SEWERAGE & WATER BOARD OF NEW ORLEANS
BOARD OF DIRECTORS' MEETING

SKYPE 12PM, MARCH 20, 2020
INFORMATION ONLY

625 ST. JOSEPH STREET
2ND FLOOR BOARD ROOM

LaToya Cantrell, President • Tamika Duplessis, President Pro Tem • Jay H. Banks, Councilmember • Joseph Peychaud •Robin Barnes • Ralph Johnson • Alejandra Guzman• Lynes Sloss • Maurice Sholas • Janet Howard

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FINAL AGENDA

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1. **ROLL CALL**
2. **COVID19 UPDATES**
   - **a.** Mayor Cantrell, President of the Board
   - **b.** Ghassan Korban, Executive Director
3. **INFORMATION ITEM**
   a. Black & Veatch 2018 Report on Operations
   b. Power Master Plan
4. **ADJOURNMENT**

This teleconference meeting is being held pursuant to Executive Order JBE 2020-30, Section 4.

R-050-2020

CERTIFICATION TO HOLD TELECONFERENCE
BOARD MEETINGS

WHEREAS, on March 11, 2020, Mayor LaToya Cantrell authorized a Mayoral Proclamation of a State of Emergency Due to COVID-19; and

WHEREAS, on March 11, 2020, Governor John Bel Edwards authorized a Public Health Emergency pursuant to Proclamation No. 25 JBE 2020; and

WHEREAS, on March 16, 2020, Governor John Bel Edwards authorized Additional Measures for COVID-19 Public Health Emergency, pursuant to Proclamation No. JBE 2020 – 30; and

NOW, THEREFORE, BE IT RESOLVED, pursuant to Governor John Bel Edwards Emergency Proclamation Number JBE 2020 – 30, Section 4, the Sewerage and Water Board of New Orleans (SWBNO) hereby notices a teleconference/video conference on March 20, 2020, at 12:00 noon, to undertake the business of the SWBNO as described in the attached Agenda. The SWBNO has taken all reasonable efforts to allow for observation and input by members of the public. Under the existing emergency conditions, the SWBNO may be unable to operate pursuant to quorum requirements.

I, Ghassan Korban, Executive Director, of the Sewerage and Water Board of New Orleans, do hereby certify that the above and foregoing is a true and correct copy of a resolution adopted at the Regular Monthly Meeting of said Board, duly called and held, according to law on March 20, 2020

GHASSAN KORBAN
EXECUTIVE DIRECTOR
SEWERAGE AND WATER BOARD OF NEW ORLEANS

REPORT ON OPERATIONS FOR 2018

B&V PROJECT NO. 199395

PREPARED FOR

Sewerage and Water Board of New Orleans

9 MARCH 2020

JULIEN ENGINEERING & CONSULTING

Bruno & Tervalon LLP Certified Public Accountants

BLACK & VEATCH

MISSION STATEMENT

We serve the people of New Orleans and improve their quality of life by providing safe drinking water, removing waste water for safe return to the environment and draining storm water to protect our community. Our team of experts do this reliably, continuously, and at a reasonable cost.

VISION STATEMENT

Our vision is to earn and hold the trust and confidence of our customers and community for reliable and sustainable water services and to be a model utility in the water industry.

OUR GUIDING PRINCIPLES

Team Work
Customer Focus
Honesty & Integrity
Service Excellence
Safety
Workplace Climate
Accountability

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Introduction

PURPOSE AND SCOPE

This report covers operations of the Sewerage and Water Board of New Orleans for the year ending December 31, 2018. This report presents findings of studies made in compliance with covenants of the General Water Revenue Bond Resolution and the General Sewerage Service Revenue Bond Resolution. Subjects covered include the following:

1. Adherence to covenants of the General Water Revenue Bond Resolution and the General Sewerage Service Revenue Bond Resolution.
2. Ability to finance projected revenue requirements including proposed capital improvements.
3. Operations of the water, sewerage, and drainage systems.

DEFINITIONS

In this report, “Sewerage and Water Board of New Orleans,” “Sewerage and Water Board,” and “Board” are used synonymously. “General Resolution” refers to either the General Water Revenue Bond Resolution adopted on May 21, 2014 by the Board or the General Sewerage Service Revenue Bond Resolution adopted on May 21, 2014 by the Board.

“Water Department” is the Sewerage and Water Board organization providing domestic water service to residents of the City of New Orleans. “Sewerage Department” is the organization providing wastewater service, and “Drainage Department” is the organization providing stormwater conveyance and pumping. The Board organization includes some groups who participate in two or more operational activities.

HISTORY

The Sewerage and Water Board of New Orleans was created by Act No. 6 of the Louisiana Legislature in 1899 as a special board independent of City government to develop, operate, and maintain the water and sewerage systems in the City of New Orleans. In 1903, the Louisiana Legislature gave control of the City’s drainage system to the Board. Since that time, growth of the service area and increased service requirements have expanded the magnitude and complexity of operations.

Available sources of funds prior to 1958 for financing utility operations and improvements included ad valorem taxes, contributions-in-aid-of-construction, general obligation bonds of the City of New Orleans, and water revenues.

In 1974, the American Institute of Certified Public Accountants expanded their reporting guidelines for government operated utilities to include depreciation accounting. As a result, the Board initiated a preliminary system of accounting recognizing estimated historical investment as a basis for annual depreciation accruals. Implementation of the detailed plant accounting and record keeping required was started in 1979.

The Board’s computer based budget code system provides a method of identification of operation and maintenance expenses for the Water, Sewerage, and Drainage Departments. Allocation of expenses is based upon actual or direct expenses of each Department together with an apportionment of joint

expenses. accounting for debt service, interest is charged to current year's income and principal and debt service reserve payments are charged to the respective account balances. Historical operating costs, discussed later in this report, reflect the functional classifications.

Water Department

Act No. 541 increased the Board's ability to finance needed water system improvements by authorizing the Board to issue water revenue bonds. In 2014, the Board issued Water Revenue and Refunding Bonds in the amount of $103,525,000 and established the existing General Bond Resolution under which all debt is issued. A portion of the proceeds were used to defease all outstanding bonds. In 2015, the Board issued Water Revenue Bonds in the amount of $100,000,000. Principal payments will begin in 2018. As of December 31, 2018, total outstanding debt service on all outstanding revenue bonds totaled $197,300,000.

Act No. 566 reauthorized the Board to fix and administer a schedule of water rates to meet the operational and capital costs of the public water system, to issue water revenue bonds, and to discontinue the free water allowance for sewerage purposes effective November 9, 1966.

Sewerage Department

Act No. 567 gave the Board authority to set and collect sewerage service charges to be used for operational and capital costs of the Sewerage Department, and to issue sewerage service revenue bonds. This Act permitted the Board, for the first time in its history, to charge users of the sewerage system directly for related costs. Under the authority of Act No. 567, sewerage service charges were implemented May 1, 1967 and subsequently, sewerage service revenue bonds were sold. In 2014, the Board issued Sewerage Service Revenue and Refunding Bonds in the amount of $158,990,000 and established the existing General Bond Resolution under which all debt is issued. A portion of the proceeds were used to defease all outstanding bonds with the exception of the Series 2011 bonds.

In November 2011, the Board and Louisiana Department of Environmental Quality (LADEQ) entered into a loan agreement whereby $9,000,000 of proceeds from the Revolving Loan Fund were borrowed through the issuance of Sewerage Service Subordinate Revenue Bonds, Series 2011. Debt service payments assume a 20-year term with a 0.45 percent interest rate plus an administrative fee of 0.5 percent. The Board began drawing down the funds during the first quarter of 2012 and as of December 31, 2014, had received a total of $9,000,000 in disbursements. Principal payments began in November of 2013. With the issuance of the Series 2014 bonds, the Series 2011 bonds became Senior Parity Debt under the General Bond Resolution and entitled to the provisions of the General Sewerage Service Revenue Bond Resolution. Principal payments will begin in 2021. In 2015, the Board issued Sewerage Service Revenue Bonds in the amount of $100,000,000. In 2019, the Board issued the Series 2019 LADEQ loan in the amount of $10,000,000 with principal payments beginning in 2021. Outstanding principal on all revenue bonds totaled $226,915,000 as of December 31, 2018.

Drainage Department

In 1966 three constitutional amendments, Acts No. 565, 566, and 567 were enacted by the Louisiana Legislature and subsequently approved by the State's voters. Act No. 565 authorized the City of New Orleans to levy a three-mill ad valorem tax, effective January 1, 1967, to be used solely for operations and

capital costs of the drainage system. Provision for issuance of bonds repayable solely from the three-mill tax was also included in the Act.

Under the Louisiana State Constitution, all assessments beginning in 1978 were equalized, with residential property assessed at 10 percent of its market value and commercial and personal property assessed at 15 percent of market value. The constitution also provides that no tax revenues shall be lost by reassessments; thus, it has been necessary to revise the millage rates in effect at various times. If reassessment results in a lower tax base, the millage rate may be adjusted upward. If a larger tax base results, the millage rates must be rolled back. However, by state law, the City Council, upon request and after a public hearing, may increase the millage rates to the prior year's level. The three-mill tax rate, 6.01 mills since 1988, was increased to 6.40 mills in 1992 due to reassessment and remained at that level through 2007. In 2007, it was reduced to 4.544 and in 2010 it was increased to the current rate of 4.66 mills.

Passage of a referendum in April 1977, authorized the collection of an additional six-mill, ad valorem tax for drainage purposes, effective January 1, 1978. The six-mill ad valorem tax was increased to 6.09 mills in 1988 and to 6.48 mills in 1992 due to reassessment and remained at that level through 2007. In 2007, it was reduced to 4.60 and in 2010 it was increased to the current rate of 4.71 mills.

In 1981, a nine-mill ad valorem tax was approved and became effective January 1, 1982. It was reauthorized in December 2016. The purpose of the nine-mill tax levy is to provide funds for the operation, maintenance, and construction of the drainage system. In 1998 nine-mill bonds in the amount of $10,000,000 were issued and additional nine-mill bonds in the amount of $20,000,000 were issued in 2002. In 2014, the Board issued Drainage System Refunding Bonds in the amount of $14,900,000 for the purpose of refunding Series 1998 and Series 2002. The total nine-mill Drainage System Bonds outstanding as of December 31, 2018 was $7,665,000.

In 1988, reassessment caused the nine-mill ad valorem tax to be increased to 9.13 mills. It was increased due to reassessment again in 1992 to 9.71 mills and remained at this level through 2007. In 2007, it was reduced to 6.89 and in 2010 it was increased to the current rate of 7.06 mills.

Collection of the three-mill ad valorem tax levy is authorized through 2046; six-mill tax through 2026; and nine-mill tax through 2031. At the expiration date of the millages draws closer, the Board will need to consider identification of other possible sources of revenue to maintain the future sustainability of the Drainage system in the event that the millages are not renewed.

General

In July of 2006 the Board entered into a Cooperative Endeavor Agreement with the State of Louisiana to secure proceeds from the State's Gulf Opportunity Tax Credit Bond Loan Program to assist in payment of debt service requirements from 2006 through 2008. The Board has borrowed $77,465,247, which was the total amount available to the Board. Of that amount, $31,500,000 was used to make a partial payment on the Sewerage Service Refunding BANs Series 2005A that matured on July 26, 2006. The remainder was used to make debt service payments on the Drainage System special tax bonds, the Sewerage Service revenue bonds, and the Water revenue bonds that were due on December 1, 2006; June 1, 2007;

December 1, 2007; and June 1, 2008. Principal payments on the bonds began in July 2012 and continue through July 2026. As of December 31, 2018, the amount outstanding was $47,762,154.

The Board is currently receiving funds from the U.S. Army Corps of Engineers (COE) sponsored and congressionally authorized Southeast Louisiana Urban Flood Control (SELA) Project. This funding will allow additional construction projects which were identified in the 1970s, but which have not been completed because of funding limitations. The identified projects are to be funded either 100 percent from federal funds or 65 percent from federal funds and 35 percent from local funds.

The Board provides water and sewer for public services to the City of New Orleans and its public institutions as mandated by state law in accordance with R.S. 33:4096 and R.S. 33:4121, respectively. The Sewerage and Water Board and the Orleans Parish School Board (OPSB) reached an agreement effective July 1, 1992, whereby the schools would be charged for any water exceeding an allowance of six gallons per day, for 365 days per year, for each student enrolled and any other person regularly assigned to that campus or facility. The allowance was lowered to four gallons per day effective July 1, 1993.

SOURCES OF FINANCIAL DATA

Financial information included in this report is obtained from audited financial reports provided by the Board.

SUMMARY OF FINDINGS

This section contains a summary of the financial operations of the Water, Sewerage, and Drainage Departments for the year 2018. Projections of future operations are also presented as a basis for determining the adequacy of present revenue sources to finance projected operating expenses and proposed capital program costs of the respective departments.

The statistical data maintained by the Board includes the compilation of detailed information on water sales and revenues. Operation and maintenance expenses are summarized by supplemental accounts that are used for internal purposes to identify the cost in each functional category that is incurred for personal services, services and utilities, material and supplies, replacement and maintenance, and other special charges.

Water Department

Water Revenue Bond Resolution Requirements

Sewerage and Water Board financial operations for 2018 have complied with the requirements set forth in the General Water Revenue Bond Resolution.

Summary of 2018 Operations

The total revenue from water sales, delinquent fees, interest income and other income decreased from $94,656,734 in 2017 to $94,507,453 in 2018. Operation and maintenance expenses (excluding claims paid) increased from $76,415,700 in 2017 to $85,996,300 in 2018. After deducting claims of $484,441 and debt service payments of $13,333,550, the balance available for capital related expenditures in 2018 was a deficit of $5,306,838.

Ability to Finance Future Operations and Proposed Improvements

A summary of projected financial operations of the Water Department for the period 2019 through 2023 is shown in Table 10 of the report. Revenues under existing rates effective January 1, 2019 and adopted rates effective January 1, 2020 are shown on Line 1 of Table 10. Revenue from future proposed annual revenue increases of 6.0 percent effective January 1, 2021, and 3.0 percent effective January 1, 2022 and January 1, 2023 are shown on Lines 2 through 6 of Table 10.

It is anticipated that a total of $78,000,000 in Revenue bonds will be issued through 2023 to fund the proposed capital improvement program. Included in this amount is a $60,000,000 DHH loan that is anticipated to be issued in 2020.

It is anticipated that current revenue sources will be adequate to readily finance both projected capital program requirements and estimated future operation expenses of the Water Department during the 2019-2023 study period examined herein.

Sewerage Department

Sewerage Service Revenue Bond Resolution Requirements

Sewerage and Water Board financial operations for 2018 have complied with the requirements set forth in the General Sewerage Service Revenue Bond Resolution.

Summary of 2018 Operations

The total revenue from sewer charges, delinquent fees, interest income and other income increased from $114,321,779 in 2017 to $118,029,792 in 2018. Operation and maintenance expenses increased from $64,597,617 in 2017 to $80,212,900 in 2018. After deducting claims of 1,969,339 and debt service payments of $23,139,113, a balance of $12,708,440 was available for capital related expenditures in 2018.

Ability to Finance Future Operations and Proposed Improvements

A summary of projected financial operations of the Sewerage Department for the period 2019 through 2023 is shown in Table 20 of the report. Revenues under existing rates, effective January 1, 2019 and adopted January 1, 2020 are shown on Line 1 of Table 20. Revenue from a future proposed annual revenue increase of 3 percent effective January 1, 2021 is shown on Line 4 of Table 20.

It is anticipated that a total of $75,400,000 in future long-term debt financing will be issued in 2020. In addition, the Board has applied for a $100,000,000 Water Infrastructure Finance and Innovation Act (WIFIA) loan to be received in 2020.

It is anticipated that current revenue sources will be adequate to readily finance both projected capital program requirements and estimated future operation expenses of the Sewerage Department during the 2019-2023 study period examined herein.

Drainage Department

Summary of 2018 Operations

Total revenues received from all sources including interest income totaled 57,734,583 in 2018, an increase of approximately 1.5 percent from $56,882,973 reported for the same sources in 2017. Total operation

and maintenance expenses decreased about 6.4 percent, from $54,848,500 in 2017 to $51,347,300 in 2018. After adding a net receipt for claims of $9,656,464 and deducting debt service payments of $2,028,550, a balance of $14,015,197 was available for capital related expenditures in 2018.

Ability to Finance Future Operations and Proposed Improvements

An analysis of financial operations projected for the Drainage Department for the period 2019 through 2023 is summarized in Table 29 of the report. Revenue from the three-mill, six-mill, and nine-mill ad valorem taxes may be used for operating expenses, debt service, and capital expenditures.

The analysis indicates that the current revenue sources are not adequate to meet operation and maintenance expenses and total debt service on existing bond issues beginning in 2020. In addition, the Drainage Department will not have the debt capacity to fund all of the capital requirements during the 2019-2023 period. Due to constraints on revenue, it is anticipated that capital projects during the 5-year period will exceed the amount of funding available from the Drainage Department. It is recommended that the Board defer capital projects until an additional source of operating revenue has been identified and the SWBNO has the capacity to debt finance more projects. This deferment is shown on Line 9 of Table 28.

Other Findings

The Board operates a power plant at the Carrollton Water Purification Plant which provides power for the water purification process as well backup power in the event that commercial power fails or becomes unavailable. The Board's analysis of power purchased and produced is shown in the supplemental section of the 2018 Comprehensive Annual Financial Report. In 2018, approximately 70.7 million kilowatt hour (kWh) of power was purchased and 32.5 million kWh of power was generated.

On a unit cost basis, the average cost of purchased power has increased over the past five years from about 9.9¢ per kWh in 2013 to about 11.3¢ per kWh in 2018. During the same period, the Board's unit cost for generated power has decreased from about 33.3¢ per kWh to about 31.3¢ per kWh. In 2018, the cost of Board generated power was 2.8 times higher than that of purchased power; however, this higher cost is offset by the fact that the Board generated power is much more reliable that the purchased power from the local utility company.

In conducting our analyses and in forming an opinion of the projection of future operations summarized in this report, Black & Veatch has made certain assumptions with respect to conditions, events, and circumstances that may occur in the future. The methodology utilized by Black & Veatch in performing the analysis follows generally accepted practices for such projections. Such assumptions and methodologies are summarized in this report and are reasonable and appropriate for the purpose for which they are used. While Black & Veatch believes the assumptions are reasonable and the projection methodology valid, actual results may differ materially from those projected, as influenced by the conditions, events, and circumstances that actually occur.

Facilities Evaluation – Operation, Maintenance, and Reconstruction

This evaluation summarizes the onsite assessment findings of the Sewerage and Water Board of New Orleans (SWBNO) facilities conducted by Black & Veatch from August 5 to August 9 of 2019. Site visits were conducted at the water and wastewater treatment plants, Carrollton Power Plant facilities, and Central Yard facilities to evaluate their condition and operational capabilities. In addition, the sewage and drainage pump stations (DPSs) were inspected to evaluate their condition. Interviews were conducted with SWBNO management and supervisors during the site visit to assess the current operations status of the various facilities.

INTRODUCTION

The Operations Department of the SWBNO is comprised of four units: (1) Water Purification, (2) Sewage Treatment, (3) Water Pumping and Power, and (4) Sewage and Drainage Pumping. The SWBNO operates the Carrollton and Algiers Water Purification Plants (WPPs), which purify raw water from the Mississippi River and supply potable water to New Orleans residents. The Carrollton Plant currently purifies approximately 135 million gallons per day (mgd) of water for the east bank of the Orleans Parish. The Algiers Plant, which serves the predominantly residential west bank portion of the parish, purifies roughly 10 mgd of water. The treated water from the two plants is pumped through approximately 1,800 miles of mains to the service connections within the city and to several customers in adjacent parishes.

The sewerage collection system includes several miles of lateral sewers, trunk sewers, and 83 electrically-operated pump stations. Raw sewage is conveyed through a force main system. Sewage Pumping Stations (SPS) A and D on the east bank and SPS C on the west bank are attended stations. SPS A houses a supervisory control and data acquisition (SCADA) system, which monitors operation of all other sewage stations 24 hours a day.

The SWBNO operates two sewage treatment plants, one on the east bank and one on the west bank. The East Bank Sewage Treatment Plant has a treatment capacity of 122 mgd (dry weather) and treats sewage from the east bank community. The West Bank Sewage Treatment Plant has a treatment capacity of 20 mgd (dry weather) and serves the west bank community, as well as a few customers in Plaquemine Parish. Both plants were built or expanded in the 1970s and have been upgraded or expanded to increase reliability and capacity. The contract operator, Veolia Water, currently operates and maintains the plants for SWBNO.

In addition, the SWBNO is responsible for operating and maintaining the 24 major drainage pumping stations in New Orleans and 11 smaller (automatic) underpass stations. The majority of those stations are manned 24 hours per day, 7 days per week. Each station is equipped with multiple pumps, which are activated in response to increasing water levels. Personnel routinely monitor these pumps and the numerous miles of drainage canals to ensure proper drainage in the area.

The 25 cycle power plants operated by the SWBNO provide power to portions of the WPPs and approximately 60 percent of the drainage pumps. Two large vertical sewage pumping units at Station A are also run on 25 cycle power. The following sections summarize key issues within several departments of the SWBNO.

STAFFING

At December 31, 2018, the total number of SWBNO employees was 13,21, 122 more than the previous year; while the number of employees related to operations and maintenance decreased from 172to 171 over that same period. Adequate staffing continues to be an issue for most departments at the SWBNO. Additional maintenance is required for the SWBNO facilities as equipment ages and more equipment is added. Vacancies still exist in several departments, especially the ones that require highly educated and skilled personnel. These shortages are reflected within the more technical disciplines, such as mechanical maintenance, electrical maintenance, plant maintenance, welding and fabrication, and operations.

The SWBNO has a domicile policy which requires employees to live in New Orleans. Departments within the SWBNO are currently actively recruiting from local college campuses, career fairs, and trade schools to fill vacancies.

In addition to those highly skilled positions, a significant portion of the SWBNO's leadership will retire within the next five years. Very few successors have been identified to assume the leadership positions of the departing personnel.

Most departments have staffing issues related to inadequate personnel to fulfill the current needs of the SWBNO. Table 1 summarizes the staff on the payroll for each department related to operations and maintenance and the percentage of staff eligible for retirement within five years of December 31, 2018. These conditions demonstrate the need for an effective succession plan for the department heads and supervisors.

Table 1 - Current Number of Board Employees and Employees Eligible for Retirement

DEPARTMENT	EMPLOYEES ON PAYROLL	ELIGIBLE FOR RETIREMENT	% ELIGIBLE FOR RETIREMENT
Operations – WPPs	69	15	21.7%
Operations - Water Quality Laboratory at Carrollton Plant	10	2	20.0%
Operations - Water Pumping and Power	89	18	20.2%
Operations - Sewage and Drainage Pumping Stations	127	31	24.4%
Facility Maintenance	83	18	21.7%
Engineering	53	11	20.8%
Networks	332	48	14.5%
Support Services	114	23	20.2%
Environmental Affairs	19	5	26.3
Total	**898**	**172**	**19.2%**

WATER PURIFICATION PLANTS

The Black & Veatch representative accompanied the WWP's superintendent on facility tours of the Carrollton and Algiers WPPs. The Carrollton and Algiers WPPs were operational and producing water that meets or exceeds federal drinking water standards. Treatment systems at both plants function well and continue to produce potable water for the east bank and west bank.

The staffing levels at the Carrollton and Algiers WPPs have been able to consistently produce finished water that complies with federal and state regulations and meets the capacity of the service population. Due to retirements in 2018, the department lost various management personnel and their internal water treatment plant knowledge; however, the department has continued to hire more entry level staff. The department would like to hire experienced operators, ideally with certifications in hand, but has difficulty due to the residency requirements and pay rates. Staff feel that there is not an incentive to become certified, and there is a lack of certified operators state-wide. No management staff was hired in 2018.

The SWBNO internal operator training program stopped in 2017 due to a retirement within the department. No internal training program was re-established in 2018. This internal training program assisted operations staff with passing state certification exams and with job training. Instead of the internal training program, the SWBNO uses Delgado Community College operator certification classes, paying for staff to take the class to obtain a license. The SWBNO will pay for additional classes as part of ongoing training and it assigns operations staff higher level certifications once training has been completed. These training strategies are implemented to mitigate the number of senior operators that have already retired or will be retiring within the next few years who need to be replaced to maintain compliance.

At the time of the visit, a total of 18 operators hold a Water Treatment 4 license. Out of those operators, five are eligible for retirement, one is retired and works part time in the filter gallery, and four are currently in the DROP Program (fully retired in the next five years). Within those indicated for retirement are key staff in the chemical house and filter gallery as well as one senior operator at the Algiers WPP. Their replacements are already in the deferred retirement option plan (DROP) program and will be retired within 5 years with few candidates to promote within the department. At the time of the visit, there were not enough certified water plant operators to cover all the shifts, and the department was using overtime to ensure compliance is maintained.

As stated previously in the 2017 report, the Louisiana Department of Health's (LDH) plant inspection conducted in 2018 of both plants noted again that a lack of managers and certified operators at both WPP was a major deficiency that needed to be addressed by the SWB. It was noted that attracting experienced staff is still a challenge due to pay compared to surrounding utilities and the residency requirement.

Carrollton Water Purification Plant

The Carrollton WPP has a design capacity of 210 mgd. The water treatment processes at the plant consist of flocculation with a polymer and ferric sulfate followed by pH adjustment with lime. The flocculated particles are allowed to settle in sedimentation basins and traveling mechanical rakes remove the settled solids from the sedimentation basins for discharge to the Mississippi River.

Chlorine in the form of sodium hypochlorite is used to disinfect the clarified water. Anhydrous ammonia is then added to form chloramines for residual disinfection. Additional settling time and disinfection contact time occur in the secondary settling basins. The clarified water is also treated with sodium hexametaphosphate for calcium sequestration and hydrofluorosilicic acid for fluoride addition. The SWBNO is feeding all chemicals at appropriate dosages and maintains adequate chemical storage at each site.

Filtration is the final step in the treatment process: the water is filtered through rapid sand filters. Finished water is then pumped to the populace through the distribution network.

The Carrollton WPP treated an average of approximately 137 mgd of water for the east bank of the Orleans Parish in 2018. Leaks in the distribution network are still a persistent problem. These leaks are currently being addressed under the water main replacement program funded by the Federal Emergency Management Agency (FEMA). The water delivery pressure at the WPP was between 65 and 70 pounds per square inch (psi) during the inspection, which was consistent throughout the last year.

Second Water Tower nearing completion

Leak in L4 Basin

Figure 1 Carrollton Water Purification Plant

Improvements initiated and/or completed at the Carrollton WPP during 2018 include:

- As stated in 2017 report, LDH communicated that leaks in the G and L basins must be fixed and was noted as a major deficiency in its 2017 inspection. At the time of the visit, G3 is in service and G4 is out of service for routine maintenance. L4 was out of service due to leaks in 2018. The basin was cleaned out and a contract was put out for L4 repairs. The contract will go out for rebid and work towards the repairs in 2019.

- As part of the water hammer project, construction of two elevated storage tanks began in late 2016 to assist with maintaining adequate distribution pressure in case of a line break. Construction of both of the elevated water tanks was ongoing in 2018. The water tower in front of the WPP was finished and placed into service in November of 2018. The second tank was under construction in 2018 and will be completed in 2019. The third water tower, Michoud, located in New Orleans East/Venetian isles area, was out of service for 14 years and was rehabbed in 2018.

  The following maintenance and/or improvement projects for existing facilities at the SWBNO are planned or ongoing:

  - A filter rehabilitation program is in progress for the Sycamore filter galleries and planned for Claiborne filter galleries. Valves, actuators, corroded piping supports, and leaking pipes associated with the filters need to be repaired or replaced. In 2017, an emergency contract was issued to repair 4 filters. In 2018, 4 filters in Sycamore galleries were repaired (the contract is for 8 total filters). No repairs on Claiborne filter galleries were conducted in 2018.
  - In 2017, a temporary Sycamore filter backwash pumping system was installed and used during 2018 while the new station was being constructed. The new filter backwash station started construction in 2018 and was completed at the time of the visit.
  - A new chemical storage and feed facility is currently under design, with the 90 percent design phase completed in 2018. This project was scheduled to start construction but is awaiting funding.
  - The Oak Street pump station is being replaced, including complete pump replacement and other improvements. Those improvements were ongoing in 2018.
  - In 2018, some valves, actuators, and steel pipe supports in Sycamore filter galleries were replaced.
  - It was noted during the visit that repairs were conducted in 2018 to the effluent lines leading to the plant due to cracks in the lines causing leaks.

It was noted a long-term project was in the design stage (90%) for installation of second sludge line to the river to add redundancy. In 2018, the line broke during Oak Street construction, but was able to be fixed. In terms of compliance, the Carrollton WPP had no compliance issues in 2018.

Algiers Water Purification Plant

The Algiers WPP has a capacity of 24 mgd. The treatment process at the plant is similar to the Carrollton WPP and uses the same chemicals with a slightly modified application scheme in the upflow clarifiers. The plant treated approximately 9.4 mgd of water and is serving the predominantly residential west bank portion of the parish.

Improvements that are needed or ongoing at the plant include the following:

- A large CIP project, including SCADA upgrade, rehab of clarifiers 2, 3 and 4, a complete replacement of Clarifier 1 (including adding flash mixing to assist with total organic carbon (TOC) removal) and upgrading the fluoride chemical feed system, is in the near future. The contract was awarded in 2017 and construction started in 2018. At the time of the visit, Clarifier 1 was under construction.
- Filter rehab (valves, filter media, air scour system) is still needed on all filters and should be scheduled in 2020. The Engineering department is still working on specs, which should go out to bid in late 2020.

- EIMCO clarifiers 3 and 4 are under contract for the replacement of the launder troughs. The troughs and steel structures have significant corrosion and required rehab. The contract went out in 2018, and rehab started in 2019. At the time of the visit, Clarifier 3 was being rehabbed and scheduled to be put online in 2019. Clarifier 4 will be placed out of service and rehabbed once Clarifier 3 is back into service.
- In addition to the rehab and painting the EIMCO clarifiers, flash mixing will be added to assist with better TOC removal in the clarifiers. The existing clarifiers will be modified to include an additional mixer near the chemical injection point.
- The fluoride storage and feed system need to be upgraded to meet state requirements. The fluoride system will consist of a bulk storage tank, a day tank, and metering pumps, and it will be in an existing sodium hypochlorite generating process room. The removal of the old onsite sodium hypochlorite generation equipment started in late 2018 and is ongoing. At the time of the visit, most of the old sodium hypochlorite generation equipment was removed from the room and the new bulk tank was onsite.
- Lime is currently slaked at the WPP. SWBNO is considering replacing the lime equipment pending a decision to change the process (different type of lime) or replace the existing slaking equipment. A study must be conducted to establish which option will be selected. No work was completed on this process in 2018.
- The raw water pumping and piping systems need to be improved in order to provide redundancy to the intake system. No work in 2018 was conducted to address this concern. The SWB Engineering Department is specifying new pumps at Old River Intake at Algiers.

Clarifier 3 under rehab

Clarifier 1 under construction

Figure 2 Algiers Water Purification Plant

In terms of compliance, the Algiers WPP had two compliance issues in 2018. It was noted that two notice of violations were issued by LDEQ for TOC. Those violations are in the process of being rescinded due to errors by contract lab.

WATER QUALITY LABORATORY

The water quality laboratory located at the Carrollton WPP conducts daily analyses of river water quality and purified water for both WPPs. Water samples from the distribution network are also analyzed at the laboratory facility. The lab continues to meet the state and federally mandated analytical requirements of the water plants, and it is certified by the Louisiana Department of Health and Hospitals for analysis of coliform bacteria.

The laboratory collects samples for protozoan analysis in addition to coliform analysis. Other regular analyses include hardness, turbidity, fluoride, ammonia, pH, alkalinity, TOC, dissolved organic carbon, phosphorus, corrosion monitoring, and chlorine residual at different stages of treatment. The solids are analyzed for total suspended solids (TSS) and total dissolved solids concentrations. The laboratory also analyzes river water and finished water samples for volatile organic compounds.

The laboratory continues to maintain its involvement in the Early Warning Organics Contamination Detection System (EWOCDS), run by the State Department of Environmental Quality (LDEQ). The EWOCDS program has been previously underfunded and understaffed by Louisiana but has changed recently and is now more active and stable. SWBNO is actively involved this program.

The remaining reliable monitoring stations are connected by telecommunications to notify LDEQ if any of the 60 Environmental Protection Agency (EPA)-listed pollutants are detected in the river water samples. The LDEQ disseminates the information to the program participants, allowing early warning of possible problems. The LDEQ maintains EWOCDS equipment at all participating locations while the program participants provide the manpower to collect and analyze the samples.

At the time of the inspections, the laboratory was understaffed. Needed staff include additional sample collectors and lab technicians due to increased water line testing per FEMA waterline replacement program. In 2018, the lab hired four entry level chemists and 1 microbiologist because of the pay increases in 2017. During the visit, there were two microbiologists, five chemists, and three technicians. The lab supervisor position is still vacant; the head of the WPPs are currently filling the role. The laboratory staff had obtained certification to analyze TOC at the SWBNO facility in the past; however, the certification has lapsed due to a lack of lab staff (mainly chemists) to maintain the QA/QC requirements for TOC analysis and was not reestablished in 2018. Due to increased staffing, the lab is currently working on reestablishing this certification.

Some of the lab instrumentation and equipment is reaching or has reached the end of its service life and should be replaced. Newer analytical instruments and equipment are needed, such as a new gas chromatograph/mass spectrometer (GC/MS) and fume hoods in the chemistry lab. A GC/MS was ordered in 2018. No other major purchases are planned for 2019.

WATER PUMPING AND POWER

The primary function of the water pumping and power unit of the operations department is to produce steam for the generation of 25 hertz (Hz) power in addition to pumping potable water to the City of New Orleans. The facilities at the Carrollton Power Plant include 3 pumping steam turbines and 1 gas turbine for a total theoretical capacity of 61 megawatts (MW of 25 cycle power). The steam required for the turbines is generated in the 6 boilers at a total capacity of 650,000 pounds of steam per hour. In addition to the 25 Hz turbine, the newly-installed Turbine 6 produces 15 MW of 60 Hz power and was made operational in early 2014. The turbine only serves as backup, but it is run weekly to ensure it is working properly.

The generating station at the Algiers Plant is capable of producing 60 cycle power using a diesel generator. The power generation facility can generate enough power to support operations at the Algiers Plant. This station is also capable of performing a frequency change from 25 Hz power, supplied from the Carrollton Plant, to 60 Hz power.

At the time of the inspections, the capacity of the Carrollton Power Plant was 73.5 MW (design capacity). Turbine 3 is limited to 8 MW (out of 15 MW) and for emergency use only. Repairs to Turbine 4 were ongoing in 2017 and the turbine was undergoing testing at the time of site visit. Turbine 4 was placed online in 2018. The rehab on Turbine 3 was suspended and will be retired from service, as well as Turbine 1. Currently, a power master plan is being created, proposing Turbines 1 and 3 replacement with a 20 MW static frequency converter, Turbine 6 upgrade to 25 MW and adding substation as a long term item to access power from the power utility making operations more reliable. At the time of the inspections, Turbine 3 was offline, Turbine 1 and 4 were online, and Turbine 5 was being used as needed. The department was made aware of a cross connection to the cooling systems for Turbine 1 and 3 and the Carrolton WPP clearwell. To address this issue, the department is planning to retire Turbine 1 and 3 as soon as possible. Steam Pumps A and B also contribute to the cross connection, but recent conversion of the drive to electric on Pump A has eliminated that contribution to the cross connection. Pump B will convert in 2019 and will no longer be a contributor. The department is trying to determine how to eliminate the contribution from Turbine 4. Additional boiler piping is scheduled for repair and replacement and will occur once all the boilers are rehabbed and operational. The bid for boiler rehab was placed on hold in 2018 due to the power master plan.

A 200 psi high pressure natural gas line supplies fuel for the 15 MW 60 cycle, dual fuel generator turbine package (Turbine 6) and the existing Turbine 5. The 15 MW, 60 Hz generator facility supplements the commercial power available from Entergy to provide power redundancy and continued service in the event of a commercial power loss from storms, hurricanes, etc. The generator serves the majority of the plant and raw water intake stations and provides additional drainage station capacity.

Two steam-driven distribution pumps (Pump A and B) are located at the power plant. During late 2018, the Pump A gear box failed, and the department decided to change it to a electric drive, The drive work was complete at the time of the visit. Pump B will also be converted, and that work is scheduled for 2019. The Claiborne Pumping Station, which consists of 4 water distribution pumps (2, 60 Hz drive and 2, 25 Hz drive), and the Panola Station, which consists of two pumping units (each with a 25 and 60 Hz motor), are usually adequate (with 100 percent redundancy) for pumping finished water to the distribution network. The 25 Hz pump at Panola Station has been converted to operate on both 25 and 60 Hz power for more

pumping operation redundancy. Future work for the pump stations is part of the water hammer program, which will include replacing equipment and associated valves at the Panola A and B pump room and Claiborne pumping stations. These projects were currently in construction at the time of the visit, but project completion is holding on the Claiborne project is being held up, largely due to road work. Both elevated water towers at the Carrollton WPP were under construction at the time of the visit last year and were placed online in 2019.

Generator 5 underwent major repairs in 2017 and was placed back into service in early 2018. Generator 4 rehab is complete, and the generator is in service. Five additional diesel generators (2.5 MW each) have been added and five of the five were in service at the time of the inspections. These additional generators add 12.5 MW of power.

Storm-proofing projects for critical SWBNO facilities, including the power buildings, were completed by USACE in 2017. Improvements for the power buildings included reinforcing the walls, roofing, doors, and windows. Additional damage-related work from Hurricane Katrina includes valve replacement and repair to electrical components and controls. Related items for the water pumping and power unit are in various stages of design or construction. Additional projects, which include replacing the diesel storage tank with 2 new above-ground tanks that have a total capacity of 250,000 gallons, are scheduled to finish in 2019. This project was under construction in 2017 and was still ongoing in 2018.

At the time of the visit, the water pumping and power unit had 87 employees, which provides for continued operations of the water, sewerage, and drainage systems that require staffing 24 hours per day, 7 days a week. Given the current levels of staffing, overtime is still required to cover all the necessary areas within the pumping/power unit and for emergency response. The department is continuously trying to improve on reducing overtime by focusing on training operators and using overtime to bridge the gap in knowledge. That effort was still ongoing in 2018. Approximately 11 senior operators or supervisors are set to retire in 5 years or less. In 2018, 5 senior operators have left and took voluntary retirement. Retirement was mentioned as a continuous staffing problem in this department, especially at higher pay levels, such as turbine and boiler operations positions. Additionally, it was also noted that the Chief of Operations will be retiring in September 2020 and a successor is currently not in place to take over. It is anticipated that additional staff will be hired and trained to fill the vacancies due to retirement.

It was noted again that more technically-advanced staff was needed to operate and maintain Turbine 4 and oversee future upgrades to the powerhouse, but the level of pay currently being offered does not allow the station to hire the necessary skillset for the job. Retirements also make conducting training to bring staff up to speed problematic. Due to this situation, the department is using maintenance contacts on equipment to help train staff with the help of vendors and manufacturers until staff is up to speed and can conduct the maintenance and troubleshooting in house. The department purchased portable generators in 2018 for critical facilities to ensure those stations would stay online if power loss occurred.

Central Control

The Central Control Power Dispatching Department (Central Control) is primarily responsible for the delivery of an adequate supply of board-generated electrical power, the continuous monitoring of the operational status of all electrical switchgear, and the testing of related electrical feeders and equipment. This department is also responsible for verifying and enforcing the SWBNO's safety clearance procedures

and associated clearances within the power distribution system. Additionally, this department monitors local and regional weather to provide advance warning of storms, which could affect power generation requirements for the drainage and sewerage systems. Coordination of various power supplies, including alternative backup power supplies such as diesel generators and frequency changers, also comprise part of this department's responsibilities. The Central Control plays a vital role in many emergency operational situations. Serving as a hub of communications, Central Control informs the SWBNO's management and senior level staff of changes in conditions that will affect the SWBNO's ability to provide adequate sewerage, water, and drainage services. Central Control provides valuable information during emergencies, such as hurricanes, floods, freezes, etc., to the Office of Emergency Preparedness through established SWBNO protocols.

During the inspections, it was noted that Central Control still did not have enough trained and experience staff. This staffing situation was cited as the Center's largest issue. As a result, the department has made training a focus. It was noted that 2 of the 3 most senior staff members are in DROP. Therefore, training new staff members is very critical. Additionally, one experienced staff person retired in 2018, adding to the experienced drain in the department. Additionally, it was noted that the department's responsibility has expanded. A new platform was implemented and becoming familiar with that platform, as well as work related to Generator 4, has created a learning curve for the department. It was noted that more technically-savvy staff and I&C technicians are needed to work with the new technology.

SEWAGE TREATMENT PLANTS

Operations and maintenance activities of both plants have been contracted to Veolia Water. A representative of the SWBNO oversees the contract operator. This representative works for the Operations department, which is within the SWBNO. Both treatment plants were operational at the time of the site visits and met the discharge limits according to treatment plant personnel. Veolia will continue to be the contract operator for the next five years.

East Bank Sewage Treatment Plant

The East Bank Plant has a treatment capacity of 122 mgd (dry weather). At the time of the inspections, the plant was receiving approximately 90 mgd of flow. The treatment facilities at the plant include bar screens, grit removal, a pure oxygen activated sludge system, final clarification, and disinfection. The solids generated during sewage treatment are thickened, dewatered (using belt filter presses), and incinerated. A new sludge dryer is under design as an alternative sludge treatment system to supplement the existing fluid bed incinerator (FBI).

New Mixers in Reactor 1

New High Efficiency Motor on RAS Pump

Figure 3 East Bank Sewage Treatment Plant

The following items summarize the improvements that will be or have recently been performed at the East Bank Plant:

- Reactor 1 was not placed online in 2017 because of issues with the mixers. New mixers were installed in Reactor 1 and was placed back online by end of 2018. Reactor 4 was cleaned out in 2018 and is waiting mixer installation when for available funds are in place.
- VFDs were added to bar screen rakes drives in 2018, but currently still run on timers.
- Clarifier 8 was rehabbed in 2018 and was placed online in 2018. Clarifier 6 is scheduled to be rehabbed in 2020.
- A 2400 V effluent pump electrical distribution system, a switchgear, and effluent pump variable frequency drives (VFDs) finished construction in 2018 and was placed online in mid-2018.
- A heated air lance was added to the FBI wet scrubber in 2018.
- Replacing the vacuum swing absorption (VSA) oxygen system equipment (blowers, motors) is being solicited for quotes by the contract operator. All equipment was obtained in 2018 and waiting installation in 2019.
- All gas chlorine equipment was removed from the building in 2018.
- The North RAS line was replaced in 2018.
- Two RAS pump motors were upgraded to high-efficiency motors in 2018.

- 3,500 trees and 4,000 bushes were planted in demonstration cell in early 2018.
- The electrical phase 2 project, which includes a new 480-volt MCC in the solids building, was under construction during late 2018 and is scheduled for completion in 2019.
- The sludge dryer project went out to bid in 2017 and is expected to be constructed in 2020.
- Effluent Pump 6 project is in design and ready for bid. Project construction will be 2021 when funds are available.

In 2018, average flow for the plant was 103.51 mgd, which was greater than the 2017 average of 100.5 mgd. Effluent quality has been adequate over the last year, with an average effluent TSS concentration of 10 mg/L and an average effluent BOD concentration of 12 mg/L. One exceedance was noted in February 2018 for fecal coliform.

West Bank Sewage Treatment Plant

The West Bank Plant has a treatment capacity of 20 mgd (dry weather). At the time of the inspections, the plant was receiving approximately 9 mgd of flow. The West Bank Treatment Facility consists of bar screens, primary clarifiers, trickling filters, final clarifiers, and chlorine disinfection. Primary and secondary solids are co-thickened in a gravity thickener and hauled to the East Bank Facility for incineration.

New Bar Screen No. 2

Re-coated Grit Chamber 1

Figure 4 West Bank Sewage Treatment Plant

The following items summarize the improvements that will be made or were recently made at the West Bank Plant:

- Bar Screen 2 was completely replaced in 2018 and was operational at the time of the inspections. It is anticipated that Bar Screen 3 and 4 will be replaced in 2021 or when funds become available.

- In 2018, of Grit Basin 1 and 2 pumped down and were recoated due to issues with the old coating falling off and clogging the grit pumps. Replacing all eight gear boxes on the influent side sluice gates is planned as an additional future job.
- Clarifier number 2 was rehabbed (steel work) in 2018. Primary Clarifier 1 was off line at the time of the visit and ready for-rehab. Final Clarifier 1 is scheduled to have the drive unit replaced in 2019.
- Main collection basin Pumps 1 and 2 rehab was not completed in 2018, but is anticipated to occur in 2019. Pump 1 was removed from site in 2018 and is awaiting repairs. Pump 2 is still onsite and awaiting assessment.
- The operator noted during the field visit that the effluent flowmeter stopped communicating to SCADA in 2017 and flow was estimated. In 2018, this issue was corrected, and active monitoring of the meter is ongoing.
- The operator noted that changing the SCADA system to a different platform is anticipated to occur in 2018. This upgrade did not happen and is awaiting a whole system update at both treatment plants. Documentation of the existing SCADA system platform was conducted in 2018 to prepare for the upgrade when funds are available.

The monthly average effluent TSS and BOD concentrations for 2018 were approximately 13.0 and 10.0 mg/L, respectively. The average flow for 2018 was 10.04 mgd, which was slightly less than in 2017 (which was 10.9 mgd). For 2019, this plant met or exceeded all permitted effluent limits.

SEWERAGE AND DRAINAGE PUMPING STATIONS

Site assessments of the drainage pump stations (DPS) and sanitary sewer lift stations (SLS) of both the East and West banks of New Orleans were conducted starting August 8, 2019 and concluded on August 30, 2019. A representative from Black & Veatch attended the site visits of Drainage Stations 4, 5 and 9 on August 8, 2019. This section and tables at the end of the report details the operational status of each SLS and DPS across the city of New Orleans. Pumps that were not running at the time of the observations were deemed to be either “in service” or “out of service” based on direction from Sewerage and Water Board supervisors or pump station operators.

Many SLSs are slated to be demolished and re-built, including Station 1, Shorewood station, Weber station, and more. Within the last year, the only SLS that was re-built was Station 8 at the corner of Toulouse and N. Broad. This station was re-built entirely with new pumps, a new structure, transformer, site paving, etc. The Sewerage and Water Board has installed nearly all required Emergency Discharge Connections (EDC) to older above ground stations where they deemed necessary (at some stations, an EDC is not required if it is a gravity-flow station).

Some of the most frequently occurring issues at the SLS are things such as damaged flaps or valves, leaking, motor being burned out, etc. In almost all cases, the S&WB are aware of the issue and know how to make the repair. The main hurdle they must make regarding the actual repairs is either funding or a lack of skilled workers to make the necessary repair. One of the most mysterious and concerning issues, however, was observed at the Michoud Station. The station has a large sinkhole right behind the station that has resulted in the S&WB taking one of the pumps out of service because it was not pumping properly. They have

attempted to fill the sinkhole with asphalt to no avail; the sinkhole continues to get deeper and larger. There is concern that if the sinkhole continues to get larger that it will affect both the pumps, then the entire station itself.

Of the 82 SLS across the city, there are 18 stations not operating at full capacity due to a pump being out of service. Most of these stations are able to operate with one pump or have a portable pump on site to assist the station. Of the 25 DPS across the city, there are only 3 not operating at full capacity due to pumps being out of service at the time of inspection.

There does not appear to be any planned construction projects at any of the DPS other than Station 17, where they are remodeling the bathroom on the inside and doing some major repair work to the exterior wall of the entire facility. This station is shared with S&WB employee offices and should have no impact on the pumps or equipment. As always, the maintenance and repair of pumps, screens, and generators is an on-going daily task. Our last report did not show any pumps out for over a year. Most issues at the pumps were new issues, and most should be repaired in the coming months. At each station, the required repairs do not appear to be critical and the pump stations should all be able to run close to full strength from the adequate capacity provided by other pumps at the stations.

FACILITY MAINTENANCE

The Facility Maintenance department has four units: (1) plant maintenance, (2) welding & fabrication, (3) electrical maintenance, and (4) mechanical maintenance and meter shop. These units provide meter repairs, removals and installations, major electrical, welding, and fabrication, and mechanical maintenance for all SWBNO facilities throughout the system, with the exception of Veolia Water-operated sewage treatment plants. The department has the specialized equipment and technology necessary to maintain the plant process equipment, drainage pump stations, sewage pump stations, power generation equipment, and water meter servicing. Automated lathes and mills are located in the machine shop and break press, as well as shear and other specialized repair equipment that is located in the welding and fabrication shop, which provide the ability to fabricate parts when replacement parts are excessively expensive or no longer available due to equipment vintage, such as gears and parts for older valves. Additionally, new facilities, such as Turbine 6, have been built within the SWBNO system, which requires additional staff to operate and maintain it though no additional increase in workload since last inspection was noted. Finding knowledgeable, qualified staff to troubleshoot issues for complex equipment, such as Turbine 6, has been hard and results in dependence on vendors and suppliers. In 2017, the underpass stations had backup generators added, so more maintenance and upkeep for those facilities is required by the Maintenance department. This additional work continued in 2018: the department utilized a diesel mechanic and four helpers for all the drainage stations and existing generators at other facilities. It was noted that future generators will be added to all the sewerage stations (currently over 100 diesel generators are under design). When that happens, maintenance will not be able to provide the same level of service with current staff at the time of the visit.

These additional assets prevent in-house rehabilitation and preventative maintenance from being completed, which creates a large backlog of work for this department. Additional project delays, such as needed repairs to various issues with Drainage Pump Station 6 pumps, add to the maintenance back log.

One pump was restored in 2018, but another pump is currently under repairs due to a failed bearing. It is scheduled to be returned to service in late August 2019.

The department completed the G3 basin rehab in 2018, and the basin was placed into service. Currently, maintenance is working on the G4 basin. The basin is offline and requires significant sediment removal due to sediment buildup (100 dump trucks completed at the time of the visit) at the end of the basin due to bridge issues. It was noted that cleanup will continue in 2019. Previous basins were contracted out; however, it was noted that many times the contracted work required the department to inspect and occasionally redo the work to keep the system online. Other times, items were left out of the initial work order, creating additional change orders. Additional rehab work completed in 2018 included bearing work on DPS 11 (screen gearbox failure) and is awaiting new screen placement. This replacement design is currently with Engineering. Once screens are removed, they will be stripped for spare parts.

The department continues to assist engineering with pulling together and reviewing contracts due to new hires in engineering. It was noted in last report that feedback from maintenance was not being carried over into engineering and construction projects. This situation has improved since last visit due to new staffing in Engineering on the IT side. The IT workers are helping better monitor the equipment and selection of common equipment to make spare parts more common at all facilities.

At the time of the inspections, the department had 16 authorized positions. Human Resources closed all vacant positions in 2018, leaving a few vacant positions left (mostly highly skilled experienced labor). Most of the highly skilled positions (welding and fabrication, electrical, mechanical maintenance) remained vacant. As stated previously, the current vacancies have been opened through Civil Service, but finding qualified candidates is still a challenge for the department. The residency requirement and pay scales are still site as a major problem for hiring and retaining more experienced, permanent staff, especially higher-level skill crafts. It was also mentioned that harder, more skilled positions were often paid the same or similar as less skilled positions, which does not assist in keeping higher skilled staff. This pay situation continued into 2018. It was noted in 2018 that no additional experienced staff has retired, but in the next 5 years almost all senior staff members will retire and will no longer be a resource. In 2018, the head of the machine shop entered the DROP program, joining heads of the instrument shop and the welding shop (who are all currently in DROP and will be retired in 1.5 years). To combat this situation, people were hired previously and are positioned for succession, especially in the instrument shop. At the time of the visit, it was noted that several electrical staff were in progress to be promoted. These promotions will result in less experienced staff in the field.

It was noted that overtime is necessary to compensate for the limited workforce. The amount of overtime for each department cannot exceed 750 hours or it must request a waiver. Despite this limitation, the department did not exceed its overtime limit in 2018. This department does use a Labor contract, and those contract staff do take the same performance test. It was, however, noted those workers make more than SWB employees, but when contract runs out many of those staff opt to become full time SWB employees.

During last year's visit, the department noted that it is facing a lack of qualified personnel to adequately supervise or oversee subcontractors. It was noted that during 2018, and into 2019, that situation has improved slightly due to promotions and hiring. At the time of the inspections, approximately 22 percent

of the maintenance employees were eligible for retirement or will be eligible to retire within 5 years. Thirteen positions (mostly high-level senior supervisors in the machine shop) are in DROP and could leave in the next five years. In 2018, maintenance was able to hire/promote staff to fill the vacant supervisor positions in the machine shop. Maintenance has tried unsuccessfully to rehire recent retirees. Currently, the rehire must be hired back into his or her original position or a position he or she held previously; however, if those positions are filled, then the retiree cannot be rehired. Because of the lack of experienced people left to assist with training, training of lower level staff is very limited due to lack of trained staff and is done on the job. It was noted by the department head promoting many senior level staff up the ranks leaves a void for skilled staff to work in the field. The department stopped recruiting at job fairs and trade schools due to lack of finding qualified entry level candidates. SWBNO still tries to hire from the community college but have found most students do not received training or have the capacity to become full time SWB employees. The department no longer offering internships at the time of the visit due to not being able to attract compete workforce from the college.

It was noted that Maintenance had sufficient equipment to maintain the system and do repairs. In 2018, the department did purchase a new bucket truck. It was noted that getting enough functional vehicles was an issue to lack of funding.

Lastly, due to the flooding in August 2017, it was noted that Maintenance has become more proactive on documenting repairs. In 2018, Operations and other departments have improved at writing their own work orders and understand the importance of documentation. Maintenance mentioned no upgrades to the current work order system have been done in 2018 though it is very needed. Having the new software accessible on laptops or at the station computers would help make sure work orders are closed out and documented correctly. Lastly, additional changes to purchasing policies have made it more difficult for maintenance to buy supplies. The new policy requires going out to public bid rather than adding additional funds to existing Pos, which has caused delays in repairing critical equipment. This requires management of more contracts, which the department does not current have staff to do. It was also noted that not enough of a grace period is given between starting new policies.

ENGINEERING

The Engineering department includes mechanical engineering, electrical engineering, civil engineering, construction administration and inspection, and networks engineering. The Engineering department administrators typically contract throughout the SWBNO facilities and coordinate with other agencies for the design and construction activities impacting SWBNO-maintained facilities. At the time of the inspections, the department was managing 217 project contracts for FEMA and capital improvement projects.

The status of major contracts administered through the Engineering department is itemized in the following list:

- New sludge line from the Carrollton WPP to the river is at 90 percent design; however, it is currently on hold due to permitting issues and a lack of available funding. This project status was in the same in 2018.
- Sycamore filter has two emergency contracts opened recently to repair the offline filters (5 Phase Project). Phase 1-2 was completed in 2018, including the rehab of four filters (adding actuators, valves,

and much needed pipe supports). A Pilot program will be part of the phased work to pilot membrane filters as a possible technology for the future filter gallery upgrade. Additional phases (3-5) are dependent on funding dependent. The Complete rehab will be completed within the next 5 to 10 years.

- Chemical feed storage improvements to add additional chemical storage at the Carrollton WPP are in 95 percent design phase; however, this project was on hold at the time of inspections due to lack of funding. This project is scheduled to start in 2020.
- The filter backwash pump was under construction in 2018 and scheduled to be placed online in 2019.
- The fuel tanks at Carrollton WWP are being replaced with a 250,000 gallon above-ground storage tank. Construction started in 2018. This project is ongoing and scheduled to be completed in late 2019.
- The water hammer project, which includes installing two new elevated tanks at Carrollton WPP, is currently under construction in 2018 and is scheduled for completion in 2019.
- Filter media rehab at Algiers WPP is currently scheduled but has not yet begun due to funding. This work is part of a larger project mentioned in the Algiers WPP section update.
- A contract was issued to rehab one of the clarifiers at Algiers WPP and rehab started in 2018. Clarifier 3 is currently being rehabbed and is scheduled to be complete in 2019. Once complete, it will be placed back in line. Clarifier 4 rehab is scheduled to start in late 2019.
- Two major uptown roadway drainage projects were ongoing at the time of the inspections: Jefferson Ave. Phase 1 and Louisiana Ave. Both projects were ongoing during 2018 and are scheduled to finish in 2019.
- Contracts for the water line replacement program with the City of New Orleans were awarded in 2016 / 2017 and the program was ongoing in 2018.
- Flood mitigation contracts for nine sewage pump stations were awarded and the Engineering department is supervising these contracts. Eight station construction projects were completed in 2016. Most were complete by 2018. Sewerage Pump Station 8, which started construction in 2017, was approximately 90 percent completed in 2019.
- Ten major underground 25-cycle electrical feeders are being replaced throughout the SWBNO facilities. The project is still under construction but is scheduled to be online in 2019. This project is the first design-build project for the SWBNO.
- The Old River Intake Station rehabilitation project remained in construction during 2018 because of delays related to high river water levels. It is scheduled to be complete in 2019.
- Florida Ave. Phase 4 project is still in construction in 2018 with a scheduled complete date in 2022. Phase 2 and 3 were also ongoing and scheduled to be complete in 2019.
- The SWBNO plans to add a sludge dryer, including a new air emission system, to the East Bank Plant. The equipment is onsite and in storage. The dryer was purchased in 2018, and installation is scheduled to start in 2019.
- East Bank WWTP effluent pump motors and VFDs replacement was completed in 2017/2018, hitting substantial completion in July 2018.

- Phase 2 of electrical improvements at the East Bank plant began in 2018, and contract close out will happen in 2019.
- The West substation project includes a new substation to power the plant using power from the local electric company. Site work design is 100 percent design, but detail design is on hold due to funding.

Additional projects planned by the Engineering department include the following:

- There will be new lime storage and feed facilities at both WPPs. This project is still on hold due to lack of funding.
- Construction will start on a new chemical storage and feed facility at Carrollton WPP. This project is still on hold due to lack of funding.
- A new filter gallery addition at the Carrollton WPP will be designed. SWB will be piloting membranes to determine if that is the best technology for the upgrade. This is a long-term design and construction project (next 10 years).
- Rehab of the head house building is planned to convert the building into the SWBNO's new resiliency complex. As part of the resiliency complex project, a new infield building is being planned for additional office space at Carrollton WPP. Both the infield and the resiliency complex will meet FEMA's safe house requirements for a hurricane shelter. The engineering building will be rehabilitated to replace the roof, windows, and doors to make them withstand a higher wind rating. This project is still on hold due to lack of funding.

In addition to contract administration, the Engineering department added geographical information system (GIS) technology to enhance the ability to track the water distribution and sewer pipes in 2018. The FEMA-funded water main replacement and emergency sewer system assessment requires GIS identify and fix broken or leaking pipes in the water distribution and collection system. It was noted during the interview that funding for drainage improvements projects is needed. Additionally, it was noted that the department needs to hire more electrical engineers due to upcoming retirements to manage electrical contracts and review electrical design work. The department was able to hire a new electrical engineering intern in 2018, but still lacks mid to senior level electrical engineers. It was noted during the visit that staffing has improved, and the department was able to hire more senior level Civil and Mechanical engineering managers to assist in developing their younger staff. It was noted they were retired from the private industry. Lastly, the department still needs a Department Head of Civil Engineering and more experience staff.

NETWORKS

The Networks department is charged with maintaining the sanitary sewer system and the potable water distribution system. The capital replacement to portions of the water distribution network funded by FEMA in response to damage associated with Hurricane Katrina remains ongoing.

The Networks department is divided into nine operational units. Field Services coordinates Networks' first response to service requests and manages the data entry for closing work orders. Zones 1, 3, 4, 5, and 6 are responsible for sewer and water infrastructure maintenance in assigned geographical areas in New Orleans. Zone 2 operates the barricade unit that provides safe lane closures and visibility for Networks' work areas. Zone 2 also performs preventive maintenance activities, including exercising and inspecting

valves and fire hydrants as well as sewer smoke testing required to maintain EPA consent decree compliance. Zone 7 provides limited surface restorations following repair excavations by Networks' crews, conducts sewer video and manhole inspections, and provides staff for after-hours crews that respond to emergency calls for service. Each zone has a staff of approximately 35 to 45 people who are responsible for repairs within the designated areas and/or other assigned responsibilities. Technical Services manages Networks' contracts including leak detection, sewer video inspection, operations and maintenance repair contracts, and contracts to perform capital rehabilitation, replacement, and modifications required to improve system performance.

A new chief of networks started in late 2018. During late 2018, Networks shifted from using contractors to do routine activities such, as repairs and general maintenance, to using in house staff, but it still utilizes contractors to assist with larger replacement work. From late 2018 until the time of the visit, it was noted that Networks' overall backlog was reduced in half using in house staff. It was noted that staff were empowered, allowing them to work more effectively.

According to department personnel, the biggest challenge is keeping up with aging infrastructure in the distribution and collection systems, as well as lack of equipment to do repairs and proactive maintenance (including backhoes, dump trucks, and rigs). It was stated that there is lack of funds at the current time to purchase new equipment. It was noted by the department that maintaining the same level of service was a concern if this situation does not change soon.

It was noted in 2017 report that the additional city events, as well as new developments, were adding to Network's workload. In 2018, Networks started using insertion valves and other methods to ensure less impact to the Central Business District (CBD) of New Orleans when doing repairs and replacement work. This approach has allowed the department to stay on top of the additional work load without impacting a larger portion of the CBD.

The SWBNO has conducted an evaluation of the piping system to detect leaks, and this effort is still on going. The department is trying to extend the serviceable life of the infrastructure by performing more capital upgrades, such as lining and full-line replacement in addition to point repairs in both the water distribution system and sewer collection system. The department has conducted several large-diameter pipe lining projects on critical large diameter lines that have experienced cracking and failure from excessive corrosion. There was an increased focus in 2018 on rehabilitating and replacing valves on transmission lines in the water distribution system. This continues as an effort to improve system performance and minimize community impact during anticipated water main tie-ins associated with a major increase in coordinated capital projects city-wide. In 2018, the department started valve data collection programs, increasing valve exercising, and identifying large valves that need replacement. This is currently being done with in house employees. Additionally, it was noted that from late 2018 to the time of the visit, the paving work order projects backlog has decreased dramatically and the SWBNO is making huge progress to keep the backlog within reasonable.

Emergency response times in 2018 were also improved. Currently, average response time for emergency inspectors to get on site is one hour (compared to 3-4 hours previously). The number of complaints received by SWB has gone down as well.

It was noted the pay raises in 2017 have helped retain current staff, but have not assisted in attracting new staff, especially in engineering. The specialized set of knowledge and skills required by the department necessitates a significant investment in on-the-job training and formal instruction in a variety of subjects, such as safe handling of materials containing asbestos, safe excavation and shoring, confined space entry, etc. The department noted that certification testing and certification classes for distribution and collection operators are offered at Delgado Community College for any staff requiring operator licenses and particularly those struggling to pass the required tests. This additional resource will greatly supplement departmental test preparation and help the department ensure its staff obtains sufficient operator licenses to remain in compliance. As stated in previous report, pay is still a factor in attracting new staff to Networks.

No major changes to engineering staff occurred in 2018. It was noted in the 2017 report that productivity in engineering has continued to improve due to lower level staff continuing to build on their experience and eligible staff achieving PE licensure. This situation was still true in 2018. It was noted that Networks did lose three Zone manager positions in 2018 and were not able to hire replacements for those key staff positions. This inability to hire replacements was attributed to not having any qualified candidates in the register. It was stated that job requirements for these positions need to be revised but Civil service will not revise the minimum qualifications for these positions (currently requiring a bachelor's degree). Additionally, Networks is not able to transfer staff within different departments due to Civil Service requirements, making it hard for the department to move staff where needed. It was also noted that the lack of response from Civil service for promotes and hiring was still an issue. It was noted that Networks did, however, receive support and budgeting to hire entry level technicians in 2018. The department noted that it does use overtime when needed but have either stayed within the allotted time or have requested a wavier when needed.

Approximately 1,223 water mains were repaired in 2018. Identifying leaks is an ongoing process, and SWBNO will continue to incorporate identified leaks into the water main replacement program funded by FEMA. As part of the ESSA program, manholes are also being inspected as a part of the ongoing inspection of the sewer system. Approximately 1,256 sewer repairs were completed in 2018. In addition to the FEMA-funded projects, the Networks department also responds to requests for valve closures by contractors and the City.

The Networks department works in conjunction with the New Orleans Fire Department to monitor and maintain all fire hydrants located in SWBNO's service area. The Networks Department inspects all fire hydrants within the system. All city hydrants have been mapped and assigned an identification number. The fire hydrants program requires fire hydrants in the database to be inspected. In 2018, the department inspected 5,171 hydrants. The Networks department is assisting the city with hydrant capacity color coding to comply with the new hydrant rating standards required for the city's insurance rating. It also conducted flow testing on critical hydrants to find leaks, ensure they meet the rating, and are operational.

