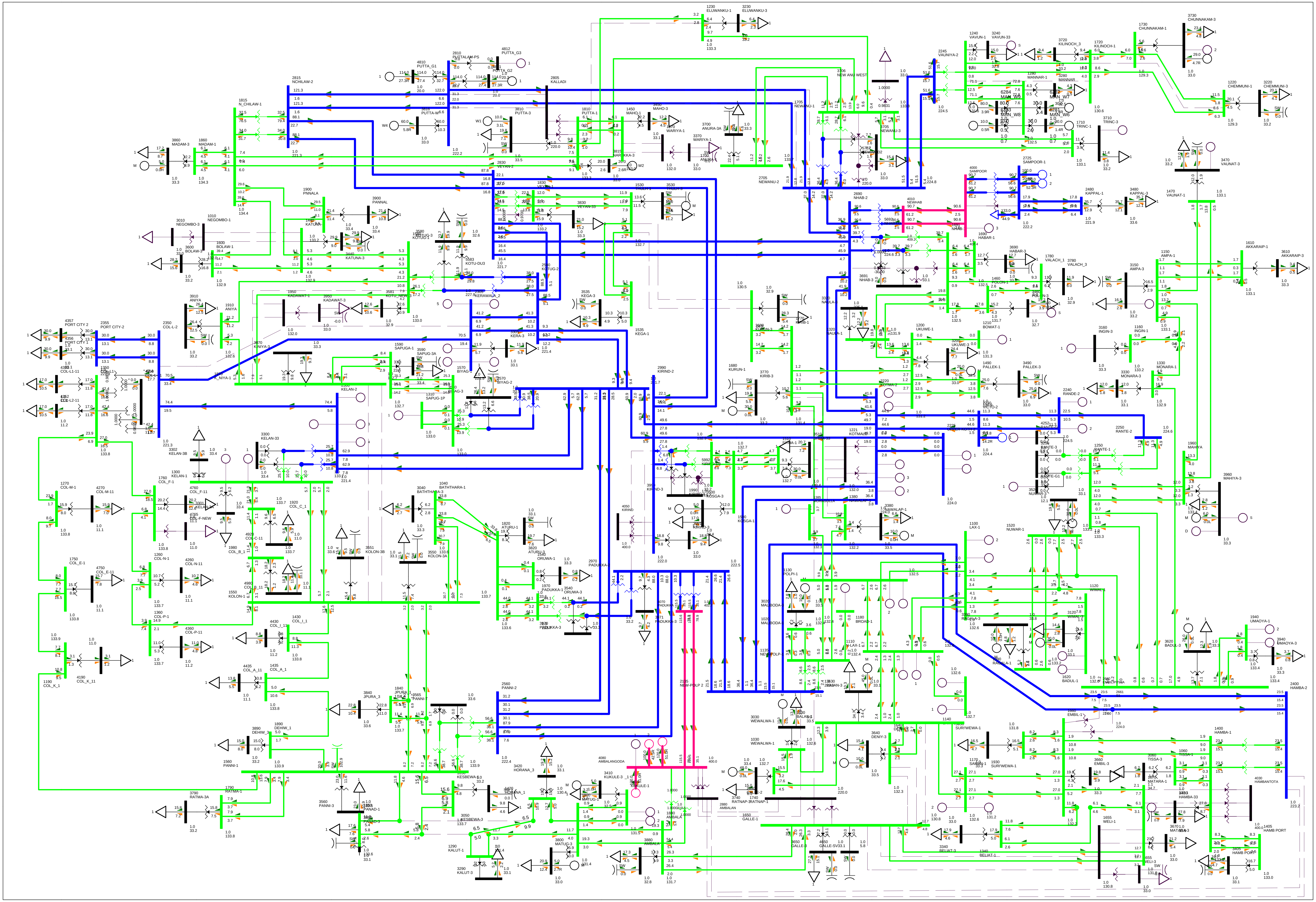


Annex C-18: Year 2017 Sri Lanka Transmission Network- Off Peak





Annex C-20: Year 2022 Sri Lanka Transmission Network-Night Peak Thermal Maximum



Long Term Transmission Development Plan 2013-2022

Annex C-20: Year 2022 Sri Lanka Transmission Network-Off Peak

ANNEX- D

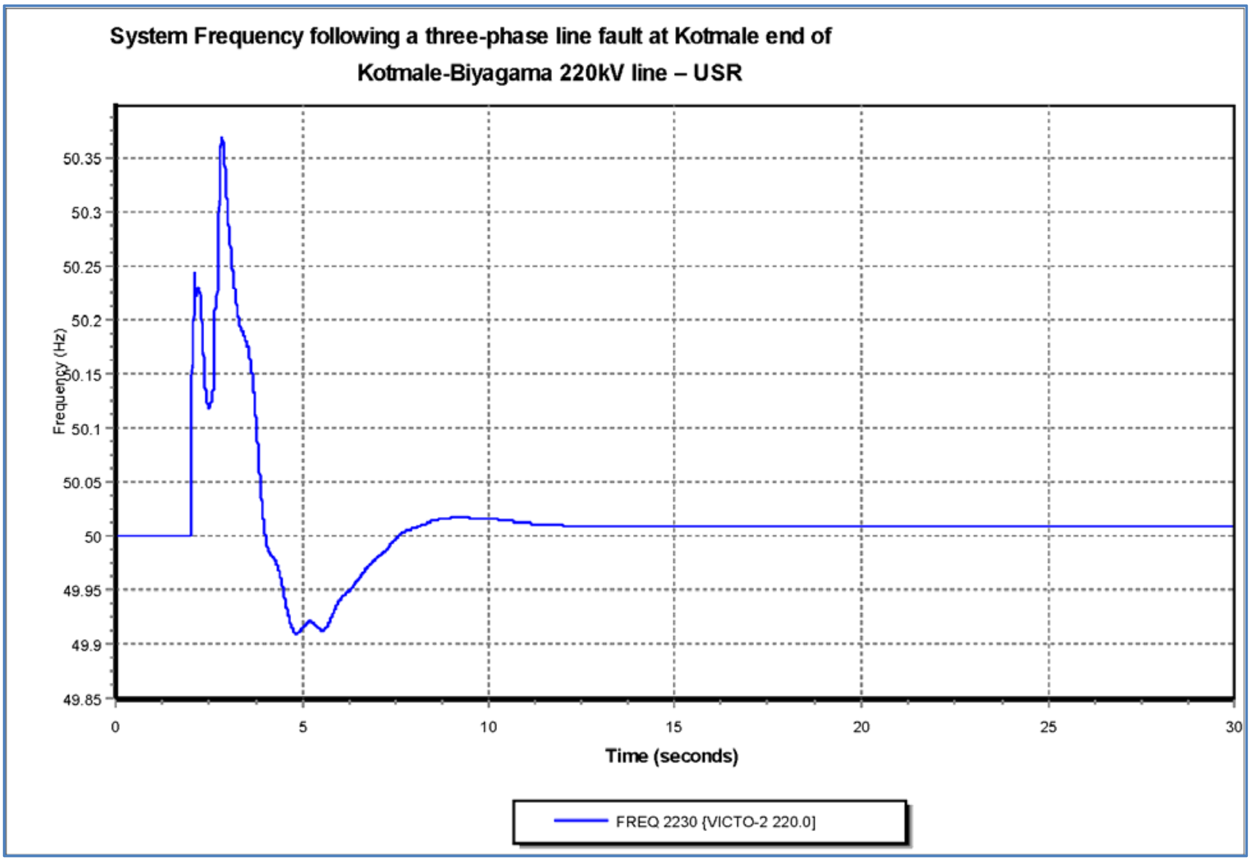
Generation Interconnection Schedule

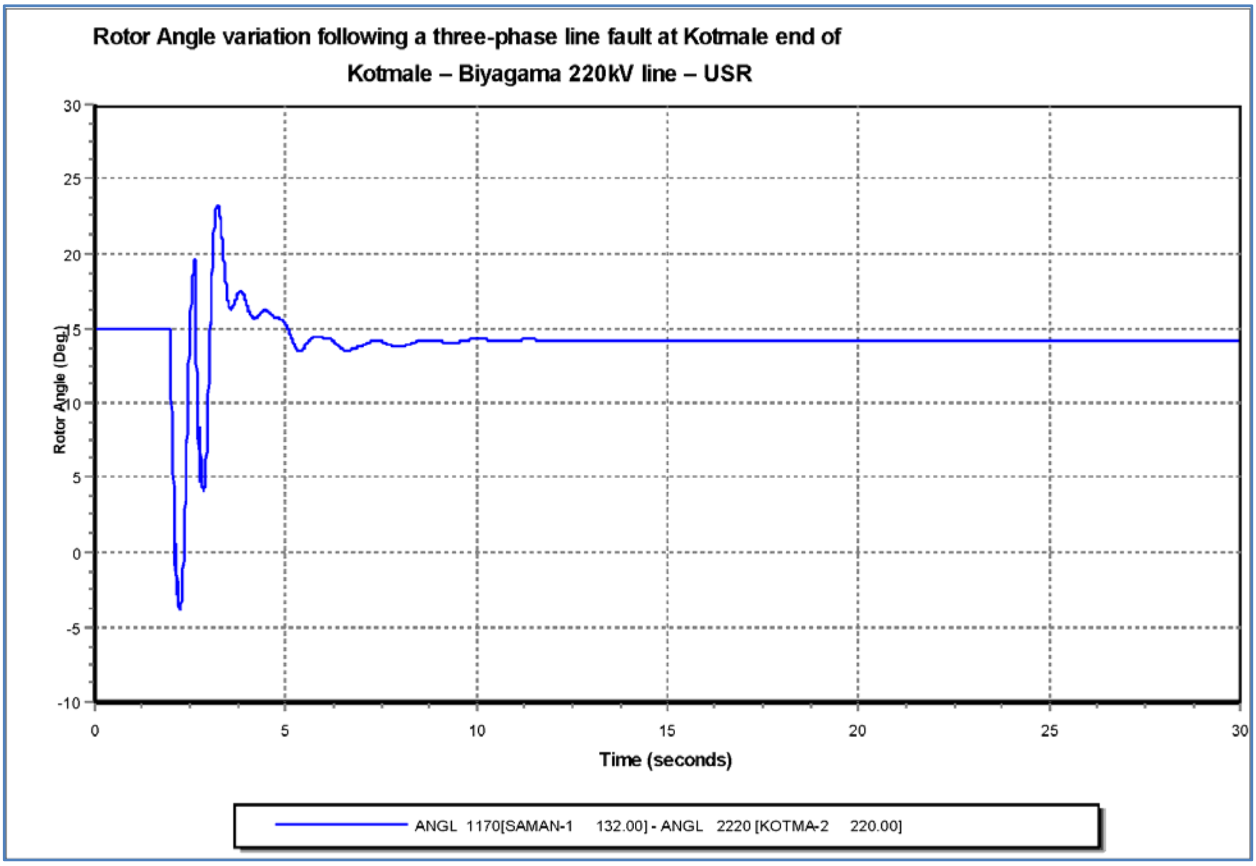
YEAR	RENEWABLE ADDITIONS	THERMAL ADDITIONS		THERMAL RETIREMENTS
		CAPACITY	LOCATION	
2013	-	-	-	4x5 MW ACE Power Matara 4x5 MW ACE Power Horana 4x5.63 MW Lakdanavi
2014	-	*4x5 MW Northern Power*** *3x8 MW Chunnakum Extension*** *1x300 MW Puttalam Coal (Stage II)*	Chunnakum Chunnakum Puttalam	-
2015	-	*1x300 MW Puttalam Coal (Stage II)* **1x75 MW Gas Turbine** **2x75 MW Gas Turbine**	Puttalam Kelanitissa Kerawalapitiya	6x16.6 MW Heladanavi Puttalam 14x7.11 MW ACE Power Embilipitiya 4x15 MW Colombo Power
2016	*35 MW Broadlands* *120 MW Uma Oya*	-		-
2017	-	**1x105 MW Gas Turbine**	Kerawalapitiya	-
