Final Report

TRANSMISSION DEVELOPMENT PLAN 2014-2015

Volume II (Part 1)

OPERATION AND MAINTENANCE

JULY 2016

NGCP

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. Introduction

The 2014-2015 Transmission Development Plan (TDP) Volume II was prepared by the Operations & Maintenance (O&M) Group in compliance with the requirement of Republic Act 9136, otherwise known as the Electric Power Industry Reform Act of 2001 or EPIRA. As required by EPIRA, the TDP, submitted to the Department of Energy (DOE), shall be integrated to the Philippine Development Plan (PDP) and the Philippine Energy Plan (PEP).

In adherence to the National Grid Corporation of the Philippine's (NGCP) mandate to maintain, operate, expand and improve the high voltage backbone transmission system and facilities throughout the Philippines, the TDP Volume II contains the Capital Expenditures (CAPEX) program of O&M from the years 2016 to 2025 with the objective of increasing the reliability of the Grid and addressing the problems of obsolescence and ageing in the transmission facilities.

The difference between the 2013 TDP and 2014-2015 TDP is that the latter provided the details on the replacement of power transformers with major defects, deteriorated operating conditions and/or units that are beyond its economic life. The program aimed to pre-empt forced outages resulting from the failure of this equipment which usually results in costly and prolonged power interruption, causing adverse effects to various stakeholders.

The TDP Volume II is one of the three (3) volumes that compose the 2014-2015 TDP. Volume I covers all major network upgrades while the Volume III covers the CAPEX program of System Operations. Volume II is made up of two parts. Part 1 focuses on the CAPEX for the operations and maintenance of the power transmission grid while Part 2 covers the CAPEX for Revenue Metering.

The major categories of expenditures of TDP Volume II Part 1 are as follows:

1. Installation, replacement, rehabilitation, relocation and acquisition of Spares for High Voltage Equipment
2. Installation, replacement and acquisition of Spares for Protection and Secondary Device
3. Rehabilitation and acquisition of Spares for Transmission Lines and Sub-transmission Lines
4. Construction of Slope Protection of Transmission and Sub-transmission Lines
5. Replacement and acquisition of Test & Measuring Equipment
6. Construction and rehabilitation of Substation and Support Facilities that include projects to:
   a. Control and mitigate the effects of Fire and Flood;
   b. Preserve and protect the Environment; and
7. Construction of District Command Centers

The TDP Volume II Part 1 consists of seven (7) chapters.

Chapter 1 Provides a macro view of Volume II of the Transmission Development Plan

Chapter 2 Contains the description of the transmission system in circuit kilometers, the capacities of substations in MVAs and the reactive/capacitive compensation in MVARs presently installed in North Luzon, South Luzon, Visayas and Mindanao Regions

Chapter 3 Shows the transmission line profile of the four (4) NGCP regions. It provides information on the existing transmission lines and substations of each region and the major customers it serves. The geographical maps showing the set-up and route of the power system are also included in this chapter

Chapter 4 Explains the criteria and factors that were considered in preparing the CAPEX program

Chapter 5 Justifies the necessity of implementing the CAPEX program to sustain and/or improve the reliability of the system

Chapter 6 Provides detailed information on the CAPEX program of each region

Chapter 7 Summarizes in tables and graphs the CAPEX Program of the O&M Group

II. Existing Transmission System

1.0 North Luzon Region

North Luzon Operation and Maintenance (NLOM) is responsible for operating and maintaining the longest transmission and sub-transmission lines compared with other regions. NLOM operates and maintains a total length of 5,445.31 circuit kilometers. NLOM has also the largest substation installed capacity of 12,932.5 MVA. The region is in charge of transmitting the electric power generation from the different power generating plants in North Luzon Region to the load centers. In order to maintain node voltages within the level prescribed by the Grid Code, a total of 2,458.5 MVARs capacitors and reactors are installed strategically in the North Luzon grid particularly in Bolo (Kadampat), San Jose and Mexico substations.

The table below summarizes the transmission facilities of the North Luzon Region.

Table 1: NLOM Summary of Existing Transmission Facilities

Voltage Level	Transmission Lines (ckt-km)	Sub-Transmission Lines (ckt-km)	Substation Capacity (MVA)	Reactive/ Capacitive Compensation (MVAR)
500-kV	**548.96**	**-**	**6,000**	**300**
230-kV	**2950.27**	**-**	**6,536**	**825**
115-kV	**165.13**	**4.59**	**270**	**7.5**
69-kV & below	**178.58**	**1,597.78**	**126.5**	**1,326**
Total	**3,842.94**	**1,602.37**	**12,932.5**	**2,458.5**

2.0 South Luzon Region

The South Luzon Operation and Maintenance (SLOM) is responsible for transmitting the electric power generation of the different power generating plants in South Luzon Region. While SLOM is responsible for operating and maintaining the shortest length of transmission and sub-transmission lines compared to other regions, it is in-charge of transmitting the biggest generation capacity. Out of the 13,204 MW generation capacity installed in Luzon, SLOM is accountable for transmitting about sixty percent (60%) of this total capacity. The South Luzon O&M has a total transmission and sub-transmission line length of 4,013.42 circuit kilometers (ckt-km), and total substation capacity of 10,462.5 MVA.

To maintain node voltages within the level prescribed by the Grid Code, a total of 692.5 MVAR capacitors and reactors are installed strategically in the South Luzon Grid. SLOM, together with VOM, operates and maintains the one-of-a-kind HVDC system in the country, i.e. the Leyte-Luzon HVDC interconnection. The interconnection between the Luzon and Visayas grids is through HVDC overhead lines and submarine cables. Of

the total 863 ckt-km HVDC overhead lines, 344.40 ckt-km is under the area of responsibility of SLOM. Furthermore, the whole stretch of 42.59 ckt-km submarine cables is under the area of responsibility of SLOM. With the operation of Wholesale Electricity Spot Market (WESM) in the Visayas, the HVDC link plays a very important role in this competitive electricity trading.

Table 2 summarizes the transmission facilities of SLOM.

Table 2: SLOM Summary of Existing Transmission Facilities

Voltage Level	Transmission Lines (ckt-km)	Sub-Transmission Lines(ckt-km)	Submarine Cable (ckt-km)	Substation Capacity (MVA)	Reactive / Capacitive Compensation (MVAR)
500-kV	**433.34**	**-**		**4,800**	**150**
350-kV DC	**386.99**	**-**	**42.59**	**516**	**-**
230-kV	**2,248.79**	**-**		**4,740**	**375**
115-kV	**-**	**21.59**		**300**	**100**
69-kV & below	**30.95**	**891.76**		**106.5**	**67.5**
Total	**3,100.07**	**913.35**	**42.59**	**10,462.5**	**692.5**

3.0 Visayas Region

The Visayas Operation and Maintenance (VOM) group is responsible for transmitting the electric power generation of the different power generating plants in Visayas Region. VOM is also in charge of the most number of submarine cable interconnection in the country with submarine cable links to five (5) major islands namely: Leyte, Cebu, Bohol, Negros and Panay. The Samar Island is connected to Leyte through a special transmission line crossing at San Juanico Strait. The transmission and sub-transmission infrastructure cover a total of 4,821.22 circuit kilometers (ckt-km) length of lines and 3,733.5 MVA substation capacities spread across the region. The transmission infrastructure includes the submarine cables interconnecting the main islands of the region, namely Leyte, Cebu, Bohol, Negros and Panay.

In 2012, the Barotac Viejo Substation which is part of the Negros-Panay interconnection was completed and turned-over to the Operations & Maintenance Group.

To maintain the node voltages within the level prescribed by the Grid Code at any given time, a total of 275.7 MVAR capacitive compensations connected at 69-kV system are situated strategically throughout the grid to maintain the voltage level within tolerable limits. Likewise, there are reactive compensations with a total aggregate rating of 420 MVAR connected to the 230-kV system and 155 MVAR connected to 138-kV system as

components of the island to island submarine cable interconnection intended for voltage correction.

Table 3 summarizes the transmission facilities of the Visayas Region.

Table 3: VOM Summary of Existing Transmission Facilities

Voltage Level	Transmission Lines (ckt-km)	Sub-Transmission Lines (ckt-km)	Submarine Cable (ckt-km)	Substation Capacity (MVA)[1]	Reactive/ Capacitive Compensation (MVAR)
350-kV DC	**518.00**	**-**	**-**	**516**	**-**
230-kV	**343.84**	**-**	**64**	**980**	**420**
138-kV	**1,907.84**	**11.88**	**72.1**	**2,160**	**155**
69-kV & Below	**1,442.32**	**597.34**	**-**	**77.50**	**275.7**
Total	**4,212**	**609.22**	**136.1**	**3,733.5**	**850.7**

4.0 Mindanao Region

The Mindanao Operation and Maintenance (MOM) is responsible for transmitting the electric power generated from the different power generating plants in Mindanao Region. The transmission and sub-transmission assets cover a total length of 5,271.52 circuit kilometers (ckt-km) and total substation capacity of 3,477.5 MVA. Of all the regions, MOM operates the second longest transmission and sub-transmission lines, next only to NLOM. To maintain node voltages within the level prescribed by the grid code, a total of 339.51 MVARs capacitive compensation are installed strategically in the Mindanao grid.

Table 4 summarizes the transmission facilities of MOM.

Table 4: MOM Summary of Existing Transmission Facilities

Voltage Level	Transmission Lines (ckt-km)	Sub-Transmission Lines (ckt-km)	Substation Capacity (MVA)[1]	Capacitive Compensation (MVAR)
138-kV	**3,512.45**	**33.84**	**3,400**	**22.5**
69-kV & Below	**4**	**1,721.23**	**77.5**	**317.01**
Total	**3,516.45**	**1,755.07**	**3,477.5**	**339.51**

III. Transmission System Profile

1.0 North Luzon Region

The transmission system under North Luzon Region area of responsibility stretches from Cagayan province to Rizal province and northern portion of Metro Manila. It covers a total of 22 provinces including major cities and urban centers.

The backbone of the system is a network of 500-kV Extra High Voltage (EHV) transmission lines that run through the provinces of Pangasinan, Nueva Ecija and Bulacan and a network of 230-kV lines that covers majority of the entire area of North Luzon except areas up to Ilocos Norte which are still served by 115-kV radial lines. Power generated by the Hydroelectric Power Plants particularly in Ambuklao, Binga, Bakun, Magat, San Roque, Casecnan, Pantabangan and Angat, and by the Coal Fired Power Plants located in Masinloc and Sual are transmitted to the load centers in North and Central Luzon and Metro Manila through these networks of 500-kV and 230-kV transmission lines.

The Quezon (Balintawak)[1] and Dona Imelda (Araneta)[1] substations operate as the power interchange between North Luzon and South Luzon and together with Taytay (Dolores) Substation also serving as the gateway of power generated from North Luzon to Metro Manila.

The North Luzon Region has a total of 30 major substations, 8 load-end substations, 5 power plant switchyards and 1 switching station. There are a total of 95 load customers comprising of 40 Electric Cooperatives and Distribution Utilities which include MERALCO; 6 Government Agencies which include 2 Economic Zones; 9 NIA Pumping Stations; 40 Non-Utilities consisting of 3 Cement Plants, 5 Steel Factories, 5 Mining Companies and various industrial plants. These customers are being served at various voltage levels of 230-kV, 115-kV, 69-kV, 34.5-kV and 23-kV.

The geographical map of North Luzon Grid as shown on the next page, illustrates the set-up of power systems in the North Luzon Region that include power plants, transmission system, sub-transmission networks and load-end substations.

[1] Quezon Substation was originally named Balintawak substation while Dona Imelda Substation was originally designated as Araneta Substation. The names were changed following the convention prescribed in the Site and Equipment Identification and Labeling (SEIL) proposed by TransCo and approved by ERC

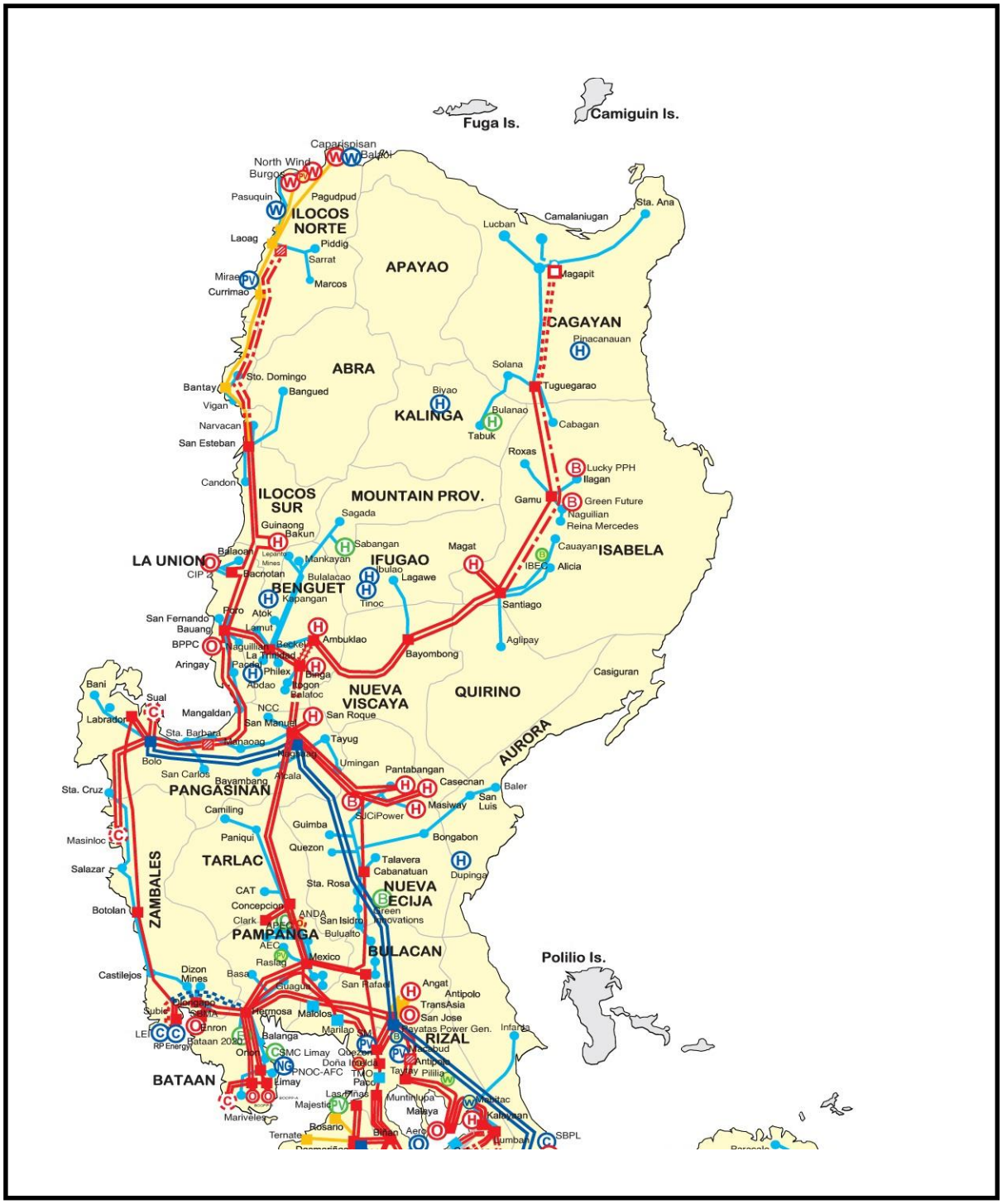


Figure 1: North Luzon Grid Map

2.0 South Luzon Region

The main transmission system under the South Luzon Region area of responsibility is rated at 500-kV and 230-kV. The 230-kV transmission system extends from the provinces of Laguna, Cavite, Batangas and some south portions of Metro Manila down to provinces of Quezon, Camarines Norte, Camarines Sur, Albay and Sorsogon—covering a total of eight (8) provinces.