The Networks Department completed 6,083 paving project work orders in 2018, both in-house and in cooperation with contractors. This department has several contracts to assist with maintenance of the water distribution, wastewater collection, and drainage stations. These contracts have increased the amount of work accomplished within the division.

SUPPORT SERVICES

The Support Services department has ten divisions:

1. Support Services Administration division
2. Support Services CDL division:
    a. Trains not only S&WB employees but also the following political subdivisions:
        i. Regional Transit Authority
        ii. Orleans Levee District
        iii. Orleans Civil & Criminal Sheriffs
        iv. New Orleans Police Department
        v. City Department of Public Works
        vi. Park & Parkways Department
        vii. Lewis Armstrong International Airport
3. Support Services Plant Engineering division:
    a. Performs most all-ground maintenance functions.
    b. Operates the St. Joseph and Julia Streets Administration Buildings and the Algiers Bill Collection Facility
4. Support Services Building Maintenance division:
    a. Maintains the Central Yard Complex and all Pumping Stations Buildings
5. Support Services Grounds Maintenance division:
    a. Maintains all open canals within Orleans Parish
6. Support Services Warehouse division:
    a. Stores valves, pipes, hydrants, tools, etc., required by the Networks department for repair of existing water distribution and sewer pipelines
7. Support Services Equipment Maintenance Information System (EMIS) Division:
    a. Maintains the Cyndrus software that tracs fleet purchases, maintenance work orders, and billing transactions
8. Garage I:
    a. Maintains the small and medium size fleet
9. Garage II:
    a. Maintains large and heavy-duty fleet
10. Garage III:
    a. Performs body work on the entire fleet

The SWBNO owns approximately 954 pieces of rolling stock, which include trucks, backhoes, and sewer cleaning equipment. The available equipment is being assigned to the various divisions based on the needs of the departments. Approximately 10 pieces of new stock were obtained in 2018.

At the time of the inspections, Garage II has been completely rehabbed and is occupied by mechanics, along with diagnostic equipment by late 2018. Office furniture, shelving, and items for Garage II have been installed. The Support Services Administrative staff and EMIS staff will move its offices on the second floor of Garage II when the fiber optics are completed in 2019. A new Site Relocation building (Garage III/new

body shop) was constructed in 2014 to house personnel until the garage renovations are completed. Staff and materials from Garage II were stored in the Site Relocation building. Ultimately, the Site Relocation building will be used to house the body repair shop, which is now a separate entity from Garage II due to organizational restructuring. Staff is scheduled to move into Garage II in 2019. The old body shop will be converted into the tire shop.

FEMA continues to reimburse equipment and tools for each garage lost to the hurricane, in addition to replacing some of the buildings. One of the buildings set to be replaced is the Annex building, which is used to house locker rooms, shower facilities, training rooms, CDL training unit, etc. It was noted that Support Services has been able to purchase and use diagnostic equipment in-house, reducing the dependency on vendor services. Projects being completed or conducted within Support Services include the following:

- Take home vehicles were reduced to 48 as of 2018.
- The contractor assigned to mitigate problematic vegetation (lilies) in the canal systems since 2015 is no longer affiliated with the SWBNO. This function went out to bid and the contract was awarded in late 2018. Support Services will be exploring the possibility of using a non-chemical option to help reduce invasive species in canals and lagoons in the near future.
- A major change to the janitorial services contract occurred in 2016 to include all Board facilities. This service will go out to bid in 2019.
- In 2017, new employees were hired in all areas of support services, including mechanics, laborers, and public utility workers etc., to help support all departments within SWBNO. At the same time, three upper/middle management staff retired. Their successors have been determined. Promoting those staff into those positions was ongoing at the time of the inspections and is still ongoing in 2018. If internal candidates are not promoted, the department will look at outside options.
- Additional staffing changes that occurred in 2017 include the ability to rehire retirees part time. Support Services utilized this option for one position to assist with maintaining the level of service and training of existing employees. It was noted during the interview with Support Services that merit raises were finally awarded to all its staff in 2018. The department feels it continues to lose staff to other departments because it cannot compete with pay and pay increases, especially for lower level staff.
- The department noted that most of the staff is approaching retirement age, including the director of the department. As a result, it will be short-staffed. Many senior level staff, including several successors, are in DROP or retiring within the next five years. The department continues to actively identify candidates to replace staff close to retirement. Ground maintenance continues to have high labor turnover because of the nature of the work, lack of pay increases, and ability to promote competent staff to supervisory roles. The Head of Support Services is scheduled to retire in 2019, but succession planning has been a focus for the department and a successor has been identified. The department is focused on filling vacancies and getting promotions awarded through Human Resources. Additionally, the department is working on creating a position under Support Services that interfaces with Networks to better serve that department and better control services to that department. Currently, Networks has staff members in its department that interface with Support Services about their needs. In 2018, a CDL trainer was identified as that staff interface between Networks and support services and will be brought on board under Support services in 2019.

- To comply with the reduced overtime requirement, the department has continued using its established procedures for vetting overtime requests by department employees. Staff must fill out an overtime authorization form, including projected overtime for the task, and submit the form a week ahead of time. The forms are reviewed every week, and then updated based on the actual work done. It was noted in 2018 that overtime was still being accounted for and monitored.
- In 2017, Support Services internally revamped the department's policy and procedures. These procedures were worked on in 2018 and are still in progress.

Future projects/concerns:

- One elevator in the St. Joseph building is inoperable, and repair or replacement is needed. The Engineering department has worked on bid documents, but the project is on hold due to the Board's financial status. The Peoples Avenue building elevator design is on hold and will be completed when funds are available.
- A new whole house building generator for the St. Joseph Street Administration building is on hold due to funding.
- The Central Yard facility plans to add two additional parking lots and replace the parameter fence around the entire Central yard. The fence project is on hold due to planned street work for the Florida Avenue Canal SELA activity which was ongoing in 2018.
- Support Services Department phone system started in 2018 and will be on going into 2019.
- Modular units that act as temporary offices will be moved off site once Garage 2 is done. Those units were used during 2018 and will be removed from site in 2019.
- It was noted that in 2018 there was a leadership change and the department of logistics was dismantled. Support services now reports to the general superintendent. The department noted the leadership shift was helpful and has provided stability.
- It was noted that the Engineering department and support services are working on an application (survey 123) that ground maintenance staff can access on their cellphones to document the condition of canals during inspections. The app will be GIS based and will be rolled out to staff in 2019.
- The department noted that, due to lack of funds, they were not able to purchase much rolling stock in 2018 despite the need for vehicles.

ENVIRONMENTAL AFFAIRS

The Environmental Affairs department oversees the consent decree and all administrative orders. The department reports sewer bypasses and overflow to the Region 6 EPA. Some activities being undertaken by the department include the following:

- Continuing to monitor industrial users through the pretreatment program and the fats, oil, and grease (FOG) program.
- Permit compliance in air, water, wastewater, storm water management, solid waste, and underground fuel storage tanks.

- Community outreach programs that focus on environmental education in the areas of water, wastewater, and drainage.

The construction of the piping for the East Bank Sewage Treatment Plant wetlands assimilation has been completed. The piping allows treated effluent to be discharged to the demonstration and expansion cells. SWBNO has a permit from LDEQ to discharge to the demonstration cells, but no permit has been issued to discharge into the expansion cells. It was noted that 3,500 trees and 4,000 bushes were planted in the demonstration cell by wastewater plant contract operator. The current EBSTP permit expired on May 31, 2014, but the permit has been administratively extended until the final permit is issued. LDEQ is in the process of addressing public comments received during the comment period and at the public meeting. It is likely the final permit will be issued by the end of this year, 2019. Until LDEQ issues the final permit for the East Bank WWTP, there can be no discharge into the expansion cells. Tree planting cannot start until the final permit is issued and the effluent can be discharged to the cells.

On February 25, 2018, the East Bank Sewage Treatment Plant exceeded the daily maximum limit for Fecal Coliform Bacteria, 400 colonies/100 ml. The result was 500 colonies/100 ml, the only permitted parameter which was exceeded in 2018.

On May 1, 2018, a customer complaint reported a Sanitary Sewer Overflow, SSO, to LDEQ. The SSO was associated with the operation of a local restaurant in the Orpheus Court area. On November 1, 2018, LDEQ issued a warning letter for the incident. On March 15, 2019, the Board filed a response to LDEQ. This warning letter was associated with the Agency No. 4859, East Bank Sewer Treatment Plant, which is the reason for listing this enforcement action in this section.

On August 17-21, 2018, LDEQ performed a compliance inspection of the East Bank WWTP Title V Air Permit. On January 2, 2019, LDEQ issued a warning letter for failure to comply with Specific Conditions No. 97 and 112 of the facility's air permit. Condition 97 and 112 require maintenance to be performed i.e. change engine oil and filter after every 500 hours of operation, or annually (whichever comes first). Veolia Water was following the recommendation of the manufacturer which states, "change engine oil and filter after the first 100 hours and every 250 hours thereafter. Since the 98 HP diesel generator and the 450 HP diesel generator did not meet this condition, the oil in these two generators were not changed in 2017. Work orders are now being generated so this task is performed on an annual basis. Due to this interpretation of the regulation, the deviation was not reported on the 2017 Annual Compliance Report filed in 2018. A corrected report has been filed.

The East Bank WWTP Title V Air Permit is current and will not expire until January 23, 2020. This permit regulates emissions from the FBI and the use of the emergency generator during times when power is not available from Entergy. Title V Air Permit Condition 70 requires a semi-annual report to be filed on February 19th each year for the reporting period of July 2018 to December 2018. Due to an oversight by the Board's contractor, Veolia, the report was filed on March 28, 2019. MACT 129 requires annual stack testing to demonstrate all emission standards are met. In 2018, the East Bank WWTP did have an exceedance in mercury. A retest in 2018 showed all emission standards were met.

The permit for the West Bank WWTP expired on May 31, 2019. The permit renewal application was filed on November 16, 2018. A draft permit was issued on June 11, 2019 with a public comment period ending July

31, 2019. No comments were received by LDEQ. According to LDEQ, the anticipated date for the final permit to be issued is on or before September 30, 2019.

On March 16, 2018, a warning letter was issued by LDEQ for sanitary sewer overflows in the West Bank Sewer Collection System. A response was filed on May 15, 2018.

The components of the pretreatment program include monitoring the discharge of the East and West Bank Sewage Treatment Plants in addition to other significant industrial users during the year. No additional users were permitted in 2018. An annual report was submitted to LDEQ to demonstrate pretreatment performance. Additionally, yearly revenue has been received from the following sources associated with the pretreatment program:

- Industrial users billed monthly for excess strength surcharges: $147,426.89
- Sanitary sewerage discharged to the wastewater plant from special events: $42,895.43
- Septage disposal program: $249,535.00 (total). Board's share, 50% of the total: $124,767.50
- Food service establishments billed for permit fees for the FOG program: $85,616.90

The total for all the above revenue sources is $400,706.72

The Power Plant located at the Main Water Purification Plant uses diesel and natural gas-powered units to provide power to DPSs and other SWBNO facilities. The Power Plant is required to meet air quality regulations found in the facility's Title V Air Permit. Emergency back-up generators are also located at DPSs and other SWBNO facilities. These units are permitted by emergency engine permits. The permit renewal of the power plant was submitted in 2016. LDEQ reviewed the application in 2017 and issued the permit in February 2018. SWBNO continues to utilize compliance software for air quality programs at the Carrolton WPP.

The following items were noted as deviations on the 2018 Title V Air Permit Annual Compliance Report for GRP 003 1-96 Emission Cap for Boilers 1, 3, 4, 5, 6 & Turbine No. 5. The natural gas totalizer on Turbine No. 5, which is used to record natural gas usage for the unit, was broken. To repair or replace, Turbine No. 5 had to be taken out of service; however, the operating hours and the permitted firing rate for Turbine No. 5 were used to calculate monthly emissions for Turbine No. 5, as required by Specific Requirement No. 93. Taking Turbine No. 5 out of service to make the repair is difficult to schedule due to the unit being used to pump potable water throughout the East Bank of Orleans Parish. Turbine No. 5 is also used to operate drainage pumps in Orleans Parish. The Boiler No. 1 natural gas meter was out of service from July 29, 2018 to January 8, 2019. The Boiler No. 3 natural gas meter was out of service from October 1, 2018 to January 8, 2019. The replacement of the natural gas totalizer for Turbine No. 5 was completed on December 31, 2018. The repair of the natural gas totalizer for Boilers No. 1 and No. 3 were completed on January 8, 2019.

Emissions from the Boiler CAP were calculated monthly on a 12-consecutive month basis. Formaldehyde exceeded the permitted limit of 0.17 tons. The emission for the 12-month period, beginning January 1, 2018 to December 31, 2018, was 0.22 tons. With the replacement of Turbine No, 5 gas meter emissions will be calculated on gas usage rather than hours of operation. This improvement will result in lower emissions, which will be based on gas consumption and more truly reflect emissions.

The Municipal Separate Storm Sewer System (MS4) Permit for the Orleans Parish is managed by the SWBNO. The SWBNO, along with co-permittees, met the requirements found in the permit and it was documented in the annual report, filed on May 1, 2019, for the reporting year 2018. The MS4 permit renewal application was filed on June 15, 2018. At this time, the draft permit has not been issued by LDEQ.

Prior to 2015, the Environmental Affairs department used a contractor for stormwater sampling required for the M4 permit. In 2017, stormwater sampling was still done completely in-house by the department's staff and continued into 2018. All required samples were successfully collected by the department's staff to meet 2018 permit requirements. The department continued to sample in house, including testing for TMDLs, water quality, and all NPDES sites.

The department has implemented a comprehensive FOG monitoring and permitting program. The program has identified approximately 3,000 food service facilities, such as schools, restaurants, daycare centers, hospitals, convenience stores, and other facilities that prepare food. Each facility, which has a food permit from the department of Health and Hospitals, is required to have a grease trap/grease interceptor. The department tracks all permits, trap pumping records, and applications using a database, and it proactively works with facilities to prevent improper disposal of grease to the collection system. The department held meetings and community outreach events in 2018 to assist the public and businesses in being more aware of the impacts of FOG on the collection system.

The department has provided training and certification to grease trap pumping companies to make sure their staff are consistently cleaning the traps properly. Training was also provided for the inspection of grease traps, which is required to be submitted with the FOG permit application. Certified technicians from the grease trap cleaning companies or licensed plumbers can inspect grease trap/interceptor. There were 473 FOG permits issued in 2018. Department staff use database software to manage the permitting process and are able to track noncompliance, permit applications, and grease trap pumping records.

In 2018, the SWBNO continued with its green infrastructure pilot program. The requirement for green infrastructure projects ended in 2018, but funds are available to award for projects 2019. In 2018, 14 demo projects were completed. A notice to proceed for a school is scheduled to be issued in 2019. An RFP will be finalized to advertise for green infrastructure projects for a Board-owned property on Bayou St. John.

These projects focus on community outreach and education. Program accomplishments for 2018 included:

- 19 school events; some schools visited multiple times
- 3,525 students reached
- All grades reached (pre-kindergarten-undergraduate)
- 24 teachers trained on water management and water quality issues
- 12 MS4/Orleans Parish Water Quality Task Force meetings
- 5 tours of SWBNO facilities and sites
- 162 drains cleaned and/or marked in 6 separate events by 144 people
- 5 professional trainings attended; 6 trainings facilitated by Board staff
- 5,605 community members reached directly by outreach activities and events
- 13 community-wide events
- 21 Neighborhood or Civic Association events
- Applied to 2 grants

- 73 total events during the reporting period, reaching an estimated 9,290 individuals

The Environmental Affairs department continues to hire more staff for the tasks necessary to maintain compliance with all the rules and regulations that apply to the SWBNO. In 2018, the department did not lose any staff and all 23 positions were fully staffed. In 2019, one employee is in DROP and has retired. Due to lack of office space in the Central Yard building, the department will be relocating to the Carrolton WPP. The stormwater team relocated to Carrollton WPP in 2018. The rest of the staff is scheduled to move in 2019.

Information for the manifest of the FOG program is currently handwritten. The department currently has the equipment and software to scan information and printed manifest was obtained in 2018. Staff is awaiting training on the equipment and software scheduled for 2019.

As a result of the flooding in August 2015, the department had to take on more responsibility, such as conducting monthly Spill Prevention, Control, and Countermeasure (SPCC) inspections. In 2018, the SPCC inspections at the drainage stations and emergency generator locations were conducted monthly by department staff. Environmental Affairs has updated all existing SPCC plans in 2018 as required by the regulations. The SPCC inspections are done monthly by department staff.

Additional duties of the department included environmental consulting with other SWBNO departments to advise the SWBNO on Asbestos abatement, and RECAP investigations and removal of contaminated soil at various SWBNO-related construction projects. The SWBNO hired environmental personnel for the Project Delivery Unit (PDU) section, which resulted in better response to environmental issues for SWBNO construction projects. The department works with PUD on RFPs and contracts for chemical spill cleanup services, the backflow prevention program, and asbestos abatement at Drainage Station 13.

STATUS OF CONSENT DECREE FOR SEWERAGE SYSTEM

The SWBNO complies with the EPA Region 6 and Department of Justice consent decree, which requires reduction of unauthorized discharges by implementing preventative maintenance requirements and completing repairs to the collection system as outlined in the Third Modified Consent Decree.

Some provisions outlined in the consent decree include those listed below:

- Quarterly and annual reporting requirements are to be submitted to the regulatory agency.
- The SWBNO will meet the preventive maintenance requirements of the consent decree.

The SWBNO is in compliance with the consent decree. It has met every construction and reporting deadline in the decree and has had no fines related to construction or reporting schedules in 2018.

SUMMARY OF FINDINGS

The following items are a summary of the findings during the site inspections:

- The management team is losing individuals with significant water, sewerage, and drainage experience due to retirement. This experience has been developed both internally at SWBNO and at other respected water and sewer utilities. This concern was also noted by LDEQ as a major deficiency at both of the WPPs during their 2017 and 2018 WPP inspections.

- During 2018, the department of logistics was dismantled, and departments now report to a more stable leadership structure under a permanent general superintendent.
- Staffing remains a key item of concern for the SWB. Like many water and sewer utilities across the United States, the SWBNO departments are faced with a significant number of pending retirements. Approximately 17 percent of current employees are either in DROP or are eligible for retirement. Unless these employees are replaced with qualified individuals, these pending retirements pose a significant threat to SWBNO's ability to perform its core operational and administrative functions. Succession planning and recruitment of qualified employees to mitigate the pending retirements will be a key element for SWBNO. This problem was noted by each department at the time of the visit, as well as previous years' reports, especially for Water Operations, Control Center, and Facility Maintenance.
- Several departments are experiencing vacancies, including the water purification unit of the Operations department, as well as the Facilities Maintenance and Networks departments. Within the last year, one high level department head retired (supervisor of operations of both WPPs) and a new department head for power pumping was assigned. SWBNO needs to address these vacancies as soon as possible to ensure effective operational and maintenance performance and administrative oversight. It was noted by every department that during the last year, the high turnover within the SWBNO's Human Resources group along with new human resource procedures hindered efforts to hire and promote staff in a timely fashion. This situation has improved slightly, with each department being assigned a Human Resource representative to provide more support.
- Construction of the two 2 MG water towers -- as part of the water hammer project, started in late 2016, and contractors continued to work on both towers in 2018. At the time of the visit, both towers were online.
- The Operations department was made aware of a cross connection to the cooling systems for Turbine 1 and 3 and the Carrolton WPP clearwell. To address this issue, the department is planning to retire Turbine 1 and 3 as soon as possible. Steam Pumps A and B also contribute to the cross connection, but recent conversion of the drive to electric on Pump A has eliminated that contribution to the cross connection. Pump B will be converted to an electric drive in 2019 and will no longer be a contributor. Approximately 11 senior operators or supervisors are set to retire in 5 years or less. In 2018, 5 senior operators have left and took voluntary retirement. Retirement was mentioned as a continuous staffing problem in this department, especially at higher pay levels, such as turbine and boiler operations positions. Additionally, it was also noted that the Chief of Operations will be retiring in September 2020 and a successor is currently not in place to take over.
- It was noted during the site visit that Central Control still did not have enough trained and experience staff. This staffing situation was cited as the Center's largest issue.
- The SWBNO has a clear understanding of the existing conditions of the drainage, water, and sewage facilities, and is aware of the immediate needs within each division and area; however, funding is needed for the SWBNO to address these issues. This was still the case in 2018 and at the time of the visit. Many projects are on hold due to funding, such as the new chemical building at the Carrolton WPP and other sewerage and WWP improvements.

- The SWBNO continued and completed emergency filter repairs in 2018 that included a rehab of 4 filters in the Sycamore filter gallery, including replacing pipe supports, valves, and actuators, and construction of a new filter backwash station. The station was online at the time of the visit.
- Aging infrastructure and lack of equipment needed to make repairs was noted as Networks main concern. It was noted that the Networks work backlog has been significantly reduced since August 2018 due to change in how Network staff are utilized. It was also noted that paving work order projects were completed. Emergency response time was also noted to have improved significantly
- Many SLSs are slated to be demolished and re-built, including Station 1, Shorewood station, Weber station, and more. Within the last year, the only SLS that was re-built was Station 8 at the corner of Toulouse and N. Broad. This station was re-built entirely with new pumps, a new structure, transformer, site paving, etc. The Sewerage and Water Board has installed nearly all required Emergency Discharge Connections (EDC) to older above ground stations where they deemed necessary (at some stations, an EDC is not required if it is a gravity-flow station).
- The East bank WWTP had one exceedance in February 2018.

Water Department

ADHERENCE TO WATER REVENUE BOND RESOLUTION REQUIREMENTS

In 2014, the Sewerage and Water Board sold $103,525,000 of Water Revenue and Refunding Bonds. The sale of these bonds has obligated the Board to fulfill the covenants of the current bond resolutions. The covenants are designed to protect the interests of the bond holders. Particular covenants of the Board in the General Water Revenue Bond Resolution pertain to the payment of indebtedness; limitations on indebtedness; covenants and representations of the Board; covenants with credit banks, insurers, etc.; operation and maintenance; free service, completing service, billing and enforcement of charges; sale or encumbrance of the system; insurance; damage, destruction, condemnation and loss of title; records and accounts, inspections and reports; and the capital budget. The Requirements of the General Water Revenue Bond Resolution adopted on May 21, 2014, (hereafter collectively called the General Resolution) are discussed in this section.

The Board was in compliance with the General Water Revenue Bond Resolution in 2018.

Payment of Indebtedness; Limited Obligations

The General Resolution obligates the Board and the Board of Liquidation (BOL) to promptly pay the principal and interest on all senior and subordinate debt that are obligations payable from the net revenues of Board.

Limitations on Indebtedness

The Board must not issue bonds, other senior parity indebtedness or subordinate debt unless it complies with Sections 4.03, 4.04 or 4.05 of the General Resolution, as applicable.

Covenants and Representations of Board

The General Resolution gives the Board the power to issue bonds and pledge the revenues according to the resolution. In addition, the Board "… faithfully observe and perform all covenants, conditions and agreements on its part contained in this Resolution, in every issue of Indebtedness issued hereunder and in all proceedings of the Board pertaining thereto."

Covenants with Credit Banks, Insurers, etc.

The Board may make covenants and agreements in a supplemental resolution with any insurer, credit bank or other financial institution that agrees to insure or to provide a credit facility to the Board. These covenants and agreements shall be binding on the Board and all the holders of indebtedness the same as if such covenants were set forth in the General Resolution.

Operation and Maintenance

The Board "… shall establish and enforce reasonable rules and regulations governing the use of and the services furnished by the System, shall maintain and operate the System in an efficient and economical manner shall maintain the same in good repair and sound operating condition and shall make all necessary repairs, replacements and renewals." In addition, all compensation, salaries, fees and wages paid by the Board shall be reasonable. Finally, the Board shall observe and perform the terms and conditions contained in the Sewerage and Water Board Act (Part III of Chapter 9 of Titles 33 of the Revised

Statutes of Louisiana, as amended), and "comply with all valid acts, rules, regulations, orders and directions of any legislative, executive, administrative, or judicial body applicable to the System or the Board."

Free Service, Competing Service, Billing and Enforcement of Charges

The Board shall not "… provide any services of the System without making a charge therefor in accordance with the Board's schedule of rates, fees and charges … other than those connections, use or services already in existence or as may be required by law …" In addition, the Board may not "… provide, grant any franchise to provide or give consent for anyone else to provide such services which would compete with the System unless the Board determines that such franchise … would provide services that the Board has determined are not in its best interest to provide and would not materially impair the interests of the holders of indebtedness."

The Board will bill customers for services on the regular basis and if the rates, fee or other charges are not paid when due, the Board shall " … to the extent permitted by applicable laws and regulations, disconnect the premises from the System or otherwise suspend service to such premises until …" delinquent rates, fees or other charges have been paid or a payment plan has become effective.

Sale or Encumbrance of System

The General Resolution requires that, with exceptions, "… neither the System nor any integral part thereof shall be leased, sold, mortgaged or otherwise disposed of …"

Insurance

The Board "… shall continuously maintain insurance with recognized responsible commercial insurance companies against such risks and in such amounts as are customary for public bodies owning and operating similar systems …"

Damage, Destruction, Condemnation and Loss of Title

The Board shall restore "… property destroyed or damaged to substantially the same condition as before such destruction, damage; condemnation or loss of title …"

Records and Accounts; Inspections and Reports

The Board is required to "… keep proper books of records and accounts … showing complete and correct entries of any transactions relating to the System…."

The Board is also required to file with the Board of Liquidation, City Debt an annual report with financial statements audited by and containing the report of a nationally recognized independent public accountant. The auditor's report is to include a statement that during their examination, made in accordance with generally accepted auditing standards, nothing came to their attention that would lead them to believe that a default had occurred under the resolution, or to state the nature of the default.

The Board engaged the firms of Postlethwaite & Netterville and Bruno & Tervalon to comply with this covenant. Financial reports with the Accountants' Certificate have been furnished to the Board of Liquidation, City Debt and have been reproduced for public distribution. The Government Finance Officers

Association (GFOA) has awarded to the Board the "Certificate of Achievement for Excellence in Financial Reporting" for their annual financial reports for 29 years.

Capital Budget

The Board is required to adopt an annual multi-year financial plan for capital expenses for a minimum of 5 future years.

2018 WATER DEPARTMENT OPERATIONS

Funds for the operation, maintenance, and debt service requirements of Water Department are derived from sales of water, delinquent fees, plumbing inspection and license fees, charges for disconnections and reconnections, interest earned on available funds, and other miscellaneous revenue sources. Analyses of the 2018 Water Department operations are discussed in the following paragraphs.

Operating Revenues

A summary of historical treated water billings and other Water Department revenue is presented in Table 2 for the period 2014 through 2018. The historical revenues shown in Table 2 were developed from detailed records provided by Board Staff. Operating revenues are derived from charges for sale of water and delinquent fees. Sales of water in 2018 were $89,281,924 which, when compared with $88,740,868 for 2017, shows an increase of approximately 0.6 percent. Delinquent fee revenues were $1,005,157 in 2018 which represent a 42 percent decrease over 2017 delinquent fees. The decrease in total operating revenue in 2018 is most likely due to the moratorium on water shut-offs which resulted in unpaid water bills.

Table 2 - Statement of Historical Revenue

Revenue Source	2014	2015	2016	2017	2018
	$	$	$	$	$
Operating Revenue					
Sales of Water	69,529,431	76,909,522	81,320,346	88,740,868	89,281,924
Delinquent Fee	1,288,824	1,098,415	1,838,594	1,723,942	1,005,157
Total Operating Revenue	70,818,255	78,007,937	83,158,940	90,464,810	90,287,081
Nonoperating Revenue					
Interest Earned	350,018	966,949	2,104,903	1,923,464	1,723,942
Plumbing Inspection and License Fees	339,176	305,384	319,991	297,115	319,127
Revenue Sharing	254,577	258,721	251,002	264,074	264,567
Other Income	2,841,110	3,416,155	2,506,704	1,707,271	1,912,736
Total Nonoperating Revenue	3,784,881	4,947,209	5,182,600	4,191,924	4,220,372
Total Revenue	74,603,136	82,955,146	88,341,540	94,656,734	94,507,453

Non-Operating Revenues

Also shown in Table 2, non-operating revenue of the Water Department includes interest earned on invested funds and other income from miscellaneous sources. During 2018, non-operating revenue included $1,723,942 of interest earned from the investment of available funds in the Water System Fund and the Water Revenue Bond Account and $2,496,430 from other sources.

Operation and Maintenance Expenses

Table 3 presents a summary of historical operation and maintenance expenses. Expenditures in 2018 increased about 12.5 percent from 2017 expenditures. Historical operation and maintenance expenses shown in Table 3 do not include the non-cash portion of Provision for Claims as recorded in the Comprehensive Annual Financial Report.

Table 3 - Historical Operation and Maintenance Expense

Description	2014	2015	2016	2017	2018
	$	$	$	$	$
Personal Services	33,949,200	39,106,300	39,044,700	36,548,100	33,662,500
Services & Utilities	16,520,800	16,081,600	17,330,900	18,479,100	14,286,400
Supplies & Materials	14,630,200	16,883,200	18,846,900	20,741,300	21,812,500
Special Current Charges	2,300,100	(95,600)	244,700	381,400	15,991,800
Furniture & Equipment	291,600	323,000	228,300	265,800	243,100
Repairs & Facility Maintenance	0	0	0	0	0
Total Operation and Maintenance	67,691,900	72,298,500	75,695,500	76,415,700	85,996,300

Capital Budget and Expenditures

Capital expenditures of the Water Department include the cost of replacements and improvements to waterworks facilities, the water distribution system, and the Water Department pro rata share of power projects and general budget costs.

The Water Department's 2018 capital expenditures totaled $66,540,401. The Water Department's capital improvement expenditures for the year are shown in Table 4.

Table 4 - 2018 Capital Expenditures

C.P. #	Project	Actual Expenditures
		$
	Waterworks	
110	Normal Extensions & Replacements	10,421,828
112	Modification to Oak St Raw Water Intake Station	4,230
122	Sycamore and Claiborne Filter Rehabilitation	5,204,781
156	Advanced Water Treatment (Carrollton)	478,187
157	Advanced Water Treatment (Algiers)	592,109
159	Water Plant Security Improvements	67,767
175	Water Hurricane Recovery Bonds	38,565,190
180	FEMA Review of Change Orders - Water	(24,217,552)
	Total Waterworks	31,116,541
	Water Distribution	
214	Normal Extensions & Replacements	1,176,464
216	Water Systems Replacement Program	1,616,008
239	Mains DPW Contracts	2,728,116
	Total Water Distribution	5,520,587
	Power Projects and General Budget	
600	Water Share of Power Projects	17,483,242
700	Water Reserve for Emergencies	3,000,144
800	Water Share of General Budget Items	9,419,886
	Total Power Projects and General Budget	29,903,272
	Total Water Department	66,540,401

Summary of Operations

The following tabulation shows a summary of the receipts and expenditures of the Water Department during 2018:

Total Revenues	$94,507,453
Operation and Maintenance Expense	-85,996,300
Claims	-484,441
Debt Service Payments	-13,333,550
Revenue Primarily Available for Capital Expenditures [a]	**-5,306,838**

[a] Excludes depreciation.

PROPOSED CAPITAL IMPROVEMENT PROGRAM

Table 5 presents a summary of the projected major capital improvement program for the period 2019 through 2023. Table 5 is based on the Board's amended 2019 Adopted Operating and Capital Budget and the 10-Year Capital Improvement Plan for 2020 - 2029. The five-year major capital improvement program costs are estimated to total $614,288,900. The proposed annual capital expenditures for the water system include $37,195,400 for the Water Department's share of power projects and $115,365,900 for its share of general budget items.

Table 5 - Projected Capital Improvements (a)

Project	2019	2020	2021	2022	2023	Total
	$	$	$	$	$	$
Equipment						0
Facilities	10,654,400	57,500,000	8,100,000	19,750,000	7,000,000	103,004,400
Normal Extensions	37,474,800	104,357,200	120,140,500	91,339,100	5,411,600	358,723,200
Other						0
Water Share of Equipment	6,095,400	5,305,000	39,903,500	16,864,000	7,534,000	75,701,900
Water Share of Facilities	4,628,200	10,477,400	7,419,300	6,484,500	528,000	29,537,400
Water Share of Hardware	155,400	858,990	268,000	228,400	183,600	1,694,390
Water Share of Other		660,000	0	0	0	660,000
Water Share of Power	7,864,900	3,048,500	1,972,000	10,200,000	14,110,000	37,195,400
Water Share of Software	165,000	2,771,010	2,475,200	781,400	424,600	6,617,210
Water Share of Normal Extensions		165,000	330,000	330,000	330,000	1,155,000
Total Major Capital Improvements	67,038,100	185,143,100	180,608,500	145,977,400	35,521,800	614,288,900

(a) The improvements for 2019-2023 are based on the Board's Adopted 2019 Operating and Capital Budgets and 10-Year Capital Improvement Plan for Fiscal Years 2020-2029.

ABILITY TO FINANCE PROPOSED CAPITAL EXPENDITURES

This section of the report analyzes the adequacy of projected revenues to finance the proposed capital improvements shown in Table 7.

Operating Revenues

Operating revenues of the Water Department consist of revenues from water sales. Projected operating revenues for the years 2019 through 2023 are shown in Table 6. Estimated revenue in Table 6 reflects December 2019 year-to-date revenue and the Board's budgeted revenue for 2020. It is assumed that projected revenue from water sales will remain flat through 2023.

Table 6 - Projected Operating Revenue

Year	Revenue From Charges
	$
2019	112,313,400
2020	118,952,400
2021	118,952,400
2022	118,952,400
2023	118,952,400

Other Revenue Sources

Based upon past practices, the Water Department can expect to obtain revenues or funds from non-operating sources. These include interest earned on available funds, participation by others, house connection charges, fire connections, fire hydrant relocations, and various other income sources. Also, by

Board policy, the Water Department receives one-half of the plumbing inspection and license fees currently projected at $293,200 per year.

Interest income from the investment of funds held for future use depends upon the level of water revenue available for investment and the amount of revenue accrued towards payment of future capital expenditures.

Projections of other revenue sources are presented in a subsequent table, which summarizes the Department's financial position during the financing of projected operating and capital requirements.

Operation and Maintenance Expenses

A summary of projected operation and maintenance expense for the period 2019 through 2023 is shown in Table 7. Projected expenses for 2019 are based on December 2019 year-to-date expenses which reflect a decrease of approximately 8.5 percent from the adopted budget. Projections of future operating and maintenance expenses for the study period are based on the Board's requested 2020 operating budget, which reflects an increase of approximately 20 percent over December 2019 year-to-date expenses, and allowances for inflationary factors.

Table 7 - Projected Operation and Maintenance Expense

Description	2019 (a)	Adjusted 2019 (b)	2020 (c)	2021	2022	2023	2024
	$	$	$	$	$	$	$
Personal Services	32,626,200	29,858,092	35,887,700	36,784,900	37,704,500	38,647,200	39,613,300
Services & Utilities	13,846,600	12,671,812	15,230,800	15,611,600	16,001,800	16,401,900	16,811,900
Supplies & Materials	21,141,000	19,347,332	23,254,400	23,835,800	24,431,600	25,042,400	25,668,500
Special Current Charges	15,499,500	14,184,474	17,048,900	17,475,100	17,912,000	18,359,800	18,818,800
Furniture & Equipment	235,600	215,611	259,200	265,600	272,300	279,100	286,100
Repairs & Facility Maintenance	0	0	0	0	0	0	0
Total Operation and Maintenance	83,348,900	76,277,321	91,681,000	93,973,000	96,322,200	98,730,400	101,198,600

(a) Represents the Adopted 2019 Operating and Capital Budgets
(b) Represents December YTD Actuals
(c) Represented the Requested 2020 Operating Budget.

Debt Service Requirements

Future debt service requirements of the Water Department are made up of principal, interest, and reserve fund payments for currently outstanding and future water revenue bond issues. As of December 31, 2018, outstanding debt obligations consisted of $98,000,000 Water Revenue and Refunding Bonds, Series 2014 and $99,300,000 Water Revenue Bonds, Series 2015.

Table 8 - Existing and Proposed Debt Service Requirements

Description		2019	2020	2021	2022	2023
		$	$	$	$	$
Existing Revenue Bonds						
Series 2014		7,700,000	7,690,000	7,683,500	7,685,000	6,528,800
Series 2015		5,694,600	5,783,600	5,787,800	5,785,400	6,941,300
Total Existing Debt Service		13,394,600	13,473,600	13,471,300	13,470,400	13,470,100
Projected Senior Debt (a)						
	Amount of Issue					
	$					
2019	0	0	0	0	0	0
2020	60,000,000		735,000	3,830,673	3,830,673	3,830,673
2021	10,000,000			638,400	638,400	638,400
2022	8,000,000				510,800	510,800
2023	0					0
Total Projected Senior Debt Service		0	735,000	4,469,073	4,979,873	4,979,873
Total Projected Debt Service		13,394,600	14,208,600	17,940,373	18,450,273	18,449,973

(a) Due to the uncertainty of projected revenue, the projected timing and amount of future bond issues is tentative and subject to change.

To adequately fund the proposed capital improvements, additional revenue bonds are indicated as shown in Table 8. It is anticipated that the Board will issue a $60,000,000 Revenue Bond through the Department of Health and Hospitals (DHH) Drinking Water State Revolving Fund (SRF) program in 2020. Additional revenue bonds in the amount of $10,000,000 in 2021 and $8,000,000 in 2022 are projected. The payment schedule for the anticipated DHH loan was provided by the Board's financial advisor. Future bonds, shown in Table 8, for 2021 through 2023 are assumed to be sold at an average annual interest rate of 2.45 percent for a term of 20 years.

Adequacy of Revenues to Finance Proposed Capital Improvements

Total revenue requirements for the Water Department recognized for purposes of this report include operation and maintenance expense, allowance for claims, debt service costs on major capital improvements financed through the sale of bonds, and expenditures for capital improvements not financed from bond proceeds. Table 11 examines the financing of the major capital improvement program and Table 12 summarizes the financing of operation and maintenance expense, debt service costs on outstanding and proposed bonds, and the transfer of operating funds for major capital improvement financing.

Capital Projects Funding

Table 9 presents the major capital improvement financing plan which summarizes the projected source and application of funds over the five-year study period. The amount of Funds Available at Beginning of Year, shown on Line 1, is $42,726,500. This amount is based on audited data provided by the Board.

Table 9 - Capital Improvement Program Financing

Line No.	Description	Fiscal Year Ending December 31, 2019	2020	2021	2022	2023	Total
		$	$	$	$	$	$
1	Funds Available at Beginning of Year	42,726,500	36,457,600	12,062,100	1,223,900	1,304,700	42,726,500
2	Revenue Bond Proceeds (a)	0	60,000,000	10,000,000	8,000,000	0	78,000,000
3	Operation Fund Transfers	36,000,000	0	0	13,000,000	14,000,000	63,000,000
4	Participation By Others (b)	28,653,000	133,641,100	167,584,000	134,443,500	24,811,100	489,132,700
5	Interest Income	457,600	728,800	271,300	180,500	47,300	1,685,500
6	Total Funds Available	107,837,100	230,827,500	189,917,400	156,847,900	40,163,100	674,544,700
7	Obligated Contracts & Capital Jobs	(33,674,100)	0	0	0	0	(33,674,100)
8	Major Capital Additions	(67,038,100)	(188,846,000)	(187,905,100)	(154,912,400)	(38,449,900)	(637,151,500)
9	Deferred Capital Improvements	29,332,700	(29,919,400)	0	0	0	(586,700)
10	Bond Issuance Expense	0	0	(150,000)	(120,000)	0	(270,000)
11	Revenue Bond Reserve Fund	0	0	(638,400)	(510,800)	0	(1,149,200)
12	Total Application of Funds	(71,379,500)	(218,765,400)	(188,693,500)	(155,543,200)	(38,449,900)	(672,831,500)
13	End of Year Balance	36,457,600	12,062,100	1,223,900	1,304,700	1,713,200	1,713,200

(a) Due to the uncertainty of projected revenue, the projected timing and amount of future bond issues is tentative and subject to change.
(b) Includes funding from FEMA, HMCP, Grants, and Fair Share Program.

Projected revenue bond proceeds, totaling $78,000,000, are shown on Line 2. The amounts and years of issue are developed by considering capital program needs, current policies, other sources of major capital improvement financing, and the debt service coverage requirements of the bond covenants regarding the issuance of parity revenue bonds.

Financing of the major capital improvement program anticipates the transfer of a total of $63,000,000 of operating revenue as shown on Line 3. Other sources of funds available to meet major capital improvement expenditures are Participation by Others and interest income. Participation by Others, as shown on Line 4, includes anticipated funding by FEMA, HMCP, grants and the Fair Share Program. Interest earnings recognize an assumed 1.0 percent average annual interest rate and are shown on Line 5. Line 6 of the table shows the projected major capital improvement funds available each year.

As of December 31, 2018, the Board had $33,674,100 obligated for open contracts and capital jobs as shown on Line 7 of Table 9. Line 8 shows the projected Major Capital Additions to be funded. These costs reflect the total improvements shown Table 7 with 2 percent inflation beginning in 2019. Line 9 indicates that the total capital projects completed in 2019 was less than the amount proposed in the 2019 Capital Budget. This deferral is assumed to be funded in 2020.

Estimated issuance costs related to the proposed bond issue amounts are shown on Line 10. Line 11 shows the required deposits into the Revenue Bond Reserve Fund associated with proposed bond issues. The debt service reserve on proposed debt is a three-prong test estimated as the lessor of (i) 10 percent of the original principal amount, (ii) the maximum annual debt service, or (iii) 125 percent of the average annual debt service.

The Total Application of Funds is shown on Line 12 of Table 9. The net End of Year Balance is shown on Line 13.

Operating Fund

Line 1 of Table 10 shows projected Revenue from Charges as previously presented in Table 6. In 2012, the New Orleans City Council approved eight consecutive annual 10 percent water rate increases beginning January 1, 2013. Revenue shown on Line 1 reflects revenue from the approved increases. It is projected that a 6 percent revenue increase will be necessary effective January 1, 2021, followed by a 3 percent revenue increase effective January 1, 2022 and January 1, 2023. The revenue from these proposed revenue increases are shown in Lines 4 through 6. The date and magnitude of proposed revenue increases are based on consideration of two principal criteria, which include: (1) total revenue necessary to meet cash requirements, and (2) total revenue required to meet minimum bond coverage requirements.

Total projected revenue from service charges is shown on Line 8. Additional operating revenue includes Interest Income, revenue from Plumbing Inspection and License Fees, Revenue Sharing, Other Miscellaneous Income, and FEMA Reimbursement. Interest income available to the operating fund, shown on Line 9, is estimated to be 1.0 percent of the average of the beginning and end of year Net Annual Balance, except as the average is affected by identifiable nonrecurring major receipts, transfers, or expenditures during the year. Revenue from other sources shown on Lines 10 through 14 are based on 2019 December year-to-date revenue and 2020 budget. Total Operating Revenue is shown on Line 15.

Operation and Maintenance expense, previously projected in Table 7, is shown on Line 16 of Table 10. Lines 17 and 18 include the estimated allowance for claims and bad debt expense which is assumed to be 5 percent of projected revenue in 2019 and 2020 and decreases to 3 percent by 2022. Projected Net Operating Revenue from system operations is shown on Line 19.

Lines 20 through 22 present debt service requirements on currently outstanding and proposed senior revenue bonds. Existing debt includes the Series 2014 and Series 2015 bonds. Line 21 reflects projected principal and interest payments on additional revenue bond debt financing of $60,000,000 in 2020, $10,000,000 in 2021, and $8,000,000 in 2022.

In July of 2006 the Board entered into a Cooperative Endeavor Agreement with the State of Louisiana to secure proceeds from the State's Gulf Opportunity Tax Credit Bond Loan Program to assist in payment of debt service requirements from 2006 through 2008. The Board has borrowed $77,465,247 on this agreement. Payments for the water portion of principal and interest began in July 2012 and are shown on Line 25 of Table 10 as subordinate debt. It is assumed that the Sewerage Department will make the total payment, including the Water Department's share, beginning in 2020.

Anticipated non-operating revenue is shown on Line 27. This amount includes revenue from the Fair Share Program in 2019.

Line 28 reflects the projected transfer of accumulated net earnings from system operations to assist in major capital financing. Typically, such accumulated net earnings may be used to help recover portions of the annual costs of system operations or to assist in major capital improvement financing.

The General Resolution requires an Operating Reserve Fund of 90 days of the previous year's operation and maintenance expense; however, the SWBNO's Financial Management Policy requires an Operating Reserve Fund of not less than 180 days. Line 29 indicates the projected annual transfers available to meet this requirement throughout the study period.

Table 10 - Analysis of Ability of Forecasted Revenue to Finance Projected Revenue Requirements

Line No.	Description			Fiscal Year Ending December 31, 2019	2020	2021	2022	2023
				$	$	$	$	$
1	Revenue from Charges			112,313,400	118,952,400	118,952,400	118,952,400	118,952,400
	Additional Revenue Required							
	Year	Revenue Increase	Months Effective					
2	2019	0.0%	11.0	0	0	0	0	0
3	2020	0.0%	11.0		0	0	0	0
4	2021	6.0%	11.0			6,542,400	7,137,100	7,137,100
5	2022	3.0%	11.0				3,467,500	3,782,700
6	2023	3.0%	11.0					3,571,500
7	Total Additional Revenue			0	0	6,542,400	10,604,600	14,491,300
8	Total Service Charge Revenue			112,313,400	118,952,400	125,494,800	129,557,000	133,443,700
9	Interest Income			318,000	308,600	417,600	454,100	460,200
10	Plumbing Insp. & License Fees			293,200	310,400	310,400	310,400	310,400
11	Revenue Sharing			132,300	259,600	259,600	259,600	259,600
12	Other Miscellaneous Income			2,883,400	0	0	0	0
13	FEMA Reimbursement			1,356,900	756,900	756,900	756,900	756,900
14	Interest from Bond Reserve Fund			169,000	169,000	172,000	178,000	181,000
15	Total Operating Revenue			117,466,200	120,756,900	127,411,300	131,516,000	135,411,800
16	Operation & Maintenance (a)			(76,277,300)	(91,681,000)	(93,973,000)	(96,322,200)	(98,730,400)
17	Provision for Claims			(1,257,100)	(1,288,500)	(1,320,700)	(1,353,700)	(1,387,500)
18	Provision for Doubtful Accounts			(6,007,100)	(5,947,600)	(5,019,800)	(3,886,700)	(4,003,300)
19	Net Operating Revenue			33,924,700	21,839,800	27,097,800	29,953,400	31,290,600
	Debt Service							
	Senior Lien Revenue Bonds							
20	Existing			(13,394,600)	(13,473,600)	(13,471,300)	(13,470,400)	(13,470,000)
21	Projected			0	(735,000)	(4,469,100)	(4,979,900)	(4,979,900)
22	Total Senior Lien Revenue Bonds			(13,394,600)	(14,208,600)	(17,940,400)	(18,450,300)	(18,449,900)
	Subordinate State Revolving Fund Loans							
23	Projected			0	0	0	0	0
24	Total Subordinate State Revolving Fund Loans			0	0	0	0	0
25	Gulf Opportunity Zone Act Loan			(639,900)	0	0	0	0
26	Total Debt Service			(14,034,500)	(14,208,600)	(17,940,400)	(18,450,300)	(18,449,900)
27	Other Non-Operating Revenue			5,511,900	2,501,000	2,501,000	2,501,000	2,501,000
28	Transfer to Construction			(36,000,000)	0	0	(13,000,000)	(14,000,000)
29	Transfer to Operating Reserve Fund			(704,700)	0	(2,673,200)	(565,200)	(579,300)
30	Net Annual Balance			(11,302,600)	10,132,200	8,985,200	438,900	762,400
31	Beginning of Year Cash Balance (b)			12,092,600	790,000	10,922,200	19,907,400	20,346,300
32	End of Year Balance			790,000	10,922,200	19,907,400	20,346,300	21,108,700
33	Beginning of Year Cash Balance (b)			12,092,600	28,150,501	38,282,701	49,941,101	50,945,201
34	Customer Deposits			7,427,400				
35	Operating Reserve Fund			19,933,101	0	2,673,200	565,200	579,300
36	Net annual Balance			(11,302,600)	10,132,200	8,985,200	438,900	762,400
37	End of Year Balance			28,150,501	38,282,701	49,941,101	50,945,201	52,286,901
38	Days of O&M Cash on Hand			123	141	182	183	183

(a) Excludes non-cash expenses of depreciation and allowances, pension liability adjustment, and pension contributions.

(b) Reflects beginning of year balance in unrestricted and undesignated cash and cash equivalents and cash and cash equivalents designated for capital projects, less operating reserve requirement.

Line 30 indicates the estimated Net Annual Balance from operations remaining at the end of each year.

The balance of operating funds available at the beginning of the year 2019, shown on Line 31, is comprised of the current cash assets and reflects a balance of $12,092,600. The End of Year Balance, which is exclusive of the operating reserve fund, is shown on Line 32.

Lines 33 through 38 demonstrate that the Board is maintaining an operating reserve equal to at least 180 days of the previous year's operation and maintenance expense beginning in 2021.

As demonstrated in Tables 9 and 10, it is anticipated that current revenue sources will be adequate to readily finance both projected capital program requirements and estimated future operation expenses of the Water Department during the 2019-2023 study period examined herein, with the adopted 10 percent revenue increases in 2019 and 2020, and future revenue increases as indicated.

Bond Coverage Requirements

An additional consideration in measuring the adequacy of revenues is the provision of sufficient debt service coverage to meet the bond covenant requirements for the issuance of parity revenue bonds. The General Resolution provides that rates shall be maintained at levels which are expected to yield net revenues (as defined in the resolution) equal to at least 125 percent of the annual principal and interest requirement for senior debt and 110 percent for senior and subordinate debt in each fiscal year. The SWBNO's Financial Management Policy requires coverage at a minimum of 150 percent for senior debt and 125 percent for senior and subordinate debt.

The calculation of net revenue is shown on Lines 1 through 10 of Table 11. The ability of the Water Department revenues to meet revenue bond coverage requirements is shown on Lines 11 through 15. As shown on Lines 13 and 15, the indicated projected revenue and revenue increases will provide sufficient net revenue to meet coverage requirements during the study period.

The General Resolution further prescribes that additional parity revenue bonds may be issued if net revenue from a previous test year (any 12 consecutive months of the last 24 months) is equal to at least 125 percent of the maximum annual principal and interest requirement for senior debt and 110 percent for senior and subordinate debt. For purposes of the additional bonds test, net revenue may be adjusted to reflect any increases not in effect during the selected test year but have been approved by the Board, Board of Liquidation and City Council and will go into effect within the following five years.

The results of the additional bonds test are shown on Lines 16 through 22 of Table 11. Lines 20 and 22 of the table indicate that with the magnitude of the adopted annual revenue increases, required minimum levels of coverage are met in each year with indicated coverage levels ranging from 250 percent to 336 percent.

Table 11 - Coverage Requirements

Line No.	Coverage Requirements	2018	2019	2020	2021	2022	2023
		$	$	$	$	$	$
	Projected Net Revenues						
1	Revenue Under Existing Rates (a)	99,293,900	112,313,400	118,952,400	118,952,400	118,952,400	118,952,400
2	Additional Revenue Under Proposed Rates		0	0	6,542,400	10,604,600	14,491,300
3	Interest Income	1,723,900	944,600	1,206,400	860,900	812,600	688,500
4	Plumbing and Inspection Fees	319,100	293,200	310,400	310,400	310,400	310,400
5	Revenue Sharing	264,600	132,300	259,600	259,600	259,600	259,600
6	Other Miscellaneous Revenue	0	2,883,400	0	0	0	0
7	Operation & Maintenance Grants	1,912,700	1,356,900	756,900	756,900	756,900	756,900
8	Transfer from Rate Stabilization Fund		0	0	0	0	0
9	Operation & Maintenance (b)	(80,839,800)	(76,277,300)	(91,681,000)	(93,973,000)	(96,322,200)	(98,730,400)
10	Net Revenue	22,674,400	41,646,500 5,610,400	29,804,700	33,709,600	35,374,300	36,728,700
	Rate Covenant Coverage						
11	Projected Net Revenues	22,674,400	41,646,500	29,804,700	33,709,600	35,374,300	36,728,700
	Annual Debt Service						
12	Senior Debt	13,333,550	13,394,600	14,208,600	17,940,400	18,450,300	18,449,900
13	Coverage (c)	170%	311%	210%	188%	192%	199%
14	All Debt	13,973,495	14,034,500	14,208,600	17,940,400	18,450,300	18,449,900
15	Coverage (d)	162%	297%	210%	188%	192%	199%
	Additional Bond Coverage						
16	Preceding Year Projected Net Revenues		22,674,400	41,646,500	29,804,700	33,709,600	35,374,300
17	Future Additional Revenue		12,367,500	16,515,100	20,220,200	14,968,400	13,668,200
18	Adjusted Projected Net Revenues		35,041,900	58,161,600	50,024,900	48,678,000	49,042,500
	Maximum Debt Service						
19	Senior Debt		13,473,550	17,304,173	17,942,573	18,453,373	18,453,373
20	Coverage (c)		260%	336%	279%	264%	266%
21	All Debt		14,034,450	17,304,173	17,942,573	18,453,373	18,453,373
22	Coverage (d)		250%	336%	279%	264%	266%

(a) 2018 revenue reflects preliminary budget amount and does not reflect actual revenue collected which may be less than the amount shown.
(b) Reflects 2018 audited operating expenses for debt service coverage.
(c) The General Bond Resolution requires net revenue to equal or exceed 125% of debt service, however, the Board's Financial Management Policy aims for 150% coverage.
(d) The General Bond Resolution requires net revenue to equal or exceed 110% of debt service, however the Board's Financial Management Policy aims for 125% coverage.
(e) Net Revenue excludes transfers from the Rate Stabilization Fund and proceeds of Operation & Maintenance Grants.
(f) The General Bond Resolution requires net revenue to equal or exceed 100% of debt service.

Sewerage Department

ADHERENCE TO SEWERAGE SERVICE REVENUE BOND RESOLUTION

In 2014, the Board issued $158,990,000 Sewerage Service Revenue and Refunding Bonds. Issuance of these bonds obligated the Board to adhere to the covenants of the Bond Resolution. Briefly, the covenants are concerned with:

- Payment of indebtedness; limited obligations.
- Limitations on indebtedness.
- Covenants and representations of Board.
- Covenants with credit banks, insurers, etc.
- Operation and maintenance.
- Free service, competing service, billing and enforcement of charges.
- Sale or encumbrance of system.
- Insurance
- Damage, destruction, condemnation and loss of title.
- Records and accounts; inspections and reports.
- Capital budget.

The provisions of the General Sewerage Service Revenue Bond Resolution are virtually identical to those of the General Water Revenue Bond Resolution described in the preceding section of this report. The Board was in compliance with these covenants in 2018.

2018 SEWERAGE DEPARTMENT OPERATIONS

Funds for the operation, maintenance, and debt service requirements of the Sewerage Department are obtained from sewerage service charges, delinquent fees, plumbing inspection and license fees, interest earned on available funds, and other miscellaneous revenue sources. Analysis of the 2018 Sewerage Department operations are discussed in the following paragraphs.

Operating Revenues

A summary of historical sewer billings and other Sewerage Department revenue is presented in Table 12 for the period 2014 through 2018. The historical revenues shown in Table 12 were developed from detailed records provided by Board staff. Operating revenues are derived from sewerage service charge revenue, which includes excess strength charges, and delinquent fees. Sewerage service charge revenues in 2018 were $113,363,591 which, when compared with $109,141,514 for 2017, shows an increase of approximately 3.9 percent. Delinquent fee revenues were $1,250,566 in 2018 which represent a decrease of approximately 35 percent over 2017 delinquent fees.

Table 12 - Statement of Historical Revenue

Revenue Source	2014	2015	2016	2017	2018
	$	$	$	$	$
Operating Revenue					
Sewerage Service Charges	85,692,093	94,902,241	102,541,874	109,141,514	113,363,591
Delinquent Fee	861,169	734,725	2,253,310	1,922,205	1,250,566
Total Operating Revenue	86,553,262	95,636,966	104,795,184	111,063,719	114,614,157
Nonoperating Revenue					
Interest Income	257,413	1,341,518	2,308,629	2,109,401	1,922,205
Plumbing Inspection and License Fees	339,176	305,384	318,511	291,215	329,205
Revenue Sharing	317,506	322,674	313,048	329,350	329,965
Other Income	906,120	560,157	505,847	528,094	834,260
Total Nonoperating Revenue	1,820,215	2,529,733	3,446,035	3,258,060	3,415,635
Total Revenue	88,373,477	98,166,699	108,241,219	114,321,779	118,029,792

Non-Operating Revenues

Also shown in Table 12, non-operating revenue of the Sewerage Department includes interest earned on the invested funds and other income from miscellaneous sources. During 2018, non-operating revenue included $1,922,205 of interest earned from the investment of available funds in the Sewerage System Fund and the Sewerage Revenue Bond Account and $1,493,430 from other sources.

Operation and Maintenance Expenses

Table 13 presents a summary of historical operation and maintenance expenses. Expenditures in 2018 increased about 24 percent from 2017 expenditures. Historical operation and maintenance expenses shown in Table 13 do not include the non-cash portion of Provision for Claims as recorded in the Comprehensive Annual Financial Report.

Table 13 - Historical Operation and Maintenance Expense

Description	2014	2015	2016	2017	2018
	$	$	$	$	$
Personal Services	22,566,500	27,658,400	27,252,700	26,612,500	26,722,900
Services & Utilities	17,764,600	15,348,100	20,000,200	25,871,600	17,455,300
Supplies & Materials	4,790,800	8,135,700	10,070,500	11,611,200	9,590,300
Special Current Charges	1,707,400	552,800	(55,500)	332,800	26,243,300
Furniture & Equipment	198,600	240,600	199,700	169,500	201,100
Repairs & Facility Maintenance	0	0	0	0	0
Total Operation and Maintenance	47,027,900	51,935,600	57,467,600	64,597,600	80,212,900

Capital Budget and Expenditures

Capital expenditures of the Sewerage Department include the cost of replacements and improvements to wastewater treatment and collection facilities and the Sewerage Department pro rata share of power projects and general budget costs.

Table 14 – 2017 Capital Expenditures

C.P. #	Project	Actual Expenditures
		$
	Sewerage Systems	
310	Extensions & Replacements - Gravity Mains EPA Consent Decree	1,358,899
313	Extensions & Replacements - Sewer Force Mains EPA Consent Decree	1,380,414
317	Extension & Replacement - Gravity Mains EPA Consent Decree	7,694,216
318	Rehabilitation Gravity Sewer System	5,933,124
326	Extensions & Replacements to Sewer Pumping Stations	489,059
339	Mains in Street Dept. Contracts	3,793,231
340	Sewerage Hurricane Recovery Bonds (FEMA)	1,771,298
348	Normal Extensions & Replacements	11,757,316
368	Wetlands Assimilation Project	26,511
375	Sewerage Hurricane Recovery Bonds	6,021,849
380	FEMA Review of Change Orders-Sewer	(1,297,021)
	Total Sewerage System	38,928,894
	Power Projects and General Budget	
600	Sewerage Share of Power Projects	8,317,189
800	Sewerage Share of General Budget Items	11,163,511
	Total Power Projects and General Budget	19,480,700
	Total Sewerage Department	58,409,594

The Sewerage Department's 2018 capital expenditures totaled $58,409,594. The Sewerage Department's capital improvement expenditures for the year are shown in Table 14.

Summary of Operations

The following tabulation shows a summary of the receipts and expenditures of the Sewerage Department during 2018:

Total Revenues	$118,029,792
Operation and Maintenance Expense	-80,212,900
Claims	-1,969,339
Debt Service Payments	-23,139,113
Revenue Primarily Available for Capital Expenditures [a]	**12,708,440**

[a] Excludes depreciation.

PROPOSED CAPITAL IMPROVEMENT PROGRAM

Table 15 presents a summary of the projected major capital improvement program for the period 2019 through 2023. Table 15 is based on the Board's amended 2019 Adopted Operating and Capital Budget and the 10-Year Capital Improvement Plan for 2020 - 2029. The five-year major capital improvement program costs are estimated to total $418,768,500. The proposal annual capital expenditures for the sewerage system include $13,621,300 for the Sewerage Department's share of power projects and $52,348,000 for its share of general budget items.

Table 15 - Projected Capital Improvements (a)

Project	2019	2020	2021	2022	2023	Total
	$	$	$	$	$	$
Equipment						0
Facilities	6,248,400	7,950,000	3,600,000	8,300,000	6,600,000	32,698,400
Normal Extensions	49,109,000	86,215,300	90,265,800	62,438,200	32,072,500	320,100,800
Other						0
Sewerage Share of Equipment	1,410,000	3,305,000	7,403,500	6,364,000	6,034,000	24,516,500
Sewerage Share of Facilities	2,545,700	5,527,400	2,619,300	6,484,500	528,000	17,704,900
Sewerage Share of Hardware	155,400	859,000	268,000	228,400	183,600	1,694,400
Sewerage Share of Other		660,000	0	0	0	660,000
Sewerage Share of Power	2,406,700	1,165,600	754,000	3,900,000	5,395,000	13,621,300
Sewerage Share of Software	165,000	2,771,000	2,475,200	781,400	424,600	6,617,200
Sewerage Share of Normal Extensions		165,000	330,000	330,000	330,000	1,155,000
Total Major Improvements	62,040,200	108,618,300	107,715,800	88,826,500	51,567,700	418,768,500

(a) The improvements for 2019-2023 are based on the Board's Adopted 2019 Operating and Capital Budgets and 10-Year Capital Improvement Plan for Fiscal Years 2020-2029.

The Board is currently complying with the EPA Region 6 Administrative Order. In January of 2010, the Board successfully completed negotiations for a modification of the Consent Decree. The Capital Improvement Program shown in Table 15 represents the schedule for complying with the modified Consent Decree.

ABILITY TO FINANCE PROPOSED CAPITAL EXPENDITURES

This section of the report analyzes the adequacy of projected revenues to finance the proposed capital improvements shown in Table 15.

Operating Revenues

Future operating revenues of the Sewerage Department consist of sewerage service charge revenues. Projected operating revenues for the years 2019 through 2023 are shown in Table 16. Estimated revenue in Table 16 reflects December 2019 year-to-date revenue and the Board's budgeted revenue for 2020. It is assumed that projected revenue from sewerage service charges will remain flat through 2023.

Table 16 - Projected Operating Revenue

Year	Revenue From Charges
	$
2019	142,155,600
2020	148,910,500
2021	148,910,500
2022	148,910,500
2023	148,910,500

Other Revenue Sources

Based upon past practices, the Sewerage Department can expect to obtain revenues or funds from non-operating sources. These include interest earned from the investment of available funds, participation by others, and miscellaneous other income. By Board policy, the Sewerage Department receives one-half of the plumbing inspection and license fees, currently projected at $288,700 per year.

Interest income from the investment of funds held for future use depends upon the level of sewerage revenue available for investment and the amount of revenue accrued towards payment of future capital expenditures.

Projections of other revenue sources are presented in a subsequent table, which summarizes the Department's financial position during the financing of projected operating and capital requirements.

Operation and Maintenance Expense

A summary of projected operation and maintenance expense for the period 2019 through 2023 is shown in Table 17. Projected expenses for 2019 are based on December 2019 year-to-date expenses which reflect a decrease of approximately 21.8 percent from the adopted budget. Projections of future operating and maintenance expenses for the study period are based on the Board's requested 2020 operating budget, which reflects an increase of approximately 43.7 percent over December 2019 year-to-date expenses, and allowances for inflationary factors.

Table 17 - Projected Operation and Maintenance Expense

Description	2019 (a)	Adjusted 2019 (b)	2020 (c)	2021	2022	2023	2024
	$	$	$	$	$	$	$
Personal Services	30,742,800	24,030,854	34,522,300	35,385,400	36,270,000	37,176,700	38,106,200
Services & Utilities	20,081,100	15,696,878	22,549,800	23,113,600	23,691,400	24,283,700	24,890,800
Supplies & Materials	11,033,000	8,624,212	12,389,300	12,699,100	13,016,600	13,342,000	13,675,500
Special Current Charges	30,191,100	23,599,605	33,902,700	34,750,300	35,619,000	36,509,500	37,422,300
Furniture & Equipment	231,400	180,879	259,800	266,300	272,900	279,800	286,800
Repairs & Facility Maintenance	0	0	0	0	0	0	0
Total Operation and Maintenance	92,279,400	72,132,429	103,623,900	106,214,700	108,869,900	111,591,700	114,381,600

(a) Represents the Adopted 2019 Operating and Capital Budgets
(b) Represents December YTD Actuals
(c) Represented the Requested 2020 Operating Budget.

Debt Service Requirements

Future debt service requirements of the Sewerage Department are made up of principal, interest, and reserve fund payments for currently outstanding and future sewerage revenue bond issues. As of December 31, 2018, outstanding debt obligations consisted of $6,475,000 Sewerage Revenue Bonds Series 2011, $110,440,000 Sewerage Service Revenue and Refunding Bonds Series 2014, and $100,000,000 Sewerage Service Revenue and Refunding Bonds Series 2015.

