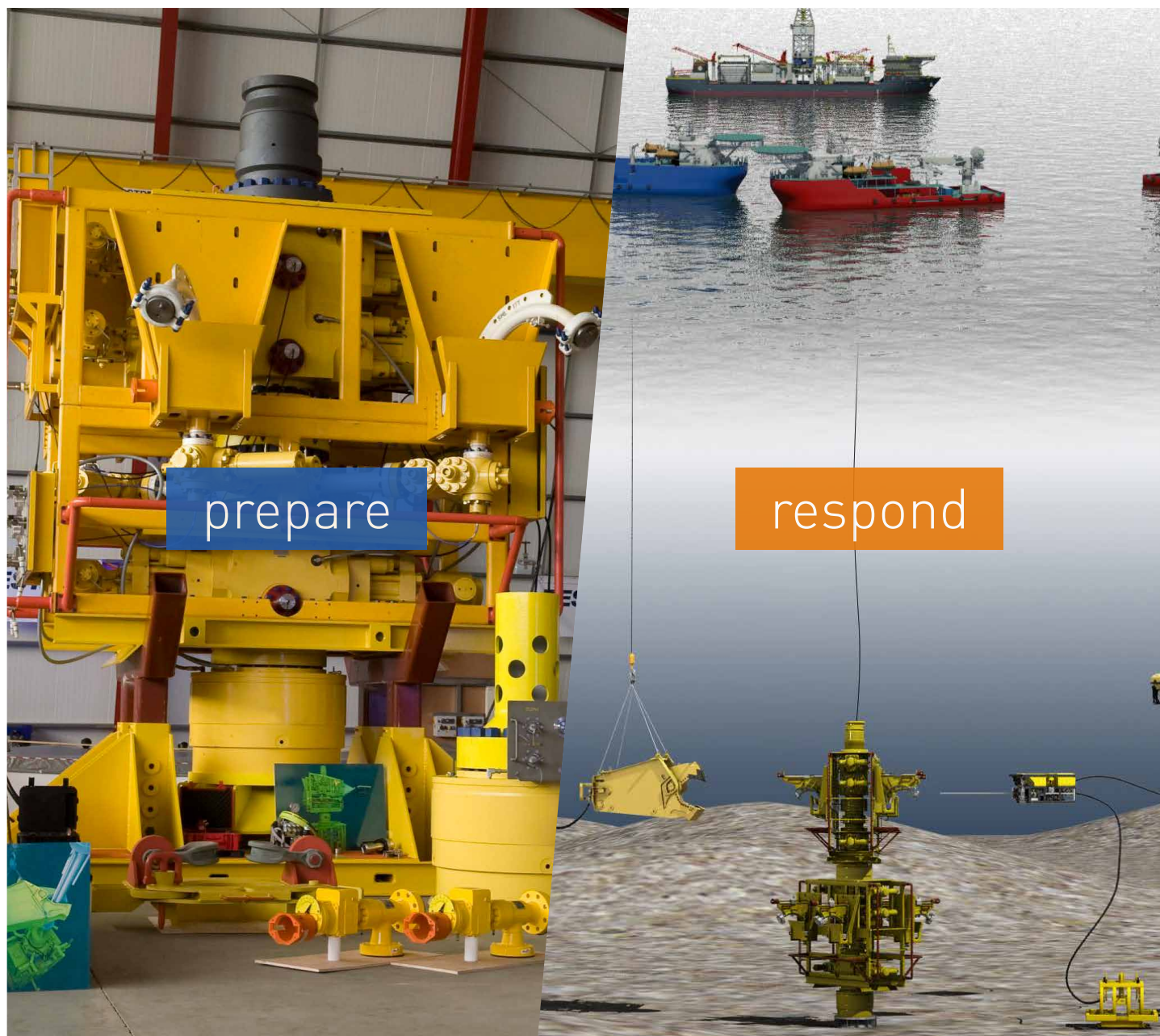


Source Control Emergency Response Planning Guide for Subsea Wells



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Source Control Emergency Response Planning Guide for Subsea Wells

Revision history

VERSION	DATE	AMENDMENTS
1.0	January 2019	First release

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Scope

This report has been developed to guide Operating Companies in the planning and preparation of a suitable subsea source control emergency response plan. The scope covers basic emergency response organisational format, roles and responsibilities, well design considerations, source control options and implementation considerations. In doing so, it is expected to support Operating Companies in the development of their emergency response plans as well as providing non-technical stakeholders an insight to what is involved in subsea source control. Topics addressed in this document include:

- Overview of subsea source well control
- Elements of source control
- Emergency response framework
- Well design considerations for supporting source control equipment
- Subsea well source control response planning
- Capping stack equipment and preparation
- Flow containment equipment and preparation

Topics that are related to aspects of source control and may be mentioned throughout this document but do not form part of this documents core body include:

- Prevention of well control incidents
- Surface oil spill response
- Surface or dry tree well response
- Incident Command Systems in detail or formal ICS structures
- Continual tracking of capping stack systems
- Regulatory compliance
- Relief well planning, drilling and incident well kill operations

Foreword

It is not possible to eliminate all risk of blowout, but where possible, subsea wells can be designed to survive a well blowout, be capped, and either restrict or mitigate the discharge of hydrocarbons to the environment.

While the IOGP WEC believes that the focus of the industry should primarily be on preventing blowouts, they acknowledge that the oil and gas industry must also be prepared to adequately and efficiently respond to a major loss of containment from a subsea well systematically and with a standard methodology.

Well Source Control is a generic term for all activities related to the direct intervention of a well that has experienced loss of containment with the intent to halt or control the release of hydrocarbons to the environment.

Well source control response operations have been around for some time and in the context of subsea operations, the primary method of control was by drilling a relief well. Relief well operations are an effective but time-consuming method and the environmental consequences can be pronounced. Additional subsea remedial source control options were limited due to lack of specialised equipment tailored for the demanding environment, but with the evolution of subsea capping stack technology and associated containment equipment technology developments, this has changed. One of the key advantages of the capping stack is its ability to isolate and stop flow in a relatively short period of time. In certain circumstances, it may not be possible to safely shut in a well with a capping stack. In this case, containment methods may be chosen which may limit the environmental impacts while a relief well is being drilled.

As Deepwater wells have grown in complexity and are being drilled further below the mudline into high flow potential reservoirs, the industry has recognised that having subsea source control technology available and valid response plans in place to rapidly intervene and shut in an incident well is paramount to minimise environmental impacts. As part of that learning, IOGP's GIRG report, IOGP 463 - *Deepwater wells - Global Industry Response Group recommendations* was published which among others, recommended that Operating Companies have a Source Control Emergency Response Plan (SCERP). The SCERP contains information on management systems and plans. Management systems are typically organisational structures, key documents, ready prepared authorisations for expenditure (AFEs), and communication protocols. Plans are the activities that must be performed to some degree in every subsea source control incident and are needed to ensure that certain equipment requirements are met, procedures are defined and understood, and requisite response personnel are trained and available.

Source control methods include secondary BOP (blowout preventer) activation, capping, containment and relief well drilling. BOP activation involves trying to close the BOP using an ROV (remotely operated underwater vehicle) with the help of a subsea intervention skid. Subsea capping involves installing a capping stack onto the incident well and then closing it to shut off flow. Subsea Containment involves installing a capping stack onto a well and then hooking up subsea production equipment to divert flowing hydrocarbons back to surface for surface capture through one of several means that are beyond the scope of this document. Cap and Flow may be an interim phase or tactical response when well integrity concerns prohibit the safe shut in of a flowing well¹. For all intents and purposes, the capping stack portion of both concepts is the same. To avoid confusion, relief well activities should be underway in parallel to capping activities. Relief well planning is beyond the scope of this document.

Well Capping and Well Containment are complex, cross-functional activities with significant logistics and Simultaneous Operations (SIMOPS) considerations. The activities require the deployment of equipment not normally under contract to the Operator and requires specific detailed plans, investments, contracts and mutual aid agreements not specifically related to normal drilling and completion operations. Further, Operator investment of time and resources for planning, preparedness and the development of response organisational capability is necessary to effectively integrate the Operator's response equipment and incident response capabilities. Overall, the Operating company needs to own the plan and ensure all assumed interface points are robust.

Subsea capping equipment is available industry-wide through membership, subscription, or direct purchase from manufacturers. Containment systems are considerably more complex and require extensive additional resources to develop a robust response plan. Reliably securing equipment in regions outside the Gulf of Mexico may also be a challenge.

The objective of this document is to promote a standard approach in the planning and implementation of a SCERP, provide practical guidance, and describe what needs to be considered as well as its relevance.

Most of this document focuses on capping, as this typically will be the most effective response and to avoid confusion, content that relates to containment has been located in Appendix 1.

¹ Note: Within the context of Source Control, there are some differences in language used in the U.S. and internationally. Some examples of language differences include the U.S. term 'Cap and Contain', which internationally means 'Capping', and 'Cap and Flow' which internationally means 'Containment'. This document follows international language conventions.

Understanding Capping and Containment Responses

The level of source control emergency preparedness should be a technical, risk-based decision. It should consider well factors, industry and local capability, and regulatory requirements. If a well can be capped and safely contain reservoir fluids, capping should be the primary response. Capping is scenario specific and actual incident events and wellbore characteristics may prevent a capping stack from being installed.

Capping preparedness requires access to a capping stack and a planning process to verify capping feasibility. Operator owned equipment may be needed for the related capping activities. Much of this work is similar to blowout contingency planning.

Containment is a response option that follows from capping and is, essentially, the constructing and commissioning of a mini subsea production and offloading system. Preparedness requires specialist expertise, comprehensive engineering activities and access to equipment through service agreements or procurement. Containment equipment includes: subsea infrastructure and control components, production risers, surface production vessels and offloading/disposal systems. A notable consideration factor is that some equipment such as suitably designed mobile or floating temporary production systems are not readily available in all parts of the world.

When evaluating whether to prepare for Capping or Capping plus Containment, an important factor to consider is that these activities may be limited by the remaining well integrity and could require significant time for deployment and commissioning (if applicable). The time and complexity involved with installing and commissioning a containment system is substantial and should be evaluated relative to the time required to drill a relief well.

Part 1: Overview of Source Control Emergency Response

The development of a robust SCERP will be specific to each company's Incident Management System. Whether directly or indirectly, many Operating Companies and Governments follow the principles of the Incident Command System (ICS) as defined by the US National Incident Management System, NIMS. ICS provides a standardised process for managing emergency responses of varying degrees of complexity. To help communicate clearly in this document, a similar response organisational structure is adopted.

Shown below is the first level framework for the incident command system. As formally defined by the ICS system source control would reside within the Operations Section. However, due to the criticality of Source Control during a blowout response, some Operators and Response Networks place Source Control as a direct report to Incident Command.

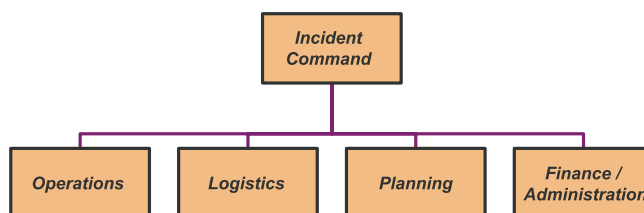


Figure 1: First level framework for an incident command system model.

1.1 Source Control IMT Structure

The Source Control Incident Management Team (IMT) Structure is modular and will be specific to each Operating Company or Response Network, and to the nature of the event requiring a response. The underlying premise is that there are 5 main areas of focus: relief well planning, SIMOPS, well capping, well containment, and engineering. An example model for a full Source Control Branch is shown in Figure 2. There is no “best structure”, and the design varies from Operator to Operator and potentially regulator framework. What is essential is that the SCERP details a structure that adequately addresses the potential needs of a source control response. Additional Source Control tasks that should be considered are:

- **Site Survey:** Inspection and mapping of the area around the incident well
- **BOP Intervention:** The task of stopping or attempting to stop the flow using the existing BOP
- **Debris Removal:** Providing access to the BOP capping stack attachment point, if obstructed
- **Subsea Dispersant:** Delivering dispersant to the flow path to reduce the amount of volatile hydrocarbons and restore working conditions over the well to the responders.
- **Capping:** Mobilising and installing the capping stack.

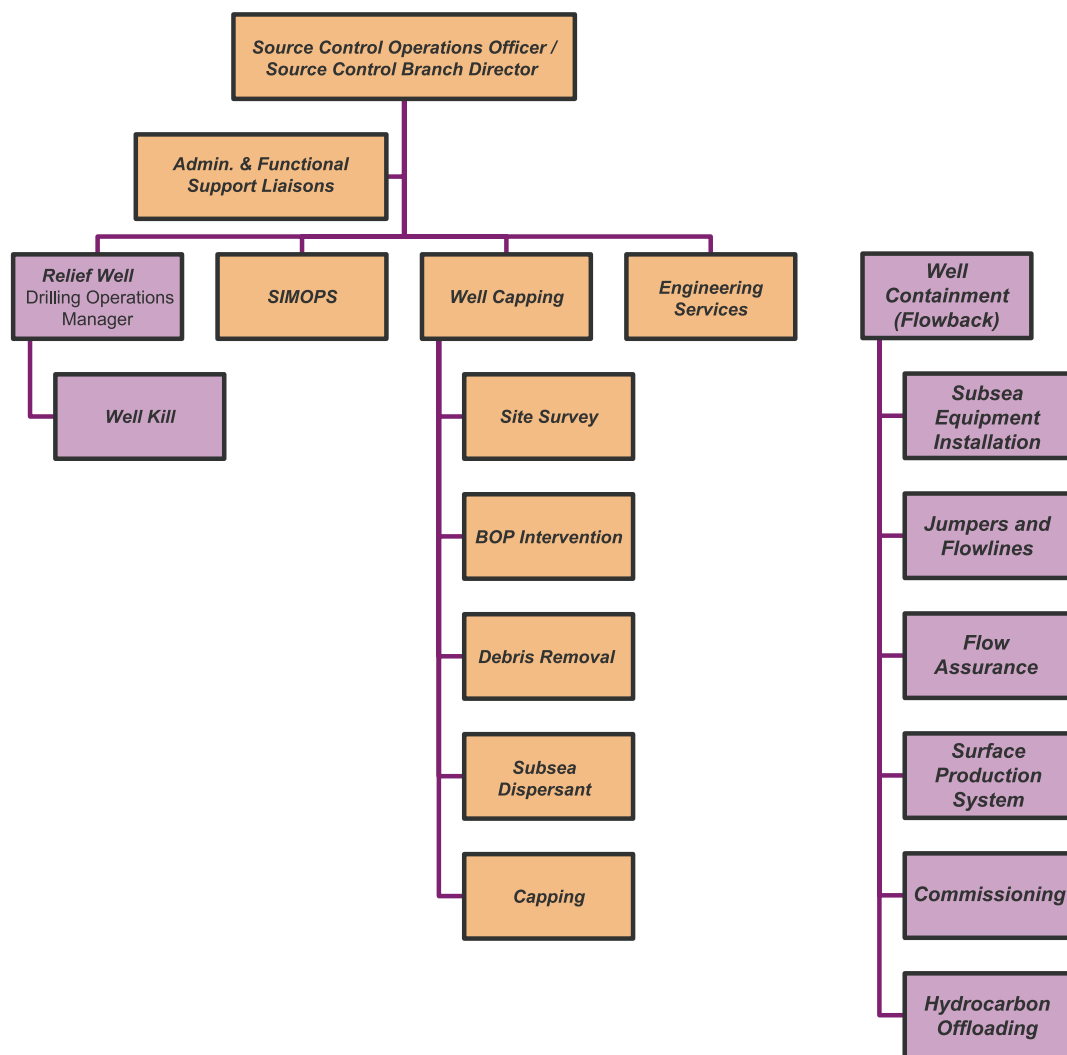


Figure 2: A conceptual organisational model for a Source Control Response Branch. Depending on the Operating companies' overall IMT structure, this model may take some different forms though the underlying task groups should not change much. If Well Containment (Flowback) were required, that group would form a separate tree as shown to the right. Containment (Flowback) group should not be required for a capping only response.

1.1.1 Relief Well Group

The Relief Well Group is responsible for the management and coordination of relief well design and operations. The Relief Well Group coordinates the development of the drilling plans and procedures, secures resources and manages relief well operations to ensure the relief well successfully reaches its target. Relief wells begin early in the source control process and continue operations concurrently with all other source control efforts until the incident well is intercepted and permanently killed. This group writes procedures that

involve the use of drilling equipment and offshore rigs and plans an intercept with the source well using intercept techniques and related equipment. Relief Well procedures and plans should be approved according to regulatory agency requirements and coordinated through the SIMOPS group.

1.1.2 SIMOPS Group

The SIMOPS Group coordinates the multiple marine activities associated with a source control response. Numerous supply vessels, MODUs (Mobile Offshore Drilling Units), and ROVs work simultaneously during a response, and it is the primary function of the SIMOPS group to ensure this is done safely and efficiently. The SIMOPS Group also plays an active role in procuring, inspecting, and approving source control related vessels. The SIMOPS Group issues and regularly updates the SIMOPS plan and co-ordinates communications around it.

Depending on the nature of the incident and company response plans, the SIMOPS group may also assume responsibilities for surface oil spill response or other tasks. In this case, SIMOPS may become a subgroup to a broader SIMOPS function. For the purposes of this document, the underlying point is that they are the link to co-ordinate the in-field response activities.

1.1.3 Well Capping Group

The function of the Capping Group is to facilitate the attachment and monitoring of a capping device and to control or stop the flow of hydrocarbons into the environment. The Capping Group sources and directs the deployment of all necessary equipment (e.g., connection devices, debris removal equipment, flex-joint alignment and restraint tools, capping equipment, valves) to facilitate well capping. In addition, the Capping Group is responsible for developing incident specific procedures for all operational steps leading to safe well capping.

To achieve this in practice, it is suggested to breakdown tasks, known as missions, into smaller sub groups as shown in the organisational diagram, Figure 2, and expanded on in the following sub headings.

1.1.4 Engineering Services Group

The Engineering Services Group provides a range of technical, engineering, and scientific services to the other response groups related to the engineering issues associated with source control, well integrity, and reservoir. Some of the services provided by the Engineering Services Group are included below. The Engineering group may have expertise that are embedded in other groups.

- Assurance (e.g., design reviews sourced mainly by segment engineering technical authorities, local technical authorities, or senior specialist/discipline engineers).
- Assesses the status of various wellbore barrier elements on the incident well.
- Re-validation of plume or other models that may affect source control activities.
- Safety (e.g., HAZID or Hazard and Operability [HAZOP] facilitation and action tracking).
- Liaison with third party science groups.
- Organisational capability and resourcing (e.g., assist other groups in finding required engineering/specialist resources [e.g., pore pressure prediction]).
- Specialised graphic arts and technical writing skills (e.g., to assist with developing presentations and storyboards for Simultaneous Operations [SIMOPS] and engineering plans).

1.1.5 Site Survey Task Group

The Site Survey Task Group is responsible for the management and coordination of surveying the site subsea. The Site Survey Team helps gather data for all other source control efforts to assist in the development of the operational plans and procedures. This group conducts operations utilising surface vessels and ROVs.

1.1.6 BOP Intervention Task Group

The BOP Intervention Task Group is responsible for the management and coordination of an intervention on the BOP of the incident well. Based on the initial subsea survey results, the task group assess the situation and develops the BOP intervention plans and procedures, secures resources and manages BOP intervention operations with the objective of closing the BOP. If the existing BOP can be successfully closed to seal the well, the focus can shift to well kill operations.

1.1.7 Debris Removal Task Group

The Debris Removal Task Group is responsible for the management and coordination of removing debris resulting from the incident that led to the source control event. These activities include clearing the area around the incident well to allow access to the BOP, subsea intervention panel(s), the capping stack interface and the sea floor for installation of ancillary equipment and drilling of relief wells. Based on the initial subsea survey results, the task group assess the situation and develops the response plans and procedures, secures resources and manages the site clearance activities.

