Village of Winnetka
Village Council Study Session

July 11, 2023 at 7:00 PM
Village Hall
510 Green Bay Road

AGENDA

1. **Call to Order**
2. **Public Comments**
3. **Discussion**
   a. Winnetka Electric System & Power Plant Overview
4. **Closed Session**
5. **Adjournment**

NOTICE

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Village of WINNETKA, IL

Agenda Item Executive Summary

TITLE: Winnetka Electric System & Power Plant Overview

PRESENTER: Brian Keys

AGENDA DATE: July 11, 2023

CONSENT: No

ITEM TYPE: Presentation

ITEM HISTORY:
None.

EXECUTIVE SUMMARY:
This report provides background information on the Village's electric distribution system, power supply agreement and electrical generating resources located at the Electric Plant. The purpose of this report is to provide a broad overview of the various elements that comprise this system that will assist the Council with making policy decisions with respect to future capital investments. The Electric Fund's 5 Year Capital Plan contains $3.6M of capital improvements required for the on-going operation of the Electric Plant. During future Village Council meetings and annual budget reviews, staff will be requesting policy direction related to funding capital projects such as turbine overhauls and boiler tube replacement.

RECOMMENDATION:
Informational Only - No policy direction requested at this time.

ATTACHMENTS:
1. Agenda Report: Winnetka Electric System & Power Plant Overview

AGENDA REPORT

SUBJECT: **Winnetka Electric System & Power Plant Overview**

PREPARED BY: Brian Keys, Director Water & Electric

REF: **Informational Only – No Action Requested**

DATE: July 11, 2023

Executive Summary:
This report provides background information on the Village's electric distribution system, power supply agreements and electrical generating resources located at the Electric Plant. The purpose of this report is to provide a broad overview of the various elements that comprise this system to assist the Council with making policy decisions with respect to future capital investments. The Electric Fund's 5 Year Capital Plan contains $3.6M of capital improvements required for the on-going operation of the Electric Plant. During future Village Council meetings and annual budget reviews, staff will be requesting policy direction related to funding capital projects such as turbine overhauls and boiler tube replacement.

Power Supply Overview
Winnetka receives its electric power supply from either the Electric Plant or two substations that connect the Village's distribution system to the surrounding electric grid. One substation is located in Northbrook and owned by ComEd. The Village's interconnection point with this substation is near the Car Max dealership, located on Skokie Boulevard. The Village can receive about 21,000 kW from this source. The second substation is located in Northfield near New Trier's west campus, adjacent to ComEd's transmission line corridor. The Village owns this substation located on property leased from the Cook County Forest Preserve. It was constructed in the mid-1990's with an initial capacity of about 30,000 kW. A second substation transformer was installed in 2022, providing an additional 30,000 kW of capacity. The third source of power is the Electric Plant located at Tower Road and Lake Michigan. Through a combination of steam boilers and turbines fueled by natural gas and diesel engines, the Plant has a production capacity of about 30,000 kW.

This redundancy of the sources of power mitigates the risk of a long-term outage due to a failure of a substation transformer or turbine at the Electric Plant. Based on historical demand, the electric system's historical peak demand on a hot summer day is 40,600 kW. If the Village were to lose a key component of its source of power, the electrical needs of the Village can still be met.

Since March 1, 1991, the electricity required to meet the Village's power and energy requirements has been provided pursuant to contractual agreements between the Village and the Illinois Municipal Electric Agency (IMEA). On the Village's behalf, IMEA acquires power and energy by generating it at an IMEA-owned plant; purchasing it from other entities; and/or utilizing the capabilities of the Village's Electric Plant or of other members' plants.

By contract with IMEA, the output capacity of the Electric Plant is dedicated to the agency. Upon IMEA request, Village staff operates the generating units to produce electricity that is used by the agency to meet electrical demand or offset the cost of higher priced wholesale power from another source. In return for IMEA's right to use the plant's capacity, the Village receives a credit of approximately $1.4 million annually on the Village's wholesale power bill from IMEA. The IMEA contract extends through September 20, 2035, and IMEA is in the preliminary stages of seeking renewal energy contracts with its members.