The 500-kV EHV transmission system stretches from Dasmariñas Substation in Cavite with one of the lines branching to Ilijan Power Plant to Tayabas Substation in Southern Tagalog Area down to Naga Substation in Bicol Area. Physically, the Tayabas-Naga EHV transmission lines were designed or rated at 500-kV but energized at 230-kV system. Up to this date, the Naga Substation is not yet uprated to 500-kV. The 500-kV transmission lines consist of double-circuit, bundle-of-four, 795 MCM ACSR. Also from Tayabas Substation are similar EHV transmission lines linking San Jose 500-kV Substation of NLOM.

The 230-kV transmission system covers a total of 2,248.79 ckt-km, consisting of a total of 4,785 structures (steel towers and steel poles). It traverses different types of terrain, that is, about 60 % plain (open/rice field) and 40 % rugged (mountainous areas).

The SLOM and VOM interconnection is through the high voltage DC overhead transmission lines and submarine cables linking Naga Converter Station and Ormoc Converter Station rated at 350-kV DC. The total length of the HVDC overhead lines is 431.50 lkm., 172.50 lkm. of which, is under the area responsibility of SLOM. The total length of submarine cables is 21.29 lkm., all of which is under the area of responsibility of SLOM.

SLOM has a total of 44 power customers, broken down as follows: 28 directly connected industries, 13 electric cooperatives and 3 government utilities / agencies. Almost all the power customers under SLOM are being served at 69-kV level, except for Meralco, which is served at 230-kV, 115-kV and 34.5-kV levels. Furthermore, the Cavite Economic Zone and directly connected government customers are being served at 34.5-kV and 13.8-kV levels, respectively.

The South Luzon's power contribution to the load center, through its transmission backbone, accounts for about 60 to 70% of the total power generation in Luzon. SLOM has a total of 15 major substations, 20 load-end substations, 3 power plant switchyards and 2 switching stations.

The geographical map of South Luzon Grid as shown on the next page, illustrates the set-up of power systems in the South Luzon Region. The map includes power plants, transmission system, sub-transmission networks and load-end substations.

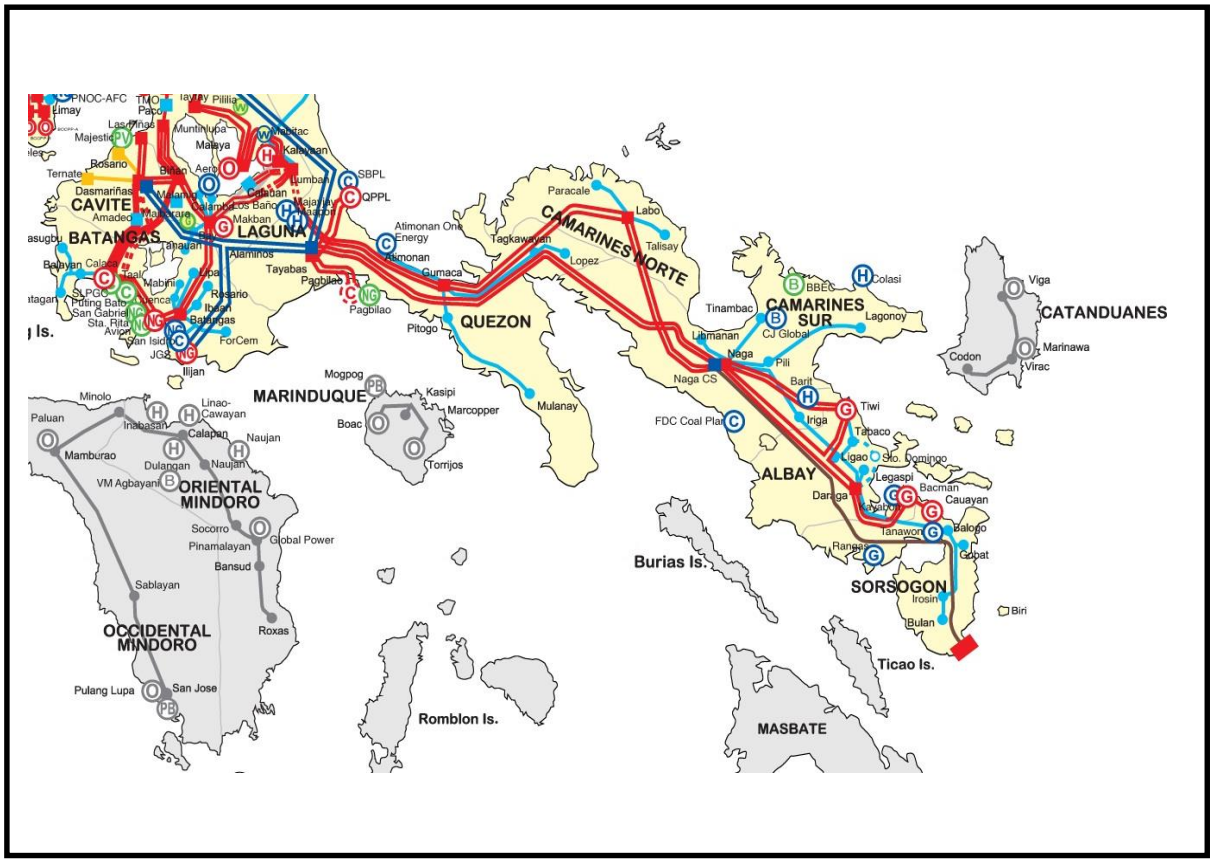


Figure 2: South Luzon Grid Map

3.0 Visayas Region

The transmission network under the Visayas Region area of responsibility serves as back-bone of the Visayas Grid. The transmission system covers the major islands of Samar, Leyte, Bohol, Cebu, Negros and Panay, consisting of 11 provinces. It is a combination of 230-kV and 138-kV transmission system that are installed strategically across these islands. The power requirement of Bohol Island is served by a 69kV transmission network. In June 2014 the island's electricity was complemented by a 138kV transmission line through the Leyte – Bohol 138 kV interconnection.

The interconnections of transmission systems between the Visayas islands were made possible with the laying out of underwater high voltage submarine cables rated at 230-kV and 138-kV. The bulk of the generation comes from the geothermal fields of Leyte in the Northeastern part. However, additional generating plants are coming in at Cebu, Negros and Panay areas to answer the increasing demand. Under such condition, power flow in the Visayas region is normally from the Northeastern to the western part of the region.

A 350-kV high voltage DC located at the Northeast part of Visayas serves as interconnection between Visayas and Luzon Grids.

In order for the end-consumers to avail of the electric power via the distribution network, NGCP continues to operate and maintain the 69-kV sub-transmission line assets that are yet to be divested to the qualified distribution utilities. Furthermore, by virtue of ERC decision on ERC Case No. 2008-088 dated October 12, 2009, a number of 69kV lines in Visayas Grid were re-classified to transmission assets. ERC Resolution No. 18 dated August 10, 2009 similarly mandated that Residual Sub-transmission Assets (RSTAs) which has not been disposed by the end of 2010 will be reclassified as transmission/network assets highlighted the need for NGCP to rehabilitate these RSTAs.

The Visayas Region has a total of 52 load customers, broken down as follows: 20 non-distribution utilities mostly directly connected industries and 32 distribution utilities comprising of private utilities and electric cooperatives. The load customers are being served at different receiving voltage levels, depending on their requirement, through their connection facilities that include dedicated lines and load-end substations.

The Visayas Region has a total of 31 major substations, 7 load-end substations, and 15 switching stations.

The geographical map for Visayas Grid as shown on the next page, shows the set-up of power generation and transmission systems in the Visayas Region that include power plants, transmission system comprising of high voltage lines and power substations and sub-transmission network.

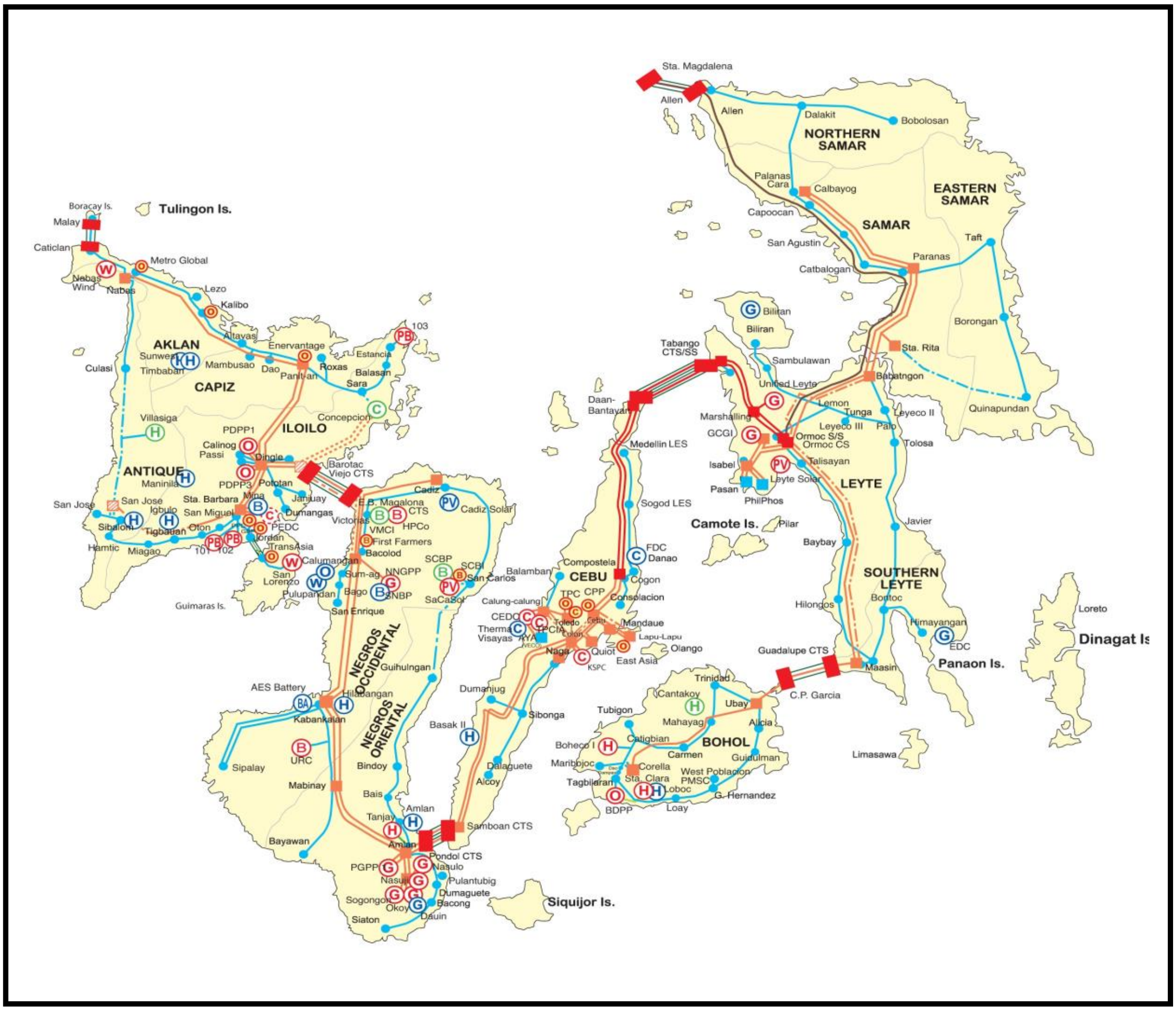


Figure 3: Visayas Grid Map

4.0 Mindanao Region

In Mindanao, with the bulk of power coming from the northern part of the Region, power is transmitted to the Southern, Eastern and Western part through the 138-kV transmission lines.

The Region covers 21 provinces, with forty seven (47) customers, thirty one (31) of which are Distribution Utilities with twenty-seven (27) Electric Cooperatives which are connected mainly by either 138-kV or 69-kV lines. Fifteen (15) various industries which are mostly agricultural, cement, mining and steel factories located in Central and Southern Mindanao are directly connected to the grid at 138-kV level while other customers are served at 69-kV level like the NIA Pumping Station in Butuan.

MOM operates and maintains 3,516.45 ckt-km of transmission lines and 1,755.07 ckt-km of sub-transmission lines that are interconnected via 26 major substations, 3 power plant switchyards, 6 switching stations and 2 load-end substations.

To provide for the needed 1,459 MW peak demand in the Mindanao grid, there is a total of 1773 MW installed generating capacity. On the northern and central parts of Mindanao, there are Hydroelectric Plants operated by NPC, the Agus and Pulangi Hydroelectric Plants with a total installed capacity of 982 MW, Mapalad Power Corporation (NPC-IPPs)-98 MW, and Mindanao Coal Fired Power Plant (MCFPP), 200 MW. There are two (2) Power Barges at the eastern and southern parts, rated at 100MW each and Diesel Plants; SPCC at General Santos, 50 MW and WMPC at Zamboanga City, 100 MW. There is also geothermal power plant; MGPP, operated by PNOC rated at 95 MW.

In the Region, there is still significant number of sub-transmission lines that are not yet divested to the distribution utilities. Hence, NGCP continues to operate and maintain these facilities in order to maintain service reliability of these sub-transmission assets.

The Geographical Map on the next page illustrates the set-up of transmission system network in the Mindanao Region, including the network of sub-transmission system that links the various customers.

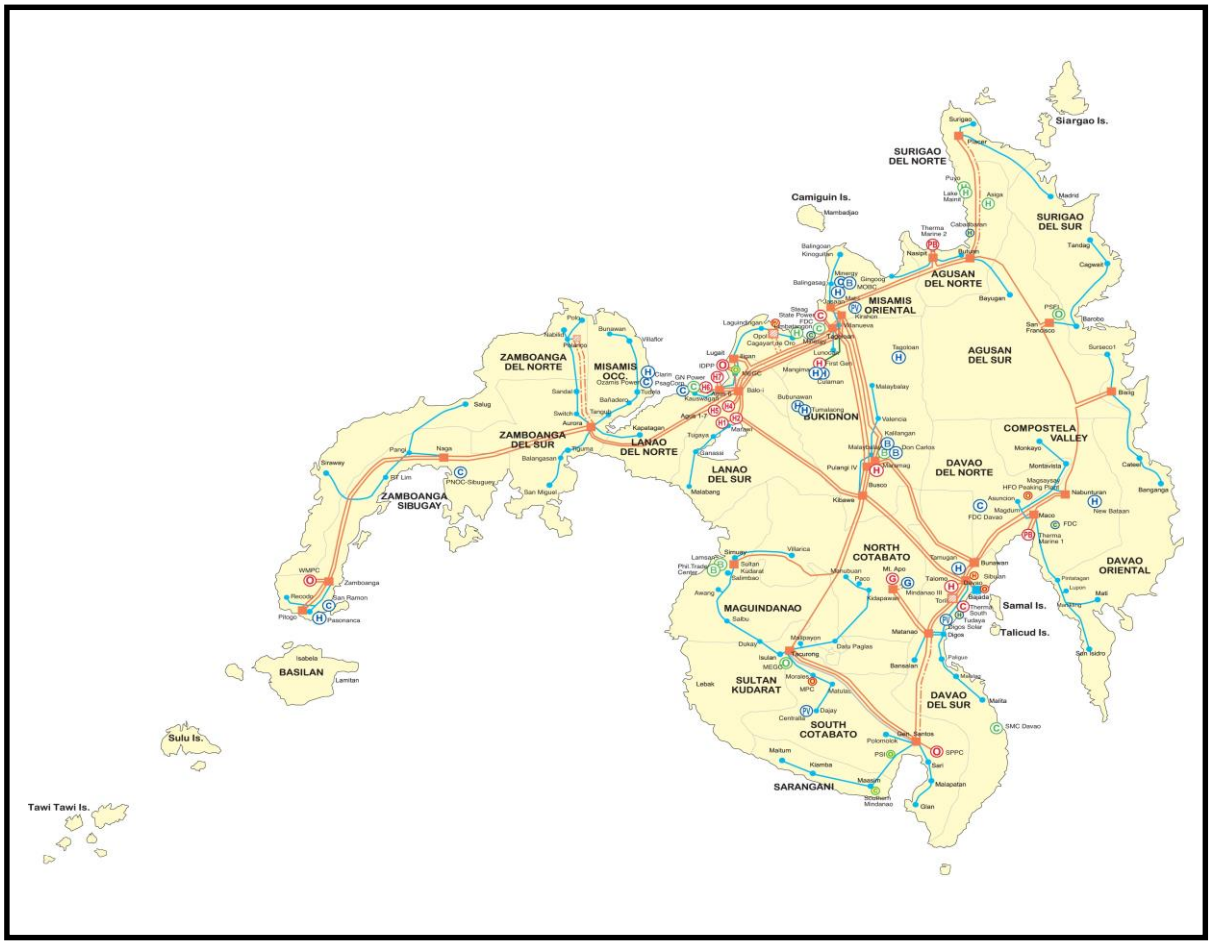


Figure 4: Mindanao Grid Map

IV. Planning Criteria

The main objective of the 2014-2015 Transmission Development Plan (TDP), Volume II, Part 1 is to enhance system reliability by means of preventing forced outages. Given this objective, a thorough review of the current condition of existing transmission facilities was given attention to identify proactive measures that need to be undertaken.