2018	**27 MW Moragolla Plant**	**2x250 MW Coal Power plant**	Sampoor	4x5 MW Northern Power 8x6.13 MW Asia Power
2019	-	**2x300 MW Coal Power plant**	Ambalangoda	5x17 MW Kelanitissa Gas Turbines 4x18 MW Sapugaskanda diesel
2020	-	-	-	-
2021	-	**1x300 MW Coal plant**	Ambalangoda	-
2022	**49 MW Gin Ganga**	**1x300 MW Coal plant**	Sampoor	-
2023	-	**2x300 MW Coal plant**	Ambalangoda	163 MW AES Kelanitissa Combined Cycle Plant 115 MW Gas Turbine 4x9 MW Sapugaskanda Diesel Ext.
2024	-	-	-	-
2025	-	**1x300 MW Coal plant**	Sampoor	4x9 MW Sapugaskanda Diesel Ext.
2026	-	-	-	-
2027	-	**1x300 MW Coal plant**	Sampoor	-
2028	-	**1x300 MW Coal plant**	Hambantota	-
2029	-	-	-	-
2030	-	**1x300 MW Coal plant**	Hambantota	-
2031	-	**1x300 MW Coal plant**	Hambantota	-
2032	-	**1x300 MW Coal plant**	Hambantota	-

ANNEX- E

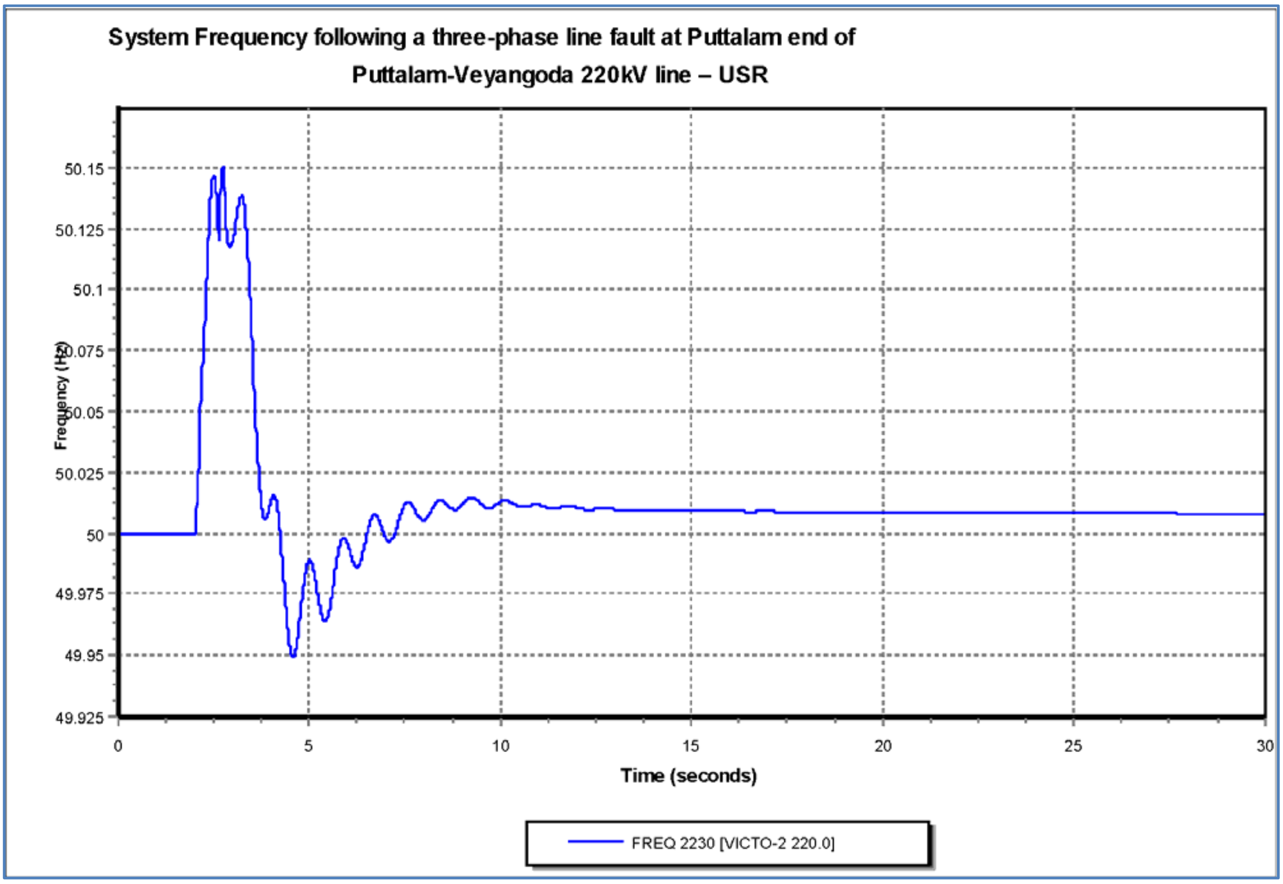
Annex E-1: Stability Plots for Transmission System   Year 2013

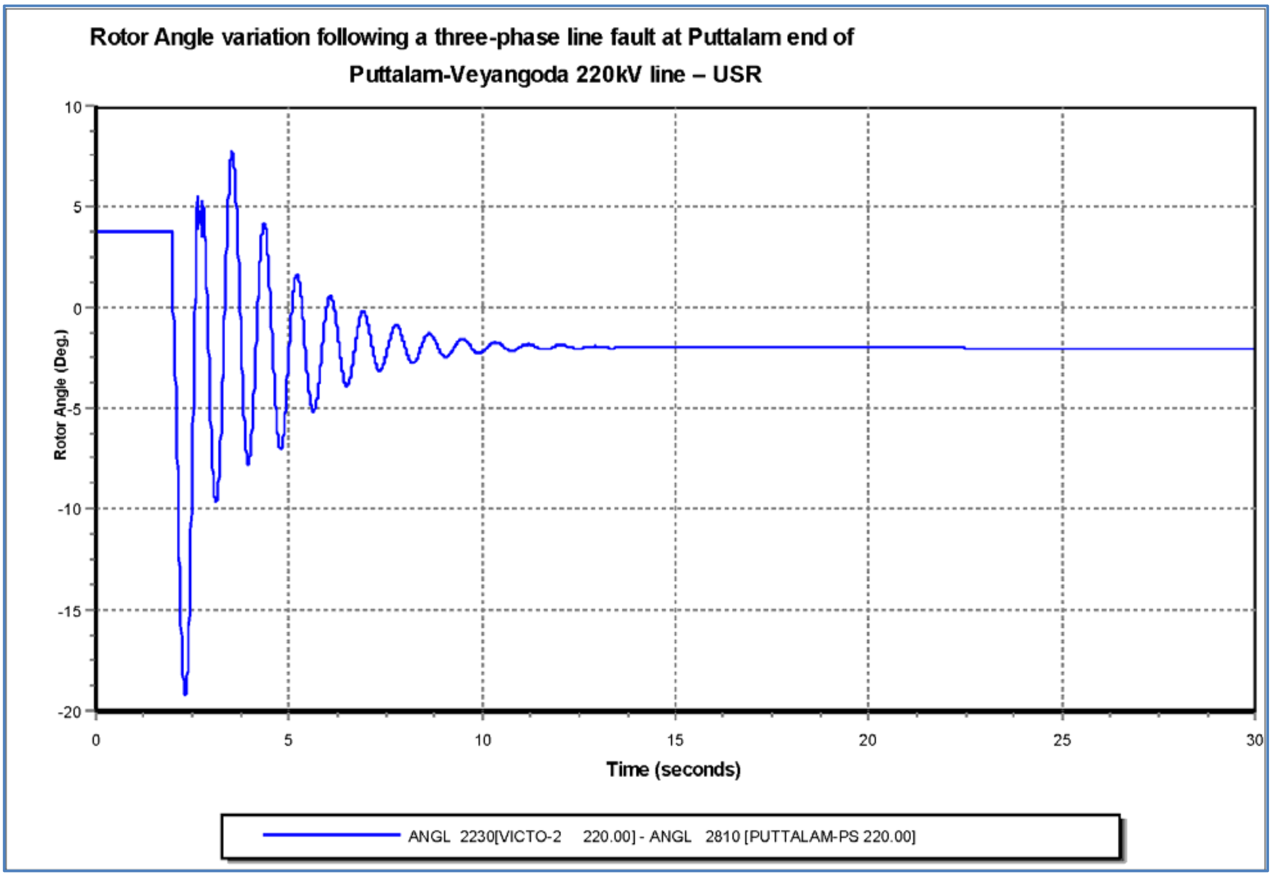
Stability plots following a three-phase line fault at Kotmale end of Kotmale-Biyagama 220kV line   USR-Night Peak Loading Condition