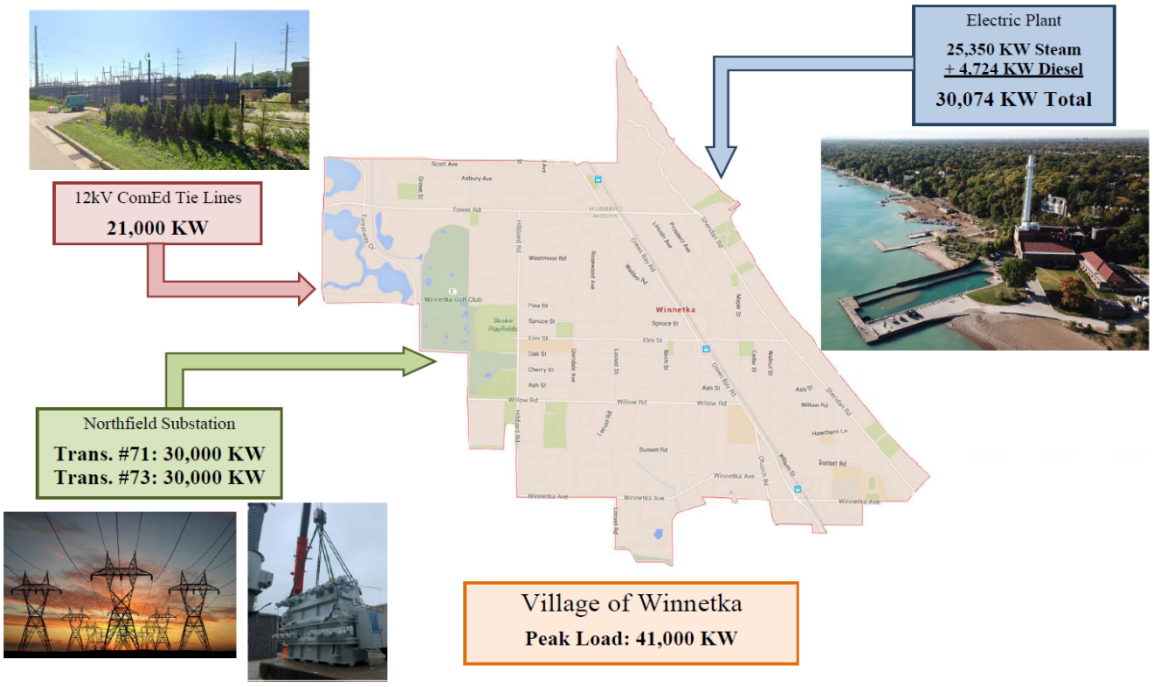

Illustration: Overview of Electric System Power Sources

Winnetka's Electric Generating Plant

When the electric plant first opened, electricity was originally generated by small reciprocating engines. Service was limited to a few residents, businesses, and street lighting. Over time, the Village's electric utility evolved from this small beginning with the little steam driven units, to a modern plant that used steam turbine generators and boilers. The nearly constant increase in the use of electricity made it necessary to add generating capacity regularly. The following table shows the dates when generating units were added and the kilowatt capacity of the plant after adding the unit:

Plant Capacity After Adding Unit		Plant Capacity After Adding Unit	
Year	kW Capacity	Year	kW Capacity
1900	50	1926	3,750
1902	125	1930	6,250
1907	2,125	1937	7,500
1913	450	1948	10,500
1914	750	1953	15,500
1921	1,350	1960	25,500
1924	2,050	1978	31,900

Coal, the historical fuel of choice, was delivered to the Plant by truck to a concrete unloading platform at the top of the bluff, from which it flowed by gravity to bunkers and a coal silo having a combined capacity of approximately 1,000 tons. Coal conveying equipment moved the coal from these storage bunkers and silo through a series of conveyors, weighed it, and delivered it to the overhead coal hoppers located at the front of each boiler. Coal was used at the plant through 1990 and then discontinued.