Another consideration is the remaining useful life of the assets. With assets nearing their economic life, it would be reasonable to assume that maintenance and tests performed on these assets would become more frequent and the need for spares and spare parts for the eventual replacement of the assets would increase.

The table below shows the age profile of major NGCP assets:

Table 5: Age Profile of NGCP's Transmission Assets

Equipment	ERC Recommended Economic Life	Percentage of Installed Equipment that have not reached 50% of Economic Life	Percentage of Installed Equipment that have reached 50% of Economic Life	Percentage of Installed Equipment that have reached 80% of Economic Life	Percentage of Installed Equipment that have reached 100% of Economic Life
Power Transformer	35	45.97%	16.74%	15.68%	21.61%
Power Circuit Breaker	40	66.89%	18.79%	13.17%	1.16%
Potential Transformer	40	68.43%	15.08%	14.66%	1.84%
Current Transformer	40	67.76%	20.20%	10.99%	1.05%
Protective Relays	15	38.11%	18.96%	7.22%	35.71%
Batteries	15	62.06%	24.12%	8.79%	5.03%
Chargers	15	49.65%	16.08%	8.39%	25.87%

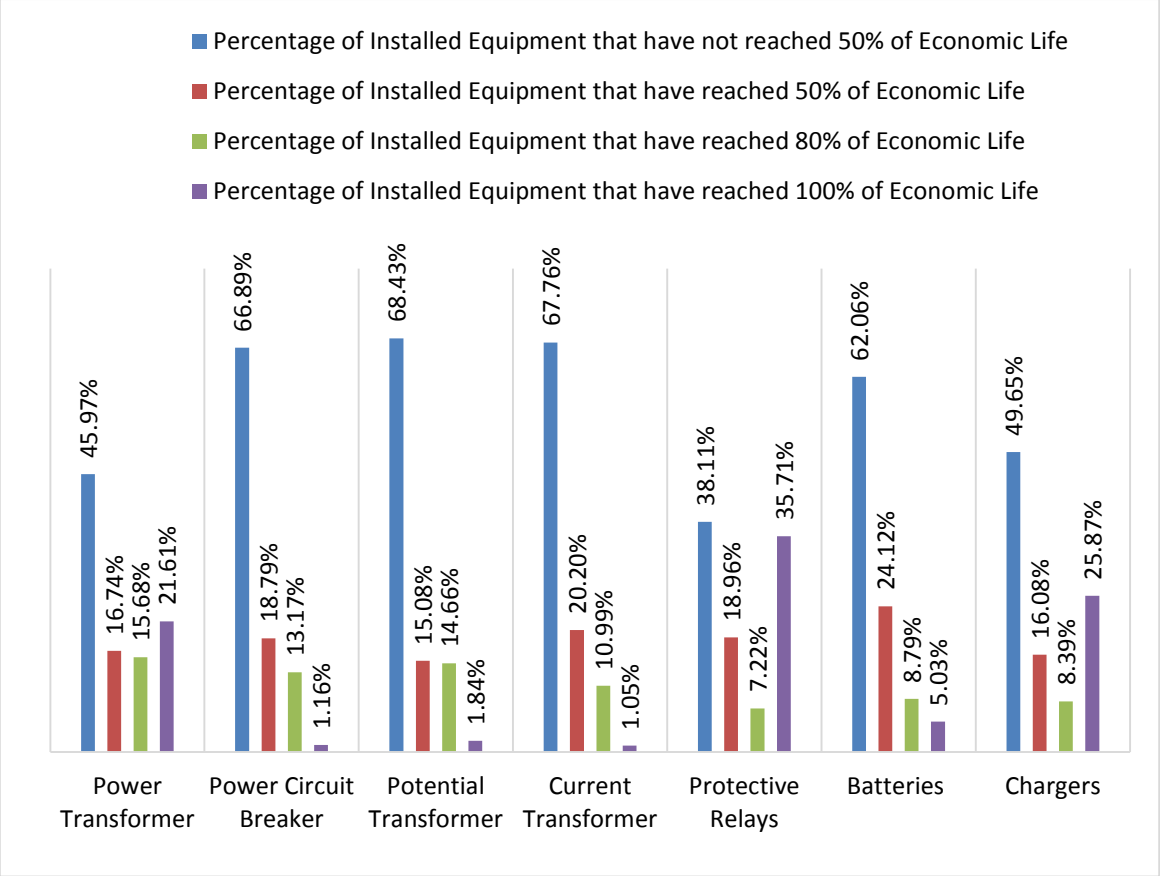


Figure 5: Age Profile of NGCP's Transmission Assets

The location of the Philippines poses an inherent risk for our transmission line structures and substations due to continuing occurrence of natural calamities. With the effectiveness of anti-flooding and slope protection projects having been proven, the continuation of these measures is a must for the reliability of the transmission system.

In support of NGCP's aim for faster restoration time and better services to our customers, the storage of more spare materials, equipment and logistics in strategic locations throughout the country has to be implemented.

V. Need for O&M Capital Expenditures

Following the planning criteria set and with the goal of meeting the PIS targets set forth by ERC, the following activities have to be implemented:

1. Installation, replacement, rehabilitation, relocation and acquisition of Spares for High Voltage Equipment
2. Installation, replacement and acquisition of Spares for Protection and Secondary Device
3. Rehabilitation and acquisition of Spares for Transmission Lines and Sub-transmission Lines
4. Construction of Slope Protection of Transmission and Sub-transmission Lines
5. Replacement and acquisition of Test & Measuring Equipment
6. Construction and rehabilitation of Substation and Support Facilities and other Non-Network Assets:
    a. Control and mitigate the effects of Fire and Flood; and
    b. Preserve and protect the Environment.
7. Construction of District Command Centers

1.0 High Voltage Equipment

The Power Transformer Replacement Program involves units that experienced high forced outage (FO) tripping incidents or falls in any or combination of the following conditions:

1. Equipment that manifest major defect and is beyond or uneconomical to repair;
2. Equipment that is beyond its economic life;
3. Continuous use will lead to power system disturbance and risk to safety of personnel and the environment; or
4. Transformers that contain Polychlorinated Biphenyls (PCBs)

The Power Transformer Criticality Index is shown in Annex A. The Replacement Program for the three-year period (2017-2019), the Criticality Level and the Ages at the time of power transformers' replacement, are shown in Annex B.
The units that are still repairable will be repaired and will be either installed for N-1 contingency or will serve as a spare transformer. The transformers that contain Polychlorinated Biphenyls (PCBs), irreparable units, or have reached its economic life will be retired or disposed. The Deployment Schedule of the replaced power transformers are summarized in Annex C.

Other high voltage equipment are also subjected under the same criteria, with a particular requirement for power circuit breaker - "definite purpose", used for capacitor banks.

The Graphs below illustrate that for the period of January to December 2014, tripping due to Substation Equipment trouble and Fault Clearance System Failure / Mis-operations and defects constitute 49% and 14% of major causes of Forced Outage respectively. This statistics clearly supports the need for the replacement of defective high voltage equipment and upgrading of Fault Clearance System.

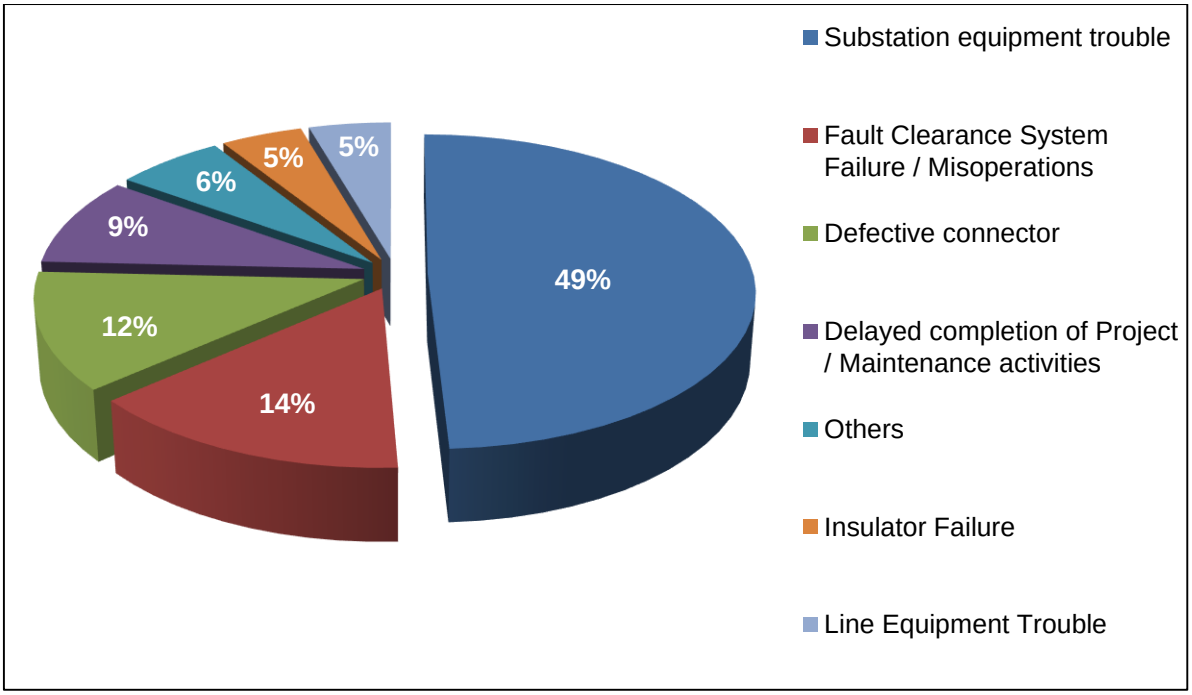


Figure 6: Major Causes of Forced Outage (Percentage)

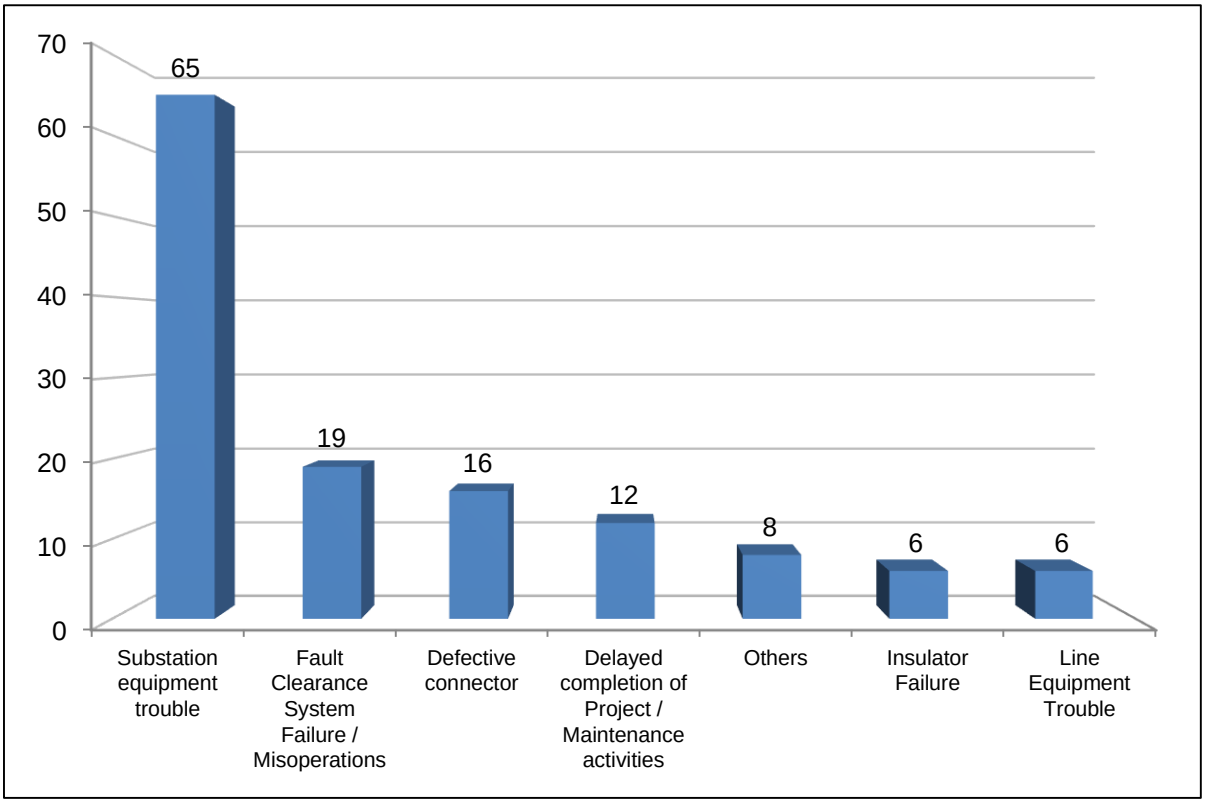


Figure 7: Major Causes of Forced Outage (Count)

2.0 Protection and Secondary Devices

With the continuous drive of O&M for the upgrade of secondary devices, a reduction in undesired operation of the secondary devices was achieved. This necessitates the continuity of the program for the improvement of our system reliability.

North Luzon O&M has already upgraded Taytay (Dolores) and Quezon (Balintawak) Substation in 2010 and 2012 respectively. The upgrade of Doña Imelda (Araneta) Substation is expected to be completed in 2015. These substations are considered critical links in transmitting power from the Northern Region to the Southern Region. In addition to these substations, O&M has also completed the upgrade of Mexico and San Jose Substations in 2014. Similar to Quezon and Doña Imelda, these substations also play a vital role in transmitting power from the North to Metro Manila.

South Luzon O&M, on the other hand, completed the upgrade of the secondary devices of Biñan and Muntinlupa (Sucat) substations, and started the upgrade of Calaca substation in 2014. Following the criteria of criticality, age and function, the-first and second substations can be compared with Mexico and San Jose. Furthermore, these substations are responsible for transmitting power from the Southern Region to Metro Manila. On the other hand, Calaca substation is a turned-over facility to NGCP.

Visayas O&M has also completed the upgrade of the micro-processor-based substation control (MBSC) of Ormoc and Bacolod Substations in 2011 and 2013 respectively, and Compostela Substation in 2014.

Mindanao O&M has upgraded the Balo-i (Abaga) Substation which is the largest Substation in terms of the number of connected lines. Figuratively speaking, it is the heart of the power transmission in Mindanao. It is responsible in transmitting power to various parts of the Mindanao Region. Agus 6 and Davao Substations were completed in 2015; Agus 2 is expected to be completed by 2016.

NLOM, SLOM, VOM and MOM have also identified other critical substations in need of upgrading and those whose secondary devices have reached the ERC economic life.

3.0 Transmission and Sub-transmission Lines

Sustaining reliability, maximizing the useful life of lines, preventing failures, ensuring public safety and mitigating impact of unforeseen events that cause damage to facilities resulting to electrical system disturbances are the overriding considerations in the preparation of CAPEX proposal for the operation and maintenance of transmission and sub-transmission lines.

Out of the 19,551.47 circuit kilometers (ckt-km) of transmission lines under NGCP, around 7,820.59 ckt-km or 40% are older than 30 years while around 1,564.12 ckt-km or 8% are 50 years and older. Considering the advanced age of these transmission lines, a considerable number of line materials and hardware are expected to become defective, hence, replacement will be needed.

