



International
Association
of Oil & Gas
Producers



Capping & Containment

Global Industry Response Group recommendations

Report No. 464

May 2011

OGP Vision, Mission and Objectives

Vision

To work on behalf of the world's oil and gas exploration and production (E&P) companies to promote safe, responsible, and sustainable operations.

Mission

- To facilitate continuous improvement in HSE, security, social responsibility, engineering and operations.
 - To undertake special projects and develop industry positions on critical issues affecting the industry.
 - To create alignment between oil & gas E&P companies and with relevant national and international industry associations.
 - To advance the views and positions of oil & gas E&P companies to international regulators, legislative bodies and other relevant stakeholders.
 - To provide a forum for sharing experiences, debating emerging issues and establishing common ground to promote cooperation, consistency and effectiveness.
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Objectives

- To improve understanding of our industry by being a visible, accessible, reliable and credible source of information.
 - To represent and advocate industry views by developing effective proposals based on professionally established technical arguments in a societal context.
 - To improve the collection, analysis and dissemination of data on HSE and security performance.
 - To develop and disseminate good practice in HSE, security, engineering and operations continually improved by feedback from members, regulators and other stakeholders.
 - To promote awareness and good practice in social responsibility and sustainability.
 - To ensure that the membership is highly representative of our industry.
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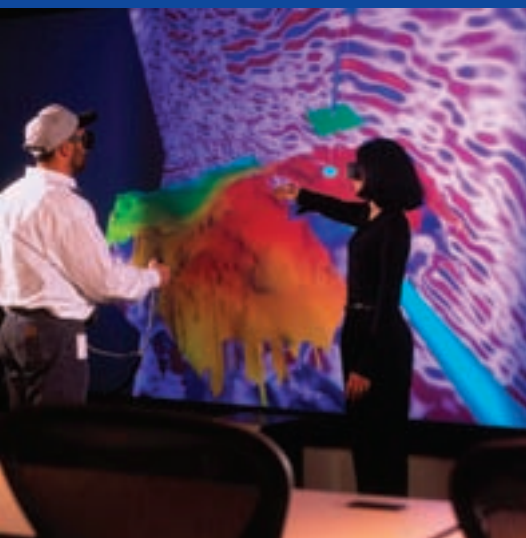
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Contents

Executive Summary **04**
Capping and Containment for I/JDA Project **06**
1.0 OGP'S Global Industry Response Group (GIRG) **07**
2.0 GIRG'S Capping & Containment Team **09**
3.0 Deepwater Regions outside the Gulf of Mexico **12**
4.0 Global Technical Specifications & Response Time **14**
5.0 Response Time **17**
6.0 Capping and Subsea Dispersant Systems **20**
7.0 Containment Systems **26**
8.0 Organisational Models for Project Execution & Deployment Phases **33**
9.0 Proposal **34**
10.0 Conclusions & Proposals **37**
Glossary **40**



Executive Summary

GIRG

The International Association of Oil & Gas Producers (OGP) formed the Global Industry Response Group (GIRG) in July 2010 in the aftermath of the tragic accident in the Gulf of Mexico on the Macondo prospect, Montara in Australia, and other similar incidents. Previously, the oil and gas industry had drilled more than 14,000 deepwater wells around the world without major incident but, this history notwithstanding, the Macondo and Montara accidents were a reminder of the risks inherent in such operations.

GIRG aimed to ensure that the lessons learned from Macondo, Montara and other accidents are applied around the world. To do that, part of GIRG's remit is to monitor and collate the outcomes of the official Macondo and Montara accident investigations. This process is helping to identify and answer other questions about Macondo, Montara and other deepwater operations.

GIRG is working in three areas:

- Prevention: developing better capabilities and practice in well engineering design and well operations management in order to reduce the likelihood of future incidents
- Intervention: improving well capping response readiness (in the event of an incident) and to study further the need for, and feasibility of, global containment solutions
- Response: delivering effective and fit-for-purpose oil spill response preparedness and capability

OGP formed three teams of technical experts to address these objectives: Well Engineering Design and Equipment/Operating Procedures; Capping and Containment; and Oil Spill Response. Each team has prepared a report documenting its work in support of GIRG's objectives. This report documents the conclusions and recommendations of the Capping and Containment Team.

Scope for the Capping and Containment Team

The Capping and Containment Team was tasked to “determine whether a single, worldwide, standardised capping and/or containment system (outside the Gulf of Mexico) could and should be designed and deployed with the support of international and national associations, in consultation with governments and regulators.” The work was performed by a full-time team, called the ‘GIRG Capping and Containment Team’ (the Team), which included staff from BG Group, BP, Chevron, ConocoPhillips, ENI, ExxonMobil, Petrobras, Shell, Statoil and Total. This report summarises the work and recommendations of the Team drawn up over a 14-week period (September to mid-December 2010).

Results

The main conclusions and recommendations are:

- Industry should further develop capping and dispersant injection capability so that it is available for global response to deepwater well control incidents
- Industry should study further the need for and feasibility of containment solutions

Further work is required to understand the net benefits and potential impact on risk of providing containment in the different regions.

The Team recommends these actions be performed by having the companies of the Management Committee of OGP negotiate a Joint Development Agreement (JDA) to execute the following main activities:

- Design a capping toolbox with a range of equipment to allow wells to be closed in
- Design additional hardware for the subsea injection of dispersant
- Study further the need for, and feasibility of, a global containment system:
 - Advance the design of a Common Subsea System (flowlines, jumpers and risers) that would support a range of potential surface capture vessels
 - Assess the technical and commercial feasibility of using Vessels of Opportunity (drillships, DP FPSOs, DP well test vessels) employed from their main functionality to improve their processing/storage capacity
 - Review alternatives such as the use of purpose-built containment vessels
 - Continue to assess the need for containment systems on a worldwide basis
- Develop organisation models for the storage, maintenance, and potential deployment of any equipment
- Review requirement for procedures related to equipment being designed under the JDA Project for application in shallow water and for producing subsea wells

The work to develop these capping, subsea dispersant and possible containment systems for use worldwide is anticipated to be performed in stages with final investment decisions made for different systems at different dates. Future investments in capping and containment systems would depend on the final decisions on the systems to be developed and deployed, but could be in the range of hundreds of millions of dollars.

Acting on the Team's recommendations, the eight companies in the Management Committee of OGP – together with BG Group – have signed an Interim Joint Development Agreement (IJDA) with Shell acting as the operator. This IJDA has no contractual ties to OGP, but is an agreement between the companies to provide the resources to carry out the activities recommended by the Team to assess further and develop international capping and containment systems. A full JDA is expected to be signed in the near future.



Capping & Containment Phases for I/JDA Project

The long-term storage, maintenance and operation of the equipment developed under the I/JDA Project could be managed by one or more potential deployment organisations, ranging from commercial suppliers of equipment and services to a (not-for-profit) deployment organisation where all companies of the oil and gas industry can participate – similar to the Marine Well Containment Company (MWCC) in the Gulf of Mexico, or Oil Spill Response Ltd (OSRL).

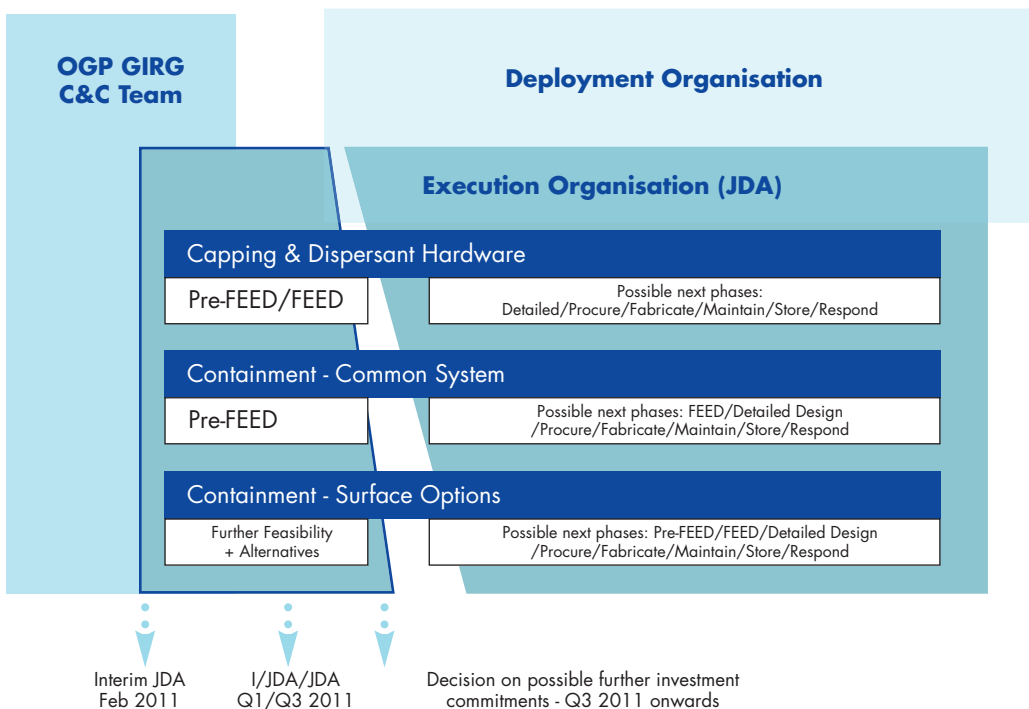
The I/JDA Project could function up to the point when commercial entities construct equipment, provide services and/or a new company/organisation is formed. The details of the

deployment organisation, the way in which operating companies could access the equipment and procedures, and its funding mechanisms and fee structure, could be developed during the I/JDA Project.

The planned work scope and the cooperation of nine major oil and gas companies under an I/JDA, demonstrates the oil and gas industry's continued commitment to jointly take action.

Continued cooperation is being sought with organisations like the MWCC and OSPRAG to:

- avoid duplication of effort by taking advantage of the work and learnings from these other initiatives; and
- encourage standardisation of emergency response equipment.



1.0 OGP'S Global Industry Response Group (GIRG)

OGP and GIRG

The International Association of Oil & Gas Producers (OGP), announced the formation of a Global Industry Response Group (GIRG) on the 14th of July 2010. The overall objective of the OGP GIRG was to discuss and devise practices to:

- (a) Improve drilling safety and reduce likelihood of a well incident
- (b) Decrease the time it takes to stop the flow from an uncontrolled well
- (c) Improve both subsurface and surface response capabilities

GIRG did this by identifying and gathering work being done by OGP's member companies and associations, and national regulators, in response to the Macondo and Montara accidents and other well incidents.

After the announcement of the plan to develop a Marine Well Containment System (MWCS) for the Gulf of Mexico, other oil and gas companies, governments and authorities raised questions on the potential need for and desire to have similar capability available in different

regions around the world.

Some individual initiatives had already started among operators and national associations, and some coordination was needed between these initiatives to avoid duplication and inconsistency.

GIRG was tasked to examine the industry's capability to prevent and respond to a major well incident and identify opportunities for improvement.

Structure of GIRG and setup of Sub-Groups

In order to achieve these objectives, three separate GIRG sub-groups were established to focus on Prevention (Well Engineering Design & Equipment/Operating Procedures Team), Intervention (Capping & Containment Team), and Response (Oil Spill Response Team). See *Figure 1.1*.

Prevention is the most effective way to reduce the risks from well control events, and remains a primary focus for the industry's work. Improvements to oil spill response, and capping and containment, could reduce the consequences of an event.

