

# SEVERN POWER STATION



# DONG ENERGY

## SEVERN POWER STATION

Severn Power Station is situated at Uskmouth near Newport in South Wales and began generating power commercially on 9 November 2010 when the first of its twin gas and steam turbines was brought on-line. The second line followed shortly after, supplying electricity to the national grid.

Severn Power Station has the capacity to generate up to 824 megawatts (MW) net of electricity – sufficient to meet the average power needs of around 1.5 million homes or capable of meeting more than 1 per cent of the UK peak electricity demand on its own.

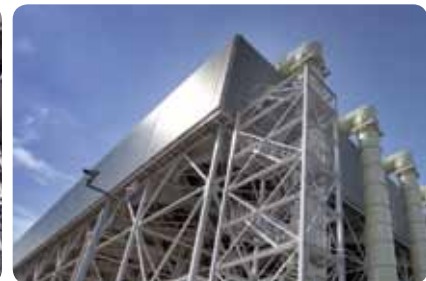
Using some of the most modern energy generating equipment available, Severn Power Station has a thermal efficiency of approximately 58 per cent, making it one of the most efficient natural gas-fired UK power stations of its type. The technology represents a huge improvement compared to the performance of old style power stations. As a result, it produces far less emissions per unit of

energy generated, thus reducing the impact on the environment to a minimum.

Severn Power Station is owned by DONG Energy, Denmark's leading energy company, which acquired the project from Welsh Power in 2009. Severn Power Station has taken less than three years to construct and commission, and it represents a significant investment. DONG Energy has been operating in the UK since 2001, and Severn Power Station makes clear the company's commitment to the UK. In addition to developing onshore power stations, DONG Energy is a key player in offshore wind energy and is responsible for approximately 30 per cent of the offshore wind market in the UK.

### Need for new generation capacity

The UK is facing a potential energy gap, as by 2018 it is anticipated that approximately 18 gigawatts (GW) of UK



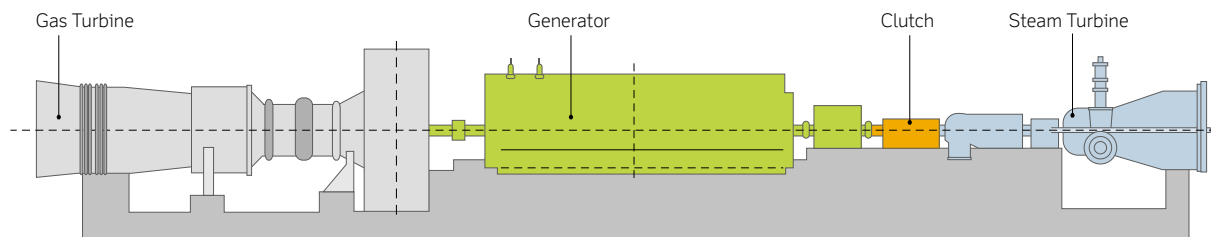
generating capacity will need replacement to balance the closing of existing power stations. This loss is equivalent to approximately 25 per cent of the present capacity.

The Government's overall energy policy is guided by the UK Large Combustion Plant Directive (LCPD) which introduced more stringent emission limits that will lead to the closing of a number of old, less efficient coal and oil-fuelled power stations. There is a need for new power stations to bridge the shortfall in generating capacity. In parallel with the use of low carbon technologies, the UK needs to have secure and reliable supplies of energy, and Combined Cycle Gas Turbine (CCGT) represents a technology which is able to respond quickly according to the varying power demand.

## Technical key data

Commissioned:	2010
Max power production (net):	824MW
Thermal efficiency:	Approx 58%
Identical CCGT units:	2
Gas consumption at full load:	Approx 140,000 Nm <sup>3</sup> /h
Gas Turbine:	Siemens
Steam Turbine:	Siemens
Generator:	Siemens
HRSG (Boiler):	CMI
Flexible plant:	Start-up time 30-35 min.
Low emissions:	15 ppm NO <sub>x</sub>
Cooling method:	Air Cooled Condenser

## Combined Cycle Gas Turbine – CCGT



*Outline diagram of single-shaft configuration of Gas Turbine, Generator and Steam Turbine.*

# HOW IS POWER PRODUCED AT SEVERN POWER STATION

The generation of electricity at Severn Power Station is based on the use of natural gas, which ensures that the environmental impact is reduced to a minimum, and that a high level of electrical efficiency can be attained.

At an electrical efficiency of approximately 58 per cent, Severn Power Station is one of the most efficient power plants in the UK, ensuring that valuable natural resources are used as sparingly as possible.

One of the reasons for this high level of efficiency is because of the enhancement of the generation cycle, where not only the gas turbine produces electricity, but the surplus heat from the gas turbine is also used to make steam to generate additional electricity via a steam turbine.

Atmospheric air is compressed and mixed with natural gas, and burned inside the combustion chamber of the

gas turbine. This releases very high energy which is transformed into rotation of the gas turbine shaft, which turns the generator to make electricity.

