An aerial photograph of a large dam and reservoir, likely the Shannon Hydro-Electric Scheme. The dam is a long, straight structure across a wide river. The reservoir is a large body of water upstream of the dam. The surrounding landscape is hilly and wooded.

THE STORY OF THE SHANNON HYDRO-ELECTRIC SCHEME



ELECTRICITY SUPPLY BOARD
BORD SOLÁTHAIR AN LEICTREACHAIS

THE STORY OF THE SHANNON HYDRO-ELECTRIC SCHEME

At the time Dr. Tommy McLoughlin returned to Ireland from Germany in 1923, the annual consumption of electricity in this country was a mere 48 million units, 36 million of which was consumed in Dublin. By comparison, the annual consumption at the present time exceeds 10,000 million units.

Dr. McLoughlin had spent his first post-graduation year gaining engineering experience in Germany and while there had found ample confirmation of his belief that a cheap and plentiful supply of electricity was essential for rapid growth and consequent prosperity.

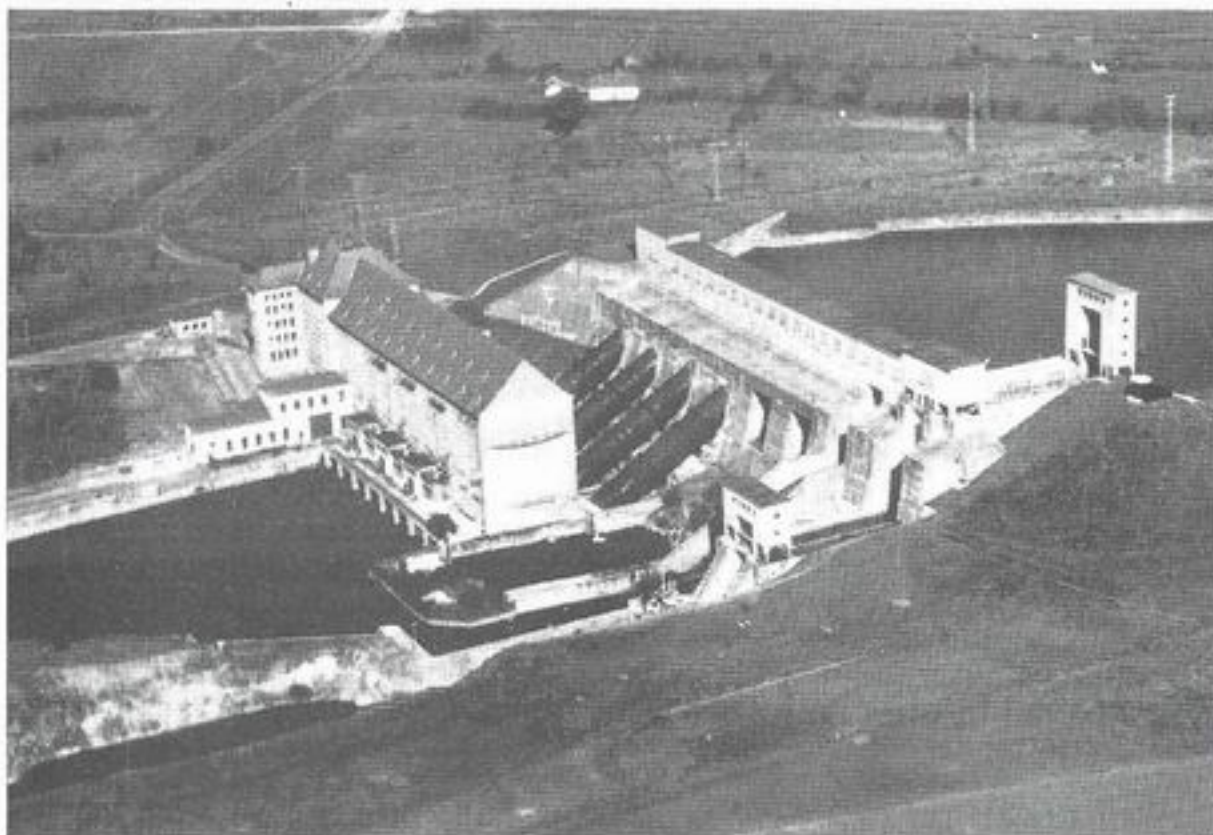
With the help of a friend Patrick McGilligan, who was soon to be appointed Minister for Industry and Commerce, Dr. McLoughlin set about convincing the Government to adopt his plans for a Shannon Scheme. Having eventually received a hesitant green light in Dublin, McLoughlin then had to persuade his German employers Siemens Schuckert to prepare a report with a design and economic justification for the Scheme. Siemens produced this report in the incredibly short time of six months and it was presented to the Government on 1st September, 1924.