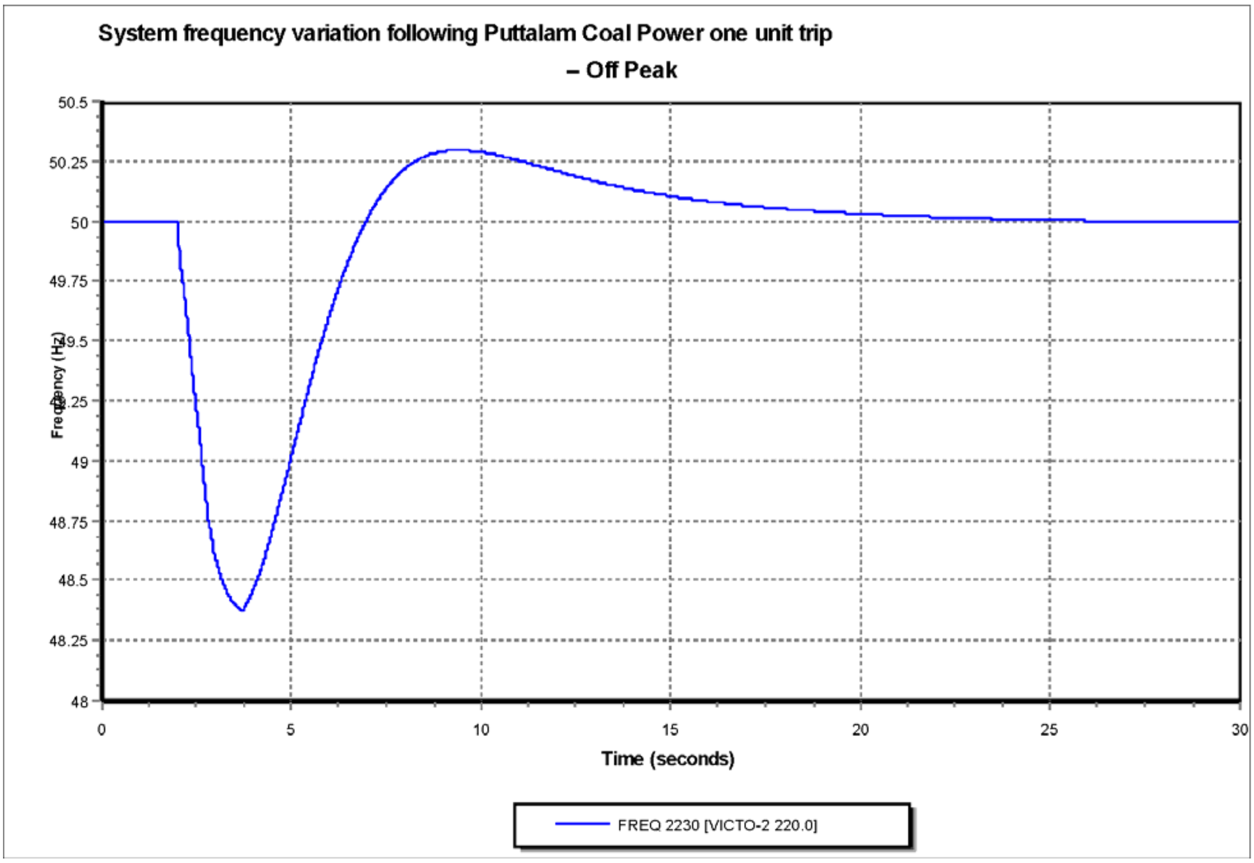


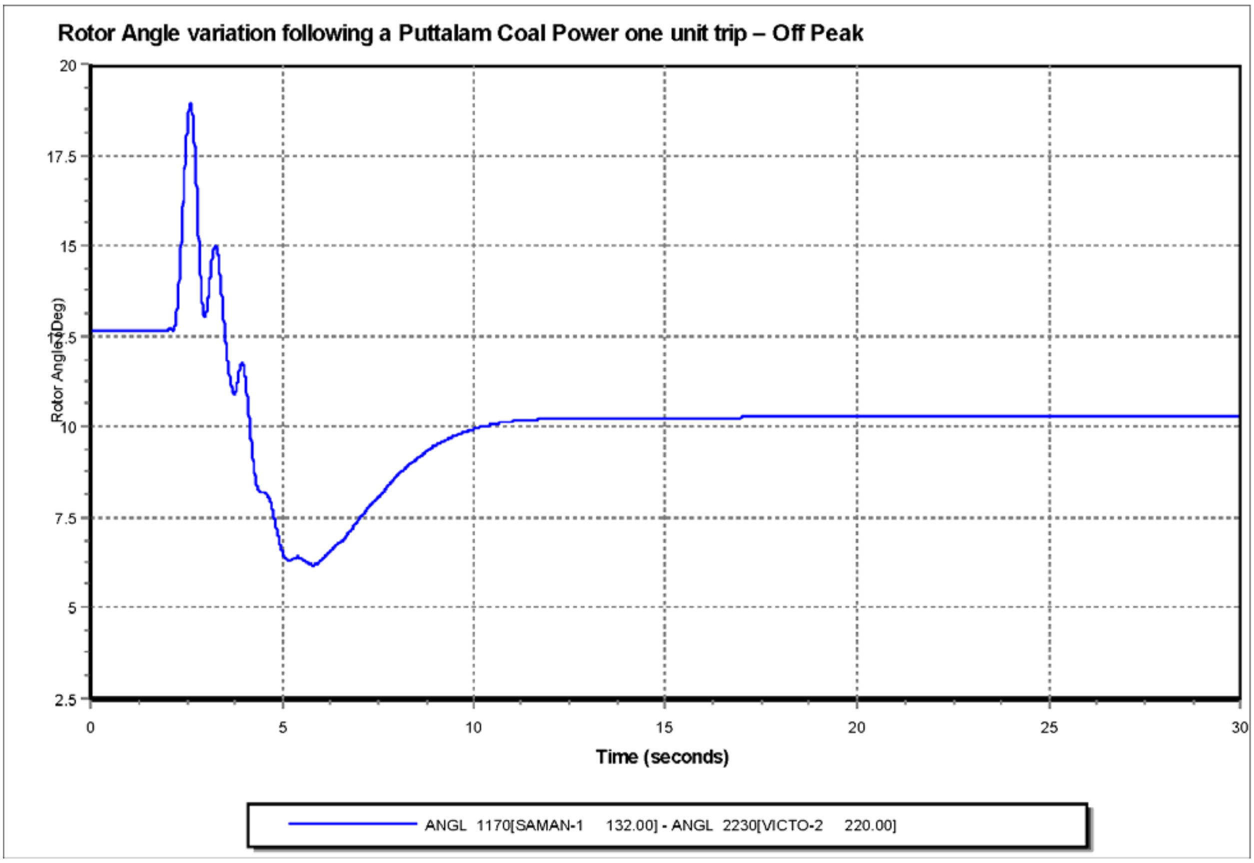
Stability plots following a three-phase line fault at Puttalam end of Puttalam-Veyangoda 220kV line USR-Night Peak Loading Condition





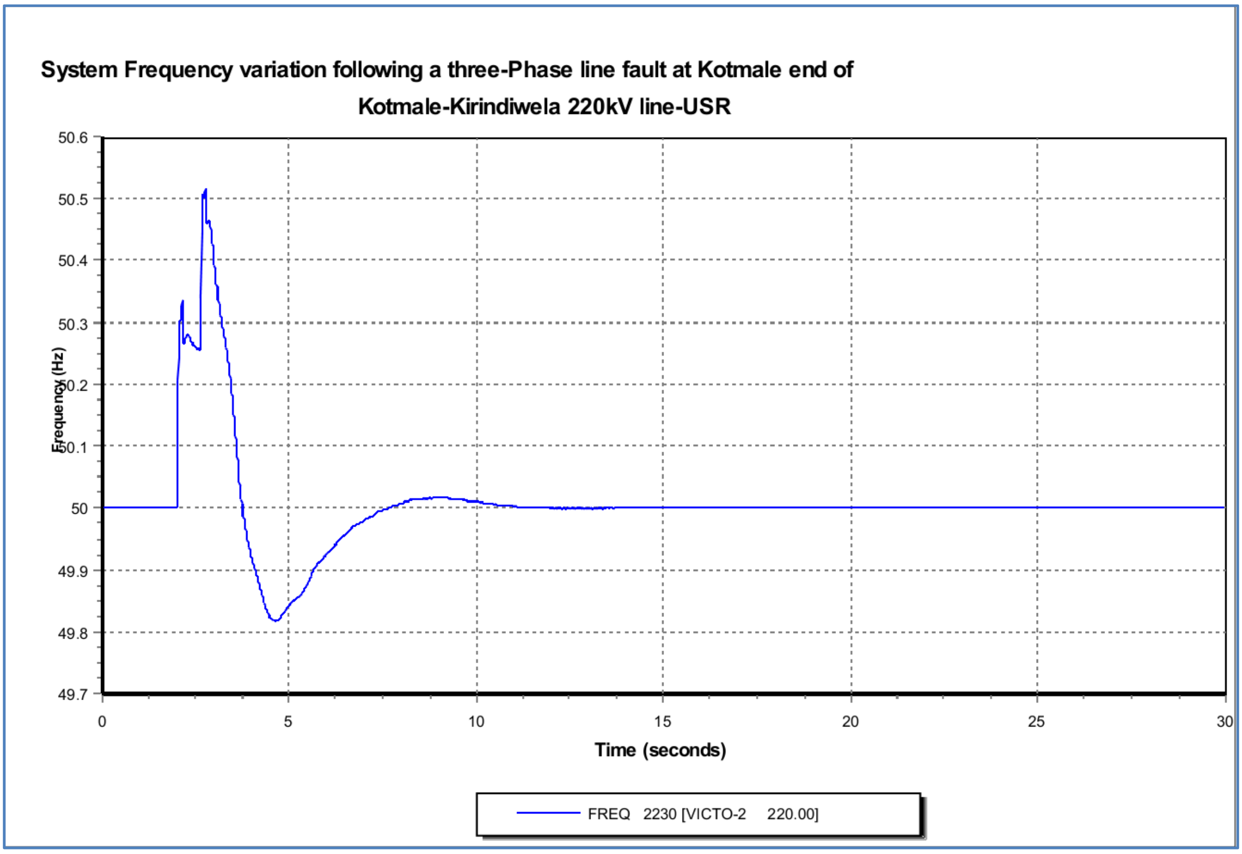
System fre uency variation following a unit trip of Puttalam Coal Power Plant
Off Peak Loading Condition