The exhaust from the gas turbine is directed to the Heat Recovery Steam Generator (HRSG), where the heat in the gas is used to produce steam. The exhaust gas passes over a series of coiled pipes containing water, heating it up very rapidly and converting it to steam. This steam exits the HRSG at very high temperature and pressure, and is directed onwards to the steam turbine, where its energy is converted into supplementary rotation of the same single shaft generator as the gas turbine.

After passing through the steam turbine, the steam is recycled in the Air Cooled Condenser and converted back to water to be re-used in the Heat Recovery Steam Generator all over again.

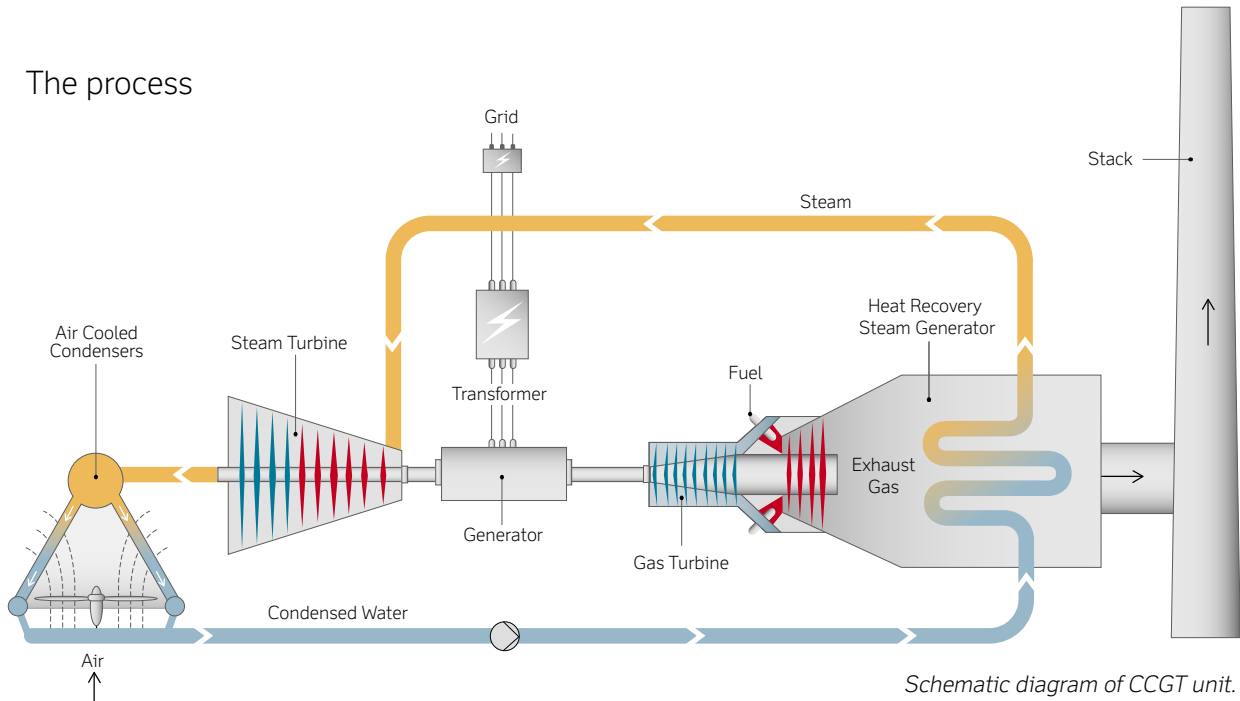


## Single-Shaft Combined Cycle Power Plant concept

Severn Power Station is equipped with two identical CCGT (Combined Cycle Gas Turbine) units, each consisting of a gas turbine and a heat recovery steam generator, steam turbine and a generator. Both the gas turbine and the steam turbine are placed on a single shaft driving the same generator.

The 824 megawatt (MW) power station can achieve full output after only 30 to 35 minutes. The power station's high operating flexibility means that it is capable of very quickly compensating the fluctuating feed-in to the national grid, for example from wind turbines.

### The process



# CONSTRUCTION CHALLENGES

The construction of the new power station started in March 2008, following a huge pre-construction civils works effort in order to prepare the site to enable permanent works to start.

A major challenge was associated with exposing the remaining 2000 concrete piles from the site of the demolished power station on which the new power station was built. The new power station has 1612 piles in total (711 ductile piles and 901 bored piles), which had to be installed in between the existing 2000 piles from the old power station.

The power station was constructed as a turnkey project and is located adjacent to an operational 320MW coal-fired power station.

## 6km gas pipeline secures the gas supply

The company Severn Power Gas Transportation Ltd was set up to build and operate the gas pipeline. Due to the land being designated as a Site of Special Scientific Interest (SSSI) the 452mm diameter gas pipeline feeding the power station was directionally drilled throughout its length (4 drills).