To adequately fund the proposed capital improvements, additional revenue bonds are indicated as shown in Table 18. In 2019, the Board issued the Series 2019 LADEQ loan in the amount of $10,000,000 with principal payments beginning in 2021.

The Board is current working with its financial advisor in anticipation of issuing a total of $64,500,000 revenue bonds in 2020. It is anticipated that $10,250,000 of the issue will be a direct placement through

the WIFIA program and the remaining $55,150,000 will be a public offering. The total project fund proceeds will be $75,000,000 which includes a premium of $11,489,053. The Board has also submitted a Letter of Intent for a WIFIA loan in the amount of $100,474,500, to be issued in 2020 as well. The payment schedule for the 2020 loans was provided by the Board's financial advisor.

Table 18 - Existing and Proposed Debt Service Requirements

Description		2019	2020	2021	2022	2023
		$	$	$	$	$
Existing Bonds						
Series 2014		16,217,500	16,234,100	13,106,300	11,089,000	7,279,800
Series 2015		5,000,000	5,000,000	6,950,000	6,850,000	6,750,000
Series 2011 (LADEQ)		463,400	465,400	467,400	469,500	471,400
Total Existing Debt Service		21,680,900	21,699,500	20,523,700	18,408,500	14,501,200
Projected Senior Debt (a)						
	Amount of Issue					
	$					
2019	10,000,000	0	50,400	551,000	551,700	551,300
2020	65,400,000		918,528	2,962,500	4,709,850	6,025,900
2021	0			0	0	0
2022	0				0	0
2023	0					0
Total Projected Debt Service		0	968,928	3,513,500	5,261,550	6,577,200
Projected WIFIA Loans						
	Amount of Issue					
	$					
2019	0	0	0	0	0	0
2020	100,474,500		5,725	827,398	1,863,294	2,193,063
2021	0			0	0	0
2022	0				0	0
2023	0					0
Total Projected WIFIA Loan Debt Service		0	5,725	827,398	1,863,294	2,193,063
Total Projected Debt Service		0	22,674,153	24,864,598	25,533,344	23,271,463

(a) Due to the uncertainty of projected revenue, the projected timing and amount of future bond issues is tentative and subject to change.

Adequacy of Revenues to Finance Proposed Capital Improvements

Total revenue requirements for the Sewer Department recognized for purposes of this report include operation and maintenance expense, allowance for claims, debt service costs on major capital improvements financed through the sale of bonds, and expenditures for capital improvements not financed from bond proceeds. Table 19 examines the financing of the major capital improvement program and Table 20 summarizes the financing of operation and maintenance expense, debt service costs on outstanding and proposed bonds, and the transfer of operating funds for capital improvement financing.

Capital Projects Funding

Table 19 presents the major capital improvement financing plan which summarizes the projected source and application of funds over the five-year study period. The amount of Funds Available at Beginning of Year, shown on Line 1, is $44,088,000. This amount is based on audited data provided by the Board.

Table 19 - Capital Improvement Program Financing

Line No.	Description	Fiscal Year Ending December 31, 2019	2020	2021	2022	2023	Total
		$	$	$	$	$	$
1	Funds Available at Beginning of Year	44,088,000	1,743,500	42,761,993	59,378,493	49,069,893	44,088,000
2	Revenue Bond Proceeds (a)	10,000,000	65,400,000	0	0	0	75,400,000
3	WIFIA Disbursements (b)	245,000	17,382,700	48,087,600	18,160,500	8,041,200	91,917,000
4	Operation Fund Transfers	15,000,000	0	0	12,000,000	11,000,000	38,000,000
5	Participation by Others (c)	5,363,800	81,381,600	80,083,500	53,249,500	22,252,100	242,330,500
6	Interest Income	197,200	476,800	512,900	544,800	422,200	2,153,900
7	Total Funds Available	74,894,000	177,873,700	171,445,993	143,333,293	90,785,393	505,378,500
8	Obligated Contracts & Capital Jobs	(33,110,300)	0	0	0	0	(33,110,300)
9	Major Capital Additions	(62,040,200)	(110,790,700)	(112,067,500)	(94,263,400)	(55,818,500)	(434,980,300)
10	Deferred Capital Improvements	22,000,000	(22,440,000)	0	0	0	(440,000)
11	Bond Issuance Expense	0	(951,627)	0	0	0	(951,627)
12	Revenue Bond Reserve Fund	0	(929,380)	0	0	0	(929,380)
13	Total Application of Funds	(73,150,500)	(135,111,707)	(112,067,500)	(94,263,400)	(55,818,500)	(470,411,607)
14	End of Year Balance	1,743,500	42,761,993	59,378,493	49,069,893	34,966,893	34,966,893

(a) Due to the uncertainty of projected revenue, the projected timing and amount of future bond issues is tentative and subject to change.
(b) Based on WIFIA application preliminary loan amortization provided by Financial Advisor.
(c) Includes funding from FEMA, HMCP, Grants, and Fair Share Program.

Projected revenue bond proceeds, totaling $75,400,000, are shown on Line 2. Line 3 reflects the proposed WIFIA disbursement schedule for the $100,474,500 2020 WIFIA loan. This schedule was provided by the Board's financial advisor.

Financing of the major capital improvement program anticipates the transfer of a total of $38,000,000 of operating revenue as shown on Line 4. Other sources of funds available to meet major capital improvement expenditures are Participation by Others and interest income. Participation by Others, as shown on Line 5 includes anticipated funding by FEMA, HMCP, grants and the Fair Share Program. Interest earnings recognize an assumed 1.0 percent average annual interest rate and are shown on Line 6. Line 7 of the table shows the projected major capital improvement funds available each year.

As of December 31, 2018, the Board had $33,110,300 obligated for open contracts and capital jobs as shown on Line 8 of Table 19. Line 8 shows the projected Major Capital Additions to be funded. These costs reflect the total improvements shown in Table 15 with 2 percent inflation beginning in 2019. Line 9 indicates that the total capital projects completed in 2019 was less than the amount proposed in the 2019 Capital Budget. This deferral is assumed to be funded in 2020.

Estimated issuance costs related to the proposed bond issue amounts are shown on Line 11. Line 12 shows the required deposits into the Revenue Bond Reserve Fund associated with proposed bond issues. The debt service reserve on proposed debt is a three-pronged test estimated as the lessor of (i) 10 percent of the original principal amount, (ii) the maximum annual debt service, or (iii) 125 percent of the average annual debt service.

The Total Application of Funds is shown on Line 13 of Table 19. The net End of Year Balance is shown on Line 14.

Operating Fund

Line 1 of Table 20 shows projected Revenue from Charges as previously presented in Table 16. In 2012, the New Orleans City Council approved eight consecutive annual 10 percent sewer rate increases beginning January 1, 2013. Revenue shown on Line 1 reflects revenue from the approved increases. It is projected that a 3.0 percent revenue increase will be necessary effective January 1, 2021. The revenue from this proposed revenue increase is shown in Line 4. The date and magnitude of proposed revenue increase in 2021 is based on consideration of two principal criteria, which include: (1) total revenue necessary to meet cash requirements, and (2) total revenue required to meet minimum bond coverage requirements.

Total projected revenue from service charges is shown on Line 8. Additional operating revenue includes Interest Income, revenue from Plumbing Inspection and License Fees, Revenue Sharing, Other Miscellaneous Income, and FEMA Reimbursement. Interest Income available to the operating fund, shown on Line 9, is estimated to be 1.0 percent of the average of the beginning and end of year Net Annual Balance, except as the average is affected by identifiable nonrecurring major receipts, transfers, or expenditures during the year. Revenue from other sources shown on Lines 10 through 14 are based on 2019 December year-to-date revenue and 2020 budget. Total Operating Revenue is shown on Line 15.

Operation and Maintenance expense, previously projected in Table 17, is shown on Line 16 of Table 20. Lines 17 and 18 show the estimated allowance for claims and bad debt expense which is assumed to be 5 percent of projected revenue in 2019 and 2020 and decreases to 3 percent by 2022. Projected Net Operating Revenue from system operations is shown on Line 19.

Lines 20 through 22 present debt service requirements on currently outstanding and proposed senior revenue bonds. Existing bonds include the Series 2011, Series 2014 and Series 2015 bonds. Line 21 reflects projected principal and interest payments on additional revenue bond debt financing of $10,000,000 in 2019 and $65,400,000 in 2020.

In July of 2006, the Board entered into a Cooperative Endeavor Agreement with the State of Louisiana to secure proceeds from the State's Gulf Opportunity Tax Credit Bond Loan Program to assist in payment of debt service requirements from 2006 through 2008. The Board has borrowed $77,465,247 on this agreement. Payments for the sewerage portion of principal and interest began in July 2012 and are shown on Line 25 of Table 20 as subordinate debt. Starting in 2020, the Sewerage Department will pay the total payment, include the amounts for the Water Department and Drainage Department.

Anticipated non-operating revenue is shown on Line 27. This amount includes revenue from the Fair Share Program in 2019.

Line 28 reflects the projected transfer of accumulated net earnings from system operations to assist in major capital financing. Typically, such accumulated net earnings may be used to help recover portions of the annual costs of system operations or to assist in major capital improvement financing.

The General Resolution requires an Operating Reserve Fund of 90 days of the previous year's operation and maintenance expense; however, the SWBNO's Financial Management Policy requires an Operating Reserve Fund of not less than 180 days. Line 29 indicates the projected annual transfers available to meet this requirement throughout the study period.

Table 20 - Analysis of Ability of Forecasted Revenue to Finance Projected Revenue Requirements

Line No.	Description			Fiscal Year Ending December 31, 2019	2020	2021	2022	2023
				$	$	$	$	$
1	Revenue from Charges			142,155,600	148,910,500	148,910,500	148,910,500	148,910,500
	Additional Revenue Required							
	Year	Revenue Increase	Months Effective					
2	2019	0.0%	11.0	0	0	0	0	0
3	2020	0.0%	11.0		0	0	0	0
4	2021	3.0%	11.0			4,095,000	4,467,300	4,467,300
5	2022	0.0%	11.0				0	0
6	2023	0.0%	11.0					0
7	Total Additional Revenue			0	0	4,095,000	4,467,300	4,467,300
8	Total Service Charge Revenue			142,155,600	148,910,500	153,005,500	153,377,800	153,377,800
9	Interest Income			445,300	646,400	787,200	867,300	883,100
10	Plumbing Insp. & License Fees			288,700	311,100	311,100	311,100	311,100
11	Revenue Sharing			165,000	323,800	323,800	323,800	323,800
12	Other Miscellaneous Income			943,000	0	0	0	0
13	FEMA Reimbursement			2,261,500	1,261,600	1,261,600	1,261,600	1,261,600
14	Interest from Bond Reserve Fund			293,000	298,000	302,000	302,000	302,000
15	Total Operating Revenue			146,552,100	151,751,400	155,991,200	156,443,600	156,459,400
16	Operation & Maintenance (a)			(72,132,400)	(103,623,900)	(106,214,700)	(108,869,900)	(111,591,700)
17	Provision for Claims			(1,257,100)	(1,288,500)	(1,320,700)	(1,353,700)	(1,387,500)
18	Provision for Doubtful Accounts			(10,314,700)	(7,445,500)	(6,120,200)	(4,601,300)	(4,601,300)
19	Net Operating Revenue			62,847,900	39,393,500	42,335,600	41,618,700	38,878,900
	Debt Service							
	Senior Lien Revenue Bonds							
20	Existing			(21,680,800)	(21,699,500)	(20,523,800)	(18,408,400)	(14,501,300)
21	Projected			0	(968,900)	(3,513,500)	(5,261,600)	(6,577,200)
22	Total Senior Lien Revenue Bonds			(21,680,800)	(22,668,400)	(24,037,300)	(23,670,000)	(21,078,500)
	SubordinateWIFIA Loans							
23	Projected			0	(5,700)	(827,400)	(1,863,300)	(2,193,100)
24	Total Subordinate WIFIA Loans			0	(5,700)	(827,400)	(1,863,300)	(2,193,100)
25	Gulf Opportunity Zone Act Loan			(6,235,200)	(4,136,600)	(3,641,300)	(3,641,300)	(3,641,300)
26	Total Debt Service			(27,916,000)	(26,810,700)	(28,506,000)	(29,174,600)	(26,912,900)
27	Other Non-Operating Revenue			6,820,200	873,700	873,700	873,700	873,700
28	Transfer to Construction			(15,000,000)	0	0	(12,000,000)	(11,000,000)
29	Transfer to Operating Reserve Fund			0	0	0	0	0
30	Net Annual Balance			26,752,100	13,456,500	14,703,300	1,317,800	1,839,700
31	Beginning of Year Cash Balance (b)			1,268,600	28,020,700	41,477,200	56,180,500	57,498,300
32	End of Year Balance			28,020,700	41,477,200	56,180,500	57,498,300	59,338,000
33	Beginning of Year Cash Balance (b)			1,268,600	28,020,700	41,477,200	56,180,500	57,498,300
34	Operating Reserve Fund			0	0	0	0	0
35	Net annual Balance			26,752,100	13,456,500	14,703,300	1,317,800	1,839,700
36	End of Year Balance			28,020,700	41,477,200	56,180,500	57,498,300	59,338,000
37	Days of O&M Cash on Hand			122	146	180	183	184

(a) Excludes non-cash expenses of depreciation and allowances, pension liability adjustment, and pension contributions.

(b) Reflects beginning of year balance in unrestricted and undesignated cash and cash equivalents and cash and cash equivalents designated for capital projects, less operating reserve requirement.

Line 30 indicates the estimated Net Annual Balance from operations remaining at the end of each year.

The balance of operating funds available at the beginning of year 2019, shown on Line 31, is comprised of the current cash assets and reflects a balance of $1,268,600. The End of Year Balance, which is exclusive of the operating reserve fund and rate stabilization fund, is shown on Line 32.

Lines 33 through 37 demonstrate that the Board is maintaining an operating reserve equal to at least 180 days of the previous year's operation and maintenance expense beginning in 2021.

As demonstrated in Tables 19 and 20, it is anticipated that current revenue sources will be adequate to readily finance both projected capital program requirements as currently scheduled and estimated future operation expenses of the Sewerage Department during the 2019-2023 study period examined herein, with the adopted 10 percent revenue increases in 2019 and 2020, and future revenue increases as indicated.

Bond Coverage Requirements

An additional consideration in measuring the adequacy of revenues is the provision of sufficient debt service coverage to meet the bond covenant requirements for the issuance of parity revenue bonds. The General Resolution provides that rates shall be maintained at levels which are expected to yield net revenues (as defined in the resolution) equal to at least 125 percent of the annual principal and interest requirement for senior debt and 110 percent for senior and subordinate debt in each fiscal year. The SWBNO's Financial Management Policy requires coverage at a minimum of 150 percent for senior debt and 125 percent for senior and subordinate debt.

The calculation of net revenue is shown on Lines 1 through 10 of Table 21. The ability of the Sewerage Department revenues to meet revenue bond coverage requirements is shown on Lines 11 through 15. As shown on Lines 13 and 15, the indicated projected revenue and revenue increases will provide sufficient net revenue to meet coverage requirements during the study period.

The General Resolution further prescribes that additional parity revenue bonds may be issued if net revenue from a previous test year (any 12 consecutive months of the last 24 months) is equal to at least 125 percent of the maximum annual principal and interest requirement for senior debt and 110 percent for senior and subordinate debt. For purposes of the additional bonds test, net revenue may be adjusted to reflect any increases not in effect during the selected test year but have been approved by the Board, Board of Liquidation and City Council and will go into effect within the following five years.

The results of the additional bonds test are shown on Lines 16 through 22 of Table 21. Lines 20 and 22 of the table indicate that with the magnitude of the adopted annual revenue increases, required minimum levels of coverage are met in each year with indicated coverage levels ranging from 144 percent to 327 percent.

Table 21 - Coverage Requirements

Line No.	Coverage Requirements	2018	2019	2020	2021	2022	2023
		$	$	$	$	$	$
	Projected Net Revenues						
1	Revenue Under Existing Rates (a)	114,614,100	142,155,600	148,910,500	148,910,500	148,910,500	148,910,500
2	Additional Revenue Under Proposed Rates		0	0	4,095,000	4,467,300	4,467,300
3	Interest Income	1,922,200	935,500	1,421,200	1,602,100	1,714,100	1,607,300
4	Plumbing and Inspection Fees	329,200	288,700	311,100	311,100	311,100	311,100
5	Revenue Sharing	330,000					
6	Other Miscellaneous Revenue	0	943,000	0	0	0	0
7	Operation & Maintenance Grants	834,300	2,261,500	1,261,600	1,261,600	1,261,600	1,261,600
8	Transfer from Rate Stabilization Fund		0	0	0	0	0
9	Operation & Maintenance (b)	(81,271,000)	(72,132,400)	(103,623,900)	(106,214,700)	(108,869,900)	(111,591,700)
10	Net Revenue	36,758,800	74,451,900	48,280,500	49,965,600	47,794,700	44,966,100
			4,428,700				
	Rate Covenant Coverage						
11	Projected Net Revenues	36,758,800	74,451,900	48,280,500	49,965,600	47,794,700	44,966,100
	Annual Debt Service						
12	Senior Debt	23,139,113	21,680,800	22,668,400	24,037,300	23,670,000	21,078,500
13	Coverage (c)	159%	343%	213%	208%	202%	213%
14	All Debt	29,374,293	27,916,000	26,810,700	28,506,000	29,174,600	26,912,900
15	Coverage (d)	125%	267%	180%	175%	164%	167%
	Additional Bond Coverage						
16	Preceding Year Projected Net Revenues		36,758,800	74,451,900	48,280,500	49,965,600	47,794,700
17	Future Additional Revenue		3,438,400	4,264,700	4,467,300	0	0
18	Adjusted Projected Net Revenues		40,197,200	78,716,600	52,747,800	49,965,600	47,794,700
	Maximum Debt Service						
19	Senior Debt		21,749,900	24,037,300	24,037,300	23,669,900	21,078,500
20	Coverage (c)		185%	327%	219%	211%	227%
21	All Debt		27,916,000	29,174,600	29,174,600	29,174,600	27,295,900
22	Coverage (d)		144%	270%	181%	171%	175%

(a) 2018 revenue reflects preliminary budget amount and does not reflect actual revenue collected which may be less than the amount shown.
(b) Reflects 2018 audited operating expenses for debt service coverage.
(c) The General Bond Resolution requires net revenue to equal or exceed 125% of debt service, however, the Board's Financial Management Policy aims for 150% coverage.
(d) The General Bond Resolution requires net revenue to equal or exceed 110% of debt service, however the Board's Financial Management Policy aims for 125% coverage.
(e) Net Revenue excludes transfers from the Rate Stabilization Fund and proceeds of Operation & Maintenance Grants.
(f) The General Bond Resolution requires net revenue to equal or exceed 100% of debt service.

Drainage Department

2018 DRAINAGE DEPARTMENT OPERATIONS

The Sewerage and Water Board has provided for the drainage needs of New Orleans since 1903. The City encompasses a saucer-shaped depression between the Mississippi River and Lake Pontchartrain on the East Bank and an area bordered by the river and adjoining wet lands on the West Bank. Prior to January 1, 1967, when the three-mill drainage tax became effective, the City of New Orleans was obligated to reimburse the Board for the cost of operating and maintaining drainage facilities.

In 1969, studies of projected capital improvement financing needs and revenue requirements indicated the need for additional sources of funds. Constitutional amendments, which would have provided the required funds from an additional three-mill ad valorem tax, were offered in 1970, and again in 1972. The State's electorate rejected both amendments; however, an additional six-mill ad valorem tax was approved April 16, 1977 and became effective January 1, 1978. Subsequently, a nine-mill property tax increase was approved May 16, 1981 and implemented January 1, 1982. The nine-mill tax, which is to be used for operation and maintenance as well as funding of capital improvements, was reauthorized in December 2016.

The Board is charged with operating, maintaining, repairing, and expanding the major drainage system located throughout the City. Revenues and expenditures related to the 2018 operations of the Drainage Department are discussed in the following paragraphs.

Revenues

Revenues that were available to the Drainage Department for operation and maintenance expenses, and capital additions, consisted of proceeds from the three-mill, six-mill, and nine-mill ad valorem tax, interest on investments, and miscellaneous income. Other revenues available for Drainage Department capital improvements included interest income and other miscellaneous sources.

A summary of historical revenues received by source is shown in Table 22 for the period 2014 through 2018. The historical revenue shown in Table 22 was developed from detailed records provided by Board Staff. Total revenue in 2018 reflects an increase of 1.5 percent over 2017 revenue.

Table 22 - Statement of Historical Revenue

Revenue Source	2014	2015	2016	2017	2018
	$	$	$	$	$
Two-mill Ad Valorem Tax	1,193	4,960	7,526	2,735	553
Three-mill Ad Valorem Tax	13,481,526	14,139,193	16,043,825	15,309,309	15,504,589
Six-mill Ad Valorem Tax	13,626,539	14,290,667	16,215,799	16,229,098	15,576,221
Nine-mill Ad Valorem Tax	20,425,388	21,421,102	23,762,398	23,881,671	23,570,261
Plumbing License and Inspection Fees	0	0	0	0	0
Interest Earned	203,832	202,579	253,938	244,250	142,751
Other	1,277,250	4,313,845	1,065,829	1,215,909	2,940,207
Total Revenue	49,015,728	54,372,346	57,349,315	56,882,973	57,734,583

Operation and Maintenance Expenses

Table 23 presents a summary of historical operation and maintenance expenses. Expenditures in 2018 decreased about 6.4% percent from 2017 expenditures. Historical operation and maintenance expenses shown in Table 23 do not include the non-cash portion of Provision for Claims as recorded in the Comprehensive Annual Financial Report.

Table 23 - Historical Operation and Maintenance Expense (a)

Description	2014	2015	2016	2017	2018
	$	$	$	$	$
Personal Services	16,652,900	21,339,600	20,619,800	20,928,800	20,180,500
Services & Utilities	11,163,000	8,642,100	9,992,400	10,824,700	6,264,600
Supplies & Materials	1,483,800	1,265,500	1,641,900	22,555,500	11,520,300
Special Current Charges	736,700	312,100	356,000	450,400	13,273,900
Furniture & Equipment	60,400	91,900	100,000	89,100	108,000
Repairs & Facility Maintenance	0	0	0	0	0
Total Operation and Maintenance	30,096,800	31,651,200	32,710,100	54,848,500	51,347,300

Capital Budget and Expenditures

Capital expenditures of the Drainage Department include the cost of replacements and improvements to pumping stations and canals and the Drainage Department's pro rata share of power projects and general budget costs.

The Drainage Department capital improvement expenditures for 2018 totaled $50,598,092. The Drainage Department's capital improvement expenditures for the year are shown in Table 24.

Table 24 - 2017 Capital Expenditures

C.P. #	Project	Actual Expenditures
		$
	Canals	
418	Normal Extensions & Replacements	19,994
439	Major Drainage Participation in DPW Projects	225,573
466	Louisiana Avenue Canal (SELA)	5,604,846
471	SELA Program Management	1,551,813
478	S. Claiborne-Lowerline to Monticello Street	1,195,599
480	FEMA Review of Change Orders-Drainage	(2,134,618)
497	Florida Ave. Canad - DPS#19 to Peoples Ave. (SELA-B)	616,112
498	Dwyer Intake Canal (St. Charles to Dwyer DPS) (SELA-A)	18,990
499	Jefferson Avenue Canal	449,553
	Total Drainage Canals	7,547,860
	Pumping Stations	
511	Normal Extensions & Rep./Stations	9,878,743
535	DPS #6 Improvements	436,345
575	Drainage Hurricane Recovery Bonds	1,420,692
	Total Drainage Pumping Stations	11,735,780
	Power Projects and General Budget	
600	Drainage Share of Power Projects	24,758,349
800	Drainage Share of General Budget Items	6,556,104
	Total Power Projects and General Budget	31,314,453
	Total Drainage Department	50,598,092

Summary of Operations

The following tabulation shows a summary of receipts and expenditures of the Drainage Department during 2018:

Total Revenues	$57,734,583
Operation and Maintenance Expense	-51,347,300
Claims	9,656,464
Debt Service Payments	-2,028,550
Revenue Primarily Available for Capital Expenditures [a]	**14,015,197**

PROPOSED CAPITAL IMPROVEMENT PROGRAM

Table 25 presents a summary of the projected major capital improvement program for the period 2019 through 2023. Table 25 is based on the Board's amended 2019 Adopted Operating and Capital Budget and the 10-Year Capital Improvement Plan for 2020 - 2029. The five-year major capital improvement program costs are expected to total $245,648,300. The proposed annual capital expenditures for the drainage system include $50,909,000 for the Drainage Department's share of power projects and $49,576,000 for its share of general budget items.

Table 25 - Projected Capital Improvements (a)

Project	2019	2020	2021	2022	2023	Total
	$	$	$	$	$	$
Engineering						0
Canals		700,000	250,000	250,000	0	1,200,000
Facilities	24,700	1,200,000	800,000	600,000	600,000	3,224,700
Legal		1,250,000	4,000,000	500,000	0	5,750,000
Normal Extensions	13,391,900	5,162,600	34,764,000	31,721,700	3,248,400	88,288,600
Power						0
SELA	11,000,000	7,300,000	7,800,000	7,800,000	12,800,000	46,700,000
Other						0
Drainage Share of Equipment	680,000	2,890,000	6,511,000	5,440,000	5,100,000	20,621,000
Drainage Share of Facilities	6,972,700	3,788,800	535,100	6,681,000	544,000	18,521,600
Drainage Share of Hardware	160,100	885,000	276,100	235,300	189,200	1,745,700
Drainage Share of Other		680,000	0	0	0	680,000
Drainage Share of Power	5,187,900	4,752,100	3,074,000	15,900,000	21,995,000	50,909,000
Drainage Share of Software	170,000	2,855,000	2,550,200	805,000	437,500	6,817,700
Drainage Share of Normal Extensions		170,000	340,000	340,000	340,000	1,190,000
Total Major Capital Improvements	37,587,300	31,633,500	60,900,400	70,273,000	45,254,100	245,648,300

(a) The improvements for 2019-2023 are based on the Board's Adopted 2019 Operating and Capital Budgets and 10-Year Capital Improvement Plan for Fiscal Years 2020-2029.

The Sewerage and Water Board is currently receiving funds from the COE sponsored and congressionally authorized SELA Project. This funding will allow additional construction of projects which were identified in the 1970s, but which have not been completed because of funding limitations. The identified projects are to be funded either 100 percent from federal funds or 65 percent from federal funds and 35 percent from local funds. The payback period for the local share is 30 years and is anticipated to begin in 2020.

ABILITY TO FINANCE PROPOSED CAPITAL EXPENDITURES

This section of the report analyzes the adequacy of projected revenues to finance the proposed capital improvements shown in Table 25.

Operating Revenues

Projected operating income of the drainage system is shown in Table 26. Projections include proceeds from the three-mill, the six-mill, and the nine-mill ad valorem tax and other revenue and are based on the 2018 assessed taxable value. It is assumed that the projected revenue from the ad valorem taxes will remain constant beginning in 2020 due to the roll-back provisions of Louisiana state law.

Table 26 - Projected Operating Revenue

Year	Ad Valorem Tax Revenue			Other	Total
	Three-Mill	Six-Mill	Nine-Mill		
	$	$	$	$	$
2019	15,316,900	16,149,000	24,206,700	729,600	56,402,200
2020	18,013,000	19,022,700	28,513,900	729,600	66,279,200
2021	18,013,000	19,022,700	28,513,900	729,600	66,279,200
2022	18,013,000	19,022,700	28,513,900	729,600	66,279,200
2023	18,013,000	19,022,700	28,513,900	729,600	66,279,200

The projection of millage revenue for 2019 through 2023 is based on 4.66, 4.71, and 7.06 mills for three-mill, six-mill, and nine-mill taxes, respectively.

Other Revenue Sources

Other sources of income include interest earned from the investment of funds held for future use; sales of three-mill, six-mill, and nine-mill ad valorem tax bonds; and participation by others. Projections of interest income, which vary according to the balance of funds held for future use, are shown in a later section of this report.

Operation and Maintenance Expenses

A summary of projected operation and maintenance expenses for the period 2019 through 2023 is shown in Table 27. Projected expenses for 2019 are based on December 2019 year-to-date expenses which reflect a decrease of approximately 31.5 percent from the adopted budget. Projections of future operating and maintenance expenses for the study period are based on the Board's requested 2020 operating budget, which reflects an increase of approximately 81.9 percent over December 2019 year-to-date expenses, and allowances for inflationary factors.

Table 27 - Projected Operation and Maintenance Expense

Description	2019 (a)	Adjusted 2019 (b)	2020 (c)	2021	2022	2023	2024
	$	$	$	$	$	$	$
Personal Services	22,064,400	15,114,386	27,488,800	28,176,000	28,880,400	29,602,500	30,342,500
Services & Utilities	6,849,400	4,691,924	8,533,300	8,746,600	8,965,300	9,189,400	9,419,200
Supplies & Materials	12,595,700	8,628,210	15,692,400	16,084,700	16,486,800	16,898,900	17,321,400
Special Current Charges	14,513,000	9,941,584	18,081,000	18,533,000	18,996,400	19,471,300	19,958,100
Furniture & Equipment	118,100	80,900	147,100	150,800	154,600	158,400	162,400
Repairs & Facility Maintenance	0	0	0	0	0	0	0
Total Operation and Maintenance	56,140,600	38,457,004	69,942,600	71,691,100	73,483,500	75,320,500	77,203,600

(a) Represents the Adopted 2019 Operating and Capital Budgets
(b) Represents December YTD Actuals
(c) Represented the Requested 2020 Operating Budget.

Debt Service Requirements

Future debt service requirements of the Drainage Department are made up of principal, interest, and reserve fund payments for currently outstanding and future drainage revenue bond issues. As of December 31, 2018, outstanding debt obligations consisted of $7,665,000 of Drainage Revenue Bonds, Series 2014.

It is assumed that no future debt will be issued during the 2019 – 2023 study period.

Adequacy of Revenues to Finance Proposed Capital Improvements

Total revenue requirements for the Drainage Department recognized for purposes of this report include operation and maintenance expense, allowance for claims, debt service costs on major capital improvements financed through the sale of bonds, and expenditures for capital improvements not financed from bond proceeds. Table 28 examines the financing of the major capital improvement program and Table 29 summarizes the financing of operation and maintenance expense, debt service costs on outstanding and proposed bonds, and the transfer of operating funds for major capital improvement financing.

Capital Projects Funding

Table 28 presents the major capital improvement financing plan which summarizes the projected source and application of funds over the five-year study period. The amount of Funds Available at Beginning of Year, shown on Line 1, is a deficit of $3,180,500. This amount is based on audited data provided by the Board.

Projected revenue bond proceeds are shown on Line 2; however, it is projected that the Board will not have the capacity to issue additional bonds during the study period.

Financing of the major capital improvement program anticipates the transfer of a total of $18,000,000 of operating revenue as shown on Line 4. Other sources of funds available to meet major capital improvement expenditures are Participation by Others and interest income. Participation by Others, as shown on Line 4 includes anticipated funding by FEMA, HMCP, grants and the Fair Share Program. Interest earnings recognize an assumed 1.0 percent average annual interest rate and are shown on Line 5. Line 6 of the table shows the projected major capital improvement funds available each year.

Table 28 - Capital Improvement Program Financing

Line No	Description	Fiscal Year Ending December 31, 2019	2020	2021	2022	2023	Total
		$	$	$	$	$	$
1	Funds Available at Beginning of Year	(3,180,500)	(3,763,100)	(3,763,100)	(3,763,100)	(3,763,100)	(3,180,500)
2	Revenue Bond Proceeds	0	0	0	0	0	0
3	Operation Fund Transfers	18,000,000	0	0	0	0	18,000,000
4	Participation by Others (a)	11,000,000	19,542,900	45,658,000	56,452,800	38,771,000	171,424,700
5	Interest Income	0	0	0	0	0	0
6	Total Funds Available	25,819,500	15,779,800	41,894,900	52,689,700	35,007,900	186,244,200
7	Obligated Contracts & Capital Jobs	(18,582,600)	0	0	0	0	(18,582,600)
8	Major Capital Additions	(37,587,300)	(32,266,200)	(63,360,800)	(74,574,300)	(48,984,500)	(256,773,100)
9	Deferred Capital Improvements	26,587,300	12,723,300	17,702,800	18,121,500	10,213,500	85,348,400
10	Bond Issuance Expense	0	0	0	0	0	0
11	Revenue Bond Reserve Fund	0	0	0	0	0	0
12	Total Application of Funds	(29,582,600)	(19,542,900)	(45,658,000)	(56,452,800)	(38,771,000)	(190,007,300)
13	End of Year Balance	(3,763,100)	(3,763,100)	(3,763,100)	(3,763,100)	(3,763,100)	(3,763,100)

(a) Includes funding from FEMA, HMCP, Grants, and Fair Share Program.

As of December 31, 2018, the Board had $18,582,600 obligated for open contracts and capital jobs as shown on Line 7 of Table 28. Line 8 show the projected Major Capital Additions to be funded as shown in Table 25. Due to constraints on revenue, it is anticipated that the capital projects that are not funded through the Participation of Options, on Line 4, will need to be deferred until an additional revenue source has been identified. This deferral is shown on Line 9.

The Total Application of Funds is shown on Line 12 of Table 28. The net End of Year Balance is shown on Line 13.

Operating Fund

Money deposited in the Drainage System Fund is obtained primarily from the three-mill, six-mill, and nine-mill ad valorem tax as shown on Lines 1 through 3 of Table 29.

Other revenue available for system operations is shown on Line 4. Miscellaneous revenue includes rental income, gain or loss on the sale of assets and other miscellaneous income. Interest Income available to the operating fund, shown on Line 5, is estimated to be 1.0 percent of the average of the beginning and end of year Net Annual Balance, except as the average is affected by identifiable nonrecurring major receipts, transfers, or expenditures during the year. Revenue from FEMA shown on Line 6 is based on 2019 and 2020 budget. Total Operating Revenue is shown on Line 7 of Table 29.

Operation and Maintenance expense, previously projected in Table 27, is shown on Line 8 of Table 29. Lines 9 and 10 show the estimated allowance for claims and bad debt expense which is assumed to be 0.2 percent of projected revenue. Projected Net Operating Revenue from system operations is shown on Line 11.

Table 29 - Analysis of Ability of Forecasted Revenue to Finance Projected Revenue Requirements

Line No	Description	Fiscal Year Ending December 31, 2019	2020	2021	2022	2023
		$	$	$	$	$
1	Three-Mill Ad Valorem Tax Revenue (4.66 Mills)	15,316,900	18,013,000	18,013,000	18,013,000	18,013,000
2	Six-Mill Ad Valorem Tax Revenue (4.71 Mills)	16,149,000	19,022,700	19,022,700	19,022,700	19,022,700
3	Nine-Mill Ad Valorem Tax Revenue (7.06 Mills)	24,206,700	28,513,900	28,513,900	28,513,900	28,513,900
4	Other Miscellaneous Income	0	0	0	0	0
5	Interest Income	8,300	8,400	0	0	0
6	FEMA Reimbursement	904,600	504,600	504,600	504,600	504,600
7	Total Operating Revenue	56,585,500	66,062,600	66,054,200	66,054,200	66,054,200
8	Operation & Maintenance (a)	(38,457,000)	(69,942,600)	(71,691,100)	(73,483,500)	(75,320,500)
9	Provision for Claims	(630,900)	(646,700)	(662,900)	(679,500)	(696,500)
10	Provision for Doubtful Accounts	(11,700)	(13,100)	(13,100)	(13,100)	(13,100)
11	Net Operating Revenue	17,485,900	(4,539,800)	(6,312,900)	(8,121,900)	(9,975,900)
12	Debt Service					
13	Senior Lien Revenue Bonds					
14	Existing	(2,028,550)	(2,035,950)	(2,039,100)	(2,045,000)	0
15	Projected	0	0	0	0	0
16	Total Senior Lien Revenue Bonds	(2,028,550)	(2,035,950)	(2,039,100)	(2,045,000)	0
17	Gulf Opportunity Zone Act Loan	(407,600)	0	0	0	0
18	SELA Capital Repayment	(2,341,000)	(7,611,800)	(8,460,400)	(8,460,400)	(8,460,400)
19	Total Debt Service	(4,777,150)	(9,647,750)	(10,499,500)	(10,505,400)	(8,460,400)
20	Other Non-Operating Revenue	18,984,100	512,900	512,900	512,900	512,900
21	Transfer to Construction	(18,000,000)	0	0	0	0
22	Transfer to Operating Reserve Fund	0	0	(470,600)	(215,600)	(221,000)
23	Net Annual Balance	13,692,850	(13,674,650)	(16,770,100)	(18,330,000)	(18,144,400)
24	Beginning of Year Cash Balance (b)	(6,770,200)	6,922,650	(6,752,000)	(23,522,100)	(41,852,100)
25	End of Year Balance	6,922,650	(6,752,000)	(23,522,100)	(41,852,100)	(59,996,500)
26	Beginning of Year Cash Balance (b)	(6,770,200)	15,075,150	9,553,000	1,406,000	(8,085,400)
27	Operating Reserve Fund	8,152,500	8,152,500	8,623,100	8,838,600	9,059,600
28	Net annual Balance	13,692,850	(13,674,650)	(16,770,100)	(18,330,000)	(18,144,400)
29	End of Year Balance	15,075,150	9,553,000	1,406,000	(8,085,400)	(17,170,200)
30	Days of O&M Cash on Hand	143	50	7	(40)	(83)
	Debt Service Coverage					
	Reflecting Nine-Mill Ad Valorem Tax Revenue Only					
31	Annual Test (c)	731.3%	858.3%	857.0%	854.5%	N/A
32	Additional Bonds Test (d)	725.4%	854.5%	854.5%	854.5%	N/A
	Reflecting All Ad Valorem Tax Revenue					
33	Annual Test (c)	1193.3%	1400.5%	1398.4%	1394.3%	N/A
34	Additional Bonds Test (d)	1183.7%	1394.3%	1394.3%	1394.3%	N/A

(a) Excludes non-cash expenses of depreciation and allowances, pension liability adjustment, and pension contributions.
(b) Reflects beginning of year balance in unrestricted and undesignated cash and cash equivalents and cash and cash equivalents designated for capital projects, less operating reserve requirement.
(c) The General Bond Resolution requires Nine-Mill Ad Valorem Tax Revenue to equal or exceed 100% of annual debt service.
(d) The General Bond Resolution requires Nine-Mill Ad Valorem Tax Revenue to equal or exceed 133% of maximum annual debt service.

Lines 13 through 16 present debt service requirements on currently outstanding and proposed senior revenue bonds. Existing debt includes the Series 2014 bonds. As previously mentioned, it is projected that the Board will not have the capacity to issue additional bonds during the study period.

In July of 2006 the Board entered into a Cooperative Endeavor Agreement with the State of Louisiana to secure proceeds from the State's Gulf Opportunity Tax Credit Bond Loan Program to assist in payment of debt service requirements from 2006 through 2008. The Board has borrowed $77,465,247 on this agreement. Payments for the drainage portion of principal and interest began in July 2012 and are shown on Line 17 of Table 35. Starting in 2020, the Sewerage Department will pay the total payment, include the amounts for the Water Department and Drainage Department.

Line 18 reflects the estimated SELA repayments that will begin in 2020. Total debt service is shown on Line 19.

Anticipated non-operating revenue is shown on Line 20. This amount includes revenue from the Air Share Program in 2019.

Line 21 reflects the projected transfer of accumulated net earnings from system operations to assist in major capital financing. Typically, such accumulated net earnings may be used to help recover portions of the annual costs of system operations or to assist in major capital improvement financing.

The SWBNO's Financial Management Policy requires an Operating Reserve Fund of not less than 45 days of the previous year's operation and maintenance expense. Line 22 indicates the projected annual transfers necessary to meet this requirement throughout the study period.

Line 23 indicated the estimated Net Annual Balance from operations remaining at the end of each year.

The balance of operating funds available at the beginning of the year 2019, shown on Line 24, is comprised of current cash assets and reflects a balance of deficit of $6,770,200. The End of Year Balance, which is exclusive of the operating reserve fund, is shown on Line 25 and drops to a deficit of $6,752,000 in 2020 which indicates that the existing source of revenue for the Drainage Department will not be sufficient to fund operation and maintenance expense and required debt service payments starting in 2020.

Lines 26 through 30 demonstrate that the Board is not able to maintain an operating reserve equal to at least 45 days of the previous year's operation and maintenance expense starting in 2021.

Bond Coverage Requirements

A requirement of the Drainage Bond Resolution provides that revenues derived from the nine-mill ad valorem tax should provide an amount sufficient to provide for the interest and principle payment on the Series 2014 bonds. As shown on Line 31 of Table 29 the projected revenue from the nine-mill ad valorem tax will provide sufficient revenue to meet coverage requirements on existing debt during the study period.

The Drainage Bond Resolution also provides that additional parity bonds may be issued, but only after certain conditions have been met. One condition is that the revenues derived from the nine-mill ad valorem tax for the most recently completed calendar year prior to the year of issuance are equal to at

least one and one-third (1-1/3) times the maximum debt service on all bonds outstanding and the additional bonds.

Due to the constraints to meet operation and maintenance expense and required debt service payments on existing debt during the study period, the Drainage Department does not have the revenue capacity to issue additional debt. In addition, the revenue from the nine-mill ad valorem tax does not provide the debt capacity needed to fund the five-year capital improvement program; therefore, a portion of capital improvements must be deferred. Therefore, in order to completely fund the five-year capital program, an alternative funding source would need to be identified for the Drainage Department.

Black & Veatch suggests that when a new funding source is identified, the Board work with its bond counsel and financial advisor to refund all outstanding debt at that time and issue new debt reflecting a general bond resolution that includes the new funding source and all other revenue in the coverage calculation and reflects covenants more consistent with the 2014 water and sewerage resolutions. It is anticipated that the Board will have the capacity to debt finance more projects under the new resolution.

Appendix

Table 30 - Assessment of East Bank Sewage Stations

NO.	DATE	FACILITY NAME	LOCATION	STATUS
1	8/30/19	Chickasaw	Chickasaw at Metropolitan	Two (2) pumps total; both operational.
2	8/30/19	K-Mart	Desire at Gentilly	Two (2) pumps total; one (1) in service: • Pump #2 has been out of service for several months. The discharge valve needs to be replaced. Repair time is currently unknown.
3	8/30/19	Station 23	4500 Mithra	Two (2) pumps total; both operational.
4	8/28/19	Station 17	4975 Spain at Selma	Two (2) pumps total; both operational • There is a water leak in the station that is coming from the suction line under the wet well. They believe it is from a fresh water source or break in the main. It has only been occurring for 2-3 days. Further investigation is required for repair solution. • This is a gravity flow station and does not require an Emergency Discharge Connection (EDC).
5	8/28/19	Station 22	5705 Perlita	Two (2) pumps total; both operational.
6	8/29/19	Station 19	3730 Jumonville at Milton	Two (2) pumps total; both operational.
7	8/28/19	Station 21	6670 Memphis At Filmore	Two (2) pumps total; both operational.
8	8/28/19	Station 18	Vicksburg at Florida	Two (2) pumps total; both operational.
9		City Park	5701 Marconi Drive	Two (2) pumps total; both operational.
10	8/28/19	Station 20	328 37th Street	Two (2) pumps total; both operational.
11	8/28/19	Station 4	5899 Fleur de Lis	Two (2) pumps total; both operational. • There is a crew on site painting the pump motors, EDC, and other exposed metals, along with doing general cleaning at the station.
12	8/28/19	Lakewood South	Country Club Drive near Marconi	Two (2) pumps total; both operational. • No placard at this location. • This is a gravity flow station.
13	8/29/19	Station 6	242 S Solomon at Palmyra	Three (3) pumps total; all operational. • No placard at this location.
14	8/29/19	Station 3	8720 Olive near Eagle	Two (2) pumps total; both operational.
15	8/29/19	Station 1	7336 Cohn	Two (2) pumps total; both operational. • Older station that is planned to be rebuilt in future. • No placard at this location.
16	8/29/19	Station 14	4000 Clara	Two (2) pumps total; both operational. • No emergency discharge connection.
17	8/29/19	Station 5	3912 Erato St	Two (2) pumps total; both operational.

NO.	DATE	FACILITY NAME	LOCATION	STATUS
18	8/29/19	Station 15	2431 Palmyra near Rocheblave	Three (3) pumps; each operational. • No placard at this location.
19	8/29/19	Station 8	Corner of N. Broad and Toulouse	Two (2) pumps total; both operational. • This is a brand-new station that was turned over to the S&WB within the past year.
20	8/29/19	Station 9	2540 Annette at Law	Two (2) pumps total; both operational.
21	8/26/19	Station 16	3751 N Miro at Pauline	Two (2) pumps total; both operational.
22	8/26/19	Station 24	5027 N Tonti at Forstall	Two (2) pumps total; both operational.
23	8/26/19	Station 25	2245 Charbonnet	Two (2) pumps total; one (1) in service. • Pump #1 out because the vacuum pump is not functioning properly. It has been out for a week and the repair time is unknown.
24	8/26/19	Station 26	2244 St Maurice at Tonti	Two (2) pumps total; one (1) in service. • Pump #1 out because the flapper is damages and needs to be replaced. Part has been ordered and should be repaired in the next few weeks.
25	8/26/19	Station B	4725 St Claude Avenue	Two (2) pumps total; both operational.
26	8/26/19	Southern Scrap	Southern Scrap Rd	Two (2) pumps total; one (1) in service. • Pump #1 is out.
27	8/26/19	France & Florida	Harbor Rd	Two (2) pumps total; both operational.
28	8/26/19	MECO	2701 France Road	Two (2) pumps total; both operational. • No placard at this location.
29	8/26/19	American Marine	3855 France Road	Two (2) pumps total; both operational.
30	8/26/19	Victoria @ Gentilly	3620 Victoria	Two (2) pumps total; both operational. • No placard at this location.
31	8/20/19	Dodt	8118 Chef Menteur Highway	Two (2) pumps total; both operational. • No placard at this location.
32	8/20/19	Plum & Orchid	7300 Chef Menteur Highway	Two (2) pumps total; both operational. • No placard at this location.
33	8/20/19	Wilson	7709 Wilson Avenue	Two (2) pumps total; both operational.
34	8/20/19	Crowder	5500 Block of Crowder	Two (2) pumps total; both operational.
35	8/20/19	Castle Manor	4950 Gawain at Dwyer	Two (2) pumps total; both operational.
36	8/20/19	Cerise	5001 Cerise	Two (2) pumps total; one (1) in service. • Pump #2 is out because sewer is coming through the wall at the lead joint at the pipe. S&WB will need to excavate to get to point of repair. This pump has been out for 2 or 3 weeks and may be repaired in the next couple months.

NO.	DATE	FACILITY NAME	LOCATION	STATUS
37	8/20/19	Lakewood Terrace	5057 Warren Drive	Two (2) pumps total; both operational.
38	8/20/19	McCoy	McCoy at Gentilly	Two (2) pumps total; both operational. • No emergency discharge connection at station.
39	8/20/19	Amid	6800 Almonaster Road	Two (2) pumps total; both operational.
40	8/20/19	Lake Forest	10451 Lake Forest Blvd	Two (2) pumps total; both operational.
41	8/20/19	Wright Road	Wright Road at Lake Forest	Two (2) pumps total; both operational. • No emergency discharge connection at station.
42	8/20/19	Bullard	5501 Bullard Road	Two (2) pumps total; both operational. • No placard at this location.
43	8/26/19	Pines Village	6155 Dwyer Road at Foch	Two (2) pumps total; both operational.
44	8/26/19	America	6789 Dwyer Road at Westlake	Two (2) pumps total; both operational.
45	8/20/19	Station A	1321 Orleans Avenue	Six (6) pumps total; all operational.
46	8/20/19	Shorewood	14441 Morrison Road	Two (2) pumps total; both operational.
47	8/20/19	Briarwood	13701 Morrison Road	Two (2) pumps total; both operational.
48	8/20/19	Liggett	12501 Morrison Road	Two (2) pumps total; both operational.
49	8/20/19	Berg	11501 Morrison Road	Two (2) pumps total; both operational.
50	8/20/19	Weber	10141 Morrison Road	Two (2) pumps total; both operational.
51	8/20/19	Burke	9001 Morrison Road	Two (2) pumps total; one (1) in service. • Pump #2 is off because the flap is not functioning properly. Machinist is making the repairs now and the pump should be back in service by next week.
52	8/20/19	Lawrence	8001 Morrison Road	Two (2) pumps total; both operational. • No placard at this location.
53	8/20/19	Lamb	6450 Morrison Road	Two (2) pumps total; one (1) in service: • Pump #2 is out of service because the flap is bad. Should be repaired in a couple weeks after the machinist is done at the Burke station.
54	8/16/19	Gentilly Oaks	5000 Papania Road at Vienna	Two (2) pumps total; one (1) in service. • Pump #2 is out of service because it is making a strange noise. To not risk anything, the pump is off until further investigation.
55	8/16/19	Eastover	6051 Eastover Drive	Two (2) pumps total; both operational.
56	8/16/19	Paris Road	Dwyer West of Paris Road	Two (2) pumps total; both operational. • No placard at this location.
57	8/16/19	Venetian Isles #2	20711 Old Spanish Trail	Two (2) pumps total; one (1) in service. • Pump #1 is not in service because a wooden board was sucked into the pump and broke a check valve

NO.	DATE	FACILITY NAME	LOCATION	STATUS
				this week. Crew is discussing a plan of action to bring the pump back in service. Repair time is unknown.
58	8/16/19	Industrial Parkway	4200 Industrial Parkway	Two (2) pumps total; both operational.
59	8/16/19	Blvd X	4433 Chef Menteur Highway	Two (2) pumps total, both operational.
60	8/16/19	Alcee Fortier	Alcee Fortier Blvd at the Levee	Two (2) pumps total; both operational.
61	8/16/19	Willow Brook	Willowbrook off of Michoud	Two (2) pumps total; both operational.
62	8/16/19	Oak Island	14201 Michoud Blvd	Two (2) pumps total; one (1) in service. • Pump #2 has been out for about 6 months due to the motor pulling high amps. Further investigation is required to find a solution.
63	8/16/19	Village de Lest	11324 Dwyer	Two (2) pumps total; one (1) in service. • Pump #1 is out due to a bent plate in the pump housing unit. The pump has been out for about a month and should be repaired once the machinist becomes available.
64	8/16/19	Michoud	4400 Michoud Blvd	Two (2) pumps total; one (1) in service. • Pump #2 is not pumping properly due to a large sinkhole in the rear of the station. The pump has been off for about a month. More investigating is required to determine how to fill the sinkhole and turn the pump back on.
65	8/16/19	Folgers	14601 Gentilly Blvd	Two (2) pumps total; one (1) in service. • Pump #1 has been out for about a year. The need to replace the check valve, discharge gate valve, and the station isolation valve. There is no timetable for repair.

Table 31 - Assessment of West Bank Sewage Stations

NO.	DATE	FACILITY NAME	LOCATION	STATUS
1	8/14/19	Memorial	2501 Memorial Park Dr.	Two (2) pumps total; both operational.
2	8/14/19	Garden Oaks	3201 Memorial Park Dr.	Two (2) pumps total; both operational.
3	8/14/19	Park Timbers	4100 Lennox Blvd.	Two (2) pumps total; one (1) in service. • Pump #2 is out because the motor blew up after the station flooded due to a sump pump failing. It has been out for 2 or 3 months and should be back in service within a month.
4	8/14/19	Tall Timbers	3800 Tall Pines Dr.	Two (2) pumps total; one (1) in service. • Pump #1 is out of because the volute has a crack in it and the discharge valve needs to be replaced. A diver will be required to make the repairs. No timetable for the repair; it has been out for 6 months.
5	8/14/19	Forest Isle	5631 West Forest Park Dr.	Two (2) pumps total; both operational. • No emergency discharge connection at this station.
6	8/14/19	Blair	3800 Blair St	Two (2) pumps total; both operational.
7	8/14/19	Aurora	6000 Carlisle Ct	Two (2) pumps total; both operational. • No emergency discharge connection at this station.
8	8/14/19	English Turn I	2201 Stanton Rd.	Two (2) pumps total; both operational.
9	8/14/19	English Turn II	123 ½ Oak Alley	Two (2) pumps total; one (1) in service. • Pump #2 has a motor that has burned up. The motor is in the mechanic's shop for repair and should be back in service in a couple weeks.
10	8/14/19	English Turn III	400 English Turn Parkway	Two (2) pumps total; both operational.
11	8/14/19	Lower Coast	3700 Old Woodland	Two (2) pumps total; both operational. • No emergency discharge connection at this station.
12	8/14/19	Woodland	4150 Woodland Dr.	Two (2) pumps total; one (1) in service. • Pump #1 is out because the flap is not operating properly. Pump should be repaired and back in service in a couple weeks. • No emergency discharge connection at this station. • No placard at this location.
13	8/14/19	Eton	3440 Eton St	Two (2) pumps total; both operational.
14	8/14/19	Huntlee	3201 Huntlee Dr.	Two (2) pumps total; one (1) in service. • Pump #1 is not in service. Entire pump needs to be re-built and is in the mechanic's shop now for repair. Pump should be back in service in two weeks to one month.

NO.	DATE	FACILITY NAME	LOCATION	STATUS
15	8/14/19	Holiday	2799 Holiday Dr.	Two (2) pumps total; both operational.
16	8/14/19	Bridge Plaza	2914 Vespasian St	Two (2) pumps total; both operational.
17	8/14/19	Horace	3301 Lawrence St	Two (2) pumps total; both operational.

Table 32 - Assessment of East Bank Drainage Stations

NO.	DATE	FACILITY NAME	LOCATION	STATUS	NOTES
1	8/7/19	Station 1	2501 S. Broad St.	Eleven (11) pumps total, 2 are constant duty; all operational.	No debris screens to prevent trash from entering pumps at this station. All debris is moved with the storm water to the next station.
2	8/7/19	Station 6	345 Orpheum	Fifteen (15) pumps total; fourteen (14) in service.	• Some vegetation appearing at the discharge basin and the debris screens. • At Pump A, maintenance crews are doing repair to the mortus windings and checking the bolts. This pump will only be out today, and the crew will do the same work on Pump B tomorrow. • Constant Duty #1 has problem with shaft. This pump has been out since April of this year and is expected to be repaired in about 2 weeks.
3	8/7/19	I-10 Station	I-10 Service Road	Four (4) pumps total; all operational.	Anti- reverse ratchets at the three vertical pumps need to be replaced. Pumps are still operational, and the repair time is currently unknown.
4	8/8/19	Station 7	5741 Orleans Ave at Marconi Dr.	Five (5) pumps total; all operational.	
5	8/8/19	Canal Blvd	5500 Canal Blvd	Three (3) pumps total; all operational.	
6	8/7/19	Station 2	444 N. Broad St.	Six (6) pumps total, 2 are constant duty; all operational.	
7	8/7/19	Station 3	2251 N. Broad St.	Nine (9) pumps total, 4 are constant duty; all operational.	• The “lake” gate will not seal properly and must remain open. As a result, the Marigny gate must stay close at all times. • The full-grown tree amongst other vegetation in the basin needs to be removed as well. • Transformer #5 is being replaced so the exhaust fans at Pump D are not working. The crew is using two portable fans attached to the exhaust fan as a substitute. It has been out for three to four months and should be replaced soon.
8	8/7/19	Pritchard	2901 Monticello	Two (2) pumps total; both operational.	This is an unmanned station.

NO.	DATE	FACILITY NAME	LOCATION	STATUS	NOTES
9	8/7/19	Oleander	9400 Oleander	Three (2) pumps total; all operational.	This is an unmanned station.
10	8/8/19	Station 4	5700 Warrington Dr.	Six (6) pumps total; four (4) pumps in service.	
11	8/7/19	Station 12	Robert E Lee and Pontchartrain Blvd	One (1) pump total; one (1) in service.	The pump at this station is having issues with the hydraulic vacuum breaker. No timetable set for repair.
12	8/8/19	Station 16	Danube Rd. at Wales	Four (4) pumps total; all operational.	This is an unmanned station.
13	8/8/19	Station 10	Citrus 9600 Haynes	Four (4) pumps total; all operational.	This is an unmanned station.
14	8/8/19	Station 14 (Jahnke)	Oneida at Haynes	Four (4) pumps total; all operational.	Pump #2 is out because the motor is being replaced. Pump has been out for about two months and should be repaired in the next month or two.
15	8/8/19	Grant	Grant St. at Gentilly Blvd.	Six (6) pumps total; all operational.	This is an unmanned station.
16	8/8/19	Elaine	3100 Elaine St.	Two (2) pumps total; both operational.	This is an unmanned station outdoors.
17	8/8/19	Station 17 (D)	2801 Florida Ave.	Two (2) pumps total; both operational.	Pump E is out because the motor needs to be repaired. S&WB has been having problems with this pump for months. It is out until further funding is received to replace or repair again. The bathroom on the second level is being remodeled.
18	8/8/19	Station 5	4841 Florida Ave.	Eight (8) pumps total; all operational.	No placard at this location. Two vertical pumps housed in separate building. The feeder is out of service at this station.
19	8/8/19	Station 19	4500 Florida Ave.	Five (5) pumps total; all operational.	
20	8/8/19	Station 20 (AMID)	6300 Intercostal Waterway at Terminal Rd.	Two (2) pumps total; both operational.	This is an unmanned station. Debris collected from the screens needs to be hauled away.
21	8/8/19	Maxent	Alcee Fortier	Two (2) pumps total; both operational.	Overgrown vegetation is causing severe blockage at suction basin.
22	8/8/19	Station 15	Industrial Parkway	Three (3) pumps total; all operational.	Overgrown vegetation is causing severe blockage at suction basin. This is an unmanned station.
23	8/8/19	Dwyer	5801 Dwyer Rd.	Three (3) pumps total; all operational.	This is an unmanned station.

Table 33 - Assessment of West Bank Drainage Stations

	DATE	FACILITY NAME	LOCATION	STATUS	NOTES
1	8/13/19	Station 11	5301East Sixth St.	Five (5) pumps total; all operational.	3 out of 4 debris screens are not working.
2	8/13/19	Station 13	4201 Tall Spruce Dr.	Seven (7) pumps total; five (5) pumps operational.	Pumps #4 and #5 are out of service while they are being repaired or replaced for something regarding asbestos. Repair time unknown.

Power Master Plan

Sewerage and Water Board of New Orleans

Power Master Plan Report

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Power Master Plan

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A	01/2020	Draft for SWBNO Review	SLR	CRF	AG
B	03/2020	Draft Final Report	SLR	CRF	AG

Contents

Appendixes

Tables

Figures

Abbreviations, Acronyms, and Definitions

CEMS	continuous emissions monitoring system
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
CP	Contract Package
CTG	Combustion Turbine Generator - An electric generator coupled to a combustion turbine as the prime mover - Current units are CTG-5 (25 Hz) and CTG-6 (60 Hz).
CWP	Carrollton Water Treatment Plant
Data Historian	Electronic data collection and storage system
Diesel Engine Generator	Backup diesel generators located around the SWBNO power network. These units have blackstart capabilities due to local fuel oil storage on site.
Diversity Factor	Percentage of maximum demand compared to maximum generating capacity.
DPS	Drainage Pump Station
Drainage Pump Station Demand	Power required by pumps at drainage pump stations located at various locations throughout the city.
Dual Fuel	Ability of equipment to operate on two types of fuel. (In this case natural gas and diesel).
EMD	Electro-Motive Diesel Generator – Current units are EMD 01, 02, 03, 04, and 05
Feeders	Medium- and low-voltage cables that connect the power generating sources to the loads or users in the power network.
Firm Generating Capacity (N-1)	Generating capacity of a network of generating units, if the largest unit is unavailable.
Frequency Changer / Converter	Equipment designed to convert the frequency of electricity from 60 Hz to 25 Hz, so the energy can be utilized by existing loads that operate at 25 Hz (conversion from 25 Hz to 60 Hz is also possible).
Fuel Oil	Common source of liquid fuel to operate generating assets. Sometime used synonymously with diesel fuel, which is stored on site in a tank near the generator.
Generator	SWBNO owned equipment that generates electricity for the SWBNO Power Distribution Network.
GHG	greenhouse gas
GWh	gigawatt-hour(s)
HMGP	Hazard Mitigation Grant Program

Hz	hertz
IPP	Independent Power Producer
Island Mode Operation	Operation of the SWBNO Power Generation and Distribution Network, while disconnected from the utility (i.e., independent from Entergy of New Orleans).
kV	kilovolt(s), a measure of electric potential
LCC	Life Cycle Cost - Total cost of ownership and operation over 30 years, inclusive of construction cost, purchased fuel and electricity, operation, maintenance and other expenses.
Load/Demand	Equipment on the SWBNO Power Distribution Network that requires power to operate (stormwater drainage pumps, potable water pumps, sewage pumps).
Maximum generating capacity	Net amount of power available for use beyond the auxiliary loads of a generating unit.
MW	megawatt(s), a measure of power
MWh	megawatt-hour(s), a measure of electric energy equivalent to power consumption of one megawatt per hour
MVA	megavolt ampere(s), a measure of apparent power in an electrical system
Nameplate generating capacity	Originally-designed capability of a generator connected to a prime mover. Does not consider any limitations which may be imposed by other critical system components such as auxiliary mechanical equipment, power distribution systems or controls.
Natural Gas	Common source of fuel to operate generating assets. Natural gas is purchased from the local utility.
NOx	nitrogen oxide
Old City Drainage	The upriver portion of New Orleans bounded by the parish line between Orleans Parish and Jefferson Parish to the West, the Mississippi River to the South, Lake Ponchartrain to the North, and the Industrial Canal to the East.
PFC	Plant Frequency Changer
psig	pound(s) per square inch gauge
Redundancy	The duplication of critical components or functions of a system to increase reliability. Redundancy prevents a larger system outage from occurring as the result of a single component failure.
Reliability	Ability of a system or component to reliably and consistently serve its intended purpose.
Reliable Capacity	The expected output from a system or component considering present day condition and external limitations which may be imposed by other critical system components such as auxiliary mechanical equipment, power distribution systems or controls.

Resiliency	An ability to recover from or adjust easily to change.
RFC	Rotary Frequency Changer
RICE	reciprocating internal combustion engine
SCADA	Supervisory Control and Data Acquisition System
SFC	Static Frequency Changer
STG	An Electric Generator coupled to a Steam Turbine as the prime mover - Current units are STG-1, STG-3, and STG-4 (all 25 Hz).
Substation	Electrical infrastructure and equipment used to transform high voltage electrical power to medium or low voltage power for distribution to consumers.
Sustainability	For the purposes of this plan, sustainability refers to a focused mitigation or reduction of environmental impact.
SWBNO Power Distribution Network / System	All of the SWBNO-owned assets connected via a complex system of feeders (generators, frequency convertors, pumps, etc.).
Total Reliable Generating capacity	The sum of the reliable generating capacities of a network of generating units.
WPC	West Power Complex

Executive Summary

<u>STUDY OBJECTIVE:</u> Identify, evaluate, and select the most beneficial alternative that addresses the goals included in the project Problem Statement.

<u>STUDY RESULTS:</u> The most beneficial alternative considers: (1) A new Entergy substation, which acts as the single interconnection point for all SWBNO demand loads; (2) Elimination of steam use for power generation; (3) Retirement of all 25 Hz generating assets, and addition of new 60 Hz generating assets; and (4) Conversion of all demand loads to 60 Hz.

EXISTING SYSTEM

The Sewerage and Water Board of New Orleans (SWBNO) is the agency responsible for the reliable operations and maintenance of three utility systems which are critical to the residents of New Orleans. These systems include drinking water treatment and pumping, sewer collection and treatment, and stormwater drainage. Each system requires a reliable and resilient source of electric power to operate effectively. Loss of electric power to any segment of these systems can result in conditions that compromise the health and safety of the residents of New Orleans. Currently, energy is provided by two main sources:

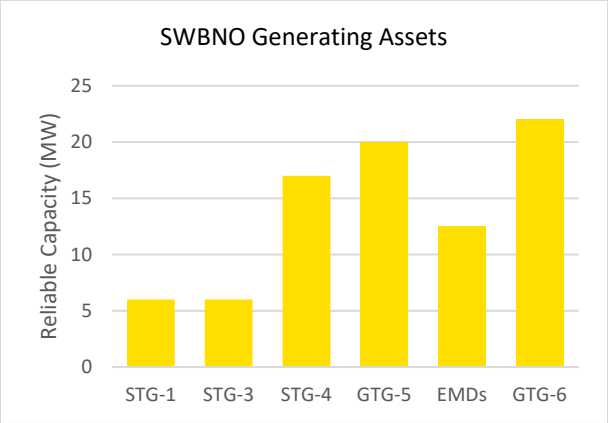
- SWBNO self-generation: SWBNO Power Distribution Network (25 Hz and 60 Hz)
- Entergy of New Orleans: Multiple connection points to purchase 60 Hz energy and natural gas.

