POWER FROM GRAND LAKE

GRAND LAKE PLANT IS A FINE ENGINEERING FEAT

Modern Steam Electric Plant Designed and Built in Ten Months — 5000 K. W. Available

Water Power has been in the public eye in Canada to such an extent that the value of its twin brother, Steam Power, is commonly overlooked in this country. Steam is not a big factor in the sense that it will ever be likely to threaten the supremacy of Hydro Electric Power in Canada, but it has, during the past decade, made such great strides that it is no longer to be ignored in the consideration of hydro projects and hydro systems.

Modern steam electric generating plants are being produced that will, in many cases, compare favourably in final cost of electric power with hydro electric plants. This possible result is indicated whenever the cost of hydro development is unfavourably influenced by location, physical or other controlling conditions—especially if conditions also favour steam generation. The value of a steam plant as a unit in a hydro system is dependent on a number of conditions inherent in the system, such as widely variable water flow, relative demand for primary and secondary power, reliability of existing hydro electric equipment, ice interference, etc.

In New Brunswick we have several reasons to consider steam as an auxiliary to the Provincial Hydro Electric system. The geographical locations of sources of hydro power in relation to load centres leave a need for more capacity in a region where hydro power is not available at costs comparable with steam. Industries were contemplating leaving the Province in favour of locations where reliable and cheap power could be secured. Low water conditions, such as have recurred in recent years, make a reliable steam station highly desirable as a supplementary source of power to feed into the system and, while filling these needs, a market is provided for one of the natural resources of the Province—coal in the Minto Field.

These were among the causes leading up to the decision to build the first unit of a steam plant on Grand Lake where conditions favour steam. The two chief essentials for such a plant are present—coal from the nearby mines and unlimited suitable water for condensing and boiler feed purposes. The third important factor is its location close to the geographical centre of a developing industrial load near Fredericton. This location is likewise not far from the geographical centre of the Province and power from Grand Lake is thus within econominal transmission distance of the centres of distribution at Moncton and Saint John.

To the layman, a steam station is a much more complex and mysterious affair than a water power plant. Every boy has built his mud dams and seen them washed away by the flood he has created .As a man, he has seen dams built that were not washed away by their own flood waters and he can understand how the water rushing through the turbines can turn the generators that produce the blessed electric current that has made life so much easier and brighter for both city and rural dweller. But a steam plant is usually well placarded "Keep Out" and even if he does not believe in signs and enters, he sees little that enlightens him as to what really goes on in the two grand divisions of the plant that are so different in their purposes and activities.

As every taxpayer in the province is a part owner of Grand Lake Power Station, the Engineers who designed it have been asked to describc the plant in language as free from technical terms as possible. They have done this by making an imaginary trip through the plant, to which you may now be a party and have each thing you see explained as you go. Before starting, a few general statements will be helpful:

The plant is on the shore of Grand Lake at Newcastle Landing, 40 miles from Fredericton, and is reached by a spur line form the Fredericton and Grand Lake Coal & Railway Company's line at Minto. The building is on solid rock foundations and is of brick, steel and concrete construction except for one end closed in with wood construction to provide for extension. The roof is of concrete and the sash are steel. A special sprinkler system protects the temporary wooden end wall.

The building is divided into three principal divisions—the boiler room, 58 ft. x 26 ft., the turbne room, 66 ft. x 42 ft., and the bus or electrical room, 42 ft 6 ins., x 21 ft. The boiler room is 46 ft. high and is 14 ft. above the level of the generator floor—the turbine room is six inches above the surrounding grade, having a condenser and pump room basement 14 ft. below the turbine floor level—the bus room is 14 ft. high and has one level.

Two open channels from the lake cut in the rock, lead to a well at the building and provide inlet and outlet for water, the uses for which will be described later.

