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Longannet Electricity Generating Station nr Kincardine , Fife NS98NE 40 (NS9520 8530)

Summary Record

Longannet Electricity Generating Station from south [DP017135, 2006. Crown copyright: HES]

Summary record compiled as a result of a photographic survey carried out by Architecture and Industry, Survey and Recording Section, Heritage Directorate, HES, 2016.

Longannet Power Station, Alloa, Fife

Background

The largest of its kind in Europe when it was completed, Longannet was a thermal power station using coal to generate electricity. It was the largest generator of power in Scotland prior to its decommissioning on the 24th March 2016. It occupied an 89-hectare site on the north side of the Firth of Forth,(partly on land reclaimed from the Firth of Forth using ash from the nearby Kincardine Power Station. (1)

The foundations of the power station contained 270,000 cubic metres of concrete. Most foundation work took place at the east where large bore holes were created into which the concrete was poured. The main building contained 35,000 tonnes of steel including specialist steels to support the weight of the boilers (11,000 tonnes each). The lattice girder in the boiler suspension steelwork weighed in at 225 tonnes and carried a load of some 6,000 tonnes. (2)

Longannet Power Station came on line in 1969 although the planning, design and build had begun many years before (ground preparations had begun in 1961) and had a projected 30 year lifespan. It began to generate electricity in 1970 and by 1973 was fully operational. It was designed by the architects Robert Matthew, Johnson and Marshall and Partners and the consulting engineers were Mertz and McLellan. (3) Work on the construction of the access road to the station and on the excavations for the foundations of the main building was begun in January 1964. (4) The main building was 300m in length by 150m in width, rising to a height of 75m. The chimney was comprised on four 183m flues encased in a 174m concrete windshield. (5)

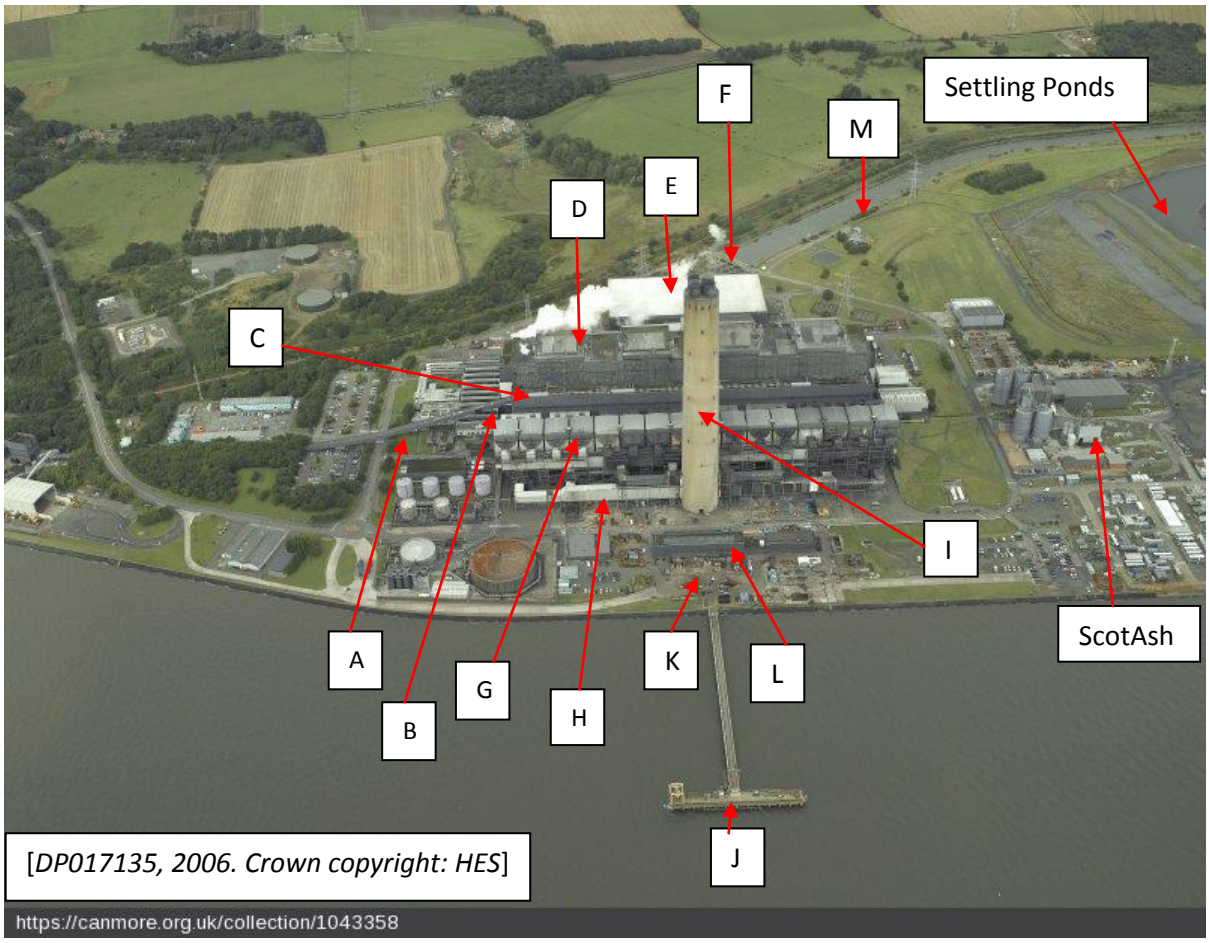
It was operated by the South of Scotland Electricity Board (1973-1991) and then by Scottish Power (a subsidiary of Iberdrola) after privatisation of the UK electricity industry in 1990. (6)