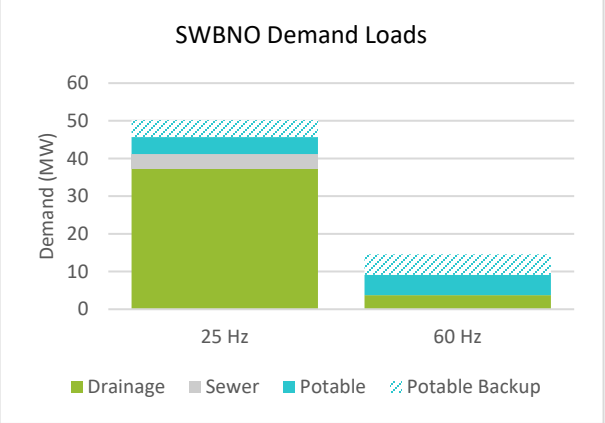
PROBLEM STATEMENT

The Sewerage and Water Board of New Orleans is conducting a study to assess the needs and capabilities of the existing power generation and distribution network with a goal of defining an economic, efficient, and sustainable path toward modernizing and improving its electrical power system to meet all power demands with adequate redundancy and robust resiliency. The study results will be presented in a Power Master Plan, which will outline a path to the most reliable, resilient, and efficient energy use through a combination of self-generation and electricity purchase. The Power Master Plan will emphasize elimination of the current cooling water cross-connection and steam production, while transitioning away from 25 Hz to 60 Hz power production and use.

SWBNO POWER DISTRIBUTION NETWORK

EXISTING ASSET INVENTORY





25 Hz	***60 Hz***
Total Generation = 61.5 MW Total Connected Demand Loads = 51.6 MW Max Instantaneous Demand Loads = 50.1 MW	Total Generation = 22 MW Total Connected Demand Loads = 16.6 MW Max Instantaneous Demand Loads = 9.1 MW

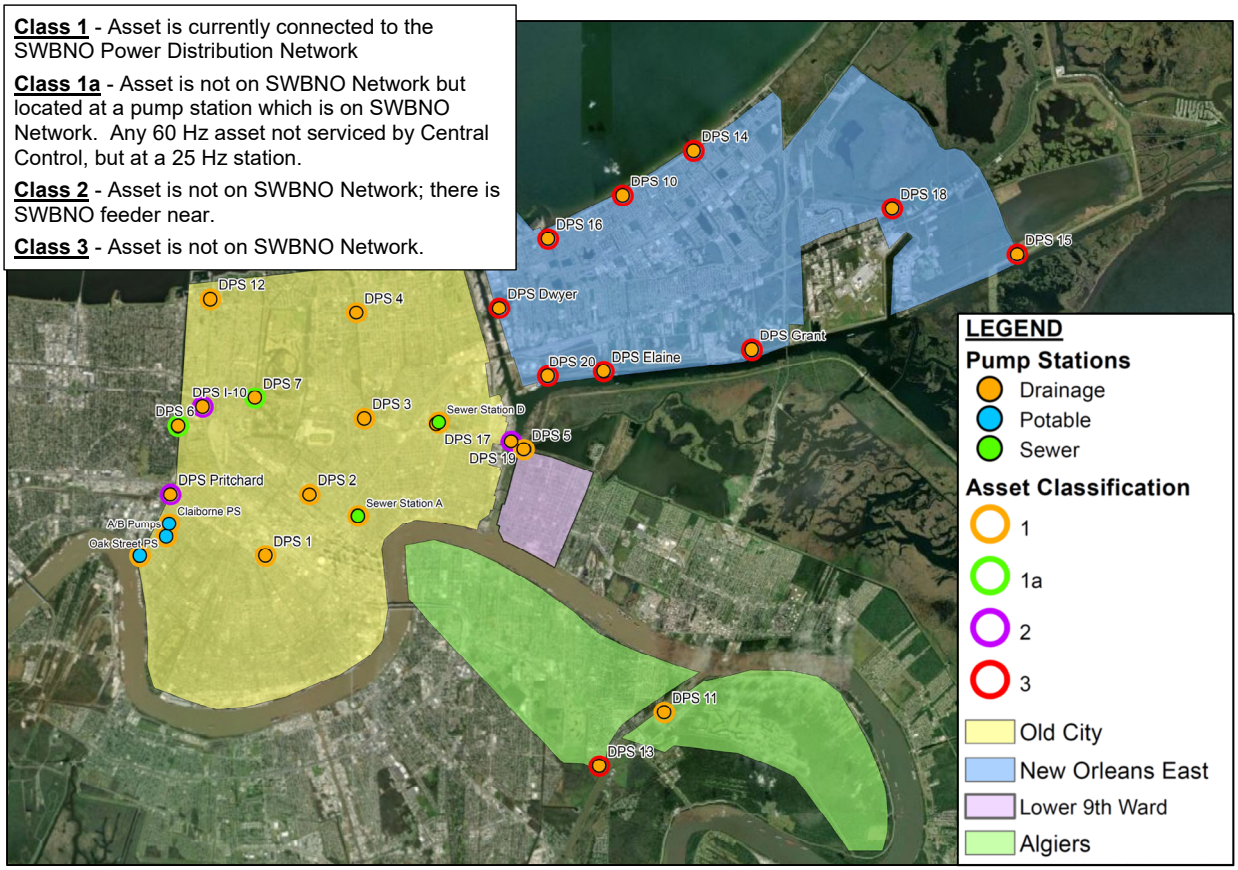
ASSET CLASSIFICATION

Class 1 - Asset is currently connected to the SWBNO Power Distribution Network

Class 1a - Asset is not on SWBNO Network but located at a pump station which is on SWBNO Network. Any 60 Hz asset not serviced by Central Control, but at a 25 Hz station.

Class 2 - Asset is not on SWBNO Network; there is SWBNO feeder near.

Class 3 - Asset is not on SWBNO Network.



RECOMMENDED GENERATION CAPACITY

This study focuses on the emergency scenario when Entergy is unavailable and all critical assets must be powered by SWBNO generating assets. This scenario is referred to as **Island Mode Operation**. In Island Mode, SWBNO should maintain enough generation capacity to meet the Total Required Generation Capacity even when the largest generation asset is unavailable due to a planned or unplanned outage. This is referred to as the Firm Reliable Generation Capacity.

Based on an evaluation of current loads and demands, it is recommended that the Firm Reliable Generation Capacity be maintained at a minimum of 77.3 megawatts (MW). Jacobs further recommends that SWBNO consider provisions for future generation capacity to allow for the connection of additional pumping stations that are geographically located near the existing Power Distribution Network feeders (Asset Classification 2). This will require a Future Firm Reliable Generation Capacity of 88.3 MW.

The following Firm Reliable Generation Capacity values have been used to develop the Power Master Plan alternatives:

- Minimum Present Firm Reliable Generation Capacity = 77.3 MW
- Minimum Future Firm Reliable Generation Capacity = 88.3 MW

ALTERNATIVES EVALUATION

Alternative 0: Baseline

Alternative 1: New Substation, Reduce steam use; Convert demand to 60 Hz

Alternative 2: New Substation, Eliminate steam use; Three new 22 MW CTGs; Convert demand to 60 Hz

Alternative 3: New Substation, Eliminate steam use; Three new 18 MW RICE units; Convert demand to 60 Hz

Alternative 4: New Larger Substation, Eliminate steam use; Three new 22 MW CTGs; Convert demand to 60 Hz

Jacobs developed five alternatives that meet the key components included in the SWBNO Power Master Plan Problem Statement. The alternatives were developed based on the evaluation of feasible options including Alternative 0, which is defined as a base case with the addition of essential upgrades to ensure ongoing and reliable operations of the Carrollton Water Plant to meet the basic threshold of reliable power.

During the Alternative Review Workshop with Jacobs and SWBNO on November 6, 2019, each alternative was evaluated and ranked against one another using an evaluation matrix. The results are presented in Table ES-1.

Table ES-1. Evaluation Matrix

Evaluation Factors	Max Points	Evaluation Points Assigned to Each Alternative				
		0	1	2	3	4
Life Cycle Cost	35	0	35	28	32	18
Reliability /Resiliency	25	0	12.5	25	25	25
GHG Emissions /Sustainability	10	0	6	8	10	8
Capital Cost	5	5	3.5	2.5	2.5	2.5
Elimination of 25 Hz	5	0	2.5	5	5	5
Location	5	0	4	4	4	5
Operability	5	0	0	2.5	5	2.5
Maintainability	5	0	0	5	2.5	5
Stakeholder Impact	5	0	0	5	5	5
TOTAL	**100**	**5**	**63.5**	**85**	**90.5**	**75.5**
Capital Cost		$508,271,000	$535,360,000	$575,672,000	$573,026,000	$579,040,000
Life Cycle Cost		$1,071,115,000	$812,657,000	$830,146,000	$828,190,000	$886,671,000
LCC Savings		$0	$258,458,000	$240,969,000	$242,925,000	$184,444,000
GHG Emissions (tons/yr)		120,232	79,832	78,116	77,788	77,820

tons/yr = tons per year

Based on this evaluation, Alternatives 2 and 3 are the best available options, with a reciprocating internal combustion engine (RICE) engine solution (Alternative 3) assessed as slightly more favorable than a combustion turbine solution, primarily due to cost and operational flexibility.

RECOMMENDED ALTERNATIVE

In Alternative 3, purchased utility power is the primary source of energy via a dedicated substation, and SWBNO Generation is needed only during significant rain events or when utility power is unavailable. This alternative eliminates all existing steam turbine generators and adds three new engine generators at a new West Power Complex.

Table ES-2 below outlines how Alternative 3 addresses the Key Components of the study.

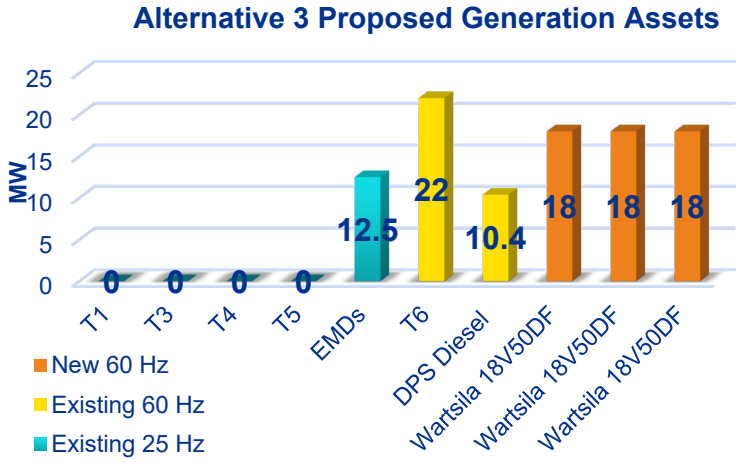


Table ES-2. Alternative 3 Summary

Key Component	Solution
Public Welfare	
Cooling Water System	Cross-connection would be eliminated by the retirement of all existing cross-connected equipment.
Island Mode Operation	The capacity of the new West Power Complex will exceed the system load by about 5 MW even if one generator is out of service.
Greenhouse Gas Emissions and Pollution Control	This option produces an estimated 77,800 tons per year of GHG emissions compared to 120,200 tons per year with Alternative 0. Each option will comply with applicable state and federal laws for emissions from generating equipment.
Efficiency, Sustainability and Cost of Operation	
Reduced Steam Generation / Natural Gas Purchase	Retire all steam generation and use. Natural gas purchase would only be required when power demand exceeds substation capacity and SWBNO generating assets are running, or in an emergency situation when Entergy is not available.
Equipment Selection	
Generating Assets	**Install three new Wartsila 18V50DF dual fuel engine generators with an approximate capacity of 18 MW each.** Retire STG-1, STG-3, STG-4, Combustion Turbine Generator No. 5 (CTG-5), and boiler plant.
Frequency Conversion	Install three 25 MW capacity static frequency changers (SFCs) (75 MW total capacity) to allow for retirement of T-1, T-3, T-4, T-5, and the boiler plant after new 60 Hz generators are installed but before drainage pump systems are converted to 60 Hz.
Electric Demand Assets	Replace all 25 Hz pump motors with new 60 Hz motors and gearboxes installed above maximum considered flood elevation. This work will need to be phased over multiple years.
SWBNO Network Feeders	All remaining 6.6 kV feeders in the SWBNO Power Distribution Network not previously replaced in the Hazard Mitigation Grant Program project will be replaced with new 13.8 kV feeders.
Substation Capacity	
Entergy Feeders	Install a new Entergy substation with 50 MVA total capacity All SWBNO generating assets become backup only for when Entergy is not available, or demand exceeds substation capacity.

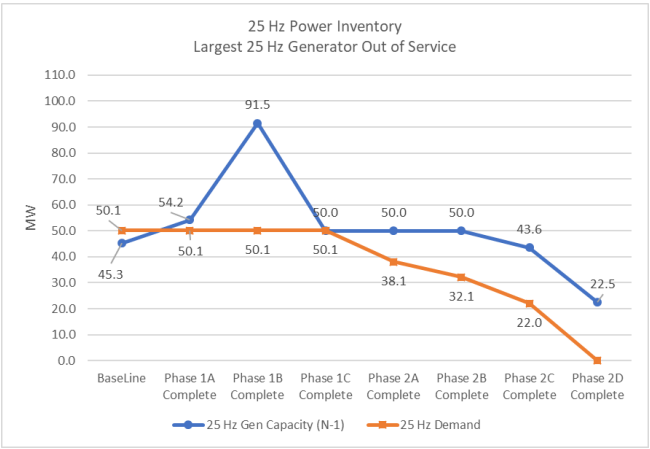
CTG = combustion turbine generator; kV = kilovolt(s); MVA = megavolt(s) ampere; STG = steam turbine generator

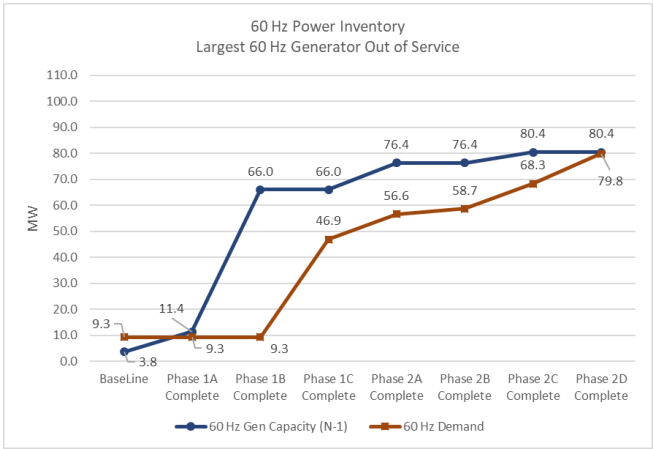
POWER SYSTEM PHASING

The phasing plan presented in this report considers installation of the new West Power Complex, including a new substation, new generators, and new SFCs with a clear point of demarcation before the rest of the assets are transitioned. The strategy is adaptable and may need to be modified to accommodate the availability of funding, coordination with other related projects, availability of qualified local contractors, and many other factors which are currently unknown.

Phase	Description	Detail
Baseline	Existing power inventory, considering the operational status of all assets in November 2019	
Phase 1A	Installation of 25 MW SFC	Add one 25 MW SFC.
Phase 1B	Construction of West Power Complex	Add two more 25 MW SFCs (one standby); install T7, T8, T9, and 60 Hz ring bus.
Phase 1C	Retire All 25 Hz Steam Power Generation Turbines	Remove T1, T3, T4, and T5 and all associated equipment.
Phase 2A	Convert Drainage Pump Stations to 60 Hz	Connect Diesel Generators at Drainage DPS-6 and DPS-7; convert DPS-6, -7 (partial), -12, and -17 (partial) to 60 Hz.
Phase 2B	Convert Drainage Pump Stations to 60 Hz and DPS-5 to an Independent Station	Convert the rest of DPS-7 to 60 Hz; connect Pritchard and I-10; Convert DPS-5 to an independent station.
Phase 2C	Convert Drainage Pump Station to 60 Hz	Connect Diesel Gen at DPS-19; Convert DPS-1 and DPS-2 (partial) to 60 Hz.
Phase 2D	Convert Drainage Pump Station to 60 Hz and Retire Frequency Changers	Convert the rest of DPS-2, DPS-3, DPS-4, Panola, and Claiborne pump stations to 60 Hz; retire the Carrollton frequency changers and the Station D frequency changers.

The following graphs summarize the status of the 25 Hz assets and 60 Hz power inventory through the proposed phases of the power system. The Power Inventory Graphs represent the SWBNO available generation capacity when considering the largest 25 Hz generator out of service and the largest 60 Hz generator out of service. The proposed phasing shows that there is currently a generation capacity deficit, but that excess capacity is achieved and maintained through the multiple construction phases.





RECOMMENDATIONS/NEXT STEPS

Based on the findings presented in this Power Master Plan report, the following items are recommended as next steps:

- Finalize negotiations on the new Entergy substation, and begin construction.
- Complete the work that is currently in progress:
  - 1370A Switchgear / Transformer Project
  - Procurement and installation of a new 25 MW SFC
  - Upgrades to T-6 to allow for cold weather operation
- Begin preparation of performance specifications for major long-lead time equipment.
- Prepare a conceptual level design to accommodate updated cost estimates of preferred alternative to be used in financing discussions.
- Refine phasing of preferred alternative to mitigate loss of T-5.

1. Introduction

1.1 Background

The Sewerage and Water Board of New Orleans (SWBNO) is the agency responsible for the reliable operations and maintenance of three utility systems which are critical to the residents of New Orleans. These systems include drinking water treatment and pumping, sewer collection and treatment, and stormwater drainage. Each system requires a reliable and resilient source of electric power to operate effectively. Loss of electric power to any segment of these systems can result in conditions that compromise the health and safety of the residents of New Orleans.

At the request of SWBNO, Jacobs developed and evaluated alternatives for power generation and Power Distribution Network improvements supporting the water, sewer, and drainage systems currently powered from the existing Carrollton Power Plant. The existing power distribution infrastructure is highly complex and extends to various pumping stations throughout the City. Many of the system components were constructed more than 100 years ago and are in immediate need of upgrades, modifications or replacement. The goal of the study is to identify the optimal strategy to improve the long-term reliability, resiliency, efficiency and sustainability of electric power to these critical systems.

To commence the study, Jacobs collected and reviewed the following historical studies and design documents prepared by various entities working on the SWBNO Power System:

- SWB Phase I Power Study, 1974 – Ford, Bacon, Davis
- SWB Phase II Power Study, 1974 – Ford, Bacon, Davis
- Power Study, 1994 – CH2M HILL
- Power System Bid Package, 2000 – CH2M HILL
- CP-1372 (T5) Specifications & Drawings, 2015 – Black and Veatch
- CP-1373 (T3 Refurbishment) Specifications & Drawings, 2015 – Black and Veatch
- Substation Estimate, 2016 – Entergy of New Orleans
- City of New Orleans Root Cause Analysis Draft Report, 2018 – ABS Group
- Power Alternatives Assessment, 2018 – Jacobs
- Drainage System Conditions Assessment, 2018 – Veolia
- Cooling Water System Analysis and Results, 2019 – Jacobs
- DRAFT Resilience-Inclusive Cost Benefit Analysis of Microgrids for New Orleans, LA, 2019 – Sandia National Laboratory

Additionally, Jacobs facilitated discussions with SWBNO operations staff, and attended tours of the power house and drainage pump stations (DPS) as noted:

- Discussions with SWBNO Boiler Plant Operations Staff
- Discussions about ongoing and upcoming projects in the SWBNO system
- Discussion on SWBNO Overall Operations with SWBNO's Chief of Operations
- Discussion on Drainage System and DPS Emergency Generation with SWBNO Engineering
- Tour of DPS 6, DPS 7, DPS 17 (Pump Station D), Panola Station
- Tour of T-6, Electro-Motive Diesel (EMD) Generators, Power House, High-Lift Building, and Low-Lift Building

Review of past studies identified that most of the ideas still being assessed today have been evaluated previously, often more than once. The goal of this Power Master Plan is not to repeat work from prior studies. Rather, the intent is to leverage the options previously identified, and advance the assessment of those options to confirm a feasible and optimal path forward for SWBNO, incorporating current inputs and requirements provided by SWBNO as of 2019.

The most recent pre-feasibility power study conducted by Jacobs demonstrated that options which allow for SWBNO to transition from a primary system of power generation to a primary system of power purchase provide the best overall value in terms of life cycle cost (LCC). Therefore, the alternatives

studied in this report will focus more specifically on feasible solutions that include reliable utility power from Entergy of New Orleans (Entergy), while still maintaining the ability to independently generate enough power to operate all critical systems in emergency situations or when utility power from Entergy may not be available.

Note: During this study, Combustion Turbine Generator Number 5 (CTG-5) was operational and was used in the evaluation of alternatives. On December 14, 2019, after the alternatives had been evaluated, CTG-5 experienced a failure event and is currently no longer operational. Due to the timing of this event, the impacts of this on the power generation portfolio and future are not evaluated in this study. For the purposes of this Power Master Plan, it is presumed that the lost generating capacity will be replaced.

1.2 Power Master Plan Problem Statement

During the Power Master Plan project kickoff meeting on May 29, 2019, the project purpose was established in the form of a problem statement with direct input from SWBNO. The following project Problem Statement provides a key reference point and series of guiding principles for the study.

> The Sewerage and Water Board of New Orleans is conducting a study to assess the needs and capabilities of the existing power generation and distribution system with a goal of defining an economic, efficient, and sustainable path toward modernizing and improving its electrical power system to meet all power demands with adequate redundancy and robust resiliency. The study results will be presented in a Power Master Plan which will outline a path to the most reliable, resilient, and efficient energy use through a combination of self-generation and electricity purchase. The Plan will emphasize elimination of the current cooling water cross-connection and steam production, while transitioning away from 25 Hz to 60 Hz power production and use.

Based on the Problem Statement and further discussion with SWBNO during the Project Planning Review meeting on July 10, 2019, Jacobs prepared the following list of Guiding Principles and their relation to the Problem Statement (Table 1-1).

Table 1-1. Guiding Principles

No.	Guiding Principle	Relative to Problem Statement
1	Reliability and resiliency of the proposed solution is critical.	Meet all power demands with adequate redundancy and robust resiliency.
2	The proposed solution must include a practical construction plan. It is understood and expected that modifications to existing systems will need to be phased to maintain minimum reliability threshold of the overall system throughout construction.	Define an economic, efficient, and sustainable path toward modernizing and improving its electric power system.
3	Construction cost, energy efficiency, LCC and sustainability are important criteria that will help determine which solution is optimal, but not at the expense of reliability, resiliency or constructability.	Outline a path to the most reliable, resilient, and efficient energy. Meet all power demands with adequate redundancy and robust resiliency.
4	The recommended solution must include provisions to eliminate the current cooling water cross connection. The proposed construction phasing should allow for this work to be complete within 5 years.	Emphasize elimination of the current cooling water cross-connection and steam production.
5	The recommended solution must include provisions to maintain reliability in the absence of utility power (from Entergy) as well as natural gas fuel supply to the plant (i.e., all equipment must be capable of operating on back-up fuel stored on site.)	Outline a path to the most reliable, resilient, and efficient energy use through a combination of self-generation and electricity purchase.
6	The firm capacity of the plant shall be sized to meet the peak demand of any realistic operating scenario that could take place with the loads presently connected. Firm capacity for this project will be defined as the generation capacity of the plant with the largest generator unavailable (N-1).	Meet all power demands with adequate redundancy and robust resiliency. Assess the needs and capabilities of the existing power generation.
7	Prior studies have recommended a migration from 25 Hz power	Transition from 25 Hz to 60 Hz power production

Table 1-1. Guiding Principles

No.	Guiding Principle	Relative to Problem Statement
	production to 60 Hz power production. This migration remains a key objective, but not at the expense of reliability, resiliency, or constructability.	and use while meeting all power demands with adequate redundancy and robust resiliency.
8	SWBNO generally has no preference regarding the combinations of self-generation equipment systems or electric utility interconnections to be evaluated or proposed. Jacobs will provide a brief design narrative to explain why the alternatives selected for the evaluation are the most beneficial.	Outline a path to the most reliable, resilient, and efficient energy use through a combination of self-generation and electricity purchase.

Jacobs organized the Guiding Principles into a table of Key Components and Subcomponents (Table 1-2). A version of this table was prepared for each Alternative, to clearly identify how the specific solutions meet the goals of the Problem Statement.

Table 1-2. Key Components and Subcomponents

Key Component	Subcomponent	Description
Public Welfare	Cooling Water System	Each alternative must eliminate the cooling water cross-connection at the CWP. This is a requirement of the Louisiana Department of Health.
	Island Mode Operation	Each option must include provisions for 100% Island Mode self-generation to reliably operate all critical systems in a design event in the absence of purchased utility power.
	Reduced Greenhouse Gas Emissions and Pollution	Each option must incorporate provisions for reduced greenhouse gas (GHG) emissions compared to the current baseline emission. Each option must comply with applicable state and federal laws for emissions from generating equipment.
Efficiency, Sustainability, and Cost of Operation	Reduced Steam Generation / Natural Gas Purchase	Each option must consider a reduction in steam generation. Steam is generated in the boiler house by burning natural gas and / or diesel fuel. Fuel costs can be reduced by reducing steam production.
Equipment Selection	Generating Assets	Each option studied which combines all loads onto a single 60 Hz Power Distribution Network must maintain a Firm Reliable Generation Capacity of 77.3 megawatts (MW). Any new generating equipment must produce power at 60 Hz and have duel fuel operating capabilities.
	Frequency Conversion	The transition plan from 25 Hz generation and use to 60 Hz generation and use may require the inclusion of a frequency converter.
	Electric Demand Assets	To meet SWBNO's long-term system goals, electric demand loads at the drainage pump stations must be converted to 60 Hz and raised above the historic high-water line. The recommended solution should include any fuel storage or handling modifications required to allow for 7 days of continuous operation without fuel delivery.
	SWBNO Network Feeders	All existing 6.6 kilovolt (kV) feeders in the SWBNO Power Distribution Network will be replaced with 13.8 kV feeders.
Substation Capacity	Entergy Feeders	Each option must consider utility interconnection to a new industrial-grade Entergy substation instead of connection to local residential or commercial utility feeders.

1.3 Evaluation Approach

This report documents Jacobs' effort in identifying, evaluating, and selecting the most beneficial alternative which addresses the goals included in the project Problem Statement.

Jacobs' review of SWBNO system assets facilitated the identification of five alternatives, which generally consider different types and sizes of generators, substation capacity, and incorporation or retirement of existing assets. With SWBNO's input, an alternative was selected based on pre-determined evaluation factors. The evaluation factors include monetary and non-monetary aspects that align with the project Problem Statement. Finally, a phasing plan was prepared, which outlines a realistic sequence of construction for the selected alternative.

The evaluation approach for the Power Master Plan Alternatives included the following activities further described in the remainder of this report:

- Perform a right-sizing analysis of the SWBNO power system. The intent of the right-sizing analysis is to establish the optimal configuration and size range for the new equipment with consideration of the current and anticipated connected loads.
- Develop the alternatives to be evaluated in the study. The list of alternatives includes a "business as usual" case as a baseline. The other alternatives include proposed updates to the power system to accomplish the goals in the Problem Statement.
- Compare Alternatives. Each alternative has been evaluated based upon several factors which are deemed important to SWBNO and in alignment with the objectives of the Problem Statement. An Evaluation Matrix, including all evaluation factors, scores, and alternatives allows for a quantifiable method of determining the most beneficial alternative. Upon evaluation and discussion with SWBNO, the successful Alternative has been selected.
- Prepare a Phasing Plan for the selected Alternative.

2. Right-sizing Analysis

Entergy, the sole electric and natural gas utility in the city of New Orleans, has stated that it cannot guarantee power during significant tropical weather events. To maintain reliable critical operations, SWBNO requires adequate power to start and operate the potable water, sewer, and drainage pumps. Operation of the existing SWBNO network in Island Mode allows SWBNO to provide Orleans Parish residents confidence that critical services will still operate if the main utility, Entergy, is out of service. To confidently operate in Island Mode, the SWBNO system assets including generators, pumps, frequency converters, and feeders must be reliable and resilient.

The first step in providing a reliable and resilient system is confirming that there is sufficient Generation Capacity available to provide power to all the loads in the system. A clear understanding of the existing connected loads and power generating assets in the SWBNO Power Distribution Network is necessary to determine a recommended Total Required Generation Capacity, which is the basis of each Alternative evaluated in this Power Master Plan. Jacobs completed the following tasks to determine the Total Required Generation Capacity of the SWBNO generating assets:

- Compile a comprehensive inventory of all existing SWBNO assets including generators, pumps, frequency converters, and feeders. The inventory includes a description of the asset, its current location, year installed, capacity, and frequency.
- Identify system classification categories and separate the existing SWBNO assets based on their location in the SWBNO Power Distribution Network.
- Calculate the Total Required Future Generation Capacity of the Carrollton Power Plant. This capacity considers recommended changes in the SWBNO Power Distribution Network, such as the conversion of 25 Hz loads to 60 Hz, the connection of additional drainage pump stations to the network, and the disconnection of others.
- Calculate the minimum Firm Reliable Generation Capacity, which considers the necessary redundancy required for a resilient system.

2.1 Inventory of Existing Assets

Existing SWBNO power assets are located across Orleans Parish in the following areas:

- Old City
- Algiers
- New Orleans East
- Lower 9th Ward

This Power Master Plan study focuses on SWBNO assets that are currently connected to or located near the existing SWBNO Power Distribution Network. Most of these pump stations fall within the Old City area. Old City is defined as the upriver portion of New Orleans bounded by the parish line between Orleans Parish and Jefferson Parish to the west, the Mississippi River to the south, Lake Pontchartrain to the north, and the Industrial Canal to the east. The drainage pump stations included in this area are the original and oldest drainage pump stations in the City. When these pump stations were originally designed and installed in the early 1900s, AC power in the United States was not yet standardized to 60 Hz frequency, and the pumps in the New Orleans system were designed to utilize power at 25 Hz frequency. Now that the United States are standardized to 60 Hz power, it is difficult and often costly to maintain the 25 Hz equipment. Several of the existing pump stations have only 25 Hz-powered equipment, while others have a combination of equipment using both 25 and 60 Hz. Only DPS 19 is solely 60 Hz-powered.

Figure 2-1 identifies the pump stations within the areas of Orleans Parish.

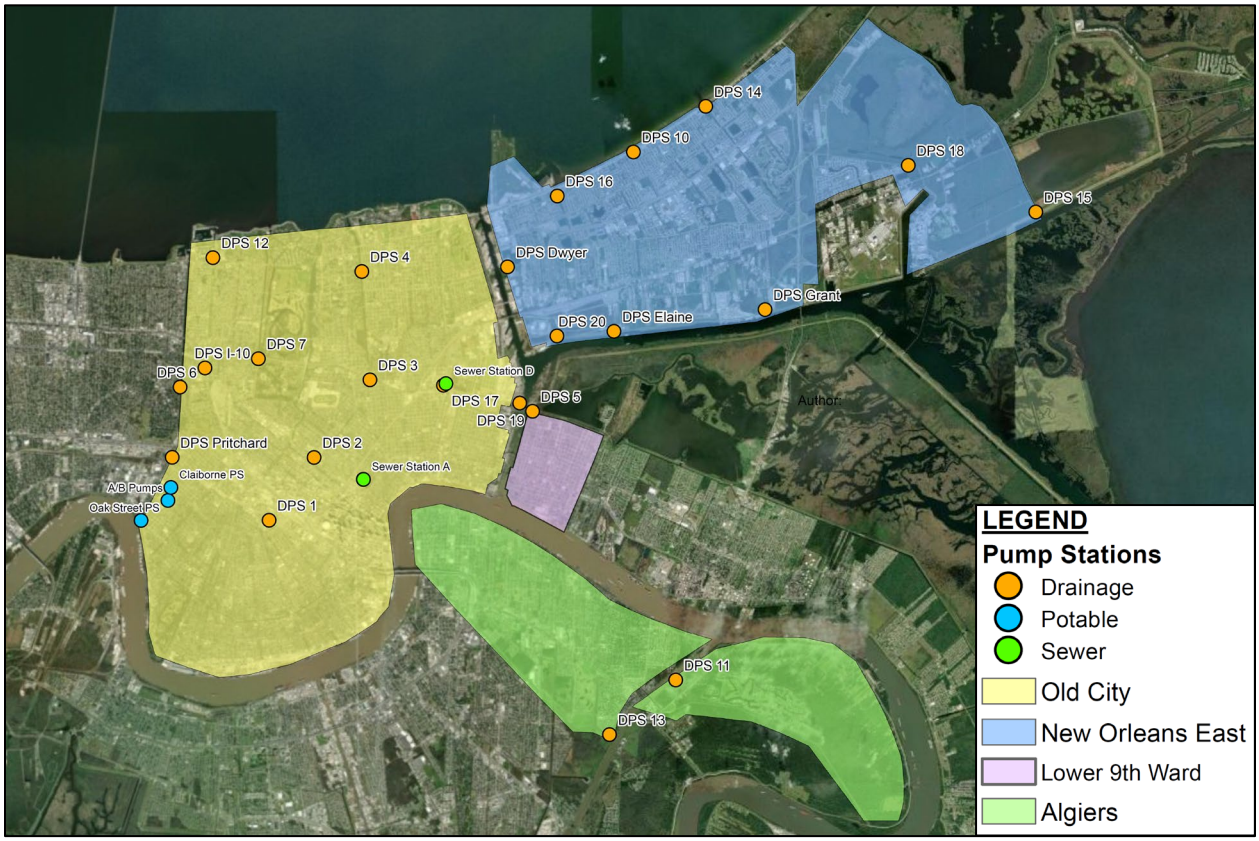


Figure 2-1. Power Master Plan Area Boundaries

The existing SWBNO Power Distribution Network includes a network of feeders across the Parish that connect the Carrollton Power Plant to drainage pump stations, sewer pump stations, potable water pumping stations, river intake stations, and frequency changers. Loads currently connected to the SWBNO Power Distribution Network primarily run on 25 Hz power distributed from the Carrollton Power Plant. The Power Distribution Network also includes a smaller number of loads at specific pump stations that operate through a local 60 Hz connection to Entergy. Existing rotary-type frequency changers, located at the Carrollton Plant (Plant Frequency Changer), Drainage Pump Station 17 (also referred to as Pump Station D or Central Yard), and the Carrollton Frequency Changer allow for a limited amount of 60 Hz power from Entergy to be converted to 24 Hz power. Note that 24 Hz power (converted from the rotary frequency converters) and 25 Hz power (generated from the existing turbine generators) are different and cannot be combined. Many of the assets were originally installed in the early 1900s and are still operating today.

Tables 2-1 and 2-2 summarize the existing generating assets and frequency converters which provide power to the critical load assets throughout the current SWBNO Power Distribution Network.

Table 2-1. Generators Connected to the SWBNO Power Distribution Network

Hz	Location	Description	Nameplate Capacity (MW)	Reliable Capacity (MW)	Year Installed
25	Carrollton Power Plant	STG-1	6	6	1913
25	Carrollton Power Plant	STG-3	15	6	1928
25	Carrollton Power Plant	STG-4	20	17	1917/1954
25	Carrollton Power Plant	CTG-5	20	20	1963
25	Carrollton Power Plant	EMD 1-5	12.5	12.5	2018

Table 2-1. Generators Connected to the SWBNO Power Distribution Network

Hz	Location	Description	Nameplate Capacity (MW)	Reliable Capacity (MW)	Year Installed
60	Carrollton Power Plant	CTG-6	22	22	2010

Note: Reliable Capacity considers known constraints to the existing generators. For the purposes of this study, it is assumed that the constraints on CTG-6 (such as cold weather operation and switchgear bus limits) and EMDs (such as shore power, fuel delivery and oil make-up) have been corrected.

Table 2-2. Frequency Converters Connected to SWBNO Power Distribution Network

Hz	Location	Description	Nameplate Capacity (MW)	Reliable Capacity (MW)	Year Installed
25/60	Plant Frequency Changer (Carrollton Power Plant)	PFC-1	3.75	3.75	
24/60	Carrollton Frequency Changer	CFC-1	6	6	
24/60	Carrollton Frequency Changer	CFC-2	2.5	2.5	
24/60	Station D (DPS 17)	FC-3	6	6	
24/60	Station D (DPS 17)	FC-4	6	6	
25/60	Station C (Sewage)	FC-1	Frequency converters at Station C and on the Westbank are SWBNO owned assets, but located outside of the Old City area, therefore not included in this study		
25/60	Station C (Sewage)	FC-2			
25/60	Westbank	FC-3			

To achieve high reliability of power to the critical infrastructure, both the power generation system and the distribution feeders providing that power must be robust. SWBNO assessed their power feeder system in the past, and some upgrades have been made. Recent testing conducted in 2017 showed a high percentage of the existing feeder system did not pass industry standard quality tests, and feeder failures are still occurring and disrupting power supply to the critical loads. The older feeders in the system are rated for 6.6 kV, while the more recently installed feeders are rated at a minimum of 13.8 kV. It is recommended that any additions or upgrades to the Power Distribution Network include cables rated as 13.8 kV at a minimum, to allow more power to be transferred through the same lines. Figure 2-2 shows the existing feeder network connecting the generating assets to the critical load assets in the SWBNO Power Distribution Network.

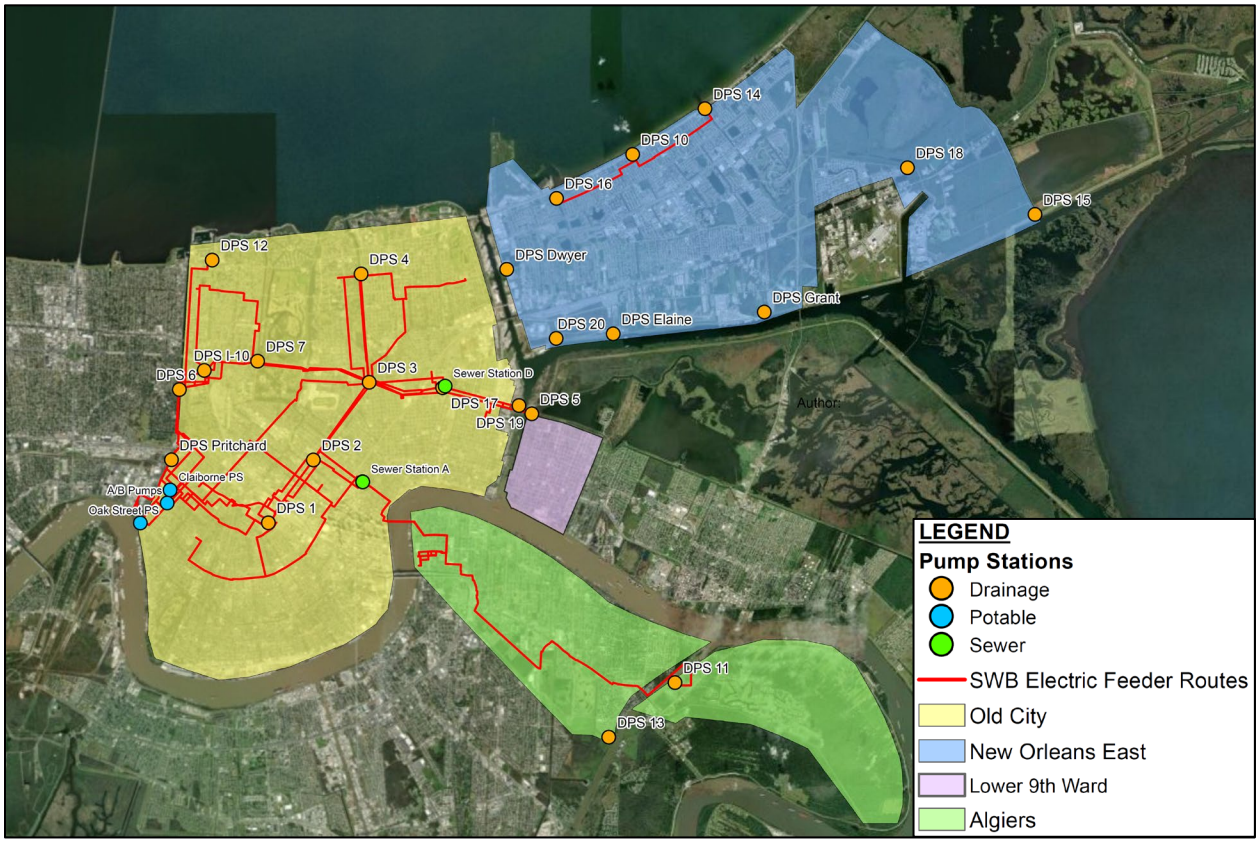


Figure 2-2. Power Master Plan Electric Feeder Routes

Presently, SWBNO's critical infrastructure includes additional 60 Hz assets (pumps) that are not connected to the feeder Power Distribution Network. These assets are fed from a nearby 60 Hz Entergy feeder with onsite backup diesel generation in most cases. The Entergy connections are via above ground residential or commercial feeds, which are generally unreliable, especially during storm events. Figure 2-3 details the highly complex network of assets (generation, loads, and feeders) connecting SWBNO's critical infrastructure. This diagram and other documents provided by SWBNO were used to prepare a consolidated asset list, which is included in Appendix A.

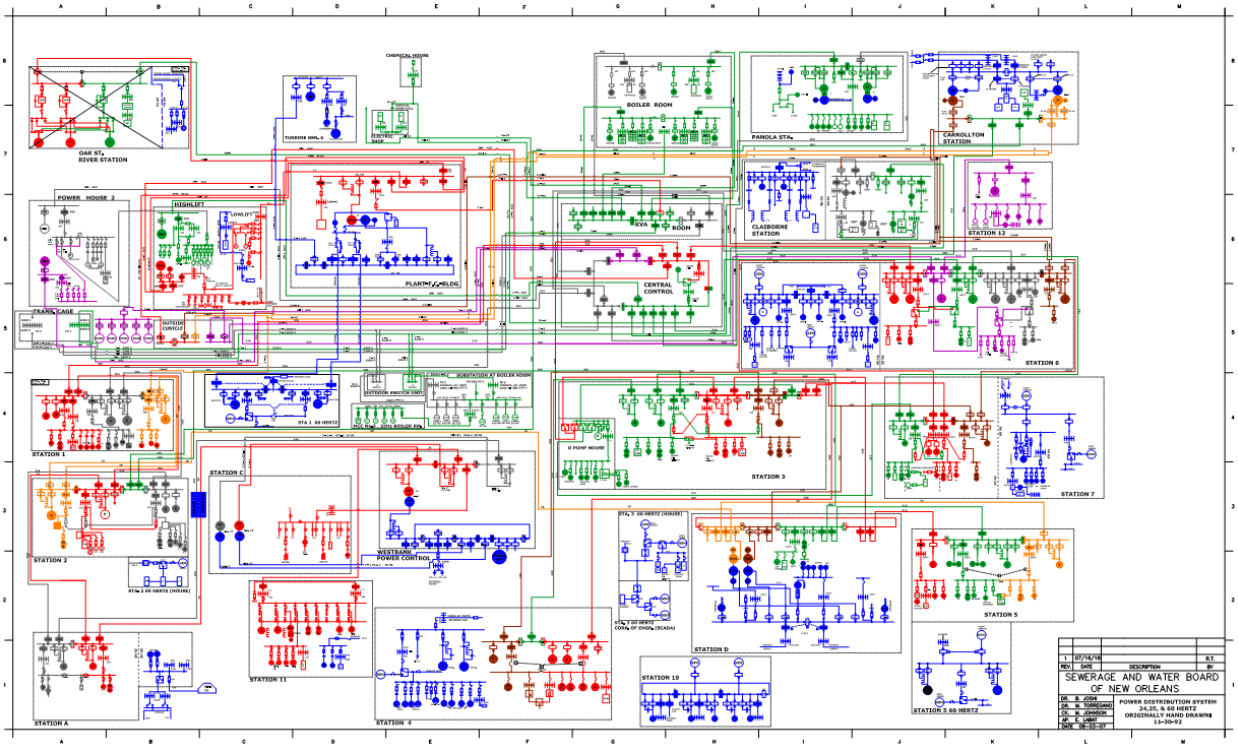


Figure 2-3. SWBNO 24, 25 and 60 Hz Power Distribution Network

2.1.1 Asset Classification

Before any alternatives can be defined, it was imperative to define the Required Generation Capacity for Island Mode operation of the SWBNO Power Distribution Network. Total demand of all electric loads (drainage, potable water, and sewage) connected to the SWBNO Power Distribution Network was identified as the basis of the system's Required Generation Capacity.

This section includes a summary of existing electric demand assets and available generating assets classified into four categories and displayed on Figure 2-4:

- Classification 1 – Asset is currently connected to the SWBNO Power Distribution Network.
- Classification 1a – Asset is not on SWBNO Power Distribution Network, but is installed in a pump station that is currently serviced by the SWBNO Power Distribution Network, e.g., a 60 Hz asset at a 25 Hz station not serviced by Central Control.
- Classification 2 – Asset is not on SWBNO Power Distribution Network; however, there is an underground feeder in close proximity. Jacobs recommends planning for future addition onto the Power Distribution Network.
- Classification 3 – Asset is not on SWBNO Power Distribution Network, and not recommended for future addition due to isolated location relative to SWBNO Power Distribution Network.

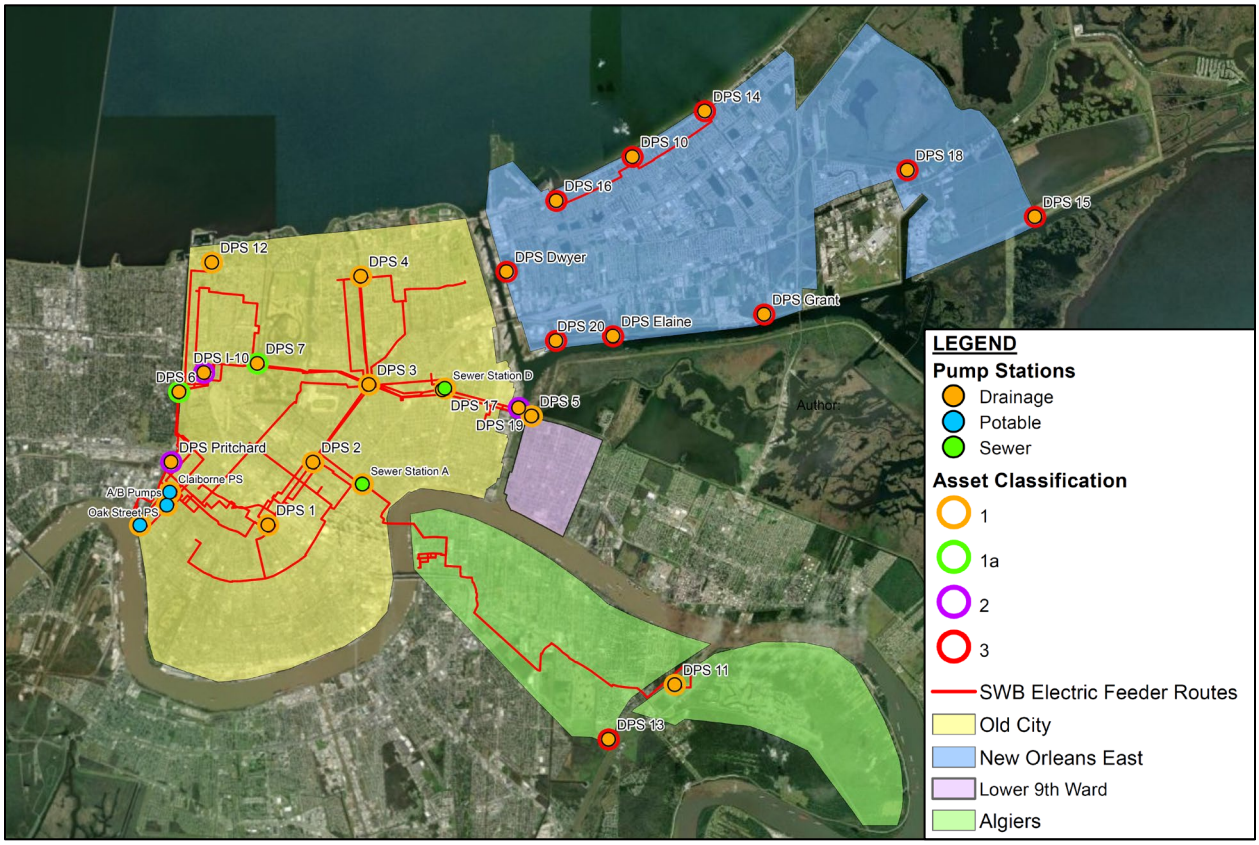


Figure 2-4. Power Master Plan Asset Classification Distribution

2.1.2 SWBNO Demand Assets

Table 2-3 summarizes the loads at each pump station and how they are currently assigned to each classification. This compilation of assets roughly differentiates between connected demand loads and maximum instantaneous demand where specific pumps do not operate at the same time as other pumps (i.e., back-up pumps).

Table 2-3. Electric Demand Assets by Classification

Classification	Hz	Location	Load (kW)	25 Hz Total (MW)	60 Hz Total (MW)
Class 1 **Loads currently connected to the SWBNO Power Distribution Network**	25	DPS 1	4,300	50.1 max instant *51.6 connected*	
		DPS 2	3,969		
		DPS 3	6,356		
		DPS 4	4,625		
		DPS 5	3,805		
		DPS 6	9,922		
		DPS 7	2,163		
		DPS 11	597		
		DPS 12	1,492		
		Oak Street Pump Station	1,492 max use *2,984 connected*		
		Panola Pump Station	3,357		
		Claiborne Pump Station	2,685		

Table 2-3. Electric Demand Assets by Classification

Classification	Hz	Location	Load (kW)	25 Hz Total (MW)	60 Hz Total (MW)
		Sewer Station A	1,865		
		Auxiliary Allowance	2,000		
	60	DPS 1	1,865 max use *3,730 connected*		
		Oak Street Pump Station	466 max use *932 connected*		
		Panola Pump Station	1,679 max use *3,357 connected*		
		Claiborne Pump Station	1,343 max use *2,685 connected*		9.3 max demand *16.6 connected*
		Low Lift Pump Station	261 max use *522 connected*		
		High Lift Pump Station	1,679 max use *3,357 connected*		
		Auxiliary Allowance	2,000		
	Total Class 1			**51.6**	**16.6**
				68.2	
Class 1a **Loads at SWBNO pump stations but currently served by Energy feeds**	60	DPS 4	1,044		
		DPS 6	6,565		
		DPS 7	1,865		14.9
		DPS 17	3,730		
		Sewer Station A	1,715		
	Total Class 1+1a			**51.6**	**31.5**
				83.1	
Class 2 **Loads not on SWBNO network but close to an existing feeder**	60	DPS 19	7,907		
		DPS I-10	3,245		11.9
		DPS Pritchard	764		
	Total Class 1+1a+2			**51.6**	**43.4**
				95.0	

kW = kilowatt

An auxiliary allowance of 2,000 kW 25 Hz and 2,000 kW 60 Hz represents an aggregate of loads too small to tabulate separately.

An additional 24.3 MW of load at Pump Stations 10, 11, 13, 14, 15, 16, 18, 20, Dwyer, Elaine, Grant, Monticello, Industrial Avenue, and all Underpass Stations are included in Classification 3. As noted above, Classification 3 assets are not currently connected to the SWBNO Distribution Network and are not recommended for future addition due to isolated location. Figure 2-5 summarizes the total 25 Hz and 60 Hz electric demand assets by classification.

Note: It is anticipated that the existing feeders which cross the Mississippi River and the Industrial Canal (Feeder 226) will be retired in the foreseeable future, due to difficult maintainability and increased rate of failure. When those feeders are retired, assets at DPS-5 and DPS-11 will no longer be included in the demand asset allocation. However, given the uncertainty in timing of this event, they are included herein for completeness.

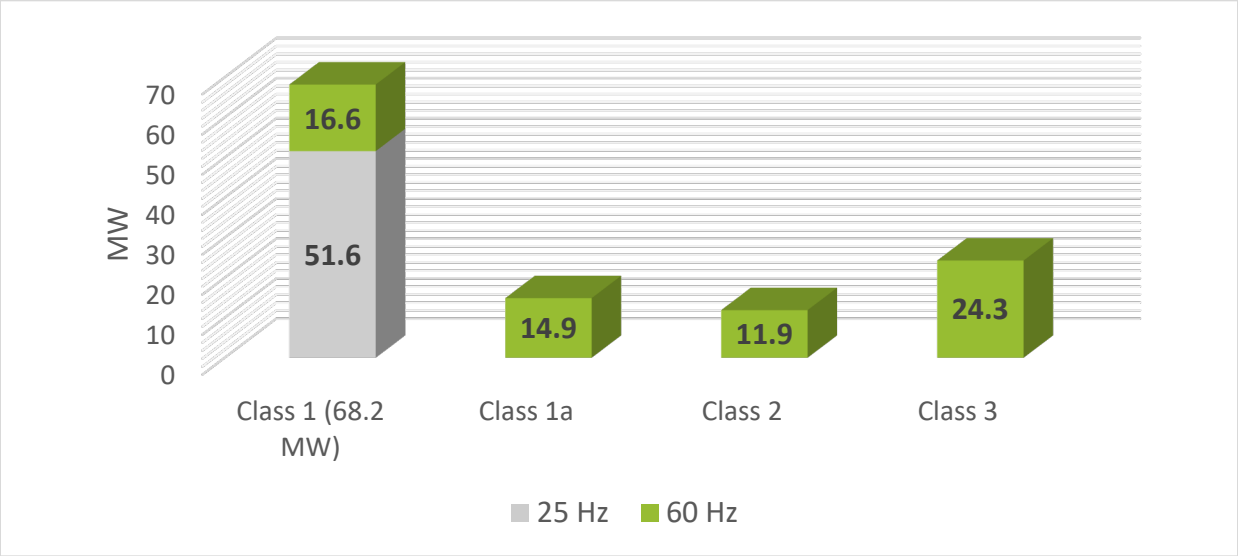


Figure 2-5. Total Electric Demand Assets by Classification

2.1.3 SWBNO Generating Assets

Existing 25 Hz generating equipment includes STG-1, STG-3, STG-4, CTG-5, and the EMDs. The sum of the 25 Hz generation is 73.5 MW (nameplate capacity if all equipment were restored to achieve maximum operational capacity). Due to present-day system constraints and equipment conditions, Jacobs estimates that the current reliable capacity of the existing 25 Hz generating assets is less than the sum of the nameplate capacities. With input from SWBNO, the total reliable capacity of these generating assets is estimated to be approximately 61.5 MW.

Existing 60 Hz generating equipment includes CTG-6 and the backup diesel generators installed at the drainage pump stations. As currently installed, these 60 Hz generation assets all serve segregated loads and cannot be used as redundant backup for one another. The only 60 Hz generation asset currently connected to the SWBNO Power Distribution Network is the 22 MW combustion turbine generator (CTG-6) at the Carrollton Power Plant. It is recommended that the distributed generators be connected to the Power Distribution Network. Under Classification 1a, an additional 10.4 MW of 60 Hz generating assets are located at drainage pump stations which are connected to the existing 25 Hz Power Distribution Network, and can be added to the system. Classification 2 adds another 10.0 MW of distributed generation to the SWBNO system. There is another 21.6 MW of distributed generation within the Classification 3 category, but the added benefit does not outweigh the cost associated with the addition.

Table 2-4 summarizes the generating assets in the SWBNO system and how they are assigned to each classification. Figure 2-6 summarizes the total 25 Hz and 60 Hz generators by classification.

Table 2-4. Electric Generating Assets by Classification

Classification	Hz	Description / Location	Nameplate Capacity (MW)	Reliable Capacity (MW)	Total Reliable (MW)
Class 1 Generators currently connected to the SWBNO Distribution Network	25	STG-1 / Carrollton Plant	6	6	61.5
		STG-3 / Carrollton Plant	15	6	
		STG-4 / Carrollton Plant	20	17	
		STG-5 / Carrollton Plant	20	20	
		EMDs / Carrollton Plant	12.5	12.5	
	60	CTG 6 / Carrollton Plant	22	22	22.0
	Total Class 1				**83.5**

Table 2-4. Electric Generating Assets by Classification

Classification	Hz	Description / Location	Nameplate Capacity (MW)	Reliable Capacity (MW)	Total Reliable (MW)
Class 1a Generators at SWBNO pump stations but not connected to SWBNO system	60	Permanent Diesel Generator / DPS 6	7.5	7.5	10.4
		Permanent Diesel Generator / DPS 7	2.86	2.86	
	Total Class 1+1a				**93.9**
Class 2 Generators not on SWBNO network but close to an existing feeder	60	DPS 19	4	4	10.0
		DPS I-10	4.7	4.7	
		DPS Pritchard	1.29	1.29	
	Total Class 1+1a+2				**103.9**

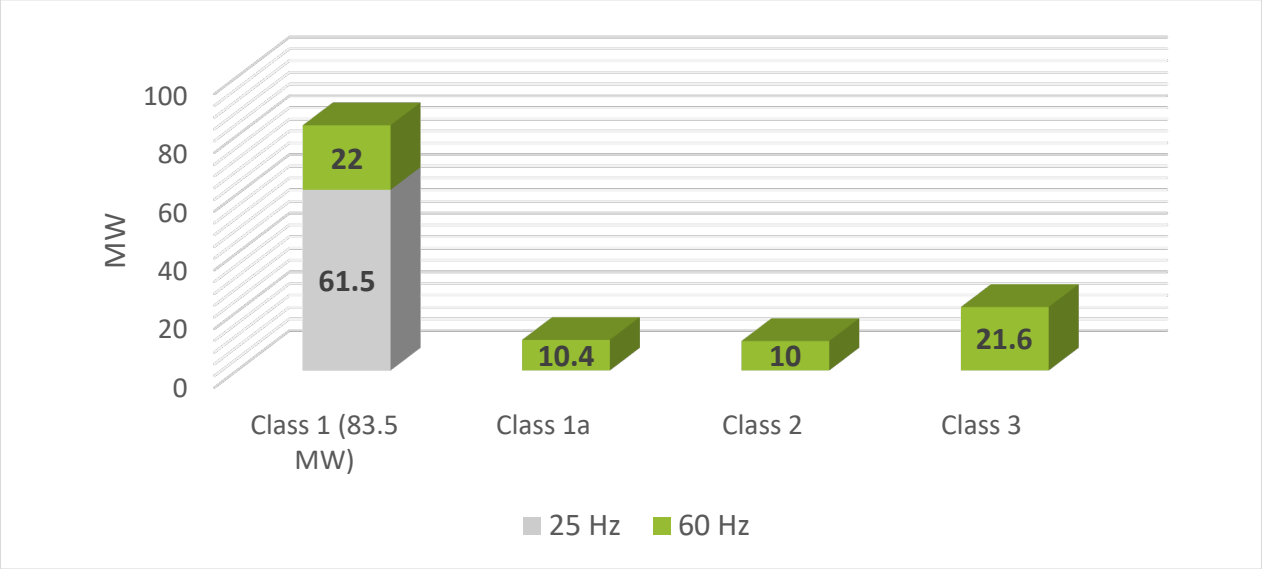


Figure 2-6. Total Reliable Generation by Classification

2.2 Total Required Generation Capacity

The Total Required Generation Capacity of the SWBNO generating assets is a critical value in the development of the SWBNO Power Master Plan because it is the base value that is used to determine the minimum Firm Reliable Generation Capacity of each alternative. The Required Generation Capacity value is based on the total load that the generating assets are expected to power at one time and is calculated by multiplying the total connected load by the SWBNO load diversity factor. The total connected load is the total capacity of all electric demand assets (Table 2-3). Since the Problem Statement requires eventual conversion of all assets to 60 Hz, the 25 Hz loads and 60 Hz loads are combined to obtain the total connected load.

$$\boldsymbol{Total\ Required\ Generation\ Capacity} = (Total\ 25\ Hz\ Load + Total\ 60\ Hz\ Load) x\ Load\ Diversity\ Factor$$

Load Diversity is the calculated percentage of an actual historical peak load compared to maximum connected load. For the purpose of this Power Master Plan, load diversity has been calculated based on records of historical events, including the May 12, 2019 storm event in which a peak 25 Hz load of 48 MW

was observed. These data were used to calculate a load diversity of 92.0% for the 25 Hz demand assets: 48 MW (peak load) / 51.6 MW (maximum connected load) = 0.93.

Although the historical peak demand of all 60 Hz sources is not known, Jacobs assumes that a similar diversity factor among presently connected 60 Hz loads is appropriate and conservative to assume for the purposes of developing power master plan alternatives. SWBNO has confirmed that this assumption is acceptable given 60 Hz operating history and knowledge.

The Total Required Generation Capacity has been calculated for each asset classification in the asset inventory. For Asset Classification 1, which includes only those 25 Hz and 60 Hz loads which are currently connected to the SWBNO Power Distribution Network, the recommended Total Required Generation Capacity of the Carrollton Power Plant is 63.4 MW.

$$\mathbf{63.4\ MW} = (51.6\ MW + 16.6\ MW)x\ 0.93$$

It is the recommendation of Jacobs that SWBNO consider the generators and loads included in Asset Classifications 1+1a as the baseline requirement to establish the Power Master Plan alternatives. This classification combines all existing loads onto a single 60 Hz Power Distribution Network. When including Asset Classification 1a, the system load is increased to include an additional 14.9 MW of 60 Hz load from drainage Pump Stations 5, 6, and 7. Therefore, it is recommended that the Total Required Generation Capacity be maintained at a minimum of 77.3 MW.

$$\mathbf{77.3\ MW} = (51.6\ MW + 16.6\ MW + 14.9\ MW)x0.93$$

Jacobs further recommends that SWBNO consider provisions for future generation capacity to allow for the connection of additional pumping stations which are geographically located near the existing Power Distribution Network feeders (Asset Classification 2) - DPS 19, Pritchard, and I-10. The additional 11.9 MW of load from these stations are nearly offset by the 10.0 MW of existing generation located at the Class 2 stations. Once connected, the existing generating assets at these stations will become part of the total generating assets, which contribute to the Total Required Generation Capacity of the 60 Hz Power Distribution Network. When including Asset Classification 2, it is recommended that the Total Required Generation Capacity be maintained at a minimum of 88.3 MW (Table 2-5).

$$\mathbf{88.3\ MW} = (51.6\ MW + 16.6\ MW + 14.9\ MW + 11.9MW)x0.93$$

Table 2-5. Total Required Generation Capacity by Classification

Classification	25 Hz Total (MW)	60 Hz Total (MW)	Diversity Factor	Total Required Generation Capacity (MW)
Class 1	51.6	16.6	0.93	63.4
Class 1+1a	51.6	31.5		77.3
Class 1+1a+2	51.6	43.4		88.3

These calculations and recommendations were reviewed with SWBNO stakeholders at the Interim Alternatives Review Meeting on August 28, 2019. SWBNO concurred with these recommendations as the basis for the Alternatives evaluated in the subsequent sections of this report.

2.3 Firm Reliable Generation Capacity

It is not practical to assume that all equipment can be kept in service concurrently at all times. All mechanical equipment requires planned outages for maintenance and is vulnerable to unplanned outages regardless of condition. As such, it is Jacobs' recommendation that SWBNO maintain enough generation capacity to meet the Total Required Generation Capacity even when the largest generation asset is unavailable due to a planned or unplanned outage. This is referred to as the Firm Reliable Generation Capacity. Based on the approved Total Required Generation Capacity described above, the following

minimum Firm Reliable Generation Capacity values will be used to develop the Power Master Plan alternatives:

- Minimum Present Firm Reliable Generation Capacity = 77.3 MW
- Minimum Future Firm Reliable Generation Capacity = 88.3 MW

For the purposes of this report, the Minimum Present Firm Reliable Generation value applies to the design of the generation capacity; while the Minimum Future Firm Reliable Generation value applies to the design of the electrical infrastructure such as switchgear, feeders, etc. The future firm value allows for expansion of the power system loads, without replacing the critical electrical infrastructure.

3. Alternative Development

Jacobs developed five alternatives which meet the key components included in the SWBNO Power Master Plan Problem Statement defined in Section 1. The Alternatives were developed based upon the evaluation of feasible options including Alternative 0, which is defined as a base case with the addition of essential upgrades to ensure ongoing and reliable operations of the Carrollton Water Plant to meet the basic threshold of reliable power. The following Alternatives were developed based on the key considerations outlined below:

- Alternative 0 – Extend Remaining Useful Service Life of Existing Plant
- Alternative 1 – Install 50 MW Utility Substation, Reduce Steam Use and Convert Loads to 60 Hz
- Alternative 2 – Install 50 MW Substation, Eliminate Steam Use, Add CTGs and Convert Loads to 60 Hz
- Alternative 3 – Install 50 MW Substation, Eliminate Steam Use, Add Engine Generators and Convert Loads to 60 Hz
- Alternative 4 – Install 120 MW Substation, Eliminate Steam Use, Add CTGs and Convert Loads to 60 Hz

Numerous options for locating new generating equipment were assessed. For efficiency of operation and maintenance, it is recommended that the new substation and generating assets be placed at the same location. Two main options were evaluated including a new West Power Complex (WPC) at the Carrollton site, and addition of assets at DPS 17 / Station D. Station D was removed from consideration due to low site elevation, distance from existing generation infrastructure, and substation hardening requirements. In coordination with SWBNO during the Interim Review meeting on August 28, 2019, it was determined that a new WPC could be developed at the location of the former sludge ponds on the west side of the Carrollton site. This option allows for new generation to be constructed before existing equipment is retired. The WPC would include a new utility substation as well as new generation assets, switchgear, and a power control station. See site layouts in Appendix B for additional information. After completion of the project, the existing power plant facilities could be repurposed for other uses.