After much debate, the Shannon Electricity Bill was passed unopposed by Dáil and Senate in June, 1925, the contract with Siemens was signed in August, 1925 and work began immediately.

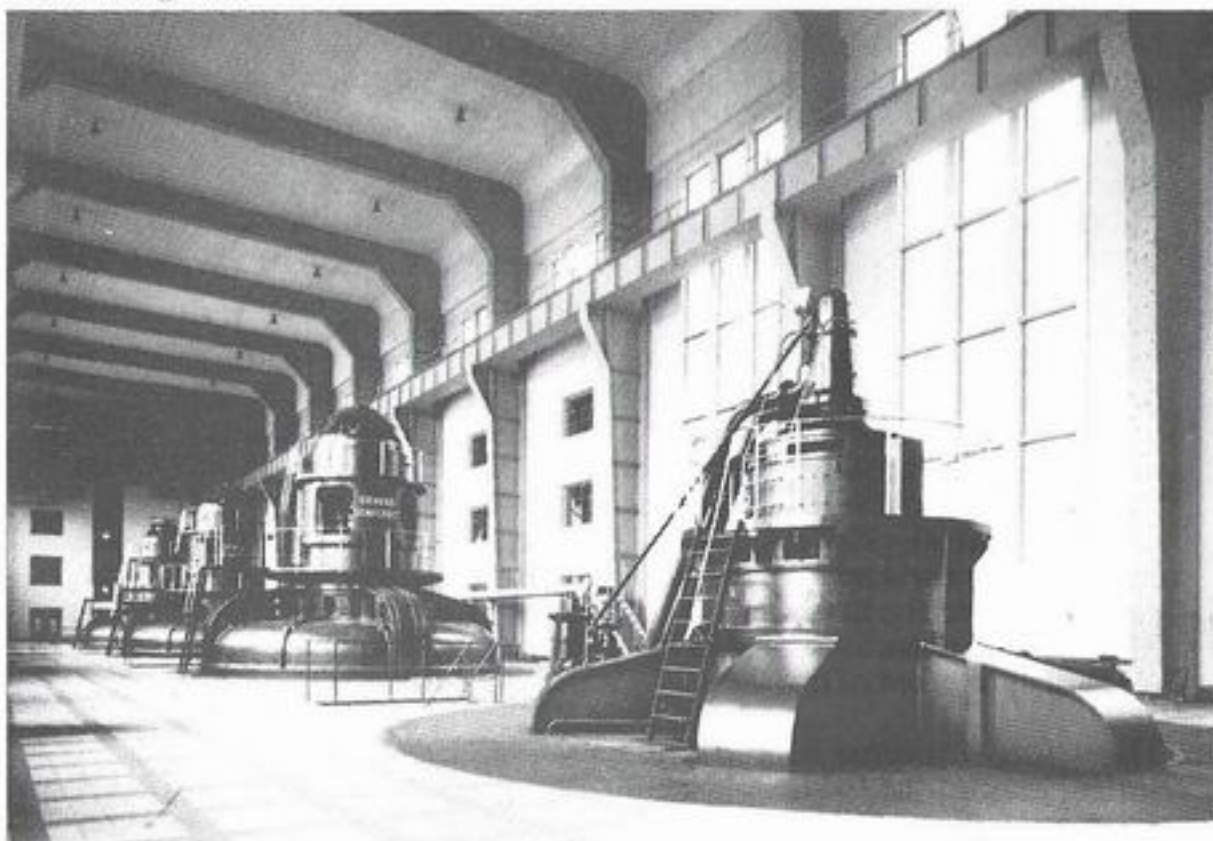
The conventional design of a large storage basin formed by a high dam with a power station at its foot was not possible due to the topography of the area. The design instead involved the construction of a smaller dam or weir on the river just upstream of O'Briensbridge and five kilometres south of Killaloe. A canal was then constructed from the weir to the site of the power station 12.6 kilometres away, following the slope of the hills to minimise the amount of material required for the embankments on either side. At Ardnacrusha, the canal terminates in a 30 metre high dam through which the 6 metre diameter penstocks feed the water to the turbines in the power station at the foot of the dam.

