The Corrib Gas Tunnel >>>

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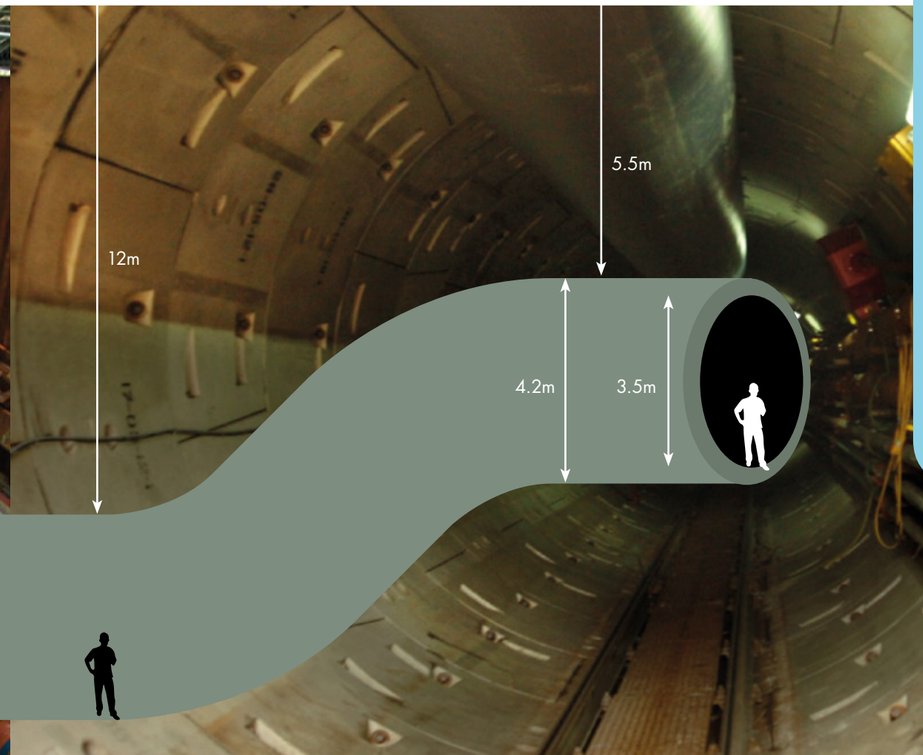


“This will be the longest tunnel in Ireland and the longest gas pipeline tunnel in Europe”

The Corrib Tunnel

The onshore pipeline is the final phase of the Corrib gas project to be completed. The onshore pipeline section is 8.3km long and 4.9km of this will be installed in a tunnel, the majority of which will run under Sruwaddacon Bay, in north Mayo.

The tunnel will have an external diameter of 4.2m and an internal diameter of 3.5m and will run at depths of between 5.5m and 12m under Sruwaddacon Bay.

The building of the tunnel requires the use of a large tunnel boring machine (TBM).

"The compound has been surrounded by a visual barrier and an acoustic fence"

"The rock, sand and gravel from the TBM is pumped back through the tunnel to Aughoose"

The Aughoose and Glengad sites

Excavation of the tunnel is in one direction, starting at a launch shaft on a SEPIL-owned site in the townland of Aughoose and running to a reception site in Glengad where the offshore pipeline reaches land.

The construction of the tunnel and the installation of the pipeline require the construction of two temporary compounds – the launch shaft site at Aughoose and the recovery shaft site at Glengad.