The first problem in such a plant is to burn coal in such a way as to lose the least possible heat value contained in the coal, either as heat going up the stack or as unburned coal left in the ash. As the purpose in burning the coal is to make steam, the next problem is to conserve the steam and the heat it contains in every possible manner. Steam may be made to do useful work either by using its pressure, its velocity of travel when released or by using its heat. The skill of the designer lies in securing the best combination of uses of these three properties of steam. As the primary purpose of the steam is to drive electric generators, the third problem is to secure the maximum value from the electric generators in exchange for steam supplied to the driving machines. The ultimate object of the designer is to secure the most electricity for the least possible coal burned and to keep a proper balance between operating economies and the fixed charges represented chiefly by the interest on capital invested in building the plant. He can spend money on refinements that will not pay for themselves in added economy of operation. The purpose of the plant must, therefore, be kept clearly in mind so that such refinements may be stopped at the limits of ecenomy justified by the results desired.

A trip through the plant begins naturally at the boiler room, where the coal enters the station. Coal is delivered by rail in hopper cars that are dumped into a pit outside the plant. The coal passes through a crusher to an automatic skip hoist bucket, which raises the coal to the level of the boiler room roof about 75 ft. above the ground. It passes through a hopper to a magnetic separator which picks up any iron or steel pieces which may be in the coal and would damage the coal pulverizing mills. From the separator the coal drops into an automatically operated car which distributes the coal the full length of the storage bunker above the boiler and in front of them. From the bunker it is fed by gravity through dust tight chutes to the four pulverizer mills in front of the boilers at the firing floor level. An automatic weighing scale is provided just before the coal reaches the pulverizers so that the amount of coal fed to the boiler can be accurately measured. If coal is being received faster than required, it may be shunted from the top of the skip hoist to a point on the ground outside the station where a drag line scraper spreads it in a storage pile until it is wanted. A reserve supply of coal in addition to what can be carried in the bunker is an essential to guard against interruptions in receiving coal due to weather or other adverse conditions affecting the supply of coal. Coal is reclaimed from the storage pile by the same drag line bucket and dropped into the crusher pit from which it is carried through the series of movements above described.

There are two coal pulverizer mills for each boiler which are fully enclosed in a cast iron casing so that nothing can be seen of their operation and no dust can escape. The mills will each handle three tons of coal per hour. Action of the pulverizer mills resembles nothing so much as the crude operation of flailing grain by hand. But the result is a powder as fine as talcum. A blast of air through the mills blows the pulverized coal through a pipe into the furnace with the correct mixture of air such that instant and complete combustion occurs when the mixture is ignited.

The two boilers and furnaces are each able to evaporate over 60,000 lbs. of water per hour and are a surprise in size. Each boiler and its furnace is as large as a small four-storey house. On peering through a tiny inspection window—and using a smoked glass to protect the eyes—the whole inside of the furnace, 12 ft. wide and perhaps 20 ft. high, is seen as a seething mass of flame. There is little ash and little smoke—such unburnable particles as remain in the coal fall to the bottom of a hopper at basement level through a screen of water jets and like so much sand are sluiced from the bottom of the hopper in a stream of water through a pipe to a storage pit and are later pumped with water to the ash dump in a nearby swamp.

The ash hoppers are the first thing seen on entering the boiler room basement door at ground level. The flames and hot gases of combustion pass up and through a labyrinth of passageways around some 6,000 square feet of boiler tubes connecting the drums of each boiler. As the gases pass out of the boiler on the way to the stack they go through a double system of ducts—one duct carrying gases out and the next one carrying fresh air bound for the coal pulverizer mills. Thus the waste heat in the flue gases is transmitted to the fresh air needed to feed into the fire and several hundred degrees of heat contained in the flue gases are recovered. This method of recovering heat was hardly known ten years ago. Two great fans, located on an upper level above the boilers, handle the gases and fresh air. One fan sucks the gases out and discharges them up the stack and the other fan pushes air through the preheaters and thence to the pulverizers and on into the furnace. The air entering the furnace is 100 degrees or more hotter than the outgoing gases entering the stack. A vacuum cleaner permanently connected removes soot from the inner parts of the boiler and discharges it into the ash pit.