The water emerging from the power station is then carried by way of a tailrace canal, 2.4 kilometres long, back to the river 3 kilometres upstream of Limerick.

Ardnacrusha Power Station.



Generating Hall.



The initial design was for three turbines with the facility for adding a further three at a later stage. The first three were completed in 1929 and a fourth was added in 1934. The fifth and sixth were not installed.

Construction work involved the removal of 7.6 million cubic metres of earth and 1.2 cubic metres of rock, four major bridges were built and nine rivers and streams diverted. To do this work, numerous machines including 138 locomotives and 1770 wagons were transported from Germany to Limerick. Five thousand men, German and Irish, were employed, many of them being accommodated in camps at Ardnacrusha, Parteen Weir, O'Briensbridge and Clonlara.

The work took four years to complete. On 22nd July, 1929, Mr. W.T. Cosgrave, President of the Executive Council of the Irish Free State, started the mechanism which opened the sluice gates at Parteen Weir and allowed the River Shannon to begin filling the headrace canal.

On 21st September, current was first generated on a trial basis and on 24th October, 1929, the Scheme was handed over to ESB.

The construction of the Shannon Scheme was a mammoth undertaking for a country the size of Ireland, especially when the State was barely three years old. The cost of five and a half million pounds consumed a huge proportion of the new state's finances and caused bitter argument in the Dáil and elsewhere. However, those who dubbed the Scheme 'McGilligans White Elephant' were soon proved wrong when electricity consumption began to rise at a phenomenal rate as soon as Shannon power became available.

In 1929, when Ardnacrusha joined Pigeon House as the major suppliers of electricity, there were over 300 other producers in Ireland, most of them very small. ESB on its foundation in 1927, set about supplying cheap power to the whole nation and gradually took over all the small utilities.

Ardnacrusha at this time was the headquarters of ESB. The decision as to which machines in the system would supply the demand at any time was made by the control room staff at Ardnacrusha and they retained this function until the load despatch office was established in Dublin in 1954.

In its early life, Ardnacrusha could supply practically all the electricity needs of the country. The highest proportion of system demand supplied by Ardnacrusha was 87% in 1936/37.