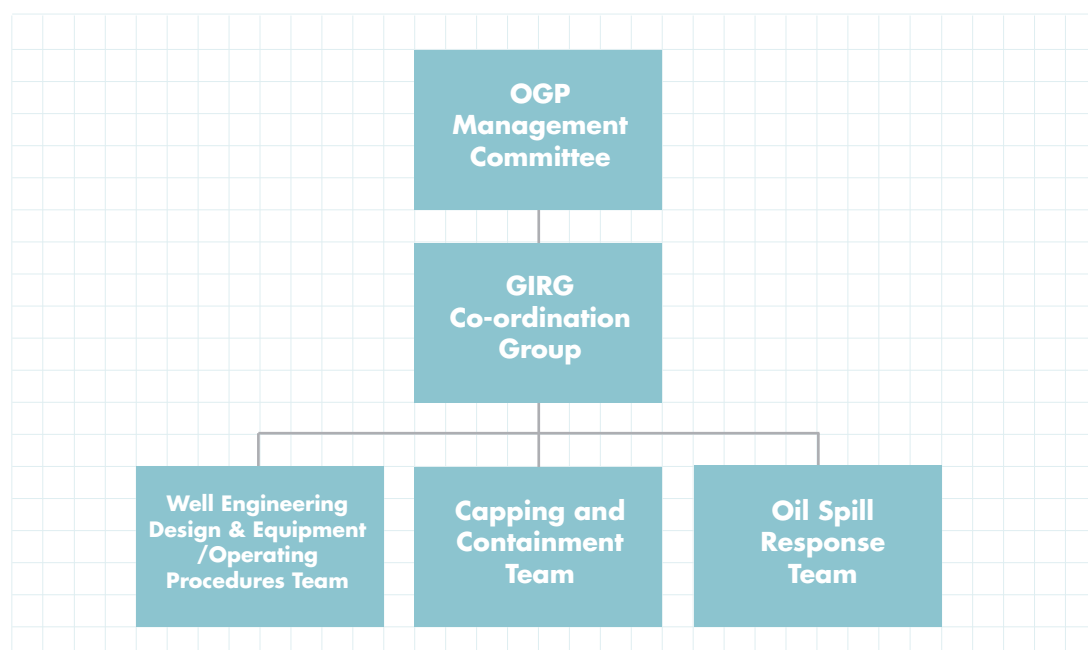


Figure 1.1 Organisational structure of GIRG

OGP'S Global Industry Response Group (GIRG)

continued

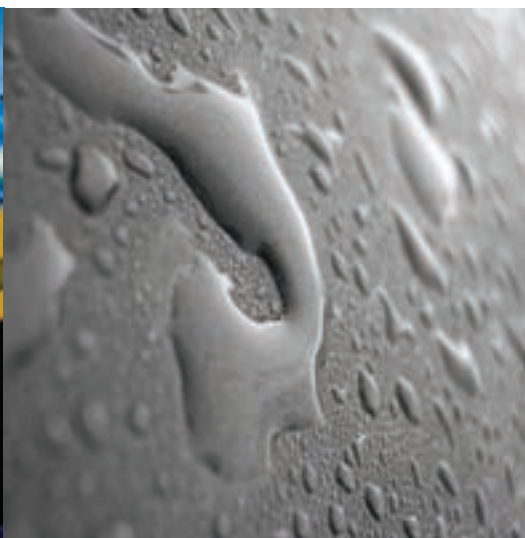
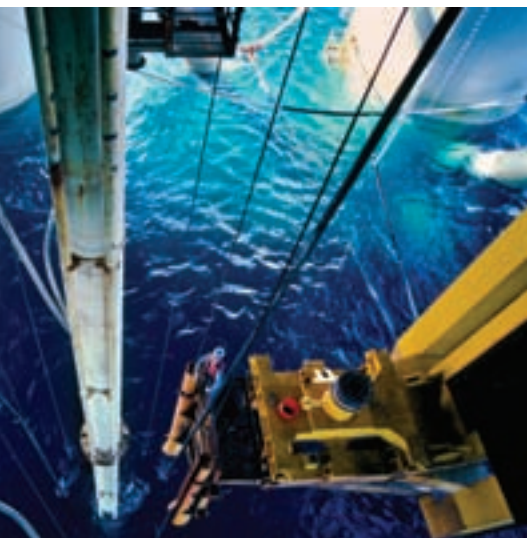
Over the past 10 months more than 100 industry specialists have worked on these three teams. These teams have established cooperation with other existing industry efforts, such as MWCC, API JITF, OSPRAG, OLF, IADC, API, and specialist service providers (e.g. OSRL) and continue to work closely with them to align efforts and eliminate duplication where possible.

- The Well Engineering Design & Equipment/Operating Procedures Team is looking into improvements in well design and procedures and has brought forward recommendations. It is likely that the most significant reduction in the risk of deepwater drilling will come from work in this area
- The Capping & Containment Team was tasked to determine whether a single worldwide standardised capping and/or containment system could and should be designed and deployed with the support of international and national associations, in consultation with governments and regulators. The Capping and Containment Team was a full-time 12-person team that included specialists from BG Group, BP, Chevron, ENI, ExxonMobil, Petrobras, Shell, Statoil, and Total

- The overall purpose of the Oil Spill Response (OSR) Team was to gather and share information and conclusions on OSR performance from members and member associations in respect of Macondo, Montara and similar accidents, distil learning points and recommend possible improvements for OGP/IPIECA action

OGP will continue to monitor developments in this area and will continue to assess the need for any additional activities that might be required to assist in achieving the objectives of GIRG.

This document summarises the conclusions and recommendations of the Capping & Containment Team. Separate documents have been prepared that summarise the findings and recommendations of the Well Engineering Design & Equipment/Operating Procedures Team and Oil Spill Response Team.



2.0 GIRG'S Capping & Containment Team

Capping and containment are only parts of an incident response.

In the case of a loss of well control, there are a number of actions which need to be considered before a containment system may become necessary.

The primary focus during a response is to be able to shut in the well – stopping all hydrocarbon flow to the environment. Many methods could and would be taken to shut in a well before a containment system could be deployed at site, including using the BOP, intervening downhole, capping, or using other direct intervention means such as commencing development of relief wells.

Methods that involve closing off the flow from the wellbore at the mudline, rather than downhole, are defined by OGP as capping methods. In the rare case that the flow of hydrocarbons from the well could not be stopped, the use of a containment system could reduce the flow of hydrocarbons to the environment until a relief well or other method stops the flow. A containment system could be designed to capture well fluid to reduce discharge to the environment and bring it to the surface for processing, collection and export.

The equipment and facilities used to cap or contain a well vary and increase if containment is used. Figure 2.1 shows an overview of potential systems and sub-systems, both subsea and surface, considered by the Capping and Containment Team as part of its analysis and

development of functional requirements. The industry would benefit from a common definition of capping and containment terminology. OGP recommends that the terminology in Figure 2.1 be used by its members.

Definition of Capture Device

A capture device is a mechanism used to enable either the shut-in of a subsea well or the capture and collection of hydrocarbons from an uncontrolled release and feed them to a selected conduit for collection and disposal. This can be capping stacks, “top hats”, cofferdams, open water funnels, etc.

Definition of Capping

Capping is the act of putting a device on a well with an uncontrolled flow of hydrocarbons. The device has the capacity to close in the well, if the cap itself and the equipment downhole in the wellbore have integrity to withstand the resulting shut-in pressures.

The cap would typically be placed on the existing wellhead, subsea Blowout Preventer (BOP) or Lower Marine Riser Package (LMRP) through which the well is blowing out.

The capping device could also have the ability to connect with or include a diverter spool that would enable containment of liquid hydrocarbons if there were an inability to shut in the well, such as with concern about downhole integrity.



GIRG'S Capping & Containment Team

continued

The functional capabilities of the capping device are affected by the well status (integrity or damage to the wellhead) can be further defined as:

- Hard Seal Cap: provides a high-pressure connection to an existing connector on the wellhead, BOP or LMRP and may be mechanically latched
- Soft Seal Cap: provides a low pressure seal (may be an elastomeric seal to an element of the well or a seabed caisson over the well with the capacity to prevent seawater from mixing with well fluids. It may not be mechanically latched (but could be) to the riser flange, BOP or wellhead if directly over the well (e.g. "top hat"). Some devices are designed to allow the release of some of the hydrocarbons (e.g. for pressure control)

- No Seal Cap: provides no seal to the seabed, BOP or wellhead, can freely allow seawater to intermix with well fluids and does not ensure capture of all hydrocarbons (e.g. Cofferdam)

Definition of Containment

In the rare event that intervention in the well or capping cannot shut-in a well, a containment system could be used to bring leaking oil from a subsea wellhead in a controlled way to the surface for storage and disposal.

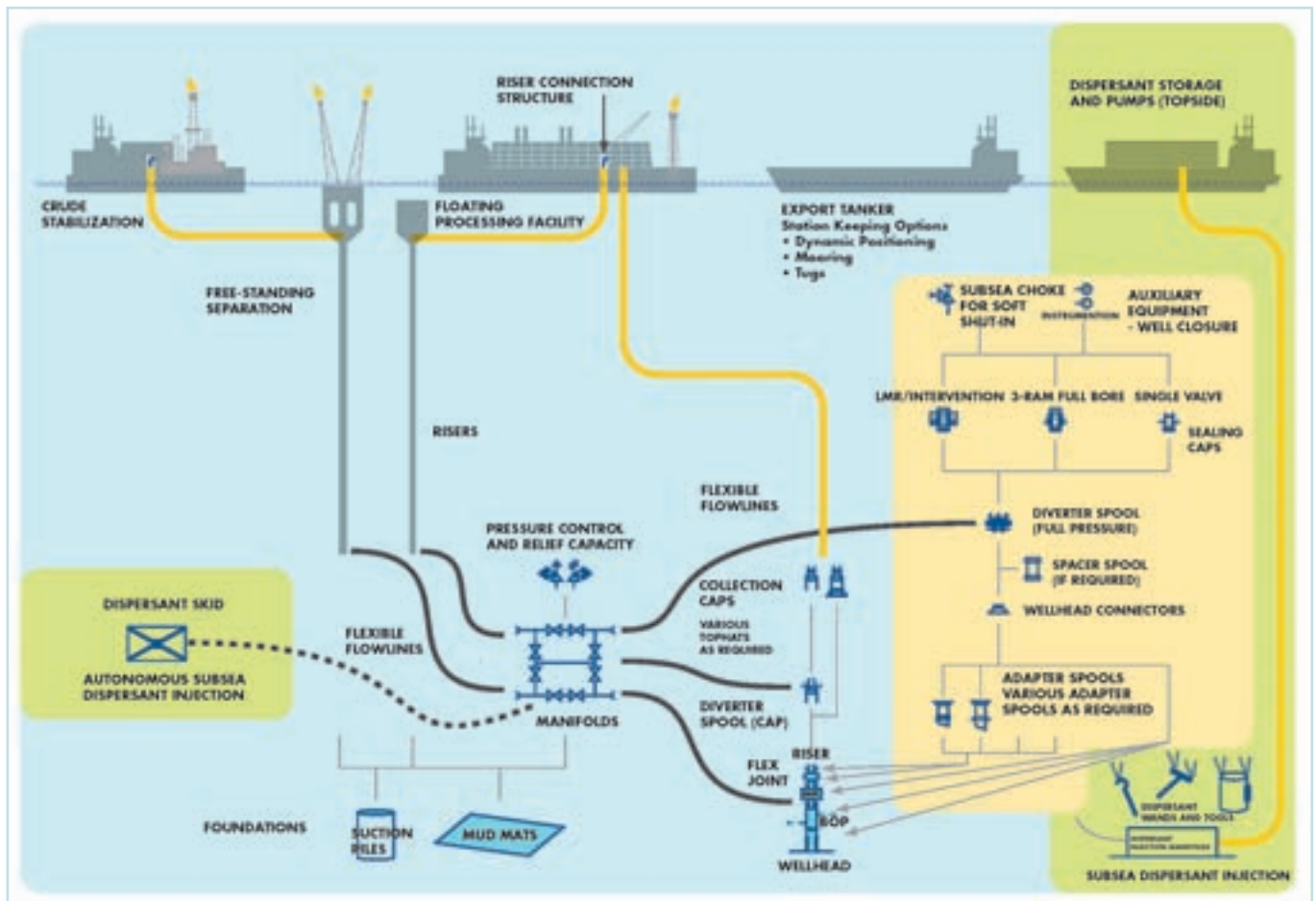


Figure 2.1 Overview of possible capping and containment elements

Dispersant Options Containment Options Capping Options

GIRG'S Capping & Containment Team

continued

System Overview

An overview of a number of possible subsea and surface elements, including possible vessels to be used to capture and contain liquid hydrocarbons, are provided in Figure 2.1.

System components range from capture devices (hard seal, soft seal, or no seal) with diverter spools that fit over a subsea well, the subsea systems and relevant surface systems and/or vessels for handling, flaring, storing, and shipping to facilities that can effectively dispose of the liquid hydrocarbons and associated contaminated water.

Key activities performed by the Capping & Containment Team

1. Mapping of the regions around the world (outside the Gulf of Mexico) that have offshore drilling, particularly in deep water, and the establishment of regional metocean and reservoir conditions such as maximum discharge rates and fluid compositions.
2. Definition of the key global technical specifications for capping and containment system(s) based on the data received.
3. Estimation of potential response times that could be achieved for each region.
4. Review and analysis of concepts (currently known or newly developed) against a set of acceptance criteria, taking the global specifications into account.
5. Recommendation of global capping and containment systems and identification of concepts/options of subsea and surface components that could be engineered and constructed.
6. Definition of the activities to be performed by industry through an I/JDA for the next phase of work.

At a high level the following boundaries were developed to define the work scope covered by the Team:

Wells

1. Subsea Wellhead / BOP in Water
Depths up to 3000 metres
2. Oil and Condensate Exploration and Development Wells
(note: Arctic wells are excluded)

Capping

3. Capping Devices (including gas wells)

Containment

4. Containment System (excluding gas wells)
5. Subsea systems and infrastructure
6. Riser systems and foundations
7. Riser-to-vessel connection system
8. Emergency disconnect systems
9. Surface or subsea processing system
10. Surface containment vessels
11. Shuttle tankers

General

12. Subsea power supplies – hydraulic and electric
13. Subsea controls
14. Subsea dispersant injection systems for introduction into hydrocarbon flow
15. Installation vessels and support
16. Subsea exploration wells
17. Global (except Gulf of Mexico)
18. Cost and schedule to develop
19. Schedule to deploy after incident
20. Governance model

Based on informal discussions with regulators and within the Team, a number of topics that were not part of this initial work are recommended to be included in the next phase of work under the I/JDA Project. A full list of recommendations and proposed actions is found in Section 10 Conclusions and Recommendations.

3.0 Deepwater Regions outside the Gulf of Mexico

The map below (*Figure 3.1*) shows potential offshore basins in the world where wells have been or could, in the next 5 years, be drilled using subsea BOPs.