1.1.8 Subsea Dispersant Task Group

The Subsea Dispersant Task Group is responsible for the management and coordination of subsea dispersant operations at or near the source at mud line. The group coordinates plans, prepares procedures, secures resources, and oversees the application and efficacy of subsea dispersant operations. It is anticipated that support needed for regulatory approvals is provided at the Incident Command level.

1.1.9 Capping Task Group

The Capping Task Group is responsible for the management and coordination of overall capping stack staging, installation plan, and operations. The group begins its task early in the process and continues to operate concurrently with all other source control efforts until the well is secured.

If it becomes necessary for offset installation to be used, it may be desirable for the Operator to establish a separate task group for that activity.

1.1.10 Well Containment (Flowback) Group

Where wells have been designed for a capping only criteria, it should not be necessary to consider this group in the SCERP. The Well Containment Group is responsible for the management and coordination of well containment design and operations. The Well Containment Group coordinates the development of the installation plans and procedures, secures resources, and manages operations to ensure the source is safely produced. If decided as the preferred option, well containment begins early in the source control process and continues operations concurrently with all other source control efforts until the incident well has been killed. Containment procedures and plans should be approved according to regulatory agency requirements and be coordinated through the SIMOPS group. Refer to Appendix 1 for additional information on well containment.

1.2 Source Control Key Events

The typical timeline or flow of source control activities is depicted in Figure 3.

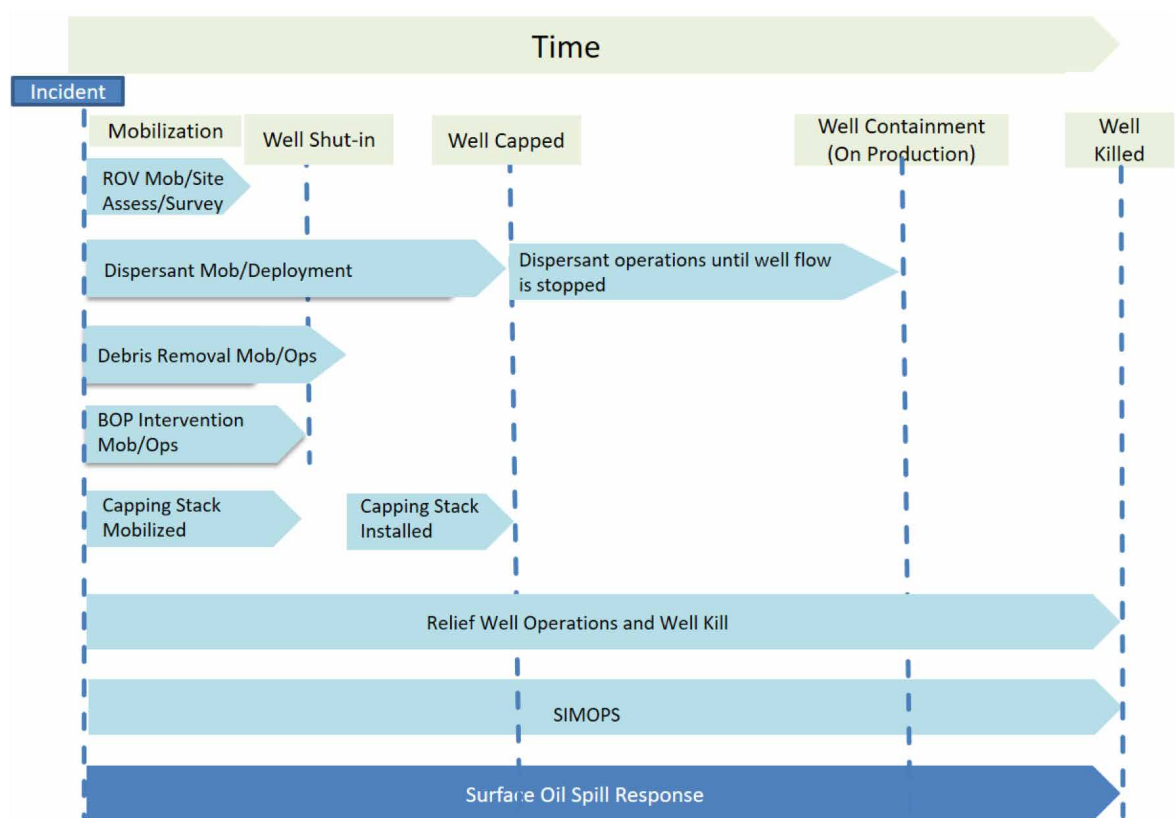


Figure 3: A conceptual timeline of the headline activities associated with source control response planning. For simplification, tasks associated with installing and commissioning subsea and surface infrastructure for containment have been omitted. If of interest, a detailed timeline is located in Appendix 1.

1.3 Emergency Response Preparedness

In preparing a robust SCERP, the table below summarises the key elements that should be included.

Item	Description	Resources/References
Incident/Crisis Management Plans	<p>Emergency response plans should be in place and ready for immediate implementation.</p> <ul style="list-style-type: none"> Plans should be validated by scheduled drills that address the readiness of personnel and their interaction with equipment. Written action plans should be established to assign authority to appropriate personnel, address emergency reporting and response, and comply with applicable government regulations. Emergency Control Centre(s) should be designated for each facility. Training and Drills should be conducted periodically and based on realistic scenarios to test action plans. 	<ul style="list-style-type: none"> API RP75, Section 10 Emergency Response and Control.
Incident Command System Training and Planning	<ul style="list-style-type: none"> Provides a standardised, on-scene, all-hazards incident management concept. Enables coordinated response among various jurisdictions and agencies. Establishes common processes for planning and managing resources. Allows for integration within a common organisational structure. 	<ul style="list-style-type: none"> International Maritime Organization (IMO), <i>Implementation of an Incident Management System (IMS)</i>, 2012, K581E. US Coast Guard Incident Management Handbook, May 2014.
Incident Command Organisation	<p>The broad spectrum of Corporate, Country, and Project (local) response teams required to manage emergency response associated with operated activities includes:</p> <ul style="list-style-type: none"> Crisis Management Teams – usually executives and Senior officers. Also called Unified Command when including Government officials Incident Management Team – Incident Commander and appropriate Command and General staff assigned to an incident. Emergency Response Team – local on-scene commander or person-in-charge and direct reports located at the emergency scene. 	<ul style="list-style-type: none"> International Maritime Organization (IMO), <i>Implementation of an Incident Management System (IMS)</i>, 2012, K581E. US Coast Guard Incident Management Handbook, May 2014.
Source Control Emergency Response Plan - SCERP	<p>SCERP is an integrated and systematic approach to source control incident management that provides the basic policies and procedures designed to guide well operations personnel in the event of source control incident</p>	<ul style="list-style-type: none"> Available through source control equipment providers.

Item	Description	Resources/References
Source Control Emergency Response Team	A defined organisational structure that sits in the Operations section of an ICS structure directly focused on capping and containment of a subsea blowout. Groups report to the Source Control Operations Officer/Source Control Branch Director and include Relief Well, SIMOPS, Capping, Containment & Engineering.	
Emergency Contacts List	Comprehensive list of names, titles, position and phone numbers for Crisis management and operations personnel; response contractors; and equipment providers.	
Source Control Equipment Provider	Define primary and back up contact information for provider of capping stack and ancillary equipment.	
Source Control Equipment Call-out	Define procedures for authorising the mobilisation of emergency response equipment.	

1.4 Response Plan Implementation

Response plan implementation involves performing a range of activities that are designed to test that the plan is robust, train organisational participants as well as promote continual improvement. Activities that form part of plan implementation and testing involve but are not limited to some of the following. Activities should be fit for purpose and scalable, depending on the organisation size, complexity, location and risk factors. Activities should/may/might include:

- Drills and tabletop exercises
- Training
- Audits
- Updating documents and plans – lessons learned
- Inspections and testing of equipment
- Market assessments for vessels and equipment

Of particular importance is the continuous monitoring of market conditions for vessels. This is to ensure that if vessels with unique or special capability are determined to be necessary in the SCERP, that they are available if needed. If not available, the response plan may require amendment to consider an alternative.

Part 2: Engineering Activities to Support SCERP Planning

The development of an SCERP for a specific project requires a number of tasks to be completed during the well planning phase and certain engineering considerations to be included in the well design. Two critical considerations are whether the well can be safely shut in and how the capping stack will interface with the well or BOP. The Table below highlights key considerations to be included in the well design process and information to include in the SCERP.

2.1 Summary of Tasks

Item	Description	Resources/References
WCD Analysis	<p>Worst Case Discharge – evaluate the range of blowout scenarios for analysis of the incident well conditions for capping and containment. Factors that might be considered include:</p> <ul style="list-style-type: none"> • Degree of penetration into a hydrocarbon reservoir. • Flow path: annulus, drill pipe or both. • BOP closure: partially closed or open. 	<ul style="list-style-type: none"> • SPE Calculation of Worst-Case Discharge (WCD) March 2015 • SPE WCD Summit New Orleans, LA March 2014 • API JITF – Joint Industry Task Force Subsea Dispersant Injection Project • IPIECA Dispersants: Subsea application. Good practice guideline for incident management and emergency response personnel. • API RP 96 - Deepwater Well Design and Construction
Casing Design for WCD & Displacement to Hydrocarbon (Blowout load case)	<p>Considers the impact on well integrity when the wellbore is displaced to formation fluids during an unrestricted blowout. In this load case the reduced internal support pressure, combined with increased annulus pressure due to heating may lead to the burst or collapse of casing. If the casing fails, it could result in a breach of hydrocarbons into shallower weaker formation or loss of access. Casing design evaluates the situation and may make changes to mitigate the consequence.</p>	<ul style="list-style-type: none"> • NCS Well Capping Status Report, 26 January 2017
Well Integrity & Source Control Selection	<p>Well design screening that assesses whether the well can be shut-in after capping. A well should be able to be categorised into one of three below:</p> <ul style="list-style-type: none"> • Full mechanical and geologic integrity • Mechanical or geologic integrity not intact, but consequence of failure is acceptable • Wellbore integrity does not exist and well cannot be shut-in without hydrocarbons escaping/broaching to sea 	<ul style="list-style-type: none"> • US Department of Interior – Bureau of Ocean Energy Management, Regulation and Enforcement

Item	Description	Resources/References
Structural Integrity Analysis	<ul style="list-style-type: none"> Consider the impact a blowout will have on the structural integrity of the well. Assess temperature and damage effects on fatigue loading of wellhead. Consider any additional weight of a capping stack on the subsea components. May not be a factor when capping on top of a BOP when the LMRP has been removed. 	<ul style="list-style-type: none"> API RP 2GEO - Geotechnical and Foundation Design Considerations API 16Q - Design, Selection, Operation, and Maintenance of Marine Drilling Riser Systems
Plume Study	<ul style="list-style-type: none"> Perform subsea plume dispersion study. Consider water depth, flowrate and phase of escape fluids. Perform Computational Fluid Dynamics (CFD) analysis. Plume force landing analysis. Evaluate blowout scenarios where hydrocarbons in the water column interfere with surface operations to cap or kill the well (vertical access assessment). Determine extent and likely hood of a flammable cloud, VOCs and violent surface boils. 	<ul style="list-style-type: none"> SPE-181393-MS - How to Develop a Well Specific Blowout Contingency Plan that Covers Engineering Analysis of the Deployment, Installation, and Soft Shut-In of a Subsea Capping Operation
Relief Well Locations Identified	<p>At least two relief well locations should be identified that are:</p> <ul style="list-style-type: none"> A safe distance from the well (blowout) Consider seabed and sub-bottom hazards/shallow hazards assessment. Consider seasonal dominant wind conditions and currents to avoid volatile gases and accumulations of oil on the surface 	<ul style="list-style-type: none"> OGUK Guidelines on Relief Well Planning For Offshore Wells
Relief Well – Dynamic Kill Plan	<p>Develop blowout scenarios based on targeted hydrocarbon zones.</p> <ul style="list-style-type: none"> Plan relief well trajectories considering proximity ranging tools, approach and intersect method & approach. Dynamic kill analysis – determine volumes, density, and pump rates for well kill fluids Determine pump and ancillary equipment needs for well kill including redundancy during critical well kill operations 	<ul style="list-style-type: none"> OGUK Guidelines on Relief Well Planning For Offshore Wells
Back-up equipment/casing for drilling relief	<p>Multiple back up subsea wellheads, float equipment, full casing strings and other ancillary well equipment and services should be on hand or readily available for the relief well drilling operations to avoid delay.</p>	
Alternate Rigs/ Mutual Aid	<p>Identify rigs capable of drilling relief well(s) that can be mobilised in short order. Consider entering mutual aid agreements with other regional operators for rigs and other critical resources that will be required.</p>	

2.2 Worst Case Discharge (WCD)

WCD is defined as the maximum rate a well will flow. WCD information is used to:

- Develop a pressure and temperature profile along the wellbore which is used for determining the casing's design reliability
- Creating an input for computational fluid dynamics (CFD) models that are used for modelling the land out of a capping stack and plume analysis
- Establish relief well kill requirements

When calculating WCD, take care to ensure the output is not unrealistically conservative as it may result in conclusions that the well potential exceeds the available capping and containment equipment capability. Some prefer to use the term worst case credible discharge to reflect a more realistic alternative scenario such as a partial reservoir penetration, drill pipe in well and across the BOP or a partially closed BOP. For further reading, refer to SPE Technical Report, Calculation of Worst Case Discharge and SPE 181393-M.

2.3 Casing Design for WCD & Displacement to Hydrocarbon (Blowout Load Case)

The Blowout Load Case considers the impact on well integrity when the well has been displaced to formation fluids and continues to produce with unrestricted flow. From a casing design perspective, the key considerations are burst loads on the inner most casing due to the pressure exerted by flowing fluids (displacement to gas load case) as well as a combination of collapse and burst loads on inner and outer casings that may be a result of trapped annulus fluid volumes that expand due to the heat generated from flowing conditions. This phenomenon is commonly referred to as annulus fluid expansion or annular pressure build-up (AFE/APB). Various AFE mitigations exist and can be built into the well design.

If AFE is not mitigated, the damaged casings may impose restrictions to the possible source control solutions since the collapse of the internal casing may jeopardise the ability to shut-in the well. Hence, capping operations may result in an underground blowout and containment operations may have a limited operational envelope. Furthermore, relief well kill operations may become more challenging depending on the remaining well integrity.

2.4 Well Integrity & Source Control Selection

During the well construction process, it is important to ensure that the well barrier elements can withstand the maximum anticipated loads and (pressure, temperature, fluids) it may be exposed to, for the time the barrier element is in use.

Understanding the formation strength at the lowest casing shoe is important for establishing whether the well can be capped. If the open hole is displaced to hydrocarbons, and the formation is not strong enough to withstand the higher pressures applied, an underground blowout will result. When capping a well, the formations below may be able to accommodate the underground crossflow; but this requires assessment on a case by case basis. As an example, the open hole may be exposed to depleted reservoirs and those reservoirs may be able to accept formation fluids that flow from the source reservoir. All information regarding formation strength and any decisions that may affect formation strength should be addressed in the relief well drilling planning process.

Designing wells for full displacement to gas is the most conservative approach to insuring well barrier integrity. However, this may not always be feasible for all wells and reservoir conditions – in those circumstances, alternative scenarios should be considered in the source control plan.

2.5 Structural Integrity

The ability to land out a capping stack on the incident well should be considered during the conductor design phase. In addition, fatigue loading on the conductor, the wellhead with the BOP, LMRP and capping stack installed should also be considered. Part of this scope should also include aspects of API RP 2GEO to ensure the soil capacity around the conductor has sufficient capacity, or, if not, consider mitigation options, such as conductor deepening, or reliance on surface casing to provide axial support.

In general, wellhead fatigue should not be a problem if the primary interface point (top of BOP after LMRP removal) is used, since this load case with Capping Stack installed should be similar to the BOP with LMRP. However, further analysis is required if damage to the well's structural integrity is caused by the incident.

2.6 Plume Evaluation

The objectives of plume modelling are to establish the safe working areas at surface as well as evaluate capping stack access routes.

In-water plume and gas dispersion modelling should be considered as part of the oil spill response planning activities. This modelling will confirm if vertical access to the incident well is feasible and aid in developing the surface vessel layout with expected Exclusion Zone based on Volatile Organic Compounds (VOC) and Lower Explosive Limit (LEL) of gasses present. Subsea dispersant injection options should also be considered as this may substantially improve the potential for surface vessel vertical access.

Note: In general, as water depth increases, vertical access becomes less constrained by plume effects. Although the worst case discharge modelling may indicate that vertical

access to the incident well is not feasible, it is still important to ensure equipment, resources and plans for a vertical capping operation are in place as the actual incident in practice may have a lower flow rates than modelled allowing for vertical access.

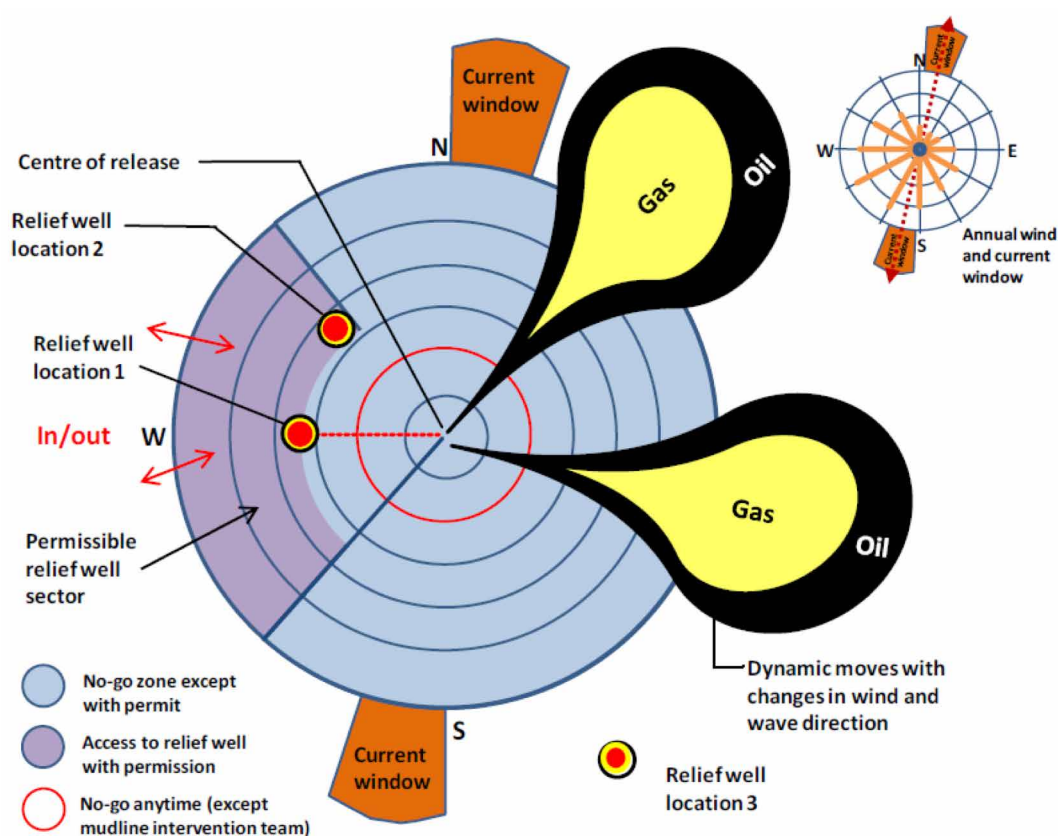


Figure 4: Graphic: Sourced from OGUK Guidelines on Relief Well Planning. The example graphic above is a useful way of conveying important conceptual information on how hydrocarbon effluent will flow and what working areas can be used for locating surface support vessels, installing a capping stack and spudding a relief well. In the event of an actual blowout, this information will require a site specific update.