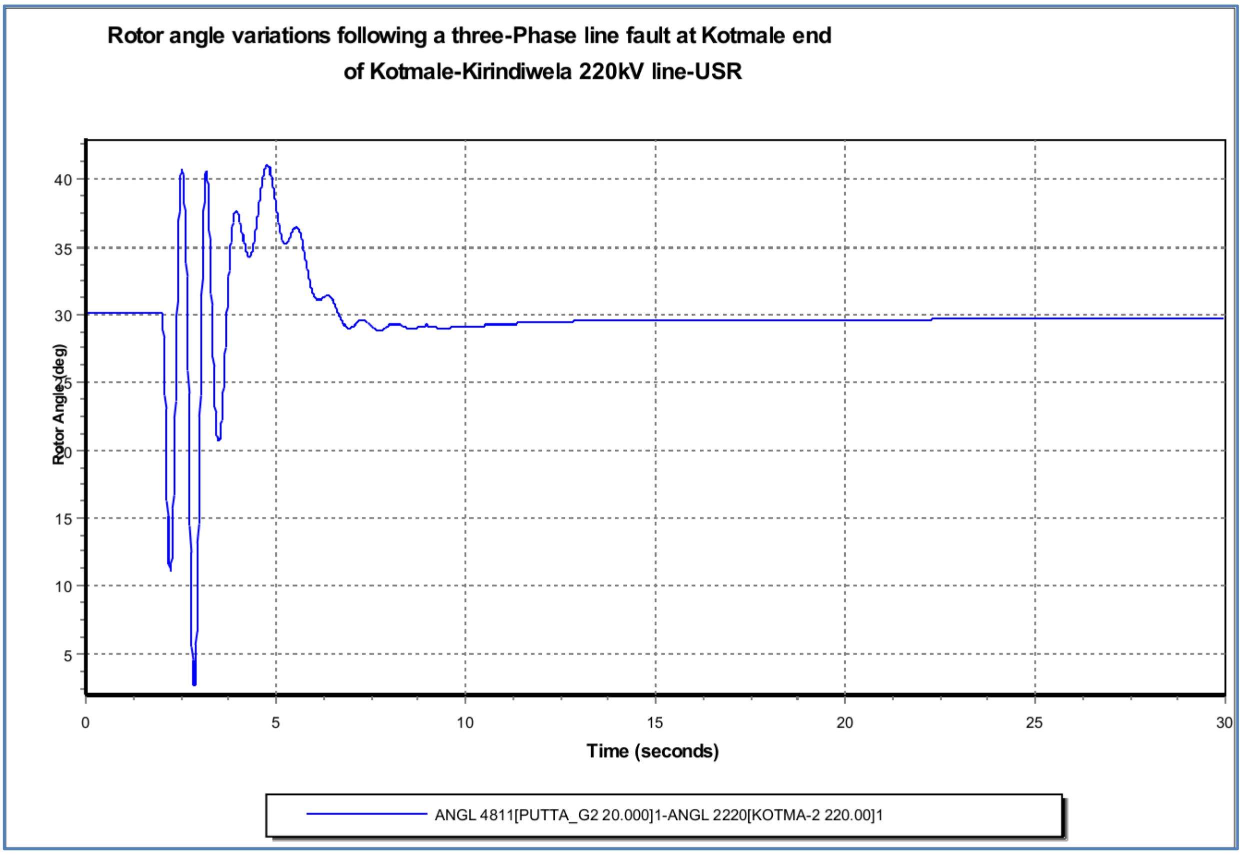




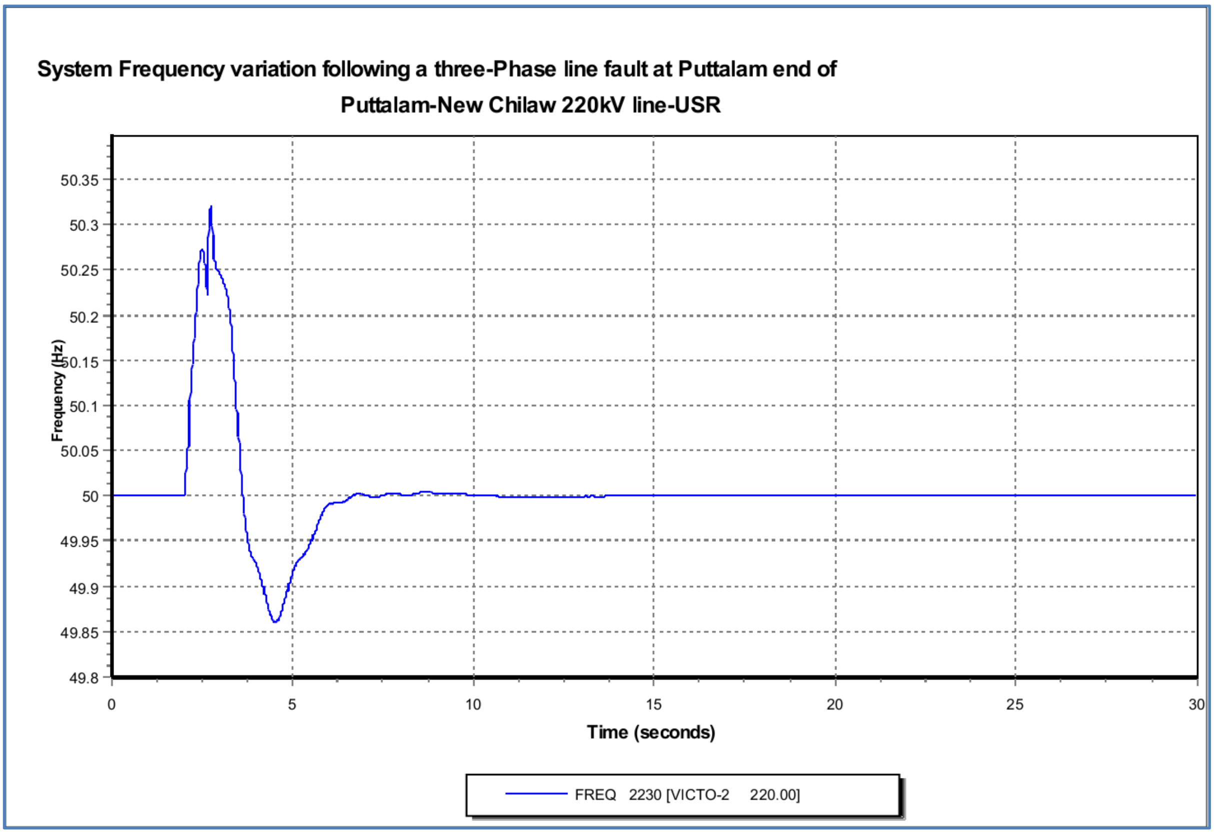
Annex E-2: Stability Plots for Transmission System   Year 2017

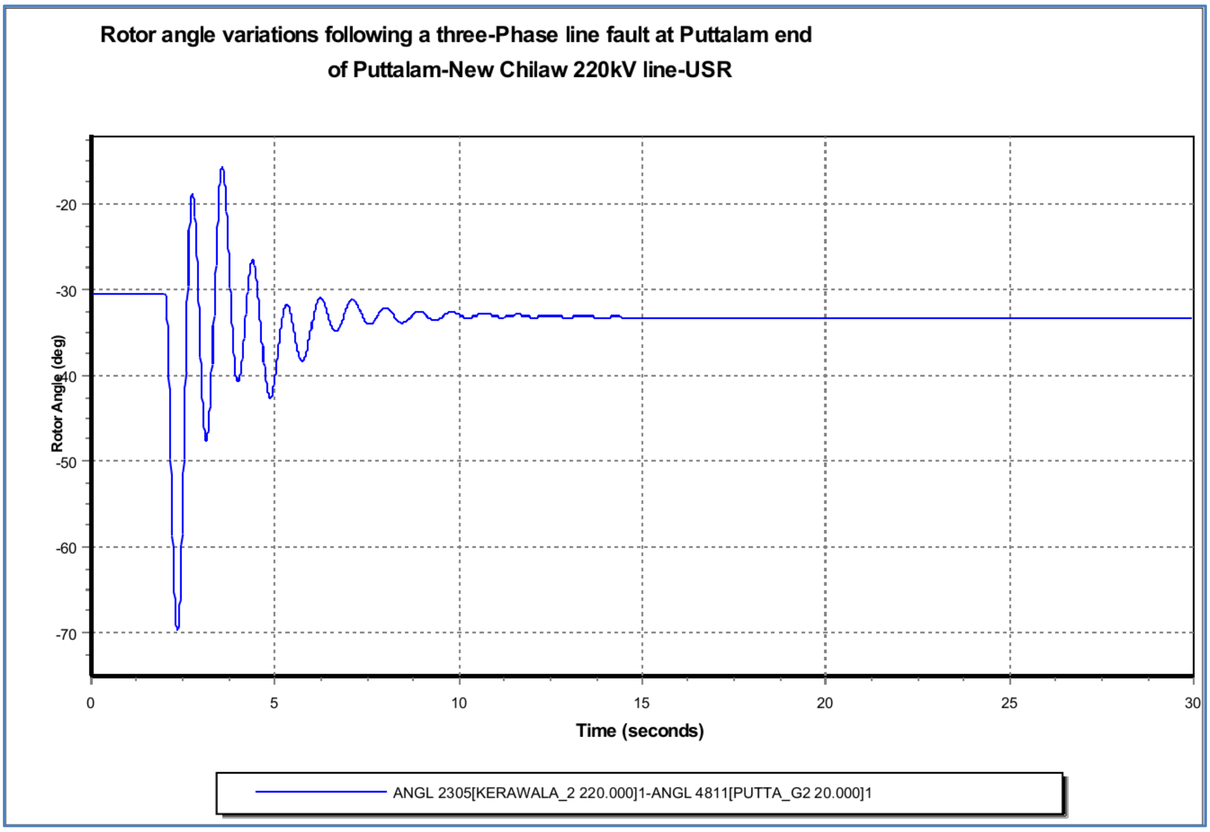
Stability plots following a three-phase line fault at Kotmale end of Kotmale-Kirindiwela 220kV line   USR-Night Peak Loading Condition