Longannet was built with a capacity of 2,400MW (although in reality the capacity was 2,304MW) and represented more than half the generating ability capacity of all of the South of Scotland Electricity Board's other stations. Longannet produced 9,525 GW hours of electricity in 2012. (7) This was enough electricity for 2 million households.

Longannet Power Station was supplied by the Longannet Mine until 2002. The incoming coal was received in a system of three hoppers. Two of these were originally for coal from Longannet Mine and the third for the small amount arriving by road in the 1970s. Latterly coal was mostly supplied from abroad by ship via the British Steel terminal at Hunterston in Ayrshire and by rail from the rest of Scotland.

Scottish Power is currently decommissioning the site, beginning late 2016. The closure of Longannet Power Station marks the end of coal fired electricity production in Scotland.

Layout



KEY

A	coal conveyor to boiler house from coal stock yard
B	coal bunkers
C	vertical spindle mills (8 per boiler)
D	boiler house and plant (containing 4 boilers)
E	turbine hall and plant
F	electrical switchstation
G	electro-static precipitators
H	induced draught (ID) Fan
I	windshield (containing 4 flues from boilers - chimney)
J	seawater inlet (seawater used as coolant)
K	strainers or screens (debris removal)
L	circulating water pump house and plant
M	1.5 km cooling channel to Firth of Forth

Any coal -fired power station is made up of several components to enable the generation of electricity by burning coal:

- coal handling area
- boiler house
- turbine hall
- ash handling
- chimney
- water circulation system

Notes on layout (see aerial photograph and key above)

Coal handling or coal delivery area

Longannet Power Station could use 4,500,000 metric tonnes of coal per year. The coal was brought on site, initially from Longannet Mine, in bottom emptying railway coal wagons which unloaded automatically as they rolled through the site.