Figure 3.1 Overview of potential offshore basins with Subsea BOPs in the next 5 years

In order to achieve an effective evaluation of concepts within the expected time frame, the Team decided to narrow the near-term scope from a comprehensive global view to a review of selected key regions and countries. The Team decided to focus the near-term efforts on the mature areas shown in Figure 3.2. The seven mature regions are believed to be representative of all global basins, but this view could be tested against specific requirements of other regions and countries during the further work detailed in Section 9.

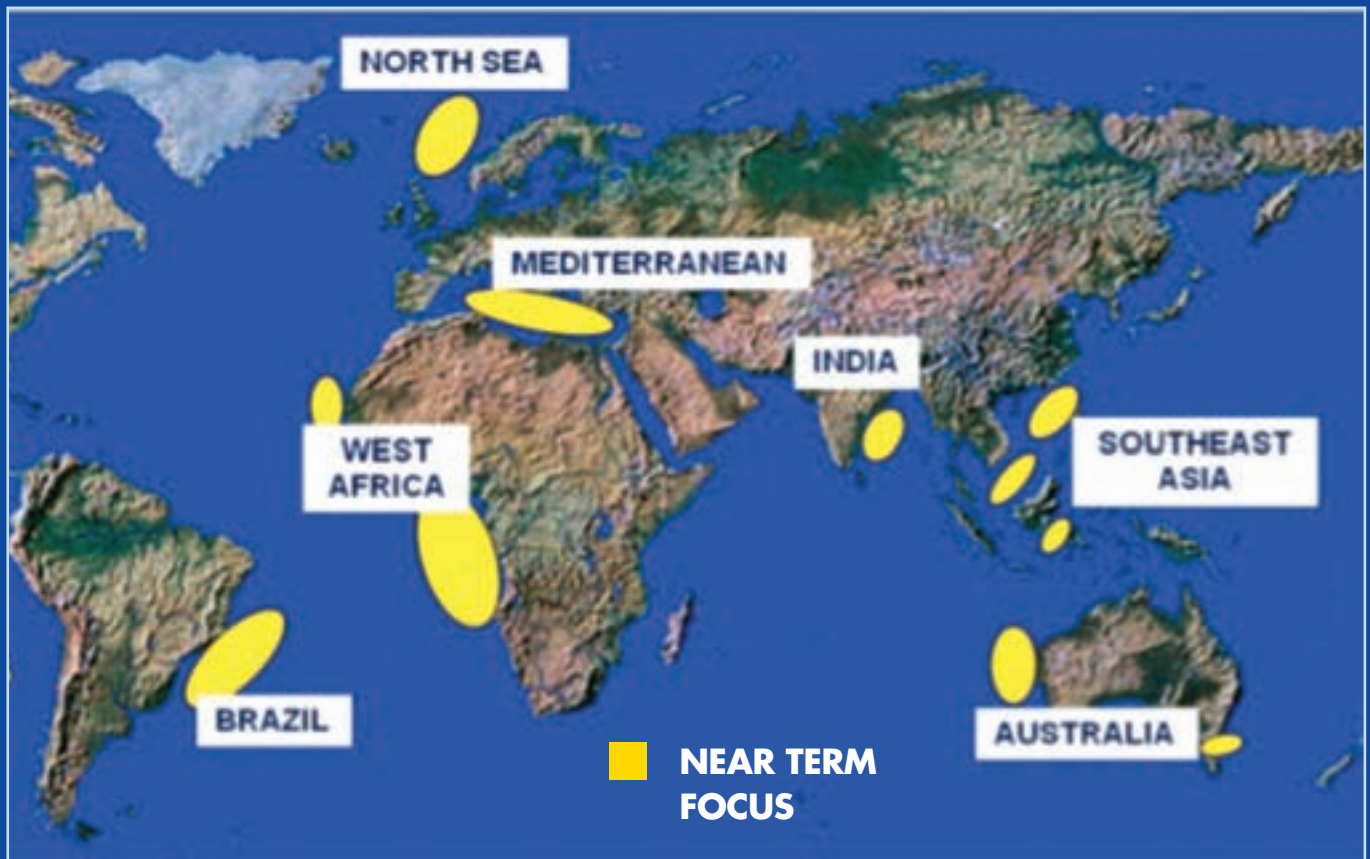


Figure 3.2 Overview of mature offshore basins (excluding Gulf of Mexico) with Subsea BOPs

Any “single solution” for response to a subsea uncontrolled hydrocarbon release occurring anywhere in the world outside the US Gulf of Mexico would have to be able to operate within the most demanding design and operating conditions to be seen anywhere around the globe where wells are being or might be drilled with subsea BOPs.

4.0 Global Technical Specifications & Response Time

A set of Global Technical Specifications was established as the basis for technical assessment of various capping and containment system options that were identified and/or developed. The Team obtained reservoir, metocean, technical and operational data for representative countries in the mature deepwater regions.

The data enquiry focused on potential drilling operations in water depths equal to or greater than 300 metres as this is where developments generally transition from fixed platforms to floating production and/or subsea development. The data collected does not represent a complete data set of industry activities, but is sufficient to allow the high-level screening assessment presented in this report. The key technical variables assessed were:

- Worst Case Discharge
- Shut-in wellhead pressure at the seabed
- Metocean conditions
- Water depth
- Contaminants in the produced fluids

Global Technical Specification

The Worst Case Discharge rate (WCD) used here is as defined by BOEMRE (the United States Bureau of Ocean Energy Management, Regulation and Enforcement) and as clarified by the Society of Petroleum Engineers (SPE). The analysis of the data showed (see Figure 4.1) that most of the wells (85-90%) have a WCD flow potential of 100 kbpd or less. It also highlights that those wells that have a flow potential of more than 100 kbpd have flow potentials significantly higher. In other words a step change in flow potential appears to occur at around 100 kbpd.

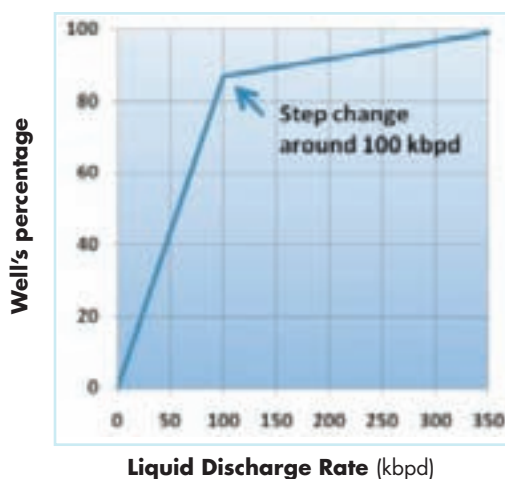


Figure 4.1 Worst case discharge Rate Distribution (excluding Gulf of Mexico)

Global Technical Specifications & Response Time

continued

On this basis, the proposal developed for containment capacity for a global system was set at a flow capacity of 100 kbpd. WCD rates are unlikely to occur in cases where containment would be required. In cases where the well is fully unconstrained, normal access to the wellbore should be possible and normal killing operations could take place as is safe and appropriate. If there are restrictions in the wellbore that limit access to the wellbore, these restrictions could likely reduce the flow considerably compared to the WCD rate.

The shut-in wellhead pressure at the seabed is shown in Figure 4.2. The vast majority of wells outside of the Gulf of Mexico (85-90%) for which information was provided have a shut-in wellhead pressure of less than 10 kpsi. There are some deeper wells, and some high potential gas wells, which have the potential for higher pressures which would require the provision of a 15 kpsi capping system. The higher pressure rating affects only the capping components of a capping and containment system. Only those components directly attached to the wellhead would be exposed to the full wellhead shut-in pressure. Containment systems components, downstream of the capping system, would be exposed only to a reduced pressure determined by the setting of the pressure control and relief system.

There are operational advantages to using the lightest cap suitable for the pressure to be contained, such as air transportability and the ability to install using a range of offshore vessels. Therefore the Team concluded that it is reasonable and desirable to have both 10 kpsi and 15 kpsi systems available in the capping tool box, allowing selection of the most appropriate one for coping with the specific uncontrolled hydrocarbon release characteristics.

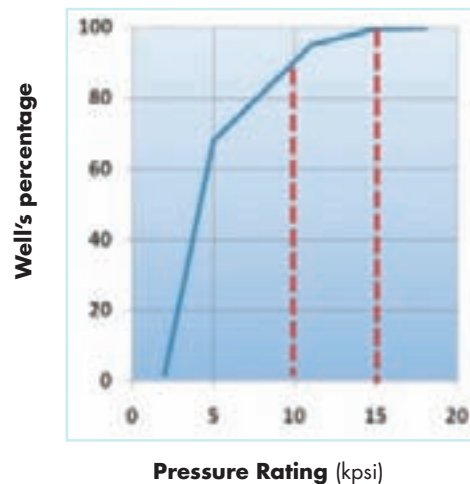


Figure 4.2 Wellhead Pressure Distribution (excluding Gulf of Mexico)

Global Technical Specifications & Response Time

continued

Other parameters of importance are:

- Metocean conditions. Wind, wave, and current conditions are an important design consideration for offshore systems, as they can define when a floating system has to abandon location because of weather and when offloading operations can be performed. The magnitude and duration of extreme conditions varies greatly between regions. In general, there are three categories of metocean regions:
 - ‘Benign’ regions, such as West Africa, where both the operating and extreme conditions are moderate
 - Regions which experience occasional severe (tropical) storms, but which have moderate day-to-day operating conditions, such as the Gulf of Mexico
 - Regions with extreme conditions and with rough day-to-day operating conditions, particularly in winter, such as Northwest Europe (North Sea/West of Shetland) and Eastern Canada
- Water depth. The data collected by the Team shows that 3000 metres is a reasonable maximum depth to use at present for design purposes when developing capping and containment systems. If and when deeper wells are drilled, available capping and containment systems would have to be reviewed for applicability in the greater depths. In particular, the availability of installation equipment (umbilicals, ROVs, etc.), capable of operating in depths greater than 3000 m should then be considered
- Contaminants. The data include actual or anticipated levels of Carbon Dioxide and Hydrogen Sulphide, as these could affect the metallurgy selection for a global capping and containment system. Most wells have levels of both contaminants well within the capabilities of ‘standard’ materials and, therefore, the proposal for capping and containment equipment is to select materials complying with NACE MR-075 Zone 3.

In summary, most wells and operating regions fit within:

- 100 kbd WCD flow potential
- 10 kpsi wellhead pressures
- Flowing wellhead temperature < 150 deg C.
- NACE MR-075 (ISO-15156) zone 3 metallurgy (study required to confirm metallurgy)
- 300m – 3000m water depths
- Broad range of metocean conditions with occasional severe storms

These criteria formed the foundation of the design basis for the proposed capping and containment system components. Although most wells fit within a 10 kpsi shut-in wellhead pressure, the Team concluded that it is reasonable and desirable to have both 10 kpsi and 15 kpsi systems available in the capping tool box.

It is inevitable when design limits are selected that some wells will fall outside the design envelope. In the next phase of OGP work, the Team recommends that the GIRG Well Engineering Design & Equipment/Operating Procedures Team reviews these wells to consider how their design might be altered to provide dedicated mitigations for well parameters that fall outside the design envelope.

5.0 Response Time

Response time is an important parameter when comparing capping and containment system configurations.

Response time (see Figure 5.1) is the time needed to mobilise and deploy the system, from the notification of the uncontrolled hydrocarbon release, to the moment a cap or a full containment system is connected to the well and functioning.

All incidents are different, and all responses will be specific to the incident. Figure 5.1 is

a generic chart that the Team used to assess response times for the systems at locations it studied. The figure is not intended as a tool for planning specific well incident responses. Immediately following an uncontrolled hydrocarbon release there would be an initial period during which response teams are mobilised and the general situation is assessed. This is the time needed to set up response teams and determine requirements for people, equipment and vessels.

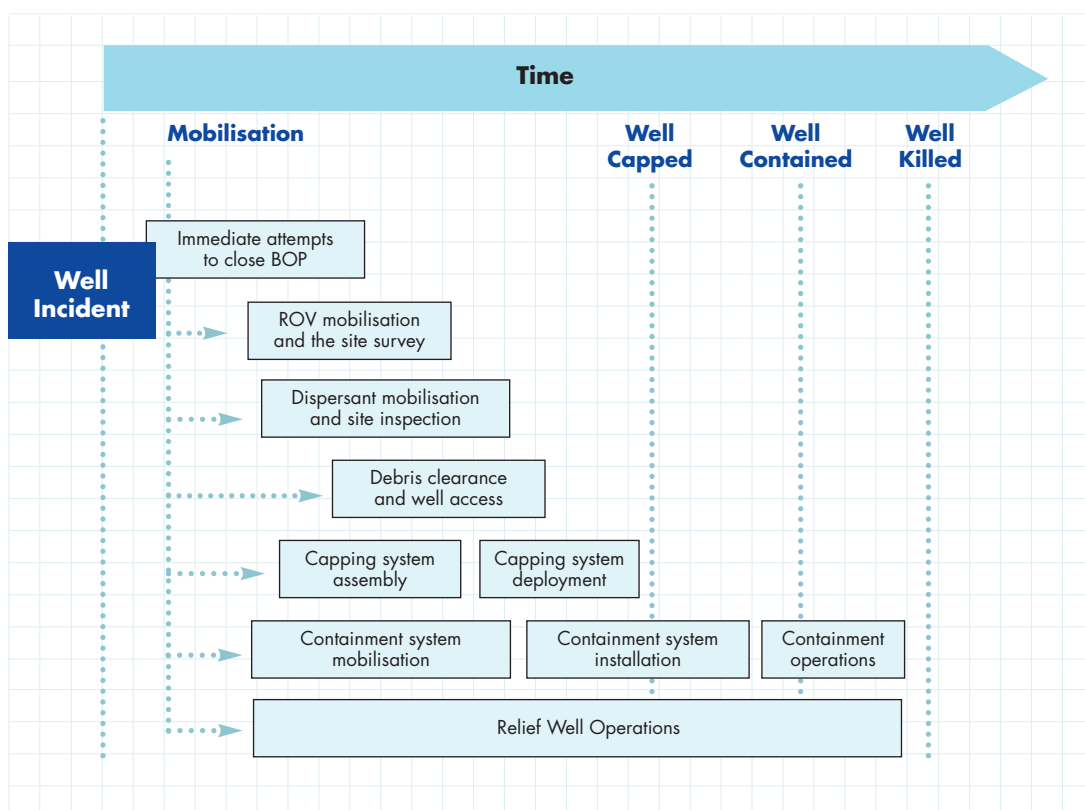


Figure 5.1 Generic Response Activity Model

Response Time

continued

Following a notification, detailed survey operations would begin, and in parallel mobilisation of a subsea dispersant injection system, debris removal equipment, capping equipment and containment systems would commence simultaneously. Once the first survey is done, the results are analysed and the first assessment of the situation is updated, and debris removal operations to get access to the well (if needed) may be carried out. The survey and debris clearance operations are very much dependent upon the actual damage observed and may range substantially.