3.1 Key Considerations

The Key Components of the project Problem Statement guide the development of the power master plan alternatives. To be considered a viable option, the alternative must include a solution to address the Key Components outlined in Table 3-1, which are further elaborated in this section.

Table 3-1. Alternative Requirements

Key Component	Solution
Public Welfare	
Cooling Water System	• Each alternative must eliminate the cooling water cross-connection at the CWP
Island Mode Operation	• Each option must include provisions for 100% Island Mode self-generation to reliably operate all critical systems in a design event in the absence of purchased utility power
Greenhouse Gas Emissions and Pollution Control	• Each option must incorporate provisions for reduced GHG emissions compared to the current baseline emissions • Each option must comply with applicable state and federal laws for emissions from generating equipment.
Efficiency, Sustainability, and Cost of Operations	
Reduced Steam Generation / Natural Gas Purchase	• Each option must consider a reduction in steam generation due to the condition of the existing steam plant. Steam is generated in the boiler house by burning natural gas and / or diesel fuel. Fuel costs can be reduced by reducing steam production.

Table 3-1. Alternative Requirements

Key Component	Solution
Equipment Selection	
Generating Assets	• Each option studied which combines all loads onto a single 60 Hz Power Distribution Network must maintain a Firm (N-1) Reliable Generation Capacity of 77.3 MW • Any new generating equipment must produce power at 60 Hz and have duel fuel operating capabilities
Frequency Conversion	• The transition plan from 25 Hz generation and use to 60 Hz generation and use may require the inclusion of a frequency converter.
Electric Demand Assets	• Electric demand loads at the drainage pump stations must be converted to 60 Hz and raised above the historic high-water line. • The recommended solution should include any fuel storage or handling modifications required to allow for 7 days of continuous operation without fuel delivery
SWBNO Network Feeders	• All existing 6.6 kV feeders in the SWBNO Power Distribution Network will be replaced with 13.8 kV feeders.
Substation Capacity	
Entergy Feeders	• Each option must consider utility interconnection to a new industrial-grade Entergy substation instead of connection to local residential or commercial utility feeds

3.1.1 Public Welfare

3.1.1.1 Cooling Water System

Following completion of a cooling water system study in December 2018, SWBNO requested that Jacobs facilitate a Turbine Cooling Water Assessment Workshop to fully understand the impacts from various perspectives and chart a path forward to mitigate the cooling water cross-connection without impacting public health or hindering plant operations. One of the main goals of the workshop was to develop solutions to address the cross-connection. It was determined that changing the source of cooling for the 25 Hz turbines in the existing powerhouse building impacts several other projects and should be part of a larger strategic master plan to address efficiency and reduce risk to the power and potable water systems.

The use of potable water for equipment cooling constitutes an illegal cross-connection between an industrial and potable water system, per the Louisiana Plumbing Code adopted in 2014. The SWBNO has committed to mitigating the connections listed in Table 3-2, and submitted a mitigation plan in June 2019.

Table 3-2. Mitigation of Cooling Water Cross-Connection (as described in June 2019 mitigation plan)

Equipment	Connection	Short-term Resolution	Long-term Resolution
Turbine 1	Condenser cooling water	Continuously circulate water within cooling system pipes and install disinfection loop	Retire Turbine 1
Turbine 3	Condenser cooling water	Continuously circulate water within cooling system pipes and install disinfection loop	Retire Turbine 3
Turbine 4	Condenser cooling water	Continuously circulate water within cooling system pipes and install disinfection loop	Segregate cooling system from the clearwell
Turbine 5	Generator cooling water	Send cooling water to drain	Segregate cooling system from the clearwell

These cross-connections need to be eliminated in a timely manner, to meet the requirements of the Louisiana Department of Health. Routing the T5 generator cooling water to drain is complete, and turbines 1 and 3 are the very last to be dispatched in the order of operations. Plans for a disinfection loop for Turbine 4 are currently under development, with options for segregating the Turbine 4 cooling system from the clearwell system to be evaluated later.

3.1.1.2 Island Mode Operation

Entergy has stated that it cannot guarantee power during significant tropical weather events. To maintain reliable drainage operations, SWBNO needs to have adequate power available for starting and operating their large drainage pumps, potable water pumps, and sewage pumps during Island Mode operation.

3.1.1.3 Greenhouse Gas Emissions and Pollution

Greenhouse Gas

GHG emissions are primarily comprised of CO_2 and equivalent compounds and are a natural product of the combustion process. The quantity of GHG emitted by a particular process is proportional to the amount and composition of fuel burned. The City of New Orleans Climate Action Plan establishes an ambitious goal of reducing annual GHG pollution by 50% from 2017 levels. This plan is predicated upon citywide use of 100% low-carbon electricity among other strategies. Furthermore, the City has committed to lead by example in taking measurable and consistent steps to reduce GHG pollution from government facilities.

Based on a 2014 inventory of government facilities and operations, the City of New Orleans has calculated their total annual volume of GHG emissions at 204,136 metric tons of carbon dioxide equivalent (CO_2e). Of this volume, 62% (approximately 162,500 metric tons) is attributed to the water and wastewater treatment facilities. As documented in the Problem Statement for this Power Master Plan, the goal of this Power Master Plan is to “define an economic, efficient, and sustainable path toward modernizing and improving its electrical power system” and to “outline a path to the most reliable, resilient, and efficient energy use through a combination of self-generation and electricity purchase.”

Pollution Control

Proper planning for emissions control and monitoring equipment should take place prior to development of major equipment requirements to ensure compliance with applicable state and federal regulations. The two most common pollutants associated with power producing facilities are nitrogen oxide (NOx) compounds and carbon monoxide (CO), both of which can be minimized through the use of emission control technology. Coordination with the Louisiana Department of Environmental Quality has not been performed at this time but will be required during design.

The existing power plant equipment has minimal provisions for control of emissions, and is not currently monitored with a continuous emissions monitoring system (CEMS). It is assumed for the purposes of this evaluation that new equipment will require some form of emission controls but likely not CEMS monitoring, since it will be operated primarily as emergency backup to utility power. As such, an allowance for emission control equipment has been included in the cost estimates and in the site layouts in the appendices. For alternatives that include the use of a gas turbine, it is assumed that a dry low-NOx engine design or a water injection system will be sufficient for pollution control. For alternatives that include the use of a reciprocating engine, selective catalytic reduction is assumed to be required.

3.1.2 Efficiency, Sustainability, and Cost of Operation

The total cost of ownership and operation for a power generation facility is greatly dependent upon the efficiency of the process by which power is generated. The environmental impact, also influenced by process efficiency, is greatly impacted by the quantity and types of fuels consumed as well. These factors are closely related, as discussed below.

3.1.2.1 Sustainability and Renewable Generation

Renewable generation technologies that harvest wind or solar energy could be added to offset the daily consumption of energy, thereby further improving both operational efficiency and environmental sustainability. However, there are physical limits to the amount of energy that can be extracted from a given area of land. Therefore, the biggest constraint to renewable generation will be space available. For example, a photovoltaic solar plant which produces 1 gigawatt-hour (GWh) per year requires approximately 2.8 acres. Excluding all rain events, the base load for constant duty equipment powered from the Carrollton Water Treatment facility is approximately 8 MW, or 70.1 GWh per year. Partnering with Entergy to construct remote renewable generation assets could be a more practical alternative to on-site renewable generation assets which would require SWBNO in-house capabilities to operate and maintain these facilities.

Also, it should be noted that wind or solar generation assets are not suitable for use as a source of emergency backup generation, as the environmental factors they require to produce power are not constantly available. As such, these types of technologies are not included in the inventory of firm capacity assets required to operate the system in an emergency event. These assets can provide significant value to SWBNO's power portfolio in reducing operating cost and GHG emissions; however, SWBNO does require 100% available power, regardless of environmental condition, to provide power to critical infrastructure, hence the focus in this study is on firm generation power assets.

3.1.2.2 Cost Reduction

Currently steam is generated in the boiler house by burning natural gas and / or diesel fuel. Fuel costs can be reduced by reducing or eliminating steam production and operating more efficient equipment.

The most critical factor that can influence the total cost of ownership and operation for the Carrollton facility relates to the amount of power that needs to be generated on site, which requires fuel and gas consumption. By constructing a dedicated and reliable utility substation, SWBNO can drastically reduce the amount of power produced onsite throughout the year. The reason that the cost of purchased utility power from Entergy is lower than the cost of power generated onsite stems from the diversity of generation sources in Entergy's portfolio, including the contributions from renewable technologies and nuclear energy.

The second most critical factor influencing the total cost of ownership and operation relates to the cost of operation and maintenance to maintain a state of readiness for emergency events when utility power is not available. These costs can be greatly reduced by replacing the existing inefficient steam generation assets with new dual fuel engine or turbine driven generation equipment. The specific impact of these two factors are evaluated more closely in the subsequent sections for each alternative studied.

3.1.3 Equipment Selection

3.1.3.1 Generating Assets

The two primary generation technologies analyzed include combustion turbine generators and reciprocating internal combustion engine (RICE) generators. Both technologies are well suited to provide the required reliability and efficiency in power generation. Both generation technologies are proven, in wide use in many utility and industrial facilities, and are available with dual fuel capability. It is assumed for all options that seven days of fuel oil reserves will be kept on site as a backup to natural gas.

For the purposes of developing the conceptual cost estimates and equipment layouts in this power master plan, Jacobs selected GE LM2500 as the basis of design for combustion turbine generators. These units provide a power output of approximately 22 MW, which is the same combustion turbine as T-6. Standardizing around this model would have the advantages of familiar operating procedures and for sharing of spare parts, driving efficiency in operations and maintenance of these units. However, other engine manufacturers such as Solar, Siemens and Kawasaki have similar offerings to allow for competitive bid procurement.

A Wartsila model 18V50DF was selected as the basis of design for the RICE generator. Wartsila currently has the most efficient offering of large capacity, dual fuel reciprocating engines in the market, which would allow SWBNO to install the fewest number of engines required to meet the Total Required Backup Generation Capacity. The 18V50DF provides a power output of 18.0 MW. Using three large capacity units is expected to reduce the total cost of installation and the land area or building footprint required compared to a larger number of smaller capacity units. Jacobs anticipates that other RICE generator manufacturers such as Jenbacher would be willing to provide competitive bids, but the fleet available may require a higher number of smaller capacity units. One notable advantage of RICE engine technology compared to combustion turbines is turn-down ratio (minimum-to-maximum range of operability). Combustion turbines operate most efficiently at or very near their full nameplate capacity, and when operated at partial load, the operating efficiency declines and the emission of GHG and pollutants increases. This can present a substantial constraint to an operations staff when operating a power network in Island Mode, particularly at times when demand is low. The RICE units can be operated efficiently at a percentage of their nameplate capacity to match a given demand load.

3.1.3.2 Electric Demand Assets

Currently, the large drainage pumps powered directly by SWBNO are operated at 25 Hz, 6,600 volts. However, modern electric generators and other electrical equipment are not designed to operate on 25 Hz power; unless designed in a custom configuration, which can add substantial cost. Furthermore, utility power in the United States is delivered at 60 Hz. For these reasons, conversion of the existing system to a 60 Hz Power Distribution Network has been recommended for many decades. Frequency changers (discussed in subsequent section) could help with construction phasing, allowing new 60 Hz generation assets to be installed and existing 25 Hz assets to be retired before converting the loads throughout the drainage pump station network. However, this should be considered a short-term solution. Due to energy losses sustained as a result of frequency conversion and the higher cost of operating and maintaining 25 Hz equipment, this report recommends that all 25 Hz pump motors throughout the drainage pump stations be replaced with new 60 Hz vertical synchronous motors mounted above the maximum considered flood elevation.

Upgrades at the drainage pump stations will be required to be compatible with the transition from 25 Hz to 60 Hz power production from SWBNO. Additional benefits of the 60 Hz pump motor conversion include improved maintenance costs and reduced lead times to source parts with the standardization to modern 60 Hz power.

Table 3-3 summarizes the upgrades that will be necessary for SWBNO to use these drainage pump station assets with 60 Hz power production.

Table 3-3. Drainage Pump Station Upgrades

Upgrade	Rating / Description
60 Hz Motor for Each Pump	Located above base flood elevation
Gearbox for Each Pump	Maintain current pump speed after motor conversion
New Motor Switchgear and Soft Starter	4,160 Volts, located above base flood elevation
Transformer(s) Inside Drainage Pump Stations	13.8 kV to 4,160 V, located above base flood elevation
New Feeder Switchgear Bus	13.8 kV, located above base flood elevation
New Feeder Cables	Rated for 15 kV Minimum

The phasing of upgrading the drainage pump stations from 25 Hz to 60 Hz must be completed in such a way that:

- Adequate drainage can be performed as required throughout construction. (Pump configurations vary by pump station.)

- Drainage pump stations are required to be at full capacity during hurricane season (June – November); that is, no pump can be out of service during this time frame.
- Redundant feeders with adequate ampacity for all loads are required.
- All new equipment must be received before work begins at each site to minimize pump down time.

These constraints are meant to protect the residents of New Orleans from flooding due to a large rain event or hurricane while the drainage pump stations are being upgraded.

3.1.3.3 Frequency Conversion

Existing rotary-type frequency changers allow for a limited amount of 60 Hz power to be converted to 24 Hz power. If the capacity for frequency conversion were to be substantially increased, it is reasonable to conclude that new 60 Hz generation assets could be installed and existing 25 Hz assets retired in advance of converting the loads throughout the drainage pump station network to 60 Hz.

Static frequency changer (SFC) sizing for each alternative must be determined by the maximum anticipated transfer of power between the 25 Hz and the 60 Hz electrical distribution systems, in either direction. It is strongly dependent on the Alternative chosen as well as the implementation plan or work phasing strategy ultimately chosen to complete the project. Under each alternative, the largest single generating source is assumed to be out of service during an emergency or maximum demand condition. This operating condition is assumed to occur at the completion of each phase of the project and the energy balance of the system is reviewed at that point. From this analysis, the maximum required power transfer across the SFC is determined.

For alternatives which do not convert the Power Distribution Network to 60 Hz, the connection of additional 60 Hz drainage pump stations to the 25 Hz Power Distribution Network would require new frequency changers and is not recommended.

3.1.3.4 SWBNO Network Feeders

The SWBNO Power Distribution Network is a mixture of 25 Hz and 60 Hz feeders that consist primarily of insulated cable belowground in duct banks with a very limited portion above ground as insulated cable or non-insulated overhead power lines. The physical duct bank infrastructure is a mix of aging tile formed ‘conduits’ and manholes, aging direct buried conduits and brick manholes, and contemporary concrete encased non-metallic conduit and precast concrete manholes. Many of the duct bank alignments are along public rights-of-way. The availability of vacant usable duct bank pathways is limited throughout the system.

The topology of the SWBNO managed Power Distribution Network is a hybrid of radial and looped feeders with multiple multi-feeder interconnection nodes. There are multiple power supply source interconnections throughout the SWBNO managed Power Distribution Network with a few of the major hubs being the Carrollton Water Treatment Plant Power Complex, the Carrollton Frequency Changer, and STA-D (DPS-17) Frequency Changer.

A portion of the SWBNO managed Power Distribution Network feeders have been replaced under the Hazard Mitigation Grant Program (HMGP). However, many more feeders still require replacement, as they exhibit signs of aging beyond their usable life with frequent failures. The nominal voltage of the 25 Hz portion of the SWBNO managed Power Distribution Network is 6600 V while the nominal voltage of the 60 Hz portion of the network is 4160 V. Feeders that have been replaced under the HMGP are 15 kV rated cable operating at 4160 V.

This Power Master Plan recommends replacement of feeders that have not yet been upgraded, and raising the distribution voltage to 13.8 kV in alignment with the upgrades associated with the HMGP. The conversion to a higher distribution voltage will allow more power to be delivered through the same conduits presently installed, garnering efficiencies in the Power Distribution Network.

3.1.4 Substation Capacity

Another differentiator between the alternatives relates to the capacity of substation to be constructed. Jacobs analyzed two different sizes, a 50 MVA and a 120 MVA. The 120 MVA substation was sized based on the total connected loads of approximately 119 MW in Old City Drainage, allowing for all pumping power to be supplied by the Entergy substation now and in the future. In this scenario, SWBNO could purchase 100% of their power from Entergy on a regular basis, including heavy drainage events. The generation assets would not be needed for any pumping scenario as long as utility power is available. However, a disadvantage of purchasing large amounts of utility power is that SWBNO would incur a larger demand charge, therefore, increasing the total average cost of purchased electricity throughout the entire year.

The 50 MVA sized substation was nominally selected to analyze the potential savings of a smaller substation. This alternative would still be capable of supplying all power required by the SWBNO Power Distribution Network for typical operations up to 50 MW. However, during a peak demand event, the 50 MVA substation would not be able to deliver all the power required. Therefore, SWBNO would need to operate their generation assets during heavy drainage events in parallel with the utility power available. For the purpose of the economic analysis, Jacobs assumed that annual drainage activities requiring power in excess of 50 MVA will occur for approximately 300 hours per year on average.

3.2 Alternative 0 – Extend Remaining Useful Service Life of Existing Plant

Alternative 0 represents the current trajectory of operation and maintenance of the Carrollton Power Plant and Power Distribution Network if existing systems are upgraded to prolong useful service life for 30 years but are not replaced. Previous studies have conclusively demonstrated that continued operation of the power generation and Power Distribution Network as-is is not viable due to age and condition of equipment; therefore, investment is required in order to maintain use of the existing system, and provide an equivalent solution for comparison to the other alternatives in this Power Master Plan evaluation. Table 3-4 outlines how each of the key components of the Problem Statement are addressed in Alternative 0, and Figure 3-1 summarizes the proposed generation assets.

Table 3-4. Alternative 0 Solutions

Key Component	Solution
Public Welfare	
Cooling Water System	• A new “river cooling” heat exchanger system will be installed to eliminate the cooling water cross connect at the STG-1, STG-3, and STG-4 condensers. • A fin-fan cooler would be installed to eliminate the cooling water cross connect at CTG-5
Island Mode Operation	• Total Reliable Generating Capacity = 83.5 MW • Firm Reliable Generating Capacity = 61.5 MW (note that this is less than the recommended value) • Future Firm Reliable Generating Capacity = N/A (*Connection of additional 60 Hz drainage pump stations to 25 Hz Power Distribution Network would require new frequency changers and is not recommended*)
Greenhouse Gas Emissions and Pollution Control	• This option produces an estimated 120,200 tons/yr of GHG emissions • Upgrades to equipment will include emissions controls and/or permitting revisions as required for compliance with state and federal laws
Efficiency, Sustainability and Cost of Operation	
Reduced Steam Generation / Natural Gas Purchase	• Steam generation will not be reduced. • Natural gas purchase will not be reduced.

Table 3-4. Alternative 0 Solutions

Key Component	Solution
Equipment Selection	
Generating Assets	• Major equipment upgrades will be required at STG-1, STG-3 and CTG-5 to extend useful service life and facilitate parallel operation. • Major upgrades to the boiler house will be required to extend the useful life of the system and to produce additional steam to improve the power output of STG-4.
Frequency Conversion	• The existing rotary frequency changer in the plant frequency changer building will be replaced with a minimum 15 MW capacity SFC.
Electric Demand Assets	• SWBNO would continue to operate with a power network and drainage pump stations bifurcated into 60 Hz and 25 Hz system components. • All existing pump motors, switchgear and other electrical components sensitive to floodwaters would be relocated or replaced above the maximum considered flood elevation.
SWBNO Network Feeders	• All remaining 6.6 kV feeders in the SWBNO Power Distribution Network not previously replaced in the Hazard Mitigation Grant Program project will be replaced with new 13.8 kV feeders.
Substation Capacity	
Entergy Feeders	• No new substation. • The reliability of existing 60 Hz feeders from Entergy would not be improved.

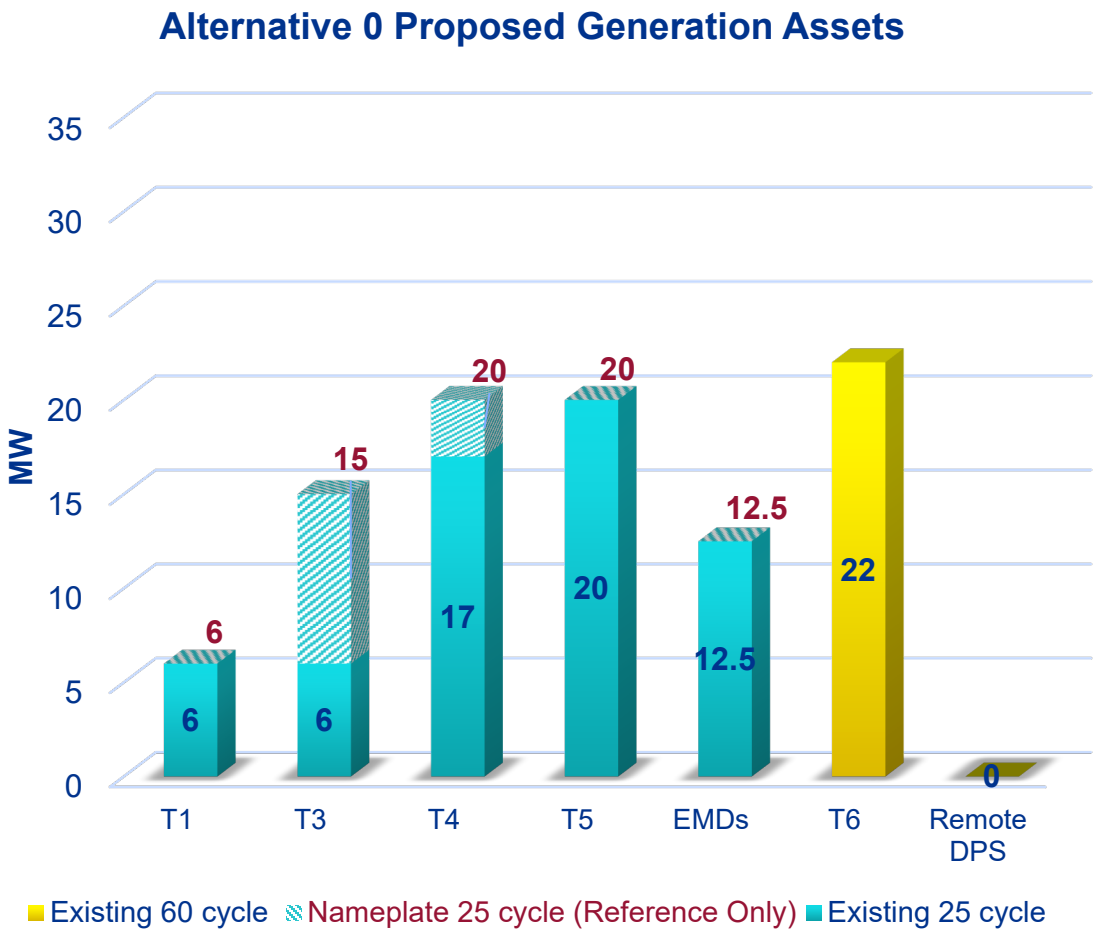


Figure 3-1. Alternative 0 Proposed Generation Assets

3.3 Alternative 1 – Install 50 MW Utility Substation, Reduce Steam Use and Convert Loads to 60 Hz

In Alternative 1, purchased utility power becomes the primary source of energy via a dedicated substation. SWBNO Generation is needed only when system demand exceeds substation capacity or when utility power is unavailable (estimated to be 300 hours per year). Table 3-5 outlines how each of the key components of the Problem Statement are addressed in Alternative 1, and Figure 3-2 summarizes the proposed Generation Assets.

Table 3-5. Alternative 1 Solutions

Key Component	Solution
Public Welfare	
Cooling Water System	• A new "river cooling" heat exchanger system will be installed to eliminate the cooling water cross connect at the STG-4 condenser. • A fin-fan cooler would be installed to eliminate the cooling water cross connect at CTG-5
Island Mode Operation	• Total Reliable Generating Capacity = 106.9 MW • Firm Reliable Generating Capacity = 84.9 MW • Future Firm Reliable Generating Capacity = 94.9 MW (10 MW added by connection of Class 2 generating assets)
Greenhouse Gas Emissions and Pollution Control	• This option produces an estimated 79,800 tons/yr of GHG emissions • New equipment will include emissions controls and/or permitting revisions as required for compliance with state and federal laws
Efficiency, Sustainability and Cost of Operation	
Reduced Steam Generation / Natural Gas Purchase	• Retire all boilers except for Boiler #2. Demolish all existing steam piping and install a new direct steam connection from Boiler #2 to STG-4 only • Install new 150 kpph Auxiliary Boiler to meet T4 optimum operating conditions • Natural gas purchase would only be required when power demand exceeds substation capacity and SWBNO generating assets are running or in an Emergency situation when Entergy is not available.
Equipment Selection	
Generating Assets	• Install one new 60 Hz LM2500 dual fuel combustion turbine generator with an approximate capacity of 22 MW • Retire STG-1 and STG-3. • Boiler plant upgrades as noted above. However, a new deaerator and new water treatment equipment will still be required, at a minimum • Major equipment upgrades will be required at CTG - 5 to extend useful service life and facilitate parallel operation • New 600 psi gas compressor • Connect Class 1a generating assets (DPS Diesel Generators) to Power Distribution Network
Frequency Conversion	• Install three 25 MW capacity 60 Hz to 25 Hz SFCs to allow for replacement of existing 25 Hz generation assets with new 60 Hz generation at the WPC prior to conversion of 25 Hz load throughout the City to 60 Hz. SFCs may be retired as loads are converted.
Electric Demand Assets	• Replace all 25 Hz pump motors with new 60 Hz motors and gearboxes installed above base flood elevation. This work will need to be phased over multiple years.
SWBNO Network Feeders	• All remaining 6.6 kV feeders in the SWBNO Power Distribution Network not previously replaced in the HMGP project will be replaced with new 13.8 kV feeders.
Substation Capacity	
Entergy Feeders	• Install a new Entergy substation with 50 MVA capacity • All SWBNO generating assets become backup only for when Entergy is not available or demand exceeds substation capacity.

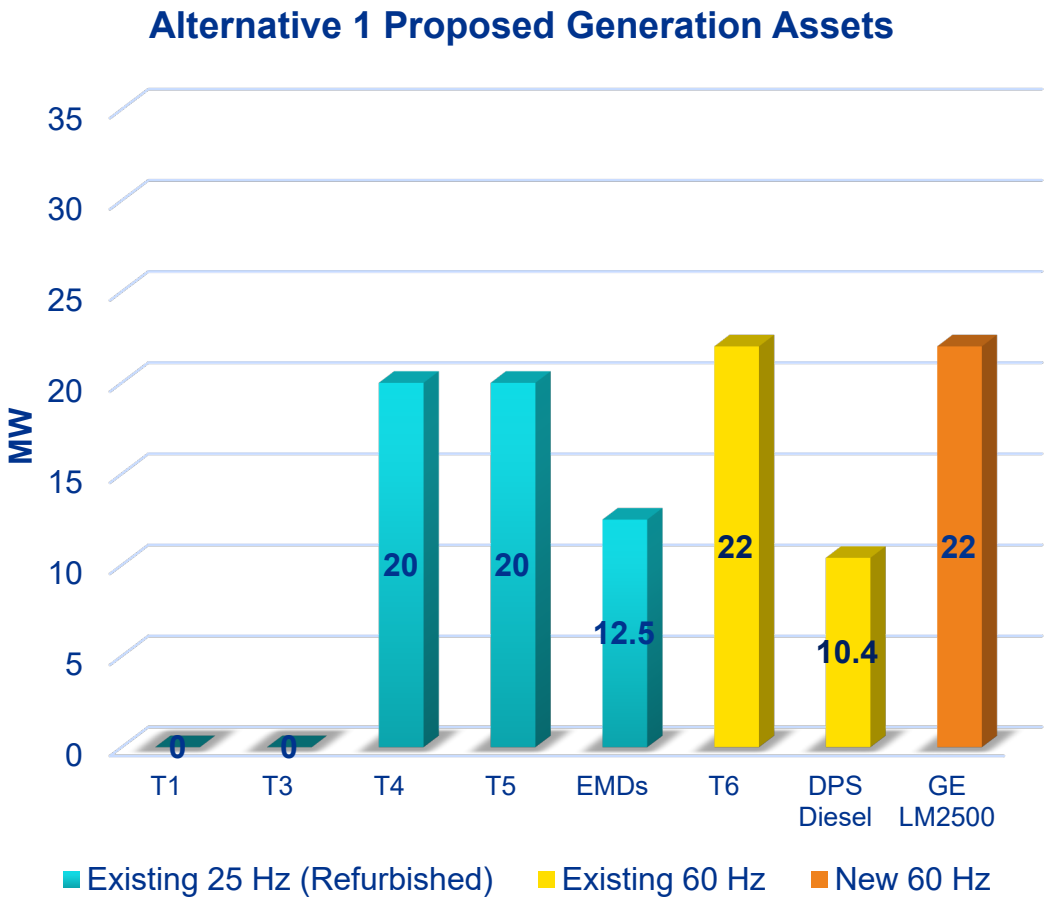


Figure 3-2. Alternative 1 Proposed Generation Assets

3.4 Alternative 2 – Install 50 MW Substation, Eliminate Steam Use, Add CTGs and Convert Loads to 60 Hz

In Alternative 2, purchased utility power is the primary source of energy via a dedicated substation, and SWBNO generation is needed only when system demand exceeds substation capacity or when utility power is unavailable. This alternative considers eliminating all steam production equipment, steam turbine generators, and CTG-5. Three new combustion turbine generators similar to the existing CTG-6 at the Carrollton Power Plant would be installed to replace this generation capacity. Table 3-6 outlines how each of the key components of the Problem Statement are addressed in Alternative 2, and Figure 3-3 summarizes the proposed Generation Assets.

Table 3-6. Alternative 2 Solutions

Key Component	Solution
Public Welfare	
Cooling Water System	• Cross connect concerns would be eliminated by the retirement of all existing cross connected equipment
Island Mode Operation	• Total Reliable Generating Capacity = 110.9 MW • Firm Reliable Generating Capacity = 88.9 MW • Future Firm Reliable Generating Capacity = 98.9 MW (10 MW added by connection of Class 2 generating assets)

Table 3-6. Alternative 2 Solutions

Key Component	Solution
Greenhouse Gas Emissions and Pollution Control	• This option produces an estimated 78,100 tons/yr of GHG emissions • New equipment will include emissions controls and/or permitting revisions as required for compliance with state and federal laws
Efficiency, Sustainability and Cost of Operation	
Reduced Steam Generation / Natural Gas Purchase	• Retire all steam generation and use. • Natural gas purchase would only be required when power demand exceeds substation capacity and SWBNO Generating assets are running or in an Emergency situation when Entergy is not available.
Equipment Selection	
Generating Assets	• **Install three new LM2500 dual fuel combustion turbine generators with an approximate capacity of 22 MW each** • Three new 600 psi gas compressors • Retire STG-1, STG-3, STG-4, CTG-5, and boiler plant • Connect Class 1a generating assets (DPS Diesel Generators) to Power Distribution Network
Frequency Conversion	• Install three 25 MW capacity 60 Hz to 25 Hz SFCs to allow for replacement of existing 25 Hz generation assets with new 60 Hz generation at the WPC prior to conversion of 25 Hz load throughout the City to 60 Hz. SFCs may be retired as loads are converted.
Electric Demand Assets	• Replace all 25 Hz pump motors with new 60 Hz motors and gearboxes installed above base flood elevation. This work will need to be phased over multiple years.
SWBNO Network Feeders	• All remaining 6.6 kV feeders in the SWBNO Power Distribution Network not previously replaced in the HMGP project will be replaced with new 13.8 kV feeders.
Substation Capacity	
Entergy Feeders	• Install a new Entergy substation with 50 MVA total capacity • All SWBNO generating assets become backup only when Entergy is not available, or demand exceeds substation capacity.

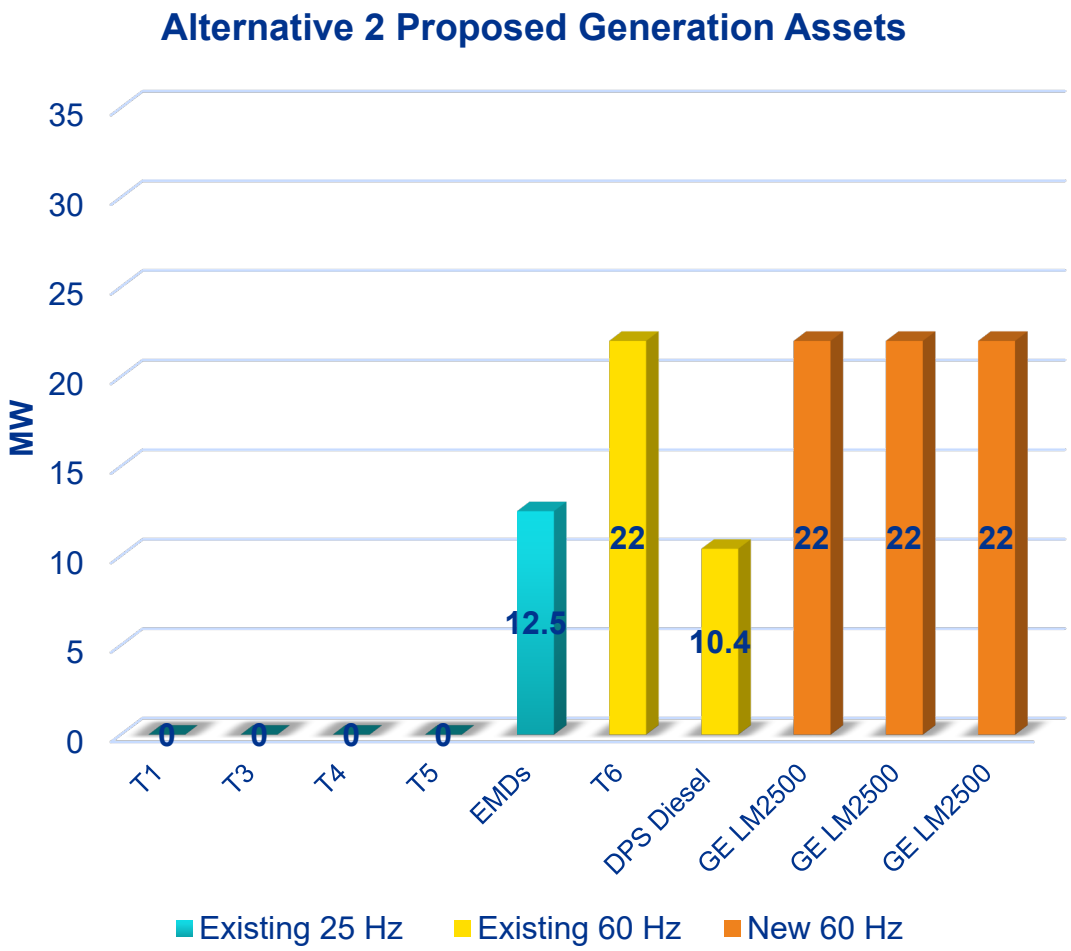


Figure 3-3. Alternative 2 Proposed Generation Assets

3.5 Alternative 3 – Install 50 MW Substation, Eliminate Steam Use, Add Engine Generators and Convert Loads to 60 Hz

In Alternative 3, purchased utility power is the primary source of energy via a dedicated substation, and SWBNO Generation is needed only when system demand exceeds substation capacity or when utility power is unavailable. This alternative considers eliminating all steam production equipment, steam turbine generators and CTG-5. Three new engine generators would be installed to replace this generation capacity. This option evaluates the LCC benefit of engine generators in lieu of combustion turbine generators. Table 3-7 outlines how each of the key components of the Problem Statement are addressed in Alternative 3, and Figure 3-4 summarizes the proposed Generation Assets.

Table 3-7. Alternative 3 Solutions

Key Component	Solution
Public Welfare	
Cooling Water System	• Cross connect concerns would be eliminated by the retirement of all existing cross connected equipment
Island Mode Operation	• Total Reliable Generating Capacity = 98.9 MW • Firm Reliable Generating Capacity = 76.9 MW • Future Firm Reliable Generating Capacity = 86.9 MW (10 MW added by connection of Class 2 generating assets)
Greenhouse Gas Emissions and Pollution Control	• This option produces an estimated 77,800 tons/yr of GHG emissions • New equipment will include emissions controls and/or permitting revisions as required for compliance with state and federal laws
Efficiency, Sustainability and Cost of Operation	
Reduced Steam Generation / Natural Gas Purchase	• Retire all steam generation and use. • Natural gas purchase would only be required when power demand exceeds substation capacity and SWBNO generating assets are running or in an emergency situation when Entergy is not available.
Equipment Selection	
Generating Assets	• **Install three new Wartsila 18V50DF dual fuel engine generators with an approximate capacity of 18 MW each** • Retire STG-1, STG-3, STG-4, CTG-5, and boiler plant • Connect Class 1a generating assets (DPS Diesel Generators) to Power Distribution Network
Frequency Conversion	• Install three 25 MW capacity 60 Hz to 25 Hz SFCs to allow for replacement of existing 25 Hz generation assets with new 60 Hz generation at the WPC prior to conversion of 25 Hz load throughout the City to 60 Hz. SFCs may be retired as loads are converted.
Electric Demand Assets	• Replace all 25 Hz pump motors with new 60 Hz motors and gearboxes installed above base flood elevation. This work will need to be phased over multiple years.
SWBNO Network Feeders	• All remaining 6.6 kV feeders in the SWBNO Power Distribution Network not previously replaced in the Hazard Mitigation Grant Program project will be replaced with new 13.8 kV feeders.
Substation Capacity	
Entergy Feeders	• Install a new Entergy substation with 50 MVA total capacity • All SWBNO generating assets become backup only for when Entergy is not available, or demand exceeds substation capacity.

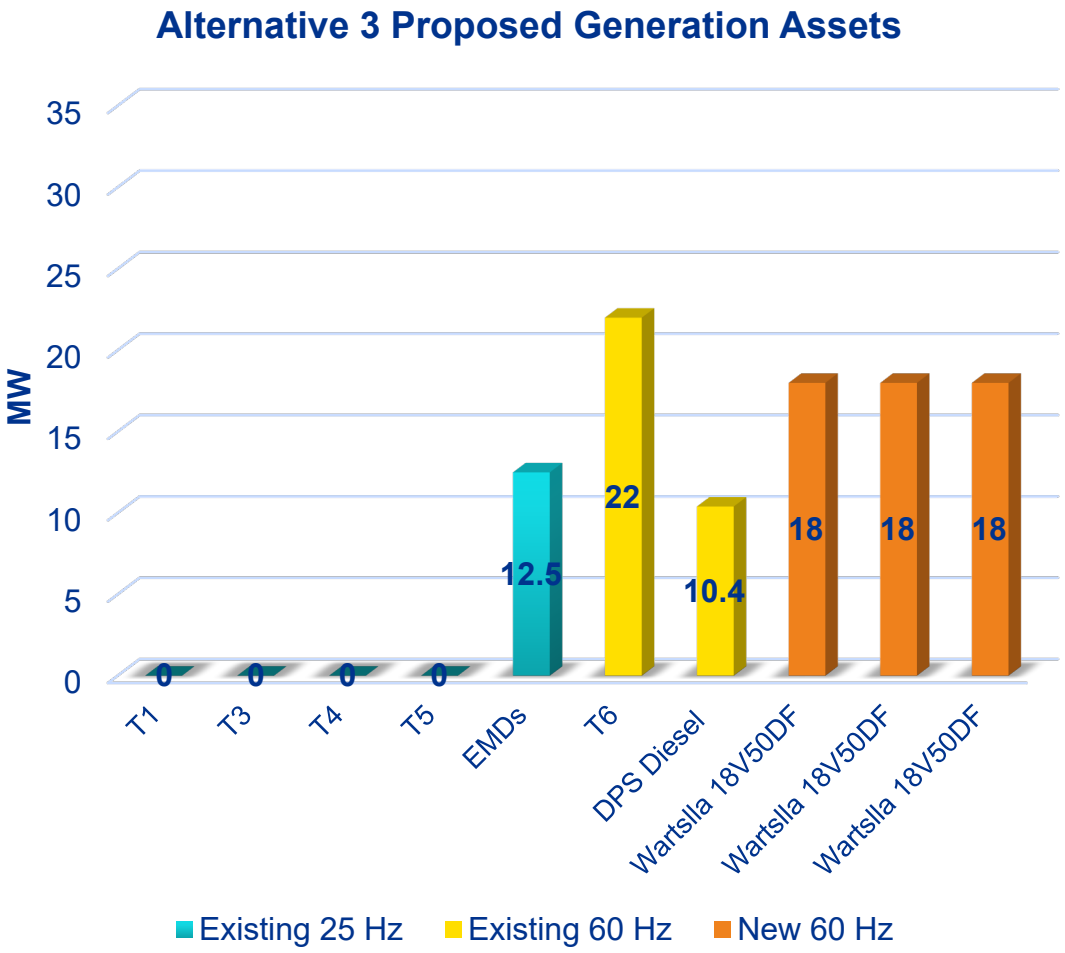


Figure 3-4. Alternative 3 Proposed Generation Assets

3.6 Alternative 4 – Install 120 MW Substation, Eliminate Steam Use, Add CTGs and Convert Loads to 60 Hz

In Alternative 4, purchased utility power is the primary source of energy via a new Entergy substation with 120 MVA total capacity. SWBNO Generation is needed only when utility power is unavailable. This option would likely result in higher charges for standby power capacity, but would also allow SWBNO to use generation assets less frequently during rain events. This option would allow SWBNO to assess the cost benefit of potentially selling power back into the transmission grid when the wholesale price of power is favorable. This alternative considers eliminating all steam production equipment, steam turbine generators and CTG-5. Three new combustion turbine generators similar to the existing CTG-6 at the Carrollton Power Plant would be installed to replace this generation capacity. Table 3-8 outlines how each of the key components of the Problem Statement are addressed in Alternative 4, and Figure 3-5 summarizes the proposed Generation Assets.

Table 3-8. Alternative 4 Solutions

Key Component	Solution
Public Welfare	
Cooling Water System	• Cross-connect concerns would be eliminated by the retirement of all existing cross-connected equipment
Island Mode Operation	• Total Reliable Generating Capacity = 110.9 MW • Firm (N-1) Reliable Generating Capacity = 88.9 MW • Future Firm (N-1) Reliable Generating Capacity = 98.9 MW (10 MW added by connection of Class 2 generating assets)
Greenhouse Gas Emissions and Pollution Control	• This option produces an estimated 77,800 tons/yr of GHG emissions • New equipment will include emissions controls and/or permitting revisions as required for compliance with state and federal laws
Efficiency, Sustainability and Cost of Operation	
Reduced Steam Generation / Natural Gas Purchase	• Retire all steam generation and use. • **Natural gas purchase would only be required when Entergy is unavailable.**
Equipment Selection	
Generating Assets	• **Install three new LM2500 dual fuel combustion turbine generators with an approximate capacity of 22 MW each** • Three new 600 psi gas compressors • Retire STG-1, STG-3, STG-4, CTG-5, and boiler plant • Connect Class 1a generating assets (DPS Diesel Generators) to Power Distribution Network
Frequency Conversion	• Install three 25 MW capacity 60 Hz to 25 Hz SFCs to allow for replacement of existing 25 Hz generation assets with new 60 Hz generation at the WPC prior to conversion of 25 Hz load throughout the City to 60 Hz. SFCs may be retired as loads are converted.
Electric Demand Assets	• Replace all 25 Hz pump motors with new 60 Hz motors and gearboxes installed above maximum considered flood elevation. This work will need to be phased over multiple years.
SWBNO Network Feeders	• All remaining 6.6 kV feeders in the SWBNO Power Distribution Network not previously replaced in the Hazard Mitigation Grant Program project will be replaced with new 13.8 kV feeders.
Substation Capacity	
Entergy Feeders	• Install a new Entergy substation with two 60 MVA peak rated transformers (120 MVA total capacity) • All SWBNO generating assets become backup only for when Entergy is not available

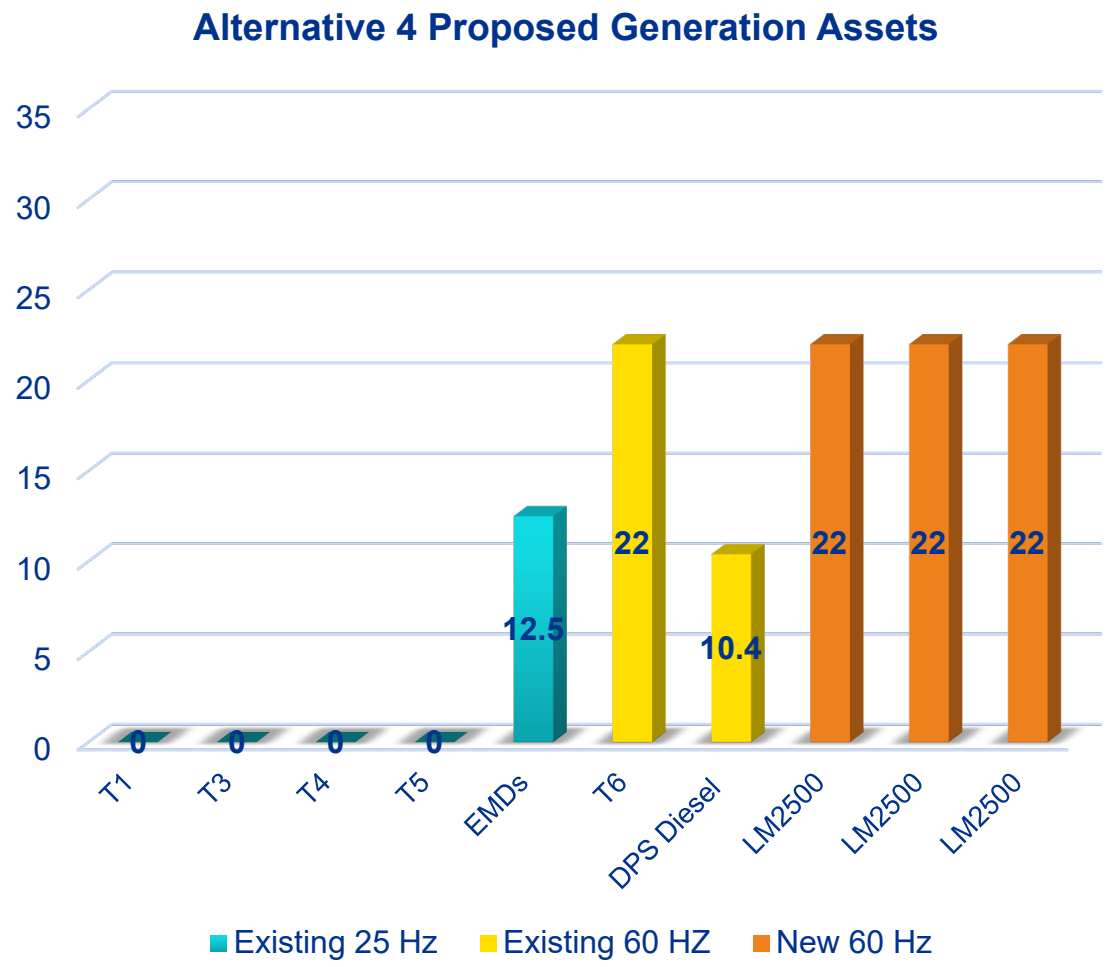


Figure 3-5. Alternative 4 Proposed Generation Assets

A comparative summary table of the alternatives is included in Appendix C.

4. Comparison of Alternatives

Each of the alternatives described in this report were evaluated and ranked against one another using an evaluation matrix, during the Alternative Review Workshop with SWBNO on November 6, 2019. Table 4-1 lists the evaluation factors and associated maximum points that were defined during the Workshop and utilized in the evaluation.

Table 4-1. Evaluation Factors and Associated Points

Max Points	Evaluation Factor	Rank / Reasoning
35	Life Cycle Cost (LCC)	(1) SWBNO is interested in a long-term cost-effective solution for critical public health and safety services in Orleans Parish. The optimal solution for the power system will provide an opportunity to re-allocate funds from the aging power system to other infrastructure in the Parish.
25	Improved Reliability / Resiliency	(2) New Orleans' critical infrastructure is crucial to the health and safety of residents and visitors. Because of its age and condition, the existing power system is unreliable. If a component stops working there is low confidence that it can start again in a timely manner. Confidence in the critical power infrastructure is important to SWBNO.
10	GHG Emissions / Sustainability	(3) Environmental considerations are important in climate change management. The Climate Action for a Resilient New Orleans plan was incorporated into the evaluation criteria.
5	Capital Cost	(4) The remaining six evaluation factors contribute an equal weight to the overall ranking. Each of the factors is important to SWBNO, and helps differentiate each of the alternatives.
5	Elimination of 25 Hz Systems	
5	Location	
5	Operability	
5	Maintainability	
5	Stakeholder Impact / Marketability	
100	**Total**	The maximum amount of points is 100

4.1 Evaluation Factors

4.1.1 Life Cycle Cost

The LCC analysis calculates a total LCC in current-day dollars for each alternative, taking into account capital investment, annual purchased utilities, relative operation and maintenance costs, utility cost escalation, inflation, etc. The following assumptions apply to the LCC analysis:

- It is assumed that the transition of load from existing 25 Hz generation assets to new 60 Hz utility power or backup generation assets will be phased over at least 5 years. The LCC evaluation will be calculated based on an assumed completion date 5 years from now.
- Length of the economic study is 30 years after project completion
- Capital costs for procurement and installation of new plant equipment are spread over 30 years, with a 3.75% interim finance rate.
- Discount rate is 3.75%
- Inflation rate is 3%
- Operation and maintenance escalation rate is 3%
- Utility rate escalations are based on U.S. Department of Energy escalation projections for both natural gas and purchased electricity, specific to the state of Louisiana

- End-of-year accounting convention is utilized
- It is assumed that backup (diesel) fuel will only be consumed when natural gas is unavailable. Because the loss of natural gas supply is unlikely to occur often, the use of backup (diesel) fuel is not considered in the analysis.
- Tax implications are not considered

LCC results (presented in Appendix D) summarize the spreadsheet-based analysis completed for each alternative. The Alternative 0 model includes major necessary upgrades to the existing plant and to the pump stations as required to achieve the fundamental goals of the project such as improved reliability, elimination of cooling water cross connections, etc. Without these Alternative 0 upgrades, the existing plant would be unreliable and inadequate to continue serving the current drainage load demand. This alternative is an important benchmark against which the cost and economic performance of other alternatives can be compared and evaluated.

For purposes of comparison, major generating equipment maintenance costs are based on Long Term Service Agreement (LTSA) budget quotes from the equipment manufacturers. It is understood that this is not necessarily the contractual mechanism by which this work will be done by SWBNO. The estimated cost of operation and maintenance for each option includes an approximation for the number and type of personnel required and the approximate cost per employee to adequately operate and maintain the on-site power generation systems at the Carrollton Power Plant and/or a new WPC. It does not attempt to capture the cost of operation and maintenance of other SWBNO-owned systems such as water treatment facilities, water distribution systems, or remote stormwater drainage and sewer pumping stations (Appendix E). Cost savings resulting from efficiencies gained with pump motor upgrades are not included in this analysis but should be considered in future master planning efforts.

The LCC analysis considers the cost of electric utilities. The 2018 utility bill spreadsheet provided to SWBNO from Entergy identifies multiple rate structures used to calculate charges for SWBNO's various utility accounts. For the purpose of this evaluation, the cost and consumption of electric energy and natural gas for Alternative 0 is assumed to continue accordingly. Based on a meeting with SWBNO and Entergy on October 3, 2019, Entergy cannot definitively say what rate structure would be utilized to calculate the cost of utility power from the planned transmission level substation. However, two published rate structures were discussed as likely candidates. These include the High Voltage Service rate schedule (HV-24) and the Large Interruptible rate schedule (LIS-13). For the purpose of this analysis, Jacobs created a load profile based on the connected load and the estimated minimum connected load, along with the total kilowatt-hours purchased and produced in 2018. Both rate schedules were applied to Alternatives 1 through 4, and an associated LCC was calculated. Details of the analyses are included in Appendix E.

In addition to the baseline LCC comparison, the spreadsheets created for this evaluation allow for each option to be subjected to a sensitivity analysis to verify the stability of the LCC savings against unforeseen fluctuations in purchased utility costs. The intent of this analysis is to provide greater confidence that the recommended plant configuration will result in economic benefit to SWBNO over a broad range of potential market volatility as well as changes in utility rate structures. The following values may be manipulated with instant recalculation of LCC:

- Increased/decreased escalation of the fuel gas rate
- Increased/decreased escalation of the electric rate

A graphical representation of the sensitivity analysis is included in Appendix F. Based on the calculations, a fluctuation in the cost of fuel gas has the greatest impact on the LCC savings of each alternative, primarily due to the present day (Alternative 0) sensitivity to fuel cost.

Each alternative was ranked based on the LCC evaluation factor, and points were assigned based on the following six criteria listed in Table 4-2. The LCC contributes about 35% to the total evaluation.

Table 4-2. Life Cycle Cost Evaluation

Points	Criteria
35	Lowest Cost Option
31.5	Within 2% of Lowest Cost Option
28	Within 4% of Lowest Cost Option
24.5	Within 6% of Lowest Cost Option
17.5	Within 10% of Lowest Cost Option
0	>10% Above Lowest Cost Option

4.1.2 Improved Reliability / Resiliency

Reliability describes the ability of a system or component to function under stated conditions for a specified period of time. Reliability is closely related to availability, which is typically described as the ability of a component or system to function at a specified moment or interval of time. Resilience is an ability to recover from or adjust easily to unforeseen events or change. This Plan addresses resilience by including a dependable connection to Entergy at a new substation as well as generator redundancy in the SWBNO system.

Reliability of each alternative was based on the following factors:

- Type of generating equipment – steam turbines vs. combustion turbines vs. reciprocating generators
- Equipment age – older equipment is less reliable
- Estimated equipment run time – day-to-day operation vs. operation during rain events vs. operation during Island Mode only
- Ease of operation and maintenance
- Availability of skilled talent
- Availability of spare parts

Each alternative was ranked based on the Improved Reliability / Resiliency evaluation factor, and points were assigned based on the criteria listed in Table 4-3. Improved Reliability / Resiliency contributes about 25% to the total evaluation.

Table 4-3. Improved Reliability / Resiliency Evaluation

Points	Criteria
25	Substation Installed All existing equipment (T1, T3, T4, and T5) replaced All steam generation retired
12.5	Substation installed Some existing equipment refurbished (T5 refurbished and power controls upgraded to allow for parallel operation) Some existing equipment (T1 and T3) replaced
0	Equipment refurbished, but not replaced Frequency conversion capacity improved No substation installed

4.1.3 Greenhouse Gas Emissions / Sustainability

Jacobs evaluated the volume of GHG currently being emitted by the SWBNO as a result of thermal energy generated at the Carrollton Power Plant and how those emission quantities would be affected by

implementing each of the options studied. These calculations do not include GHG emissions attributable to other power-producing plants, power consumed at other substations, or other sources such as transportation emissions. Refer to Appendix D of this report for a summary and comparison of CO_2 emissions for each option considered. All options other than Alternative 0 offer a significant reduction in annual GHG emissions.

Utility power in New Orleans is produced at a lower GHG intensity compared to self-generated power at the Carrollton Power Plant today. The utility power originates from many sources which include nuclear power plants in addition to fossil fuel plants and renewable sources. According to data published by the U.S. Energy Information Administration, the GHG emissions created in the production of all utility power in the region averages 1,125 pounds per megawatt-hour (MWh). Because all alternatives contemplated in this Power Master Plan propose the addition of a utility substation, SWBNO will be able to reduce plant emissions by approximately 36,650 metric tons per year (18% of the City of New Orleans calculated metric tons of CO_2) simply by purchasing utility power in lieu of self-generation.

Each alternative was ranked based on the Greenhouse Gas Emissions / Sustainability evaluation factor, and points were assigned based on the six criteria listed in Table 4-4. Greenhouse Gas Emissions / Sustainability contributes about 10% to the total evaluation.

Table 4-4. Greenhouse Gas Emissions / Sustainability Evaluation

Points	Criteria
10	Lowest GHG Option
8	Within 1% of Lowest GHG Option
6	Within 3% of Lowest GHG Option
4	Within 5% of Lowest GHG Option
2	Within 10% of Lowest GHG Option
0	>10% Above Lowest GHG Option

4.1.4 Capital Cost

Preliminary cost estimates presented in Appendix G were prepared for each alternative. These construction cost estimates may have a margin of error of roughly ±30% for the scope of proposed construction. The costs are based on Jacobs' database of previous project costs and estimates previously prepared for the SWBNO. These costs are prepared on a comparative basis, and should not be considered all-inclusive for an individual alternative. Additional costs for each alternative may include permitting, general site work, site lighting, and costs associated with construction phasing.

Each alternative was ranked based on the capital cost evaluation factor, and points were assigned based on the six criteria listed in Table 4-5. The initial capital cost contributes about 5% to the total evaluation.

Table 4-5. Capital Cost Evaluation

Points	Criteria
5	Lowest Cost Option
4.5	Within 1% of Lowest Cost Option
4	Within 2% of Lowest Cost Option
3.5	Within 5% of Lowest Cost Option
3	Within 7% of Lowest Cost Option
2.5	Within 10% of Lowest Cost Option

4.1.5 Elimination of 25 Hz Assets

25 Hz power systems are increasingly becoming more difficult and expensive to maintain, as extremely few systems in the United States continue to operate at this frequency. Furthermore, most of the existing 25 Hz assets at the Carrollton Power Plant, aside from the recently refurbished T4 and the relatively new EMDs, have exceeded their useful service life. Because 25 Hz pump motors cannot operate on utility power without the use of frequency converters, a total transition away from the production and use of 25 Hz assets can substantially simplify the SWBNO system while improving both efficiency and reliability. This transition has been recommended in numerous previous engineering reports dating back to 1974 and remains a fundamental goal of this Power Master Plan. All alternatives except Alternative 0 and Alternative 1 consider complete transition to a 60 Hz system of generation and use.

Each alternative was ranked based on the Elimination of 25 Hz Assets evaluation factor, and points were assigned based on the three criteria listed in Table 4-6. Elimination of 25 Hz Assets contributes about 5% to the total evaluation.

Table 4-6. Elimination of 25 Hz Assets Evaluation

Points	Criteria
5	All 25 Hz assets (T1, T3, T4, and T5) replaced with 60 Hz generation capacity
2.5	Some 25 Hz assets (T1 and T3) replaced with 60 Hz generation capacity
0	All 25 Hz generation retained

4.1.6 Location

Each alternative was ranked based on the Location evaluation factor, and points were assigned based on the criteria listed in Table 4-7. Location contributes about 5% to the total evaluation. At the request of SWBNO, the cost analysis in this report assumes that new generating equipment will be installed in a new power plant building, though equipment enclosures are also available that would allow for outdoor installation potentially at reduced cost. In either case, acoustic enclosures will be required to mitigate noise transmission and ensure a safe working environment for plant personnel.

Table 4-7. Location Evaluation

Points	Criteria
5	All generation located at a new WPC, located further from residents Generation assets only operated when Entergy is not available (very rarely)
4	EMD assets near residents rarely operated Generation Assets only operated during drainage events Most Generation Assets elevated
0	Generation assets near residents at existing site, frequently in operation

4.1.7 Operability

Each alternative was ranked based on the Operability evaluation factor, and points were assigned based on the three criteria listed in Table 4-8. Operability contributes about 5% to the total evaluation. The primary operability goals of SWBNO include prompt start-up to respond quickly to weather or power availability events, as well as a significant engine turn-down rate to allow for one primary generator to be able to carry anticipated dry-weather connected load of approximately 6 to 10 MW, within the manufacturer's recommended operating parameters of the equipment.

Table 4-8. Operability Evaluation

Points	Criteria
5	New Engines can be started in less than 5 minutes Capacity of Single New Generator is limited to capacity of largest existing generators (resulting in an equivalent minimum generation capability) New Engine Power output can be turned down to 30%
2.5	New Engines can be started in less than 15 minutes Capacity of Single New Generator is higher than capacity of largest existing generator (resulting in a higher minimum generation capability) New Engine Power output can be turned down to 50%
0	Start-up requires heating up steam boiler - more than 1 hour

4.1.8 Maintainability

Each alternative was ranked based on the Maintainability evaluation factor, and points were assigned based on criteria listed in Table 4-9. Maintainability was primarily evaluated based on ease of procuring and storing spare parts, as well as training required for maintenance activities. Maintainability contributes about 5% to the total evaluation.

Table 4-9. Maintainability Evaluation

Points	Criteria
5	All Steam Generation and Aging Assets Retired, Uniform Engine Fleet
2.5	All Steam Generation and Aging Assets Retired, Diverse Engine Fleet
0	Retain Existing Aging Assets, including steam generation

4.1.9 Stakeholder Impact / Marketability

Significant infrastructure upgrades like those proposed in this Power Master Plan will likely require coordination and agreement among community stakeholders such as public interest groups, members of the political community, and potential funding partners. Some of the factors important to stakeholders may include the following:

- Timing and location of construction activities / temporary inconvenience to the community
- Availability of local jobs and/or workforce development opportunities
- Efficient use of funds and expeditious payback
- Reduced potential of street flooding and boil-water events due to power availability
- Resilience and / or expandability of system relative to climate escalation and/or drainage system expansion
- Environmental stewardship
- Implemented solution is equitable amongst stakeholders
- Solution is both practical and innovative in alignment with coastal city leaders like Singapore and the Netherlands

Each alternative was ranked based on the Stakeholder Impact / Marketability evaluation factor, and points were assigned based on the criteria listed in Table 4-10. Stakeholder Impact / Marketability contributes about 5% to the total evaluation.

Note that the majority of the factors discussed above are already factored into the Problem Statement and alternatives development; therefore, differentiation is based primarily on cost and sustainability.

Table 4-10. Stakeholder Impact / Marketability Evaluation

Points	Criteria
5	Minimal Rate Impact Due to LCC Savings Substantial Improvement to Ambient Air Quality and Reduction to GHG Emissions
2.5	Moderate Rate Impact Due to LCC Savings Moderate Improvement to Ambient Air Quality and Reduction to GHG Emissions
0	Significant Rate Increase due to Poor LCC Savings No Improvement or Minimal Improvement to Ambient Air Quality and GGH Emissions

4.2 Evaluation Matrix

An evaluation matrix considering cost and non-cost factors provides an objective method to evaluate multiple alternatives. For this Power Master Plan, Table 4-11 was discussed and completed with SWBNO during the Alternatives Evaluation Workshop on November 6, 2019.

Table 4-11. Evaluation Matrix

Evaluation Factor	Maximum Points	Alternative 0	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Life Cycle Cost	**35**	0	35	28	32	18
Improved Reliability / Resiliency	**25**	0	12.5	25	25	25
Greenhouse Gas Emissions / Sustainability	**10**	0	6	8	10	8
Capital Cost	**5**	5	3.5	2.5	2.5	2.5
Elimination of 25 Hz Systems	**5**	0	2.5	5	5	5
Location	**5**	0	4	4	4	5
Operability	**5**	0	0	2.5	5	2.5
Maintainability	**5**	0	0	5	2.5	5
Stakeholder Impact / Marketability	**5**	0	0	5	5	5
Total	**100**	**5.0**	**63.5**	**85.0**	**90.5**	**75.5**

Based on this evaluation, Alternatives 2 or 3 are the best available options, with a RICE engine solution assessed as slightly more favorable than a combustion turbine solution, primarily due to cost and operational flexibility.

5. Phasing Plan

To validate the feasibility of the Power Master Plan, the evaluation team was tasked with preparing a feasible implementation strategy, including a phasing plan that outlines a path for continuous operation throughout construction. A preliminary phasing plan was prepared and discussed with SWBNO which estimated conversion of the entire 25 Hz system within 5 years, and included fewer SFCs. Due to the approximate $500 million cost, SWBNO suggested evaluation of a phasing plan where the 25 Hz demand loads could be transitioned opportunistically as funding becomes available.

The phasing plan presented in this report considers installation of the new West Power Complex including new substation, new generators, and new SFCs with a clear point of demarcation before the rest of the assets are transitioned. The strategy outlined in this document is adaptable and may need to be modified to accommodate the availability of funding, coordination with other related projects, availability of qualified local contractors, and many other factors which are currently unknown. The proposed phasing considers implementation of Alternative 2 or 3, which includes decommissioning all 25 Hz steam turbines, a new substation and three new 60 Hz generating units with a capacity of 18-22 MW each (referred to in the tables below as T7, T8, and T9).

To ensure that adequate emergency backup power is available at all times throughout implementation, the following basic phases prioritize the installation of new generation assets before existing generation assets are retired.