4.0 Slope Protection of Transmission Line Structures

The Philippines is frequently visited by an average of 20 typhoons per year. These typhoons often carry not only high-velocity wind but also devastating floodwater. This flooding had caused soil erosion at the transmission line structure foundations and, sometimes, has even caused the toppling of these structures. Hence, it is necessary that remedial measures be implemented immediately whenever these problems occur to strengthen the foundations in preparation for the occurrence of another typhoon.

5.0 Acquisition of Spares of High Voltage Equipment, Line Materials and Hardware

In the course of operating the grid, immediate or urgent needs may arise from time to time. Optimum level/quantity of spares[1], which include high voltage primary equipment and line materials/hardware, have to be maintained at all times to prevent prolonged outage and further delay in restoration efforts. The graph below illustrates the percentages of outages caused by substation primary equipment for the period January to December 2014:

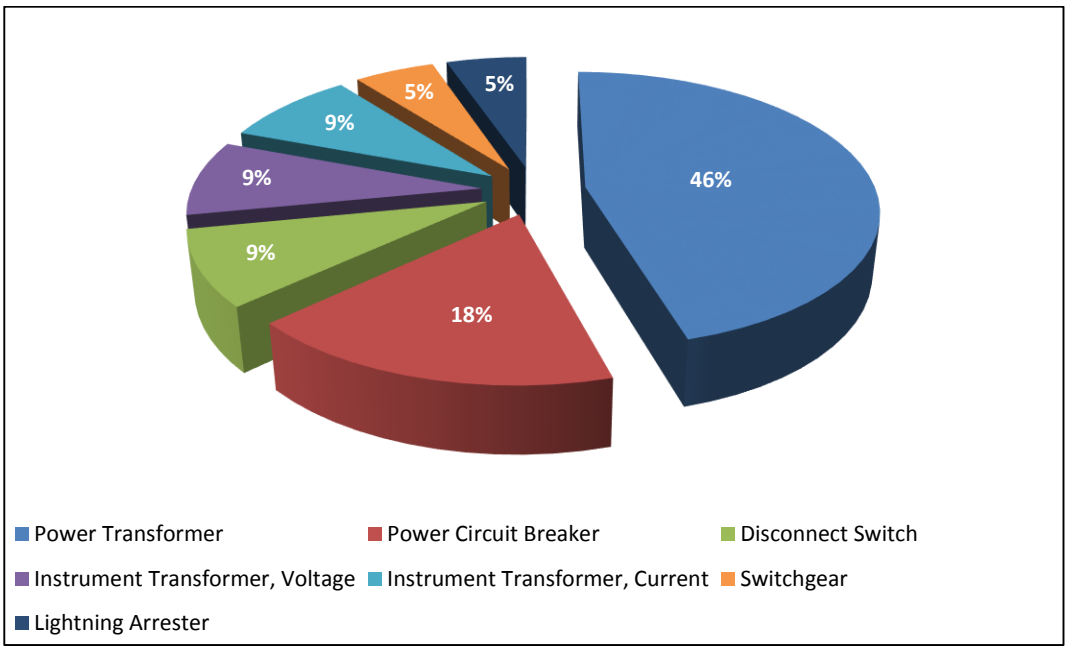


Figure 8: High Voltage Equipment Outages

6.0 Construction of District Command Centers

Having constructed the regional command centers, NGCP now has the capability to be forewarned of impending calamities that might cause damage to NGCP facilities like those of typhoons. Coordination between regions before, during and after calamities is now easier resulting in mitigation of damages and faster restoration time. In addition to the regional command centers, complementing district command centers are now lined-up to further bolster NGCP's capabilities during natural calamities.

[1] *Please see appendix for optimum level of spares per equipment/material*

7.0 Acquisition of Heavy Equipment, Vehicles, Test Instruments and Linemen Tools

General Plant Equipment which include items such as substation and line testing and maintenance tools & equipment, line vehicles, heavy equipment, and office & support equipment will from time to time, be replaced or upgraded to address the requirements of maintaining the grid.

Based on the result of the evaluation made in line with the standardization policy of NGCP, a significant number of vehicles, tools and test equipment are already old, obsolete, unreliable, and costly to maintain not to mention that in some aspect, appropriate equipment are not available to substation and transmission line maintenance personnel (lines and substations). Statistics show that 49.62% of the existing boom, cargo and line truck are over 10 years old.

VI. CAPEX Program

With the monitoring of the ERC of the performance of NGCP according to the set parameters and criteria in the Third Regulatory Period, the enhancement of system reliability and integrity were retained as the two main considerations in the development of the O&M CAPEX for 2016-2025.

As with the 2014 TDP, full compliance to the Grid Code and other energy regulations with due concerns to safety, quality and environmental aspects were also considered. Internally, the TDP supports the programs being espoused by the corporation such as the Quality Management System, Environmental Management System and the Occupational Health and Safety Assessment System. This approach aims to enhance the system performance by the consolidation and integration of procedures, strategies and techniques in addressing technical and administrative issues.

1.0 North Luzon CAPEX Program

The Summary of the CAPEX Program of North Luzon is shown below.

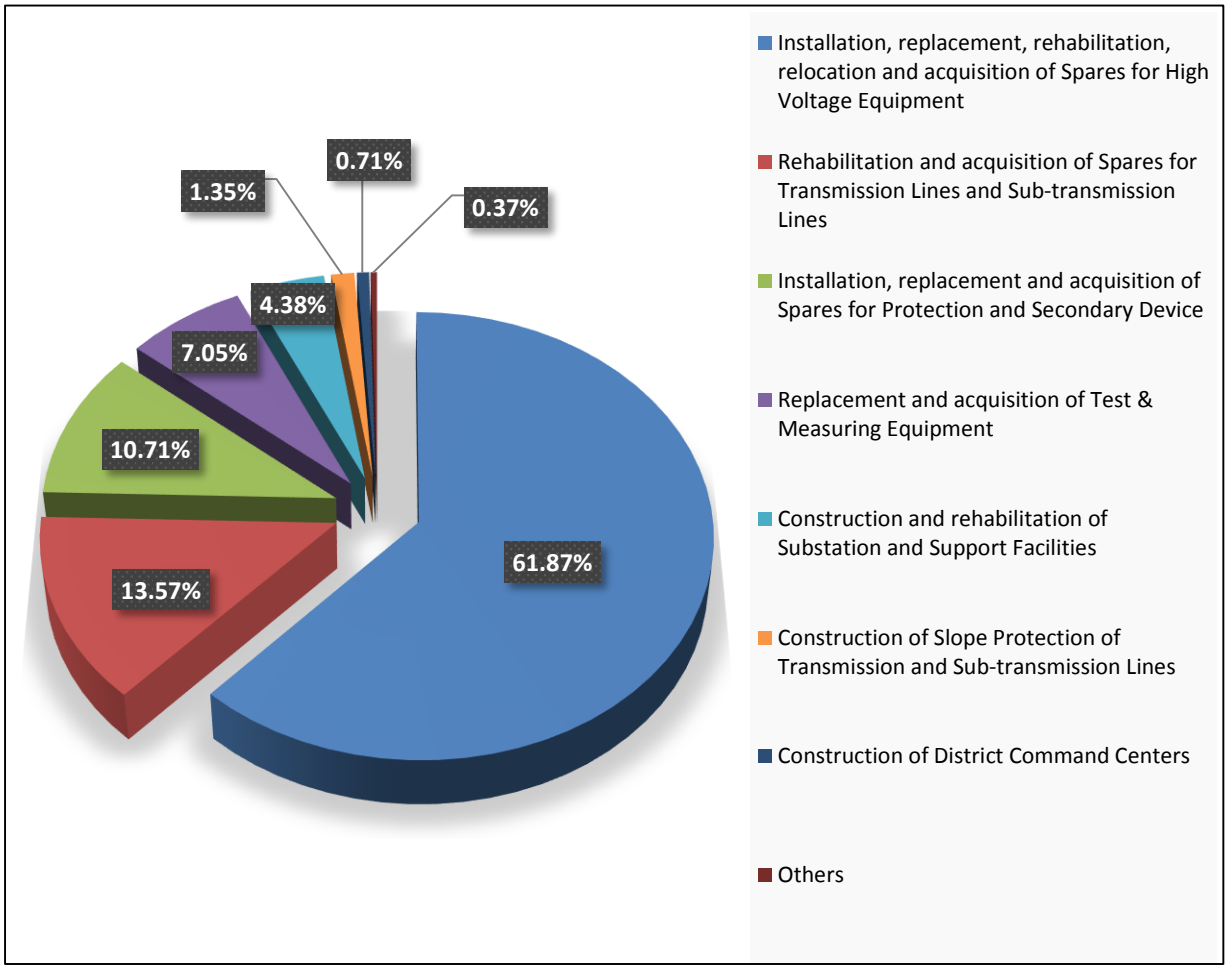


Figure 9: NLOM 2016-2025 CAPEX Summary

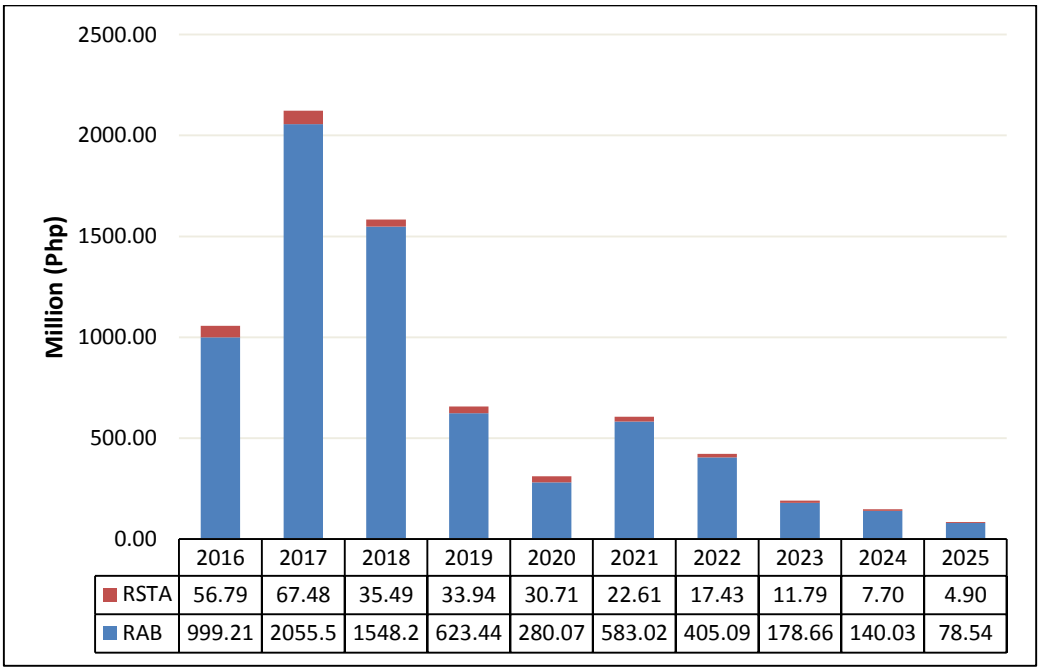
1.1 North Luzon Work Orders

The proposed Work Orders of North Luzon are geared on the improvement of system reliability. These include among others, the rehabilitation, replacement or installation of high voltage equipment; upgrading of substation control and monitoring system for reliable on-line monitoring of critical substation equipment; replacement of old and unreliable electromechanical relays such as transformer differential relays, bus differential relays, feeder protections with numerical relays; upgrading of transformer monitoring and control system for reliable control and real time monitoring on critical power transformers; installation of additional line arresters for reliability and protection from lightning strike; installation of fire and flood control projects; upgrading of switchgears in substations; and the construction of hazardous waste storage facilities at various substations.

For transmission and sub-transmission lines, the proposed projects include the upgrading and rehabilitation of ageing line hardware; replacement of wood poles with steel structures; construction of tower foundation; and replacement of wood poles with steel poles along various 69-kV lines.

The rest of the work orders cover the repair, rehabilitation and/or refurbishment of building/support facilities, and the needed compliance with environment and IMS requirements.

The projects will require an amount of **7.181 Billion Pesos** for the period 2016 to 2025. The project cost summary is shown in Figure 10.



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
RSTA	56.79	67.48	35.49	33.94	30.71	22.61	17.43	11.79	7.70	4.90
RAB	999.21	2055.5	1548.2	623.44	280.07	583.02	405.09	178.66	140.03	78.54

Figure 10: North Luzon Work Orders

1.2 North Luzon General Plant Equipment

The proposed GPE consists mainly of acquisition of Maintenance Tools and Equipment for the replacement of old and defective units. Replacement and acquisition of various equipment used for maintenance and repair of power equipment as well as diagnostic tools are also covered in the proposal.

The rest of the proposed GPE mostly covers the purchase of personal protective equipment (PPE), ICT, building/office equipment and other vital support devices.

The projects will require an amount of **0.934 Billion Pesos** for the period 2016 to 2025. The summary is shown in Figure 11.

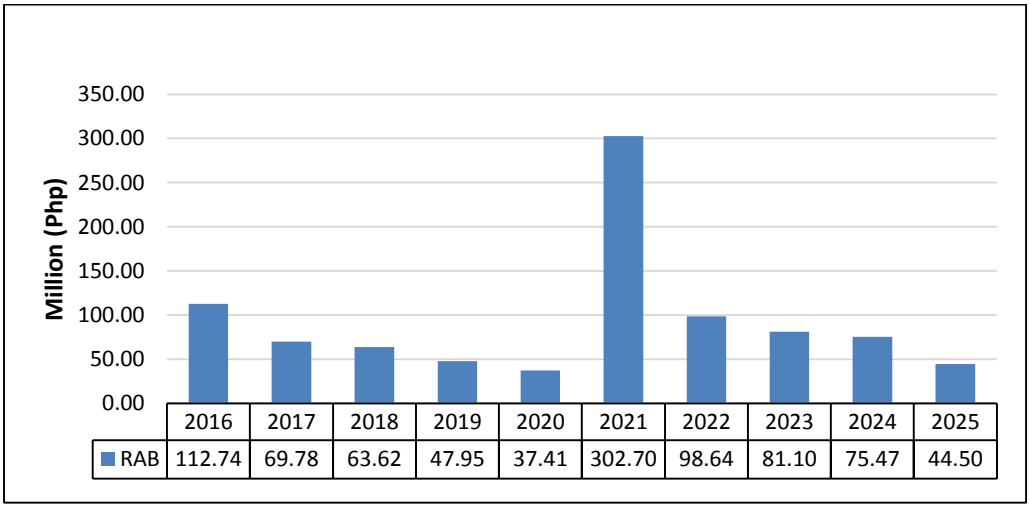


Figure 11: North Luzon GPE

1.3 North Luzon Spares

In planning for the spares requirement, utmost consideration were given to the minimum stock level and economic life of power equipment and accessories/ devices, transmission line hardware, the materials for use in reconditioning of oil & SF6 insulated equipment; substation primary and secondary equipment such as transformer bushings & cooling fans, current transformers, potential transformers, battery banks, capacitor cells, and lightning arresters; steel poles and steel cross arms; and other line hardware such as connectors, insulators, clamps, vibration dampers, conductors, bolts and others.

The projects will require an amount of **3.103 Billion Pesos** for the period 2016 to 2025. The spares cost summary is shown in Figure 12.

