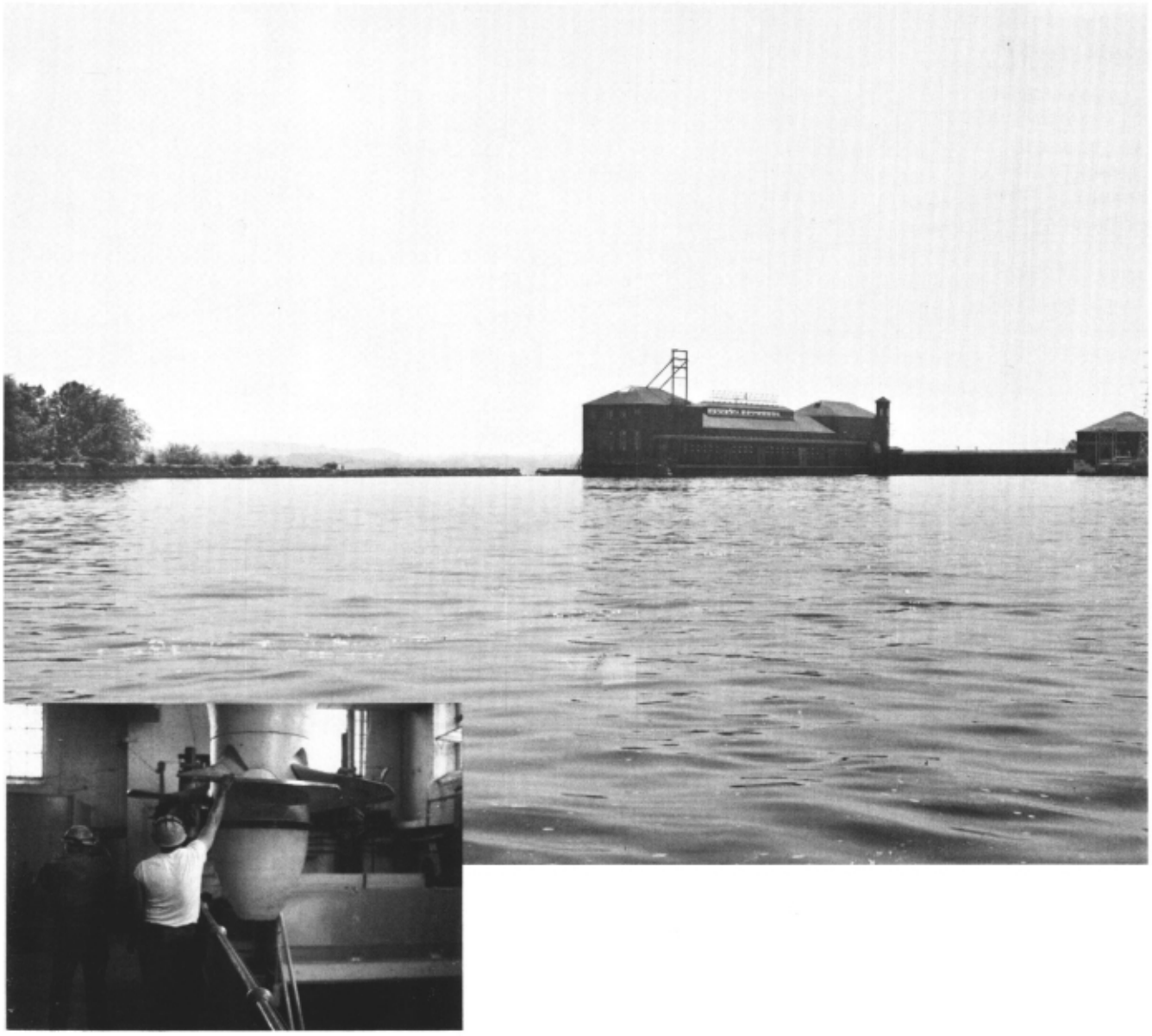


The American Society of Mechanical Engineers

NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK

Kaplan Turbine

York Haven Hydroelectric Station

York Haven, Pennsylvania

October 20, 1980

Introduction

Early 20th century technological development led the country to a new era of industrialization. Within the Susquehanna Valley of Pennsylvania new manufacturing facilities were under construction. The Conewago Falls, near the sixteen foot descent of the Susquehanna River, was chosen as the site of the newly-incorporated York Haven Water and Power Company. Land and water rights on the river were purchased from the York Haven Paper Company, and construction of the power plant began in 1901. By 1904 construction of the first six turbines had been completed and York Haven was placed in operation. At this time the station had the distinction of being one of the three largest hydroelectric stations in the United States, in fact the world. The building was ultimately completed in 1907. Newer and better turbines (such as the Kaplan type) were gradually introduced and incorporated into the York Haven Plant. These replaced the older types.

