What is a capping stack?

A capping stack is a large well closure device that connects to the top of the blowout preventer (BOP) and is capable of sealing off a well. It is only used in the highly unlikely situation where a loss of well control includes both a surface blowout and failure of the blowout preventer (BOP).
Once connected to the BOP the capping stack’s valves can be closed to slowly reduce the flow until the well is closed off completely. Capping stacks are engineered to withstand the high pressure of a flowing well, and can therefore weigh up to 100 tons. They are deployed from a subsea construction vessel, which will remain on location during our operation. A capping stack consists of a series of large, specialised valves that seal, control and permit monitoring oil and gas wells.

**How does it work?**

First designed and developed to help control the Macondo accident in the Gulf of Mexico in 2010, a capping stack is a large, prefabricated well closure device that connects to the BOP and is capable of sealing off (‘shutting in’) a well experiencing a LOWC. It includes the connectors, tools and accessories required to install and operate the capping stack to control a LOWC. Once securely connected to the BOP (left), its valves can be closed to slowly reduce the flow until the well is closed off completely. As capping stacks are rated to contain the high pressure behind the flowing well, they are large and heavy, weighing over 100 tonnes.

**What is a loss of well control?**

A loss of well control (LOWC) occurs when there is an uncontrolled flow of subterranean fluids, such as gas, oil and/or water, from rock layers. The flow may be from one rock layer to another (an underground ‘blowout’) or at the surface or seabed (a surface ‘blowout’). Loss of well control also includes flow of fluids through a rig’s diverter system, a safety measure that redirects fluids away from the rig of uncontrolled flow resulting from a failure of equipment or procedures.

While a LOWC is unlikely, preventing it is Equinor’s highest priority when operating new or existing wells. Drilling operations are performed under Best Practices Safety in drilling and well operations, a program developed and implemented by Equinor that provides maximum reasonable assurance that well control will be maintained at all times. In addition, drilling operations are continuously monitored in real-time by drilling experts in Equinor’s Remote Support Centre based in Stavanger.

In the rare situation where a LOWC includes both a surface blowout and failure of the blowout preventer (BOP), the capping stack is used to stop the flow.
How will Equinor provide capping stack capability for the Bight?

Globally, capping stack solutions are built around a network of centralised teams and facilities to ensure reliable maintenance, training and deployment standards. After the Macondo accident, Equinor participated in an organisation of oil and gas operators to develop a global response capability for capping and containment.

Oil Spill Response Limited (OSRL), an industry-funded cooperative of which Equinor is a member, was established to manage capping stack systems for operations outside the United States. Equinor is on the board of directors for OSRL and retains a strategic role in the continued development and oversight of the ORSL equipment. OSRL has four capping stacks on standby ready for immediate transport by sea or air from strategic locations in Singapore, South Africa, Norway and Brazil.

Equinor also subscribe to Wild Well Control (WWC) WellCONTAINED system which is an adaptable-response equipment package built for a variety of subsea scenario including a capping stack to stop LOWC with outflow at the seabed. The capping stack’s modular design facilitates rapid global deployment on a readily available Boeing 747 cargo aircraft. The system is verified by third parties and staged for deployment at locations in Aberdeen and Singapore.

In the highly unlikely event it would be required, the primary capping stack for Equinor’s proposed exploration activities in the Bight will be the flyable WWC stack from Singapore, with a further backup stack at OSRL’s quayside facility in Singapore.

Both WWC and OSRL operates world-class response facilities that provide the people, equipment and facilities necessary to inspect, test, and maintain their capping stacks in a ready to deploy condition. Detailed transport and logistics plans are in place to ensure key aspects of the transport process are clearly understood and ready to execute. By locating their capping stack facilities in major energy regions, they ensure necessary services (e.g. technicians, trucks, cranes, vessels) are available to maintain and transport their capping stacks if required. Equinor’s partnership with both WWC and ORSL provides access to those robust, well-maintained capping stack solutions.

A capping stack solution is far more than just the physical piece of equipment, just as a fire response service is more than just a fire engine.