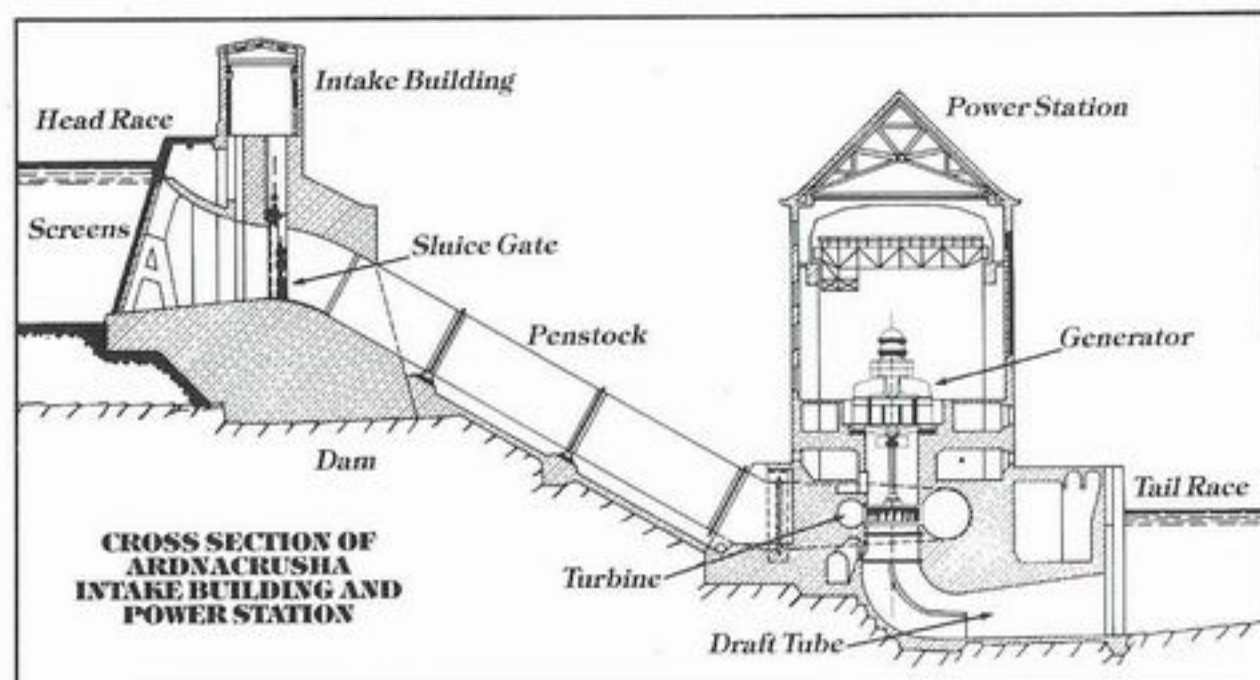
Although at the present time, Ardnacrusha supplies only about 3% of the annual demand, it is still vitally important to the system as a 'rapidly available' source of peak power and for cover in cases of emergency or sudden breakdown of other plant.

The River Shannon is 240 kilometres long from its source in the Cuilcagh Mountains, County Cavan to Ardnacrusha and in that distance it drains 10,000 square kilometres or 1/8th of the area of Ireland. It flows through three major lakes, Lough Allen, Lough Ree and Lough Derg which together have a storage capacity for 600 million cubic metres. As the station uses 5,500 million cubic metres annually, the total storage is used 9 times over in the course of the year.

The station at full load consumes 400 cubic metres or tonnes of water per second and produces 85,000 units per hour. The average flow in the river is 180 tonnes per second but this ranges from 600-700 tonnes per second in winter floods to as little as 10 tonnes per second in summer dry periods.

For fishery and environmental purposes a flow of 10 tonnes per second is allowed down the old river channel at all times. In order to utilise this flow a 600 kW set was constructed at Parteen in 1980. This runs almost continually and produces about 3.5 million units of electricity per year.

To allow for the passage of migratory fish - salmon, trout and eels - there are fish passes at Ardnacrusha and Parteen Weir.



DETAILS OF THE SHANNON WORKS, PLANT & EQUIPMENT

Plant commissioned 1929. Capital cost £5½ million
Capacity 85 MW (4 machines)
Parteen Set 0.6 MW

Average annual output 332 million units.
Record annual output reached in 1960/61
432 million units.
Record weekly output 14.72 million units
1965/66.

PARTEEN WEIR:

Parteen Weir, situated just upstream of the village of O'Briensbridge, controls the flow of water from the Shannon into both the headrace and the old river bed. There are six sluice gates on the old river outlet and three sluices and a navigation gate on the headrace canal. The sluice gates on the river can discharge all flows from the minimum of 10 tonnes per second, which must be allowed down the old river bed for fishery and environmental purposes, to extreme floods of 900 tonnes per second and more. On the east bank is the 600 kW set, a 13-stage fish pass and the Parteen Fish Hatchery, where salmon and trout are reared from eggs for release in rivers and lakes throughout Ireland for re-stocking.

HEADRACE (EMBANKMENTS):

The headrace carries the water from the Shannon at Parteen Weir to the power station at Ardnacrusha, a distance of 12.6 km. Throughout most of this distance the canal flows between man-made embankments. The headrace ends in a 30 metre high concrete dam above the power station.

INTAKE BUILDING:

The intake building is constructed on top of the dam at Ardnacrusha and houses the sluice gates for controlling the flow of water into the four penstocks. These gates usually remain at a fixed opening except when a machine is shut down for repairs or overhauls. They can be dropped, in emergency, by push-button in about 30 seconds. Screens in front of the gates prevent debris from entering the penstocks. They are kept clean by a motorised rake running on tracks the full length of the building.