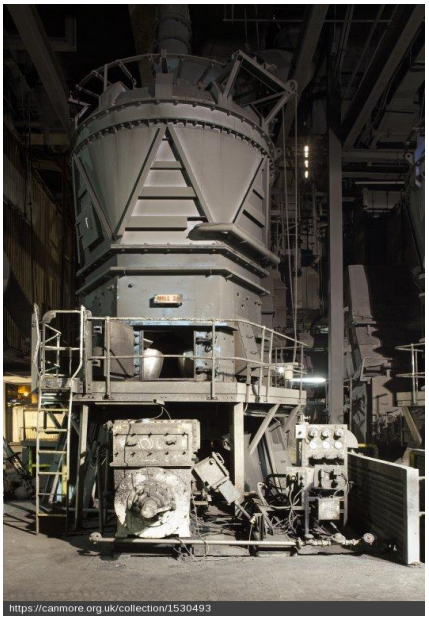
The coal handling area was designed to handle upto 24,000 tonnes per day. The coal arrived on site (by ship and train) and was put into one of three hoppers for both road and rail. These are of different sizes. There was an exchange hopper that was built to take the Longannet Mine coal that was transferred into bunkers (**B**) in the main boiler house by a 1.5km long conveyor (**A,** and see DP244011). This conveyor carried 3,500 tonnes of coal per hour. In addition, 2,000,000 metric tonnes of coal could be held in reserve in the coal yard (to the west of the power station site). (8)

General view of coal yard from northwest. The power station is visible on the left. The conveyor on the right received coal from the vehicle coal discharge and the NCB buffer hopper that received its coal from the NCB Longannet Mine network discharge hopper
[DP 237614, 2016. Crown copyright: HES]

Interior general view. Boiler House. Ground floor level (44 feet level). Shuttle conveyor no. 25 and 26 - system of delivering coal (via 31 conveyors in total) to boiler units
[DP 237532, 2016. Crown copyright: HES]

Boiler House

The coal was then taken by conveyor from the bunkers and pulverised or ground down into a powder by the vertical pulverising mills (**C,** see DP244006). There were eight pulverisers for each of the four 64m high boilers in the boiler house. Each mill could handle 40 tonnes of coal per hour. The pulverised coal was then air-blown into the furnaces where it burned at very high temperature.



Boiler House. Vertical spindle mill no. 3A. The angled rollers which can just be glimpsed through the open door at gantry level.
[DP 237576, 2016. Crown copyright: HES]

The four, front-wall fired Foster Wheeler boilers (**D**) were made up of many metal, water-filled tubes. The combusting coal powder below the boiler tubes send up hot gases that caused the water in the tubes to boil and produce steam. Each boiler had a steam drum

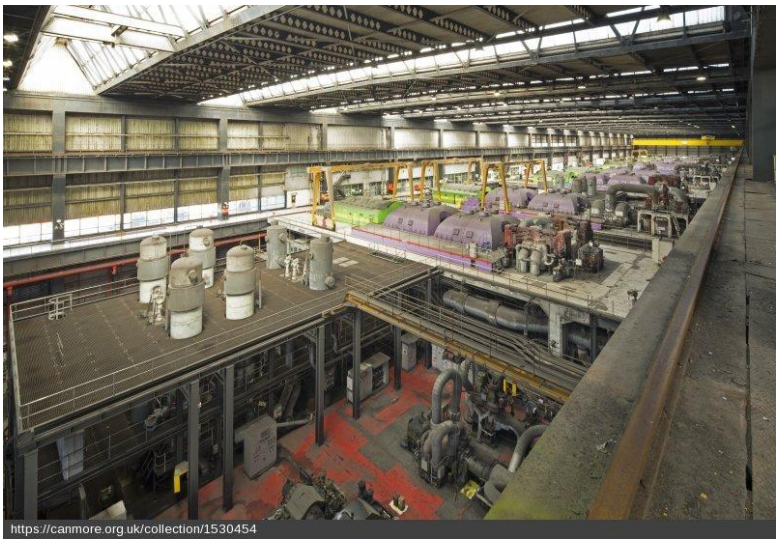
Boiler House (198 foot level) Unit 4 boiler forced draught fan suction inlet duct. [DP 237522, 2016. Crown copyright: HES]

into which the pressurized steam was fed. This steam then passed through a bank of steam tubes placed at the top and back of the boiler. The steam was then reheated centigrade to be passed to the high pressure turbine cylinder. Each boiler could burn 250 tonnes of coal per hour and had two forced and two induced draught fans. Gas was also used as a fuel in the boilers. (9)

Boiler House. Basement level. Forced draught fan (right) 2B and forced draught fan discharge to main airheater (centre)
[DP 237568, 2016. Crown copyright: HES]

Turbine Hall

Power at Longannet Power Station was from four 600MW (6,000,000-kilowatt) turbine - generators. Some 1,800 tonnes of steam (see DP 243992) an hour per boiler was superheated to 586 degrees centigrade and piped (at at pressure of 168 bars) to the high pressure cylinders of two 300 MW GEC turbo generators (in **E** and see DP 244007).