The compound at Aughoose contains all of the services and materials needed for the tunnelling process. The compound has been designed and constructed to minimise its environmental impact, particularly the impact on Sruwaddacon Bay which is a designated conservation site, a candidate Special Area of Conservation (cSAC) and proposed Special Protection Area (pSPA). Peat removed during construction was stored either on site or removed to the Bord na Móna peat deposition site at Srahmore, near Bangor-Erris. The Aughoose compound was designed and constructed to limit its environmental impact. The compound has been surrounded by a visual barrier and an acoustic fence. All of the lower buildings have been painted green and taller structures are grey to reduce the visual impact of the compound. Taller structures have been fitted with lights for the protection of birds. The acoustic fence is one of the measures implemented on site to reduce noise from construction activities. Surface water is treated at the established site water treatment plant where the water discharges into Sruwaddacon Bay. The TBM commenced excavation of the tunnel in early January 2013. The entire tunnelling operation, which is 24 hours per day seven days per week, is expected to take approximately 15 months to complete. A smaller site, at which the TBM will be recovered when tunnelling is complete, is being constructed at Glengad.

BAM Civil/Wayss & Freytag Joint Venture

The contract for the 4.9km Corrib tunnel under Sruwaddacon Bay was awarded to a joint venture between BAM Civil and Wayss & Freytag, group members of the Royal BAM Group.

BAM Civil (formerly Ascon) is one of the largest civil engineering and public works contractors in Ireland while Wayss & Freytag, one of Germany's largest construction companies, specialises in the construction and development of tunnels using TBMs. Founded in 1875, Wayss & Freytag has developed many of the techniques used today in tunnel construction world-wide.

This partnership brings together the vast tunnelling experience and expertise of Wayss & Freytag with BAM Civil's expertise in civil engineering and its experience in the Irish construction industry.

"Temperatures can reach over 35 degrees in the tunnel"

Well-known tunnels around the world >>>

1 The world's longest tunnel carries water 170km to New York City from the Delaware River in the United States.

2 The Channel Tunnel, completed in 1994, connects Great Britain to Europe through three, 50km long tunnels. 37km of this tunnel are underwater.

A Brief History of Tunnelling

Tunnelling as part of major infrastructure projects has a long history. Early versions of the TBM were used to excavate the Thames Tunnel, London in the 1820s.

By 1870 tunnelling technology had already advanced for the construction of the Tower Subway under the Thames where a new design for a circular tunnel, which was both simpler in construction and better able to support the weight of the surrounding soil, was used for the first time.

The modern precursor of today's TBMs were developed for dam construction in the US in the 1950s and since then tunneling has been a major part of the construction of transport, service and energy infrastructure projects around the world. The TBMs used in tunnel construction today are highly sophisticated machines that bring together the latest advances in safety, engineering and technology.

At the front of the TBM is a large rotating cutting wheel, equipped with cutting discs and scrapers. As the cutting wheel/head rotates, hydraulic cylinders attached to the spine of the TBM propel it forward a few feet at a time.

As well as excavating the tunnel, the TBM also provides support by putting in place segments of tunnel lining as it moves along.

The rotation of the cutting head breaks up the ground in front of the TBM, loose material is scooped up by openings in the cutter head and the debris/slurry mixture is then pumped back to the surface for treatment or disposal.

3 The longest Irish tunnel is the 2.6km Dublin Port Tunnel, which links the M1 and M50 motorways around Dublin.

4 Other well-known Irish tunnels are the 675m Limerick tunnel under the River Shannon and the Jack Lynch tunnel under the River Lee in Cork.

5 Seikan is currently both the longest and the deepest operational rail tunnel in the world but the Gotthard Base Tunnel in Switzerland will be longer when it opens to traffic in 2017. It is also the longest undersea tunnel in the world.

"Fionnuala is over 149m long and weighs 500 tonnes"

'Fionnuala'- the Corrib TBM

The TBM for the Corrib tunnel was designed and built in Schwanau, Germany, by Herrenknecht, one of the world's largest makers of TBMs.

The Corrib TBM took more than a year to design and build.

The single shield TBM is 140m long, weighs almost 500 tonnes and comprises 14 sections.

The 28-tonne cutter head drills under the bay using a combination of cutter discs, scrapers and buckets and requires two 400kw motors to turn it.