Once the capping and containment system (if used) components have arrived in country and have been assembled, the actual deployment – which constitutes the load-out, offshore installation and hook-up – is carried out prior to in-situ function testing.

It is impossible to estimate absolute response times for installing a capping assembly or for starting containment through a containment system, because the actual time would be

dependent upon inter alia the type of the uncontrolled release, the specific damage to the well/BOP, storage location of equipment, regional infrastructure and available installation/support vessel spreads. The Team used some of the Macondo activity durations strictly for relative comparative purposes to establish general ranges of minimum response time.

Estimate of minimum response time for Capping Equipment

Mobilisation by air and assembly of the capping equipment is anticipated to be completed during the survey and site clearing operations. The components of a capping assembly would likely be flown in from a global storage location. Once arrived in country and assembled, the actual deployment and offshore installation of the cap is estimated to take a minimum of 3-4 days, assuming the rig remains operational and can install the cap and/or another Vessel of Opportunity is available in country to undertake that activity.

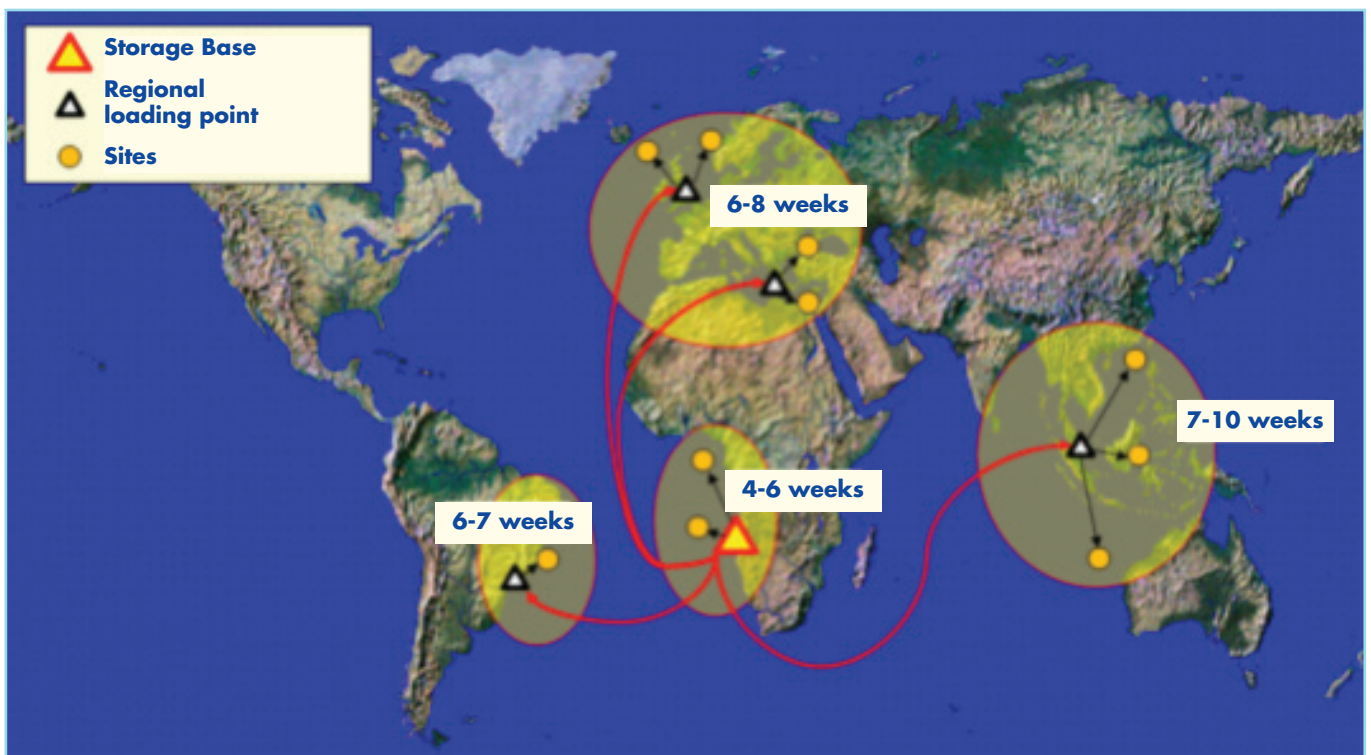


Figure 5.2 Example of possible response times with assumed storage and load-out locations

Response Time

continued

As noted earlier, it is impossible to develop a single response time value for a capping assembly. The Team estimated a global response time range of some 1-4 weeks for capping based on the actual activity durations experienced on Macondo once the required equipment had been built and/or been modified.

Estimate of minimum response time for Containment System

Several issues make it difficult to estimate a minimum response time for the containment system. It may not be possible to transport all components of a containment system by air. The longer duration of the marine transportation of those components needs to be taken into account in the response time calculation. Furthermore, if one centrally-stored, single containment system is intended to serve all regions in the world, then the distance between the storage base location and the uncontrolled hydrocarbon release location has a significant effect on the response time, due to the need for marine transportation.

The impact on response time is illustrated in Figure 5.2, for an example where the containment system is stored in a base along the coast of West Africa. Since the offshore installation of an entire containment system is more complex than deployment of a cap, another key input parameter is the availability in the region of Vessels of Opportunity (VoO) to install containment equipment and/or support the overall operation, regardless of whether the drilling rig is still intact and functioning.

Once equipment has arrived in the country, a minimum of two additional weeks is estimated to be needed to install the subsea, flowline and riser components of a containment system and to hook-up capture vessel(s), resulting in a minimum containment response time range of some minimum of 4-6 weeks (though it is impossible to develop a single response time value for a containment system). This range applies to a scenario where the elements of a containment system that cannot be transported by air are stored in the deepwater region where the uncontrolled hydrocarbon release occurred.

The team recommends that more work be performed as part of the assessment of technical and commercial feasibility of potential containment solutions in the next phase of work in the I/JDA Project. This work could estimate response times for a range of possible containment systems, considering the number of systems used and outline the investments required and changes in risk resulting from the different assumptions.

6.0 Capping & Subsea Dispersant Systems

The Team assessed the state-of-the art equipment that could be used to cap a subsea well and provide subsea injection of dispersants into a flowing subsea well. These systems are described in this section and based on the functional requirements outlined in Section 4. The Team's recommendations on capping and subsea dispersant systems that could be pursued further by industry are given in Section 10 Conclusions and Recommendations.

Capping Equipment

The Team reviewed existing, committed, and proposed solutions for subsea well capping systems. The capping configurations were divided into three main groups;

- hard seal capping devices
- soft seal capping devices
- no seal capping devices

Many groups have started development of deepwater subsea capping equipment as a result of the Macondo accident.

- MWCS: interim response cap and longer-term cap, each with diverting capabilities to allow for containment in the Gulf of Mexico
- OSPRAG: capping device for use in UK waters
- Helix Fast Response System: subsea shut off device (SSOD) for use as a cap and diverter with Helix's Gulf of Mexico-based containment system
- Wild Well Control: developing commercially-available subsea capping devices

All the capping initiatives include a valve stack with choking capability and several interfaces to cover a variety of scenarios. Individual oil companies are also performing work to develop ways to cap a blowing well.

The major part of the cap configurations made for use in the Macondo response will be part of the response kit available for the Gulf of Mexico, under the MWCC. Two of the soft-seal capture devices are now part of the kit prepared for the UK offshore sector.



Figure 6.1 Custom-made Capping Stacks (left Flange Stack used on Macondo, Middle OSPRAG, Right MWCS)

Capping and Subsea Dispersant Systems

continued

Hard Seal Capping Devices

Capping Stacks

Capping stacks are devices made explicitly for capping subsea wells after an uncontrolled hydrocarbon release. They can have a range in the number of valves, which may be a combination of gate valves and/or ram valves. Design pressures and bore diameters can vary, depending on the functional requirements. A typical feature utilised for these types of capping stacks is that they come with a number of different connection interfaces.

Typical configurations are the capping stacks proposed by MWCS and OSPRAG. Two capping stacks were designed and made for Macondo. Chevron rented a 3-ram stack for its drilling operations West of Shetland in late 2010.

Work Over (WO), Light Well Intervention (LWI) and Through Tubing Rotary Drilling Systems (TTRD)

These systems exist and are in regular use. They are designed to perform Work Over and Light Well Interventions on subsea wells. A through-tubing drilling system has also been developed to connect to existing wells and perform drilling through the production tubing.

These systems may be used as capping devices due to their configuration with standard connector systems and valve stacks able to shut in against well pressure. A purpose-built diverter system would have to be installed together with these systems to be able to connect to a flowing well.

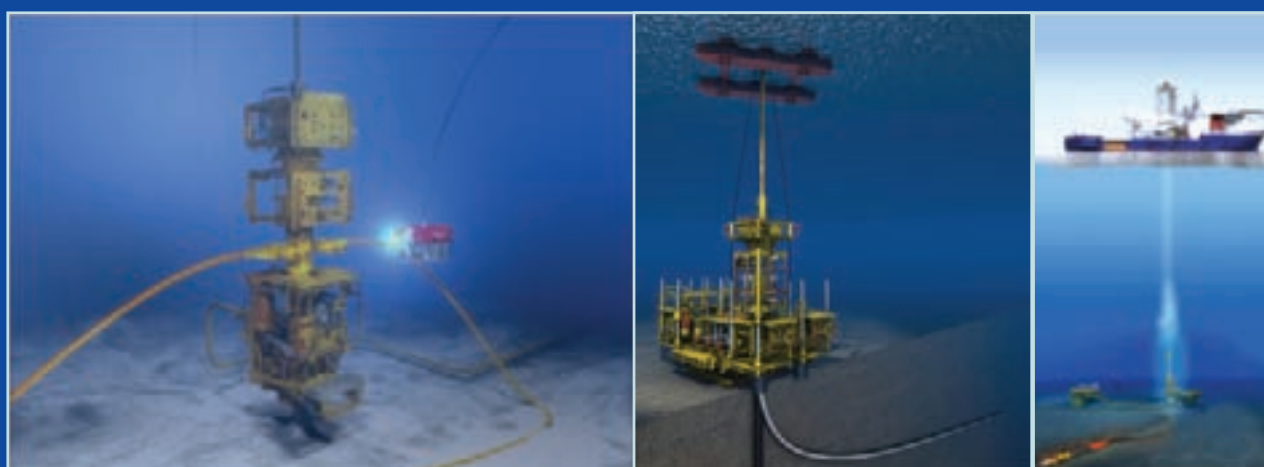


Figure 6.2 WO System with Diverter (Left), TTRD (Middle), LWI (Right) - Courtesy of FMC

Capping and Subsea Dispersant Systems

continued

HXT and VXT systems

Valve trees for production and injection wells may also be suitable as capping devices. These are divided into two types, vertical (VXT) and horizontal (HXT) trees. The main difference between these two types used as a capping device is that the VXT has a valve that allows the vertical bore to be closed after installation, while the HXT would need a plug or high pressure cap in order to close the vertical bore access.

There are several systems from different vendors in use in all the subsea regions. The technology is proven in use and the systems contain many of the same features as WO, LWI and TTRD systems. However, few systems are kept in stock as most of them are installed on production and injection wells.

Most of the systems are 5 to 10 kpsi, only a few are 15 kpsi.

BOP systems

A BOP could be used as a hard seal capping device. BOPs provide full-bore access with different rams to close in a well which is out of control. A BOP is, however, large and heavy and this may cause challenges if connecting to a well head with integrity issues. It may also cause installation challenges.

Special arrangements may be developed to accommodate the requirements for a specific scenario (such as using only a part of the BOP).