2.7 Computational Fluid Dynamics (CFD) / Uplift Forces

Depending on the flow rates and fluid properties, it is recommended to perform Computational Fluid Dynamics (CFD) analysis of uplift forces during the installation of the Capping Stack. Model output is used for Landing Analysis activities which are described further in the next chapter. In some cases, these uplift forces will influence the selection of installation methods/procedures and may even prevent the installation of the capping stack or dictate the use of a stack of different dimensions and/or design. CFD crucially relies on accurate capping stack information and engineering drawings should be imported into the

CFD model. When undertaking CFD analysis, it is suggested to also consider a range of wellhead inclination sensitivities as these may impact capping stack landing assumptions.

A subset of CFD work involves performing erosional analysis on the capping stack bore and across the rams or valves when closing. Usually this work is undertaken during the capping stack design and is part of the API RP 17W specification, however, if anticipated solids content exceeds those assumed limits, additional analysis may be required.

For further reading and discussion on CFD and Plume Evaluation, recommend reading SPE 181393-MS.

2.8 Location Specific Considerations

When planning subsea wells, it is standard practice to evaluate the surface location with respect to environmental constraints such as water depth, metocean data, bathymetry, shallow hazards, shipping lanes, subsea production and associated subsea infrastructure. For source control activities, some additional elements to consider are:

- Plume effect in shallow water. In shallow water, the plume effect from the subsea blowout may jeopardise vertical access to the incident well, triggering the possible need for offset installation equipment or other solutions for capping operations.
- An overview of subsea infrastructure and an understanding of soil conditions (composition, strength and slope) is relevant for the possible installation of capping and containment equipment and operational activities. For moored rigs, and when evaluating relief well locations, this information may also be important when considering anchoring patterns

2.9 Dispersant Use and Approval

Within the realm of subsea source control, subsea dispersant serves as both a health and safety tool as well as an environmental tool. Dispersant theory and application is comprehensively discussed within the IOGP IPIECA reports on *Dispersants: Subsea Application and Regulatory Approval of Dispersant Products and Authorisation for Their Use*. The principal of dispersant use is summarised below and intended to promote an overview to the reader. Equipment needed for the delivery of dispersant to the incident well should be included in the SCERP.

From an environmental perspective, whether applied through surface distribution or subsea delivery, the reason for using dispersants is the same – to minimise or prevent released oil from drifting into nearshore or coastal habitats and onto the shore. Through experience, application of subsea dispersant has been found to be beneficial in both protecting the environment and the workplace. When correctly applied, dispersant delivered at the subsea flow source mixes with produced hydrocarbons and seawater to produce very small droplets of hydrocarbon within the water column. The micron-sized

droplets that result from dispersant mixing will still rise buoyantly to the sea surface, but at a very slow rate when compared with larger bubbles giving microbes more time to consume the oil. Moreover, for a given volume of oil, very small droplets have a much larger surface area when compared to larger droplets making it easier for microbes native to the water column to consume the oil before it can reach surface or sensitive coastal areas. The biodegradation process has been measured to have a half-life of days to weeks. Although subsea dispersant application is an effective response technique, some larger bubbles may still surface though it has been found that when treated with dispersant, they can break up from weathering and degrade more easily than they otherwise would.

In the context of health and safety, subsea dispersant delivery plays an important role in significantly reducing concentrations of volatile organic compounds (VOC) that reach surface and thereby reduce human exposure and concentrations to be within safe low explosive limits (LEL's) of those hydrocarbons. If a series of dynamically positioned vessels are used in response, it is imperative, that they be protected from VOC exposure.

2.9.1 Regulatory Approval

Use of dispersants usually require specific approval from the host regulator. The SCERP should to identify the local regulatory agencies and their requirements regarding dispersant use. It should also describe the process that the Operator intends to use to engage with the regulatory agencies to seek pre-approval for dispersant utilisation. API Bulletin 4719 (June 2017) provides useful guidance on how to request regulatory concurrence. Regulators may have certain requirements that must be complied with before, during and after use of dispersants. Refer to the IPIECA Oil Spill Response Joint Industry Project, Finding 2.

2.9.2 Quantities & Replenishment

Establishing continued access to dispersant should be part of the SCERP. Different concentrations and quantities of dispersant will be required for different types of hydrocarbons and the source well flow rate. Though concentration rules of thumb exist, sensitivity modelling and/or laboratory testing on representative oil samples may also be performed to optimise injection quantities.

In addition to identifying consumption rate, an assessment of total volume should be made. In doing so, the assessment should consider when dispersant can be applied and for how long it would be needed before the well is capped, or, if capping is unsuccessful, when a relief well would kill the incident well.

With the above information being available, suitable dispersant stock piles can be identified and those volumes worked into the logistics plan.

2.9.3 Water Column Monitoring

Water column monitoring involves mobilising a field laboratory and sampling the water column at different depths up-current of the hydrocarbon plume as well as inside the plume. Water column monitoring should be considered regardless of subsea dispersant availability. Within industry, there are also references to Dispersant Monitoring which is about monitoring dispersant efficacy in the water column which is an output from water monitoring activities. The objectives of water column monitoring are to:

- Assess the efficacy of dispersant application and refine the delivery rate (Dispersant Monitoring)
- Characterise the nature and extent of subsea or near surface dispersed oil and aid in the validation or accuracy enhancement of plume trajectory models
- Support health and safety goals (low VOC concentrations)
- Assess particle size and chemical concentration
- Provide an assessment of potential ecological toxicity
- Provide information to Incident Command to make informed decisions

In practice, it is likely that specialist scientist support and science vessel will be required, for which suitable contacts should be identified within the SCERP. Some important points to consider with water column monitoring are:

- 1) A sufficient quantity of sample bottles needs to be mobilised
- 2) Mobile laboratory equipment may not have all the tools necessary for complete analysis and in which case, procedures should be in place for how to export and import samples between two countries
- 3) Water column monitoring equipment within the industry is sparse and a mutual aid agreement may be necessary to attain access

Reference can be made to API Technical Report 1152, Industry Recommended Subsea Dispersant Monitoring Plan for more details. See also IPIECA *Dispersants: Subsea application*.

2.9.4 Dispersant Delivery

A dispersant delivery system involves providing a continuous feedstock of dispersant to the incident well as close to the source as possible. The process involves first installing a subsea manifold on the seabed. Next, a supply vessel with high pressure pumping equipment and dispersant stock pile is located above the manifold, coil tubing or a suitable conduit is used to connect the vessel to the subsea manifold and a jumper hose is connected between the manifold and an ROV with an injection nozzle inserted in the well flow.

Various capping stack providers are able to supply the ROV jumpers, injection nozzles, pressure pumps and manifold but not the conduit to get dispersant from surface to mud line. The SCERP should consider where to source a conduit from, how to transport and deploy the conduit, how to implement the conduit with the stack providers manifold, as well as the effects of metocean conditions, such as fatigue and vortex induced vibrations.

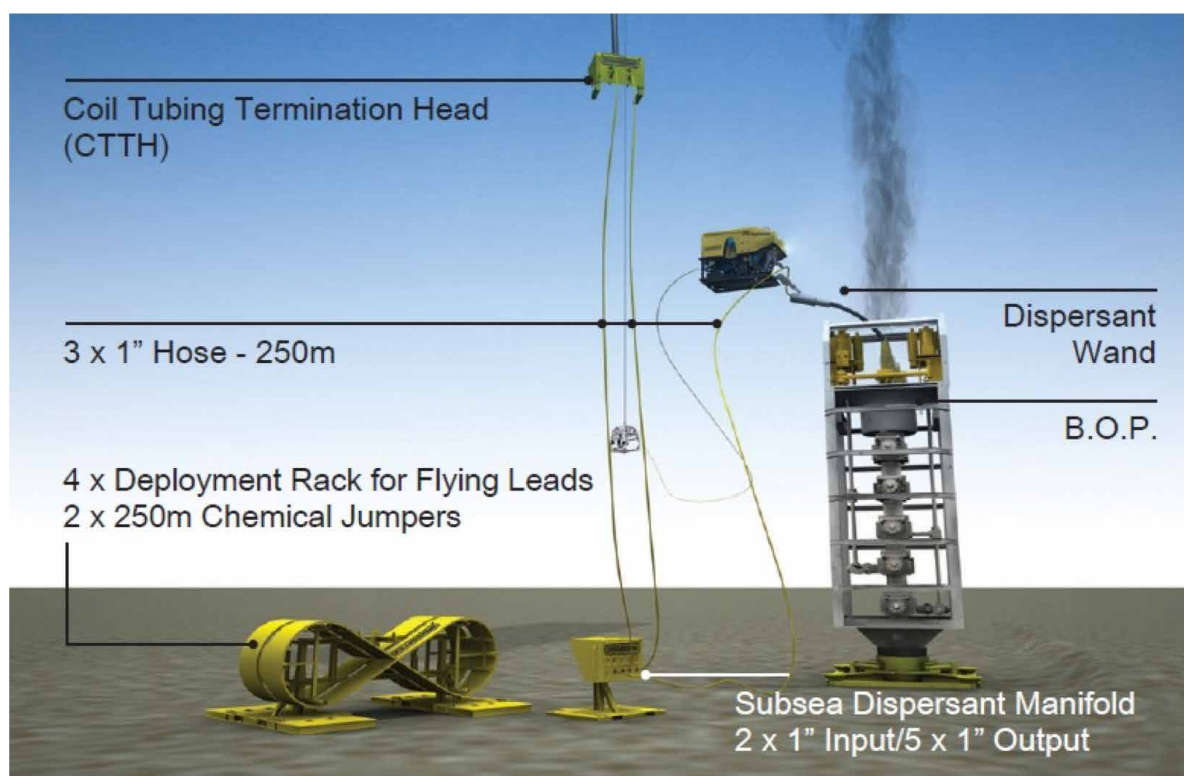


Figure 5: An illustration of the equipment used for subsea dispersant

2.10 Capping Considerations

As part of the well design process some early analysis should be considered to evaluate the Capping stack specification, required ancillary equipment, mobilisation, deployment methods and interface problems such as vertical access. Refer to Part 3 of this document for details on capping stack considerations.

2.11 Relief Well Planning & Interfacing With Source Control

Source control planning has a close but independent relationship with relief well planning. The underlying point to make in this document is to ensure the two emergency response plans are compatible with one another. Areas of potential clashes could be, but are not limited to:

- 1) Relief well locations and how they may be affected by hydrocarbon plume.
- 2) Use of supply bases and support vessels.
- 3) Positioning of surface vessels and consequences if station keeping is lost.
- 4) Sourcing of equipment like conductors that may be used for relief wells as well as to support capping or cap and contain subsea infrastructure.
- 5) Pressure limitations on the source well during proposed intersection and kill operations.

For further reading on relief well planning, refer to OGUK Guidelines on Relief Well Planning For Offshore Wells.

2.12 Mutual Aid

Mutual aid is a multi lateral support network that provides a pre-agreed framework for the sharing of equipment and expertise. The objective is to enable rapid response to control the source as efficiently as possible.

SCERP development may give consideration towards mutual aid between Operators. In situations where equipment and/or expertise is not readily available, other Operator assistance could be beneficial. Consideration should be given towards evaluating critical services and how they would be accessed. Once identified, a mutual aid agreement can be implemented with the relevant parties.

Mutual aid agreements generally feature:

- Legal liability control.
- Seconded arrangements.
- Equipment sharing.
- Commercial considerations.
- Notification and communication protocols.

Part 3: Capping Stack Planning and Installation

Item	Description	Resources/References
BOP ROV Panel Verification	<ul style="list-style-type: none"> Have the correct ROV hot stabs to mate with the BOP panel. Possible need for subsea hydraulic intervention skid. Suitable grab handles for stabilisation on the BOP intervention panel. 	<ul style="list-style-type: none"> API RP 17H - Recommended Practices for Subsea Capping Stacks
Well or BOP to Capping Stack interface analysis/interference study	<ul style="list-style-type: none"> Perform interface checks for capping stacks to drilling BOPs and subsea trees. Collect dimensional drawings of the BOP or subsea tree. Prepare 3D and 2D drawings of capping stack connectors interfacing with lower BOP/SSXHT mandrel. Check for clashes with inner diameter of guide funnel/LMRP interface. Recommend performing physical checks as well as drawing checks. 	<ul style="list-style-type: none"> Capping stack providers will generally have information or procedures on interfacing.
Provisions for BOP Adapter or spare connector	<ul style="list-style-type: none"> For cases where capping stack connector clashes with BOP/SSXHT mandrel or different hub profile. Cross-over adapter. Locate connector with smaller OD. 	
Landing Analysis	<ul style="list-style-type: none"> Using the results of plume dispersion study, simulate the landing of a capping stack on the subsea blowout and determine stability as capping stack is landed. For shallow water cases, offset landing methodologies should be studied. 	
Offset Landing Plan	<ul style="list-style-type: none"> Consider results from plume study to determine if vertical access is feasible. Shallow water and/or high rate gas blowouts are cases where this would be most likely. Field layouts during development planning should consider offset landing scenarios when designating exclusion zones or approach areas. 	<ul style="list-style-type: none"> NOROG Well Capping Status Report, 26 January 2017. OTC-25259-MS - Subsea Well Response Project enhances international well incident intervention capabilities
Ultra-deepwater Capping stack deployment	<ul style="list-style-type: none"> Consider methodologies for landing capping stack in ultra-deep water where weights (stack + wire) begin to exceed vessel capabilities. <ul style="list-style-type: none"> Installation by MODU on drill pipe <p>Heave compensated landing system</p>	

3.1 Capping Considerations

3.1.1 General

As part of the well design process some early analysis should be considered to evaluate the Capping stack specification, required ancillary equipment, mobilisation, deployment methods, and interface issues for vertical access.

3.1.2 Capping Selection

Not all capping stacks are equally created or specified. When preparing the SCERP and implementing response contracts, it is important to ensure the proposed capping stack meets its intended requirements. Performance specifications that need to be considered are:

- Conformance with API RP 17W - Recommended Practices for Subsea Capping Stacks and other applicable industry standards
- Wellhead, BOP top, and LMRP top interface points
- Through bore size
- Water depth rating which affects stack specification and deployment method(s)
- Flowing temperature, pressure rating, flow rate, and fluid type rating
- Re-entry considerations
- Chemical injection functionality for hydrate mitigation or management
- Pump-in capability for well kill operations
- Pressure and temperature monitoring sensors
- Modularity of design and ability to mobilise expediently from point of location (air versus sea freight)
- Choke size and specification (important for cap and contain methods or contingency)
- Containment flowback system interface design
- Overall shape and weight of the selected capping stack related to installation methodology when considering water depths, subsea currents, plume force uplift, etc.
- Recovery operations – either during the cap installation operation, or during retrieval after the well has been killed

3.1.3 Mobilisation Options and Pre-Deployment Handling

In evaluating which capping stack system to make use of, consideration should be given for how that system will be mobilised. Some specific considerations that the SCERP should consider are:

- Mode and timing of mobilisation
- If mobilising via air freight, what planes can be used, are they readily available and can those planes land at the designated airport

- Airport handling equipment at the destination
- Transportation from the airport to the dock site
- If equipment requires assembly, having a wide range of spare parts for re-assembly is critical. Function and pressure testing are also necessary and the plan needs to identify availability of necessary handling equipment such as cranes, power supplies and scaffolding
- Plan and prepare for any permitting requirements (import/export/duties/road transportation)
- Marine vessel sourcing and offloading

3.1.4 ROV Interface Points

ROV interface points need to consider the type of ROV functions that are on the capping stack and how the ROV will interface with same. Some interface equipment may be supplied by the capping stack provider while others may require sourcing. If the interfaces do not mate, the operation cannot be carried out. Necessary ROV tooling will be dependent on the capping stack that has been chosen.

3.1.5 Capping Stack Actuation

Consideration should be given toward the closing method of the capping stack which may be closed mechanically, hydraulically, or both. Consideration should be given to what equipment is needed to enable alternate or contingent actuation possibilities without having to recover the stack. Suitable equipment needs to be contained in the capping stack system, to facilitate the method of choice.

3.1.6 Alternative Installation Methods

The SCERP should consider deployment and alternative installation methods. This topic will be discussed further in the landing analysis section.

3.1.7 Connection Interface Points and Clash Checks

The SCERP should consider connection interface points. These are usually the wellhead connector, Xmas Tree (horizontal, SSXHT), top BOP connector, or the top LMRP connector. Of these, the top LMRP connector is often the most difficult to connect to due to many riser connectors being proprietary and the additional load placed on the wellhead may be prohibitive. There may be some capping stacks that are not compatible at all. Regardless, a detailed interface study is recommended.

Part of capping and containment planning is to “clash check” to confirm there is no interference when landing the capping stack on any of the three landing points (e.g., BOP

hub, LMRP flex joint (FJ) riser adapter, and the wellhead). It is recommended to perform physical interface checks on clearances as there have been cases where 'as-built' systems have been different to the drawings. It should also be noted that BOP stack frame designs have changed and re-entry systems on the LMRP are not all standard. The following is an example of a clash check:

- A clash check may be performed for each of the three attachment points (top of lower BOP, wellhead, and the LMRP FJ riser adaptor)
- Models of the attachment points can be created using a combination of:
 - BOP OEM and/or drilling contractor drawings
 - Laser survey by specialist contractor
 - A clash check can be undertaken by engineering contractors with suitable CAD software. Include ROV access to capping stack ROV panels in the check

Outcomes from an identified clash could be:

- Locating an alternative connector (e.g., FMC Technologies Slimline H4, Dril Quip DX 15)
- Devising a plan to modify capping stack post incident (e.g., removing a capping stack funnel or grinding off a BOP post)
- Inserting a spacer spool between the connector and the capping stack
- Re-orienting the capping stack prior to landing

It is recommended that 2D and 3D engineering interface drawings be included in the SCERP for each stage of the interface. As part of the compliment, detailed drawings of each connector and in required connector adapter be included. See Appendix 5 for examples.

3.1.8 Handling Tools and Methods

Once in the field and ready for deployment, the SCERP should consider how the capping stack will be landed and what equipment is required to facilitate the land out. Typically, capping stacks will come furnished with basic handling tools, but at some point, there is an interface with either the rig or installation vessel that needs to be considered and appropriate interface tooling sourced.

3.1.9 Considerations for Transitioning from Cap to Cap & Contain

If containment or flowback is being considered, or if site conditions dictate that capping alone is not feasible, specific thought should be given for how the transition between modes of operation will be implemented. For example, some capping stacks may require that a barrier is removed to connect flowback lines.

3.2 Capping Stack Options

Several capping stack options are available within industry. These are generally accessed through a form of membership or subscription service. Moreover, different regulatory bodies, have different requirements for where capping stacks may, should, or must be located as well as the component inventory and services associated with it. The SCERP needs to anticipate any such requirements. To assist with understanding availability, a snapshot of available equipment and providers is provided in Appendix 3.

3.3 Tooling and Spares

Like all well operations, ensuring an appropriate level of tooling and spares is a good practice. Generally, capping stack providers will have suitable inventories of spares and common adapters and components, however, they may not have everything. As an example, if choosing to use coil tubing to facilitate dispersant delivery, confirming the capping stack provider has the necessary interface equipment to mate the coiled tubing with the subsea manifold is an important interface point. Another consideration could be how the rig or deployment vessel mates with the capping stack and that there are suitable spares available for that interface. Another consideration is whether the assumed tooling provides flexibility or contingency for the non-ideal situation.