Due to EPA air regulations, the plant's boilers were converted to natural gas as the primary fuel source. It is purchased through a gas supplier and delivered to the Electric Plant by North Shore Gas. Except for building heat, the fuel costs are reimbursed to the Village through our IMEA contract. All of the presently operating boilers can use natural gas for fuel. Three boilers, #4, 5, and 7, have the additional capability of using diesel fuel as a backup, which is only permitted to be used under emergency situations.

Diesel fuel is stored in a 20,000 gallon permanent storage tank and confinement structure at the Electric Plant. Diesel fuel is principally used in the two 2,400 kW diesel engines. Diesel fuel costs are also reimbursed by IMEA.

Boiler Room

The boiler room contains four boilers, designed for 450-lb. pressure, 775° F. total temperature, with a total rated steaming capacity of 344,000 pounds per hour. A fifth boiler was taken out of service when the Plant stopped using coal as fuel. The units are set side-by-side with a passage between each boiler leading to the turbine room. The boilers are fired by natural gas, with the combustion controlled automatically. This system maintains constant steam pressure and controls the fuel feed and air flow by means of electronic equipment. Combustion control panels are located directly in front of the boilers. The panels contain draft gauges and recording instruments for all boiler performance indicators as well as the combustion control devices.

Photo: Boiler Controls

Photo: Lower Section of Boiler

Specific information on each of the boilers is as follows:

Electric Plant Boilers

No.	Year of Commercial Operation	Manufacturer	Fuel (Primary/Alt.)	Input (MMBTU/hr)	Design Rating (lbs./hr.)
4	1958	B&W	Gas/Oil	145	110,000
5	1938	B&W	Gas/Oil	63	40,000
7	1948	B&W	Gas/Oil	102	69,000
8	1964	Erie City	Gas	174	125,000
			Total:	484	344,000

Forced draft air is supplied to each boiler unit by a fan located either on the operating floor in back of the boiler. The induced draft fans on the smaller boilers are located in the basement, while on the "new" larger boilers, the induced draft fan is placed above the boiler drums. These fans discharge the exhaust gases into a common horizontal breaching in the upper part of the boiler room from which, in turn, they are delivered to the stack. Both the forced and induced draft fans are electric motor driven; they operate at a constant speed with combustion control regulators acting on the fan dampers.

Turbine Room

The turbine room contains three Westinghouse Electric Corporation turbo-generating units set with their shafts parallel to each other. They have a total net capacity of 25,400 kilowatts. All of the units were manufactured by Westinghouse and have direct-connected exciters and utilize Allis-Chalmers surface condensers to condense the steam into water for return to the boilers. The lower level of the turbine room also contains two Fairbanks-Morse diesel engines with a total nameplate capacity of 4,700 kilowatts.

Photo: Steam Turbine #6

Photo: Diesel Generator #8

Specific information on each of the generating units is as follows:

Electric Plant Generating Units

Unit	Year of Commercial Operation	Manufacturer	Prime Mover	Net Capability (kW)	Steam Required (lbs./hr.)
4	1953	Westinghouse	Steam	8,650	103,800
6	1948	Westinghouse	Steam	5,500	66,000
7	1960	Westinghouse	Steam	11,200	134,400
8	1978	Fairbanks/Morse	Diesel	2,365	
9	1978	Fairbanks/Morse	Diesel	2,359	
			Total:	30,074	304,200

Metal-enclosed switchboard with removable truck-type circuit breakers and equipped with the necessary metering and protective relaying equipment is installed at the north end of the turbine room. The switchboard is in two sections, separated by a brick wall and distance, so that a complete failure of one section would still permit partial operation from the other section. The switchboard controls and distributes the current from the generators to the circuits supplying the Village.