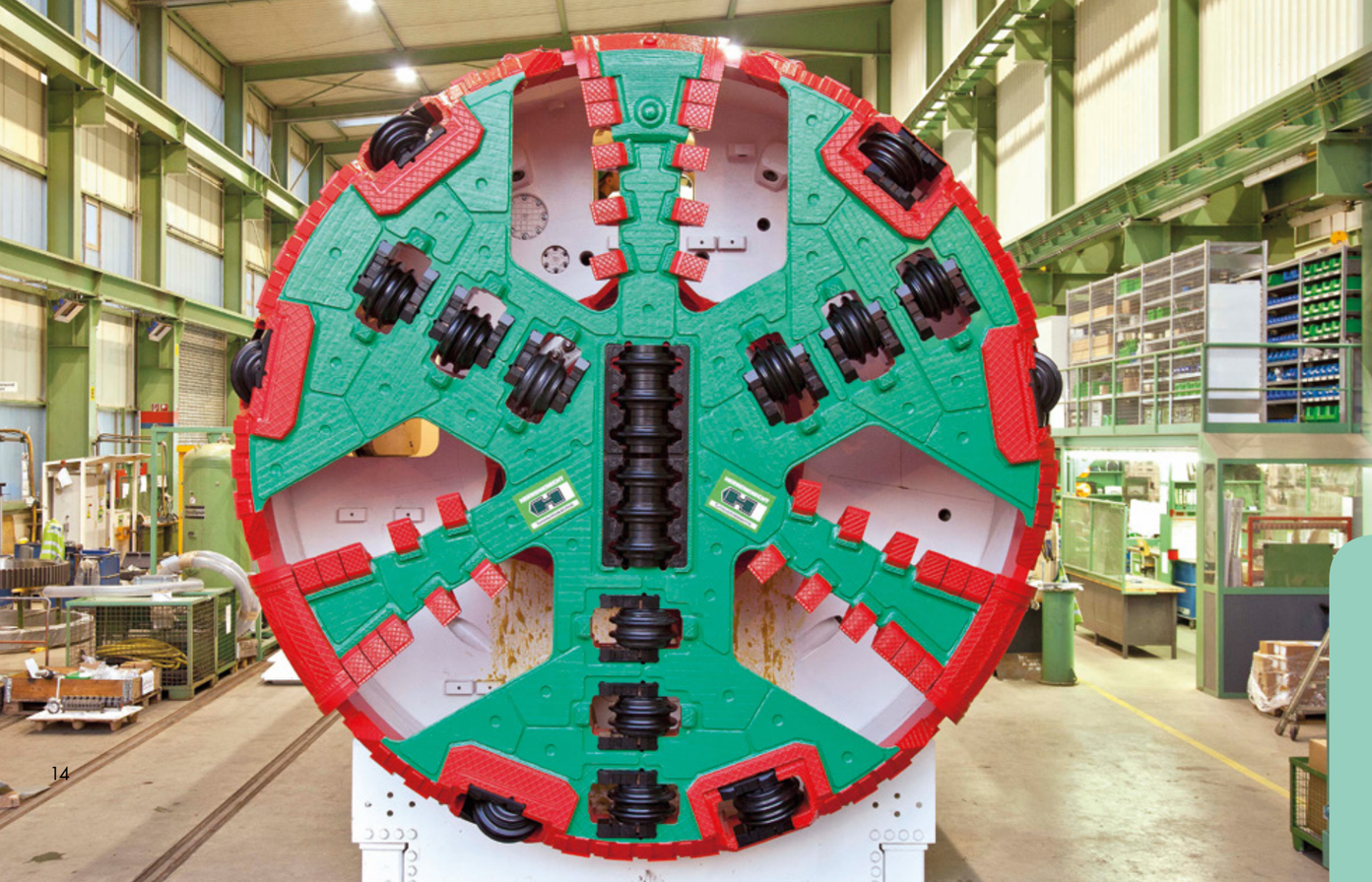
Following in a long tunnelling tradition of naming TBMs, the Corrib TBM has been named 'Fionnuala' after the female of the Children of Lir, one of the legends most closely associated with the Erris region.