- Baseline: Existing power inventory considering the operational status of all assets in November 2019.
- Phase 1: Initial Work (Construction of new West Power Complex and deployment of new generating assets)
  - Phase 1A: Add one 25 MW SFC (Note that SWBNO has already undertaken project planning for this work. Although it is anticipated that this equipment will be located within the existing power plant complex, it is considered new generation so is included in Phase 1.)
  - Phase 1B: Add two more 25 MW SFCs (one standby); Install West Power Complex to include New Substation, T7, T8, T9, New Plant Control System and 60 Hz ring bus
  - Phase 1C: Remove T1, T3, T4, T5, and all associated equipment.
- Phase 2: DPS Conversions and Power Distribution Network Upgrades (Upon completion of the new WPC, conversion of the loads from 25 Hz to 60 Hz can begin).
  - Phase 2A: Connect Diesel Gens at DPS- 6, 7; Convert DPS-6, 7, 12, 17 to 60 Hz
  - Phase 2B: Convert more 25 Hz load to 60 Hz
  - Phase 2C: Connect Diesel Gen at DPS-19; Convert more 25 Hz load to 60 Hz
  - Phase 2D: Convert all remaining 25 Hz load to 60 Hz

Aligning with the alternative evaluation and key Guiding Principles of the study, Table 5-1 identifies how the phasing plan addresses the overall Problem Statement.

Table 5-1. Phasing Plan Solutions

Key Components	Solution
Public Welfare	
Eliminate Cooling Water Cross-Connection	Cross-connect concerns are eliminated when the existing 25 Hz generators are decommissioned at the completion of Phase 1C.
Island Mode Operation	Island Mode capability exists today and will remain fully operational throughout construction. At the completion of Phase 1, this capability will transition to the new equipment at the WPC so that the older existing assets can be retired. Existing distributed generators at DPS 6 and DPS 7 will be added to the Power Distribution Network during Phase 2.

Table 5-1. Phasing Plan Solutions

Key Components	Solution
Greenhouse Gas Emissions and Pollution Control	GHG emissions are reduced at the completion of Phase 1 once the substation is installed and SWBNO shifts to primarily energy purchase instead of energy production. Additionally, all new equipment installed in Phase 1 will include emissions controls and/or permitting revisions as required for compliance with state and federal laws.
Efficiency, Sustainability and Cost of Operation	
Reduced Steam Generation	All steam generation and use will be retired at the completion of Phase 1, and natural gas purchase would only be required when Entergy is unavailable or when demand exceeds substation capacity.
Equipment Selection	
Generating Assets	At the completion of Phase 1, three new turbines or reciprocating engines (T7, T8, and T9) will be in place at the West Power Complex. At the completion of Phase 1C, STG-1, STG-3, STG-4, CTG-5 will be retired. During Phase 1, 50 MW SFC capacity (plus 25 MW redundant backup capacity) will be installed to convert power from the newly installed 60 Hz generating assets to 25 Hz . The SFCs will be required until all 25 Hz loads are converted to 60 Hz at the end of Phase 2.
Frequency Conversion	New SFCs will be in place to convert the 60 Hz power for distribution at 25 Hz.
Electric Demand Assets	After completion of Phase 1, SWBNO may proceed with the opportunistic replacement of all 25 Hz pump motors, switchgear and other electrical components with new 60 Hz equipment and installation of gearboxes above maximum considered flood elevation. This work will be phased over multiple years. New equipment will be located above the maximum considered flood elevation.
SWBNO Network Feeders	Through Phase 2, all remaining 6.6 kV feeders in the SWBNO Power Distribution Network not previously replaced in the HMGP project will be replaced with new 13.8 kV feeders.
Substation Capacity	
Entergy Feeders	Phase 1 includes installation of a new Entergy substation. Any other Entergy connections may be considered backup only. All SWBNO generating assets will become backup only for when Entergy is not available, or demand exceeds substation capacity.

5.1 Basis of Phasing

The following basis of project phasing was developed to maintain generation at or above demand during each phase.

This plan presented involves an aggressive development of the WPC for several reasons which include the following:

1) The existing power plant systems face a number of challenges related to age, condition, efficiency, and obsolescence that compromise the reliability and resiliency of service to the drainage pump stations. Prompt action is urgently needed to address these challenges.
2) Further investment in the rehabilitation of equipment and systems that have far exceeded their useful service life does not constitute good investment value.
3) Retirement of STG-1, STG-3, STG-4, CTG-5, and the boiler plant will allow for retirement of all remaining equipment which is cross-connected with City Water systems. This is a public health and safety concern that needs to be accomplished in a timely fashion.
4) Major cost savings are realized from the conversion of natural gas and diesel fueled equipment to purchasing electric power, which will have an immediate impact on reduced operational expense upon implementation.

Phase 1 is intended to take a big step toward solving the most urgent needs faced by SWBNO in the operation of the Carrollton Power Plant. This will require the construction of a new WPC including site preparation, construction of a new plant building shell, installation of new dual fuel-generating assets, 60 Hz ring bus switchgear, plant control system, a 50 MW substation, and additional SFC capacity. This will allow generation of 60 Hz power from modern generating sources and will allow all 25 Hz self-generated power to originate from these new sources. As the new generating assets become operational, the existing assets, including steam turbine generators, can be retired. At that time, a continuous source of gas from the utility is no longer necessary as the need to keep the steam plant on hot standby has been eliminated. The normal operations load, ("dry weather" load or "house load") can be satisfied by power delivery from Entergy via the new substation. **Because of the poor heat rate of the steam generating equipment, significant operating cost savings with respect to current operation can begin to be realized at that time.**

Phase 1: Construction of West Power Complex

Phase 1A: Installation of 25 MW Static Frequency Changer

The installation of a 25 MW SFC is proposed as the first phase of this project, which will convert 60 Hz power from Turbine 6 to 25 Hz power, reducing the demand on the existing steam generation equipment.

Phase 1B: Install New 60 Hz Generators

After the SFC has been installed, the next phase will be to install three new 60 Hz generators (T7, T8, and T9) and a new 60 Hz ring bus. This will result in an increased capacity of 60 Hz generation; however, the drainage pump stations will still operate using 25 Hz power. Therefore, increasing the capacity of the SFC from 25 MW to 75 MW is also recommended. This phase also includes the installation of a new substation, connecting the CTG-6 bus to the new 60 Hz ring bus and adding the WPC Control Building.

Phase 1C: Retire All 25 Hz Steam Power Generation Turbines

Upon completion of Phase 1, sufficient 60-Hz power generation and frequency changers to meet the 25 Hz load demand will be available within the system. At this point, SWBNO will be able to retire all the existing steam turbines and associated equipment. After this phase, the only remaining 25 Hz power generation equipment will include the five EMD generators.

Phase 2: DPS Conversions and Power Distribution Network Upgrades

With the completion of the WPC, the conversion of the feeders and pump stations from 25 Hz to 60 Hz can be performed independently. Pump station and associated feeder conversion can be performed when funding and appropriate resources are available. In reviewing the electrical distribution, an observation was made that the system can be envisioned as consisting of three separate power distribution "highways." In addition to supplying power to its own pumps, an individual pump station may also serve as a power distribution center to other pump stations. A good example is DPS-6, which includes 15 pumps but also delivers power to DPS-7 and DPS-12. The following three main power highways are shown on a simplified system asset schematic (Figure 5-1):

- **Power Highway 1 –** DPS-6, 7, and 12
- **Power Highway 2 –** DPS-1, 2, and Sewer Station A
- **Power Highway 3 –** DPS-3 and 4

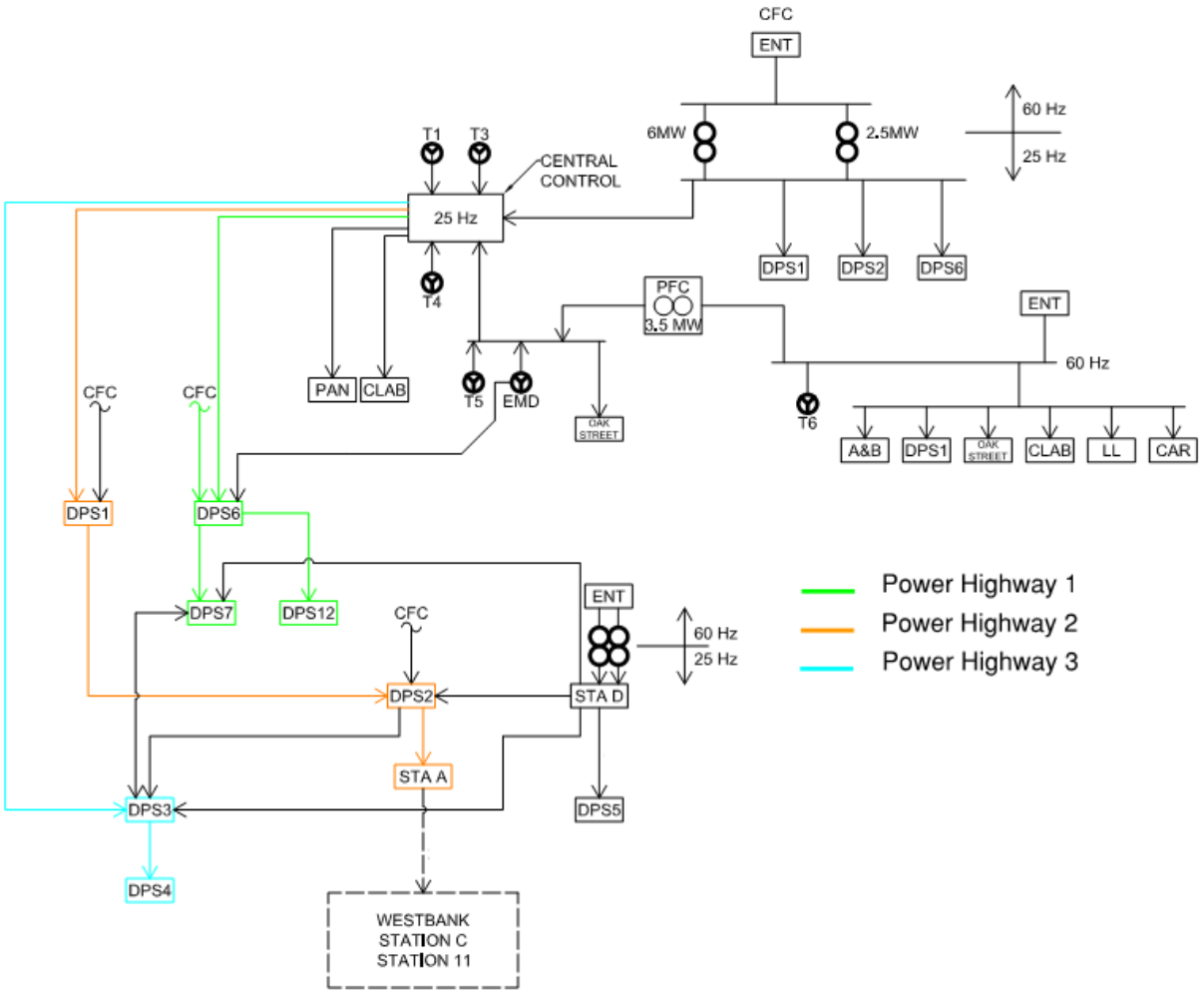


Figure 5-1. Existing Power System Asset Schematic with Power Highways

The individual components of Phase 2 focus on conversion of these highways and associated assets including the associated pumping equipment, motors, electrical switchgear, and feeders. It is recommended that work involving pump station conversions be scheduled outside of hurricane season. This minimizes the exposure to significant rain events.

Conversion of a single 25 Hz pump will be accomplished by installation of a new 60/25 gear reducer along with a new motor and switchgear for that pump. This type of conversion has been performed previously on pumps at DPS-6 and DPS-7. Prior to the beginning of each phase, careful planning will be necessary to ensure all equipment required for the transition is on site and the installation contractor is mobilized. Work on each pump must be coordinated such that all mechanical modifications are performed concurrently with electrical modifications. With proper planning it is expected that only one pump will be out of service at any one time.

During a pump station conversion, the station will be in a temporary “hybrid” configuration. The newly converted portion will operate as a 60 Hz station and the portion remaining will operate as a 25 Hz station. At that time, it is envisioned that a minimum of two feeders would be required to power each section for a total of four feeders to the station. When the final pump in that station is converted to 60 Hz, the existing 25 Hz feeders can be disconnected.

Phase 2A: Convert Drainage Pump Stations to 60 Hz and Install 60 Hz Switchgear

During Phase 2A, it is recommended that SWBNO begin to convert the drainage pump stations to 60 Hz. DPS-6, DPS-7 (partial), DPS-12, and DPS-17 (partial) are recommended to be the first drainage pump stations to be converted to 60 Hz since they are included on the first feeder highway. In addition to partially converting DPS-17 to 60 Hz, it is recommended that a new 60 Hz switchgear be installed at DPS-17 during this phase to allow for increased connectivity and flexibility to the rest of the SWBNO Power Distribution Network.

Phase 2B: Convert Drainage Pump Stations to 60 Hz and DPS-5 to an Independent Station

In this phase, SWBNO will continue conversion of the pump stations by completing the 60 Hz conversion of DPS-7 and replacing electrical feeders that are associated with DPS-7. It is also recommended that SWBNO connect the Pritchard and I-10 drainage pump stations to the network. Additionally, during this phase, DPS-5, located on the other side of the Industrial Canal, is removed from the SWBNO Power Distribution Network and converted to an independent 60 Hz drainage pump station by adding redundant generation capacity.

Phase 2C: Convert Drainage Pump Stations to 60 Hz

This phase continues converting drainage pump stations from 25 Hz to 60 Hz. In this phase, DPS-1 and DPS-2 (partial) will be converted to 60 Hz. Additionally, DPS-19 will be added to the network.

Phase 2D: Convert Drainage Pump Stations to 60 Hz and Retire Frequency Changers

This phase continues converting drainage pump stations from 25 Hz to 60 Hz. In this phase, the remaining equipment associated with DPS-2 will be converted; along with DPS-3, DPS-4, Panola and Claiborne potable water pump stations will be converted to 60 Hz. Additionally, the Carrollton Frequency Changers and frequency changers at DPS-17 will be retired, as 25 Hz demand has been removed.

Detailed Phasing Diagrams included in Appendix H outline the major work scope items, the approximate amount of power converted to 60 Hz, and the approximate quantity of new feeder cables added in each proposed phase.

5.2 Power Inventory

To validate the feasibility of any phasing strategy, the generating capacity vs. system demand must be examined at the completion of each phase. This involves a review of both 25 Hz and 60 Hz systems. Each system is analyzed assuming the largest 25 Hz generator is out of service, then repeated assuming the largest 60 Hz generator is out of service. These assumptions reflect variations of the Firm Reliable capacity requirement. Analysis of each system (25 Hz and 60 Hz) is important because generation capacity is shared across the frequency changers. Credit is taken for energy transfer across the SFC; however, appropriate limitations are applied which consider SFC capacity as well as the limitation of excess capacity from the adjacent system. The results are presented as eight data points at the completion of each phase.

The Power Inventory Graphs (Figures 5-2 through 5-6 on the following pages) represent the SWBNO power asset inventory when considering the largest 25 Hz generator out of service and the largest 60 Hz generator out of service. By utilizing a graphical summary of the power assets at each phase, any deficits in the power system are clearly evident. These graphs are also included in Appendix H after the phasing diagrams.

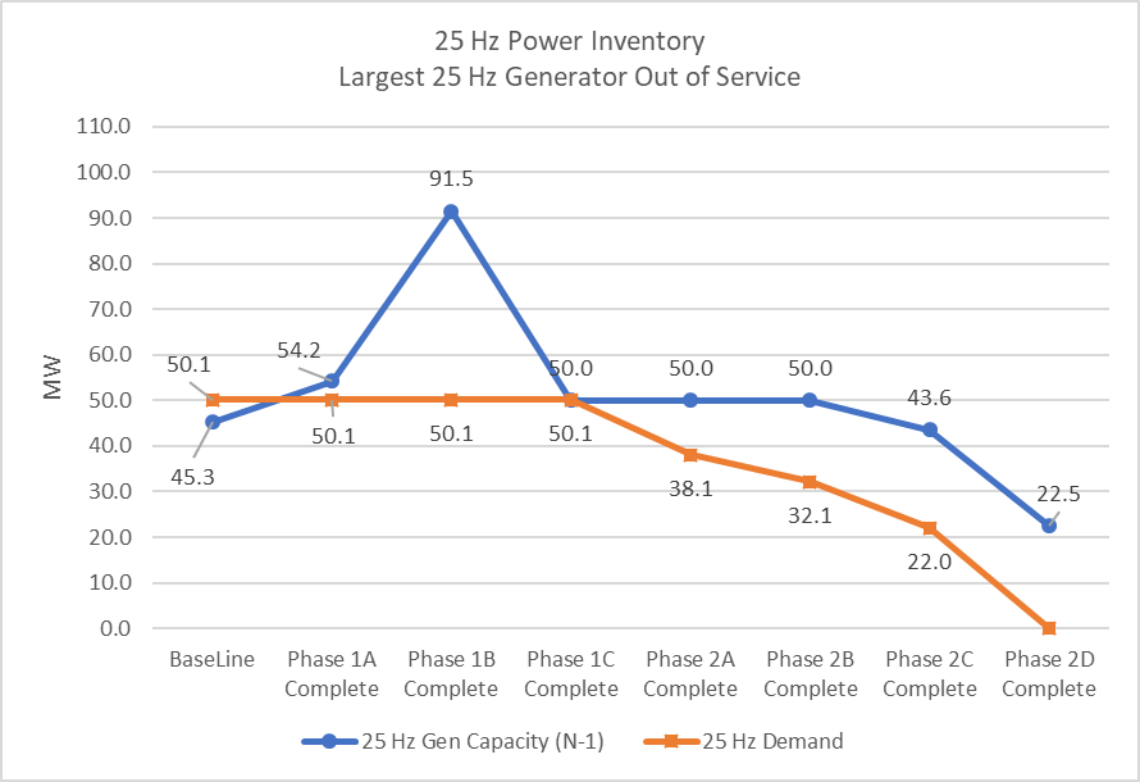


Figure 5-2. 25 Hz Power Inventory, Largest 25 Hz Generator Out of Service

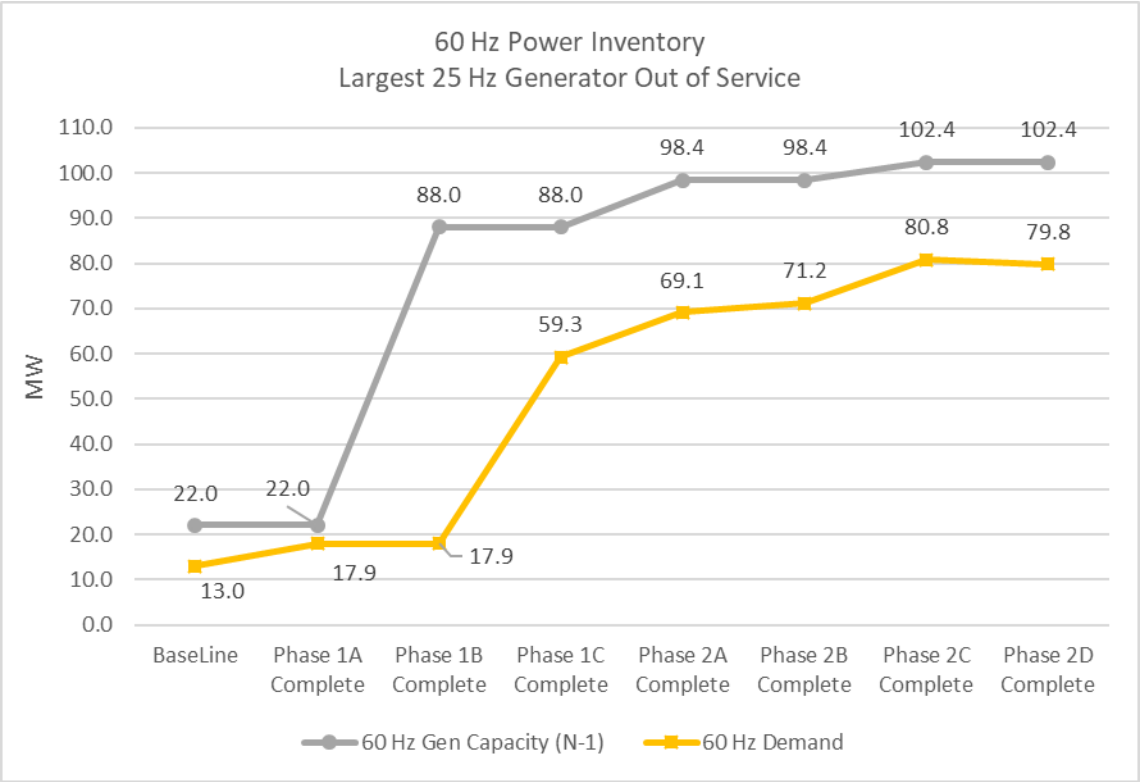


Figure 5-3. 60 Hz Power Inventory, Largest 25 Hz Generator Out of Service

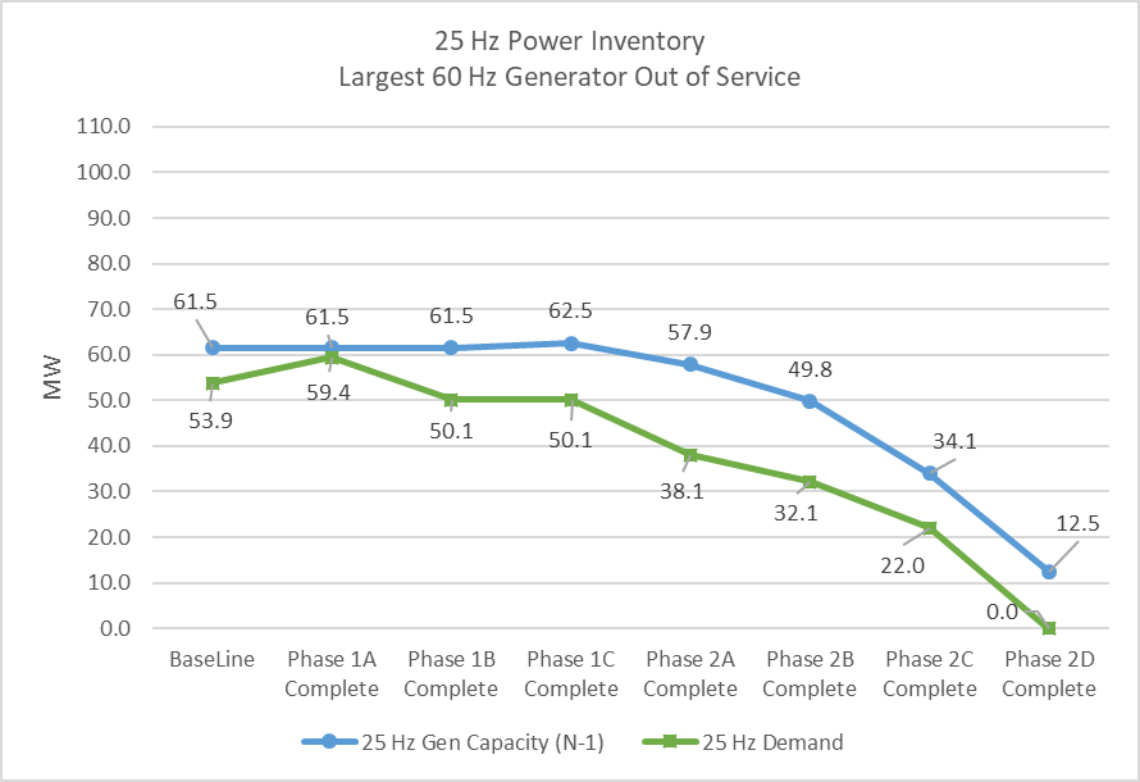


Figure 5-4. 25 Hz Power Inventory, Largest 60 Hz Generator Out of Service

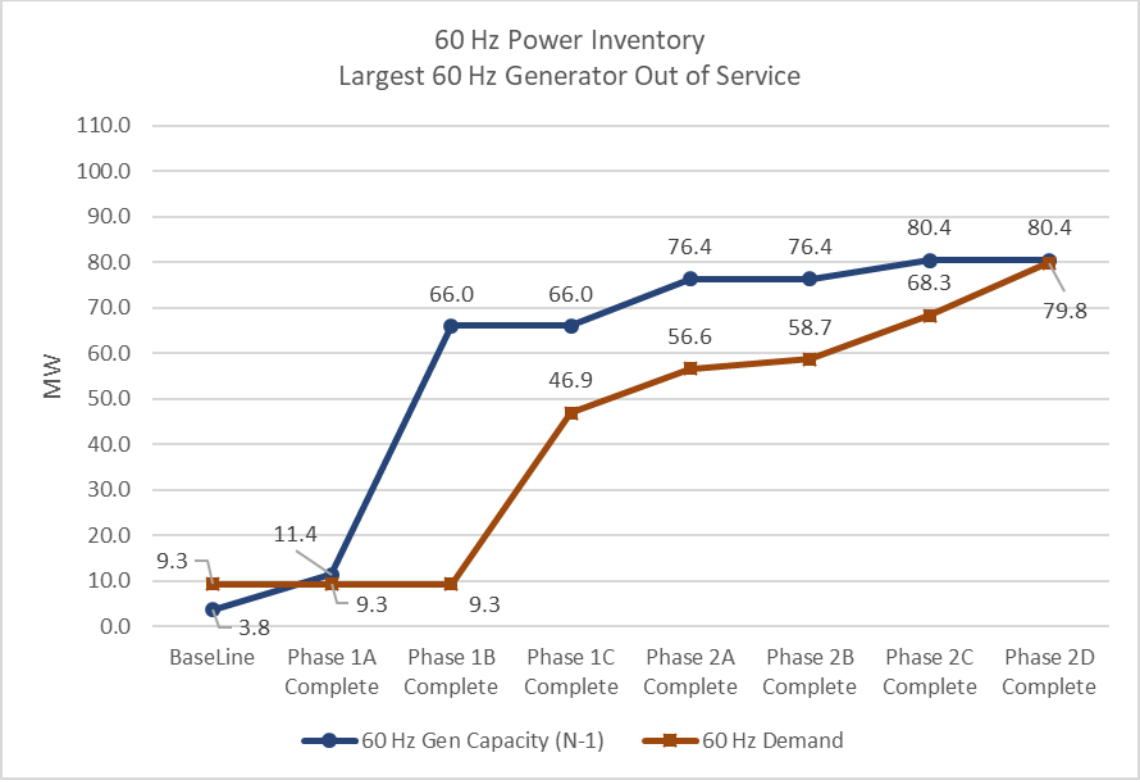


Figure 5-5. 60 Hz Power Inventory, Largest 60 Hz Generator Out of Service

The system in its current configuration exhibits a minimal deficit of Firm Reliable generating capacity on both the 25 Hz and the 60 Hz systems. Two ongoing projects which affect the Power Inventory are the CP-1370A 60 Hz Switchgear Project and the installation of the SFC (Phase 1A discussed above). These projects will facilitate full utilization of T6 generating capacity as well as increase the amount of energy that can be transferred across the 25 Hz to 60 Hz system interface in either direction. Completion of these projects will essentially eliminate the generation shortfall on both 25 Hz and 60 Hz systems.

Note: Figures 5-2 through 5-5 indicate only a slight deficit in 25 Hz generating capacity in the baseline scenario when the largest 25 Hz generator is out of service. Although this Power Master Plan does not evaluate a scenario when a second generator is out of service, a quick evaluation of the current state of the system was conducted following the recent failure of T5. Figure 5-6 indicates a significant deficit in the Firm Reliable generating capacity of the existing system. It is recommended that the generating capacity lost with T-5 be replaced as soon as possible.

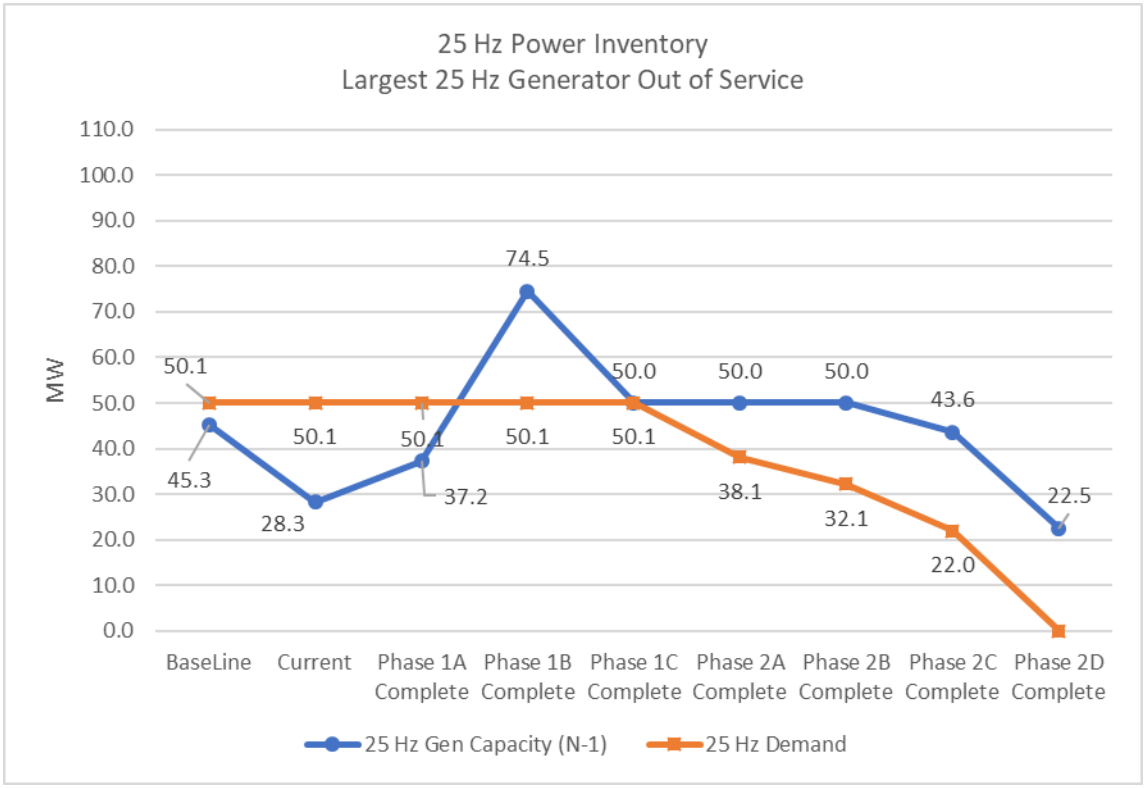


Figure 5-6. 25 Hz Power Inventory, Largest 25 Hz Generator Out of Service, Current State

6. Recommendations

Based on the findings presented in this report, the following items are recommended as next steps:

- Finalize negotiations on the new Entergy substation, and begin construction.
- Complete the work that is currently in progress:
  - 1370A Switchgear / Transformer Project
  - Procurement and installation of a new 25 MW SFC
  - Upgrades to T-6 to allow for cold weather operation
- Begin preparation of performance specifications for major long-lead time equipment.
- Prepare a conceptual level design to accommodate updated cost estimates of preferred alternative to be used in financing discussions.
- Refine phasing of preferred alternative to mitigate loss of T-5.

Appendix A
Asset Lists

Asset List - Pump Loads

Pump Station	Distribution System*	Motor Hz	KW	Equip. Number	Pump	Installation Date	Pump Capacity (cfs)	Unit of Measure	Rated Pump Head	Pump Diameter (ft)	Primary Feeders	Secondary Feeders
1	1	60	1865	DPS01-HPF-PMP	11' F*	1991	1100	cfs	8	11	-	-
1	1	60	1865	DPS01-HPG-PMP	11' G*		1100	cfs	8	11	-	-
1	1	25	895.2	DPS01-HPC-PMP	14' C	1929	1000	cfs		14	46	2-AC
1	1	25	895.2	DPS01-HPD-PMP	14' D	1929	1000	cfs		14	202	204
1	1	25	895.2	DPS01-HPE-PMP	14' E	1929	1000	cfs		14	202	204
1	1	25	447.6	DPS01-HPA-PMP	12' A	1929	550	cfs	5.75	12	302	304
1	1	25	447.6	DPS01-HPB-PMP	12' B	1929	550	cfs	5.75	12	302	304
1	1	25	298.4	DPS01-VTP1-PMP	6' #1Vert.		225	cfs		6	302	304
1	1	25	298.4	DPS01-VTP2-PMP	6' #2Vert.		225	cfs		6	302	304
1	1	25	93.25	DPS01-CD1-PMP	3' CD #1		60	cfs		3	302	304
1	1	25	29.84	DPS01-CD2-PMP	2' CD #2		15	cfs		2	2-AC	46
2	1	25	1492	DPS02-HPC-PMP	11' C	1914	1000	cfs		11	18	46
2	1	25	1492	DPS02-HPD-PMP	11' D	1914	1000	cfs		11	24	304
2	1	25	447.6	DPS02-HPA-PMP	12' A	1914	550	cfs		12	204	224
2	1	25	447.6	DPS02-HPB-PMP	12' B	1914	550	cfs		12	204	224
2	1	25	44.76	DPS02-CD2-PMP	42" CD #2	1974	25	cfs		3.5	204	224
2	1	25	44.76	DPS02-CD3-PMP	42" CD #3	1974	25	cfs		3.5	204	224
3	1	25	1492	DPS03-HPC-PMP	14' C	1930	1000	cfs		14	340	180
3	1	25	1492	DPS03-HPD-PMP	14' D	1930	1000	cfs		14	312	432
3	1	25	1492	DPS03-HPE-PMP	14' E	1930	1000	cfs		14	506	508
3	1	25	895.2	DPS03-HPA-PMP	12' A	1916	550	cfs	5.14	12	432	408
3	1	25	895.2	DPS03-HPB-PMP	12' B	1916	550	cfs	5.14	12	432	408
3	1	25	44.76	DPS03-CD1-PMPL	3' CD 1 (L/R)	1916	40	cfs		3	506	508
3	1	25	44.76	DPS03-CD2-PMPL	3' CD 2 (L/R)	1916	40	cfs		3	340	180
4	1	25	1492	DPS04-HPC-PMP	14' C	1957	1000	cfs	12	14	340	432
4	1	25	1492	DPS04-HPD-PMP	14' D	1957	1000	cfs		14	400	432
4	1	25	1492	DPS04-HPE-PMP	14' E	1957	1000	cfs		14	400	432
4	1a	60	522.2	DPS04-VTP1-PMP	8' #1*	1938	320	cfs		8	-	-
4	1a	60	522.2	DPS04-VTP2-PMP	8' #2*	1938	320	cfs		8	-	-
4	1	25	149.2	DPS04-CD1-PMP	3' CD		80	cfs		3	400	432
5	1	25	895.2	DPS05-HPA-PMP	12' A	1914	550	cfs	14	12	410	20
5	1	25	895.2	DPS05-HPB-PMP	12' B	1914	550	cfs	14	12	20	410
5	1	25	1492	DPS05-HPB-PMP	12' D	1914	550	cfs	14	12	510	410
5	1	25	261.1	DPS05-CD1-PMP	3' CD 1 (L/R)		40	cfs		3	410	20
5	1	25	261.1	DPS05-CD2-PMP	3' CD 2 (L/R)		40	cfs		3	410	20
5	N/A	60	0	DPS05-VTP1-PMP	7' #1*		300	cfs		7	-	-
5	N/A	60	0	DPS05-VTP2-PMP	7' #2*		300	cfs		7	-	-
6	1a	60	2238	DPS06-HPH-PMP	11' H*	1984	1100	cfs	12	11	-	-
6	1a	60	2238	DPS06-HPI-PMP	11' I*	1984	1100	cfs	12	11	-	-
6	1	25	1492	DPS06-HPC-PMP	14' C	1928	1000	cfs	14	14	130	14CD
6	1	25	1492	DPS06-HPD-PMP	14' D	1928	1000	cfs	14	14	216	130
6	1	25	1492	DPS06-HPE-PMP	14' E	1928	1000	cfs	14	14	216	130
6	1	25	1492	DPS06-HPF-PMP	14' F	1928	1100	cfs	14	14	316	314
6	1	25	1492	DPS06-HPG-PMP	14' G	1984	1000	cfs		14	516	612
6	1	25	895.2	DPS06-HPA-PMP	12' A	1914	550	cfs		12	414	416
6	1	25	895.2	DPS06-HPB-PMP	12' B	1914	550	cfs		12	414	416
6	1a	60	522.2	DPS06-VTP1-PMP	6' #1V*	1983	250	cfs	16	6	-	-
6	1a	60	522.2	DPS06-VTP2-PMP	6' #2V*	1983	250	cfs	16	6	-	-
6	1a	60	522.2	DPS06-VTP3-PMP	6' #3V*	1983	250	cfs	16	6	-	-
6	1a	60	522.2	DPS06-VTP4-PMP	6' #4V*	1983	250	cfs	16	6	-	-
6	1	25	335.7	DPS06-CD1-PMP	3' CD #1	1984	90	cfs		3	216	130
6	1	25	335.7	DPS06-CD2-PMP	3' CD #2	1984	90	cfs		3	216	130
7	1a	60	1865	DPS07-HPD-PMP	14' D*	1908	1000	cfs		14	-	-
7	1	25	895.2	DPS07-HPA-PMP	12' A	1931	550	cfs		12	314	312
7	1	25	895.2	DPS07-HPC-PMP	14' C	1908	1000	cfs		14	14CD	180
7	1	25	186.5	DPS07-CD1-PMP	3' CD #1		70	cfs		3	414	412
7	1	25	186.5	DPS07-CD2-PMP	3' CD #2		70	cfs		3	414	412
10	3	60	522.2	DPS10-VTP1-PMP	6' #1*	1984	250	cfs	21.5	6	-	
10	3	60	522.2	DPS10-VTP2-PMP	6' #2*	1984	250	cfs	21.5	6	-	
10	3	60	522.2	DPS10-VTP3-PMP	6' #3*	1984	250	cfs	21.5	6	-	
10	3	60	522.2	DPS10-VTP4-PMP	6' #4*	1984	250	cfs	21.5	6	-	
11	3	60	932.5	DPS11-HPD-PMP	12' D*	1990	570	cfs	12	12	-	-
11	3	60	932.5	DPS11-HPE-PMP	12' E*	1990	570	cfs	12	12	-	-
11	1	25	298.4	DPS11-HPA-PMP	8' A	1953	250	cfs	8	8	28A	28B
11	1	25	298.4	DPS11-HPB-PMP	8' B	1952	250	cfs	8	8	28A	28B
11	3	60	111.9	DPS11-CD1-PMP	30" CD #1*	1953	50	cfs	8	2.5	-	-
12	1	25	1492	DPS12-HPD-PMP	14' D	1961	1000	cfs	14	14	612	
13	3	60	1865	DPS13-HP4-PMP	10' #4-D*	1981	1000	cfs	12	10		
13	3	60	1865	DPS13-HP5-PMP	10' #5-D*	1981	1000	cfs	12	10		
13	3	60	1865	DPS13-HP6-PMP	10' #6*	1981	1050	cfs	11	10		
13	3	60	1865	DPS13-HP7-PMP	10' #7*	1981	1050	cfs	11	10		
13	3	60	522.2	DPS13-VTP1-PMP	6' #1*	1981	250	cfs		6		
13	3	60	522.2	DPS13-VTP2-PMP	6' #2*	1981	250	cfs		6		
13	3	60	111.9	DPS13-CD3-PMP	3' CD #3*	1981	50	cfs	9.5?	3		
14	3	60	596.8	DPS14-VTP1-PMP	6' #1*		300	cfs	17	6		
14	3	60	596.8	DPS14-VTP2-PMP	6' #2*		300	cfs	17	6		
14	3	60	596.8	DPS14-VTP3-PMP	6' #3*		300	cfs	17	6		
14	3	60	596.8	DPS14-VTP4-PMP	6' #4*		300	cfs	17	6		
15	3	60	373	DPS15-VTP1-PMP	5' #1*		250	cfs		5		
15	3	60	373	DPS15-VTP2-PMP	5' #2-D/E*	1975	250	cfs		5		

Asset List - Pump Loads

Pump Station	Distribution System*	Motor Hz	KW	Equip. Number	Pump	Installation Date	Pump Capacity (cfs)	Unit of Measure	Rated Pump Head	Pump Diameter (ft)	Primary Feeders	Secondary Feeders
15	3	60	373	DPS15-VTP3-PMP	5' #3-D/E*	1975	250	cfs		5		
16	3	60	596.8	DPS16-VTP1-PMP	63" #1*	1966	290	cfs	16	5.25		
16	3	60	596.8	DPS16-VTP2-PMP	63" #2*	1966	290	cfs	16	5.25		
16	3	60	596.8	DPS16-VTP3-PMP	63" #3*	1966	290	cfs	16	5.25		
16	3	60	596.8	DPS16-VTP4-PMP	63" #4*	1966	290	cfs	16	5.25		
17/Station D	1a	60	1865	DPS17-HPA-PMP	3' A*	1975	150	cfs		3		
17/Station D	1a	60	1865	DPS17-HPD-PMP	3' D*	1975	150	cfs		3		
18	3	60	93.25	DPS18-VTP1-PMP	3' #1*	1983	62	cfs		3		
18	3	60	93.25	DPS18-VTP2-PMP	3' #2*	1983	62	cfs		3		
19	2	60	2238	DPS19-HP3-PMP	10' #H1*	1975	1100	cfs	12.8	10		
19	2	60	2238	DPS19-VTP1-PMP	10' #H2*	1975	1100	cfs	12.8	10		
19	2	60	2238	DPS19-VTP2-PMP	10' #H3*	1975	1100	cfs	12.8	10		
19	2	60	596.8	DPS19-HP1-PMP	6' #V1*	1975	310	cfs	15.1	6		
19	2	60	596.8	DPS19-HP2-PMP	6' #V2*	1975	310	cfs	15.1	6		
20	3	60	447.6	DPS20-VTP1-PMP	6' #1*	1989	250	cfs	8.5	6		
20	3	60	447.6	DPS20-VTP2-PMP	6' #2*	1989	250	cfs	8.5	6		
Dwyer	3	60	857.9	DPSDWY-VTP1-PMP	68" #1*		356	cfs		5.67		
Dwyer	3	60	857.9	DPSDWY-VTP2-PMP	68" #2*		356	cfs		5.67		
Dwyer	3	60	857.9	DPSDWY-VTP3-PMP	68" #3*		356	cfs		5.67		
Elaine	3	60	44.76	DPSELN-HP1-PMP	30" #1*		45	cfs		2.5		
Elaine	3	60	44.76	DPSELN-HP2-PMP	30" #2*		45	cfs		2.5		
Grant	3	60	298.4	DPSGRT-VTP5-PMP	#5*		70	cfs		1.167		
Grant	3	60	298.4	DPSGRT-VTP6-PMP	#6*		70	cfs		1.167		
Grant	3	60	14.92	DPSGRT-VTP1-PMP	14" #1*		8	cfs		1.167		
Grant	3	60	14.92	DPSGRT-VTP2-PMP	14" #2*		8	cfs		1.167		
Grant	3	60	14.92	DPSGRT-VTP3-PMP	14" #3*		8	cfs		1.167		
Grant	3	60	14.92	DPSGRT-VTP4-PMP	14" #4*		8	cfs		1.167		
I-10	2	60	932.5	DPSI10-VTP1-PMP	60" #1*		250	cfs	31.5	5		
I-10	2	60	932.5	DPSI10-VTP2-PMP	60" #2*		250	cfs	31.5	5		
I-10	2	60	932.5	DPSI10-VTP3-PMP	60" #3*		250	cfs	31.5	5		
I-10	2	60	447.6	DPSI10-CD1-PMP	40" CD #1*		100	cfs	38	5		
Oleander	N/A	60	0	DPSOLR-VTP1-PMP	30" #1*	1979	33	cfs		2.5		
Oleander	N/A	60	0	DPSOLR-VTP2-PMP	30" #2*	1979	33	cfs		2.5		
Oleander	N/A	60	0	DPSOLR-VTP3-PMP	30" #3*	1979	33	cfs		2.5		
Pritchard	2	60	373	DPSPTC-VTP1-PMP	48" #1*		125	cfs	22.65	4		
Pritchard	2	60	373	DPSPTC-VTP2-PMP	48" #2*		125	cfs	22.65	4		
Pritchard	2	60	18.65		6" CD #1*		3	cfs	22.65	0.5		
Monticello	3	60	74.6	1								
Monticello	3	60	74.6	2								
Monticello	3	60	74.6	3								
Oak St.	1	25	1119	A1								
Oak St.	1	25	0	A2								
Oak St.	1	25	1119	B1								
Oak St.	1	25	0	B2								
Oak St.	1	25	746	C1								
Oak St.	1	25	0	C2								
Oak St.	1	60	932.5	D								
Industrial Ave.	3	60	373	1								
Industrial Ave.	3	60	373	2								
Industrial Ave.	3	60	373	3								
Panola	1	25	1678.5	1								
Panola	1	25	1678.5	2								
Panola	1	60	1678.5	1								
Panola	1	60	1678.5	2								
Claiborne	1	25	1342.8	1								
Claiborne	1	25	1342.8	4								
Claiborne	1	60	1342.8	2								
Claiborne	1	60	1342.8	3								
Low Lift	1	60	261.1	6								
Low Lift	1	60	261.1	7								
High Lift	1	60	1678.5	A								
High Lift	1	60	1678.5	B								
Sewer Station A	1	25	932.5		2							
Sewer Station A	1	25	932.5		3							
Sewer Station A	1a	60	1715.8									
Sewer Station C	N/A	60	0									
Sewer Station C	N/A	25	0									
Underpass 1	3	60	0	PMP-1			0.18	cfs				
Underpass 1	3	60	0	PMP-2			0.18	cfs				
Underpass 10	3	60	0	PMP-1			13	cfs				
Underpass 10	3	60	0	PMP-2			13	cfs				
Underpass 10	3	60	0	PMP-3			13	cfs				
Underpass 11	3	60	0	PMP-1			33	cfs				
Underpass 11	3	60	0	PMP-2			33	cfs				
Underpass 11	3	60	0	PMP-3			33	cfs				
Underpass 12	3	60	0	PMP-1			10.5	cfs				
Underpass 12	3	60	0	PMP-2			10.5	cfs				
Underpass 2	3	60	0	PMP-1			10	cfs				
Underpass 2	3	60	0	PMP-2			10	cfs				
Underpass 2	3	60	0	PMP-1			10	cfs				

Asset List - Pump Loads											
Pump Station	**Distribution System***	**Motor Hz**	**KW**	**Equip. Number**	**Pump**	**Installation Date**	**Pump Capacity (cfs)**	**Unit of Measure**	**Rated Pump Head**	**Pump Diameter (ft)**	**Primary Feeders**	**Secondary Feeders**
Underpass 3	3	25	0	PMP-1			14	cfs				
Underpass 3	3	25	0	PMP-2			14	cfs				
Underpass 4	3	25	0	PMP-1			5	cfs				
Underpass 4	3	25	0	PMP-2			5	cfs				
Underpass 5	3	60	0	PMP-1			24	cfs				
Underpass 5	3	60	0	PMP-2			24	cfs				
Underpass 6	3	60	0	PMP-1			6	cfs				
Underpass 6	3	60	0	PMP-2			6	cfs				
Underpass 7	3	60	0	PMP-1			7	cfs				
Underpass 7	3	60	0	PMP-2			7	cfs				
Underpass 8	3	60	0	PMP-1			7	cfs				
Underpass 8	3	60	0	PMP-2			7	cfs				
Underpass 8	3	60	0	PMP-3			7	cfs				
Underpass 9	3	60	0	PMP-1			24	cfs				
Underpass 9	3	60	0	PMP-2			24	cfs				
Underpass 9	3	60	0	PMP-3			24	cfs				
Carrollton Plant	1	25	2000	25 Hz Aux Allowance								
Carrollton Plant	1	60	2000	60 Hz Aux Allowance								

NOTES:
Sources of information: Asset_Registry_GIS.xls

*System Classification:

1 Currently on SWBNO Power Distribution Network
1a Not on SWBNO Power Distribution Network but at a pump station that is currently serviced by SWBNO Network
2 Not on SWBNO Power Distribution Network but there is an underground feeder close by, therefore, should be added to the Network
3 Not on SWBNO Power Distribution Network and should not be included due to isolated location or capacity of generation

Classification	Hz	kW	Total
1	25	50,121	66,705
	60	16,584	
1+1a	25	50,121	81,625
	60	31,504	
1+1a+2	25	50,121	93,542
	60	43,422	
1+1a+2+3	25	50,121	117,862
	60	67,741	

Asset List - Generators

Location	Frequency (Hz)	Asset Class	Nameplate Capacity (MW)	Reliable Capacity (MW)	Equip. Number	Type	Install Date	Gen-Voltage	Notes
Power Plant	25	1	6	6	STG-1	Steam Turbine	1913	6,600	
Power Plant	25	1	15	6	STG-3	Steam Turbine	1928	6,600	Capacity limited due to condition of equipment, turbine is at the end of its useful life.
Power Plant	25	1	20	17	STG-4	Steam Turbine	1917/1954	6,600	Capacity limited due to steam pressure. T4 requires a higher steam pressure than the boiler plant can supply it.
Power Plant	25	1	20	20	CTG-5	Gas Turbine	1963	6,600	
Power Plant	60	1	22	22	CTG-6	Gas Turbine	2010	13,800	Assumption that 1370A will be complete and T6 will be upgraded for full, continuous operation (emissions, anti-icing).
Power Plant	25	1	2.5	2.5	EMD-1	EMD	2018	6,600	
Power Plant	25	1	2.5	2.5	EMD-2	EMD	2018	6,600	
Power Plant	25	1	2.5	2.5	EMD-3	EMD	2018	6,600	
Power Plant	25	1	2.5	2.5	EMD-4	EMD	2018	6,600	
Power Plant	25	1	2.5	2.5	EMD-5	EMD	2018	6,600	
Power Plant	25	1	3.75	3.75	FC-1	Frequency Convertor		6,600	
Carrollton FC	24	1	6	6	FC-1	Frequency Convertor		6,600	60 Hz from Entergy converted to 24 Hz for SWBNO
Carrollton FC	24	1	2.5	2.5	FC-2	Frequency Convertor		6,600	60 Hz from Entergy converted to 24 Hz for SWBNO
Station D	24	1	6	6	FC-3	Frequency Convertor		6,600	60 Hz from Entergy converted to 24 Hz for SWBNO
Station D	24	1	6	6	FC-4	Frequency Convertor		6,600	60 Hz from Entergy converted to 24 Hz for SWBNO
Station C	25	1			FC-1	Frequency Convertor		6,600	
Station C	25	1			FC-2	Frequency Convertor		6,600	
Westbank	25	1			FC-3	Frequency Convertor		6,600	
DPS 3	60	3	0.08	0.08	60 Hz Gen.	Permanent Generator		4,160	Not utilized for distributed power.
DPS 5	60	3	3.58	3.58	60 Hz Gen.	Permanent Generator		4,160	Not utilized for distributed power.
DPS 6	60	1a	3.75	3.75	60 Hz Gen.	Permanent Generator		4,160	
DPS 6	60	1a	3.75	3.75	60 Hz Gen.	Permanent Generator		4,160	
DPS 7	60	1a	2.864	2.864	60 Hz Gen.	Permanent Generator		4,160	
DPS 11	25	3	0.5	0.5	25 Hz Gen.	Permanent Generator		4,160	Not utilized for distributed power.
DPS 11	60	3	1.45	1.45	60 Hz Gen.	Permanent Generator		480	Not utilized for distributed power.
DPS 13	60	3	0.23	0.23	60 Hz Gen.	Permanent Generator		480	Not utilized for distributed power.
DPS 13	60	3	0.23	0.23	60 Hz Gen.	Permanent Generator			Not utilized for distributed power.
DPS 13	60	3	3	3	60 Hz Gen.	Permanent Generator			Not utilized for distributed power.
DPS 13	60	3	3	3	60 Hz Gen.	Permanent Generator			Not utilized for distributed power.
DPS 14	60	3	2.665	2.665	60 Hz Gen.	Permanent Generator			Not utilized for distributed power.
DPS 16	60	3	2.665	2.665	60 Hz Gen.	Permanent Generator			Not utilized for distributed power.
DPS 19	60	2	2	2	60 Hz Gen1	Permanent Generator			
DPS 19	60	2	2	2	60 Hz Gen2	Permanent Generator			
DPS 20	60	3	1.5	1.5	60 Hz Gen1	Permanent Generator			Not utilized for distributed power.
DPS 20	60	3	0.2	0.2	60 Hz Gen2	Permanent Generator			Not utilized for distributed power.
I-10	60	2	2.35	2.35	60 Hz Gen1	Permanent Generator			
I-10	60	2	2.35	2.35	60 Hz Gen2	Permanent Generator			
Pritchard	60	2	1.285	1.285	60 Hz Gen	Permanent Generator			
Dwyer	60	3	3	3	60 Hz Gen	Permanent Generator			Not utilized for distributed power.
Station D	60	3	2	2	A1	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	A2	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	A3	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	A4	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	A5	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	A6	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	B1	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	B2	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	B3	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	B4	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	B5	Temporary Generator			Not utilized for distributed power.
Station D	60	3	2	2	B6	Temporary Generator			Not utilized for distributed power.
DPS 4	60	3	2	2	Gen. 1	Temporary Generator			Not utilized for distributed power.
DPS 10	60	3	2	2	Gen. 1	Temporary Generator			Not utilized for distributed power.
DPS 10	60	3	2	2	Gen. 2	Temporary Generator			Not utilized for distributed power.
DWYER	60	3	2	2	Gen. 1	Temporary Generator			Not utilized for distributed power.
DWYER	60	3	2	2	Gen. 2	Temporary Generator			Not utilized for distributed power.
CFC	60	3	2	2	Gen. 1	Temporary Generator			Not utilized for distributed power.
CFC	60	3	2	2	Gen. 2	Temporary Generator			Not utilized for distributed power.
CFC	60	3	2	2	Gen. 3	Temporary Generator			Not utilized for distributed power.
CFC	60	3	2	2	Gen. 4	Temporary Generator			Not utilized for distributed power.
CFC	60	3	2	2	Gen. 5	Temporary Generator			Not utilized for distributed power.
CFC	60	3	2	2	Gen. 6	Temporary Generator			Not utilized for distributed power.
Underpass 1	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 2	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 3	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 4	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 5	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 6	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 7	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 8	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 9	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 10	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 11	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
Underpass 12	60	3	0.2	0.2	Gen. 1	Temporary Generator			Not utilized for distributed power.
DPS 18	60	3	0.5	0.5	Gen. 1	Temporary Generator			Not utilized for distributed power.

Asset List - Generators

Location	Frequency (Hz)	Asset Class	Nameplate Capacity (MW)	Reliable Capacity (MW)	Equip. Number	Type	Install Date	Gen-Voltage	Notes

Classification	Hz	kW	Total
1	25 Hz Gen	61.5	83.5
	60 Hz Gen	22	
1+1a	25 Hz Gen	61.5	93.9
	60 Hz Gen	32.364	
1+1a+2	25 Hz Gen	61.5	103.8
	60 Hz Gen	42.349	
1+1a+2+3	25 Hz Gen	61.5	125.4
	60 Hz Gen	63.949	

Sources of Information:
Asset Registry
1994 CH2M Power Study
Ford, Bacon, Davis Power Study

*Asset Classification:

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1a Not on SWBNO Power Distribution Network but at a pump station that is currently serviced by SWBNO Network
2 Not on SWBNO Power Distribution Network but there is an underground feeder close by, therefore, should be added to the Network
3 Not on SWBNO Power Distribution Network and should not be included due to isolated location or capacity of generation

Appendix B
Site Layouts

GENERAL NOTES

A. INSTALL A STATIC FREQUENCY CHANGER TO SHARE LOAD BETWEEN THE 25 HZ AND 60 HZ SYSTEMS.

KEYNOTES

001 15 MW STATIC FREQUENCY CHANGER
002 RIVER COOLING HEAT EXCHANGER SERVICING T1, T3, AND T4 TO ELIMINATE CROSS CONNECTION OF COOLING WATER. LOCATE IN LOW LIFT ROOM.
003 FIN-FAN COOLER SERVICING T5 TO ELIMINATE CROSS CONNECTION OF COOLING WATER. LOCATED NEAR T5.
004 REFER TO ALTERNATIVES FOR DETAILS ON CARROLLTON POWER PLANT AND BOILER HOUSE UPGRADES

REV.	DATE	DESCRIPTION	BY
0	01/24/2020	ISSUED FOR REVIEW	LL

PRELIMINARY FOR REVIEW ONLY

THESE DOCUMENTS ARE FOR CONCEPT DESIGN AND NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES. THEY WERE PREPARED BY, OR UNDER SUPERVISION OF:

MECH ENGINEER
NAME
XXXXXX — REGISTRATION #
XX/XX/2018 — DATE

TRUE NORTH
PLAN NORTH

JACOBS
JACOBS ENGINEERING GROUP INC.
1515 POYDRAS STREET
NEW ORLEANS, LA 70112

JACOBS PROJECT NO. XXX

SEWERAGE AND WATER BOARD OF NEW ORLEANS

SEWERAGE AND WATER BOARD
POWER MASTER PLAN

ALTERNATIVE 0: CONCEPTUAL SITE LAYOUT

DR. LL
TRC.
CK. HT
AP. HT
SCALE: NTS
DATE: 09/19/2019

GA-100

DWG. No. **XXXXX-W-XX**

SET NO.
SHEET NO. 1 OF 5

GENERAL NOTES

A. NEW POWER GENERATION EQUIPMENT WILL INCLUDE (1) GE LM2500 PRODUCING 22 MW AT 60 HZ.

KEYNOTES

(XXX)

001 LM2500
002 TRANSMISSION LEVEL SUBSTATION
003 T4 RIVER COOLING WATER SYSTEM
004 T5 FIN FAN COOLING WATER SYSTEM
005 FUEL OIL LINE
006 NATURAL GAS COMPRESSOR
007 REFER TO ALTERNATIVES FOR DETAILS ON CARROLLTON POWER PLANT AND BOILER HOUSE UPGRADES
008 60 HZ SUBSTATION
009 THREE 25 MW STATIC FREQUENCY CHANGERS
010 WEST POWER COMPLEX CONTROL CENTER
011 PARKING
012 NATURAL GAS LINE

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MECH ENGINEER
NAME
XXXXXX — REGISTRATION #
XX/XX/2018 — DATE

REV.	DATE	DESCRIPTION	BY
0	01/24/2020	ISSUED FOR REVIEW	LL

SEWERAGE AND WATER BOARD OF NEW ORLEANS

SEWERAGE AND WATER BOARD
POWER MASTER PLAN

JACOBS
JACOBS ENGINEERING GROUP INC.
1515 POYDRAS STREET
NEW ORLEANS, LA 70112

JACOBS PROJECT NO.
XXX

ALTERNATIVE 1: CONCEPTUAL SITE LAYOUT

DR. LL
TRC.
CK. HT
AP. HT
SCALE: NTS
DATE: 09/19/2019

GA-100

DWG. No. **XXXXX-W-XX**

SET NO.
SHEET NO. 1 OF 5

GENERAL NOTES

A. NEW POWER GENERATION EQUIPMENT WILL INCLUDE (3) GE LM2500 PRODUCING 22 MW AT 60 HZ EACH.

KEYNOTES

(XXX)

001 LM2500 (TYP. 3)
002 TRANSMISSION LEVEL SUBSTATION
003 THREE 25 MW STATIC FREQUENCY CHANGERS
004 60 HZ SUBSTATION
005 NATURAL GAS LINE
006 FUEL OIL LINE
007 NATURAL GAS COMPRESSOR
008 WEST POWER COMPLEX CONTROL CENTER
009 PARKING

PRELIMINARY FOR REVIEW ONLY

THESE DOCUMENTS ARE FOR CONCEPT DESIGN AND NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES. THEY WERE PREPARED BY, OR UNDER SUPERVISION OF:

MECH ENGINEER
NAME
XXXXXX — REGISTRATION #
XX/XX/2018 — DATE

REV.	DATE	DESCRIPTION	BY
0	01/24/2020	ISSUED FOR REVIEW	LL

SEWERAGE AND WATER BOARD OF NEW ORLEANS

SEWERAGE AND WATER BOARD
POWER MASTER PLAN

ALTERNATIVE 2 OR 4: CONCEPTUAL SITE LAYOUT

JACOBS

JACOBS ENGINEERING GROUP INC.
1515 POYDRAS STREET
NEW ORLEANS, LA 70112

JACOBS PROJECT NO. XXX

DR. LL
TRC.
CK. HT
AP. HT
SCALE: NTS
DATE: 09/19/2019

GA-100

DWG. No. **XXXXX-W-XX**

SET NO. — SHEET NO. 1 OF 5

GENERAL NOTES

A. NEW POWER GENERATION EQUIPMENT WILL INCLUDE (3) WARTSILA 18V50DF.

KEYNOTES

(XXX)

001 WARTSILA 18V50DF (TYP. 3)
002 TRANSMISSION LEVEL SUBSTATION
003 60 HZ SUBSTATION
004 NATURAL GAS LINE
005 FUEL OIL LINE
006 THREE 25 MW STATIC FREQUENCY CHANGERS
007 WEST POWER COMPLEX BUILDING WITH CONTROL CENTER
008 PARKING
009 SCR, STACK, AND EXHAUST SYSTEM PER ENGINE (TYP. 3)
010 AMMONIA STORAGE TANK

PRELIMINARY FOR REVIEW ONLY

THESE DOCUMENTS ARE FOR CONCEPT DESIGN AND NOT INTENDED FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES. THEY WERE PREPARED BY, OR UNDER SUPERVISION OF:

MECH ENGINEER
NAME
XXXXXX — REGISTRATION #
XX/XX/2018 — DATE

REV.	DATE	DESCRIPTION	BY
0	01/24/2020	ISSUED FOR REVIEW	LL

SEWERAGE AND WATER BOARD OF NEW ORLEANS

SEWERAGE AND WATER BOARD
POWER MASTER PLAN

JACOBS
JACOBS ENGINEERING GROUP INC.
1515 POYDRAS STREET
NEW ORLEANS, LA 70112

JACOBS PROJECT NO. XXX

ALTERNATIVE 3: CONCEPTUAL SITE LAYOUT

DR. LL
TRC.
CK. HT
AP. HT
SCALE: NTS
DATE: 09/19/2019

GA-100

DWG. No. **XXXXX-W-XX**

SET NO.
SHEET NO. 1 OF 5

Appendix C
Summary of Alternatives

Alternative	Description	Distribution System from Carrollton Plant	Pump Stations	Utility Connection	Steam Generation Capacity	Elimination of Cross Connection	New Gas Compressor	Upgrades Required to Existing Generation Assets
Alternative 0	Business as Usual, Extend Remaining Useful Service Life of Existing Plant	25 Hz, Operated at 6.6 kV Replace 24 existing feeders	-25 Hz Pumps remain powered by 25Hz Generators at Carrollton Power Plant and/or Frequency Changers (from utility power) -60 Hz Pumps reamain powered locally by unreliable Entergy sources, backed up by local Emergency Diesel Generators	Utilize existing Entergy connections, which are a combination of residential and commercial quality	Major upgrades required required to upgrade boiler plant and maintain reliability for the duration of the Life Cycle Cost (LCC) evaluation.	T1 - River Cooling (pretreatment stream) T3 - River Cooling (pretreatment stream) T4 - River Cooling (pretreatment stream) T5 - Install Fin-Fan Cooler or send cooling water to drain	Not Required	-Replace existing PFC with a 15 MW Static Frequency Changer -Major equipment upgrades required at STG1, STG3 and CTG5 to improve system reliability for the duration of the LCC evaluation. -T6 upgrades required to mitigate emissions -All pump motors, switchgear and electrical equipment susceptible to water damage must be raised.
Alternative 1	Install 50 MW Utility Substation, Reduce Steam Use and Convert to 60Hz	Converted to 60 Hz, 13.8 kV. Replace 24 existing feeders	Replace 25 Hz pump motors with new 60 Hz vertical sychronous motors mounted above the maximum considered flood elevation in the pump stations. New gearboxes installed.	New industrial / utility grade substation, two 15/20/25 MVA transformers Install three 25 MW Static Frequency Changers to share power power across 25 and 60 Hz, as needed. All generation assets become backup only for when Entergy is not available or demand exceeds substation capacity.	-Decommission all boilers except #2 -Install new 150 kpph Auxiliary Boiler -Install new steam piping from Boilers #2 and Aux. to T-4 -Decommission all existing steam piping, including main header -New Deaerator and Water Treatment Systems required, but less extensive boiler house upgrades compared to full 1370 project scope.	T1 - retire, no action needed T3 - retire, no action needed T4 - River Cooling (pretreatment stream) T5 - Install Fin-Fan Cooler or send cooling water to drain, or river cooling	Yes - 600 PSI gas required	Major equipment upgrades required at CTG5 to improve system reliability.
Alternative 2	Install 50 MW Substation, Eliminate Steam Use, Add CTGs and Convert to 60Hz	same as Alternative 1	Same as Alternative 1	same as Alternative 1	Retire all steam generation & use	T1 - retire, no action needed T3 - retire, no action needed T4 - retire, no further action needed T5 - retire, no action needed	Yes - 600 PSI gas required	Minimal
Alternative 3	Install 50 MW Substation, Eliminate Steam Use, Add Engine Generators and Covert to 60 Hz	same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Retire all steam generation & use	Same as Alternative 2	Not Required	Minimal
Alternative 4	Install 120 MW Substation, Eliminate Steam Use, Add CTGs and Convert to 60 Hz	same as Alternative 1	Same as Alternative 1	New industrial / utility grade substation, two 60 MVA transformers Install three 25 MW Static Frequency Changers to share power power across 25 and 60 Hz, as needed. All generation assets become backup only for when Entergy is not available or demand exceeds substation capacity.	Retire all steam generation & use	Same as Alternative 2	Yes - 600 PSI gas required	Minimal

Alternative	25 Hz Generation Assets	60 Hz Generation Assets	Future Generation Assets	Total Reliable Capacity of SWB assets	Firm (n-1) Reliable Generation Capacity at Carrollton Pwr Plant and Connected DPS	Future Firm (n-1) Reliable Capacity at Carollton Plant and Connected DPS
Alternative 0	T1 (STG) - 6.0 MW (6.0 MW reliable) T3 (STG) - 15 MW (6.0 MW reliable)* T4 (STG) - 20 MW (17.0 MW reliable)* T5 (CTG) - 20 MW (20.0 MW reliable) EMDs - 12.5 MW (12.5 MW reliable) TOTAL - 73.5 total/61.5 reliable	**Carrollton Power Plant:** **T6 (CTG) - 22 MW** **Remote Drainage Pump Stations -** **60 Hz Backup Generators Not Connected**	Connection of additional 60 Hz drainage pump stations would require new frequency changers and is not recommended.	Carrollton Power Plant 83.5 MW* *Frequency changers used to convey power between 25Hz and 60Hz sytems as needed	Carrollton Power Plant 61.5 MW 60 Hz Pumps at Drainage Pump Stations Varies by Station	N/A Connection of additional 60 Hz drainage pump stations to 25 Hz power distribution system would require new frequency changers and is not recommended.
Alternative 1	T1 (STG) - retire T3 (STG) - retire T4 (STG) - 20 MW (20.0 MW reliable) T5 (CTG) - 20 MW (20.0 MW reliable)* EMDs - 12.5 MW (12.5 MW reliable) **TOTAL - 52.5 total/52.5 MW reliable** *T4 reliable capacity further reduced due to reduction in steam generation capacity	T6 (CTG) - 22 MW DPS diesel generators - 10.4 MW **(1) New Gas Turbine Dual Fuel LM2500 - 22 MW** **TOTAL - 54.4 MW**	DPS diesel generators - 10.0 MW* TOTAL - 10.0 MW *existing generators currently not on SWBNO distribution (ex. DPS 19)	106.9 MW	84.9 MW	94.9 MW
Alternative 2	T1 (STG) - retire T3 (STG) - retire T4 (STG) - retire T5 (CTG) - retire EMDs - 12.5 MW (12.5 MW reliable) **TOTAL - 12.5 MW**	T6 (CTG) - 22 MW DPS diesel generators - 10.4 MW **(3) New Gas Turbines, Dual Fuel LM2500 (22MW each)** **TOTAL - 98.4 MW**	Same as Alternative 1	110.9 MW	88.9 MW	98.9 MW
Alternative 3	Same as Alternative 2	T6 (CTG) - 22 MW DPS diesel generators - 10.4 MW **(3) Wartsila 18V50DF - 18 MW** **TOTAL - 86.4 MW**	Same as Alternative 1	98.9 MW	76.9 MW	86.9 MW
Alternative 4	Same as Alternative 2	Same as Alternative 2	Same as Alternative 1	110.9 MW	88.9 MW	98.9 MW

Appendix D
Life Cycle Costs

HIGH VOLTAGE RATE SCHEDULE - SUMMARY OF LIFE CYCLE COST COMPARISONS
SWBNO Power Master Plan

Sensitivity Adjustments -->				
Natural Gas Escalation:	0.0%	Natural Gas Adder:	0.0%	
Purchased Electricty Escalation:	0.0%	Purchased Electricity Adder:	0.0%	

Option	Estimated Installed Costs	Annual Purchased Utility Costs		Incremental Annual O&M Costs	30-Year Life Cycle Cost	30-Year LCC Savings	Emissions (tons/yr)	Payback Period (yrs)	WPC Payback Period (yrs)
		Fuel	Electricity						
Alternate 0	$508,271,100	$10,427,424	$2,935,752	$4,813,909	$1,071,114,925	N/A	120,232	-	-
Alternate 1	$509,409,000	$330,396	$6,236,753	$2,674,588	$785,732,477	$285,382,448	79,832	0.12	26.81
Alternate 2	$549,721,000	$246,884	$6,236,753	$1,866,300	$803,221,334	$267,893,591	78,116	4.64	28.56
Alternate 3	$547,075,000	$206,961	$6,236,753	$1,943,157	$801,265,547	$269,849,378	77,788	4.31	28.35
Alternate 4	$553,089,000	$1,351	$8,472,857	$1,800,000	$859,746,716	$211,368,209	77,820	6.36	36.19

LARGE INTERRUPTIBLE RATE SCHEDULE - SUMMARY OF LIFE CYCLE COST COMPARISONS
SWBNO Power Master Plan

Sensitivity Adjustments -->				
Natural Gas Escalation:	0.0%	Natural Gas Adder:	0.0%	
Purchased Electricty Escalation:	0.0%	Purchased Electricity Adder:	0.0%	

Option	Estimated Installed Costs	Annual Purchased Utility Costs		Incremental Annual O&M Costs	30-Year Life Cycle Cost	30-Year LCC Savings	Emissions (tons/yr)	Payback Period (yrs)	WPC Payback Period (yrs)
		Fuel	Electricity						
Alternate 0	$508,271,100	$10,427,424	$2,935,752	$4,813,909	$1,071,114,925	N/A	120,232	-	-
Alternate 1	$509,409,000	$330,396	$3,362,831	$2,674,588	$705,152,351	$365,962,574	79,832	0.09	20.90
Alternate 2	$549,721,000	$246,884	$3,362,831	$1,866,300	$722,641,208	$348,473,717	78,116	3.57	21.95
Alternate 3	$547,075,000	$206,961	$3,362,831	$1,943,157	$720,685,421	$350,429,504	77,788	3.32	21.83
Alternate 4	$553,089,000	$1,351	$4,568,945	$1,800,000	$750,287,329	$320,827,595	77,820	4.19	23.84

Notes:
1. Electric costs are the same in Alt 1-3 since the total KWH and rate schedule used are consistent.
2. Alternate 0 Fuel and Electric Costs were taken from the 2018 Utility spreadsheets provided by SWBNO.
3. A value of 1,125 lbs/MWh of emissions was used to calculated the Purchased Power Emissions; US Energy Information Administration for the New Orleans region.
4. Fuel usage and emissions were calculated using 300 hours based on actual usage included in the 2018 Utility spreadsheets provided by SWBNO.
5. Per the EPA it is estimated that are 0.0551 tons of emissions per Mcf of natural gas, this value was used to calculate the emissions in alternate 0.