Turbine Hall from east looking towards Units 1 and 2 turbine alternators. HP (high pressure) heaters on left. [DP 237537, 2016. Crown copyright: HES]

The turbine parallel rotors spun at 3,000 r.p.m. each turning the electromagnet of a 300,000 -kilowatt electrical generator at the rate of 50 revolutions per minute. The rings of the blades of the rotors were divided between a series of cylinders which were interconnected by steam pipework. The steam expanded throughout the high pressure cylinder on one of the shafts and was then piped back to the boiler. It was then reheated to its original temperature and passed to the first of the two intermediate pressure cylinders both of which were on the other rotor.

Tubine Hall. Boiler feed pump. G and J Weir Ltd. [DP 237565, 2016. Crown copyright: HES]

From the second intermediate pressure cylinder, the steam flowed to the steam casings, two of which were mounted on either shaft. Both the two intermediate pressure and the four low pressure cylinders were of double flow design, where the steam entered at the centre and travelled to both ends of the casing.

To allow for the expansion of the stream through the turbine, larger blades were used towards the low pressure end of the machine: the largest blades (914mm in length) were positioned before the eight exhausts of the low pressure cylinders. There was a condenser (operating at high vacuum) mounted below each pair of low pressure cylinders which condensed steam into water which was then used as feed water for the boilers via feed heaters. These heaters utilised the steam bled from various points on the turbine to heat it to the correct temperature. (10) The townswater supply was used for steam generation.

The central control room was fitted with supervisory desks and it was from here that 'hot starts' and shut downs were controlled as well as normal everyday operation. When fitted, all of the control panels were had close circuit television for monitoring boiler drum water levels and fully automatic boiler controls. The annex to the control room was from where communications for the power station were controlled along with the common electrical and mechanical services. There was also a control panel for the 275kV switchgear. (11)

Central control room. Circular space with clerestory lights, 1968/9. Upgraded 1980s. The console desks installed c.1995.
[DP 237549, 2016. Crown copyright: HES]

The condensers used seawater (**J**) from the Firth of Forth to cool the steam (see DP 244009 and DP 244010) with upto 327,000 cubic metres of water required per hour. This cooling water was then returned to the Firth of Forth via a 1.6km long channel (**M**) which

measured 38m in width (top) and 7.3m in depth. (12)

Central control room, annex. Part of switchhouse control panel. [DP 237552, 2016. Crown copyright: HES]

General view of water cooling channel or flume outflow from south west. [DP 237519, 2016. Crown copyright: HES]

Switchhouse

The outputs of the two generators were combined at a generator transformer where the pressure of the electricity was raised from 17 kilovolts (kV) to 275 kilovolts (kV) before passing to an indoor switchhouse adjacent to the main building. This electricity was then fed

into the National Grid via 275kV overhead lines to 275kV transforming and switching stations on the transmission system. (13)

Switchhouse from north west [DP 237583, 2016. Crown copyright: HES]