Overall, it is recommended that a system operability assessment be performed between all components can mate and that suitable spares are available. Note, it may be best to complete this assessment during the subscription service evaluation phase.

3.4 Landing Analysis and Landing Plan

Landing analysis consists of three main components which includes CFD analysis, deployment methods, and wellhead inclination.

CFD analysis is used to model uplift forces that act on the capping stack as well as provide insight into how the capping stack may respond to asymmetric flow as well as impacts of water column currents. The stack can be misaligned, rotated, or pushed off balance as a result of fluids flowing non-vertically. Output from the model may guide the landing solution to be on drill pipe or require additional vessels to stabilise the cap while another lowers the stack.

Particular attention should be given to wells that are in shallower water depths as well as those that have high gas rates or high GOR oil potential.

3.4.1 Offset Landing Plan

Offset landing involves submerging the capping stack to near mud line from a location that is away from the incident well and then guiding the stack into position for landing out. This situation is most likely to happen in shallower water depths where the water depth is insufficient to allow hydrocarbons to travel far enough down current before reaching surface and thereby engulfing the deployment vessel. At this point in time, the methods that are available for offset landing involve using several vessels with “tag lines” or utilisation of a subsea carrier to guide the stack into position or other commercially available technologies. Whichever method is selected, it is recommended to ensure suitable rigging spares and interface equipment is identified and can be sourced.

3.4.2 Ultra-Deepwater Capping Stack Deployment

The main consideration with capping in ultra-deep waters resides in surface vessel capability. The combined weight of the stack and wire may exceed the vessels capability and the only deployment choice may be via a drilling unit. If this is the case, it may be difficult to pass the capping stack to the moonpool and an underwater method may be required.

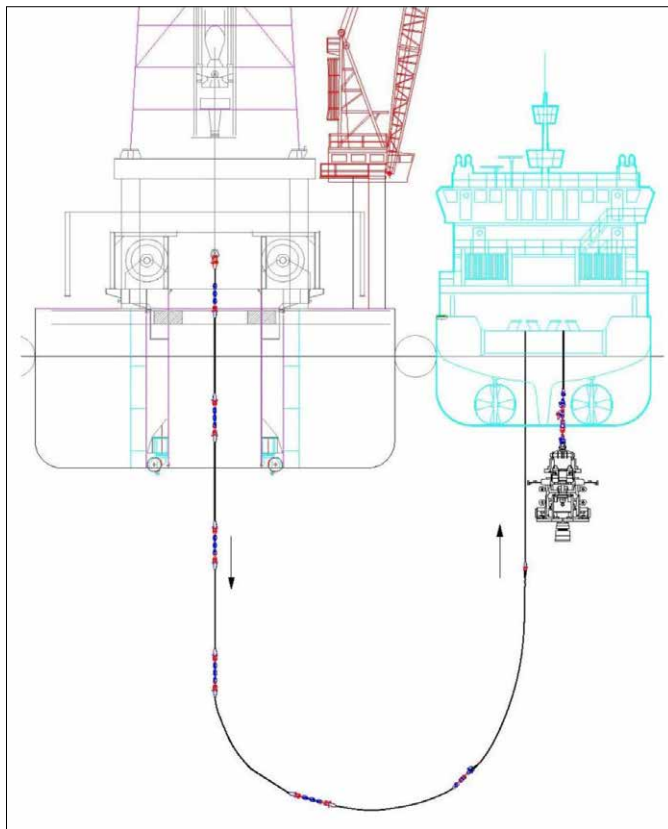


Figure 6: An extract from a keel hauling plan where a capping stack needs to be transferred from an anchor handling supply vessel to a drill ship.

3.4.3 Inclined Wellhead

Wellhead inclination may hinder the ability to adequately land the capping stack. API RP 17W specifies that capping stacks are able to land on the incident well with an angle of at least 2 degrees. Some capping stacks have been qualified to land with an angle as high as 10 degrees. Whatever the stack capability, the actual angle of the wellhead or interface point will not be known until the post incident site survey has been completed. In the meantime, consider and prepare a range of contingency plans. Some methods include:

- 1) Mechanical shims
- 2) Hydraulically operated tool that mates with the capping stack and can be aligned to match the angle of the incident well.
- 3) Installation of a subsea pile with either an on-bottom hydraulically actuated straighten tool or a sheave with a line connected to a surface vessel to pull the wellhead straight again.

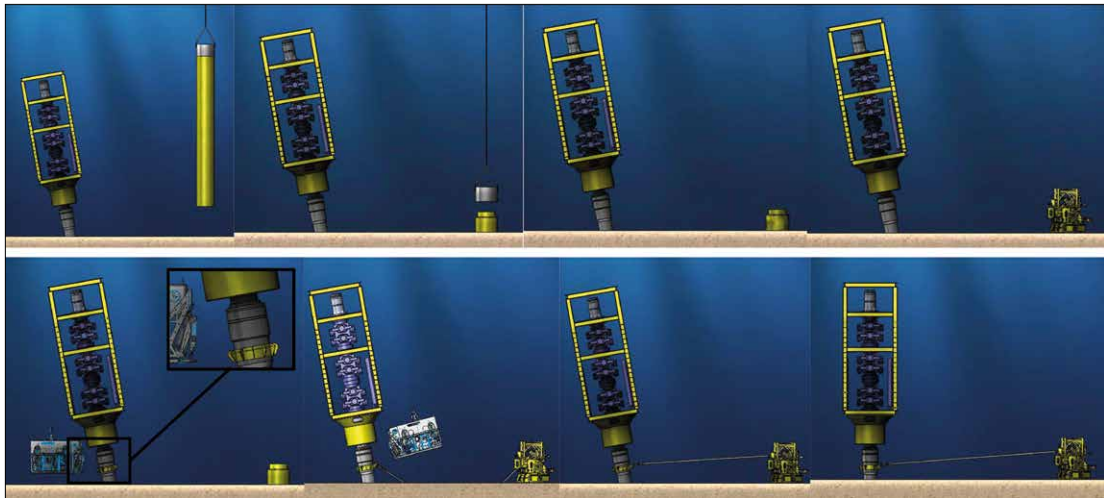


Figure 7: An example of a well straightening concept. This concept involves installing a subsea pile with a winch that is hydraulically actuated by an ROV.

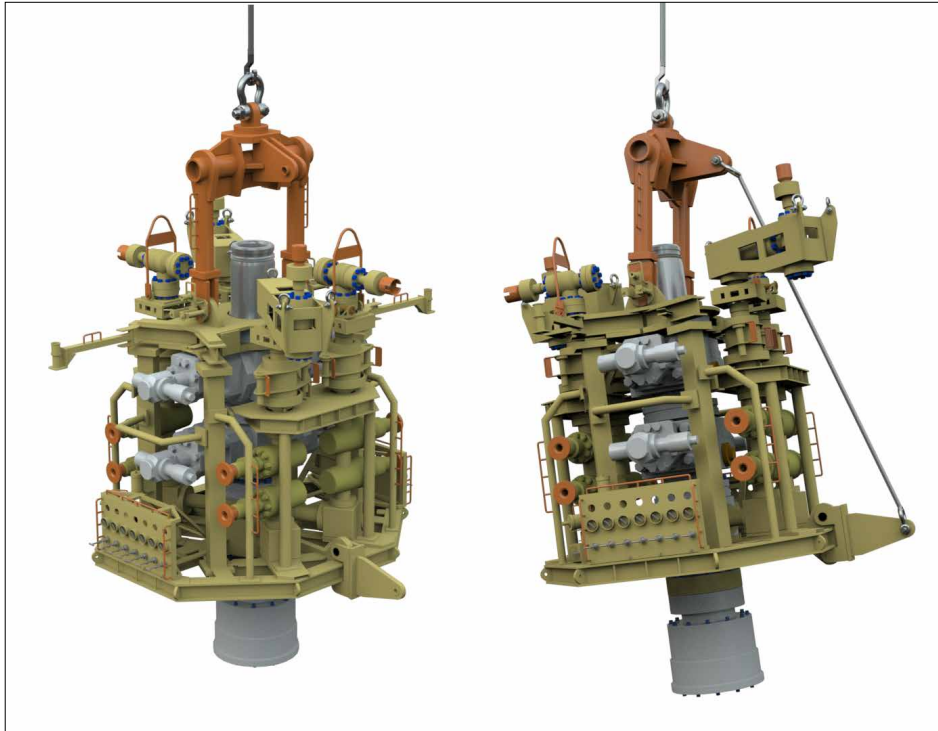


Figure 8: Alternative method for landing a capping stack on an inclined BOP.

Part 4: Logistics Planning

Subsea capping, containment, and dispersant equipment is stored in a number of strategic locations positioned around the world and if needed, will require a rapid mobilisation response, potentially involving air freight. To that end, having a robust logistics plan is an integral piece of the SCERP and should be developed. Operators have to supply equipment and resources for the complete solution. Given the nature of the equipment and available logistical resources, it is recommended to seek specialist expertise to develop the logistics plan. Key components or considerations of the plan are tabled below and some specific prompts are provided in the sub headings that follow.



Figure 9: A snapshot of commercially available capping stacks as at 2018 which gives a sense of where equipment is strategically located (NOROG NCS Wells Capping Status Report 2016)



Figure 10: Conceptual elements of a logistics plan. This example is based on an Oil Spill Response Limited (OSRL) plan but can be applied to most circumstances in general.

Item	Description
Establish Timeline for deployment of capping stack	<ul style="list-style-type: none"> • Mobilise equipment from storage location to quayside or airport • At airport/quayside, organise, test, and load equipment onto transports (plane or ship) • Consider impact of local infrastructure (roads, traffic, power lines, etc.) on ability to move large heavy loads
Establish Timeline for mobilisation of Operator's Equipment	<ul style="list-style-type: none"> • Mobilisation of support equipment that is not provided by the capping stack provider. Equipment includes: <ul style="list-style-type: none"> - Dispersant conduit system - Hydrate prevention or remediation chemicals (MEG or Methanol) - Specialist adapters or interfacing equipment - Wellhead straightening equipment - Additional debris removal tools - Specialist ROV site survey and debris clearance tools - Rigging equipment
Air transport – time estimates	<ul style="list-style-type: none"> • Determine aircraft availability and time necessary to move to deployment airport • Multiple flights likely
Airport infrastructure assessment	<ul style="list-style-type: none"> • Determine availability and capability of load out equipment (cranes, scissor lifts, dollies, etc.) • Establish staging areas; ability to accommodate multiple aircraft • Customs clearance
Road Transportation	<ul style="list-style-type: none"> • Route planning and permits to transfer equipment from the airport to the sea port
Equipment Staging and Preparation	<ul style="list-style-type: none"> • Available space for staging • Available resources such as high capacity cranes, air, water, power, pressure testing areas, etc.
Installation vessels	<ul style="list-style-type: none"> • DP Station keeping • High capacity active heave compensated crane or winch; assess wire size, length and age/condition • Launch and recovery capabilities/over-board cranes • Deck space • Sea fastening plan
Customs clearance	<ul style="list-style-type: none"> • Establish contacts and plans for swift customs clearance upon arrival in country of destination
Personnel visas	<ul style="list-style-type: none"> • Ensuring that specialist or other support personnel obtain business visas
Dispersant use approval process	<ul style="list-style-type: none"> • Consider obtaining pre-approval for import of dispersants • Understand National Oil Spill Contingency Plan and protocol/stakeholders for dispersant approvals • Exercise and plan NEBA/SIMA process
Subsea Dispersant Use and water column monitoring plan	<ul style="list-style-type: none"> • Ensuring there is regulatory alignment with any dispersant plans • Bulk replenishment and transfer

4.1 Logistics Survey

Operators should conduct logistics surveys to understand their own requirements and limitations regarding:

- Airport capabilities
- Availability of equipment to handle the incoming air freight
- Ease of egress from the airport to the port
- A route survey between the airport and the port of operations to understand transport and load restrictions (e.g., height, width, and load restrictions)
- Offloading capabilities at the port of operations

A yearly, or as needed, review of the logistics survey can identify changes in handling equipment (e.g., cranes and trucks) as well as changes in infrastructure (e.g., roads and bridges).

4.2 Airfield Location

Consideration should be given to relying on the expertise of freight-forwarding companies to assist selecting the appropriate airport closest to port of operations. The Logistics Survey should identify appropriate airports related to the landing and handling of heavy-lift aircraft (e.g., Antonov AN 124 and Boeing B747F). Typical airport limitations include:

- Runway length, width, and load capacity
- Ground handling equipment e.g., cranes, main deck loader availability and capacity (required for B747F), trucks, and trailers to support operations at the airport
- Access to and egress out of the airport for cranes, trucks, and trailers for shipping equipment to the selected port of operations

4.3 Ground Transportation

- The logistics survey should identify special transportation needs and the availability of cranes, trucks, and trailers to handle transport of incoming cargo to the port of operation. Most equipment in the mutual aid response kits are standard container loads, and no special truck and trailer arrangements are necessary.
- Depending on local transport restrictions identified in the logistics survey, a “low boy” trailer configuration can be used for some components, e.g., the capping stacks if shipped assembled.

4.4 Customs Clearance for Mobilisation of Oil Spill Response Equipment

- The Incident Notification procedure is set up to mobilise a large amount of emergency response equipment and is likely to take place in parallel with establishment of an IMT in the Region. Procedures should be in place to mobilise the oil spill response equipment independently of the IMT.
- Mobilisation to the offshore location is via the port of operations, although there can be cases in which equipment is transported directly from storage to the incident site (e.g., flexible flowlines on board a flowline lay vessel).

4.5 Quayside Capabilities

- Understand the quayside maximum vessel draft and provide drawing(s) showing quayside load rating for use during crane outrigger rig up and lifting operations.

4.6 Cranes, Lifting and Rigging

Rigging and lifting contractors should be engaged and the requirements considered as part of the logistics plan.

4.7 Bulk Replenishment and Transfer

An incident response uses a large volume of bulk material e.g., dispersants, drilling fluids, well-kill fluids, methanol, glycol, and mono-ethylene glycol. Methanol and glycol for hydrates mitigation and suppression, dispersants for subsea delivery and drilling, and well kill fluids are considered bulk material.

Dispersants are essential and sourcing of additional volumes for replenishment should be considered. There may be local or regional stock piles that may be accessible through mutual aid mechanisms.

Note that due to safety concerns, a special safety plan should be developed for hydrate inhibition chemicals, such as methanol, to include storing, handling and use.

Appendix 1: Containment Planning

A1.1 Well Containment Overview

The Subsea Well Containment method follows the concept of developing a temporary subsea production system. It may be necessary in cases where the Well Capping is not feasible. The majority of discussion within this Appendix assumes the incident well is some distance from existing infrastructure. It may be that if the incident well is within an existing subsea field development area, implementing containment is a simpler exercise. The following information attempts to summarise a complex system. It does not cover all options, such as the Top Hat or insertion systems. These guidelines originated by the IOGP Subsea Well Response Project (SWRP) in response to recommendations made in the IOGP GIRG report.

The Well Containment concept (as illustrated below in Figure 7) involves combining subsea production foundations and equipment, subsea well test and surface production equipment with the Generic Containment Toolkit (available through subscription) to create a temporary subsea field production system. In addition to combining the equipment, dedicated production operations procedures are required as well as all other necessary process safety tasks such as HAZOP, HAZID and vessel classification type activities. Depending on the uncontrolled flow potential and flow assurance considerations, multiple production legs may be required to safely flow hydrocarbons from a wellhead to the surface in a controlled way, ready for storage or disposal.

In terms of the production process, hydrocarbons flow from the capping stack chokes to a flow line end termination module. From there, they flow through a flexible flow line to a flow spool that is mounted on a conductor. On top of the flow spool, the capture vessel's marine riser or landing string system is installed. A subsea test tree (SSTT) is then run and essentially a well test plan follows. Note that in shallower water depths, a jack-up rig could be an option and an open water riser (OWR) system considered. Produced liquids could then be offloaded to crude tankers or by incineration during periods of tanker absence. In addition to the production stream, to mitigate hydrates and other flow assurance concerns that may arise, a chemical injection stream is also necessary. Similar to dispersant injection, a vessel is required which pumps the necessary chemicals via a conduit (in the example below coil tubing is used, other methods exist), to a termination head. From there, the chemicals are routed to a chemical distribution assembly, flying leads installed to the capping stack and possibly flow line end termination module and chemicals injected into the flow stream.

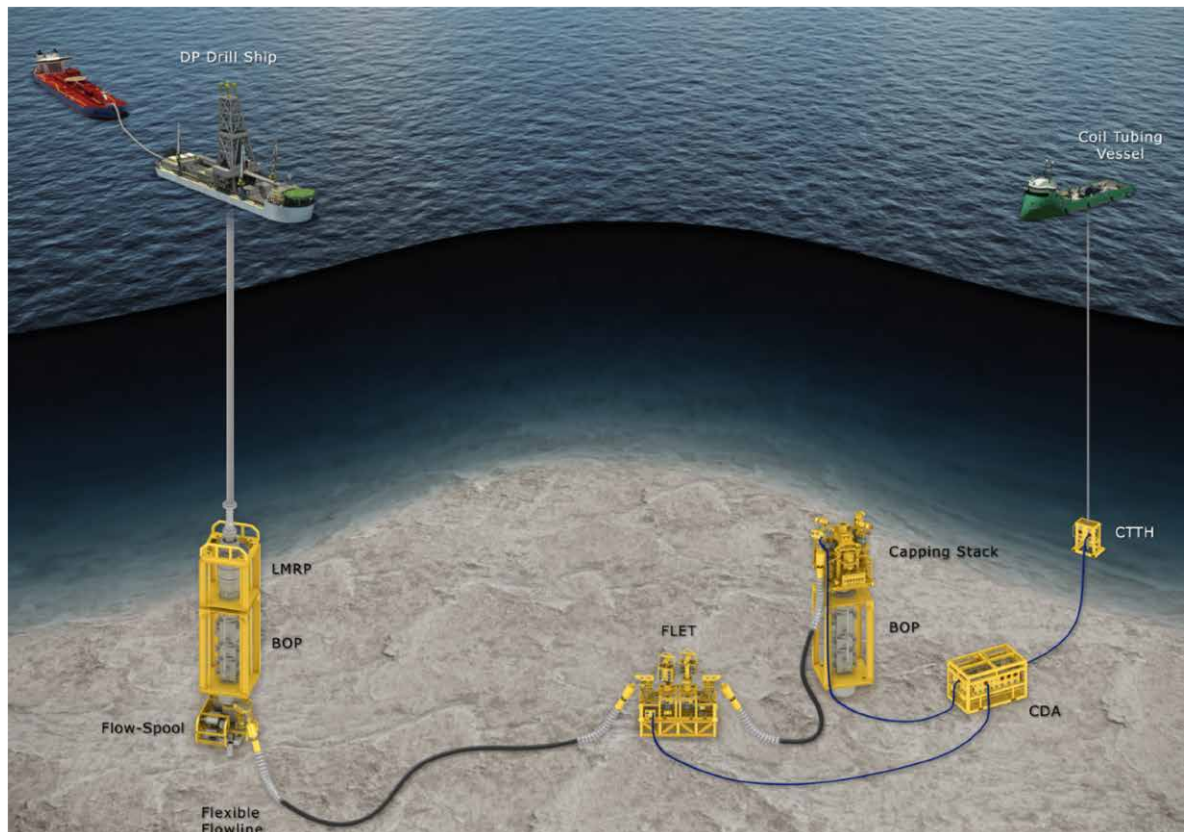


Figure 11: A graphic depicting a single leg subsea containment system.
Source: IOGP SWRP Containment Guidelines.