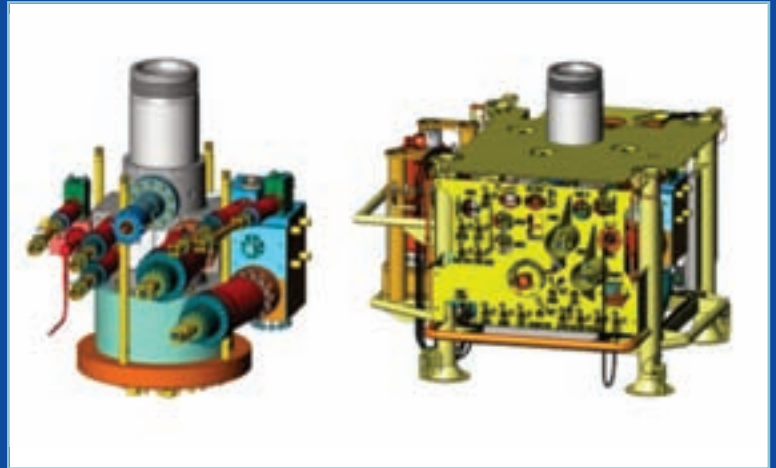


Figure 6.3 Typical Subsea Configuration



Figure 6.4 BOP Configurations - Small BOP with RAMS (Left), Full Size BOP (Right)

Capping and Subsea Dispersant Systems

continued

External tree caps/debris caps

External tree caps and debris caps have been designed to be used as a second barrier on top of production or injection trees. They have also been used as a second barrier cap on wellheads during drilling operations (in between drilling and completion operations).

There may be an installation issue if a cap like this is used on a flowing well as they do not have vertical access (do not allow flow through).

Internal capping devices

This sealing device may be used to seal inside tubulars, BOPs or subsea trees. A development and testing phase would be needed because this technology is not proven in use.

There may be an installation issue because it requires full access inside and through the BOP, which cannot be assumed for all blowouts.

Soft Seal Capping Devices

Top hat configurations

The term "top hat" was used in the Macondo response to describe several soft-seal caps that were built and deployed during the response. Some had an elastomer seal around a pipe or flange and some had permanent vent openings to the ocean. Only one was actually used to collect hydrocarbons.

Caisson configurations

Entities have proposed seabed soft-seal caps covering the BOP that use suction anchors or weight to give a seal. As far as the Team know, designs have not been completed for any of these concepts.



Figure 6.5 Debris Cap for Production Tree (HXT)

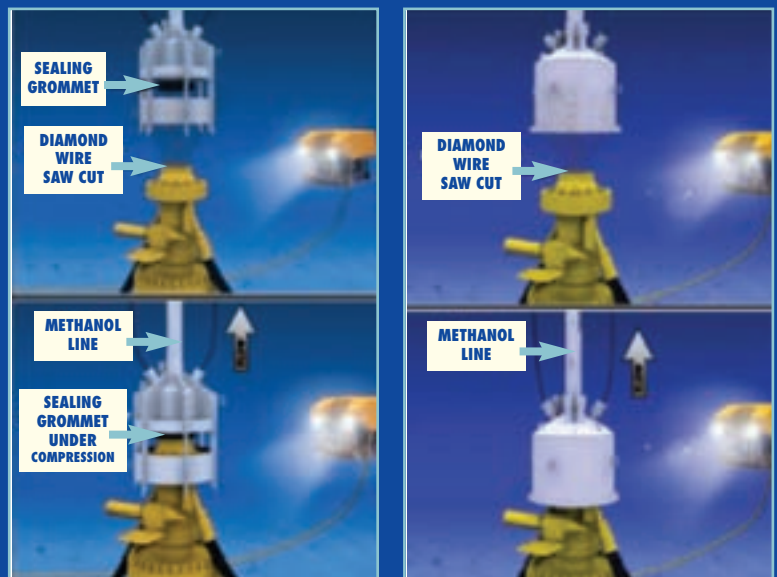


Figure 6.6 Typical Top Hat Configuration

Capping and Subsea Dispersant Systems

continued

No-Seal Capping Devices

No-sealing devices would collect oil and water from the open ocean or with large openings to the ocean but could not cap a well. Although several approaches have been proposed, only two devices have actually been used in attempts to collect hydrocarbons from flowing subsea wells. A 'Sombrero' was used by well control experts to collect oil from the shallow water IXTOC 1 in the Gulf of Mexico (1979) and a 'Cofferdam' was used on Macondo (2010).

The majority of the no-seal devices reviewed by the Team require research and development (R&D) to further enhance them. The Team recommends that investigation of no-seal capping devices be performed as separate R&D work from the I/JDA that was formed to work on capping and containment.

Subsea Dispersant Injection Systems

Deployment of dispersant to the oil at source using a subsea system is a relatively new approach. It was used in response to an oil spill for the first time on Macondo, after field testing, and pursuant to the authorisation of the federal government. Whereas dispersant has traditionally been applied to oil on the surface of the water, a subsea system injects the dispersant directly into the hydrocarbon source.

The primary purpose of dispersant is to break up large volumes of oil into microscopic droplets that can more easily disperse, evaporate, or be remediated by naturally-occurring bacteria. This can minimise the amount of oil that reaches shore and reduces environmental impact to marshes, wetlands, and beaches. Another effect observed at the sea surface above the Macondo well that is relevant to future capping and containment response as well as oil spill response efforts was that the subsea application of dispersant at Macondo caused a reduction in the concentration of volatile organic compounds (VOCs) in the air near the source area.

The Team concludes that this ability to create a safer work environment for vessels and personnel engaged in response activities has the potential to enable access to work areas above uncontrolled releases that might otherwise be inaccessible. The team recommends that industry continues to advance equipment to allow dispersant to be deployed subsea as soon as is safely possible after an incident occurs. Industry should consider developing or refining a subsea dispersant system that can be safely set up to work as an autonomous system in case of disconnection due to weather conditions or other causes. In normal operational mode, the system would be operated from a vessel fit for the purpose.

The subsea system may consist of subsea storage tanks, flowlines, a manifold, distribution panels, subsea pumps and a control system. A possible conceptual subsea dispersant configuration is shown in *Figure 6.7*.

Engineering would be helpful to further develop systems and enable a more efficient application and injection. It is important to design the dispersant system to interface efficiently with the capping and possible containment systems and to allow dispersant to be provided through a variety of options. The MWCC plans to include a subsea dispersant injection system. This system is expected to be ready for use in the Gulf of Mexico together with the rest of the MWCS package.

The logistical demands of dispersant supply merit further consideration.

Capping and Subsea Dispersant Systems

continued

The Team has advised the GIRG OSR Team on the importance of subsea injection of dispersant. The OSR Team will take the lead on behalf of OGP for advocacy with regulators to pre-approve the use of subsea dispersants worldwide.

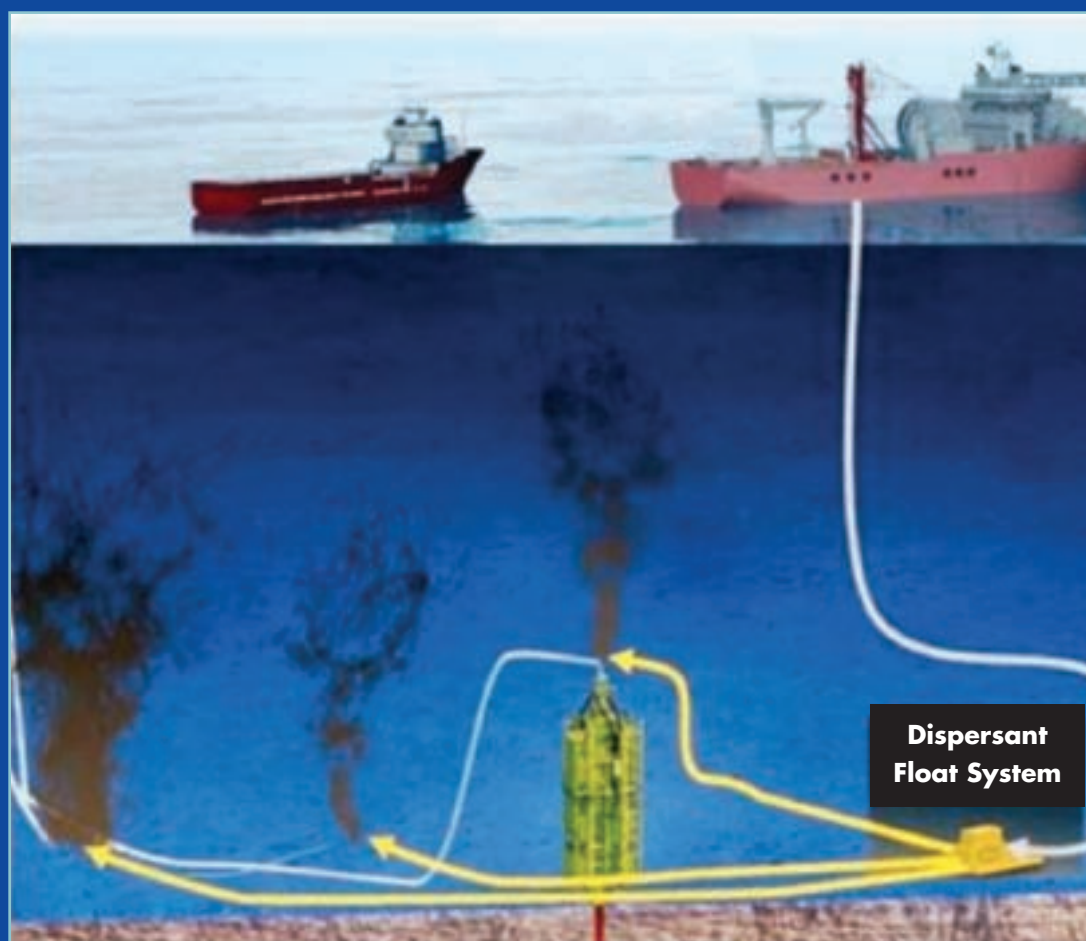


Figure 6.7 Conceptual Subsea Dispersant Injection System

7.0 Containment Systems

This section presents the potential containment systems that the Team reviewed. The Team's recommendation on systems to be pursued further by industry is given in Section 10 Conclusions and Recommendations.

Functional Requirements

The following technical specifications from the list discussed in Section 4 form the basis for the assessment of global containment systems:

- 100 kbpd WCD flow potential
- NACE MR-075 (ISO-15156) zone 3 metallurgy
- 300m – 3000m water depths
- Broad range of metocean conditions with occasional severe storms

In addition, the Team suggests these key functional requirements as the industry assesses the technical and commercial feasibility of possible containment systems:

- All containment equipment should be suitable for use or long-term storage for at least 20 years
- All containment equipment should be designed for a six month operating life during a response
- Dispersant injection points should be provided for any residual subsea hydrocarbon flow to sea

- In the case where well pressure integrity is not assured, the pressure control and pressure relief system should be capable of protecting the well from high pressure
- Flowlines should be sufficiently long to be able to locate manifolds or riser bases a significant distance (on the order of 1000 m) away from the well
- Quick disconnect and easy re-connect capability of the surface capture vessel(s) to manage possible adverse weather conditions is recommended

Containment Solutions Reviewed

The Team reviewed existing, committed, and proposed industry solutions for subsea oil containment. The systems that were of most interest during the evaluation were:

- Marine Well Containment System (MWCS)
- Helix Fast Response System (Helix FRS)
- Below Water Separation System (BWS)
- Use of existing surface vessel fleet such as DP Drill ships, Well Test Vessels and FPSOs

Each is described in this section.

Capping Systems

continued

In July 2010, Chevron, ConocoPhillips, ExxonMobil and Shell sanctioned the design and construction of the essential equipment required to provide a capping and containment system in the Gulf of Mexico for 100,000 barrels a day of liquid handling with 200 mmscfd of associated gas flaring. BP has since joined the Marine Well Containment Company. The system includes a subsea containment assembly that comprises a diverter spool and sealing cap, flowlines, manifolds, and two free-standing risers to carry the hydrocarbon liquids to two modular capture vessels of 50,000 bpd of fluid and 100 mmscfd gas flaring capacity each. Capture vessels are based on Dynamic Positioning (DP) tankers used for alternative service and on well-test type separation facilities installed during an incident. Export is by commercially available tankers.

