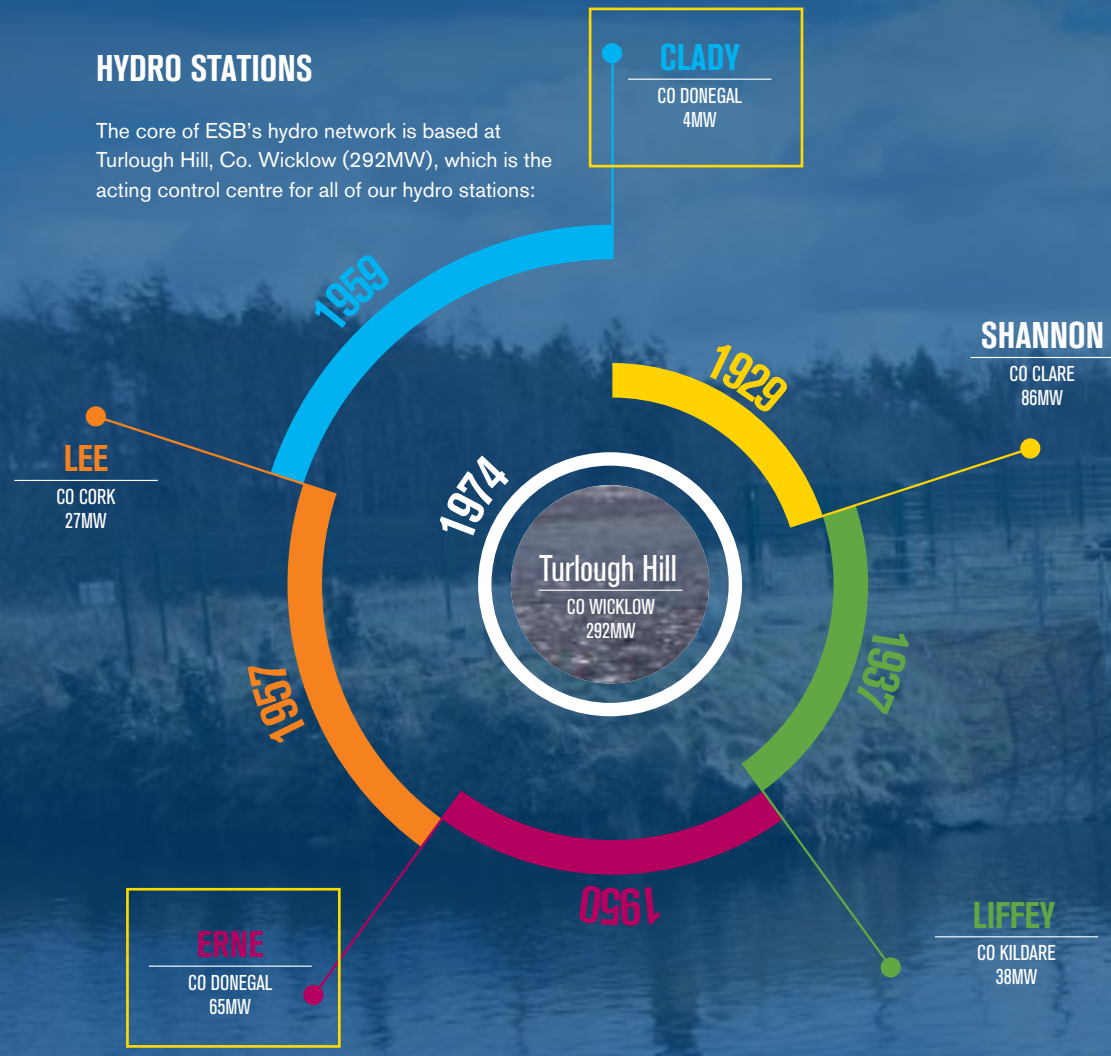

ESB
Energy for
generations
Erne Stations

Contents

HYDRO STATIONS

The core of ESB's hydro network is based at Turlough Hill, Co. Wicklow (292MW), which is the acting control centre for all of our hydro stations:



Design: Zahra Media Group

Welcome to the Erne Stations

ESB was established in 1927 as a corporate body in the Republic of Ireland under the Electricity (Supply) Act 1927. As a strong, diversified, vertically-integrated utility, ESB operates right across the electricity market: from generation, through transmission and distribution to supply.