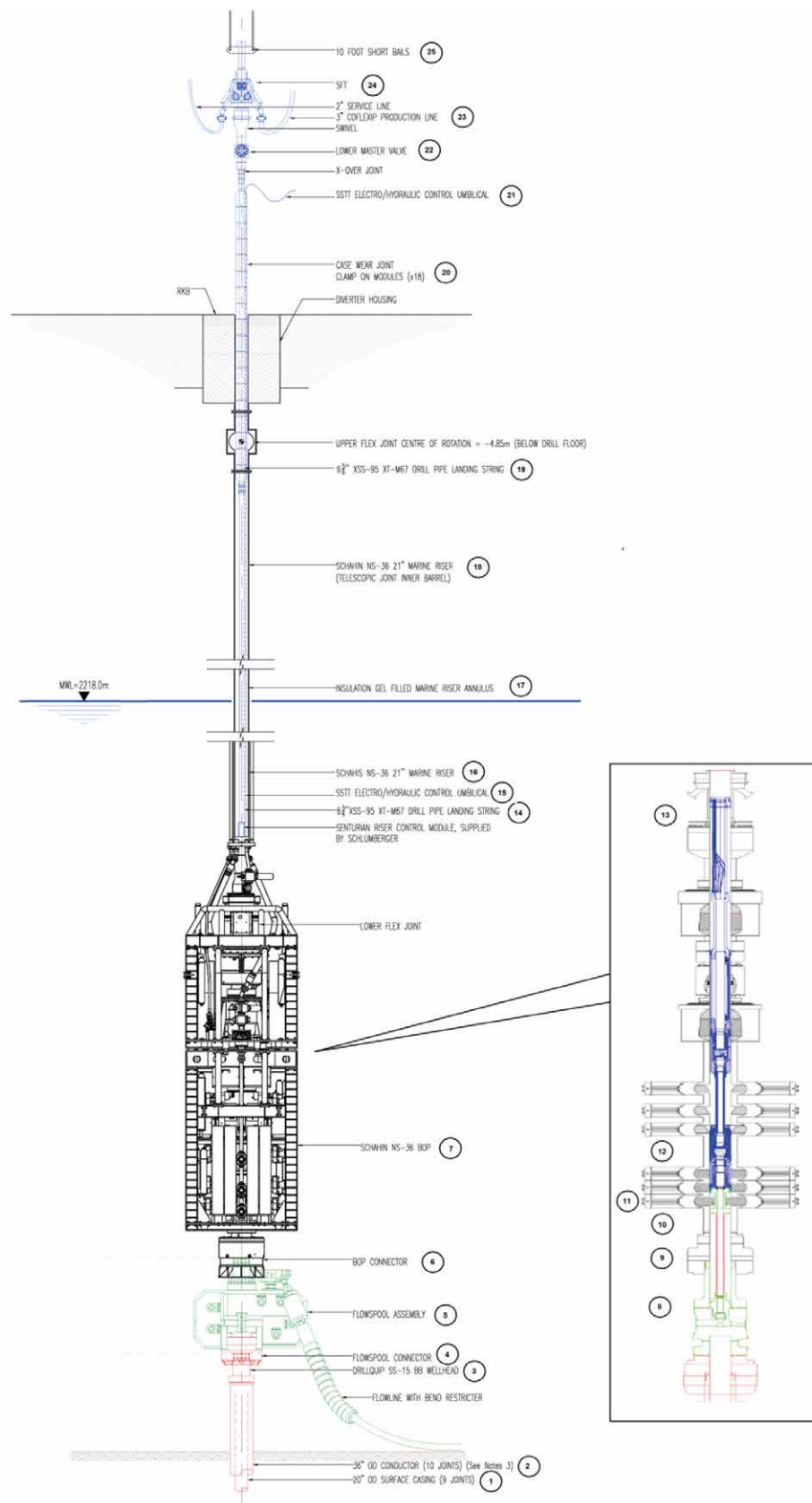


Figure 12: Conceptual equipment layout for a containment riser configuration with subsea well test equipment installed. Source: Courtesy of IOGP member.

A1.2 Cap and Containment Planning Process

When preparing or evaluating Well Containment response it is necessary to obtain knowledge about the equipment available, and, examine the specifications and limitations with reference to the incident wells basis of design. This input data is essential for the initial modelling and analysis which are required to define seabed and surface architecture for Well Containment operations.

In order to prepare a timely mobilisation and deployment plan, it is important to identify Operator provided equipment and resources which are required for the Well Containment concept. The extent of this evaluation with related pre-investment will depend on the required level of emergency preparedness (i.e., the response time), number of containment legs required as well as the number and type of support vessels needed to implement the system.

Furthermore, well intervention tactics and flow assurance analysis must be engineered to preclude additional and potentially irreversible wellbore or subsea infrastructure damage which could result in prolonged environmental impacts, as well as prevent interference with other response operations.

These evaluations should be performed prior to the spudding of the well to ensure that no major gaps related to logistics, equipment or methods for Well Containment are identified and addressed within the project. The planning flow chart shown below can be used as a guide to help develop a workflow and Well Containment emergency response plan.

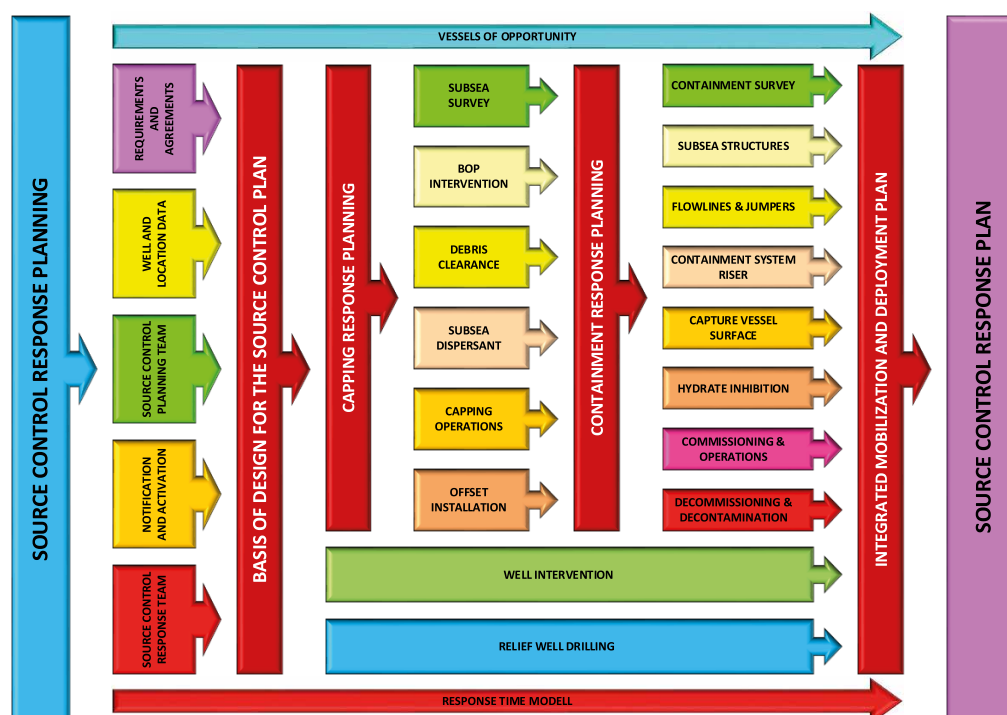


Figure 13: An overview of the containment planning work flow.

A1.3 Well Containment System Modelling and Analysis

In addition to the Well Capping response planning activities, Well Containment response planning requires a basis of design for production process, definition of subsea production legs and flow assurance. With analytical information prepared, a draft field layout plan, equipment lists and Well Containment response tasks may be produced. This modelling may require multiple revisions as an increased amount of data become available and be flexible enough to be easily adapted to actual field conditions on the day of incident.

A system compatibility analysis should be performed to confirm the ability to combine the identified equipment. This analysis includes, but is not limited to the following:

- **Fluid characterisation:** Characterise and tune a thermohydraulic model to predict transport/physical/thermal properties of the fluid in the interest range of T and P.
- **Hydrate:** Predicted hydrate (HSZ) curves.
- **Wax and asphaltene:** Predict the wax and asphaltene curves.
- **Maximum uncontrolled flow:** Identify the well potential maximum uncontrolled flow discharge rate.
- **Operating boundaries:** Define initial pressure and flow boundary conditions.
 - Define minimum allowable cap pressure to avoid water ingress (e.g., hydrostatic pressure).
 - Define maximum cap pressure (e.g., from capping integrity assessment or maximum expected design pressure of the subsea system).
 - Identify the expected range of blowout rate.
- **Define potential operating scenarios:** Define expected range of flow rate per Well Test train and Fluid arrival temperature to the topsides.
 - Identify the expected flow rates, per Leg, per train, based on the reservoir performance and limitation of the containment system.
 - Predict the required wellhead pressure in order to capture the expected flow rates.
 - Identify the expected operating envelope.
 - Identify the expected arrival fluid temperature to the topsides.
- **Well trajectory:** Add reservoir and well trajectory to the model in order to capture the effect of the containment system on the reservoir productivity and the expected flow to be captured.
- **Topside requirements:** Predict the required inlet pressures at well test packages topsides based on the flow rates and the arrival temperatures. Develop surface processing equipment layout (paying particular attention to sand production, heat exchangers and offloading specifications).
- **System limitations:** Identify the maximum allowable backpressure on the Incident Well in order to maintain well integrity and for selection of Bust Discs.
- **Operating envelope:** Define operating envelope for different combination of vessels/trains in order to identify optimum number of vessels / legs / trains required to contain the flow.

Supporting documentation for these evaluations can be found in the OSRL-SWRP “Master Guide to Subsea Well Capping and Containment Response Planning” (SWR-PR-AA-PRO-10000) and the Subsea Well Containment Guidelines (SWCG).

A1.4 Field Layout Definition

The objective of this task is to define the seabed and surface architecture for Well Containment operations. This is achieved by combining output from the Well Containment System Modelling and analysis (legs for containment) with the Containment Toolkit data and preliminary Operator data (e.g., incident well location and relief well positions) to enable drawings detailing both the Capture Vessel(s) surface positions layout and the subsea equipment layout local to the incident well. This analysis includes, but is not limited to the following:

- **Surface Slick and Debris Location:** Determine where the surface slick will be based on calculated blowout rates, production chemistry, and Metocean data. Estimate subsea debris that is in alignment with the envisaged incident scenario in the project’s basis of design.
- **Surface Layout:** Document the heading and location of the Capture Vessel(s) with relation to the Incident Well. The distance of the Capture Vessels from the incident well may vary depending on water depth and type of capture vessel selected.
- **Seabed Layout:** Document the heading and location of the capping and containment subsea equipment with relation to the incident well.

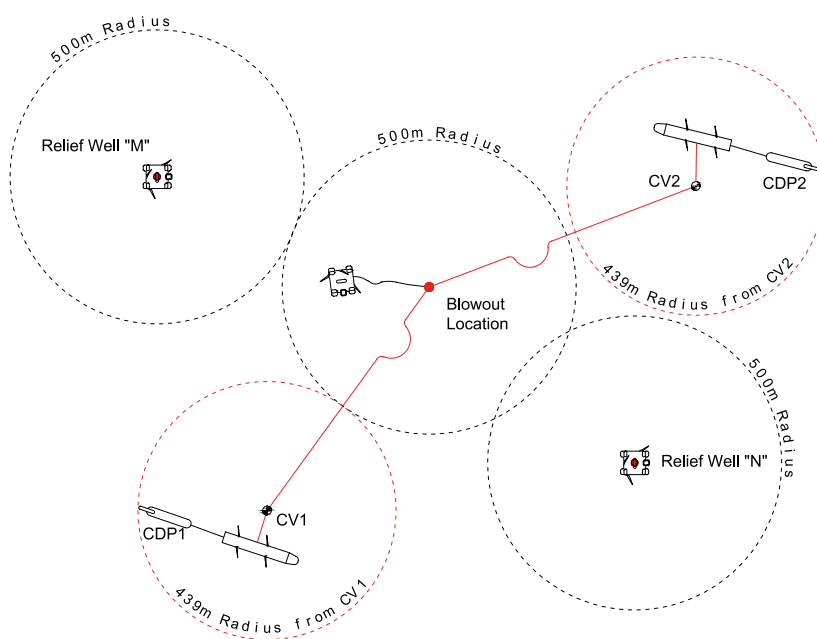
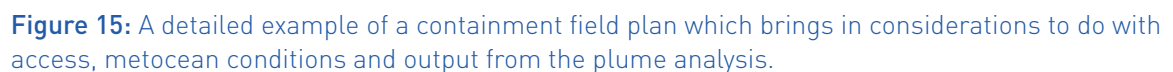


Figure 14: An example of a first pass conceptual layout depicting an incident well that has been capped and flowing hydrocarbons through the red flowlines to CV1 and CV2 processing facilities which then offload to CDP1 and CDP2. In addition, two relief well locations have been identified.



A1.4.1 Key Operational Tasks for System Deployment

- 1) **Containment Survey:** The Scope of the Containment Survey is to conduct the over-arching survey which will facilitate the Containment activities that follow. This includes the identification of seabed features and debris caused by the incident which may affect the previously planned locations for the Common Subsea System.
- 2) **Installation of Subsea Structures:** The scope of this task is to prepare and install the subsea structures as per overall field layout for the subsea system, prior to subsea lay of the flexible flowlines.

- 3) **Installation of Flowlines and Jumpers:** The scope of this task is to prepare and lay the subsea flowlines and jumpers that will be required for the subsea system as well as hook-up to the Capping stack and Flowspool on each containment leg.
- 4) **Installation of the Containment System Riser (CSR):** The scope involves mobilising, deploying and installing the CSR with foundation, flow spool, subsea test tree, landing string, surface flow tree and thermal insulation gel-filled Marine Riser.
- 5) **Deployment of Surface Capture Vessel:** The scope of this task is the deployment of a surface hydrocarbon processing and offloading system, for the safe capture and disposal of processed fluids. This includes the execution of the required modifications for the capture vessel and well test equipment according to previously prepared modification plans.
- 6) **Hydrate Inhibition:** The scope of this task is to prepare and deploy a chemical delivery system capable of providing the subsea system with MEG on demand.
- 7) **Pre-commissioning, Start-up and Operations:** The scope of this task is to provide guidance with regards to pre-commissioning of the containment system prior to start-up, ensure a controlled start-up of the system with the containment of the uncontrolled flow, and provide monitoring requirements during the containment operation for steady state and transient flow operations.
- 8) **Decommissioning and Decontamination:** In addition to the tasks mentioned above, a plan should be prepared for decommissioning and decontamination of equipment and resources used. This plan should also include the procedure for decontamination of vessels supporting the ongoing Well Capping and Well Containment operations.

Appendix 2: SCERP Group Descriptors

The following tables may be of use when preparing a SCERP to help define the different roles, responsibilities and actions that are associated with each task group's activities.

A2.1 Site Survey & Initial Assessment

Site assessment operations should be conducted to determine the extent of damage to the well, chart damaged structures and equipment, and plan debris removal operations to gain safe access to the well. Initial assessments can also indicate whether specialised subsea intervention tools are needed.

Example of Key Activities:	<ul style="list-style-type: none"> • Deploy ROVs to inspect well site • Install acoustic positioning system • Conduct air monitoring at surface • Map debris field • Determine wellhead & BOP damage, subsea structure integrity, wellhead inclination • Determine source(s) of hydrocarbon release and geometry of release point(s) • Provide continuous ROV video and data feed to support facilities (intervention vessels, command posts, etc.) • Conduct air monitoring at surface
Example Engineering Analysis:	<ul style="list-style-type: none"> • Determine whether sonar equipment is necessary to conduct Subsea Survey, or if ROV camera is adequate (ref. visibility from previous BOP inspections). • Identify Vessels of Opportunity according to minimum requirements
Examples of Required Resources:	<ul style="list-style-type: none"> • ROVs with support vessel and operator(s) • Positioning & Communications equipment • Air & Water monitoring equipment • Marine vessels & surveillance aircraft • Sonars (2D, 3D) and ROV Manipulator Operated Camera. • Gas Detection System. • Personal Protective Equipment (PPE). • Sea Fastening and Lashing Gear

Description	Recommended Vessel Requirements
Positioning	DP 2
ROV	Min (1) Medium Work Class w/ capability to reach mud line at incident well centre and survey 50m radius around well centre
Crane	n/a
Tank Capacity	n/a
Helideck	Preferred
Communications	Voice and Data (streaming video preferred)
Accommodations	5 Operator personnel
Other	Compliance with SIMOPS and HSE Requirements for operations within Safety Zone

A2.2 BOP Intervention

BOP intervention is conducted during the initial response stages in order to attempt to shut-in a well with the existing BOP equipment by closing the rams by using a ROV. If the well is successfully shut-in, sealed, and holds the shut-in pressure, no other activities will likely be required other than killing the well.

Example of Key Activities:	<ul style="list-style-type: none"> • Review site assessment survey • Mobilise marine vessel with ROV and Subsea Accumulation Module (SAM) • Connect to BOP and attempt to close rams • Monitor well for closing and breaching • Monitor wellbore pressure and temp
Example Engineering Analysis:	<ul style="list-style-type: none"> • Conduct review of BOP operational requirements and confirm that BOP Intervention equipment is suitable for use • Requirement for Nitrogen and Hydraulic fluid • Determine the configuration of BOP Intervention system which would be the most efficient based on the deployment vessel capabilities • Depending on selected vessel, verify that the stack-up height of the combined ROV and BOP Intervention Skid is acceptable • Verify that soil conditions may facilitate the use of the Intervention system without additional mud mats • Identify Vessels of Opportunity according to minimum requirements
Examples of Required Resources:	<ul style="list-style-type: none"> • Marine vessel with work class ROV's • As built BOP drawings • BOP interface tools • SAMS & Flying Leads • Nitrogen and Hydraulic Fluid according to well and location requirements. • Pre-charging pump or subsea accumulator bottles (SAM) mobilised as air freight • Mud mats (depending soil conditions and SAM configuration) • Gas Detection System • Personal Protective Equipment (PPE) • Sea Fastening and Lashing Gear

Description	Recommended Vessel Requirements
Positioning	DP 2
ROV	Min (2) Medium Work Class w/ capability to reach ML at incident well centre and survey 50m radius around well centre Hydraulic Capability: 9.5lpm Carrying Capacity: 100kg
Crane	Yes – Capable of deploying 35t to ML (Active Heave Compensation preferable)
Tank Capacity	n/a
Deck Space	400 m ²

Helideck	Preferred
Communications	Voice and Data (streaming video preferred)
Accommodations	10 Operator and 3rd Party personnel
Other	Compliance with SIMOPS and HSE Requirements for operations within Safety Zone

A2.3 Debris Removal

Debris removal is conducted as needed to make the site safe for work and allow access to the source so that well intervention and capping operations can be conducted.

Determination of the LMRP removal is a key part of this activity. Removal of the drilling rig and other associated debris outside of the immediate work area is not part of this activity.

Example of Key Activities:	<ul style="list-style-type: none"> • Cut/remove choke and kill lines • Cut and remove riser • Removal of LMRP • Clear all other debris that could impede well control operations • Provide a clear chain of custody for any debris recovered • Identify and maintain a "wet store" area
Example Engineering Analysis:	<ul style="list-style-type: none"> • Conduct review of Debris Clearance requirements and confirm that Debris Clearance equipment is suitable for use on the expected debris • Identify Vessels of Opportunity according to minimum requirements
Examples of Required Resources:	<ul style="list-style-type: none"> • Vessels with Dynamic Positioning for debris removal operations • Subsea cutting and grinding equipment • Rigging and lifting for debris removal • ROVs (2) with support vessels and crew • Subsea hydraulic power for operating cutting equipment • Well Control Specialists • Marine Engineering • Mineral Oil Tellus 22 (or similar) for refilling the Hydraulic Power Unit • Gas Detection System • Personal Protective Equipment (PPE) • Sea Fastening and Lashing Gear

Description	Recommended Vessel Requirements
Positioning	DP 2
ROV	Min (2) Heavy Work Class w/ capability to reach ML at incident well centre and survey 50m radius around well centre Hydraulic Capability: 57 lpm Carrying Capacity: 100 kg

Crane	Yes – Capable of deploying 50t to ML (Active Heave Compensation preferable) Second crane with same or greater rating is preferred to secure loads during cutting.
Tank Capacity	n/a
Deck Space	400 m ²
Helideck	Preferred
Communications	Voice and Data (streaming video preferred)
Accommodations	15 Operator and 3rd Party personnel
Other	Compliance with SIMOPS and HSE Requirements for operations within Safety Zone. Dry air supply.