The steam has a pressure of 450 lbs. per square inch and is passed from the boiler nozzle through the superheater, which is merely an additional set of tubes in the hottest part of the furnace to raise its temperature to over 700 degrees F. It is then entirely free of any moisture and is piped to the turbines on the upper level of the next room through lines that are heavily covered with the finest of insulating material to save heat. The boiler and furnace are also heavily insulated and covered in large part with steel plate.

In the turbine the steam is first released in jets directed against vanes or buckets around the rims of a series of wheels or discs, mounted on the turbine shaft. This causes the shaft to revolve in much the same way a water turbine is driven by a jet of water. The turbine shaft is coupled to the generator which, by revolving, produces electricity. There comes a time when it is more profitable to extract some of the steam and use its heat than it is to allow it to go on without interruption through the turbine and into the condenser where it is turned back into water This extraction of steam is done at two stages of the travel of the steam through the turbine—one at 40 lbs. pressure and one at 10 lbs. pressure. (This will be referred to again).

The condenser is in the basement directly below the turbine and is a large cast iron shell or box filled with hundreds of three-quarter inch tubes of a special alloy of copper. These tubes are fitted into head sheets within the box. Cold water from the lake is circulated through these tubes, in at the bottom of the shell and out at the top. Steam from the turbine enters the shell and surrounds the copper tubes, the cold water within the tubes chilling the exhaust steam and condensing it into water, which drains to the bottom of the shell, namely to the hot well. From there it passes through a series of heaters which raise the water from the hot well temperature of 110 degrees F. to a final temperature of about 325 degrees F. at which it is fed back to the boilers. These heaters receive their heat from the steam extracted from the turbine at two points previously mentioned.

It is hardly enough to leave the visitor with the impression that the condenser's main business is only to condense the steam back to water. A more important purpose is served by the fact that a vacuum is created within the condenser, which sucks the steam away from the turbine, thus reducing to a minimum the resistance to the rotation of the turbine, which would be produced if the turbine had to expel the last of the steam at some small pressure. In other words, the turbine is made to rotate, first, by pushing it around with steam under pressure, and second, by pulling it around by sucking the steam away from it at the end of its travel through the turbine.

From the boiler feed pumps the water goes through the last of the heaters and then to the boilers. One feature of the boiler construction not previously mentioned is the "Water Walls." These Water Walls are one of the most recent developments in steam power station economy. Ten years ago they were just becoming known. Today they are still not up to perfection, but they recover a very substantial amount of heat formerly wasted by losses through the walls of the boilers. In principle, the four walls of the furnace all around the fire are filled with a network of four-inch pipes, sometimes partially or wholly protected by firebrick in the wall construction. The boiler water, in its regular circulation within the boiler, is forced to pass through all of these water all tubes, absorbing heat and keeping the firebrick at less than a destructive temperature. This permits higher flame heats than were formerly permissible within the limits of firebrick life and greatly improves combustion conditions in the furnace —besides saving heat in the water and steam system.

Water boils normally at 212 degrees F., but at the boiler pressure of 450 lbs. per square inch the feed water at 325 degrees F. is still below the boiling point and can be handled as water. It is circulating in the water walls and boiler tubes at still higher temperatures before it is finally reconverted into steam at 660 degrees F.

Of course there is some loss of water or steam in the whole system, but this is very small—perhaps three or four per cent of the total used by the turbines. This loss is from leakage at points where absolutely sealed joints are not permissible around some moving part. This loss of water is replaced from a storage tank in the feed water system located at the fan floor level in the boiler room. All of the water fed to the boilers is distilled in a steam operated evaporator, so that all mineral content of the water is removed before it reaches the boilers. The inside surface of the boiler drums and tubes is coated with a special paint that withstands such high temperatures and preserves the metal for long periods against corrosion or pitting. The use of distilled water also permits boilers to be operated for a year or more without shutting down for removal of the scale deposited from the water on the inner surfaces of the boiler tubes and drums.

It is the steady improvement in the highly complex equipment in the steam side of a station that accounts for the great increase of reliability and economy of steam generated power. Where 20 years ago it required from 2½ to 4 lbs. of coal to produce 1 kilowatt hour of electric power, it now requires only 1 to 2 lbs. of coal in plants of good design, depending of course on the size of the plant and the class of coal available.