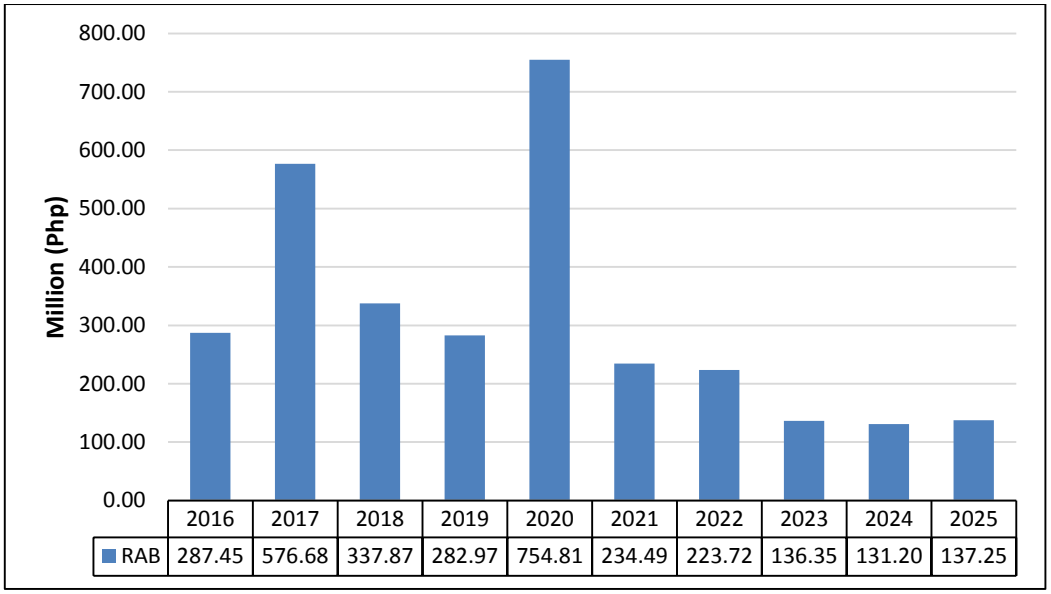


Figure 12: North Luzon Spares

2.0 South Luzon CAPEX Program

The CAPEX Program of the South Luzon is shown below.

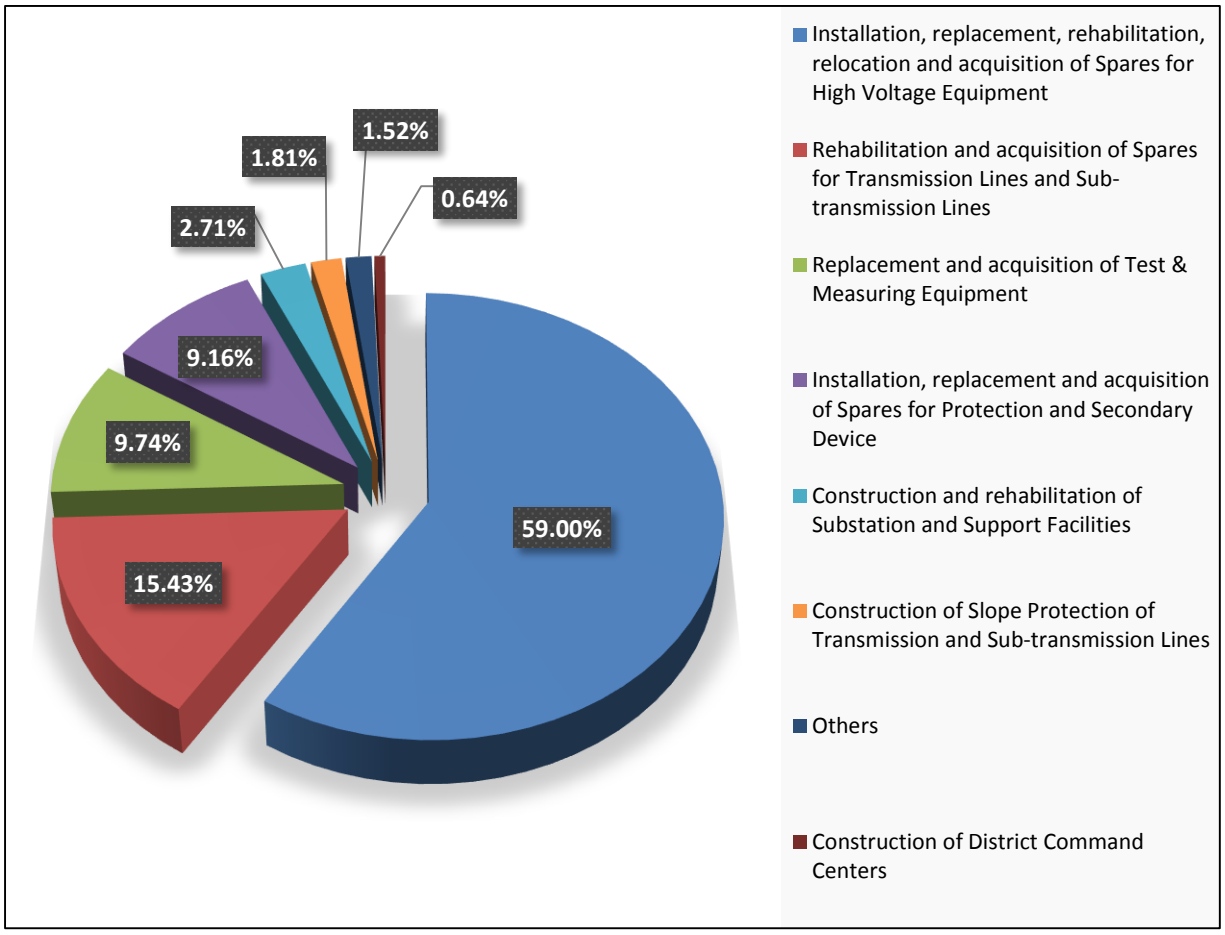
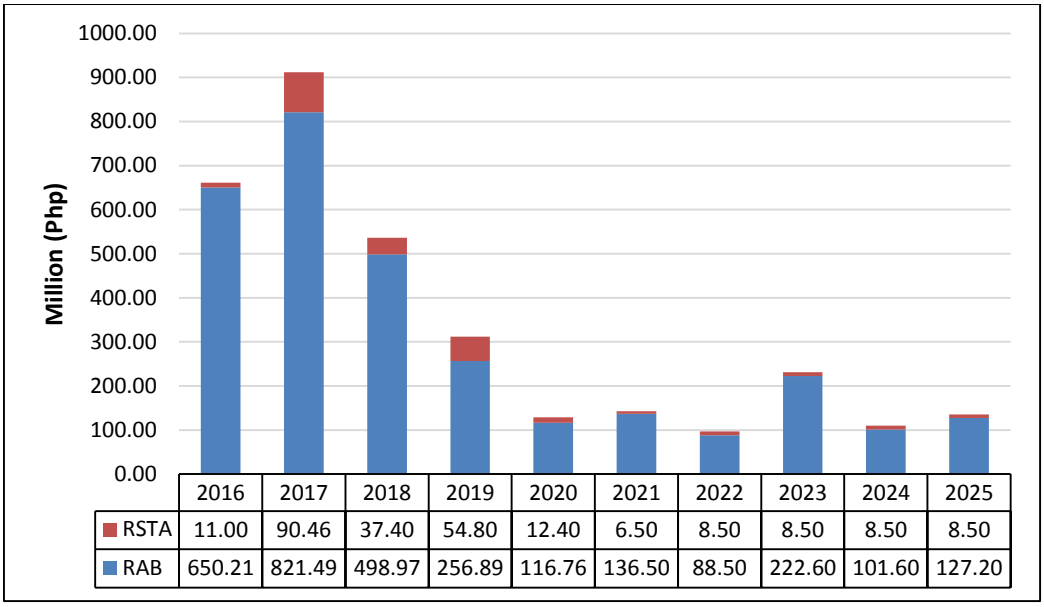


Figure 13: SLOM 2016-2025 CAPEX Summary

2.1 South Luzon Work Orders

The Work Orders for the replacement, rehabilitation, repair, and refurbishment of the existing power transmission facilities (Substations, Transmission Lines, Sub-Transmission Lines including Support Facilities) aim to enhance the reliability of the power system in South Luzon, with the end objective of providing reliable safe and quality power service to all customers. The work orders primarily cover the replacement of major substation components due to obsolescence, defects and/or operating problems. Bulk of the work orders also includes the replacement/ rehabilitation of transmission/sub-transmission line materials and hardware, due to severe corrosions, especially the overhead ground wires. The rest of the work orders cover the repair, rehabilitation and/or refurbishment of building/support facilities, and the needed compliance with environment and IMS requirements.

The projects will require an amount of **3.267 Billion Pesos** for the period 2016 to 2025. The Work Order summary is shown in Figure 14.



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
RSTA	11.00	90.46	37.40	54.80	12.40	6.50	8.50	8.50	8.50	8.50
RAB	650.21	821.49	498.97	256.89	116.76	136.50	88.50	222.60	101.60	127.20

Figure 14: South Luzon Work Orders

2.2 South Luzon General Plant Equipment

The bulk of the proposed GPE is primarily intended for the acquisition of test equipment, tools, instruments and devices as replacement to the obsolete and defective units. Acquisition of additional GPE is also included to ensure that tools and equipment are adequate for the effective and efficient implementation of various substation and line maintenance activities. The rest of the proposed GPE mostly cover the purchase of personal protective equipment (PPE), ICT, building/ office equipment and other vital support devices.

The projects will require an amount of **0.642 Billion Pesos** for the period 2016 to 2025. The GPE summary is shown in Figure 15.

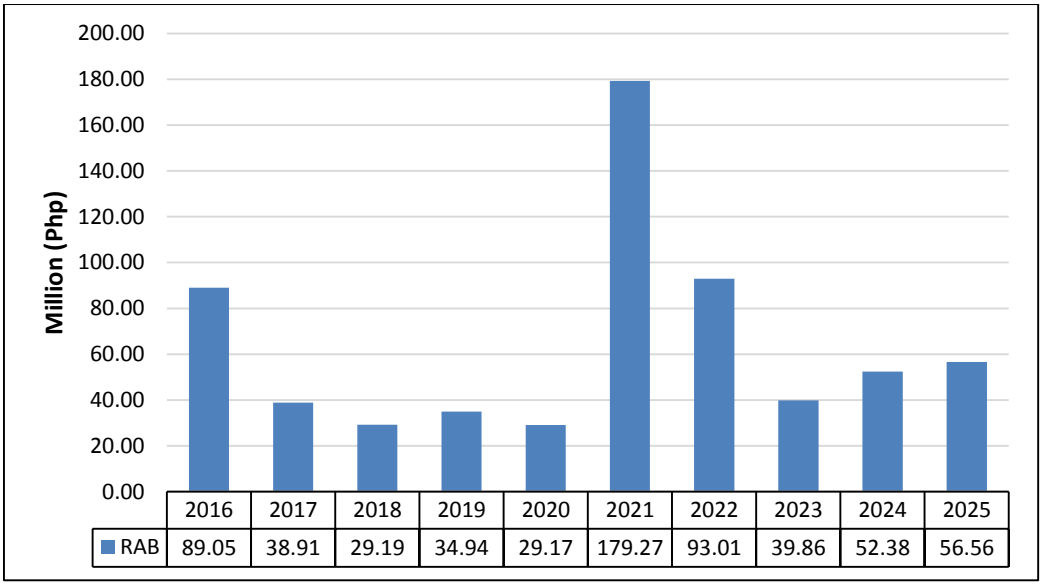


Figure 15: South Luzon GPE

2.3 South Luzon Spares

The spares requirement, as proposed, considers the minimum stock level of installed power equipment, instruments, devices and accessories as well as line materials and hardware. It is aimed primarily to provide readily available spares for all critical and slow moving equipment. Bulk of the proposed Spares requirements cover the acquisition of substation primary equipment, such as but not limited to: power transformers, circuit breakers, instrument transformers, lightning arresters, transformer bushings, and a number of substation secondary devices.

The projects will require an amount of **2.068 Billion Pesos** for the period 2016 to 2024. The spares cost summary is shown in Figure 16.

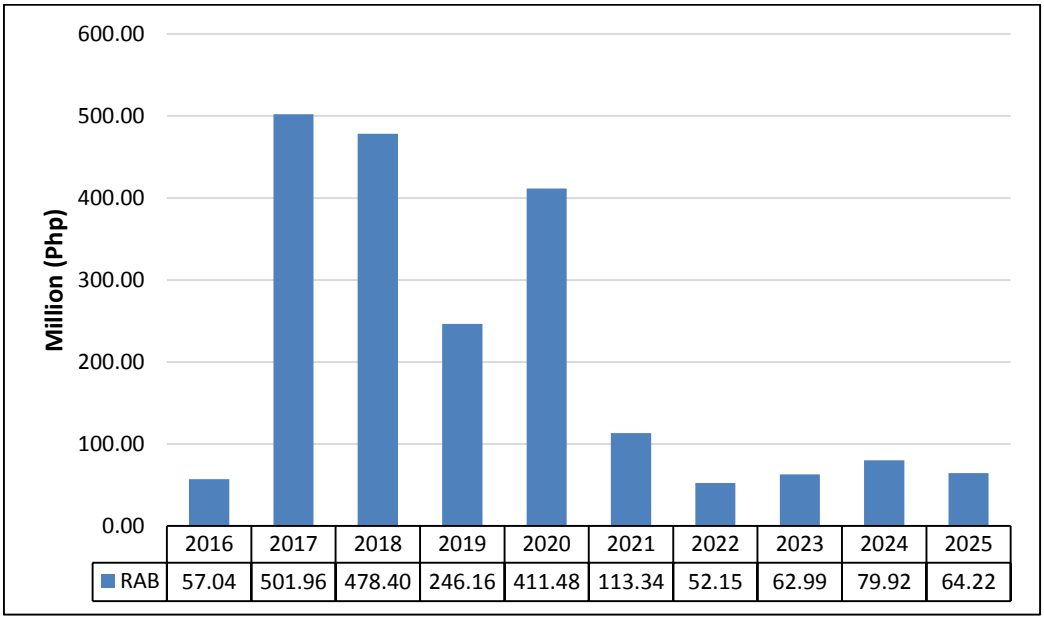


Figure 16: South Luzon Spares

3.0 Visayas CAPEX Program

The summary of the CAPEX Program of Visayas is shown below.

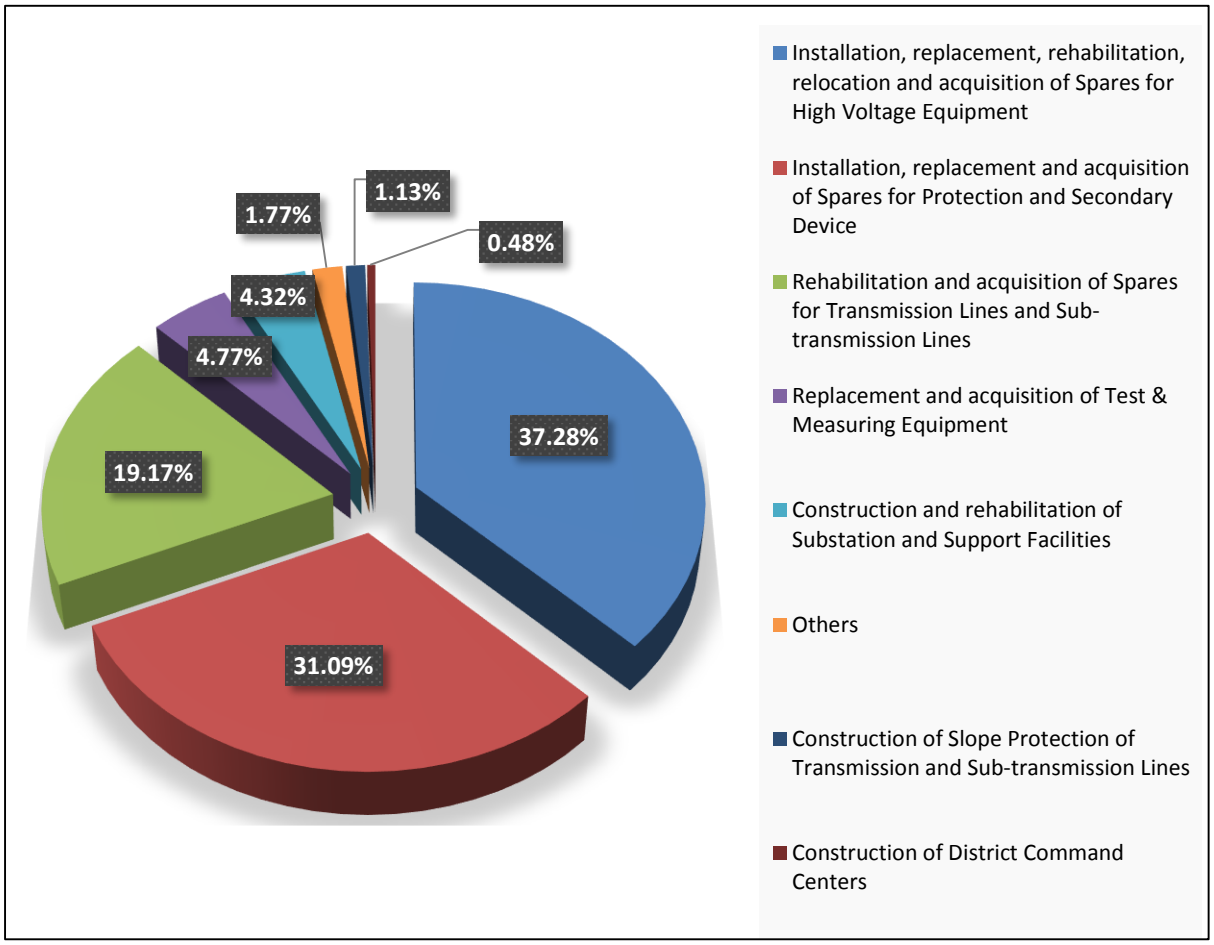


Figure 17: VOM 2016-2025 CAPEX Summary

3.1 Visayas Work Orders

The work order proposals for the region primarily consists projects that are intended for the operation and maintenance of major facilities which are directly used in the transmission of electric power. These are the following:

a. Replacement and major rehabilitation of substation defective and ageing primary equipment, or its major component that had experienced excessive wear and tear and needs to be re-conditioned in order to restore it to its top operation condition.

b. Upgrading substation secondary devices which are either old, obsolete (spare parts not already available in the market) and with recurring operational problem such as protective relays giving undesired tripping signal, etc.

c. Rehabilitation of existing transmission lines to restore them to their top operating condition by replacing defective and old component such as insulators, vibration dampers, poles, cross-arms and other hardware. This

includes also the rehabilitation of HVDC facilities in Leyte and construction of tower foundation slope and river bank protection.