A2.4 Subsea Dispersant Application

Subsea dispersant is used to help minimise surface spill impact and enable a safe working environment by accelerating the breakdown of hydrocarbons below the surface and reducing volatile organic compounds (VOCs) on the surface. Subsea dispersant can be injected into the flow of hydrocarbons from a release point. Application rates and methods will vary based on conditions. Subsea dispersants would not be required for gas wells.

Example of Key Activities:	<ul style="list-style-type: none"> • Determination of whether the discharge is dispersible • Selection of the dispersant for the discharge • Develop dispersant application (rate and location(s)) plan and monitoring plan • Advance approval to use subsea dispersant chemicals through the appropriate approval authority • Conduct water column and surface monitoring and reporting per approved plan • Activate replenishment vendor
Example Engineering Analysis:	<ul style="list-style-type: none"> • Conduct review of Subsea Dispersant requirements and confirm that Subsea Dispersant equipment is suitable for use • Evaluate and select Pump and Conduit solutions with possible adaptors according to interfaces requirements. Both water depth (length of conduit) and dispersant injection rate should be considered when selecting pump and size of conduit • Evaluate regulatory requirements and strategy for the use of subsea dispersant chemicals. If possible, it is recommend obtaining pre-approval for dispersant application, including Net Environmental Benefit Analysis (NEBA) identifying approved dispersant type and application rate • Determine the appropriate dispersant application rate and total volume requirement. In general, a Dispersant to Oil Ratio (DOR) of 1:100 should be assumed for planning purposes. However, the actual DOR will be determined based upon the actual dispersant type and results of Net Environmental Benefit Analysis (NEBA) • Identify Vessels of Opportunity according to minimum

Examples of Required Resources:	<ul style="list-style-type: none"> • Spill modelling • Subsea dispersant chemical (e.g. COREXIT 9500) • Pump (4-10 gpm) • Dispersant injection system with hose/umbilical's • Conveyance and Downline for dispersant supply • Equipment deployment vessel • Dispersant supply vessel • Subsea and Surface monitoring equipment & crew • Location beacons. • Vessel Positioning and Communication System with Streaming Video. • Gas Detection System. • Personal Protective Equipment (PPE). • Sea Fastening and Lashing Gear.
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Note: For dispersants, please refer country specific regulatory requirements for the use of dispersants.

Description	Recommended Vessel Requirements
Positioning	DP 2
ROV	Min (2) Heavy Work Class w/ capability to reach ML with Tether capable of reaching well centre and navigating work area at mud line. Carrying Capacity: 100kg
Crane	Yes – Capable of deploying 17.5t to ML (Active Heave Compensation preferable).
Tank Capacity	Preferred. Deck tote tanks can be used, but below deck bulk storage is preferred.
Deck Space	750 m ²
Helideck	Preferred
Communications	Voice and Data (streaming video preferred)
Accommodations	25 Operators and 3rd Party personnel
Other	Compliance with SIMOPS and HSE Requirements for operations within Safety Zone. Deck air, water and electricity. Moonpool is recommended for hose / CT deployment.

A2.5 Capping

The well Operator is responsible for developing and implementing plans for capping operations. Initial operations should address mobilisation of the capping device and deployment of all support equipment to the well site. The type of equipment and procedures to be used will be outlined in the Operators Well Source Control Plan.

Example of Key Activities:	<ul style="list-style-type: none"> • Pre-existing access agreement/subscription to a capping stack provider • Review of the well structural integrity to contain pressure and determine shut-in and kill options • Mobilization and deployment of capping stack and support equipment (e.g. hydraulic accumulator for subsea controls) • Development and execution of plan to for wellhead straightening if needed to properly install the capping stack • Testing and preparation of the capping stack before deployment • Install capping stack and hydraulic system • Evaluate need for hydrate management • Shut-in the well with the capping stack • Develop well kill options
Example Engineering Analysis:	<ul style="list-style-type: none"> • Conduct review of Capping operations requirements and confirm that Capping equipment is suitable for use – i.e., water depth rating, internal temperature rating, internal pressure rating, etc. • Assessment of Capping Stack mechanical interfaces to verify that the Wellhead and BOP interfaces are compatible with the Capping Stack connector • The worst-case scenario, that of an open-hole blowout (no drill string in the hole) with discharge to seabed, should be evaluated to confirm that the flowing well conditions are within Capping equipment specifications and that the equipment is suitable for use • The well integrity at the maximum expected shut-in wellhead pressure should be evaluated to confirm that Capping equipment is suitable for use and to define if the well can be classified as 'Cap only', or if a Well Containment solution may be required • The impact of the blowout on the wells structural integrity should be assessed to determine fatigue loading on wellhead / BOP assembly with the Capping Stack installed • Depending on flow rates and fluid properties it is recommended to perform Computable Fluid Dynamics (CFD) analysis of uplift forces during the installation of the Capping Stack • In-water plume and gas dispersant modelling should be considered to determine if an Offset Installation Solution and/or additional safety precautions and mitigating actions for marine operations are required • Prior to the start of capping stack shut-in operations, a soft shut-in model should be constructed to provide a baseline pressure chart which should be referenced during the actual shut-in operations to ensure that well integrity is maintained • Well and location specific requirement for Nitrogen and Hydraulic fluid • Identify Vessels of Opportunity according to minimum requirements

Examples of Required Resources:	<ul style="list-style-type: none"> • Well Control Response plan that analyses the well design for worst case discharge, shut-in capability, • Capping stack that is rated for the water depth and well pressure and temperature with the appropriate connector • Deployment vessel with sufficient lift capacity for capping stack and support equipment (e.g., deepsea intervention vessel, anchor handling vessel with 40' A frame) • ROVs (min. 3) with support vessel(s) and crew • Hydraulic power, e.g., ROV belly skid • Hydrate inhibition system and methanol supply • Wellhead straightening equipment if required • Inclination Tool (if inclined wellhead / BOP) • Secondary containment cap • Nitrogen and Hydraulic Fluid according to well and location requirements • Mud mats (depending soil conditions) • Vessel Positioning and Communication System with Streaming Video • Gas Detection System • Personal Protective Equipment (PPE) • Sea Fastening and Lashing Gear
Description	Recommended Vessel Requirements
Positioning	DP 2
ROV	Min (2) Heavy Work Class w/ capability to reach ML at incident well centre and navigating work area at mud line. Carrying Capacity:100kg
Crane	Capable of deploying capping stack at mud line. Active Heave Compensation required.
Tank Capacity	n/a
Deck Space	400 m ²
Helideck	Preferred
Communications	Voice and Data (streaming video preferred)
Accommodations	25 Operator and 3rd Party personnel
Other	Compliance with SIMOPS and HSE Requirements for operations within Safety Zone. Deck air, water and electricity.

A2.6 Capture, Contain and Flow to Surface

Capture and collection operations apply to subsea hydrocarbon collection in the interim of or simultaneous to the execution of the capping solution and/or relief well drilling. It also refers to the integration of flowlines with the capping device to transfer hydrocarbons to the surface in the instance of a cap and flow scenario. In this instance an intervention riser system can be used to direct the release for processing, transfer, and offloading of oil to a shuttle vessel.

Key Activities:	<ul style="list-style-type: none"> • Placing “Top Hats” or other collection devices over the source to capture the oil • Hydrate remediation • Transferring the captured oil to a marine capture vessel • Processing the captured oil into gas and oil on the marine capture vessel • Venting and burning the processed gas • Transferring the processed oil to a tank vessel or barge using a floating transfer hose • Transporting oil to shore • Destination facilities on shore
Required Resources:	<ul style="list-style-type: none"> • Top Hat (one or more), Riser Insertion Tube Tool (RITT), or other collection device • Drill ship for equipment deployment and flow-back • Subsea riser assembly • Hydrate inhibition system and methanol supply • Topsides processing facility (oil/water and oil/gas separation, gas flaring) • Shuttle tankers or barges for lightering/offloading • Offloading transfer hoses and hawsers
Example Equipment & Service Providers:	<ul style="list-style-type: none"> • Well Containment Provider: HWCG, MWCC, OSRL • Wild Well Control • Boots & Coots (Halliburton) • Edison Chouest • Trendsetter Engineering, Inc. • Schlumberger (well test package) • InterMoor (offloading/lightering) • Oceaneering (hydrate inhibition) • Hornbeck Offshore • Helix Energy Solutions

A2.7 Simultaneous Operations (SIMOPS) Planning

Simultaneous operations (SIMOPS) is a formal written process and defined as performing two or more operations concurrently that might cause conflicts with one another in normal or emergency situations. SIMOPS should be coordinated to ensure safe and efficient operations between all marine and subsea assets deployed in support of the incident.







Key Activities:	<ul style="list-style-type: none"> • Identify the SIMOPS hierarchy and priorities for the major scopes of work between surface oil spill response, all well control, and intervention operations and safety and monitoring operations • Outline high-level SIMOPS decision-making steps and provide detailed SIMOPS process and procedures to follow by all responders • Provide a detailed communications plan to ensure that all responders understand and abide by SIMOPS requirements • Establish a SIMOPS area/zone (typically 500-1000 meters) • Coordinate and schedule all activities within the SIMOPS area • Arrange for the transport of all well control materials to the site • Create and maintain SIMOPS plan detailing organisation and process flow • Maintain constant communications within the source control group and with other Operations functions (e.g., Air Operations, Emergency Response)
Required Resources:	<ul style="list-style-type: none"> • Support Vessels (type and amount to be determined) • Communications package (e.g., AIS)
Example Equipment & Service Providers:	<ul style="list-style-type: none"> • To be manned by the Responsible Party








A2.8 Decontamination & Demobilisation






Decontamination needs to be conducted as soon as equipment has been mobilised to prevent cross contamination of relatively clean environments. Decontamination stations should be established at the entry/exit of ports that support the Source Control efforts of the response. Vessels may be required to go through a gross decontamination at port entrances prior to entry.

Key Activities:	<ul style="list-style-type: none"> • Gross decontamination of vessels prior to entering a port booming off a vessel at berth within the port • Hazardous waste disposal • Final decontamination prior to demobilisation from the incident • Large vessels may require final decontamination at a shipyard • Rigs or drillships will require final decontamination offshore since these vessels, by design, cannot enter most commercial waterways due to draft limitations
Required Resources:	<ul style="list-style-type: none"> • Multiple small boats • Containment Boom • Pressure Washers • Sorbents
Example Equipment & Service Providers:	<ul style="list-style-type: none"> • Local OSROs • Shipyards (for rigs & large vessels)

Appendix 3: 2018 Global Capping Stack Resource Locations

	Oil Spill Response					
Summary of Capabilities						
Location / Status	Norway, Stavanger / Ready	Brazil, Angra dos Reis / Ready	South Africa, Saldanha / Ready	Singapore, Loyang / Ready	United Kingdom, Aberdeen / Ready (OSPRAG)	Italy, Trieste / Under Commissioning
Pressure Rating	15k psi	15k psi	10k psi	10k psi	15k psi	n/a
Seal Elements	2 x 18-3/4" Rams	2 x 18-3/4" Rams	2 x 7-1/16" Gate Valve	2 x 7-1/16" Gate Valve	2 x 5 1/8" Gate Valve	N/A
Connector Profile OD	27"	27"	27"	27"	27"	N/A
Hub Profile	HCH4 or HC	HCH4 or HC	HCH4 or HC	HCH4 or HC	H4	N/A
Water Depth (m)	3,000	3,000	3,000	3,000	3,000	75m - 600m
Stack Weight	~102mT	~102mT	~83 mT	~83 mT	~43 mT	236 mT
Footprint	16' x 13' x 28' to top of shackle	16' x 13' x 28' to top of shackle	16' x 13' x 28' to top of shackle	16' x 13' x 28' to top of shackle	13' x 13' x 15'	
Diverter Spool Outlets	4 x Outlets w/ 2 x 5-1/8" 15k PSI Gate Valves per outlet	4 x Outlets w/ 2 x 5-1/8" 15k PSI Gate Valves per outlet	4 x Outlets w/ 2 x 5-1/8" 15k PSI Gate Valves per outlet	4 x Outlets w/ 2 x 5-1/8" 15k PSI Gate Valves per outlet	1 x 5 1/8" Outlets	N/A
# Chokes / Flow	Three / 100,000bpd	Three / 100,000bpd	Three / 100,000bpd	Three / 100,000bpd	One / 75,000bpd	N/A
Deployment	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Wire
Operation	ROV (manual or hydraulic - hot stabs)	ROV (manual or hydraulic - hot stabs)	ROV (manual or hydraulic - hot stabs)	ROV (manual or hydraulic - hot stabs)	ROV, hydraulic	ROV
Design Temp degF = (degC x1.8)+32	minus 2 deg C to 150 deg C (302 deg F) - Operational minus 20 deg C to 40 deg C - Storage	minus 2 deg C to 150 deg C (302 deg F) - Operational minus 20 deg C to 40 deg C - Storage	minus 2 deg C to 150 deg C (302 deg F) - Operational minus 20 deg C to 40 deg C - Storage	minus 2 deg C to 150 deg C (302 deg F) - Operational minus 20 deg C to 40 deg C - Storage	250 deg F	minus 20 deg C to 50 deg C (Air) minus 2 deg C to 50 deg C (Water)
Manufacturer	Trendsetter	Trendsetter	Trendsetter	Trendsetter	Cameron	Saipem
Transportation Options / Scope	Sea or Air Stored assembled, disassembly required for transportation by air into 13 containers and 15 skids	Sea or Air Stored assembled, disassembly required for transportation by air into 13 containers and 15 skids	Sea or Air Stored assembled, disassembly required for transportation by air into 13 containers and 15 skids	Sea or Air Stored assembled, disassembly required for transportation by air into 13 containers and 15 skids	Sea	Sea or Air
Miscellaneous Comments					No ability to inject any fluid	

	Wild Well Control				Marine Well Containment Company		
Summary of Capabilities							
Location / Status	United Kingdom, Aberdeen / Ready	Singapore / Ready	United Kingdom, Montrose / Storage	United Kingdom, Montrose / Storage	USA, Ingleside (US Waters Only) / Ready	USA, Ingleside (US Waters Only) / Ready	USA, Ingleside (US Waters Only) / Ready
Pressure Rating	15k psi	15k psi	10k psi	15k psi	15k psi	15k psi	10k psi
Seal Elements	3 x 18-3/4" Rams	2 x 18-3/4" Rams	2 x 13 5/8" Ram BOPs	2 x 13 5/8" Ram BOPs	2 x 18-3/4" Blind Rams	1 x 18-3/4" Blind Ram	7-1/16" Dual Blind Ram
Connector Profile OD	27"	27"	27"	27"	27" or 30"	27" or 30"	27" or 30"
Hub Profile	H4 or HC	H4 or HC	H4 or HC	H4 or HC	H4 or HC	H4 or HC	H4 or HC
Water Depth (m)	3,800	3,800	3,000	3,000	3,000	2,440	3,000
Stack Weight	~96 mT	~116 mT w/ connectors	Weight with 2 Modules, ~28 mT	Weight with 2 Modules, ~42 mT	~170 MT w/ connectors and H4	~100 MT w/ connectors and H4	~40 MT w/ connectors and H4
Footprint	20' x 20'	20' x 20'	20' x 20'	20' x 20'	27' x 21' x 21' to 32.5' x 21' x 21' based on configuration (secondary containment cap installed)	22' x 16' x 16' (secondary containment cap installed)	18' x 9' x 9'
Diverter Spool Outlets	4 x 4-1/16" 15k PSI Outlets	4 x Outlets w/ 2 x 5-1/8" 15k PSI Gate Valves per outlet	BOP Side Outlets, 2x 3-1/16" Dual Block Gate Valves	BOP Side Outlets, 2x 3-1/16" Dual Block Gate Valves	4 x 5 1/8" Outlets	4 x Outlets w/ 1 x 5-1/8" 15k psi Gate Valves per outlet	2 x Outlets w/ 1 x 5-1/8" 10k psi Gate Valves per outlet
# Chokes / Flow	Two P25 Manual Chokes / 100,000bpd	2x 5-1/8" 15k CC40HP Choke / 150,000bpd	2x 3-3/16" 10k CC40HP Choke/350,000 bpd	2x 3-3/16" 10K CC40HP Choke/350,000 bpd	Four / Site and condition specific, seek advice.	Two / Site and condition specific, seek advice.	Two / Site and condition specific, seek advice.
Deployment	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Wire
Operation	ROV (hydraulic and manual)	ROV (hydraulic and manual)	ROV	ROV	Umbilical or ROV	ROV	ROV
Design Temp degF = (degC x 1.8)+32	API 16A, T-20/250	API 16A, T-20/250	API 16A, T-20/250	API 16A, T-20/250	250 deg F @ 15k PSI	350 deg F @ 15k PSI	300 deg F @ 10k PSI
Manufacturer	Cameron	Trendsetter	Cameron	Cameron	Aker	Trendsetter	Trendsetter
Transportation Options / Scope	Sea or Air	Sea or Air	Sea or Air	Sea or Air	Sea Stored assembled	Sea	Sea
Miscellaneous Comments				Parts have been used in different areas of operation			

	HWCG			PSW	Boots & Coots
Summary of Capabilities					
Location / Status	USA, Ingleside (US Waters Only) / Ready	USA, Ingleside (US Waters Only) / Ready	USA, TBC (US Waters Only) / Pending	Norway, Mongstad / Ready	USA, Houston / Ready
Pressure Rating	10k psi	15k psi	20k psi	10k psi	15k psi
Seal Elements	2 x 13-5/8" BSR Rams	2 x 18-3/4" Rams	1 x 5 1/8" Gate Valve per outlet 3 x 5 1/8" outlets 1 x 7" center bore valve	18 3/4" Dual Ram BOP	2 x 7 1/16" Gate Valves
Connector Profile OD	27"	27"	30"	27"	27"
Hub Profile	H4	H4 or HC	Dxe H4 profile	H4 or HC	DX15 H4 Connector
Water Depth (m)	3,000	3,000	3,000m	3,000m	3,000m
Stack Weight	~74 mT w/ connectors	~71 mT w/ connectors and H4	~75mT w/ connector	~80 mT w/ connectors and H4	~45 MT
Footprint	17.25'x14.6'x19.17'	16.94' x 16.94'x17.2'	15' x 11' x 26' (with running tool)	16' x 13.85'	10' x 20'
Diverter Spool Outlets	2 x 3 1/16" gate valves	2 x Outlets w/ 1 x 5-1/8" 15k psi Gate Valves per outlet	3 qty 5-1/8" Bores with 20k psi gate valves per outlet (3 side + 1 center)	2x outlets w/ 2 x 5 1/8" 10k psi Gate valves per outlet	2 x Outlets w/ 2 x 5-1/8" 15k psi Gate Valves per outlet
# Chokes / Flow	One / 130Kbpd / 220 MMCFpd	Two / 130Kbpd / 220 MMCFpd	Two / 130Kbpd / 220 MMCFpd	No chokes - but flowlines can be connected to clamp connector on diverter outlet Flowrate 95 000 bpd (water and oil)	Two / 330,000bpd
Deployment	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Drill Pipe / Wire	Wire
Operation	ROV, hydraulic	ROV, hydraulic	ROV, hydraulic	ROV / Hydraulic	ROV
Design Temp degF = (degC x1.8)+32	250 deg F	350 deg F	350 deg F @ 20k PSI	API -20°F to 250°F	250 deg F @ 15K psi
Manufacturer	WOM	Trendsetter	Trendsetter	Trendsetter	Trendsetter
Transportation Options / Scope	Sea Stored Assembled	Sea Stored Assembled	Sea	Sea Stored Assembled	Air Freight / Sea Freight Stored Assembled Shipped Partially Assembled
Miscellaneous Comments			Land Transport requires specialist heavy haul transport	Not rated for Air freight, not rated for OSRL flowback connections	System can be air freighted on 2 x 747-400 Capping Stack disassembled into 2 parts for rapid response

Appendix 4: An Overview of The Capping Stack Installation Process

- 1) Once the top of the BOP or wellhead has been cleared of any protrusions (using debris removal cutting tools if necessary), it is ready to accept the capping stack. The cap is deployed on either wire or drill pipe by an active heave-compensated crane or draw-works and lowered to within two to five feet of the BOP hub before being moved into the hydrocarbon flow stream and landed.
- 2) Detailed procedures are developed to address capping stack deployment and landing.
- 3) The operator should have detailed knowledge of capping stack interfacing to BOPs in the rig fleet, BOP spec breaks, FJ riser adapters, and wellheads.
- 4) The primary capping stack landing point is on the top of the BOP following LMRP removal. Alternative landing options are on the FJ riser adapter or on the wellhead.
- 5) Landing the capping stack on the FJ riser adapter necessitates use of the FJ straightening tool and installation of steel wedges (both of which are done to arrest FJ movement with the installed capping stack following removal of potential obstructions such as platforms and hydraulic hoses around the FJ). Removal of components around the FJ can be an ROV-intensive operation.
- 6) A high-level plan of events during a capping stack installation should cover all phases of the installation (including risk assessments, vessel details, flow regime and assurance, hydrates mitigations, vessel waypoints, lifting and handling, and storyboards).