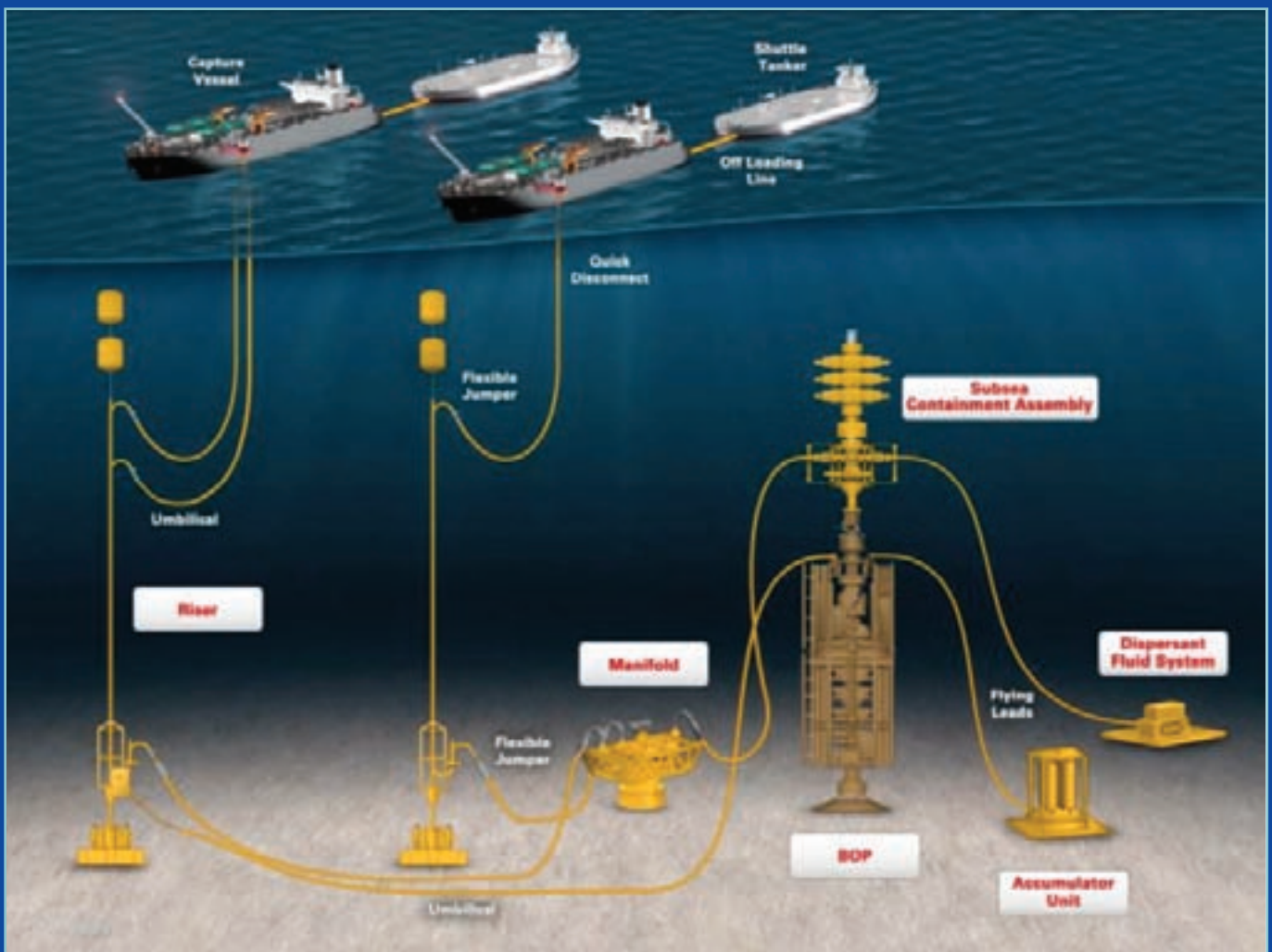


Figure 7.1 Marine Well Containment System (MWCS)

Capping Systems

continued

Helix Energy Services is proposing a containment system based on existing floating assets it has in the Gulf of Mexico that were used for containment during the Macondo accident. The system will have a total capacity of 55,000 bpd and 95 mmscfd gas flaring in 8,000 feet of water and will be stationed in the Gulf of Mexico.

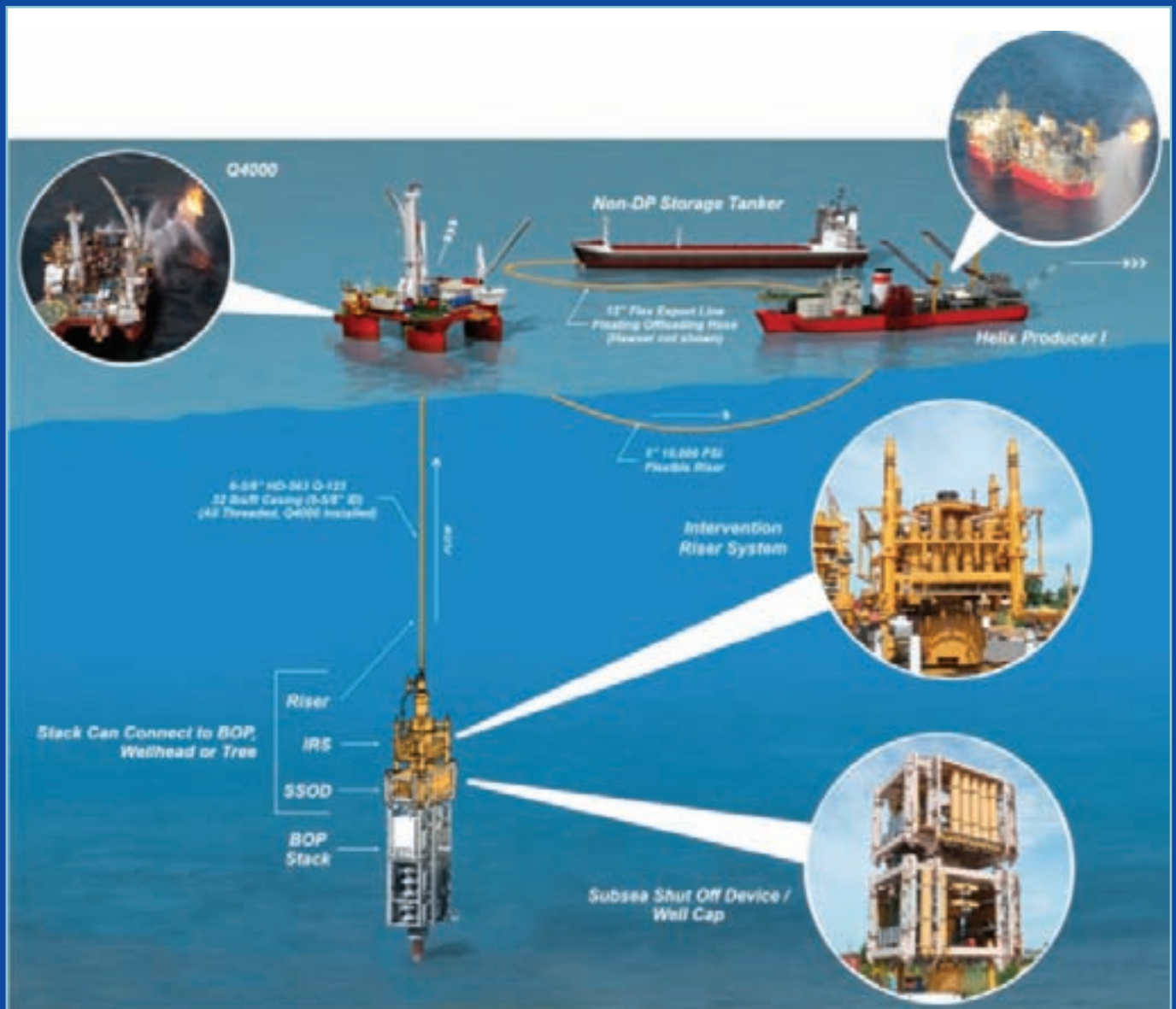


Figure 7.2 Helix Fast Response System (Helix ESG Fast Response System)

Capping Systems

continued

The Below Water Separator System (BWS) is a concept based on a novel combination of existing equipment to create a new system. Well production is contained and collected at the base of a riser tower and transmitted to buoyancy module / separator (below water) where high-pressure liquid and gas separation takes place. Gas flow is sent to an oil/gas burner. Oil flow is sent to a low-pressure separation package skid mounted on a support vessel of opportunity (Floating Capture Facility, FCF) or to the flare system to be incinerated during disconnect of the FCF. Feasibility of the system needs to be demonstrated and it requires further design maturation, including prototype testing.

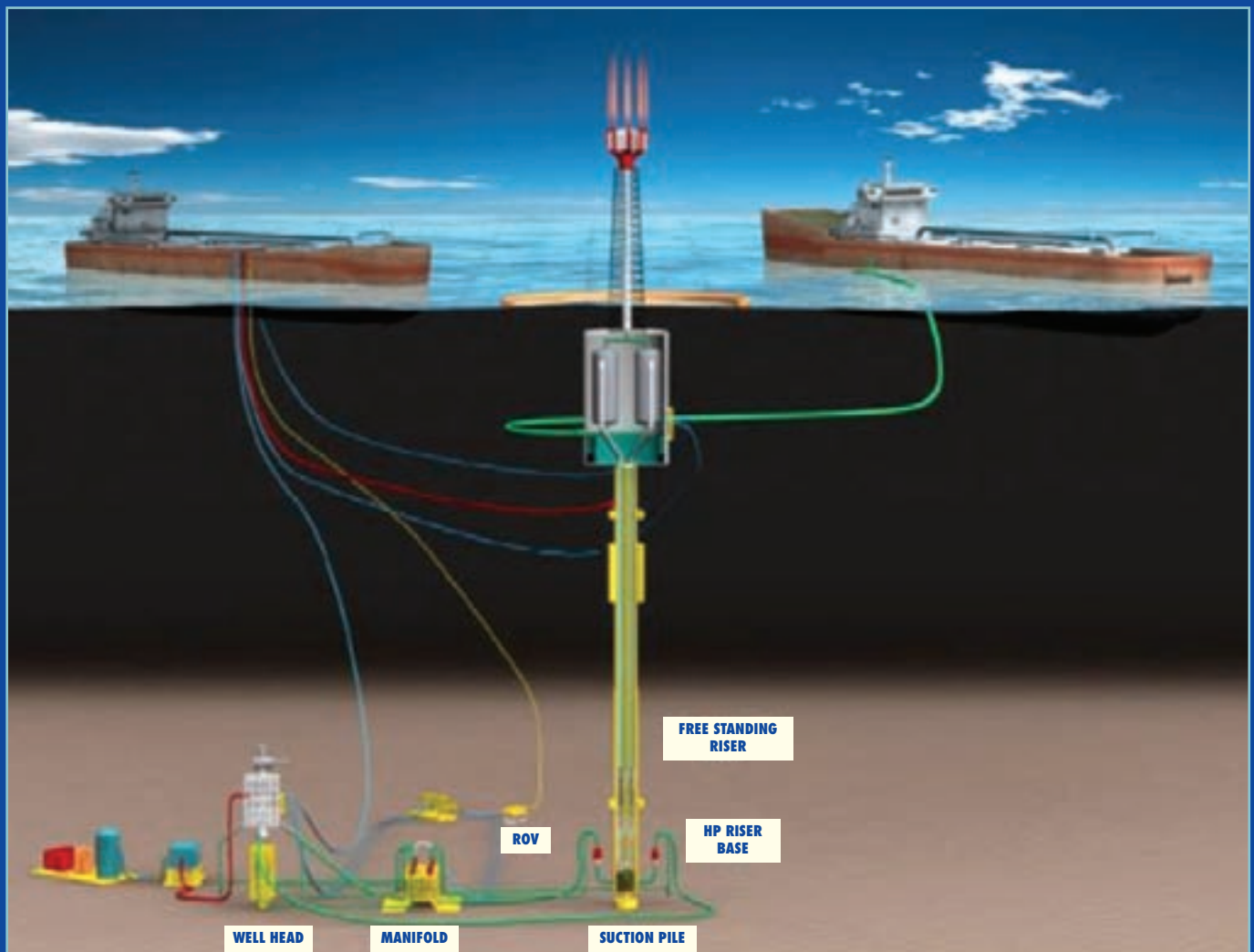


Figure 7.3 Below Water Separation System (BWS)

Capping Systems

continued

Several DP drillships with well test capability and DP Extended Well Test vessels exist. Other DP drillships could be upgraded to have well test capability, adding to the fleet. In addition, there are a few DP FPSOs that could potentially be mobilised. In the event of an uncontrolled hydrocarbon release, several of these vessels could be contracted and connected in a response to achieve the required 100 kbpd capacity. A Common Subsea System (see below) would have to be deployed with multiple connection points to allow the connection of multiple risers.

