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NORTHERN INDIANA PUBLIC SERVICE COMPANY
NORWAY AND OAKDALE HYDRO ELECTRIC PLANTS
MONTICELLO, INDIANA

INTRODUCTION:

NIPSCO is the proud owner of two Hydro Electric Plants located near Monticello, Indiana. The Norway Hydro Electric Plant is located approximately one mile north of Monticello. The Oakdale Hydro Electric Plant is located approximately seven miles south of Monticello and approximately seven miles northwest of Delphi.

The Norway Hydro Electric Plant was put in service in 1923 and forms Lake Shafer. The Oakdale Hydro Electric Plant was put in service in 1925 and forms Lake Freeman.

HISTORY:

Two Norwegians, Hoarse Erasmus Hiorth (pronounced Yert) and Peter B. Smith, were the original settlers of the property that the town of Norway and the Norway Plant occupies. They purchased 293 acres of ground for $1.25 per acre. The first dam and a saw mill was built at the Norway Plant location in 1836 by Hiorth. The dam was made of brush and stone. A flour mill was built at a later date below the dam for the settlers to grind their grain. There has since been many dams and mills at this location since Hoarse Erasmus Hiorth built the first dam.

Hiorth passed away in 1845 and willed all the property to his wife. His wife had a village named Mount Walleston platted. Mount Walleston was named in honor of the ship that brought Hoarse Hiorth to America and one street would be named Francis Street, in honor of the captain of that ship. The settlement of Mount Walleston was later known as Norway, Indiana, and Norway Road was originally named Hiorth Street.

Monticello Dam (Wilson Dam) was the first hydro electric dam built in the Monticello area. The first dam was built at this location in 1849 by the Monticello Hydraulic Company. In 1906 the Tippecanoe Electric and Power Company purchased the dam and installed the first hydro generators. At a later date the Interstate Public Service Company purchased the property and installed new machinery. This dam was in service until Oakdale Hydro Electric Dam was built and put in service November, 1925. Indiana Hydro Electric Power Company purchased the Norway Dam site and three other sites (Tioga, Oakdale and Springboro) south of Norway on December 30, 1921. Indiana Hydro hired Roger Freeman, in which Lake Freeman is named after, to engineer and design the four hydro plants, and John Shafer (Lake Shafer) performed studies for Indiana Hydro and took elevations around the lakes. Construction of the Norway Hydro Electric Plant was started in April, 1922, by Mansfield Engineering Co. of Indianapolis and finished in June, 1923. Construction of the Oakdale Hydro Electric Plant was started September, 1924, by L. E. Myers Co. of Chicago and finished November, 1925.

The plants were built by Indiana Hydro Electric Company and were ran by the Interstate Public Service Company. NIPSCO started leasing Norway and Oakdale in 1933 and bought the plants in 1944.

PLANT INFORMATION:

Norway and Oakdale Hydro Electric Dams are considered "Run of the River" dams and are not used for flood control. The water discharge through "Run of the River" dams is as close to the flow of the river as possible with out loosing efficiency on the generators. There are two main ingredients needed to control a "Run of the River" dam. They are the present discharge and the forebay level (lake level). By continually monitoring the forebay level the operator can figure an approximate flow of the river. Using the calculated flow of the river the operator can decide what water discharge is needed to raise or lower the forebay level. The forebay level at Norway is controlled within 2.4" range and Oakdale is controlled within a 3.5" range.

The lake formed by Norway Dam is Lake Shafer. Lake Shafer is approximately 10 miles long with a maximum depth of 30'. The average depth of the lake is 10' and covers approximately 1,291 acres of ground. The lake level at Norway is maintained between 645.00 to 645.20 feet above sea level. The lake level varies approximately 2.5" at Norway.

Norway has four generating units. During normal plant operations the small generating unit will discharge 520 cu ft/sec (3,890 gal/sec) of water through it's turbine and the three large generating units will discharge 915 cu ft/sec (6,844 gal/sec) of water through each generating unit's turbine. During times of flooding when the generating units are running at full capacity the total discharge for all four units would be 3,640 cu ft/sec (27,227 gal/sec).

Norway also has three (3) floodgates to discharge water after all the units are running at full capacity. Each floodgate is 30 ft wide and 22 ft high and will discharge up to 7,700 cu ft/sec (57,596 gal/sec) of water. With all three floodgates open to the maximum and all four units running at full capacity, the total discharge for the Norway Plant with the lake level in the normal range would be 26,740 cu ft/sec (200,015 gal/sec). The largest discharge of water in Norway's history is approximately 18,000 cu ft/sec (134,640 gal/sec).

The lake formed by Oakdale Dam is Lake Freeman. Lake Freeman is approximately 12 miles long with a maximum depth of 45'. The average depth of the lake is 16' and covers approximately 1,547 acres of ground. The lake level at Oakdale is maintained between 610.20 to 610.50 feet above sea level. The lake level varies approximately 3.5" at Oakdale.