Photo: North – South 4kV Bus

Photo: East 4kV Bus

ComEd Tie Lines

The Village is served by three 12,470 volt tie lines from ComEd. The lines were originally installed in the 1970's and originate from ComEd's Northbrook Substation. The interconnection point is a piece of switchgear located near the CarMax dealership on Skokie Boulevard. At this location, ownership and maintenance of the facilities transfers from ComEd to Winnetka. Since their original installation, Winnetka has replaced their portion of the three underground tie lines with new cable. The cable lines are routed in a common duct bank along Tower Road. Two lines terminate at the Village's South Load Center on Spruce Street and one line terminates at the Electric Plant.

Northfield Substation

In 1996, the Village constructed the Northfield Substation to provide additional capacity for the Village's electrical distribution system. The substation is located in Northfield, near the New Trier West campus on Happ Road. The 30,000 kW transformer is connected to ComEd's

transmission system. The transformer reduces the electric voltage from 138,000 volts to 12,470 volts for distribution on the Village's electrical system. The substation is located on property owned by the Forest Preserve with a lease that extends through 2056.

In 2022, the Village completed the expansion of the Northfield Substation which provided an additional source of power to the electric distribution system. The multi-year project included the installation of a transformer fire wall, new 15kV switchgear and circuit breakers, a fire protection system and a second 30,000 kW substation transformer. Expansion of the Northfield Substation was undertaken to address system contingency issues related to the electric system's sources of power. Prior to the substation's expansion, electric system contingency was reliant on aging generation assets at the Electric Plant that require several hours to place in service and have started to experience an increasing number of repairs. The second transformer also services as an in-service spare to the original transformer which is twenty-eight years old.

Electric Distribution System

The Village's electric distribution system is comprised of nine 7,200/12,470 volts (referred to as 12kV) circuits and four 4,160 volts (referred to as 4kV) circuits. The 4kV circuits originate from the Electric Plant and serve New Trier High School, the Public Safety Building, AT&T building, two properties near the intersection of Oak Street and Chestnut Street, and the Village Yards. The 12kV circuits originate from either the Plant Load Center (at the Electric Plant), South Load Center (Spruce & Berkeley) or the Public Works Facility.

Three transformers located outside of the Electric Plant, referred to as the Plant Load Center, are used to convert 4kV energy into 12kV energy when the generating units are in operation. During periods that the generation is not in operation, these same transformers have the ability to convert 12kV energy into 4kV energy to supply the four 4kV circuits along with the 4kV circuits to serve the Electric Plant and Water Plant. Specific information on each of the transformers is as follows:

Step Up/Step Down Transformers Located At The Plant Load Center

Unit	Manufacturer	KVA	Voltage	Manufacture date
TR Spare	GE	5000	4160/12470	1970
TR #1	GE	7500	4160/12470	1970
TR #2	GE	5000	4160/12470	1970
TR #3	Magnetek	10500	4160/12470	1995

In addition to the distribution circuits, there are three 12kV underground circuits that connect the Northfield Substation, South Load Center, and Plant Load Center. This arrangement allows the Village to use either or both the Electric Plant and its interconnections at all times to supply the energy needs of the residents.

Distribution transformers, for reducing the 4kV or 12kV voltage to a customer's service voltage, are located at various points on the distribution system or on a customer's property. The typical service voltage for a residential customer is single phase 120/240 volts and the typical service voltage for large residential and commercial customers is three phase 120/208 volts.

IMEA Generation Contract

The electrical generation capacity of the Electric Plant is dedicated to the IMEA. On an annual basis, the Village is required to demonstrate the capability of each generating unit and affirm the net "dedicated capacity." In return for the dedicated capacity, the Village receives a credit of approximately $1.4M annually on the Village's wholesale power bill. Capacity payments for the generation vary by the type and size of the generating unit. For the steam turbines, the Village receives a credit of $4.00 per kW/month. The diesel units receive a credit of $3.20 per kW/month. A summary of each unit's dedicated capacity and the associated capacity credits is shown below.