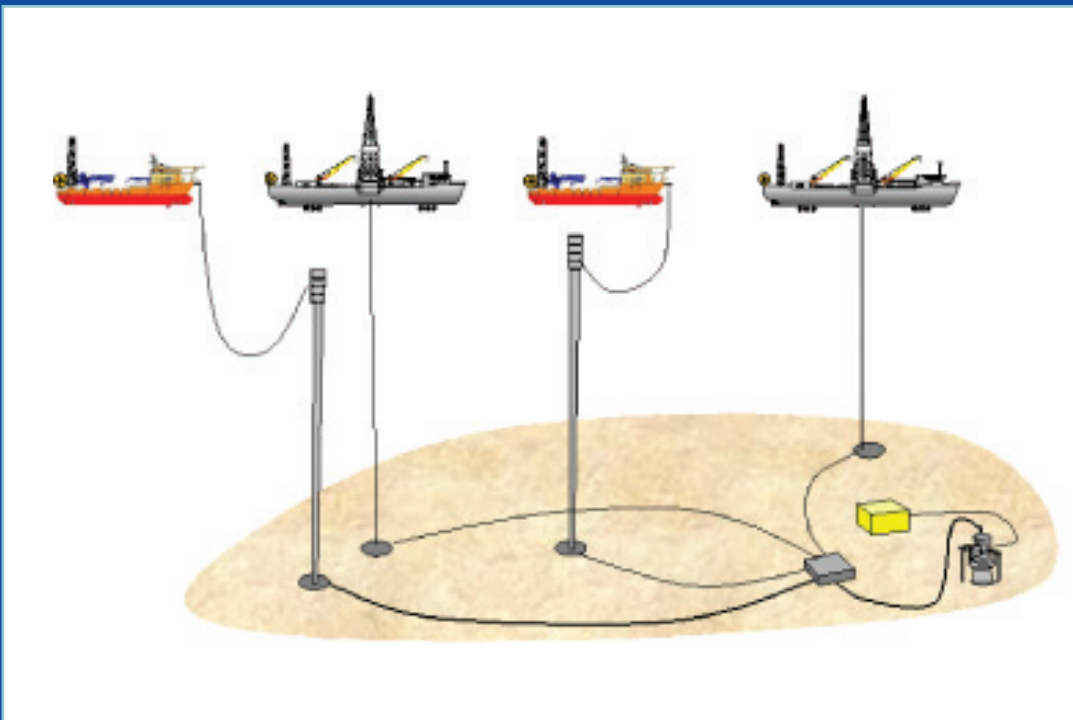


Figure 7.4 Use of existing surface vessel fleet such as DP Drill ships, Well Test Vessels and Floating Production, Storage and Offloading Vessels (FPSOs)

Capping Systems

continued

All of the containment solutions considered share the need for subsea infrastructure for collecting well hydrocarbons from the discharge location and moving them to the capturing vessels or to the oil and gas flaring device on the surface. Such a Common Subsea System, shown in Figure 7.5, could consist of free-standing hybrid risers, top-tensioned risers, catenary risers, riser bases, jumpers, flowlines and manifolds. These components should be compatible, in terms of interfaces and connecting points, with different options of surface facilities and capture vessels.

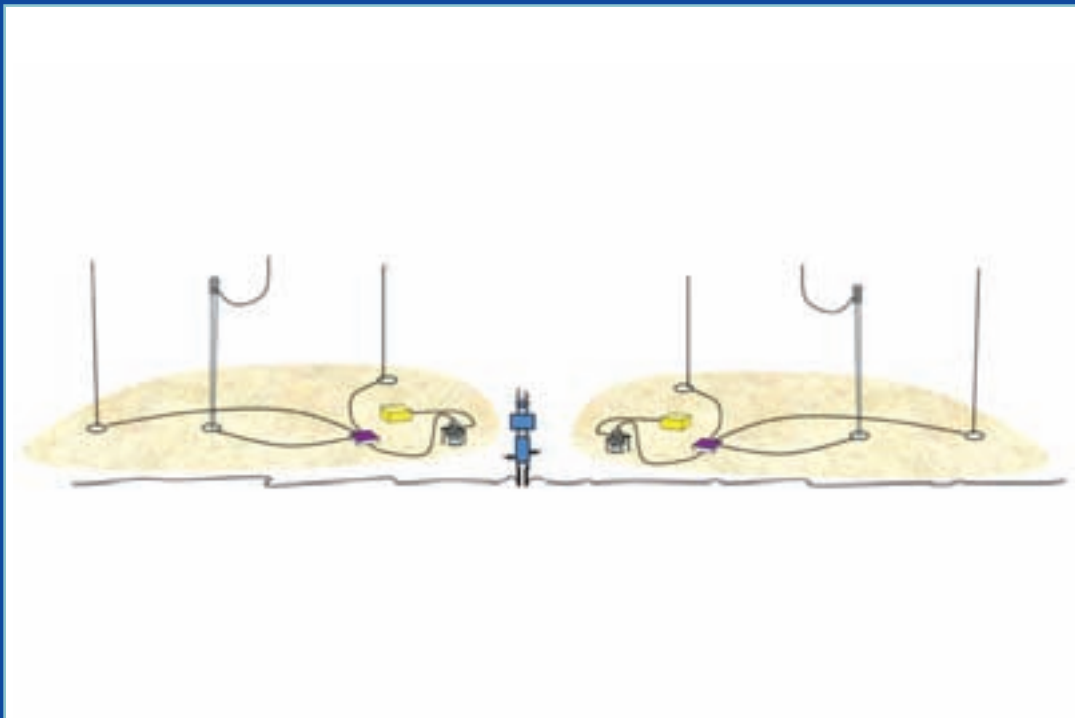


Figure 7.5 Common Subsea System

Capping Systems

continued

Evaluation of Containment Systems for Use Globally

The focus of the evaluation of the surface facilities has been to identify facilities that meet the technical and functional specifications and that could be deployed within similar response times to each of the regions considered. As explained in Section 5, the mobilisation of a single system such as the MWCS or the Helix system from one storage base would result in a wide range in response times. The MWCS has station-keeping limitations and would not be able to work reliably in harsh environments (like the North Sea or West of Shetlands) without major upgrades to the vessels' dynamic positioning capability, which creates concerns about costs and deliverability. The Helix system has similar limitations and in addition does not meet the technical specification of 100 kbpd flow potential.

Review of available vessels in each of the regions has concluded that even in the less-prolific regions there are often at least a few drill ships, extended well test vessels, DP FPSOs, and multi-service vessels (MSV) that could be used for containment response. If employed to allow capture or disposal of oil, these vessels and vessels operating in an adjacent region could be mobilised to allow for rapid deployment in the event of an uncontrolled hydrocarbon release in the region. The Team concluded that the advantages of this are:

- The relatively large number of vessels available that could be employed
- The geographic spread of deployment of those vessels and the resulting quick response times
- The capability of drillships to remain on station in severe weather
- And the fact that the vessels would be in continuous use, rather than stacked

The team recommends that the technical and commercial feasibility of using the existing and upgraded fleet as containment vessels should be studied.

Recognising that technical and commercial feasibility have not yet been demonstrated and that there is not yet a consensus that the provision of containment around the world gives a net benefit, the Team recommended that the work under the JDA Project advance the possible development and assessment of alternative containment solutions during the next phase of work.

The BWS has the potential to provide an alternative approach to dealing with an uncontrolled hydrocarbon release and the possibility for a further reduced response time and reduced safety risks (due to lower staffing levels). The reduced response time is based on the ability to locate the BWS in regional centres. The BWS riser system could be mobilised and operational whilst the vessels of opportunity (described above) are brought to location to capture and process the liquid hydrocarbons.

8.0 Organisational Models for Project Execution & Deployment Phases

The Capping and Containment Team reviewed organisation models for the Execution and Deployment Phases of the international capping and containment systems recommended in Section 1. Figure 8.1 defines the activities performed during the Execution and Deployment Phases of the capping and containment systems.

Project Phase

A Project Execution Phase model similar to that of the MWCC is being adopted. The eight companies in the Management Committee of OGP – together with BG Group – signed an IJDA in February 2011. The IJDA may progress to a JDA, under which the following activities may be performed:

- Cooperation in the selection and design of a capping toolbox and dispersant hardware
- Study further the need for and feasibility of a common containment system (including fallback solutions and alternatives), and
- Further investigation of, and development of solutions for, certain operational issues related to capping and containment of hydrocarbons released from a well.

Shell is the operator under the I/JDA. The I/JDA Project has no contractual ties to the OGP, but is a consortium of companies that wish to support further development and assessment of international capping and containment systems.

Deployment Phase

The Team does not make a recommendation for a particular organisational model for the Deployment Phase of international capping and/or containment systems. The execution of any work required to develop new equipment and the long-term maintenance and operation of that equipment could be managed by a combination of a not-for-profit organisation – similar to the MWCC in the Gulf of Mexico or Oil Spill Response Ltd (OSRL) – and commercial suppliers of goods and services.

The Team reviewed potential models for the Deployment Phase and has included development of the Deployment Phase Organisation as part of the work recommended to be performed by the I/JDA Project. The Team recommends that the scope of the I/JDA Project include work to:

- Provide the mechanism for funding and managing the activities agreed (see Section 9) by the participating companies until the establishment of a deployment organisation
- Determine the most appropriate permanent deployment organisation (structure, commercial and organisational models, governance) for the operational phase

The Team suggests that these factors be considered as the deployment organisation is developed:

- Assigned scope
- Equipment exclusive to response or available for other jobs
- Regional, multi-regional, or global
- Commercial or not-for-profit
- OPEX and CAPEX
- Funding mechanism
- Ownership of equipment

Project Phases

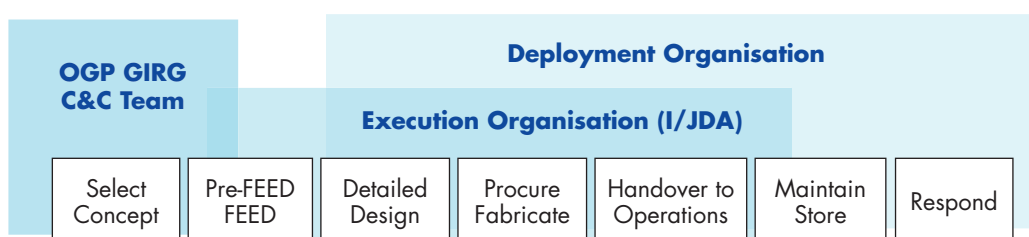


Figure 8.1 Capping and Containment Organisational Plan

9.0 Proposal

The work to develop capping, subsea dispersant, and containment systems for use worldwide is anticipated to be performed in stages with final investment decisions for different systems at different dates.

Proposal regarding Capping and Dispersant Systems

From the analysis undertaken, the Team proposes the development of a "capping tool box" rather than a capping tool, to accommodate differences in the various wellhead/BOP configurations which could be found, as well as the various regional requirements in terms of pressure rating. The Team recommends that engineering of systems for capping is pursued in the next phase of work.

Activity 1: Develop a "Capping Toolbox"

Enter into Pre-FEED and FEED phases for capping equipment. The objective of this phase of work is to provide a design that, if constructed, would provide the industry with a "toolbox" of capping equipment available for a number of scenarios and circumstances (e.g. different pressure regimes, varying wellbore access, several adaptor spools). As appropriate, the Team recommends that the designs are developed in cooperation with OSPRAG and the MWCC to maximise interchange-ability and minimise design effort.

The Team acknowledges the substantial benefits derived from the subsea application of dispersant at Macondo. Specifically relevant to capping and containment is the reduction in the concentration of hydrocarbons, including VOCs, at the sea surface. This has the potential to make possible access to work areas above uncontrolled releases that might otherwise be inaccessible. The Team recommends that

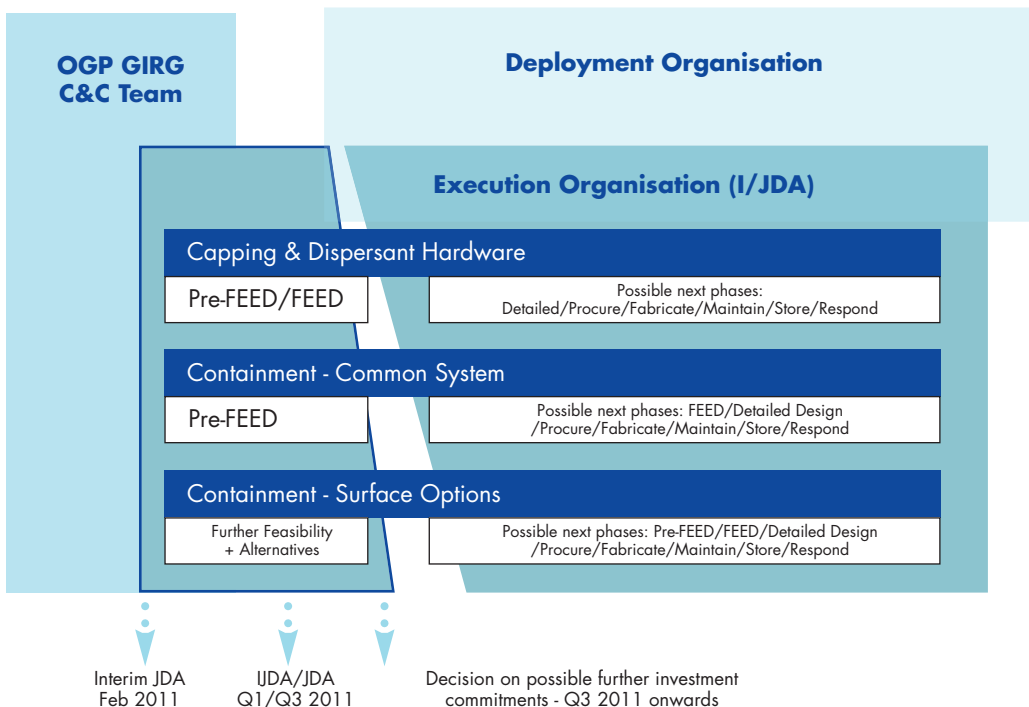


Figure 9.1 Phases for work on Capping and Containment for I/JDA

Proposal

continued

design, engineering and possible procurement of enhanced systems for subsea application of dispersant chemicals is pursued in the next phase(s) of work.

Activity 2: Design Subsea Dispersant Injection Hardware

Enter into Pre-FEED and FEED phases for equipment/facilities to inject dispersant into the flow of hydrocarbons at, or above, the seabed. As appropriate, the Team recommends that the designs be developed in cooperation with OSPRAG and the MWCC to maximise interchangeability and minimise design effort.