Distribution in the beginning included a 2,400 volt line around the York Haven area, a 23,000 volt line into the city of York, and a 23,000 volt line serving the borough of Middletown. A number of individual power customers in the metropolitan area were serviced as well. In 1906 this line was extended to Steelton to serve the Steelton Light, Heat and Power and the Valley Traction Lines.

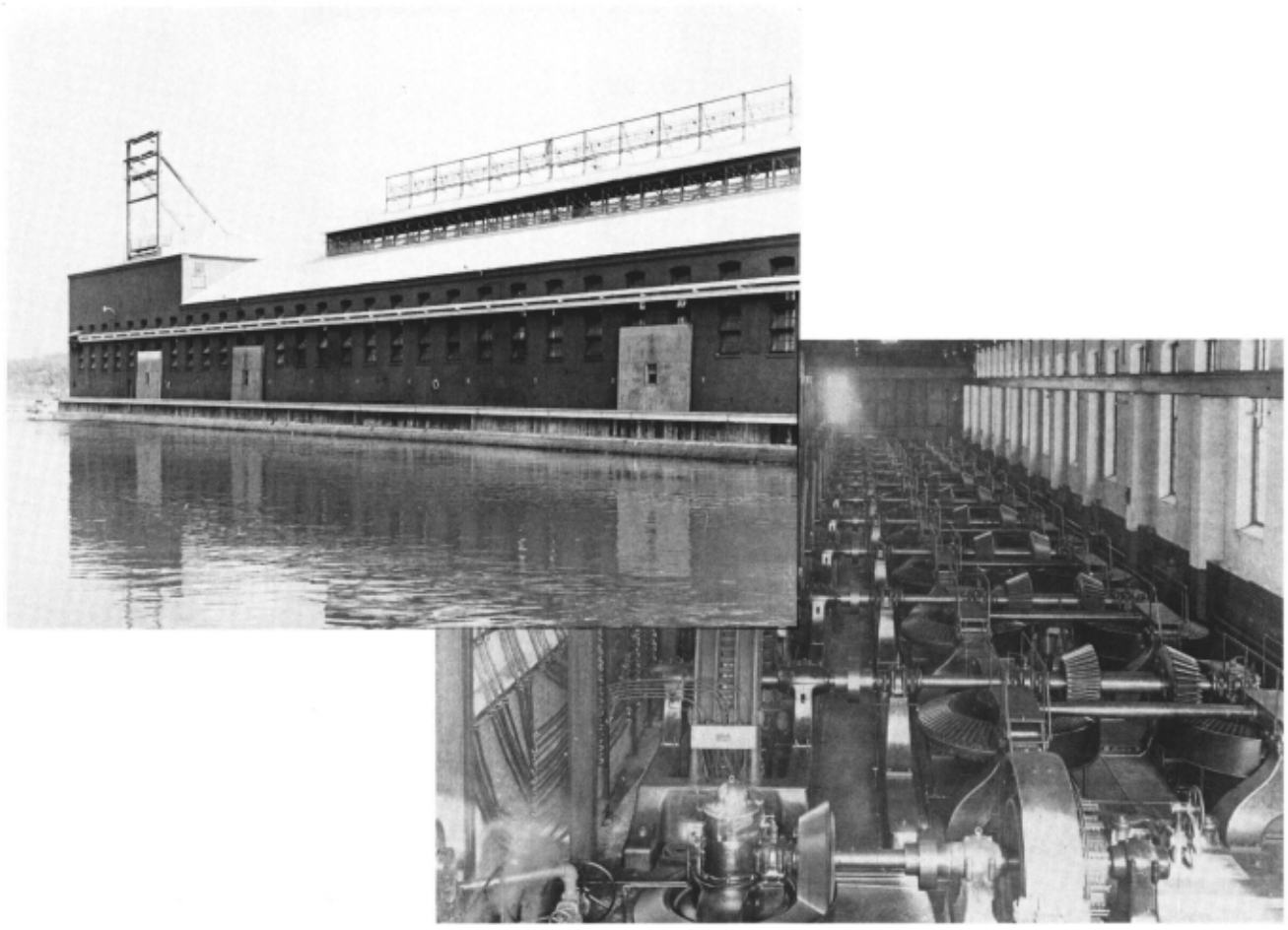
The Station

The hydroelectric station is one of the most basic and dramatic

concepts in the making of electricity. The waters of the Susquehanna River are trapped and directed by a 5,000 foot diversion dam and a 3,000 foot headrace. The headrace was designed to complement natural rock formations and river islands existing in the river.

The quantity of electricity produced by the generators is controlled by hydraulically regulated turbine gates which raise or lower the water level.

There are seven vertical generators, all of which are capable of producing from 1,200 to 1,600 kilowatts of electricity, and thirteen horizontal generators, which produce up to 1,000 each. Combined, these twenty generators produce approximately 20,000 kilowatts. Four of these units use Kaplan turbines. The #4 turbine went into service April 5, 1929. The runner is 93" in diameter, developing 1825 H.P., and operates at 200 R.P.M. with a 23 foot head. These turbines,



along with the remaining twenty, are located in the generating room.

The Kaplan Turbine

The first known attempt to use an adjustable-blade turbine is evidenced by a United States Patent issued to O.W. Ludlow in 1867. In his design, only the blades were adjustable. There were no water-control gates on the turbine, and stationary guide vanes were used.

At the same time Ludlow received his patent, other patents were also issued showing axial-flow runners with adjustable gates of the cylinder, wicket, and other types. However, the advantage of adjusting the blades and the gates simultaneously were not yet realized, and no attempt was made to design such a turbine. Dr. Viktor Kaplan, of the Technische Hochschule in Vienna, was the first to apply this principle. Dr. Kaplan conceived the idea and did extensive laboratory tests. Patent applications were filed in Europe in 1913 and in the United States in 1914. However, because of the advent of World War I no practical use of his design was made until after 1920. At that time a European builder entered into a contract to furnish two turbines with automatically adjusting blades. Wide spread acceptance resulted and by 1930 automatic adjustable-blade turbines were installed in practically every instance having suitable head conditions.