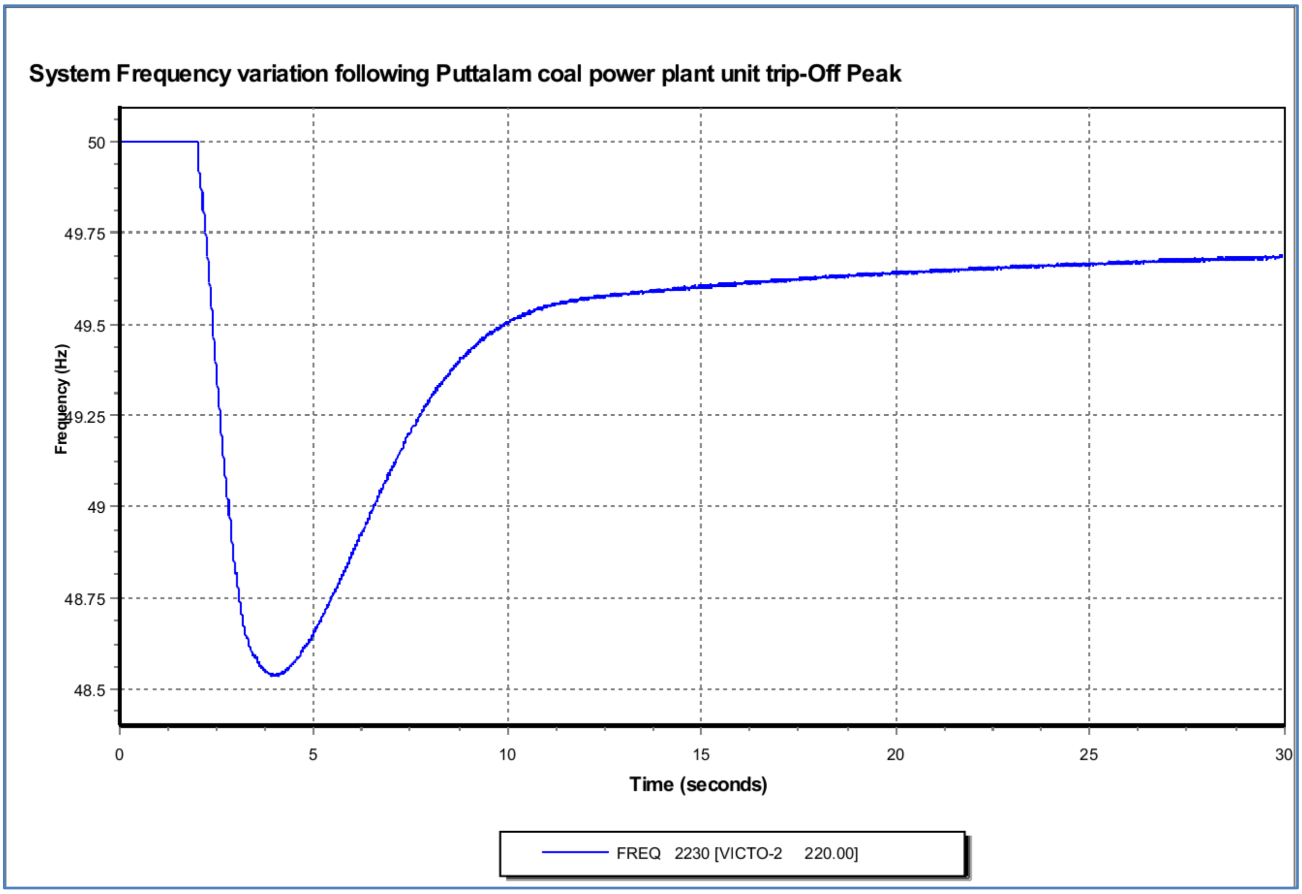


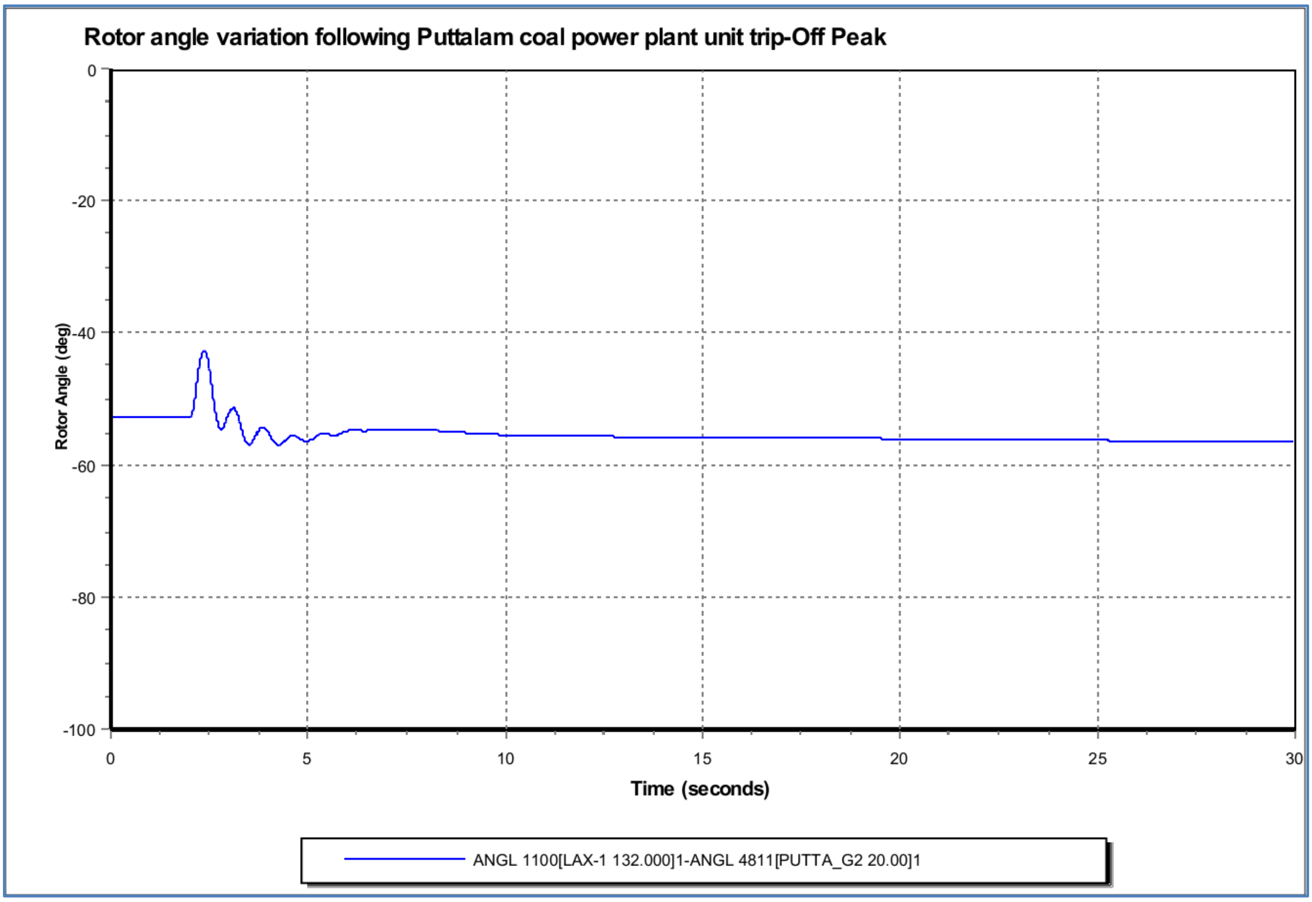
Stability plots following a three-phase line fault at Puttalam end of Puttalam New Chilaw220kV line USR-Night Peak Loading Condition