Appendix E
Operation and Maintenance Costs

Alternate 0: O&M Cost Estimate

Sewerage and Water Board of New Orleans

Item	Quantity	Interval (Years)	First Year	Cost / Each	Cost/Interval
Annually Recurring					
Gas/Steam Turbine LTSA (per kW-h)	109,374,768	1	1	$0.0055	$601,561
Water Consumption (gal)	6,364,800	1	1	$0.008	$50,918
Ammonia Consumption (gal)	2,858	1	1	$0.50	$1,429
Misc. BOP O&M	1	1	1	$1,250,000	$1,250,000
Annual Labor					
Plant Manager	1	1	1	$200,000	$200,000
Plant Engineer	4	1	1	$150,000	$600,000
Turbine Specialist	1	1	1	$100,000	$100,000
Operation Supervisors	3	1	1	$100,000	$300,000
Steam Plant Operator	5	1	1	$80,000	$400,000
Power Plant Operator	3	1	1	$80,000	$240,000
Mechanic	4	1	1	$80,000	$320,000
Electrician	4	1	1	$80,000	$320,000
I&C/Controls	2	1	1	$80,000	$160,000
Administrative	2	1	1	$60,000	$120,000
Non-Annually Recurring					
Boiler 1 Re-Tube	1	25	25	$750,000	$750,000
Boiler 2 Re-Tube	1	25	15	$750,000	$750,000
Boiler 3 Re-Tube	1	25	25	$750,000	$750,000
Boiler 4 Re-Tube	1	25	27	$750,000	$750,000
Boiler 5 Re-Tube	1	25	27	$750,000	$750,000
Boiler 6 Re-Tube	1	25	28	$750,000	$750,000

Notes:
LTSA based on actual hours used in 2018 based on Utility bills provided by SWBNO.
Assumed emissions control by SCR (selective catalytic reduction) ammonia consumption: 0.12 gal/MMBTU fuel consumed at average load, based on industry standar
Water consumption was based on using max steam plant output for 900 hrs/yr and min output for remaining of year.
Water consumption was calculated as 4% makeup water only, based on industry standard.
BOP O&M includes preventative maintenance budget items for various valves, pipes, building, electrical, etc.
Applied a complexitity factor increase of 25% to the LTSA and the BOP O&M, due to the limited amount of parts and labor
for 25 Hz equipment in comparision to modern equipment.

Total Annual O&M $4,813,909

Alternate 1: O&M Cost Estimate
Sewerage and Water Board of New Orleans

Item	Quantity	Interval (Years)	First Year	Cost / Each	Cost/Interval
Annually Recurring					
Gas/Steam Turbine LTSA (per kW-h)	7,800,000	1	1	$0.0096	$74,588
Water Consumption (gal)	0	1	1	$0.0080	$0
Ammonia Consumption (gal)	0	1	1	$0.50	$0
Misc. BOP O&M	1	1	1	$450,000	$450,000
Annual Labor					
Plant Manager	1	1	1	$200,000	$200,000
Plant Engineer	4	1	1	$150,000	$600,000
Turbine Specialist	1	1	1	$100,000	$100,000
Operation Supervisors	2	1	1	$100,000	$200,000
Steam Plant Operator	2	1	1	$80,000	$160,000
Power Plant Operator	3	1	1	$80,000	$240,000
Mechanic	2	1	1	$80,000	$160,000
Electrician	2	1	1	$80,000	$160,000
I&C/Controls	2	1	1	$80,000	$160,000
Administrative	2	1	1	$60,000	$120,000
Non-Annually Recurring					
Boiler 2 Re-Tube	1	25	15	$750,000	$750,000
Aux Boiler Re-Tube	1	25	25	$750,000	$750,000

Notes:
LTSA values based on 26 MW and 300 hrs run time.
Assumed emissions control by SCR (selective catalytic reduction) ammonia consumption: 0.12 gal/MMBTU fuel consumed at average load
Water consumption is zero due to operating the gas turbines prior to operating T4.
Ammonia consuption is zero due to operating the gas turbines prior to operating the boilers for T4.
BOP O&M includes preventative maintenance budget items for various valves, pipes, building, electrical, etc.
Applied a complexitity factor increase of 12.5% to the LTSA and the BOP O&M, due to the limited amount of parts and labor for 25 Hz equipment in comparision to modern equipment.

Total Annual O&M $2,674,588

Alternate 2: O&M Cost Estimate
Sewerage and Water Board of New Orleans

Item	Quantity	Interval (Years)	First Year	Cost / Each	Cost/Interval
Annually Recurring					
Gas Turbine LTSA (per kW-h)	7,800,000	1	1	$0.0085	$66,300
Misc. BOP O&M	1	1	1	$200,000	$200,000
Annual Labor					
Plant Manager	1	1	1	$200,000	$200,000
Plant Engineer	4	1	1	$150,000	$600,000
Turbine Specialist	1	1	1	$100,000	$100,000
Operation Supervisors	1	1	1	$100,000	$100,000
Steam Plant Operator	0	1	1	$80,000	$0
Power Plant Operator	3	1	1	$80,000	$240,000
Mechanic	1	1	1	$80,000	$80,000
Electrician	1	1	1	$80,000	$80,000
I&C/Controls	1	1	1	$80,000	$80,000
Administrative	2	1	1	$60,000	$120,000
Non-Annually Recurring					

Notes:
LTSA values based on 26 MW and 300 hrs run time.

Total Annual O&M $1,866,300

Alternate 3: O&M Cost Estimate
Sewerage and Water Board of New Orleans

Item	Quantity	Interval (Years)	First Year	Cost / Each	Cost/Interval
Annually Recurring					
Reciprocating Engine LTSA (per kW-h)	7,800,000	1	1	$0.0214	$202,524
Ammonia Consumption (gal)*	81,266	1	1	$0.50	$40,633
Misc. BOP O&M	1	1	1	$200,000	$200,000
Annual Labor					
Plant Manager	1	1	1	$200,000	$200,000
Plant Engineer	4	1	1	$150,000	$600,000
Turbine Specialist	0	1	1	$100,000	$0
Operation Supervisors	1	1	1	$100,000	$100,000
Steam Plant Operator	0	1	1	$80,000	$0
Power Plant Operator	3	1	1	$80,000	$240,000
Mechanic	1	1	1	$80,000	$80,000
Electrician	1	1	1	$80,000	$80,000
I&C/Controls	1	1	1	$80,000	$80,000
Administrative	2	1	1	$60,000	$120,000
Non-Annually Recurring					

Notes:
Assumed SCR ammonia consumption: 0.12 gal/MMBTU fuel consumed at average load, based on industry standard.
LTSA values based on information from Wartsila provided 10/22/2019

Total Annual O&M $1,943,157

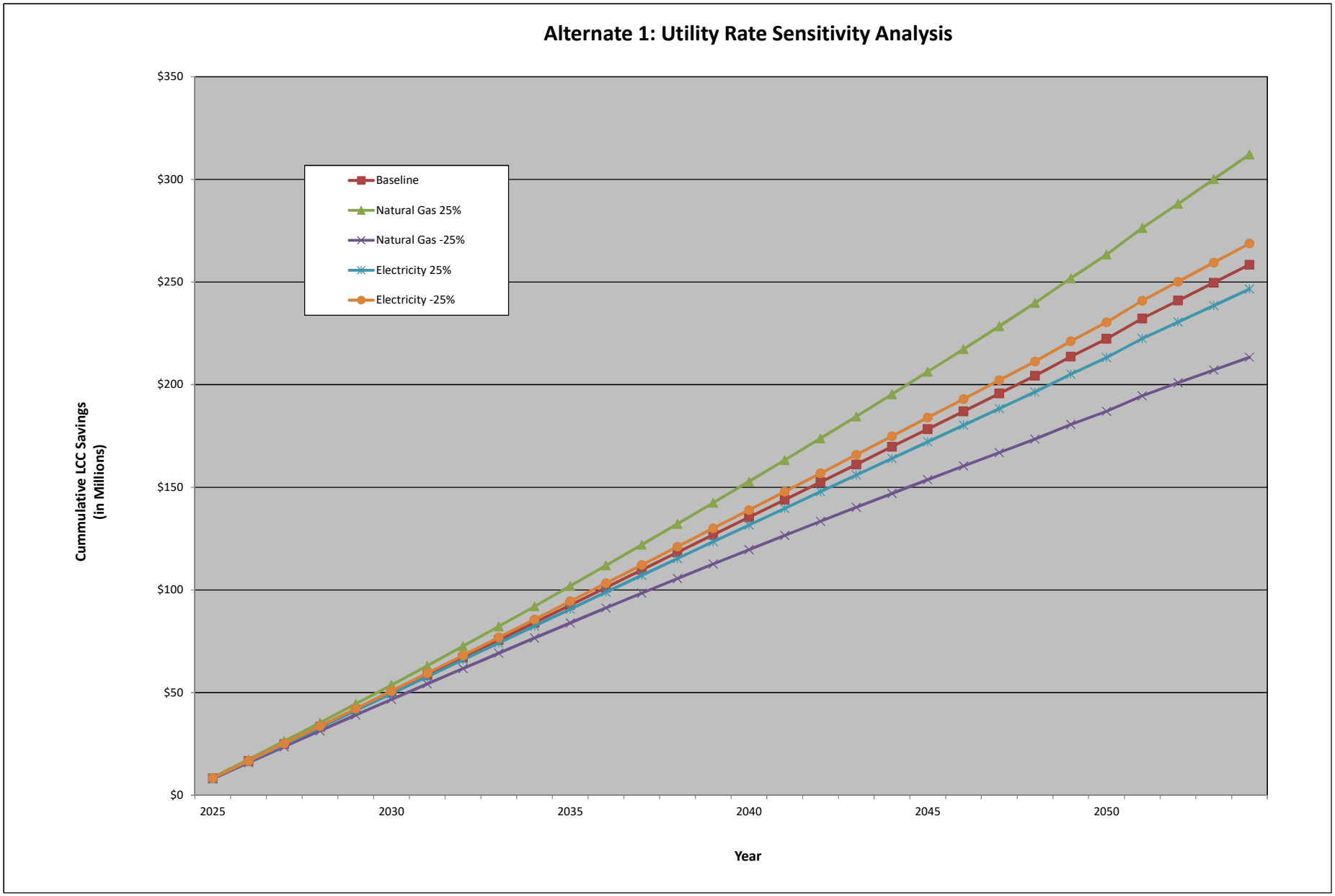
Alternate 4: O&M Cost Estimate
Sewerage and Water Board of New Orleans

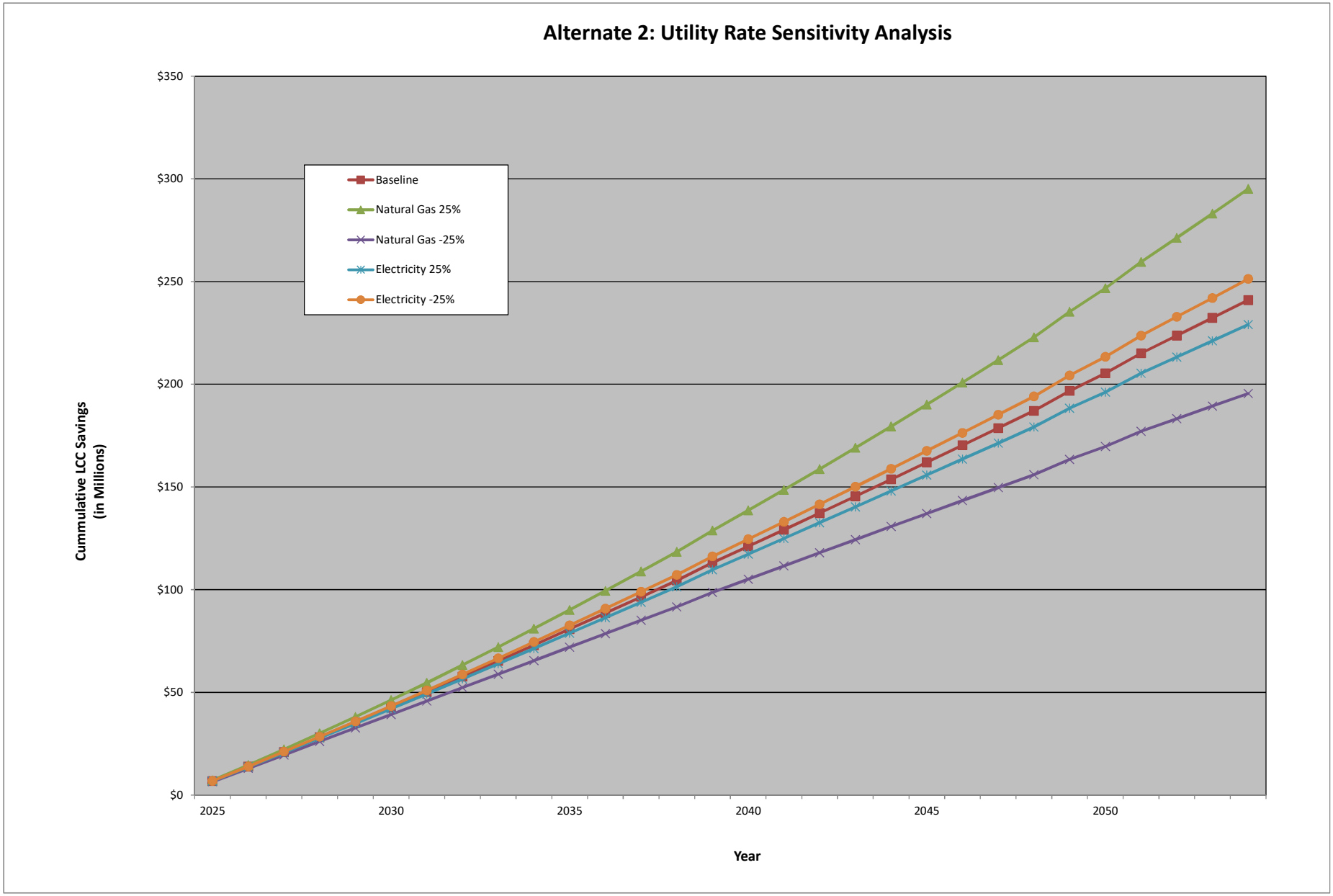
Item	Quantity	Interval (Years)	First Year	Cost / Each	Cost/Interval
Annually Recurring					
Gas Turbine LTSA (per kW-h)	0	1	1	$0.0085	$0
Misc. BOP O&M	1	1	1	$200,000	$200,000
Annual Labor					
Plant Manager	1	1	1	$200,000	$200,000
Plant Engineer	4	1	1	$150,000	$600,000
Turbine Specialist	1	1	1	$100,000	$100,000
Operation Supervisors	1	1	1	$100,000	$100,000
Steam Plant Operator	0	1	1	$80,000	$0
Power Plant Operator	3	1	1	$80,000	$240,000
Mechanic	1	1	1	$80,000	$80,000
Electrician	1	1	1	$80,000	$80,000
I&C/Controls	1	1	1	$80,000	$80,000
Administrative	2	1	1	$60,000	$120,000
Non-Annually Recurring					

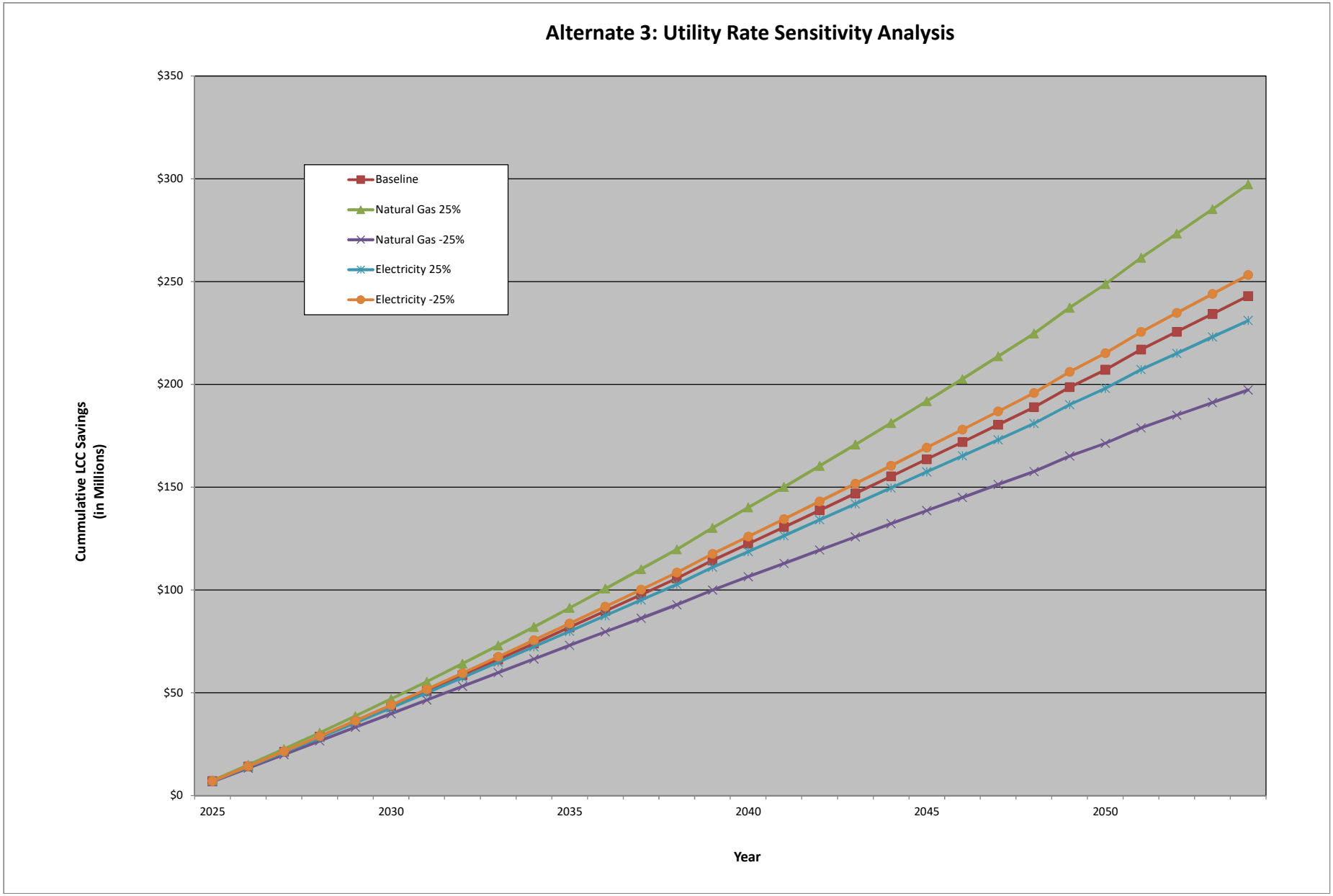
Notes:
LTSA values are based on run time. In this alternative, it is assumed that all normal demand will be provided by Entergy and the new generators will not run.

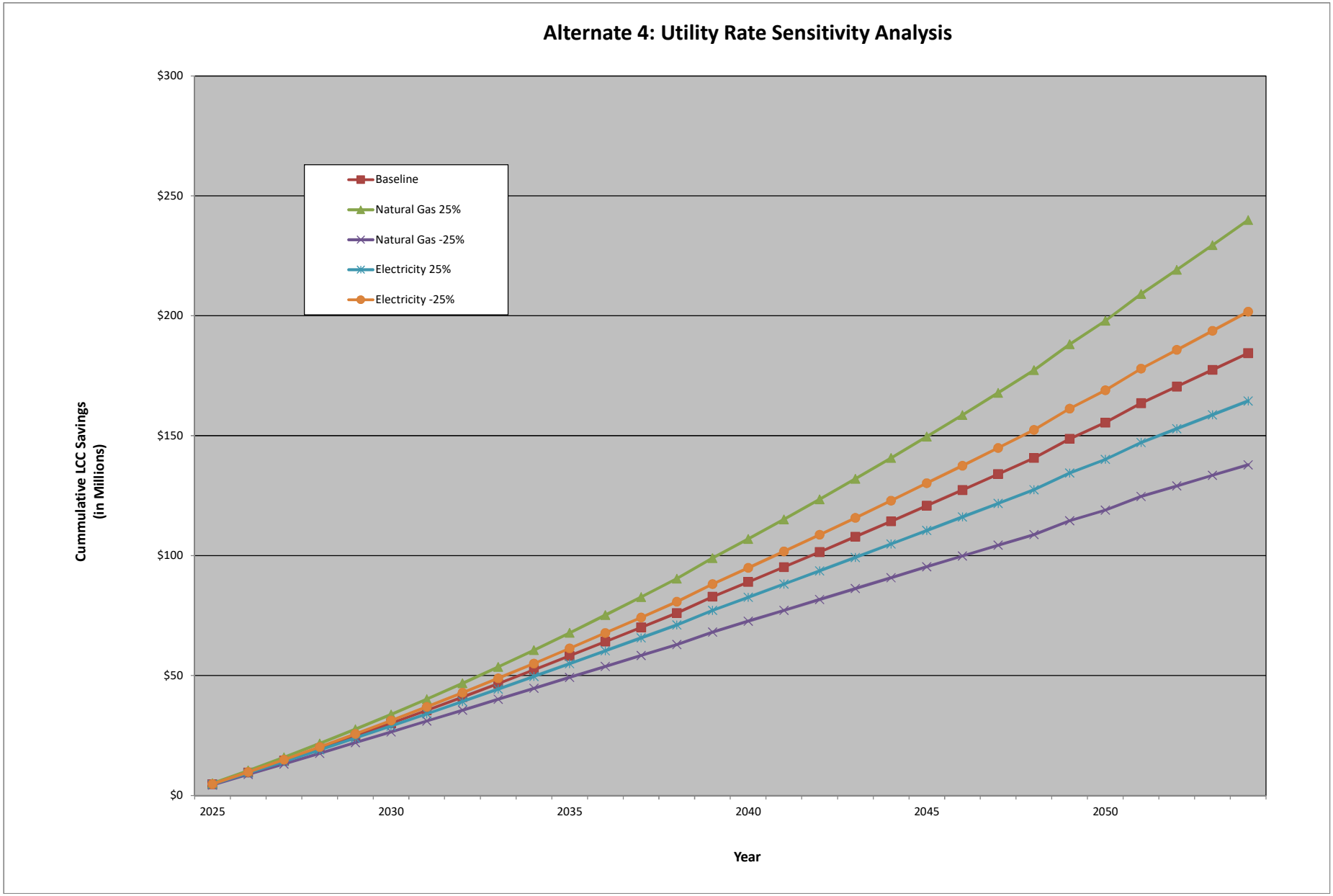
Total Annual O&M $1,800,000

Appendix F
Sensitivity Analysis


Alternate 1: Utility Rate Sensitivity Analysis
Cummulative LCC Savings (in Millions)
$350
$300
$250
$200
$150
$100
$50
$0
2025
2030
2035
2040
2045
2050
Year
Baseline
Natural Gas 25%
Natural Gas -25%
Electricity 25%
Electricity -25%


Alternate 2: Utility Rate Sensitivity Analysis
Cummulative LCC Savings (in Millions)
$350
$300
$250
$200
$150
$100
$50
$0
2025
2030
2035
2040
2045
2050
Year
Baseline
Natural Gas 25%
Natural Gas -25%
Electricity 25%
Electricity -25%


Alternate 3: Utility Rate Sensitivity Analysis
Cummulative LCC Savings (in Millions)
$350
$300
$250
$200
$150
$100
$50
$0
2025
2030
2035
2040
2045
2050
Year
Baseline
Natural Gas 25%
Natural Gas -25%
Electricity 25%
Electricity -25%


Alternate 4: Utility Rate Sensitivity Analysis
Cummulative LCC Savings (in Millions)
$300
$250
$200
$150
$100
$50
$0
2025
2030
2035
2040
2045
2050
Year
Baseline
Natural Gas 25%
Natural Gas -25%
Electricity 25%
Electricity -25%

Appendix G
Preliminary Cost Estimate

SEWERAGE AND WATER BOARD OF NEW ORLEANS
POWER MASTER PLAN **SWBNWO08**
PROJECT COST ESTIMATE **3/3/2020**

	Phase 1	Phase 2A	Phase 2B	Phase 2C	Phase 2D	Total
Alternative 0	$ 111,268,290	$ 136,594,778	$ 80,943,023	$ 105,435,904	$ 74,028,838	**$ 508,271,000**
Alternative 1	$ 188,914,079	$ 124,205,383	$ 44,576,025	$ 90,813,927	$ 86,850,037	**$ 535,360,000**
Alternative 2	$ 231,488,224	$ 123,394,439	$ 44,284,986	$ 90,220,997	$ 86,282,988	**$ 575,672,000**
Alternative 3	$ 230,424,219	$ 122,827,273	$ 44,081,436	$ 89,806,309	$ 85,886,400	**$ 573,026,000**
Alternative 4	$ 232,842,559	$ 124,116,365	$ 44,544,077	$ 90,748,840	$ 86,787,792	**$ 579,040,000**

ALTERNATE 0 - BASELINE

DESCRIPTION	QTY	UM	CONSTRUCTION UNIT $$	CONSTRUCTION TOTAL	Construction Contingency	Design Contingency	Escalation Year
Phase 1 Work							
Full 1370 Boiler Upgrades	1	LS	$ 44,806,000	$ 44,806,000	20%	20%	
Elimination of Cross Connect to T1, T3, T4 and T5	1	LS	$ 4,168,000	$ 4,168,000	20%	30%	2021
Development and installation of integrated communications & control system, Old Equip	1	LS	$ 15,000,000	$ 15,000,000	20%	30%	
	-	LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 63,974,000**	**$ 12,795,000**	**$ 14,712,000**	
Escalated Total				**$ 67,212,684**	**$ 13,442,747**	**$ 15,456,795**	
Phase 2A							
Reconditioning of T1	1	EA	$ 24,550,000	$ 24,550,000	20%	30%	
Alt 0 - Phase 2A Waterproofing motors & switchgear inside DPS buildings	1	EA	$ 24,480,000	$ 24,480,000	20%	30%	2023
Phase 2A Feeder Replacements	1	EA	$ 25,721,250	$ 25,721,250	20%	30%	
SubTotal (2019 Dollars)				**$ 74,751,250**	**$ 14,950,000**	**$ 22,425,000**	
Escalated Total				**$ 82,511,393**	**$ 16,502,003**	**$ 24,753,004**	
Phase 2B							
Reconditioning of T3	1	LS	$ 24,550,000	$ 24,550,000	15%	15%	
Alt 0 - Phase 2B Waterproofing motors & switchgear inside DPS buildings	1	EA	$ 8,520,000	$ 8,520,000	20%	30%	2025
Phase 2B Feeder Replacements	1	LS	$ 9,091,500	$ 9,091,500	20%	30%	
SubTotal (2019 Dollars)				**$ 42,161,500**	**$ 7,205,000**	**$ 8,966,000**	
Escalated Total				**$ 48,894,414**	**$ 8,355,591**	**$ 10,397,811**	
Phase 2C							
Reconditioning of T5	1	LS	$ 17,839,000	$ 17,839,000	15%	15%	
Alt 0 - Phase 2C Waterproofing motors & switchgear inside DPS buildings	1	EA	$ 17,790,000	$ 17,790,000	20%	30%	2027
Phase 2C Feeder Replacements	1	LS	$ 16,644,000	$ 16,644,000	20%	30%	
SubTotal (2019 Dollars)				**$ 52,273,000**	**$ 9,563,000**	**$ 13,006,000**	
Escalated Total				**$ 63,689,575**	**$ 11,651,587**	**$ 15,846,548**	
Phase 2D							
Phase 2D Feeder Replacements	1	LS	$ 22,543,500	$ 22,543,500	20%	30%	
Alt 0 - Phase 2D Waterproofing motors & switchgear inside DPS buildings	1	EA	$ 12,390,000	$ 12,390,000	20%	30%	2029
		LS		$ -			
SubTotal (2019 Dollars)				**$ 34,933,500**	**$ 6,987,000**	**$ 10,480,000**	
Escalated Total				**$ 44,717,833**	**$ 8,943,951**	**$ 13,415,286**	
Combined Material and Labor Subtotal (including escalation)				**$ 307,026,000**			
Miscellaneous Contractor Costs							
General Conditions and Project Staff (9%)	1	LS	$ 27,632,340	$ 27,632,340			
Overhead (5%)	1	LS	$ 15,351,300	$ 15,351,300			
Bond and Insurance (1.35%)	1	LS	$ 4,144,851	$ 4,144,851			
General Contractor Fees (5%)	1	LS	$ 15,351,300	$ 15,351,300			
Material Sales Tax	1	LS	$ -	$ -			
	-	LS	$ -	$ -			
SubTotal				**$ 62,480,000**			
Total Construction Contingency				**$ 58,895,878**			
Total Design Contingency				**$ 79,869,444**			
Total Construction Cost				**$ 508,271,000**			

Items Specifically Excluded from Estimate
Private Communication Network (assumes use of third party fiber)

ALTERNATE 1 - INSTALL 50 MW SUBSTATION, REDUCE STEAM USE AND CONVERT TO 60 HZ POWEF

DESCRIPTION	QTY	UM	CONSTRUCTION UNIT $$	CONSTRUCTION TOTAL	Construction Contingency	Design Contingency	Escalation Year
Phase 1							
Partial Boiler Upgrades (Keep Boiler 2, Add Aux Boiler, DA and Wtr Trtmt)	1	LS	$ 10,800,000	$ 10,800,000	20%	30%	
Demolition of T1, T3 and Auxiliaries	1	LS	$ 700,000	$ 700,000	20%	30%	
Partial Boiler House Equipment Demolition	1	LS	$ 1,600,000	$ 1,600,000	20%	30%	
Elimination of Cross Connect to T4 and T5 only	1	LS	$ 4,168,000	$ 4,168,000	20%	30%	
New 50 MVA Substation	1	LS	$ 14,000,000	$ 14,000,000	20%	20%	
West Site Redevelopment and Retention Pond Removal	1	LS	$ 5,000,000	$ 5,000,000	20%	30%	
LM2500 - Complete Outdoor Package with Gas Compressor - Installed	1	LS	$ 16,240,000	$ 16,240,000	20%	20%	
Gas Compressor for LM2500	1	LS	$ 750,000	$ 750,000	20%	20%	
Turbine Install (Struct, Mech, Elec, I&C)	1	LS	$ 5,000,000	$ 5,000,000	20%	20%	2021
Plant Building to House Engine Generators and Control Room	1	LS	$ 7,200,000	$ 7,200,000	20%	30%	
Fuel Gas and Fuel Oil Lines to West Power Complex	1	LS	$ 731,700	$ 731,700	20%	30%	
New 60 Hz Ring Bus at WPC or PFC Building	1	LS	$ 2,500,000	$ 2,500,000	20%	30%	
New Aux Ring Bus at DPS 3	-	LS	$ 1,200,000	$ -	20%	30%	
New 25 MW Static Frequency Changer	3	LS	$ 7,250,000	$ 21,750,000	20%	30%	
Power Plant Control System	1	LS	$ 4,000,000	$ 4,000,000	20%	30%	
New Carrolton Feeders From West Power Complex to Loads	1	LS	$ 1,860,000	$ 1,860,000	20%	30%	
Development and installation of integrated communications & control system, New Equip	1	LS	$ 10,000,000	$ 10,000,000	20%	30%	
	-	LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 106,299,700**	**$ 21,260,000**	**$ 28,291,000**	
Escalated Total				**$ 111,681,122**	**$ 22,336,288**	**$ 29,723,232**	
Phase 2A							
Phase 2A DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	EA	$ 40,800,000	$ 40,800,000	20%	30%	
Phase 2A Feeder Replacements	1	LS	$ 25,721,250	$ 25,721,250	20%	30%	2023
	-	LS	$ -	$ -			
	-	EA	$ -	$ -			
SubTotal (2019 Dollars)				**$ 66,521,250**	**$ 13,304,000**	**$ 19,956,000**	
Escalated Total				**$ 73,427,013**	**$ 14,685,127**	**$ 22,027,690**	
Phase 2B							
Phase 2B DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	EA	$ 14,200,000	$ 14,200,000	20%	30%	
Phase 2B Feeder Replacements	1	LS	$ 9,091,500	$ 9,091,500	20%	30%	2024
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 23,291,500**	**$ 4,658,000**	**$ 6,987,000**	
Escalated Total				**$ 26,352,194**	**$ 5,270,099**	**$ 7,905,149**	
Phase 2C							
Phase 2C DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	LS	$ 29,650,000	$ 29,650,000	20%	30%	
Phase 2C Feeder Replacements	1	LS	$ 16,644,000	$ 16,644,000	20%	30%	2025
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 46,294,000**	**$ 9,259,000**	**$ 13,888,000**	
Escalated Total				**$ 53,686,847**	**$ 10,737,601**	**$ 16,105,822**	
Phase 2D							
Phase 2D DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	LS	$ 20,650,000	$ 20,650,000	20%	30%	
Phase 2D Feeder Replacements	1	LS	$ 22,543,500	$ 22,543,500	20%	30%	2026
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 43,193,500**	**$ 8,639,000**	**$ 12,958,000**	
Escalated Total				**$ 51,343,498**	**$ 10,269,056**	**$ 15,402,990**	
Combined Material and Labor Subtotal (including escalation)				**$ 316,491,000**			
Miscellaneous Contractor Costs							
General Conditions and Project Staff (9%)	1	LS	$ 28,484,190	$ 28,484,190			
Overhead (5%)	1	LS	$ 15,824,550	$ 15,824,550			
Bond and Insurance (1.35%)	1	LS	$ 4,272,629	$ 4,272,629			
General Contractor Fees (5%)	1	LS	$ 15,824,550	$ 15,824,550			
Material Sales Tax	1	LS	$ -	$ -			
	-	LS	$ -	$ -			
SubTotal				**$ 64,406,000**			
Total Construction Contingency				**$ 63,298,171**			
Total Design Contingency				**$ 91,164,883**			
Total Construction Cost				**$ 535,360,000**			

Items Specifically Excluded from Estimate
Hardening DPS buildings to prevent flood water intrusion
Private Communication Network (assumes use of third party fiber)

ALTERNATE 2 - INSTALL 50 MW SUBSTATION, ELIMINATE STEAM USE, ADD CTGs AND CONVERT TO 60 HZ POWEF

DESCRIPTION	QTY	UM	CONSTRUCTION UNIT $$	CONSTRUCTION TOTAL	Construction Contingency	Design Contingency	Escalation Year
Phase 1							
Demolition of T1, T3 and Auxiliaries	1	LS	$ 700,000	$ 700,000	20%	30%	
Demolition of T4, T5 and Auxiliaries	1	LS	$ 700,000	$ 700,000	20%	30%	
Complete Boiler House Equipment Demolition	1	LS	$ 1,700,000	$ 1,700,000	20%	30%	
New 50 MVA Substation	1	LS	$ 14,000,000	$ 14,000,000	20%	20%	
West Site Redevelopment and Retention Pond Removal	1	LS	$ 5,000,000	$ 5,000,000	20%	30%	
LM2500 - Complete Outdoor Package with Gas Compressor - Installed	3	LS	$ 16,240,000	$ 48,720,000	20%	20%	
Gas Compressor for LM2500	3	LS	$ 750,000	$ 2,250,000	20%	20%	
Turbine Install (Struct, Mech, Elec, I&C)	2	LS	$ 5,000,000	$ 10,000,000	20%	20%	
Plant Building to House Engine Generators and Control Room	1	LS	$ 7,200,000	$ 7,200,000	20%	30%	2021
Fuel Gas and Fuel Oil Lines to West Power Complex	1	LS	$ 731,700	$ 731,700	20%	30%	
New 60 Hz Ring Bus at WPC or PFC Building	1	LS	$ 2,500,000	$ 2,500,000	20%	30%	
New Aux Ring Bus at DPS 3	-	LS	$ 1,200,000	$ -	20%	30%	
New 25 MW Static Frequency Changer	3	LS	$ 7,250,000	$ 21,750,000	20%	30%	
Power Plant Control System	1	LS	$ 4,000,000	$ 4,000,000	20%	30%	
New Carrolton Feeders From West Power Complex to Loads	1	LS	$ 1,860,000	$ 1,860,000	20%	30%	
Development and installation of integrated communications & control system, New Equip	1	LS	$ 10,000,000	$ 10,000,000	20%	30%	
	-		$ -	$ -			
SubTotal (2019 Dollars)				**$ 131,111,700**	**$ 26,222,000**	**$ 31,837,000**	
Escalated Total				**$ 137,749,230**	**$ 27,549,489**	**$ 33,448,748**	
Phase 2A							
Phase 2A DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	EA	$ 40,800,000	$ 40,800,000	20%	30%	
Phase 2A Feeder Replacements	1	LS	$ 25,721,250	$ 25,721,250	20%	30%	2023
	-	LS	$ -	$ -			
	-	EA	$ -	$ -			
SubTotal (2019 Dollars)				**$ 66,521,250**	**$ 13,304,000**	**$ 19,956,000**	
Escalated Total				**$ 73,427,013**	**$ 14,685,127**	**$ 22,027,690**	
Phase 2B							
Phase 2B DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	EA	$ 14,200,000	$ 14,200,000	20%	30%	
Phase 2B Feeder Replacements	1	LS	$ 9,091,500	$ 9,091,500	20%	30%	2024
		LS	$ 24,550,000	$ -			
SubTotal (2019 Dollars)				**$ 23,291,500**	**$ 4,658,000**	**$ 6,987,000**	
Escalated Total				**$ 26,352,194**	**$ 5,270,099**	**$ 7,905,149**	
Phase 2C							
Phase 2C DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	LS	$ 29,650,000	$ 29,650,000	20%	30%	
Phase 2C Feeder Replacements	1	LS	$ 16,644,000	$ 16,644,000	20%	30%	2025
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 46,294,000**	**$ 9,259,000**	**$ 13,888,000**	
Escalated Total				**$ 53,686,847**	**$ 10,737,601**	**$ 16,105,822**	
Phase 2D							
Phase 2D DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	LS	$ 20,650,000	$ 20,650,000	20%	30%	
Phase 2D Feeder Replacements	1	LS	$ 22,543,500	$ 22,543,500	20%	30%	2026
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 43,193,500**	**$ 8,639,000**	**$ 12,958,000**	
Escalated Total				**$ 51,343,498**	**$ 10,269,056**	**$ 15,402,990**	
Combined Material and Labor Subtotal (including escalation)				**$ 342,559,000**			
Miscellaneous Contractor Costs							
General Conditions and Project Staff (9%)	1	LS	$ 30,830,310	$ 30,830,310			
Overhead (5%)	1	LS	$ 17,127,950	$ 17,127,950			
Bond and Insurance (1.35%)	1	LS	$ 4,624,547	$ 4,624,547			
General Contractor Fees (5%)	1	LS	$ 17,127,950	$ 17,127,950			
Material Sales Tax	1	LS	$ -	$ -			
	-	LS	$ -	$ -			
SubTotal				**$ 69,711,000**			
Total Construction Contingency				**$ 68,511,372**			
Total Design Contingency				**$ 94,890,400**			
Total Construction Cost				**$ 575,672,000**			

Items Specifically Excluded from Estimate
Hardening DPS buildings to prevent flood water intrusion
Private Communication Network (assumes use of third party fiber)

ALTERNATE 3 - INSTALL 50 MW SUBSTATION, ELIMINATE STEAM USE, ADD ENGINE GENERATORS AND CONVERT TO 60 HZ POWER

DESCRIPTION	QTY	UM	CONSTRUCTION UNIT $$	CONSTRUCTION TOTAL	Construction Contingency	Design Contingency	Escalation Year
Phase 1							
Demolition of T1, T3 and Auxiliaries	1	LS	$ 700,000	$ 700,000	20%	30%	
Demolition of T4, T5 and Auxiliaries	1	LS	$ 700,000	$ 700,000	20%	30%	
Complete Boiler House Equipment Demolition	1	LS	$ 1,700,000	$ 1,700,000	20%	30%	
New 50 MVA Substation	1	LS	$ 14,000,000	$ 14,000,000	20%	20%	
West Site Redevelopment and Retention Pond Removal	1	LS	$ 5,000,000	$ 5,000,000	20%	30%	
Wartsila 18V50DF - Installed	3	LS	$ 19,800,000	$ 59,400,000	20%	20%	
Plant Building to House Engine Generators and Control Room	1	LS	$ 7,200,000	$ 7,200,000	20%	30%	
Fuel Gas and Fuel Oil Lines to West Power Complex	1	LS	$ 731,700	$ 731,700	20%	30%	2021
New 60 Hz Ring Bus at WPC or PFC Building	1	LS	$ 2,500,000	$ 2,500,000	20%	30%	
New Aux Ring Bus at DPS 3	-	LS	$ 1,200,000	$ -	20%	30%	
New 25 MW Static Frequency Changer	3	LS	$ 7,250,000	$ 21,750,000	20%	30%	
Power Plant Control System	1	LS	$ 4,000,000	$ 4,000,000	20%	30%	
New Carrolton Feeders From West Power Complex to Loads	1	LS	$ 1,860,000	$ 1,860,000	20%	30%	
Development and installation of integrated communications & control system, New Equip	1	LS	$ 10,000,000	$ 10,000,000	20%	30%	
	-		$ -	$ -			
SubTotal (2019 Dollars)				**$ 129,541,700**	**$ 25,908,000**	**$ 31,523,000**	
Escalated Total				**$ 136,099,749**	**$ 27,219,593**	**$ 33,118,852**	
Phase 2A							
Phase 2A DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	EA	$ 40,800,000	$ 40,800,000	20%	30%	
Phase 2A Feeder Replacements	1	LS	$ 25,721,250	$ 25,721,250	20%	30%	2023
	-	LS	$ -	$ -			
	-	EA	$ -	$ -			
SubTotal (2019 Dollars)				**$ 66,521,250**	**$ 13,304,000**	**$ 19,956,000**	
Escalated Total				**$ 73,427,013**	**$ 14,685,127**	**$ 22,027,690**	
Phase 2B							
Phase 2B DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	EA	$ 14,200,000	$ 14,200,000	20%	30%	
Phase 2B Feeder Replacements	1	LS	$ 9,091,500	$ 9,091,500	20%	30%	2024
		LS	$ 24,550,000	$ -			
SubTotal (2019 Dollars)				**$ 23,291,500**	**$ 4,658,000**	**$ 6,987,000**	
Escalated Total				**$ 26,352,194**	**$ 5,270,099**	**$ 7,905,149**	
Phase 2C							
Phase 2C DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	LS	$ 29,650,000	$ 29,650,000	20%	30%	
Phase 2C Feeder Replacements	1	LS	$ 16,644,000	$ 16,644,000	20%	30%	2025
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 46,294,000**	**$ 9,259,000**	**$ 13,888,000**	
Escalated Total				**$ 53,686,847**	**$ 10,737,601**	**$ 16,105,822**	
Phase 2D							
Phase 2D DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	LS	$ 20,650,000	$ 20,650,000	20%	30%	
Phase 2D Feeder Replacements	1	LS	$ 22,543,500	$ 22,543,500	20%	30%	2026
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 43,193,500**	**$ 8,639,000**	**$ 12,958,000**	
Escalated Total				**$ 51,343,498**	**$ 10,269,056**	**$ 15,402,990**	
Combined Material and Labor Subtotal (including escalation)				**$ 340,909,000**			
Miscellaneous Contractor Costs							
General Conditions and Project Staff (9%)	1	LS	$ 30,681,810	$ 30,681,810			
Overhead (5%)	1	LS	$ 17,045,450	$ 17,045,450			
Bond and Insurance (1.35%)	1	LS	$ 4,602,272	$ 4,602,272			
General Contractor Fees (5%)	1	LS	$ 17,045,450	$ 17,045,450			
Material Sales Tax	1	LS	$ -	$ -			
	-	LS	$ -	$ -			
SubTotal				**$ 69,375,000**			
Total Construction Contingency				**$ 68,181,476**			
Total Design Contingency				**$ 94,560,503**			
Total Construction Cost				**$ 573,026,000**			

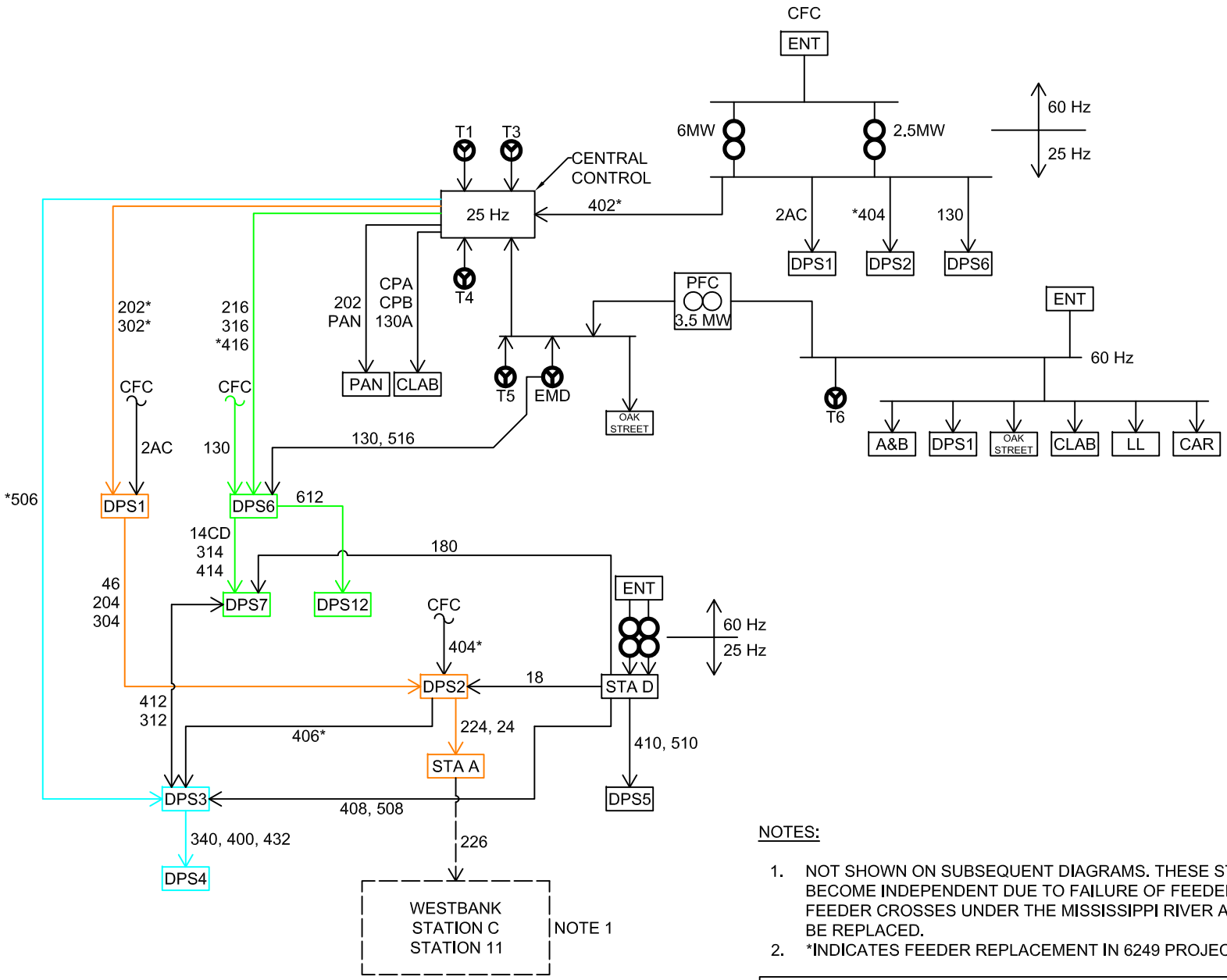
Items Specifically Excluded from Estimate
Hardening DPS buildings to prevent flood water intrusion
Private Communication Network (assumes use of third party fiber)

ALTERNATE 4 - INSTALL 120 MW SUBSTATION, ELIMINATE STEAM USE, ADD CTGs AND CONVERT TO 60 HZ POWEF

DESCRIPTION	QTY	UM	CONSTRUCTION UNIT $$	CONSTRUCTION TOTAL	Construction Contingency	Design Contingency	Escalation Year
Phase 1							
Demolition of T1, T3 and Auxiliaries	1	LS	$ 700,000	$ 700,000	20%	30%	
Demolition of T4, T5 and Auxiliaries	1	LS	$ 700,000	$ 700,000	20%	30%	
Complete Boiler House Equipment Demolition	1	LS	$ 1,700,000	$ 1,700,000	20%	30%	
New 120 MVA Substation	1	LS	$ 16,000,000	$ 16,000,000	20%	20%	
West Site Redevelopment and Retention Pond Removal	1	LS	$ 5,000,000	$ 5,000,000	20%	30%	
LM2500 - Complete Outdoor Package with Gas Compressor - Installed	3	LS	$ 16,240,000	$ 48,720,000	20%	20%	
Gas Compressor for LM2500	3	LS	$ 750,000	$ 2,250,000	20%	20%	
Turbine Install (Struct, Mech, Elec, I&C)	2	LS	$ 5,000,000	$ 10,000,000	20%	20%	
Plant Building to House Engine Generators and Control Room	1	LS	$ 7,200,000	$ 7,200,000	20%	30%	2021
Fuel Gas and Fuel Oil Lines to West Power Complex	1	LS	$ 731,700	$ 731,700	20%	30%	
New 60 Hz Ring Bus at WPC or PFC Building	1	LS	$ 2,500,000	$ 2,500,000	20%	30%	
New Aux Ring Bus at DPS 3	-	LS	$ 1,200,000	$ -	20%	30%	
New 25 MW Static Frequency Changer	3	LS	$ 7,250,000	$ 21,750,000	20%	30%	
Power Plant Control System	1	LS	$ 4,000,000	$ 4,000,000	20%	30%	
New Carrolton Feeders From West Power Complex to Loads	1	LS	$ 1,860,000	$ 1,860,000	20%	30%	
Development and installation of integrated communications & control system, New Equip	1	LS	$ 10,000,000	$ 10,000,000	20%	30%	
	-		$ -	$ -			
SubTotal (2019 Dollars)				**$ 133,111,700**	**$ 26,622,000**	**$ 32,237,000**	
Escalated Total				**$ 139,850,480**	**$ 27,969,739**	**$ 33,868,998**	
Phase 2A							
Phase 2A DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	EA	$ 40,800,000	$ 40,800,000	20%	30%	
Phase 2A Feeder Replacements	1	LS	$ 25,721,250	$ 25,721,250	20%	30%	2023
	-	LS	$ -	$ -			
	-	EA	$ -	$ -			
SubTotal (2019 Dollars)				**$ 66,521,250**	**$ 13,304,000**	**$ 19,956,000**	
Escalated Total				**$ 73,427,013**	**$ 14,685,127**	**$ 22,027,690**	
Phase 2B							
Phase 2B DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	EA	$ 14,200,000	$ 14,200,000	20%	30%	
Phase 2B Feeder Replacements	1	LS	$ 9,091,500	$ 9,091,500	20%	30%	2024
		LS	$ 24,550,000	$ -			
SubTotal (2019 Dollars)				**$ 23,291,500**	**$ 4,658,000**	**$ 6,987,000**	
Escalated Total				**$ 26,352,194**	**$ 5,270,099**	**$ 7,905,149**	
Phase 2C							
Phase 2C DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	LS	$ 29,650,000	$ 29,650,000	20%	30%	
Phase 2C Feeder Replacements	1	LS	$ 16,644,000	$ 16,644,000	20%	30%	2025
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 46,294,000**	**$ 9,259,000**	**$ 13,888,000**	
Escalated Total				**$ 53,686,847**	**$ 10,737,601**	**$ 16,105,822**	
Phase 2D							
Phase 2D DPS 60 Hz Conversions (New Xfmrs, Swgr, 60 Hz Motor, Gearboxes, etc)	1	LS	$ 20,650,000	$ 20,650,000	20%	30%	
Phase 2D Feeder Replacements	1	LS	$ 22,543,500	$ 22,543,500	20%	30%	2026
		LS	$ -	$ -			
SubTotal (2019 Dollars)				**$ 43,193,500**	**$ 8,639,000**	**$ 12,958,000**	
Escalated Total				**$ 51,343,498**	**$ 10,269,056**	**$ 15,402,990**	
Combined Material and Labor Subtotal (including escalation)				**$ 344,660,000**			
Miscellaneous Contractor Costs							
General Conditions and Project Staff (9%)	1	LS	$ 31,019,400	$ 31,019,400			
Overhead (5%)	1	LS	$ 17,233,000	$ 17,233,000			
Bond and Insurance (1.35%)	1	LS	$ 4,652,910	$ 4,652,910			
General Contractor Fees (5%)	1	LS	$ 17,233,000	$ 17,233,000			
Material Sales Tax	1	LS	$ -	$ -			
	-	LS	$ -	$ -			
SubTotal				**$ 70,138,000**			
Total Construction Contingency				**$ 68,931,622**			
Total Design Contingency				**$ 95,310,650**			
Total Construction Cost				**$ 579,040,000**			

Items Specifically Excluded from Estimate
Hardening DPS buildings to prevent flood water intrusion
Private Communication Network (assumes use of third party fiber)

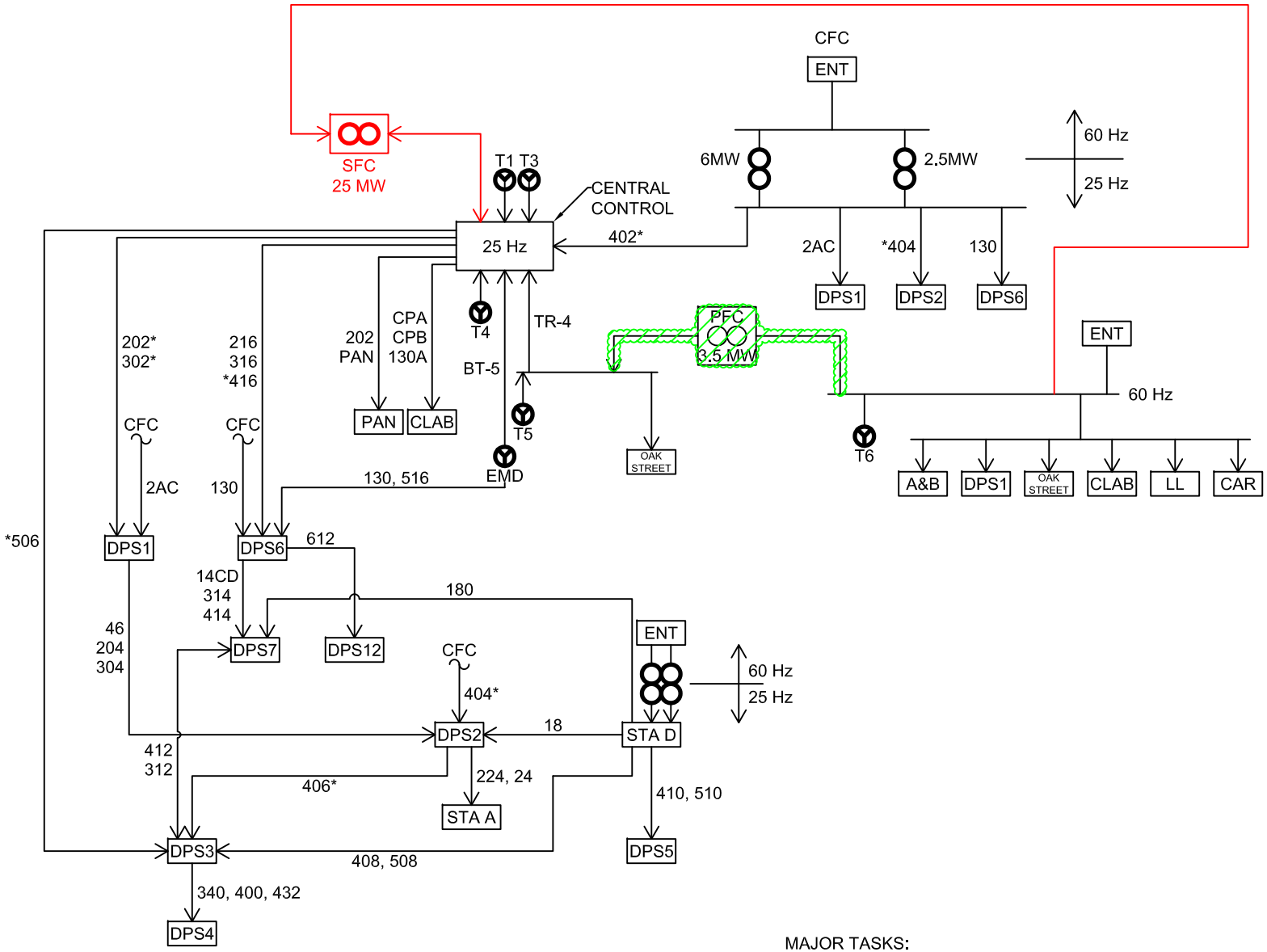
Appendix H
Phasing Diagrams



NOTES:

1. NOT SHOWN ON SUBSEQUENT DIAGRAMS. THESE STATIONS WILL BECOME INDEPENDENT DUE TO FAILURE OF FEEDER 226. THIS FEEDER CROSSES UNDER THE MISSISSIPPI RIVER AND WILL NOT BE REPLACED.
2. *INDICATES FEEDER REPLACEMENT IN 6249 PROJECT.