POWER STATION:

PENSTOCKS:

There are four penstocks, or pipes, each six metres in diameter, to convey the water from the intake building to the four turbines. At maximum load, each penstock delivers approximately 100 tonnes of water per second. This figure, equivalent to 360,000 tonnes in an hour, appears very large but it requires a potential energy of 15 tonnes of water at a head of 30 metres to keep a 1kW electric fire heated for an hour.

TURBINE GALLERY & MACHINE FLOOR:

There are four turbines, three of them Francis and one of Kaplan design, each rated at about 30,000 HP. Each turbine has its own high pressure oil pump for supplying the power to the servo motors in order to control the amount of water entering the turbines via the guide vanes. Each unit has its own governor which serves to control speed variations of the machine within limits and provides means of starting, stopping, loading and unloading of the unit.

GENERATORS:

Generators 1, 2 and 3 are rated at 30,000 kVA and run at a speed of 150 rpm, while Generator 4 is rated at 25,000 kVA and runs at 167 rpm. One generator can produce an average of 21,000 units of electricity every hour when on full load.

VOLTAGE:

The generators at Ardnacrusha produce electricity at 10.5 kilovolts (kV). This is transformed to 40 kV for local distribution or 110 kV for transmission purposes. The 110 kV lines feed bulk load to the national grid which serves the whole country. Transformer stations at major centres reduce this voltage to 40 kV for distribution in the area. This in turn is reduced locally to 400 volts for power purposes and to 220 volts for domestic distribution.

CONTROL ROOM:

The control room is the control centre for the power station. There the generators are connected and loaded on ESB system at the request of the National Control Centre in Dublin. Information on alarms and signals to alert staff of impending faults on the plant are routed to the control room. Serious faults which necessitate the tripping of plant or power lines are also indicated. The main parameters indicating running conditions and headrace and tailrace levels are continuously monitored. The control room is staffed 24 hours a day and every day of the year.

TAILRACE:

Water from the turbines is discharged through the draft tubes, the bell-mouthed openings of which are below the water surface, into the tailrace, a 2.4 km channel which takes the water back to the River Shannon.

110 kV TRANSFORMERS:

There are four of these situated on the tailrace platform. Each is rated at 30,000 kVA and their function is to step up the generated voltage (10.5 kV) to 110 kV for long-distance transmission. Each transformer weighs about 100 tonnes.

40 kV TRANSFORMERS & SYSTEM:

Situated at the front of the building there are four transformers, each rated at 8,000 kVA, which step up the generated voltage to 40 kV for local distribution. In addition to these 10/40 kV transformers, there is also a 110/40 kV transformer rated at 31,500 kVA feeding into the 40 kV system. The latter steps down voltage from 110 kV to 40 kV and is situated in the 110 kV station. The 40 kV system comprises lines feeding Cratloe/Caherdavin, Moylish, Corbally, Gillogue, Bruff, Patrickswell, Cappamore, Silvermines, Birdhill, Tulla and Ennis/Shannon.

110 kV STATION:

This is the switching station from Ardnacrusha. There are 110 kV lines from here to Ennis and Drumline (Shannon), two lines to Limerick city and there are two spare bays.

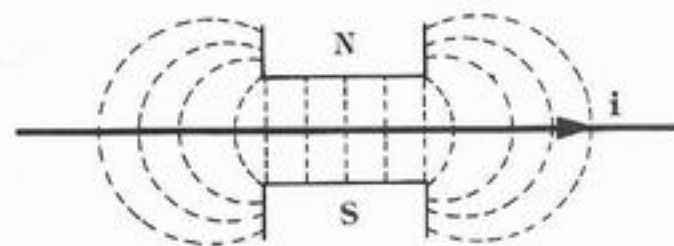
NAVIGATION LOCKS:

The navigation locks are situated on the south-eastern side of the station. This provides passage for boats going up the Shannon or to Dublin by the Grand Canal. Boats are raised in two stages through a height of 30 metres when passing from the tailrace to the headrace. The time take for this operation is about 35 minutes.