In terms of generation, ESB currently operates 7 thermal stations, 12 windfarms and 10 hydro stations in the Republic of Ireland, three of which are based in Co. Donegal: Cliff and Cathaleen's Fall at Ballyshannon, and Clady at Gweedore, Co. Donegal.

The Ballyshannon stations are known collectively as the Erne hydro-electric scheme. It was the largest construction project of its time, bringing a workforce of approximately 1,500 to the town. Construction began in 1946, with building the dams at Cliff and Cathaleen's Fall, and ended in 1955 with the commissioning of a second turbine at Cliff Station.

Clady Station, the third member of the Donegal hydro-electric family, was constructed between 1954 and 1959. The station is located at the Clady River in Gweedore, Co. Donegal.

Collectively, the three Donegal stations generate a capacity of almost 70MWs, supplying electricity to over 38,000 homes.

Fáilte chuig Stáisiúin na hÉirne

Rinneadh BSL a bhunú mar chomhlacht corpraithe i bPoblacht na hÉireann sa bhliain 1927 faoin Acht Leictreachais (Soláthar) 1927. Mar fhóntas láidir éagsúlaithe atá comhtháite go hingearach, oibríonn BSL i ngach réimse den mhargadh leictreachais: giniúint, tarchur agus dáileadh, agus soláthar.

I dtéarmaí giniúna, tá 7 stáisiún theirmeacha, 12 fheirm ghaoithe agus 10 stáisiún hidrileictreachais á n-oibriú ag BSL faoi láthair i bPoblacht na hÉireann agus tá trí cinn díobh sin suite i gContae Dhún na nGall: An Bhinn agus Eas Chaitlín i mBéal Átha Seanaidh, agus Stáisiún na Cláidí i nGaoth Dobhair, Contae Dhún na nGall.

Scéim hidrileictreach na hÉirne a thugtar ar stáisiúin Bhéal Átha Seanaidh le chéile. Ba é an tionscadal ba mhó ar tugadh faoi ag an am, agus tháinig fórsa saothair thart ar 1,500 chuig an baile dá bharr. Cuireadh tús leis an tógáil i 1946, nuair a tógadh dambaí ag An Bhinn agus ag Eas Chaitlín agus tugadh chun críche é i 1955 nuair a coimisiúnaíodh an dara tuirbín ag Stáisiún na Binne.

Tógadh Stáisiún Chláidí, an tríú ball de theaghlach hidrileictreach Dhún na nGall, idir 1954 agus 1959. Tá an stáisiún suite ar an Chláidigh i nGaoth Dobhair, Contae Dhún na nGall.

Le chéile, gineann an trí stáisiún i nDún na nGall beagnach 70MW, agus soláthraíonn leictreachas do bhreis is 38,000 áras cónaithe.

Erne Stations

01

Electricity for an expanding economy

In 1929, Ireland's first and largest hydro-electric scheme, the Shannon Scheme, started operating. This was very much the start of Ireland's 'quiet revolution' of rural electrification.

ESB then commissioned a number of projects during the late 1940s/early 1950s to meet the burgeoning national demand for electricity. One of those projects was the River Erne hydro-electric development, commissioned with the intention of meeting the surge in demand, particularly south of the border, while also providing a practical solution to flooding issues across the River Erne catchment.

Map of the River Erne Catchment.

Getting started: Two-phase development

Phase 1: 1946 – 1952
Construction of dams at Cliff and Cathaleen's Fall

Phase 2: 1953 – 1955
Deepening of the Belleek channel
Commissioning of 2nd turbine set at Cliff Station

Timescale of the River Erne hydro-electric development:

Started 1946 → **Completed 1955**

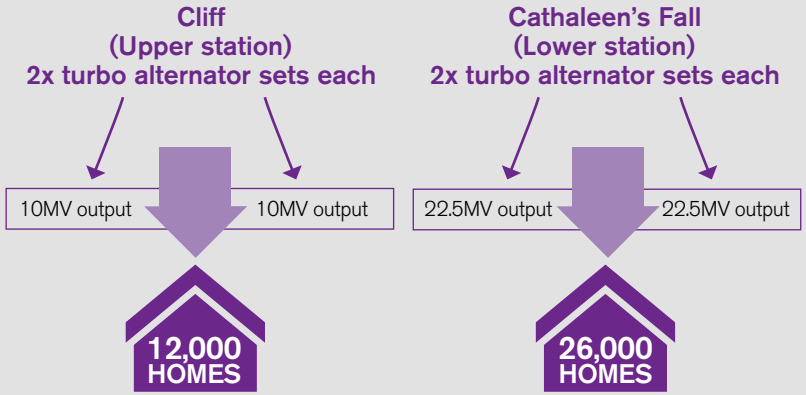
The Erne hydro-electric scheme was commissioned in two phases, beginning with construction in 1946 of two separate hydro-powered stations on the stretch of the River at Ballyshannon and the sea.

Why were the hydro stations built at Ballyshannon?

This is a question often asked about the dams and the answer lies in the height that the water falls from and the rate of its flow. At Ballyshannon, and along the stretch of the river to the sea, the natural fall of water is 45m, with an average flow of 93 cubic meters per second, which makes the Erne catchment and Ballyshannon the perfect location for hydro-electric dams.

The first dam was built just below the town of Belleek, at a point on the River Erne where it is 65m wide and at a shallow gorge with cliffs 7.5m high. Two turbo-alternator sets were commissioned separately at Cliff station: Unit 1 in 1950 and Unit 2 in 1955. Each set has an output of 10MW under a head of 10m of water. Combined, these turbo-sets generate enough power to supply over 12,000 homes with electricity. There is also an additional 300kW generator which provides supplementary power for local needs.

The second dam, Cathaleen's Fall, was built upriver of Ballyshannon. It is the larger of the two Erne stations, with a 30m high dam. This dam has two turbo-alternator sets: Unit 3 was commissioned in 1951 and Unit 4 in 1952. Each unit has an output of 22.5MW under a head of 29m of water. Together, these generate enough hydropower to supply over 26,000 homes with electricity. There is also a 400kW generator which supplies additional power for local needs.



The two stations have a combined capacity of 65MWs and generate electricity at 10.5 kilovolts. They are connected to step-up transformers (10.5kV/110kV) in an outdoor compound at Cathaleen's Fall and the electricity produced is fed through these transformers into the national grid.

Construction, Cathaleen's Fall at night with crane, 1950.

Cliff View, looking upstream to power house mid construction.

Digging in

The Erne hydro-scheme required major drainage works within the mid-catchment area and required significant cross border co-operation during its construction.

- The upper and lower loughs channel (17km long) was deepened and sluice gates were constructed at Portora, near Enniskillen.
- The Belleek Channel (6km long) was dug out and enlarged. This was done in order to improve water flow, improve drainage on the catchment and mitigate against flooding.
- The whole process involved the excavation of 600,000m^3 of earth and rock from the river bed. A total of 98.8% of the Erne catchment area became harnessed for hydroelectricity generation.
- The scheme also involved the creation of Assaroe Reservoir between the two hydroelectric installations.
- Quantities of the construction work for Cliff and Cathaleen's Fall:

Earth excavation: 293,000m^3
Concrete: 132,000m^3
Rock excavation: 394,000m^3
Steel reinforcement: 2,235 tonnes

Regular flooding

Before the development was commissioned, up to 24,000 acres of land would be regularly flooded across the Erne Catchment. With the development of the Erne Scheme and the follow up Erne Drainage and Development Act [1950] works, this scale of flooding has been mitigated, with ESB maintaining relationships with statutory agencies in Northern Ireland to manage levels and flows to minimise the risk of flood.

Taking care

The Erne catchment is mostly rural, with an economy based on farming, fishing and tourism. As a result, ESB operates in close contact with the Department of Agriculture and Rural Development, Northern Ireland and the Rivers Agency to ensure water management is kept within regulated limits.