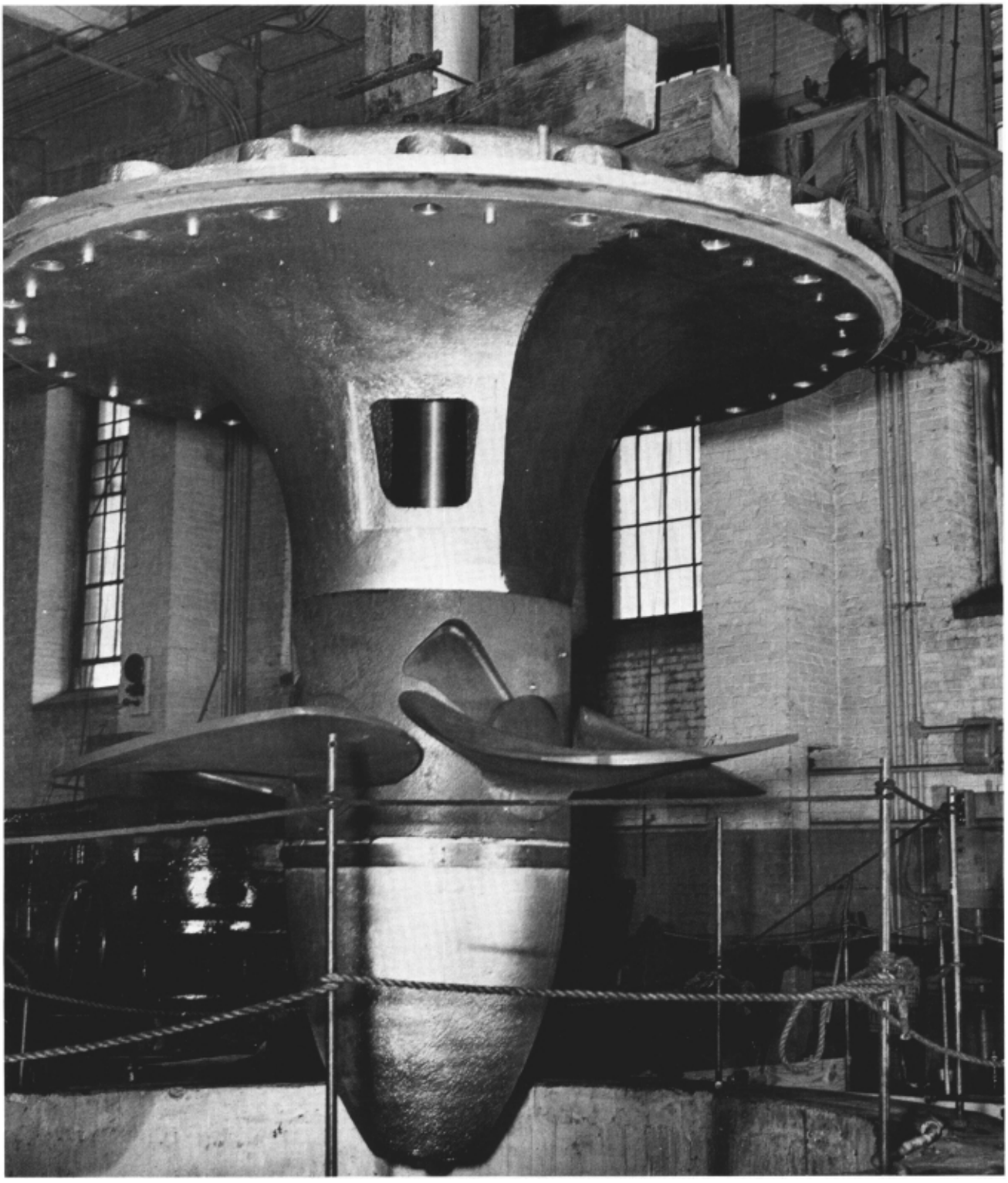
Propeller-type turbines were first introduced in the United States in 1917. By 1928 the first automatic adjustable turbine was installed. This type permitted the automatic simultaneous adjustment of the runner vanes and wicket gates while the unit remained in operation. Earlier units were not automatic and could be adjusted only after the turbine had been shut down. The first unit was bought by the Metropolitan Edison Company, York Haven, Pennsylvania on July 19, 1928. It became fully operational April 5, 1929. The second was sold to the Central Power & Light Company, in Texas and the third to the Wisconsin Power & Light Company in Illinois.

The Kaplan turbine differs from other wicket-gate turbines because of the design of its top plate and the construction of its runner and shaft. The top plate is shaped so as to form a transition space free from vanes between the wicket-gates and the runner, in which the direction of flow of the water is changed from radial to axial. The runner hub carries the movable blades, and the operating connections for moving the blades are located inside the single-piece casting. The S. Morgan Smith Company, manufacturer of this turbine, was eventually acquired by Allis-Chalmers.

Plaque Wording:

Kaplan Turbine
1929

This Kaplan turbine is one of the first three machines to be put into service in the United States. Named for its Austrian inventor, Viktor Kaplan (1876-1934), the turbine type was an outstanding innovation, operating with a high, nearly constant efficiency over a wide load range. The machine was built by the S. Morgan Smith Company of York, Pennsylvania.



Acknowledgements

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The Kaplan turbine is the 53rd landmark dedicated since the program's inception in 1973. For a complete list of the Society's landmarks, please contact the Public Relations Dept., ASME Headquarters, 345 E. 47th St., NYC, NY (212) 644-7740.

This brochure was compiled and edited by Jill Birghenthal

Source: The Metropolitan Edison Company; "The Kaplan Adjustable-Blade Turbine", B.E. Smith, Secretary, S. Morgan Smith Company; 1930 ASME Transactions, paper # HYD-52-8.