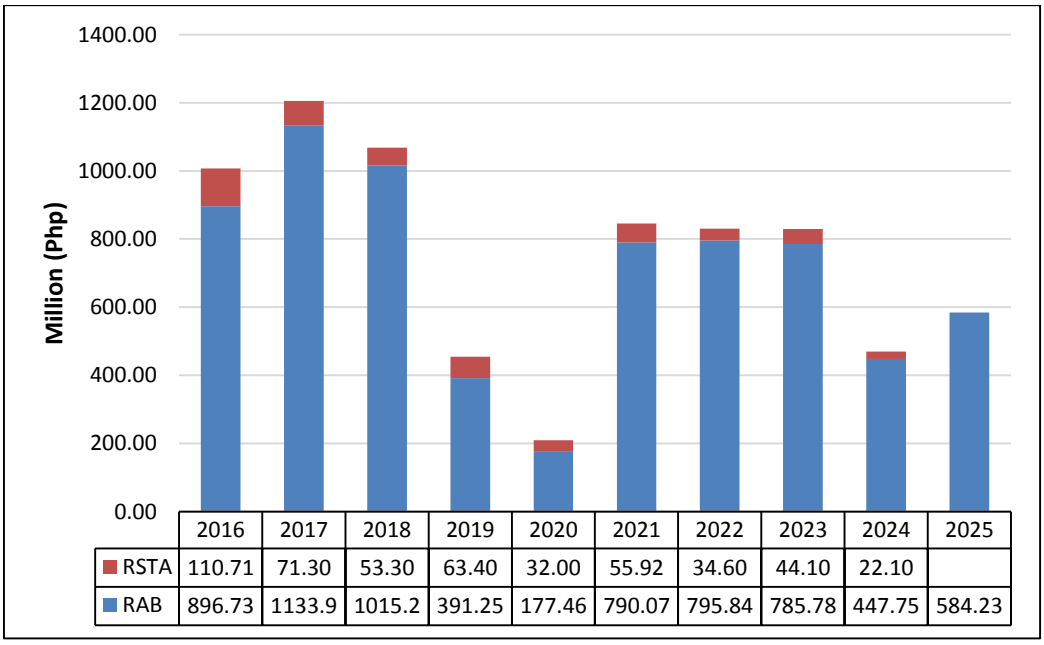
d. Installation of additional substation secondary devices which will improve the reliability of the system, such as provision of N-1 compliant 125VDC system; separate DC power supply for M1 and M2 protection.

e. Construction of anti-fire and anti-flooding projects that would protect the facilities inside the substation.

f. Re-routing portion of transmission/sub-transmission lines that is frequently affected by soil movement or with ejectment complaint from the landowner.

In order to comply with the environmental, safety and security requirements, proposals for the construction of oil secondary containment were made; the rest of the work orders include the construction of new support facilities and repair of the existing structures.

The summary of Work Orders which amounts to **7.506 Billion Pesos** is shown in Figure 18.



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
RSTA	110.71	71.30	53.30	63.40	32.00	55.92	34.60	44.10	22.10	
RAB	896.73	1133.9	1015.2	391.25	177.46	790.07	795.84	785.78	447.75	584.23

Figure 18: Visayas Work Orders

3.2 Visayas General Plant Equipment

Bulk of GPE proposals for Visayas include the acquisition of test and diagnostic equipment, tools, instruments and devices. Likewise, there are also proposals for the replacement of obsolete and defective units, to ensure that tools and equipment are reliable, adequate for the safe and efficient implementation of various substation and line maintenance activities. It also considers the replacement of obsolete testing equipment with multi-function and state of the art technology.

The rest of the proposed GPE covers the purchase of new personal protective equipment (PPE), ICT, building/office equipment and other vital O&M support

devices. The summary of GPE which amounts to **0.633 Billion Pesos** is shown in Figure 19.

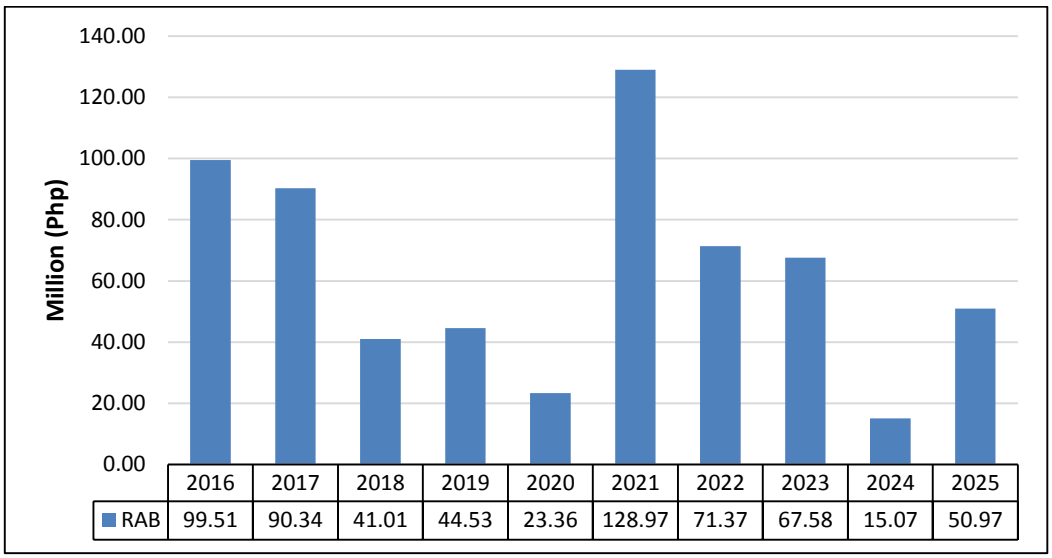


Figure 19: Visayas GPE

3.3 Visayas Spares

In planning for the Spares requirement of the Region, the minimum stock level and economic life of installed facilities and testing/measuring devices were given utmost consideration. Maintaining the minimum stock level is part of the contingency measures in order to assure readiness and attain high level of response efficiency. This is particularly important in Visayas Region where sharing of spares is very difficult due to its geographical configuration.

The summary of Spares which amounts to **2.366 Billion Pesos** is shown in Figure 20.

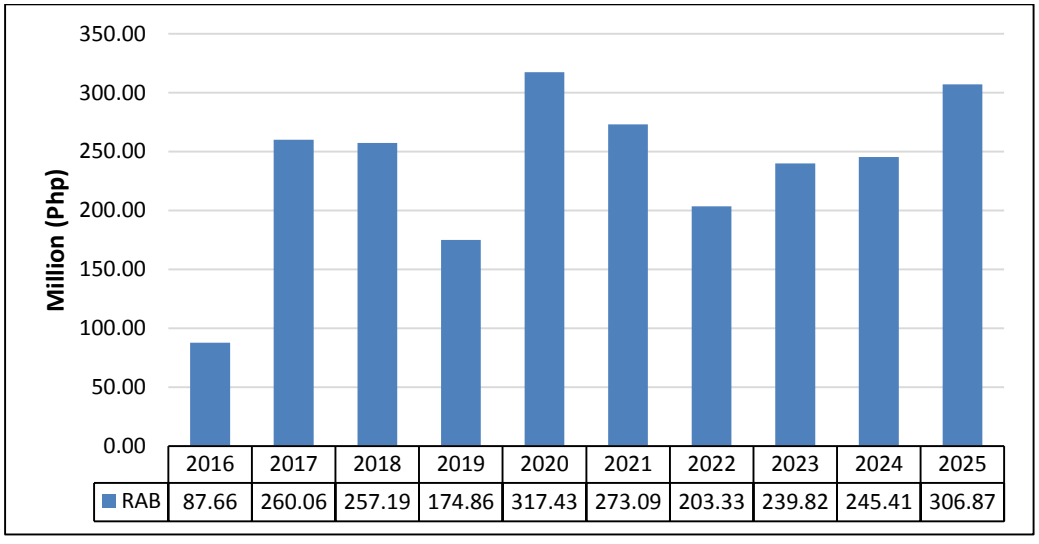


Figure 20: Visayas Spares

4.0 Mindanao CAPEX Program

The Summary CAPEX Program of Mindanao is shown below.

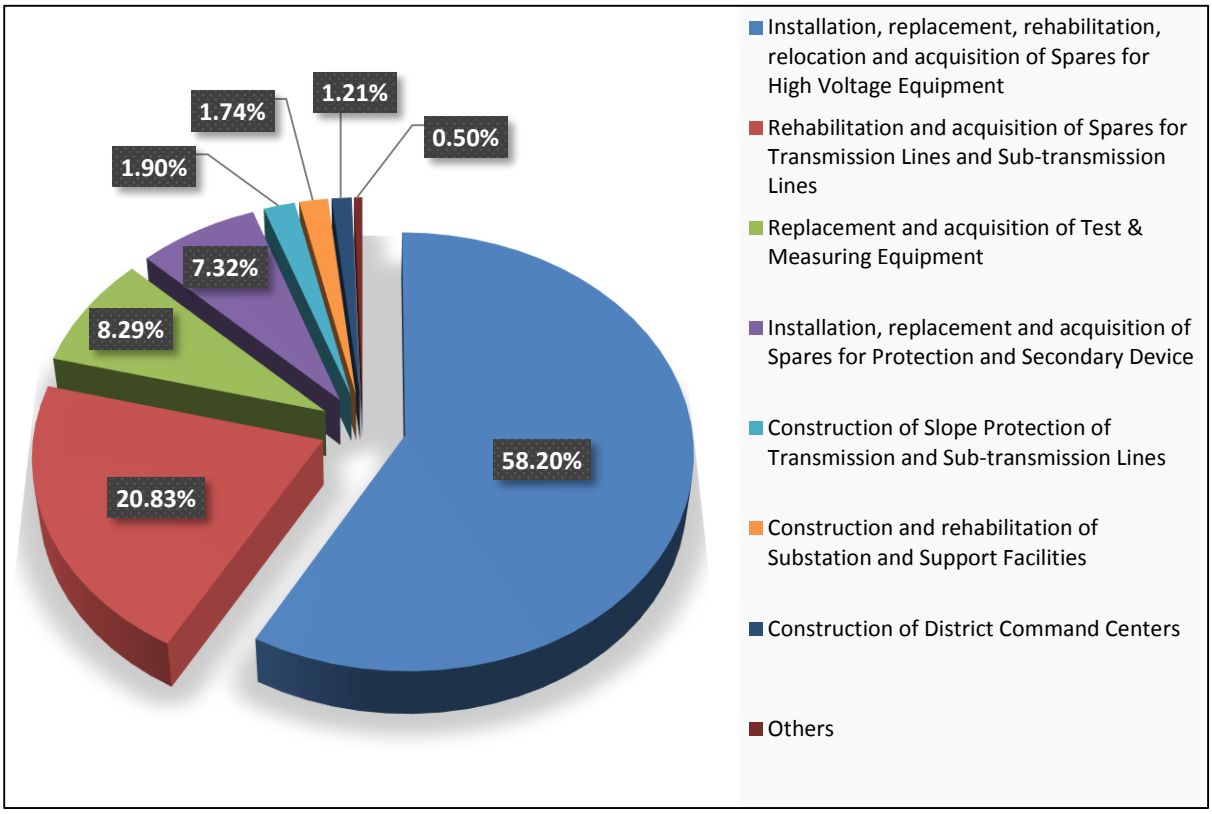


Figure 21: MOM 2016-2025 CAPEX Summary

4.1 Mindanao Work Orders

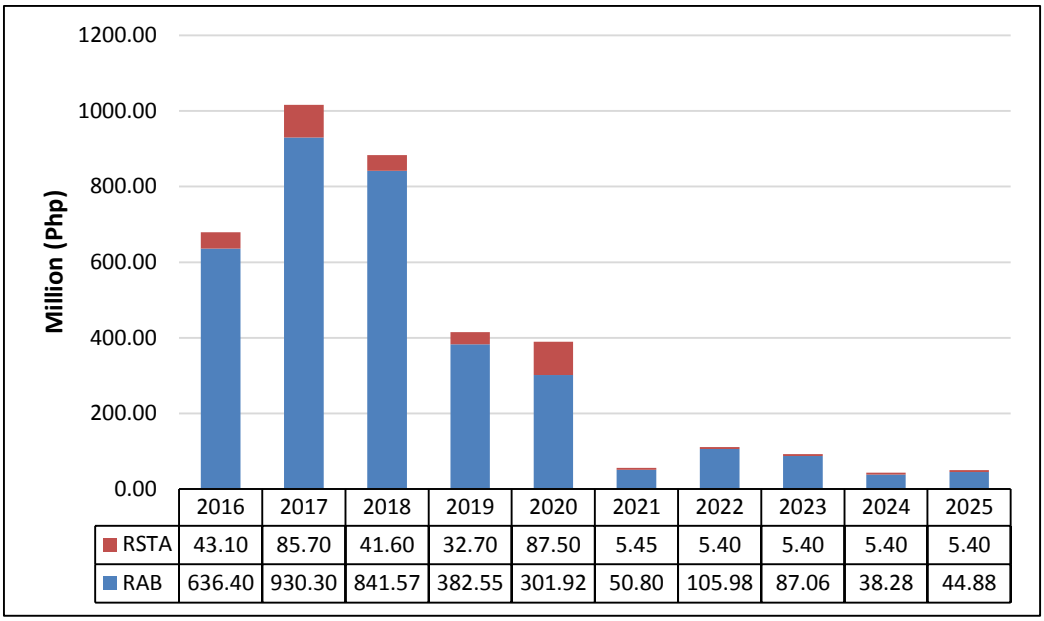
The Mindanao Region work order proposals primarily consist of replacement, rehabilitation, repair, and refurbishment of the existing substation equipment, transmission and sub-transmission lines, switchyards and other support facilities. In particular, this includes power transformers, circuit breakers, capacitor banks and other high voltage equipment; the upgrading of the DC system of the substations; upgrading of the protection system of the grid by replacing old and unreliable fault clearance equipment with state-of-the-art and numerical relays.

Also included, are the reconstruction of transmission line towers which were toppled or have suffered structural instability due to sabotage/pilferage and the implementation of slope protection of structures.

To comply with the environmental and safety requirement, there are proposals for the construction of oil containment basins and hazardous waste storage facilities, the implementation of the anti-fire and anti-flood programs for the substations, to mitigate the risk involve in fire and flooding. The rest of the Work Orders include the improvement and renovation of existing support facilities, as well as the construction of new ones.

These projects are considered to ensure the reliability of the power system in Mindanao, with the end objective of providing reliable, safe and quality power service to all customers.