The gas pipeline was installed to a depth of 34m below the surface of the River Usk. The pipeline connects to the Wales & West Utility (WWU) system at Marshfield, 6km on the other side of the River Usk from the power station.

## Connection to the power grid

In the generator electrical power is produced at a voltage of 20kV, and in order to reduce the power loss in the grid, the voltage is transformed to 275kV before it is transmitted to the national grid via an adjacent substation, which was constructed by National Grid in connection with the power station.

## Strong focus on Health and Safety

DONG Energy strongly believes that a good working environment and a high level of safety for our employees and suppliers are prerequisites for operating a healthy and efficient business. Therefore, we think safety into everything from our everyday lives at our offices to large-scale construction projects, and the work performed at our production plants.

During the construction period of Severn Power Station, there was a major focus on safety. Building a new power station on the site of an old power station meant that a significant amount of additional safety measures had to be introduced, due to the risk of hidden installations in the ground. From the time DONG Energy acquired the project in March 2009, a full-time Health and Safety Manager was allocated during the construction period to make sure all proper safety measures were implemented.

More than three million working hours were clocked up at one stage during the construction period without a single injury causing lost time. This sets a benchmark for the entire construction sector for power generating facilities. At peak times there were over 1200 workers on the Severn Power Station construction site.

## Operation and maintenance

The two identical units at Severn Power Station are controlled from a common control room. The control room is manned by operators at all times, and both units are controlled and monitored by advanced large-area display screens.

A 16-year service agreement was signed with Siemens covering both operation and maintenance service. Siemens will have 36 staff employed at the Severn Power Station which is complemented by a small contingent of DONG Energy staff. Electricity from the plant is sold in the UK market by DONG Energy's trading division Energy Markets.



# SEVERN POWER STATION FROM ABOVE

## 1. Turbine building

The turbine building contains the power train with gas turbine, generator and steam turbine.

## 2. Steam generator building

Heat recovery steam generator.

## 3. Stack

The utilisation of natural gas ensures that the environmental impact is reduced to a minimum.

## 4. Water treatment/storage

The water treatment facility produces demineralised make-up water for Severn Power Station's steam turbines.



## 5. Control room

Monitoring of the plant is carried out in the control room which is situated on the lower floor of the administration building.

## 6. Gas compressors

These are necessary in order to increase the pressure of the natural gas so that it can be used effectively by the burners in the Gas Turbine.

## 7. Air cooled condenser

Air cooled condensers condense exhaust steam from the steam turbine which is returned as condensate to the heat recovery steam generator.

## 8. Generator transformer

In order to reduce the power loss in the grid, the voltage is transformed from 20kV to 275kV in the generator transformer.

## 9. 275kV substation

Power is transferred to the adjacent substation where it is distributed for usage into the national grid.

## 10. Switchgear and control system

Houses process control equipment and distribution boards for motors for pumps, fans, valves etc.



## CONCERN FOR THE ENVIRONMENT

Severn Power Station uses some of the most advanced energy generating equipment available in order to secure efficient use of the natural gas, which makes it one of the world's most efficient power stations, with a strong focus on environment and cost effectiveness.

Furthermore, natural gas is a favourable fuel in that it reduces the environmental impact to a minimum. Firing natural gas at the power station ensures that no dust particles, fly ash or sulphur are produced during operation. Thanks to the advanced burner technology, the power station's nitrogen oxide emission levels are very low.

Advanced large-area display screens in the control room allow qualified and trained operators to monitor all environmental data, and to optimise the units to allow their best environmental operation. All operational data is stored to record that the power station is below the environmental limits set up for its operation.

The power station is equipped with air cooled condensers for process cooling as an alternative to seawater cooling. This solution enables the plant to minimise any environmental impact on the nearby River Usk.

**One of the world's most efficient power stations with a strong focus on environment and cost effectiveness.**



# **DONG ENERGY**

## A LEADING ENERGY COMPANY

DONG Energy is one of the leading energy groups in the Nordic region, and we are headquartered in Denmark. Our business is based on procuring, producing, distributing, and trading in energy and related products in Northern Europe. DONG Energy is an integrated company with activities along the entire value chain, and this ensures a reliable supply of energy and gives us the necessary expertise for developing our company for the future.

DONG Energy has many years of experience. For more than a hundred years we have been supplying power to the Danish consumers and developed a unique combined production of heat and power. Since the beginning of the 1980s, we have also supplied oil and natural gas to the Danish consumers.

Innovation is a natural part of how we work. We have been involved in the extraction of the North Sea's reserves of oil and natural gas for 25 years, and our power stations are among the most efficient in the world and have a minimum environmental impact. We are also at the cutting edge in the development of renewable energy, not least in the establishment of offshore wind farms.

DONG Energy has increased its international activities significantly and is now an international energy company focusing on the North European energy markets.

[www.dongenergy.com](http://www.dongenergy.com)

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