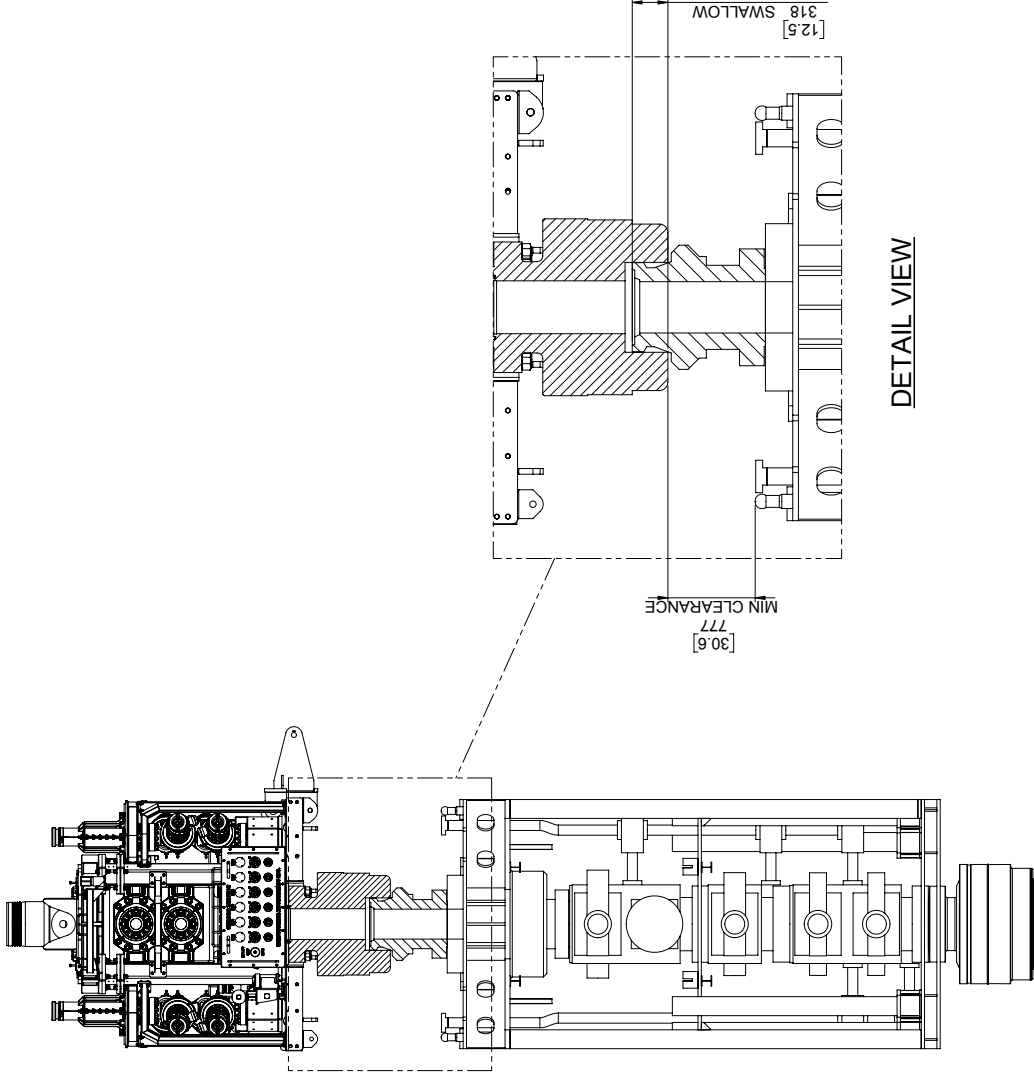
Once the LMRP and any debris protruding above the upper mandrel of the BOP have been removed, the capping stack can be installed. The high-level sequence of events are:

- 1) The capping stack running tool or rigging is installed on the capping stack assembly.
- 2) The capping stack is run to a predetermined depth at a predetermined safe location away from the BOP while being observed by an ROV.
- 3) An ROV provides feedback to enable the vessel to follow waypoints until the capping stack is near the BOP and ready to be landed and installed.
- 4) The capping stack is oriented, brought into the well stream, and landed. CFD analysis shows that the well stream will have a centralising effect on the capping stack.
- 5) An ROV disconnects the running tool and/or rigging while another ROV handles the locking of the connector.
- 6) The well is closed-in by closing the rams or the gate valves in the centre bore of the capping stack.
- 7) The open outlets are choked back for final shut-in (if the well can be shut in).
- 8) A survey is performed of the BOP and the capping stack to verify that no additional leaks formed while shutting-in the well.

A continuous ROV survey routine is established of the seabed, BOP and LMRP (if the LMRP stays connected), wellhead, and containment cap to confirm that no additional leaks have formed. Once the well is shut in, the field is set up so that the ROVs can conduct sonar surveillance to view an overlapping area of the incident for any breaches in the seafloor.

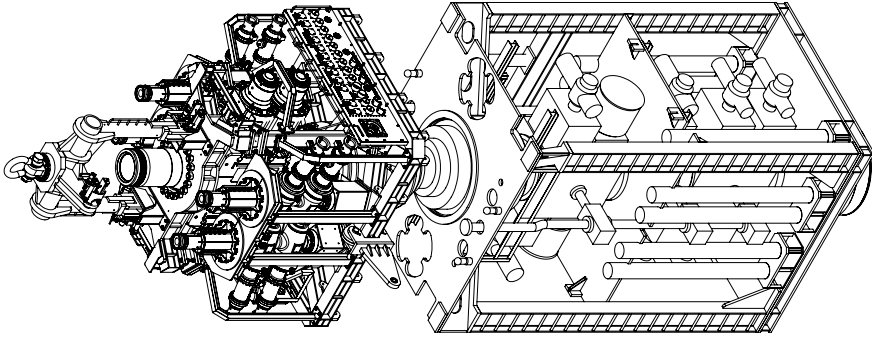
Appendix 5: Examples of 2D and 3D Engineering Drawings

Pages that follow illustrate a series of example engineering drawings that can be created during the SCERP planning phase. These drawings all feature the same capping stack, wellhead and drilling rig's subsea BOP. Each drawing shows a different aspect or configuration for where the capping stack lands. The intention is to identify any physical interference, identify any missing components as well as give familiarity to the wider response team to aid communication when considering subsea activities, tactics and interventions.

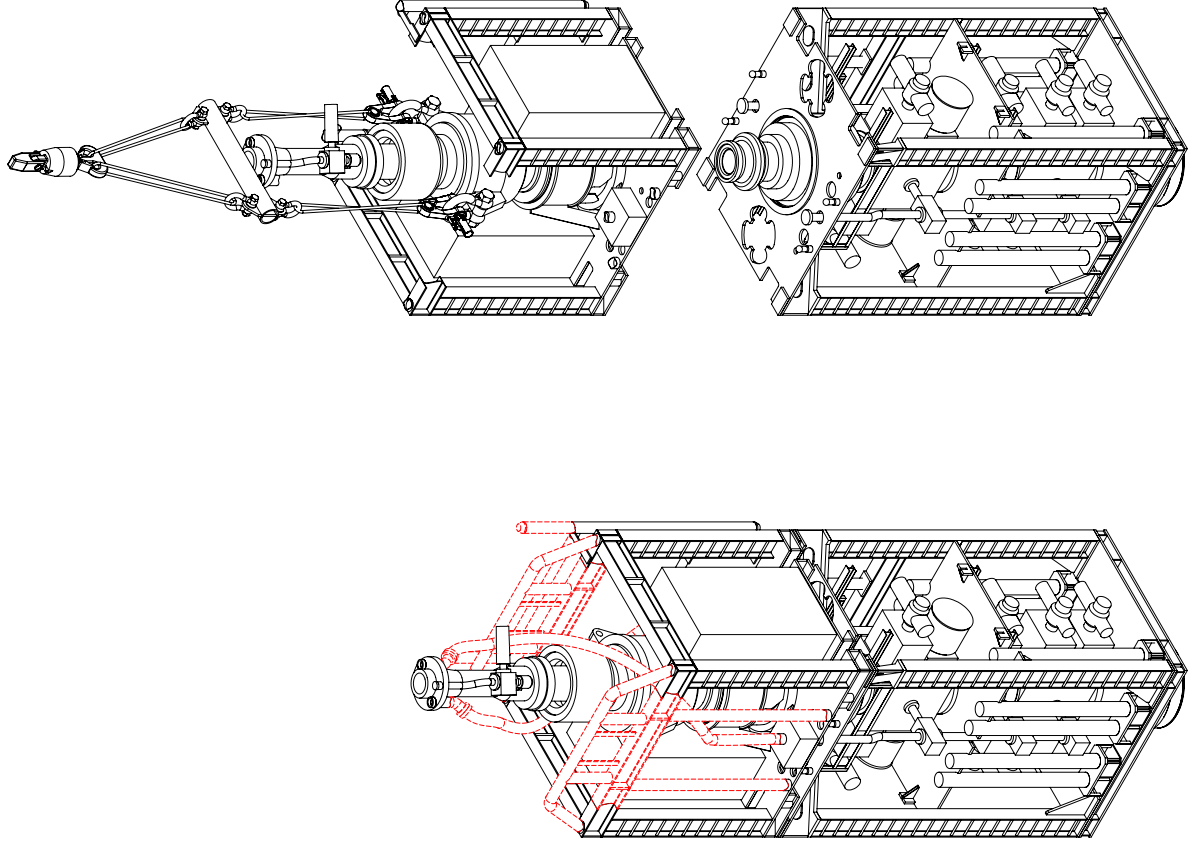


DETAIL VIEW

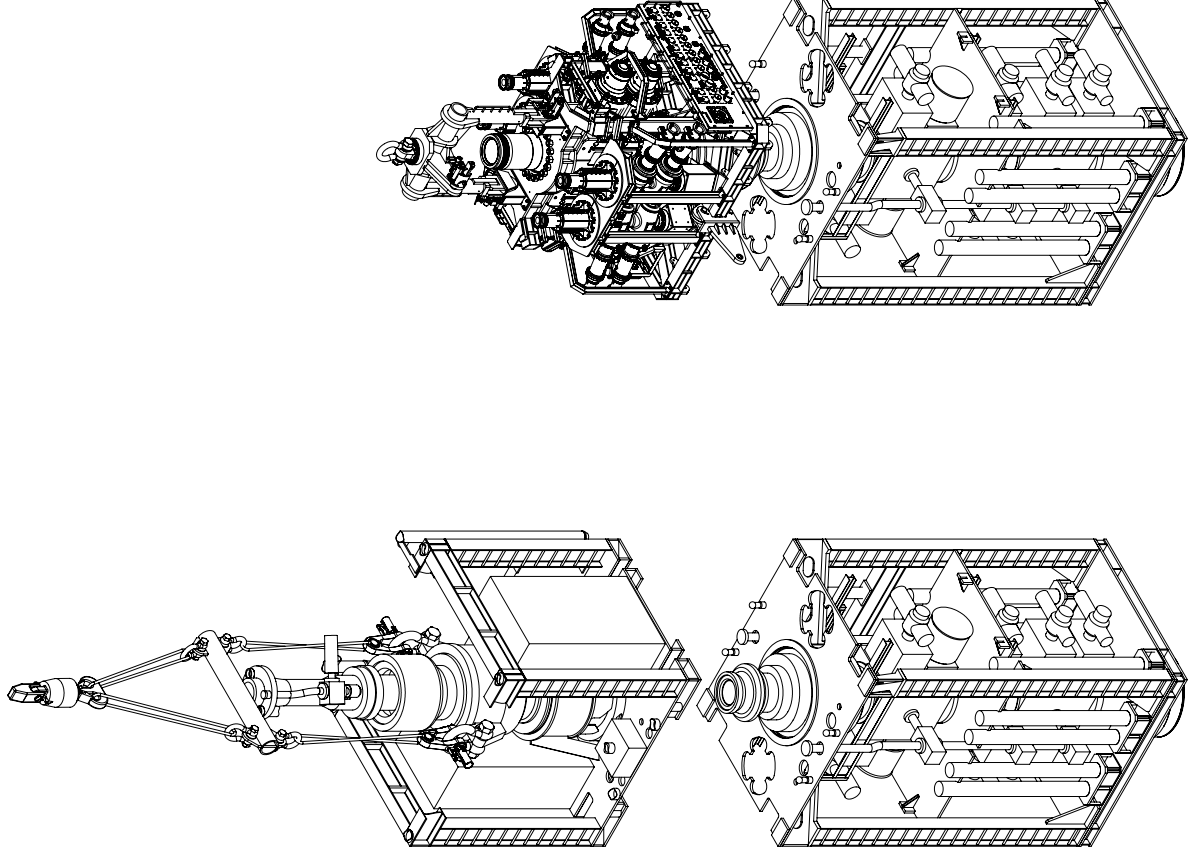
FRONT ELEVATION
(SPREADER BAR REMOVED)



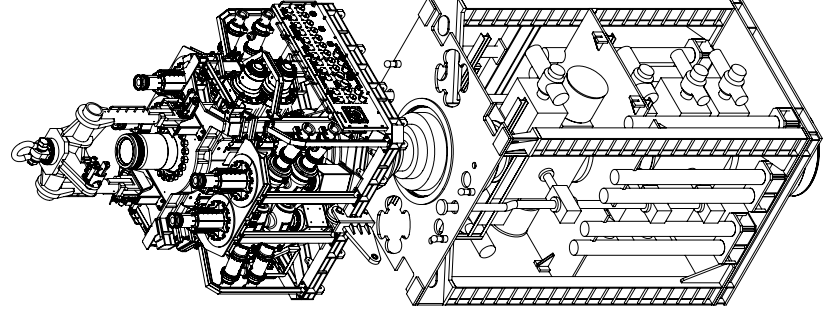
CAPPING STACK LANDED ON BOP



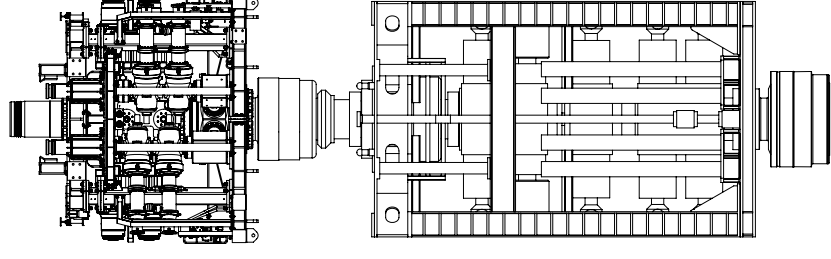
BOP & LMRP STACK



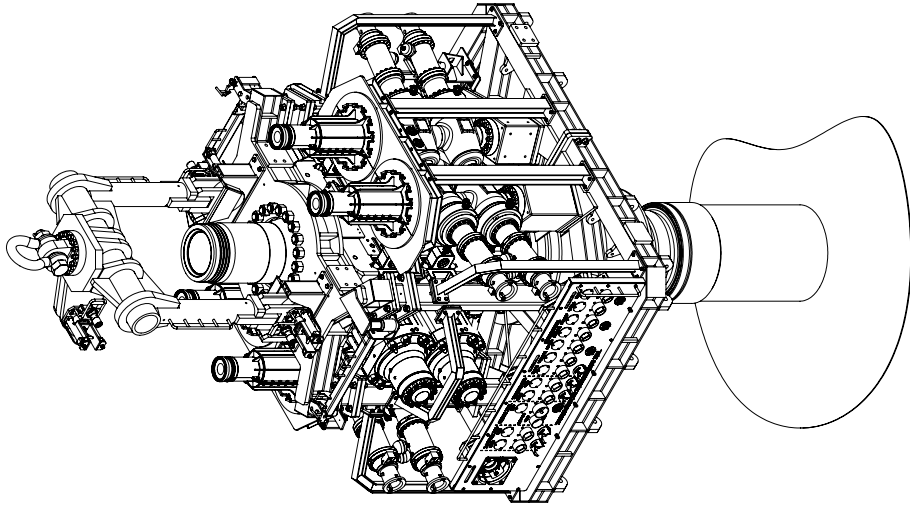
LMRP REMOVED



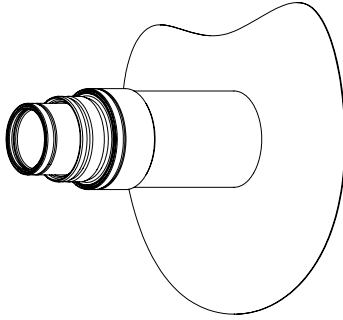
CAPPING STACK LANDED OUT



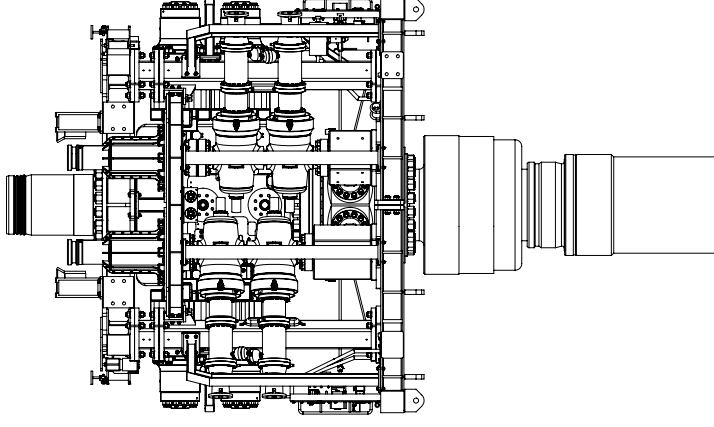
FRONT ELEVATION
(SPREADER BAR REMOVED)



CAPPING STACK LANDED OUT
(c/w SPREADER BAR)