FIGURE 1 - EXISTING SYSTEM



MAJOR TASKS:

1. PREPARE WEST POWER COMPLEX.
2. INSTALL NEW 25 MW SFC.

FIGURE 2 - EXISTING SYSTEM TO INSTALLATION OF STATIC FREQUENCY CHANGER (SFC)

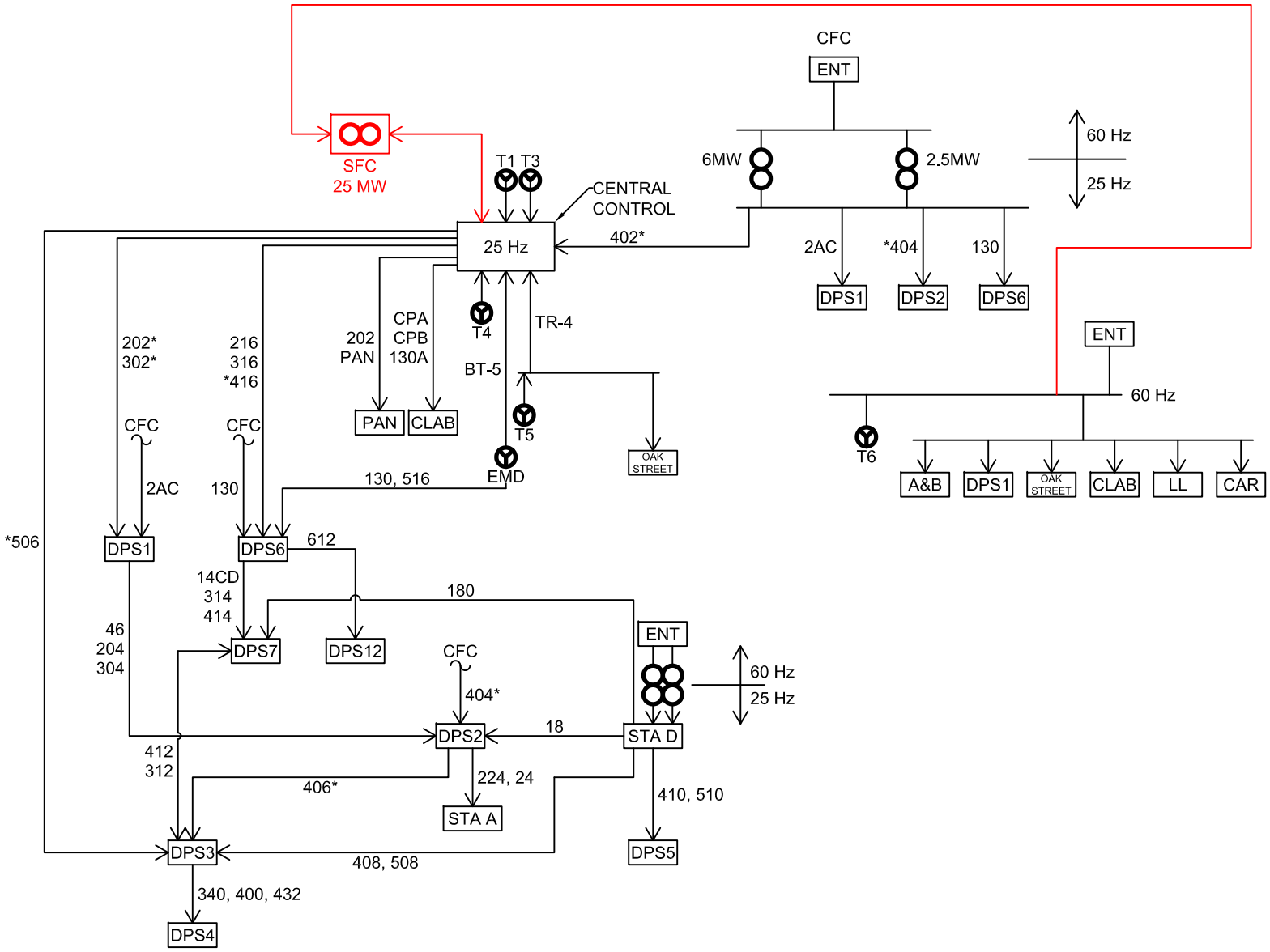
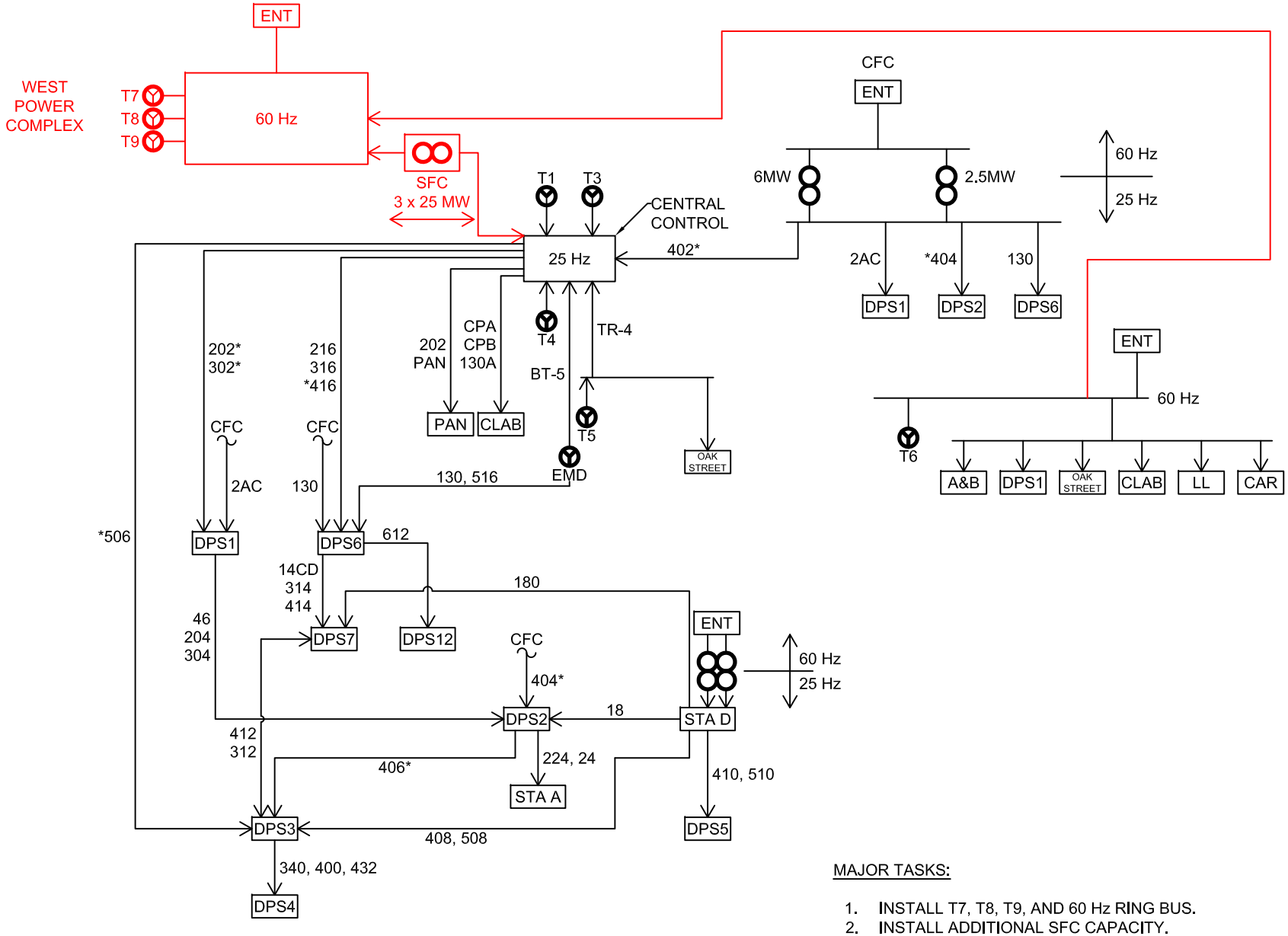


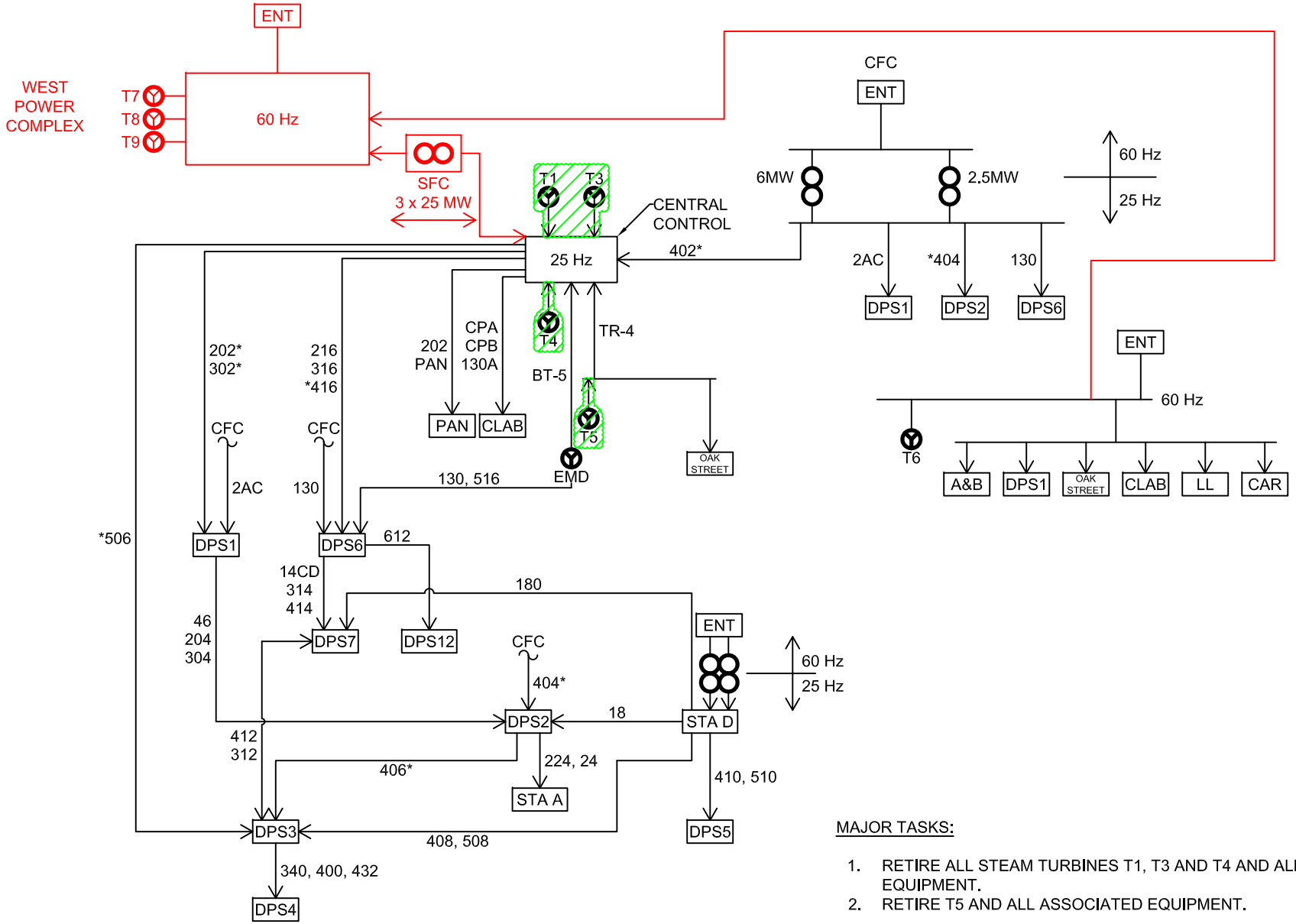
FIGURE 3 - STATIC FREQUENCY CHANGER (SFC) ADDITION COMPLETE



MAJOR TASKS:

1. INSTALL T7, T8, T9, AND 60 Hz RING BUS.
2. INSTALL ADDITIONAL SFC CAPACITY.
3. INSTALL NEW SUBSTATION.
4. CONNECT T6 BUS TO 60 Hz RING BUS.
5. ADD WPC CONTROL BUILDING.

FIGURE 4 - EXISTING SYSTEM TO CONSTRUCTION OF WPC



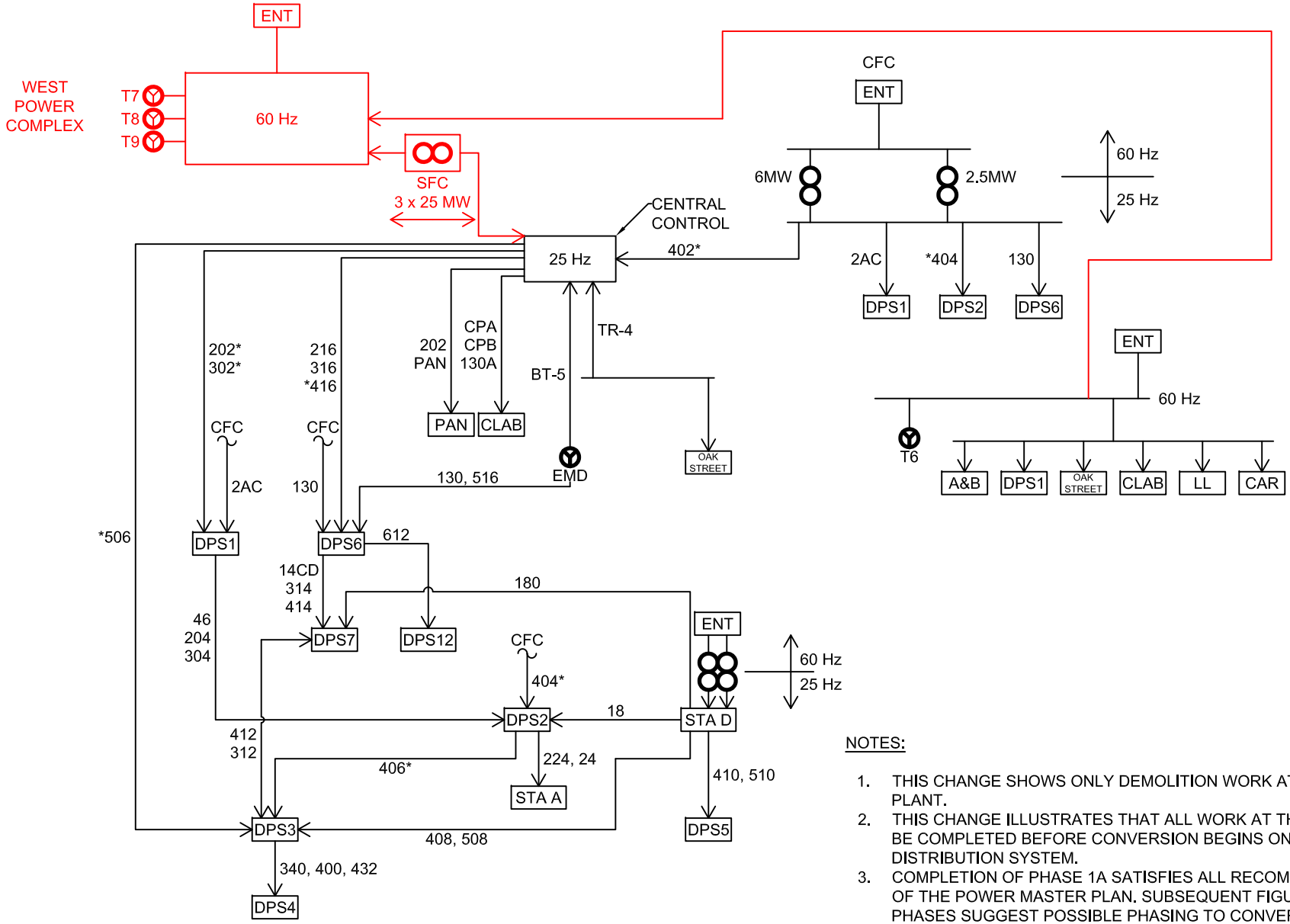
MAJOR TASKS:

1. RETIRE ALL STEAM TURBINES T1, T3 AND T4 AND ALL ASSOCIATED EQUIPMENT.
2. RETIRE T5 AND ALL ASSOCIATED EQUIPMENT.

NOTES:

1. THIS FIGURE ONLY SHOWS DEMOLITION.

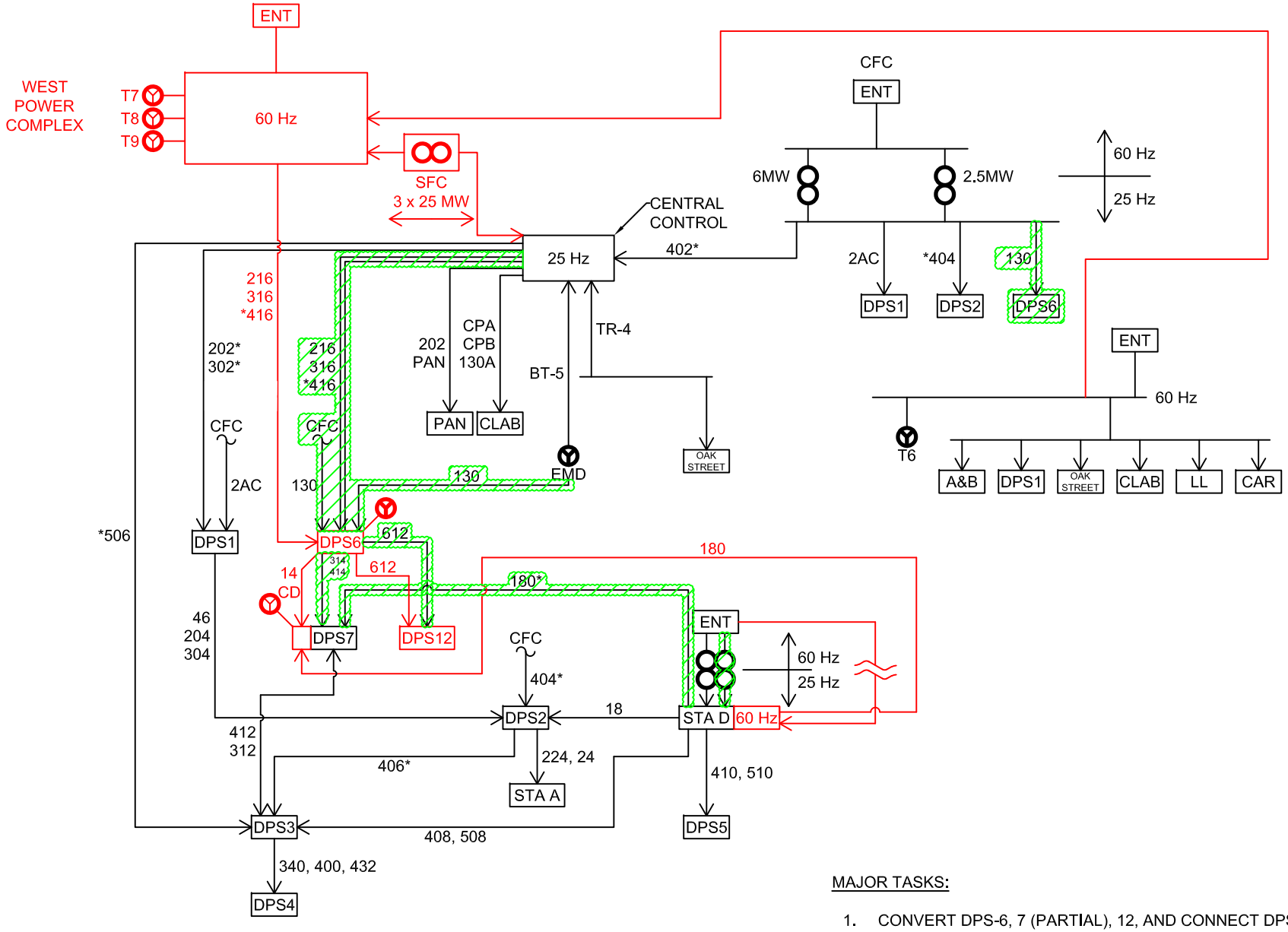
FIGURE 5 - WPC COMPLETE - RETIRE STEAM GENERATORS



NOTES:

1. THIS CHANGE SHOWS ONLY DEMOLITION WORK AT POWER PLANT.
2. THIS CHANGE ILLUSTRATES THAT ALL WORK AT THE PLANT CAN BE COMPLETED BEFORE CONVERSION BEGINS ON THE DISTRIBUTION SYSTEM.
3. COMPLETION OF PHASE 1A SATISFIES ALL RECOMMENDATIONS OF THE POWER MASTER PLAN. SUBSEQUENT FIGURES AND PHASES SUGGEST POSSIBLE PHASING TO CONVERT DISTRIBUTION SYSTEM FEEDERS AND LOADS. THIS WORK IS BEYOND THE SCOPE OF THE POWER MASTER PLAN AND REQUIRES ADDITIONAL ANALYSIS TO CONFIRM FEASIBILITY.

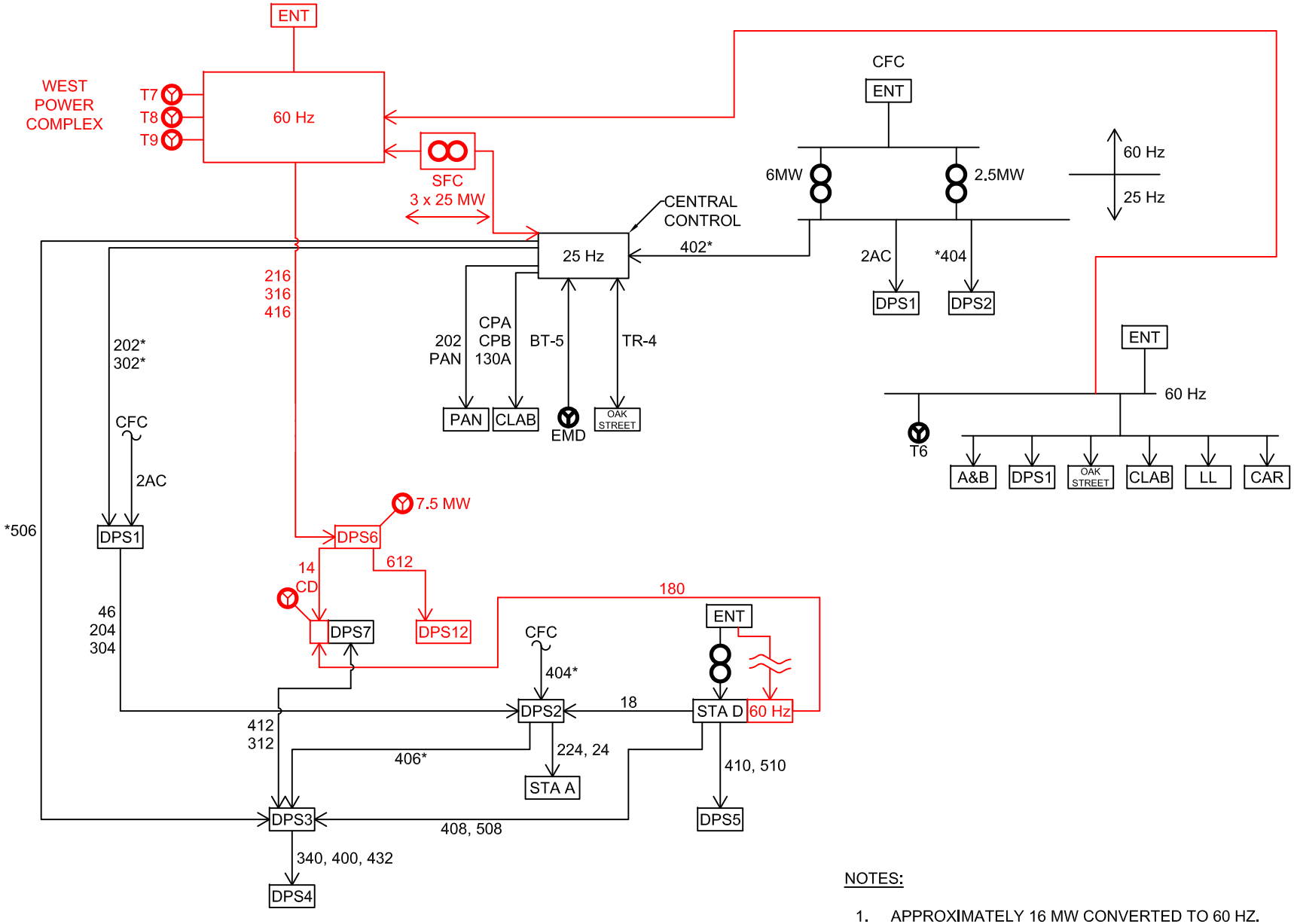
FIGURE 5A - WPC AND ALL POWER HOUSE WORK COMPLETE - PHASE 1 COMPLETE



MAJOR TASKS:

1. CONVERT DPS-6, 7 (PARTIAL), 12, AND CONNECT DPS-25 (OLEANDER) TO 60 Hz.
2. ADD NEW SWITCHGEAR AT STA-D AND CONVERT STA-D (PARTIAL) TO 60 Hz.

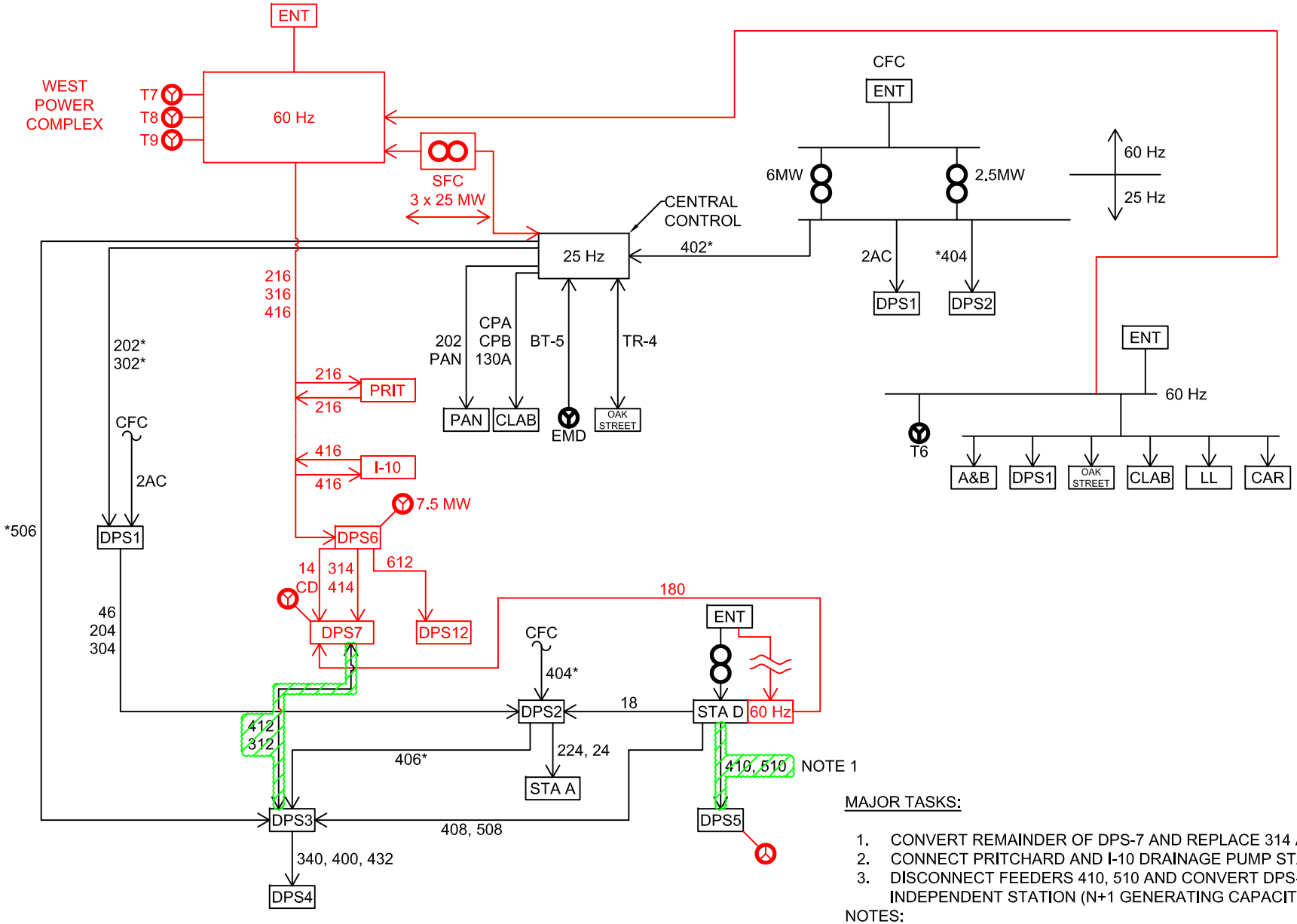
FIGURE 6 - TRANSITION TO PHASE 2A



NOTES:

1. APPROXIMATELY 16 MW CONVERTED TO 60 HZ.
2. APPROXIMATELY 13 MILES OF FEEDERS REPLACED.
3. APPROXIMATELY 11 MW OF 60 HZ DISTRIBUTED GENERATION ADDED.

FIGURE 7 - PHASE 2A COMPLETE



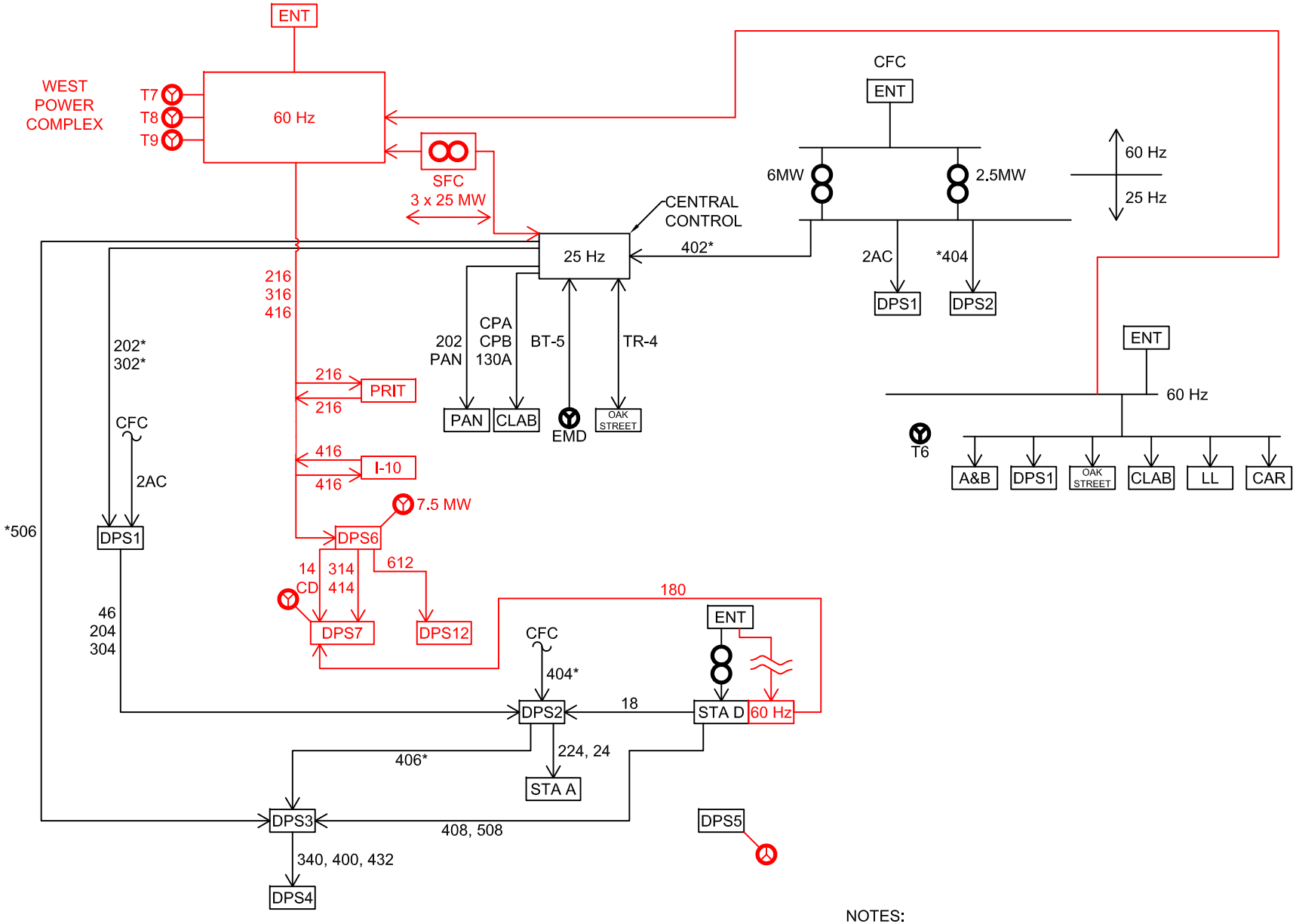
MAJOR TASKS:

1. CONVERT REMAINDER OF DPS-7 AND REPLACE 314 AND 414.
2. CONNECT PRITCHARD AND I-10 DRAINAGE PUMP STATIONS.
3. DISCONNECT FEEDERS 410, 510 AND CONVERT DPS-5 TO AN INDEPENDENT STATION (N+1 GENERATING CAPACITY REQ'D).

NOTES:

1. FEEDERS 410 AND 510 CROSS UNDER CANAL AND WILL NOT BE REPLACED.

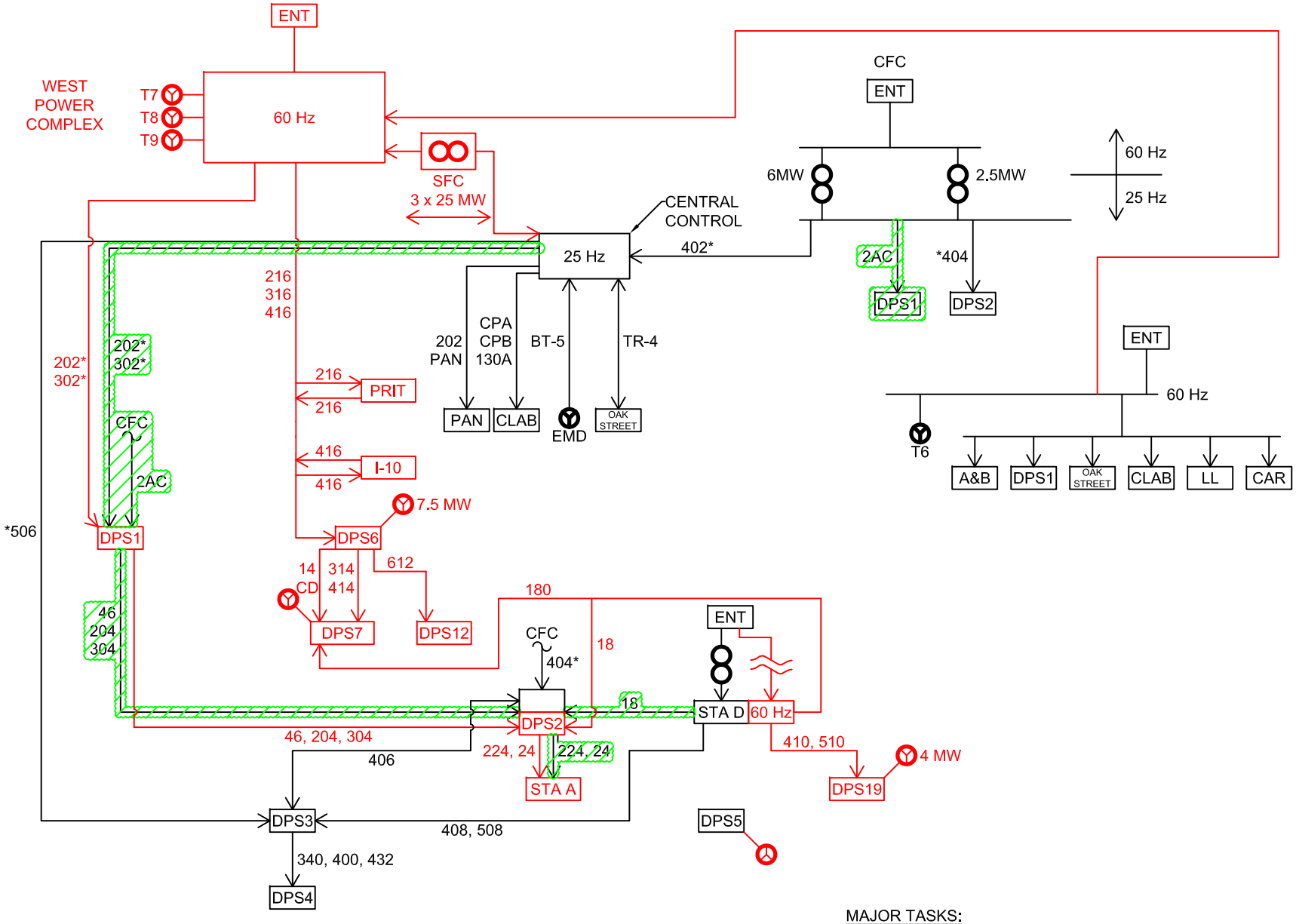
FIGURE 8 - TRANSITION TO PHASE 2B



NOTES:

1. APPROXIMATELY 3.8 MW REMOVED FROM THE SYSTEM.
2. APPROXIMATELY 3 MILES OF FEEDERS REPLACED.

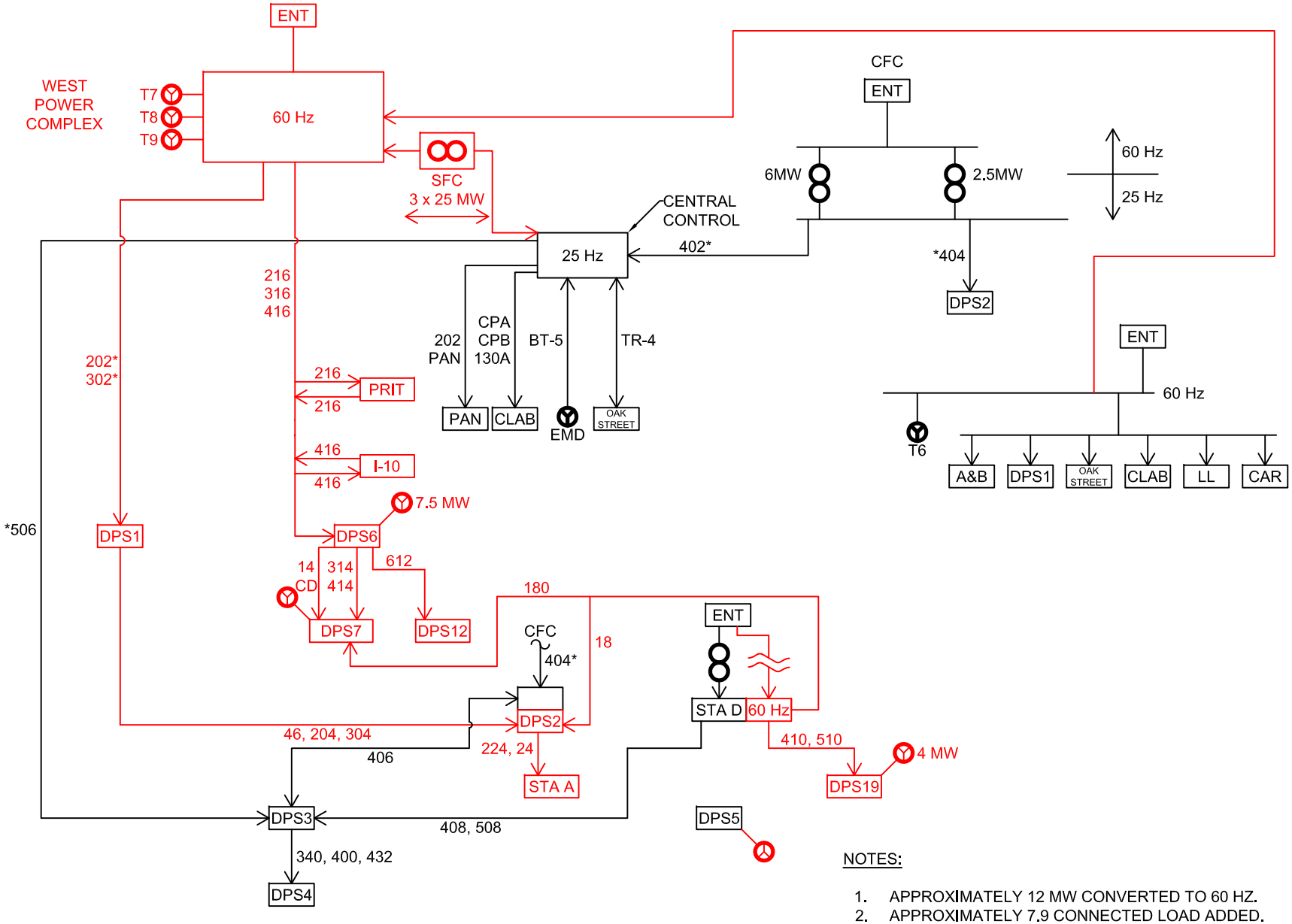
FIGURE 9 - PHASE 2B COMPLETE



MAJOR TASKS:

1. CONVERT DPS-1, DPS-2 (PARTIAL), AND STA-A TO 60 Hz.
2. ADD DPS-19 TO NETWORK.

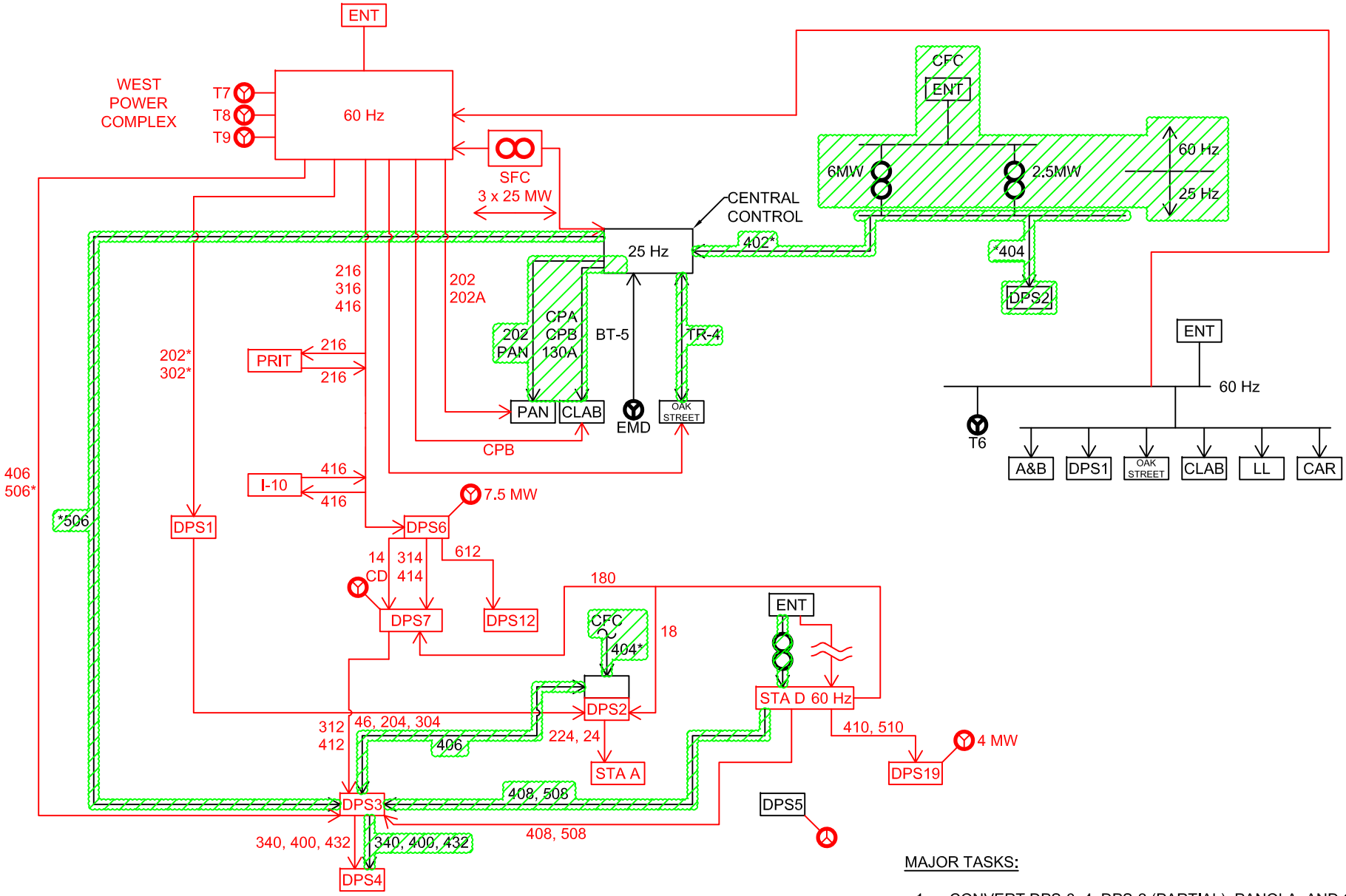
FIGURE 10 - TRANSITION TO PHASE 2C



NOTES:

1. APPROXIMATELY 12 MW CONVERTED TO 60 HZ.
2. APPROXIMATELY 7.9 CONNECTED LOAD ADDED.
3. APPROXIMATELY 18 MILES OF FEEDERS REPLACED.
4. APPROXIMATELY 4 MW OF 60 HZ DISTRIBUTED GENERATION ADDED.

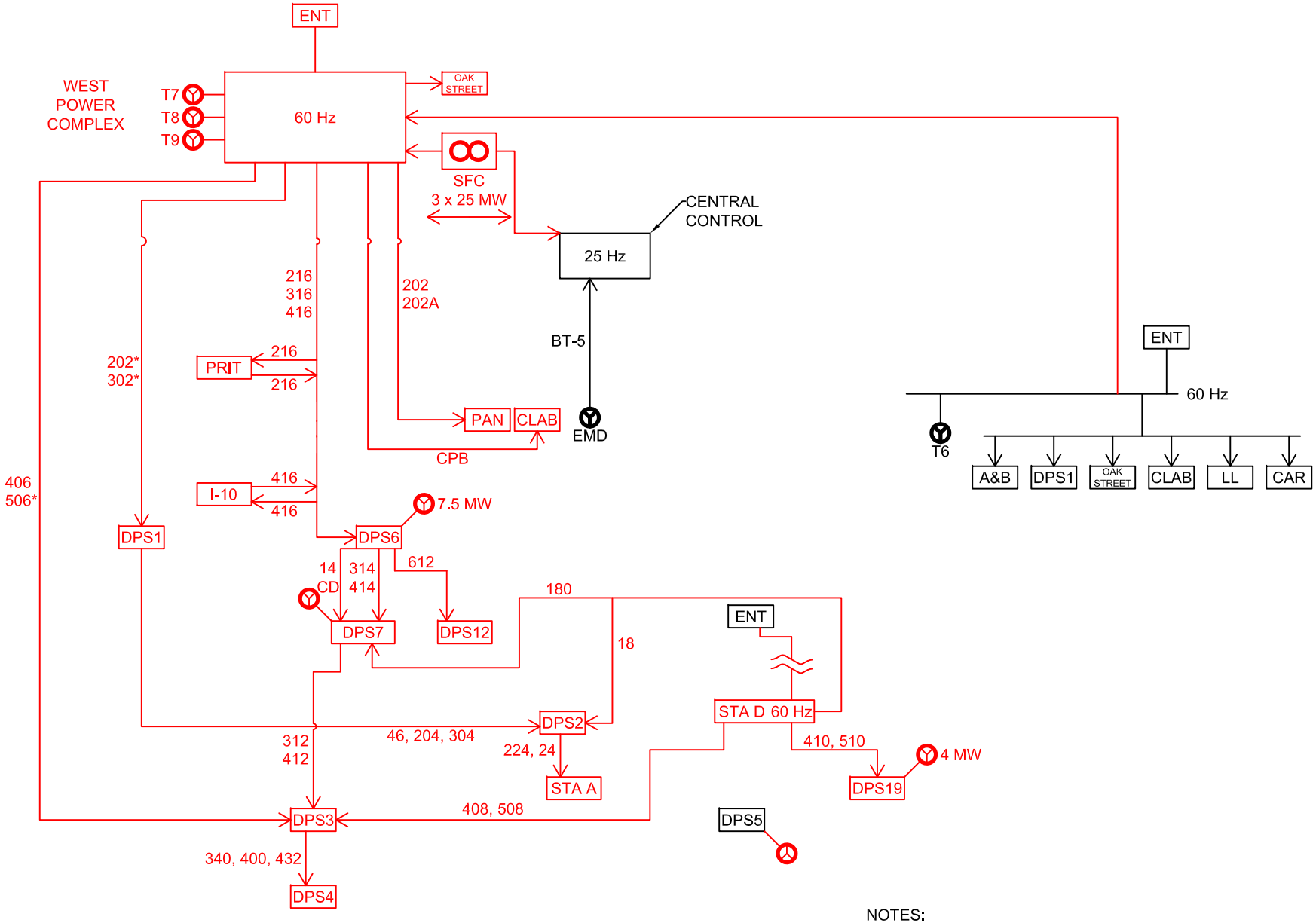
FIGURE 11 - PHASE 2C COMPLETE



MAJOR TASKS:

1. CONVERT DPS-3, 4, DPS-2 (PARTIAL), PANOLA, AND CLAIBORNE TO 60 Hz.
2. RETIRE CFC.
3. RETIRE RFC AT STA-D.

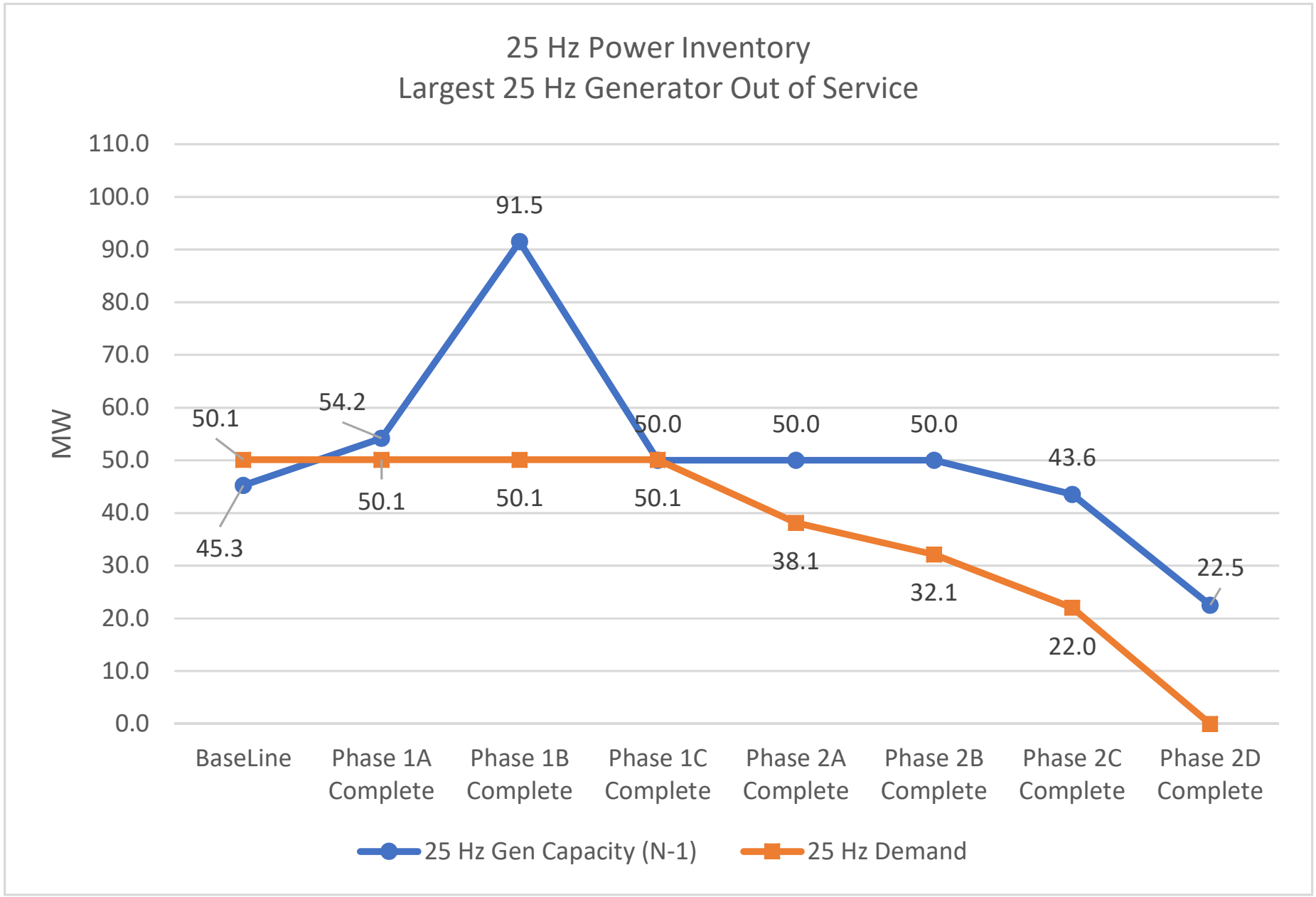
FIGURE 12 - TRANSITION TO PHASE 2D

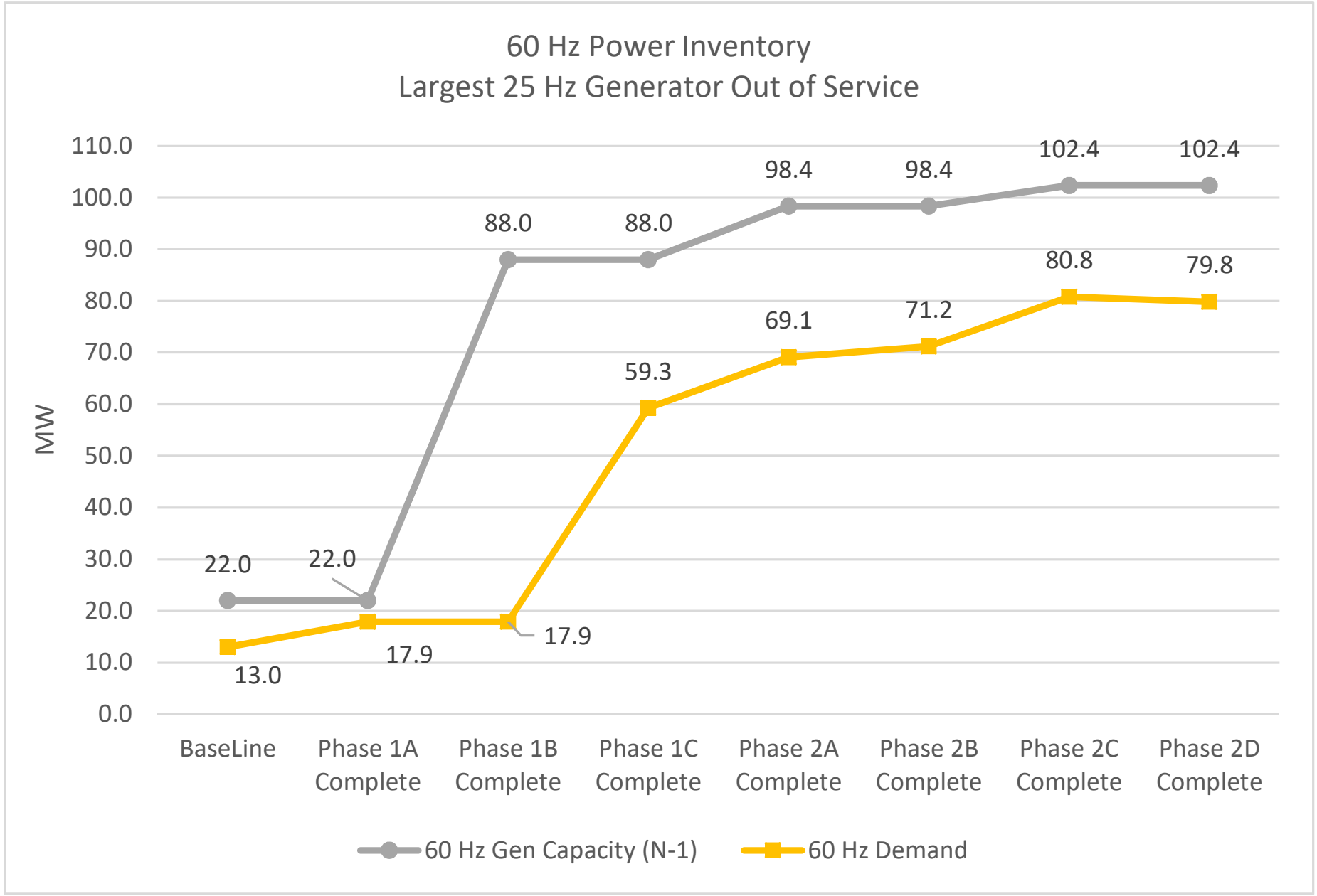


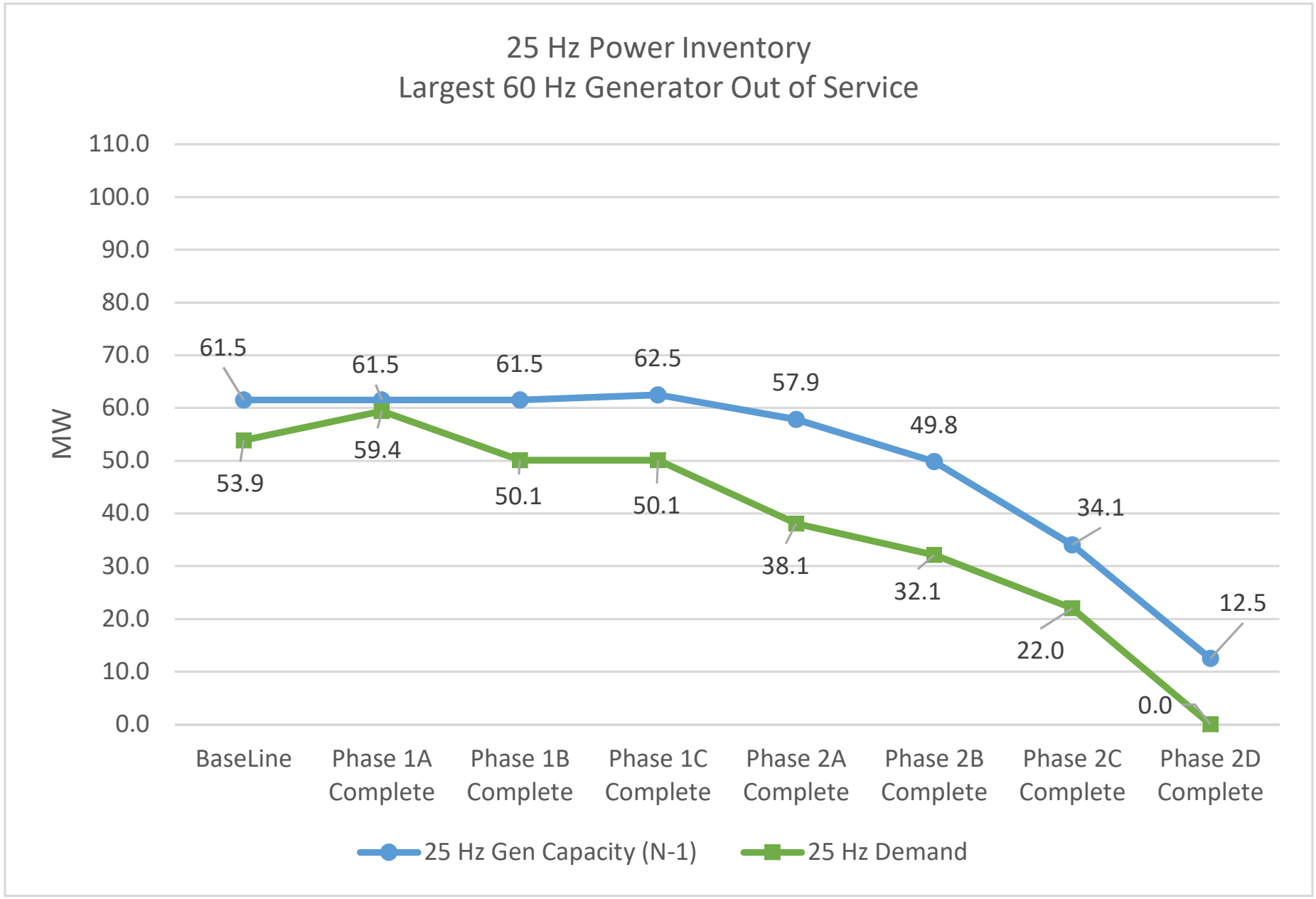
NOTES:

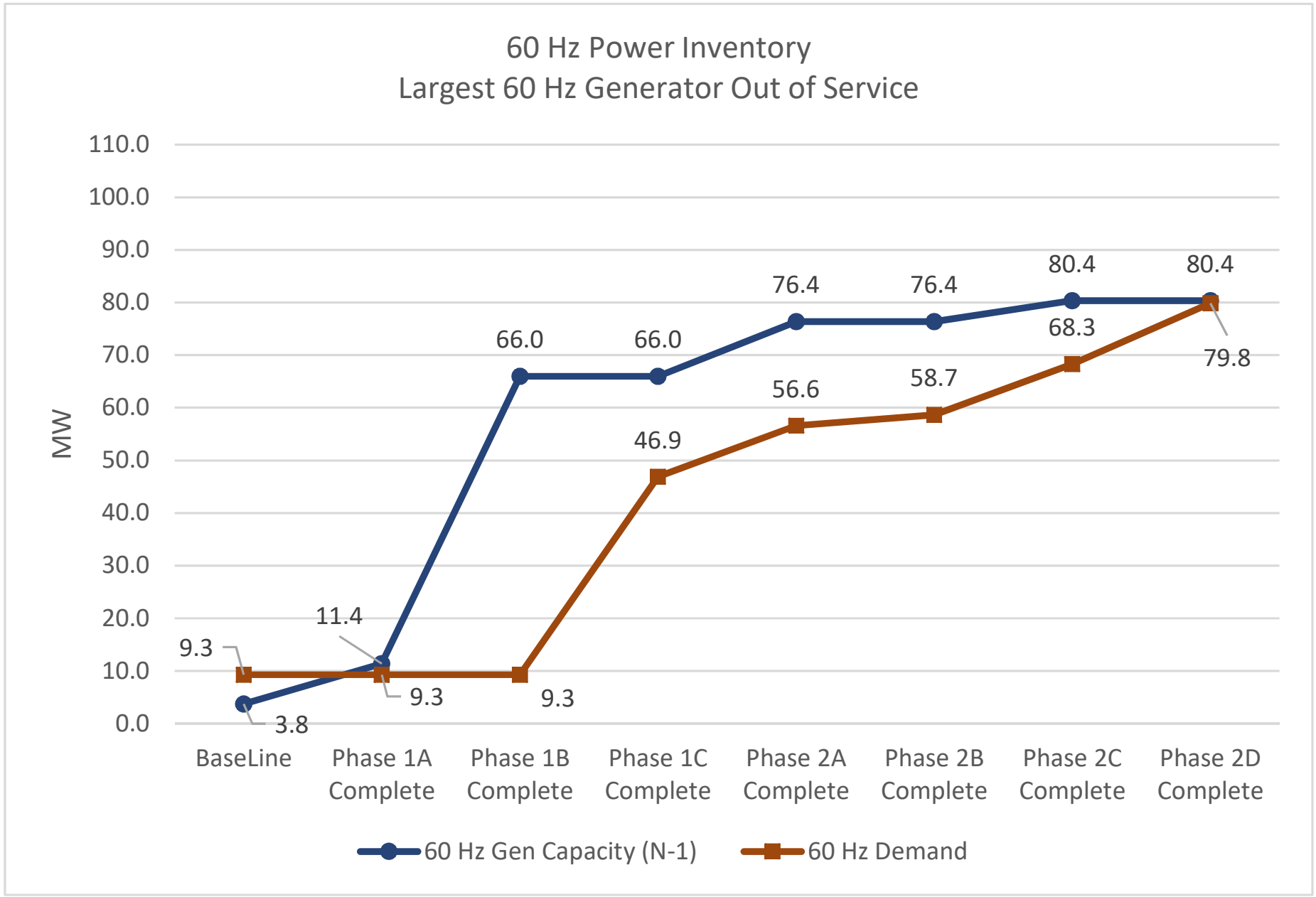
1. APPROXIMATELY 20 MW CONVERTED TO 60 HZ.
2. APPROXIMATELY 17 MILES OF FEEDERS REPLACED.

FIGURE 13 - PHASE 2D COMPLETE


25 Hz Power Inventory
Largest 25 Hz Generator Out of Service
MW
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
50.1
54.2
91.5
50.0
50.0
50.0
43.6
22.5
45.3
50.1
50.1
50.1
38.1
32.1
22.0
BaseLine
Phase 1A Complete
Phase 1B Complete
Phase 1C Complete
Phase 2A Complete
Phase 2B Complete
Phase 2C Complete
Phase 2D Complete
25 Hz Gen Capacity (N-1)
25 Hz Demand


60 Hz Power Inventory
Largest 25 Hz Generator Out of Service
MW
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
22.0
22.0
88.0
88.0
98.4
98.4
102.4
102.4
13.0
17.9
17.9
59.3
69.1
71.2
80.8
79.8
BaseLine
Phase 1A Complete
Phase 1B Complete
Phase 1C Complete
Phase 2A Complete
Phase 2B Complete
Phase 2C Complete
Phase 2D Complete
60 Hz Gen Capacity (N-1)
60 Hz Demand


25 Hz Power Inventory
Largest 60 Hz Generator Out of Service
MW
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
61.5
61.5
61.5
62.5
57.9
49.8
34.1
12.5
53.9
59.4
50.1
50.1
38.1
32.1
22.0
0.0
BaseLine
Phase 1A Complete
Phase 1B Complete
Phase 1C Complete
Phase 2A Complete
Phase 2B Complete
Phase 2C Complete
Phase 2D Complete
25 Hz Gen Capacity (N-1)
25 Hz Demand


60 Hz Power Inventory
Largest 60 Hz Generator Out of Service
MW
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
BaseLine
Phase 1A Complete
Phase 1B Complete
Phase 1C Complete
Phase 2A Complete
Phase 2B Complete
Phase 2C Complete
Phase 2D Complete
9.3
3.8
11.4
9.3
66.0
9.3
66.0
46.9
76.4
56.6
76.4
58.7
80.4
68.3
80.4
79.8
60 Hz Gen Capacity (N-1)
60 Hz Demand