Ash Handling

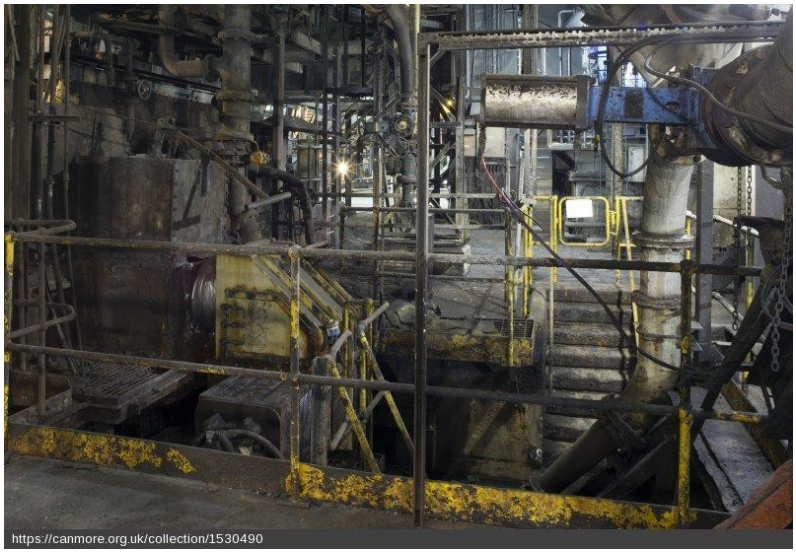
The generation of electricity from coal generates ash, dust and other emissions. The power station could produce up to 4,350 tonnes of ash a day. Most of this was mixed with water and pumped to off-shore disposal lagoons at Valleyfield (some 5km distant) for land reclamation. (14) Electrostatic precipitators (**G** - ESP, refurbished 1989-1994) were used to capture dust particles (using plates with a static electricity charge) from the flue gases followed by sulphur trioxide equipment in the 1980s. Longannet was also fitted with a BOFA

Boiler House. Basement. Furnace ash hopper area, ash plant Here the clinker (material left after coal burnt to heat boilers to generate steam for turbines) would be broken up by hand. [DP 237570, 2016. Crown copyright: HES]

system (in 1994) to reduce nitrous oxide (NOx) emissions by injecting natural gas into the boiler and flue gas desulphurization (FGD) equipment was installed to reduce sulphur dioxide (SO2).

General view taken from the north west. From left to right, electrostatic precipitators, coal handling, boiler house and turbine house.
[DP 237589, 2016. Crown copyright: HES]

The fuel ash produced by the burning of the coal falls into two categories: pulverised fuel ash (PFA) removed by the electrostatic precipitators (**G**) and furnace bottom ash (FBA from the boilers and sent to settlement ponds) which collected at the bottom of the boiler. Most of this ash was in the form of a fine dust (PFA) from the electrostatic precipitators. The rest of the ash (PFA and FBA) was transported to the storage lagoons at Valleyfield (east of the site). (15) Latterly, a company called ScotAsh (based at Longannet) made construction products from the ash on site. (16)



Boiler House. Basement area.
Ash crusher. Here the ash was moved mechanically into the crusher. A water jet forced the crushed ash through the pipe on the right to the lagoon. The ash hopper is to the left. Each boiler (there were four) had an ash hopper and two ash crushers.
[DP 237573, 2016. Crown copyright: HES]

Valleyfield ash lagoons. Longannet Power Station in distance. [DP 88477, 2016. Crown copyright: HES]

The windshield or chimney is 183m (600 feet) in height (**I**) and was the tallest concrete structure in Scotland when built. (17)

The Longannet 183m high chimney with its concrete windshield protecting the four flues. [DP 237601, 2016. Crown copyright: HES]

Cooling Water

When in operation, 636 cubic metres (3,217 million litres) of water per hour was drawn through intake headworks 150m offshore (**K**) in the River Forth. (18) The intake structure was of course screens to filter out matter and to protect the salmon smolt. Finer screening

was carried out at the station pump house (**L**) which was connected to vertical shafts and tunnels 11m below the riverbed.

Circulating Water Pump House. CW Pump 1. Seawater was taken in through fixed bar, removable smolt and maintenance screens to remove debris. The water then went through the intake tunnel and through drum screen to the pumps. [DP 237603, 2016. Crown copyright: HES]

The pump-bay of the Pump House contained four large electrically driven pumps, each with a capacity to pump 80,000,000 litres of condenser cooling water per hour along four culverts (3.7m in diameter) to the condensers. (19)

Circulating Water Pump House from west. Water pipes distributing seawater from the CW pump-house to the rest of the site. [DP 237604, 2016. Crown copyright: HES]

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