14 "The number of trailers that link to Fionnuala"

The feast day of St Barbara falls on December 4th

Tunnelling Traditions

Since medieval times St Barbara has been considered the patron saint of mining and then tunnelling. That tradition continues today and a small statue of the saint is placed at the entrance of tunnelling projects to provide good luck and safety during construction. According to tradition, all TBMs need a name before work begins, and, as with ships, the name must be female. The world's largest hard rock TBM – with a diameter of 14.4m – was used to build the Niagara Falls Tunnel and was named 'Big Becky'. TBMs used in the construction of the Channel Tunnel were named 'Brigitte', 'Europa', 'Catherine', 'Virginia', 'Pascale', and 'Severing'.



How does the TBM work?

The entire TBM comprises of 14 trailers, including support and back-up services for the main TBM head.

The cutter head at the front of the TBM breaks the rock, sand and gravel that it meets while tunnelling. This material is pumped in a suspended mixture back through the tunnel to the surface at Aughoose where it is later separated.

A naturally-occurring, inert clay called bentonite is used for lubrication and cooling of the cutter head, and to assist in the transportation of the arisings to the surface.

As the TBM moves forward, a series of 1.2m wide concrete rings made up of precast interlocking concrete segments is erected. These concrete rings, which are fabricated in Ireland, will eventually line the entire tunnel.

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As the cutter head rotates, hydraulic cylinders attached to the spine of the TBM propel it forward a few feet at a time.

Behind the cutter head the entire TBM has 14 trailers which transport the tunnel segment erector and all of the support and back-up services needed for the excavation and tunnel building.

The TBM advances forward and the cutter head breaks the rock, sand and gravel that it meets. Larger stones and rocks are broken up by a hydraulic stone crusher located behind the cutter head.

All this sludge and aggregate material is pumped back through the tunnel to the surface at Aughoose where it is later separated. Some of this material is reused in the tunnelling process and site reinstatement, while the rest is removed from the site.

Personnel, tools and materials, including the concrete segments, are brought from the tunnelling compound to the front of the tunnel using a small train.

The TBM operator

The TBM is controlled by an operator, who sits in a control cabin at the front of the machine. The operator's role is to ensure the TBM stays on course. There are two other monitors on the surface to ensure the trajectory of the tunnel is correct; manual surveys are also conducted routinely. The TBM is kept on course by a laser guidance system which recalibrates itself every second to guarantee complete accuracy throughout the process.

Maintaining The Tunnel

8
Crew members on the TBM (2x12 hour shifts)

60
Segments erected, on average, each day

4.9
Kilometers: the length of the tunnel

100
Metres of ventilation duct (every 100m)

1000
Litres daily of grease for tail skin and bearings

2.4m³
Metres of external grouting: 2.4m³ every 1.2 m in length

140m³
Metres of bentonite in and 180m³ of bentonite and spoil out

lots!
of food, tea and coffee

"The plan is to leave nothing visible behind us"

Installation of the pipeline and reinstatement

Once the tunnel is completed, the 20-inch (50cm) diameter pipeline (which is more than one inch/27 millimeters thick) will be installed in it, together with a number of service and umbilical control lines.

The pipeline and services are tested before the last stage in the process when the tunnel is backfilled with a grout mix of water, cement and bentonite to completely seal it. The finished pipeline is then ready to transport gas from the offshore pipe to the Ballinaboy Bridge Gas Terminal.

When the tunnel is completed, work will commence on the reinstatement of the Aughoose and Glengad sites. Site installations will be removed. The stored peat from the Aughoose site and the soils from the Glengad site will be used to reinstate the sites. The only installation to remain will be the Landfall Valve Installation (LVI) in Glengad.

The Corrib gas Tunnelling Team

Corrib natural gas

Shell

Statoil

Vermilion Energy