ESB has a responsibility towards fisheries conservation and maintains this commitment on the River Erne, which is a noted freshwater fishery. The development of the salmon hatchery at Cathaleen's Fall with restocking and conservation programmes in place has stabilised salmon numbers.

The hatchery produces juvenile salmon each year which are used to restock the Erne. Salmon runs are monitored at each of the two hydro stations by automatic fish counters. Juvenile eel called elvers are also trapped at the lowermost station (Cathaleen's Fall), and distributed throughout the Erne catchment above the stations to ensure steady eel stocks.

Clady

In addition to Cliff and Cathaleen's Fall, Clady Station is the third member of the Donegal hydro-electric family, located on the Clady River in Gweedore, Co. Donegal. The station was constructed between 1954 and 1959, when it came into full operation and was synchronised to the Donegal 38kV network. Clady is equipped with a horizontal Francis-type turbine, coupled to a generator with a capacity of 4.2MW.

For the construction of Clady Station:

- Two lakes, Dunlewey Lough and Lough Nacung, were enlarged to create sufficient storage capacity to run the Clady power station. Water levels at Dunlewey Lough have been raised by the construction of the Cung Dam at the promontory between the two lakes.
- The Clady River has also been partially diverted by Gweedore Weir into a 2.5km canal.

An Chláidigh

I dteannta stáisiúin na Binne agus Eas Chaitlín, is é Stáisiún Chláidí an tríú stáisiún hidrileictreach i nDún na nGall, agus tá sé suite ar an Chláidigh i nGaoth Dobhair. Tógadh an stáisiún idir 1954 agus 1959, nuair a chuaigh sé i mbun oibre go hiomlán agus nuair a sioncronaíodh é le líonra 38kV Dhún na nGall. Tá tuirbín cothrománach den chineál Francis ag stáisiún Chláidí, agus é ceangailte le gineadóir 4.2MW.

D'fhonn Stáisiún Chláidí a thógáil:

- Méadaíodh dhá loch, Loch Dhún Lúiche agus Loch na Cuinge, chun dóthain spás stóráilte a chruthú le stáisiún cumhachta Chláidí a rith. Ardaíodh an leibhéal uisce i Loch Dhún Lúiche trí Dhamba na Cuinge a thógáil ar cheann tíre idir an dá loch.
- Cuireadh an Chláidigh ar atreo de bheagán go dtí canáil 2.5km ag Cora Ghaoth Dobhair.

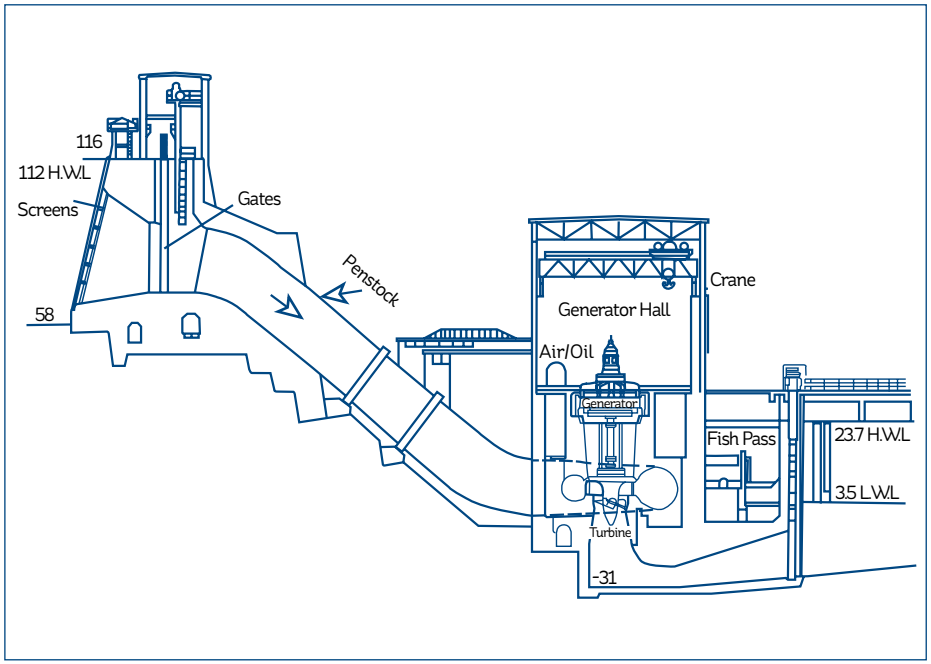
Clady Generating Station, Gweedore, Co. Donegal.