FISH PASS:

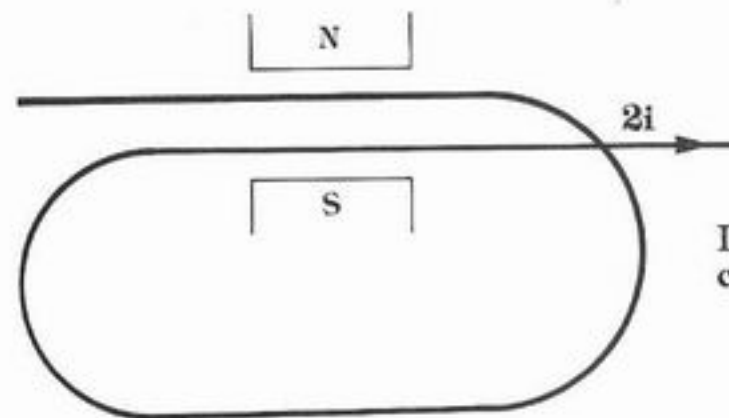
The Borland type fish-pass was commissioned in April, 1959 to facilitate the passage of fish past the power station. The tower is 5 metres in diameter, has a vertical lift of 30 metres and uses 1.5 tonnes of water per second. The equipment incorporates an automatic electronic fish counter which records the number of salmon passing upstream (record 8002-1973).

HOW ELECTRICITY IS MADE



Movement of wire between poles of magnet produces electrical current.

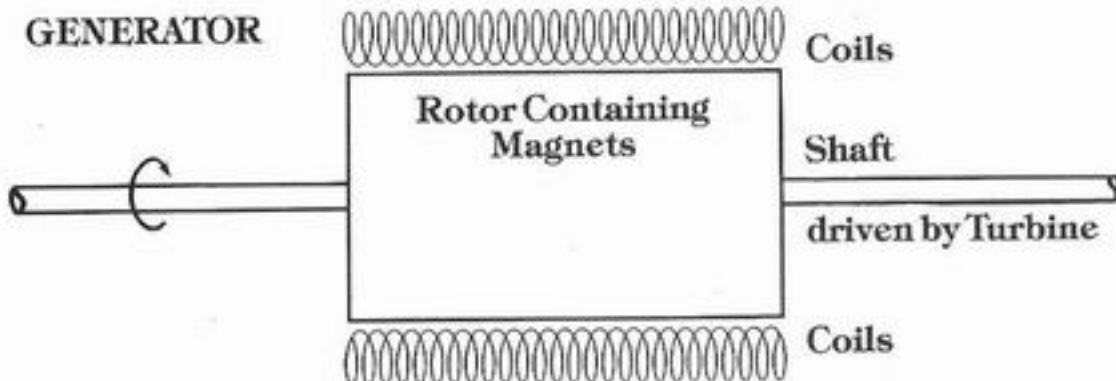
The wire must move with respect to the magnetic poles. No movement, no current.



Double strand coil causes double current.

One thousand loop coil produces current $1000i$

By varying the size and strength of the magnets and the number of coils any current can be produced.



If a coil of wire is moved between the ends of a magnet, an electric current will flow through the wire. If the coil of wire is held steady and the magnet moved, electricity is again generated in the wire. This is the principle used in making electricity in all power stations.

The machines that make electricity are called generators.

A generator in a power station consists of many coils of heavy copper wire held in position around the inside of a large cylindrical case. A long shaft passes through the centre of the case and carries several large magnets. When this shaft is turned the magnets spin with it and electricity is generated in the coils.

In a hydro power station, the power of flowing water is used to turn the shaft. A dam is built across a river so that the water level upstream of the dam rises. The water then flows from this high level through large pipes, or penstocks, to a machine called a turbine which is connected to the shaft. This turbine is similar, in principle, to the large timber paddle-wheels used in streams and rivers long ago. The modern turbine is made of steel and the water pushes against the paddles, now called a runner, which drives the turbine. This movement is transmitted to the shaft carrying the magnets, thus rotating them across the face of the coils to produce the electricity.

Text by Alan Shaw.