Oakdale has three generating units. During normal plant operations the small generating unit will discharge 380 cu ft/sec (2,843 gal/sec) of water through it's turbine, the middle size generating unit will discharge 1,050 cu ft/sec (7,854 gal/sec) of water through it's turbine and the large generating unit will discharge 1,250 cu ft/sec (10,771 gal/sec) of water through it's turbine. During times of flooding when the generating units are running at full capacity the total discharge for all four units would be 3,200 cu ft/sec (23,936 gal/sec).

Oakdale also has two (2) floodgates to discharge water after all the units are running at full capacity. Each floodgate is 30 ft wide and 20 ft high and will discharge up to 7,425 cu ft/sec (55,539 gal/sec) of water. After both floodgates are open close to their maximum output there are six (6) siphons that can be open. Each siphons puts out 2,000 cu ft/sec (14,960 gal/sec). With all six siphons open, two (2) floodgates open to the maximum and all three units running at full capacity, the total discharge for the Oakdale Plant with the lake level in the normal range would be 30,050 cu ft/sec (224,774 gal/sec). The largest discharge of water in Oakdale's history is approximately 20,000 cu ft/sec (149,600 gallons) per second.

Oakdale Hydro Electric Plant was converted to an automatic system in June, 1960, and Norway Hydro Electric Plant was converted to an automatic system in June, 1963, with controls located at the Monticello Substation. In April, 1986, the controls were moved from the Monticello Substation to the Plymouth Substation located in Plymouth Indiana. In April, 1992, the controls were moved from the Plymouth Substation to NIPSCO's South Lake Complex located in Merrillville, Indiana.

NIPSCO started a major rehabilitation program for the plants and generators in 1982. Since this time all seven hydro generating units have been overhauled and new windings put in the generators. Norway Plant has had the concrete repaired and is in good structural shape. Oakdale Plant's concrete repair is approximately 50% done and will be finish by the year 2000. The Oakdale Plant structure is in good shape, but the outside layer (6" to 12") of concrete is in need of repair. There are many other major repairs that are needed and all should be done by the year 2000.

HOW HYDRO GENERATOR WORKS:

A hydro generator has four parts. The exciter, the a. c. generator, governor and turbine. The exciter is a d. c. generator. You need a d. c. generator to produce a. c. electricity. The a. c. generator produces the electricity that goes out on the electrical lines. The water from the lake flows through the side and out the bottom of the turbine to make the generator spin. The governor controls how much water flows through the turbine.

At the Norway and Oakdale Hydro Electric Plants the water from the lake or the reservoir passes through intake screens which catch any large floating objects which might injure the machinery. These screens extend the full length of the power house proper, on the upstream side.

After passing through the intakes, the water drops through the penstockes - one for each generator - and passes into a scroll shaped chamber completely surrounding the turbine. From this scroll casing the water passes through the turbine gates and presses with great force against the blades of the turbine, causing it to revolve.

From the turbine the water discharges downward into the draft tube and thence out into the river.

The revolving turbine is connected by a vertical shaft to the electrical generator directly above. The output from the generator is passed through a transformer raising the voltage from 2,300 volts to 34,000 or 69,000 volts. The electricity is then sent out onto the transmission lines.

Under favorable conditions these units can convert into electrical energy, 85% of the total energy in the falling water.

GENERATOR INFORMATION:

The electrical output of the generators at Norway and Oakdale are 2,300 volts. The transformer in Norway's substation steps up the 2,300 volts to 34,000 volts. The transformers in Oakdale's substation steps up the 2,300 volts to 69,000 volts. The electricity is then sent out onto the transmission lines to other substations. At these substations, the transformers step the voltage down to 12,500 volts. The electricity then goes down the alleys, streets and roads on pole lines by your homes. The transformers on these pole lines step down the voltage to 120/240 volts. This is the voltage of the electricity that goes into your houses.

The generators produce the electricity in kilowatts (kw) or megawatts (mw - 1,000 kw). It takes 10 - 100 watt light bulbs to equal 1 kw. The average home on NIPSCO's lines uses approximately 3 kw.

Norway has four generating units. The small unit will produce 1,200 kw or 1.2 mw and would feed approximately 400 average homes. The three large units will produce 2,000 kw or 2.0 mw each and would feed approximately 667 average homes each. All four units running at the same time would produce 7,200 kw or 7.2 mw and feed approximately 2,400 average homes.

Oakdale has three generating units. The small unit will produce 1,400 kw or 1.4 mw and would feed approximately 466 average homes. The middle unit will produce 3,400 kw or 3.4 mw and would feed approximately 1,133 average homes. The large unit will produce 4,400 kw or 4.4 mw and would feed approximately 1,466 average homes. All three units running at the same time would produce 9,200 kw or 9.2 mw and feed approximately 3,066 average homes.