Equinor and its partners have worked together to develop detailed plans for transport and offshore deployment of a capping stack as well as training of personnel. These elements of planning and competency, coupled with a known track record through regular verifications, ensures Equinor’s capping stack solution is capable of a predictable mobilisation to provide a timely and reliable response. Additionally, Equinor maintains an Source Control team in Bergen capable of responding to well control incidents worldwide. This team has developed logistics plans, standard procedures, mission plans and well interface plans to support WWC and ORSL’s capping stack systems.

Regular workshops and drills are held around the world to maintain preparedness to respond at short notice if a major well source control incident were to occur.
How is a capping stack maintained?

Periodic maintenance and testing is critical for long-term capping stack preservation and ensures functional readiness for deployment. To ensure reliable operation, maintenance and testing of key components – as well as the system as a whole – in various combinations every 90 days are done according to detailed procedures. This includes cleaning, inspection, lubrication and function testing of all components and systems as well as pressure testing to detect potential leaks. All maintenance is clearly documented for compliance verification by the capping stack manufacturer.

How would a capping stack be transported to the well location if there is a LOWC?

Due to the size and weight of a capping stack, transportation can be by:

› Air - a capping stack is packaged into multiple parts ready for air transport, with assembly and testing required upon arrival in Australia. The capping stack would be transported to the well site using a large crane vessel already in the Bight, that would also lower it onto the well.

› Sea - transporting a capping stack by sea using a readily assembled capping stack stored in Singapore. The capping stack would be transported directly to the well site using a large crane vessel that would also lower it onto the well.

In the highly unlikely the event of a LOWC in the Bight, Equinor will mobilise capping stack from Singapore by air. To avoid delays upon arrival in Adelaide Equinor will make available a large crane vessel and remotely operated vehicles (ROV). For the purposes of understanding the environmental impact of a LOWC contained by a capping stack, Equinor has used a conservative installation estimate of 15 days from the time of an incident.

Subscription to multiple sources of capping stacks and subsea equipment provides Equinor with redundant, robust and global resources. In the unlikely event of a LOWC, Equinor will use those resources and mobilise a back-up capping stack to South Australia to further mitigate deployment risks.

In the event of a LOWC, how would a well be prepared to receive a capping stack?

A number of activities must be conducted in preparation for capping stack installation. These can occur while the capping stack is in transit and may include the following:

› Use a crane vessel for debris removal.
› Conduct sea surface survey to assess health and safety risks from flammable or harmful fluids.
› Operate BOP closing functions (if possible) using an ROV override feature supported by subsea accumulator modules, units lowered to the seabed to provide large amounts of stored hydraulic energy to help increase the chance of successful well closure.
› Conduct an ROV survey of the well, BOP, riser and local seabed to identify the location of the LOWC and any debris that may interfere with well control response.
› Remove any debris that could limit access for a ROV and the well control equipment.
› Install equipment (if required) for the application of subsea dispersant directly at the source of the LOWC to minimise the amount of oil that surfaces.

what are capping stacks?
How would a capping stack be lowered to a well?

Once well preparation is complete, the capping stack is lifted by the crane vessel that transported it to site and lowered onto the BOP, guided by ROVs. This operation is very similar to the routine installation of subsea equipment. An ROV verifies the capping stack is properly connected to the BOP prior to closing the capping stack to control the well.

Will there be a capping stack in place?

Our priority is to ensure that a capping stack is never needed, by preventing any well control incidents through careful planning. Secondly, we will install a 400-ton blowout preventer before we drill, which can shut in the well in minutes, has multiple shut-in mechanisms, and has proven to be highly effective in controlling any loss of well control.

In the extremely unlikely event of the blowout preventer failing, we will fly in a capping stack. By having a construction vessel onsite we have reduced the response time by 20 days, to 15 days.

Why would it take 15 days to deploy a capping stack and why isn’t there a capping stack in Australia?

A capping stack is a specialised piece of equipment and there are a limited number of capping stacks and teams of people capable of deploying them. It is just one component of an elaborate oil spill contingency plan and is kept in readiness at a central hub with suitable storage and mobilisation facilities, along with its trained crew. Singapore is the local hub and at least two capping stacks are maintained and tested here for urgent deployment across the region.

It takes some days to prepare the well head, during which time the capping stack would be airlifted to the location as fast as possible.