Erne Stations

02

Auxiliary unit at Cathaleen's Fall.

How hydro-generation works



Cross-section of Cathaleen's Fall Generating Station.

What is hydro-electricity?

Hydro-electricity is electric power generated by the gravitational force of falling or flowing water. It is the world's main source of renewable energy, supplying 16% of the total global electricity production. Ireland generates 220MW worth of hydro-power, which represents 2.8% of the total connected generation capacity.

How the process typically works

- A dam is typically built on a large river that has a vast drop in elevation. It is the role of the dam to hold back water behind it, which creates a reservoir to store the extra water.
- Near the bottom of the dam wall there is the water intake. Gates on the dam open and gravity causes water to fall through the penstock, a pipeline that leads to the turbine. As the water flows through this pipe, its pressure builds up, which creates a flow.
- At the end of the penstock is a turbine propeller, which is turned by this flowing water; in other words, the power source. The turbine is attached to a generator above it by a shaft.
- The generator produces power through magnets inside it, which produce an alternating current.
- The transformer inside the powerhouse converts this alternating current into a higher-voltage current.
- Power lines are connected to the transformer to carry the electric current to residential and commercial properties.
- The water continues past the turbine propeller, through pipelines called tailraces, and re-enters the river downstream.

Upstream fish pass, Cliff Station.

ESB and hydro-power generation

Generation today

ESB continues to evolve its business in supplying electricity across Ireland. The generation part of ESB that was responsible for the Erne Stations still exists but its remit and activity have expanded.

It not only operates ESB's generation assets, it also develops and trades them with the implementation of this business model:

- Asset Development identifies and develops new generation assets;
- Generation produces electricity from those assets; and
- Trading takes that electricity and the associated commodities and trades them on the market.

ESB's generation asset portfolio includes approximately 4,300MW of generation in the

Generation traces its core purpose right back to the building of Ardnacrusha and the creation of ESB in 1927: providing a reliable supply of electricity for our customers, for the economy and for the future in a safe, cost-effective and sustainable way.

Single Electricity Market (SEM) of the island of Ireland and around 475MW in Great Britain.

Overall, ESB generated approximately 1.4 TWh of electricity from renewable sources, in other words wind and hydro, by the end of 2013. Generation has reduced its CO^2 emissions by over 35% between 2005 and 2013.

Looking into the future

ESB strategy has set its generation business on a path of growth and change, setting out its ambition to be a company of scale in the Irish and UK markets. To help achieve that ambition, the generation business has set the following strategic objectives:

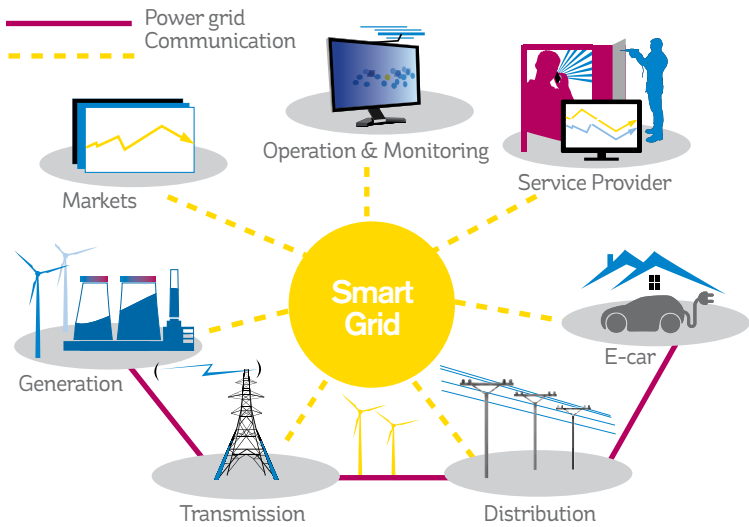
- Build a sustainable position of scale in the Ireland and UK markets. Grow ESB's Irish and UK generation portfolio to 7GW and approximately 7% market share by 2025;
- Deliver a balanced low-carbon generation portfolio that reflects the balance in the Irish and UK markets;
- Integrate generation and supply operations in the Irish and UK markets to optimise earnings and mitigate risks across the value chain;
- Optimise the return from ESB's Ireland and UK assets by delivering excellent asset performance and managing costs to maximise trading and commercial opportunities.