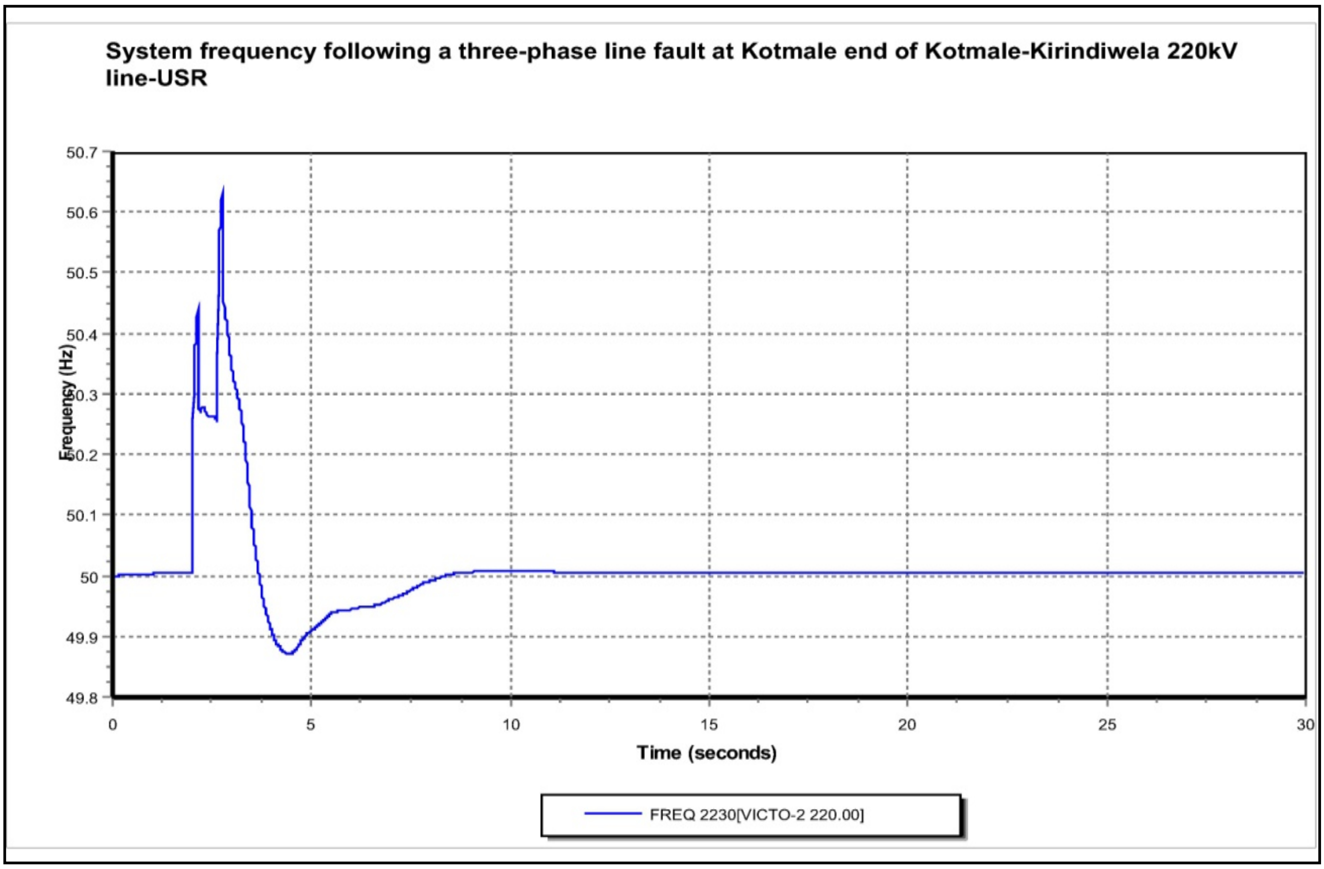
System fre uency variation following a unit trip of Puttalam Coal Power Plant
Off Peak Loading Condition

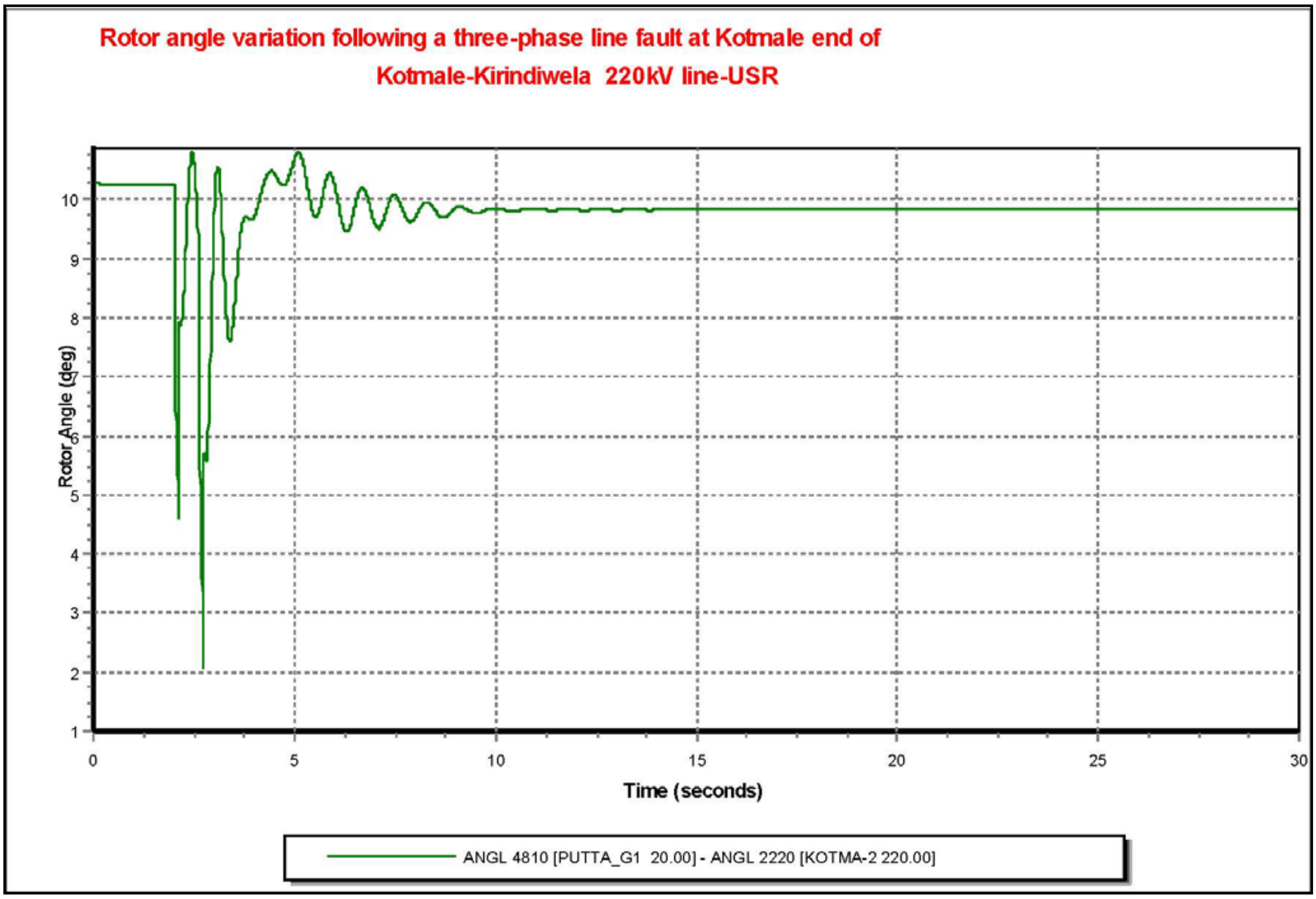




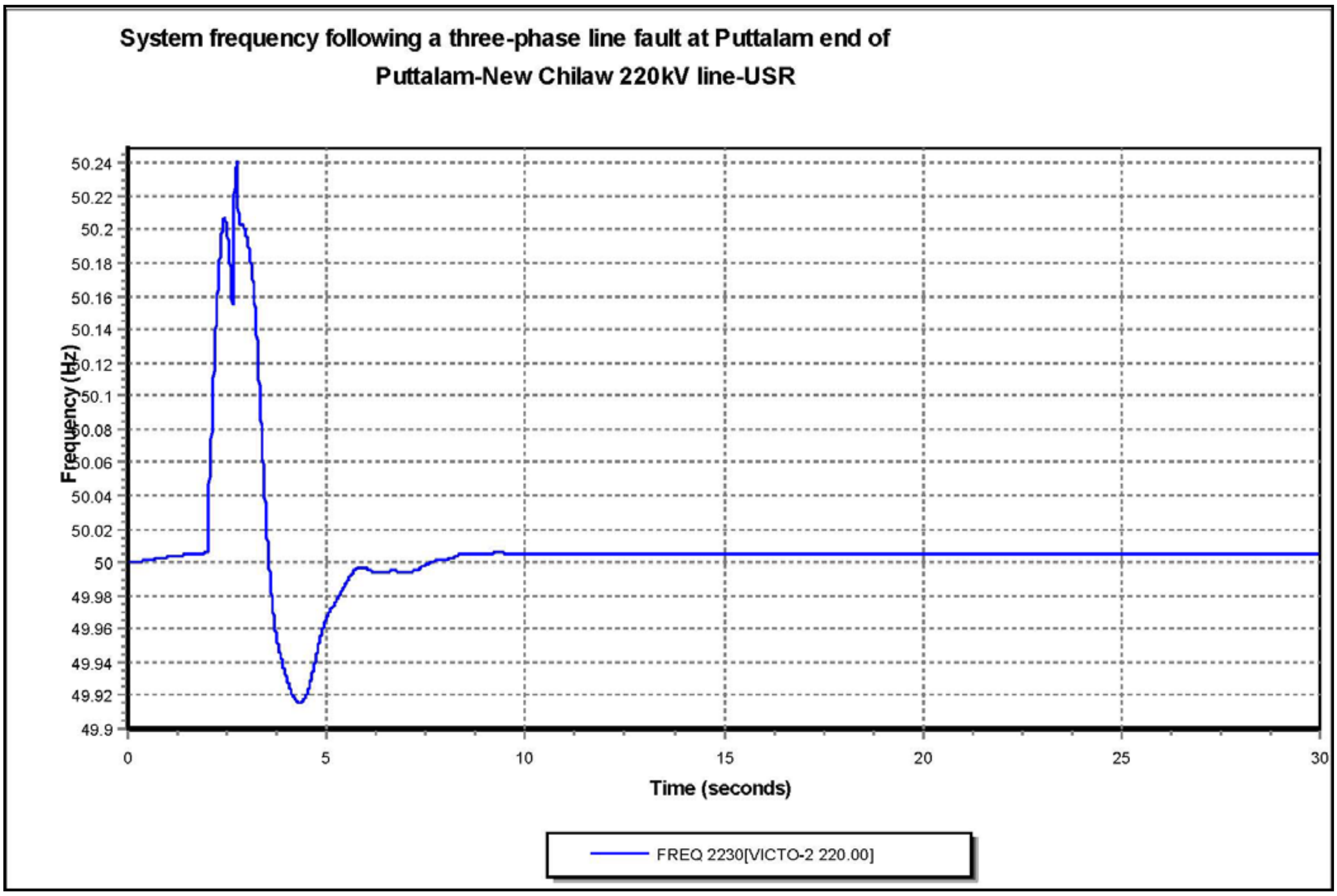
Annex E-3: Stability Plots for Transmission System Year 2022