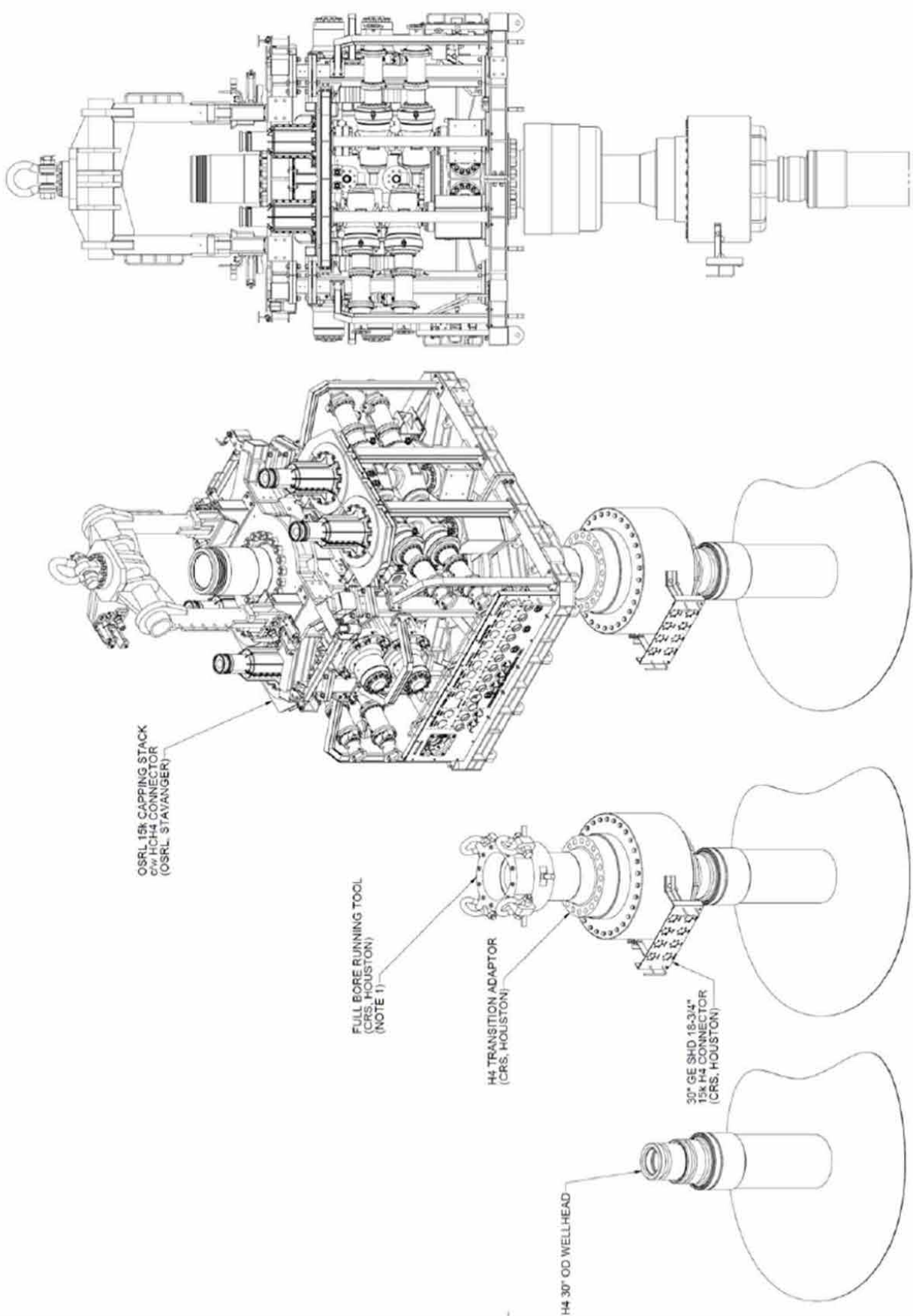


WELLHEAD



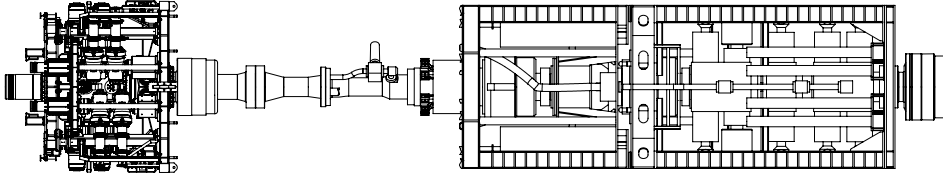
FRONT ELEVATION
(SPREADER BAR REMOVED)

OPTION 2: RUN 30" GE SHD ADAPTOR ASSEMBLY & CAPPING STACK (c/w 27" HCH4 CONNECTOR) INDEPENDENTLY

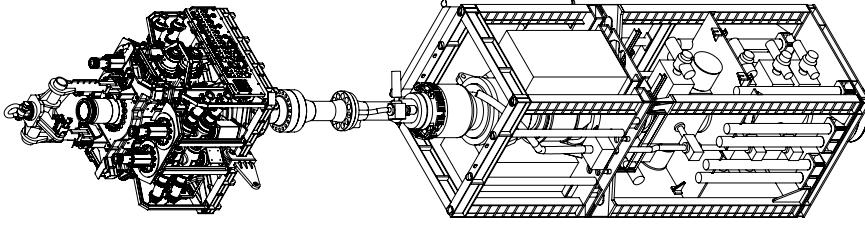


NOTES
1. RUNNING TOOL TAKEN FROM EXISTING 3-D MODEL NSE PROJECT No. 1501 (e.g. NSE-006-0526).

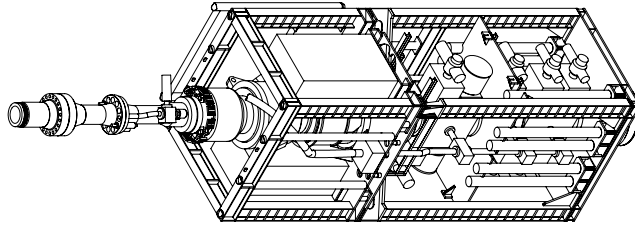
WELLHEAD
ADAPTOR LANDED OUT (c/w RUNNING TOOL)
CAPPING STACK LANDED OUT (w/o RUNNING TOOL)
FRONT ELEVATION



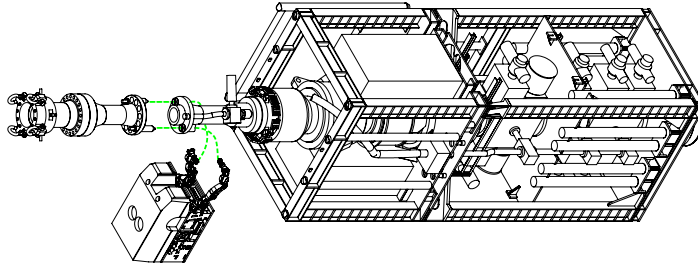
CAPPING STACK
LANDED OUT
(w/o SPREADER BAR)



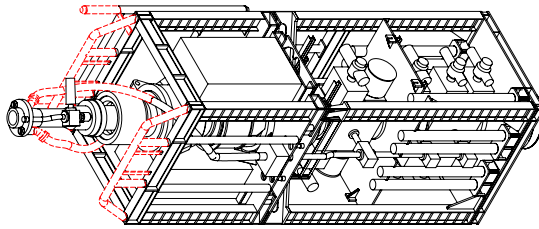
CAPPING STACK
LANDED OUT
(c/w SPREADER BAR)



ADAPTER LANDED OUT
(FBRT REMOVED)



ADAPTER BEING LANDED
(ON FBRT)



BOP & LMRP STACK

Appendix 6: Capping and Containment Plan Checklist

The check lists that follow are intended to be an aid. They do not present a mandatory or prescriptive requirement. Their validity or relevance depends on the type of well(s), region, regulatory regime and Operating Company policies.

Description	Available?	Comments or Details
Procedures and Planning		
Has the need for onsite coordinator been assessed?		SIMOPS Field Director (located on one of the primary response vessels) will coordinate with the onshore SIMOPS centre.
Has a seabed infrastructure layout plan (including location of relief wells) developed?		
Is there an overview of availability of Regional response vessels and MODUs?		This may also be a mutual aid matter.
Have emergency response duties been communicated to and acknowledged by the relevant parties?		IMT.
Is the emergency response training and competence of crews in place and maintained?		IMT, Wells.
Is there a resource plan for the mobilisation and utilisation of capping and containment equipment?		
Has a contact list for capping and containment operations been developed?		
Has a schedule for commencement of subsea dispersant delivery according to local requirements been developed?		Regulator dependent.
Is there a subsea dispersant delivery plan?		
Is there a high-level contingency plan for wellhead straightening?		
Has a generic SIMOPS plan for source control been developed?		
Is there an incident site air monitoring plan (VOC's and LEL)?		
Are metocean conditions understood?		
Do plans include limitations and challenges in operating under difficult met-ocean conditions?		

Description	Available?	Comments or Details
Region Incident Response		
Has capping and containment been integrated into IMT and source control plans?		IMT has an important role to understand source control activities.
Have Regional and Global Subject Matter Experts (SMEs) been identified?		
Has the ROV Command Centre plan been developed?		
Has a support centre(s) plan developed?		
Have SIMOPS Command Centre plans been developed?		
Has a first 48-hour plan been developed?		
Have source control plans been developed?		IMT to provide guidance.
Is the Communication plan known, developed, and tied-in with multiple support centres?		IMT to provide guidance.
Is there an understanding of emergency call-out procedures and incident notification chart for mobilising capping and containment equipment?		
Logistics (immediate start)		
Are Capping stack provider(s) mobilisation procedures available and understood?		
Are regional requirements for inspection and certification of lifting gear known?		
Has the Region identified and sourced lifting equipment to crossover between crane and lifting gear provided in emergency response toolkits?		
Does the Region have a logistics survey, and are airport capabilities of receiving and servicing the AN-124 and the B747F well understood?		
Does the receiving airport have Main Deck Loader capacity to offload a B747F?		Review maximum loads being shipped by airfreight.
Is the Regional logistics survey current?		
Have Customs pre-clearance checks been completed and approved?		
Are the method and route of transport from airport to port of operations known?		
Are the method and route of transportation and deployment from port to offshore location known?		
Have crane capacities through the entire logistics path been reviewed and confirmed to be sufficient?		
Have visas for non-domiciled personnel been obtained?		

Description	Available?	Comments or Details
Air Monitoring Plan		
Has an air monitoring plan been developed?		
Do support vessels and MODUs have equipment to measure VOC and LEL levels?		
Do support vessels and MODUs have qualified personnel to operate VOC and LEL monitoring equipment and manage use of facemasks?		
Is there a plan to source facemasks and the support team?		
Are vessel personnel trained to operate VOC and LEL monitoring equipment and manage air mask fitting for crewmembers?		
Are carbon filters available and ready to be sourced for support vessels and MODUs working inside the source area?		
Are mitigations in place for areas in which the air monitoring plan is not fully developed?		
ROV Surveillance and BOP Intervention (less than 48 hours)		
Has ROV availability and the interface matrix been confirmed/developed?		
Has a suitable vessel and ROV system identified?		
Have Mutual aid agreement(s) been established?		
Is an ROV-deployable BOP intervention skid immediately available?		
Is sufficient hydraulic fluid immediately available for functioning 2-off BOP rams?		
Has a seabed monitoring plan been developed using ROVs and AUVs?		
Is there mapping capability to update seabed debris maps as ROV and AUV data becomes available?		
Subsea Dispersant Delivery (less than 10 days)		
Have suitable support vessels been identified?		
Have anchor-handling vessels and supply boats for first 48 hr response been identified?		Type of vessel is not always as important as early vessel availability.
Are construction vessels with subsea cranes available?		
If not under contract, has a mutual aid agreement or equivalent established?		
Is the deck layout plan understood?		

Description	Available?	Comments or Details
Can the subsea dispersant delivery system provide the minimum recommended dispersant rate at the BOP?		Typical dispersant pump rate can be 1% of the well flow rate (e.g., 29 gpm for a 100,000 BOPD).
Have suitable fire monitors been identified?		Firefighting and knocking back VOCs.
Are plans in place for installation of dispersant delivery system on support vessel?		
Have the potential effects of metocean conditions on dispersant delivery systems been assessed?		
Are Wands, Hydraulic Flying Lead (HFLs), manifolds, and/or 17H hot stabs available?		
Is subsea dispersant stock that meets ESIA / Regulatory requirements available?		
Are surface storage tanks available?		
ROV Debris Clearance		
Has a suitable vessel been identified?		Survey (ROV, AUV).
If not under contract, is there a mutual aid agreement (or equivalent) established?		
Is the deck layout plan for placement of ROV tooling and equipment understood?		
Are the debris removal tools (including marine riser shears, saws, and grapples interfacing) present?		
Is there additional hydraulic fluid available and designed for ROV tools in the subsea equipment emergency response systems?		
Has an AUV and an AUV survey contingency plan been developed?		
Are import restrictions of AUV systems and components because of export restrictions on inertial navigation equipment understood?		
Well Capping		
Have suitable vessels been identified?		MODU or construction with subsea crane(s).
Have BOP-specific interface drawings for the designated landing points been developed?		
Is a ROV interface matrix with capping equipment available?		
Is there developed understanding of specification breaks in the BOP (10K annular on top of 15K BOP)?		

Glossary

BOP Stack

Subsea Blow out prevent (BOP) and Lower marine riser package (LMRP) as an assembly.

Capping

The process in which a capping stack is installed onto a flowing well and then used to shut-in the flowing well.

Contractor

Company or other legal entity that provides a service to a client.

Containment

The process in which a capping stack is installed onto a flowing well and then partially closed in such a way that flow is diverted to surface processing facilities. It differs from Capping in that the well is not shut in.

Flexible Hose Assembly (FHA)

A complete hose with end fittings and any associated accessories.

Hose

A flexible conduit normally of circular cross-section and usually with an inner lining reinforcement and an outer cover.

HAZID (Hazard Identification)

A qualitative technique for the early identification of potential hazards and threats effecting people, the environment, assets or reputation.

HAZOP

A hazard and operability study (HAZOP) is a structured and systematic examination of a complex planned or existing process or operation in order to identify and evaluate problems that may represent risks to personnel or equipment.

Third Party

Independent party that is not the OEM or equipment owner but is one of the following:

- A technical classification society (e.g., American Bureau of Shipping [ABS] or Det Norske Veritas [DNV]).
- A licensed professional engineering firm that performs verifications.

Verification

Provision of objective evidence that determines the extent to which a procedure, task, equipment item, operating system, or model conforms to its specification

Acronyms

AFE	Annulus Fluid Expansion
APB	Annulus Pressure Buildup
API	American Petroleum Institute
ASME	American Society for Mechanical Engineers
BOP	Blow Out Preventer
CFD	Computational Fluid Dynamics
CT	Coil Tubing
CSR	Containment System Riser
ERP	Emergency Response Plan
GIRG	Global Industry Response Group
GPM	Gallons per minute
ICS	Incident Command Structure
IMT	Incident Management Team
ISO	International Organisation for Standardisation
LEL	Low Explosive Limit
LMRP	Lower Marine Riser package
MASP	Maximum Anticipated Surface Pressure
MEG	Mono-ethylene Glycol
MODU	Mobile Offshore Drilling Unit
OEM	Original Equipment Manufacturer
OGUK	Oil and Gas United Kingdom
OTC	Offshore Technology Conference
OWR	Open Water Riser
QA/QC	Quality Assurance/Quality Control
ROV	Remotely Operated Vehicle
SCERP	Source Control Emergency Response Plan
SIMOPS	Simultaneous Operations
SIT	System Integration Test
SPE	Society of Petroleum Engineers
SSTT	Sub Sea Test Tree
VOC	Volatile Organic Compounds
WCD	Worst Case Discharge
WEC	Wells Expert Committee

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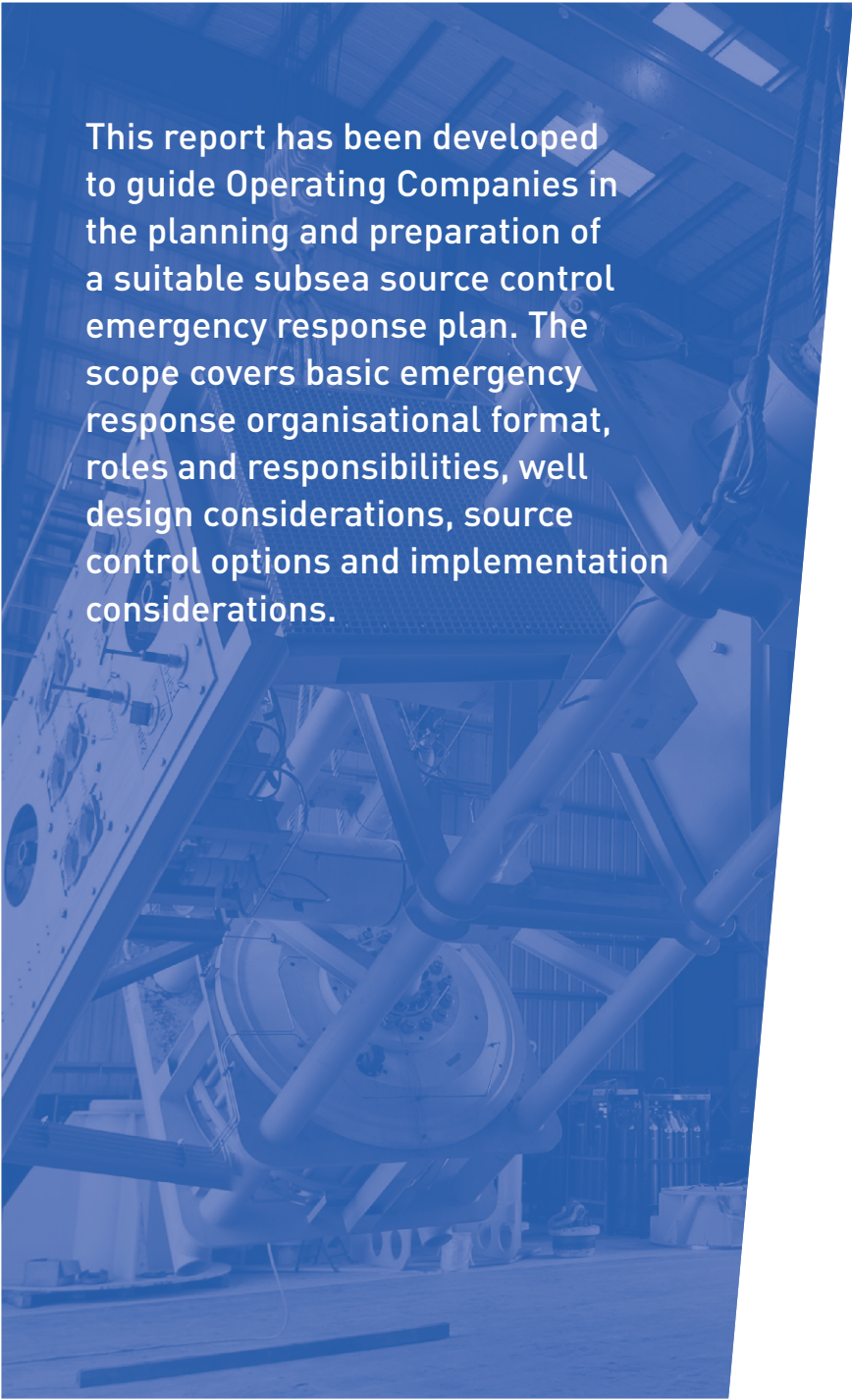
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This report has been developed to guide Operating Companies in the planning and preparation of a suitable subsea source control emergency response plan. The scope covers basic emergency response organisational format, roles and responsibilities, well design considerations, source control options and implementation considerations.