The Work Order projects will require the amount of **3.737 Billion Pesos** for the period 2016 to 2025. The cost summary is shown in Figure 22.



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
RSTA	43.10	85.70	41.60	32.70	87.50	5.45	5.40	5.40	5.40	5.40
RAB	636.40	930.30	841.57	382.55	301.92	50.80	105.98	87.06	38.28	44.88

Figure 22: Mindanao Work Orders

4.2 Mindanao General Plant Equipment

The GPE for the transmission lines and substation maintenance, testing and calibration is driven by the criteria imposed by System Reliability Enhancement, End-of-Life Assets Replenishment, Philippine Grid Code and Environmental/ Safety Compliance, Timely Response and Data Management & Analysis Improvements. It also considers the replacement of obsolete testing equipment with state of the art units. The acquisition of new technology equipment as part of quality advancement is also considered.

Replacement of obsolete and defective tools and equipment and acquisition of modern test and monitoring equipment, such as Earth Resistance Tester, Insulation Resistance Tester, Frequency Response Analyzer, Insulation Power Factor Tester, Transformer Diagnostic Devices, UV Scanner, Battery Load Capacity Tester, Hotline Tools, various type of stringing blocks and other power line related tools are components in the implementation of maintenance strategy. Included in the proposal is the re-fleeting of line maintenance vehicles and equipment consisting of line and boom trucks.

The projects will require the amount of **0.495 Billion Pesos** for the period 2016 to 2025. The cost summary is shown in Figure 23.

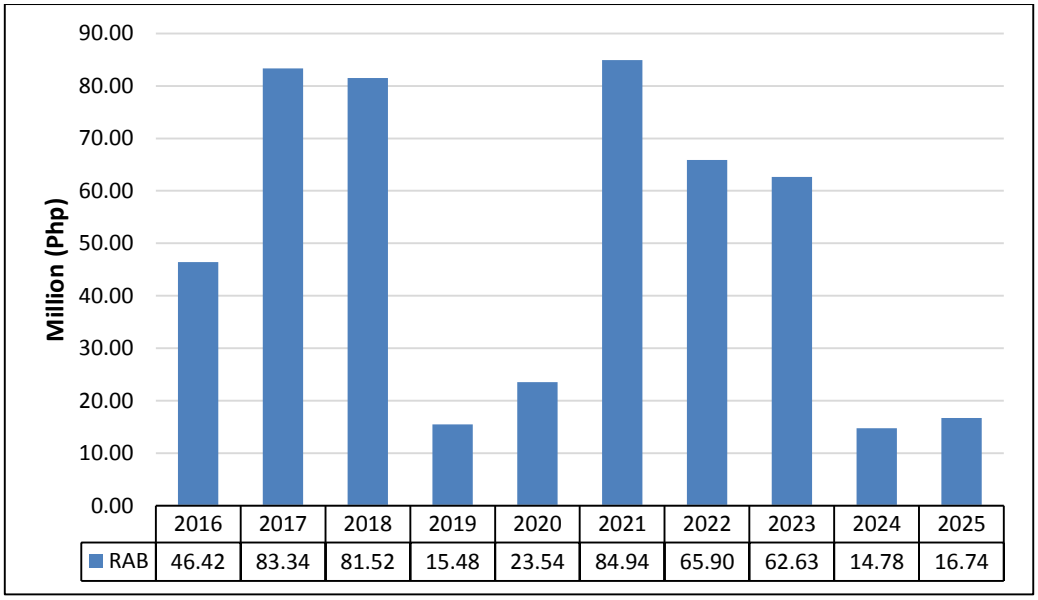


Figure 23: Mindanao GPE

4.3 Mindanao Spares

The spares requirement considers the minimum stock level for the installed transmission/sub-transmission line hardware, high voltage power equipment and devices/accessories. It also focuses on the existing and future replacement of defective units of protection & control equipment, statistical meters, and test & communication equipment. This also includes provision for transmission line hardware replacement in case of force majeure and sabotage.

In the span of 10 years, spares projection will require the amount of **1.680 Billion Pesos** for the period 2016 to 2025. The spares cost summary is shown in Figure 24.

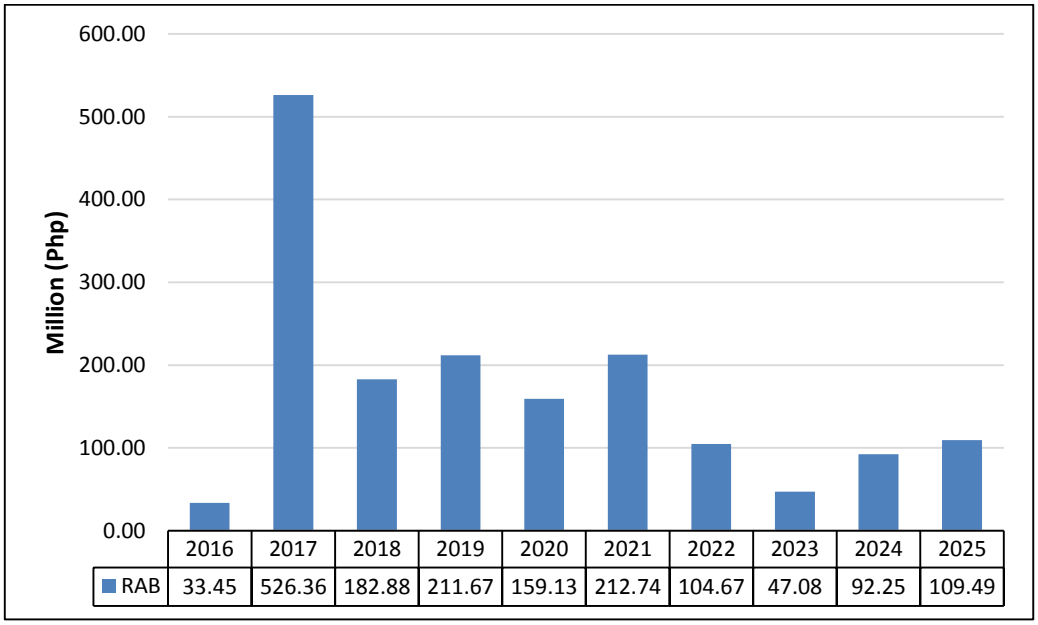
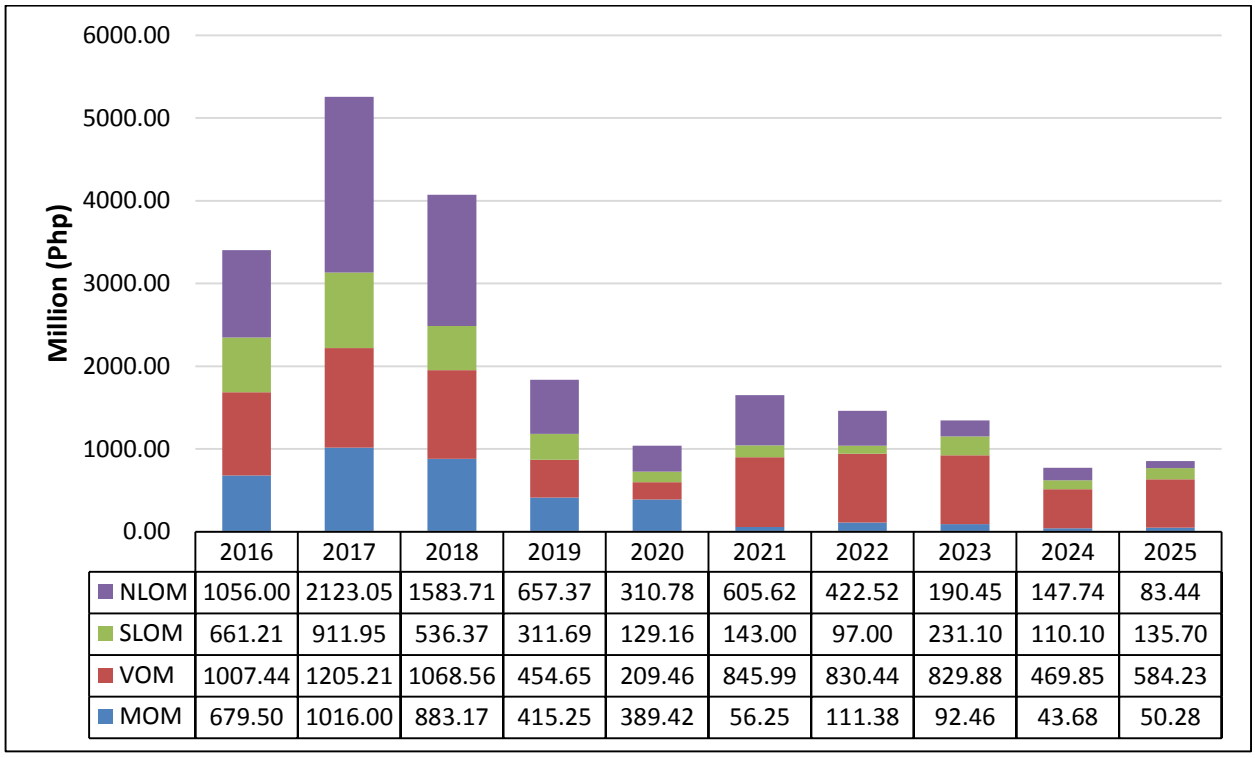


Figure 24: Mindanao Spares

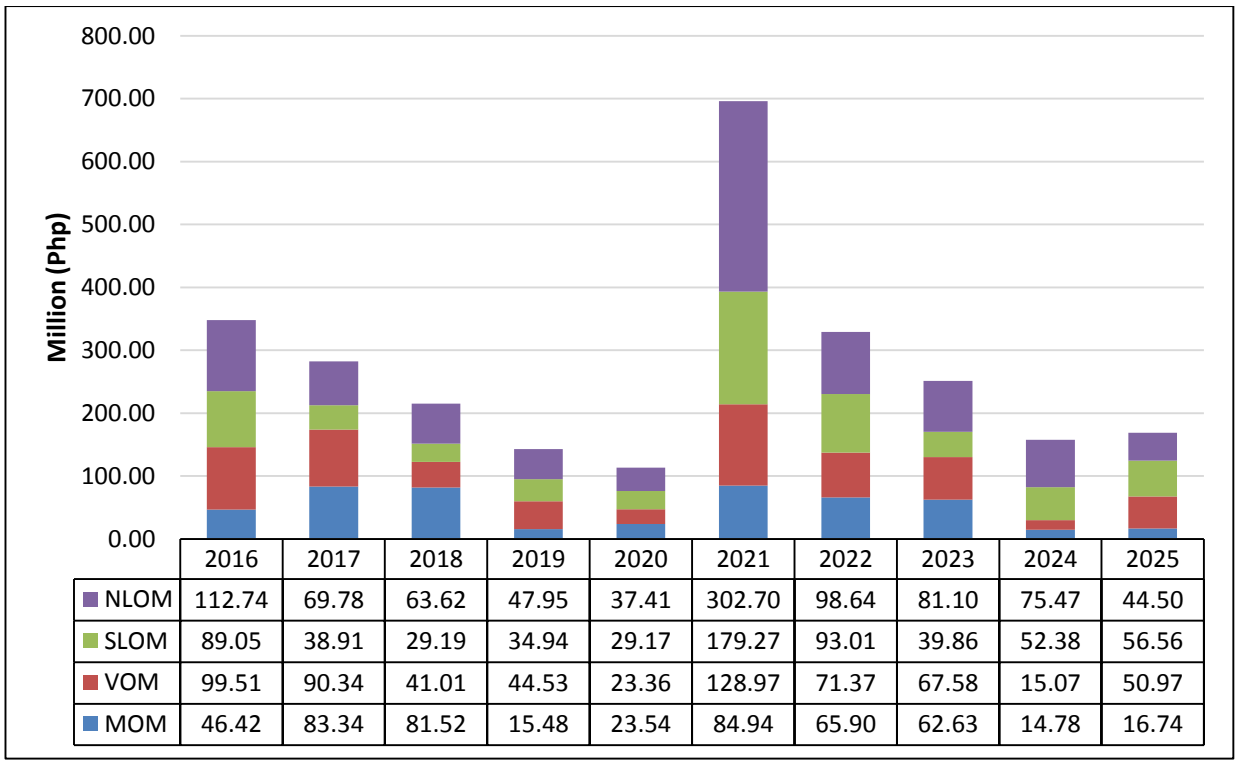
VII. CAPEX Summary

The following graphs show the summary of the O&M's CAPEX program.



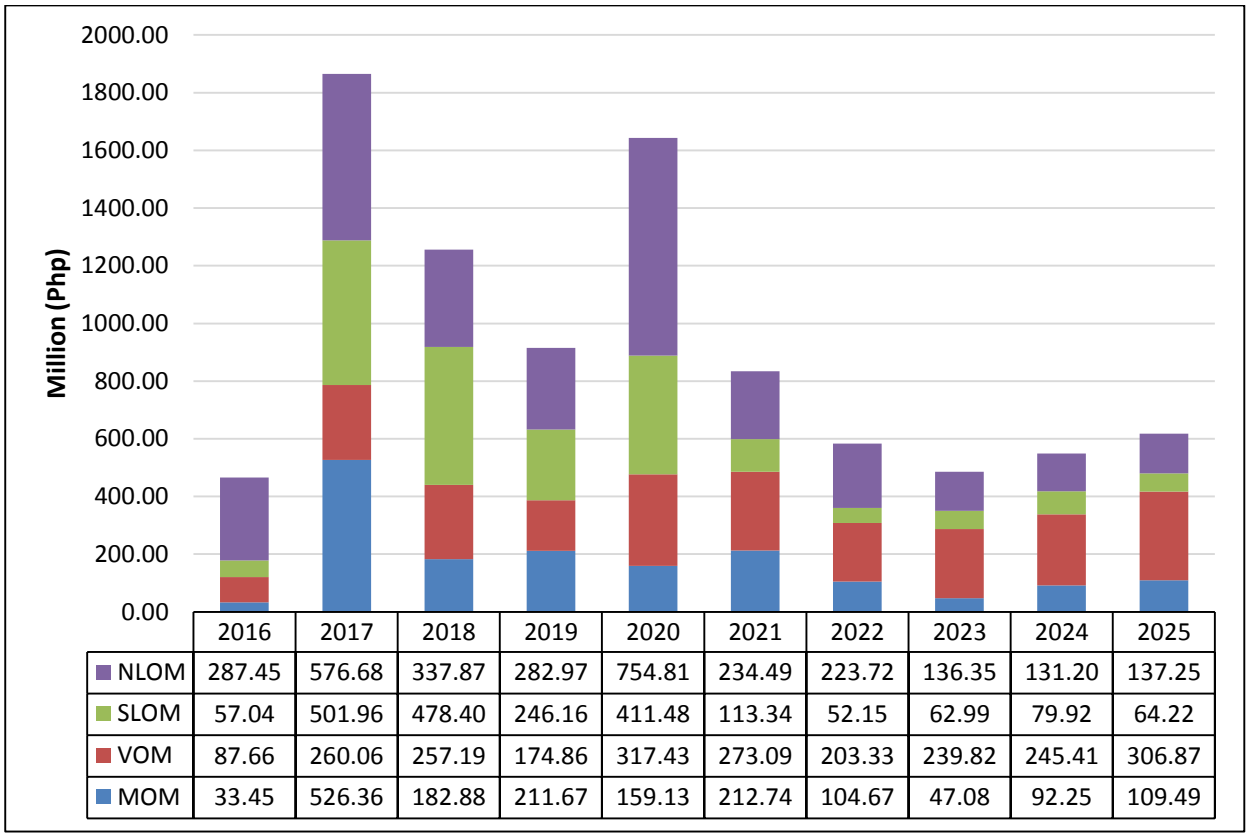
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
NLOM	1056.00	2123.05	1583.71	657.37	310.78	605.62	422.52	190.45	147.74	83.44
SLOM	661.21	911.95	536.37	311.69	129.16	143.00	97.00	231.10	110.10	135.70
VOM	1007.44	1205.21	1068.56	454.65	209.46	845.99	830.44	829.88	469.85	584.23
MOM	679.50	1016.00	883.17	415.25	389.42	56.25	111.38	92.46	43.68	50.28