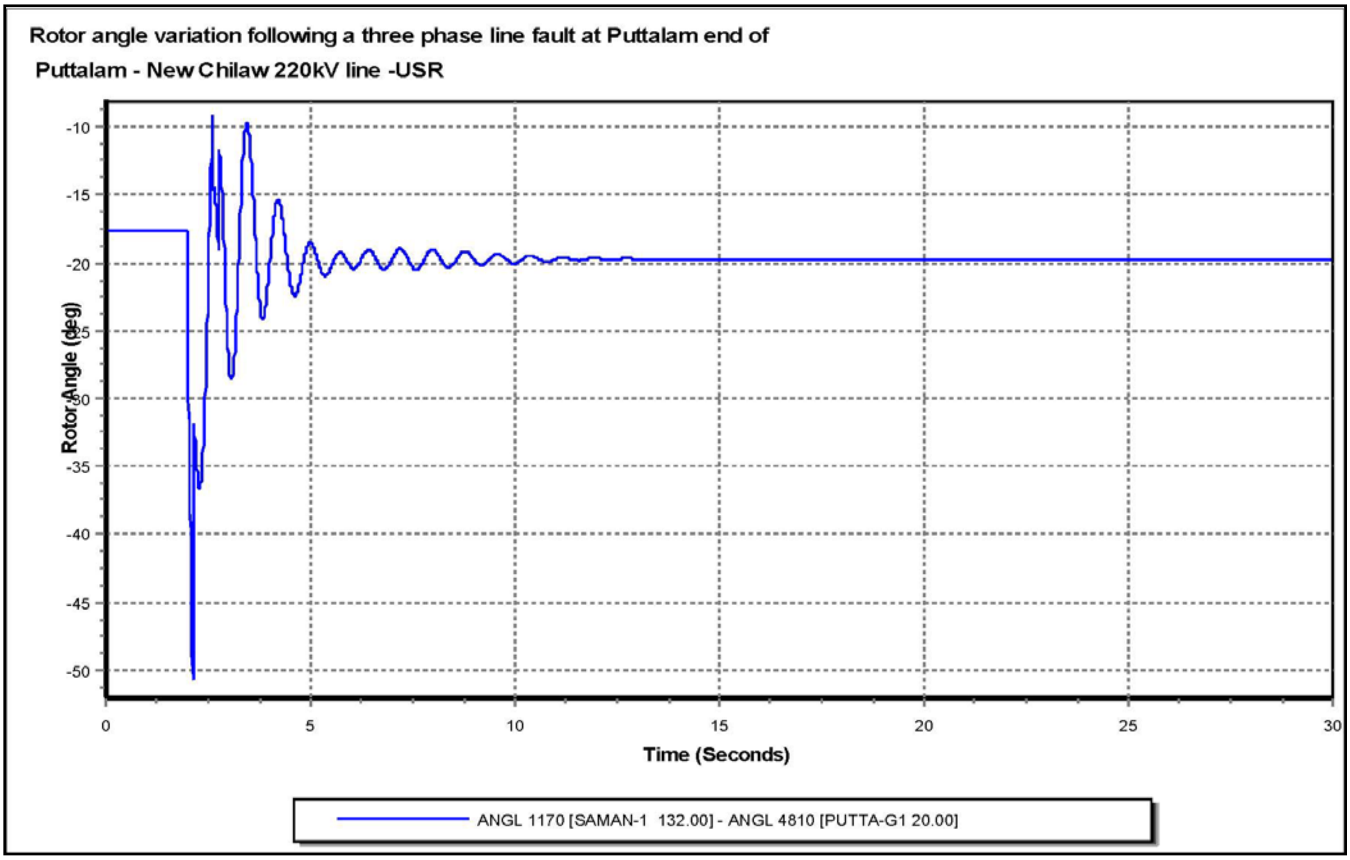
Stability plots following a three-phase line fault at Kotmale end of Kotmale-Kirindiwela 220kV line USR-Night Peak Loading Condition