Some examples of current activities in ESB that support those objectives include:

- A highly efficient, low-carbon gas power plant, generating 880 MW near Manchester;
- Developing a project pipeline of power plants in the UK;
- Investing in renewable technologies to reduce the carbon intensity of the generation portfolio;
- Developing alternative and newer technologies, including biomass, offshore wind, solar and wave energy.

The Erne hydro-electric scheme was a significant step by ESB towards developing and maintaining a sustainable and low-carbon generation portfolio and continues to play its part in ESB's renewable strategy today.

Generator Floor, Cathaleen's Fall Generating Station.



Erne Stations

04

Unit 1, Generator rewind, Cliff Station.

Technical data and key facts

Cliff Generating Station.

Data for mechanical and electrical equipment

Building the two dams at Ballyshannon involved major construction and excavation work. Each power station has a headrace to direct the flow of water. A 1379m long tailrace, or water outflow channel, was excavated from rock below Cathaleen's Fall Dam. The River Erne is 100km long and its total water storage, including its lakes, is approximately 194 million m^3. The average flow of the river is 92m^3/s, which can rise to over 400m^3/s in a major flood. The annual rainfall of the Erne catchment is approximately 1200mm.

The length of the dam at Cliff is 210m, with a 10m head of water. There is also a salmon pass on the left side (facing downstream) of the dam. There are three spillway gates at Cliff, at 6m in length.

The length of Cathaleen's Fall dam is 257m, with a 30m head of water. There are three spillway gates at 11m in length.

The upper station at Cliff and the lower power station at Cathaleen's Fall each have two Kaplan propeller-type turbines driving electrical generators with an output of 10MW each at Cliff Station and 22.5MW each, at Cathaleen's Fall.

Both Cliff and Cathaleen's Fall Power Stations generate at 10.5kV.

The Clady River catchment makes up 80km of the landscape and is partially diverted by Gweedore weir into a 2.5km canal. The storage of the weir ranges between 60.96m OD (Ordanance Datum) to 63.70m OD. The level of Lough Nacung was also raised by the Weir, ranging between 60.96m OD to 61.57m OD.