Both Norway and Oakdale running at full capacity would produce 16,400 kw or 16.4 mw and would feed approximately 5,466 homes. The question is always asked would the dams produce enough power to feed the town of Monticello. The answer is no. Obviously with both dams running at full capacity there would be enough kw produced to feed all the homes in Monticello and the surrounding area. But when including the industrial load in Monticello (approximately 14,500 kw or 14.5 mw in winter and 16,000 kw or 16.0 mw in summer) with the residential load, the demand of Monticello would be greater than what the dams can produce at full capacity. The other problem is that the dams only run at full capacity about three months (usually spring and fall) during the year. During the summer and winter, when the electrical demand is the greatest, the dams are producing very little electricity because of low water flow in the river.

Norway and Oakdale Hydro Electric Plants produce less than one percent of the total electricity produced by NIPSCO. NIPSCO has four coal fired plants (Bailly, Michigan City, Dean H. Mitchell, and R.M. Schahfer Generating Stations) that produce the majority of the electricity. The advantage of hydro power versus coal power is the cost of the water compared to coal. The water is virtually free but the coal cost is about $.70 of each dollar that NIPSCO spends. The hydro plants do produce enough electricity to pay for all maintenance and repairs on the dams with some left over. Also, the plants are indirectly responsible for the tourist trade by forming Lake Shafer and Lake Freeman for public recreation.

NORWAY HYDRO-ELECTRIC PLANT STATISTICS

Location - On Tippecanoe River, one mile north of Monticello, Indiana.

Construction Data - Started in April, 1922
In service June, 1923

Type of Dam - Reinforced concrete dam on bedrock of limestone

Reservoir - Know as Lake Shafer Covering an area of 1,291 acres approximately 10 miles in length

Head - The fall of water for generation is 30 feet.

Length of Dam - Dam and powerhouse 1,200 feet long

Length of Overflow Spillway - 225 feet with flashboards attached

Flood Gates - Three, each 30 feet wide by 22 feet high

Generating Units - Three - 2,000 kilowatts or 2,500 horsepower and
One - 1,200 kilowatts or 1,500 horsepower

Total Generating Capacity - 7,200 kilowatts or 9,000 horsepower

Voltage at Generators - 2,300 volts

Voltage at Transmission Lines - 34,000 volts

Normal Yearly Output - 27,000,000 kilowatt hours

Plant 24 Hour Capacity - 127,800 kilowatt hours

Water Discharge of Generating Units - Three, 915 cubic feet per second (120 rpm) and one, 520 cubic feet per second (150 rpm).

Floodgate Discharge - First foot open - 835 cubic feet per second and
open ten feet - 6,700 cubic feet per second

Norway Hydro Electric Plant was converted to automatic in June, 1963, with controls located at the Monticello Substation. In April, 1986, the controls were moved to the Plymouth Substation located in Plymouth, Indiana. In April, 1992, the controls were moved to the South Lake Complex in Merrillville, Indiana.

OAKDALE HYDRO-ELECTRIC PLANT STATISTICS

Location - On Tippecanoe River, seven miles south of Monticello, Indiana and seven miles northwest of Delphi, Indiana.

Construction Data - Started in September, 1924
In service November, 1925

Type of Dam - Earth fill with corewall and piling.

Reservoir - Know as Lake Freeman Covering an area of 1,547 acres approximately 12 miles in length

Head - The fall of water for generation is 45 feet.

Length of Dam - Dam and powerhouse 1,600 feet long

Flood Gates - Two, each 30 feet wide by 20 feet high

Siphons - Six, each 10 feet wide by 10 feet high

Generating Units - One - 4,400 kilowatts or 5,100 horsepower,
One - 3,400 kilowatts or 4,350 horsepower, and
One - 1,400 kilowatts or 2,380 horsepower

Total Generating Capacity - 9,200 kilowatts or 11,830 horsepower

Voltage at Generators - 2,300 volts

Voltage at Transmission Lines - 69,000 volts

Normal Yearly Output - 40,000,000 kilowatt hours

Plant 24 Hour Capacity - 220,800 kilowatt hours

Water Discharge of Generating Units - One - 1,250 cubic feet per second (163 rpm), one - 1,050 cubic feet per second (120 rpm), and one, 380 cubic feet per second (163 rpm).

Floodgate Discharge - First foot open - 810 cubic feet per second and
open ten feet - 6,425 cubic feet per second

Siphon Discharge - 2,000 cubic feet per second for each siphon

Oakdale Hydro Electric Plant was converted to automatic in June, 1960, with controls located at the Monticello Substation. In April, 1986, the controls were moved to the Plymouth Substation located in Plymouth, Indiana. In April, 1992, the controls were moved to the South Lake Complex in Merrillville, Indiana.

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