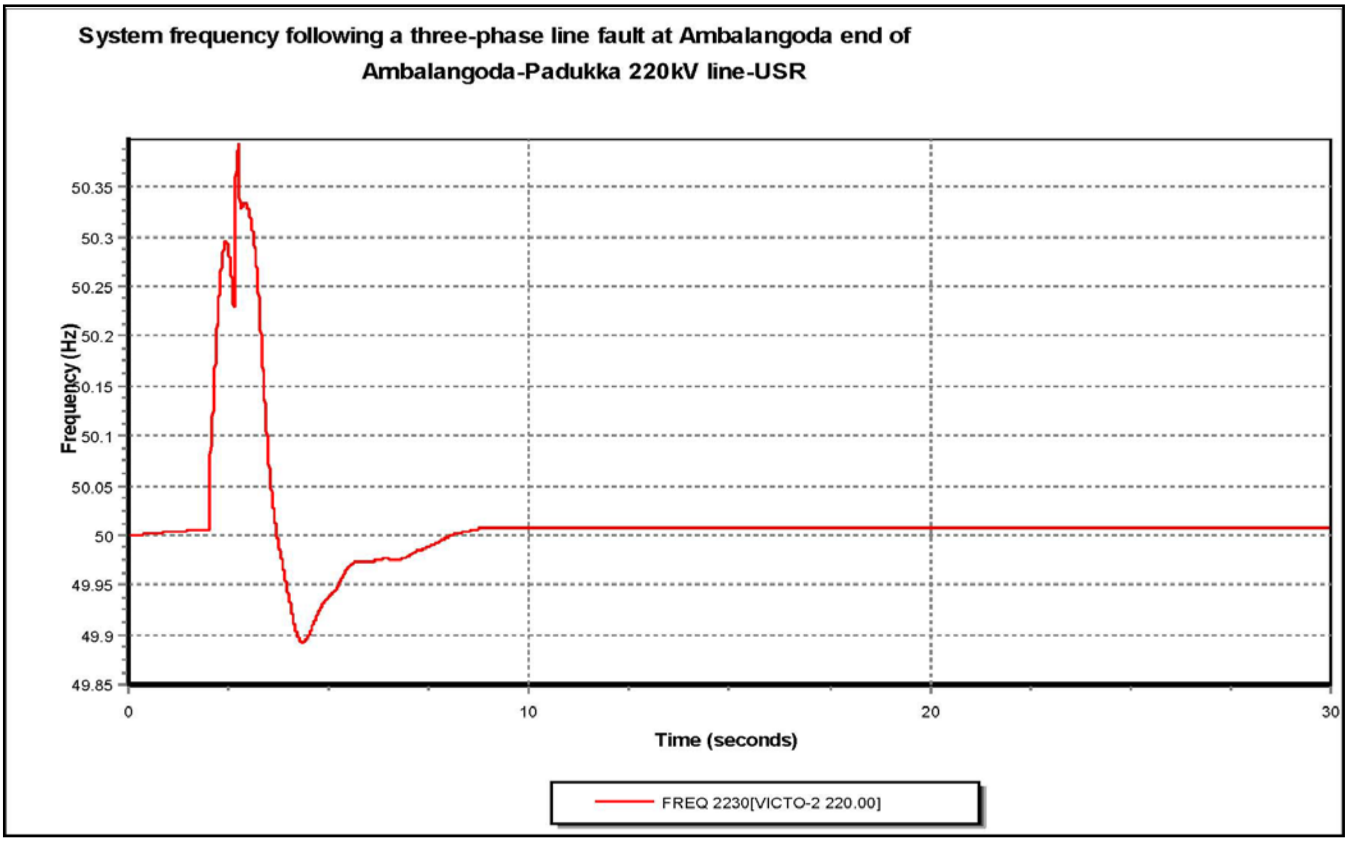


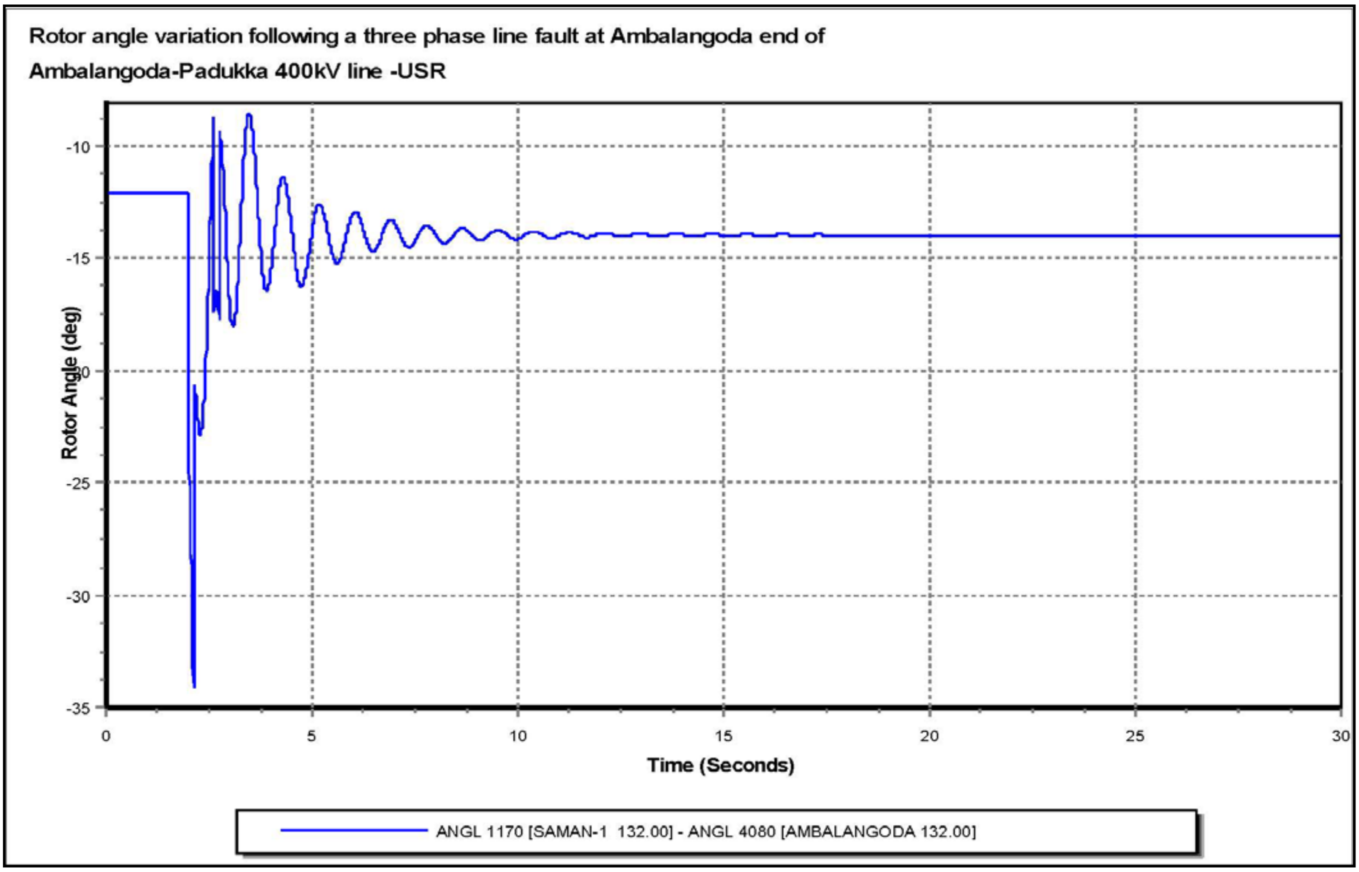
Stability plots following a three-phase line fault at Puttalam end of Puttalam New Chilaw220kV line USR-Night Peak Loading Condition



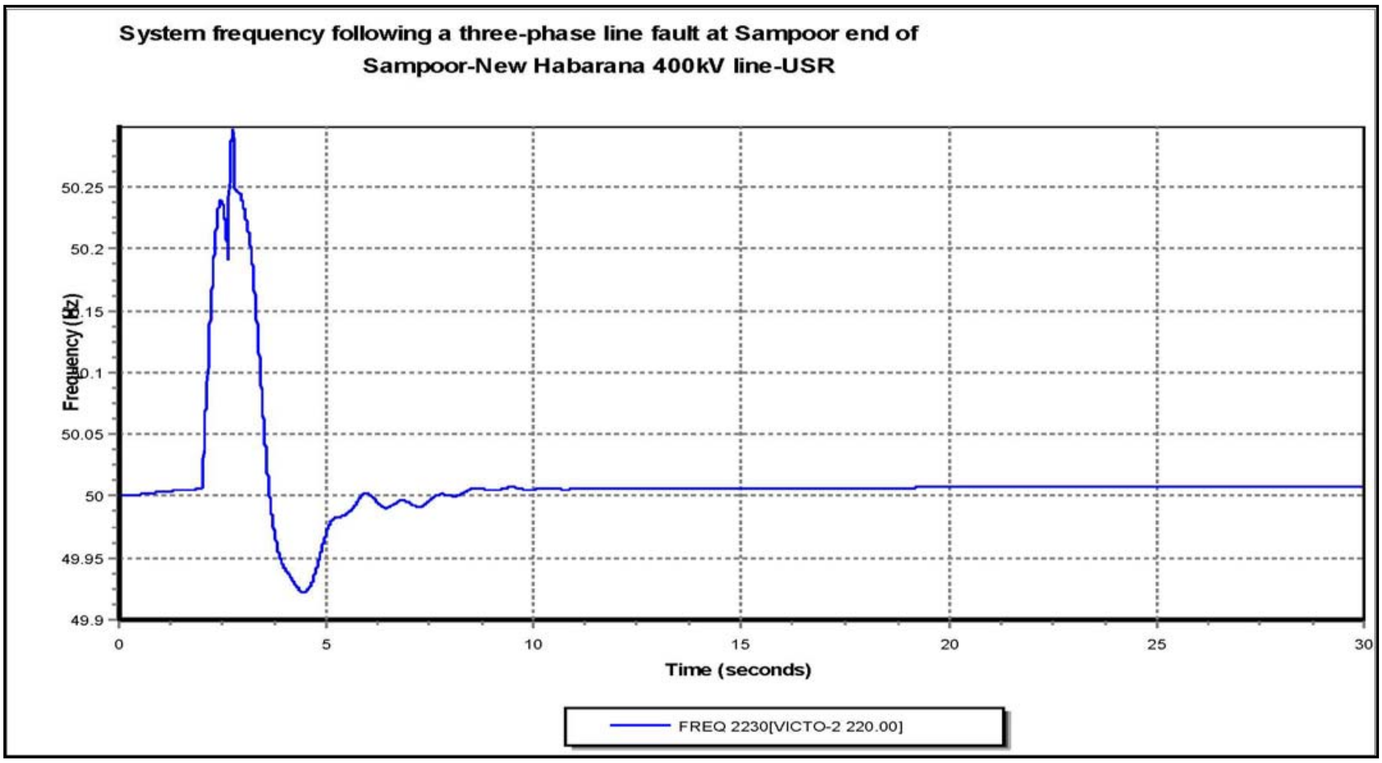


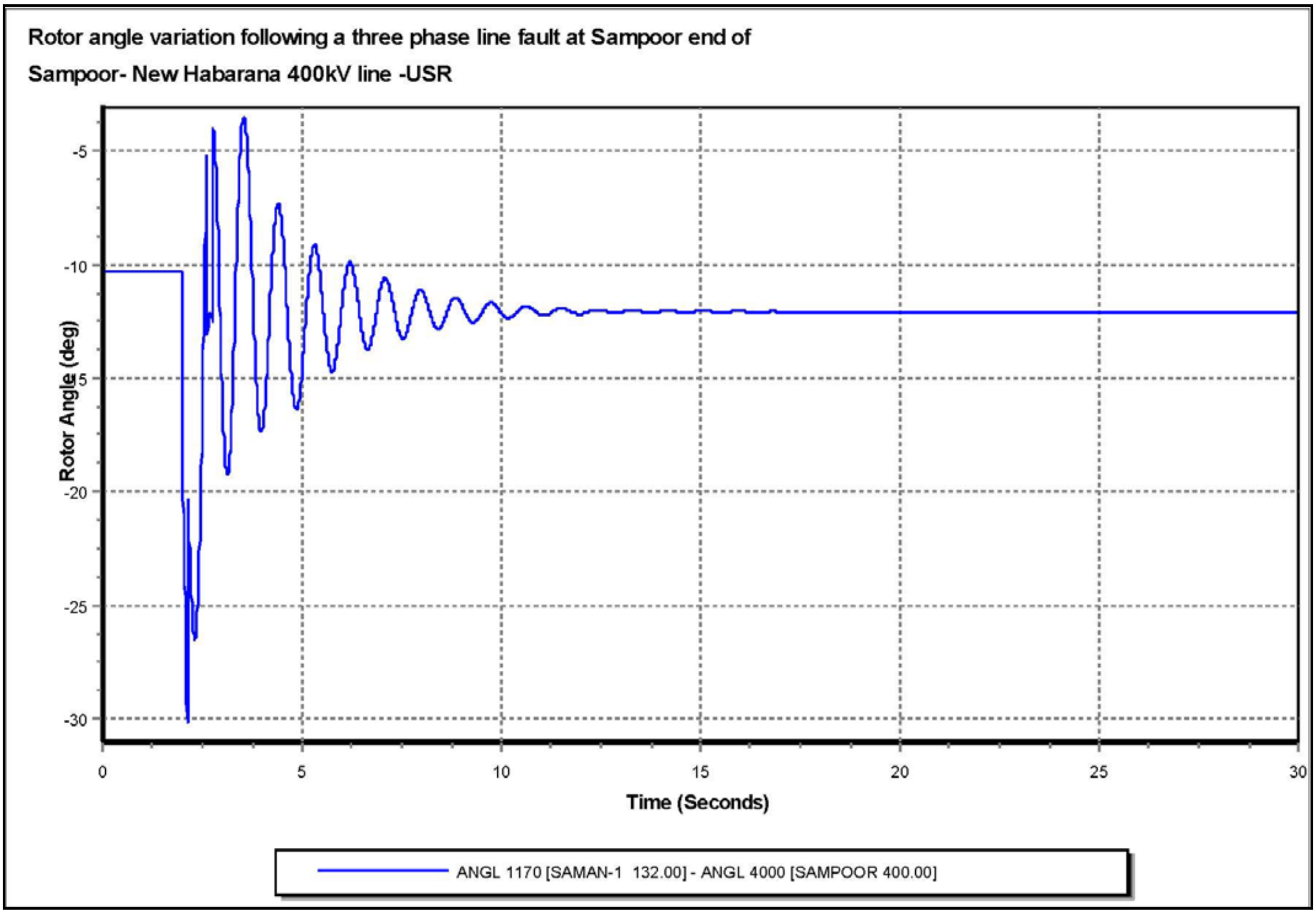
Stability plots following a three-phase line fault at Ambalangoda end of Ambalangoda Padukka400kV line USR-Night Peak Loading Condition





Stability plots following a three-phase line fault at Sampoorend of Sampoor-New Habarana400kV line USR-Night Peak Loading Condition





System fre uency variation following a unit trip of Puttalam Coal Power Plant
Off Peak Loading Condition