Proposal regarding Operational Issues

A recurring theme in the review of the Team's work and regulators' feedback was the request to look into capping and containment issues regarding operations in shallow water and for existing producing subsea wells. As most of the wells around the world are in water depths shallower than the 300m cut-off used here, and many producing subsea wells exist, the Team recommends that further work is done in response to these comments. For the hardware being developed, the next phase should explore issues and solutions with regards to installation and operations in shallow water as well as the applicability of those systems on current producing subsea wells.

Activity 3: Work Operational Issues related to Capping and Containment

Develop outstanding items of work that were not included in the GIRG first phase but are important to be included in the total project.

- Installation of capping/capture/containment devices developed under the I/JDA Project in shallow water and operational procedures related to this

- Review of capping/containment capabilities developed under the I/JDA Project for producing subsea wells

The intent of this work is to understand the applicability of the systems developed by the I/JDA Project, and not to design new hardware for use in shallow water or on producing subsea wells.

Proposal regarding Containment System

Containment system equipment can be split into subsea and surface elements. The subsea elements are relatively independent of the surface elements and are termed the 'Common Subsea System'. The Common Subsea System consists of subsea elements such as free standing hybrid risers, top-tensioned risers, catenary/lazy wave risers, riser bases, jumpers, flowlines, and manifolds. The Team proposes to start further work on pre-FEED and FEED of the 'Common Subsea System'.

The comparative analysis of the different surface elements of the containment system has concluded that several containment systems largely meet the system and regional criteria. Therefore, the differences in minimum response time and cost became overriding for the selection of the surface facilities solution. Further work is recommended to assess the need for containment worldwide and the technical and commercial feasibility of, and potential improvements to, surface handling capabilities for hydrocarbons using currently available dynamically-positioned vessels/drillships/mobile testing units. The Team recommends further assessment of alternatives in case technical or commercial feasibility of the vessel of opportunity solution is not proven.

Proposal

continued

Activity 4: Study further the need for and feasibility of a Containment System

The design of the Containment System includes both hardware and procedural elements. Key activities potentially include:

- Enter into Pre-FEED for subsea facilities architecture, comprising manifolds, jumpers, umbilicals, flow lines and risers, which are intended to allow deployment of the Common Subsea System and then connection to surface handling infrastructure. Include studies of critical elements and Pre-FEED of common system: preliminary engineering design plus development of key design, installation and operating philosophies. The Team anticipates that the design work will be done with an appropriate contractor and that the I/JDA Project will attempt to liaise with the MWCC
- Develop operating procedures including simultaneous operations, taking lessons learned from accidents like Macondo and Montara into account. Describe the scope and limits of the equipment, procedures and operations that would be provided by the containment organisation and how that interacts with the overall well response activities. Develop logistics and operating procedures (including simultaneous operations) and command control procedures to enable safe and efficient use of equipment developed as part of the I/JDA Project. Develop most appropriate models for organisations that will assemble, own, operate and maintain the equipment
- Analyse capability and commercial agreements required to use current vessel/testing fleet as surface containment vessels. Workscope includes preparation of agreements and due diligence (HAZID/HAZOP) of potential vessels to estimate technical modifications/enhancement requirements (storage and offloading, flare capability). Existing testing and operating equipment around the world would be used rather than building purpose-built/converted vessels
- Work on alternatives and fall back solutions for surface elements of the containment systems. Investigate the drivers for cost and schedule of such vessels and their operability
- Continue to work with the member companies of the I/JDA to assess whether global containment provides a net benefit for the reduction of the risks of well control incidents, given the improvements in well control and deployment of capping stacks proposed by OGP

10.0 Conclusions and Proposals

The Capping and Containment Team gathered and assessed information that allowed it to develop conclusions and recommendations addressing the objectives it was given. It did its work within the context of the overall objectives of OGP GIRG to discuss and devise practices to:

- (a) Improve drilling safety and reduce the likelihood of a well incident
- (b) Decrease the time it takes to stop the flow from an uncontrolled well
- (c) Improve both subsurface and surface response capabilities

Conclusions

GIRG concludes that the most effective means for reducing the risk of well control incidents is through improvements to drilling safety that can reduce the likelihood of incidents.

Capping

- Capping equipment can be developed based on existing technology to provide a hard seal cap. The capping equipment can also divert flow to a containment system or allow well kill operations when set up with a diverter spool equipped with side outlets and adequate connectors to kill, choke and divert
- It is reasonable and desirable to have both 10 kpsi and 15 kpsi caps available so that the responding operator can select the most appropriate one for coping with the specific blowout characteristics. There are operational advantages to using the lightest cap suitable for the pressure to be contained
- Reduced bore caps are judged to be acceptable, providing work in next phase confirms the preliminary results showing installation forces are acceptable
- Capping components are or can be designed to be transportable by air
- It is impossible to estimate absolute response times to cap a well, as the actual time is dependent upon the type of uncontrolled hydrocarbon release, the actual damage to the well/BOP, storage location of equipment, regional infrastructure and available installation/support vessel spread, and a host

of other environmental and human factors. Installation of capping equipment requires 1-4 weeks best case, though this could be considerably longer driven by site survey and complicated debris clearance. Air transport for capping components may reduce time compared to marine transport

Subsea Dispersant

- Application of dispersant subsea could be helpful in a number of ways including allowing safe access to work areas above an uncontrolled release to carry out surveys, wellbore intervention, capping, and containment

Containment

- The Team was asked “to determine whether a single worldwide standardised containment system (outside the Gulf of Mexico) could and should be designed and deployed”. The Team did not make a final conclusion on this, but rather recommends that further work be done to understand technical and commercial solutions (the “could” part) and the net benefit of providing containment (the “should” part). Describing the net risk benefit of providing containment for deepwater drilling for different regions requires a clear description of the risks involved in deepwater drilling and the resources required to develop containment systems to reduce those risks. The Team recommends that the following drivers be considered as OGP and the I/JDA Project assess the net benefit to risk of providing containment:
 - Improved prevention can reduce the likelihood of a well control event
 - Macondo showed that a hard-seal cap can successfully stop the flow of oil to the ocean
 - Macondo showed that a containment system could reduce flow into the environment
 - Containment may reduce the consequences of other release scenarios (like damaged top connections on a BOP)

Conclusions and Proposals

continued

- It is impossible to estimate absolute response times for a containment system, as the actual time is dependent upon the type of uncontrolled hydrocarbon release, the actual damage to the well/BOP, storage location of equipment, regional infrastructure and available installation/support vessel spread. Initiation of containment could require a minimum of 4-6 weeks best case from initial notification to first operation
- Not all containment components could be transportable by air. The marine transportation time of containment components and the mobilisation of installation vessels required to install subsea containment equipment drive the critical path schedule, which affects the number of locations at which containment equipment might be stored. Some or all containment equipment might be stored regionally
- Sea conditions in certain areas of the world (like the North Sea – West of Shetlands, and Eastern Canada) demand powerful DP systems for station keeping, beyond the current capability of ordinary DP tankers or well test vessels
- The high DP power demand of North Sea/West of Shetland/Canada drives the global solution towards including drillships, which have high powered DP systems when compared to other DP vessels. Drillships have other advantages, including:
 - They carry their own riser systems for connection to subsea infrastructure
 - Some have tanks which are (or could be) capable of oil storage
 - They are in regular operation and maintenance with trained and experienced crews, hence availability is high
- Dedicated DP FPSOs for collection would be large and complex facilities. Unless used in regular service, readiness and availability would be a concern. The equipment required to make them capable of regular service (gas compression, water treatment, subsea control systems, etc) would make the vessels even more complex and costly

Collaboration with other initiatives

- The capping, dispersant, and subsea containment systems proposed by GIRG are aligned with the MWCC
- The capping system being developed by OSPRAG is compatible with GIRG capping toolbox.

Recommendations

- The Team recommends that industry pursue design of a capping toolbox and additional subsea dispersant equipment. Designs should be developed with OSPRAG and the MWC Project to maximise interchange-ability and minimise design effort
- The Team recommends that the need for global containment is further assessed. Containment is needed only if the well cannot be shut in using the BOP, downhole interventions, or capping stacks. Well incidents are extremely rare; those that cannot be handled by BOP, downhole intervention or capping are even rarer
- The Team recommends that a JDA be executed to establish an Execution Phase organisation similar to that executing the MWCC. That organisation should then carry out the proposed scope of work defined in the activities shown in Section 9
- The Team recommends that a special workshop be held to hand over the work of the Team to the new JDA Project. During this workshop a number of specific tasks can be passed on to the JDA Project
- Recognising that technical and commercial feasibility have not yet been demonstrated and that there is not yet a consensus that the provision of containment around the world gives a net benefit, the Team recommended that the work under the I/JDA Project advance the possible development and assessment of alternative containment solutions during the next phase of work

Conclusions and Proposals

continued

- As most of the wells around the world are in water depths shallower than the 300m cut-off used here, and many producing subsea wells exist, the Team recommends that further work is done to look into capping and containment issues regarding operations in shallow water and for existing producing subsea wells
- The Team recommends that a Joint Industry Project is considered to develop further and validate the Below Water Separation concept, studying the structure stability, separation design, pressure control and relief, and the burning of hydrocarbons. This JIP could develop a clear path forward comprising further design maturation followed by system integration, qualification testing, and a field trial
- Review of available vessels in each of the regions has concluded that even in the less-prolific regions there are often at least a few drill ships, extended well test vessels, DP FPSOs, and multi-service vessels (MSV) that could be used for containment response. The team recommends that the technical and commercial feasibility of using the existing and upgraded fleet as containment vessels should be studied
- The industry would benefit from a common definition of capping and containment terminology. The Team recommends that the terminology in Figure 2.1 be used by its members

The Team recommends that some of the work that is identified should be considered by OGP and should not be part of the JDA Project. Specific tasks to be transferred to OGP are:

- It is inevitable when design limits are selected that some wells will fall outside the design envelope. In the next phase of work, those

wells (i.e. wells which have extreme characteristics outside the capability of any industry-provided capping and containment equipment) should be reviewed with the GIRG Well Design Team to consider how the well design might be altered to provide dedicated mitigations for such wells

- Decide on potential future work activities with regards to

1. Arctic or Ice Prone Areas
2. No-Seal Capping Devices and Soft Seal Devices for setting on interfaces with a high incline
3. Operating procedures for capping devices for production templates and cluster wells

- The team recommends that industry develop equipment to allow dispersant to be deployed subsea as soon as is safely possible after an incident occurs. Industry should consider developing or refining a subsea dispersant system that can be safely set up to work as an autonomous system in case of disconnection due to weather conditions or other causes. In normal operational mode, the system would be operated from a vessel
- Further work is recommended to assess the need for containment worldwide and the technical and commercial feasibility of, and potential improvements to, surface handling capabilities for hydrocarbons using currently available, DP vessels/drillships/mobile testing units. The Team recommends further assessment of alternatives in case the technical or commercial viability of the vessel of opportunity solution is not proven.

Glossary

API	American Petroleum Institute
APPEA	Australian Petroleum Production & Exploration Association
Bpd	Barrels per day
BOP	Blowout Preventer
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
CMS	Competency Management System
Containment	System used to bring leaking oil from a subsea wellhead in a controlled way to the surface for storage and disposal
Deepwater	Greater than 300m
Ultra-deepwater	Greater than 3000m
Deepwater Horizon	Rig that operated on the Macondo prospect in the Gulf of Mexico (see Macondo)
Dispersant	A group of chemicals used to accelerate the process of natural dispersion of oil (both at the surface and subsurface)
DP	Dynamic Positioning
E&P	Exploration & Production
FEED	Front-End Engineering and Design
FPSO	Floating, Production, Storage and Off-loading Vessel
GIRG	Global Industry Response Group
GoM	Gulf of Mexico
HWCG	Helix Well Containment Group
IADC	International Association of Drilling Contractors
IJDA	Interim Joint Development Agreement
IMO	International Maritime Organization
In Situ Burning	The process of burning surface oil at sea, at or close to the site of a spill
IPIECA	International Petroleum Industry Environmental Conservation Association
IRF	International Regulators Forum
ISO	International Organization for Standardization

Glossary

continued

JDA	Joint Development Agreement
JIP	Joint Industry Project
JITF	Joint Industry Task Force
Mmscfd	Million standard cubic feet per day
MWCC	Marine Well Containment Company
NOIA	National Oil Industry Association
NOGEPa	Netherlands Oil & Gas Exploration & Production Association
NORSOK	Norwegian Petroleum Industry Standards
OGP	International Association of Oil & Gas Producers
OLF	Norwegian Oil Industry Association
OSPRAG	Oil Spill Prevention and Response Advisory Group (UK)
OSRL	Oil Spill Response Limited
OSRO	Oil Spill Response Organisation
Macondo	Oil and gas prospect in the Gulf of Mexico. Also used as shorthand for the Deepwater Horizon drilling rig accident that took place on 20 April 2010
Montara	Oil field in the Timor Sea off the northern coast of Western Australia. Also used as shorthand for the blowout from the Montara wellhead platform that took place on 21 August 2009
MWCS	Marine Well Containment System
R&D	Research & Development
TTRD	Through Tubing Rotary Drilling
VOC	Volatile Organic Compounds
VoO	Vessels of Opportunity
WCD	Worst Case Discharge Rate
WEC	Wells Expert Committee
Well cap	Device deployed to control a well incident at source
Well incident	Uncontrolled event e.g. blowout
WO	Workover



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