Summary – Capacity Credits

Unit		kW Dedicated	$/mo. Per kW	Monthly Capacity Credit	Annual Capacity Credit
Diesel Engines	#8	2,365	$3.20	$7,568.00	$90,816.00
	#9	2,359	$3.20	$7,548.80	$90,585.60
Steam Turbines	#4	8,650	$4.00	$34,600.00	$415,200.00
	#6	5,500	$4.00	$22,000.00	$264,000.00
	#7	11,200	$4.00	$44,800.00	$537,600.00
				Total:	**$1,398,201.60**

At various times during the year, especially during summer months and/or extreme winter weather, the agency will request generation from the Village. When generation is scheduled, the Electric Plant is required to deliver at a minimum of 95% of the requested capacity for the specified time period. To the extent possible, the agency provides advance notification, of the need for generation. Under emergency conditions, IMEA can request output from the diesel generators within an hour and the steam driven generation output in an eight hour period.

For all generation scheduled and requested by IMEA, the Village is reimbursed the fuel cost (natural gas or diesel) required to operate the units. The agency also provides a generation payment of 3 Mills ($0.003) per kWh. All other costs associated with maintenance, repairs, and labor are funded by the Village's Electric Fund.

Each generating unit is required to perform a mandatory generation exercise every four months. During a mandatory exercise, the unit must produce at least 90% of the declared net tested capability. In the event of an equipment failure or any type of inability to respond, the Village incurs a deduction in the monthly capacity credits for the unit(s) unable to produce the requested output. Depending on the time of year (peak vs. non-peak) and the nature of the event (maintenance exercise vs. dispatch), the agency applies a penalty, a reduction in that month's capacity credits. In no circumstance is a penalty an amount greater than a unit's monthly capacity credit.

Under the IMEA contract, the Village has the sole determination regarding the continued operation or retirement of any and/or all generating units. In the absence of an equipment failure requiring the unplanned retirement of a unit, the Village is to provide at least one year's notice to IMEA. When a generating unit is retired, the corresponding capacity credits are no longer

applied to the monthly wholesale electric bill from IMEA. There are also provisions in the agreement for the Village to replace a generating unit. If it is determined by the Village that a unit should be permanently retired from service, the Village is allowed to replace any or all of its dedicated capacity within one year, provided the replacement generation is not greater in capacity than what was in service prior to replacement.

Annual Operation

For the vast majority of the year, the Electric Plant is maintained in a stand-by mode. On a periodic basis, the units are operated to train staff and ensure operational readiness and also to fulfill IMEA's requirement to demonstrate unit output every four months. At various times during the year, the agency will request generation from the Village due to market conditions, transmission system conditions or other requirements such as load shedding obligations. These requests are typically associated with extended periods of extremely hot or cold weather. The most recent generation request occurred in December 2022. Due to the frigid weather conditions prior to the Christmas holiday weekend, various power plants experienced difficulty operating, and transmission system operators in both northern and southern Illinois requested additional generation. Below is a two year summary of the operational hours for each generating unit.

Summary Of Generating Unit Operating Hours

Unit	Type	2021 Operating Hours	2022 Operating Hours
4	Steam	300	380
6	Steam	280	521
7	Steam	347	579
8	Diesel	61	132
9	Diesel	60	121

Next Steps

At a future Council meeting, staff will provide additional detail on the Electric Plant's generating components, capital investment and financial considerations related to maintaining the current generating capacity through the existing IMEA contract period. The Electric Plant has reached a transition point at which an increasing amount of capital funding is required for the long-term operation of the plant. Policy direction will be required in conjunction with the preparation of the 2024 Electric Fund Budget and 5 Year Capital Plan.

RECOMMENDATION:

Informational Only - No policy direction requested at this time.