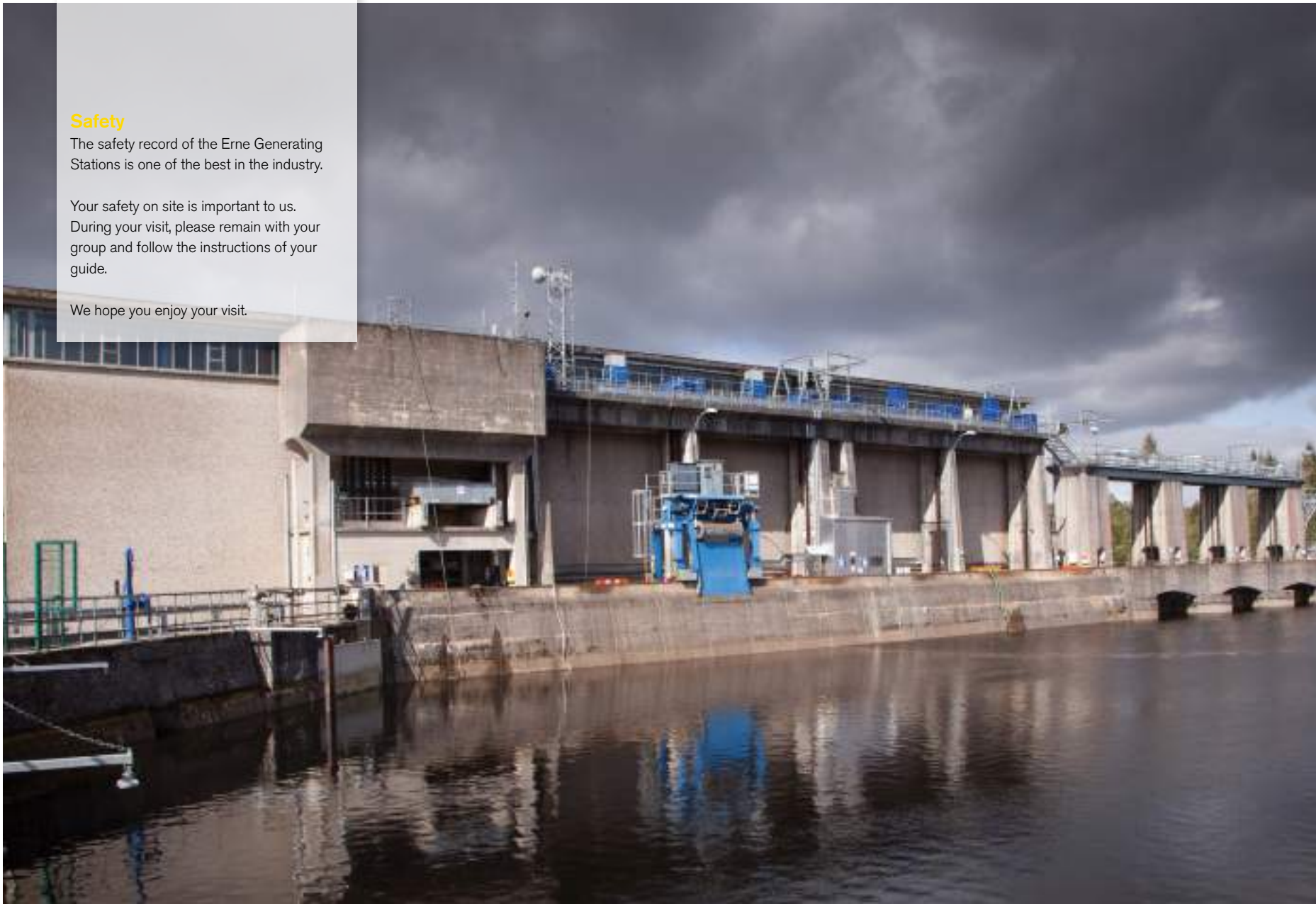
Clady Station is equipped with a horizontal Francis-type turbine, coupled to a generator with a capacity of 4.2MW.

Safety

The safety record of the Erne Generating Stations is one of the best in the industry.

Your safety on site is important to us. During your visit, please remain with your group and follow the instructions of your guide.

We hope you enjoy your visit.



Key facts

River Erne

- The River Erne is the second largest river system in Ireland (approximately 100km long).
- The total catchment water storage is approximately 194 million cubic metres.

The annual average catchment rainfall is 1200mm.

Erne Hydro-electric Scheme

- The 6km-long Belleek Channel was enlarged by excavating 600,000m^3 of earth and rock from the river bed.
- Originally, The Erne Hydro-electric Development was controlled completely manually by a staff of 70 from control rooms at the Cathaleen's Fall and Cliff sites.
- The Erne Scheme is the second largest source of hydroelectric power in the country.
- It was also the first significant act of political and economical co-operation between north and south relations since 1922.
- Producers of the Olivier-awarded play 'The Weir' have often used the ESB-constructed weir at Cathaleen's Fall to represent the fictional location where the play was located.
- There is a Campbell Stokes Sunshine Recorder located on the dam at Cathaleen's Fall - it measures the duration of bright sunshine per day.

Ballyshannon

- Ballyshannon is thought to be the **oldest town** in Ireland.
- Ballyshannon in Irish "Béal Átha Seanaid" translates to "The Mouth of Seannach's Ford". (Seannach was a 5th century warrior who was slain there.) In old Irish, the town name translates as 'Slopes,' and Ballyshannon could also be translated as **'the town or place of the slopes'.**

Hydro-power

Did you know...

the idea of using water for power generation goes back thousands of years; the ancient Greeks are believed to have used a water wheel for grinding wheat into flour, similar to the kinetic work of turbines today.

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