Figure 25: Summary of Work Orders (2016-2025)



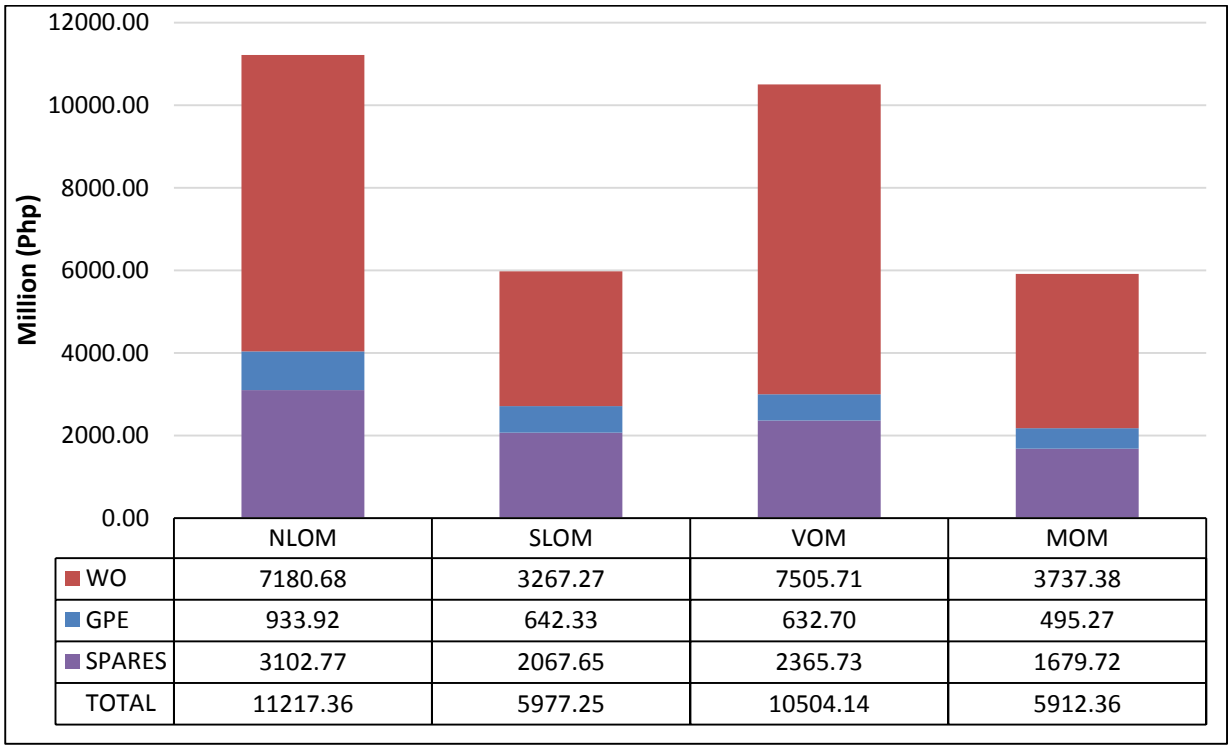
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
NLOM	112.74	69.78	63.62	47.95	37.41	302.70	98.64	81.10	75.47	44.50
SLOM	89.05	38.91	29.19	34.94	29.17	179.27	93.01	39.86	52.38	56.56
VOM	99.51	90.34	41.01	44.53	23.36	128.97	71.37	67.58	15.07	50.97
MOM	46.42	83.34	81.52	15.48	23.54	84.94	65.90	62.63	14.78	16.74

Figure 26: Summary of General Plant Equipment (2016-2025)



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
NLOM	287.45	576.68	337.87	282.97	754.81	234.49	223.72	136.35	131.20	137.25
SLOM	57.04	501.96	478.40	246.16	411.48	113.34	52.15	62.99	79.92	64.22
VOM	87.66	260.06	257.19	174.86	317.43	273.09	203.33	239.82	245.41	306.87
MOM	33.45	526.36	182.88	211.67	159.13	212.74	104.67	47.08	92.25	109.49

Figure 27: Summary of Spares (2016-2025)



	NLOM	SLOM	VOM	MOM
WO	7180.68	3267.27	7505.71	3737.38
GPE	933.92	642.33	632.70	495.27
SPARES	3102.77	2067.65	2365.73	1679.72
TOTAL	11217.36	5977.25	10504.14	5912.36

Figure 28: Grand Total (2016-2025)

APPENDIX

THE DESIRABLE LEVEL OF SPARES

Spares should be maintained at all times to answer for immediate or urgent need that may arise from time to time in the course of operating the grid. The needed spare should be available at the right place and at the right time. However, the level of inventory must be managed prudently considering that each item in the inventory has a carrying cost.

The desired level of spares has been determined based on the following factors:

a. Age of the equipment, devices and transmission line materials;
b. Failure rate;
c. Geographic location of warehouses where spares will be stored;
d. Redundancy of the installed equipment, devices and materials to be provided with spares;
e. Centralized and strategic location of spares;
f. Unavailability of spares at the local market;
g. Lead time for procurement; and
h. Manufacturing time of the spares

Based on the above factors, the following level of spares has been established:

1. Power Transformers – refer to Table 6
2. Power Circuit Breakers – refer to Table 7
3. Current Transformers – refer to Table 8
4. Voltage transformers – refer to Table 9
5. Surge Arresters – refer to Table 10
6. Disconnect Switches – refer to Table 11
7. Shunt Reactors – refer to Table 12
8. Capacitor Cells – refer to Table 13
9. Emergency Restoration System – 100 sets for whole NGCP
10. Steel pole – 2,000 poles for the whole NGCP

Other needed spares, materials and consumables for primary and secondary equipment, transmission and sub-transmission lines are also included in the TDP.

Table 6: Power Transformer

Voltage Level (kV)	Recommended Quantity To Be Maintained Per Year (unit)					
	2015	2016	2017	2018	2019	2020
LUZON						
230/115	3	3	3	4	4	4
230/69	3	3	4	5	5	6
115/34.5	2	2	2	2	2	2
115/69	2	2	2	2	2	2
69/13.8	4	6	7	8	9	10
VISAYAS						
230/138	1	1	1	1	1	1
230/69	1	1	1	1	1	1
138/69	1	2	2	3	3	4
69/13.8	2	2	2	3	3	3
MINDANAO						
138/69	2	3	4	4	5	5
69/13.8	2	2	2	2	2	3

Table 7: Power Circuit Breaker

Voltage Level (kV)	Recommended Ideal Quantity To Be Maintained Per Year (unit)					
	2015	2016	2017	2018	2019	2020
LUZON						
230	6	8	9	10	12	13
115	4	5	5	6	6	7
69	5	6	7	8	9	10
13.8	3	4	5	5	6	6
VISAYAS						
230	4	4	5	6	7	7
138	4	5	5	6	7	7
69	6	7	8	9	11	12
13.8	2	2	3	3	3	3
MINDANAO						
138	4	5	5	6	7	7
69	4	5	6	7	8	9
13.8	2	2	2	2	2	3

Table 8: Current Transformer

Voltage Level (kV)	Recommended Quantity To Be Maintained Per Year (set)					
	2015	2016	2017	2018	2019	2020
LUZON						
230	6	7	9	10	11	13
115	3	3	4	4	5	5
69	4	5	6	7	8	9
13.8	3	4	4	5	5	6
VISAYAS						
230	2	2	2	2	2	3
138	3	4	5	5	6	6
69	5	6	6	7	8	9
MINDANAO						
138	4	5	6	6	7	8
69	5	6	7	8	9	10

Table 9: Voltage Transformer

Voltage Level (kV)	Recommended Quantity To Be Maintained Per Year (set)					
	2015	2016	2017	2018	2019	2020
LUZON						
230	6	7	8	9	11	12
115	3	3	4	5	5	5
69	5	7	8	10	11	12
13.8	4	4	5	5	6	6
VISAYAS						
230	2	2	2	3	3	3
138	4	5	6	6	7	8
69	4	6	7	8	8	9
MINDANAO						
138	4	5	6	7	8	9
69	4	5	6	7	8	9

Table 10: Surge Arrester

Voltage Level (kV)	Recommended Quantity To Be Maintained Per Year (set)					
	2015	2016	2017	2018	2019	2020
LUZON						
230	5	7	8	9	10	11
115	3	4	4	5	6	6
69	5	6	7	8	9	10
13.8	2	3	3	4	4	4
VISAYAS						
230	2	2	2	3	3	3
138	5	6	6	7	8	9
69	5	7	8	9	10	11
13.8	3	3	3	4	4	4
MINDANAO						
138	5	6	7	8	9	10
69	5	7	8	9	10	11
13.8	2	3	3	3	3	4

Table 11: Disconnect Switch

Voltage Level (kV)	Recommended Quantity To Be Maintained Per Year (set)					
	2015	2016	2017	2018	2019	2020
LUZON						
230	3	4	5	6	7	8
115	2	3	3	4	4	5
69	4	5	6	7	8	9
34.5	2	3	3	3	3	3
23	2	2	2	2	2	2
13.8	1	1	1	1	1	1
VISAYAS						
230	1	1	1	1	2	2
138	1	2	2	3	3	4
69	1	2	3	3	4	5
34.5	1	1	1	1	1	1
MINDANAO						
138	3	4	4	5	6	7
69	3	4	5	6	7	7
34.5	2	2	2	2	2	2
13.8	2	2	2	3	3	3

Table 12: Shunt Reactor

Voltage Level (kV)	Recommended Quantity To Be Maintained Per Year (unit)					
	2015	2016	2017	2018	2019	2020
LUZON						
230	2	2	2	3	3	3
69	6	7	8	8	9	9
VISAYAS						
230	1	1	1	2	2	2
138	1	1	1	2	2	2
MINDANAO						
138	1	1	1	1	1	1
13.8	1	1	1	1	1	1

Table 13: Capacitor Cell

Rated Capacity per cell (kVAR)	Recommended Quantity To Be Maintained Per Year (unit)					
	2015	2016	2017	2018	2019	2020
LUZON						
312.5	3	4	4	5	5	6
378	3	3	4	5	5	6
417	4	5	5	6	7	8
463	27	37	47	56	65	74
695	27	38	48	57	67	76
795	22	30	37	44	51	58
VISAYAS						
150	15	25	33	40	47	47
208	9	14	16	19	22	24
250	14	19	23	28	32	36
378.13	16	24	26	31	36	40
378.7	19	32	43	47	47	47
416.7	5	8	11	13	15	17
MINDANAO						
250	24	41	47	47	47	47
278	20	26	27	27	27	27
625	12	15	19	22	25	29
670	6	7	9	10	11	12
830	4	5	6	7	8	9

ANNEX A

Transformer Criticality Index

Condition	Description
1	Problem on the internal components of the transformer that requires opening of main tank which only the manufacturer could do the repair. This applies for existing transformers with: ▪ Internal fault as evidenced by increasing trend or abnormal generation of dissolved gas. ▪ Factory sealed type tank which prohibits opening of the tank to conduct repair.
2	▪ Polychlorinated Biphenyl (PCB) Contamination
3	▪ Heavy oil leaks or abnormal rise in winding/oil temperature and/or other defects not covered under criticality 1 & 2
4	▪ Heavily loaded or 80% of rated MVA or higher loading or with significant impact to the system if the unit fails.
5	▪ No N-1 contingency (lone transformer in the substation)

Criticality 4: With health index of 1 or 2 or 3&4&5
Criticality 3: With combination of either health indices 3&4 or 3&5

ANNEX B

Summary of Power Transformer Replacement Program

New MVA Rating	Existing Transformers to be replaced			
	2017	2018	2019	Total
300	7 Las Piñas 300 MVA T2 San Jose 300 MVA T1 Naga Luz) 100 MVA T1 Taytay 300 MVA T3 Taytay 300 MVA T4 San Jose 100 MVA T2 Cabanatuan 100 MVA T2	2 Biñan 300 MVA T1 Hermosa 100 MVA T2	1 Hermosa 100 MVA T1	10
100	5 Gamu 50 MVA T1 Tagoloan 100 MVA T1 Batangas 100 MVA T2 Bayombong 40 MVA T1 Daraga 50 MVA T2	5 Olongapo 50 MVA T2 Butuan 50 MVA T1 Currimao 20 MVA T1 San Manuel 100 MVA T1 Labo 50 MVA T1	2 Tacurong 50 MVA T1 Limay 50 MVA T2	12
50	5 Zamboanga 50 MVA T2 Tuguegarao 40 MVA T1 Kibawe 50 MVA T1 San Francisco 50 MVA T1 Isabel 30 MVA T1	4 Calungcalong 30 MVA T1 Bislig 30 MVA T1 Iligan 20 MVA T1* Naga(Vis) 50 MVA T7	3 Botolan 50 MVA T1 Mabinay 30 MVA T1 Nasipit 50 MVA T1	12
Total	**17**	**11**	**6**	**34**

*-to be retained as 20MVA

Legend: Criticality 4 Criticality 3

ANNEX C

Deployment Schedule of Replaced Power Transformers

REGION	TRANSFORMERS FOR REPLACEMENT	NEW MVA RATING	PROCUREMENT YEAR	COMMISSIONING YEAR	DEPLOYMENT AFTER REPAIR
MOM	Kibawe 50 MVA T1	50	2016	2017	DISPOSE
MOM	Butuan 50 MVA T1	100	2018	2018	DISPOSE
MOM	Iligan 20 MVA T1	50	2017	2018	DISPOSE
MOM	San Francisco 50 MVA T1	50	2016	2017	N-1, SAN FRANCISCO SS
MOM	Zamboanga 50 MVA T1	50	2017	2017	N-1, KIBAWE SS
MOM	Bislig 30 MVA T1	50	2018	2018	SPARE (BISLIG SS)
MOM	Tacurong 50 MVA T1	100	2019	2019	N-1, BISLIG SS
MOM	Tagoloan 100 MVA T1	100	2017	2017	N-1, AGUS 6
MOM	Nasipit 50 MVA T1	50	2019	2019	N-1, NASIPIT SS
NLOM	Taytay 300 MVA T4	300	2016	2017	DISPOSE
NLOM	San Jose 300 MVA T1	300	2017	2017	DISPOSE
NLOM	Gamu 50 MVA T1	100	2017	2017	DISPOSE
NLOM	Bayombong 40 MVA T1	100	2016	2017	DISPOSE
NLOM	Taytay 300 MVA T3	300	2017	2017	DISPOSE
NLOM	Olongapo 50 MVA T2	100	2018	2018	DISPOSE
NLOM	Currimao 20 MVA T1	100	2018	2018	DISPOSE
NLOM	Botolan 50 MVA T1	50	2019	2019	DISPOSE
NLOM	San Manuel 100 MVA T1	100	2017	2018	N-1, SAN MANUEL SS
NLOM	Hermosa 100 MVA T2	300	2017	2018	SPARE (OLONGAPO SS)
NLOM	San Jose 100 MVA T2	300	2016	2017	SPARE (SAN JOSE SS)
NLOM	Hermosa 100 MVA T1	300	2018	2019	SPARE (HERMOSA SS)

NLOM	Limay 50 MVA T2	100	2019	2019	SPARE (LIMAY SS)
NLOM	Cabanatuan 100 MVA T2	300	2016	2017	N-1, CABANATUAN SS
NLOM	Tuguegarao 40 MVA T1	50	2017	2017	DISPOSE
SLOM	Labo 50 MVA T1	50	2016	2017	DISPOSE
SLOM	Las Pinas 300 MVA T2	300	2017	2017	DISPOSE
SLOM	Batangas 100 MVA T2	100	2016	2017	DISPOSE
SLOM	Binan 300 MVA T1	300	2019	2019	DISPOSE
SLOM	Naga (Luz) 100 MVA T1	300	2016	2017	N-2 NAGA(Luz)
SLOM	Daraga 50 MVA T2	100	2017	2018	REPLACEMENT, DARAGA T1
VOM	Naga (Vis) 50 MVA T7	20	2017	2018	DISPOSE
VOM	Calungcalung 30 MVA T1	50	2018	2018	DISPOSE
VOM	Mabinay 30 MVA T1	50	2019	2019	DISPOSE
VOM	Isabel 30 MVA T1	50	2016	2017	DISPOSE