Canadian materials, machinery and equipment were purchased as far as possible—a large part originating in New Brunswick. With the exception of a few specially qualified men and technical experts, the labour employed was practically all drawn from the province. The operating staff is 100 per cent from the province.

Of Interest to Women

CONCENTRATED MILKS OR MILK IN VARIOUS FORMS

Now that the schools are closed, thousands of happy children and parents have temporarily left their city homes to enjoy the summer vacation in the country. Perhaps the holiday season will be spent in a cottage situated sufficiently near a town or city to procure the family food supply, including milk, meat and groceries without any difficulty. On the other hand, the camp or cottage may be so located that fresh foods cannot be regularly obtained, in which case careful planning is necessary to ensure three wholesome, healthful meals every day.

Milk is one food that should be given special consideration under such circumstances, for this valuable food must be provided in adequate amounts —particularly for the children, Where the purity of the milk is doubtful, or where there is the problem of obtaining a daily supply of fresh milk or of keeping the milk sweet, it is indeed fortunate that one can turn to the various concentrated milks on the market, and use them unhesitatingly in place of fluid milk.

In using any of the concentrated milks the directions appearing in the container should be carefully followed. Evaporated milk may be reconstituted to resemble whole milk by adding sufficient water to replace the amount evaporated in process of manufacture. This milk will keep for a prolonged period of time in the unopened can, but after being exposed to the air, should be treated as fresh milk.

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TOMATO EGGS

This is a dish for the children — scrambled eggs with tomatoes.

Beat four eggs with salt and pepper, then add three skinned and thinly sliced tomatoes.

Put the nut of butter in a pan, gently beat, then add the eggs and tomatoes and gently cook, stirring all the while.

Pour on rounds of buttered toast and garnish with chopped parsley.

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RICE KEEPS SALT LOOSE

Salt shakers will remain unclogged even in the dampest weather if a half teaspoonful of rice is mixed with the salt and left in the shaker.

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HOUSEHOLD HINTS

Flowers will last longer, if a snip is taken off the stalks every day and the water changed.

Rub olive oil round a tight stopper and place near fire. Tap lightly and it can be removed.

On a wintry day, put a clip-on clothes-peg on the end of each stocking or other light article when hanging out to dry. This prevents them blowing over the line and becoming twisted.

To keep the hands smooth, keep a jar of oatmeal by the kitchen sink, and rub some into the hands after washing up, etc. If you have to run to the door without drying the hands, oatmeal rubbed over as you go will prevent them getting rough.

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TOASTED BANANA SANDWICH

Toast two slices sandwich bread, crusts removed. Spread with butter, then spread one slice with cream cheese then with orange or grapefruit marmalade. Place slices of bananas attractively on the other buttered slice. Serve both slices, open, on an individual plate.

MINTO NOTES

(By Myrle Harben)

Miss Dolly Vanheddegem of Minto is a guest of her grandparents Mr. and Mrs. G. Peyembroak, Cape Breton, N. S.

Mrs. A. Fearon of Harcourt is spending a few days with her son Paul of Minto.

Miss L. Robinson of Moncton, who has been visiting friends at Minto, has returned home.

Miss Isobel Kilburn of Fredericton, is a guest of Mr. and Mrs. A. T. Smith Minto.

An enjoyable afternoon was spent recently at the home of Mrs. A. D. Taylor when two tables of bridge were played. The prizes were won by Mrs. Max Welton and Mrs. J. J. Johnston. Refreshments were served by the hostess.

Misses Louise Kincade and Christine Smith of Minto and Miss I. Kilburn of Fredericton are spending two weeks' vacation at Grand Lake.

Miss Greta O'Dell, Sussex, is visiting Mr. and Mrs. George Cole.

Mrs. James Jardine of Gaspereau Forks and Mrs. M. Fulton were recent guests of Mr. and Mrs. Enoch Harben, Minto.

The Daily Mail is the only "daily" in New Brunswick with a full radio page and programme.